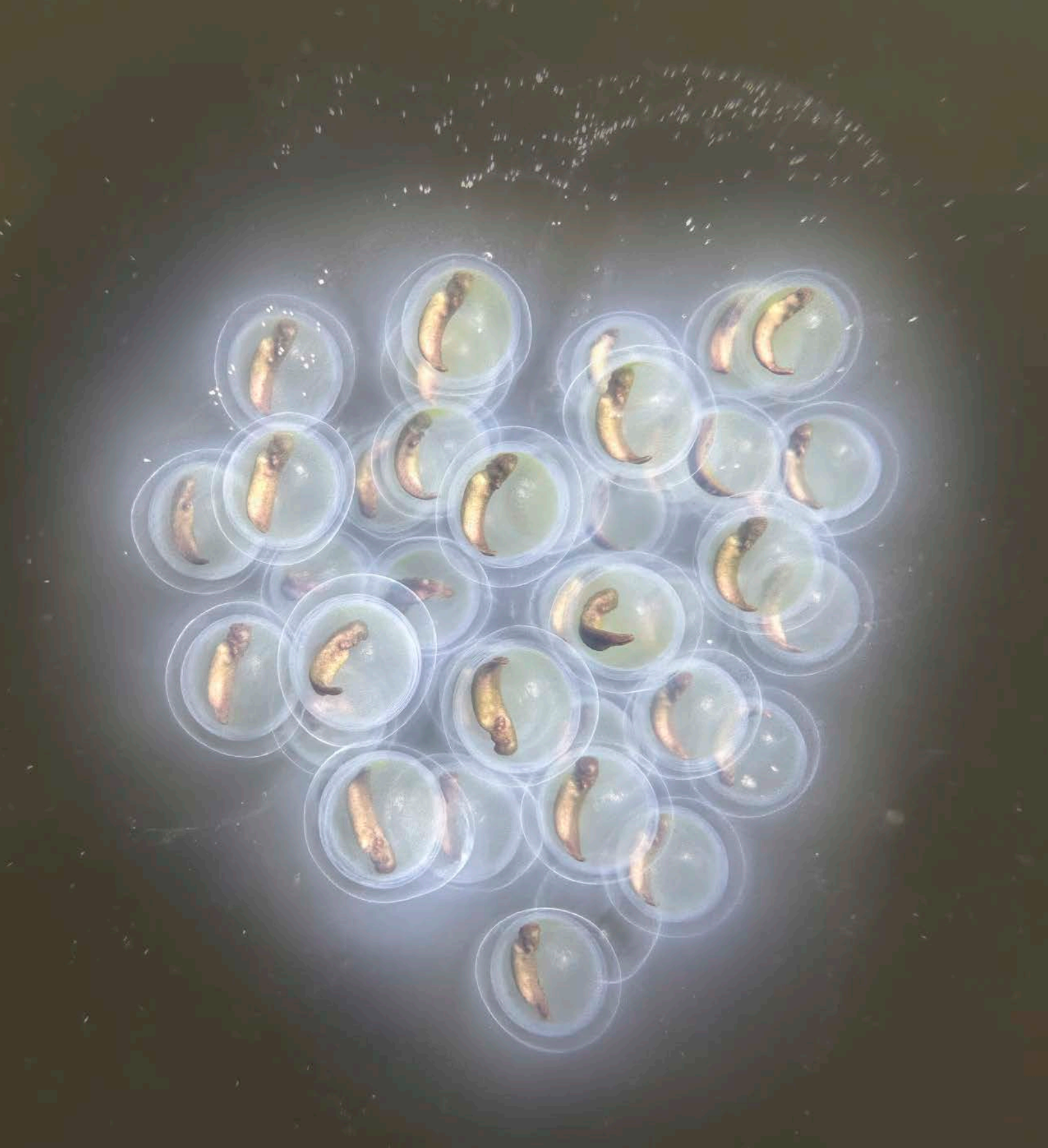

ALGONQUIN WILDLIFE RESEARCH STATION

2023

RESEARCH REPORT

Photo: Samantha Stephens

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ALGONQUIN WILDLIFE RESEARCH STATION

COVER IMAGE BY JUSTICE KING

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A MESSAGE FROM THE CHAIR OF THE BOARD OF DIRECTORS

Greetings friends of the Algonquin Wildlife Research Station!

I am very excited to share the 2023 AWRS Research Report. It is easy to be inspired by the experiences and new findings shared by our research community in this 16th annual report. In the following pages are updates from the familiar long-term studies as well as a few new surprises. There is a lot to celebrate from 2023: the return of many students to the woods and waters of Algonquin in pursuit of knowledge, reinvigorated field course activities, and the first full year of charitable status for the AWRS.

The AWRS has been the training grounds for thousands of students since its inception in 1944. We regularly hear from alumni, spread far and wide, who attribute their fondest memories, lifelong friendships, and/or the launch of their career to a summer at the Station. The power of this place to bring people together is truly astounding. The camaraderie and immersive learning environment are what make biological field stations so special. Our facilities and location provide exceptional opportunities for studies in ecology and the environmental sciences. Are you starting a research project, expanding your research program, or planning a field course or workshop? Contact us to discuss how the Station can support your science and educational initiatives.

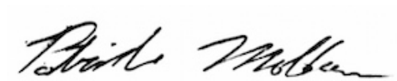
The many successes of 2023 would not be possible without the dedicated staff team at the AWRS. The AWRS Board of Directors again extends sincere thanks to Kevin Kemmish, Station Manager. Kevin's detailed and diverse working knowledge of the Station gives him the flexibility to confirm bookings and work on budget projections in the morning, then turn to snowplowing and plumbing in the afternoon. Returning staff Farqd Barghash and Amanda Semenuk operated the kitchen seamlessly and made sure that no one went hungry at the end of a long field day. Drayke Evans, Assistant Manager, was dedicated to all facets of the job and even found time to pursue a newfound love of birdwatching. Samantha Stephens has continued to elevate communications for the Station and has produced yet another beautifully illustrated research report. A big thank you to Kevin and all staff members for being the heart and soul of the Station!

Likewise, the many successes of 2023 would not be possible without our partnerships. Ontario Parks was a steadfast supporter of operations and our long-term ecological studies. In collaboration with the Friends of Algonquin Park, Meet the Researcher Day was a terrific opportunity to showcase the importance of ecological monitoring and research in parks. A special mention to our friends at Loop Paint who provided free recycled paint and stain products for the upkeep of essential infrastructure. Finally, thank you to our extended family of users with whom we shared research ideas, laughs, volleyball games after dinner, and the beauty of Algonquin Provincial Park.

This year we are planning to host our Annual General Meeting in person at the Station on June 7th. Information will follow for our users and partners. I truly look forward to connecting and sharing lunch with the group at the Cookhouse after the meeting! Also, stay tuned to AWRS newsletters for updates about our 80th anniversary celebrations (13th–15th September, 2024). If you would like to subscribe to our newsletter, you can sign up on our website at the top of the home page.

Supporting the Station has never been easier. Our charity profile on CanadaHelps securely processes donations and issues tax-deductible receipts. Please consider monthly giving as a means of providing sustained support. Wishing you a safe and enjoyable year ahead.

See you at Lake Sasajewun,



Dr. Patrick Moldowan
AWRS Interim Board Chair

We pay our respects to the traditional stewards of the land on which the AWRS exists and of Algonquin Park in its whole. The Station and much of Algonquin Park are located within unceded Algonquin territory. Algonquin Park as a whole also contains territory of the Anishinaabeg, specifically the Chippewa, Ojibwa and Nippissing, and lands under the Robinson-Huron Treaty of 1850 and the Williams Treaties of 1923. This land has also been used by Métis and other Indigenous people as it includes major travel routes on its rivers and waterways. We are always open to learning and discussion.

OUR MISSION

TO INSPIRE

Environmental stewardship, a community of collaboration, and a connection with nature through educational workshops, public events and social media.

TO EDUCATE

Scientists, the public, and policy makers by facilitating peer-reviewed publications, producing research reports, and hosting field courses and workshops.

TO CONSERVE

Biodiversity, ecological integrity, and a culture of field-based learning by providing facilities and logistical support for research projects, with an emphasis on long-term ecological studies.

SUPPORT THE STATION'S MISSION

You can make a one-time donation or sign up to be a monthly supporter on our CanadaHelps profile. Your support helps us maintain and improve our infrastructure, grow our staff team, and create educational content and programs.

FROM THE MANAGER'S DESK

I am excited to present the 2023 Algonquin Wildlife Research Station's annual Research Report. The 2023 season was a lively one—we served as the base camp for eleven field courses, research teams working on the ongoing long-term monitoring projects on turtles, salamanders, and small mammals, and those working on novel projects on gastropods, minnows, habitat restoration and archaeology. In total, we hosted over 300 researchers, students, filmmakers, and other professionals.

Although there is much to celebrate, this year the Station is also grieving the loss of Dr. Ron Brooks. Dr. Brooks was the academic advisor and dear friend to many alumni of the Station. He played an integral role in the long-term turtle and small mammal monitoring projects, as well as ensuring the longevity of the AWRS throughout multiple organizational transitions. He was a champion for experiential learning and wildlife conservation. His valuable contributions to the Board of Directors, his insights and his humor will be missed.

I would like to recognize those that provided support to the Station and its users throughout 2023. Thank you to Ontario Parks, MECP, Canada Summer Jobs, The Friends of Algonquin Park, Wild Ontario, Loop Paint and NOHFC. Thank you to our monthly donors on Patreon and CanadaHelps. Thank you to the AWRS volunteer Board of Directors who dedicated their time and expertise to guide the Station throughout the past year. This year that guidance was especially appreciated as the Station navigated the transition from a non-profit organization to a charitable organization.

The successes of this past year would not have been possible without our small but mighty staff team. The Station is a bustling place with groups coming and going, conducting all forms of field work and expeditions, and living here as a community. It takes a special team of people to be up for the monumental task of ensuring everything is running smoothly and our users are accommodated. Drayke Evans has been essential in his role as Assistant Manager as he ensures our facilities are operating day-to-day, and that all users feel welcomed. Farqd Barghash and Amanda Semenuk, our Head and Assistant Cooks, accomplished no small feat each and every day of the season by making sure everyone was well fed. Samantha Stephens continued her work as our Communications Manager highlighting the work of the Station and its users and ensuring that AWRS outputs are of an exceptional quality—including this report!

As I read through the contributions to this report, I'm inspired not only by the current scope of the research and experiential learning taking place here, but for our potential to grow as an organization. In 2023, the Algonquin Wildlife Research Station reached 79 years functioning as a hub of research, education, and community within Algonquin Provincial Park. Our path forward as a charitable organization with a focus on research, education and outreach will allow for the Station to expand activities through new partnerships and funding opportunities. Throughout the report you will find links to specific donation funds each aimed at directly supporting specific long-term projects and education. You can make a one-time donation to these funds, or sign-up to become a monthly donor. All donations are now eligible for a tax-deductible receipt.

Lastly, I would like to recognize all the researchers, field course students and other users that brought a joy of learning and a passion for discovery to the Station—you make this place what it is. A special thank you to those who took the time to contribute to this report. Your enthusiasm for the work that you do is contagious, and we are proud to share your work through this report.

Enjoy your read,

Kevin Kemmish

Kevin Kemmish
Station Manager

Spike-lip Crater (*Appalachina sayana*) found near Smoke Lake in September 2022. Photo by Annegret Nicolai.

DR. RONALD J. BROOKS (1942–2023), IN MEMORIAM

RON AND THE AWRS, TOGETHER THROUGH LIFE

Written by Patrick Moldowan

On December 18th, 2023, the AWRS lost its most fervent devotee, Dr. Ronald J. Brooks. Ron dedicated tremendous effort, time, and goodwill to advancing the main pillars that the Station stands on: discovery, student training, and solid science. His sense of wonder for the natural world, wicked sense of humour, pragmatic pessimism, and 'turtle recall' will be greatly missed.

As aptly stated in Ron's obituary, he had a love affair with Algonquin Provincial Park. Ron's involvement with the "wildlife station" (his words) was incremental at first, then became a way of life. He first visited Algonquin Provincial Park sometime in his youth (before 1960) with his parents. By all accounts, the trip was uneventful. He wrote, "*my parents took us through on Highway 60 in August and we saw . . . no bears, wolves or even deer. Just lots of cars trundling along . . . I was unimpressed.*" By 1960, at age 19, Ron's first visit to the AWRS was during a September weekend with four friends, among them Fred Gilbert, who had a job the summer prior trapping American Marten at the Wildlife Research Station. Ron wrote of his first impressions, "*we arrived at the WRS in the dark quite late and tired . . . At this point in our lives, we Toronto boys, except Fred, had no experience in a place as wild as Algonquin. When we walked down a forest path to our cabins, I felt an unforgettable thrill from the smell of fallen leaves, coniferous trees, and mold.*" The objective of the weekend was to live trap marten, but most of the weekend devolved into shenanigans amongst the group of young friends.

"Fred had told us to go up the Chit Lake Trail, a trail of modest clarity, through underbrush and forbiddingly dark conifers blocking out any starlight . . . We had no compass, but if we had, none of us knew how to use one. I was the only one who even had been a Cub Scout, and I was kicked out for insubordination before I could make Scouts or even a reef knot. Nevertheless, we managed to navigate the half mile or so to the start of the trail, which was beside the Wolf Cabin, so named because the wolf biologists used it in their ground-breaking studies of wild wolves that lived far too close by. I can still recall us stumbling about trying to locate good places to set the traps while knowing virtually nothing about Pine Martens. None of us wanted to get too far from the cabin in case of attack by its namesake. We were all fascinated to learn that martens, murderous little weasels, liked jam. After 30 or so minutes of really pathetic stumbling around we headed back to our own cabins and went to bed satisfied by a full day's work . . . The next day dawned, again cool and partly cloudy and after a completely forgettable breakfast we marched . . . to see how many martens we had caught. We were quite surprised to see in daylight how close the traps were to each other and to the Wolf Cabin. Fred was not just surprised, he was furious. He seemed to think we had not placed them on the trail, but more or less on the parking area next to the cabin. I had to admit, it looked much more benign in daylight."

Nonetheless, this less-than-successful start to field research planted a seed that would grow to become the start of a career … and this was not the last time that a weasel had an oversized influence on Ron's career and ties to Algonquin Park. In 1963, Ron completed his undergraduate degree at the University of Toronto and returned to the Station to begin a masters research project on song structure and individual song variation of White-throated Sparrows under the supervision of renowned ornithologist Dr. J. Bruce Falls. Keeping with Ron's study of song, it was during this time that he "*discovered Bob Dylan and his songs became my mantra for Algonquin.*" After his masters, Ron took a brief hiatus from Algonquin Park as he studied lemmings in Churchill, Manitoba, through a doctoral program at the University of Illinois Urbana-Champaign. By 1969, he was hired as an Assistant Professor at the University of Guelph and tasked with assembling a research program. In 1975, Ron returned to Algonquin Park with Martyn Obbard, his first graduate student. A study of Southern Bog Lemmings abruptly shifted to Snapping Turtles after low trapping success of lemmings and a twist of fate at the university that involved a Tayra, a South American weasel, getting loose and eating the few lemmings in the captive colony. Biologists Don Loncke and Martyn Obbard had been affixing numbered tags to turtles on the Lake Sasajewun dam for a few years prior, and so the transition to turtles was seamless. In the years that followed, Ron would come to focus his research at the AWRS:

"*In 1981, . . . (I) went up to the Park for the (turtle) nesting season. It was the first time since 1965 that I had spent more than a weekend or so at a time there, and it was fantastic. The nesting turtles were numerous, the work endless, the telemetry and trapping exciting, sweaty and the holes in our waders kept our feet cool. I decided that I was forever finished with lemmings and Churchill after that summer and that I would 'refocus' my research on the mighty snapper. At some point I decided to use the old Fortran data sheets to record basic information on each turtle and the number of lines at one line per year meant that the study would end in 1995. That was so far away, I never thought that year would come or that many of our turtles from 1972 would still be alive then.*"

And alive they are, even today! Throughout 1981–2008, Ron oversaw the study of turtles, played a leading role in the study of small mammals, and supervised students working with amphibians and invertebrates—and that's just in Algonquin Park. Following retirement in 2006, he continued to supervise students and remained engaged with the long-term research projects. It is difficult to say what Ron would have counted as his major research highlights from his years devoted to Algonquin Park, but his co-discovery of the ever-fascinating Antler Fly and freeze tolerance of hatchling Painted Turtles might rank highly. There is no questioning that his research on turtle life history has been instrumental in informing the status and conservation of turtles globally. Ron was a prolific writer and alongside his students published 102 research papers (and counting) related to studies at the AWRS. In addition to directly introducing hundreds of students to field biology through his research program and field course teaching, Ron directly supervised 26 graduate projects (23 MSc, 3 PhD) and several dozen undergraduate theses based on research conducted at the AWRS.

Ron was a long-serving Director and Chair of the AWRS User Committee (18 years, 1983–2001), most notably during the time that the Station transitioned from a government-run facility to an organization with shared operational responsibilities among academic user groups. His ongoing service as a member of the AWRS Board of Directors (14 years, 2009–2023) provided historical perspective to guide current and future decision-making.

Telling the turtles that Ron is gone will be a sad task for field season 2024. His memory and spirit will live on at the wildlife station as we blast Bob Dylan from the speakers, sit down to a glass of red wine after a long day in the field, and dive into lively debate and thoughtful scientific discussion. ♦

Photo: Doug Armstrong

AN UPDATE ON THE LONG-TERM TURTLE PROJECT

Written by Robin Lloyd

This year we saw another successful field season of monitoring turtles in Algonquin Provincial Park. Annual monitoring includes mark-recapture of individual turtles from previous years, as well as collecting data on nests, such as nest location, number of eggs laid, and size of eggs. This year marked the 51st year of the continuation of the Snapping Turtle study and the 33rd consecutive year for monitoring the Midland Painted Turtle population at the Arowhon ponds. This field work was executed by a team of turtle researchers from the University of Toronto led by Robin Lloyd and supervised by Dr. Njal Rollinson. In total, we captured 366 turtles throughout Algonquin Provincial Park. This included 341 Midland Painted Turtles, 24 Snapping Turtles, and one Blanding's Turtle—which turned out to be NEW to the study and not previously observed at the Arowhon Ponds! In addition, our team continued with the method of PIT tagging all Painted Turtles we captured this year to allow for a more efficient process of identifying turtles in future years of study. During the nesting season, we observed the first Painted Turtle nest on June 2nd and continued to observe turtle nests throughout the month of June until the first week of July. We collected data on nearly 150 nests belonging to Painted and Snapping Turtles. The vast amount of data collected from this study allows us to follow population demographics, growth patterns, life histories, and much more, giving insight into the mysterious world of the turtles of Canada's temperate forests and wetlands.

> "THIS SEASON MARKED THE ESTABLISHMENT AND FIRST YEAR OF A NEW PROJECT MONITORING THE MOVEMENT ECOLOGY OF SNAPPING TURTLES IN CANOE LAKE AND TEA LAKE. . ."

NEW SNAPPING TURTLE SPATIAL ECOLOGY PROJECT

This season marked the establishment and first year of a new project monitoring the movement ecology of Snapping Turtles in Canoe Lake and Tea Lake using acoustic transmitters. In July of 2023, the team, led by Robin Lloyd and Matthew Keevil, set out to trap 16 Snapping Turtles between Canoe Lake and Tea Lake, both large open lake systems, to attach transmitters on the lower back portion of the shell of each turtle. Each transmitter was approximately three centimetres in length and weighed a minimal 10 grams. They are designed to fall off after two to three years of collecting a wealth of location, temperature, and water depth data. In total, we successfully attached 15 of the 16 transmitters to turtles between the two lake systems. The goal of this project is to use data provided from the transmitters in real time to follow the movement behaviour of these animals, which is currently relatively unknown. The turtle team is grateful to the park for their support of this project and their enthusiasm for outfitting turtles with transmitters. In the coming years, it will be very exciting to see how turtles move across these lakes and use depth and habitat types to thermoregulate in their underwater environment.

STUDENT INDEPENDENT RESEARCH

Alongside the long-term monitoring study, our team also worked on four independent research projects based on the turtles of Algonquin Provincial Park. Robin Lloyd, a PhD student at the University of Toronto, worked on his thesis investigating how turtle sex determination is influenced by environmental conditions via stressful factors in the environment. In Robin's study, he collected turtle eggs to incubate at differing incubation regimes to investigate how the sex ratio of hatchlings was impacted by each incubation environment. The goal of this research is to provide insights on how and why turtles may have evolved temperature dependent sex determination, a form of sex determination where

Photo: Robin Lloyd

the environmental temperature is the dominant factor in producing male or female offspring. Additionally, our work included three undergraduate research projects from students enrolled in the Research Excursions Program (REP) at the University of Toronto. Jack Gadoury, a second-year undergraduate student, investigated the relationship between sex and carapace scute deformities in the Midland Painted Turtle, testing a theory that predicts deformities should be greater in female turtles than in male turtles. Emile Watanabe, a second-year undergraduate student, investigated adult Snapping Turtle vocalizations and communication, exploring how male size and the perceived presence of other turtles influences vocalization frequency and type. Wynn Murakami-Clisham, a second-year undergraduate student, explored the relationship between Midland Painted Turtle nest depth, temperature, and limb length to test whether females lay deeper nests under warmer nesting conditions. These independent research projects will fill gaps in our current understanding and provide insights in the field of evolutionary ecology.

Three graduate students defended their theses in 2023, each of which was focused in whole or in part on long-term data collection from the ongoing turtle project. Congratulations to Matthew Keevil who defended his PhD in April (Laurentian University, supervised by Dr. Jacqueline Litzgus), Jessica Leivesely who also defended her PhD in April (University of Toronto, supervised by Dr. Njal Rollinson), and Claudia Lacroix who defended her MSc in September (University of Toronto, co-supervised by Dr. Njal Rollinson & Dr. Christina Davy). ♦

ACKNOWLEDGEMENTS

Thank you to Wynn Murakami-Clisham and Emile Watanabe for their work throughout the entirety of the field season. Thank you to Celina Yang for her assistance with fieldwork in May along with an extended stay in June to help with the nesting season. Thank you to students Dylan Kaufman, Jack Gadoury, and Justice King for their assistance with data collection and mark-recapture surveys during May. Thank you to Matthew Keevil for assisting with the logistics and methods for the Snapping Turtle spatial ecology project. Field technicians, Noah Stein and Rylan Vincent, assisted with Snapping Turtle fieldwork throughout July. Thank you to cameramen, Jonathon Qu and Kevin Li, for filming the turtle team for a possible documentary series. Thank you to the many volunteers from field courses, AWRS staff and Station visitors that were welcome company on several mark-recapture surveys during May, the nesting season surveys in June, and assistance with checking Snapping Turtle traps in July. Lastly, thank you to Kevin Kemmish, Amanda Semenuk, Farqd Barghash, and Drayke Evans for hosting us and keeping spirits alive throughout the long field season.

Photo: Emile Watanabe

DO PAINTED TURTLES DIG DEEPER NESTS IN WARMER TEMPERATURES?

Written by Wynn Murakami-Clisham

The feminization of turtle populations has become an increasingly pressing issue in the wake of climate change. This is because in some species of turtles sex is determined by the incubation temperatures they experience in the nest. For the Midland Painted Turtle, a nest will produce predominantly female offspring at temperatures above roughly 29°C, and predominantly male offspring at temperatures below 27°C. Incubation temperature also plays a major role in turtle embryonic development and survival. For turtles, warming temperatures are expected to lead to more female-skewed populations and poorer quality offspring. But, is it possible that female turtles will alter their nesting behaviour in response to rising temperatures? One hypothesis is that they will dig deeper, subsequently cooler, nests on warmer days to yield a more balanced sex ratio in their offspring. To investigate this hypothesis, I studied the nesting behaviour of Algonquin Midland Painted Turtles.

Over the span of the nesting season, I measured the depths of 72 nests to see whether females were digging deeper nests on warmer days. To measure temperature, I set up temperature data loggers in the soil, air and water of Wolf Howl Pond and left them there for the season. Since the turtle team was already out in the field every day recording nesting events and collecting eggs as part of the long-term study, I only had to take the extra step of measuring the depths of the nests. In this way, my study was supported by the ongoing long-term project. In addition to nest depth and temperature, I measured the hind leg length of nesting females and found that females with longer hind legs generally dug deeper nests than those with shorter hind legs.

When the season ended, I mapped the effects of temperature on nest depth. The results indicate that female Painted Turtles tend to dig shallower nests on warmer days, and deeper nests on cooler days. This has the implication that nests dug on warm days, with eggs closer to the soil surface, are likely to experience higher incubation temperatures throughout the season. This would in turn yield more female hatchlings. The most plausible explanation for this behaviour is that on warmer days, females run the risk of dehydration or overheating while nesting. As such, they will spend less time on land digging their nests and will retreat to the water shortly after. In past studies, it has been found that turtles prefer to nest in shaded areas, which demonstrates that female nest site choice may be greatly influenced by temperature. In the future, it would be interesting to study the effects of other factors on turtle nest depth and to further investigate the extent to which climate change will influence their nesting behaviour. ♦

ACKNOWLEDGEMENTS

I could not have done this project without the guidance of Dr. Njal Rollinson and I am endlessly grateful to have been a part of the field team in 2023. In the field, I had the help of Robin Lloyd, Celina Yang and Emile Watanabe, who, in addition to flagging nests for me, also made this past summer one of my best yet. And, of course, thank you to all the wonderful staff at the AWRS for creating such a warm and welcoming work environment, with a special shoutout to Amanda Semenuk and Farqd Barghash for the amazing chocolate banana muffins!

“THE RESULTS INDICATE THAT FEMALE PAINTED TURTLES TEND TO DIG SHALLOWER NESTS ON WARMER DAYS, AND DEEPER NESTS ON COOLER DAYS.”

SINGING SNAPPING TURTLES! THE VOCAL RANGE OF THE SNAPPING TURTLE

Written by Emile Watanabe

Communication is fundamental to social structure and behaviour in the animal kingdom. It plays a key role between different species in an environment, and within a species to attract mates, forage or stay in a group. In fact, signaling behaviour as a whole has contributed to the different sizes and appearances of wildlife, by favouring the evolution of animal traits that facilitate this communication (think plumage or fur color, or bird calls that are unique to a species). There are many different forms of communication, but best studied is acoustic communication. The acoustics of mammals and birds are particularly well studied as they are known to be social animals who vocalize frequently, but reptiles have long been ignored in this field. This is partly because they were thought to lack a sense of hearing and were seen as less social creatures. Even among reptiles, some species were further ignored if they were mostly solitary, lacking social interactions outside of mating. Among these were turtles.

When you think of an animal vocalizing, you don't think of a turtle do you? Neither did I, until this past summer! In fact, turtles are far more social creatures than we previously thought. In the past 50 years, an abundance of research has been published on turtle vocalizations, with over 50 species having a documented vocal range to date. Unlike birds, these sounds are short, lasting a fraction of a second, and very low frequency making them hard to hear for people over 40 years of age. The sound of moving water from swimming is enough to mask these turtle vocalizations! This has likely contributed to their very recent discovery, thanks to modern acoustic technology and some keen researchers.

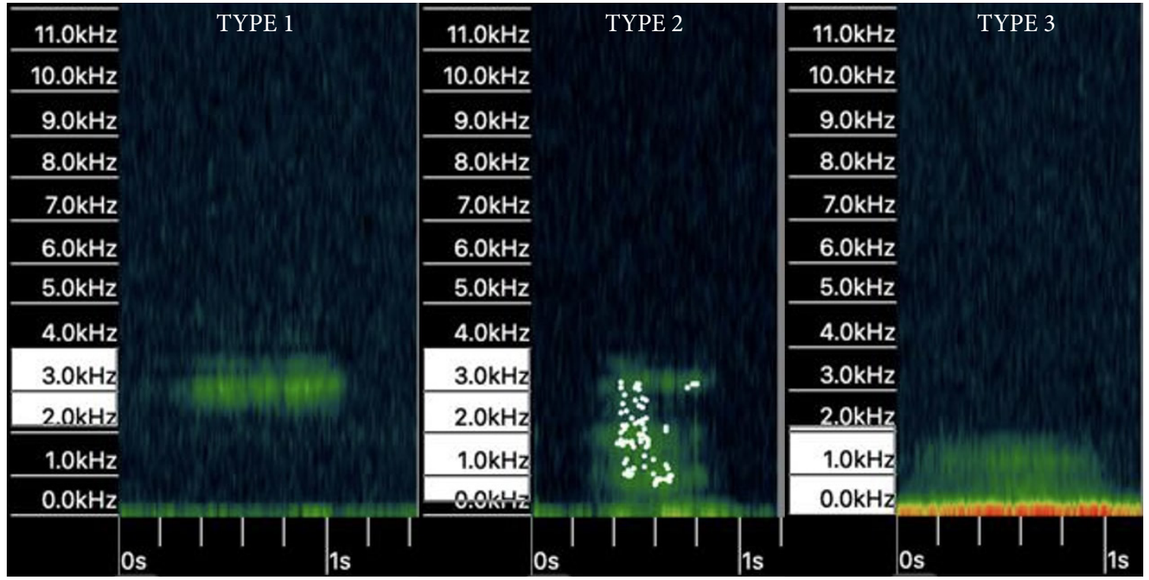
If you've visited any ponds in Algonquin Park, chances are you've come across a basking turtle on a bog mat or seen some broken eggshells on a bank. The largest of the park's turtles is the Snapping Turtle (*Chelydra serpentina*), whose vocal range is largely unknown. As such, we sought to characterize this vocal range for the first time.

Over the month of July, we caught 17 Snapping Turtles in three lakes (Sasajewun, Canoe and Tea) and recorded them for 24 hours in large tanks. We replicated the turtle's environment by filling the tanks with naturally murky lake water and sand, and used underwater microphones to capture their faint vocalizations. These recordings were imported into a software that allowed us to visualize the acoustic sound waves, and manually identify the turtles' vocalizations. Imagine sifting through hours of scratching and bumping sounds to find short whistles or growls no longer than a second. Whew!

> "WHEN YOU THINK OF AN ANIMAL VOCALIZING, YOU DON'T THINK OF A TURTLE DO YOU? NEITHER DID I . . ."

Believe it or not, we found that Snapping Turtles produce at least three distinct types of vocalizations! As we'd expect, they are simple, low frequency sounds that would be very hard to hear without specialized equipment. Type 1 resembles a short hiss quite like air coming out of a car tire, type 2 is a sharp puffing sound (imagine a sharp sigh), and type 3, is a low percussive growl.

These results are exciting because they reveal a new dimension of sociality to this species. We're still unsure whether Snapping Turtles use these vocalizations to communicate with and attract each other, or as a show of aggression towards other species. We're currently addressing these questions in an extension



ABOVE: Spectrograms of the three distinct vocalizations made by adult Snapping Turtles identified in this experiment. On the x-axis is time in seconds, and on the y-axis is frequency measured in kilohertz.

Photo: Emile Watanabe

> "THESE RESULTS ARE EXCITING BECAUSE THEY REVEAL A NEW DIMENSION OF SOCIALITY TO THIS SPECIES."

of this project, so check back next year for a potential update! ♦

ACKNOWLEDGEMENTS

I'd like to thank the members of the 2023 turtle team, including my supervisor Dr. Njal Rollinson, and our leaders Robin Lloyd and Celina Yang for their support and guidance in completing this project. Jack Gadoury, Wynn Murakami-Clisham, Justice King, Noah Stein and Rylan Vincent were instrumental in experimental set up, turtle catching, and fostering a fun and supportive working environment. Additionally, thank you to the dedicated team of staff at the AWRS, who could not have been more welcoming, kind, and attentive. The fantastic work conducted at the AWRS would be impossible without them!

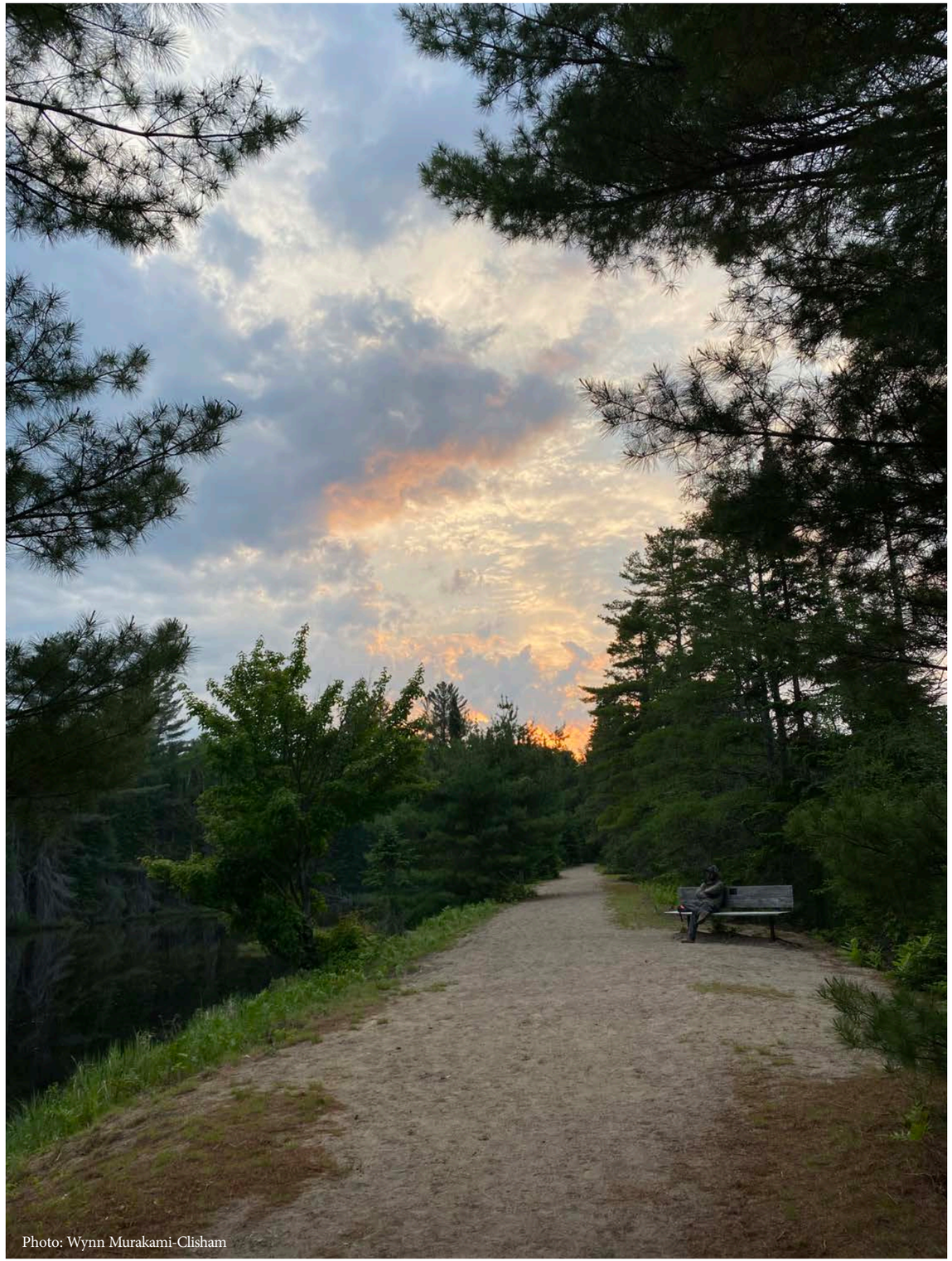


Photo: Wynn Murakami-Clisham

CORVID BIRDS AS SUBSIDIZED PREDATORS OF TURTLES

Written by Patrick Moldowan

WHEN FEEDING THE BIRDS GOES AWRY

Subsidized predators are animals, native or introduced, whose populations greatly increase through association with humans. Resource subsidies—such as food, water, and/or shelter—allow predators to rapidly increase in population size, expand their geographic range, and overexploit prey. Mammals, such as Common Raccoons and Red Foxes, often come to mind as examples of subsidized predators. Corvid birds, including ravens and crows (*Corvus* spp.), also fit the description. These intelligent, highly social, long-lived, and widespread generalist predators have undergone explosive regional population growth in response to human subsidies. Tortoises and freshwater turtles are among the most imperiled vertebrates globally, and elevated mortality caused by subsidized predators is a leading threat. As you've probably guessed, matters don't look good when these two groups mix. As subsidized predators, corvids pose an additional mortality threat to turtle eggs, juveniles, and, in some cases, adults.

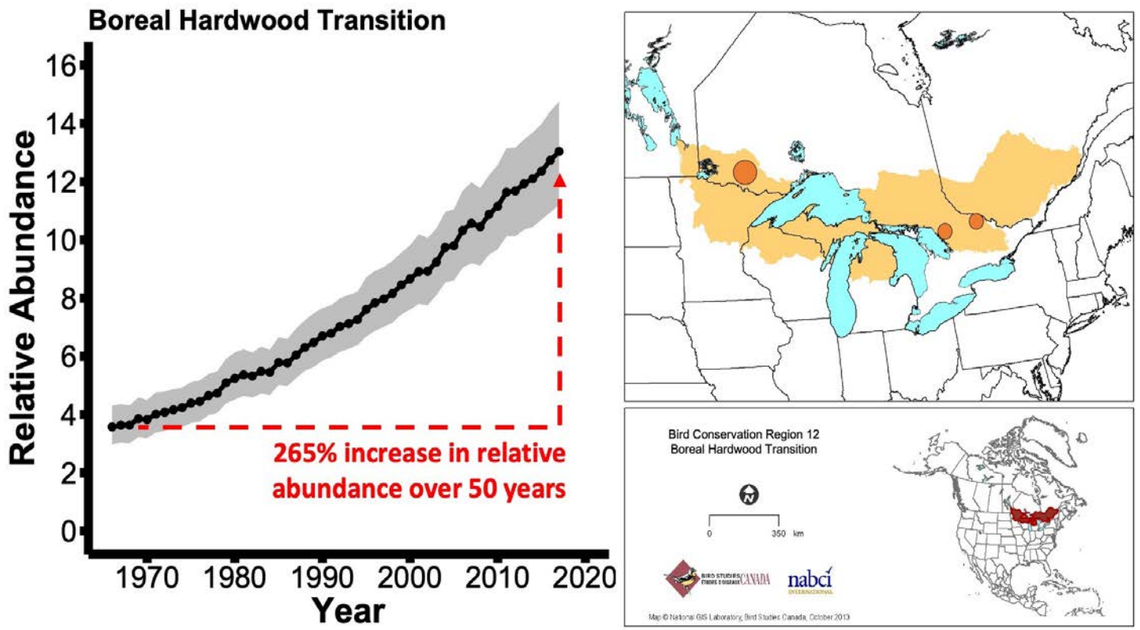
INVESTIGATING A CONSERVATION CONUNDRUM

There are a couple well known case studies of corvids overexploiting turtle populations, but most such cases were word-of-mouth anecdotes with little supporting information. I set out to summarize available information about this corvid-turtle conundrum with a few objectives in mind: (1) review published and unpublished case studies of corvids as predators of turtles, (2) examine regional population trends of corvids relative to the status of co-occurring turtle species, and (3) evaluate our current understanding of subsidized corvids as threats to turtles. The project started at home in Algonquin Provincial Park and expanded to include case studies from elsewhere in North America (eastern Canada and United States), Europe and the Mediterranean region (Israel and Morocco), South Africa, and Australia. Across continents, I assembled parallel examples of turtle mass mortality events (hyperpredation) caused by subsidized corvids.

> "ACROSS CONTINENTS, I ASSEMBLED PARALLEL EXAMPLES OF TURTLE MASS MORTALITY EVENTS (HYPERPREDATION) CAUSED BY SUBSIDIZED CORVIDS."

A WORLD TOUR

Recent records link Northern Ravens (*Corvus corax*) to the mortality of many dozens of Painted Turtles (*Chrysemys picta* ssp.) and Wood Turtles (*Glyptemys insculpta*) in regions of Ontario, New Brunswick, and New Hampshire. In some desert regions of the world, where human subsidies have been a major boon for corvids, mortality events of tortoises are stark. In the Mojave Desert of California, carcasses of dozens to hundreds of Mojave Desert Tortoises (*Gophrus agassizii*) littered the ground under Northern Raven nest and roost sites throughout the 1980s. This pattern continues today, however, there are now far fewer tortoises of which to make a meal. In the coastal plains of Israel, at the advancing front of human development, the abundance of Carrion Crows (*C. corone*) soared 20-fold while the abundance of Spur-thighed Tortoises (*Testudo gracea*) plummeted 500-fold. In South Africa, one pair of nesting Pied Crows (*C. albus*) dined on the tidbits of at least 475 juvenile tor-



ABOVE: One example of corvid population trends close-to-home: relative abundance of the Northern Raven (*Corvus corax*) in the Boreal Hardwood Transition zone of North America (1966–2017). Orange dots on the map represent regions where raven hyperpredation of Painted Turtles (*Chrysemys picta*) have been documented: Lake of the Woods, Parry Sound District, and eastern Algonquin Provincial Park, Ontario.

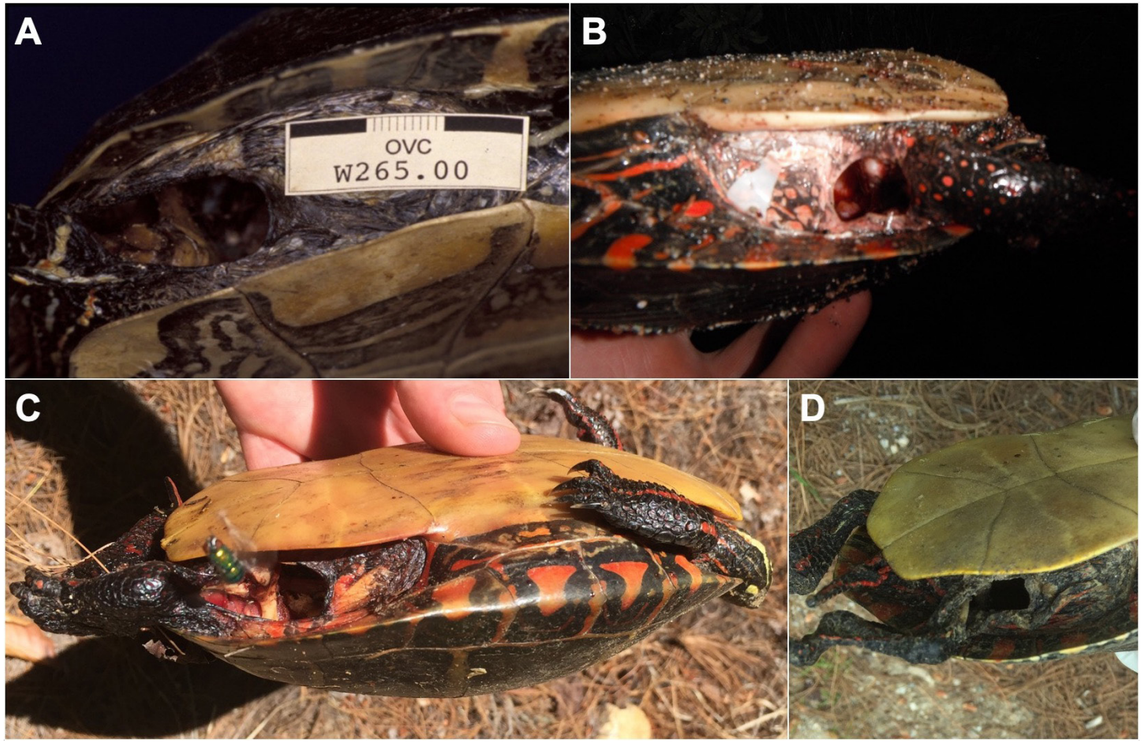
toises over two years! In western Australia, a complex suite of land use change and human provisioning of Australian Raven (*C. coronoides*) is proving problematic for one of the most imperiled turtles in the world, the Western Swamp Turtle (*Pseudemydura umbrina*). To date, cross-continental case studies of corvid predators and turtle prey have been discussed in isolation, but their similarities are remarkable and entirely predictable: supply predators with a previously limiting resource, predator abundance and range increases, and prey populations get gobbled up (... rinse, lather, wash, and repeat).

A STORY EMERGES. . .

Following detailed sleuthing of case studies, umpteen emails, a few interviews, and hundreds of hours of manuscript crafting, conclusions took shape. Corvid hyperpredation of turtles is geographically widespread, facilitated by human subsidies (e.g., food, water, and nesting sites) and linear corridors (e.g., roads, railways, and electrical infrastructure), and often coincides with regional corvid population increases. Corvid exploitation of turtles can be severe where and when predation occurs. Hyperpredation by corvids appears to disproportionately impact juveniles and reproductive females and very likely has long-term detrimental consequences considering the slow life history of turtles (i.e., slow growth, late maturity, low annual reproductive effort, low and variable population recruitment, high adult survival, and long generation times).

ONGOING CONSERVATION CHALLENGES

Substantial regional increases in corvid populations and the apparent underreporting of observations suggests that the threat posed by subsidized corvids to turtles (and probably other prey) populations is likely more widespread than currently recognized. For turtle populations, overkill from subsidized corvids is another slice in a 'death by a thousand cuts.' Addressing this conservation challenge will require a collaborative approach including, but not limited to, reducing access to subsidies (i.e., changing human behaviour), reproductive interference (e.g., egg addling, nest destruction), aversion training, and/or lethal control of corvids. Predatory corvids pose a particular challenge for conservation because of their intelligence, sociality, and generalist habits. Hyperpredation of prey species by subsidized corvids warrants immediate action from the conservation community, especially for several turtle species that are at imminent risk of extinction. ♦



Above: Northern Ravens work singly or cooperatively when hunting turtles. One observer I spoke with described the "surgical" and consistent method by which ravens puncture the hindlimb pocket of turtles to extract eggs and organs. Painted Turtles from A. Lake of the Woods, B. Parry Sound District, and C. and D. New Hampshire. Photos: A. Doug Campbell, B. James Baxter-Gilbert, and C. and D. Michael Marchand.

ACKNOWLEDGEMENTS

This project was made possible by the many people who contributed their observations, time, and photos. Please see the research paper on the *Publications* page for a full list of acknowledgements.

> "...THE THREAT POSED BY SUBSIDIZED CORVIDS TO TURTLES (AND PROBABLY OTHER PREY) POPULATIONS IS LIKELY MORE WIDESPREAD THAN CURRENTLY RECOGNIZED."

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UPDATE ON THE LONG-TERM SALAMANDER PROJECT

Written by Robin Lloyd

SIX YEARS OF MONITORING THE ENTIRE AMPHIBIAN COMMUNITY AT BAT LAKE

In April of 2023, researchers Robin Lloyd and Celina Yang from the University of Toronto, supervised by Dr. Njal Rollinson, were tasked with taking over the annual Bat Lake amphibian monitoring project, previously spearheaded by Dr. Patrick Moldowan, who completed his PhD in January. This study, a project originating from the long-term Bat Lake Inventory of Spotted Salamanders (BLISS), features a drift fence encompassing the entirety of Bat Lake with the goal of monitoring all migrating amphibians coming to and from the lake to breed in the spring. The spring of 2023 marked the sixth year of the amphibian census at the Bat Lake drift fence. The season spanned from April 24th to May 25th during which we observed 5304 amphibians across seven species: Spotted Salamander, Blue-spotted Salamander, Wood Frog, American Toad, Green Frog, American Bullfrog, and Eastern Red-backed Salamander. Two tree frog species were observed as well, the Spring Peeper and the Gray Treefrog; however, the counts of tree frogs underestimate their abundance since these species can easily scale the fence. The Spotted Salamander was by far the most abundant species, making up an astounding 74% of all captures followed by the Blue-Spotted Salamander (25%). The American Bullfrog, Green Frog, and Eastern Red-backed Salamander made up the least encountered species. In addition, not a single Eastern Newt was observed this year, which was not surprising considering that the species represented less than 0.1% of captures in past years. Using this enormous wealth of demographic and abundance data, combined with data on spatial habitat use, body condition, reproduction, phenology, and climate, we can answer novel questions concerning amphibian ecology and learn more about these unique amphibian communities in Algonquin Provincial Park.

This year marked the last year for the drift fence with its disassembly at the end of the field season. Ultimately, the decision to take down the fence was a balance of workload and animal welfare. The drift fence served its purpose in addressing questions related to abundance, demography and key population vital rates (such as sex ratio and survival), and community composition of amphibians at Bake Lake over a highly productive six-year period. On to new projects!

> “...WE OBSERVED 5304 AMPHIBIANS ACROSS SEVEN SPECIES...”

FUTURE RESEARCH

Moving forward with future research endeavors, the salamander team will resume aquatic surveys to estimate population metrics of salamanders at Bat Lake. These surveys will use aquatic funnel traps and possibly some terrestrial funnel traps at focal points around the lake that experience high migration traffic. In addition, two new graduate students will oversee the continuation of the long-term amphibian monitoring project. Dylan Kaufman and Justice King, both from the University of Toronto under the supervision of Dr. Njal Rollinson, were present in 2023 to assist with amphibian monitoring and will be continuing with graduate studies in 2024. The long-term monitoring project of the amphibian communities will continue with previously used surveying methods and will see the establishment of new independent research projects from Dylan and Justice in 2024. ♦

Photo: Samantha Stephens

ACKNOWLEDGEMENTS

Many thanks to Celina Yang who co-led the salamander team with myself, and who handled most of the organizing and logistics for the 2023 salamander field season. Spring students Jack Gadoury, Wynn Murakami-Clisham, Justice King, and Emile Watanabe received an introduction to amphibian field biology and were instrumental in data collection. Thanks to Dylan Kaufman for assisting with data collection and fieldwork. Thank you to Farqd Barghash, Amanda Semenuk, and Drayke Evans, alongside several other volunteers from field courses and other station visitors who were welcome company on several nighttime and early morning surveys. In addition, Noah Stein and Rylan Vincent led the metamorphic salamander surveys in the late summer. Thank you to Kevin Kemmish, Amanda Semenuk, Farqd Barghash, and Drayke Evans for keeping everyone comfortably housed and very well fed. Lastly, a special thanks to Jonathon Qu and Kevin Li for filming the fieldwork and the salamander team for a possible documentary series!

FIRST FIELD SEASON IN ALGONQUIN: ESTABLISHING A PROJECT ON SALAMANDER MATING ECOLOGY

Written by Dylan Kaufman

MY FIRST AWRS EXPERIENCE

When I accepted my offer of admission to pursue my master's degree at the University of Toronto, I was excited to gain two months of hands-on research experience in Algonquin Park. Prior to starting my degree, I was given the opportunity to visit the Algonquin Wildlife Research Station this past May to assist with Spotted Salamander and Painted Turtle long-term research projects. My experiences at the AWRS this past spring gave me an amazing introduction to field research, while also helping to motivate my master's project on Spotted Salamander mating ecology.

Throughout my time in Algonquin, I was overwhelmed with the diversity of wildlife sightings that surrounded me. From my first morning where I saw evidence of a visiting bear, to spotting moose on the side of the highway on our way to research sites, I felt an amazing connection to both the park and the Station grounds. Though the wildlife filled my time at the AWRS with novelty, my experience would not have been as welcoming if it were not for the people who I lived and worked alongside. Both my own team and researchers working on other projects brought a variety of passions and expertise to the Station. Through the cycle of visiting researchers, it was the AWRS staff that went well beyond their general responsibilities to maintain the Station's welcoming culture.

PROJECT ON SPOTTED SALAMANDER SEX RATIOS

Of all the wildlife I was lucky enough to see, I was most excited about observing the natural spectacle that brought me to Algonquin in the first place: the amphibian breeding season at Bat Lake. Bat Lake is unique because it is naturally acidic making it a fish-less environment. As a consequence, many amphibian species mate in Bat Lake by the thousands, seemingly adapted to the lake's acidic conditions. Long-term study of the Spotted Salamanders at this site has been conducted through the Bat Lake Inventory of Spotted Salamanders (BLISS) project. Annual aquatic funnel trapping and drift fence surveying have provided fifteen years of demographic data for the BLISS project.

> "PREVIOUS RESEARCH USING THE BLISS LONG-TERM DATA HAS FOUND THAT MORE FEMALE SPOTTED SALAMANDERS BREED EACH YEAR THAN MALES."

In addition to their adorably passive temperament and eye-catchingly bright yellow-orange spot pattern, Spotted Salamanders are an interesting species to study because we know so little about what they do for most of their life cycle. Spending most of their life in abandoned small mammal burrows, they are only conspicuous for a few weeks of the year when they risk their lives to breed in freshwater. Previous research on Spotted Salamanders has mostly centered around their mating due to the ease of data collection when they are congregated at their breeding site. Consequently, it is a necessity to take advantage of Spotted Salamander breeding data not only to directly inform our understanding of how they mate, but also to infer the ecological pressures that Spotted Salamanders may experience outside of a breeding context.

Photo: Samantha Stephens

Previous research using the BLISS long-term data has found that more female Spotted Salamanders breed each year than males. This is not what would be expected in a species that engages in dense mating aggregations seemingly characterized by large amounts of male-male competition. This is because the cost of producing eggs for females is much greater than the cost of producing sperm, so we would expect females to forgo reproduction intermittently to accrue sufficient energy to mate in later years. This expected pattern is the opposite of what has been observed at Bat Lake. The goal of my project is to use the BLISS demographic data to understand the mechanism that has led to this female bias in the Spotted Salamander mating pool.

I plan to elucidate this mechanism by building a population model to estimate abundances of males and females of the full population, which includes individuals that are not breeding, from the mating season data. These findings can help explain how the Bat Lake population may differ in its mating system structure from other Spotted Salamander populations while also shedding light on why these deviations from expected sex ratios may occur in the first place. This work can help identify the ecological pressures that both sexes experience at Bat Lake, and provide insight into their life cycle outside of mating. As the Bat Lake amphibian community is of great ecological interest, I am very excited to understand how its unique ecology has influenced the Spotted Salamander mating system.

Though my project has only just begun, I owe a lot of the passion I have for this research to the introductory field season I had this past spring. I am grateful to be returning to Algonquin in 2024 for the amphibian and turtle breeding seasons to help lead data collection for their long-term study and witness more breathtaking natural phenomena that surround the research station. ♦

ACKNOWLEDGEMENTS

I would like to thank Dr. Njal Rollinson, for access to previous and ongoing BLISS research and the opportunity to obtain field experience with my study system before the start of my master's degree. I am extremely grateful for all members of the Rollinson Lab who I worked alongside this past spring for providing a warm welcome to the team, with a special thanks to Robin Lloyd and Celina Yang who showed me the ropes of amphibian and reptile field research. I would also like to thank the 2023 AWRS staff team for their commitment to the station, which is evident in everything they do to make it such a fantastic place. Lastly, my thanks go to Dr. Patrick Moldowan and Dr. Doug Armstrong for their comprehensive advice throughout my project's development.

THERMAL THRESHOLDS: THE TEMPERATURE-DEPENDENT EMBRYONIC DEVELOPMENT OF SPOTTED SALAMANDERS

Written by Justice King

SPRING BREEDING SEASON

The onset of spring at Bat Lake heralds a significant event for the Spotted Salamander (*Ambystoma maculatum*). As the ice melts and the forest floor begins to thaw, the salamanders emerge from their underground winter shelter, marking the start of their annual breeding season. In 2023, the 16th year since egg mass counts began at Bat Lake in 2008, our study aimed to gain insight into the temperature-dependent developmental intricacies of the Spotted Salamanders, considering how temperature—a fundamental ecological driver—influences their embryonic growth rates and hatching success. By developing a degree-day model, we aimed to quantify the thermal thresholds essential for their developmental stages, providing a critical tool for understanding and predicting the impacts of environmental changes on their life cycle.

EGG MASS COUNTS

During this breeding season, we paddled around the vegetated edges of Bat Lake to count egg masses. The salamander reproductive period was defined from the first sighting of an egg mass to the peak of their abundance. This season's peak egg mass count was recorded on May 14th, with 4829 egg masses; a sight that encapsulates the amount of life in and around Bat Lake's waters.

OPTIMAL DEVELOPMENTAL CONDITIONS

Our research identified a temperature profile ranging from 2°C to 24°C for optimal embryonic development and hatching. If temperatures reach beyond that range—either too cold or too hot—development stops. This delicate balance is crucial, especially as our world's climate changes, impacting the hidden amphibian inhabitants of Bat Lake. We hope to collect additional data in future years to further validate the degree-day model.

CLIMATE CHANGE IMPLICATIONS

In an era of climatic uncertainty, the implications of our research reach beyond Bat Lake. Understanding these thermal thresholds offers insight into how climate change might alter the developmental pathways of amphibians in various ecosystems. Our degree-day model aims to offer a tool for predicting future population shifts, revealing the adaptive capacity of these species in a warming world. ♦

ACKNOWLEDGEMENTS

My heartfelt thanks go to everyone who made gathering this year's data possible, particularly during the chilly spring nights and the hot early-summer days spent out on the water. I extend appreciation to Dr. Njal Rollinson for his invaluable guidance, and especially to Wynn Murakami-Clisham, Jack Gadoury, Emile Watanabe, Robin Lloyd Celina Yang, and the entire Rollinson Lab and Algonquin Wildlife Research Station (AWRS) team for their support throughout this project. Their collective effort out in the field, on the boat I called home, in my inbox, and back in Toronto has been fundamental to the success and enjoyment of this study. I would also like to express my gratitude to Dr. Patrick Moldowan for his expertise and foundational work, which provided significant insights that enriched my contribution to salamander research.

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Photo: Justice King

UNRAVELING THE INFLUENCE OF SEASONALITY ON THE THERMAL BIOLOGY OF SPOTTED SALAMANDERS

Written by Danilo Giacometti & Glenn Tattersall

OF BODY TEMPERATURE, SALAMANDERS, AND SEASONALITY

From the perspective of body temperature, amphibians and reptiles are classified as ectotherms. In short, this strange word means that these animals obtain body heat primarily from the environment, and use different behaviours to control how much heat is exchanged between them and their surroundings. It is common to observe diurnal (i.e., those that are active during the day) ectotherms engaging in behavioural thermoregulation: just picture yourself hiking the Bat Lake trail on a sunny day and you notice a snake basking in the sunlight. Basking is a behaviour that allows diurnal ectotherms to soak up warmth from solar radiation until body temperature is at a favourable value. For ectotherms that are active at night, like most amphibians, warming up through sunlight is impossible. Thus, behavioural thermoregulation in nocturnal ectotherms is limited by their ability to move between habitats that differ in environmental temperature.

Studies available in the scientific literature often assume that nocturnal ectotherms are not as precise thermoregulators as diurnal ones. This reasoning, however, is not based on comparisons of behavioural thermoregulation between diurnal and nocturnal species. Instead, it is based on the observation that environmental temperature is less variable at night than during the day. Because of this, nocturnal ectotherms should have fewer opportunities to thermoregulate than diurnal ones, and should end up simply conforming to prevailing climatic conditions. While this rationale may be applicable in the short-term (e.g., hours), it overlooks the fact that both diurnal and nocturnal ectotherms are subjected to long-term shifts (e.g., months) in environmental temperatures through seasonality. Our understanding of how seasonality affects the thermal biology of ectotherms is still in its early stages, especially when we consider nocturnal species like the Spotted Salamander.

The Spotted Salamander is a long-lived species of amphibian. Under favourable conditions, that is, if predation is avoided, diseases are overcome, and food is aplenty, individuals may live for up to 30 years of age. As a result, Spotted Salamanders experience the changing of seasons multiple times over the course of their lives. Unsurprisingly, seasonality influences various attributes in this species. For example, seasonal changes in temperature and precipitation are known to influence food habits, hormone levels, and reproduction. In a recent publication, researchers associated with the Bat Lake Inventory of Spotted Salamanders (BLISS) demonstrated that seasonality also had an effect on salamander body size. Specifically, an increase in autumn and summer temperatures partly explained why Spotted Salamanders declined in body condition over the course of 12 years of monitoring.

While the study highlighted morphological changes in response to seasonal changes in climatic parameters, the extent to which seasonality affects the thermal biology of Spotted Salamanders remains unclear. Body temperature influences many processes in salamanders, including locomotion, growth, and food assimilation. Preliminary studies suggest that larval Spotted Salamanders are particularly good at dealing with changing temperatures. However, whether this ability is sustained after juveniles undergo metamorphosis is currently unknown. Ultimately, evaluating how the thermal biology of adult Spotted Salamanders changes between seasons can shed light on their ability to cope with long-term shifts in environmental temperatures.

ABOVE: Thermal image of a female Spotted Salamander in the laboratory thermal gradient used in this study.
BELOW: Spotted Salamander in the lab. Photos by Danilo Giacometti.

STUDYING THERMOREGULATION IN THE LAB

In this project, we set out to determine how acclimating (i.e., habituating) Spotted Salamanders to summer and winter conditions would affect their motivation to thermoregulate. We purposely chose these seasons, because summer represents the active season of Spotted Salamanders after they breed, and wintertime is a period of minimal activity due to adverse climatic conditions. To measure thermoregulation, we used a laboratory thermal gradient. A thermal gradient is an apparatus that offers animals an equal opportunity to freely choose from a range of temperatures in a setting that does not impose costs over thermoregulation (e.g., presence of a nearby predator). Based on temperature records for the understory around Bat Lake, we established that Spotted Salamanders would be acclimated to 14°C in the summer and 2°C in the winter. We also determined that the thermal gradient would range from 3–25°C in the summer, and -2.5–15°C in the winter. Thus, our study was designed to match the range of possible environmental temperatures experienced by Spotted Salamanders in nature.

We ran our experiments in the summer of 2022 and winter of 2023. Our results suggest that the thermal biology of Spotted Salamanders is influenced by seasonal changes in temperature. We found that this species of nocturnal ectotherm does not passively tolerate gradient temperatures, as theory would predict. Instead, we found that Spotted Salamanders actively thermoregulate in both the summer and winter. The effect of seasonality over thermal biology is noticed when we look at their preferred gradient temperatures. In the summer, Spotted Salamanders had a preferred temperature of 17.1 ± 1.9°C (median ± standard deviation). In the winter, their preferred temperature was 7.6 ± 2.1°C. This amounts to a difference of 9.5°C in preferred temperature between seasons. While a striking magnitude of temperature change at first glance, our finding is comparable to work done in larval Spotted Salamanders. Thus, this result suggests that the ability to cope with changing temperatures is not lost when larval Spotted Salamanders undergo metamorphosis and reach adulthood.

Our results are also supported by studies suggesting that ectotherms that live in highly seasonal habitats (temperate zone) are able to remain active across a relatively wide range of temperatures. Data collected by BLISS over the years indicate that the Spotted Salamander fits well with this description. At the cool end of the temperature spectrum, we can refer to salamanders migrating to breeding sites in late winter/early spring, when snow and ice still persist. At the warm end, we can refer to salamanders metamorphosing in the summer and dispersing overland when humidity is high. In sum, our work highlights the role of seasonality in shaping the thermal biology of Spotted Salamanders. Our assessments of behavioural thermoregulation between seasons challenge the idea that nocturnal ectotherms do not engage in active temperature selection. Comparisons of preferred temperatures between season support the idea that Spotted Salamanders are able to tolerate a wide range of environmental temperatures. Together, these findings contribute to a broader understanding of the climatic parameters that affect the biology of Spotted Salamanders. ♦

ACKNOWLEDGEMENTS

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AN UPDATE ON THE SMALL MAMMAL PROJECT

Written by Sydney Miller

In 2023, the Algonquin small mammal project celebrated its 72nd year. The small mammal team was led by Sydney Miller, a first-year Laurentian MSc student, and included MNRF staff Germain Collinge Ménard, Alexis Sherbourne, Brennan Oliver, and Thomas Burgess. Kaitlyn Connell, a Laurentian undergraduate student assisted with ongoing small mammal trapping data collection while also conducting her own undergraduate research project.

A LOW ABUNDANCE YEAR

Small mammal trapping was conducted on the 17 long-term Algonquin Park traplines, resulting in the capture of 224 individual animals including Deer Mice, Woodland Jumping Mice, Red-backed Voles, Eastern Chipmunks, Red Squirrels, several species of shrews, and even some Northern and Southern Flying Squirrels. We successfully trapped 115 Deer Mice, 40 Woodland Jumping Mice and 41 Red-backed Voles. These three small mammal species are the most abundant on the small mammal traplines. In 2022, more than 400 individuals were captured, suggesting the 2023 season was a relatively low population year. Small mammal populations frequently follow a high-low abundance cycle, as reported by previous years of this study. On a yearly basis, the small mammal team conducts live-trapping to collect data on population fluctuations, behaviour, and rodent characteristics such as body mass, sex, and reproductive condition. This year, we focused on investigating different parasitic infections to better understand how various species living in the same environment are affected by parasites.

COVID SAMPLING

Deer Mice were analysed for COVID-19 every two weeks as part of an innovative small mammal trapping experiment managed by the MNRF. In addition to the 17 long-term Algonquin Park traplines, four additional traplines where human disturbance is more frequent were used to gather data: two at the Algonquin Park Visitor's Centre, one at the East Beach Theater, and one at the Lake of Two Rivers Beach. The small mammal team swabbed 76 Deer Mice to investigate if they are able to contract COVID-19 from nearby tourist populations. These tests are currently being processed.

TROMBICULIDAE PARASITE INFECTIONS

As part of her undergraduate thesis, Kaitlyn Connell was interested in the distribution of Trombiculidae mites. These mites have a parasitic life stage and are a distinctive orange colour. The mites predominately infest Deer Mice and Red-backed Voles, and Kaitlyn was interested in how the mites are distributed among these hosts. The degree of infestation was determined using a numerical scale (0–3), as well as identifying the location of the infections. Typically, these mites infest the ears and genitalia, but this year we found no mites on the genitalia of the small mammal hosts.

We were able to monitor how parasite infections affected the traits of the small mammal hosts, such as body mass, and understand what qualities of small mammals influenced infections, such as reproductive condition. This project is a continuation of several investigations on the patterns of infestation by these mites on the Algonquin small mammal community. ♦

ACKNOWLEDGEMENTS

Thank you Dr. Albrecht Schulte-Hostedde (Laurentian University) and Dr. Jeff Bowman (Ontario Ministry of Natural Resources and Forestry), for supporting the small mammal team and our research. Thank you to the members of the 2023 field team for their outstanding efforts, as well as the students who attended AWRS field courses and the AWRS researchers/staff who expressed interest in the small mammal project and helped with obtaining data when applicable. Additionally, thank you Bryan Hughes, the lead small mammal researcher during the 2021 and 2022 field seasons, who trained the team how to successfully gather small mammal data. We wish Bryan the best of luck with his PhD. The 2023 small mammal field season would not have been possible without the contributions from these individuals.

Photos: Samantha Stephens

ANOGENITAL DISTANCE: NOT A PREDICTOR OF MASCULINIZED BEHAVIOURS IN FEMALE RODENTS

Written by Julia Goss

In 2022, the goal of the small mammal research was to focus on behavioural differences among the individuals of Algonquin's various small mammal populations. It was anticipated that looking into their behaviours would help to better understand the ecology and evolution of these often overlooked animals. I decided to use the data from the long-term study to determine if the anogenital distance of female rodents could predict the general behaviours of Deer Mice, Red-backed Voles and Woodland Jumping Mice.

WHY ANOGENITAL DISTANCE?

The anogenital distance (AGD)—measured as the distance between the anus and the genitals—is used in scientific and medical studies of humans and other animals for topics such as sex determination and exposure to endocrine disrupting chemicals. It can also be used as a measure of female masculinization, as it is correlated with testosterone levels. In general, the AGD is twice the length in males than it is in females, however, it can vary among individuals based on exposure to testosterone during development. Previous research has shown that higher testosterone levels are associated with more masculine behaviours, including higher explorative behaviours and decreased docility. With this in mind, I hypothesized that female individuals of the three focal species with larger AGDs would present more masculine behaviours than those with shorter AGDs.

THE EXPERIMENT

Comparing the abundance data from the summer of 2022 to that of previous years, we can conclude that 2022 was a high capture year for small mammals. The small mammal team performed various behavioural tests to measure behaviours related to dispersal and risk-taking, in addition to collecting the data for the long-term project. In order to test my hypothesis, we took the amount of time males spent performing each behaviour and compared it against that in females. We then plotted the time spent performing each behaviour against the average AGD of each female individual. We did not find any significant differences between male and female behaviours, or any significant correlation between AGD and behaviour in females, despite the behavioural trends in female Deer Mice and Woodland Jumping Mice leaning towards what we had predicted. Surprisingly, the Red-backed Vole behavioural tests showed trends leaning opposite to what we had predicted, suggesting that more masculinized behaviours were associated with a shorter AGD in this species.

WHAT DOES IT MEAN?

Although the results did not support my hypothesis, we were still able to learn valuable information about these small mammal populations. We know that the behavioural patterns displayed by both males and females, across all three study species do not follow the predicted trends, meaning there are other factors at play. These can include environmental factors, such as food and resource abundance, or anthropogenic factors, where the increased presence of tourists in the park has caused a shift in behaviour. It could be interesting for future projects to further look into the different factors that could be causing these shifts. ♦

ACKNOWLEDGEMENTS

I would first like to thank the staff, researchers, and volunteers at the Algonquin Wildlife Research Station for their continuous support. Notably, Bryan Hughes and Kiara Duval, for helping with data collection and constant feedback. I would like to thank my supervisor, Dr. Albrecht Schulte-Hostedde—without your guidance this project would not have been possible. Lastly, I would like to thank Laurentian University, the Ontario Ministry of Natural Resources and Forestry, and NSERC for funding my research.

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EXPLORING HYBRIDIZATION BETWEEN MINNOW SPECIES IN SOUTHERN ONTARIO

Written by Amanda Meuser

PROJECT SUMMARY

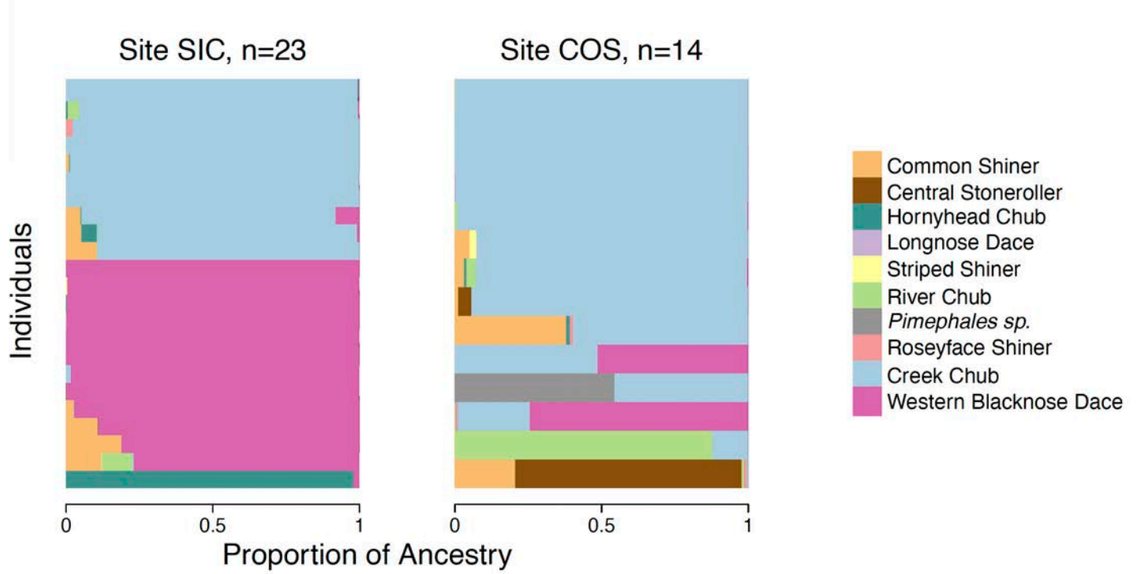
In the year since field work concluded for this project, I've finished my research, defended my thesis, and graduated. I'm grateful for my short stay at the AWRS and the benefit that sampling in Algonquin contributed to my project. The goals of my project were to quantify hybridization—breeding between genetically distinct populations or species—between nine minnow species from the leuciscid family in Southern Ontario, and to estimate the influence of anthropogenic disturbance on hybridization outcomes. Sampling in Algonquin was ideal because it could provide sites that were representative of lower disturbance areas. The park has ample waterways and is recorded to be home to three of the most abundant fish species that I was sampling: Creek Chub, Common Shiner, and Western Blacknose Dace. My lab mate, Amy, field assistant, Teaghan, and I had success at Simms Creek and Costello Creek, catching a total of 74 minnows from our species of interest between the two sites. Because the sampling was done in late May, we were lucky enough to beat the peak of the bugs and catch many of the minnows in beautiful spawning colours. It was a fantastic sampling trip in a beautiful park, and kicked off a highly successful field season in which we caught almost a thousand minnows.

OVERALL FINDINGS

Overall, I found extensive hybridization within the leuciscid family of minnow species. All nine species hybridized with other species to different degrees, and almost 30% of sampled individuals were found to be hybrids when we examined DNA sequence data, despite none being visually identified as hybrids. There were hybrids detected at all sites—including the two sites in Algonquin. Additionally, I identified hybridization with two *Pimephales* species (Bluntnose Minnow and Fathead Minnow) and Creek Chub, Common Shiner, and Western Blacknose Dace, which had not been previously documented by Western scientific literature.

ALGONQUIN-SPECIFIC FINDINGS

After sequencing DNA from the sampled fish and filtering out genetic markers and individuals with little data, 14 individuals from Costello Creek and 23 individuals from Simms Creek remained for analysis. Costello Creek had a greater proportion of hybrids, from a wider variety of species than Simms Creek. Hybrid combinations included Creek Chub with Common Shiner, Western Blacknose Dace, River Chub, and a fish from the *Pimephales* genus, as well as a Common Shiner × Central Stoneroller cross. From Simms Creek, on the other hand, I found almost all fish to be non-hybrid individuals, with only a few Common Shiner × Western Blacknose Dace Hybrids. One individual, though, appeared to be a three-species hybrid—potentially the descendant of a Common Shiner × River Chub hybrid who mated with a Western Blacknose Dace. Despite being in low disturbance areas, I didn't observe a significantly lower proportion of hybrids at these sites than other sites in urbanized or agriculturalized areas. While only Creek Chub, Common Shiner, and Western Blacknose Dace were identified visually during sampling, consistent with previous surveys of the park, my results show that there are additional species present and they are hybridizing with one another. These fish may potentially have been introduced in small numbers via bait bucket release. However, as global climate change warms the planet, the ranges of some of these currently more southern species may expand further northward, which would likely increase incidences of hybridization.



ABOVE: Bar plots depicting the ancestry of individuals sampled at Simms Creek (SIC) and Costello Creek (COS) in Algonquin Park. Individual fish are represented by horizontal bars, with proportion of ancestry for each individual being represented by the amount of the bar taken up by a given colour.

NEXT STEPS FOR THIS DATA

While I personally will be moving on from working with this data now that I've finished my master's degree, additional members of the Mandeville lab are continuing to investigate this family of fishes. Amy Pitura is continuing her master's project on demographic history of these species from colonization of North America to present day. Katherine Drotos, post-doctoral fellow, is examining the history of hybridization in this family with ABBA-BABA statistics and comparing methods for detecting hybridization. ♦

Creek Chub. Photo: Amy Pitura

Western Blacknose Dace. Photo: Amy Pitura

ACKNOWLEDGEMENTS

I would like to thank everyone at the AWRS for making our stay and fieldwork so lovely. I would also like to thank Dr. Liz Mandeville for advising me on my master's thesis, Amy Pitura for all her work planning and executing field and lab work with me, and Teaghan Frauley for assisting us during the entire fieldwork season. Finally, I would like to acknowledge that this research was undertaken thanks in part to funding from the Canada First Research Excellence Fund through the Food From Thought Program at the University of Guelph.

RED SPRUCE AT FOUND LAKE

Written by Peter Mills

There are lots of Red Spruce tucked here and there in Algonquin Park, standing in wonderful and secret little groves, or sometimes by themselves, hidden by the immense numbers of Black and White Spruce that grow between them, around them, with them. I spent over a decade in close company with Red Spruce before realizing these strange trees were in my midst. With time I got good at telling them apart from White Spruce and Black Spruce, of which there are probably many thousand of each for every one Red Spruce in Algonquin Park. I have come to love looking for them. I hunt for them.

There are some diagnostic features that need to be examined to say whether a spruce is a Red, versus a White or a Black. Subtle things, pertaining to the needles, how those needles are arranged on the twigs, features of the twigs themselves, and the shape of the cones.

But with the time to develop a feel, the importance of these technical criteria fall away. There are other important things about Red Spruce—things that are a bit harder to put into words, that can be seen and noticed at great distance, and with great speed, which separate them from other spruces. It's in their architecture, and in the way they stand. The way they reach out, and flare at the edges. And in their sturdy, castle-gray trunks, with those muscular and elegant branches. You can also find it in the rich evergreen plush of their crowns, which recall the ancient, rain-soaked canopies of the west coast. On rain-shrouded mornings I have set eyes on Red Spruce and felt for a moment like the Pacific Ocean could be just over the brow of the next hill.

These differences are subtle but they are there for the noticing once you've had some time to develop that feel. I had time to work over these things during our (re) assessment of a Red Spruce stand located near Found Lake. The stand has been known about since the 1960s but had apparently not been monitored in recent decades. Our question was whether the trees were still there. And, if so, how many there were, and whether there were signs of ongoing recruitment from seedling to adult.

Winter is usually a time of indoor work for me, but that year I made use of those cold, snowy weeks between late December and early March to answer these questions. Each morning Quinten and I were greeted by a pair of ravens who came looking for handouts, and who sometimes even landed on our trucks while we prepared our gear. There must have been few other begging opportunities in the Park because they often shadowed us closely for most or all of the day.

We found the stand with very little effort. In fact, it was hardly a stone's throw from Highway 60. We knew this collection of trees was the one we were after because some of them still had little metal tags nailed into their trunks. There were also blue stakes driven into the ground in places, presumably to mark the corners of a sampling grid, though the grid had been implemented so long ago that it was no longer clear exactly how it had been laid out. What I remember most about those days of field work was trying to lay out our own grid, which we needed to help us walk systematic transects to count the Red Spruce. Perhaps in other Red Spruce stands elsewhere we would have found cathedral-like conditions and been able to walk with ease through a sun-starved understory, devoid of dense growth and scratchy thickets. But most of the Red Spruce we found near Found Lake were scattered in near-impenetrable thickets of young evergreens. The going was not easy and we needed a grid to be sure we were walking straight and not double-counting individuals.

The first grid we used was just a digital one, which we superimposed onto high-resolution aerial imagery, and which we could navigate through using the Avenza Maps app. This worked well actually, as long as we moved slow enough and were careful to ensure the satellite-read on our position was accurate enough to be

Photo: Peter Mills

confident we were in fact where the map showed we were. Sometimes the satellite-read on our position (or was it our cold phones?) lagged a bit behind where we actually were, and half-way through a count we would notice, with dismay, that the little blue dot representing our supposed position was slowly floating through the grid. It was catching up to where we were now, coming from where we had in fact been a minute ago, which up until a moment ago is where we had been assuming we still were. Darn. Time to start again. But with patience for the inadequacies of the technology, we managed to work through our grid day by day, and in due time had covered the entire area.

Our counting was thorough but we knew that occasionally the dense growth and the shortfalls of our digital grid could have compromised our numbers. So we decided to resample six of our grid cells, which we would quite literally bound with flagging tape on all sides, fifty metres by fifty metres (. . . by fifty metres by fifty metres). There could be no getting confused about cell boundaries or getting lost inside these roped-in pens. Laying out that flagging tape was not easy and we suffered through hours of snapped ribbon (brittle in the cold) or crooked lines (I guess the cold was getting to us). But in due course we marked out these six cells, with nice 90º corners, and then conducted an exceptionally thorough count within each to get a sense of how wrong we had been in our initial census of those same cells, if at all.

This secondary exercise to correct the inadequacies of our first count was worth it. We learned that we actually under-counted Red Spruce in those cells by comparing what we had tallied in the first census (using the digital grid) and in the second census (using the clearly-marked cell-squares). On average we had only caught 75% of the Red Spruce per cell in the first sample. This helped us calibrate our final tallies to make a more robust assessment of how many trees there were in the stand.

The verdict? We found the Found Lake Red Spruce stand is made up of about 640 trees, although only 50 of those are mature individuals (the remainder are mid- or understory trees, which we qualitatively described as having trunks that could, in theory, be snapped or broken with bare hands). All of those 640 trees are packed into an area that is exactly two hectares, so density at this site is high. We took diameter-at-breast-height

Photo: Peter Mills

measurements of the 50 mature trees and found that their sizes were normally distributed (ranging from 14.3cm to 51.6cm).

We lean on a few facts to suggest that the Found Lake Red Spruce stand is a healthy one, despite its small size. There are a good number of mature trees and beneath them is a sea of younger trees ready to fill any future gaps that form in the canopy. It doesn't seem particularly likely that Balsam Fir, Eastern Hemlock, or the other spruce species are likely to overtake this stand any time in the near future. And, given that the mature Red Spruce come in a variety of sizes, it feels reasonable to guess that over the decades this stand has routinely recruited younger trees growing in the lower levels of the forest up into the canopy. However, size and age are not always tightly correlated so there is an element of conjecture to this, and our work did not include taking core samples to determine how old the mature trees were. This might have painted a picture for us of how regularly the stand has recruited new adults up into the canopy as the older guard inevitably dies out, and it could be an avenue for further work.

It feels a bit like Red Spruce follow me around now. Of course this couldn't really be the case, but I find that I regularly cross paths with them in my ramblings across Algonquin Park. It's not that they are everywhere you look. It's just that there are enough of them here and there that you might encounter one just about anywhere you go. Paddling across Cache Lake toward the portage into Hilliard Lake, I look to my right, and—Red Spruce. Watching the setting sun over Lake Kioshkokwi—there, at the top of a distant hill, silhouetted against the sky—a Red Spruce. For these enjoyable moments of noticing, I have the Found Lake Red Spruce stand to thank. You need the time to get to know these strange trees, and I have had it.

Gratefully, I have had it. ♦

ACKNOWLEDGEMENTS

I thank Ron Tozer (retired Park Naturalist), Dave Morris (Ministry of Natural Resources and Forestry), and Dr. Andy Gordon (University of Guelph) for their background information on this stand. I also gratefully acknowledge the seminal work conducted on this species in Algonquin Park, and in this very stand, by Dr. Alan Gordon. I also thank Dan Brunton, Paul Pratt, Bill Crins, Steve Darbyshire, and Dan Strickland.

RAPID UNDERSTORY RESTORATION TECHNIQUES AT CACHE LAKE

Written by Estella Crosby

The Cache Lake area is a highly modified location within the Park, just off Highway 60. Among other disturbances, it has been the site of a 50-year-old pine plantation. The understorey of a forest provides essential habitat to wildlife, increases vegetation diversity, and enhances the organic matter on the forest floor. In pine plantations, the forest understorey is nearly to completely nonexistent. This is due to the lack of light reaching the forest floor and the thick layer of pine needles which prevents vegetation growth and acidifies the soil.

This understorey restoration project is a four-year collaboration between the University of Waterloo and Algonquin Park. After planning during 2020 and early 2021, this project was first implemented in winter 2021 when park staff thinned some of the unhealthy pine trees and applied herbicide to the invasive plant species that were there. In 2021 and 2022, Jason Phoenix (the lead researcher on the first phase of the project) and his team of field assistants established an experimental grid where they added two additional treatments. The first involved planting shrubs across the site with the expectation that they will enhance seedling recruitment of native understorey species, which will spread outwards over time. For this treatment, they transplanted 128 Beaked Hazel shrubs during the spring of 2022. The second experimental treatment is windthrow guards, a novel technique that uses rings of herbaceous plants around woody species to protect them from being uprooted by strong winds. Canada Goldenrod was used for the windthrow guard treatment, with 768 transplants forming rings around the hazel shrubs.

In 2023, I began the 2nd phase of the project. I added unthinned plots to the project to act as a reference state of what the forest used to be. I also added insect sampling to the project, as insects can act as indicators of ecosystem health. The vegetation surveys of the understorey, as well as monitoring the mortality of the transplanted plants are being continued by me. I also took soil samples which will be tested to look at the nutrient levels present in the soil. This data will allow me to analyze how the understorey area is changing year to year and see if the treatments are helping to restore it. ♦

Photo: Samantha Stephens

ACKNOWLEDGEMENTS

The initial planning for this work was conducted by Stephen Murphy, as well as Park staff Sandy Dobbyn, Jennifer Hoare, Joe Yaraskavitch, and Alison Smith, among others. Thank you to the Weston Family Foundation, who provided the funding for this project. We also thank AWRS for the delicious food and great company!

FOUND, LOST, AND FOUND AGAIN: AN ARCHAEOLOGICAL ADVENTURE AT THE AWRS

Written by Roderick (Rory) MacKay

I was somewhat familiar with the road to the Algonquin Wildlife Research Station (AWRS), since during early adolescence I had ventured there from my parents' cottage on Lake of Two Rivers to have a creature unusual to me identified as a Horsehair Worm. About a decade later, I was one of the Algonquin Park Museum seasonal naturalists invited to compete in the annual "Algonquin Olympics" held at the AWRS. But, in early May 2023, as I drove off the highway, with my equipment trailer in tow through the muddy ruts of spring and past someone on a tractor trying to level out the road surface, I knew this time was different. I was to be one of the researchers at the Algonquin Wildlife Research Station. My research in archaeology would be a first for the AWRS.

It may seem strange for someone to be looking for a shanty from the square timber period in a location world renowned for wildlife research, but I knew I was in roughly the right place. In Russell Rutter's 1967 history of Pembroke District he had written that the remains of a camboose shanty had been found among the buildings of the AWRS. Two years later, the AWRS camboose shanty was ranked as one of the top five for protection in the Park. But then it was gone. No mention of it was made in the Algonquin Park Master Plan of 1974 or any document thereafter. Where did it go?

In 2014, at an AWRS event, someone was overheard talking about having brought back some historic period artifacts found when a drainage ditch was dug. That conversation was reported to me and led to many attempts to find the camboose shanty along the river bank between the Directors Cabin and the Lake Sasajewun dam. I had been told that was where to find the shanty and presumably the drainage ditch. Unfortunately, I had set my sights too small. I would walk right around a huge gully of a drainage ditch (covering 291 square metres) to look for a tiny one. All I found were fallen trees and wet, moss-covered rocks.

In early 2022, a box of artifacts collected from a camboose or shanty hearth in 1971 by Bruce Stephenson, a WRS staff member at that time, was found in the Park archives. It was disappointing to think that collection had been made without an archaeologist. However, it was a relief to find the artifacts, even if there was no context for each. Unfortunately, there was no record of how much digging had been done and there was no indication of the location of the camboose. In 2022, I looked along the river again, and then asked myself, if I was Director how would I get to the dam from the Directors Cabin? I decided I would take the path to the road and then walk along the road. I was not very far along the road when I spotted two low mounds that met as a corner, not far from the road.

> "MY RESEARCH IN ARCHAEOLOGY WOULD BE A FIRST FOR THE AWRS."

A proposal to do research archaeology on the Stephenson Site Camboose Shanty, as a salvage project, was submitted to Ontario Parks. Approval of that research was what brought me back in 2023.

Early May was a perfect time to begin my work as an independent researcher. It was late enough in the month that there was no frost in the ground to impede digging. There would be no emergent understory vegetation . . . yet. There would be no Black Flies . . . yet. There would not be much competition for accommodation . . . yet. Additionally, a younger assistant in his thirties, Sandy Hunter, would be arriving shortly to help work around obstacles that made things difficult for a 73-year-old archaeologist.

Sandy Hunter and Dora Yateman removing debris from the Stephenson Site camboose mound. Photo by Rory Mackay.

A reference point or datum was set and a north-south datum line of yellow string was established out to a distance of 30 metres. A similar east-west baseline was laid as well, and then a grid at five-metre intervals. Anything found would be recorded by its location on the grid. We walked the landscape looking to relocate the small foundation mounds that had brought us here. Our metal detector proved useful in locating part of a horseshoe at the edge of the drainage ditch and the head of a felling axe near the small foundation mounds. We also found metres of bunched up fence wire lying at the edge of the drainage ditch.

Not far from the datum we found a mound partly covered by woody debris. A glance around showed the mound had an extension on the other side of a cut through it, made by the big drainage ditch. Associated with one side of the mound was a linear depression, parallel with the mound. Mounds and ditches each can be caused by tree-falls in the forest, but in association they suggest the outside wall of a logging camp, or a shanty where loggers spent the winter. Earth "borrowed" from a ditch and piled against the lower logs of a structure helped keep the cold out.

A five-metre long by one-metre wide excavation through the mound and borrow ditch was made over the next three days. The results were unexpected. There were only seven artifacts found; none in the mound, and six tin cans and an axe head in the borrow ditch. From the appearance of the soil, the axe and cans appeared to have had about the same age of deposition. Perhaps an expert in cans could narrow down their age of manufacture, but given their rusty condition, I could not.

About day four, Sandy Hunter chose to wander through the woods, on his way back from lunch at the Cookhouse. Just a few metres farther than where we had walked the landscape he found a mound with rocks on top. A comparison with photographs from 1971 showed it was the camboose for which we were

looking, so that became our focus once our grid was extended to include it.

Once an overlying duff layer had been removed, the camboose mound appeared to be fairly intact, although one rock had been tipped over from a vertical position. Inquiries earlier had revealed that the dam at the outlet of Lake Sasajewun had broken in 1998, releasing a wall of water that reached the road and the Directors Cabin. It was also apparent that the camboose had been stripped of all surface artifacts. What was not apparent was if the camboose had been dug into.

> "A COMPARISON WITH PHOTOGRAPHS FROM 1971 SHOWED IT WAS THE CAMBOOSE FOR WHICH WE WERE LOOKING...."

A decision was made to excavate a one-metre by one-metre unit on the south east side of the camboose mound. As is apparently the case with other camboose shanties, a hard concrete-like layer formed from wood ash, sand, and rainwater had developed on the top of the camboose. That "concretion layer" did not extend down the sides of the mound. Once the boarders of the unit were established, Sandy Hunter began removing the top layer of soil. Almost immediately the bowl of a clay pipe was exposed. The soil around it was removed, the bowl was lifted, and it was placed in a bag identified on the outside by location on the grid. A few more artifacts were found but more important were the stories told in the soil layers. We found evidence that sand had been piled on an original soil surface and that wood had been used around the camboose to hold the sand in place. That was a confirmation of what had been found at another camboose shanty site nearby.

Sandy had to return home after just a week at the AWRS but I enjoyed staying another six days at the Station to do an additional half unit excavation on the side of the camboose, as well as some shovel testing around the camboose. That work revealed evidence of flooring made of wooden poles made flat on top, as well as indicating that there had been log walls of a shanty around the camboose.

I have a feeling that the first mound we excavated was from a shanty, but one of a later date than the camboose and its shanty. There is no knowing if signs of a camboose associated with that first mound were removed during excavation of the drainage ditch, but there may not have been one to remove and surely it would have been noticed. I am assuming that the mound was from a shanty heated by an iron stove (a stove shanty), as was sometimes the case for a period of time in the late 1890s. While no artifacts from the camboose suggest a specific date, clay pipe specialists in Britain who were consulted suggest a date between 1860 and 1875.

So far the AWRS Research Report is the first publication in which this work has been mentioned, although I have plans to publish a short note in the Ontario Archaeological Society newsletter, *Arch Notes*. A chapter on the archaeology of camboose shanties will be included in an upcoming edition of a book to be published by The Friends of Algonquin Park in the spring of 2024.

One highlight for me during my stay, was the interest shown in my work by other researchers doing more traditional work in biology. It was a good feeling to be included in the daily life of the Station. I was even invited to participate in some evening volleyball games, although I decided my older bones would benefit more from watching the fun than risking active participation. ♦

ACKNOWLEDGEMENTS

Thanks are extended to the Superintendent of Algonquin Provincial Park and the Science Research folks at Ontario Parks who approved the research. The report has been sent. An additional thanks to the managers and staff of the AWRS who accommodated our every need. This work would not have been as pleasantly done without the assistance of Dora Yateman, an observer from the Algonquins of Ontario, who got to actually participate in doing archaeology, and especially Raymond "Sandy" Hunter, who drove from Rhode Island to assist in this work and learn about Algonquin Park logging camp studies.

Rory Mackay excavating at the side of the Stephenson Site camboose mound. Photo by Sandy Hunter.

ON THE SLIME TRAIL ACROSS ALGONQUIN PARK: SURVEYING SNAILS AND SLUGS

Written by Annegret Nicolai

Terrestrial gastropods are the third-most successful group of terrestrial animals, yet they are poorly studied, especially in Canada. This is surprising, because they are of biodiversity significance among ground dwelling species. They play important ecological roles, particularly nutrient cycling in the soil, providing food for other animal species (e.g., birds and parasites) and determining plant community structure. They are often utilized as ecological indicators (e.g., for management of logging in forests of British Columbia or for anthropogenic disturbance in ecosystems). The IUCN lists over 1000 terrestrial gastropod species as extinct, endangered, critically endangered or vulnerable worldwide with habitat loss and perturbation responsible for two thirds of population losses. Climate change is another threat to terrestrial gastropods as they are highly vulnerable to extreme and fluctuating temperatures in the winter due to the loss of snow cover in many temperate regions and to prolonged droughts and fires in the summer.

Although many species have been noted as being rare in Canada, only 14 terrestrial gastropods are protected under the federal species at risk act, with a few more to be assessed in the near future by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Most of the species of conservation concern occur in the Carolinian forests of southwestern Ontario, which is a highly developed agricultural area with only a few forest remnants. Some species are historically known from the deciduous or mixed wood forests from throughout southern Ontario and southern Québec. As all snail and slug species rely on a moist microhabitat and decaying plants and logs with fungus for food, they could still be found in undisturbed forests with deep leaf litter and many decaying logs on the ground. Logging has directly disturbed the snails' and slugs' habitat and induces long-term changes in tree and understory vegetation composition as well as soil parameters that will further affect the gastropod populations.

For the past 10 years, I have been surveying gastropods in forests in Canada—mainly in Ontario and Québec. The search for rare terrestrial gastropod species in particular focuses on any well-preserved forest, starting with sites where the species have been historically found. Algonquin Park is one such historical occurrence site for Big-tooth Whitelip (*Neohelix dentifera*) based on a record from J. R. Dymond and another unknown person at Smoke Lake in 1942 and 1957, respectively. Big-tooth Whitelip is a very rare species, looked for in the past by the Ottawa Naturalists Club. Despite many hours of search effort, the search was not successful. Many doubtful records are discussed in the literature, some museum records raise more doubts, some other specimens have disappeared and these records can not be confirmed. It is this cryptic and mysterious species that I came looking for in the vicinity of Smoke Lake in September 2022. I've found many other species ranging from those that are much smaller to those that are the same size as Big-tooth Whitelip. If you find any snails or slugs in the park, please send pictures to the AWRS to help us learn more about terrestrial gastropods in Algonquin Park and hopefully find the very rare Big-tooth Whitelip. ♦

ACKNOWLEDGEMENTS

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AWRS x FREED: BREAKING DOWN BARRIERS AND CULTIVATING DIVERSITY IN ECOLOGY AND EVOLUTION

Written by Justice King

Growing up in the Rocky Mountains and on the North American West Coast, I always felt at home in the outdoors. My passion for wildlife and nature led me to pursue an academic path in ecology and evolution. Despite a natural interest in science and comfort with the outdoors, throughout my academic career, I was often left questioning whether I could pursue scientific research and fieldwork. I attributed this to the lack of mentors I saw myself reflected in as a black student in science. At the Algonquin Wildlife Research Station (AWRS), I had my first encounter with fieldwork, where the natural world ceased to be just a backdrop and instead became a landscape where I could confidently pursue my career goals. My initial visit to the AWRS was in the spring of 2023 for an independent research project. During my time at the Station, I discovered a sense of independence in my research, studying temperature-dependent embryonic development in the Spotted Salamander (*Ambystoma maculatum*) at Bat Lake. I became invested in understanding how interconnected and dependent species are within their ecosystems. While my research at the Station helped me find my footing in science, my journey in ecology and evolution has also become a pursuit of breaking down the barriers that often hinder Indigenous, Black, and/or Racialized (BIPOC) individuals from accessing and thriving in this field. This led me to my next outdoor adventure, Field Research in Ecology and Evolution Diversified (FREED), an initiative aligned with my vision of an inclusive and accessible ecological science and hosted at the AWRS.

FREED's grassroots approach to increasing access to field research, outdoor experiences, and mentorship for BIPOC students is more than just an initiative; it's a movement reshaping the landscape of ecological studies. Driven by graduate students and early career professionals in ecology, evolution, and conservation, FREED organizes events that offer field research and outdoor experiences to students from diverse backgrounds and various universities. These events aren't just about learning technical skills; they're a journey towards building community, understanding nature, and nurturing a sense of belonging in the field of ecology and evolution. The program aims to address the disproportionate challenges Indigenous, Black, and/or Racialized students face in connecting with nature and pursuing careers in ecology. For many within BIPOC communities, establishing a connection with nature is often hindered by various barriers, including financial constraints and lack of representation in the field. These challenges arise from historical and ongoing biases, where naturalist work, initially a colonial enterprise, led to exclusive scientific practices and institutions. Addressing these issues head-on, FREED was established to dismantle these barriers and foster inclusive ecological research. To address financial barriers, FREED covers transportation, accommodation, and food costs and provides students with equipment subsidies and wage bursaries. In 2023, FREED had 42 participants, including myself, with organized events at the Toronto Zoo, Bronte Creek Provincial Park, and the AWRS, providing immersive experiences in naturalist-based courses, skills development, and community building.

Participation in FREED broadened my ecological perspective with diverse aspects of field research and naturalist experiences. The workshops not only complimented my focused research at the AWRS, but enriched and expanded my understanding of how Western Science and Indigenous Knowledge can be woven together when studying ecology. We participated in daily workshops, with topics ranging from invasive plant identification, entomology, science communication and illustration, pollution and aquatic ecosystems, forest management, and land stewardship, contextualizing the broader implications of ecological studies. Skills-based workshops like learn-to-canoe, hosted by The Friends of Algonquin Park, and fly fishing, hosted by Brown Girl Outdoor World, equipped students with practical, hands-on knowledge on how to navigate our time outdoors, fostering a more

Photo: Samantha Stephens

well-rounded understanding of fieldwork and fun, all within a supportive environment. FREED allowed us to disconnect from the chaos of daily life, providing us with an opportunity to breathe and take in the world around us.

Following my experiences in 2023, I decided to continue my journey with FREED as a leader to take part in planning and organizing a week-long event at AWRS for August 2024. I aim to instill in future generations of FREED students the same sense of possibility I experienced at the AWRS. My upcoming 2024 workshop on amphibian development and ecological interactions will be an exciting opportunity to share the insights and skills I've gained through my own research as a BIPOC individual. As a leader, I am excited about creating a space where diversity in ecology is acknowledged and celebrated, and students from all backgrounds can see themselves as integral parts of the ecological community. Through both my experiences as a student researcher, a FREED participant, and now a FREED leader, I've learned the importance of inclusive mentorship and developed a more holistic view of how various aspects of ecology and evolution interact and influence each other and how to make the field more accessible and inclusive.

I invite you to explore more about FREED and its impactful work in promoting diversity in ecology. For those interested in learning more or supporting our mission, please visit our website or read our event summaries: AWRS, Toronto Zoo, and Bronte Creek. This year, there are many ways to support us, such as spreading the word, donating to our initiative, or getting in touch at directorsfreed@utoronto.ca. Together, we can continue to nurture a community of field biologists who advocate for inclusivity and sustainability. ♦

SUPPORT EDUCATION AT THE AWRS

You can make a one-time donation or sign up to be a monthly supporter on our CanadaHelps profile. Your support helps fund equipment for educational programs, and subsidize accommodation costs for students participating in field courses at the AWRS.

REFLECTING ON MY FREED EXPERIENCE

Written by Ephrata Gidey

I remember the day I received the email that I had been accepted into the Field Research in Ecology and Evolution Diversified (FREED) program. I was overjoyed to have been given this opportunity that I had been waiting for throughout my undergraduate degree. I was eagerly counting the days until I arrived at the Algonquin Wildlife Research Station, looking forward to all the valuable knowledge I was about to learn. Initially, I felt a bit hesitant when meeting all the staff and students, as I didn't know anyone who was going on this trip. However, after the first campfire, I felt a sense of belonging. Many of us shared the same goals, anxieties and vulnerabilities in a place that felt foreign to us, but soon felt like home. Throughout the week, the workshops opened my perspectives on what it means to conduct and present scientific research. I used to think that research was strictly done in the lab, as that was the only type of research that I had been exposed to before this experience. Therefore, I had thought that lab work, or research in general, wasn't for me due to the anxiety and stress I experience when preparing for lab sessions in school. On the other hand, fieldwork taught me that research doesn't have to be in a controlled environment. Experiencing research in a natural setting rather than a lab setting reminded me that research can have surprising outcomes, and those outcomes can lead to something great.

The aquatic workshop was an incredible experience. Wearing the waders made me feel like an astronaut taking my first steps on the moon. Collecting samples using different techniques and identifying various aquatic species was engaging. I also learned about different types of sciences, communication skills, and how the general public needs access to research papers. In addition, I never thought I would enjoy collecting insects. Normally, I would be opposed to this activity if it was taking place in the city, but since I was in the great outdoors, I decided to give it a try. I was surprised that I caught a cricket with my hands! It signified to me that I was becoming more comfortable with my surroundings.

The activity that struck me the most was camping. I had never been camping before, so I was excited for the occasion. Camping showed me the beauty of nature and taught me to respect the land. I was lucky enough to wake up early in the morning during the camping trip and head to the lake. I was able to capture a breathtaking photo (below) that perfectly represented the emotions I felt on this trip—a sense of tranquillity, being in the present moment, and finding inner peace. Allowing myself to be fully present during this experience has made me even more grateful for the natural world around me and helped me forge a deeper connection with it. This experience has inspired me to consider a career path that involves fieldwork and has reminded me of a passion I thought I had lost—caring for the environment. I'm grateful for this opportunity and the positive impact it has had on my life. ♦

Photo: Ephrata Gidey

Photos: Samantha Stephens

Photos: Samantha Stephens

THE BENEFITS OF EXPERIENTIAL LEARNING AT THE AWRS

Written by Dylan Pond

THE VALUE OF IMMERSION

This past September, I had the privilege of taking a group of high school students to the AWRS for a short three-day field trip. I had worked at the AWRS on the long-term small mammal project in the summer of 2011, and since I had such a good time, I have been hoping to organize a field trip to the Station since I started teaching high school five years ago. I found my summer at the AWRS a formative time in my science career, and I hoped to share the immersive experience of field work at the Station with my students.

While planning the trip I tried to think back to what I found most valuable about my time at the AWRS. As a technician, I learned many practical field skills that I am thankful for, but what truly stuck with me is being completely immersed in Algonquin Park surrounded by like-minded people. Whether I was on a trapline, hiking a trail with my camera, or sitting at the dinner table, I was constantly immersed in the ecosystem of the park, and I was constantly observing. I came to the AWRS with an interest in biology and left with a passion for it. I hoped to share just a fraction of that experience with my students, and judging by their feedback, I believe that is what happened.

HYPOTHESIS TESTING

As a teacher, it is easy to treat science as a series of facts or concepts that we learn in a textbook and lose track of the process of science itself. This sometimes causes students to assume that we know everything there is to know about science. Giving the time and space to allow students to make interesting observations and ask interesting questions is the first step in the research process. Being in the field helps the students practice formulating hypotheses and consider how research is conducted.

As a part of our International Baccalaureate (IB) program, completing hypothesis-driven experiments is a requirement for all of our science courses. The first designed experiment we do is always a collaborative project between the entire cohort. In a typical year, we give students a general theme that they have to plan an experiment around. This year we decided to complete the collaborative project at the AWRS.

OUR TRIP

Once our transportation was booked and everyone had paid their deposit, I broke the news to my students that the AWRS has very poor cell signal and they probably would not be able to use their phones for three days. If you are reading this and don't spend much time around teenagers, you might not truly understand how much of a concern this was to our students. The lack of cellular service greatly impacted the immersion experience for the students.

From an educational perspective, I think there are some serious advantages of doing a project like this with no internet access. With internet access, one of the first things that most students will do is search Google to try to come up with ideas. Without the internet, students are forced to use their own observations, thoughts, and creativity to design an experiment. Due to the time constraints of having only three days on site, we placed a strong emphasis on recording observations and asking questions.

We focused our observations on a couple of key areas within walking distance of the Cookhouse, that we felt had a distinct enough ecology; The Chit Lake Trail, the Station road, and the shoreline of Bat Lake. In each of these locations, groups of students would lay a 20 meter transect and to the best of their abilities, record everything they could find, taking observations along the way.

Finding several Red-backed Salamanders was certainly a highlight for many of our students. The diversity of mushrooms that seemed to change between each site was an emphasis of many questions and observations.

In the evenings, we spent most of our time either playing volleyball or gathered around the campfire. Once the sun had set, several students continued their observations when they discovered that several species of mushrooms would glow under a black light. Peter Simons was kind enough to come to the Station to discuss the biology of the Eastern Wolf with our students, which was a highlight for many of them.

REFLECTION

It is now February of 2024, and I recently asked my students to reflect on what was memorable about our trip to the AWRS. For many of them, this was the first time that they had truly experienced being outdoors away from a town or city. Almost all their comments surrounded this idea of immersing themselves in Algonquin Park. For some of them, it was about being outside of the classroom and having hands-on experiences. For others, the social immersion helped to build a stronger cohort in the class. Since September, many students have been asking me if we can take another trip out to Algonquin Park, so I am pretty sure that it was a success. Out of the 22 students that were on this trip 12 had never been to Algonquin Park, nine had never seen a salamander, and four had never been camping before.

THOUGHTS FROM STUDENTS

"At the AWRS, I researched the moisture content of mushrooms with my peers to determine if there was a correlation between the moisture content and the pH of the soil. To do this, we took many different samples in varying locations and elevations from a small body of water. The variety of wildlife surrounding the research station provided much diversity in our research. Although the results of our research were inconclusive, being able to conduct our study at AWRS was immeasurably helpful to learning about wildlife biology. The Station itself, as well as the abundance of wilderness surrounding the Station, made it an incredible location for our research project and being so close to the natural world during our visit was an incredible experience."

-Taya Kiidumae

"In our research at the park, we were able to investigate many different wonders of our natural environment in Ontario. As a class we conducted our own research in small groups which allowed us to gain knowledge on the specific relationships between certain aspects of the environment such as temperature and pH and its effect on specific species located within the park, like ferns, moss and mushrooms. We did this by exploring areas near the research station where we resided for the duration of the trip, like Bat Lake. The research my group specifically did was to discover if there was a relationship between soil pH and the length of a mushroom cap. We conducted this by measuring the cap size of a mushroom, then taking a small sample of the soil which surrounded it, and then measured the soil pH with a pH meter. Our results showed there was no correlation between the two, but the experiment allowed for us to educate ourselves on various biomes within the Algonquin forest and the many different mushroom species within it. We also had an opportunity to be educated on the Eastern Wolves, and how their species developed and ended up local to Algonquin. We didn't just do research, we also shared other experiences like eating and cleaning up as well as sitting around a campfire after a long day's work of researching, and we were able to share stories of our experiences at the park. This experience was a great way of acquiring knowledge, but it was also an opportunity to get closer to our peers and have a bonding experience revolving around the nature of our home land. Personally, the experience was so inspiring that I applied to work there during the summer of 2024, it gave me a new perspective of Canada's land and a great appreciation for all that it holds."

-Maia Bailey ♦

Winter Retreat: A Widlife Club Tradition

Written by Chloë Chang

As our car drove up the dark road towards the brightly lit cabin with its giant icicles and hat of snow, I felt my fingers starting to grab at the door handle in anticipation. My feet crunched on the snow as I felt my nostrils freeze, but I saw the brightest smiles on everyone's faces. The Winter Algonquin Trip at the Algonquin Wildlife Research Station is a Wildlife Club tradition. Kevin had already turned on the heaters for all the cabins, so each was welcomingly warm as our impressive group of 20 unloaded their things.

As other drivers slowly made their way up, we all settled with hot chocolate and tea and excitedly chatted about the amazing finch eruption this year and what we were hoping to spot. Our members range from plant fiends to ichthyology enthusiasts—Algonquin always has something for everyone. Observing and appreciating wildlife is always the draw for our club's trips, but the Winter Algonquin Trip is particularly special because of its extraordinary opportunities to observe mammals and winter boreal birds.

This opportunity is precious and special for so many of us who don't live in the north and could never experience this nature otherwise. Last year, I remembered having my mind blown by otter slides and Snowshoe Hare tracks in the snow as a girl from the southwestern-most tip of continental Canada. This year, we were all amazed at the towering Red Pines that gently sprinkled icy dust onto our faces when the wind blew, frosty orange Witch's Butter Mushrooms on fallen logs, and the burrows of Deer Mice on our Bat Lake hike.

Coming to the AWRS is the only trip that we run every year, and we do so because of its perfect location in the park that allows us to spot wildlife each morning, amenities like a full kitchen for us to make pancakes in, and the care from the staff that helps us feel safe. The AWRS is a magical place because of the wildlife, the memories, and the people who make it feel like a home away from home. Each of us spotted new species for the first time, bought new field guides from the Visitor's Centre, took incredible close-up photos of Pine Siskins and White-winged Crossbills flying around the Birdhouse Cabin, made new friends while playing card games and chess in the cozy Director's Cabin, or felt our souls warmed in the brisk nights with views of the stars. ♦

Photo: Chloë Chang

PUBLICATIONS

2023 PEER-REVIEWED RESEARCH PAPERS

Addison EM, Thompson DP, McLaughlin RF & DJH Fraser. 2023. **Influence of Winter Ticks (*Dermacentor albipictus*) and temperature on recumbent behaviour of Moose (*Alces alces*).** Canadian Journal of Zoology 101: 317–326.

Fieschi-Méric L, Van Leeuwen P, Denoël M & D Lesbarrères. 2023. **Encouraging news for in situ conservation: translocation of salamander larvae has limited impacts on their skin microbiota.** Molecular Ecology 32(12): 3276–3289.

Fieschi-Méric L, Denoël M & D Lesbarrères. 2023. **No detection of ranaviruses nor chyrids among salamanders and newts in Algonquin Provincial Park, Ontario, Canada.** Herpetological Review 54(2): 204–207.

Moldowan PD. 2023. **Hyperpredation of freshwater turtles and tortoises by subsidized corvids.** Herpetological Monographs 37: 70–94.

MEDIA

2023 MEDIA APPEARANCES

SALAMANDERS

Canadian Geographic Magazine. Sept/Oct 2023. Big Picture: Celebrating Canada's Grandeur. Features image of salamander-eating pitcher plant by Samantha Stephens. [Print & Online]

Canadian Geographic Magazine. Best of Canadian Geographic 2023. Big Picture: Celebrating Canada's Grandeur. Features image of salamander-eating pitcher plant by Samantha Stephens. [Print & Online]

GEO Magazine. Oct 2023. Features image of salamander-eating pitcher plant by Samantha Stephens. [Print]

The Economist. End-of-year science newsletter 2023. Our Image of the Year. Features image of salamander-eating pitcher plant by Samantha Stephens. [Online]

TURTLES

BBC. 2023. Big Little Journeys, Episode 1. Featuring a Painted Turtle sequence filmed at the Station with guidance from Patrick Moldowan. [Online]

BBC. 2023. Why did the Turtle Cross the Road? Featuring an interview with Patrick Moldowan. [Online]

DEFENDED THESES & STUDENT PROJECTS

The AWRS has been a host to many graduate and undergraduate students since its inception in 1944. We continue to provide exceptional opportunities for students to gain invaluable experiential learning in field biology. Listed here are the students that graduated from their studies in 2023.

GRADUATE

Hughes, Bryan. 2023. The role of animal personality in the pace-of-life of coexisting rodents. MSc Thesis, Laurentian University.

Keevil, Matthew. 2023. Demographic processes and behaviour of Snapping Turtles (*Chelydra serpentina*) in the context of past catastrophes and ongoing threats. PhD Thesis, Laurentian University.

Leivesley, Jessica. 2023. Evolution and ecological consequences of temperature-dependent sex determination in long-lived reptiles. PhD Thesis, University of Toronto.

Lacroix, Claudia. 2023. It's time to go: ecological and social drivers of nest emergence in turtles. MSc Thesis, University of Toronto.

Meuser, Amanda. 2023. Hybridization among leuciscid minnow species in anthropogenically disturbed environments. MSc Thesis, University of Guelph.

Moldowan, Patrick. 2023. Ecology and sensitivity to environmental change of a northern population of Spotted Salamander, *Ambystoma maculatum*. PhD Thesis, University of Toronto.

UNDERGRADUATE

Duval, Kiara. 2023. The effect of distance to anthropogenic structures on rodent Pace of Life and behaviour. Undergraduate Thesis, Laurentian University.

Goss, Julia. 2023. Anogenital distance: not a predictor of masculinized behaviours in female rodents. Undergraduate Thesis, Laurentian University.

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IF YOU ARE INTERESTED IN BEING A SPONSOR, PARTNER OR USER OF THE ALGONQUIN WILDLIFE RESEARCH STATION PLEASE CONTACT KEVIN KEMMISH AT ALGONQUINWILDLIFERESEARCH@GMAIL.COM OR +1-705-633-5621.