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Instructions for Authors

We will print articles and news of interest to herpetologists in Canada. These may be in the form of short announcements or letters, or may be written as longer articles. We especially request news of your lab and current conservation and research activities, lists of your latest publications (up to one year old), travel plans, new students, grants, awards, fellowships, new books or book reviews, trivia or concerns. We also encourage you to send in your photographs of Canadian herpetofauna. Please send your submissions as MS Word documents attached to an email to the Editors (jlitzgus@laurentian.ca or Joe.Crowley@ontario.ca).

EDITORIAL NOTES

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Happy spring! A very long cold winter in Ontario turned into instant summer, although things are still behind in phenology. The peonies in my front garden typically bloom on June 1st, but at the time of editing this spring issue of TCH (June 16th), they still had not bloomed. Nonetheless, the turtles are now nesting and the mosquitoes and black flies are biting in full force. Ah, field season…

It was a great spring for financial support for stewardship research on Species at Risk herps in Ontario with several projects being generously supported by the Ontario Ministry of Natural Resources Species at Risk Stewardship Fund. Such agency recognition of the need to investigate and mitigate threats to Canada's amphibians and reptiles seems quite appropriate given that this is the Year of the Salamander, as Joe Crowley describes in one of this issue's Feature Articles. Other contributions in this issue range widely from the effects of mountain biking on herps in the West to a volunteer effort to save Blue Iguanas in the Cayman Islands.

Included herein is also the call to our first annual general meeting as our new merged society! Hope to see you all in Calgary, Alberta in September. Big thanks to all the contributors to this issue of TCH. Enjoy!"

MEETINGS

TCH will post announcements about upcoming herpetological meetings and provide reports of recently-held meetings.

CHS Annual General Meeting
Calgary, AB
12-15 September 2014

Greater Short-horned Lizards, Prairie Rattlesnakes and Plains Hog-nosed snakes… No I'm not taking about Saskatchewan, this is Alberta, baby!

Greater Short-horned Lizard (Photo by Nick Cairns)

The Canadian Herpetological Society will be hosting its first Annual General Meeting (AGM) in western Canada this year. The meeting will be held 12-15 September 2014 at the University of Calgary, Calgary, AB. Register and submit your abstract before August 1st to receive the early registration price!

The meeting will kick off with registration and a wine-and-cheese reception on Friday evening beginning at 7pm. The platform and poster presentations, as well as keynote speakers, will be on Saturday September 13 and Sunday September 14th. There will also be an optional banquette, award presentations and general business meeting on the Sunday. We will finish off with a field trip on Monday September 15th (more details about the field trip to follow).

Accommodations: The Hotel Alma, located on the university campus, is providing a reduced group rate of $125 per night for CHS meeting delegates. The hotel rate includes Wi-Fi internet, local and long-distance phone calls, continental breakfast and gym access. There is also a mini-fridge, microwave, and coffee maker in each room. We encourage guests to stay at the Hotel Alma because of its proximity to the conference: the Friday evening wine and cheese will be on the top floor of the hotel, and the conference will take place in an adjoining building. Stay tuned to the CHS website for further conference details and registration (carcnet.ca). We look forward to seeing you there!

The CHS Meetings and Workshops Committee

Joint Meeting of Ichthyologists and Herpetologists (JMIH)
Chattanooga, TN
30 July - 3 August 2014

The 2014 Joint Meeting of Ichthyologists and Herpetologists (JMIH) will take place at the Chattanooga Convention Center in downtown Chattanooga, Tennessee, USA on July 30–August 3, 2014. It will include the 30th annual meeting of the American Elasmobranch Society (AES), the 57th annual meeting of the Society for the Study of Amphibians and Reptiles (SSAR), the 72nd annual meeting of the Herpetologists' League (HL), and the 94th annual meeting of the American Society of Ichthyologists and Herpetologists (ASIH). The meeting will be hosted by the amazing Tennessee Aquarium and the University of Tennessee at Chattanooga. See http://www.dce.k-state.edu/conf/jointmeeting/ for more information.

FEATURE ARTICLES

2014: The Year of the Salamander

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Photographs by Joe Crowley unless otherwise indicated

On one of the first warm, rainy spring evenings after the snow had retreated, my wife Amelia and I — equipped with our GPS, flashlights and notepad — headed to a spot just north of Peterborough, Ontario. The sun had just set by the time we arrived and we began driving along the road very slowly, our eyes peeled for anything that wasn't a leaf or a twig. We were in search of amphibians, specifically salamanders on their spring migration from overwintering sites to breeding ponds. We found about twenty-five Blue-spotted Salamanders and a few large Spotted Salamanders, their bright yellow spots almost glowing in the light of our headlamps. At one place, we stopped to move two salamanders off the road and before we

could return to our car another two had emerged from the darkness of the surrounding forest and were slowly but diligently making their way across the road. After assisting about eight or nine salamanders across the road at this hotspot we continued on with our successful evening.

Blue-spotted Salamander (top) and Amelia Argue helping a Spotted and Blue-spotted Salamander across the road (bottom)

Salamanders are very abundant in many ecosystems, occurring at densities of up to two individuals per square meter. A classic study at the Hubbard Brook Experimental Forest by Burton and Likens (1975) found that salamander biomass was twice that of birds during peak breeding season and equal to that of small mammals. Consequently, salamanders play an import role in their ecosystems as predators of invertebrates and prey for larger animals. Partially owing to their high abundance in most forest ecosystems, as well as their sensitivity to environmental conditions, salamanders are commonly used as indicators of ecosystem health and environmental change.

The day after our evening road surveys, I sent an e-mail around our office with a summary of our findings and a few photos. Shortly thereafter, one of our administrative assistants dropped by my desk and asked "what are those?" After I explained that they were salamanders, she exclaimed, somewhat in disbelief "do those occur around here — in Ontario!?" It's an interesting reminder that, despite their high abundance in North American forest ecosystems, many people have never seen one and may not even know what they are. Salamanders spend most of their time foraging and hiding under leaf litter, logs, rock or even underground. Their secretive behaviour is driven by predator avoidance as well as the need to remain moist in order to avoid desiccation. Thus, salamanders are rarely encountered outside of targeted surveys, even by biologists and naturalists. The result is a general lack of knowledge about this unique and important part of our biodiversity, as well as a paucity of data on species abundance, trends and distributions. A recent analysis of the past five years of data from the Ontario Reptile and Amphibian Atlas demonstrated that salamanders are, by far, the most under-reported taxonomic group of herpetofauna.

2014 has been designated as the Year of the Salamander by Partners in Amphibian and Reptile Conservation (PARC) and other conservation groups. This campaign will help to raise awareness about salamanders, the role they play in our ecosystems and their conservation needs. It is also a call to organizations, researchers and individuals to make a concerted effort to contribute to salamander education, research and conservation. As an example, Ontario Nature is hiring a "salamander intern" to analyze existing salamander data in Ontario and set up a research project. Specifically, Ontario Nature wants to determine if the significant reduction in salamander occurrence data is related to observer bias — simply a lack of observations due to the cryptic nature of the species — or a real decline in salamander abundance in some parts of the province.

Four-toed Salamander

Check out the PARC year of the salamander website (http://www.parcplace.org/news-a-events/2014-year-of-the-salamander.html) for ideas about how you or your organization can get involved in the Year of the

Salamander campaign. An easy way to contribute is to get outside and collect some information about salamander species occurrences in your area and submit that information to your local Conservation Data Centre or herp atlas. Share your salamander stories with friends, family and co-workers, or encourage them to accompany you in the field. Although salamanders are cryptic and finding some species can be a challenge, there are several tips and tricks that can be helpful. The rest of this article will provide a little more information about the types of salamanders that occur in Canada, the habitats they reside in and how to search for them.

There are twenty-four species and subspecies of salamanders in Canada. Although some species, such as the Dusky Salamanders, have very limited distributions just north of the U.S. border, others like the Eastern Newt and Blue-spotted Salamander occur throughout relatively large areas in Canada.

The Mole Salamanders, family **Ambystomatidae**, make up half of the salamander species diversity in Canada. As the common name implies, these species are highly fossorial and spend most of their time under cover or underground. In the spring they travel to vernal pools or permanent wetlands and ponds where they breed and deposit their eggs in the water. The larvae are aquatic and breathe through gills. These salamanders are most conspicuous in the spring during the breeding season. They can be encountered moving to their breeding ponds on warm rainy nights, and for a few nights during the peak of breeding they are very abundant in the ponds. They can also be located throughout the spring by searching under logs, rocks and other cover on the forest floor near the breeding sites. Most of these species retreat underground and are difficult to find during the warm summer months.

Blotched Tiger Salamander of the family Ambystomatidae (Photo by Nick Cairns)

The other salamander family that encompasses most of the remaining Canadian species is the **Plethodontidae**. This group of species does not have lungs and breathe entirely through their skin, so they need to remain moist at all times to facilitate respiration. Several of the species in this family, such as the red-backed salamanders and the Wandering Salamander, are fully terrestrial and do not migrate to breeding ponds in the spring; instead, they lay their eggs in moist habitats such as in rotting logs or under cover on the forest floor. These species can be found by searching under cover in forest habitats. Although the terrestrial Plethodontids can be detected throughout the active season, they become more difficult to find during dry conditions. Other species within the family Plethodontidae, such as the Dusky and Spring Salamanders, are highly aquatic and inhabit forest streams, especially in mountainous regions and on the Canadian Shield. In Canada, the eggs of these species are deposited in or around streams and the larvae are aquatic with gills. These stream salamanders can be found by carefully searching under cover in and around stream habitats throughout the active season.

Two Plethodontid species: Eastern Red-backed Salamander (top) and the Northern Dusky Salamander (bottom)

The Mudpuppy is the only member of the family **Proteidae** in Canada and is also our largest salamander species, attaining adult lengths of up to 45 cm. This species is neotenic; individuals retain larval

characteristics and remain fully aquatic as adults, breathing through large, red, feathery gills. Mudpuppies inhabit deep water of large lakes and rivers which makes them difficult to search for — except when forced into the shallows around dams and other structures — but they can occasionally be found under rocks along shorelines.

The Eastern and Rough-skinned Newts belong to the family **Salamandridae**. The Eastern Newt is aquatic but breathes through lungs rather than gills, and Rough-skinned Newts can be either terrestrial or aquatic as adults. Interestingly, Eastern Newts have a terrestrial juvenile stage — the Red Eft — that occurs between the aquatic larval and adult stages. Aquatic newts can be found in wetland habitats and shallow bays of lake and rivers, whereas the terrestrial newts can be found under cover in the forest floor.

Eastern Newt (adult)

Last but not least, the largest terrestrial salamander species in North America is the Coastal Giant Salamander, of the family **Dicamptodontidae**. In Canada, this species is found near streams in forest habitats in the Chilliwack River Valley of British Columbia.

When searching for salamanders, there are a few important considerations to keep in mind. Always return cover objects to the way they were found so that the microclimate under the cover remains suitable for salamanders. Before replacing the cover object, encourage the salamander to move out of the way so that it does not get crushed. Salamanders are very sensitive to handling and should not be picked up unless necessary. If handling salamanders, ensure that your hands are free of chemicals and lotions such as insect repellent and sunscreen as these toxins will be absorbed through the salamander's porous skin. Remember that salamanders have to stay moist to facilitate gas exchange through their skin, so they should never be exposed to dry conditions. And of course, avoid picking up salamanders by an appendage or the tail as this can cause injury or may even entice some Plethodontid salamander to autotomize (drop) their tail. Even exclusive of rough handling, many salamanders — especially the newts — secrete toxins through their skin when nervous, so be sure to wash your hands after handling salamanders.

Wandering Salamander

I hope you've finished this article feeling inspired to learn more about salamanders and explore and document the local salamander diversity in your area. For more information about Canadian salamanders, check out the species accounts on the CARCNET website (www.carcent.ca). Other good resources include *Salamanders of the United States and Canada* by J.W. Petranka as well as *North American Amphibians: Distribution and Diversity* by D.M. Green, L.A. Weir, G.S. Casper, and M.J. Lannoo. Have a great 2014 field season and take the time to celebrate the Year of the Salamander!

Trail Hazards: Outdoor Recreators and the Seasonal Movements of Reptiles and Amphibians

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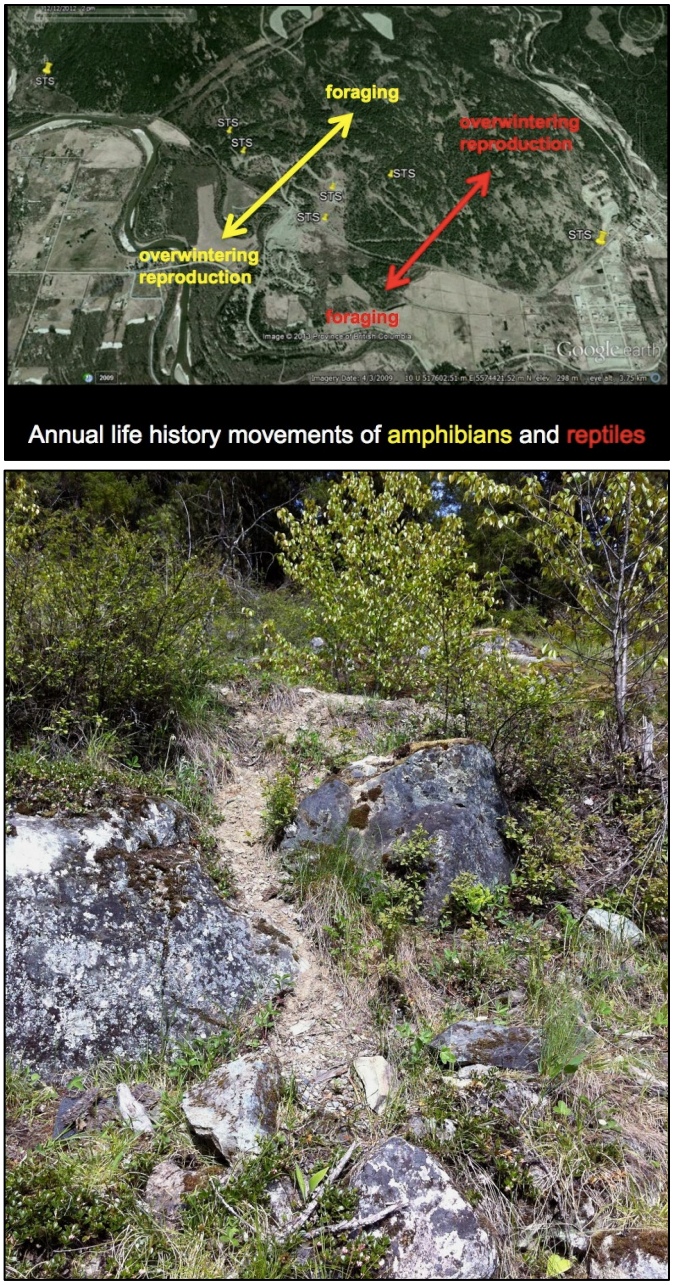
Photographs by Leslie Anthony

It is spring, and young folks' fancies across the country rightly turn to love… and mountain biking. Of course humans aren't the only animals that mate in

spring, and the habits around that behaviour have an interesting relationship to our other spring preoccupation. Like roadways, mountain bike trails can become death zones for migrating reptiles and amphibians, some of which are already endangered and threatened species. So here's the dirt on what's out there in the spring-to-summer season on the West Coast and how you can encourage local conservation and recreation groups to do their part in helping to avoid making things messier (so to speak) — and maybe even help out herp atlas efforts with sightings.

To begin, wintery mountain towns like Whistler (alt. 600 m), where I dwell, don't have as many species as nearby Squamish (sea level coastal climate) and Pemberton (alt. 200 m and a hybrid Interior-Coast climate), both of which host earlier thaws that attract mountain bikers like spring robins and ensure that most bike-meets-critter problems occur in these places. Second, although most of these animals are rarely seen, in spring they aggregate in various places for purposes of mating. Generally salamanders and toads and some frogs overwinter in or near valley bottom wetlands. Then, after migrating to ditches, ponds and slow streams to mate and lay eggs, slowly disperse away into cooler forest and upland foraging habitat. Because they're going up and away from water, they often cross the things humans like to build along watercourses—railroads, roads, trails. But because amphibians (excepting toads) generally have moist semi-permeable skin, they pretty much confine their immigration/emigration to rain events, and even then mostly at night when predators won't see them. Unless you're riding under these conditions you won't threaten too many amphibians. Still, on the south coast it is possible to encounter land-loving adult Red-legged frogs (an endangered species in BC) and Western Toads (a threatened species) more than a few of which can be seen pancaked on both hiking and mountain bike roads and trails each spring.

It makes sense, then, to keep your eyes on the ground around wetlands. Another reason for doing so involves the snake fauna, particularly populous and diverse in areas like Pemberton and further inland. Snakes spend winter in hillside dens on south-facing slopes, mating there in the warm days of May, then transiting to the valley floor for the summer—basically the opposite of amphibians. The area around wetlands is particularly busy because many snakes feed there—on the same amphibians that you're trying to avoid squashing (another, albeit pyrrhic, reason for doing just that). With three species of gartersnake along the coast, and these animals being among the most abundant vertebrates in many habitats, squashing too many means interrupting a major mechanism of energy transfer between aquatic and terrestrial ecosystems, especially in river valleys spotted with remnant wetlands. This is how to explain it to laymen and wide-eyed kids: solar energy blooms algae in the water; tadpoles eat the algae, then transform into frogs that consume enormous numbers of insects; snakes eat the frogs, and then birds and a few carnivorous mammals eat the snakes. Why would you want to get in the way of that?



Schematic of herpetofauna movements (top) and West Coast mountain bike trail (bottom)

In spring and summer at lower elevations you'll encounter gartersnakes coming and going between wetlands and forest or rocky hillsides for a few hours every morning and late afternoon. These are the major

times they get squished, so that's when to be on the lookout. And though garternsnakes are numerous and not in need of conservation, abundance can decrease with mortality pressure. In Pemberton, for instance, the Mackenzie Forest Service Road that's so popular for downhill mountain bike drops sees numerous dead gartersnakes and alligator lizards (another common insect-munching species) littering the lower portion *every day* in the summer. That's why bikers will notice "Brake for Snakes" signs for vehicles and cyclists—courtesy of the local Stewardship Pemberton Society—on the way in and running along the base of the hillside.

When it comes to snake hazards in this part of the world, however, the biggest problem is a tricky one to solve, though awareness is again the best tool for conservation.

Although it is a species of "special concern" in B.C. because of widespread habitat loss, the primitive Northern Rubber Boa is, for the moment, common enough in Pemberton and other Interior towns; good thing, too—if it weren't for the abundance of this and other snake species many valleys would have a genuine rodent problem. Despite its constrictor pedigree, the boa is harmless and never, ever bites, its somnolent nature making it easy to remove from trails and roads by bikers and hikers alike. This secretive semi-burrower is active only at dusk and nocturnally in summer, but occasionally seen abroad on warm, cloudy days in spring—usually crossing trails on its way from hillside dens to the rodent-ridden grass- and cropland of the valley bottom. A few bracelet-like young are live-born sometime in July or August; they're pink or orange-ish in colour and look more like worms; being small, tough to see and coloured like vegetation means they're particularly vulnerable to unintentional squashing. Knowing when you might see rubber boas helps: early morning rides are particularly snakey in this regard.

Lastly, although it is rarely, if ever, seen abroad, these same dry, south-facing, open-canopy hillsides that make for such great mountain biking on Vancouver Island, some of the Gulf Islands and in the Pemberton Valley, are also perfect for the tiny (30 cm max), ultra-secretive, egg-laying Sharp-tailed Snake, a federally and provincially endangered species first discovered in Pemberton in 2011 (the only mainland population in the province, see TCH vol. 2, no. 2) and currently under threat from large-scale developments planned for these hillsides. The problem with Sharp-tails—and boas to some extent—is that they hide under rocks and logs on these hillsides, so riding trail edges and off-trail can kill them without you even knowing (see photo); I recently even found Sharp-tail hatchlings under a rock at a popular rock-climbing belay stance! Ditto for building trails without consulting organizations like Stewardship Pemberton (*stewardshippemberton.com*) that study these animals and can advise on proper trail placement in delicate habitats.

Northern Rubber Boa (top) and young Northern Rubber Boa killed on bike trail in Pemberton (bottom)

And finally, it is good to advise recreators of all stripes that if they see *any* creatures out there, even if they are accidentally squashed, take a photo and send it to the local conservation organization—distribution data is another key to conservation.

My Time with the Blues

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Photographs by Daniel Greenberg

Last fall, I had just finished my Masters degree, and a summer filled with lab experiments and writing my thesis had left me hungry to find some adventure of a herpetological nature. I began to search online for opportunities that would let me stretch my legs, experience new places, escape the frigid comings of winter, and work with cool herpetofauna. Recalling a brief article I'd read many months ago in a daily newspaper about an organization that worked with endangered Blue Iguanas (*Cyclura lewisi*) in the Caribbean, I discovered the Blue Iguana Recovery Program (BIRP). I was pleased to learn they accommodated volunteers and quickly contacted them. One month later, I found myself on the sunny island of Grand Cayman, where the Blue Iguanas are endemic, to help out with a project that involved radio-tracking iguanas at a release site in the remote island interior.

Endangered Blue Iguana

I knew little about the Blue Iguanas before I arrived except that they were endangered and had declined precipitously over the past few decades primarily due to habitat loss, various introduced species, and human persecution. I was picked up from the airport by two staff members who'd been happily working with BIRP for many years. They both started with the project as volunteers and, like many people working with BIRP, became captivated by the iguanas. For the first few days we visited various sites around the island where the Program is active in working with the iguana populations. The base of central operations is located in the Queen Elizabeth II Botanical Park, a large expanse of tended gardens and natural woodlands that hosts the BIRP breeding facility. It is here that they raise and care for both juvenile and adult Blue Iguanas, giving them a head start before they are released into the wild. In this matter, the Program has been very successful. Over 700 individuals have been raised in this facility and released at various sites around the island, and this has helped bring the island population from a mere 15 wild individuals in 2003 to an estimate of 750 as of last year. These impressive numbers belie the relative modesty of their facility, which consists primarily of outdoor pens and many rows of smaller wire cages, which house adults and juveniles, respectively. At the facility, juveniles are reared to a size where they are relatively safe from predators, principally the endemic Cayman Racer (*Alsophis cantherigerus caymanus*), and thus have much better prospects for survival in the wild. This operation requires a lot of human effort, every other day the staff at the breeding facility travel around the island in the early morning to gather various native flora for the iguanas daily meals. Their recipe has been perfected over many years to optimize growth and health of the iguanas, but varies with the availability of local vegetation. The facility requires a lot of upkeep. Cages must be repaired, cleaned, and maintained, and much of this work is done by both local and international volunteers. The success of this program therefore is evidently not simply a matter of scale or funding, although both of these help, but rather lies in the dedication and hard work of the people.


Cayman Racer

I was able to experience just how hard this work can be. Before I was to begin tracking iguanas at the remote release site, I had to learn the ropes by assisting with the capture of iguanas for processing. Every individual iguana that has been caught has a unique marker, consisting of a series of coloured beads attached to the crest, as well as an internal PIT (passive integrated transponder) tag that serves as a backup to visual

identification. As beads fall off due to shedding and gradual wear and tear, iguanas must be captured frequently and re-beaded, which also offers an opportunity to assess their growth and overall health. The Blue Iguana is a front-runner for the largest lizard in the Western Hemisphere, and they come equipped with sharp nails, sharper teeth, and a strong set of jaws and limbs. Needless to say they can be a handful, and any close encounter will generally end with you covered in scratches and likely defecated upon. However, this is almost worth it, as up close they are truly beautiful creatures, with magnificent hues that range from slate gray to a bright turquoise. Coupled with their prehistoric appearance and numerous spikes and spines they are about as close as you can get to real life dragons.

Why the Blue Iguanas are blue is of course a subject of much speculation. From an evolutionary stand point, they are about 3 million years separated from their closest relatives the Cuban Iguana (*Cyclura nubila*). The blue phenotype therefore likely represents a novel mutation in this isolated population that was driven to fixation by sexual selection. While the blue colouration actually does make them blend in remarkably well with parts of the landscape and the shadows of vegetation, the lack of natural predators on the Grand Cayman means it's rather unlikely that the blue colouration was driven by natural selection as camouflage. Recently, it has been found that there is considerable introgression within some Blue Iguanas that possess *C. nubila* DNA, including almost all of the individuals held in private collections and public zoos in the past. As such, maintaining pure lineages and preventing hybridization both in captivity and the wild, where occasionally Cuban Iguanas show up possibly via shipping vessels from the nearby islands of Little Cayman and Cayman Brac, is of high priority for the long-term integrity of the species. Thankfully, pure-bred founder lines have now been established in many zoos as part of an *ex situ* recovery program, which acts as insurance against extreme disaster events that may threaten the island population, particularly hurricanes.

The appearance of the Blue Iguanas matches their environment quite well. Both the iguanas and their habitat are rugged, slightly dangerous, but distinctly beautiful. While mentioning the Cayman Islands would cause most people to conjure up an image of international bankers and wealthy, tax dodging, ex-patriots lazing about on white sand beaches (fairly accurate, I may add) the iguanas occupy a very different reality that most tourists never see. The natural habitat of the interior of Grand Cayman Island consists primarily of wet subtropical forests to the west, and dry xerophytic scrubland to the east, following a rainfall gradient driven by the unusual water and air currents that surround the island. Both of these habitat types exist on top of the precarious karst topography that serves as the island's backbone. For the uninitiated, karst refers to the dissolved layers of porous, carbonate based rocks that create a very distinctive landscape of jagged rock edges, rock holes, and caves. Essentially, this base is derived from the 'skeletal' systems of ancient coral reefs, which form the geological basis of much of the island. It's hard to adequately describe what this looks and feels like exactly, but it could perhaps be best described as walking on sharp razor blades with numerous holes to trip on or fall into — almost a jungle-overgrown Mordor.

Blue Iguana in its habitat (top) and close up (bottom)

As you can probably imagine, this is a very dangerous landscape to work in, as any fall will likely lead to stitches and a strong dose of antibiotics. Coupled with this is a selection of flora that seems designed to at least annoy, if not outright maim, you. Some of the most toxic plants in the Americas are found here. To name a few, the manchineel tree (*Hippomane spp.*) exudes a water soluble toxin that can cause blisters with skin contact, and even blindness, needless to say you want to avoid walking under these trees when it rains. Maiden plum (*Comocladia dentate*) is a very common plant that releases a sticky, toxic, black sap when the leaves are

broken. I was able to witness what this sap can do first hand, when an unfortunate BIRP staff member contacted it on his hand during trail clearing. It first started with a mild blister, which results in incessant itching for the next several weeks, and culminates in what can only be described as a type of necrosis as the blister expands and turns the flesh a disturbing black. Interestingly, the Blue Iguanas themselves appear to be impervious to these toxins, as they have been observed foraging on both of these plants with no ill effects. Needless to say, there are a few occupational hazards working in this environment.

After a few days of getting acquainted with the Iguanas and their environment I was ready to start radio-tracking the Blue Iguanas full-time in the remote release site on the interior eastern end of the island. Accessing the site is the first challenge, as it involves a 1 km hike along a perilous trail off a dirt road. While this doesn't sound like much, indeed my first reaction was to dismiss this as a minor inconvenience, putting it into the context of the landscape means this hike takes about twice as long as it should, if not more, to complete. Balancing over jagged rock formations, avoiding all manner of spiny or toxic plants, while hauling in all the gear and food needed for a few days in the bush made for a fairly exhausting warm-up to a long day of field work. Once you make it through this trek, however, you really do feel a comforting sense of remoteness from the outside world. Given the hurdles in accessing the site, the amenities available at the camp set up in the reserve are quite remarkable. A large carport served as a break from the sun, within this was a small but functional kitchen area and a few air mattresses covered by a mosquito net for sleeping. This set up provided a rustic, but functional and charming abode that was still essentially like sleeping outdoors. I discovered this quickly during my first night, as the camp came alive with insects and their predators, Cuban tree frogs (*Osteopilus septentrionalis*) and "Woodslave" geckos (*Aristelliger praesignis*). While the geckos and frogs provided ample evening entertainment, there were also many unwelcome visitors, including large scorpions (better than small ones at least!), black widow spiders, and the ever grating presence of rats, which would descend upon our kitchen area looking for scraps every night. During my first sleepless night, as I listened to these rats scurry about the camp, I at least discovered a new phobia. Thankfully, the long days of tracking meant for most of my time in the field I was often too tired to care about such inconveniences.

Despite these hurdles, working with and observing Blue Iguanas in their natural habitat was simply fascinating and certainly worth the risk. Even as someone who has always loved reptiles and observed them frequently in nature, I was quite shocked at the level of intelligence and individualism the Blue Iguanas appeared to exhibit during my daily monitoring and tracking of individuals. Not only do they show fairly complex social dynamics in their interactions with other iguanas, including what appears to be a dominance hierarchy and the communication of territory and mating rights, but they even seem distinctly curious towards humans. Several times while clearing trails or tracking individuals I would have an iguana come over to observe me, check out what I was doing, give a head bob of recognition and then amble off. While living at the remote field camp, we would wake up with the sunrise, make a cup of coffee and be greeted in the morning by the usual cast of iguanas who would come by to catch the morning sun and bob at each other and us. Over several weeks, as I got to know the individuals I was tracking, it became quite evident that each had a somewhat unique 'personality' (and I truly hesitate to use this word), as they varied considerably in their habits, activity, and behaviour. It is easy to see how they've captured the interest of the people who work with them and why they have begun to attract the attention that they have from both the public and funding agencies.

The remote field camp (top) and a Cuban Treefrog (bottom)

At the end of my experience, I began to reflect on what we can learn from the success of the Blue Iguana Recovery Program and how it can be applied to the current situation for herpetofauna conservation in Canada. While certainly the initially dire situation, endemism, and charismatic nature of the Blue Iguana naturally lends itself to a strong public response to their demise, there are many aspects of the Program that have resulted in its tremendous success. These include involving the local community, encouraging and supporting volunteers, acquiring government support and actively promoting their organization. One aspect that BIRP, in conjunction with the government, has been particularly successful with is public awareness of the Blue Iguanas. Almost every Island resident, and many of the tourists, are made aware of the Blue Iguanas' story. On Grand Cayman, the Blue Iguana is used as a marketing tool. It is a symbol of the Cayman Islands, and this inherently gives the species a lot of value. This perhaps is something we overlook here in Canada, although granted there are few species that are amenable for this sort of 'branding', but this is a strategey that conservation organizations could and should be attempting to help raise public awareness, which will in turn direct needed funding. There are many species of *Cyclura* iguanas distributed throughout the Caribbean and almost all are very unique, endemic, and highly endangered. Thankfully, for most species, there are now local recovery efforts run by start-up conservation organizations, many of which have been modelled after BIRP, which have been improving the outlook for many of these fascinating and evolutionarily distinct reptiles.

Blue-throated Anole (*Anolis conspersus conspersus*)

While I hate to end on a low note, it must be stated that the Blue Iguanas aren't quite completely 'out of the woods' yet. As you may be aware, the Cayman Islands are a tax haven, with no personal income tax. Of course, governments still need revenue, and for the islands this is primarily through indirect taxation, including through property taxes and land transfer fees. As a result, the government is distinctly pro-development (well, aren't they all) to the point where much of the non-protected habitat, including most of the islands' interior, is under threat of becoming another hotel development or opulent mansion. This point is driven home at the eastern release site. Recently a road was constructed to the interior to service a planned visitor's center located on the edge of the refuge that has recently been funded to promote the Blue Iguanas and generate revenue for the Program. This road has now opened up previously inaccessible land for development, and is currently lined with realty signs promoting the many acres for development. This land was exactly the sort of habitat the iguanas seem to thrive in, and now much of it will likely be destroyed. And of course, with this development comes increased traffic, humans, and feral animals, which represent a big threat for the Blue Iguanas.

On my last day at the field site, as I hiked out towards this service road and looked upon the many 'for sale' signs along the road, I couldn't help but think that if I ever come back here, the beauty and remoteness are things I will never truly experience again. Despite this, I do believe the continued and dedicated work of the Blue Iguana Recovery Program will ensure that this species will always have a space carved out for them in the Cayman Islands, thankfully, as they are simply too unique to lose.

For more information on the Blue Iguana Recovery Program, and Blue Iguanas generally, visit www.blueiguana.ky.

FIELD NOTES

The Ojibway Massasauga Recovery Project

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Monitoring surveys are ongoing in Windsor and LaSalle Ontario targeting one of the last populations of Eastern Massasaugas in Canada's Carolinian zone (the Ojibway Prairie population). As of late April 2014, we have been conducting standardized detection surveys to better estimate detection probability and occupancy of this endangered and declining population. We are monitoring a total of 14 two-hectare sites within the current and historical range of the species. As of mid June, Butler's Gartersnakes and Eastern Foxsnakes (the

two other Species at Risk snakes in the study area) have each been detected at six or more sites, whereas Eastern Massasaugas have only been detected at two closely situated sites. Based on our results from 2013, we expect the presence of this species will be confirmed at a third site, which is in close proximity the other two." Regardless, in the absence of management interventions, the steady trend in range decline is strongly suggesting the population will become extirpated in the near future. A feasibility study has been completed and submitted to the Ministry of Natural Resources in order to solicit feedback and approvals to begin a population augmentation program.

Massasauga (photo by Joe Crowley)

BOOK REVIEWS

This section of TCH includes reviews of not just books but other vehicles for the dissemination of information that might interest Canadian herpetologists.

Bibliography of Anuran Literature

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Recently, I had the pleasure of being asked by the SSAR to review Kenneth Dodd's new book on the Frogs and Toads of the United States and Canada (Hecnar 2014). Dodd's (2013) two volume tome is destined to become the definitive reference source on the natural history, biology, and conservation of anurans for the foreseeable future. Herpetological Conservation and Biology recently published a monograph of an updated bibliography from the text that covers the published literature on anurans in the United States and Canada from 1734 to the end of 2012 (Dodd 2014). This bibliography was produced to be a free downloadable reference source for North American herpetologists. While Ken did an excellent job of locating most of the published literature for each species it is not complete. Dodd quoted Ernie Liner "You can't get them all!" but he is definitely trying. Dodd deserves a medal for this contribution alone to herpetology. He confided to me that one must be off their rocker (and retired) to attempt such a task. He is trying to track down any other publications that he may have missed that deal with individual species or communities of anurans. The bibliography is downloadable as a searchable pdf. If you use the bibliography and can think of other publications (no later than 2012) that have been missed, please send them along to Ken for inclusion in the next update. A good place to start is with your own publications involving anurans – did he find and include them? Please send any overlooked citations to Ken by email and he will be very grateful < http://www.herpconbio.org/Volume_8/monographs/Dodd_2013.pdf >

Dodd, C.K., Jr. 2013. Frogs and Toads of the United States and Canada, two volumes. John Hopkins University Press, Baltimore. xxvii + 982 pp. ISBN10: 1-4214-0633-0.

Dodd, C.K., Jr. 2014. A bibliography of the anurans of the United States and Canada (1734-2012). Herpetofaunal Conservation and Biology, Monograph #4. 208 pp. http://www.herpconbio.org/Volume_8/monographs/Dodd_2013.pdf

Hecnar, S.J. 2014. Book Review: Frogs of the United States and Canada by C.K. Dodd Jr. Herpetological Review 44: 175-178.

THESIS ABSTRACTS IN CANADIAN HERPETOLOGY

TCH publishes abstracts of recently completed Honours, M.Sc., and Ph.D. theses from Canadian universities and professors. Students or their supervisors are invited to send abstracts to the Editor.

Baxter-Gilbert, J.H. M.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisors: J. Litzgus and D. Lesbarrères)

The long road ahead: Understanding road-related threats to reptiles and testing if current mitigation measures are effective at minimizing impacts

Reptile populations are suffering substantial global losses and roads are identified as one of the leading threats to their persistence. Currently, efforts to mitigate this threat are being implemented with various levels of success. I studied the effectiveness of exclusion structures (*i.e.,* fencing) at preventing reptiles from gaining access to the road, and reducing road mortality. I also examined if population connectivity structures (*i.e.,* ecopassages) were effective at reducing habitat and population fragmentation and allowing individuals to access habitats, resources, and mates on both sides of a major road (4 lane highway). I found that the fence was ineffective at preventing reptiles from gaining access to the road; however, reptiles were observed using the ecopassages to cross the road. Behavioural trials testing painted turtles' (*Chrysemys picta*) willingness to use an ecopassage demonstrated that refusal was twice more likely than use of an ecopassage. I also examined the potential for roads to pose a physiological threat to roadside populations of reptiles by examining corticosterone (CORT), a stress hormone linked to negative health effects in cases of elevated levels over the long-term. To assess if individuals living near a major road had higher CORT levels than individuals from a less impacted population, I developed a novel means of measuring CORT from painted turtle claws in partnership with Dr. Gabriela Mastromonaco (Toronto Zoo). With long-term CORT levels considered as a proxy for chronic physiological stress, I did not find evidence that populations near roads had altered stress levels. However, this seminal study will provide the framework for further examination of more species, including species-at-risk, and a better understanding of effects of anthropogenic environments on wildlife health. As road ecologists strive to expand our understanding of the threats roads pose to reptiles, it is important that this field spans multiple disciplines, so that we can both understand the direct and indirect threats that roads cause and develop effective mitigation that preserves biodiversity within our anthropogenic landscape.

Beale, M. B.Sc. 2014. University of Ottawa, Ottawa, ON. (Supervisor: G. Blouin-Demers)

Anthropogenic disturbance increases movement and crypsis in western diamond-backed rattlesnakes (*Crotalus atrox*)

Anthropogenic disturbance contributes to species endangerment, but relatively few studies have examined the interactions between reptiles and humans. The purpose of our study was to test the hypothesis that movements and concealment of western diamond-backed rattlesnakes are affected by anthropogenic disturbance. We predicted that rattlesnakes would have a higher probability of movement and be more concealed in highly disturbed areas. Twenty-five rattlesnakes were captured at the Arizona-Sonora Desert Museum near Tucson, Arizona, between July 2005 and September 2011 and were equipped with radio-transmitters. During the active season, rattlesnakes were significantly less likely to move while in highly disturbed areas. During the mating season, however, rattlesnakes were significantly more likely to move while in highly disturbed areas. During the inactive season, unsurprisingly, disturbance had no significant effect on the probability of movement. In all seasons, rattlesnakes were more likely to be concealed in highly disturbed areas. Therefore, anthropogenic disturbance affects movement and concealment of western diamond-backed rattlesnakes, but not always in the way we had predicted.

Châteauvert, J. M.Sc. 2013. University of Ottawa, Ottawa, ON. (Supervisor: G. Blouin-Demers)

Influence of feeding ecology on mercury accumulation in turtles and fish of the Rideau Canal, Ontario, Canada

Pollution is a major cause of biodiversity declines worldwide. Therefore, understanding exposure and uptake mechanisms for contaminants such as mercury (Hg) is a crucial step in our efforts to understand the causes of species decline. I investigated the influence of dietary reliance on the benthic food chain, and the influence of the proportion of zebra mussels in the diet, on the accumulation of Hg in freshwater fish and turtle species. I collected turtle blood samples and fish muscle samples in 2012 and analyzed these tissue samples for carbon and nitrogen isotope ratios (δ13C and δ15N), and for Hg concentrations. Isotopic ratios were used to calculate trophic level, dietary reliance on the benthic food chain, and the proportion of zebra mussels in the diet. Reliance on the benthic food chain was a good predictor of Hg concentration in fish muscle, but not in turtle blood. The proportion of zebra mussels in the diet was not a good predictor of Hg in turtles or in fish. My results indicate that dietary reliance on the benthos should be considered in future tissue Hg modelling studies for fish, and that this predictor variable could be used to identify other fish species likely to be burdened by high concentrations of Hg.

Dano, M. B.Sc. 2014. University of Ottawa, Ottawa, ON. (Supervisor: G. Blouin-Demers)

Does landscape composition determine home range size of Blanding's turtles, *Emyoidea blandingii*, in disturbed habitats in Ontario, Canada?

Habitat loss is a major factor in species decline around the world (Venter et al., 2006). Almost all of Blanding's turtle (*Emydoidea blandingii*) habitat in Ontario has some degree of anthropogenic disturbance. To maintain relevant protection criteria for this species at risk, we must investigate what factors influence their home range size. I hypothesized that landscape composition predicts home range size. Using radio telemetry and GPS tags we recorded location data for 39 turtles (33 females, 6 males) from April 2012 to October 2013. I used a multiple linear regression model to show that the proportion of four landscape classes were marginally significant in predicting home range size. There was no significant difference in home range size of males and females. My results suggest that we should be concerned with the conservation of high quality upland areas and wetlands within Blanding's turtles habitat. Landscapes across the province have varying proportions of disturbed areas. Further research could determine at what proportion disturbed environments begin to significantly affect home range size.

Blanding's Turtle (Photo by Joe Crowley)

Ellis, N.M. B.Sc. 2013. Lakehead University. Thunder Bay, ON (Supervisor: S. Hecnar)

Body size and clutch size determinants of geographic range size in reptiles of North America

Range maps of 351 North American reptiles were analyzed in order to determine how range sizes were influenced by geographic variables, body size and clutch size. Variables measured included range size, perimeter, north-south and east-west extents, latitude and longitude midpoints, body lengths and clutch size. Range sizes were analyzed by order and body form. Range size frequency distributions were significantly right skewed similar to other taxa. Mean range size did not differ among reptile orders. Mean range sizes of snakes were significantly larger than lizards which may reflect their trophic position and dispersability. Range sizes of lizards were significantly correlated with latitude and clutch size, while range sizes of snakes were found to be significantly correlated with body mass. Multiple regression demonstrated that range sizes of all reptiles was positively correlated with clutch size and negatively correlated with latitude. Multiple regressions on lizards showed that range sizes were positively correlated with clutch size and negatively correlated with longitude, while range sizes of snakes were positively correlated with body size. This study establishes that range size can be partially explained by differences in body size and clutch size for particular species. It further reveals that rules for ectotherms may not follow previously described rules for endotherms.

Hewitt, B. B.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisor: J. Litzgus)

Aggressive behaviour and combat in sexually mature male snapping turtles (*Chelydra serpentina*)

Aggression between males is observed in many sexually dimorphic animals and male combat often occurs in response to limiting resources such as shelter, food, or females. If females or mating opportunities are limiting factors, then males may compete with one another for access to females. Sexually mature male snapping turtles (*Chelydra serpentina*), which are larger than females, engage in combat during the mating season and often sustain injuries to the face and tail. I hypothesized that larger males would sustain more injuries compared to smaller males because larger individuals engage in combat more frequently. I also predicted that females would not display combat injuries. Data regarding injuries were extracted from Microsoft Access® database records spanning 2009 to 2013 from a long-term study (started in 1972 by R.J. Brooks, University of Guelph) in Algonquin Provincial Park, and only records with individual physical descriptions were included in the statistical analyses. I found that larger males sustained more injuries than smaller males indicating that larger males were more aggressive and were more likely to engage in combat. Males had significantly higher than expected rates of injury, and females and juveniles had lower than expected rates of

injury. Furthermore, there was a positive relationship between rate of injury and carapace length, supporting the idea that larger body size is advantageous in species that engage in male-male combat. No juveniles had combat-related injuries, suggesting that male-male combat comes with sexual maturity and increased levels of testosterone. In future studies, head measurements of males of different body sizes should be taken to test for allometry, and blood samples should be collected to examine testosterone levels of males involved in combat. Understanding combat between males in snapping turtles has important implications for better understanding the evolution of mating strategies.

Snapping Turtle (Photo by Joe Crowley)

Kamula, C.M. B.Sc. 2012. Lakehead University. Thunder Bay, ON (Supervisor: S. Hecnar)

Seasonal water analysis of amphibian breeding ponds in Northwestern Ontario

Water is essential for life on Earth; it provides a medium for biological processes and influences the chemical composition of all organisms. Small bodies of water are highly susceptible to seasonal chemistry changes due to drastic modification in hydrological inputs such as flooding and outputs such as evaporation, many times resulting in drought, over summer and fall. The purpose of this study was to examine the seasonal trends of water chemistry in semi-permanent and permanent water bodies used as breeding sites by amphibians in Northwestern Ontario. The ponds selected were from a subset of ponds used for long term amphibian studies in and around the City of Thunder Bay, Ontario, Canada. Water samples were tested for various water chemical variables and compared with spring and summer water data previously collected from the same ponds. ANOVA and Tukey post hoc tests were used to determine if water chemistry variables differed among seasons. An ANOVA and multiple regression were used to determine if associations occurred among fall water chemistry, land use type, and various geographical features. Ponds had good buffering capacity throughout the seasons with relatively neutral pH and increasing concentrations of alkalinity and calcium throughout the year. Hard water within the study area could increase the toxic effects of aluminum, particularly for ponds exceeding the recommended limits of aluminum (0.1 mg/L) while sulphate toxicity may be lessened due to harder water. Nutrients such as sulphate and potassium decreased during summer which is attributed to increased assimilation by plants during the growing season. Sodium and magnesium increased during summer months likely as a result of concentration from evaporation and increased use of pond water for irrigation. Total nitrogen, total phosphorous and total suspended solids were higher in fall but were likely attributed to a nearby forest fire rather than seasonal trends.

Greenberg, D.A. M.Sc. 2014. McGill University, Montreal, PQ. (Supervisor: D. Green)

Population dynamics of a declining amphibian

With concern rising over the global decline of amphibian populations, identifying the onset of declines and the factors driving them is paramount. Amphibian populations are naturally characterized by large fluctuations in abundance, which makes separating natural fluctuations from true declines very difficult. By improving our understanding of the natural dynamics of amphibian populations, we can separate normal fluctuations from altered dynamics associated with decline. I apply this principle to an endangered population of Fowler's toads (*Anaxyrus* [=*Bufo*] *fowleri*) in Long Point, Ontario which appears to have gradually declined in abundance. With over two decades of mark-recapture data, I investigate what factors, intrinsic and extrinsic, drive growth in this population. Over this same period, there have been considerable changes to the toads' habitat, as an invasive strain of the common reed, *Phragmites australis*, has overtaken the wetlands used by toads for breeding. I show that the expansion of this reed has altered the dynamics of the toad population, causing progressive decline due to breeding habitat loss. Prior to 2002, the population of toads was driven by density-dependent growth and overwinter mortality. After 2002, at which point the reeds had eliminated most of the open water habitat, the population of toads responded only to extrinsic factors, particularly the water level of Lake Erie. I then ask whether the

expansion of invasive *Phragmites* has changed not just the quantity of larval habitat, but also its quality, through the release of secondary compounds. I hypothesize that Fowler's toad larvae, as obligate gill breathers, will experience reduced survival, growth, and development in the presence of gill damaging secondary compounds from the invasive *Phragmites* and native *Typha*. In contrast, the sympatric Northern leopard frog (*Lithobates* [=*Rana*] *pipiens*) should exhibit similar performance as tadpoles in the presence of secondary compounds, as a facultative gill breather. Contrary to my expectations, I found that Fowler's toad tadpoles had a similar performance across treatments, despite the presence of secondary compounds. Furthermore, the native plant, *Typha*, but not the invasive *Phragmites*, appeared to impede growth in Leopard frog tadpoles. Based on these results, I conclude that the expansion of invasive *Phragmites* has the potential to impact species through changes to available habitat, but not by reducing larval habitat quality. By incorporating population dynamics into the study of amphibian declines we can improve our ability to infer causal links between population declines and the mechanisms that drive them.

Fowler's Toad (Photo by Scott Gillingwater)

Maillet, Z. B.Sc. 2014. University of Ottawa, Ottawa, ON. (Supervisor: G. Blouin-Demers)

Exploratory and defensive behaviours change with sex and size in eastern garter snakes (*Thamnophis sirtalis*)

Behavioural syndromes are important to consider when examining behaviour in animals since they can help explain the persistence of maladaptive behaviours. These suites of correlated behaviours may be governed by underlying factors such as body size or sex. Behaviours such as exploration, boldness, and defense may vary with body size and sex because different intensities of a behaviour may be advantageous for males versus females, or at different body sizes. I tested the hypothesis that there is a behavioural syndrome related to body size and sex in *Thamnophis sirtalis*. I conducted three behavioural trials to elicit three separate responses on wild snakes from eastern Ontario, Canada. I measured exploratory, boldness, and defensive behaviour to investigate whether a syndrome between these behaviours existed in garter snakes. Although the presence of a behavioural syndrome was not found, exploratory and defensive behaviours were related to body size and sex. The relationship between exploratory behaviour and size differed between males and females. Defensive score was lower in males than in females, meaning that males were more likely to flee when faced with an attack. I also tested the assumption of individual consistency in behaviour and found that the measured behaviours were consistent through time. Future studies should further investigate whether snakes have behavioural syndromes, while taking into account the individual consistency of behaviours.

Mendler, A. B.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisors: D. Lesbarrères and J. Litzgus)

Murder Mystery at Misery Bay: Demise of a turtle population

Turtle populations are declining worldwide. Habitat loss, climate change, and disease are some of the major causes associated to these declines. In Misery Bay Provincial Park on Manitoulin Island, 49 Blanding's Turtles (*Emydoidea blandingii*; BLTU), a threatened species, were discovered dead last summer. I tested two hypotheses to explain this mass mortality: (1) The mortality was caused by predation; (2) The mortality was a result of an outbreak of ranavirus. Deceased BLTU were photographed and examined for signs of predation. Bone (spine and small bones) and dried skin were collected from deceased animals. Blood, tail tips, cloacal and oral swabs were collected from 4 live BLTU. Toe tips were collected from 13 frogs (n=5 *Lithobates clamitans*; n=8 *Lithobates pipiens*) and DNA was extracted from all tissues (n=98) using standard protocols and tested for ranavirus using TaqMan quantitative PCR. Similar inner carapace markings were found in 31 specimens and broken limbs were associated with 14 BLTU; however, no obvious pathologies resulting from predation or scavenging were observed. It is inconclusive whether or not a predator caused the mass mortality. Further studies of the park and its turtle population must be conducted to understand and test the predation hypothesis. Of all 98

DNA samples, only 1 green frog toe clip had low levels of FV3-like virus. Despite these negative results, we cannot confidently exclude ranavirus as the cause of the mortality because the virus is short-lived, therefore it is possible too much time had elapsed for it to be detected. Also, the bone samples may not have had enough marrow, which is where the virus would likely be present. Future studies include collecting different sample types from deceased BLTU for molecular analysis and monitoring of the turtle population for any signs of disease.

Neufeld, C.J.H. B.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisor: J. Litzgus)

Effects of habitat fragmentation on the spatial ecology of two endangered turtle species

Habitat fragmentation occurs when a habitat is divided into smaller, non-continuous pieces. It can be caused by anthropogenic disturbances (roads, settlements, etc.) or by natural disturbances (forest fires, floods, etc.). Having a smaller habitat to live in can alter the behaviour of the species within that habitat, and such alterations can include changes in home range size and daily movement patterns. My study focused on how habitat fragmentation affects the spatial behaviour of spotted turtles (*Clemmys guttata*) and Blanding's turtles (*Emydoidea blandingii*), and the potential implications for the recovery of these at-risk species. I hypothesized that habitat fragmentation would decrease home range size and movement patterns of both species because it will restrict movement. I also hypothesized that Blanding's turtles would be less affected by habitat fragmentation than spotted turtles because of the mobile nature of Blanding's turtles. Therefore, I predicted to see smaller home range sizes and smaller daily movements in fragmented compared to non-fragmented habitats for both species, and I predicted that Blanding's turtle home ranges would be larger than those of spotted turtles in fragmented habitats. I found that home range size and daily distance moved were smaller in fragmented habitats for spotted turtles, but there was no difference in spatial attributes between fragmented and non-fragmented sites for Blanding's turtles. These results indicate that Blanding's turtles are less susceptible to habitat fragmentation than spotted turtles. Knowing this is important in designing roads and other infrastructure that could affect the home range sizes of these endangered species, and thus could lead to better mitigation measures and conservation efforts.

Perron, M.A. B.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisors: K. Sasaki and J. Litzgus)

Climate-growth relationship in snapping turtles (*Chelydra serpentina*): Development of an innovative approach

Ectothermic animals, specifically chelonians, are among the most vulnerable to climate change, yet the sensitivity of turtle populations to these effects is still relatively unknown. Since growth rates of turtles are related to their fitness, long-term growth data are fundamental to predicting responses to changing climate. Part of the challenge is that long-term growth data on turtles is scarce due to their life history, which includes great longevity. Conventional methods to obtain these data, including mark and recapture, are costly and time-consuming. To address this issue, an alternative method is proposed that involves the analysis of annual growth increments visible on the carapace scutes, which if correctly dated, can provide multi-decadal growth data. A dendrochronological (tree-ring study) technique, crossdating, was applied to the growth increments present on the scutes of snapping turtles (*Chelydra serpentina*) from a population in Algonquin Park, Ontario, Canada. Crossdating allows for accurate dating of annual growth increments by cross-matching the synchronous growth response of individuals in a population to local climate variables. Such synchronicity was present among a subset of individual female turtles from the population, indicating the potential application of crossdating to this species. Age-related growth trends were statistically removed from crossdated increment data to elucidate climate-related annual variability in growth chronologies. Average growth of those individuals (1950-1984) was significantly correlated with several monthly climate variables, including summer drought, January, May and July precipitation, as well as February temperature. Such growth responses suggest that the predicted future increase in drought at the study site could negatively affect the studied population. Overall, results suggest that crossdating may be applied to other populations to provide long-term growth data and establish climate-growth relationships.

Tremblay-Beaulieu, C. B.Sc. 2014. Laurentian University. Sudbury, ON. (Supervisors: K. Sasaki and J. Litzgus)

Effects of mining on the physiological ecology and morphology of herpetofauna in Sudbury, Ontario

A century of Sudbury's mining operations has created barren landscapes with high levels of heavy metals and acidity. Our previous population-level studies of amphibians and reptiles found that severely affected sites (barren), despite their superficial recovery in vegetation cover, had lower numbers of species and lower abundances compared to reference sites. The purpose of the current study is to investigate the mechanisms behind these differences in population ecology. To test whether population-level effects are driven by individual-level variation resulting from mining impacts, we investigated the morphology and physiology of individuals from barren and reference sites. We measured bilateral asymmetry in scalation (snakes), limb deformation (frogs), body condition and standard metabolic rate (SMR, snakes). We predicted that animals from the barren sites would display poorer body condition, higher levels of asymmetry, and elevated metabolic rates as compared to animals from reference sites. We found that the proportion of individuals with limb deformities was higher in barren sites for both mink frogs (9.0%) and green frogs (4.2%) compared to reference sites where no frogs with deformities were found (0%). Limb deformities can impact fitness and the higher proportion of frogs with deformities in the barren sites may explain the lower abundances of anurans observed in these sites. Patterns of snake scalation differed between our two target species; red-bellied snakes had more asymmetries in barren sites whereas garter snakes had more asymmetries in reference sites. Preliminary analyses of metabolic rates indicate that there were no differences in SMR of snakes between barren and reference sites. Additional data on the physiological variables will be presented. These findings are important because they shed light on the mechanisms underlying impacts at population- and community-levels, and will thus help to develop more targeted restoration strategies in the context of mining operations.

RECENT PUBLICATIONS IN CANADIAN HERPETOLOGY

TCH lists recent publications by Canadian herpetologists working in Canada and abroad. Please send to the Editor a list of your recent papers, and send citation information for new papers as they come hot off the presses.

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Spotted Turtle (Photo by Joe Crowley)

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Northern Ring-necked Snake (Photo by Joe Crowley)

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NEWS AND ANNOUNCEMENTS

Two New IMPARAs Designated: Covey Hill and Grasslands National Park

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The CHS Board of Directors recently approved recommendations forwarded by the IMPARA Committee to designate two new Important Areas for Reptiles and Amphibians in Canada: Covey Hill, Quebec and Grasslands National Park, Saskatchewan, at its meeting in March 2014. These two newest sites along with two others designated late in 2012 raise the total number of IMPARAs to nine sites across the country, bringing added recognition to the importance of these areas for conserving Canada's herpetofauna. Following is a list of the current IMPARA sites:

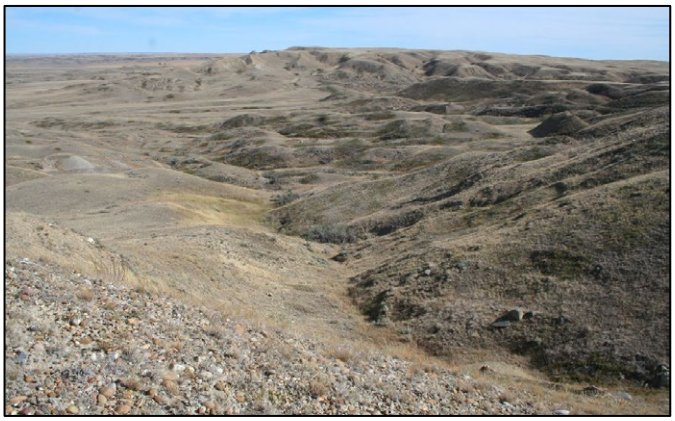
1. South Okanagan-Lower Similkameen Valley, BC
2. Creston Valley Wildlife Area, BC
3. Narcisse Wildlife Management Area, MB
4. Pelee Island, ON
5. Cootes Paradise, Carrolls Bay & Grindstone Valley Nature Sanctuaries, ON
6. Kejimkujik National Park, NS (approved 23 October 2012)
7. Spruce Woods Provincial Park, MB (23 October 2012)
8. Covey Hill, QB (28 March 2014)
9. Grasslands National Park, SK (28 March 2014)

Covey Hill is a 200 km^2 area that extends from the northernmost tip of the Adirondack Mountain Range in the Le Haut-Saint-Laurent Region of Quebec to the border with New York. The site is comprised of many privately owned properties including a large peat bog and it provides habitat for 18 amphibian and 6 reptile species including five species-at-risk such as the threatened Western Chorus Frog (*Pseudacris triseriata* [or *P. maculata*]). Covey Hill is mostly known for its impressive diversity of 10 salamander species including a population of the threatened Allegheny Mountain Dusky Salamander (*Desmognathus ochrophaeus*).

Grasslands National Park covers 921 km^2 near Val Marie in southwest Saskatchewan and borders the badlands of Montana. The park is notable because it is one of the few sizable areas of the temperate grassland biome that remains in its natural state globally. The arid shortgrass prairie at Grasslands provides habitat for six reptile and one amphibian species that coexist with wild bison. The park also contains important communal hibernacula for several snake species. The site is home to Canada's only population of Greater Short-horned Lizards (*Phrynosoma hernandesi*) and one of seven populations of Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*).

The number of IMPARA sites has nearly doubled in recent years from the original five and at least seven additional sites have recently been suggested for nomination (for example see article on Pemberton in the last TCH bulletin). We are still short of the minimum of 20 sites hoped for to produce a book on the IMPARA program. The IMPARA Committee is currently working on several new nominations and will shortly be

contacting prospective authors to write formal nominations of sites that they previously suggested. Production of a well-illustrated book that highlights important areas for amphibians and reptiles across this country is still in the works. Leslie Anthony, herpetologist and popular author, has expressed interest in editing the book. As the list above indicates, some areas of Canada are currently underrepresented by IMPARAs and the committee continues to welcome suggestions for new site nominations. These are sites that support diverse assemblages of amphibians and/or reptiles, conserve unique or important habitats for herpetofauna, or provide areas occupied by amphibian and/or reptile species at risk. For more detailed information on the IMPARA program and nomination criteria please see the old CARCNET website (www.carcnet.ca/english/important_areas/intro) while we migrate to the new CHS website or contact the committee for information or to suggest sites for nomination (shecnar@lakeheadu.ca or CAB.Bishop@ec.gc.ca).



Grasslands National Park (top) and one of its inhabitants, the Prairie Rattlesnake (bottom)

Seeking Information on Axanthic (Blue) Green Frogs

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A group of Canadian researchers is studying the distribution of axanthic (blue-coloured) Green Frogs (*Rana* [*Lithobates*] *clamitans*) across their geographic range. Skin colour in amphibians is produced by light interacting with different types of chromatophores (pigments) that reside in the skin and which are presumably under genetic control. Aberrant colours can result in some individuals when certain pigments are absent. Colours and patterns often provide important social signals or can be important for camouflage – lowering the risk of predation from visually oriented predators. Consequently, colouration may affect fitness among individuals. Although colour and pattern can be quite variable among individuals in many amphibian species, the rare axanthic trait appears to be more common in ranid frogs and especially in the Green Frog. Considerable variation appears to exist in the extent and degree of blue colouration among individuals from partial to the total dorsal surface coverage and from dark blue, grey blue, green blue, light blue, or even turquoise hues. This trait has been inadequately documented in the literature, and generally anecdotally, so we are reviewing and summarizing its occurrence to archive the condition and we will be testing for geographic trends across the entire range. Some early literature suggests that the trait may be more prevalent in some areas such as in the northern part of the range. If you have observed blue-coloured Green Frogs and would like to contribute your record(s) to our database we would be very grateful. At a minimum we would need location, date and observer information. Other details that would be very helpful include:

- Location (as precise a description as possible: e.g. in pond near Howard Johnson's orange outhouse near Mudflap, Ontario)
- Coordinates (Latitude/Longitude)
- Number of individuals
- Age (juvenile/adult)
- Sex (male/female)
- Extent of blue colouration (i.e. total, head, upper lip, back, front of back, rear of back, sides, front limbs, rear limbs etc.)
- Date
- Observer(s) name(s)

- Digital or scanned photograph (permission to use photo).

Axanthic Green Frog from Huron County, Ontario, mostly blue except for back and portions of forelimbs (Photo: D Hecnar)

Green Frog from Eliot Maine with blue lip and head (Photo: C. Spencer)

Green Frogs from Eliot Maine showing blue head, back, and sides (left) compared with more typically coloured individual (right) (Photo: C. Spencer)

Any contributions would be gratefully accepted and acknowledged in a forthcoming publication. Please send your information to Steve Hecnar at Lakehead University (shecnar@lakeheadu.ca).

PhD in Animal Conservation Biology, Uppsala University

The fungus *Batrachochytrium dendrobatidis* (Bd) causes the disease Chytridiomycosis and is believed to be one of the major causes for recent global declines of amphibians. Bd was first found in Sweden in 2011. This studentship is aimed at elucidating the relationship between Bd infection and fitness in natural populations of Swedish amphibians. The objective is to determine the extent of Bd infection in Swedish amphibians and whether resistance differs among species and populations. We seek a bright and highly motivated student who ideally holds an M.Sc. or equivalent in a relevant topic (e.g. population-, evolutionary- or conservation genetics/ecology). Experience of working with conservation genetic techniques such as MHC-genetics, sequencing, and genotyping would be advantageous, but full training will be provided. The ideal candidate will also be able to work both independently and as part of a team. A high standard of spoken and written English is required.

The student will be based at the Department of Ecology and Genetics (Animal Ecology) at the Evolutionary Biology Centre (EBC) at Uppsala University (http://www.ebc.uu.se). The centre is one of the leading centres for evolutionary biology research in the world and offers a stimulating international environment and excellent research. The working language of the Centre is English. The project is co-supervised by Professors Jacob Höglund and Anssi Laurila. Uppsala is a city of 200,000 inhabitants with an attractive historical centre and easy access to surrounding nature. It offers a very high standard of living and is well connected to the Swedish capital Stockholm and Stockholm-Arlanda international airport. This studentship, which provides a net salary of approx. €2000 per month and includes health insurance, is funded by the Oscar and Lili Lamm Foundation for a period of four years. The salary is at a fixed rate with pre-set increments. Funding is also available for attending conferences. To apply for the position, please provide: (i) a letter of motivation including a maximum 2-page statement of your research interests, relevant skills and experience; (ii) a CV including publication list; and (iii) names and contact details of three referees willing to write confidential letters of recommendation.

All materials should be emailed as a single PDF file to: jacob.hoglund@ebc.uu.se with 'PhD application' in the subject line.

Uppsala University is an equal opportunity employer. We particularly welcome applications from women. Given equal suitability, qualifications and professional achievement, women will be given preference, unless particular circumstances pertaining to a male applicant apply. The preferred start date is flexible and will depend on the timeframe of the most qualified applicant. For further information, please see: http://www.ebc.uu.se/Research/IEG/zooeko/People/Jacob_Hoglund/ http://www.ebc.uu.se/Research/IEG/zooeko/People/Ansi_Laurila/ or contact Jacob Höglund via email (jacob.hoglund@ebc.uu.se) with any informal inquiries.

For representative publications, please see:

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Wang B Ekblom R Pollock D Bongcam-Rudloff E Höglund J. 2012. Transcriptome sequencing of black grouse (*Tetrao tetrix*) for immune gene discovery and microsatellite development. Open Biology 2: 120054.

Now Available: Synopsis of Evidence on Amphibian Conservation

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The Amphibian Synopsis of conservation evidence is now available. The synopsis summarises scientific knowledge about what works and what doesn't work in amphibian conservation. It summarises over 400 studies testing 129 possible conservation interventions for amphibians, anywhere in the world. Each study is summarised in one short paragraph and all results for one conservation intervention are summarised in short key messages. The Amphibian Synopsis is freely available as a searchable database or as a pdf to download, or it can be purchased as a book from: http://www.conservationevidence.com/

The Conservation Evidence project at the University of Cambridge summarises evidence about the effects of conservation interventions for both habitats and species and presents it in an easily accessible format. Our website is a reliable information resource designed to support your decisions about how to maintain and restore biodiversity. We have completed a number of other synopses of evidence including one for birds, bees, bats, and for biodiversity in European farmland. Another nine synopses are underway.

Our open access journal Conservation Evidence publishes research, monitoring results and case studies on the effects of conservation interventions.
http://www.conservationevidence.com/
https://www.facebook.com/conservationevidence

Get Your CARCNET/CHS Greeting Cards!

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At the AGM in 2013 I announced the sale of CHS/SHC greeting cards. Although many of us miss the calendars, the greeting cards have the benefits of being cheaper and they do not expire. This year's set of four cards features the Blanding's Turtle, Gray Treefrog, Red-backed Salamander and Massasauga Rattlesnake.

These unique cards are the perfect gift for anyone with an appreciation of Canadian Herpetofauna or wildlife in general. They feature original photography of Canada's reptiles and amphibians that has been donated

by CHS members, and the back of each card includes interesting facts about the species. The cards are printed on FSC certified paper.

The money raised through the sale of the greeting cards will directly fund important CHS/SHC initiatives, including a website update, student travel grants and work on the IMPARA book. So, this is a great way to help support the organization and get some cool cards at the same time. These were printed with the CARCNET name and logo, making them limited edition collector's items!

The greeting cards are $3 each or $10 for the set of 4 cards. If you are interested in helping to sell the cards, or to order your own cards, please contact me at Joe.Crowley@ontario.ca. The cards will be for sale again at this year's AGM, so you can also pick them up in person.

Canadian Herpetological Society

Société d'Herpétologie du Canada

Membership Form

Membership begins and ends on January 1 of each year. Multi-year membership allows you to avoid the hassle of re-registering every year and protects you from increases in membership fees.

Student Membership: **$20 / year** ☐ **or $90 / 5 years** ☐

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Yes, I wish to donate to the on-going work of the Canadian Herpetological Society in the amount of: $25 ☐ $50 ☐ $100 ☐ Other (Please specify):_____

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