Tenth North American Arctic Goose Conference and Workshop

Program & Abstracts

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NAAG 2001

Tenth North American Arctic Goose Conference and Workshop

Dixième conférence nord-américaine sur les oies de l'Arctique

Québec, Canada

It is with great pleasure that we welcome you in Québec City for the 10th North American Arctic Goose Conference and Workshop (NAAG). Building up on the great success of previous NAAG meetings, we believe that this one again holds great promise of success. This conference is now coming to age as it expands more and more beyond North America. At NAAG2001, almost 20% of the papers are delivered by people coming from Europe and Asia, including 2 of the 4 plenary talks. This is perhaps not surprising given the circumpolar distribution of geese and that several conservation problems faced by the various species are holarctic. Our conference is thus becoming one of the most important international forums to discuss goose research and management.

Geese are wonderful organisms to study, and are increasingly receiving attention, whether as the subject of curiosity-driven or management-oriented research. Several populations, especially of white geese, are also offering new challenge due to their overabundance. Some of the earliest discussions on this problem occurred at a roundtable held at the Albuquerque meeting in 1995. Since then, considerable effort has been devoted to the question of overabundant goose populations and some unprecedented actions have taken place in several parts of North America to address the problem. The Québec meeting offers a timely opportunity to evaluate the success of these actions in achieving their goals. The workshop devoted to this subject will attempt to draw the first conclusions and to orient future research and management actions on these goose populations.

Québec City has the distinction of being the only city to host the NAAG meeting twice as the fifth meeting was held in October 1984. Many reasons may account for that, including the presence of large number of Greater Snow Geese and Canada Geese along the Saint Lawrence River both in spring and fall; a strong goose research and monitoring program lead by the Canadian Wildlife Service, Québec region, and Université Laval, spanning more than three decades; and last, but not the least, the charm and French flavour of the oldest city in North America.

We hope that this meeting will continue the tradition of bridging the gap between waterfowl managers and research scientists while fostering new interactions, as this is certainly one of the *raison d'être* of this conference. The close contacts between applied and basic science is probably a key reason why goose research has been so successful. We trust that you will share our excitement over the program which, we believe, is truly excellent.

Bienvenue à Québec et bon congrès!

Gilles Gauthier
Jean-François Giroux

NAAG 2001 CONFERENCE STAFF

Conference Chairpersons

Gilles Gauthier
Université Laval

Jean-François Giroux
Université du Québec à Montréal (UQAM)

Scientific Committee Members

Chair : Gilles Gauthier, Université Laval
Jean-François Giroux, UQAM
Ken Abraham, Ontario Ministry of Natural Resources
John Takekawa, U.S. Geological Survey
Jim Sedinger, University of Alaska

Organizing Committee Members

Chair : Jean-François Giroux, UQAM
Gilles Gauthier, Université Laval
Bernard Filion, Isabelle Gibson,
Ducks Unlimited
Raymond Sarrazin, Austin Reed, Luc Bélanger,
Canadian Wildlife Service

Workshops

The management of overabundant white goose populations: where do we stand and where do we go?

Convenors: Bruce Batt, Ducks Unlimited
Robert Rockwell, American Museum of Natural History

Estimating hunting mortality in geese: some methodological considerations.

Convenor: Jim Nichols, U.S. Geological Survey

Field Trip

Organisation : Jean-François Giroux, UQAM
Isabelle Gibson, Ducks Unlimited
Volunteers : Daniel Jauvin, Paul Messier,
Francis St-Pierre, Jean-Claude Bourgeois, Jean-Pierre Laniel

Student Travel Awards

Austin Reed, Canadian Wildlife Service
Jean-Pierre Savard, Canadian Wildlife Service
Scott R. McWilliams, University of Rhode Island

Mexican/Russian Affairs

John Taylor, Steven Kohl, Robert Trost,
Jeff Haskins, USFWS
John Takekawa, Michael Samuel, USGS
Ramon Olivas, USPS

WEB Site

Evan Cooch, Cornell University
Jean-François Giroux, UQAM
Lyne Gravel, Université Laval

Conference Logo

Pierre Dupuis, Canadian Wildlife Service

Conference Coordinator

Mathilde Renaud, Université Laval

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NAAG 2001 SPONSORS

No meeting of this size could ever come about without the ongoing and generous support of many individuals, agencies and corporations. We acknowledge the following major sponsors of the Tenth North American Arctic Goose Conference & Workshop :

- Ministère de la Recherche, de la Science et de la Technologie du Québec
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- Pacific Flyway Council
- Société de la faune et des parcs du Québec
- U.S. Fish and Wildlife Service

NAAG 2001 PLENARY SPEAKERS

Jan Bakker

Goose-plant interactions in winter and spring staging areas in Western Europe

Kjell Larsson

Life history strategies in a new environment: the flexible barnacle geese

David Post

A glut of goose guano: wintering geese as nutrient vectors in the managed wetlands of Bosque del Apache National Wildlife Refuge, New Mexico, USA

Joel Schmutz

Comparative population dynamics of geese nesting sympatrically on the Yukon-Kuskokwim Delta

GENERAL INFORMATION

Welcome to the Tenth North American Arctic Goose Conference and Workshop. The conference staff and volunteers are here to help you. If you have any questions, regarding any aspect of the conference, please don't hesitate to ask one of the staff or volunteers. To help you navigate in the Hilton, we included a map of the hotel at the end of this program; please refer to it.

Registration & Information

You can register for the conference, pickup your registration package (including the conference program), and obtain information at the registration desk. It will be located on the 1st floor in front of the escalator next to the *Porte du Palais* room, **except on Tuesday** when it will be located on the 2nd floor on the left of the elevators, next to the *Beauport/Beaumont/Bélair* rooms. It will be staffed at the following times:

- Monday 2 April from 6 PM to 9 PM
- Tuesday 3 April from 8 AM to 9 PM
- Wednesday 4 April from 8 AM to 5:30 PM
- Thursday 5 April from 8 AM to 5:30 PM

Workshops, Paper & Poster Sessions

The two **workshops** (Tuesday 2 April) will be held in the *Beauport/Beaumont/Bélair* rooms located on the 2nd floor. All **paper** sessions will be held in the *Porte du Palais* room located on the 1st floor. The **poster** session (Friday 6 April) will take place during the field trip at Baie-du-Febvre. Please refer to the page on the field trip for detailed information.

Previewing Room

The *Orléans* room will be available for those who wish to review their presentation. This room will be equipped with a screen, a computer, a slide projector and carousels. Please make sure that you load your presentation on the computer the day before your presentation. For those using slides, please put them in a carousel during the session preceding the one where you are presenting. A person will be present to assist you. This room will be open from 7:30 AM to 5:30 PM Tuesday to Thursday and Saturday.

Name Tags & Tickets

Your name tag is included in your registration package. The name tag is your pass for admittance to all activities of the conference including the field trip and must be worn at all times. Separate tickets are included for those that registered for the banquet. Beverage tickets (beer, wine and soft drinks) can be used at the opening and closing receptions. For those who have an invited guest, a name tag for the field trip and/or a banquet ticket are included in your registration package.

Reception & Banquet

An opening reception will take place on Tuesday 3 April from 6 to 8 PM in the *Panorama* room on the top floor (23rd) of the hotel. You will be able to admire Quebec City and its surroundings from one of the best viewpoint of the city. The closing banquet will be held on Saturday 7 April from 7:30 PM in the *Porte du Palais* room. Please bring your banquet ticket. A pre-banquet reception will take place between 6:15 and 7:30 PM in the *Villeray* room, which is located on the ground floor of the hotel.

Informal Encounters Room

A room will be available for those who which to meet informally other conference participants. The room *Courville/Montmorency* will be open Wednesday and Thursday, 4 and 5 April all day and a cash bar will be available from 8 to 10:30 PM both nights. On Saturday 7 April, the room *Beauport* will be open from 9 AM to 5 PM.

FAX Service

A fax service is available on request. Please ask one of the conference staff or volunteers.

FIELD TRIP

A day-long field trip to Baie-du-Febvre, Lac St-Pierre will take place on **Friday 6 April** to give a break to participants. The **poster session** will be held at the same time and a specific period is scheduled in the afternoon to meet with the authors.

The Lac St-Pierre is a major staging area for waterfowl in Québec. More than 400,000 Greater Snow Geese stop around Baie-du-Febvre in early April. Geese use the floodplains to roost and fly up to 60 km inland to feed on agricultural fields. In addition to Greater Snows, thousands of Canada geese and many species of water birds can be observed. Several Ducks Unlimited projects created under the Eastern Habitat Joint Venture are located at Baie-du-Febvre

The observing sites are within a walking distance from the Baie-du-Febvre Nature Centre and the community centre where posters will be put up. Both lunch and dinner will be provided on site with a taste of the Québec cuisine based on maple syrup, and geese! Baie-du-Febvre is a 2-hour bus drive from Quebec city. In early April, the climate in Québec is cool (-2°C to 8°C; 28°F to 46°F) so don't forget to **bring warm clothes.** The buses will leave the hotel at 8 AM sharp so be on time !

Please bring your **name tag**, it is your admittance to the field trip. For those who are presenting, don't forget your **poster.**

Schedule

8:00 - 10:00 AM	Travel by bus to Baie-du-Febvre
10:00 - 10:30 AM	Refreshment, setting up posters
10:30 AM-12:00 PM	Bird watching and tour of habitat management projects.
12:00 - 1:00 PM	Lunch on site
1:00 - 5:30 PM	Poster session (Poster should be attended by authors 1:00 - 3:00 PM)
3:00 - 4:30 PM	Bird watching and tour of habitat management projects.
6:00 - 7:30 PM	Diner on site
7:30 - 8:30 PM	Observation of geese returning to the roosting site
8:30 - 10:30 PM	Return by bus to Quebec city

MEETING OVERVIEW

	Monday 2	Tuesday 3	Wednesday 4	Thursday 5	Friday 6	Saturday 7
AM		Workshop 1 *BBB**	Paper session 1 *Porte du Palais*	Paper session 3 *Porte du Palais*	All day field trip to Baie-du-Febvre Poster session	Paper session 5 *Porte du Palais*
Lunch		On your own	*Panorama*	*Panorama*		*Panorama*
PM		Workshop 2 *BBB**	Paper session 2 *Porte du Palais*	Paper session 4 *Porte du Palais*		Paper session 6 *Porte du Palais*
Evening	Registration *1st floor*	Opening reception (6-8 PM) *Panorama*	Free	Conferences for the general public (*in French*) (7:30-10 PM) *Porte du Palais*		Closing reception (6:15-7:30 PM) *Villeray* Banquet (7:30-11 PM) *Porte du Palais*

* *BBB refers to Beauport/Beaumont/Bélair*

Tuesday 3 April - Workshops

8:50-9:00 **Welcome word and introduction**
Gilles Gauthier, Université Laval
Jean-François Giroux, UQAM

Estimating hunting mortality in geese: some methodological considerations

CONVENER : Jim Nichols, U.S. Geological Survey

9:00-9:10 **Opening comments**
Jim Nichols, U.S. Geological Survey

9:10-9:35 **The estimation of harvest from hunter surveys in Canada**
Hélène Lévesque, Canadian Wildlife Service

9:35-10:00 **Estimating the annual goose harvest in the United States**
Paul I. Padding, U.S. Fish & Wildlife Service

10:00-10:15 **Discussion of harvest survey estimates**

10:15-10:35 **REFRESHMENT BREAK**

10:35-11:00 **Harvest rate estimation from band recovery data**
Jim Nichols, U.S. Geological Survey

11:00-11:25 **Relevance of changing leg-band inscriptions to the estimation of band-reporting and harvest rates**
James Dubovsky, U.S. Fish & Wildlife Service

11:25-12:00 **Discussion of all estimation approaches**

12:00-13:45 **LUNCH BREAK**

The management of over-abundant white goose populations: where do we stand and where do we go?

CONVENERS : Bruce D. J. Batt, Ducks Unlimited, Inc.
Robert Rockwell, American Museum of Natural History

13:45-13:55 **An overview of the overabundant white goose phenomenon and presentation of the workshop**
Bruce Batt, Ducks Unlimited, Inc.

Management Actions in Canada and the U.S.

13:55-14:05 **Lesser Snow Goose** – Jim Kelley, U.S. Fish & Wildlife Service
14:05-14:15 **Greater Snow Goose** - Raymond Sarrazin, Canadian Wildlife Service
14:15-14:25 **Questions**

The effects of management actions on populations

14:25-14:35 **Lesser Snow Goose** – Tim Moser, U.S. Fish & Wildlife Service
14:35-14:45 **Lesser Snow Goose numbers and banding** – Dale Caswell, Canadian Wildlife Service
14:45-14:55 **Greater Snow Goose** – Gilles Gauthier, Université Laval
14:55-15:10 **Questions**

15:10-15:30 **REFRESHMENT BREAK**

Monitoring habitat changes – Accomplishments and needs

15:30-15:40 **Lesser Snow Goose range** – Ken Abraham, Ontario Ministry of Natural Resources
15:40-15:50 **Greater Snow Goose range** – Jean-François Giroux, UQAM
15:50-16:00 **Questions**

16:00-16:10 **Effects on other species in the mid-continent**
Robert Rockwell, American Museum of Natural History
16:10-16:20 **Questions**

16:20-16:30 **Looking ahead: What if the current approach doesn't work? What about other geese? Are we really committed to this program?**
Mike Johnson, North Dakota Game and Fish Department

16:30-17:00 **Discussion**

Wednesday 4 April

8:00 – 8:15 **Opening comments**
Gilles Gauthier , Université Laval
Jean-François Giroux, UQAM

8:15-9:00 **Plenary Paper 1 - Kjell Larsson**
Life history strategies in a new environment: the flexible Barnacle Geese.

PAPER SESSION 1 - Life history strategy and behaviour

CHAIR : Robert Rockwell, American Museum of Natural History

9:00-9:20 **Jeffrey Black & Kjell Einar Erikstad.** Life history strategies in arctic geese.

9:20-9:40 **Eric Reed & Gilles Gauthier.** The costs of raising a family in Greater Snow Geese *Chen caerulescens atlantica*.

9:40-10:00 **REFRESHMENT BREAK**

10:00-10:20 **Shannon S. Badzinski, C. Davison Ankney, Jim Leafloor & Kenneth F. Abraham.** Egg size as a predictor of nutrient composition of neonatal geese.

10:20-10:40 **Steven T. A. Timmermans, C. Davison Ankney & Kenneth F. Abraham.** Adaptive significance of egg size variation in Lesser Snow Geese at Akimiski Island, Nunavut.

10:40-11:00 **R. John Hughes & Jim Leafloor.** Feast or famine: Gosling growth at two Canada Goose nesting areas.

11:00-11:20 **Mark Herzog & James S. Sedinger.** Variation in size of black brant is of environmental origin.

11:20-11:40 **Julia Stahl & Rudi Drent.** Individual decisions on site use in geese - strategies of subordinates and local dominants.

11:40-12:00 **Fred Cooke, Byron Andres, Sean Boyd & Vasily Baranyuk.** Timing of first pairing in Wrangel Island Snow Geese.

12:00-13:30 **LUNCH BREAK**

13:30-14:15 **Plenary Paper 2 - David Post**
A glut of goose guano: wintering geese as nutrient vectors in the managed wetlands of Bosque del Apache National Wildlife Refuge, New Mexico, USA.

PAPER SESSION 2 - Wintering and migration ecology

CHAIR : John Taylor, U.S. Fish & Wildlife Service

14:15-14:35 **Dennis Orthmeyer, John Takekawa & Julie Yee.** Movement, home range, and nearest-neighbor analyses comparing two Lesser Snow Goose populations wintering in the Sacramento Valley California.

14:35-1455 **Arnaud Béchet, Jean-François Giroux & Gilles Gauthier.** Impact of a spring hunt on the regional movements of staging Greater Snow Geese.

14:55-15:15 **Matthieu Féret, Gilles Gauthier, Jean-François Giroux & Keith Hobson.** Impact of spring conservation hunt on nutrient storage of Greater Snow Geese staging in Québec.

15:15-15:35 **REFRESHMENT BREAK**

15:35-15:55 **Barbara Ganter & Jesper Madsen.** Within-season movement patterns in spring-staging Pink-Footed Geese.

15:55-16:15 **Jeffrey Moore & Jeffrey Black.** Distribution of spring staging Black Brant in relation to foraging opportunities on Humboldt Bay, California.

16:15-16:35 **Katherine Hagmeier, Sean Boyd, Barry Smith & G. John Smith.** Using modeling to estimate the number of Pacific Black Brant staging in the Strait of Georgia during spring migration.

16:35-16:55 **David Ward, Danielle Mather, Lee Tibbitts & Sean Boyd.** Migration of Pacific Black Brant.

16:55-17:15 **Jonathan Olson, Jean-François Giroux & Gilles Gauthier.** Fall staging of the Greater Snow Goose in southern Quebec.

17:15-17:35 **Grégory Bourguelat, Gilles Gauthier & Roger Pradel.** Estimation of stopover length in birds using capture-recapture methods : the example of the Greater Snow Goose.

Thursday 5 April

8:15-9:00 **Plenary Paper 3 - Jan Bakker**

Goose-plant interactions in winter and spring staging areas in Western Europe.

PAPER SESSION 3 - Goose-plant interactions and habitat

CHAIR : Scott McWilliams, University of Rhode Island

9:00-9:20 **Dries Kuijper.** On the facilitation between hares and geese: the effects of vegetation structure.

9:20-9:40 **Daan Bos & Maarten Loonen.** Concentrating on food: excessive forage production induces geese to aggregate.

9:40-10:00 **REFRESHMENT BREAK**

10:00-10:20 **Mike Demarchi.** Snow Geese and carrying capacity of the Fraser River estuary.

10:20-10:40 **Sean Boyd.** Snow Geese and *Scirpus* marshes on the Fraser and Skagit River deltas: the value of long-term monitoring for understanding trends and interactions.

10:40-11:00 **Amy Zacheis, Roger Ruess & Jerry Hupp.** Effects of migratory geese on nitrogen dynamics in an Alaskan salt marsh.

11:00-11:20 **Brian Person, Mark Herzog, Roger Ruess, James S. Sedinger, R. Michael Anthony & Christopher Babcock.** Feedback dynamics of grazing lawns: coupling vegetation change with animal growth.

11:20-11:40 **Jeffrey S. Gleason, Kenneth F. Abraham & C. Davison Ankney.** Foraging behaviour of sympatrically breeding geese on Akimiski Island, Nunavut.

11:40-12:00 **Maarten Loonen, Daan Bos & Nicol Heuermann.** Testing habitat preference of geese.

12:00-13:30 **LUNCH BREAK**

PAPER SESSION 4 - Breeding ecology

CHAIR : John Takekawa, U.S. Geological Survey

13:30-13:50 **Jerry Hupp, Joel Schmutz & Craig R. Ely.** Use of satellite and conventional telemetry to assess the prenesting interval of Emperor Geese.

13:50-14:10 **Bart Ebbinge, Bernard Spaans, Gerard Muskens & Paul Goedhart.** Nomadism or site-fidelity: two different breeding strategies in Dark-bellied Brent Geese.

14:10-14:30 **Gustaf Samelius & Ray T. Alisauskas.** Spatial and annual variation in nesting success of Lesser Snow Geese.

14:30-14:50 **Joël Bêty, Gilles Gauthier, Erkki Korpimäki & Jean-François Giroux.** Cyclic lemmings and Greater Snow Geese: direct observations of an indirect trophic interaction.

14:50-15:10 **John Quinn, Yakov Kokorev, Jouke Prop & Jeffrey Black.** The nesting association between Red-breasted Geese and raptors in Arctic Siberia.

15:10-15:30 **REFRESHMENT BREAK**

15:30-15:50 **Jason Schamber, James S. Sedinger & David Ward.** Effects of wintering location on reproductive parameters in Pacific Black Brant.

15:50-16:10 **Tom Fondell & Barry Grand.** Renesting by Dusky Canada Geese on the Copper River Delta, Alaska.

16:10-16:30 **Chris Nicolai, James S. Sedinger & Mike Wege.** Mechanisms of hatch synchronization in Black Brant *Branta nigricans*.

16:30-16:50 **Scott McWilliams, William Karasov, Jim Leafloor & Enrique Caviedes-Vidal.** Digestive adjustments in geese to reduced forage quality and its ecological implications.

16:50-17:10 **Pascale Otis, Jacques Larochelle & Gilles Gauthier.** Energy cost of locomotion in Greater Snow Goose goslings.

Friday 6 April - Poster Session

Life history strategy and behaviour

1. **Ken Kriese.** Foraging and growth strategies of the Orinoco Goose: the paradox of a tropical grazer.
2. **Kenneth Griggs & Jeffrey Black.** Differential allocation of parental care in western Canada Geese.
3. **Mike Eichholz & James S. Sedinger.** The influence of nutrient reserves and body size on annual survival of Canada Geese.
4. **Brian Person & Christopher Babcock.** Spatial and temporal variation in Cackling Canada gosling growth.
5. **Chris Nicolai, James S. Sedinger & Mike Wege.** Growth rates of Black Brant *Bernicla nigricans* goslings from satellite colonies on the Yukon-Kuskokwim delta, Alaska.
6. **Mark Herzog & James S. Sedinger.** Parental quality is not responsible for seasonal decline in growth of Black Brant goslings.
7. **Mathilde Renaud, Gilles Gauthier & Jacques Larochelle.** Energetic cost of thermoregulation for Greater Snow Goose goslings growing in a natural environment.
8. **Maarten Loonen & Arjen Drost.** Sensitivity of Barnacle Geese during wing moult on human disturbance.
9. **Mohamed Righi & Gilles Gauthier.** Abundance and distribution of intestinal helminths in Greater Snow Geese on the breeding colony, and during their fall and spring migration.
10. **Frédéric Demers, Jean-François Giroux, Gilles Gauthier & Joël Bêty.** Effect of collar-attached transmitters on pair bond, breeding success and behavior of Greater Snow Geese.
11. **Gretchen Ruhl, Jerry Hupp, John Pearce, Daniel Mulcahy & Martha Tomeo.** Effects of abdominally-implanted transmitters with percutaneous antennas on behaviors of Canada Geese.

Wintering and migration ecology

12. **Lee Tibbitts, David Ward & Eduardo Carrera.** Effects of El Niño Southern Oscillation on wintering Black Brant in Baja California, Mexico.
13. **Mark S. Lindberg, David Ward & William Kendall.** Factors affecting movements of the wintering metapopulation of Black Brant.
14. **James S. Sedinger, R. Michael Anthony, Bruce Conant & David Ward.** Effect of El Niño on wintering distribution and breeding propensity of Black Brant.
15. **Michael Schwitters.** Intensive observations of neck banded birds provide insights into Lesser Snow Goose natural history.
16. **Hiroko Taira, Mary Beck, Mark Vrtiska & Erin Blankership.** Physiological status of several migratory waterfowl species in the Rainwater Basins of Nebraska.
17. **Fabiola Yepez & Alejandro Carreon.** Winter ecology of Greater White-fronted Geese (*Anser albifrons*) in Tamaulipas, Mexico.
18. **J. Manuel Ochoa Barraza, Alberto Lafon Terrazas, Rod C. Drewien & Michael A. Spindler.** Winter ecology of Greater White-Fronted Geese in the Mexican interior highlands.

Goose-plant interactions and habitat

19. **Jean-François Giroux, Austin Reed, Josée Lefebvre & Luc Bélanger.** Long-term effects of staging Greater Snow Geese on bulrush marshes of the St-Lawrence estuary.
20. **Daan Bos, James S. Sedinger & Jason Schamber.** Manipulation of grazing risk for arrowgrass, *Triglochin palustris*.
21. **Karin Kurk & Sip Van Wieren.** Structuring of herbivore assemblages: effects of body mass on competition and facilitation.
22. **Paul Latour & Jim Hines.** Effects of increasing Snow Goose numbers on habitat and birds on Banks Island, Northwest Territories.
23. **Andrew Didiuk, Alain Fontaine & Mark Mallory.** Land cover mapping of West Baffin Island, Nunavut.
24. **Isabelle Duclos, Esther Lévesque & Line Rochefort.** Mesic habitats on Bylot Island (Nunavut): characterization and feeding potential for Greater Snow Geese (*Chen caerulescens atlantica*).
25. **Delia Person & Michael A. Spindler.** Summer diet composition of White-Fronted Geese that nest in Northwest and Interior Alaska

Breeding ecology

26. **Gilles Gauthier, Keith Hobson & Joël Bêty.** The role of nutrient reserves in egg formation in Greater Snow Geese: a reply to Ankney (1995).

27. **Julien Mainguy, Joël Bêty, Gilles Gauthier & Jean-François Giroux.** Is body condition of laying Greater Snow Geese and their reproduction affected by the spring conservation hunt?

28. **Gustaf Samelius & Ray T. Alisauskas.** Productivity of Lesser Snow Geese on Banks Island 1995 to 1998.

29. **Jouke Prop & John Quinn.** Protection of Red-Breasted Geese by Peregrine Falcons: privilege for pals only?

30. **Barbara Pezzanite.** Differences in brood size changes and condition of gosling Lesser Snow and Ross's geese.

Population status, structure and management

31. **Stephen R. Johnson & Lynn E. Noel.** Recent decline in the Howe Island, Alaska, Snow Goose population.

32. **Robert Burgess, Robert Ritchie & Robert Suydam.** Recent increases of breeding Snow Geese along the western Arctic Coast of Alaska.

33. **Jim Hines & Myra Wiebe.** Status, distribution and abundance of Brant on the mainland of the Western Canadian Arctic.

34. **Vladimir Morozov.** Lesser White-fronted Goose at the turn of the century: population status and numbers.

35. **Evgeny Syroechkovski Jr.** Population decline of Northeast Asian geese at the end of XXth century.

36. **Friederike Woog, Jeffrey Black, Paul Banko & Annie Marshall.** Breeding biology of released Hawaiian Geese: An assessment of the reintroduction program.

37. **Hélène Lévesque, Brian Collins & Pierre Brousseau.** Estimation of harvest during special Snow Goose conservation seasons in Québec.

38. **Rainy Inman, Kim Scribner, Michael Samuel, Kathryn Dickson, Hélène Lévesque & David Duncan.** Phylogeographic structure of Snow and Ross's Geese: applications for harvest derivation.

39. **Ada C. Fowler, John M. Eadie & Craig R. Ely.** Multi-level population structure in breeding Cackling Canada Geese.

40. **Katherine Hagmeier, Sean Boyd & André Breault.** Population compostion of Pacific Black Brant during the annual British Columbia Brant hunt (March 1-10).

41. **Vasily Baranyuk.** Differences in the size of Lesser Snow Geese (*Anser c. caerulescens*) of Wrangel Island.

42. **Dale Caswell, Ron Bazin, Andrew Didiuk, Kathy Meeres, Keith Warner, Ray T. Alisauskas, Richard Kerbes, Sam Barry, Jim Hines, Rocky Rockwell, Jim Leafloor & Kenneth F. Abraham.** A monitoring program for Lesser Snow Goose populations in the Canadian Arctic.

Saturday 7 April

8:15-9:00 **Plenary Paper 4 - Joel Schmutz**
Comparative population dynamics of geese nesting sympatrically on the Yukon-Kuskokwim Delta.

PAPER SESSION 5 - Population dynamics and demography

CHAIR : Jerry Hupp, U.S. Geological Survey

9:00-9:20 **Keith A. Patton, C. Davison Ankney & Jim Leafloor.** Relation between body mass, body size and post banding survival of Canada Geese goslings on Akimiski Island, Nunavut.

9:20-9:40 **Michael R. J. Hill, C. Davison Ankney & Jim Leafloor.** Influence of body mass and condition on harvest and survival of juvenile Canada Geese from Akimiski Island.

9:40-10:00 **REFRESHMENT BREAK**

10:00-10:20 **Kiel L. Drake, Ray T. Alisauskas, Stuart M. Slattery, Andrew Didiuk, Ron Bazin & Dale Caswell.** Distributions, survival and recoveries of Ross's Geese in North America, 1961-1999.

10:20-10:40 **Ray T. Alisauskas, Dana K. Kellett-Warner & Richard Kerbes.** Assessment of assumptions for estimation of Snow and Ross's Geese using ground and aerial photographic sampling.

10:40-11:00 **Gilles Gauthier & Jean-Dominique Lebreton.** Population models in Greater Snow Geese: a comparison of different approaches.

11:00-11:20 **William Kendall, Paul Conn, Mark S. Lindberg, David Ward & James Hines.** Combining multi-site recaptures, band recoveries, and incidental observations to estimate survival, movement, and fidelity of geese.

11:20-11:40 **Mark S. Lindberg & Ray T. Alisauskas.** Effects of neckbands on survival and fidelity of molting White-Fronted and Canada Geese.

11:40-12:00 **Michael Samuel, Diana Goldberg, Art Smith & Evan Cooch.** Neckband loss for Lesser Snow Geese banded on Wrangel and Banks islands.

12:00-13:30 **LUNCH BREAK**

PAPER SESSION 6 - Population status, structure and management

CHAIR : Sean Boyd, Canadian Wildlife Service

13:30-13:50 **Kim Scribner, Jennifer Warrillow, Harold Prince, Rainy Inman, David Luukkonen & Jim Leafloor.** Genetic analysis of spatial and temporal variation in racial composition of Michigan Canada Goose harvests.

13:50-14:10 **John Pearce, Barbara Pierson, Sandra Talbot, Don Kraege & Kim Scribner.** A genetic evaluation of morphonolgy used to identify Pacific flyway Canada geese.

14:10-14:30 **Sandra Talbot, John Pearce, Barbara Pierson, Kim Scribner & Dirk Derksen.** Intraspecific phylogeography of large- and small-bodied Canada Geese *Branta canadensis* of western North America.

14:30-14:50 **Barbara Pierson, John Pearce, Chris Rhea, Kim Scribner & Sandra Talbot.** A genetic characterization of Aleutian Canada Geese: Chagulak Island relationships to Buldir and Semidi Islands.

14:50-15:10 **Hugh Boyd & Austin Reed.** Maltby's goose and the taxonomy of Brant *Branta bernicla*.

15:10-15:30 **REFRESHMENT BREAK**

15:30-15:50 **John M. Eadie, Ada C. Fowler & Craig R. Ely.** Kinship and nesting dispersion of Greater White-fronted Geese on the Yukon-Kuskokwim Delta.

15:50-16:10 **Austin Reed, R. John Hughes & Hugh Boyd.** Patterns of distribution and abundance of Greater Snow Geese on Bylot Island, 1983-1998.

16:10-16:30 **Michael A. Spindler & Patricia Martin.** Summer movements of White-Fronted Geese that nest in the taiga of northwest and interior Alaska.

16:30-16:50 **Richard Mykut, Harold Prince & David Luukkonen.** Using satellite and radio telemetry to evaluate molt migration of Canada Geese from southeastern Michigan.

16:50-17:10 **Rod C. Drewien, Alberto Lafon Terrazas, John Taylor*, J. Manuel Ochoa Barraza & Ruth Shea.** Status of Lesser Snow Geese and Ross' Geese wintering in the Mexican interior highlands, 1998 and 1999.

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* Speaker

ABSTRACTS

Abstracts are arranged alphabetically by first author in three separate sections : Plenary papers, Workshops and contributed papers (oral and poster). The abstracts were reformatted but otherwise printed as provided by the authors, except for minor editing for style and syntax. Information contained herein should NOT be cited without first obtaining author approval.

Plenary Paper 3 - Thursday 8:15

GOOSE-PLANT INTERACTIONS IN WINTER AND SPRING STAGING AREAS IN WESTERN EUROPE

Bakker, Jan

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At the natural salt marsh of the Dutch Wadden Sea island of Schiermonnikoog few geese are found during winter and spring staging at the eastern and western part of the marsh and relatively large numbers in between. The secret of this island is that is extends eastward. Hence few geese forage in very young successional stages containing low plant biomass, many in intermediate stages. Although plant biomass increases with successional age, the tall structure of the canopy prevents geese from foraging and their numbers decline. Long-term studies indeed show that goose numbers decline when the salt marsh is aging. Apparently the geese are evicted by vegetation succession. The engine of increasing plant productivity is the accumulation of nitrogen in the increasing layer of sediment brought by the sea. Exclosure experiments revealed that another small herbivore, the European hare, favours the geese by foraging on small shrubs in winter time. Hence the hares prevent succession for some decades and facilitate for geese at the young salt marsh. On their turn hares are evicted by vegetation succession at the older successional stages. Only large herbivores can reset the successional clock. Cattle can facilitate for smaller herbivores such as hare and goose. Long-term experiments excluding livestock at different natural salt marshes in the Wadden Sea area suggest that both at the higher and lower salt marsh a tall grass gets dominant, however, the succession takes more time at the lower marsh. Nature management policy in Germany aims at the abandonment of human interference in many artificial salt marshes. This includes the cessation of drainage and livestock grazing. Again tall grass encroaches and geese do no longer forage at the abandoned marsh and seem to concentrate at the still sheep-grazed sites. The cessation of drainage may result in wet depressions. Together with increasing geese numbers, this may result in resetting of the successional clock by the geese, but only in the presence of livestock. During the 1960s and 1970s increasing numbers of geese were found at inland agricultural grasslands. This coincided with an increase of crude protein of the food plants during winter and spring. It seems that also grazing management plays a role in the occurrence of geese in agricultural grasslands in the polders of the Wadden Sea islands. Cattle start grazing late in spring which means after the geese have left for the Arctic breeding grounds. Sheep grazing starts very early in spring. Geese occur more in sheep-grazed areas harbouring short tillers of food plants, and less in cattle-grazed areas where tillers are too long to be handled by the geese. Only locally geese concentrate to such an extent that they can maintain the optimal length of food plants without the facilitation of larger herbivores. Once the structure of the canopy is attractive for foraging geese, it may seem logic that they prefer to feed on artificially fertilized grasslands. Geese foraging on traditionally managed grasslands on Norwegian islands show a higher intake of protein in relation to fat compared to geese that forage on fertilized grasslands. The latter geese feature a lower percentage of pairs with young during the next winter period.

Plenary Paper 1 - Wednesday 8:15

LIFE HISTORY STRATEGIES IN A NEW ENVIRONMENT: THE FLEXIBLE BARNACLE GEESE

Larsson, Kjell

Dept of biology, Gotland University College, Visby, Sweden

Before the 1970s barnacle geese were only found breeding in moderate numbers at a few sites in the high Arctic. Since then, the world population of barnacle geese has increased rapidly in numbers as well as expanded its breeding range about 2000 km southward into the temperate Baltic Sea region. Today we can find breeding barnacle geese in increasing numbers at various coastal sites in Sweden, Finland, Estonia, Denmark and The Netherlands. This recently established Baltic-breeding population of barnacle geese which in 1971 consisted of one breeding pair, do now consists of more than 20 000 individuals.

The natural establishment and the subsequent growth of the Baltic population has been monitored by amateur ornithologists and researchers since the appearance of the first breeding pair. I have together with colleagues, especially Pär Forslund and Henk van der Jeugd, performed studies on population dynamics, quantitative genetics and behaviour of barnacle geese breeding in large colonies along the eastern coast of the islands of Gotland and Öland in the Baltic Sea. One aim of our studies has been to analyse how the geese are able to adjust to the new biotic and abiotic environment. During the 1980s, measures of reproductive success and survival, that is, clutch size, number of fledged young per pair, post-fledging survival and adult survival were generally higher in the Baltic than in Arctic populations. Age of first breeding was most probably also lower in the Baltic. In the late 1990s the pattern became less clear because of strong density-dependent effects on the production of young in Baltic colonies. Some young colonies in the Baltic were still extremely productive whereas the production of young per pair in the older and larger colonies decreased considerably. Although density-dependent effects may be strong at the colony level there is no doubt that barnacle geese may survive and reproduce extremely well outside the Arctic.

The Baltic-breeding barnacle geese have also within short time adjusted their reproductive behaviour to the longer and earlier starting summer. For example, egg laying starts about 40 days earlier in the Baltic than in the Arctic which means that the Baltic birds start to hatch their eggs when their Arctic-breeding conspecifics still store nutrients and are on their northward migration from the Baltic spring staging areas. Start of wing moult of adults is also earlier in the Baltic than in the Arctic although the difference is much smaller than for egg laying. Even though the growth rate of young is slower in the Baltic than in the Arctic the longer interval between breeding and wing moult of adults has the consequence that flight capabilities of parents and young are less synchronised in the Baltic. By measuring selection pressures and inheritance patterns of different morphological and life-history traits we analyse if differences between individuals from the Arctic and the Baltic populations are best explained by phenotypic plasticity or by genetic responses to selection.

Plenary Paper 2 - Wednesday 13:30

A GLUT OF GOOSE GUANO: WINTERING GEESE AS NUTRIENT VECTORS IN THE MANAGED WETLANDS OF BOSQUE DEL APACHE NATIONAL WILDLIFE REFUGE, NEW MEXICO, USA

Post, David

NCEAS University of California, Santa Barbara, Santa Barbara, California, U.S.A.

Wildlife refuges are often sites of dense aggregations of wintering waterfowl because of the loss of native wetlands and increasing waterfowl numbers. High densities of wintering waterfowl can result in the destruction of wetland vegetation and agricultural crops, increase the risk of infectious disease outbreaks, and decrease water quality. Problems related to water quality may be particularly problematic in arid regions of southwestern United States where water quality and quantity are contentious issues. Over 40,000 Lesser Snow and Ross' Geese winter annually at Bosque del Apache National Wildlife Refuge in the middle Rio Grande valley of New Mexico. Daily feeding bouts by these geese move large quantities of nutrients from farm fields where they feed to managed wetlands where they roost. Refuge managers are particularly concerned that bird-borne nutrients might cause eutrophication in roosting wetlands and (or) be exported to downstream systems.

To document the role of geese in translocating nutrients, we used a combination of time budget and mass balance models for birds, nutrient bioassays of phytoplankton growth, and stable isotope methods that trace the movement of bird-borne nitrogen into aquatic food webs. Mass balance models suggest that, at peak loading rates, geese contribute over 300 kg nitrogen day^{-1} and over 30 kg phosphorus day^{-1} to refuge wetlands. Over an entire winter season, bird-borne nutrients increased nutrient loading rates to roosting wetlands by around 40% for total nitrogen and 75% for total phosphorus. High loading rates by geese are a consequence of their colonial roosting behavior; typically 90% of the geese roost on 10% of the wetland area at Bosque del Apache. Nutrient bioassays revealed that nitrogen was consistently limiting to primary production by algae in refuge wetlands. Chlorophyll a concentrations, an index of algal biomass, increased in proportion to bird densities, and stable isotope analyses of fish and crayfish indicated that bird-borne nitrogen accumulated through wetland food webs in proportion to wetland use by geese.

At the scale of individual wetlands, nutrient loading by geese has a considerable effect on wetland nutrient budgets and water quality. The local effects of nutrient loading can be offset by the dispersal of roosting waterfowl or by increased flushing rates; however, these options may be difficult to implement where geese saturate available wetlands or where water is limiting. Within a regional context, because geese only use about 10% of the available wetland area, the entire Bosque del Apache wetland system functions efficiently in retaining the bird-borne nutrient load, and only small amounts of nitrogen and phosphorus are exported downstream.

Plenary Paper 4 – Saturday 8:15

COMPARATIVE POPULATION DYNAMICS OF GEESE NESTING SYMPATRICALLY ON THE YUKON-KUSKOKWIM DELTA

Schmutz, Joel

Alaska Biological Science Center, U.S. Geological Survey, Anchorage, Alaska, U.S.A.

Four species of geese breed sympatrically on the Yukon-Kuskokwim Delta. Whereas the two most abundant species (Greater White-fronted Geese and Cackling Canada Geese) have increased dramatically in the last 15 years, numbers of Emperor Geese and Black Brant have maintained relative stability at a level significantly below population management goals. Currently, four independent management plans exist for these four species. However, competitive interactions among species on the Yukon-Kuskokwim Delta suggests that independent management of these species may fail to account for important dynamics.

Because growth and survival of goslings is generally quite sensitive to environmental variation, I focused recent studies of Emperor Geese on brood rearing. Survival of Emperor Goose goslings was similar to increasing species, varied among years, and was primarily influenced by mortality during the first five days after hatch. Survival of Emperor Goose goslings was lowest when unusually heavy rainfall occurred during early brood rearing. Sizes of families in autumn were related to rainfall during early brood rearing. Four years of data were suggestive that predation by Glaucous Gulls was an additive source of gosling mortality. However, the potential efficacy of a gull control program may be minimized by food limitations imposed by competition among geese.

Broods of Emperor Geese spent most of their time in the more saline one-third of all available habitats, which were vegetatively dominated by *Carex subspathacaea* and *C. ramenskii*. Although Cackling Canada Geese, which overall were nearly three times more abundant than Emperor Geese, selectively used a more inland array of habitats, they were numerically similar in abundance to Emperor Geese in the *C. subspathacaea* and *C. ramenskii* communities. Further, the time Emperor Geese devoted to feeding increased in relation to total densities of geese, not to densities of just Emperor Geese, thus suggesting that broods of Emperor Geese were competing with other nearby geese for food. Feeding rates of Emperor Geese that I observed during 1993–1996 were markedly higher than that observed during a previous study in 1985–1986, which is also consistent with interspecific competition due to the temporal correspondence of a large increase in Cackling Canada Geese but stability in Emperor Geese.

The consequence of interspecific competition among broods is that goslings may grow slowly and achieve a smaller body size by late summer. Body mass of Emperor Goose goslings at six weeks of age was less in 1993–1996 than in 1990, suggesting such competition was occurring. In other portions of the Yukon-Kuskokwim Delta, similar declines in body mass occurred during the early 1990s in Black Brant and more recently in Cackling Canada Geese. Small gosling size in late summer has consistently translated into low juvenile survival prior to or during fall migration. Reductions in juvenile survival of Emperor Geese during early fall may be occurring; fall age ratios during the late 1990s were significantly lower than during the previous decade, as determined from an annual aerial survey initiated in 1985. These patterns suggest that interspecific competition during brood rearing may be negatively affecting juvenile recruitment in Emperor Geese.

ESTIMATING HUNTING MORTALITY IN GEESE: SOME METHODOLOGICAL CONSIDERATIONS

CONVENER : Jim Nichols, U.S. Geological Survey

RELEVANCE OF CHANGING LEG-BAND INSCRIPTIONS TO THE ESTIMATION OF BAND-REPORTING AND HARVEST RATES

DUBOVSKY, JAMES A., U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Denver, CO, U.S.A.

Estimation of harvest rates from band-recovery data requires knowledge about the rate at which hunters report bands from harvested waterfowl to the Bird Banding Laboratory (BBL). Historically, this rate has been low. To improve the efficiency of the waterfowl banding program, Federal, Provincial, and State agencies devised a 3-phase plan to increase reporting rates: (1) assess reporting rates of standard (AVISE) bands, (2) alter band inscriptions to facilitate reporting of bands, and (3) assess reporting rates of bands with new inscriptions. The first phase was conducted in the late 1980s, and indicated an average reporting rate of ~0.38. In 1993, bands were inscribed with a more complete address for the BBL; in 1995, these were abandoned in favor of bands with a toll-free telephone number inscribed on them. Estimates of reporting rates for complete-address and toll-free bands were 0.50 and 0.62, respectively, for the 1993-95 hunting seasons. Beginning in 1998, a study using reward bands was initiated to assess whether reporting rates for the toll-free bands had stabilized. Preliminary analyses suggest a constant reporting rate (0.84) for the 1998-99 and 1999-2000 seasons. Plans are being made to conduct a large-scale, multi-species reward band study to complete phase 3 of the strategic plan.

THE ESTIMATION OF HARVEST FROM HUNTER SURVEYS IN CANADA

LÉVESQUE, HÉLÈNE, Canadian Wildlife Service, Environment Canada, Hull, Québec, Canada

COLLINS, BRIAN, Canadian Wildlife Service, Environment Canada, Hull, Québec, Canada

The National Harvest Survey (NHS) is conducted annually in Canada to estimate the total number of active hunters and the total harvest of ducks, geese and of other Migratory Game Birds hunted by permit holders. Harvest by non-permit holders (mostly native hunters) is not measured by the NHS. NHS has two components (the Harvest Questionnaire Survey (HQS) and the Species Composition Survey (SCS)) that are geographically stratified in 23 zones. Additional random stratification (hunter experience, Canadian and non-Canadian residence) of the survey sample improves overall standard error. HQS provides the overall estimation of total harvest for each zone while the information collected through the SCS allows to partition the total duck harvest and the total goose harvest by species, taking into account timing of the harvest. The NHS provides harvest estimates for the regular hunting season, while special harvest surveys (with adapted design) are implemented to estimate total harvest of Conservation seasons. Details of the methodologies and results of the NHS and of the special surveys will be presented and discussed as they pertain to the harvest of geese and particularly to Snow Geese.

HARVEST RATE ESTIMATION FROM BAND RECOVERY DATA

NICHOLS, JAMES D., U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD, U.S.A.

Inferences about the magnitude of hunting mortality risks are frequently based on band recoveries of individually marked birds. Such inferences generally involve three related, yet different, parameters: recovery rate, harvest rate, and kill rate. Estimation of harvest and kill rates from band recovery data requires not only recovery rates of banded birds but also estimates of, or data providing information about, band reporting rate and retrieval rate (the probability that a shot bird is retrieved by the hunter). Reporting rate of mallard ducks has been estimated using reward band data. Recently, such data have been incorporated directly into band recovery models to permit direct estimation of harvest rate (e.g., Kendall et al. unpubl.) under joint likelihoods. Retrieval rate has been estimated poorly using data from small-scale "spy blind" studies and large-scale harvest surveys. Discussion will focus on methods for drawing inferences about harvest rate and these related quantities.

ESTIMATING THE ANNUAL GOOSE HARVEST IN THE UNITED STATES

PADDING, PAUL I., U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD, U.S.A.

The U.S. Fish and Wildlife Service (USFWS) annually conducts a mail questionnaire survey of federal duck stamp purchasers to estimate the mean number of geese harvested per waterfowl hunter. Combined with a total count of the number of federal duck stamps sold, and an estimate of stamps sold to nonhunters, this survey enables the USFWS to estimate the total goose harvest in the U.S. Harvest estimates are adjusted for response bias, but not for nonresponse bias. The species composition and the temporal and geographic (state and county) distribution of the goose harvest is estimated from the Waterfowl Parts Collection Survey. This harvest survey system has deteriorated over time, which recently prompted the USFWS and state wildlife agencies to establish the Migratory Bird Harvest Information Program (HIP) to replace it. Under this program, states obtain the names and addresses of all migratory bird hunters and provide them to the USFWS, which uses them as a sample frame for harvest surveys. We are currently completing the second year of a 3-year transition period during which we are conducting the HIP waterfowl harvest survey and the duck stamp-based survey concurrently for comparison.

Workshop 2 – Tuesday 13:45

THE MANAGEMENT OF OVER-ABUNDANT WHITE GOOSE POPULATIONS : WHERE DO WE STAND AND WHERE DO WE GO ?

CONVENERS : Bruce D. J. Batt, Ducks Unlimited Inc.
Robert Rockwell, American Museum of Natural History

MONITORING HABITAT CHANGES – ACCOMPLISHMENTS AND NEEDS WITHIN THE LESSER SNOW GOOSE RANGE

ABRAHAM, KENNETH F., Ontario Ministry of Natural Resources, Peterborough, Ontario, Canada

Habitat monitoring and goose-plant interaction research have been undertaken at several locations in the northern migration and breeding range of Lesser Snow Geese (LSGO) at multiple scales. Long term studies at La Pérouse Bay, Manitoba include annual monitoring of biomass, grazing intensity, and percentage of bare ground at both local and colony scales, and satellite imagery has been analysed to detect vegetation change over a span of 3 decades. Experimental-scale studies of the processes involved include work on hypersalinity, assisted and natural revegetation, seed banks, and soil properties. Similar work has been recently undertaken on Akimiski Island, Nunavut, including annual monitoring of biomass and grazing impacts, remote sensing change detection, cover transects, and experimental studies of grubbing and revegetation. This work has been scaled up to the regional level through biomass surveys and change detection analyses along the entire coast of southern Hudson Bay/James Bay of Manitoba and Ontario. In Cape Churchill, biomass, dominant plant species and plant species composition is being described in current Canada goose brood rearing areas in relation to snow goose densities. Elsewhere, habitat classification of recent satellite imagery in Nunavut has been completed at Queen Maud Gulf, and is under development for parts of West Hudson Bay, western Baffin Island and southern Southampton Island and also for Banks Island, Northwest Territories. Studies of spring grazing impacts on plant species composition, productivity and nutrients were conducted at Cook Inlet, Alaska. Impacts of summer grazing on species composition and productivity were conducted on the North Slope, Alaska, and at Queen Maud Gulf. Local monitoring of grazing using exclosures (intended to be long-term) has been initiated at Cook Inlet, Banks Island, and Baffin Island. The major outstanding need is intensive ground assessment of current habitat conditions and grazing impacts at each major LSGO breeding area in northern Nunavut and Northwest Territories.

AN OVERVIEW OF THE OVERABUNDANT WHITE GOOSE PHENOMENON AND PRESENTATION OF THE WORKSHOP

BATT, BRUCE, Ducks Unlimited Inc., Memphis, TN, U.S.A.

Management agencies in Canada and the U.S. have undertaken unusual measures to control the growth of mid-continent light goose and Atlantic Flyway greater snow goose numbers. The mid-continent birds have exceeded the carrying capacity of many of their arctic and sub-arctic breeding colonies. Greater snow goose numbers have also reached record numbers but still within the carrying capacity of their breeding areas. Multiple anthropogenic factors are implicated in causing these unprecedented circumstances, the most important of which cause high adult survival rates. Management agencies and private groups have chosen to address the problems by encouraging greatly increased harvest by hunters during regular hunting season frameworks and during extended harvest periods in the late winter and early spring to reduce adult survival. These management actions require extraordinary monitoring of harvest numbers and rates, and of the ecosystem that they are designed to protect in the long-term. This program is of great interest to the general public, research scientists and game managers because of its unprecedented nature and the importance for all to learn from these actions, as there are other populations of geese that may face the same phenomena in the future. In this symposium we will review progress in achieving population management and ecosystem conservation goals and we will explore the potential approaches and consequences if additional steps have to be taken to bring about further population reduction.

THE EFFECTS OF MANAGEMENT ACTIONS ON POPULATIONS: LESSER SNOW GOOSE NUMBERS AND BANDING

CASWELL, DALE, Canadian Wildlife Service, Winnipeg, Manitoba, Canada

The Arctic Goose Joint Venture document entitled " Science Needs For The Management Of Increasing Lesser Snow Goose Populations" outlines a two-part program to monitor the effects of management actions on Lesser Snow Goose populations on a colony specific basis. First is the photo inventory which has been conducted intermittently on snow goose colonies across the Canadian arctic since 1972. A five-year rotation was recommended and initiated in 1997 with the photo inventory of eastern arctic colonies. The central arctic followed in 1998 and aerial photography of the western arctic was attempted in 2000. In addition, complementary casual, or annual population estimates are being conducted at colonies were specific studies are in place.

Secondly a colony specific banding/marking program was recommended to provide estimates of survival and recovery rates as well as additional information on the migration patterns and subsequent harvest distribution. An annual neck-banding target of 1000 adults at each colony is also used to improve the database and increase the precision of the estimates. This program was initiated on Baffin Island in 1997, expanded to La Pérouse Bay and West Hudson Bay in 1998, to the Central Arctic in 1999, and finally to Cape Henrietta Maria, Akimiski Island and the Western Arctic in 2000. The Lesser Snow Goose colonies on Southampton Island are now the only major breeding area in the Canadian Arctic that remains to be included.

THE EFFECTS OF MANAGEMENT ACTIONS ON POPULATIONS: GREATER SNOW GOOSE

GAUTHIER, GILLES, Département de biologie and Centre d'Études Nordiques, Université Laval, Saint-Foy, Québec, Canada

Several management actions aimed at stopping the population growth of the Greater Snow Goose were implemented in 1999 and 2000, the most important being a full spring conservation hunt in Québec from 15 April to 31 May. These actions lead to a large increase in harvest rate of adults, which almost tripled from 6% during the period 1985-1997 to 14-18% during the seasons 1998-1999 and 1999-2000. Even excluding the spring hunt, the US/Canada harvest averaged 10% in those years. The spring hunt not only increased mortality but apparently also had a negative impact on fecundity. Body condition of adults at the end of spring staging and during laying in the Arctic was reduced in the years of the spring hunt. This, in turn, had a negative impact on the reproductive performance of geese, which was very poor in 1999 and moderate in 2000. Following the very good reproduction of 1998, the spring population approached 1,000,000 birds in 1999. However, with the recent increase in harvest rate and the poor reproduction of 1999, the population declined by 17% last year and was estimated at 814,000 in spring 2000. With the current hunting pressure, an additional decline is anticipated for 2001. The initial objective of stabilizing the population size of Greater Snow Geese around 800,000 by 2002 will likely be achieved sooner than anticipated.

MONITORING HABITAT CHANGES – ACCOMPLISHMENTS AND NEEDS WITHIN THE GREATER SNOW GOOSE RANGE

GIROUX, JEAN-FRANÇOIS, Département des sciences biologiques, Université du Québec à Montréal, Québec, Canada

Since 1990, exclosures have been used to monitor the impact of goose grazing on sedges and grasses at the breeding colony of Bylot Island. Chronic, intense grazing by geese at this site reduces plant production and changes specific composition. However, there are no signs of permanent damage to the habitat at the current population level because, when grazing is stopped, plant biomass increases rapidly within a few years.

During their spring and fall staging along the St-Lawrence estuary, geese feed in tidal marshes on *Scirpus pungens* rhizomes. Aboveground production has remained constant between 1983 and 1999 in the Montmagny and Cap St-Ignace marshes indicating that the system was at equilibrium but at a low level compared to the potential production of these marshes. At the Cap Tourmente National Wildlife Area, the density of *Scirpus* stems has declined by 48% between 1971 and 2000. Although the presence of geese is the most apparent factor, the number staging at Cap Tourmente has decreased in recent years and the effect of other environmental variables cannot be discarded. A study using exclosures is urgently needed. On the wintering grounds, eat-outs are still occurring in some refuges (e.g. Forsythe, Bombay Hook) but the total area impacted remains relatively constant. Special hunts have been implemented in some refuges to reduce bird use and consequently habitat damages.

Finally, depredation by geese in agricultural fields remains a problem on the staging and wintering grounds. Annual compensations paid by the Canadian and Quebec governments have reached up to one million dollar and represented 60-80% of the actual loss. Despite a decrease of damages since the establishment of the Spring Conservation Hunt, there is still a strong lobby by the farmers union for a population reduction.

MANAGEMENT ACTIONS IN CANADA AND THE U.S. – LESSER SNOW GOOSE

KELLY, JIM, U.S. Fish and Wildlife Service, Ft. Snelling, MN, U.S.A.

In February 1999, the USFWS prepared an Environmental Assessment that evaluated short-term options for reducing the number of light geese (lesser snow and Ross's geese) found in the Central and Mississippi Flyways. On February 16, 1999 the Service published final rules to: 1) authorize the use of additional hunting methods for mid-continent light geese (electronic calls and unplugged shotguns); and 2) establish a conservation order that authorized Central and Mississippi Flyway States to increase take of light geese beyond normal framework dates. Also in 1999, Manitoba implemented special regulations to allow take of lesser snow geese during May 1-22 in GBHZ 1 (north zone). The combination of regular season and special regulation harvest of light geese during 1998/99 was 1.07 million birds, which was the first time harvest had exceeded 1 million in the 2 flyways. Manitoba harvested 563 birds during May, in addition to 55,600 birds during the regular season. During 1999/00, total harvest of light geese in the Central and Mississippi Flyways was 1.34 million birds.

With the addition of light goose harvest in Canada, the 1999/00 harvest of mid-continent light geese exceeded 1.4 million birds. Recent population modeling suggests that a constant annual harvest of 1.4 million birds will be sufficient to achieve a 50% reduction in the number of light geese in the mid-continent region. Future management actions in the U.S. will depend on the outcome of the Environmental Impact Statement process.

THE EFFECTS OF MANAGEMENT ACTIONS ON POPULATIONS: LESSER SNOW GOOSE

MOSER, TIM, U.S. Fish and Wildlife Service, Denver, CO, U.S.A.

Annual estimates of Mid-continent light goose harvests have increased to record levels since new harvest strategies were implemented in the United States and Canada in 1998-99. Current harvest magnitude equals the level postulated by Rockwell et al. (1997) as necessary to achieve light goose population reduction goals. A primary population-monitoring method for Mid-continent light geese is a photo-inventory of major nesting colonies which is conducted on a 5-year rotating basis, thus unavailable at this time. The major index of wintering Mid-continent and Western Central Flyway light geese has declined for the third consecutive year, the first such decline since these methodologies were initiated in 1969/70. Recent trends in several indices of light goose population status and harvest rate were examined.

EFFECTS ON OTHER SPECIES IN THE MID-CONTINENT

ROCKWELL, ROBERT, American Museum of Natural History, New York, NY, U.S.A.

Runaway consumption by an increasing Mid-continent Population of Lesser Snow Geese has initiated trophic cascades at several coastal sites in the Hudson Bay lowlands. Once-lush coastal marshes have been reduced to salt barrens supporting little vegetation. As coastal forage became more limiting and the goose population continued to grow, habitat degradation extended into adjacent but more inland areas where grass-sedge habitat grades into one including increasing numbers of shrubs. The impact of these changes on growth, body size and various demographic variables of snow geese has been well documented. An obvious question is whether this degradation is impacting other species sharing the habitat.
It is difficult to document collateral impact of vegetation loss on animal species since historic, benchmark data are usually absent. Using casually collected bird list data, we have been able to show downward trends in the presence of several species in the La Pérouse Bay region. Pairing past nesting census data with recent nesting surveys, we can show substantial declines in nesting by 3 species for which historic data existed. In attempting to develop methods that examine collateral impact in the absence of historic data, we have paired geographically adjacent areas that differ in habitat quality and surveyed them for nesting and foraging use. Results from this approach mirror those of the surveys using historic data.

MANAGEMENT ACTIONS IN CANADA AND THE U.S. - GREATER SNOW GOOSE

SARRAZIN, RAYMOND, Canadian Wildlife Service, Sainte-Foy, Québec, Canada

The Greater Snow Goose (GSGO) stages exclusively in Québec during spring and fall migrations. In late 1996, CWS undertook public consultations on GSGO population management issues. These led to the formation of a management committee made up of numerous stakeholders from a broad spectrum of Québec society. CWS' action plan of the spring of 1997 was derived from a consensus of the stakeholders.

The management strategies and recommendations of the Arctic Goose Habitat Working Group were presented to the Québec Stakeholders Committee in March 1998. These measures, including a spring conservation harvest, were unanimously accepted with the caution that all measures thought to optimize the sport harvest in the fall be implemented in order to reach the population goal during the 1999-2002 period. If spring conservation harvest was still needed, it was only to take place in specific rural communities where important investments were made for socio-cultural and economic purposes. Further discussions took place during the winter 1998-99 allowing farmers, hunters, outfitters, bird watchers, scientists and managers to submit their opinion concerning the spring conservation hunt. That process led to a broad consensus in favor of the measures.

Management recommendations were then submitted to the Canadian Minister of the Environment to bring about modifications to the Migratory Birds harvest regulations in the spring of 1999. These measures were: increased daily and possession limits; spring conservation harvest in agricultural areas with two restricted agricultural zones highly frequented by birds watchers and the public; field sneaking; electronic calls; baiting in the spring, and; lure crops in the fall with special permits from CWS. Additional measures to increase GSGO harvest were also implemented in the states of the Atlantic Flyway. They include reciprocal licences between neighboring states and extending the hunting season.

ASSESSMENT OF ASSUMPTIONS FOR ESTIMATION OF SNOW AND ROSS'S GEESE USING GROUND AND AERIAL PHOTOGRAPHIC SAMPLING

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Much debate about management of burgeoning snow goose populations relates to their population size. Populations of Ross's and lesser snow geese are estimated using aerial photography at breeding colonies. Photo surveys are thought to provide valid estimates because it is assumed that (a) breeding light geese are highly clumped and relatively sedentary, and (b) images represent true number of geese nesting. Analysis of photos taken 19 June, 1998, at Karrak Lake, Nunavut, yielded a population estimate (± 95%CL) of 437,000 ± 70,000 nesting birds on 107 km^2 of land. Counts of active nests made on the ground in 1998 using stratified sampling and 30 m radius sample plots (n=188) systematically spaced within the colony yielded an estimate of 618,000 ± 129,000 breeding geese on 124 km^2 of land. Given the small overlap in CL of the two survey methods, we were motivated to evaluate several assumptions associated with ground and photo samples of breeding geese to resolve this discrepancy. Using closed capture models, we estimated detection probability of goose images from air photos. We also measured variation in counts of images among observers. Other assumptions of ground and photo samples and their influence on population estimation are discussed.

LECTURE - SATURDAY - 10:20

EGG SIZE AS A PREDICTOR OF NUTRIENT COMPOSITION OF NEONATAL GEESE

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Fresh and pipped eggs were collected from nests of *interior* Canada (CG) and Lesser Snow Geese (LSG) to determine: 1) if egg size reliably predicted egg composition and characteristics (i.e., structural size, digestive organ masses, and nutrient constituents) of neonates, 2) allometric relations between egg size and egg constituents and characteristics of neonates. Egg size predicted mass of fresh egg constituents for both species; CG and LSG egg components varied isometrically with their respective egg sizes. Neonatal size was positively correlated with egg size in both species, but was predicted better for LSG than for CG. Neonates from smaller eggs were structurally larger for their egg sizes than were conspecifics from larger eggs. Egg size was a poor predictor of digestive organ masses for both species. Most nutrient constituents of neonates were positively correlated with egg size, but relations were stronger in LSG than in CG. Overall, egg constituents were more closely related to egg size than were nutrient constituents of neonates. Nutrient constituents of neonates of both species increased in direct proportion to egg size. We conclude that egg size reliably predicted most egg constituents, but characteristics of neonates were predicted much less reliably. Results further suggest that intra- and interspecific variation in embryonic metabolic rates limit the utility of using egg size to predict nutrient composition of CG and LSG neonates.

LECTURE - WEDNESDAY - 10:00

DIFFERENCES IN THE SIZE OF LESSER SNOW GEESE (*ANSER C. CAERULESCENS*) OF WRANGEL ISLAND

BARANYUK, VASILY, Wrangel Island Nature Reserve, Moscow, Russia

The weight and body size of geese are crucial for their adaptation to arctic conditions and, hence, are important population characteristics. Lesser Snow Geese breeding on Wrangel Island winter in two locations. The northern wintering grounds are the Skagit and Fraser River deltas in British Columbia and Washington, exploited only by the geese from Wrangel Island. The southern wintering area is the Central Valley of California, which is also occupied in this season by numerous Lesser Snow Geese from the western arctic population, originating from Banks Island. The exchange of Wrangel Island birds between the northern and southern wintering areas, as well as with Banks Island, is possible. We examined 614 individually marked geese with known wintering grounds. We have revealed differences in the summer weight and linear size of the geese of the two wintering areas. Average sizes of adult males differ to a large extent. The northern ganders have greater body mass, head lengths, culmen, tarsus, and head heights. Adult females differ only in the size of their culmens. The northern females have longer culmens, while the southern females are more variable. One-year-old females differ only in the sizes of their shoulders, which are larger in the northern females. One-year-old males also differ in the size of their shoulders, but, in contrast to females, the southern males have larger shoulders. We used data obtained from the sightings of individually marked birds, and determined their attendance of the northern or southern wintering grounds according to observations of birds at the wintering grounds between December and late February. In addition, we used mineral staining of facial plumage for division of the population into groups. The geese of the northern wintering grounds formed two groups: "A" group consisted of only birds with intensive red facial plumage (9 and 10 grades, according to our scale) and "B" group included all other northern geese (0 to 8 grades). The geese wintering in the south were also divided into two groups: the birds lacking much staining of facial plumage (0 to 3 grades) comprised "C" group, and all the rest (4 to 10 grades) formed "D" group. Several differences were found among the groups. The males of "A" group are heavier than those of "B" group and have larger shoulders and tarsuses. Differences between the groups of males of the southern population were revealed only in variability of culmen and tarsus sizes, which appeared to be higher in the male geese of "C" group than those of the "D" group. In the northern population, the females of "A" group have larger body masses, head lengths, head heights, shoulders, and tarsuses than females of "B" group. Culmens, shoulders, and tarsuses are larger in the females of "C" group of the southern population than in those of "D" group. The largest and heaviest geese, both males and females, are found in the "A" group. Birds of the "A" group winter in the northern areas, primarily on the Fraser River delta. Birds of the northern wintering area forage on both salt marsh and agricultural fields, while geese of the southern wintering area forage mainly on agricultural fields. We can assume that, on the salt marshes, larger geese have advantages in foraging on American Three-Square Bulrush (*Scirpus americanus*). This size selection is more pronounced in females, because they are generally smaller than males. The northern "B" group is comprised of large males and small females. In the southern population, "C" (unstained) group includes large females and small males, and "D" group is formed of small males and small females. In many years, the reproductive rate of the geese of "A" group was higher on the Tundra River colony.

POSTER - FRIDAY - 13:00

IMPACT OF A SPRING HUNT ON THE REGIONAL MOVEMENTS OF STAGING GREATER SNOW GEESE

BÉCHET, ARNAUD, Dépt. Sciences Biologiques Université du Québec à Montréal, Montréal, Québec, Canada

GIROUX, JEAN-FRANÇOIS, Dépt. Sciences Biologiques Université du Québec à Montréal, Montréal, Québec, Canada

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In 1999 and 2000, a spring conservation hunt was conducted for the first time in Quebec to control the exponential growth of the Greater Snow Goose population. We evaluated the potential impact of this hunt on regional movements of geese in southern Quebec, the main spring staging area that extends over 400 km along the St-Lawrence River. Using multi-strata capture-recapture models, we estimated seasonal movements of radio-tagged females tracked in 1997 (n=37) and 1998 (n=70) before the establishment of the hunt and in 1999 (n=60) and 2000 (n=59) during the hunt. In the two years preceding the hunt, migration was a west to east directional process with very low movement probabilities from eastern to western region. During both years with hunting, movement probabilities from east to west were higher than in the two preceding years. We also show that most of these backward movements occurred in the week immediately after the beginning of the hunt. Hunting disturbance rates were higher during the conservation hunt especially in the most eastern region of the lower estuary. Such a change in the migration pattern could increase the risks associated to crop depredation in regions with different levels of tolerance or with more susceptible crops such as newly sown cereals. Furthermore, regional movements are energetically costly and their increase may be an underlying cause of the poor pre-nuptial body condition attained by geese during years with a conservation hunt.

LECTURE - WEDNESDAY - 14:35

CYCLIC LEMMINGS AND GREATER SNOW GEESE: DIRECT OBSERVATIONS OF AN INDIRECT TROPHIC INTERACTION

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GIROUX, JEAN-FRANÇOIS, Dépt. Sciences Biologiques Université du Québec à Montréal, Montréal, Québec, Canada

The breeding success of many arctic-nesting goose species fluctuates considerably among years. We tested the hypothesis that cyclic lemming populations indirectly affect breeding greater snow geese (*Chen caerulescens atlantica*) on Bylot Island, Nunavut, through the behavioural and numerical responses of shared predators. Behavioural observations conducted over one 4-year lemming cycle indicate that predators were selective in their prey and increased their hunting effort on goose nests at low lemming density. Arctic foxes (*Alopex lagopus*), main nest predators, showed a numerical response to rodent densities as their breeding output was lowest during the low phase of the rodent cycle. Abundance of foxes and parasitic jaegers (*Stercorarius parasiticus*) in the goose colony showed strong inter-annual fluctuations and were generally reduced at high lemming density. The total response of predators was highly variable among years, ranging from 19% to 88% of the total number of eggs depredated, and was cyclic, being lowest during peak lemming years. Peak of egg predation by foxes and jaegers occurred with a time lag of 2 and 3 years with respect to the lemming cycle, respectively. Results from an artificial nest experiment were consistent with those obtained on real goose nests and confirmed the inter-annual variation in nest predation pressure by different predator species. Thus, we conclude that responses of predators to cyclic lemmings cause strong indirect effects on goose nesting productivity in the High Arctic and generate both short-term apparent mutualism (via behavioural responses) and long-term apparent competition (via numerical responses) among prey.

LECTURE - THURSDAY - 14:30

LIFE HISTORY STRATEGIES IN ARCTIC GEESE

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ERIKSTAD, KJELL EINAR, Norwegian Institute for Nature Research, Dept. of Arctic Ecology , Tromso, Norway

We describe the lifetime reproductive success of a cohort (1976-1999) of barnacle geese *Branta leucopsis* from Svalbard/Scotland. Mean life span and age of first successful breeding for males and females was similar (10.7 vs. 11.2 years; 2.7 vs. 2.6 years, respectively). Most geese established initial pair bonds at age 2-3 yrs and pair bonds survived between 1-19 years. Geese that maintained longer lasting pair bonds during their lifetime produced more offspring than those with shorter pair durations (range 0-21 offspring). This result was achieved while statistically controlling for the birds' lifespan and the proportion of life spent without a partner, two variables that also influenced lifetime reproductive success. Geese that failed to breed in their lifetime were smaller and had a shorter lifespan than those that did breed; 76 out of 165 adult males and 88 out of 194 adult females did not breed at all. Birds that bred for the first time at a young age died sooner but had a higher annual and lifetime reproductive success than those that delayed first successful breeding to an older age. The most successful life history strategy in this arctic goose cohort was to find a mate and begin a breeding carrier early in life, at the expense of a long lifetime.

LECTURE - WEDNESDAY - 9:00

CONCENTRATING ON FOOD: EXCESSIVE FORAGE PRODUCTION INDUCES GEESE TO AGGREGATE

BOS, DAAN, Plant Ecology University of Groningen, Groningen, The Netherlands

LOONEN, MAARTEN, Animal Ecology University of Groningen, Groningen, The Netherlands

We studied the habitat use by spring staging dark-bellied Brent geese in the Wadden Sea of Western Europe. Our aim is to arrive at an understanding of the mechanisms that determine the capacity of the foreshore for geese. Two major habitats are used by the geese in our study area. The geese forage on agricultural grassland and salt marshes. During spring, a distinct decrease occurs in the use of the agricultural land. Those birds, that continue feeding there, concentrate on an increasingly smaller surface. We hypothesized that the observed patterns are to be explained by a decreasing rate of nutrient intake, with increasing standing crop. Experimental evidence for the marsh and the polder supports this hypothesis. On the marsh, geese were shown to select plots with highest nutrient-intake rates in a full-factorial set-up. Intake rate of biomass was not correlated with patch choice. In the field, low biomass sites on the marsh have higher nutrient concentrations and are preferred over sites with high densities of forage. At the agricultural grassland, nutrient levels do not differ much with biomass. However, extreme leaf-length of the agricultural grasses actually hinders the rate of biomass-intake at high biomass densities. Geese were shown to prefer experimental plots with relatively lower biomass levels, due to previous grazing by livestock or themselves. Forage production is governing habitat use and ungrazed patches turn out to become unattractive. Within a season the birds are able to maintain a high quality sward, by increasing the grazing pressure along with primary production.

LECTURE - THURSDAY - 9:20

MANIPULATION OF GRAZING RISK FOR ARROWGRASS, *TRIGLOCHIN PALUSTRIS*

BOS, DAAN, Plant Ecology University of Groningen, Groningen, The Netherlands

SEDINGER, JAMES S., Institute of Arctic Biology University of Alaska, Fairbanks, Alaska, U.S.A.

SCHAMBER, JASON, Dept. Biology and Wildlife University of Alaska, Fairbanks, Alaska, U.S.A.

In the sub-arctic breeding sites of Black Brant *Branta bernicla nigricans* and Cackling Canada goose *Branta canadensis minima*, on the west coast of Alaska, arrowgrass *Triglochin palustris* is a favoured food source. It is unclear how the plant is able to persist under the high grazing pressure it experiences. The effect of neighbouring plants on the grazing risk for individuals of arrowgrass was examined in three parallel experiments. Removal of neighbouring plants around individual arrowgrass plants led to a two-fold increase in the number of grazed plants and a net decrease in leaf length. In a transplant experiment, a significant effect of neighbour density on grazing risk could be detected after three weeks. The type of community however, had a more pronounced effect on risk of arrowgrass being grazed, because of its strong relationship with overall grazing pressure. In the community where grazing pressure was high, even neighbouring plants were grazed, effectively reducing the potential refuge for arrowgrass. When arrowgrass was transplanted in this heavily grazed community together with the tall growth form of *Carex ramenskii* , plants were better protected, illustrating that some nurse species are more effective in providing refuge than others. The population consequences for arrowgrass under increased grazing pressure, will be determined by the growth characteristics of the plant assemblages with which it is associated.

POSTER - FRIDAY - 13:00

ESTIMATION OF STOPOVER LENGTH IN BIRDS USING CAPTURE-RECAPTURE METHODS : THE EXAMPLE OF THE GREATER SNOW GOOSE

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Migrating geese are known to move frequently and to disperse long distances to find food. Under such conditions, it is almost impossible to get a complete follow-up of marked individuals. Therefore, very few authors have managed to obtain unbiased estimates of individual stopover length in a staging area. Our objective was to apply and expand recent developments in capture-recapture methods to obtain unbiased estimates of stopover lengths in Greater Snow Geese (*Chen caerulescens atlantica*) staging along the St. Lawrence estuary in fall. We also examined annual variations in length of stay over the short term (recent years) and the long term (since mid-80s) to test the hypothesis of a decrease in stopover duration. Intensive observations of neck-banded individuals were conducted during 1985-1987 (n individuals=1,134; n observations=5,718) and 1994-2000 (n individuals=4,530; n observations=11,007). Survival analyses using classical encounter histories were performed to estimate the time spent by the geese in the estuary after an observation based on emigration probabilities. Recruitment analyses using reverse encounter histories were performed to estimate the time spent by the geese in the estuary before an observation based on immigration probabilities. We estimated that geese spent on average 19.2 ± 0.9, 23.4 ± 0.4 and 27.4 ± 0.9 days in the estuary in falls 1985, 1986 and 1987, respectively whereas they spent 28.2 ± 0.7, 20.8 ± 0.9 and 17.6 ± 1.1 days in falls 1998, 1999 and 2000, respectively. As anticipated, these estimates are larger than the ones calculated using the minimum stopover length method (i.e. time elapsed between the first and the last observation of marked individuals). Moreover, estimates for 1999 are consistent with results obtained from an independent radio-telemetry study. These preliminary analyses suggest that the method may yield reliable results and may confirm a decrease in stopover duration for the last decade. We are now applying it to additional years in our database.

LECTURE - WEDNESDAY - 17:15

MALTBY'S GOOSE AND THE TAXONOMY OF BRANT *BRANTA BERNICLA*

BOYD, HUGH, Canadian Wildlife Service Environment Canada, Ottawa, Ontario, Canada

REED, AUSTIN, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

Taxonomists in Europe, who favour the Phylogenetic Species concept, have proposed that *Branta bernicla* should be split into at least three species. Their case for doing so is spoiled by the existence of the grey-bellied brant breeding in the Parry Islands, which were first identified by Linda Maltby in 1973 and whose identity and long history were confirmed by DNA analyses by Shields in 1990. For conservation purposes, the choice of species criteria may prove important, and controversial. The distribution of *bernicla* populations will be reviewed.

LECTURE - SATURDAY - 14:50

SNOW GEESE AND SCIRPUS MARSHES ON THE FRASER AND SKAGIT RIVER DELTAS: THE VALUE OF LONG-TERM MONITORING FOR UNDERSTANDING TRENDS AND INTERACTIONS

BOYD, SEAN, Canadian Wildlife Service Environment Canada, Vancouver, British Columbia, Canada

I have been monitoring the status of the wintering population of Lesser Snow Geese *Anser c. caerulescens* and American three-square bulrush *Scirpus americanus* on the Fraser and Skagit River deltas annually from 1987 to the present (13-14 years). Aerial photo counts were used to estimate abundance and young/adult ratios and mail-out surveys to estimate harvest. A non-destructive protocol in which stem densities are counted was used to estimate Scirpus rhizome biomass in permanent plots. The Fraser/Skagit population of Snow Geese fluctuated considerably across years due mostly to breeding ground successes or failures. In the Fraser/Skagit population, whenever recruitment exceeded harvest in Year t, the number of adults (white birds) in Year t+1 increased by an almost equivalent amount. Because the Fraser/Skagit population is largely a closed one, these basic demographic data can be used to estimate survival rates and predict future population growth scenarios. Stem densities in open plots suggested that a steady-state equilibrium existed between the grubbing rate of rhizomes and rhizome re-growth between 1988-92. However, after monitoring this system for an additional 7-8 years, a subtle but statistically significant decline in rhizome biomass has emerged. This decline may be due to a recent increase in the Fraser/Skagit goose population and associated grubbing rates. Or, it may be due to the fact that annual changes in rhizome biomass are small and require >10 years before a decline can be detected with the sampling protocol used. In any case, it appears that the goose-plant interaction on the Fraser delta is gradually moving toward a steady-state at very low biomass similar to that which has existed on the Skagit delta for decades.

LECTURE - THURSDAY - 10:20

RECENT INCREASES OF BREEDING SNOW GEESE ALONG THE WESTERN ARCTIC COAST OF ALASKA

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RITCHIE, ROBERT, ABR, Inc., Environmental Research & Services , Fairbanks, Alaska, U.S.A.

SUYDAM, ROBERT, North Slope Borough Department of Wildlife Management , Barrow, Alaska, U.S.A.

For the past decade, we have monitored Snow Geese between the Colville River and Kasegaluk Lagoon along the Beaufort and Chukchi coasts of northern Alaska. Generally, two aerial surveys were conducted annually: a June survey of breeding birds and a late July survey of brood-rearing groups. Most Snow Geese in this area breed in two small colonies on the Kukpowruk and Ikpikpuk river deltas that averaged about 50 pairs per colony for the period from 1991 to 1998. The number of nests in the Ikpikpuk colony increased substantially in 1999 and again in 2000, to 250 nests. In addition, the number of non-breeders at this colony exceeded 1000 birds in 2000. During brood-rearing, the number of Snow Geese observed on the North Slope west of the Colville River has increased from roughly 400 birds in 1995-1997 to more than 2000 adults and goslings in 2000. Possible explanations for increases in the Snow Goose population in the region include intrinsic growth of local colonies, immigration from the declining Howe Island colony, or immigration from either the Pacific Flyway (Wrangel Island) or Western Canadian populations, or a combination of these. Potential lines of evidence in evaluating these possibilities include evaluation of marked birds (the proportion of marked birds is particularly high in the Howe Island population), evaluation of blue/white color-phase ratios, and evaluation of genetic affinities as determined by blood samples. Available evidence in support of these potential explanations is evaluated and recommendations are made for further study.

POSTER - FRIDAY - 13:00

A MONITORING PROGRAM FOR LESSER SNOW GOOSE POPULATIONS IN THE CANADIAN ARCTIC

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ALISAUSKAS, RAY T. , Prairie and Northern Wildlife Research Centre Canadian Wildlife Service, Saskatoon, Saskatchewan, Canada

BARRY, SAM, Canadian Wildlife Service Environment Canada, Edmonton, Alberta, Canada

HINES, JIM, Canadian Wildlife Service Environment Canada, Yellowknife, Northwest Territories, Canada

ROCKWELL, ROCKY, Dept. of Ornithology American Museum of Natural History, New York, New York, U.S.A.

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ABRAHAM, KENNETH F., Ontario Ministry of Natural Resources, Peterborough, Ontario, Canada

Following completion of the Arctic Ecosystem in Peril report a technical document "Science needs for Management of Increasing Lesser Snow Goose populations" was developed by the AGJV Technical committee and approved by the AGJV Management Board. Components associated with the population monitoring were: 1: Photo Inventory of the Breeding Colonies, 2: Integrated Banding/Marking Program on the Breeding Colonies. 1: Photo inventories of the arctic lesser snow goose colonies had been conducted intermittently by the CWS since the early 1970's. Most recently inventories were of the Eastern Arctic in 1997, the Central Arctic in 1998 and the Western Arctic was attempted in 2000. The inventory cycle is scheduled to be repeated at five year intervals commencing with the Eastern in 2002, Central in 2003 and the Western in 2005.With increased activity in the Canadian arctic other techniques are being tested and employed to gather additional information on the status of white geese on a more frequent basis These range from ground counts where active field camps exist to other types of aerial surveys during some component of the breeding season. They complement the monitoring program and provide additional information on the status of breeding and non breeding components, production rates and other vital rates. 2: A pilot banding/marking project by CWS on Baffin Island in 1997 marked 1000 Adult Snow geese with neck collars. With the final approval of the AGJV Management board and funding from AGJV cooperating agencies CWS, USFWS, Central , Mississippi and Atlantic Flyway councils the program to band snow geese and neck collar 1000 adults per location has been expanding. In 1998 the colonies along West Hudson Bay were added by CWS and La Perouse Bay by NYMNH, neck collaring by CWS was included in the Central Arctic , and in 2000 the Western Arctic was added by CWS and Cape Henrettia Maria by OMNR. The only major Canadian snow goose breeding areas that remains outstanding is on Southampton Island. The coordinated banding program has resulted in about 49,000 Snow geese being leg banded , and 14,700 of these also Neck Collared. Cooperators throughout North America have been observing these neck collars and as of spring of 2000 more than 4100 have been recorded . Direct observation rates of these neck collars (uniques/banded) have increased from 2% in 1997/98 , to 13% in 1999/2000. In addition, up to and including the 1999/2000 waterfowl season more than 1250 of the leg bands have been recovered and reported to the banding lab.

POSTER - FRIDAY - 13:00

TIMING OF FIRST PAIRING IN WRANGEL ISLAND SNOW GEESE

COOKE, FRED, Biosciences Simon Fraser University, Burnaby, British Columbia, Canada

ANDRES, BYRON, Biosciences Simon Fraser University, Burnaby, British Columbia, Canada

BOYD, SEAN, Canadian Wildlife Service Environment Canada, Vancouver, British Columbia, Canada

BARANYUK, VASILY, Wrangel Island Nature Reserve, Moscow, Russia

For birds with long term monogamy, it is crucial to know where and when the first pair formation occurs if we are to understand the population dynamics of the species. Breeding ground studies suggest that for many Snow Geese, first pairing occurs some time between the time when they leave the breeding grounds as yearlings and return as 2yr olds the following May, other birds appear to be still unpaired at 4 years of age. There are no studies away from the nesting areas which allow us to be more specific as to time and place, nor to tell us what fraction of the birds pair at each age (2, 3 or older). Without individually marked birds, observation on pairing would not discriminate between first pairing and re-pairing events. Only observations on marked pre-breeding birds can answer this question. For 3 years, necked collared yearlings marked on the Wrangel Island colony were observed throughout the winter months in Washington and BC. Unlike the conclusions from the breeding ground studies, most marked yearlings remained in sibling groups throughout their second winter, rather than pairing. By age four, however many had paired. Most observed pairing occurred in March or April, and the proportion of birds paired on Spring departure was similar to that of those returning in the following Fall. A number of possible explanations for the differences between the two findings will be discussed.

LECTURE - WEDNESDAY - 11:40

SNOW GEESE AND CARRYING CAPACITY OF THE FRASER RIVER ESTUARY

DEMARCHI, MIKE, LGL Limited, Sidney, British Columbia, Canada

Brackish marshes of the Fraser River estuary contain critical habitats for many high-profile species, including pacific salmon *Onchorynchus* spp. and lesser snow geese *Chen caerulescens caerulescens* that comprise the "Fraser-Skagit" subpopulation of the Wrangel Island population. The purpose of this study was to assess whether current management goals for that subpopulation are appropriate, according to the carrying capacity of brackish marsh habitat in the Fraser River estuary. Simulation modelling predicted that the current carrying capacity of brackish marshes of the Fraser estuary is a subpopulation of approximately 17 500 snow geese—a value that is greatly exceeded by recent numbers. The Pacific Flyway Council's target subpopulation size of 30 000 to 60 000 has been set without considering the carrying capacity of brackish marshes used by those birds. Model results suggest that only by consuming forage in agricultural fields (a relatively recent phenomenon) can the Fraser Delta sustain the current numbers of snow geese that stage and winter there. Over-use by snow geese can degrade brackish marsh habitats. Further, because published information has demonstrated that the brackish marshes of the Fraser Estuary are at about only 15% of their *Scirpus americanus* biomass potential, primarily because of grubbing by snow geese, it is possible that other species that depend on those marshes are negatively affected by current snow goose management plans.

LECTURE - THURSDAY - 10:00

EFFECT OF COLLAR-ATTACHED TRANSMITTERS ON PAIR BOND, BREEDING SUCCESS AND BEHAVIOR OF GREATER SNOW GEESE

DEMERS, FRÉDÉRIC, Dépt. Sciences Biologiques Université du Québec à Montréal, Québec, Canada

GIROUX, JEAN-FRANÇOIS, Dépt. Sciences Biologiques Université du Québec à Montréal, Québec, Canada

GAUTHIER, GILLES, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

BÊTY, JOËL , Département de biologie Université Laval, Sainte-Foy, Québec, Canada

Radio telemetry has played an important role in waterfowl studies to determine space and habitat use, survival and harvest rates as well as migration chronology. Several studies using harness attachment or implants have reached divergent conclusions about potential negative effects of radio transmitters on waterfowl behavior and condition. Our objective was to determine whether radio neck collars affect pair bond, breeding success and behavior of greater snow geese (*Chen caerulescens atlantica*). A total of 230 females were fitted with radio neck collars during the 1995-1998 molting period on Bylot Island, Nunavut, and data were subsequently obtained for 159 birds. Radios were fixed on plastic neck collars with a 15-cm downward antenna for a total mass of 59±9g representing 2.5±0.02% of the female body mass. Ten months after marking, 36% (95% CI = 27-45) of the females were separated from their original male resulting in an estimated divorce rate of 25% (95% CI = 12-37) when accounting for male mortality rate. In comparison, females with conventional neck collars (without radio) showed a separation rate of 18% (95% CI = 11-25) and a divorce rate of 4% (95% CI = 0-16). Breeding propensity, nest initiation date, clutch size and nesting success of radio marked birds were also negatively affected. Behavioral modifications associated with radio collars seem to decrease with time. We recommend to minimize the mass of radio neck collar to < 2.5% of the bird body mass and to reduce antenna length. This implies a trade-off between the effect on birds and the performance of the radio in terms of longevity (battery mass) and range (antenna length).

POSTER - FRIDAY - 13:00

LAND COVER MAPPING OF WEST BAFFIN ISLAND, NUNAVUT

DIDIUK, ANDREW, Canadian Wildlife Service Environment Canada, Saskatoon, Saskatchewan, Canada

FONTAINE, ALAIN, Canadian Wildlife Service Environment Canada, Iqaluit, Nunavut, Canada

MALLORY, MARK, Canadian Wildlife Service Environment Canada, Iqaluit, Nunavut, Canada

Land cover mapping of wetland and upland habitats was conducted for the coastal zone of west Baffin Island in 1999 and 2000 using Landsat Thematic Mapper satellite imagery. Helicopter-assisted site inspections were conducted in early August of each year to identify land cover types and their relief, substrate, moisture regime and vegetation composition. Digital image analyses were performed to create thematic maps of land cover types at 1:50,000 and 1:100,00 scales using a Universal Transverse Mercator projection. Illustrations of land cover types, examples of map products, and implications for migratory bird populations are presented.

POSTER - FRIDAY - 13:00

DISTRIBUTIONS, SURVIVAL AND RECOVERIES OF ROSS'S GEESE IN NORTH AMERICA, 1961-1999

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ALISAUSKAS, RAY T. , Prairie and Northern Wildlife Research Centre Canadian Wildlife Service, Saskatoon, Saskatchewan, Canada

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We examined survival and recovery rates of Ross's geese *Chen rossii* banded and recovered throughout North America from 1961 to 1999. The data were examined using models developed by Brownie et al. (1985) to characterize temporal patterns in probabilities of annual survival, S, and recovery, f. We considered 40 models for temporal variation in S and f including year-specific, constant, and non-linear temporal variation. The best model was composed of S as a third-degree polynomial function of time for adults, and a fifth-degree function of time for juveniles; recovery probability for both adults and juveniles varied in relation to time (year) in third-order fashion. Estimates of f for adults from the best model ranged from 0.016 ± 0.002 SE to 0.040 ± 0.002; f for juveniles ranged from 0.021 ± 0.003 to 0.074 ± 0.005. Survival rate for adults ranged from 0.738 ± 0.039 to 0.952 ± 0.024; juvenile survival rates ranged from 0.199 ± 0.040 to 0.611 ± 0.087 by 1999. Increased survival rate of juveniles over the last decade may be related to expansion of breeding areas by Ross's geese, following possible density-dependent effects on juvenile survival in the 1970s and 1980s when populations increased exponentially. It remains unclear if increases in recovery rate of both age classes over the last decade are more the result of increased harvest or increased reporting rate. Given recent legal challenges to control of snow geese on the grounds of collateral increased harvest of Ross's geese, banding efforts should continue.

LECTURE - SATURDAY - 10:00

STATUS OF LESSER SNOW GEESE AND ROSS' GEESE WINTERING IN THE MEXICAN INTERIOR HIGHLANDS, 1998 AND 1999

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During winters 1998 and 1999, we surveyed by air and ground 62 and 137 wetland areas, respectively, in 6-8 states in the Interior Highlands of Mexico for snow geese (*Chen caerulescens*) and Ross'geese (*Chen Rossii*; [light geese]). Only limited information is available on abundance, distribution and species composition of light geese winter populations in the Mexican Interior Highlands. We surveyed wetlands from the International border in Chihuahua southward for >1,400 km to the states of Jalisco and Michoacan and sampled flocks during ground surveys for species and color morph composition (n=59,666). In 1998, severe drought prevailed in the northern Highlands and most larger natural lagunas were dry; southward water levels were low. In 1999, water levels had improved in the northern Highlands but drought prevailed in the southern Highlands. Primary winter foods used by light geese were oats, corn and sorghum. During 1998 and 1999, we estimated 229,288 and 295,281 light geese respectively, with most geese in the northern states of Chihuahua and Durango (1998-94%, 1999-95%). Combining our count data with mid-winter inventories in the adjacent United States provided estimates of 465,653 (1998/99) and 432,806 (1999/00) light geese wintering in the Western Central Flyway or 69-82% higher than other peak estimates. Species composition in 1998 and 1999 averaged 78.5% and 82.3% snow geese (1.3%-1.6% blue morph) and 21.5% and 17.7% Ross' geese, respectively. Weighted estimates by flock size suggested that 30,000 -50,000 Ross' geese are currently wintering in the Interior Highlands. Ross' geese were most abundant in northern and central Chihuahua (10-53% composition by area) but their proportion in flocks declined southward by latitude (<5% in Zacatecas, <1% in Jalisco). Winter flocks contained higher proportions of Ross' geese and blue morph snow geese than reported in this region 9-15 years ago. We observed little waterfowl hunting activity and opportunities to increase harvest of light geese appear limited due to current restrictive hunting regulations, especially for foreigners. Several hunting guides and their clients focused on hunting neck-collared geese as trophies, limiting the utility of band recovery data from this region to assess survival. Changing land uses and cropping patterns could adversely impact the future quality and quantity of winter habitat for light geese.

LECTURE - SATURDAY - 16:50

MESIC HABITATS OF THE GREATER SNOW GOOSE (*CHEN CAERULESCENS ATLANTICA*) ON BYLOT ISLAND (NUNAVUT): CHARACTERISATION AND FEEDING POTENTIAL

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On Bylot Island, the Greater Snow Goose population is increasing rapidly. Estimates from 1998 indicate that 50% of the wetlands' carrying capacity is used by geese. However, wetlands represent only a small proportion of the south plain whereas mesic and dry habitats (uplands) cover approximately 90% of the landscape. Though less preferred by geese, uplands are used periodically and they can contribute significantly to the overall carrying capacity of Bylot's south plain. My project is to characterise the mesic habitats and to determine their feeding potential for geese. We established random plots in representative sections of each of the major vegetation zones pre-identified using aerial photos. Within these plots, we evaluated plant cover and diversity, grazing, faeces counts, and environmental parameters using random quadrats. A canonical correlation analysis (CCA) was performed to characterise the dominant plant communities and environmental parameters influencing their distribution. The CCA allowed us to recognize four major plant communities: dwarf-shrub heath, *salix*-graminoids-forbs, *salix*-legumes and polar semi-desert. Willows were common in all communities. We recorded abundant signs of grazing by geese and lemmings. Overall, leaves and inflorescences of graminoids (*Arctagrostis latifolia, Alopecurus alpinus, Poa arctica, Luzula nivalis, L. confusa*), alpine milk-vetch (*Astragalus alpinus*) and forbs were grazed in summer. Signs of grubbing were visible in either spring or late season in some zones, they were associated with the grazing of the tap root of the legume, *Oxytropis maydelliana*, and of the starchy rhizome of knotweed, *Polygonum viviparum*.

POSTER - FRIDAY - 13:00

KINSHIP AND NESTING DISPERSION OF GREATER WHITE-FRONTED GEESE ON THE YUKON-KUSKOKWIM DELTA

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Greater White-fronted Geese (*Anser albifrons*) exhibit strong natal and breeding philopatry, and establish long-term family bonds, often staying in family groups into the next breeding season. These characteristics could promote genetic sub-structuring within breeding populations. We tested the prediction that nesting dispersion of Greater White-fronted Geese would be non-random, with related individuals nesting more closely to one another than expected by chance. Feathers were collected from 61 nests on a breeding area on the Yukon-Kuskokwim Delta, AK. Collections were made from subsets of nests, focusing on natural clusters of breeding females in different study plots. DNA was extracted from feathers and 5 polymorphic microsatellite loci were amplified and scored. Distances between nests ranged from 12 m to over 7500 m, although a number of pairs (N = 30) nested in very close proximity (i.e., within 100 m). Analysis of all nests indicated that relatedness between females was significantly and negatively correlated with distance between nests. On average, the distance between the nests of related females on the same study area was 1021 m while that between unrelated females was 1161 m. However, pairs of females that nested in very close proximity (i.e., < 100 m) were not more likely to be closely related than those which nested further apart. Our results demonstrate that the nesting dispersion of Greater White-fronted Geese is non-random with respect to relatedness, although the pattern is best described as one of isolation by distance, rather than by close social affiliations of related individuals.

LECTURE - SATURDAY - 15:30

NOMADISM OR SITE-FIDELITY: TWO DIFFERENT BREEDING STRATEGIES IN DARK-BELLIED BRENT GEESE

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Dark-bellied Brent Geese often nest in association with Herring Gulls, but can also nest very successfully within territories of nesting Snowy Owls, or more or less scattered on the tundra. Because of year-to-year variations in predator pressure the latter two types of nesting habitat are not available every year. Snowy Owls tend to breed only in lemming peak years (once every three years on the Taimyr peninsula), and the same Snowy Owl territories are not occupied on a regular basis. This means that in order to use these types of nesting opportunities Brent Geese have to adopt a nomadic strategy and have to search for suitable nesting sites immediately after arrival in the breeding area. Within Herring Gull colonies, which are predictable from year to year, individual Brent Geese can be very site-faithful. Individually marked Brent Geese have been studied during two complete lemming cycles from 1990-1995 in the Lidia Bay, Pyasina delta, western Taimyr. Additional information from the wintering grounds allowed us to determine whether individuals were still alive and thus to estimate the rate of return of surviving individuals to the same nesting site. The data were recorded as Yij = 1 in case goose i returned to the breeding site in year j, and Yij = 0 when goose i did not return in year j. The latter required a sighting of that goose at the wintering grounds or a return in any subsequent year. Observations which did not meet these requirements were denoted as missing. The observations were modelled by means of the following Probit-Normal model: The binomial distribution arises naturally in this context, with Pij the probability of returning to the breeding site. This probability is linked to year and ringing site effects, analogous to ordinary probit regression. A random goose effect Ei was added which reflects the assumption that some geese are nomadic (with low values of Ei and thus a low probability of returning) and others are site-faithful (with high values of Ei). Parameters in this model were estimated by means of maximum likelihood, which necessitated a general purpose optimisation routine. It is postulated that at the present high Brent Goose population levels Gull colonies are fully saturated as a Brent Goose nesting habitat, and an increased proportion of the Dark-bellied Brent Goose population has to adopt a nomadic breeding strategy.

LECTURE - THURSDAY - 13:50

THE INFLUENCE OF NUTRIENT RESERVES AND BODY SIZE ON ANNUAL SURVIVAL OF CANADA GEESE

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In this study, we first test for a correlation between nutrient reserves and survival of Canada geese *Branta canadensis parvipes* staging in interior Alaska. We then use a manipulative experiment to test whether the relationship between stored nutrient reserves and survival results from limited exogenous resources. We also test for a relationship between body size and survival, independent of condition, because body size has been found to be positively related to other life history traits. We found evidence of a correlation between individual condition and survival of adult females. However, our experiment did not support the hypothesis that the variation in individual condition is a result of a limitation in nutrient availability.

POSTER - FRIDAY - 13:00

IMPACT OF SPRING CONSERVATION HUNT ON NUTRIENT STORAGE OF GREATER SNOW GEESE STAGING IN QUÉBEC

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Greater Snow Geese staging along the St. Lawrence River in spring accumulate large amount of nutrient reserves essential to complete their migration to the Arctic and breed successfully. In order to control the exponential growth of the population, a spring conservation hunt was opened from 15 April to 31 May in Québec in 1999 and 2000, a premiere in North America for over 80 years. We examined the amount of fat and protein stored during these two spring seasons and compared it with similar data obtained sporadically during the period 1979-1998 to test the hypothesis that disturbance by hunting negatively affected the storage of nutrients. Geese were collected with cannon-nets at three sites along the St. Lawrence River shortly after their arrival (2000 only) and at the end of staging (1999 and 2000) to assess their condition before their departure for the Arctic. A total of 255 geese were autopsied and we used abdominal fat and dry mass of breast muscle as indices of fat and protein reserves. In both years, the condition of birds was the lowest ever recorded: fat reserves at the end of staging were reduced by 33 to 38 % compared to the years before the hunt ($P < 0.01$) and protein reserves were reduced by 7 to 9 % ($P < 0.01$). We conclude that hunting disturbance had a negative effect on fat and protein storage of geese in spring, although some differences in diet between the years could also be involved.

LECTURE - WEDNESDAY - 14:55

RENESTING BY DUSKY CANADA GEESE ON THE COPPER RIVER DELTA, ALASKA

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We examined renesting as part of a breeding productivity study of dusky Canada Geese *Branta canadensis occidentalis* on the Copper River Delta, the primary breeding area for the dusky. If duskies renest extensively, visibility correction factors based on nest plot data will be inflated and population size will be overestimated. Understanding renesting is also important in modeling bird populations. In 1999 and 2000, during peak nest initiation, we removed the eggs from the nests of 41 females with neck collars and later searched for second nests. Of 6 females with clutches removed at mid-laying 2 laid continuation clutches and 3 renested (83% continuation clutch or renest), of 13 females with clutches removed at late-laying 8 renested (62%), and of 22 females removed in early incubation 7 renested (32%). Propensity to renest declined with nest age; initiation date at time of nest loss and year only slightly improved the fit of renesting models. The mean interval between first nests and renests was 11.9 ± 0.6 days (n = 17; range = 9-19 days). Neither incubation stage at time of first nest loss or initiation date of the first nest affected renest interval. Clutch size for first nests and renests did not differ (5.6 ± 0.2 eggs; n = 20 and 5.6 ± 0.2; n = 17). The median distance between first nests and renests was 77.6 ± 12.5 m (range = 0-214 m; n = 18). We used Monte Carlo simulations based upon parameter estimates from our study to estimate nest initiation distributions of renests and hen success.

LECTURE - THURSDAY - 15:50

MULTI-LEVEL POPULATION STRUCTURE IN BREEDING CACKLING CANADA GEESE

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Information about genetic structure and gene flow is a fundamental requirement for effective conservation and management since structured populations may merit different management strategies compared with those that are genetically uniform. Behaviors such as philopatry, which influence movement patterns of individuals, should affect the degree of population structure. Cackling Canada geese (*Branta canadensis minima*, cacklers) exhibit a strong female-biased tendency to return to specific nesting areas. Differential reproductive success may also combine with philopatry to produce patterns of female relatedness (structure) on the breeding grounds. We are using molecular techniques to investigate patterns of genetic population structuring and to examine the relationship between structure and reproductive behavior in cacklers. Data were collected between 1994 and 1997 on the Yukon Delta National Wildlife Refuge in western Alaska. DNA has been extracted from contour feathers deposited by incubating females. To investigate structuring in cacklers, we have employed microsatellite markers; the genetic identity of individuals is discernible by characteristic alleles at each of these markers. We have assessed variability of cacklers with 12 microsatellite loci and have sufficient power to distinguish between individual genetic identities. Given this variation, less than 2 individuals in 10^8 should have the same genetic pattern, while population size of cacklers is currently estimated at 2.5×10^5. We will present data on patterns of population structuring at the local scale.

POSTER - FRIDAY - 13:00

WITHIN-SEASON MOVEMENT PATTERNS IN SPRING-STAGING PINK-FOOTED GEESE

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The Svalbard population of Pink-footed Geese (*Anser brachyrhynchus*) has an annual spring staging period in agricultural areas in western Denmark. Thanks to intensive colour-marking and resighting, detailed information on site use of individual geese in spring is available. We investigated if the degree of within-season site tenacity and mobility differed among individuals and if differences were related to factors such as age, sex, pairing status, or body condition. Results showed that even site faithful birds commonly make short excursions to other areas within Denmark in the course of a season, and thus are familiar with a larger number of sites than their apparent site fidelity may suggest. Furthermore, there are genuine differences in the degree of mobility of individuals. Although quantification of these differences is difficult, sub-sets of sedentary and mobile birds can be identified. Comparison of these two groups yielded the following results: 1. No difference in mobility between males and females or between paired and unpaired birds; 2. Second-year birds tended to be more mobile than older birds; 3. Birds in good pre-migratory body condition were less mobile than those in poorer condition. 4. Sedentary and mobile birds did not differ in survival or reproductive success. Overall, there is considerable within-season movement among sites in Denmark. New sites that appear in the course of changes in land use can therefore easily be detected by individuals or small groups of birds. Although we identified some correlates of higher degrees of mobility in some birds, our results are not strong enough to suggest "typical colonizers" among Pink-footed Geese.

LECTURE - WEDNESDAY - 15:35

POPULATION MODELS IN GREATER SNOW GEESE: A COMPARISON OF DIFFERENT APPROACHES

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Population model is a powerful tool to guide decision making when managing wildlife populations. I will compare different modeling approaches that we used to evaluate the effect of increased harvest on the population growth of Greater Snow Geese. Fecundity and survival data came from the long-term study on Bylot Island, population size data from the annual spring photo inventory and harvest data from the national hunter surveys. In a first approach, we included environmental stochasticity in a matrix projection model to account for the large inter-annual difference in fecundity by simulating good, average and bad years. However, a drawback of this approach is that the predicted growth rate (lambda) is dependent on the model formulation used (post-breeding vs pre-breeding census). We developed an alternative approach based on the functional relationships between generation time and elasticity, and harvest rate and survival. Generation time was obtained from the mean transition matrix based on the observed proportion of good, average and bad years between 1985-98. The model assumes that hunting mortality is additive to natural mortality, for which we have good evidence. This yielded a simple formula that can predict changes in lambda as a function of changes in harvest. Under the current exploitation regime (spring conservation hunt and increased winter harvest), the model predicts that the greater snow goose population should decline by 10 to 17%/year, which matched what we observed between 1999 and 2000. The model can also be used to evaluate the impact of a reduction in fecundity caused by the spring conservation hunt.

LECTURE - SATURDAY - 10:40

THE ROLE OF NUTRIENT RESERVES IN EGG FORMATION IN GREATER SNOW GEESE: A REPLY TO ANKNEY (1995)

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Over the past decade, some studies have provided evidence that challenged the paradigm that endogenous reserves is the unique or primary source of nutrients for egg formation in arctic-nesting geese. In a thought-provoking paper delivered at the NAAG1995, Dave Ankney criticized these studies and concluded that they did not provide a solid case against the conventional wisdom. We re-examined this question using isotopic analyses in greater snow geese (*Chen caerulescens atlantica*), a species for which we already had evidence that females relied heavily on exogenous sources of nutrient (i.e. feeding) for egg formation. In 1999 and 2000, we collected females upon departure from their spring staging area in Quebec (n = 81) and during laying in the Arctic (n = 41); we also collected eggs (n = 76) and food plants eaten by geese during spring staging and the pre-laying period in the Arctic. Abdominal fat, breast muscles, liver, albumen, yolk and plant tissues were analysed for $^{13}C/^{12}C$ and $^{15}N/^{14}N$ isotopic ratios. The corn eaten by geese in spring provided a distinctive $^{13}C/^{12}C$ signature in goose tissues that was still detectable in the tissues of laying geese. Similarly, plants eaten on the spring staging were more enriched in $^{15}N/^{14}N$ than arctic plants and also provided a distinctive signature in goose tissues. The isotopic ratios in goose eggs were intermediate between those of endogenous reserves and arctic plants, thus showing that both endogenous and exogenous nutrients were incorporated into eggs. This confirms that greater snow geese have a more flexible nutrient use strategy than other goose populations.

POSTER - FRIDAY - 13:00

LONG-TERM EFFECTS OF STAGING GREATER SNOW GEESE ON BULRUSH MARSHES OF THE ST-LAWRENCE ESTUARY

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BÉLANGER, LUC, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

The number of greater snow geese in eastern North America has increased from 100,000 in the early seventies to over 800,000. During their spring and fall migration, they stage along the St-Lawrence river estuary where they feed in tidal marshes by grubbing bulrush *Scirpus pungens* rhizomes. In 1999, we found no significant difference in net aboveground primary production (NAPP) for the main plant species in the Montmagny and Cap St-Ignace marshes when compared to the 80s. The system thus seems to remain at a low level steady state. We observed a slight increase of *Scirpus* NAPP in a portion of the Montmagny sanctuary where hunting was allowed in fall and a decrease in other sections where goose use increased. This resulted from some management practices aimed at reducing depredation in adjacent fields. A long term monitoring (1971-2000) at the Cap Tourmente National Wildlife Area has shown that the density of *Scirpus* stems has declined by 48%. No significant trends were observed for other plant species. The most important factor responsible for the decline of *Scirpus* is the repeated presence of geese on the NWA although the effect of other environmental factors cannot be excluded. A study using exclosures is therefore required. Concerns are expressed for the Cap Tourmente marshes specially when considering the significant decline of goose numbers on the NWA during the last 30 years. Caution should also be taken for the other marshes if management strategies are implemented to increase their use by geese.

POSTER - FRIDAY - 13:00

FORAGING BEHAVIOUR OF SYMPATRICALLY BREEDING GEESE ON AKIMISKI ISLAND, NUNAVUT

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We studied foraging behavior of Canada *Branta canadensis interior* and Lesser Snow Geese *Chen caerulescens caerulescens* on Akimiski Island, Nunavut. We used exclosures to enhance above-ground forage availability to try and increase interspecific interactions, and to document species-specific differences in foraging behavior. Relatively homogeneous stands of *Puccinellia phryganodes* (n = 10 plots) and *Carex subspathacea* (n = 2 plots) were exclosed for 8-13 d to prevent grazing. Upon removal of exclosures, we documented goose species visits and behaviors, including peck rates (adults and goslings), step rates (goslings only), foraging bout length (adults and goslings), and time spent vigilant by adults. One hundred forty-six plot visits were observed including 10 and 136 visits by Lesser Snow and Canada Geese, respectively. For complete visits, time spent on plots ranged from 1-23 min and averaged approximately 4 min. Vegetation type and biomass were not significant explanatory variables in any foraging behavior models. Sex, daily sample period, and species-by-sex interaction were significant variables affecting peck rates. Sex-and age-specific peck rates followed the pattern of gosling > adult females > adult males. Diurnal patterns for peck rates indicated mid-day > early morning > evening. Canada Goose males exhibited higher peck rates than did male Lesser Snow Geese, resulting in the species-by-sex interaction. Foraging bout length was greatest for adult males, intermediate for adult females, and of shortest duration for goslings. Length of feeding bouts was positively related to number of days since peak hatch (DSPH) and negatively related to number of days since exclosure removal (DSER). Regression analysis of DSER on vigilance indicated a negative relationship, with adult vigilance declining as DSER increased. Adult males tended to spend more time vigilant than adult females, with both sexes being more vigilant during the early morning period. Gosling step rates declined as DSER increased. Sex-and age-specific foraging patterns of geese documented in this study generally follow behavioral patterns documented elsewhere. Though there was a limited number of plot visits by Lesser Snow Geese, results from the mixed-species peck rates model indicate the potential that species-specific differences in foraging behaviors exist. Opposite to our predictions, adult male foraging bout length was greater than either adult females or goslings.

LECTURE - THURSDAY - 11:20

DIFFERENTIAL ALLOCATION OF PARENTAL CARE IN WESTERN CANADA GEESE

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Western Canada geese (*Branta canadensis moffitti*) provide prolonged parental care consisting of vigilance and defense from competitors and predators, and guidance to food, grit and roost sites. Offspring in closest proximity to parents receive the greatest benefit. These goslings are thought to have enhanced survival and a greater likelihood of finding mates and other resources that enable success in reproduction. By regulating gosling proximities, parents may effectively control which goslings receive more care. In this study we investigate whether parental investment is directed to offspring that are more likely to survive and breed in the future (i.e. large, fit goslings) or to offspring that are most in need (smaller, less fit goslings). We found that within broods, goslings vary in sex, size (weight, skull and tarsus length, etc.), vigilance, and aggressiveness. This study describes the characteristics of gosling that receive most care, and provides further insight into the evolution of prolonged parental care in geese.

POSTER - FRIDAY - 13:00

POPULATION COMPOSTION OF PACIFIC BLACK BRANT DURING THE ANNUAL BRITISH COLUMBIA BRANT HUNT (MARCH 1-10)

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BREAULT, ANDRÉ, Pacific Wildlife Research Centre Canadian Wildlife Service, Delta, British Columbia, Canada

The Boundary Bay/ Roberts Bank area of the Fraser River delta supports a small, but increasing population of wintering Pacific Black Brant (*Branta bernicla nigricans*). This area also hosts the only remaining Brant hunt in British Columbia, March 1-10 annually. The hunting season is designed to incorporate the arrival of spring migrants thereby not heavily impacting the British Columbia wintering Brant. Counts conducted from 1998-2000 indicated migrants had not arrived before the hunting season and only local Brant were being targeted. To determine the proportions of wintering Brant from British Columbia other wintering grounds that compose the population during the hunt, leg-band data were examined for the 10-days before, during and after the hunt. These data were compared to wintering ground leg-band data from British Columbia, Washington, Oregon, and Mexico. The proportions of Brant from each wintering ground were estimated. Although this study is ongoing, current data show the presence of migrants from all wintering grounds during the hunt, but that the relative proportion of British Columbia Brant is increasing annually.

POSTER - FRIDAY - 13:00

USING MODELING TO ESTIMATE THE NUMBER OF PACIFIC BLACK BRANT STAGING IN THE STRAIT OF GEORGIA DURING SPRING MIGRATION

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In 1999 and 2000 Pacific Black Brant (*Branta bernicla nigricans*) were surveyed during spring migration in Boundary Bay (BB) in the Fraser River delta and Parksville-Qualicum (PQ) on the East Coast of Vancouver Island in British Columbia. These sites are on opposite coastlines of the Strait of Georgia. Both these sites are undergoing pressure from coastline development and increased recreational use. Surveys of Brant included counts and leg-band observations. In 1999, 3458 observations of 1094 bands were read in PQ and 493 observations of 317 bands were read in BB. In 2000, 3397 observations of 900 bands were read in PQ and 687 observations of 382 bands were read in BB. In 2000, band data were augmented by data from nine radio-tagged birds in PQ and three in BB. Using Program Mark, we are able to estimate the mean staging time of Pacific Black Brant in Boundary Bay and Parksville-Qualicum, the total number of Brant moving through each site, and the overlap between sites. In doing so we can identify what proportion of Brant on the Pacific Flyway moves through the area and critical times for Brant staging in the Strait of Georgia.

LECTURE - WEDNESDAY - 16:15

PARENTAL QUALITY IS NOT RESPONSIBLE FOR SEASONAL DECLINE IN GROWTH OF BLACK BRANT GOSLINGS

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Untangling covariation between parental and environmental effects on gosling growth rates has been a long-standing problem in arctic geese research. This problem is especially important when examining the effects hatching early has on growth of goslings. Late hatching goslings grow slowly because of a seasonal decline in habitat quality, or because females of poorer quality nest later. Females of poor quality may not provide goslings as much protection or access to food, thereby causing goslings to grow more slowly. To separate these effects we performed a clutch manipulation experiment on black brant (*Branta bernicla*) goslings on the Yukon-Kuskokwim Delta. We exchanged full clutches of females who nested early ("high quality females") with clutches from females who nested late ("poor quality females"). In addition, within each treatment we exchanged nests of larger clutch size with nests of smaller clutch size and vice versa. The design was fully crossed and included controls for each manipulation. After controlling for age, sex and egg size, goslings that hatched earlier but were reared with potentially low quality (late nesting) parents were significantly larger than gosling that hatched late, but were reared with high quality parents. Least square means of mass of goslings from control nests were not significantly different from either of the treatments. We did not find significant variation in growth of goslings among nests of different clutch sizes. Thus, we conclude that parental quality is not principally responsible for the variation in gosling growth that is expressed in hatch date.

POSTER - FRIDAY - 13:00

VARIATION IN SIZE OF BLACK BRANT IS OF ENVIRONMENTAL ORIGIN

HERZOG, MARK, Dept. of Biology and Wildlife University of Alaska, Fairbanks, Alaska, U.S.A.

SEDINGER, JAMES S., Institute of Arctic Biology University of Alaska, Fairbanks, Alaska, U.S.A.

We examined environmental, maternal and genetic sources of variation in growth and size at banding of black brant (*Branta bernicla*) goslings on the Yukon Kuskokwim Delta, Alaska. Our results are based on measurements at banding (approximately 30 days after hatch), of 580 known-aged goslings from unique broods of previously marked adults. Goslings are influenced not only by spatial ($P < 0.0001$), annual ($P<0.0001$), and seasonal ($P<0.0001$) variation associated with habitat quality and availability, but also by maternal effects such as egg size and age of the female. Goslings from larger eggs ($P<0.0001$) and whose mothers were older ($P < 0.0030$) were larger. Models controlling for only environmental or maternal effects explained 75% of variation in gosling size. We examined heritability of body size by regressing adult body mass of female goslings separately on adult body mass of both the mother and father. Slopes of all regressions were not different from zero. Our results indicate that nearly all variation in size in the population we studied was of environmental origin. Given the importance of growth and body size for fitness, our results suggest that understanding mechanisms for translating environmental conditions into body size will be for important evolutionary responses to the environment in this population.

LECTURE - WEDNESDAY - 11:00

INFLUENCE OF BODY MASS AND CONDITION ON HARVEST AND SURVIVAL OF JUVENILE CANADA GEESE FROM AKIMISKI ISLAND

HILL, MICHAEL R. J., Dept. of Zoology The University of Western Ontario, London, Ontario, Canada

ANKNEY, C. DAVISON, Department of Zoology University of Western Ontario, London, Ontario, Canada

LEAFLOOR, JIM, Ontario Ministry of Natural Resources, Cochrane, Ontario, Canada

Direct band recoveries for Canada goose *Branta canadensis interior* goslings from the portion of the Southern James Bay Population (SJBP) breeding on Akimiski Island have declined markedly since 1987. We suspected that poor gosling nutrition, due to degradation of brood rearing areas, was causing low survival. Consequently, we examined the relation between pre-fledging body mass and body condition (body mass corrected for variation in body size) and likelihood of band recovery from 3023 goslings (1529 males, 1494 females) that were banded during late July and early August in 1994 - 1996. We obtained 50 direct and 89 indirect recoveries and mean body mass and condition of goslings that were recovered was higher than that of non-recovered goslings in all year by sex comparisons except for direct recoveries (mean body mass only) of males and females in 1995. Separate binary regressions for each year by sex category showed positive relationships between body mass (10 of 12) and body condition (12 of 12) and recovery probability for both direct and indirect recoveries. When years and sexes were combined, there was a highly significant positive relationship between body mass and recovery probability for both indirect ($P < 0.001$) and direct ($P < 0.001$) recoveries. Similarly, there was a highly significant positive relationship between body condition and recovery probability for both indirect ($P < 0.001$) and direct ($P = 0.003$) recoveries. Unlike previous waterfowl research, our results showed that heavier and above average condition goslings were the most likely to be recovered. We suggest that goslings in poor condition are dying on the Island before they fledge. We conclude that present, or more severe, harvest restrictions on SJBP Canada geese will not result in an increase in the segment of the population that breeds on Akimiski Island.

LECTURE - SATURDAY - 9:20

STATUS, DISTRIBUTION AND ABUNDANCE OF BRANT ON THE MAINLAND OF THE WESTERN CANADIAN ARCTIC

HINES, JIM, Canadian Wildlife Service Environment Canada, Yellowknife, Northwest Territories, Canada

WIEBE, MYRA, Canadian Wildlife Service Environment Canada, Yellowknife, Northwest Territories, Canada

Black Brant *Branta bernicla nigricans* from the mainland of the Inuvialuit Settlement Region (Western Canadian Arctic) experience high rates of local harvest relative to expected population levels, yet the status of this population is uncertain. We undertook a study to determine the distribution and abundance of Brant on the mainland of the Inuvialuit Settlement Region. Aerial surveys were flown over a 5014 km² area of the Tuktoyaktuk Peninsula, Mackenzie Delta, and western Liverpool Bay in June 1995-98. The estimated number of Brant, corrected for birds not seen by observers, was 2756 ± SE 413 (0.56 ± 0.08 birds/km² on 4930 km²) at the Tuktoyaktuk Peninsula - Mackenzie Delta and 3176 ± 588 (37.81 ± 7.00 birds/km² on 84 km²) at Campbell Island - Smoke/Moose Delta in Liverpool Bay. As well, 76-225 Brant were seen on small islands in western Liverpool Bay just outside of the survey strata. Thus, the total population estimate for the Mackenzie Delta, Tuktoyaktuk Peninsula and western Liverpool Bay was 6100 birds. Numbers of Brant at western Liverpool Bay have apparently increased since the 1970s or 1980s. Several hundred Brant also nest at the Anderson River delta (east of our survey area), but numbers there have declined substantially since the 1970s. Recaptures of banded Brant suggest that some breeding individuals have shifted from Anderson River to western Liverpool Bay (approximately 70 km west), where numbers appear to have increased. Significant numbers of previously marked Brant were recaptured during banding drives, 1990-98, and this information provided a Jolly-Seber estimate of 6211 ± 868 Brant, which included both strata and Anderson River. Our results provide a baseline against which future population estimates can be compared.

POSTER - FRIDAY - 13:00

FEAST OR FAMINE: GOSLING GROWTH AT TWO CANADA GOOSE NESTING AREAS

HUGHES, R. JOHN, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

LEAFLOOR, JIM, Ontario Ministry of Natural Resources, Cochrane, Ontario, Canada

Availability of high quality forage plants is a prerequisite for rapid growth of goslings, and reductions in plant quality and availability can result in reduced growth rates, reduced body size as adults, and lower first year survival in geese. We compared growth of Canada Goose *Branta canadensis interior* goslings from 1997 through 1999 at Akimiski Island, Nunavut and near Povungnituk in the Ungava region of Quebec. Adult birds from these two areas are approximately the same size, but the two nesting populations differ in their recent trends. The Canada Goose population on Akimiski Island has not increased under restrictive harvest regulations that have been in place since 1992; conversely, the Ungava breeding population increased rapidly when hunting seasons were closed from 1995 through 1999. Goslings at Ungava were much larger and heavier than Akimiski Island birds at the same age in all years, suggesting that they grew more rapidly. We suggest that foraging conditions on brood rearing areas may have demographic effects on populations of Canada Geese, and that comparative studies of gosling growth can provide useful indicators of habitat quality on brood rearing areas.

LECTURE - WEDNESDAY - 10:40

USE OF SATELLITE AND CONVENTIONAL TELEMETRY TO ASSESS THE PRENESTING INTERVAL OF EMPEROR GEESE

HUPP, JERRY, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

SCHMUTZ, JOEL , Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

ELY, CRAIG R., Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

The interval between arrival of geese at a nesting area and nest initiation can be measured to determine when geese initiate rapid follicle growth (RFG) and where they likely acquire nutrients used during follicle development. We examined the prenesting interval of emperor geese (*Chen canagica*) in western Alaska by surgically implanting VHF or satellite (PTT) radio transmitters in 40 and 15 adult females, respectively in July, 1999. Our objectives were to assess arrival dates and timing of reproduction on the Yukon-Kuskokwim Delta (YKD) the following spring, and to evaluate prenesting distribution. Because surgically-implanted radios have rarely been used in geese, we also examined their effect on reproductive effort. Thirty-two females with VHF radios and eight females with PTT's returned to the YKD in May, 2000. We located nests of 21 radiomarked females. Nest initiation occurred 13-25 days (median = 17 days) following arrival on the YKD. Prior to nest initiation, 88% of VHF and PTT relocations were within 10 km of nest sites. Radiomarked females had a slightly smaller median clutch size (4 vs. 5 eggs) and a median hatch date that was 2 days later than emperor geese without radios. We conclude that emperor geese did not initiate RFG until after arrival on the nesting area and that females spent most of the prenesting period near nest sites. Surgically-implanted radio transmitters may have caused a slight delay in nesting and a small reduction in clutch size.

LECTURE - THURSDAY - 13:30

PHYLOGEOGRAPHIC STRUCTURE OF SNOW AND ROSS'S GEESE: APPLICATIONS FOR HARVEST DERIVATION

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SCRIBNER, KIM, Department of Fisheries and Wildlife Michigan State University, East Lansing, Michigan, U.S.A.

SAMUEL, MICHAEL, National Wildlife Health Center U.S. Geological Survey, Madison, Wisconsin, U.S.A.

DICKSON, KATHRYN, Canadian Wildlife Service Environment Canada, Hull, Québec, Canada

LÉVESQUE, HÉLÈNE, Canadian Wildlife Service Environment Canada, Hull, Québec, Canada

DUNCAN, DAVID, Canadian Wildlife Service Environment Canada, Edmonton, Alberta, Canada

Identification of demographically and reproductively isolated populations is an important aspect of resource management and conservation. This is especially crucial for highly migratory species, including waterfowl, as populations utilize multiple areas throughout their annual cycle, and as inter-population survival rates may vary over time. Breeding populations of lesser and greater snow geese (*Anser caerulescens caerulescens and A. c. atlantica*) and Ross's geese (*A. rossii*) vary greatly in population number and in rates of natality and survival. Management attempts to target harvest levels to specific populations. However, discrimination among these taxa and populations has traditionally relied on banding and on phenotypic measures that are naturally variable (i.e., size and plumage). These techniques may not provide accurate and precise means of classification. Population- and taxon-specific differences in microsatellite allele and mitochondrial DNA haplotype frequency are used to describe degree of phylogeographic structure. Genetics data together with maximum likelihood techniques are further used to estimate proportional contributions of different breeding populations and taxa to simulated admixtures that represent plausible wintering or migratory flocks that could be harvested across North America. Preliminary results reveal that the relative contributions of certain breeding populations of snow geese and Ross's geese can be accurately and precisely estimated, with the highest resolution being between species/subspecies and distant breeding locales.

POSTER - FRIDAY - 13:00

RECENT DECLINE IN THE HOWE ISLAND, ALASKA, SNOW GOOSE POPULATION

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NOEL, LYNN E., LGL Alaska Research Associates Inc. , Anchorage, Alaska, U.S.A.

The population of Lesser Snow Geese nesting on Howe Island in the Sagavanirktok River delta, was for many years the only established nesting population of this species in Alaska and the United States, and was the only Snow Goose nesting colony in proximity to an active oil field. Since the early 1990's, however, other small colonies have been discovered or have become established on the North Slope of Alaska and some of these new colonies are in areas where new oil fields are currently being developed. We have studied the Sagavanirktok Delta Snow Goose population continuously for 21 years (1980-2000). During the 11-yr period 1980 to 1990, predation pressure was relatively light and the number of snow goose nest attempts and successful nests on Howe Island increased roughly 10-fold. During this same period the number of goslings/adult female surviving to late brood-rearing (our index of productivity) averaged about 2, and the main factor accounting for most of the annual variation in colony productivity was mean daily temperature (°C) during the 1-25 June incubation period. Since 1990 the species and numbers of mammalian and avian predators preying on incubating Snow Geese and their eggs on Howe Island has increased notably, and the colony has failed or nearly failed in 6 of the past 11 years. As a result, the number of nest attempts, the number of successful nests, and the number of goslings/adult female have all declined markedly and predation interacting with temperature (TEMP x PRED), rather than temperature alone (TEMP), now accounts for most of the annual variation in colony productivity. During years when the main nesting colony on Howe Island has been disturbed by predators, most of the geese have either attempted to nest on nearby islands in the Sagavanirkotk Delta or at other locations east and west of the Sagavanirktok Delta, or have disappeared from the study area altogether. We speculate that many of the Snow Geese nesting at new locations east and west of the Sagavanirktok Delta originated from the declining Howe Island population.

POSTER - FRIDAY - 13:00

COMBINING MULTI-SITE RECAPTURES, BAND RECOVERIES, AND INCIDENTAL OBSERVATIONS TO ESTIMATE SURVIVAL, MOVEMENT, AND FIDELITY OF GEESE

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CONN, PAUL, Biomathematics Program North Carolina State University, Raleigh, North Carolina, U.S.A.

LINDBERG, MARK S., Wildlife Biology Program University of Montana, Missoula, Montana, U.S.A.

WARD, DAVID, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

HINES, JAMES, Patuxent Wildlife Research Center U.S. Geological Survey, Laurel, Maryland, U.S.A.

The unbiased and precise estimation of survival rates and fidelity, and for multi-site studies movements between study areas, is important to many studies of arctic-nesting geese. This is true whether the study be motivated by management questions, or hypotheses from population or evolutionary ecology. Given the expense and effort of capturing, marking, and recapturing/resighting geese, it makes sense to use all available information to estimate parameters of interest, resulting more precision and in many cases less bias. This is especially true for information that can be collected by the investigator relatively cheaply, such as band recoveries and incidental observations outside of the sampling design. We extend a method outlined by Barker (1995) for combining band recoveries or incidental observations with multi-site capture-recapture data. We discuss a variety of considerations, such as whether or not incidental observations can be associated with a particular area of interest, demonstrate how permanent emigration from the set of study areas can be estimated, and discuss biases that can occur in trying to estimate fidelity naively when survival is not the same among areas. We focus our presentation on a study of seasonal and annual movements of Black Brant (*Branta bernicla nigricans*) among 3 wintering sites in Mexico and 1 site in the United States (1997 - 2000).

LECTURE - SATURDAY - 11:00

FORAGING AND GROWTH STRATEGIES OF THE ORINOCO GOOSE: THE PARADOX OF A TROPICAL GRAZER

KRIESE, KEN, Dept. of Wildlife, Fish, and Conservation Biology University of California, Davis, California, U.S.A.

Arctic geese utilize extreme northern habitats for breeding. These systems are ideal because they have highly productive vegetation, few predators and long days to maximize grazing. In contrast, it has been argued that based on their nutritional needs, geese could not invade the tropics. The tropics, however, are home to two species of sheldgeese (Orinoco geese, *Neochen jubata*; Egyptian geese, *Alopochen aegyptiacus*), a group referred to as the southern ecological equivalents of arctic geese. Despite apparent similarities between these two groups, tropical sheldgeese face different habitat constraints. Within tropical savannas, nutrients are poor, predators can be abundant, and day length is shorter (12 versus 20+ hours). Under these conditions, it is likely that tropical sheldgeese have developed a different life-history. To address these differences, I have started a study of Orinoco geese in Venezuela. This project is focused on: i) an assessment of forage quality during the breeding season; ii) resource use by adults; and iii) gosling growth. While the role of nutrients has been thoroughly described for arctic geese, the impact of nutrient-poor tropical savannas on sheldgeese remains unclear. The final results of this study will: 1) help define the role of nutrients in the life-history of Orinoco geese; 2) examine potential differences between arctic geese and tropical sheldgeese; and 3) identify key resources that can be managed as part of future conservation planning for this near-threatened species. The results presented here are a preliminary analysis of behavioral and growth data collected during December, 2000 – March, 2001.

POSTER - FRIDAY - 13:00

ON THE FACILITATION BETWEEN HARES AND GEESE: THE EFFECTS OF VEGETATION STRUCTURE

KUIPER, DRIES, Laboratory of Plant Ecology Rijksuniversity of Groningen, Groningen, The Netherlands

The distribution of hare (*Lepus europaeus*) and geese (*Branta leucopsis* and *Branta bernicla*) on the saltmarsh of the island of Schiermonnikoog was studied. This island has a well-developed chronosequence representing 0-100 years of vegetation succession. Transects were put up on different aged saltmarsh sites. On these transects droppings were counted year-round and species composition was recorded. The density of both geese and hare shows an optimum at intermediate saltmarsh sites and decreases with increasing age. The cover of preferred foodplants decreases with saltmarsh age. However they still occur with high cover percentages at the oldest sites. On these sites they are overgrown with unpalatable tall plants like *Artemisia maritima* and *Elymus athericus*. Different experiments (with both wild and captive geese) are done that illustrate that geese are negatively effected by tall plants overgrowing their food. Long-term exclosure studies show that hares and not geese have a big impact on the vegetation succession. On sites grazed by hares the cover of tall plants is lower. However hares are not able to prevent the establishment of these plant species and seem to loose control over the vegetation, as saltmarsh grows older. They are also negatively influenced by these tall plants themselves as is illustrated by planting artificial tall plants on attractive vegetation, and removing tall plants in natural vegetation. In conclusion, hares facilitate for geese by retarding the vegetation succession but will eventually be controlled by the aging vegetation themselves.

LECTURE - THURSDAY - 9:00

STRUCTURING OF HERBIVORE ASSEMBLAGES: EFFECTS OF BODY MASS ON COMPETITION AND FACILITATION

KURK, KARIN, Tropical Nature Conservation and Vertebrate Ecology Group Wageningen University and Research Centre, Wageningen, The Netherlands

VAN WIEREN, SIP, Tropical Nature Conservation and Vertebrate Ecology Group Wageningen University and Research Centre, Wageningen, The Netherlands

On grasslands, many herbivore species coexist, despite the lack of choice of food plants. Prins & Olff (1992) suggest that, besides body-size-related differences in energy expenditure and digestive efficiency (Jarman 1974, Bell 1971), the relation between height of the grass and its quality and quantity leads to facilitative interactions between different sized herbivore species. At high biomass, only 'large' herbivores are able to maintain a positive energy intake rate, mainly due to low quality of the grass. An increase in grazing pressure will result in a decrease in plant standing crop and enables 'small' herbivores to feed. Thus, the 'large' herbivore facilitates for the 'smaller' one. At low biomass, competition becomes more important and at very low biomass the 'small' herbivore can keep the vegetation at a very low level where the 'larger' herbivore may not be able to exist due to low quantity. In this Ph.D. project, the theory of facilitative interactions will be tested, using subspecies of Canada geese, in which the morphology of the feeding characteristics only vary in size. In the first part, the relation between body mass and grass height will be estimated. Geese will graze at various sward heights, while several aspects of foraging behavior will be studied. In the second part the nature and outcome of herbivore-herbivore interactions on different standing crops will be studied. The exact setup will depend on the outcome of the first part. The results will be used for testing and developing models describing plant-herbivore interactions in multiple-species systems.

POSTER - FRIDAY - 13:00

EFFECTS OF INCREASING SNOW GOOSE NUMBERS ON HABITAT AND BIRDS ON BANKS ISLAND, NORTHWEST TERRITORIES

LATOUR, PAUL, Canadian Wildlife Service Environment Canada, Yellowknife, Northwest Territories, Canada

HINES, JIM, Canadian Wildlife Service Environment Canada, Yellowknife, Northwest Territories, Canada

Banks Island supports 95% of the nesting snow geese in the western Canadian Arctic, and the population of geese there has grown at a rate of more than 5% per annum over the past 40 years. Inevitably, continued population growth at this rate would result in overgrazing of the lowland habitat on Banks Island (as has already has been witnessed in some parts of the eastern Canadian Arctic). The present study was initiated in 1999 to establish an effective long term program for monitoring habitat conditions on Banks Island and examine the effects that the rapidly expanding colony of Lesser snow geese is having on the vegetation and breeding bird community there. Preliminary results obtained from remote sensing studies, grazing exclosures, and surveys of shorebirds and other "non-game" birds are described and discussed.

POSTER - FRIDAY - 13:00

ESTIMATION OF HARVEST DURING SPECIAL SNOW GOOSE CONSERVATION SEASONS IN QUÉBEC

LÉVESQUE, HÉLÈNE, Canadian Wildlife Service Environment Canada, Hull, Québec, Canada

COLLINS, BRIAN, Canadian Wildlife Service Environment Canada, Hull, Québec, Canada

BROUSSEAU, PIERRE, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

Estimation of the harvest of Snow Geese during the special conservation seasons in the Spring of 1999 and of 2000 in Québec required the development and implementation of adapted survey designs in conjunction with updated regulatory conditions. While the Migratory Game Bird Hunting Permit database provides normally the sampling frame for estimation of the regular hunting season, it was unknown, on the first year of implementation of the Conservation Season, what proportion of the hunter population would participate in the special season. A registration system allowed to target active hunters in the Spring and estimation was provided with a combination of hunter diaries and sample phone survey. On the second year of the survey a stratified sample design (fall purchasers and purchasers after March 10) was used to estimate total harvest, as cost would be reduced with this method. Total harvest for Spring 1999 is 44171, SE:5871 and for Spring 2000 is: 54575 , SE: 6693. These estimates, added to the National Harvest Survey estimation for the regular hunting season in Québec, attempt to provide a complete estimation of harvest by Migratory Game Bird Permit holders.

POSTER - FRIDAY - 13:00

EFFECTS OF NECKBANDS ON SURVIVAL AND FIDELITY OF MOLTING WHITE-FRONTED AND CANADA GEESE

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ALISAUSKAS, RAY T., Prairie and Northern Wildlife Research Centre Canadian Wildlife Service, Saskatoon, Saskatchewan, Canada

We conducted an experiment to examine the effect of neckbands, controlling for differences in sex, species and year of study (1991-1997), on probabilities of capture, survival, reporting, and fidelity in nonbreeding small Canada (*Branta canadensis hutchinsi*) and white-fronted (*Anser albifrons frontalis*) geese captured in Canada's central arctic. During banding, we systematically double-marked about half of the individuals from each species with neckbands and legbands, and we marked the other half only with legbands. We considered 48 a priori models that included various combinations of sex, species, and year effects on the 4 population parameters produced by Burnham's (1993) model, using AIC for model selection. The four best approximating models each included a negative effect of neckbands on survival and the effect size varied among years. True survival probability of neckbanded birds annually ranged from 0.006 to 0.23 and 0.039 to 0.22 (Canada and white-fronted geese, respectively) lower than for conspecifics without neckbands. Changes in estimates of survival probability in neckbanded birds appeared to attenuate more recently, particularly in Canada Geese, a result that we suspect was related to lower retention rates of neckbands. Therefore, we urge extreme caution in the use of neckbands for estimation of certain population parameters, and discourage their use for estimation of unbiased survival probability in these two species.

LECTURE - SATURDAY - 11:20

FACTORS AFFECTING MOVEMENTS OF THE WINTERING METAPOPULATION OF BLACK BRANT

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WARD, DAVID, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

KENDALL, WILLIAM, Patuxent Wildlife Research Center U.S. Geological Survey, Laurel, Maryland, U.S.A.

Movements of wintering geese may have implications for population dynamics, genetic structure, and subsequent reproductive performance of these birds. We studies factors affecting seasonal and annual movements of Black Brant (*Branta bernicla nigricans*) among 3 wintering sites in Mexico and 1 site in United States (1997 - 2000) by observing brant marked with tarsal tags. We examined the effects of food resources (quantity and quality), weather, and population density on movement probabilities using multistate models and program MARK. We also examined the potential for estimating movement probabilities using a combination of resighting and recovery data. Brant moved among wintering lagoons seasonally with strong patterns of annual fidelity. Brant movements were influenced by weather patterns. We think these movements had important implications for population dynamics of these birds, but may have limited implications for the genetic structure of these populations. By combining sources of data (resighting and recovery data) we were able to identify new parameters and estimate parameters with higher precision.

POSTER - FRIDAY - 13:00

SENSITIVITY OF BARNACLE GEESE DURING WING MOULT ON HUMAN DISTURBANCE

LOONEN, MAARTEN, Animal Ecology University of Groningen, Groningen, The Netherlands

DROST, ARJEN, Zoological laboratory University of Groningen, Haren, The Netherlands

In recent years there has been an increase in the human activity in the Arctic. To minimize detrimental effects, it is important to study the effect of human disturbance on wild animals. We have studied the flight behaviour of barnacle geese in their arctic breeding area on Spitzbergen. In summer geese are flightless and run to save water when disturbed. In 1999 and 2000 the distance was measured at which geese started to respond to an approaching human. This flight distance differed significantly between locations within the Kongsfjord area and between individuals. A large difference was found in flight distance inside and outside the village. This was explained by habituation to human disturbance in the village. Parent birds were less shy than birds without young because they have fewer alternatives for foraging. Both the fast growing young and the females, who lost a lot of weight during incubation, have to feed at good sites to get strong enough for the autumn migration to their winter areas. In 1999 there was hardly any predation on the barnacle geese in the Kongsfjord. In 2000 however, arctic foxes were present even in the village causing a high mortality of moulting and young geese. This made it possible to compare flight distances with and without predators present. With arctic foxes present in the area, geese ran much later when a human approached them. They are less sensitive to human disturbance because the arctic foxes have reduced the area where they could feed safely. This reduction of their feeding area declined their body condition and forced them to feed longer. With this study, we show that the flight behaviour of birds is the result of a complex trade-off, with body condition, food availability, the risk of predation and habituation as important factors.

POSTER - FRIDAY - 13:00

TESTING HABITAT PREFERENCE OF GEESE

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HEUERMANN, NICOL, Zoological laboratory University of Groningen, Haren, The Netherlands

Wild geese choose their foraging sites based on food availability, safety and distance to roosts. With the power of their wings and the skill of migration, they are very well adapted to find and utilize optimal sites. However with their herbivore diet and the relatively simple digestive tract, geese need to be highly selective in their habitat choice. The observed distribution of wild geese is the result of a complex trade-off optimizing the difference between costs and benefits. As intraspecific competition is strong in these flock-feeding animals, individual behavioural options also play an important role. As a result, less optimal feeding sites are used by individuals which will not take part in reproduction or are not used at all. In order to make predictions about habitat selection of geese, we have made experiments with captive geese to test various parameters used for habitat selection. We have focussed on intake rates and tested various manipulated vegetation plots. The results of these tests were compared with the preference of wild geese and entered in individually based spatially explicit habitat models.

LECTURE - THURSDAY - 11:40

IS BODY CONDITION OF LAYING GREATER SNOW GEESE AND THEIR REPRODUCTION AFFECTED BY THE SPRING CONSERVATION HUNT?

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BÊTY, JOËL , Département de biologie Université Laval, Sainte-Foy, Québec, Canada

GAUTHIER, GILLES, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

GIROUX, JEAN-FRANÇOIS, Dépt. Sciences Biologiques Université du Québec à Montréal, Québec, Canada

A spring hunt was implemented on the staging areas of Greater Snow Geese (*Chen caerulescens atlantica*) in Québec in 1999 and 2000. Because this hunt took place during the period of nutrient storage, we evaluated if it could negatively affect the body condition of laying geese and their reproduction. We collected laying females in years with a spring hunt (1999-2000, $n = 34$) and compared them with birds collected in years without hunt (1989-1990, $n = 10$). All indices of body condition and most indices of reproductive investment were significantly lower in years with hunt than in years without. Tracking of radio-marked females on the staging and breeding areas showed that fewer females successfully completed the migration in years with hunt (27% in 1999-2000, $n = 83$) than in years without (85% in 1997-1998, $n = 80$) and that fewer females nested (9% vs 56%, respectively). Our results indicated that the spring hunt negatively affected nesting geese.

POSTER - FRIDAY - 13:00

DIGESTIVE ADJUSTMENTS IN GEESE TO REDUCED FORAGE QUALITY AND ITS ECOLOGICAL IMPLICATIONS

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KARASOV, WILLIAM, Dept. Wildlife Ecology University of Wisconsin, Madison, Wisconsin, U.S.A.

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When habitat quality on the breeding grounds is poor, arctic-nesting geese must eat foods of lower quality than their preferred foods. We tested the hypothesis that when goslings eat foods of lower quality (i.e., higher fiber), (a) they eat more, (b) their digesta retention time and digestive efficiency does not change, (c) their total capacity for breakdown and absorption of nutrients increases, and (d) the mechanism responsible for the increase in total capacity will be an increase in amount of intestine rather than an increase in intestinal tissue-specific enzyme activity or nutrient transporter activity. As predicted, Canada and Snow goslings increased their food intake (100% and 15%, respectively) with increasing dietary fiber. The increase in food intake was associated with a small decrease in digestive efficiency and no change in retention time or specific activity of digestive enzymes. Our finding of active peptidases and amino acid transporters in the caeca suggest that it is especially important for protein nutrition in geese. The primary digestive adjustments of goslings to reduced forage quality was an increase in gizzard and small intestine. However, these digestive adjustments did not fully compensate for the reduction in food quality in our captive goslings as indicated by reduced growth rates of Canada and especially Snow goslings fed high-fiber, low-protein diets. Wild goslings that must eat low quality forage are likely further limited in their ability to increase food intake and gut size by time and flight constraints.

LECTURE - THURSDAY - 16:30

DISTRIBUTION OF SPRING STAGING BLACK BRANT IN RELATION TO FORAGING OPPORTUNITIES ON HUMBOLDT BAY, CALIFORNIA

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BLACK, JEFFREY, Dept of Wildlife Humboldt State University, Arcata, California, U.S.A.

Black brant (*Branta bernicla nigricans*) rely on eelgrass (*Zostera marina*), an intertidal food consisting of low protein and high fiber, to meet their energetic requirements during spring migration. Because of its relatively low nutritive quality and limited temporal availability (due to tidal submergence), energetic intake may be seriously constrained. We therefore hypothesize that brant should behave in a way that maximizes energetic intake whenever feeding is possible. One way of doing this is by feeding in areas where available food abundance is greatest. We found that biomass and availability of eelgrass on Humboldt Bay varies considerably with time and space, both daily and seasonally, and that the distribution of brant varied in response to these shifting foraging opportunities. GIS is utilized to develop a spatial model of eelgrass growth and depletion, and to test whether brant are behaving optimally with respect to food patch choice in this dynamic habitat.

LECTURE - WEDNESDAY - 15:55

LESSER WHITE-FRONTED GOOSE AT THE TURN OF THE CENTURY: POPULATION STATUS AND NUMBERS

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Lesser White-fronted Goose is a threatened waterfowl bird species. Its numbers and breeding range have been seriously declining throughout recent 50 years and this process is going on all over the species range. Since the recent review published in 1995 (Morozov 1995) new data on the Lesser White-fronted Goose population state, numbers and its dynamics in different parts of the species range have been obtained. In 1996-2000 a detailed study of Lesser White-fronted Goose population is carried out in a number of key sites of its breeding range located in European tundras of Russia, Western and Central Siberia. The data are compared during field works (1996-2000) we counted geese, mapped their breeding territories, nests, broods and non-breeding birds. Maps of distribution received were compared to each other and to available information obtained throughout previous 10-20 years at the same regions. We revealed that the distribution of Lesser White-fronted Goose reduced all over the studied areas, and its numbers declined as well. Distinguishably, ecological parameters (climate, vegetation, predator pressure) remain basically at the same rate. In some regions antropogenic impact even decreased since the numbers of people in the northern Russia reduced. Subsequently, the reasons for reducing Lesser White-fronted Goose numbers lay out of breeding range. Due to satellite tagging, ringing and banding of Lesser White-fronted Geese significant staging areas, migration routes are revealed. Our data demonstrate that the geese flexibly change their staging areas, terms of migrations depending upon environmental conditions. On the whole, however, the routes and staging areas remain basically the same. The same as formerly hunting appears to be the main reason for mortality during migration. However, the percentage of Lesser White-fronted Geese shot does not exceed the percentage of Lesser White-fronted Geese among other migrating geese species (*Anser anser, Anser albifrons*).Traditionally wintering grounds of Lesser White-fronted Goose are located in the south-eastern Europe, the Caspian Sea region and China. Environmental conditions observed in these regions are quite different. However, there is one common feature: All wintering grounds are distinguished for the high rate of hunting pressure which have been increasing recently. At the same time the area of Lesser White-fronted Goose pastures is being reduced. As a result the Lesser White-fronted Goose population steadily decreased its numbers. This process is going on in those countries where standard of living became lower and lower with the population density increasing (Azerbaijan, Turkmenistan, China).Vast majority of recently obtained data in Eurasia confirmed the hypothesis (Morozov 1995) that once continuous breeding range of Lesser White-fronted Goose at present split into several isolated areas and the world population of the species accounts for no more than 30 thousands individuals at the end of breeding season.

POSTER - FRIDAY - 13:00

USING SATELLITE AND RADIO TELEMETRY TO EVALUATE MOLT MIGRATION OF CANADA GEESE FROM SOUTHEASTERN MICHIGAN

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LUUKKONEN, DAVID, Michigan Department of Natural Resources Rose Lake Research Center, East Lansing, Michigan, U.S.A.

We initiated a study to assess the potential of using conventional (VHF) and satellite (PTT) telemetry to document the extent and timing of molt migration movements of giant Canada geese *Branta canadensis maxima* nesting in southeastern Michigan. We captured 48 female geese on nests and an additional 9 geese with rocket nets over bait (2 males and 7 females) during the 2000 breeding season and fitted them with a PTT or VHF transmitter that was attached to a neck collar. Fifteen PTT's and 42 VHF transmitters were deployed. Satellite location estimates for 10 PTT marked birds indicated that geese from Southeastern Michigan molt migrated to Cape Henrietta and the eastern coast of James and Hudson Bay as far north as Baffin Island. Locations of 10 PTT marked geese that molt migrated were used as way points to search for 22 VHF marked geese that were missing from the immediate Michigan study area in late June. Fifteen of these birds were located along the eastern coast of James and Hudson Bay and one on Cape Henrietta during a telemetry flight in mid-July. Using PTT and VHF transmitters, we compiled 26 records indicating probable molt site locations, 28 records estimating departure dates from southern Michigan, and 12 records estimating return dates to Michigan. Using a combination of PTT and VHF transmitters provided advantages over using exclusively one transmitter type for studying molt migration in geese.

LECTURE - SATURDAY - 16:30

GROWTH RATES OF BLACK BRANT *BERNICLA NIGRICANS* GOSLINGS FROM SATELLITE COLONIES ON THE YUKON-KUSKOKWIM DELTA, ALASKA

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WEGE, MIKE, Yukon Delta NWR US Fish and Wildlife Service, Bethel, Alaska, U.S.A.

Gosling growth rates influence survival and future reproduction. For Black brant *Brant bernicla nigricans*, however, all previous data were from brood-rearing areas associated with major colonies. Understanding growth rates of goslings from more dispersed nesting areas is important because such areas might provide some relief from density-dependent processes occurring on colonies. We examined brant goslings webtagged at hatch on two satellite colonies on the Yukon-Kuskokwim Delta, Alaska. We compare growth rates from recaptures during banding drives approximately 40 days after hatch for 1999 and 2000 with those from goslings hatched on the Tutakoke River colony. Goslings from satellite colonies were significantly larger than those from the Tutakoke colony, after adjusting for age and hatch date, suggesting that satellite colony birds may have a slight advantage over main colony birds in terms of survival, recruitment and fecundity. Surveys indicate that approximately 20% of nesting brant occur away from the major colonies and additional information concerning birds utilizing satellite colonies could play an important role in management of this species.

POSTER - FRIDAY - 13:00

MECHANISMS OF HATCH SYNCHRONIZATION IN BLACK BRANT *BRANTA NIGRICANS*

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WEGE, MIKE, Yukon Delta NWR US Fish and Wildlife Service, Bethel, Alaska, U.S.A.

We investigated the relationship between position in the laying sequence and development time required to hatch in Black Brant (*Branta bernicla nigricans*; hereafter brant). We also examined factors associated with variation in required incubation duration. Previous studies found that brant begin regular incubation with the laying of the second egg, raising a question about how clutches hatch relatively synchronously (within 24 hours). To examine variation in developmental rates as a synchronization mechanism, we removed eggs from nests as they are laid and reassembled them into experimental clutches comprised of eggs from the same position in the laying sequence, e.g. clutches of all first-laid eggs or clutches of all fourth laid eggs. Metabolic rates of eggs were measured from each position in the laying sequence from both experimental and control nests on the 17th day of incubation and the day before hatch. We detected no difference in metabolic rates ($P>0.05$) or time to reach the star-pipped stage ($P>0.05$) between control nests and manipulated clutches, suggesting that pipping sounds produced by brood mates are not the principal mechanism producing hatching synchrony within a clutch. Time to reach the star-pipped stage of hatch was negatively correlated with position in the laying sequence ($P<0.001$). A positive correlation was found between position in the laying sequence and metabolic rate on the 17th day of incubation ($P<0.001$), but no significant variation was detected among metabolic rates of eggs the day before hatch ($P>0.05$), suggesting embryonic development is accelerated in mid-incubation for eggs later in the laying sequence.

LECTURE - THURSDAY - 16:10

WINTER ECOLOGY OF GREATER WHITE-FRONTED GEESE IN THE MEXICAN INTERIOR HIGHLANDS

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During the 1990s, declining abundance of greater white-fronted geese *Anser albifrons frontalis* that nest in Northwest and Interior Alaska and winter in the Central Highlands of Mexico prompted a study of their winter ecology. We recorded >27,700 white-fronted geese (geese) during aerial surveys in 5 Interior Highlands states from Chihuahua south to Jalisco in December 1999. A simultaneous ground count yielded >18,000 geese in Chihuahua, Durango, and Zacatecas. Goose distribution was related to availability of water and food, which varied annually. At 2 study areas in Durango, we sighted 47 neck-collared geese in January-March 2000. Most were marked in Northwest and Interior Alaska and belong to the Mid-continent Population. We observed inter-wetland movements of marked geese, with most extending 10-18 km; 1 moved >100 km. Only limited disturbance of geese was observed; hunting disturbance was most significant. We estimated harvest at 2.6-3.9% of the wintering population at the Durango study area. Large numbers of snow geese *Chen caerulescens* often displaced white-fronted geese from feeding sites. We did not detect any single factor that had a significant adverse effect on white-fronts wintering in the Mexico highlands. However, a decade-long drought has reduced size and availability of water bodies used by geese. Generally, food availability was not affected by drought because feeding areas were near larger water bodies that provided irrigation for corn and oats, the primary winter foods. Irrigation, however, contributed to the reduction in size and availability of water bodies used for resting. We found no evidence that wintering conditions in Mexico have contributed significantly to the recent decline in abundance of this population segment.

POSTER - FRIDAY - 13:00

FALL STAGING OF THE GREATER SNOW GOOSE IN SOUTHERN QUEBEC

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Greater Snow Geese (*Chen caerulescens atlantica*) stop in southern Quebec during their fall migration. Traditionally, they staged in tidal marshes along the St. Lawrence estuary but recently, they have started feeding in agricultural fields both in proximity to the estuary and in new areas in southwestern Quebec. Our objectives were to record their current migratory behavior in Quebec, and to discover factors influencing it. The population growth of the geese has led to a liberalization of the fall hunting regulations and the introduction of a spring conservation hunt in 1999. We therefore tried to detect how these may have affected the geese. To study their movements, we radio tracked 325 females over 4 years (1996-1999). During this period, their average length of stay in Quebec increased from 15 to 23 days, while the lengths of stay for the estuary and the southwest did not vary significantly. This is most likely due to the increase in the proportion of geese using the southwest. Length of stay varied greatly (0-62 days) among individuals but social status and disturbance experienced in the previous spring did not explain this variation. Fall disturbance rates in 1999 were higher than in previous years because of changes in hunting regulations, but this did not seem to affect the behavior of the geese. While we found a certain tradition among geese, the rapid expansion into the southwest and our inability to explain the variability in behavior through intrinsic effects lead us to think that the geese are opportunistic.

LECTURE - WEDNESDAY - 16:55

MOVEMENT, HOME RANGE, AND NEAREST-NEIGHBOR ANALYSES COMPARING TWO LESSER SNOW GOOSE POPULATIONS WINTERING IN THE SACRAMENTO VALLEY CALIFORNIA

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We examined the winter home ranges and movements of lesser snow geese (*Chen caerulescens caerulescens*) from Banks Island, Canada and Wrangel Island, Russia that winter in the Sacramento Valley of California from 1994-1997. A sample of 60 geese were captured while flightless each year for 3 years near both breeding colonies and were radio-marked with standard transmitters mounted on neck collars. Each population followed separate migration routes from their breeding colonies to the Central Valley, and the wintering population from Wrangel Island arrived in the Sacramento Valley 2 weeks earlier than geese from Banks Island. We tracked a total sample of N=175 geese through the winter, and we measured semi-monthly home ranges for Banks Island (200-4,000km^2) and Wrangel Island (200-4,500km^2) wintering populations from November to February. Population level home range (locations of Wrangel or Banks radio-marked geese combined semi-monthly) sizes for Banks were 12% larger than that of Wrangel but not significantly (95% CI: -8%,36%; $F_{1,41}$= 1.41; p=0.24). Both increased through the winter at a rate of 79% per month (95% CI: 64%,96%; $F_{1,41}$= 173; p<0.0001). The distance from roosting to feeding sites also increased monthly (95% CI: 1.6,3.3km; Walds Z = 5.5; p<0.0001) from 10.3km in November to 16.5km in February. Nearest neighbor analyses suggested that geese from both wintering populations intermix completely during the winter, providing little opportunity for managing them separately in California except upon arrival when their migration chronology differs.

LECTURE - WEDNESDAY - 14:15

ENERGY COST OF LOCOMOTION IN GREATER SNOW GOOSE GOSLINGS

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In the Arctic, Greater Snow goose goslings face cold temperatures and walk extensively to feed themselves. Under conditions where the energy required by thermoregulation and locomotion may limit the energy allocated to growth, it can be advantageous to use the heat produced by the locomotory muscles as a substitute for the heat produced by thermogenic mechanisms. We have investigated this possibility in captive goslings between 10 and 40 d of age trained to walk on a metabolic treadmill at speeds of 0.3 and 0.6 m s-1 and ambient temperatures of 5 and 20°C. Our preliminary data show that during a walk, energy expenditure rises by about 30 % at 20°C and 15 % at 5°C. The lesser increase in the cold is indicative of a substitution of the heat generated through regulatory thermogenesis by that produced by working muscles. Body temperature also increases during walks, signaling a storage of heat corresponding to 16 % of the total energy expenditure. The stored heat may be used to lower the cost of exposure to cold during the following resting phase. These results indicate that heat produced by muscles during locomotion can contribute to the reduction of regulatory heat production both during activity and rest, and therefore minimize the impact of activity on the energy budget of growing goslings.

LECTURE - THURSDAY - 16:50

RELATION BETWEEN BODY MASS, BODY SIZE AND POST BANDING SURVIVAL OF CANADA GEESE GOSLINGS ON AKIMISKI ISLAND, NUNAVUT

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Canada Goose *Branta canadensis interior* goslings from Akimiski Island have had low direct recovery rates (DRR) since 1987. Contrary to the normal pattern in geese, the DRR of adult geese was nearly double that for goslings in the past five years. Hill (1999) found that banded goslings, subsequently shot by hunters, were on average, heavier, bigger and in better condition than those not harvested. Thus, we hypothesized that banded goslings that were lighter and smaller than average when banded were dying before or shortly after fledging. During regular banding operations in late July, we weighted and measured known-aged goslings and attached radio transmitters to them in 1999 (n=105) and in 2000 (n=100). We monitored these birds, using helicopters and fixed wing aircraft, from the time of banding till they died or could no longer be found on the island or the adjacent mainland. Survival rate was low in both years, but was much higher in 2000 (69%) than in 1999 (28%). We found a positive relationship between body mass and survival, and body size and survival of goslings in 1999, but not in 2000. Goslings, however, were approximately 400g heavier in 2000 than in 1999. We suggest that high mortality of goslings in late summer was caused by limited food resources on the island, but the degree of resource limitation varies annually.

A GENETIC EVALUATION OF MORPHONOLGY USED TO IDENTIFY PACIFIC FLYWAY CANADA GEESE

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SCRIBNER, KIM, Department of Fisheries and Wildlife Michigan State University, East Lansing, Michigan, U.S.A.

We used nuclear and mitochondrial (mt) DNA markers in a mixed stock analysis approach to evaluate the ability of 2 morphological measures (culmen length and plumage color) to correctly identify groups of hunter-harvested dusky (*Branta canadensis occidentalis*) and dusky-like Canada geese on the wintering grounds. Significant levels of genetic differentiation were observed across all sampled breeding sites for both nuclear microsatellite loci and mtDNA when analyzed at the sequence level. We estimated contributions from the Copper River Delta, the primary breeding area of dusky Canada geese, to groups of harvested geese classified as dusky Canada geese on the basis of morphology as 50.6 ± 10.1(SE)% for females and 50.3 ± 13.0% for males. Our analysis demonstrates that genetic markers can accurately estimate the proportion of genetically differentiated areas that comprise an admixed group. We found that the use of culmen length and plumage color to identify breeding origins of harvested geese provides conservative criteria for management of dusky Canada geese. The use of additional or different morphological characters may reduce the amount of misclassification of non-dusky Canada geese to the dusky goose category.

FEEDBACK DYNAMICS OF GRAZING LAWNS: COUPLING VEGETATION CHANGE WITH ANIMAL GROWTH

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BABCOCK, CHRISTOPHER, Dept. of Biology and Wildlife University of Alaska, Fairbanks, Alaska, U.S.A.

This study focuses on the effects of grazing by Black Brant *Branta bernicla nigricans* geese (hereafter Brant) on plant community zonation and the associated effects on gosling growth. The research is centered on our observation that when heavily grazed, *Carex ramenskii* attains a short character state that appears identical to the preferred forage of Brant, *C. subspathacea* grazing lawns. We mowed plots of ungrazed *C. ramenskii* meadows in an attempt to create swards that Brant would select and maintain as grazing lawns. Fecal counts indicate Brant selected manipulated swards following treatment application. Vegetation in mowed plots at 1 of the 3 sampling locations was both morphologically and nutritionally similar to *C. subspathacea* 5 years after treatments were applied. We estimated the areal extent of the dominant plant communities that comprise the Tutakoke River colony. *C. subspathacea* grazing lawns increased from 3 to 8 % coincident with a proportional decrease in the areal extent of *C. ramenskii* meadows, suggesting that there was a large-scale conversion between these two communities between 1991 and 1999. The number of families reared from the Tutakoke colony increased from 885 to 4,165 pairs between 1987 - 1991 after which time the population remained roughly stable, yet below historic densities. Between 1993 and 1998 gosling mass increased despite a local population trajectory characteristic of a population that has reached carrying capacity. Under density-dependent conditions, Brant trigger a vegetation conversion that favors the growth of young. Although the local population of Brant has remained stable between 1992 and 1997, gosling mass has increased. Because larger goslings have increased survival, breeding probability, and fecundity, we predict that these herbivore-mediated changes in the distribution of plant communities will result in a positive numerical response of the population within the next two decades.

LECTURE - THURSDAY - 11:00

SPATIAL AND TEMPORAL VARIATION IN CACKLING CANADA GOSLING GROWTH

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We examined the effect variation in vegetation green-up and food availability had on Cackling Canada (*Branta canadensis minima*) gosling growth. We collected 50 goslings from independent nests on their hatch-day. We collected two groups of 25 goslings within the first (early-hatched), and last (late-hatched) two days of hatch. We tested the hypothesis that vegetation quality declined over this seven-day period and that gosling growth differed because of these changes. We sub-divided both early- and late-hatched groups into high- and low-availability treatment groups. We tested the hypothesis that the availability of preferred food effected gosling growth and foraging behavior. Availability of forage was manipulated by allowing a high-availability treatment group to graze freely within a *c.* 30 m^2 enclosure for 8 ± 3 h d^{-1} for 4 days. After this period, we placed a low-availability treatment group into the enclosure and allowed them to graze freely on the preconditioned plot for the same time period. This design required establishing four temporary (8 d) enclosures to accommodate each of the four treatment groups between June 28 and August 2. Vegetation was sampled in all plots every 4 d to estimate the availability of food (aboveground biomass), offtake by goslings, and the quality of key forage species. Gosling mass and structural size (culmen, head, and tarsal-lengths) differed among treatment groups. Early hatching goslings were heavier (480 g) and larger than goslings that hatched later (351 g) after controlling for age. This result suggests cackler gosling growth is sensitive to the quality of vegetation. Only a seven-day variation in vegetation phenology resulted in a 100g difference in gosling mass. Similarly, availability of preferred food affected gosling mass and structural size. Goslings that were allowed to graze within enclosures were heavier (480 g) than those goslings that grazed in preconditioned plots (409 g). Availability of forage had similar effects on both the early- and late-hatching treatments. These results suggest Cackler gosling growth varies spatially because there is variation in the availability of forage among brood rearing areas.

POSTER - FRIDAY - 13:00

SUMMER DIET COMPOSITION OF WHITE-FRONTED GEESE THAT NEST IN NORTHWEST AND INTERIOR ALASKA

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We documented diets of greater white-fronted geese *Anser albifrons frontalis* in Northwest and Interior Alaska during the 1996 breeding season. This study was part of an investigation of summer movements of radio-marked geese. We hypothesized that one reason geese make a pre-migratory staging movement opposite to their ultimate migration direction could be that nutritional quality of forage was higher at coastal sites compared to interior sites during August. Diet of white-fronted geese was characterized by micro-histological analysis of fecal samples collected June-August on Koyukuk National Wildlife Refuge and in August on the northern Seward Peninsula (fall staging period). We also estimated forage availability and use, and collected plant samples to provide an index of forage quality. Early in the breeding season, when no other vegetation was available, *Equisetum* was the primary component of white-fronted goose diets. In July, *Arctophila*, *Juncus*, *Eleocharis*, and *Carex* graminoid species comprised the majority of the diet at lakeshore sites, while *Equisetum* was the main component in feces at riparian sites. Estuarine graminoids made up a substantial portion of the diet on the northern Seward Peninsula in August. Berries were not prominent in fecal analysis to the extent we expected based on observations of goose foraging activity in estuarine areas. These results should be interpreted with caution, because differential digestibilities of plant matter may cause micro-histological analyses to either under- or over-estimate the percentages of certain plant species found in the diet. Our preliminary diet analyses in 1996 did not detect differences in forage quality among the coastal and inland study sites. Nevertheless, we determined that coastal estuarine meadows up to 200 km away from the nesting area provided significant nourishment prior to fall migration.

POSTER - FRIDAY - 13:00

DIFFERENCES IN BROOD SIZE CHANGES AND CONDITION OF GOSLING LESSER SNOW AND ROSS'S GEESE

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For at least 40 years, lesser snow geese have been the primary goose species using the La Pérouse Bay saltmarsh to forage and brood their young. Owing to their destructive foraging habitats, they have degraded over 65% of its vegetation. Within the past several years, there has been a change in species composition on the marsh. Although Canada geese have been observed using the marsh in the past, their numbers had always been low until recently. Moreover, in 1998, a small number of Ross's geese were observed foraging and rearing their broods on the marsh, something that had not been observed before. In 1999 there was a further increase in the number of Ross's geese using the saltmarsh, as well as a decrease in the number of lesser snow geese. While these observations may be viewed as simply a change in composition of herbivores using the marsh, combined with body size differences among the species and apparent differences in success in this degraded habitat, they raise several interesting questions spanning the range from "what are the relative abilities of these species to use the degraded marsh?" to "what are the implications such use might have on further marsh degradation or recovery?" This study summarizes 3 years of data relevant to these issues. It compares the foraging behavior of lesser snow and Ross's geese using the degraded marsh, examines the relative rates of reduction in the brood sizes of families of lesser snow and Ross's geese, and contrasts the size and condition of goslings of the two species measured near fledging. These data are interpreted against a backdrop of vegetation analyses.

POSTER - FRIDAY - 13:00

A GENETIC CHARACTERIZATION OF ALEUTIAN CANADA GEESE: CHAGULAK ISLAND RELATIONSHIPS TO BULDIR AND SEMIDI ISLANDS

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Aleutian Canada Geese *Branta canadensis leucopareia* are currently proposed for delisting from "threatened" status under the Endangered Species Act. Total numbers of Aleutian Canada Geese have increased across the subspecies range, though at differing rates for individual segments. Previous genetic analyses of Aleutian Canada Geese from Buldir Island and the Semidi Islands indicated the degree of genetic differentiation was sufficient to consider each population as separate management units. However, weaknesses associated with the initial study were low sample size and the absence of samples from the geographically intermediate population of Chagulak Island. Samples from Chagulak Island and additional samples from Buldir Island and the Semidi Islands have now been analyzed for 6 microsatellite DNA loci. Preliminary results indicate the presence of unique alleles in the Chagulak samples as well as substantial frequency differences between all 3 populations. Additional microsatellite loci and mtDNA sequence data are being collected for complete analyses. These results indicate limited gene flow and substantial genetic structure among all 3 Aleutian Canada Goose segments. Delisting the Aleutian Canada Goose from its current status as "threatened" under the Endangered Species Act will require a comprehensive 5 year monitoring plan of all subspecies segments. These data provide useful information from breeding geese from across the subspecies range, and give insight into levels of gene flow not obtainable from wintering ground or breeding bird survey data alone.

LECTURE - SATURDAY - 14:30

PROTECTION OF RED-BREASTED GEESE BY PEREGRINE FALCONS PRIVILEGE FOR PALS ONLY?

PROP, JOUKE, Zoological Laboratory University of Groningen, Groningen, The Netherlands

QUINN, JOHN, Department of Zoology University of Oxford, Oxford , England, United Kingdom

To avoid predation by arctic foxes and other predators, red-breasted geese breed in colonies on small islands in rivers or associated with nesting raptors. We examined colony size in relation to the availability of food in order to help understand what limits population size in this species. Goose densities were expressed as the number of pairs per hectare over the total feeding area within reach of colonies. Food intake rates were estimated by direct observations. Hatching success and clutch size were used as a measure of reproductive success. The number of peregrine falcons, the main "host" selected by red-breasted geese, was relatively constant between years, as was the number of geese nesting with falcons. Snowy owls and rough-legged buzzards were also chosen as hosts but usually only nested every three years when lemming abundance peaked. Colony size on islands was four times bigger in non-peak compared with peak lemming years, suggesting that the geese switched from nesting with owls and buzzards to islands. In non-peak lemming years, densities were twice as high on islands compared with colonies associated with falcons. Food intake rates and reproductive success were negatively correlated with colony density. Despite the relatively poor conditions that therefore existed on islands, geese did not switch to falcons in the absence of owls and buzzards. We suggest this is because: i) Colony size at peregrine eyries is limited by food availability; ii) Individual geese specialize in the host species chosen. These results suggest that the population dynamics of red-breasted geese apparently depends on food availability and on the abundance of their host species.

POSTER - FRIDAY - 13:00

THE NESTING ASSOCIATION BETWEEN RED-BREASTED GEESE AND RAPTORS IN ARCTIC SIBERIA

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Being the smallest and one of the most conspicuous goose species, red-breasted geese face particular problems during the nesting phase in avoiding predation of themselves and their eggs. The habit of placing their nests near those of raptors is generally thought to be an adaptation to safeguard the eggs from predation, a behaviour found in many other avian taxa. Two hypotheses are tested in relation to this nesting association: i) red-breasted geese specifically choose to nest beside their 'protectors', rather than their simply selecting similar habitat; ii) the behaviour is maintained because the geese enjoy a higher rate of reproduction when nesting near raptors. Results from fieldwork undertaken on the Taymyr peninsula (1995-1999) showed that red-breasted goose distribution was explained primarily by the presence of raptors, not just by habitat. Experiments showed that geese selected the most aggressive, not necessarily the most abundant, protector species. Geese also bred more successfully with raptors than with gulls on islands. Gulls were relatively ineffective at excluding foxes from colonies but foxes almost never approached raptor colonies and were easily repelled when they did. However, there was also a risk associated with the nesting association behaviour as the probability of being attacked by the raptors leading to desertion of the nest was considerable. In years when predation pressure was low, geese nested further from the raptors within colonies. These results strongly support the hypothesis that red-breasted geese are heavily dependent on raptors. Possible evolutionary pathways that led to the close association between red-breasted geese and raptors are explored.

LECTURE - THURSDAY - 14:50

PATTERNS OF DISTRIBUTION AND ABUNDANCE OF GREATER SNOW GEESE ON BYLOT ISLAND, 1983-1998

REED, AUSTIN, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

HUGHES, R. JOHN, Canadian Wildlife Service Environment Canada, Sainte-Foy, Québec, Canada

BOYD, HUGH, Canadian Wildlife Service Environment Canada, Ottawa, Ontario, Canada

At five-year intervals since 1983 we have conducted aerial photographic surveys of Greater Snow Geese *Anser caerulescens atlanticus* on the 1600-km ^{2} south plain of Bylot Island during the brood rearing period. For each of the four surveys we estimated the total number of goslings, of parental adults, and non-breeding adults (including failed breeders). We determined separate totals for 3 strata representing habitat quality, and generated spatial distribution maps. The results showed an increasing trend (1983-1998) in numbers of parental adults, of goslings and of total geese, although the highest numbers were recorded in the exceptionally good breeding year of 1993. Adults without young (failed- and non-breeders) showed a declining trend with the lowest numbers occurring in 1993. The increase in breeding geese was apparent in all habitat strata but it was most pronounced in those judged to be of moderate and poor quality for brood rearing, suggesting that the highest quality rearing habitats were already occupied close to capacity. We also examined the spatial distribution of broods in relation to main nesting concentrations, and compared the population increase on Bylot Island with that occurring in the entire Greater Snow Goose population over the same time period.

LECTURE - SATURDAY - 15:50

THE COSTS OF RAISING A FAMILY IN GREATER SNOW GEESE *CHEN CAERULESCENS ATLANTICA*

REED, ERIC, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

GAUTHIER, GILLES, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

The notion of a fitness cost associated with parental care is a central assumption in theories of life-history evolution. If reproduction is costly, the amount of parental care provided by the parents should be a compromise between the benefits to the young and the costs to the parents. In this study we examined fitness costs associated with long term parental care in the Greater Snow Goose. We used multistrata mark-resight models to quantify the effects of providing parental care in the fall and spring (3 and 10 months following hatch) on survival and breeding probabilities of neckcollared adult females. Observations of neckcollared females were conducted during fall staging (1993 to 1999) and spring staging (1994 to 1999). Sighting and capture of marked females was carried at the Bylot Island breeding colony between 1997 and 1999. Females accompanied by young in the fall did not have decreased survival in the following year when compared to females that were not accompanied by young. However, survival probabilities of females still accompanied by young in spring were 17 percent lower in the following year than that of females not associated with young. We found little evidence for a fecundity cost as return rates to the breeding colony were not significantly different between females that were accompanied by young in either fall or spring and those that were not. These results suggest that the maintenance of long-term parental care in Greater Snow Geese may be a trade-off for females between a survival cost and some other benefits.

LECTURE - WEDNESDAY - 9:20

ENERGETIC COST OF THERMOREGULATION FOR GREATER SNOW GOOSE GOSLINGS GROWING IN A NATURAL ENVIRONMENT

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GAUTHIER, GILLES, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

LAROCHELLE, JACQUES, Département de biologie Université Laval, Sainte-Foy, Québec, Canada

Goslings growing in the Arctic are confronted to a cold environment. We evaluated the energetic cost of thermoregulation for Greater Snow Goose (*Chen caerulescens atlantica*) goslings in the High Arctic (Bylot Island, Nunavut Territory, Canada) in relation to hatching date. We used four heated taxidermic mounts representative of various development stages of Greater Snow Goose goslings (~3, 10, 20 and 30 days) to predict metabolic rates of live goslings in the field. We first calibrated the taxidermic mounts against live goslings in the laboratory under conditions representative of those found in nature. From this calibration, we developed predictive equations between goslings metabolism, heating power of the mounts and standard meteorological variables. We then used the taxidermic mounts in the field in order to describe the thermal environment of growing goslings and evaluate the costs of thermoregulation. Between 0 and 40 days of age, the mean (1994-1997) standard operative temperature (T_{se}, a thermal index that allows air temperature, radiation intensity, wind speed and their interactions to be combined into a single value expressed in temperature units) experienced by goslings was 5.3°C. Their thermal environment showed large daily variations and deteriorated between 0 and 40 days of age. During this period, we evaluated that goslings must allocate to thermoregulation about 30 % of the energy required for maintenance metabolism. We also estimated that goslings hatched 6 days after the peak hatching date spent about 6 % more energy on thermoregulation than those hatched 6 days before peak hatching.

POSTER - FRIDAY - 13:00

ABUNDANCE AND DISTRIBUTION OF INTESTINAL HELMINTHS IN GREATER SNOW GEESE ON THE BREEDING COLONY, AND DURING THEIR FALL AND SPRING MIGRATION

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GAUTHIER, GILLES, Département de biologie and Centre d'études nordiques Université Laval, Sainte-Foy, Québec, Canada

Parasites are common in waterfowl and can potentially affect the fitness of their host. We examined intestines of Greater Snow Geese (*Chen caerulescens atlantica*) to determine the seasonal change in the helminth fauna in relation to the sex and age of the host. A large sample of adult and gosling was collected from the breeding colony on Bylot Island (Nunavut), and during their fall and spring migration, at Cap-Tourmente and Baie-du-Fevbre (Quebec), between 1995 and 2000. Among 287 geese examined, 55.1% were infected by at least one of 5 cestoda species belonging to two different families, Hymenolepididae and Dilepididae. Microsomacanthus setigera (Froelich, 1789) occurred in 83.5% of the intestines, Drepanidotaenia lanceolata (Block, 1787) in 29.1%, Hymenolepis barrowensis (Schiller, 1952) in 23.4%, Retinometra longivaginata (Fuhrmann, 1906) in 1.3%, and Platyscolex ciliata (Fuhrmann, 1913) in 0.6%. The life-cycle of these parasites generally requires invertebrates like copepods as intermediate host and the Greater Snow Geese as final host. Nematoda, Trematoda and Acanthocephala species were not found; this is noteworthy and may be explained on the basis of change in location throughout the annual cycle. During the summer, mean parasite intensity of gosling was very high with a prevalence of 100% (50.39 ± 5.44, n = 112) and did not differ between sexes. Intensity of infection was much lower in adults with only 25.0% of birds infected in summer (3.69 ± 0.88, n = 52). However, adult females were more susceptible to helminth infections than males (28.6% vs. 10.6%). By fall and spring staging, prevalence and abundance of helminth in juveniles were much reduced.

POSTER - FRIDAY - 13:00

EFFECTS OF ABDOMINALLY-IMPLANTED TRANSMITTERS WITH PERCUTANEOUS ANTENNAS ON BEHAVIORS OF CANADA GEESE

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HUPP, JERRY, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

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TOMBO, MARTHA , Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

We investigated whether surgically-implanted VHF radio transmitters affected behaviors of Canada geese (*Branta canadensis*) in Anchorage, Alaska during 18 July-15 September, 2000. We implanted a small (27 g) or large (36 g) radio transmitter with a percutaneous antenna in the right abdominal air sac of 72 adult females captured during molt. Large transmitters were similar in mass and configuration to satellite transmitters. Fifty-five adult females captured, anesthetized, and released without surgery served as a control group. Each bird was identified by a uniquely coded, colored tarsus band. Following release we located radiomarked and control females that occurred in the same flocks and could be simultaneously observed. We continuously recorded behaviors of radiomarked and control females during 169 paired 10-30 minute observations (81.8 hours total). Initial analysis indicated that transmitter size did not affect behaviors of geese. Therefore we compared behaviors of all radiomarked birds to the control group. Radiomarked and control females spent similar amounts of time grazing, walking, resting, in comfort movements, and in water (MANOVA, Wilk's Lambda = 0.26, P = 0.93). Behaviors of radio-marked and control females were similar regardless of time since surgery (MANOVA, Wilk's Lambda = 0.61, P = 0.93). We rarely observed radiomarked females preening the external antenna. We conclude that abdominally-implanted radio transmitters had little affect on behaviors of Canada geese between molt and autumn migration. We will assess the effects of surgically-implanted transmitters on survival and reproductive effort of geese in future field seasons.

POSTER - FRIDAY - 13:00

PRODUCTIVITY OF LESSER SNOW GEESE ON BANKS ISLAND 1995 TO 1998

SAMELIUS, GUSTAF, Department of Biology University of Saskatchewan, Saskatoon, Saskatchewan, Canada

ALISAUSKAS, RAY T. , Prairie and Northern Wildlife Research Centre Canadian Wildlife Service, Saskatoon, Saskatchewan, Canada

Lesser snow geese nesting on Banks Island are of great importance to the Inuvialuit. These birds constitute an important part of local diets and are harvested by 5 of the 6 communities in the Inuvialuit Settlement Region. Yet, productivity of these birds are poorly documented (but see McEwen's work in 1955). This study was initiated to provide information on productivity of lesser snow geese on Banks Island which can be used for recommendations on sustainable harvest of this population. The number of geese nesting at the main nesting colony at Egg River varied considerably among years and ranged between 186,000 and 439,000 lesser snow geese in 1995 to 1998. This is about twice as many geese nesting at Egg River than that reported in the 1980's. Nesting success also showed large variation among years and ranged 65% to 94% in 1995 to 1998. We estimated that about 1-5% of the nesting population died at Egg River in 1995 to 1998. There were likely several causes of death, but avian cholera was confirmed in about half of the dead birds examined in each year. Gosling survival was low during the first 2-3 weeks after hatch in all years and ranged 37% to 47% in 1996 to 1998 (we did not estimate gosling survival in 1995). Use by geese had a strong negative influence on availability of graminoid plants in the brood-rearing areas of Banks Island Bird Sanctuary No. 1. We did not, however, see any evidence of permanent destruction to habitats.

POSTER - FRIDAY - 13:00

SPATIAL AND ANNUAL VARIATION IN NESTING SUCCESS OF LESSER SNOW GEESE

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ALISAUSKAS, RAY T. , Prairie and Northern Wildlife Research Centre Canadian Wildlife Service, Saskatoon, Saskatchewan, Canada

Reduced risk of predation may be an important advantage of colonial nesting in birds. The impact of predation may, however, vary within colonies relative to factors such as nesting location and nesting density. Birds nesting at central locations or in high densities may, for example, experience lower nest depredation compared to birds nesting in peripheral locations or in low nesting densities. However, spatial variation in nesting success has been devoted little attention among arctic-nesting geese. The objective of this study was to examine how nesting success of lesser snow geese at Egg River colony on Banks Island, Canada, vary spatially and annually. Specifically, we examined how (1) nesting density, (2) distance to the edge of the colony, (3) distance to the closest fox den, and (4) year influenced nesting success of geese in 1995 to 1998. We also attempted to examine how outbreaks of avian cholera affected nesting success of geese. Nesting success varied considerably among years and increased with increasing distance to fox dens whereas nesting density and distance to the edge of the colony were not important in affecting nesting success of geese. Outbreaks of avian cholera had a relatively minor effect on nesting success of geese when compared to other variables. However, a correlation between dead birds and nesting density suggested that cholera mortality was a cost of colonial nesting and that there was a trade-off between nesting in high densities with low rate of predator exposure but with increased risk of cholera mortality.

LECTURE - THURSDAY - 14:10

NECKBAND LOSS FOR LESSER SNOW GEESE BANDED ON WRANGEL AND BANKS ISLANDS

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GOLDBERG, DIANA , National Wildlife Health Center U.S. Geological Survey, Madison, Wisconsin, U.S.A.

SMITH, ART, National Wildlife Health Center U.S. Geological Survey, Madison, Wisconsin, U.S.A.

COOCH, EVAN, Department of Natural Resources Cornell University, Ithaca, New York, U.S.A.

Neckbands are commonly used to study behavior, movement, and survival of goose populations throughout the world. However, neckband loss can be substantial, resulting in biased survival estimates and reducing the precision of corrected survival rates. If neckband loss occurs at a constant rate, relatively simple adjustments can be made to obtain unbiased survival rate estimates for neckbanded birds; however, this assumption requires careful evaluation. We used recaptures, hunter recoveries, and resightings of neckbanded birds to estimate neckband loss for lesser snow geese *Anser caerulescens* banded on Wrangel and Banks islands. The rate of neckband loss increased with age of the band and varied between Banks and Wrangel islands and between males and females. We also considered how rates of neckband loss and precision affect the survival estimates obtained from neckbanding programs.

LECTURE - SATURDAY - 11:40

EFFECTS OF WINTERING LOCATION ON REPRODUCTIVE PARAMETERS IN PACIFIC BLACK BRANT

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SEDINGER, JAMES S., Institute of Arctic Biology University of Alaska, Fairbanks, Alaska, U.S.A.

WARD, DAVID, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

Black Brant *Branta bernicla nigricans* winter primarily in four lagoons in Baja and the mainland of Mexico, and in lower numbers in bays along the pacific coast north of Mexico. We used observations of brant from San Quintin, Ojo de Liebre, and San Ignacio in Mexico and Morro Bay and Humboldt Bay in California to assess the importance of winter habitat to the breeding success of Black Brant at the Tutakoke River colony on the Yukon Kuskokwim Delta (Y-K) during the 1999 and 2000 breeding seasons. Neither clutch size nor nest success varied significantly ($P>0.05$) for brant wintering in different areas. Similarly, female weight at hatch did not vary significantly among wintering locations ($P>0.05$). Brant wintering in the northernmost estuary in Mexico nested approximately 2 days earlier than those wintering further south ($P=0.01$). Brant wintering further north also were more likely to nest than those from southern wintering areas ($P=0.0002$). Recent survey data suggest a northward shift in the winter distribution of Black Brant (Conant et al. 1993). Sedinger et al. (1995) and Sedinger and Flint (1991) suggested that later nesting birds produced goslings that grew at a slower rate, were less likely to survive their first year, and were subsequently smaller adults. Lower recruitment and breeding rates for brant in southern Baja could reduce growth of this segment of the population directly, or favor shifts in wintering area, thereby producing the observed shift in wintering distribution in Baja.

LECTURE - THURSDAY - 15:30

INTENSIVE OBSERVATIONS OF NECK BANDED BIRDS PROVIDE INSIGHTS INTO LESSER SNOW GOOSE NATURAL HISTORY

SCHWITTERS, MICHAEL, Choteau, Montana, U.S.A.

Intensive observations of neck banded Lesser Snow Geese (*Anser caerulescens caerulescens*) in the Pacific and Central Flyways have provided many insights into goose biology. Two results outside of the collaring programs' primary objectives are reported here: 1) Formation of pair bonds by individuals from separate breeding populations. 2) reverse migration of geese in response to adverse weather. Pair Bonds between individuals of separated populations. In at least two instances, paired Lesser Snow Geese were observed where each bird was collared with a neckband from a different breeding colony. Observations and review of marking and resighting records revealed that birds from Wrangel Island, Russia and Western Arctic Canada were mated. Pair bonds were probably formed on the California wintering grounds and demonstrate that genetic exchange is being maintained between separated breeding populations. Reverse migration in response to adverse weather. Collared Snow Geese migrating northward during spring 1997 were initially observed in north central Montana. Flocks were subsequently observed in west central Saskatchewan and again back in Montana after cold temperatures froze wetlands in Canada. Four unique individuals were seen in Montana, Saskatchewan and again back in Montana. These observations demonstrate that geese will retrace their migration flights in response to adverse weather conditions. In this case, a distance of 600 kilometers.

POSTER - FRIDAY - 13:00

GENETIC ANALYSIS OF SPATIAL AND TEMPORAL VARIATION IN RACIAL COMPOSITION OF MICHIGAN CANADA GOOSE HARVESTS

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PRINCE, HAROLD, Department of Fisheries and Wildlife Michigan State University, East Lansing, Michigan, U.S.A.

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LUUKKONEN, DAVID, Michigan Department of Natural Resources Rose Lake Research Center, East Lansing, Michigan, U.S.A.

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Racial identification of Canada geese (*Branta canadensis*) has historically relied on marking individuals or measuring phenotypic characteristics that are naturally variable. Genetic markers and methods of statistical inference are currently available to estimate proportional contributions of races or breeding populations to admixed wintering or migratory flocks. We derive estimates of the composition of Michigan's fall harvest of Canada geese from Wildlife Management areas in 2 regions (southwest Michigan and east-central Michigan) for the first 2 days of the regular hunting season in each of 4 years (1993-96). Harvest samples were also obtained from early and/or late seasons in 3 additional locales in the state. Breeding populations in Canada (B. c. interior; N=4) and Michigan (B. c. maxima; N=5) were characterized for 5 microsatellite loci that were indentified as providing accurate and precise estimates of the proportional contribution of samples from each population based on significant subspecific and inter-population differences in allele frequency. Maximum likelihood estimates of the proportional contributions of breeding populations to fall harvests revealed that the racial composition of Canada goose harvests varied among years and between management areas. Harvest composition also varied greatly between managed and unmanaged areas in close geographic proximity. Higher proportions of resident giant Canada geese were harvested during early hunting seasons and on unmanaged areas relative to migratory interior Canada geese. Harvest estimates suggest that individuals from different subspecies and populations are differentially abundant or susceptible to harvest during different times of the fall season, during different years, and in different geographic regions of the state.

LECTURE - SATURDAY - 13:30

EFFECT OF EL NIÑO ON WINTERING DISTRIBUTION AND BREEDING PROPENSITY OF BLACK BRANT

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ANTHONY, R. MICHAEL, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

CONANT, BRUCE , Migratory Bird management U.S. Fish and Wildlife Service, Juneau, Alaska, U.S.A.

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El Niño events warm waters along the Pacific coast of North America, which may influence productivity of eelgrass, which is at its southern thermal limit in Baja California. Because Black brant (*Brant bernicla nigricans*) feed predominantly on eelgrass during winter climate induced reductions in eelgrass might influence use of wintering areas by brant. We examined long-term midwinter survey data and more recent surveys of breeding colonies on the Yukon-Kuskowkim (Y-K) Delta, Alaska to examine shifts in winter distribution and breeding propensity of brant. We also used observations of brant in wintering areas to examine dynamics of breeding propensity associated with specific wintering location following the 1997-98 El Niño event. Mid-winter surveys in Mexico span 6 El Niño events and more detailed data are available for wintering distribution in Mexico for 4 El Niños. Data from the breeding ground have only been collected since 1992, hence spanning the 1998 El Niño. Fewer brant (mean 13.5%) were counted in Mexico during every El Niño between 1965-66 and 1997-98 than in the preceding year ($n = 6$). Numbers of brant nesting on the Y-K Delta declined substantially (28%) following the 1997-98 El Niño and did not recover fully until the 2000 breeding season. A smaller proportion of brant from southern wintering areas in Mexico nested in 1998 than was true for brant wintering in San Quintin, the northern most wintering area in Mexico. These patterns suggest that brant shifted northward during El Niño events, likely in response to reduced food availability and reduced food availability reduced breeding probability.

POSTER - FRIDAY - 13:00

SUMMER MOVEMENTS OF WHITE-FRONTED GEESE THAT NEST IN THE TAIGA OF NORTHWEST AND INTERIOR ALASKA

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MARTIN, PATRICIA, (retired) Kanuti National Wildlife Refuge U.S. Fish and Wildlife Service, Fairbanks, Alaska, U.S.A.

Lensink (1983) estimated a breeding population of 113,000 White-fronted Geese in the taiga of Northwest and Interior Alaska. Recent estimates, however, indicated a 27% decline in this segment of the mid-continent population. Therefore we studied breeding chronology, nesting and brood-rearing habitat, and potential effects of flooding and predation on nest success. Flightless females (n=72) likely to have bred near their molting area, as indicated by brood-patch, were fitted with VHF radio collars at 2 study areas in northern and western Interior Alaska. Radio-marked geese were located weekly by aircraft during the summers of 1995-98. Of 72 radioed females, 30 were detected in the study area in the year following marking. At least 23 (71%) of these were found during nesting, of which 13 (56%) reared broods. Nine of these geese were found in a subsequent year, and three nested at a site within 25 m of their previous year's nest. Seven of 72 radioed females were known to have died of predation on the breeding grounds within two years of marking. Thirty nests were found; the majority were in forest edges or near forest patches. Most (68%) nests were in the riparian floodplain of the Koyukuk River but 31% were in uplands and were not susceptible to flooding. Geese that nested in uplands moved their broods a greater distance (up to 7 km) from the nest to the brood-rearing area. Brood-rearing areas were large (minimum convex polygons ~20 km^2). Nest initiation occurred in mid-May, while hatching occurred the second week of June. Breeding chronology was earlier than other mid-continent white-fronts that nest in arctic tundra. Pre-migratory staging occurred from early to mid-August. Geese marked in the more westerly Koyukuk NWR staged in coastal estuaries after a *northwestward* movement that was opposite to their *southeastward* migration to Canada. Geese marked in the more easterly Kanuti NWR staged in riparian habitats along the Yukon River while headed southeastward on migration. Fall departure from northwest Alaska was usually complete by the end of August. The comparatively early fall migration of taiga-nesting White-fronted Geese, relative to tundra nesters, may cause early harvest to be directed towards this small component of the overall mid-continent population.

LECTURE - SATURDAY - 16:10

INDIVIDUAL DECISIONS ON SITE USE IN GEESE - STRATEGIES OF SUBORDINATES AND LOCAL DOMINANTS

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Social dominance controls the access to patchy food in group foraging herbivores. We investigated foraging strategies of individuals with respect to their social position in the group. In barnacle geese *Branta leucopsis* on Spitsbergen, the dominance rank of marked birds within a non-breeder flock was described best by age and body mass. Subordinate individuals occupied explorative positions in the flock. They were the first to find experimentally enriched vegetation plots, which were, however, monopolized quickly by dominant geese. Females not returning to the breeding area in the subsequent season had a significantly lower dominance rank compared to females that returned. During spring fattening of brent geese *Branta b. bernicla* , site knowledge within a patchy salt marsh will pay in terms of intake efficiency. Marked family birds returned to a highly preferred foraging area every second day. Pairs without young showed less site fidelity. The consistency of this pattern in consecutive years hints at local exclusion through dominance behaviour. Individuals differed remarkably concerning the success with which they defend vegetation patches. Parental birds had a significantly higher dominance score than non-parental birds, even in years without offspring. Birds new in the area hardly won interactions from resident birds; their integration into the local hierarchy will probably take years. We will interpret individual movements within one staging area in terms of individual costs (including flight) and benefits (e.g. intake rates). These analyses should reveal why dominant individuals experience higher fattening rates. Data on movements of marked individuals will improve our understanding of the population dynamics of migratory birds, as challenged by recent behaviour-based models (Stillman et al. 2000, Pettifor et al. 2000).

LECTURE - WEDNESDAY - 11:20

POPULATION DECLINE OF NORTHEAST ASIAN GEESE AT THE END OF XXth CENTURY

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Changes in distribution and numbers of 5 geese species: White-fronted Goose (WFG), Lesser White-fronted Goose (LWFG), Bean Goose (BG), Black Brant (BB) and Emperor Goose (EG), where the subject of our survey in 1994-2000. Fieldwork was curried out during 6 field seasons, in most of key tundra wetlands of Yakutia and Chukotka by teams of 7-12 ornithologists every year. In last 15 years numbers of NE Asian geese had declined from about 800 000 birds to 470 000 in great contrast with geese of Western Palearctic that had increased nearly twice by the same time reaching 8 million geese. Detailed analyses of populations shows that 5 of 8 NE Asian geese populations where declining. Status of others is either stable or unknown. For WF, Bean, LWF and BB (Asian populations) population numbers are less then 100 000 birds each. EG populations of Anadyr Bay are not showing decline as it was suggested earlier (Kondratyev, 1996). Recent observations show that the range of the species is wider and numbers in Chukotka are higher than it was suggested before. Interview data of hunters show even some population increase of the species in spite of heavy hunting pressure near native settlements. American population of BB had expanded the breeding range for about 800-km West and met Dark-bellied Brent Goose. We have found mixed colonies in Olenyok and Lena deltas. BB population at Chukotka had declined by the time Yakutian populations had increased. Exact breeding grounds of Asian BB population (5000 birds) are still unknown. WFG, LWFG and BG populations in Chukotka and Yakutia are declining and the range is now consisting of isolated fragments of formerly continuos band along the Arctic coasts. Main remaining breeding areas are: Lena Delta, Khroma river basin, area from East Indigirka Delta to Alazeya mouth and Southeast Chukotka including Anadyr Bay coasts. The last remaining breeding spots of LWFG we have found in Abyi Lowland (middle Indigirka) and in middle reaches of Anadyr River. Total numbers of LWFG left in Asia are less then 20 000. The only increasing population is population of WFG wintering in Japan and breeding in the North of Koryak Mountains. They had increased in numbers from 5 000 to 60 000 in 35 years due to effective conservation measures in Japan. Geese populations of NE Asia in general show catastrophic declining trend in last 30-40 years. If no proper conservation measures and ban of hunting (especially in spring) will be established in East Russia and China about half of all East Asian goose populations will beat the risk of extinction in coming 20-30 years.

POSTER - FRIDAY - 13:00

PHYSIOLOGICAL STATUS OF SEVERAL MIGRATORY WATERFOWL SPECIES IN THE RAINWATER BASINS OF NEBRASKA

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BECK, MARY, Animal Science University of Nebraska-Lincoln, Lincoln, Nebraska, U.S.A.

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Hunting has been used as one mechanism to control recent increases in Lesser Snow Geese (LSGO, *Chen caerulescens*). In 1998, data (B. Cox, unpublished) indicated higher body condition scores of geese in Western Rainwater Basins (WRB) in Nebraska (no hunting) than in Eastern (ERB, open). This study was designed to determine whether disturbance of hunting affects other physiological parameters in LSGO, Greater White Fronted Geese (GWFO, *Anser albifrons*) and Northern Pintail (NOPI, *Anas acuta*). Birds were collected in 1999 and 2000 hunting seasons, and blood samples were analyzed for thyroid (T_3, T_4) and adrenal (corticosterone) function and for heterophil:lymphocyte (H:L, 2000 only) ratios. In 1999, corticosterone was higher in GWFG (P=0.026) and LSGO (P=0.056) from WRB; in LSGO corticosterone rose 78.5% in hunting vs pre-hunting seasons. Corticosterone was 43% higher in GWFG in hunting vs pre-hunting seasons and 88% higher in NOPI (P=0.098). In both goose species, T_3 fluctuated by day of harvest, with concentrations in Tuesday-sampled birds higher than either Mon/Fri samples(closed) or Sat/Sun/Wed/Thurs (open to hunting). In 2000, corticosterone in NOPI was higher (P=0.086) in WRB; in GWFG it was higher (P=0.037) in open than in closed areas; no differences were detected in LSGO except that corticosterone was 2x higher on Tues than on M/F or S/S/W/Th. No effects on H:L ratio were found. Although no consistent patterns of blood hormone concentrations or cellular ratios were found that can be attributed to stress, the data provide a baseline inventory from which to design further studies.

POSTER - FRIDAY - 13:00

INTRASPECIFIC PHYLOGEOGRAPHY OF LARGE- AND SMALL-BODIED CANADA GEESE *BRANTA CANADENSIS* OF WESTERN NORTH AMERICA

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PEARCE, JOHN, Alaska Biological Science Center U.S. Geological Survey, Biological Resources Division, Anchorage, Alaska, U.S.A.

PIERSON, BARBARA, Alaska Biological Science Center U.S. Geological Survey, Biological Resources Division, Anchorage, Alaska, U.S.A.

SCRIBNER, KIM, Department of Fisheries and Wildlife Michigan State University, East Lansing, Michigan, U.S.A.

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We used molecular markers that differ in mode of inheritance and rate of evolution to examine levels and partitioning of variation across seven nominal subspecies and 11 breeding populations of Canada goose *Branta canadensis* in western North America. Large- and small-bodied Canada geese are highly divergent and represent monophyletic groups. A majority of haplotypes resolved were observable in a single locale or subspecies; however, gene trees constructed from mtDNA control region sequence data suggest subspecies of Canada geese do not have distinct mtDNA. Within both large- and small-bodied forms, certain haplotypes are observed across all subspecies. Population trees constructed using both mitochondrial and nuclear (microsatellite) DNA markers were generally concordant, and divergence of most populations was statistically supported. However, degree of divergence of populations and subspecies varied, suggesting varying times of separation. Our data suggest current processes that may be amalgamating certain populations have not appreciably mixed gene pools within large- and small-bodied forms. We discuss the efficacy of current subspecific taxonomy in light of conservation and management concern.

LECTURE - SATURDAY - 14:10

EFFECTS OF EL NIÑO SOUTHERN OSCILLATION ON WINTERING BLACK BRANT IN BAJA CALIFORNIA, MEXICO

TIBBITTS, LEE, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

WARD, DAVID, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

CARRERA, EDUARDO, Ducks Unlimited de Mexico, Garza Garcia, Nuevo Leon, Mexico

The *El Niño* Southern Oscillation (ENSO) of 1997-98 had a dramatic impact on black brant *Branta bernicla nigricans* at their principal wintering areas in the Pacific flyway (i.e., the embayments of Baja California). Numbers of brant were 2.5-times lower than the 10-year average at 2 southerly wintering areas (Ojo de Liebre and San Ignacio lagoons), while numbers were 3-times higher at the most northern wintering area in Baja California (San Quintin Bay). In addition, brant appeared to be food-stressed; body mass of all age and sex classes was significantly lower (7-10%) in 1997-98 than in the years preceding and following the ENSO event. Differences in distribution and body mass were most likely related to an overall reduction in quality of winter foraging habitats. At all 3 wintering areas, abundance, availability, and nutrient content of seagrasses, the primary foods of brant in winter, were significantly lower than the previous year's estimates. Brant likely moved to San Quintin Bay in winter 1997-98 because of its relatively high biomass of available seagrasses. The ENSO of 1997-1998 highlighted the importance of San Quintin Bay for brant; this small bay (5,000 ha) not only supported unusually high numbers in 1997-98, but in typical years, is used by a large portion of the population as a wintering area and as a fall and spring stopover site.

POSTER - FRIDAY - 13:00

ADAPTIVE SIGNIFICANCE OF EGG SIZE VARIATION IN LESSER SNOW GEESE AT AKIMISKI ISLAND, NUNAVUT

TIMMERMANS, STEVEN, T. A., Dept. of Zoology University of Western Ontario, London, Ontario, Canada

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Egg size variation is considerably high for Lesser Snow Geese (*Chen caerulescens caerulescens*) breeding on Akimiski Island, Nunavut. Most of this variation is attributable to differences in egg size among rather than within females. This high among-female egg size variation occurs both within and among clutch sizes such that various females commit equal amounts of energy toward clutch formation yet produce different numbers of eggs (i.e., some females lay large clutches of small eggs and vice versa). From 1996 to 1998, goslings from a given clutch size, of a given age, sex and hatch date that hatched from larger eggs were, on average, larger, heavier and had longer primary flight feathers than those that hatched from smaller eggs. In 1996, goslings that hatched from smaller eggs survived equally as well as did those from larger eggs. In 1997, larger eggs conferred survival advantages to goslings. In 1998, there was a positive but non-significant relation between egg size and gosling survival. Such annual variation in egg size-specific survival probabilities is sufficient to produce varying selection coefficients for any given egg size genotype. Thus, maintenance of high egg size variation in Snow Goose populations could be a product of diversifying selection regimes resulting from annually changing survival values for any given egg size, even in presence of strong directional selection for larger eggs (goslings from larger eggs grow better). This may explain how a trait that has fitness value can maintain a relatively high heritability. It is suggested that the agent of diversifying selection is annual variation in environmental conditions when eggs hatch.

LECTURE - WEDNESDAY - 10:20

MIGRATION OF PACIFIC BLACK BRANT

WARD, DAVID, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

MATHER, DANIELLE, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

TIBBITTS, LEE, Alaska Biological Science Center U.S. Geological Survey, Anchorage, Alaska, U.S.A.

BOYD, SEAN, Canadian Wildlife Service Environment Canada, Vancouver, British Columbia, Canada

In July of 1999 we implanted 45 conventional UHF radios in postbreeding adult brant (23 females, 22 males) at the Tutakoke breeding colony on the Yukon-Kuskokwim Delta in western Alaska. Over the following 18 months we tracked these individuals at their principal fall and spring staging areas (Izembek Lagoon, Alaska; Humboldt Bay, California; Straits of Georgia, British Columbia) and primary wintering areas (San Quintin Bay, Ojo de Liebre Lagoon, and San Ignacio Lagoon, Baja California; Boundary Bay, British Columbia). Totals of 42 (93%) and 31 (68%) radio-tagged individuals were detected at Izembek Lagoon in fall of 1999 and 2000, respectively. Average length of stay (LOS) for birds at Izembek Lagoon in fall was 53 ± 11 days in 1999 (n = 39). Average duration of migration from Izembek Lagoon to San Quintin Bay was 5.5 ± 2.3 days in 1999 (n = 13) and 4.4 ± 2.1 days in 2000 (n = 10). At least 5 of these individuals made the 5,500 km migration in 42 to 76 hours confirming that fall migrant brant are capable of making a non-stop migratory flight across the Gulf of Alaska and along the Pacific Coast of Canada and the United States. Wintering birds spent an average of 59 ± 45 d (n=25) in specific Baja California embayments in 1999. In spring, birds passed quickly through Izembek Lagoon, average LOS was 10 ± 7 days (n = 28), before arriving on the breeding grounds. Implanted radios affected reproductive performance (few implanted brant attempted to nest) but we detected no evidence that radioes affected migratory behavior.

LECTURE - WEDNESDAY - 16:35

BREEDING BIOLOGY OF RELEASED HAWAIIAN GEESE: AN ASSESSMENT OF THE REINTRODUCTION PROGRAM

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BLACK, JEFFREY, Dept of Wildlife Humboldt State University, Arcata, California, U.S.A.

BANKO, PAUL, USGS Pacific Island Ecosystems Research Center, Hawaii National Park, Hawaii, U.S.A.

MARSHALL, ANNIE, U.S. Fish and Wildlife Service , Portland, Oregon, U.S.A.

In spite of major conservation efforts, the Hawaiian Goose, or 'Nene' (*Branta sandvicensis*), is still among the most endangered waterfowl species in the world. To assess the success of the reintroduction program and to fine-tune recovery techniques, we analyzed long-term breeding records of released Hawaiian Geese. Between 1960 and 1997, over 2200 captive-reared Hawaiian Geese have been released into the wild but only 196 goslings are known to have fledged in the wild. Reproductive parameters varied between release sites, and with rearing and release method. Birds in pens reproduced better than those in the wild, reflecting reduced predation and enhanced feeding opportunities. When paired to a wild bird, released birds were more successful than when paired to a released bird. Parent-reared birds in large open top pens, which eventually flew from the pens after fledging, reproduced most successfully. Males reared in the wild had a higher fledging success than captive-reared males. In Hawaii Volcanoes National Park, a declining hatching and fledging success in the wild population suggests that the carrying capacity of the habitat may be reached. Carrying capacity could be further increased through grassland management, which, coupled with predator control, has increased gosling survival in the last five years of the reintroduction program at Hawaii Volcanoes National Park.

POSTER - FRIDAY - 13:00

WINTER ECOLOGY OF GREATER WHITE-FRONTED GEESE (*ANSER ALBIFRONS*) IN TAMAULIPAS, MEXICO

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CARREON, ALEJANDRO, Agronomia Universidad Autonoma de Tamaulipas, Cd. Victoria, Tamaulipas, Mexico

The population of mid-continent white-fronted geese wintering in Mexico has increased in recent years due to expanding agriculture. Up to 200,000 whitefronts may winter in Tamaulipas in some years. Little information on wintering ecology of whitefronts exists from this region. This paper will present: 1) activity patterns and time budgets 2) amount and sources of disturbances 3) the amount of available food in agricultural fields. The study was conducted from November, 1998 to March, 2000 on a 3,445 ha private ranch in central Tamaulipas with a 101 ha artificial impoundment. The ranch was comprised of 56% sorghum *Sorghum bicolor* fields, 14% natural vegetation and 3% water, and is typical of the region. A maximum of 60,000 whitefronts were counted and geese were present from November to March. Movement patterns entailed a daybreak departure from the impoundment for feeding with a mid-morning return. A shorter feeding flight occurred from 1-2 hours before dusk. Daily averages of two and four hours were spent on feeding flights during the two seasons. Night feeding rarely occurred. Time-budget analysis indicated that feeding (49%) was followed by movement (18%) and resting (14%) in sorghum fields. On the impoundment, movement (45%) was followed by resting (19%) and feeding (14%). During 184 hours there were 20 natural, 31 man-caused and 4 disturbances of unknown origin. Random plot sampling for waste sorghum resulted in 78 and 162 kg/ha in 1998/99 and 1999/2000, respectively. Differences were attributed to dry conditions in 1998/99.This study site had an abundant quality food source with sufficient water and minimal disturbance. Whitefronts may expend less energy for daily maintenance here than other wintering areas. It would be useful to identify important wetlands to geese in Mexico and encourage beneficial management.

POSTER - FRIDAY - 13:00

EFFECTS OF MIGRATORY GEESE ON NITROGEN DYNAMICS IN AN ALASKAN SALT MARSH

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Lesser snow geese (*Anser caerulescens caerulescens*) and Canada geese (*Branta canadensis*) use several salt marshes in Cook Inlet, Alaska, as stopover areas for brief periods during spring migration. We investigated the effects of geese on nitrogen cycling processes in Susitna Flats, one of the marshes. We compared net nitrogen mineralization, organic nitrogen pools and production in buried bags, nitrogen fixation by cyanobacteria, and soil and plant characteristics on paired grazed and exclosed plots during the 1997 growing season. Grazed areas had higher rates of net nitrogen mineralization in the spring, although there was no effect of grazing on organic nitrogen availability. The increased mineralization rates in grazed plots could not be accounted for by alteration of litter quality, litter quantity, microclimate, or root biomass, which were not different between grazed and exclosed plots. In addition, fecal input was very slight. We propose that trampling had two effects that could account for greater nitrogen availability in grazed areas: litter incorporation into soils, resulting in increased rates of decomposition and mineralization of organic nitrogen in litter, and greater rates of nitrogen fixation by cyanobacteria on bare, trampled soils. A path analysis indicated that litter incorporation played a primary role in the nitrogen dynamics of the system, with nitrogen fixation secondary, and fecal input was of little importance. Greater net nitrogen mineralization rates in grazed areas did not result in higher nitrogen concentrations in plants or in higher quality diets for geese.

LECTURE - THURSDAY - 10:40

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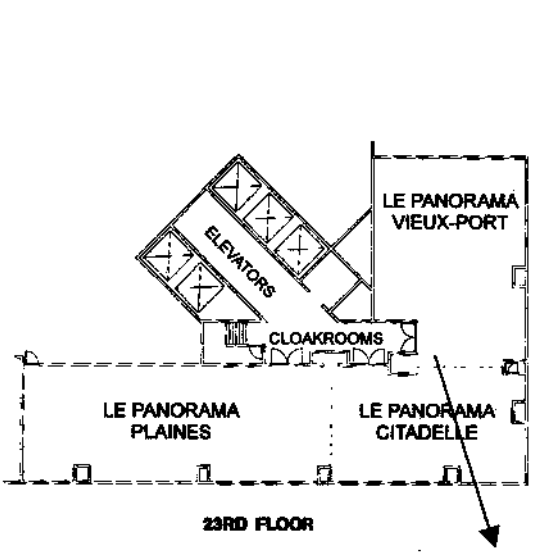

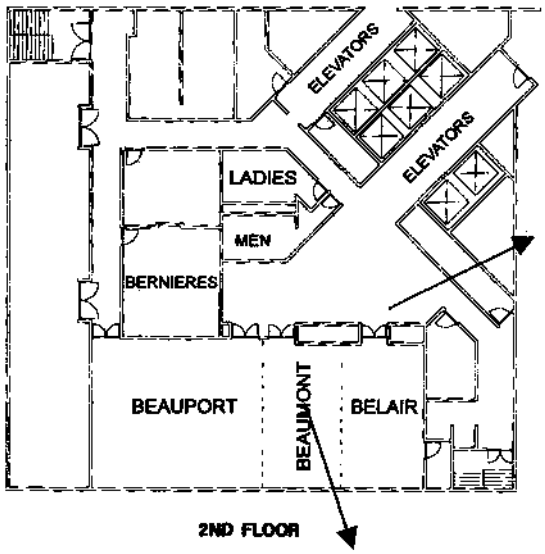

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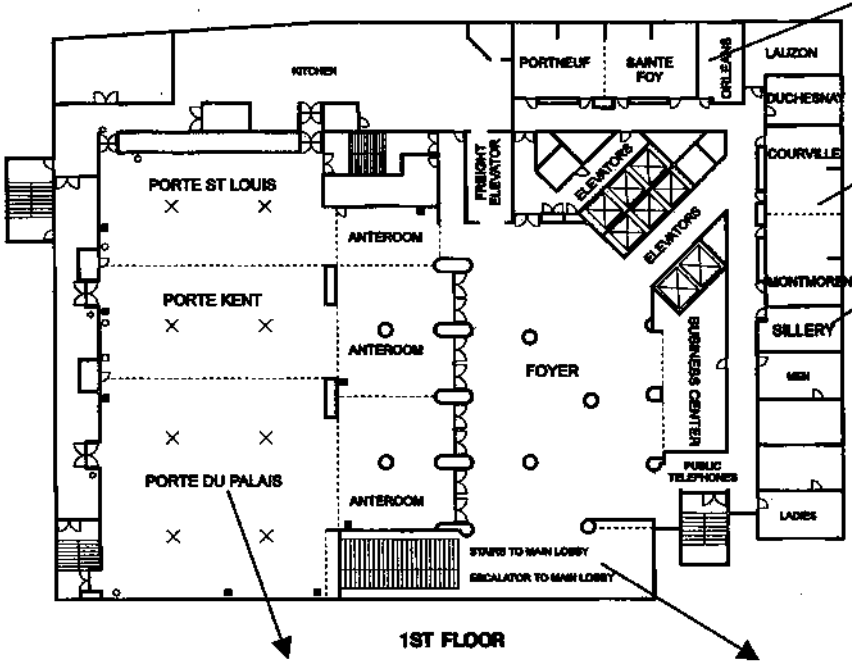

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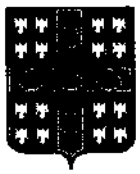

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