55TH ANNUAL MEETING OF THE ATLANTIC SOCIETY OF FISH & WILDLIFE BIOLOGISTS

Presented in partnership with

Newfoundland and Labrador Chapter

Newfoundland Labrador
Wildlife Division
Fisheries and Land Resources

Itinerary

Sunday, October 21st, 2018

5-7pm **Informal Meet & Greet, Crown & Moose Pub** (in Greenwood Inn)

- **7pm** Trivia - presented by The Wildlife Society- NL Chapter
- Prizes donated by the Nature Conservancy of Canada

Monday, October 22nd, 2018

8:00am	**Registration**
9:00am	**Opening Remarks – ASFWB President - Rosanne MacFarlane**
9:20am	Beluga babysitters: evidence of costly allomaternal behaviour in an endangered social odontocete - *Jaclyn A. Aubin, Eric Vander Wal, and Robert Michaud*
9:40am	Links between social behaviour and habitat selection in the context of caribou population dynamics in Newfoundland - *Quinn M.R. Webber, Michel P. Laforge, Maegwin Bonar, and Eric Vander Wal*
10:00am	**Break – Coffee/Snacks**
10:20am	The influence of climate on boreal caribou survival over 3 decades in Labrador, Canada - *Isabelle Schmelzer, Keith Lewis, John Jacobs, and Sara McCarthy*
10:40am	Examining the impacts of the George River caribou herd hunting ban on northern Labrador Inuit: an integrated resource management perspective - *Jason Dicker and Stephen Decker*
11:00am	Monitoring bat populations and tracking the spread of white-nose syndrome in Newfoundland - *Jessica M. Humber*
11:20am	Investigating the influence of forest-level characteristics on the activity of summer foraging bats in Gros Morne National Park, NL - *Darrian P. Washinger and Erin Fraser*
11:40am	Eastern habitat joint venture – migrating for the future - *Tania Morais*
12:00pm	**Lunch – Soup, Sandwiches, Wraps, Fruit, Coffee/Tea**
1:00pm	**Poster Session**
1:40pm	Improving the detectability of hidden lichens on trees; a sample design to determine true absences of cryptic lichen - *Patrick Lauriault and Yolanda Wiersma*
2:00pm	Macrolichen richness, diversity, and composition in boreal forested swamps, ecotones, and upland forests - *Tegan Padgett and Yolanda F. Wiersma*
2:20pm	Effect of clear-cutting created ecotones on macromoth assemblage - *Jasmine Pinksen*
2:40pm	**Break – Coffee/Snacks**
3:00pm	Summer in a winter wonderland: snowbed monitoring in Gros Morne National Park - *Holly L. Lightfoot and Darroch Whitaker*
3:20pm	Investigating the effect of competition on the intraspecific variability of foliar elemental traits - *Travis Heckford, Shawn J Leroux, Eric Vander Wal, Matteo Rizzuto, Juliana Balluffi-Fry, Isabella Richmond, and Yolanda F Wiersma*
3:40pm	Testing for scale-dependent quantity and quality selection strategies in moose using only elemental measures of forage - *Juliana Balluffi-Fry, Shawn J. Leroux, Yolanda F. Wiersma, Travis R. Heckford, Matteo Rizzuto, and Eric Vander Wal*
4:00pm	**ASFWB - AGM**
7-9:00pm	**Banquet + Silent Auction**

Tuesday, October 23rd, 2018

8:45am	**Opening Remarks – ASFWB President - Rosanne MacFarlane**
9:00am	Modelling the influence of linear feature proximity on gray wolf (Canis lupus) habitat selection and movement - *Katrien A. Kingdon, Christina M. Prokopenko, Daniel J. L. Dupont, Jonathan Wiens, Vanessa Harriman, and Eric Vander Wal*
9:20am	Is the picture worth a thousand animals? Individual differences drive space use in gregarious wildlife populations - *Levi J. Newediuk, Christina Prokopenko, and Eric Vander Wal*
9:40am	Behavioural plasticity of caribou (Rangifer tarandus) migration in response to variable spring plant phenology - *Michel P. Laforge, Quinn M. R. Webber and Eric Vander Wal*
10:00am	**Break – Coffee/Snacks**
10:20am	An applied GIS model towards the strategic management of barriers to Atlantic salmon migration in the Restigouche River watershed: watershed-scale connectivity analysis - *Michael Arsenault, Allen Curry, Tommi Linnansaari, Carole-Anne Gillis, and Jae Ogilvie*
10:40am	A tool to assess the cumulative impact of barriers and climate change on salmonid populations in rivers - *Myron King, Ian Cowx, and Michael van Zyll de Jong*
11:00am	Introduced mink frog and green frog in Newfoundland: is pH a factor in spatial separation between species? - *Christine E. Campbell and Dion O. Kelly*
11:20am	Saw-whet owls in Newfoundland: the discovery of a new breeding population in Newfoundland's boreal forests - *Brendan Kelly and Sarah Butt*
11:40am	Ruffed and spruce grouse as potential intermediaries in recent localized range expansion of pathogenic blacklegged ticks in New Brunswick - *Douglas Munn, Jackie Badcock, Robbin Lindsay, and Joseph J. Nocera*
12:00pm	Distribution of the red squirrel in western Newfoundland; present and future implications for gray-cheeked thrushes - *Jenna P.B. McDermott, Darroch M. Whitaker, and Ian G. Warkentin*
12:20pm	**Closing Remarks – ASFWB President - Rosanne MacFarlane**

Sponsors

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NATURE CONSERVANCY CANADA

Newfoundland and Labrador Chapter
The Wildlife Society

THINGS TO DO IN AND AROUND CORNER BROOK

Within walking distance from the Greenwood Inn

Indoor:

- Rotary Arts Centre
  Tina Doltman Gallery Presenting the Wind Project (Janet Langdon and Bruce Pashak)

  Hours: Closed Sundays, Open Monday-Tuesday from 10:00 AM – 4:00 PM
  Located: 5 Park Street (basement of City Hall)

- Corner Brook Public Library
  Hours: Closed Sunday, Monday 10:00 AM – 4:30 PM, Tuesday 10:00 AM – 8:30 PM
  Located: 4 West Street

- Millbrook Cineplex
  Hours: Showtimes vary
  https://www.cineplex.com/Theatre/cineplex-cinemas-millbrook
  Located: 2 Main Street

Outdoor:

- Corner Brook Stream Trail System
  Hours: All hours, though be sure to bring a flashlight or headlamp if exploring after sundown
  Located: Throughout the city, closest entrance point is on Park Street, by Sorrento's
  Map available at: http://www.cbstream.com/trailMap.html

- Margaret Bowater Park
  Hours: All hours, though sections are unlit at night
  Located: Accessible through the Corner Brook Stream Trail System OR via O'Connell Drive

- Hiking or mountain biking the Ginger Route/Gorge Lookout Loop
  - Rent a bike right across the street at Cycle Solutions.
    http://www.cyclesolutions.ca/services/rentals/
  - See map of mountain biking trails in Corner Brook and surrounding communities on TrailForks:
    https://www.trailforks.com/region/corner-brook/

Driving distance from the Greenwood Inn

- Captain James Cook Viewpoint
  - Beautiful view of Corner Brook and the Bay of Islands
  - Picnic tables and short walking trails
  - Located: Mayfair Avenue

- Crystal Water Boat Tours
  - Different packages and rates available
  - Boat tour of the beautiful Bay of Islands
  - Inquire about rates and tours at: https://www.crystalwatersboattours.com/

- Marble Mountain Ski Resort
  - Hiking and walking trails
  - Steady Brook Falls Trail and viewpoint
  - Zipline tours available (http://www.marbleziptours.com/)

- Gros Morne National Park
  - For those who have an extra day in Corner Brook
  - https://www.pc.gc.ca/en/pn-np/nl/grosmorne

Restaurants and pubs within walking distance of the Greenwood Inn:

- Crown and Moose Pub (pub)
  - Located: Within Greenwood Inn
  - Hours: 7:00 AM – 10:00 PM

- Louie Gee's (Pizza and donair restaurant)
  - Located: 70 West Street
  - Hours: 11:00 AM – 2:00 AM

- Brewed Awakening (coffee shop)
  - Located: 35 West Street
  - Hours: Sunday 9:00 AM – 6:00 PM, Monday-Tuesday 7:00 AM -9:00 PM

- Rinda's Kitchen (Thai food)
  - Located: 43 Main Street
  - Hours: Closed Sunday, Monday-Saturday 1:00 PM – 8:00 PM

- Sorrento's (Italian restaurant and bar)
  - Located: 18 Park Street
  - Hours: Sunday 4:00 PM – 10:00 PM, Monday-Tuesday 11:00 AM – 12:00 AM

Oral Presentation Abstracts (in order as listed above)

Day 1 – October 21st, 2018

Beluga babysitters: evidence of costly allomaternal behaviour in an endangered social odontocete

Jaclyn A. Aubin[1], Eric Vander Wal[2], and Robert Michaud[3]

[1]*Cognitive and Behavioural Ecology Program, Memorial University of Newfoundland, St. John's, NL. Canada*
[2]*Dept. of Biology, Memorial University of Newfoundland, St. John's, NL. Canada*
[3]*Groupe de Recherche et d'Éducation sur les Mammifères Marins. Tadoussac, QC. Canada.*

Allomaternal care, a reproductive strategy by which offspring are cared for by multiple female group members, is common among odontocetes, but has not been described in wild belugas (*Delphinapterus leucas*). Despite this, in the endangered St. Lawrence Estuary beluga population, conservationists often encourage allomaternal adoption by releasing orphaned calves into groups of females with young. However, the outcomes of these rescues are unknown, and the effectiveness of this protocol has recently been questioned. Over three summers, we collected footage of female belugas with young in the Saguenay-St. Lawrence Marine Park using an unmanned aerial vehicle, and conducted continuous focal behavioural sampling of calves, yearlings, and juveniles to determine whether allomaternal care occurs in this population. Odontocete mothers typically escort their offspring in echelon formation, a costly behaviour analogous to infant carrying in primates. We predicted that offspring would echelon swim with both mothers and allomothers, as evidenced by observations of escort-switching behaviour. Preliminary analysis shows that, as predicted, focal calves, yearlings, and juveniles were escorted in echelon formation by multiple females. Interestingly, calves were most likely to echelon swim with more than one female. These findings offer empirical support to the practice of rescuing and releasing orphaned calves in this endangered population.

Links between social behaviour and habitat selection in the context of caribou population dynamics in Newfoundland

Quinn M.R. Webber[1], Michel P. Laforge[2], Maegwin Bonar[2], and Eric Vander Wal[1,2]

[1]*Cognitive and Behavioural Ecology Interdisciplinary Program, Memorial University of Newfoundland, St. John's, NL*
[2]*Department of Biology, Memorial University of Newfoundland, St. John's, NL*

Caribou populations are declining across Canada. Understanding the causes and consequences of these declines has become a priority. While a range of hypotheses exist which may explain the causes of declining populations over the last 20 years, studies examining the consequences for current caribou populations are lacking. Behaviour is the interface between an organism and its environment, and behavioural flexibility is important for organisms to cope with environmental change. Social behaviour is important, particularly for caribou, because sociality is a dynamic process, where environmental variation influences group dynamics. Heterogeneity in the physical environment can therefore influence the social environment, for example, population density. Social behaviours are also often density-dependent, and theory predicts that density-dependent traits should affect reproduction, survival, and therefore fitness and population dynamics. Here, we discuss relationships between behaviour, habitat selection, and fitness in Newfoundland caribou and highlight how variation in the social (population density) and spatial (foraging resources) environments can affect this relationship. We demonstrate how social behaviour and habitat selection change as a function of population density and frame our findings in the context of population dynamics by linking these behaviours to calf survival, an important proxy for fitness in caribou. The social and ecological environments represent important axes of caribou conservation that and our findings highlight the adaptive potential of these behaviours. The ecological, evolutionary, and applied implications of our findings are broad and changes in population density could influence individual fitness and population dynamics.

The influence of climate on boreal caribou survival over 3 decades in Labrador, Canada

Isabelle Schmelzer[1], Keith Lewis[2], John Jacobs[3], and Sara McCarthy[4]

[1] *Government of Newfoundland and Labrador, Forestry and Wildlife Research Division, Corner Brook, NL*
[2] *Northwest Fisheries Centre, Department of Fisheries and Oceans Canada, St John's, NL*
[3]*Department of Geography, Memorial University of Newfoundland, St John's, NL*
[4]*Goverment of Newfoundland and Labrador, Wildlife Division, Goose Bay, NL*

We examined the influence of climatic conditions on adult caribou survival by pairing MERRA-based caribou-relevant climatic datasets with space use for over 250 adult female boreal woodland caribou from 4 populations in Labrador Canada. Caribou survival was determined using known-fate models in MARK and an information-theoretic approach was used to evaluate multiple models of adult caribou survival. Model sets examining monthly and annual changes in survival and the influence of a series of climatic conditions were constructed for each local population for all sources of mortality and for mortality from hunting censored. Results show that patterns of survival differed between populations with both annual and within-year variation in survival occurring. Models were consistent with and without mortality from subsistence hunting for all but one population where mortality from subsistence harvest was associated with a change from the relevance of within to between-year variation in survival. Most hypothesized influences of climate on survival were not strongly supported with the exception of snowfall and freezing rain. Survival rate was weakly but positively related to snowfall, and negatively related to freezing rain during the fall. Moderate to high survival rates were documented for the majority of populations, but lower and more variable survival occurred in a population that had undergone a significant decline. Nonetheless only 1 population consistently attained a constant survival rate of at least 85%, and all but one showed declining survival over time.

Examining the impacts of the George River caribou herd hunting ban on northern Labrador Inuit: an integrated resource management perspective.

Jason Dicker[1] and Stephen Decker[1]

[1] *Environmental Policy Institute, Memorial University of Newfoundland, Corner Brook, NL.*

Integrated resource management is the process that identifies and considers all resource use and management emphasis based on present uses, the mix of benefits produced, the ongoing capability of the land to produce benefits, and social preference. The organizational theory behind this management is that, it requires numerous types of complex information for sound, effective decision-making. Such questions can be asked like "How much wildlife habitat is protected from future development and how will such a development will unfold?" Taking this approach with respect to the George River Caribou Herd (GRCH) hunting ban that is currently in place in northern Labrador would be beneficial as it has the opportunity to provide scholarly information on how this affects Inuit within this region. The provincial government of Newfoundland and Labrador initiated the hunting ban in early 2013 as an action to help increase the population size for 5 years, in which the herd dropped to less than 9000 from an 800,000 size (resulted in a 99% decrease). In particular, the Labrador Inuit depended upon the GRCH, once of the largest herds in the world, to fulfill their utilitarian, spiritual, and cultural needs. For generations, the hunting of the GRCH by the Inuit provided them with a staple food supply, nourishment, and materials and facilitated the intergenerational sharing of knowledge and important social norms, all of which are critical to life in Arctic and subarctic environments. Research has been done within the 4 of the 5 Nunatsiavut communities (Nain, Hopedale, Postville and Makkovik) at the moment and the results have been documented by the researcher. Preliminary results will be provided in writing or by verbal communication to inform interested persons—specifically to Nunatsiavut Inuit who are affected by this hunting ban. This research will explore whether best practice examples can be identified where wildlife management policies better reflect the needs of resource users.

Monitoring bat populations and tracking the spread of white-nose syndrome in Newfoundland

Jessica M. Humber[1]

[1]*Forestry and Wildlife Research Division, Department of Fisheries and Land Resources, Gov of NL, Corner Brook, NL*

Bats are critical components of Atlantic Canadian ecosystems and play important roles in control of insect pests. Since 2010-2011, bat populations throughout the Maritimes have been devastated by white-nose syndrome (WNS), caused by the fungal pathogen *Pseudogymnoascus destructans* (*Pd*). Until recently, populations in Newfoundland and Labrador have been WNS free, with the Atlantic Ocean likely offering some impediment to movement of the disease. However, in the spring of 2017, a single Little Brown Myotis (*Myotis lucifugus*) bat found on the landscape in southwest Newfoundland tested positive for WNS via quantitative polymerase chain reaction (qPCR) and histology. Additional confirmations of diseased bats found on the landscape in 2018 indicate the disease is now established and spreading in western Newfoundland. The Forestry and Wildlife Research Division has been actively monitoring bat populations throughout the province via a variety of methods including mark-recapture with silver alloy bands and passive integrated transponder (PIT) tags, maternal colony counts, hibernacula surveys, acoustic surveys, intergovernmental partnerships and citizen science. These efforts have helped establish baseline population/activity levels and habitat use in summer and winter and will inform estimates of bat population losses anticipated to occur. Difficulty in locating hibernacula sites poses some challenges to WNS surveillance efforts in insular Newfoundland and particularly in Labrador. However, swabbing of bats and environment for *Pd* detection in known hibernacula sites in winter combined with early spring *Pd* swabbing, guano testing and surveillance of swarming bats in fall continue to help track the movement of the disease in the province and its impact on imperiled bat populations.

Investigating the influence of forest-level characteristics on the activity of summer foraging bats in Gros Morne National Park, NL

Darrian P. Washinger[1] and Erin Fraser[2]

[1] *Boreal Ecosystems and Agricultural Sciences, Memorial University of Newfoundland (Grenfell Campus), Corner Brook, NL*
[2] *Environmental Science, Memorial University of Newfoundland (Grenfell Campus), Corner Brook, NL*

After the recent detection of white-nose syndrome on Newfoundland, it is essential to monitor local bat populations in both spatial and temporal contexts to guide conservation management. This study used acoustic monitoring techniques to investigate the influence of forest-level characteristics on the activity of summer foraging bats in Gros Morne National Park (GMNP), an area highly modified by hyperabundant moose populations. SM2BAT+ detectors were deployed between mid-June and mid-August of 2017 and 2018 in four forest stand types: mature conifer forests (MCF), mature mixed forests (MMF), regenerating forests (REGEN), and moose meadows (MM). In 2017, 36 sites were acoustically surveyed, with both vegetation measurements and insect sampling conducted at each site. In 2018, these sites were resampled with an additional 27 sites. Mean species-specific bat activity per night per site was determined using Sonobat and Kaleidoscope, two commercial acoustic software packages. In 2017, 1061 recordings were identified as bat calls; the majority comprised of the two resident species, *Myotis lucifugus* and *Myotis septrionalis*. Mean bat recordings per habitat was greatest in MM (61.7 ± 101.8) and least in MMF (14.8 ± 15.3). In 2018, there were 1070 bat recordings; mean bat recordings per habitat was greatest in MCF (26.6 ± 69.9) and least in REGEN (11.1 ± 15.5). Preliminary analysis showed no significant difference between habitat types or year. Consequently, future analyses will be used to compare mean bat activity per site to a suite of explanatory environmental variables to determine which factors most influence bat activity.

Eastern habitat joint venture – migrating for the future.

Tania Morais[1]

[1]*Environment and Climate Change Canada - Canadian Wildlife Service*

As part of the continental North American Waterfowl Management Plan (NAWMP), the Eastern Habitat Joint Venture is North America's largest joint venture, at nearly three million square kilometers it includes six provinces (Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland and Labrador). EHJV partners have been delivering wetland habitat conservation projects in Eastern Canada since 1989. Since its inception in 1989, over 500 million dollars has been invested into EHJV habitat projects to retain or restore 26 million hectares of wetlands and associated upland habitat. Over the 5 year duration of the 2015-2020 Implementation Plan, the goal is to retain and restore 71,266 hectares of wetland and associated upland habitat in addition to the management of 458,482 hectares of existing properties. Moving forward, the EHJV is moving towards an integrated and adaptive management framework to the conservation of habitats, species and ecosystems to help achieve biodiversity outcomes within the EHJV. Using *Open Standards for the Practice of Conservation* and existing decision support tools and, EHJV partners are working to identify priority habitats and nested species targets within the EHJV priority conservation areas to update conservation objectives for wetlands and waterfowl but also identify conservation objectives beyond wetlands and associated uplands habitats (and waterfowl).

Improving the detectability of hidden lichens on trees; a sample design to determine true absences of cryptic lichen.

Patrick Lauriault[1] and Yolanda Wiersma[1]

[1]*Department of Biology, Memorial University of Newfoundland, St. John's, NL.*

In our study we are helping define critical habitat of two lichen species: Boreal Felt Lichen (*Erioderma pedicellatum*) and Vole Ears Lichen (*E. mollissimum*). The sampling design consists of paired sites where one site is *Erioderma* positive (i.e., the species is confirmed present) and the other is negative (i.e., the species is presumed absent). To determine the amount of search effort needed to classify a sample site as truly negative, we developed a framework for estimating probability of detecting a true absence of rare and cryptic lichen species from a sample site. Identifying sites that are truly absent will help us better define critical habitat for endangered lichens. It can also provide insight into population dynamics that have been proven difficult to measure. In this study, we set up 50 sample sites with a tree in the center and a radius of 5 metres. Each site had different permutations of fake lichens in both abundance and distributions on the trees. The fake lichens were cut out of dark grey felt to represent Boreal Felt Lichen (*E. pedicellatum*). The initial time limit set for a site was 10 minutes. We realized, however, that we had to search the sites for 20 minutes to produce an acceptably low rate of false absences. Even though this sampling design was built for sessile organisms, there is potential for use with mobile wildlife in certain contexts, for example when looking at ideal habitat for breeding, sheltering or for stational evidence such as tracks or scat.

Macrolichen richness, diversity, and composition in boreal forested swamps, ecotones, and upland forests

Tegan Padgett[1] and Yolanda F. Wiersma[1]

[1]*Department of Biology, Memorial University of Newfoundland, St. John's, NL*

Open wetlands are well studied and are found to have higher biodiversity than non-wetland ecosystems making them key areas of conservation. Forested wetlands and their biodiversity, however, are understudied. Epiphytes, such as lichens, are an abundant feature in forested wetlands and could be used to compare species richness and diversity between forested swamps, swamp-upland ecotones, and upland forests. Here, we investigate the potential use of epiphytic macrolichens as a surveying tool in 15 study sites in the Avalon Forest Ecoregion, southeast Newfoundland. Within each study site we set up three parallel 40 m transects in the 1) forested swamp, 2) ecotone, and 3) upland forest. Along each transect, we selected five balsam fir (*Abies balsamea*) trees about 10 m apart. We surveyed each tree for macrolichens on the bole and measured diameter at breast height and tree height. At each transect, we selected two average sized trees to core for age and measured canopy cover at the transect centre. We found that macrolichen richness was highest in forested swamps (12.33±0.37), slightly lower at the ecotones (11.87±0.68), and lowest in upland forests (9.73±0.62). A similar pattern was detected for lichen diversity with forested swamps (2.23±0.03) being the highest, then ecotones (2.18±0.06), and lastly upland forests (2.03±0.08). Macrolichen community composition was less similar between forested swamps and upland forests, but the composition of ecotones overlapped with both. The results of this study suggest using lichens as a tool for measuring biodiversity and that forested wetlands are key areas of conservation.

Effect of clear-cutting created ecotones on macromoth assemblage

Jasmine Pinksen[1]

[1]*School of Science and the Environment, Memorial University of Newfoundland – Grenfell Campus, Corner Brook, NL*

Macromoths provide numerous important ecosystem services including pollination, herbivory and as food for many birds and mammals. Ecotones form the transition between contrasting habitats, and are important for biodiversity, often supporting distinct and higher species diversity than the adjacent habitats. To evaluate edge effects across clearcut-forest transitions in western Newfoundland, nocturnal macromoths were light-trapped within remaining forests, along forest edges, and within clearcuts, using traps hung at ~2.5 meters and containing two insecticide strips. We established four sites, where the clearcuts were all created within the past five years. At each site, we placed a light trap within the ecotone and 30 meters into the adjacent habitats (3 traps per site), for a total of 12 traps. We collected moths on three separate occasions, June, July, and August, for 3 nights during the new moon, for a total of 9 trap nights. We will identify all macromoths to the species level to test for edge effects on community structure (i.e., diversity, abundance, composition). We hypothesize that abundance will be highest in clear-cuts due to greatest visibility, and diversity will be highest at the edges due to the edge effects. This work is important in the context of sustainable forest management, but also for biodiversity in the region.

Summer in a winter wonderland: snowbed monitoring in Gros Morne National Park

Holly L. Lightfoot[1] and Darroch Whitaker[1]

[1]*Gros Morne National Park, Rock Harbour, NL*

Late snowbeds in Gros Morne National Park support plant communities similar in structure and species composition to tundra landscapes in the Arctic. These snowbeds are home to some of the most southerly populations of these species, which are able to persist because growing season, truncated by persistent snow cover, is too short to allow southern species to colonise. However, with changing climate, these snowbeds may form later or melt earlier, leading to an increase in growing season allowing southern species to move in. To monitor bioclimatic conditions data loggers set to record ground surface temperature were placed at 14 snowbeds in the Long Range Mountains, starting in 2008. Starting in 2012 percent cover of herb willow (*Salix herbacea*) was also measured using 1 m^2 quadrats along 15 m long transects; these data were used to calculate percent cover and occurrence. Regression analysis on snow cover data indicated that there was a significant increase in meltout date from 2008 to 2018 ($F_{1,136} = 12.58$, $p < 0.01$, adjusted r-squared <0.08) suggesting that snow cover has been melting later over the past 11 years. Herb willow data indicate that both percent cover and occurrence were within calculated baseline values suggesting that amount and distribution of herb willow at snowbeds have remained stable. These results suggest that environmental conditions necessary to allow Arctic plants to outcompete more southern species are persisting. Furthermore, these later dates do not currently appear to be affecting the persistence of herb willow. However, if snow continues to persist later in the season we may eventually see a decline in herb willow, a result not anticipated at the start of this project.

Investigating the effect of competition on the intraspecific variability of foliar elemental traits

Travis Heckford[1], Shawn J Leroux[1], Eric Vander Wal[1], Matteo Rizzuto[1], Juliana Balluffi-Fry[1], Isabella Richmond[1], and Yolanda F Wiersma[1]

[1]*Department of Biology, Memorial University of Newfoundland, St John's, NL*

In response to competition plants can exhibit intraspecific trait variability to stabilize niche differences with competitors and to strengthen their competitive ability to acquire resources of carbon, nitrogen, phosphorus. Moreover, these responses can vary geographically *i.e*., be dependent on regional environmental conditions. Here, we investigate the effect of competition on the intraspecific variability of foliar elemental traits (%C, %N, %P) of balsam fir (*Abies balsamea*) and white birch (*Betula papyrifera*). In addition, we explore how these competitive effects vary within and between two biogeographic regions. Using a multidimensional approach, namely, axes of carbon, nitrogen, and phosphorus, we constructed hypervolumes based on foliar elemental traits and measured the size (i.e., intraspecific variability), overlap, and nestedness of these hypervolumes. Our results expose two emergent responses which we describe as the following patterns. Pattern 1, two hypervolumes of similar size overlapping marginally. This suggests these groups operate within different elemental trait space. Pattern 2, a small hypervolume nested within a larger hypervolume. This indicates the smaller group exhibits less intraspecific trait variability and represents a fraction of the elemental traits displayed by the larger group. When balsam fir competes with white birch the response is pattern 1. As well, within biogeographic regions balsam fir exhibits a pattern 1 response to white birch competition. When white birch competes with balsam fir the response is a pattern 2 with intraspecific trait variability exhibiting a fourfold (24% to 93%) increase with competition. Within biogeographic regions, white birch exhibits a pattern 1 response in one region and a pattern 2 response in the other with intraspecific trait variability increasing from 0.3% to 67% when in competition with balsam fir. In all cases the elemental trait space of these species does not overlap between biogeographic regions.

Testing for scale-dependent quantity and quality selection strategies in moose using only elemental measures of forage

Juliana Balluffi-Fry[1], Shawn J. Leroux[1], Yolanda F. Wiersma[1], Travis R. Heckford[1], Matteo Rizzuto[1], Eric Vander Wal[1]

[1]*Department of Biology, Memorial University of Newfoundland, St. John's, NL. Canada.*

Foraging ecology often investigates the details of an herbivore's selection of forage quality (nutritional content and digestibility) and quantity (biomass), but the scale of observation likely influences findings on such selection patterns. To test this on a large, wide-ranging herbivore, we must first develop landscape-wide quantitative estimates of both forage quantity and quality. Here, we use stoichiometric distribution models (StDMs) to attain elemental measures of understory white birch quality (% nitrogen) and quantity (g carbon/m^2) across two landscapes in northern Newfoundland. With GPS collar data from 14 moose individuals, we analyze selection for quantity and quality at the landscape and home range extents using resource selection functions (RSFs), in addition, at the patch extent with integrated step selection analyses (iSSAs). We predicted that with a decreasing spatial extent of observation, selection coefficients for quantity and quality would decrease and increase respectively. Differing to our prediction, when comparing the β-coefficients from sample-wide models, selections for our estimates of quantity and quality are neutral with low explanatory power and no scalar trends. At the individual level, however, there appear to be quality and quantity tradeoffs, most notably at the home range scale where selection models are also the most explanatory (pseudo $R^2 < 0.18$). We gather that StDMs may be useful tools for foraging studies as our findings suggest consumers do respond to forage elemental compositions, but generalized inferences regarding selection for such measures cannot always be made at a given scale due to individual variation and trade-offs.

Day 2 – October 22nd, 2018

Modelling the influence of linear feature proximity on gray wolf (*Canis lupus*) habitat selection and movement

Katrien A. Kingdon[1], Christina M. Prokopenko[1], Daniel J. L. Dupont[1,2], Jonathan Wiens[3], Vanessa Harriman[2,4], Eric Vander Wal[1]

[1]*Department of Biology, Memorial University of Newfoundland, St. John's, NL*
[2]*Sustainable Development, Wildlife Branch, Lac du Bonnet, MB*
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Anthropogenic linear features represent one of the most significant human impacts on ecosystems. The effects of anthropogenic disturbance are often linked to alterations in wildlife behaviour and the response of predatory species has cascading effects across trophic levels. Wolves, an apex predator of the boreal forest, increase movement rates with linear features, but typically avoid areas of high anthropogenic activities. Further, wolf movement could promote higher predation rates on prey populations that frequent the same areas. This study builds one of two projects Manitoba, using GPS collars to track wolf movement in response to various anthropogenic and natural linear features. We applied integrated step selection analysis by comparing used to available steps (linear connections between consecutive GPS relocations) to simultaneously model movement and selection within a logistic regression framework. Preliminary results indicate wolves avoid linear features associated with high rates of human activity (e.g. primary roads) and select for features with reduced activity (e.g. tertiary roads and transmission lines). Additionally, they are more likely to select for low-use linear features when in dense habitat, which can restrict movement, indicating wolves may use these features to increase ease of travel. Behavioural responses of wolves to anthropogenic disturbances can have cascading effects on other wildlife populations, through changes in the outcomes of predator-prey interactions. Here, we aim to understand the greater impact of anthropogenic linear features on ecosystems through linking landscape change to movement and space use.

Is the picture worth a thousand animals? Individual differences drive space use in gregarious wildlife populations

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With rapid environmental change in the Anthropocene, projecting changes in animal population distributions through time and space has become a priority for conservation biologists. Such projections are commonly predicated on the notion that populations respond as units to changing habitat availability, but individual animals select habitat differently because of trade-offs among nutritional, security, and reproductive needs. Thus, to understand how external factors influence habitat selection in changing landscapes, we also need to consider the intrinsic qualities of the individuals making decisions. We used elk as a model system to compare the ability of population selection and individual selection to predict species distributions. Riding Mountain National Park in Manitoba is primarily forested insular habitat juxtaposed by surrounding agriculture, obligating habitat selection decisions along the park edge. We predicted that (1) individual elk inside and outside the park would exhibit opposite selection for seasonal normalized difference vegetation index (NDVI, proxy for habitat productivity) and distance to roads, and (2) that individual variation in selection would dissolve when the entire population was combined into a population model. Projected distributions changed when individual variation in habitat selection was considered. We suggest that future models should be based on individual selection to derive accurate projections of population distributions in changing landscapes.

Behavioural plasticity of caribou (*Rangifer tarandus*) migration in response to variable spring plant phenology

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Dealing with the consequences of a continually changing environment is one of the main challenges facing migratory animals. The green-wave hypothesis suggests that migratory herbivores such as caribou should time their migration such that they are able to exploit highly nutritious, newly emergent vegetation that matures along a latitudinal or elevational gradient. For this strategy to be successful, individuals should have evolved the capacity to adjust when they migrate as a function of the timing of spring plant growth along their migratory route. Climate change may be disrupting this ability if individuals are not adapted to migrating in earlier summers impacted by a warming climate. Working together with government, we tested whether caribou are able to adjust the timing of their migration to changes in the timing of spring "green-up", and whether this resulted in caribou being better able to select for areas with more nutritious vegetation. We found that caribou are highly plastic in the timing of their spring migration as a function of green-up date, and that this plasticity translated to better overall selection of nutritious vegetation. Furthermore, we found no evidence that climate change is directly affecting the ability of caribou to adjust their behaviour to optimally exploit spring resources. We conclude that caribou are plastic in their response to changing environmental conditions, providing cautious optimism that caribou have behavioural plasticity to cope with climate change.

An applied GIS model towards the strategic management of barriers to Atlantic salmon migration in the Restigouche River watershed: watershed-scale connectivity analysis

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Barriers to connectivity in stream networks for fish are often associated with culverts and beaver dams. In areas of intense forestry operations, roads and stream crossing are prevalent. Together, these activities create fragmentation of stream networks, and thereby, fragmentation of Atlantic salmon (*Salmo salar*) habitat. The objective of this research project is to develop a watershed-scale stream-road crossing analysis derived from locations using a GIS model and spatial analyses tools. This study, based in the Restigouche River watershed, New Brunswick. The models outlined within this study allows stream-road crossings to be located and analyzed to determine fish passability for Atlantic salmon based on the slopes of the crossings. Managers need cost-effective identification and prioritization tools for restoration efforts, most notably to increase access to productive upstream habitats and achieve conservation requirements. There was a 278% (1202) increase in total crossings detected using our models compared to public provisional data. The results of the model validation showed a strong correlation between actual field estimates and LiDAR DEM derived values for evaluating length and slopes of culverts. This framework provides a viable set of tools and methods to evaluate parameters that will determine fish passage.

A tool to assess the cumulative impact of barriers and climate change on salmonid populations in rivers

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In order to make better informed decisions on development or restoration activities manager/planners require a comprehensive understanding of the cumulative effects of agents of change (i.e, climate change, barrier placement) on riverine values (ecological connectivity, fish production, habitat quality). The development of an assessment methodology and structured decision making framework to aid conservation authorities assess the vulnerability of populations and habitats, and to guide efficient implementation of barrier removal or mitigation strategies is key. This paper discusses the development of one such tool. Such a framework will enable development of integrated adaptation strategies, plans, policies and actions over a variety of spatial and temporal scales. The approach is applied under two case studies, one for rivers across the island of Newfoundland and one for the Trent River system in the United Kingdom. Our project aims to develop a geodatabase of barrier parameters and related data useful towards spatial environment analyses in modelling and decision making. The toolkit shall assess cumulative ecological impacts of climate change and other interacting stressors (i.e., forestry, transport, other human activities) on fish (e.g. wild Atlantic salmon) population persistence and stock production in boreal forest watersheds. Together these will integrate and provide an assessment and decision making framework and analytical toolset to help in the planning and management of barriers. Ultimately the goal is to reduce individual and cumulative impacts of barriers to salmonids at the regional and watershed level to the greatest extent possible under limited available resources.

Introduced mink frog and green frog in Newfoundland: is pH a factor in spatial separation between species?

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Native frogs and toads are absent from the island portion of the province of Newfoundland and Labrador, likely because timing of rising post-glacial sea level change prevented reinvasion of amphibian species from southern refugia. Currently four introduced species inhabit the island: American Toad, Wood Frog, Green Frog and Mink Frog. Establishment and dispersal of the recently introduced Mink Frog (*Lithobates septentrionalis*) might be influenced in western Newfoundland by the presence of the ecologically similar Green Frog (*L. clamitans*). Surveys conducted in 2001, 2011 and 2014 have shown that Mink Frog and Green Frog are segregated spatially in western Newfoundland, with Green Frogs found mainly in acidic bog ponds (near Stephenville) and Mink Frogs found mainly in ponds with circumneutral pH (in the Corner Brook area). Might pH be a driver in the observed spatial segregation of the two species? Laboratory experiments were carried out to examine effects of different pH levels on survival of eggs and tadpoles of both species. Mink Frog eggs were obtained from a pond of mean pH 8.2 and Green Frog eggs from a pond of mean pH 4.2. Juvenile (egg and tadpole) stages are often the most susceptible to environmental factors such as pH. Results suggest that pH does not have a major effect on survival of Mink Frog tadpoles but were inconclusive with regards to Green Frog. Per cent survival from hatch of Mink Frog tadpoles ranged from 72-80% at high pH (~ 8.3) compared with 60-80% at low pH (~5.1) treatments.

Saw-whet owls in Newfoundland: the discovery of a new breeding population in Newfoundland's boreal forests

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Research on owls within Newfoundland Labrador is infrequent and insufficient. Many field guides show discrepancies in species occurrence on the island portion of Newfoundland. Previous studies have shown a higher presence in Boreal Owls when compared to Saw-Whet Owls, the latter virtually non-existent. Sightings of Saw-whet owls have been sporadic on the island of Newfoundland since the mid 1980's however in recent years sightings have increased dramatically. The accumulative efforts over three years across the province with nocturnal owls surveys conducted to pinpoint location of calling males and place nest boxes in prime breeding habitat has yielded three confirmed nesting sites in 2017 and another in 2018. Resulting juveniles were banded and measurements recorded by a provincial biologist. Surveys and box placement continue with the help of the Government of Newfoundland and Ducks Unlimited Canada in order to gain a better understanding of population size and distribution, the species range, preferred habitat and territory size.

Ruffed and spruce grouse as potential intermediaries in recent localized range expansion of pathogenic blacklegged ticks in New Brunswick

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Blacklegged ticks (*Ixodes scapularis*) are the primary vector of *Borrelia burgdorferi* which causes Lyme Disease. Pathogens such as *B. burgdorferi* are present in reservoirs, or wildlife species that can pass the pathogens to ticks. Annual blacklegged tick surveillance in NB yielded the discovery of breeding populations in seven counties, four of which were new since 2017 – this recent detection of range expansion will be described. Blacklegged tick specimens collected in NB are tested for several pathogens, including *B. burgdorferi* and *Anaplasma phagocytophilum*. We analyze these data using predictive modelling, which highlights significant ecological variables. However, range expansion of blacklegged ticks in NB is likely a function of more than these ecological variables. Migratory birds are a major long-range transporter of blacklegged ticks and are a significant factor in the tick's range expansion. Comparatively little is known about localized range expansion and alternative hosts. As such, we are examining the role of two non-migratory birds, Ruffed Grouse (*Bonasa umbellus*) and Spruce Grouse (*Falcipennis canadensis*), as potential hosts that influence local distribution of blacklegged ticks and the availability of tick-borne pathogens in NB. We are examining the rate of exposure to these pathogens in grouse, which we accomplish by testing for direct infection and for antigens in the hearts of harvested birds. We expect that our sampling will detect presence of pathogenic blacklegged ticks within and outside of endemic areas, as well as improve our understanding of their movement and localized range expansion.

Distribution of the red squirrel in western Newfoundland; present and future implications for gray-cheeked thrushes

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Red squirrels (*Tamiasciurus hudsonicus*) are a species of tree squirrel that have become widespread on the island of Newfoundland since their introduction in 1963. Tree squirrels often have large economic and ecological impacts, but there has been limited formal study of the distribution or ecological impact of red squirrels in Newfoundland since their introduction. While primarily granivorous, they are also opportunistic nest predators, leading us to investigate their role in the decline of the Gray-cheeked Thrush across Newfoundland. We surveyed squirrels and thrushes across a 250 km^2 landscape in the Long Range Mountains in June and July of 2016 and 2017 to begin filling these knowledge gaps. Squirrels were most abundant at low elevations, decreasing in occurrence up to ~500 m, above which they were not present. Using Akaike's information theoretic model selection on year, elevation, and a suite of habitat variables, we identified that elevation was a strong predictor of red squirrel occurrence in our study area, along with year, coniferous scrub, water, and 30-70 year-old mixed stands of balsam fir/black spruce. In contrast, thrushes were not found in low elevation areas, suggesting that the elevational distribution of red squirrels restricts the once ubiquitous Gray-cheeked Thrush to high elevation squirrel-free habitats. Assessment of habitat availability in upper elevations, and the presence of krummholz ("tuckamore") at the treeline indicate that squirrels are unlikely to expand further upslope, hopefully leaving mountain tops as a refuge for species adversely affected by this successful invader.

The value of an integrative approach to wolf (*Canis lupus*) management

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Wolves are apex predators in large mammalian terrestrial systems, providing stability to their ecosystems across diverse contexts. However, they often experience direct and indirect human pressures, sometimes resulting in extirpation. Two ongoing sister projects in Manitoba (MB) investigate the role wolves play in geographically distinct environments experiencing parallel pressures. Riding Mountain National Park is an insular protected landscape in southwestern MB, which supports abundant and diverse prey populations. However, it is surrounded by human development and subject to a large-scale disease management program beginning in the 1990s that corresponded with a dramatic reduction in the primary prey, elk. Conversely, a provincial management unit in eastern MB has experienced extensive resource extraction, including forestry and hydroelectric transmission line development, leading to a network of linear features throughout the region. This system is primarily moose dominated but has experienced a significant population decline, prompting a hunting closure in 2010. Wolves in both areas are supported by multiple prey types, demonstrating prey switching over different spatio-temporal scales, and experience incessant mortality risks, including those that are human induced. Further, humans introducing environmental change, like linear features, can alter ecological stability by influencing movement and selection behaviour within predator-prey systems. By comparing and contrasting our observations in these two areas we can elucidate commonalities in the ecology of wolf-multiprey systems. These general ecological patterns can be applied elsewhere, particularly in multi-prey systems and human modified landscapes. Wolf-ungulate systems represent one of the most important trophic cascades in the boreal food web, thus any alterations have implications for ecosystem functioning and socioeconomic security.

Nature Conservancy of Canada's Science Support Program

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Formed in 1962, the Nature Conservancy of Canada (NCC) is the nation's leading private land conservation organization. Guided by the best-available science, NCC uses comprehensive conservation planning to inform securement efforts, and adaptive management for the ongoing stewardship of our nature reserves. These planning processes evaluate biodiversity targets and threats, and identify priority actions and knowledge gaps. As a not-for-profit organization, NCC has a limited capacity with which to address research needs and fully explore the scientific potential of our properties and datasets. Partnering with universities and academic researchers, however, helps to answer real-world, and often urgent, conservation questions. NCC's Science Support Program: 1) facilitates collaboration to produce better conservation science, 2) ensures the applicability of findings to on-the-ground conservation efforts, and 3) expands the potential of limited resources to produce valuable conservation results. NCC is looking for academic collaborators who are interested in exploring partnership projects to address conservation research questions in ecology and related fields, including social sciences and human dimensions.