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Sarcoptic mange in Prince Edward Island canids

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Sarcoptic mange, caused by the parasitic skin mite Sarcoptes scabiei, is an emerging disease of red foxes (Vulpes vulpes) and eastern coyotes (Canis latrans) in Prince Edward Island (PEI). The disease is associated with intense itching, alopecia, crusting, secondary infections, and in severe cases, emaciation and death. The first laboratory-confirmed case of sarcoptic mange in free-ranging PEI foxes was in late 2016, through a diagnostic submission to the Canadian Wildlife Health Cooperative (CWHC). From 2016 to 2018, it was the most frequently-diagnosed cause of death in PEI foxes, during the height of the mange outbreak. However, diagnostic submissions to our laboratory are typically biased toward urban / suburban areas. Until 2018, the distribution of the mite and disease in rural / wilderness areas were unknown. Since this time, we have determined the spatiotemporal distribution of the mite and disease, monitored the spread over time, characterized the disease, and established ongoing protocols to identify potential risk factors. This was completed through necropsy examination and tissue sampling on 58 foxes obtained from fur trappers from locations across PEI in the 2018-19 trapping season, and 46 foxes from the 2020-2021 trapping season. Ongoing submissions to CWHC from the years 2019-2021were also evaluated. We determined that foxes throughout PEI have mites present, but that initial occurrence of disease was more likely in urban / suburban areas due to high fox population densities. Demographic data, health status, and concurrent helminth parasitism were also documented.

Keywords: canids, parasitology, disease transmission, emerging disease

The effects of Btk (*Bacillus thuringiensis* var. *kurstaki*) application on diets of eastern North American wood-warblers

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In eastern North America the spruce budworm (SBW) is an exceptionally important prey item for several species of neotropical migrants, particularly some species of wood-warblers. Spruce budworm populations are characterized by periodic outbreaks every 30-40 years which cause significant defoliation in eastern forests. Consequently, biological control agents such as *Bacillus thuringiensis* var. kurstaki (Btk) are often applied to large areas to supress and/or reduce outbreak severity by directly reducing SBW populations by ~ 95%. Treatments often coincide with the breeding period for most temperate-breeding birds, when the effects of reducing prey availability would be most adverse. The reduction of prey availability prompted by Btk applications may indirectly affect bird species by causing a shift in diet. These effects may be most evident in wood-warblers that are significant predators of SBW larvae in eastern North America, particularly the bay-breasted warbler (*Setophaga castanea*), Cape May warbler (*S. tigrina*), and Tennessee warbler (*Leiothlypis peregrina*). Stable isotope analysis will allow us to determine whether a trophic shift occurs in these species following Btk applications. We will show early results from this research that will help us to understand how Btk applications impact warblers that significantly rely on SBW larvae as the main component of their diet, as well as better inform management decisions.
Keywords: ornithology, diet, Btk, stable isotope analysis, warbler, spruce budworm

The influence of light pollution on the behaviour and ecology of coastal crustaceans

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Sandy beach ecosystems have seen a significant increase in artificial light pollution in recent years. Light from boardwalks, wharfs, and streetlights can affect the natural day/night cycle of coastal organisms. Nocturnal organisms are especially susceptible to the increase of light at night due to the dependence on darkness for preventing predation and desiccation while feeding. Hence, the aim of this study was to evaluate the effect of artificial light pollution at night (ALAN) on sandy beach amphipods in a natural system with little light pollution at night, Prince Edward Island's north shore. Animals were surveyed using biweekly sampling to determine species number and population composition. To analyze the effect of light pollution animals were kept in two alternated environmental chambers which replicated natural conditions for one week. One chamber served as a control and the other as an experimental setting. The experimental group was exposed to 100 lux lights during the night whereas the control group was left in darkness. Amphipod activity was recorded using actographs and infrared light beams to detect movement. The results of the survey sampling showed Americorchestia longicornis to be the most abundant species and was therefore used as a model species. For the light pollution study the experimental group showed a marked decrease and disruption in locomotor activity when compared with the control during the night hours. The data also showed a further reduction of activity in colder conditions. These results suggest that ALAN has a detrimental effect on amphipod survivability in light pollution-affected areas.
Keywords: Light pollution, crustaceans, behaviour disruption, sandy beaches

A present-day connectivity analysis of native New Brunswick forest-dependent vertebrates.

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Connectivity planning addresses habitat loss and fragmentation associated with development and has the potential to enhance species resiliency to climate change. Due to its size and amount of extant forest, the interior of New Brunswick is a critical connection point within the Acadian Forest region and various connectivity programmes, such as the 2 Countries 1 Forest Initiative, have identified it as such. The Nature Conservancy of Canada (NCC) has conducted several wildlife corridor identification analyses in New Brunswick, such as in the Chignecto Isthmus and "Three Borders" region of the province; however, wildlife corridor models have not been developed for the interior of New Brunswick. My primary objective was to determine where prominent hotspots for vertebrate connectivity likely occur, based on least-cost path analysis and a tiled Circuitscape analysis of the province using habitat suitability index values of vertebrate species that reflect different vagility. I assess the present-day habitat connectivity of 29 forest-dependent vertebrates that represent one or more of, (i) indicator species, (ii) climate susceptible species, (iii) large mammals, (iv) game species, (v) small or medium mammals, or (vi) species listed under the Species at Risk Act (SARA). This method identified connectivity pinch points, which represent the best remaining habitat where wildlife movement is funnelled, and if lost, could significantly reduce species movement now and into the future. By mapping connectivity across the forest of New Brunswick, the long-term goal is to inform landscape and resource management decision-making in the province, as well as provide guidance to future land conservation initiatives.

Keywords: Connectivity, forest species, mapping, least-cost paths, Circuitscape.

Using science to inform species at risk management: predicting the effect of forest harvest on Wood turtle habitat suitability

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Sustainable forest management includes protecting species-at-risk such as the endangered Wood Turtle (Glyptemys insculpta). The Wood Turtle is a challenging species for forest management because females often travel 500+ meters perpendicular to rivers into forested habitats. Forestry occurs in approximately 40% of the Wood Turtles Canadian range making it a widespread threat to the species, however the magnitude of the threat is unknown. Our research objective is to determine the effects of commercial forest harvest on Wood Turtle habitat suitability to better **delineate critical habitat. We outfitted 20 female Wood Turtles with VHF transmitters and GPS loggers and are tracking them from 2019-**2021 to collect multi-year fine resolution Wood Turtle spatial data. We will then combine this occurrence data with environmental predictor variables collected both on-site and via remote sensing (LiDAR) in a resource selection function to quantitatively inform a habitat suitability model. We will then apply our habitat suitability model to chronosequence forest harvest blocks aged 1, 5, 10, 15, and 25 years, and late successional forests, to predict the effects of forest harvest on Wood Turtle habitat suitability. We have collected a total of 7,341 active season spatial points from the GPS loggers between June 2019 and

September 2020. Preliminary results will be presented as the research is still on-going. This study will provide important data to better delineate critical habitat which has range-wide implications for Wood Turtle conservation.

Keywords: Wood Turtle, Species-at-Risk Management, Forest Management, Policy

The coastal breeding habitat of bank swallows in Prince Edward Island National Park: determining habitat use in relation to availability

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Bank swallows (Riparia, riparia), a species of aerial insectivore occurring in eastern Canada, declined by 98% between 1970 and 2011 prompting its listing as a threatened species by COSEWIC in 2013. Its decline is hypothesized to be due in part to habitat loss or alteration. Hence, this study aimed to identify the existence of critical habitat along 47.43 kms of coastal habitat in Prince Edward Island National Park by examining the bank swallow's use of three different breeding habitats; dunes, till, or sandstone cliffs. A chi-squared goodness-of-fit test revealed that, contrary to the expectations of a null hypothesis, the habitats were not used in proportion to their availability. Among the three habitats examined, sandstone contributed the most to the chi-squared value and was used significantly more than it would be if used in proportion to its availability along PEI National Park's coastal habitat. These results suggest that selection for breeding habitat is driven by characteristics readily associated with the sandstone habitat, and additional attention and protection should be given to sandstone cliffs. Further studies should attempt to identify such characteristics and test whether similar selection trends are present in historical records.

Keywords: Bank Swallow, critical habitat, dunes, till, sandstone

Identifying key roost sites and their connectivity for swallows

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The causes for population decline in many species of aerial insectivore remain hypothetical and are likely to be multi-faceted. I seek to explore one of those facets, roost ecology, to fill in key knowledge gaps about two species of aerial insectivore experiencing significant population declines: Barn Swallow (Hirundo rustica), and Bank Swallow (Riparia riparia). I will use automated radio telemetry to gather movement data during the breeding and post-breeding seasons to identify key roost sites for these species in New Brunswick, Canada. Roost sites act as important refugia and refueling sites for these communally roosting species, but little is known about movement between roosts. I plan to analyze movement data using graph-theory based social network analysis to 1) identify roost sites within the study area and 2) determine which roost sites within the networks would have the greatest impact on the network connectivity if lost.

Keywords: ornithology, aerial insectivores, roost ecology, wetlands

“Awakening the sleeping giant”: re-Indigenization principles for transforming biodiversity conservation

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Precipitous declines in biodiversity threaten planetary boundaries, requiring transformative changes to conservation. Colonial systems have decimated species and ecosystems and dispossessed Indigenous Peoples of their rights, territories, and livelihoods. Despite these challenges, Indigenous governed lands retain a large proportion of biodiversity-rich landscapes. Indigenous Peoples have stewarded the land in ways that support people and nature in respectful relationship. Biodiversity conservation and resurgence of Indigenous autonomies are mutually compatible aims. To work towards these aims requires significant transformation in conservation and re-Indigenization. Key to both are systems that value people and nature in all their diversity and relationships. This paper introduces Indigenous principles for re-Indigenizing conservation: (i) embracing Indigenous worldviews of ecologies and *M'sit No'kmaq*, (ii) learning from Indigenous languages of the land, (iii) Natural laws and *Netukulimk*, (iv) correct relationships, (v) total reflection and truth, (vi) *Etuaptmumk*—“two-eyed seeing,” and “strong like two people”, and (vii) “story-telling/story-listening”. Although the principles derive primarily from a Mi’kmaw worldview, many are common to diverse Indigenous ways of knowing. Achieving the massive effort required for biodiversity conservation in Canada will entail transformations in worldviews and ways of thinking and bold, proactive actions, not solely as means but as ongoing imperatives.

1. The abstract has been previously published in FACETS. DOI: 10.1139/facets-2020-0083
2. We have chosen *M'sit No'kmaq*—"all my relations”—as lead author to follow cultural teachings to speak for collective intellectual rights.
3. Consistent with Mi’kmaw language, wherein there is no stronger intonation to first person, shalan chooses to not capitalize her name.
4. Dalhousie University is located in *Mi'kma'ki*, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Keywords: Indigenous resurgence, Indigenous-led conservation, Indigenous protected and conserved areas

Eels and Two-eyed Seeing

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We detail how we look at Kataq, (American eel) using Etuaptmumk (Two-Eyed Seeing). Using the strengths in the Indigenous ways of Knowing, using Western ways of seeing to complement each other and gain a broader understanding of the species, their habitat and their decline in population while applying Cultural significance to the species. Abegweit Conservation Society uses the Two-Eyed Seeing

approach when applying knowledge to subjects, using our Traditional teachings from Elders and Knowledge Keepers as well as the knowledge gained through data analysis and research. Acknowledging that the subjects have a Spirit within them, holding the values of being a part of the environment we are working in and using the values of sustainability and stewardship engrained within Indigenous Knowledge to look at the past, present and future of conservation.

Keywords: Kataq, Etuaptmuk, Two-Eyed Seeing, traditional knowledge, data, research

Combatting Kindness: Please Do Not Feed Wild Red Foxes

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The current relationship of humans and Red Foxes in urban areas of Prince Edward Island has raised concern with Nature PEI, the City of Summerside, the City of Charlottetown, Canadian Wildlife Health Cooperative and the Provincial Forest Fish and Wildlife Division after a mange outbreak in 2016 resulted in high fox mortality in urban areas. With significant feeding of Red Foxes in Charlottetown, home ranges were small and considerable mortality from mange was observed. The main reason people feed the Red Fox is because they believe the animal is unable to find enough natural food in urban areas. By encouraging behaviour change through social media, newsletters, brochures, and signage in areas of high traffic, the goal is to make residents and concerned citizens more aware of the red fox's ability to find food, and the impacts of feeding urban animals. This encouraged individuals to stop feeding foxes, as well as offering them the opportunity to educate others on the impacts. This could help restore Red Foxes to their wild ways and reduce fox and human interactions. Media messages are presented.

Keywords: urban Red Fox, interactions with people, wildlife health, behaviour change, social media

Scuds from mud: Do the environmental DNA quantities from four estuarine Gammarus spp. amphipods match abundance patterns from physical collection methods?

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Estuaries are at the interface between river and ocean forces, forming water salinity gradients. At the same time, estuaries are productive habitats with immense anthropogenic pressures, making perturbation

detection a challenge. Gammarus spp. are vital components of estuarine food webs and common indicators of habitat stressors, but practical monitoring methods that capture species turnover and indicators of abundance are lacking. The objectives of this study are to describe spatial occupancy of euryhaline G. tigrinus, G. mucronatus, G. lawrencianus, and G. oceanicus in Prince Edward Island estuaries; and compare population indicators between collection methods from artificial substrates, macrophyte raking, light-baited traps, and species-specific quantitative PCR (qPCR) assays from sediment derived environmental DNA (eDNA). Sampling occurred in three stations positioned relative to salinity within three eutrophic estuaries. Amphipods from physical collections were identified and enumerated, whereas qPCR amplifications generated eDNA copy number quantities. Species proportions indicate G. mucronatus is predominant in upper and mid estuary stations, G. lawrencianus evenly occurs across zones, G. oceanicus are predominant in more saline stations, and G. tigrinus occur in upper stations. Species abundance indicators generally correlate between physical collection methods, except for G. oceanicus on artificial substrates. eDNA quantities did not correlate with station-level abundances; however, there is weak correspondence between high copy numbers per species and the highest observed count within individual estuaries for G. mucronatus and G. oceanicus. Estuary-specific eDNA patterns for the other two species will be discussed to highlight monitoring utility between estuaries and overall limitations from DNA transport.

Keywords: Invertebrate sampling, brackish water, ecological monitoring, ecotone, crustaceans

The development of a habitat and biodiversity assessment tool to support species at risk stewardship on agricultural lands in Nova Scotia

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There is a complex relationship between biodiversity and agricultural land use; while agricultural lands can play an important role in providing wildlife habitat, agricultural expansion and intensification are also recognized drivers of habitat and biodiversity loss. In Canada, agriculture has been identified as one of three priority sectors requiring attention in order to achieve species at risk conservation outcomes across country.

In order to address this priority sector, the Canadian Forage and Grassland Association is presently leading a national-scale project to develop province specific, online habitat and biodiversity management tools, with Nova Scotia being one of three provinces participating in the first phase of the project. In Nova Scotia, challenges to biodiversity stewardship on agricultural lands include a lack of biodiversity content in the existing Environmental Farm Plan program and other extensions services, and barriers to accessing site level information about habitats and corresponding beneficial management practices (BMPs).

The Habitat and Biodiversity Assessment Tool has shown promise as a cost-effective means of helping producers become more aware of the BMPs they can undertake, or may already be undertaking, in order to support the stewardship of species at risk and their habitats on the lands they manage. The tool uses an eight-step framework to provide a simple, confidential report that prioritizes BMPs for multiple species at risk, tailored to the ecological context of an individual land parcel of interest.

Keywords: agriculture, species at risk, agricultural stewardship, beneficial management practices

Monitoring the occupancy of spruce budworm-linked warblers in response to budworm insecticides

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The "Early Intervention Strategy" in New Brunswick sprays the biocide Bacillus thuringiensis kurstaki (Btk) in forest blocks with rising but low Spruce Budworm (SBW) densities. SBW larval densities are monitored in the blocks before and after Btk application so that larval densities can be described. When SBW larvae numbers are at pre-outbreak levels, predation by SBW-linked warblers (Tennessee, Bay-breasted, and Cape May Warblers) may moderately reduce the extent of defoliation once the outbreak inevitably occurs. We monitored the presence/absence of SBW-linked warblers over two summers (2020 and 2021) during the pre and post spray time periods using autonomous recording units and avian point counts. Preliminary statistical analyses of the 2020 field season dataset showed that Cape May warblers tended to alter their occupancy based on time of the season, but not necessarily because of Btk application. Bay-breasted warblers do not leave because of either time period or Btk application. The second field season dataset will be analyzed in the upcoming months. This study should discover whether areas not sprayed with Btk (SBW insecticide) act as a reservoir for SBW-linked warblers to find food sources. Also, with the results of this research, forest managers will better understand SBW-linked warblers and have a better knowledge of the need, amount and size of an area that does or does not require Btk treatment.

Keywords: Spruce budworm-linked warblers, spruce budworm, numerical response, Btk, insecticide, ornithology

Brook trout and DDT: a connection between aquatic food-webs and legacy contaminants

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Legacy contaminants, such as organochlorine pesticides, can persist in the aquatic environment for a prolonged period of time with adverse effects to exposed biota. DDTs are persistent legacy contaminants that impact the environment through bioaccumulation, biomagnification, and chronic toxic effects in wildlife. DDT was applied aerially on large scales to the conifer forests in north-central New Brunswick, Canada between ~1950 and ~1970. Presently, DDT concentrations in New Brunswick lake surface sediments can exceed probable effect levels by ~16 times. To investigate whether the observed concentrations could lead to effects on present day organisms, we sampled five impact lakes in the sprayed north-central region, and two reference lakes in the unsprayed southern region in the summers of 2020 and 2021. We collected brook trout, aquatic invertebrates from gut contents and benthic sampling of the littoral and profundal zones, zooplankton, and surface sediments. Preliminary results show that concentrations of DDT breakdown products, DDE and DDD, are up to ~14 times higher in brook trout from impact lakes compared to brook trout from reference lakes. Ongoing efforts are focused on the use of carbon and nitrogen stable isotopes to assess and contrast food web structures among lakes and further our understanding of legacy DDT impacts on these ecosystems. Future GIS mapping will investigate the scope of historic DDT applications on a provincial scale in relation to New Brunswick lakes.

Keywords: contaminants, organochlorine pesticides, DDT, toxic effects, lakes, fish, invertebrates

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Levels of predation at two Leach's Storm Petrel Hydrobates leucorhous breeding colonies

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Seabirds are declining worldwide, and predation is one threat that affects many of them. Leach's Storm Petrel Hydrobates leucorhous (hereafter LHSP) populations are declining in a number of locations for reasons that are likely multicausal, and perhaps local or regional, but relative contributions of individual causes are poorly understood. To help understand causes, we quantified predation at two Nova Scotian LHSP breeding colonies that differ in predator management: no management occurs on Bon Portage (BP) Island, whereas management is used on Country Island (CI). Transects were monitored for evidence of predation approximately biweekly on BP and CI in 2018 and 2019, during May–October on BP and May–July on CI. Evidence such as LHSP carcasses, feather piles, dug up nest burrows, and gull and owl pellets was removed or destroyed during each visit. Predation of eggs and nestlings was scarcely detected. Similarly, adult predation on CI was seldom detected. We estimated that 4000 individuals were depredated on BP in each year of this study. Approximately 42% of predation events were ascribed to gulls and 10% to owls; 48% of remains could not confidently be ascribed to a particular predator. We do not know how general these rates will be because of differences among colonies in predator communities. In any case, LHSP are listed as "Vulnerable" globally, and although up to a 5% annual loss of adults may be sustainable for a healthy population, such losses may exacerbate population declines if other factors are additive.

Keywords: breeding colony, Hydrobates leucorhous, Leach's Storm Petrel, predation, predator management, seabird

A 27-year study of causes of mortality in Northern Gannets (Morus bassanus).

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Between 1990 and 2017, carcasses of 314 Northern Gannets (Morus bassanus) (33 hatch-year, 39 immature, 238 adult, four of undetermined age) were submitted from the three Maritime provinces for diagnostic investigation to the Atlantic regional centre of the Canadian Wildlife Health Cooperative, Atlantic Veterinary College, UPEI. The predominant causes of mortality identified (88 [28%]) were human-related (fisheries). There were roughly equal proportions of trauma of unknown cause, emaciation and undetermined cause of death (61 [19.5%], 59 [19%], and 56 [18%], respectively). Some cases of trauma of unknown cause may have been human-related or from strife with conspecifics; others may have been caused by the birds hitting the bottom of the water column. Some undetermined causes of death may have been human-related (e.g., drowning in fishing nets). Two causes of mortality stood out among the remaining 50 cases: infection of the brain and/or skeletal muscles by the protozoan Sarcocystis, presumably originating on wintering grounds (18 cases [6%]), and ischemic leg necrosis (gangrene), predominating in hatch-year birds (13 cases [4%]). While imperfect, surveys of causes of mortality among carcasses of wild animals found opportunistically in the field provide a valuable window into the life history of these animals.

Keywords: Northern Gannet, mortality, fisheries, drowning, emaciation, Sarcosystis, ischemic leg necrosis

Culvert assessment for fish passage at CFB Gagetown

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In the Range Training Area (RTA) of the 5th Canadian Division Support Base Gagetown (5 CDSB) there are a total of 1212 in-stream culverts to be maintained for our many watercourse crossings. Of these culverts, 258 were identified as perched, or hung in-stream culverts. This project is to determine if these perched culverts are a significant barrier to fish passage and habitat use. The assessment consists of determining fish presence or absence in the watercourse, the fish species present, and if there is suitable habitat upstream. The presentation will include the methodology, challenges faced, and results of the project. This project will be used to help prioritize culvert replacement and influence the type of culvert used in future construction.

Keywords: in-stream culverts, fish passage, barriers, culvert type

Do protected areas enhance the biodiversity value of forested wetlands relative to those in working landscapes?

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Nova Scotia is a leader in protected areas designation in Canada, with nearly 13% of the landscape already legally protected. However, only limited effort has been made to evaluate whether areas that have been protected are effective in conserving biodiversity relative to similar sites in the working landscape. To begin addressing part of this question, we surveyed birds using automated recording units in 24 forested wetlands (wooded bogs, treed swamps, and shrub swamps) inside and outside of Cloud Lake Wilderness Protected Area (CLWA) in western Nova Scotia during the breeding season in 2018 and 2019. This study reinforced the idea that forested wetlands are biodiversity hotspots with 79 bird species detected overall, including several at-risk species. Although bird abundance was similar at sites inside and outside of CLWA, species richness and diversity were significantly higher in sites outside CLWA. This difference was driven by the significantly higher abundance of early successional species that were detected at "outside" sites. Bird communities from different wetland types inside CLWA were significantly more distinct than those outside and species of conservation concern were more strongly associated with bogs and treed swamps inside CLWA. Two key guilds of conservation concern (long-distance migrants and insectivores) were also significantly more prevalent at sites within CLWA. Our results suggest important roles for forested wetlands both inside and outside of protected areas – sites inside CLWA providing high quality habitat for species of conservation concern and sites in the working landscape providing important refugia for a high diversity of birds.

Keywords: forested wetlands, protected areas, working landscape, bird communities

Winter habitat use of moose in Cape Breton, Nova Scotia

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ABSTRACT: Aerial survey data collected between 2001 and 2020 were used to assess moose (Alces alces) winter habitat use in the Greater Highland Ecosystem of Cape Breton, Nova Scotia. These data were analyzed using generalized additive mixed models. Moose favoured areas comprised of greater proportions of coniferous forest with moose showing a preference for younger forests. This was also true for areas with higher percentages of conifer forest experiencing abnormal forest succession due to high moose herbivory (moose meadow). Moose were more likely to be found farther away from roads. This suggests that moose prefer areas with younger plant forage and low human access.

Keywords: aerial survey, Alces alces, GIS, habitat use, roads

Big Tides-New Strategies: Adjusting Habitat Management to Sea Level Rise

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Ducks Unlimited Canada and its conservation partners in Atlantic Canada have been managing and acquiring wetland habitat in coastal areas since the mid 1960's. Projects in the 1960's to 1980's involved converting diked agricultural areas to freshwater marshes and in some cases converting salt marshes to freshwater marsh. This management was planned to compensate for the loss of breeding habitat for American black ducks and to conserve wetlands through the use of conservation agreements as wetlands including coastal wetlands were not protected by regulation. With predicted sea level rise ranging from 30 centimetres to 250 centimetres by 2100, new management strategies are required to ensure that wetlands remain functional in coastal areas. These strategies include awareness and education, science, monitoring, acquiring uplands adjacent to salt marshes, acquiring poor quality diked agriculture areas and removing dikes to restore salt marshes. While there are numerous ecological benefits to restoring tidal wetlands, public opinion is diverse and not always supportive.

Keywords: coastal wetlands, conversion diked land, sea level rise, new strategies, functional wetlands

An introduction to the Nova Scotia Invasive Species Council and behaviour change programs to prevent the anthropogenic spread of invasive species

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The Nova Scotia Invasive Species Council (NSISC) aims to raise awareness and promote a coordinated response to the threat of invasive species in Nova Scotia. The NSISC is a recognized provincial chapter of the Canadian Council on Invasive Species (CCIS). We take a broad approach to encourage Nova Scotians to change their behaviour in a way that helps prevent the introduction and reduce the spread of invasive

species. Some of the ways by which we achieve this include developing outreach resources to promote public education, conducting research on various topics surrounding invasive species, promoting citizen science and the reporting and mapping of invasive species to better understand their distribution and spread, and developing resources for the identification, mapping, and management of invasive species. Our behaviour change programs address many of the anthropogenic pathways by which invasive species spread. These programs encourage naturalists to get outside and enjoy nature while protecting our natural resources by encouraging boaters and anglers to clean, drain, and dry their boats and equipment before moving into a new waterbody, directing naturalists to brush off hiking gear to ensure that there are no seeds, spores, or plants stuck to equipment or clothing, promoting the sale and planting of native plants, and much more.

Key words: invasive species, anthropogenic spread, behaviour change programs, outreach

Interaction of American Marten and Fisher on Cape Breton Island, Nova Scotia: Implications for Marten Recovery.

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*presenter

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Historically, American Marten (*Martes americana*) occurred throughout much of the forested areas of Nova Scotia including Cape Breton Island (CBI). The CBI population of American Marten was listed as endangered under the *Nova Scotia Endangered Species Act* in 2001 when surveys indicated less than 50 individuals remained on CBI. There was no evidence of breeding and there had been extensive loss of suitable habitat from timber salvage operations following a widespread spruce budworm infestation. A marten augmentation plan was developed in 2006 and between 2007 and 2011, 140 Marten (85M, 55F) from northern New Brunswick were released at ten sites on CBI by the province. Mesocarnivore surveys have been ongoing since 2005 and have included snow-track surveys on snowmobile (1030 km), and on foot (244 km), 274 baited motion-triggered trail camera sites, and records of incidental sightings. Data from all surveys have been compiled in ArcMaps to compare habitat use for Marten and their major competitor, the Fisher (*Pekania pennanti*). The first Fisher sighting since its extirpation from CBI 50 to 80 years ago occurred in February 2002, raising concerns of potential competition on CBI affecting the recovery of Marten. The analysis of all available data sources resulted in 275 and 131 occurrences for Marten and Fisher respectively. Most of the records for Marten (85%) and Fisher (91%), was collected from the 274 baited camera trap sites. Marten and Fisher were recorded at 31% and 17% of camera sites respectively, with both species recorded at only 7% of all sites. While the two species are sympatric over CBI at elevations from less than 100 m to over 400 m, acute competition is moderated by segregation of habitat by elevation. Fisher have a higher occurrence at elevations below 100 m, whilst Marten are more likely to occur at elevations above 300 m. Separation may also be temporal, as it is possible that Fisher range is still expanding, which could threaten Marten recovery in future. Further research is needed to assess the potential for Fisher success at higher elevations considering abiotic factors, including snow characteristics (depth, density), and how these may be altered by changes in forest management and climate change.

Keywords: competition, reintroduction, augmentation, snow depth, mesopredators

River Otter Returns to PEI

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River otters were extirpated from Prince Edward Island in the early 1900's due to habitat loss and over-exploitation. Aside from isolated and sporadic occurrences in coastal waters, only anecdotal reports of tracks or sightings of the species had been documented until an adult male otter was captured in a beaver trap in early 2017. Since then, eight additional individuals have been collected opportunistically or as beaver trapping by-catch, including an adult female and a young of the year. Camera traps have also revealed the continued presence of a group of otters in western Queens County. The growing body of evidence strongly suggests a small, re-establishing resident river otter population on Prince Edward Island.

Keywords: River Otter, beaver trap, camera traps, resident population

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Fish habitat restoration and enhancement in the Fales River sub-watershed

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While threats to fish populations are numerous and diverse, degradation of freshwater habitats remains a significant contributor to the observed decline of aquatic species. Much of this habitat loss has been attributed to modifications of the physical environment by human land-uses. In the early 1990's, the Clean Annapolis River Project surveyed several tributaries to the Annapolis River, and in 2012 developed a list of seven priority sub-watersheds ideal for future fish habitat restoration work focused on the conservation of native fish populations, especially Atlantic salmon. As a historically known Atlantic salmon river, the Fales River was identified as a priority sub-watershed based on historical water quality monitoring, past restoration activities, and observations and experiences of local community members. The Fales River is affected by human alteration and land-use changes within the sub-watershed and as a result, ideal in-stream fish habitat is lost through channel modification, sedimentation and alterations to water quality. Since 2018, remediation actions to address these threats include the removal of the fine sediments from the stream to reveal the natural cobble and gravel substrate. Through the process of SandWanding, 12.3 tonnes of fine sediment was removed from over 400 meters of the river. The Fales River has also received the installation of 5 in-stream structures, resulting in over 5000 m2 of restored habitat. The installation of in-stream structures aid in redirecting excess sand and silt while supporting natural stream processes, thus enhancing the aquatic habitat for various species including, but not limited to Atlantic salmon and brook trout.

Keywords: fish habitat, restoration, freshwater, salmonids

Coyote (Canis latrans) demography during sustained harvest: tests for and a review of reproductive compensation

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Abstract: Targeted removal of problem wildlife may fail to measurably reduce populations because of compensation via enhanced reproduction, reduced mortality, reduced emigration, and/or enhanced immigration. Following a human fatality attributed to coyotes (Canis latrans) in Nova Scotia, Canada in 2009, the provincial government implemented an incentive program to reduce coyote populations; sustained harvest continued through 2018. Critics argued that reproductive compensation would outpace harvest; we tested this by quantifying placental scars over time as a measure of reproductive output. Placental scars per female remained essentially constant over time. In contrast to scar number, the proportion of females that bred declined significantly over time. Reproductive compensation is entrenched in the literature, but formal tests for it are frequently not undertaken. A literature review on terrestrial carnivores found that only 9 of 32 tests provided evidence of reproductive compensation. Significant problems with many tests are small sample sizes and open populations in which immigration likely overwhelms even sustained harvests so that there is no selection for reproductive compensation. Our study had the advantage of large sample sizes (1647 females) and a population with limited immigration because of an inhospitable isthmus that joins Nova Scotia to mainland North America. Our results suggest either limited proximate control of reproductive output in coyotes (and other terrestrial carnivores), or insufficient harvest that did not reduce populations. We conclude that reproductive compensation is not as common as is frequently assumed.

Keywords: competition, density dependence, placental scars, reproductive output

Species at risk stewardship in agro-ecosystems within the Kespukwitk Priority Place

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Within the Kespukwitk (Southwest Nova Scotia) Priority Place, agro-ecosystems have been identified as one of eleven conservation targets being used to guide collaborative species at risk (SAR) conservation and recovery efforts. Species at risk conservation can be sensitive topic for private landowners and mangers on working lands such as farms. Based on the experience of Clean Annapolis River Project (CARP), and many other conservation organizations, relationship-building is a key element to successful program delivery, with strategies requiring incremental steps to allow for trust to be built over time. Species at risk surveys are often used as a first step to identify prospective farms to target for stewardship projects. In additional to filling data gaps about SAR presence, surveys also offer a low-risk opportunity for new landowners to engage with CARP staff. In the case that properties with SAR or SAR habitat are identified, landowners may then be approached for the development of an Agricultural Biodiversity Conservation (ABC) plan, a comprehensive document that outlines how they are currently supporting biodiversity and recommendations for improvement.
When possible, CARP's desired next step is the provision of additional support to implement recommendations identified in the ABC plan; this support could include financial compensation, labour, or access to technical expertise. Planning is currently underway to expand these implementation efforts in the 2022-2023 field season through funding targeted at the Kespukwitk Priority Place.

Keywords: agro-ecosystems, species at risk stewardship, agricultural stewardship

The biology of the invasive alien plant Celastrus orbiculatus Thunb in Canada.

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Celastrus orbiculatus Thunb. is an invasive alien liana native to northern regions of Japan, Korea, China, and Russia. Since its intentional North American introduction in the 1870s, it is now found across eastern Canada and the United States. Through an extensive adventitious root system and twining growth habit, C. orbiculatus smothers and girdles surrounding vegetation, drastically altering the environment and ecosystem processes. C. orbiculatus continues to be distributed as an ornamental. In addition, birds and small mammals consume its prolific fruit and facilitate novel introductions. C. orbiculatus is susceptible to glyphosate and triclopyr. Once established, however, management intensity is compounded by its extensive root system and continual resprouting and root-suckering. The climatic requirements across eastern Canada, ease of dispersal, and rapid growth suggest that C. orbiculatus will continue to spread across its introduced range.

Keywords: invasive, alien, liana, ornamental, rapid growth

Investigating alternative roosting and hibernation structures of at-risk bats in Kespukwitk

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Aside caves and mines, bridges, culverts and other similar structures are known to be used by bats as roosting and hibernating structures in North America. Hibernating bats are experiencing serious declines due to the disease White Nose Syndrome (WNS). Identification and study of alternative roosting structures are of conservation value in order to protect any persisting or surviving individuals. In mainland Nova Scotia, Canada, the main known hibernation sites are caves and mines located in Hants County with relatively few sites identified across the landscape, one being a concrete hydro dam outflow tunnel.

The Mersey Tobeatic Research Institute (MTRI) initiated the first wide-scale assessment of alternative structures in Kespukwitk (southwest Nova Scotia). We mapped known overpasses, large bridges, tunnels and other potential structures identifying over 200 sites. To date, we have conducted rapid assessments of 80+ structures in 2021 identifying ~15 sites as potential for bat use (12) including possible evidence of use (3). Further assessments will be conducted and a subset of sites will continue to be monitored for use by bats in 2022. Our results will be used to understand the importance of alternative structures to bats and the potential for these to provide essential habitat substitutes.

Keywords: bat, bridges, hibernation, little brown myotis

It takes a community to find an ecosystem – locating the Annapolis Valley Sand Barrens

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It has been estimated that up to 97% of the original extent of the Annapolis Valley Sand Barrens (a.k.a. Broom Crowberry Sand Barrens) have been lost to various forms of human land-use. Home to species of conservation concern such as the Canada Rockrose (Helianthemum canadense) and Pine Barrens Goldenheather (Hudsonia ericoides), the Annapolis Valley Sand Barrens are largely understudied. Even the modern-day extent of sand barrens in the Annapolis Valley is not well mapped. Because of this, the Clean Annapolis River Project (CARP) and its partners launched an iNaturalist project named 'The Annapolis Valley Sand Barrens'. This project collects observations of key indicator species of this ecosystem in southwest Nova Scotia. Through this on-going citizen science project, 234 observations of seven key indicator species have been collected to-date. This data has been used to help produce a 'predictive map' of the Annapolis Valley Sand Barrens, giving us a better understanding than ever of key areas to focus on for conservation efforts. Other work being done by CARP and its partners for the Annapolis Valley Sand Barrens includes land-use change analyses, developing an Annapolis Valley Sand Barrens guide, building publicly accessible sand barrens demonstration gardens, as well as various other forms of community outreach including promotion of native landscaping, guided walking tours, and school field trips.

Keywords: sand barrens, heathland, disturbance, succession, citizen science

Arboreal lichens and bryophytes of old growth forest canopies in Nova Scotia: implications for sampling bias

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Lichen and bryophyte diversity is highest in old growth rainforests, which occupy only a fraction of their former extent. Old growth forests will likely continue to decline, particularly those at risk of infestation from pests such as hemlock woolly adelgid. Arboreal lichen surveys have traditionally focused on the lower bole of host trees; this likely causes underestimation of biodiversity that could mislead forest managers. We tested how arboreal macrolichen and bryophyte communities differ between the canopy and lower boles of 27 old growth Eastern hemlock trees at 9 sites across Nova Scotia. Each tree was surveyed using visual percent-cover estimates at the base and in the lower canopy. Single rope ascension was used to access the lower canopy with minimal impact on epiphyte communities or tree cambium health. Habitat properties were also recorded, including bark pH, tree girth and height, and canopy cover. Preliminary results showed higher pH, and a greater diversity and abundance of macrolichens in the canopy, whereas bryophyte abundance and species richness were both greater on the lower bole of host trees. Geographic location in the province (southwest, central, or Cape Breton) impacted macrolichen but not bryophyte cover. These results suggest that when research focuses only on those species within reach of the ground, macrolichen biodiversity is underestimated, as is the conservation value of forests.

Keywords: biodiversity, epiphytic, macrolichens, moss

The First Year of the New Nova Scotia Herpetology Atlas: A Community Science Success

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Reptiles and amphibians are declining globally, and lack of knowledge of their distribution, population trends and local threats can hamper recovery efforts. In 2021 the Mersey Tobeatic Research Institute launched the new Herpetology Atlas, a community-science project to track the distributions and populations of amphibian and reptile species in Nova Scotia. Building on the initial Atlas in 2003 we have utilized iNaturalist and social media to collect nearly 4,000 observations of 22 species across the province, including five species at risk and one invasive species. Our project doubled the number of observations for these species from the previous year's iNaturalist records and we reached an audience of over 80,000 people through our campaigns. Our project comes during the COVID-19 pandemic when ecologists face additional challenges and it highlights the importance of community lead science for ecological research. We will continue building the Herp Atlas with targeted surveys based on community data to improve our monitoring while developing public knowledge of and connections to the province's ecosystems.

Keywords: community science, amphibians, reptiles, species at risk, data collection

Community Science Helping to Protect the Coastal Islands of Nova Scotia

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During the COVID-19 pandemic lockdowns, the Mersey Tobeatic Research Institute and Université Sainte-Anne were able to continue research involving at risk species and coastal islands, one of the priority ecosystems for conservation in Kespukwitk. These islands provide a number of benefits to humans such as recreation opportunities and acting as storm-barriers but they also benefit numerous rare species like as the Endangered Roseate Tern and Eastern Mountain Avens. These islands, and the species on them, are threatened by the local inflated populations of gulls which continue to benefit from nearby feeding opportunities on fish waste. During the COVID lockdowns, we created a volunteer-friendly protocol and recruited a volunteer team of people who lived in different parts of our study area. With the help of this team, we examined potential feeding sites for gull activity at nearly 20 sites in southwestern Nova Scotia and conducted over 500 surveys during an 11 week period. Using this data, we can now identify the feeding sites with the highest likelihood of feeding gulls and the feeding sites with the highest number of nearby gulls. Community involvement will continue to be a critical component of this project as we now work to reduce gull access at feeding sites and to continue monitoring efforts.

Keywords: community science, coastal islands, species at risk, data collection