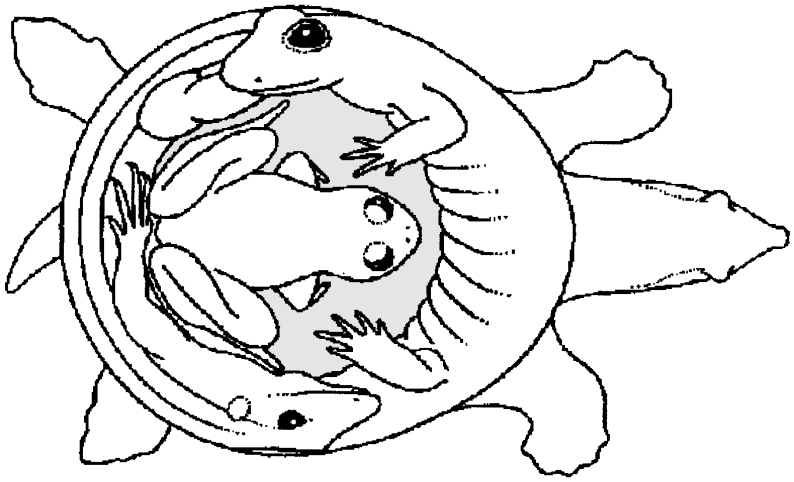
CARCN/RCCAR and CAH Annual Meeting

Wolfville, Nova Scotia

October 3-6, 1997



Conference Program

Friday Afternoon, October 3

1:30 - 4:30 **Closed meeting of the CARCN/RCCAR Board of Directors**
-room 201 of the Beveridge Arts Center

Friday Evening, October 3
Plenary Sessions at the Beveridge Arts Centre (Rm 244)

7:00 - 7:15 **Welcome to Acadia University**
-Tom Herman, Professor and Chair, Department of Biology, Acadia University, Wolfville, Nova Scotia

7:15 - 8:00 **Canadian Association of Herpetologist Guest Lecture:**
"Amphibians in Space"
-Richard Wassersug, Dalshousie University, Halifax, Nova Scotia

8:00 - 9:00 **Registration at the Art Gallery**

8:00 - 11:00 **Evening Mixer at the Art Gallery**
-finger food and cash bar

Saturday Morning, October 4
Plenary Sessions at the Beveridge Arts Center

8:00 - 5:00 **Registration at the Beveridge Arts Centre**

8:00 - 8:15 **Update from the Chairman** - Stan A. Orchard, CARCN/RCCAR/DAPCAN,

Victoria, British Columbia

8:15 - 9:00 **Conservation Genetics and Amphibian and Reptile Declines**
-David Galbraith, Canadian Botanical Conservation Network; Hamilton, Ontario

9:00 - 10:00 Florida's Silent Springs: Alligators and Environmental Contamination
- Louis Guillette, Florida State University, Gainesville,Florida

10:00 - 10:30 ******* COFFEE BREAK *******

CARCN/RCCAAR and CAH Programs Will Run Concurrently for the Remainder of Today

CARCN/RCCAR Sessions Begin:

10:30 - 10:45 Impressions from the Third World Congress of Herpetology
- Stan A. Orchard[1] and Christine A. Bishop[2]
[1]Victoria, British Columbia;[2] Canadian Wildlife Service, Environment Canada, Burlington, Ontario

10:45 - 11:00 Home range and habitat selectivity of spotted turtles *(Clemmys guttata)* in central Ontario: implications for a management strategy
- Tim J. Haxton, Ontario Ministry of Natural Resources, Pembroke,Ontario

11:00 - 11:15 Spiny softshell turtles in Missisquoi Bay, Lake Champlain: Silence no more!
- Patrick Galois, St-Lawrence Valley Natural History Society, Ste-Anne-de-Bellevue, Québec

11:15 - 11:30 A radiotelemetric study of movement in a population of the short-horned lizard *(Phrynosoma hernandezi)*
- G. L. Powell and A. P. Russell, Department of Biological Sciences,University of Calgary, Calgary, Alberta

11:30 - 11:45 Illegal reptile collection: a serious problem for conservation efforts in Ontario?
- Robert J. Willson, Department of Zoology, University of Guelph, Guelph, Ontario

11:45 - 12:00 Organochlorine contamination, embryonic development, sex hormones and sexual morphology of common snapping turtles in Canada
- Shane de Solla[1], Christine A. Bishop[2], Ronald J. Brooks[1] and Glen Van der Kraak[1]
[1]Department of Zoology, University of Guelph, Guelph, Ontario; [2]Canadian Wildlife Service, Environment Canada, Burlington, Ontario

12:00 - 1:30 ******* LUNCH BREAK *******

1:30 - 1:45 Demonstration of CARCN/RCCAR website for training volunteers
- Carolyn N. L. Seburn and David C. Seburn, Ecological Consultants, Oxford Mills, Ontario

1:45 - 2:00 Harmonic radar: a new method for tracking amphibians
- Samara Eaton, Biology Department, Acadia University, Wolfville, Nova Scotia

2:00 - 2:15 Fluctuating assymmetry: a new tool in environmental monitoring
- Greg Hellyer, U. S. Environmental Protection Agency, Boston, Massachusetts,

US.A.

2:15 - 2:30 The migrations of Jefferson salamanders are not meanderings
- Wayne F. Weller, Ontario Field Rerpetologists, Mississauga, Ontario

2:30 - 3:00 Two overwintering strategies of northern anurans
- Jason T Irwin, Department of Zoology, Miami University, Oxford, Ohio, U.S.A

3:00 - 3:30 ******* COFFEE BREAK *******

3:30 - 5:30 **Round-table Workshop on Edge of Range Species**- discussion will centre around conservation challenges for edge of range species and genetic diversity considerations
- Tom Rerman, Marlene Snyder and Steve Mockford, Biology Department, Acadia University, Wolfville, Nova Scotia

6:30 **Dinner and Ale at Paddy's Pub in Kentville**
Drive west from Wolfville along Hwy 1 (Main Street), through New Minas (a very long strip mall) until you get to downtown Kenwille. Kenmille has a one way street that encircles the main part of downtown (the square), so when you arrive there, go around the square until you reach a set of lights (turn right as you arrive in Kentville, then take your first left). Paddy's Pub is on the far corner. If you get lost, just drive around and you'll see it, or ask someone.

Sunday Morning, October 5

8:30 - 8:45 **A few words from the DAPTF Chair**
- W. Ron Heyer, DAPTF Chair, Smithsonian Inst., Washington, D. C.

8:45 - 9:30 The Biology of Amphibian Extinctions
- David Green, Redpath Museum, McGill University, Montreal, Qu´bec

9:30 - 9:45 Acoustical monitoring of anuran amphibians in Atlantic Canada
-Kerri L. Oseen and Richard J. Wassersug, Department of Biology, Dalhousie University, Halifax, Nova Scotia

9:45 - 10:00 Amphibian monitoring using drift-fences in Vermont
- James S. Andrews, Conservation Biology Laboratory, Biology Department, Middlesbury College, Middlesbury, Vermont, U.S.A.

10:00 - 10:30 ******* COFFEE BREAK *******

10:30 - 10:45 The RANA Project: researching amphibian numbers in Alberta
- Brian Eaton and Cynthia Paszkowski, Department of Biological Sciences, University ofAlberta, Edmonton, Alberta

10:45 - 11:00 Using breeding call intensity to monitor spring peeper *(Pseudacris crucifer)* population status
- Stephen J. Recnar, Darlene R. Recnar, Kym Welstead and Ronald J. Brooks, Department of Zoology, University of Guelph, Guelph, Ontario

11:00 - 11:15 An evaluation of an anuran call count index of relative abundance
- Leonard J. Shirose[1], Christine A. Bishop[1], Cameron J. MacDonald[2], Kevin Judge[2] and Ronald J. Brooks[2]; [1]Environment Canada, Canada Centre for Inland

Waters, Burlington, Ontario; [2]Dept. of Zoology, University of Guelph, Guelph, Ontario

11:15 - 11:30 Amphibian abundance in harvested and pristine ombrotrophic peat bogs of southeastern New Brunswick
- Marc J. Mazerolle, Department of Biology, Dalhousie University, Halifax, Nova Scotia

11:30 - 11:45 Amphibian abundance and diversity in ten terrestrial habitats within and in the vicinity of Fundy National Park, New Brunswick
- Jill D. Adams and Bill Freeman, Biology Department, Dalhousie University, Halifax, Nova Scotia

11:45 - 12:00 The influence of landscape structure on the movement of displaced frogs
- Nicole Nadorozny, Biology Department, Acadia University, Wolfville, Nova Scotia

12:00 - 1:30 ******* LUNCH BREAK *******

Sunday Afternoon, October 5,1997

1:30 - 1:45 Have northern leopard frogs declined in northern Ontario?
- David C. Seburn and Carolyn N. L. Seburn, Seburn Ecological Services, Oxford Mills, Ontario

Symposium on Diseases, Environmental Contaminants and Malformations
Organized and moderated by Martin Ouellet

1:45 - 2:30 Deformities and diseases in wild amphibian populations
- Martin Ouellet, Reapath Museum, McGill University, Montreal, Québec

2:30 - 2:45 A North American reporting center for amphibian malformations
- Suzanne C. Fowle, Douglas H. Johnson, Diane L. Larson and Terry L. Shaffer, Northern Prairie Wildlife Research Center, Jamestown, North Dakota

2:45 - 3:00 Preliminary surveys for amphibian deformities in New England
- Greg Hellyer[1], Robert Hillger, Rick Levey[2], Kim Babbit[3], Tracy Aylward and Brian Caserto **(Cancelled)**

Survey of deformed frogs on national wildlife refuges in the U.S. Fish and Wildlife Service's Region 5
- Laura Eaton-Poole[1] and Christopher Jenkins[2]; [1]US. Fish and Wildlife Service, Concord, New Hampshire, US.A.; [2] University of Massachusetts, Amherst, Massachusetts, U.S.A.

3:00 - 3:30 ******* COFFEE BREAK *******

3:30 - 3:45 Impacts of chemical pollutants on amphibian populations
- Christine A. Bishop, Canadian Wildlife Service, Environment Canada, Centre for Inland Waters, Burlington, Ontario

3:45 - 4:00 Environmental contaminants and amphibians: Canadian concernsand research response
- Bruce D. Pauli[1] and Christine A. Bishop[2]; [1]Canadian Wildlife Service, National

Wildlife Research Centre,Hull, Québec; [2]Canadian Wildlife Service, Environment Canada, Centre for Inland Waters, Burlington, Ontario

4:00 -4:15 Effects of surface water quality on amphibian eggs in an agricultural area of the Lower Fraser River Valley, British Columbia
- Karen E. Pettit, John E. Elliott, Christine A. Bishop, and Kim M. Cheng

4:15 - 4:30 Ability to repair damage from ultraviolet-B light: Photolyase concentrations for amphibians in Ontario
- M. Alex Smith, M. Berrill, C. Kapron, and D.R.S. Lean, Trent University, Watershed Ecosystem Graduate Program, Peterborough, Ontario

4:30 - 4:45 Malformations in a series of neotenous tiger salamanders from British Columbia
- Stan A. Orchard, CARCN/RCCAR, Victoria, British Columbia

4:45 - 5:15 Introduction to the parasitology of frogs
;- Donald F. McAlpine, New Brunswick Museum, St. John, New Brunswick

5:15 - 5:30 **Concluding Remarks**
- Carolyn N. L. Seburn, Seburn Ecological Services, Oxford Mills,Ontario

******* EVENING BREAK *******

7:00 - 10:00 **Workshop on frog parasites (Room BAC 201)**
- Donald F. McAlpine, New Brunswick Museum, St. John, New Brunswick

Monday Morning, October 6, 1997

9:00 **Field Trips All Day!**

Conference Abstracts

AMPHIBIAN ABUNDANCE AND DIVERISTY IN TEN TERRESTRIAL HABITATS WITHIN THE VICINITY OF FUNDY NATIONAL PARK, NEW BRUNSWICK

Jill D. Adains and Bill Freedman
Biology Department, Dalhousie University, Halifax, Nova Scotia, B3H 4J1

Amphibian populations in different parts of the world appear to be declining, yet information is lacking regarding many North American amphibian populations. Baseline data on amphibians and their habitats are needed so that long-term monitoring programs can be established. This study documented amphibian abundance and diversity in ten terrestrial habitats within, and in the vicinity of, Fundy National Park, New Brunswick, Canada The study sites consisted of five natural forests and five anthropogenically disturbed habitats (three conifer plantations, a gravel pit, and an abandoned field). Pitfall arrays, pitfall transects, quadrat searches, and time-constrained searches were the sampling techniques used to capture the variety of amphibian species. The most efficient sampling technique was the pitfall array, catching both the greatest species richness and abundance. Anthropogenic habitats were not significantly different in amphibian abundance from natural-forests, however, species composition did differ. Plethodon cinerius showed a specific habitat preference for soil moisture and microhabitat preferences for leaf litter, coarse woody debris and rocks. Plethodon cinereus were not found in any of the anthropogenically disturbed habitats. Suggestions for setting up a long-term monitoring program are made with regards to the most efficient sampling times and methods. Recommendations for forestry management practices are also made: (1) Leave some angiosperm trees within plantations; (2) Promote use of selective cutting; (3) Study the effects of site preparation techniques on amphibian density; and (4) Create better quality breeding habitats when dugouts are made. These recommendations may help to better protect and maintain viable populations of amphibians in these habitats.

AMPHIBIAN MONITORING USING DRIFT-FENCES IN VERMONT

James S. Andrews
Conservation Biology Laboratory, Biology Department, Middlesbury College, Middlebury, Vermont, U.S.A. 05753

Populations of amphibian species are monitored annually at three sites in the Green Mountains of Vermont using driftfences. The goals of the monitoring are to: (1) establish a baseline data set of abundance; (2) monitor year-to-year changes in their abundance; (3) monitor changes in the number or type of obvious external deformities. Drift-fences were felt to be the most effective and least biased of the methods used during initial inventories of the sites.

Although more years of data will be necessary to determine long-term population trends, four years of solid monitoring data have been gathered from one of the sites: Mt. Mansfield in north central Vermont. The data from that site can be examined for short-term population trends for the first time. Of the eight species abundant enough to monitor, none have shown steady declines or increases. The species monitored fall into two groups whose populations have oscillated synchronously. Notophthalmus viridescens, Pseudacris crucifer, Rana clamitans, and Rana palustris populations have all increased or decreased in the same years. Populations of Ambystom maculatum and Rana sylvatic (both early spring breeders) are synchronized only

with each other. Populations of Plethodon cinereus have varied in direct opposition to the N. viridescens group.

Of the over 1,000 amphibians caught at these drift-fences in the last four years, none have ever had an obvious external deformity. Of all amphibians caught using all methods at this site since 1991, only one frog showed obvious external deformities. A R. sylvatic metamorph caught in 1994 was missing one eye and a portion of its rear leg.

IMPACTS OF CHEMICAL POLLUTANTS ON AMPHIBIAN POPULATIONS

Christine A. Bishop
Environment Canada, Box 5050, Burlington, Ontario, Canada L7R 4A6

There is very little information on the impact of contaminants on amphibians in the wild. This paper reviews the current state of knowledge and assesses risk of effects in the wild. Studies of acidic deposition in North America and the United Kingdom have documented effects at the population level on anurans and salamanders. We also know chemicals used to protect sport fisheries are extremely toxic to amphibians at concentrations regularly applied in the wild. These chemicals include the lampricide 3-triflouromethyl-4-nitrophenol, and toxaphene, formalin and rotenone that are used to remove unwanted fish from sport fishing areas

While amphibians are resistant to some insecticides, they may suffer by direct contact with some herbicides and loss of invertebrate food resources due to insecticides. For example, Australia has now banned the use of 74 herbicides near water courses because of their toxicity to amphibians. Also, ammonia nitrate at 5-30 mg/1 is commonly found in surface waters due to fertilizer run-off. These concentrations are lethal to eggs of amphibians such as Rana pipiens, Bufo americanus, Pseudacris triseriata and invertebrates.

Recent studies on Necturus maculosus, and several anurans indicate that amphibians are sensitive at concentrations of PC11s which have low toxicity to many birds. Impacts such as deformities, disrupted hormone response and poor egg survival have now been documented in amphibian wild populations in the Great Lakes and St. Lawrence River.

ORGANOCHLORINE CONTAMINATION, EMBRYONIC DEVELOPMENT, SEX HORMONES AND SEXUAL MORPHOLOGY OF COMMON SNAPPING TURTLES IN CANADA

Shane de Solla1, Christine A. Bishop2 , Ronald J. Brooks 1,
Glen Van der Kraak1
1Dept. Zoology, University of Guelph, Guelph, Ontario, Canada, NIG 2WI
2Canadian Wildlife Service, Environment Canada, 867 Lakeshore Drive, Box 5050, Burlington, Ontario, Canada L7R 4A6

Eggs and plasma of the common snapping turtle (Chelydra serpentina serpentina) have been collected and analyzed for organchlorine contaminants and mercury during 1984-1995 in the Great Lakes - St.Lawrence River basin in Canada. Eggs from the same clutches were artificially incubated and those from highly contaminated sites show increased rates of deformities and reduced hatching success in eggs. Embryonic development appears to be most sensitive to polychlorinated dioxins, flarans and biphenyls. Adult turtles from sites with high contamination in

eggs and plasma also show feminized sexual morphology but do not exhibit abnormal testosterone or estradiol levels in plasma.

THE RANA PROJECT: RESEARCHING AMPHIBIAN NUMBERS IN ALBERTA

Brian Eaton and Cynthia Paszkowski
Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9

The lack of long term data on amphibian populations has, in some cases, made it difficult to determine the nature of population declines. We are in the process of establishing a network of amphibian monitoring sites which will serve the dual role of tracking changes in local amphibian populations over time, and facilitate public education about this group of animals, their place in the ecology of the landscape, and some of the potential challenges to their survival. Drift fence and pitfall trap arrays are used at RANA project sites to sample amphibians using discrete water bodies such as ponds. Captured animals are weighed, measured, and released at the capture site. During the projects inaugural year, 1997, three sites were established, with varying trapping effort and educational contacts from site to site. At the Lesser Slave Lake site alone, 326 people (mostly children), were educated about amphibians. The long tenn goals of the project are to: (1) establish monitoring sites throughout Alberta; (2) ensure each site becomes a long-term monitoring tool; and, (3) increase educational opportunities for the public.

HARMONIC RADAR: A NEW METHOD FOR TRACKING AMPHIBIANS

Samara T. Eaton
ACWERN, Biology Department, Acadia University, Wolfville, Nova Scotia BOP IXO

Movement of a species within a landscape is important to the demographics and genetics of a population and thus it is critical that movement abilities be studied in order to understand population dynamics. Movement pathways of amphibians have been tracked with a variety of different methods which are being continually developed to minimize invasiveness and expenses while maximizing effectiveness for use in the field. Harmonic radar is a tracking method that is inexpensive, effective to a range of 10 meters (ground level), is light weight, and minimally invasive to the organism. Harmonic radar tracking consists of a transmitter/receiver unit and a diode/antenna (tag) that attaches externally to the organism.

SURVEY OF DEFORMED FROGS ON NATIONAL WILDLIFE REFUGES IN THE U.S. FISH AND WILDLIFE SERVICE'S REGION 5

1Laura Eaton-Poole and 2Christopher Jenkins
1U.S. Fish and Wildlife Service, Concord, New Hampshire, U.S.A.;
2University of Massachusetts, Aniherst, Massachusetts, U.S.A.

In the fall of 1996, abnormal leopard frogs were reported to the Vermont Agency of Natural Resources (VANR) at 12 sites along Lake Chainplain, including sites very near the borders of Missisquoi National Wildlife Refuge in Swanton, Vermont. Four of the sites were verified by VANR staff in October of 1996. These were the first verified reports of deformed frogs in the U.S. Fish and Wildlife Service's (Service) Region 5 (Maine to West Virginia). Since deformed

frogs had now been observed in both Region 5 and Region 3 (midwest), including sites on federal land, the two regions collaborated in developing a methodology for surveying for deformed frogs on national wildlife refuges. The purpose of the surveys were several fold: (1) to determine if this phenomenon was occurring on Service lands; (2) to begin to develop a database on land use surrounding affected sites; and (3) to contribute to the overall knowledge of the regional and national distribution of the phenomenon. The methodology was intended to be simple and not overly time consuming as refuge time and staff was limited. The methodology had three tiers: (1) collect 100 leopard frogs (first priority), green frogs (second priority), or other species available (third priority) from each of two randomly chosen wetlands on the refuge; (2) collect 100 frogs from "hot spot" locations on the refuge, such as sites known to receive road runoff, landfill leachate, or agricultural runoff, or other known contamination; (3) re-sample sites in early fall. Refuge staff in Region 5 were encouraged to conduct tier 1 sampling, and an intern was hired to conduct "hotspot" sampling on select refuges. A total of 16 national wildlife refuges, and one national park, in Region 5 received some level of sampling. Incidences greater than two percent were found at seven refuges. However, sample sizes were small in some cases. A total of 10 species of frogs were collected and seven species demonstrated deformities. This investigation determined that deformities in frogs are occurring on Service lands in Region 5 and that multiple species are involved. Further study is needed to determine the extent and distribution of the problem in Region 5.

A NORTH AMERICAN REPORTING CENTER FOR AMPHIBIAN MALFORMATIONS

Suzanne C. Fowle, Douglas H. Johnson, Diane L. Larson, and
Terry L. Shaffer
Northern Prairie Wildlife Research Center, USGS-Biological Resources Division, 8711 37th Street SE, Jamestown, North Dakota, U.S.A. 58401

The issue of malformed amphibians has captured both scientific and public attention. Understanding of the phenomenon is hampered by the lack of a centralized data base on the occurrence of malformations in amphibians. The North American Reporting Center for Amphibian Malformations is consolidating observations in a data base so that scientists can search for patterns and trends in type and incidence of malformations. The data are geo-referenced, which will make it possible to examine spatial associations with other variables of interest. Over the years, the data base will also reflect temporal trends in malformations. Synthesis of such data also will provide land managers with objective means to assess the extent of the problem in their areas of concern. The reporting center uses the World-Wide Web (URL: http://www.npwrc.org/narcam) to facilitate the flow of information in two directions. First, scientists and the public can learn where malformations have been found, the rates at which they were recorded, the species involved, and the types of malformations noted. Second, suspected or confirmed malformation observations can be reported to the center. If appropriate, the center alerts a responsible state/provincial agency or nearby herpetologist for confirmation and finiher investigation. Funding thus far is from the U.S. Geological Survey-Biological Resources Division and the U.S. Environmental Protection Agency.

CONSERVATION GENETICS AND AMPHIBIAN AND REPTILE DECLINES

David Galbraith
Co-ordinator, Canadian Botanical Conservation Network / le Réseau canadien pour la conservation de la flore, P.O. Box 399, Hamilton, Ontario, Canada L8N 3H8

The persistence of amphibian and reptile populations undergoing declines from anthropogenic stresses, especially habitat reduction and fragmentation, is further put at risk if genetic diversity is being eroded. The objective of this paper is to review the possible consequences of the erosion of genetic diversity in reptile and amphibian populations. For example, work carried out by Gibbs, Prior and Weatherhead (1994. Mol. Ecol. 4: 329) on Black Ratsnakes and Massasauga Rattlesnakes in Ontario has demonstrated that genetic diversity in these species can be readily assessed. Kent Prior has found that habitat fragmentation is already reducing the genetic diversity of black rat snakes. A strong relationship between genetic diversity, demographic history and persistence was formulated by Micheal Soule and his colleagues as the "extinction vortex" (a positive feedback process between population decline and the erosion of genetic diversity). This may be stronger than first supposed, and may explain population extinctions that have defied "single cause" explanations to date. Recent theoretical and empirical reports indicate that the effects of genetic damage in fragmented or declining populations may be greater than previously supposed. Experiments with captive fly populations suggest that relationships between inbreeding and probability of population extinction may not linear, but show sudden increases in extinction rates at moderate levels of inbreeding (Frankham, 1995, Conserv. Biol. 9: 792).

Theoretical modeling by Lynch et al. (1995. Amer. Nat. 146: 489) indicates that populations become highly vulnerable to extinction when effective population size drops below 100 (possible in populations with census sizes of 1,000 or more) may experience increased probability of extinction through the accumulation of new mutations. The unique life history attributes and demographic structures exhibited by real populations of amphibians and reptiles are predicted to affect retention of genetic diversity differently than those of other taxa. For example, although many amphibian and reptile populations have been shown to exhibit fluctuations in census and effective population sizes, which in turn reduces effective population size, multiple paternity (already demonstrated in several reptilian taxa) increases effective population size (Sugg and Chesser, 1994. Genetics 137: 1147).

A recent review has also found that previous studies have underestimated the effects of loss of genetic diversity on population persistence (Frankham, 1995. Arm. Rev. Genet. 29: 305). However, the example of a rapidly expanding mammal population that also exhibited monomorphic DNA fingerprints and other indications of lack of genetic variation suggests that the quantitative relationship between genetic variation and demographic parameters in real populations is still poorly understood (Ellegren et al. 1993. PNAS 90: 8150). There is considerable scope for further study on the relationship between genetic diversity and the persistence of reptile and amphibian populations, which may in turn yield insights into some previously unexplained declines.

SPINY SOFTSHELL TURTLES IN MISSISQUOI BAY, LAKE CHAMPLAIN: SILENCE NO MORE!

Patrick Galois
St-Lawrence Valley Natural History Society, 21125, Chemin Ste-Marie, Ste-Anne-de-Bellevue, Québec, Canada, H9X 3L2

In 1995, a first radio-telemetry campaign in Missisquoi Bay, Lake Champlain, was conducted on spiny softshell turtles (Apalone spinifera). This species is susceptible to be designated threatened or vulnerable in Québec province though the effort to improve knowledge on habits

and habitat use. Because of transmitter problems in 1996 it was not possible to follow the individuals through winter, in fact by end August the seven transmitters seemed to have failed. In 1997, a new campaign was initiated benefitting from 1996 experience. The emphasis was put on the Pike River, situated north of Missisquoi Bay where some individuals have been observed in 1995 and 1996. The capture campaign started in May on this river using 14 hoop- traps which were progressively moved to Chapman Bay, location of a known collective nesting site. Nine softshell turtles were caught and equipped with radio-transmitters (5 females and 4 males), 3 females in the Pike River and the other individuals in Chapman Bay. At the moment, more than 250 precise localization points have been collected. In the Pike River, females moved up and down a 4 km river section from June until August. The females in Chapman Bay were more sedentary with a few short movements south. Males were located in the bay all summer long, mostly near the shore in shallow water. At the end of August, all the females, including those from Pike River, and one male moved south of Missisquoi Bay, gathering at a narrow part of the lake, some crossing to the east shore of Missisquoi Bay. In comparison, in 1996, the females captured in Chapman Bay eventually crossed over to the delta of Missisquoi River or moved down south around beginning July, right after the nesting season. The telemetry campaign is continuing, and other information is expected until the end of September while the transmitters still function. Beep beep.

THE BIOLOGY OF AMPHIBIAN EXTINCTIONS

David M. Green
Redpath Museum, McGill University, 859 Sherbrooke Street W., Montrdal, QuÉbec, Canada H3A 2K6

Amphibian decline is best thought of as excessive extinction of local populations. Yet why are some populations of amphibians more prone to extinction than others? On a local scale, stochastic processes can lead to random extinctions. Endogenous traits of life history, including large clutch size, high juvenile mortality, and short life span, for example, can be predicted to predispose certain species to local disaster. Thus we should expect greater chance of local extinctions among pond-breeding frogs rather than terrestrial, direct-developing salamanders, even in sympatry. Exogenous factors such as environment stochasticity can accentuate these trends. Human-mediated habitat degradation, however, can adversely tip the balance between losses and gains of populations. At a larger, landscape scale, interconnections and dispersal between local populations can ameliorate local losses. Therefore fragmentation of environments can be predicted to have more severe effects on some dispersing species rather than others. Finally, at the continental or global scale, the effect of climate change shifting geographic ranges can leave relict, isolated and , therefore, vulnerable populations behind. These can be easily predicted to be in the most danger of disappearance. Principles gleaned from population biology, and applied to amphibian declines at variable scales can be illustrated using data from Fowler's toads and Spotted frogs and by contrasting different amphibian life histories. Understanding the normal biology of extinction is a prelude to understanding how human-mediated disturbance can have its effects.

FLORIDA'S SILENT SPRINGS: ALLIGATORS AND ENVIRONMENTAL CONTAMINATION

Louis J. Guillette, Jr.
Department of Zoology, University of Florida, Gainesville, Florida, U.S.A. 32611

Since the onset of the industrial age, environmental contaminants have posed a major threat to wildlife health. The focus of our concern on the health consequences of environmental pollution have, in the last three decades, been on lethal, carcinogenic and/or extreme teratogenic manifestations. Evidence from a number of sources suggests that another mechanism, endocrine-disruption must also be examined. There is excellent laboratory and field evidence that manmade chemicals - xenochernicals - released into the environment act as hormones or antihormones - endocrine disrupting contaminants (EDCs). The release of EDCs occurred in the past and continues today. We have used reptiles - primarily the alligator - as an ecosystem monitor for it exhibits limited mobility and feeds at the top of the food chain.

Recent studies show that reptiles living in contaminated environments exhibit: (1) population declines due to lethal and reproductive effects of the contaminants on embryos, juveniles or adults; (2) developmental abnormalities of embryos, including subtle effects in the reproductive system of alligators; and (3) abnormalities of the endocrine system. I will examine the data available on abnormalities of the reproductive system in reptiles induced by endocrine-disrupting xenobiotics. I will discuss the role of these xenobiotics in light of experimental evidence showing that estrogenic steroids are capable of stimulating sex reversal -- male to female -- in developing reptilian embryos exhibiting environmental sex determination. A hypothesis will be presented suggesting that any compound that disrupts the normal steroid milieu of the developing embryo will have significant, life long, consequences on sex determination and the organization and function of the reproductive system. The relative relationship between these abnormalities of reproduction and those currently reported in other wildlife populations will be discussed.

HOME RANGE AND HABITAT SELECTIVITY OF SPOTTED TURTLES (Clemmys guttata) IN CENTRAL ONTARIO: IMPLICATIONS FOR A MANAGEMENT STRATEGY

Tim J. Haxton
Ontario Ministry of Natural Resources, Pembroke District, P.O. Box 220 Riverside Drive, Pembroke, Ontario, Canada K8A 6X4

A telemetry project was conducted on a northern population of spotted turtles (Clemmys guttata) in Victoria County, Ontario from April 28, 1994 through October 30, 1995. The purpose of the project was to identify habitat selectivity, seasonal activity and home range in a northern population of spotted turtles. Six turtles, three males and three females, were tracked in 1994, and nine turtles, three males and six females, were tracked in 1995. Minimum convex polygon analysis indicated that the average home range size was 4.7 hectares for females, 2.0 hectares for males, with and average of 3.7 hectares for both sexes. Six periods of activity were described: emergence; post-emergence/pre-nesting; nesting; post-nesting/pre-estivation; aestivation/pre-hibernation; hibernation. Marshes were primarily selected during post emergence/pre-nesting. Nesting and post nesting/pre-hibernation periods. Turtles aestivated or were concealed for a longer period in 1995 than in 1994 which is attributed to drought-like conditions. When aestivating, these spotted turtles primarily used bogs and exclusively used bogs when hibernating. There was high fidelity to the hibernaculum and spotted turtles appeared to be gregarious at these sites.

USING BREEDING CALL INTENSITY TO MONITOR SPRING PEEPER (Pseudacris crucifer) POPULATION STATUS

Stephen J. Hecnar, Darlene R. Hecnar, Kym Welstead, and
Ronald J. Brooks.
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We monitored the sound intensity of spring peeper choruses at 28 breeding sites among three habitats and across six years at Point Pelee National Park, Ontario, Canada. Our objectives were to determine: 1) the efficacy of using a sound level meter for monitoring; 2) the population status of spring peepers in the park; and 3) if diffierences in calling intensity existed among habitats. Use of the sound meter provided good resolution for quantifying chorus strength in large choruses where call overlap made it impossible to count numbers of individuals. Calling intensity was greatest in swamp habitat, followed by pond and marsh. A slight decline occurred over time and calling intensity was highly correlated with water levels in Lake Erie. The previous year's lake water level appeared to be a major factor determining the relative abundance of spring peepers. Lower water levels predicted under a global warming scenario would likely have a detrimental effect on spring peeper and other amphibian populations in the Great Lakes basin.

Fluctuating Asymmetry: A New Tool in Environmental Monitoring

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This abstract will be available at the registration desk.

PRELIMINARY SURVEYS FOR AMPHIBIAN DEFORMITIES IN NEW ENGLAND

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Reports of amphibian deformities have markedly increased in recent years in both the U.S. and Canada. A meeting of Canadian and American scientists at Shenandoah National Park in April 1997 identified the need for statistically valid surveys, landscape characterization, standardized deformity description, and WWW reporting system. In New England deformities were first confirmed in the fall of 1996 in northwest Vermont (VT) near Lake Champlain. The 1997 VT surveys identified deformities in 8 counties in northern leopard frog (Rana pipens), bullfrog (R. caesbeiana), wood frog (R. sylvatica), green frog (R. clamitans) and American toad (Bufo americanus). Surveys were also undertaken in New Hampshire (NH) and Massachusetts (MA) identifying deformities in green frogs and bullfrogs. Proposed causative mechanisms of deformities include viral, bacterial fungal, and parasitic diseases, such as trematode metacercaria; predation and other traumatic injuries; xenobiotic developmental analogues, such as methoprene; UVB photoactivation of xenobitic chemicals; and multiple stressors, perhaps manifested through compromised immune response, predisposing populations to ambient stressors, possibly those implicated in amphibian declines. The use of measures of Fluctuating Asymmetry (FA) has recently been cited as a predictive tool of declining amphibian populations and may be relevant to populations with deformities.

TWO OVERWINTERING STRATEGIES OF NORTHERN ANURANS

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Anurans living in northern locales have two strategies to cope with cold winter temperatures: avoid freezing by either burrowing or using aquatic hibernacula, or hibernate in exposed sites and survive freezing of their tissues. The northern cricket frog (Acris crepitans), unlike other North American hylids, is not freeze tolerant and hibernates in subterranean sites. However, unlike toads which actively burrow, this frog uses its small size to exploit existing subterranean sites such as crayfish burrows and natural crevices along the pond edge. With the decline of A. crepitans in the northern part of its range, the effect of overwintering habitat quality and winter severity on population health should be examined. Most other northern hylids and the wood frog (Rana sylvatica) hibernate under a layer of leaves or moss and thus may experience freezing of their tissues during winter. Despite much laboratory work on the wood frog's physiological responses to freezing, only recently have field experiments described the conditions under which freezing occurs in nature. These studies indicate that knowledge of overwintering biology is important to a full understanding of the habitat requirements and life history of northern anurans

INTRODUCTION TO THE PARASITOLOGY OF FROGS

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Recent studies of amphibian deformities have implicated parasitic helminths in some cases. Also, herpetologists concerned with amphibian declines may find it necessary to carry out detailed necropsies of amphibians, and may encounter parasitic hekninths in the course of this work. However, comparative studies of the helminths of birds and fish have dominated discussions on how communities of parasitic helminths are organized and there are few, comprehensive studies of the helminths of amphibians. This workshop, designed for the non-parasitologist, will introduce participants to many of the helminths commonly encountered in eastern North American frogs. An introductory lecture will review current concepts in helminth. community ecology, indicate how helminth communities in amphibians and reptiles seem to differ from other vertebrate groups, and discuss some of the possible reasons. An extensive data set available from New Brunswick bullfrogs, green frogs, and leopard frogs will be used to examine normal helminth loads and diversity that herpetologists are likely to encounter in healthy, wild-caught amphibians and some of the factors that influence infection. Representative slide-mounted material and literature on amphibian helminth identification will be available for participants to examine.

AMPHIBIAN ABUNDANCE IN HARVESTED AND PRISTINE OMBROTROPHIC PEAT BOGS OF SOUTHEASTERN NEW BRUNSWICK

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Peatlands are increasingly being exploited in Europe and North America in order to meet with the demand for peat in professional horticulture and amateur gardening. New Brunswick and Québec are North America's principal producers of peat and the peatlands of these provinces are rapidly disappearing. I am investigating the effects of this peat harvesting on amphibians.

The present study is conducted in the Greater Kouchibouguac Ecosystem of southeastern New Brunswick in 6 harvested and 6 pristine ombrotrophic peat bogs. By deploying drift fences associated with pitfall traps, I am determining the relative abundance, movements and population structure of amphibians occurring in this type of habitat. I am also investigating the relationship between precipitation and activity in peat bogs. I will present data from my first summer of field work, following 20 592 trap nights.

Preliminary results indicate that overall amphibian capture rates in harvested bogs are significantly lower than in the pristine bogs. However, within harvested bogs, the distance of drift fence arrays from harvested plots did not seem to influence amphibian captures. Species richness was generally higher in pristine bogs. Captured individuals were almost exclusively juveniles in both harvested and pristine bogs. There is a strong correlation of precipitation and activity. Captures occurred mostly in mid to late August.

Based on this summer's data, peat bog harvesting influences adjacent amphibian communities. Additional field work will be carried out next year to further assess the impact of this activity and other landscape features on amphibian abundance and movements.

THE INFLUENCE OF LANDSCAPE STRUCTURE ON THE MOVEMENT OF DISPLACED FROGS

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Changing land use patterns have altered the composition and distribution of habitat patches in a landscape. Movement and patch choice have become critical components in assessing the relative success of animals moving to required resources. The complex life histories of frogs (Genus Rana) make them ideal organisms to study how landscapes altered by human activities influence movements between required resource patches. In this study we experimentally manipulated Rana sylvatic (wood frog), R. pipiens (northern leopard frog) and R. clamitans (green frog) to determine how forested and agricultural landscapes influence movements during the breeding season. Frogs were displaced at fixed distances from ponds and we used mark-recapture (n=9) and radio-telemetry (n=32) to monitor their locations. Frogs were more likely to move through fields and along gravel roadways and less likely to move through or along streams and drainage ditches, forests or residential areas. Drainage ditches appear to be used selectively by frogs as aquatic sites, trapping frogs migrating to potentially more dependable breeding and over-wintering sites.

IMPRESSIONS FROM THE THIRD WORLD CONGRESS OF HERPETOLOGY

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The Third World Congress of Herpetology was held in Prague, capital of the Czech Republic, on August 2-10, 1997. Over 700 researchers from all parts of the globe participated and the Congress generated almost 800 scientific papers. Much of what was presented and discussed is directly relevant to the work of the CARCN/RCCAR and DAPCAN. For example, this congress was dominated by aspects of conservation biology and anthropogenic impacts such as introduced predatory fish; transmission of diseases; pesticides; pollutants; increased ultra-violet radiation; climate change; and a wide variety other issues. Ecological and applied research is becoming well-integrated, particularly in the case of the studies on amphibians, and some questions on why some populations may be declining and techniques for predicting declines are starting to emerge. There are still many fascinating 'mysteries' of amphibian disappearance and the approaches taken in studying the causes are effiectively integrating toxicology, ecology, and pathology. Discussions ran the gamut from environmental education and fund-raising to the philosophy and practicality of endangered species lists.

MALFORMATIONS IN A SERIES OF NEOTENOUS TIGER SALAMANDERS FROM BRITISH COLUMBIA

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Malformations in wild amphibian populations are not well-represented in museum specimen collections. Probably this is because, until recently, malformed amphibians do not appear to have been commonly encountered and because museum specimen collectors, in the past, have very likely tended to discard "imperfect" museum specimens.

In 1986, I attended a lake poisoning at Burnell Lake (a.k.a. Sawmill Lake) near Oliver in the Okanagan Valley in the soutlicentral Dry Interior of British Columbia. This small pot-hole lake, with no natural ichthyofauna, is a breeding site for the Blotched tiger salamander (Ambystoma tigrinum melanostictum = A. mavortium melanostictum), and where two possible developmental states are represented at sexual maturity, neotenous and metamorphous. Rainbow trout (Salmo gairdneri) were introduced into the lake by provincial fisheries authorities in 1952 and stocked annually thereafter. Pumpkinseeds (Lepomis gibbosus) were first noted in 1979, and smallmouth bass (Microperus dolomieui) in 1985. Fishermen released the pumpkinseeds and smallmouth bass. The lake was to be poisoned to remove the pumpkinseeds particularly, who by this time had become serious competitors to the trout. Larval salamanders are recorded in the stomach contents of trout from Burnell Lake. After the lake was poisoned, a series of 230 neotenous tiger salamanders were removed from this site and are now on deposit in the herpetology collections of the Royal British Columbia Museum (60%) and the Canadian Museum of Nature (40%).

Limb malformations that I noted in this series appeared, to me, to resemble malformed limbs in mudpuppies (Necturus maculatum) that have been attributed, perhaps erroneously, to the effects of environmental contaminants. Geographically isolated from agriculture and industry it is unlikely that Burnell Lake, prior to 1986, had been subjected to harmful concentrations of environmental contaminants. Malformities in this case suggest that larval tiger salamanders lose and regenerate limbs routinely. While regenerated limbs may be maladaptive in the terrestrial locomotion of metamorphs, the propulsive force for locomoting neotenes comes primarily from the tail rather than the limbs. Consequently, aquatic larval salamanders are more likely than the terrestrial stages to survive with gross limb deformities.

ACOUSTICAL MONITORING OF ANURAN AMPHIBIANS IN ATLANTIC CANADA

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Acoustical monitoring of anuran amphibians at four National Parks in Atlantic Canada began during the summer of 1996. This project was developed to test the feasibility of using automated recorders for long-term monitoring of anurans in this region. Automated recorders were placed at four sites in each of Kejimkujik, Cape Breton Highlands, Kouchibouguac, and Fundy National Parks. Two sites each in Kouchibouguac and Fundy were also sampled in 1997. Sampling took place from May to August in both years. Environmental variables were measured concurrently, both at the site (e.g. air and water temperature) and at nearby weather stations (e.g. barometric pressure). The goals of the project are to: 1) adapt the automated recorders to our wet, northern climate; 2) establish baseline data on the calling activity of anurans in this region and the effects of environmental conditions on that activity; and 3) explore the possibility of using volunteers to helpin the collection and analysis of monitoring data

DEFORMITIES AND DISEASES IN WILD AMPHIBIAN POPULATIONS

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An apparent increase in amphibian deformities and diseases has recently attracted international press coverage. Whether or not they contribute to amphibian declines and disappearances is still uncertain. Historically, isolated cases of developmental abnormalities, pathological lesions, and disease outbreaks have been encountered in natural populations of amphibians by herpetologists. Cases of deformed frogs have been reported worldwide since 1740. The French scientist, Jean Rostand (1894-1977), spent 23 years of his life studying this phenomenon. Limb deformities and other developmental abnormalities usually occur at low frequencies (less than or around 1 %) in wild populations. Recently, higher incidences of frog abnormalities (up to 69%) have been encountered at sites distributed across North America. Many biotic and abiotic agents have been proposed or proven to cause developmental abnormalities in amphibians. These factors include agricultural pesticides, chemical composition of the water, coexistence with certain fish, diseases, excessive density of tadpoles, fertilizers, hereditary mechanisms, hyperregeneration after injury, low and high temperature, low pH, nutritional deficiencies, parasitic cysts, radioactive pollution, retinoic acid analogs, teratogenic virus, trace metals, UV-B radiation, vitamin A, and xenobiotic chemicals. Several of these stressors may also contribute to outbreaks of disease and die-offs in natural populations. In all deformity surveys, it is critical to differentiate between traumatic events and true developmental abnormalities. Among the recent reports of deformed frogs, attempted predation, trematode parasite infestation, and xenobiotic pesticides or chemicals (perhaps affecting the retinoic acid pathway), along with synergistic action of UV-B radiation, emerge among the leading hypotheses to explain the occurrence of anomalies in the wild. Since a complex interaction of multiple factors is also possible, considerable effort will be necessary to isolate the causal agents.

ENVIRONMENTAL CONTAMINANTS AND AMPHIBIANS: CANADIAN CONCERNS AND RESEARCH RESPONSE

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The Canadian Wildlife Service has conducted research projects on the effects of environmental contaminants on reptiles and amphibians for over a decade. CWS-sponsored research into the effects of toxic substances and other environmental "stressors" on amphibians has included literature reviews, population monitoring, controlled laboratory experiments, outdoor microcosm experiments, field manipulations, and field studies. Besides population monitoring efforts, field studies conducted across the country have focused on frogs and mudpuppies. Current research projects are mostly aimed at examining relationships between toxic substances and acute toxicity, endocrine modulation, deformities, health deficits and population declines. A review of current and recently completed research projects reveals CWS involvement in these areas.

EFFECTS OF SURFACE WATER QUALITY ON AMPHIBIAN EGGS IN AN AGRICULTURAL AREA OF THE LOWER FRASER RIVER VALLEY, BRITISH COLUMBIA, CANADA.

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In 1996-1997, populations of amphibian species were measured and related to habitat, water quality and surrounding land use on the Sumas Prairie, an area of intensive agriculture in the Suinas watershed near Abbotsford, British Columbia. Agricultural land uses included berry farming and intensive livestock husbandry (swine, poultry, daily). Eggs of spotted frog (Rana pretiosa) and red-legged frog (R. aurora) were exposed in the field and in the laboratory to water from sites. Both species were sensitive to water quality in the field ($p<0.05$). As well, naturally occurring egg masses of the Northwestern Salamander (Ambystoma gracile) showed differences in hatching success among these sites ($p<0.05$). Finally, to determine whether water quality guidelines developed using species, such as salmonid eggs, Daphnia and Psolinastrum (Microtox assay) are sufficient to protect the eggs and larvae of amphibians, their relative sensitivities will be assessed. Tests will be conducted in the laboratory using known concentrations of agricultural pollutants occurring in the study area, such as pesticides and nitrogen compounds and compared to laboratory or published results for the above water quality indicator species.

A RADIOTELEMETRIC STUDY OF MOVEMENT IN A POPULATION OF THE SHORT-HORNED LIZARD (Phrynosoma hernandezi)

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Movements of 33 (5 males, 12 adult females, 16 subadult females) short-homed lizards were investigated through radiotelemetry at a site in southeastern Alberta. Minimum-area convex polygon estimates of home range varied greatly among lizards (1 8m2 - 3983 m2; median 601 m3), with a strong distributional skew to the right. Movements patterns typically consist of restricted movements within small areas interspersed with long movements among these restricted subranges, suggestive of large home ranges through which lizards range over the course of the active year. Annual activity was found to extend from April into late October - early November; this, together with the shallow depth of the two unequivocal hibernacula found, suggest some freeze-tolerance in this species. However, spring and fall temperature-related mortality and overwinter mortality may be important range-limiting factors in this species in Canada. Conservation implications are discussed.

ANNOUNCING THE CARCN/RCCAR WEBSITE FOR TRAINING VOLUNTEERS

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The Canadian Amphibian and Reptile Conservation Network / Réseau Canadien de Conservation des Amphibiens et des Reptiles is developing a website for soliciting and training amphibian monitoring volunteers in co-operation with the Biodiversity Convention office and the Ecological Monitoring Co-ordinating Office of Environment Canada. In addition to general information about CARCN/RWAR and the provincial monitoring projects the site will contain distribution maps, photos, calls, descriptions, natural history and conservation information about all Canadian amphibians. Users can access the full list of species or limit their query to one province. A quiz area will allow user's to test their ability to identify species by photos or calls. It is hoped that volunteers will use this to train themselves or brush up on calls after a long winter. Programme co-ordinators can down-load calls and pictures to distribute to volunteers who do not have web access. The site can also be used by public and secondary school students to research amphibians. A brief demonstration will be given. Future plans include expanding the site to add reptiles. Launch is anticipated by December, 1997.

HAVE NORTHERN LEOPARD FROGS DECLINED IN NORTHERN ONTARIO?

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Over the last 20 years, Northern Leopard Frogs (Rana pipiens) have declined across western Canada, from British Columbia to Manitoba. A lack of recent records from areas of northern Ontario in the Ontario Herpetofaunal S ummary suggested that Leopard Frogs may have declined there as well. To test this, we conducted evening auditory surveys from Sudbury to Nipigon (~900 km) with the support of the Wildlife Assessment Unit of the Ontario Ministry of Natural Resources. Listening sites were concentrated in topographic map grid squares (10x10 km) with historic records of Leopard Frogs. Ninety-seven wetlands in 27 grid squares were surveyed from May 21 to June 1. We also surveyed 61 wetlands in 26 nearby grid squares. Leopard Frogs were heard from Sudbury to Sault Ste Marie. None were heard from north of

Sault Ste Marie to Nipigon (~500 km). The apparent absence of Leopard Frogs from this area appears genuine.

AN EVALUATION OF AN ANURAN CALL COUNT INDEX OF RELATIVE ABUNDANCE

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We combined call count surveys with an intensive census of choruses, mark/recapture methods and visual encounter surveys to evaluate whether calling intensity data collected in anuran call count surveys is likely to be useful as an index of relative abundance of anurans.

We found significant linear or log-linear relationships between the number of males captured in choruses and both the calling intensity code and the number of males calling in the bullfrog (Rana catesbeiana), the American toad (Bufo americanus) and the wood frog (Rana sylvatica) . We found a significant positive relationship between population size, estimated with mark/recapture methods, and both calling intensity code and the number of male bullfrogs heard calling. There was also a positive relationship between the estimated population size and the calling intensity code in american toads. For both species the relationships appear to be nonlinear and are best described by a model in which the relationship is significantly strong only up to a certain population size (< 100 males?). We found no relationship between estimated population size and either calling intensity code or the number wood frogs heard calling, possibly because all three populations studied comprised >300 males.

Over a 3-year period (1995-1997) there was a significant linear relationship between the number of bullfrogs calling and the number of males captured in intensive censuses of choruses in Algonquin Provincial Park in all three years. The slope of the regression line was significantly different in 1997 than it was in either 1995 or 1996. The inequality of slopes over time suggests that the relationship between calling intensity and actual abundance may not be constant over time.

Because of its nonlinear and possibly variable relationship with actual abundance, calling intensity cannot be considered a true constant-proportion index of abundance, but it should be a useful index for populations below a certain size. It will likely not be possible to quantify rate of change of populations using call count data, but it should be possible to identify trends.For monitoring at smaller scales, trends likely will be detectable only over extended periods of time but call count data can be used to rank sites on the basis of both diversity and intensity of use by anurans.

ABILITY TO REPAIR DAMAGE FROM ULTRAVIOLET-B LIGHT: PHOTOLYASE CONCENTRATIONS FOR AMPHIBIANS OF ONTARIO

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Ultraviolet-B light (280-320 mn) is particularly interesting in relation to amphibian declines as UV light is present across geographic areas undergoing radically different forms of anthropogenic influence. The primary cause of damage associated with UV-B light is the formation of cyclopyrimidine dimers on adjacent pyrimidine base pairs in the DNA, and is repaired by a photoreactivated enzyme called photolyase. I am currently qualifying concentrations of photolyase from the eggs of ten south-central Ontario amphibians and am testing the hypothesis that surface laying species will have greater ability to repair damage from UV light than species which lay beneath the surface. Between developmental stage comparisons and inducible changes in photolyase concentration due to exposure to ambient UV light are also under investigation. Induction of the enzymatic repair mechanism has been demonstrated in other organisms, but has not been taken into account in earlier species comparisons of photolyase concentration. For each comparison (species, stage, induction) the substrate for enzyme activity is UV-damaged plasmid DNA. Activity is assayed using bacterial transformation of the electrophoretic banding patterns of the plasmid to determine whether the damaged plasmid DNA has been repaired by amphibian egg photolyase.

THE MIGRATIONS OF JEFFERSON SALAMANDERS ARE NOT MEANDERINGS

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Uniquely marked male Jefferson Salamanders (Ambystoma jeffersonianum) and female Jefferson (A. jeffersonianum) and associated triploid (A. lateral -(2) jeffersonianum) Salamanders migrated through a sugar maplelbeech woodlot to and from a spring breeding pond near Streetsville, Peel County, Ontario (west of Toronto) along definite routes. Migration data collected over 3 consecutive years using pitfall traps and drift fencing which encircled the pond indicated that males as a group arrived at the pond from the east side, whereas females arrived from all directions. Males (n = 47) arrived along a route different from that used by females (n = 936). Males (n = 65) departed from the pond using the same route used by females (n = 953). Females used the same route to get back to the woods as they used to get to the pond. Individual males and females generally used the same sector upon their departure from the pond as they used upon their arrival in the same year. 47% of males (n = 30) and 47% of females (n = 383) were consistent (sector displacement = 0) in their exit/entrance route; 70% of males and 80% of females choose exit routes not more than 1 sector to the left or right of entrance route. Neither length of stay in pond nor size of salamander was correlated with magnitude of sector displacement in males or females. Salamanders which returned to the breeding pond in Year 2 and Year 3 used a route less than 2 sectors apart from that used in Year 1. That Year 2 immigrants (n = 136) used a route closer to their Year 1 route (displacement = 0.75) than did Year 3 immigrants (n = 38) to their Year 1 route (displacement = 1.56) suggests that ability to orient consistently may be related to the frequency of migrating. Migrations are not meander strolls through the woodlot; habitat disturbances could influence success in getting to breeding ponds and getting back to home territories in woodlots.

ILLEGAL REPTILE COLLECTION: A SERIOUS PROBLEM FOR CONSERVATION EFFORTS IN ONTARIO?

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Reptiles in Ontario are already at the northern extremes of their range and thus unnatural sources of mortality can significantly affect small, local populations. Aside from the most noticeable anthropogenic causes of species decline such as habitat destruction, human persecution and road mortality, several reptile species are also being illegally collected to support a growing pet trade. Because reptiles are often locally concentrated at certain times of the year, intense collection may decimate populations more quickly than even large scale habitat destruction or alteration. Four species of reptiles that have recently been studied in Ontario, and are known to be collected for the pet trade are: the spotted turtle (Clemmys guttata) , the wood turtle (Glyptemys insculpta) , the five-lined skink (Eumeces fasciatus) and the eastern fox snake (Elaphe vulpina gloydi). All four species have been given l egal protection in Ontario by the Game and Fish Act, COSEWIC, or by National and Provincial Parks. Ironically, parks and protected areas often provide the source populations for illegal collecting because they give people easy access to rare flora and fauna. Possibly an even more serious concern is the information provided by professional scientists who carefully report UTMs (lat/longs) of significant populations, habitats, or microhabitats (i.e., nesting sites, hibernacula, etc.) of their study animals in their reports. Cases of illegal collecting in Ontario are being compiled and possible impacts of these activities are being assessed.

ORIGINS OF THE FROG-KICK: SWIMMNG IN PRBUTIVE FROGS

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When jumping or swimming, frogs typically push synchronously with both legs. The mode of swimming is a drag-based mechanism employing the feet as paddles and the hind limbs as thrusters. Although the archaic frogs Leiopelma and Ascaphus jump on land, they swim in a different manner. We video-recorded swimming Leiopelma hochstetteri, L. archeyi, and Ascaphus truei, and other frogs, using high resolution video. Leiopelma spp. and Ascaphus swam with alternating movements of their hind limbs, holding their forelimbs forward and outstretched. One leg always trailed the body as a rudder to prevent excessive yaw. The frogs swam with near constant velocity and, like swimming tadpoles, the body swung from side to side, pivoting at the level of the otic region. All other species swam with simultaneous and symmetrical movements of the hind limbs, without lateral movement, and with forelimbs pulled back to lie alongside the body; asynchronous leg movements were associated only with mid-water directional changes. Leiopelma and Ascaphus demonstrate that frog jumping and frog swimming are independent locomotor modes with separate evolutionary derivations and neural controls. Even though the earliest known anurans could have jumped like frogs it does not follow that they swam like frogs.

SUPERNUMERARY CHROMOSOMES IN THE PACIFIC GIANT SALAMANDER, Dicamptodon tenebrosus

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Supernumerary, or B, chromosomes are extra chromosomal elements that are morphologically distinct from the normal chromosome complement. They are often smaller and more highly heterochromatic than the regular chromosome set and can show numerical variation within and between individuals. These unique chromosomes are also highly variable in their effects, morphologies, and inheritance patterns. It is assumed these chromosomes are derived either from the autosomal chromosome set, through chromosomal fragmentation, nondisjunction, or other rare event, or through interspecific hybridization. Once present, these chromosomes are thought to evolve independently of the normal chromosome set. It is possible to test whether or not homologies exist between supernumerary chromosomes and the normal chromosome set through the microdissection and cloning of supernumerary chromosome segments for use as probes in Southern blots and chromosomal flourescence in situ hybridizations. Results of such studies have provided insight into the origin and evolution of these unique chromosomes in several plant and animal species. Supernumerary chromosomes have been found in populations of the Pacific giant salamander, Dicamptodon tenebrosus yet not in its sibling species D. ensatus, D. copei and D. aterrimus. The supernumerary chromosomes of this species vary in number, up to ten, between neighboring populations and have been found to contain nucleolar organizer regions. The origin of these extra chromosomal elements in Dicamptodon tenebrosus and how they affect the life history of this salamander species has yet to be determined.

EFFECTS OF THE PRESENCE OF FISH ON THE SUITABILITY OF BREEDING SITES TO Ambystoma maculatum

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Amphibian species which breed in temporary ponds, such as Ambystoma maculatum (the spotted salamander), are thought to be excluded from permanent habitats by fish predation. Evidence is accumulating, however, that A. maculatum. sometimes breed successfully in the presence of fish. We investigated the co-occurrence of breeding A. maculatum and fish in 11 lakes in Algonquin Park, Ontario. Stepwise multiple regression was used to determine the etlect of the presence/absence of fish, pH, Secchi depth, lake area, and the forest type surrounding the lakes on the egg mass density (egg masses per m of shoreline). We closely studied one lake, Scott Lake, to determine the relationship between egg mass density and littoral zone characteristics. We also trapped recently metamorphosed A. maculatum at Scott Lake. Variation in egg mass density among the 11 lakes was significantly related to the presence/absence of fish (excluding Salvelinus fontinalis), but was not related to the five other habitat variables we tested. Egg mass density within Scott Lake was significantly related only to lake bottom slope. Ambystoma maculatum larvae were palatable to fishes in Scott Lake, but larvae successfully reached metamorphosis in this lake despite the presence of fish. Our results indicate that fish presence is the most important factor in the suitability of a breeding site to A. maculatum, but fish do not completely exclude A. maculatum from breeding sites. The use of refuges and spatially complex habitats, and the use of a bet-hedging type life history, are potential ways in which A. maculatum can reproduce despite the presence of fish.

SPATIOTEMPORAL AUTOCORRELATION AND HOME RANGE BIAS.

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Most statistical tests require independence of observations to make valid conclusions. However, animals typically move in a non-random fashion, and thus ecologists are frequently faced with strongly autocorrelated data sets. A routine procedure of home range analyses is to eliminate non-independent data in an attempt to produce statistically rigorous results. We used computer simulations and data from radiotracked snapping turtles (Chelydra sementina) to examine the effect autocorrelation has on home range parameters. We were unable to achieve independence among observations by subsampling locational observations of radio-tracked snapping turtles. To determine the effect that autocorrelation has on home range estimates, we used a Monte Carlo simulation to generate 100 highly autocorrelated datasets from a known home range size. These datasets were subsampled to decrease autocorrelation, and various estimators were used to estimate home range for each subsample. Generally, home range estimators were more accurate and precise using highly autocorrelated datasets. We recommend that researchers maximize their sample size even at the expense of reducing independence. Finally, autocorrelation is not a problem to be eliminated, but instead can be used as a tool to infer repeated or cyclical behaviour.

ON THE MECHANICAL PROPERTIES OF THE TADPOLE TAIL FIN

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The tadpole tail fin is a simple double layer of skin surrounding a core of loose connective tissue. Three tests were conducted on longitudinal samples of the dorsal tail fin from 6-10 Rana catesbeiana tadpoles to establish the fin's uniaxial viscoelastic properties: 1) large deformation cyclic loading at 1 and 3 Hz; 2) small deformation forced vibration at 1 and 3 Hz; 3) stress relaxation under a 0. 1 s loading time. The fin was very fragile, failing easily at tensile loads of circa 5 gms. The fin was also found to be strikingly viscoelastic, as demonstrated by 70±2% hysteresis loss, 85±3% stress relaxation over 1 00s, and a phase angle of 18±1o in forced vibration. Tadpoles in nature are often found with damaged tail fins. We suggest that the unusually viscoelastic and fragile nature of the fin helps tadpoles escape the grasp of predators. Because the fin both deforms viscoelastically (literally flows) and tears easily, tadpoles can escape the grasp of predators and survive otherwise lethal attacks with only minor lacerations to the fin. In this regard the tadpole tail fin may be functionally analogous to the autotomizable tails of certain salamanders and lizards.

TESTING EXPLANATIONS FOR A MALE-BIASED SEX RATIO IN A POPULATION OF COMMON MUSK TURTLES (Sternotherus odoratus) IN GEORGIAN BAY, ONTARIO

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A population of common musk turtles (Sternotherus odoratus) was studied at Loon Island, Georgian Bay, Ontario, during the summers of 1991-1997. A total of 573 turtles (430 males, 127

females, and 16 juveniles of unknown sex) was captured, marked and released. The sex ratio was extremely male-biased (3.39 males per female). Almost all freshwater turtles have a 1: 1 sex ratio; biased ratios are most commonly attributed to either sampling bias or differential behaviour of the sexes. Neither hypothesis is supported for the Loon Island population. Biased sex ratios in freshwater turtle populations can be the result of biased hatchling sex ratios, differential ages at maturity, differential emigration or immigration rates, or differential mortality rates. We tested for each of the above effects and found that none are presently affecting the Loon Island population. Analysis of the data indicated that the sex ratio is unbiased for turtles smaller than 100mm in carapace length (1.31 males per female) and extremely male-biased for turtles greater than 100 nun carapace length (6.37 males per female). We have hypothesized that the biased sex ratio may be a result of higher mortality of older females but that these effects are too low to be statistically significant over the short time span of this study. Alternatively, the biased sex ratio may be the result of a historical event and consequently we are unable to determine its cause.

THE EFFECTS OF SELECTIVE LOGGING ON AMPHIBIANS IN ALGONQUIN PROVINCIAL PARK, ONTARIO

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Many of Ontario's amphibian species occur in forested areas of the Great Lakes St. Lawrence Forest Region. These species are potentially susceptible to habitat disturbance and alteration associated with selective logging protocols used to manage publicly-owned, shade-tolerant hardwood forests in these areas. In 1995, we began a research program to determine whether, and if so, by what mechanism(s), selective logging affects amphibian abundance and diversity in Algonquin Provincial Park, Ontario. Measures of amphibian abundance and diversity were taken from 10 randomly selected forest stands logged within the past 2 to 3 years, and 10 randomly selected forest stands left undisturbed for at least the past 30 years. Comparisons of repeated measures of amphibian abundance and diversity in both logged and unlogged stands throughout the breeding seasons of 1996 and 1997 suggest the following: (1) selective logging does not affect the relative abundance or species diversity of breeding adults, egg masses or larvae, (2) selective logging does not affect the density or relative abundance of Plethodon cinereus, and (3) selective logging does not affect the abundance of juvenile Bufo americanus in the hardwood forest stands under study. It is generally assumed that selective logging mimics natural disturbances such as fire and windthrow. However, this assumption has never been tested Although the results presented here do not contradict this assumption, we will use results of habitat surveys conducted to test this directly. Results of these analyses may indicate that other groups of organisms are expected to be affected by this type of forest management.

CURRENT INDUCED POLYPHENISM IN THE BEHAVIOUR AND MORPHOLOGY OF ANURAN LARVAE (Rana sylvatica)

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An experiment was undertaken to examine how minor changes in the physical environment could affect the morphology and behaviour of anuran larvae. Pond-dwelling larvae of Rana sylvatic were raised for > 2 months (to metamorphosis) in a flow tank with a mild current of ~ 2.6 cm/s. Control tadpoles were maintained in an identical volume of the same water, but without a current. The tadpoles raised in the flowing water experienced delayed growth, taking ~50% longer to reach metamorphosis than control larvae. The experimental tadpoles spent a significantly greater proportion of time at or near the bottom of the water column and had lower aerial respiration rates. They also differed significantly from the controls in both lung morphology and tail shape. Specifically, the tadpoles raised in the current, quickly (< 2 weeks) acquired on the morphology of typical stream-dwelling larvae; they had diminutive lungs and proportionately less tail fin height than the tadpoles raised in still water. Tadpoles reduce their activity in the presence of natural predators and can also show predator-induced changes in caudal morphology. Our experiment suggests that such predator-induced phenotypic plasticity may be a secondary result of reduced locornotor activity. Our results also suggest that some of the common traits used to describe and diagnose anuran larvae may be environmentally induced and not genetic features of the taxa.

MICROSATELLITE ANALYSIS: A TIMELY TOOL FOR HERPETOLOGISTS

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Microsatellite DNA sequences are short units of non-coding DNA repeating in tandem. Large variation in repeat number is found between individuals and this can be used to determine relationships between closely related species and subpopulations of the same species. Microsatellite analysis provides herpetologists with a fine-scale tool for answering questions about population dynamics, genetics, ecology and conservation. This technique is particularly well suited to study endangered or threatened species as only tiny amounts of animal material are needed. Dendrobatid microsatellites have been characterized and the steps involved will be reviewed. In addition, the conservation of microsatellites between Rana pretiosa and R. luteiventris has been found, and differences between these species detected.

ECOLOGICAL CONSTRAINTS OF GROWTH OF PAINTED TURTLES IN A NORTHERN CLIMATE

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Previous experiments have shown that in ectotherms, metabolic rate is positively correlated with external temperatures. The effects of this relationship on growth of freshwater turtles in the wild, however, is not well understood. We first tested for and found, that growth of juvenile painted turtles (Chrysemys picta) in Algonquin Park, Canada, correlated positively with air temperatures of the growing season. To test whether this positive correlation was directly due to temperature, or indirectly due to increased food in warmer years, we raised 90 hatchlings from Algonquin Park in the laboratory. Hatchlings were provided with the ability to thermoregulate through basking, either 0 out of 5 days, or 1, 2, 3, 4, or 5 out of 5 days, and were either fed to

satiation, or ate 68.6% of this amount. Growth in the laboratory correlated with temperature, but not with quantity of food consumed. Because passage rate of food was faster in turtles which could bask, turtles which never basked ate an average of 37.5% of that eaten by turtles which could bask daily, and 46.7% of that eaten by turtles which basked 4 out of 5 days. It is likely that this extreme reduction in food intake, as a result of lower passage rate of cool animals, contributed to the relationship between temperature and growth observed both in the laboratory and in the field, whereas food was not restricted sufficiently in the lower food group to reduce growth.

AN ASSESSMENT OF THE VALIDITY OF SKELETOCHRONOLOGY IN THE BULLFROG, (Rana catesbeiana)

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Few studies have directly tested whether chronological age can be accurately and reliably determined throughout the life of an individual using skeletochronology. This study is an attempt to validate skeletochronology for the bullfrog, (Rana catesbeiana), using individuals from a mark-recapture population on Lake Sasajewun. in Algonquin Provincial Park, Ontario. Phalanges from 35 known-age individuals and 22 unknown-age individuals, with toes removed in 1995 and 1996, were sectioned with a freezing microtome and stained with haematoxylin. Lines of arrested growth (LAG) were counted by seven trained volunteers using blind counts. Differences among volunteers with respect to LAG estimation were tested using a Friedmans test. Two tailed Mests were used to detect differences between the estimated and the expected number of LAG and between the estimated and expected annual increment. The were no significant differences among volunteers with respect to LAG estimation, or between estimated and expected number of LAG and between the estimated and expected annual increment. This study represents a partial, but limited, validation of skeletochronology as a technique for age determination in the bullfrog.

EFFECTS OF SEASON LENGTH ON BODY SIZE AND AGE AT MATURITY OF WOOD TURTLES (Clemmys insculpta)

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A general trend of increasing body size and later age of maturity with decreasing number of frost free days per year has been noted for several species of fresh water turtles. In concordance with this trend, we predicted that wood turtles, (Clemmyss insculpta), from southern Ontario would have a larger size and later age at maturity than populations with longer growing seasons and the reverse trend in comparison with populations having shorter growing seasons. A total of 270 turtles was captured, measured, and marked; body size and age at maturity were compared with those in other wood turtle populations. We found that our turtles conformed to the predicted pattern of body size, but not age, at maturity. Three explanations have been put forth to explain this trend: larger body size 1) allows for larger fat reserves, so turtles can survive long winters and reproduce without great risk; 2) reduces the risk of predation; and 3) increases fecundity. The second and third explanations are not supported by our observations of wood turtles. Therefore, we conclude that larger body size may enhance

survival of northern turtles by allowing for storage of more resources so that they have better success at reproducing and/or overwintering.

A FROG FLUKE BY ANY OTHER NAME: NOMENCLATURE IN THE GENUS Halipegus (DIGENEA: DEROGENIDAE)

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The genus Halipegus includes digeneans that are primarily parasitic in the mouth and eustachian tubes of frogs. Since most of these worms mature in the mouth of the amphibian definitive host and can be examined without killing the host, they offer unique opportunities for field studies that link amphibian behavioural ecology with parasite population dynamics. Until recently, such work has been hindered by taxonomic confusion within the genus Halipegus and difficulties in separating the several species of adult worms that occur in North American amphibians. However, separating adult worms based on egg filament length and site of infection is a reliable method of identification. Taxonomic confusion in North America has been largely due to several previously unrecognized synonyms within the genus.

COVER vs NO COVER: DOES THE FROG'S (Xenopus Laevis) OPINION COUNT?

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The use of amphibians in biological research continues to rise. In the past Rana sp. was the predominate laboratory amphibian, but that genus has now been surpassed by Xenopus. The best way to raise Xenopus, to maximize growth and reproduction, has not been established. Most animal care literature for anurans still focuses on terrestrial species (e.g. Rana) and says little about aquatic taxa, like Xenopus. A survey of 65 research laboratories that maintain Xenopus colonies revealed no consistent protocol for the care and maintenance of these frogs.

A particular controversial point is whether Xenopus should be offered cover ("hiding spots") or not. Aproximately half (46%) of the laboratories surveyed offer cover to their animals, without any evidence that it is beneficial to the frogs. Therefore, an experiment was conducted to see if Xenopus show a preference for cover or no cover. During a designated 1hr period, 18 of 20 juvenile frogs used opaque cover at some point. On average the frogs spent 45 % (27min±6.3) of the time under the opaque cover and 55% in the open. These results indicate that when undisturbed Xenopus frogs make substantial use of "hiding spots" and greatly prefer opaque cover.

These results do not yet establish whether the presence of cover potentially influence egg production or age to sexual maturity for Xenopus. A long term study on the influence of cover on Xenopus egg production and age of maturity is currently underway in our laboratory.

BIOLOGICAL SIGNIFICANCE OF POST-MATURATIONAL GROWTH IN FEMALE FRESHWATER TURTLES

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Life histories evolve as a series of trade-offs of costs of growth, maintenance and reproduction. Many models of life history suggest that optimal allocation of resources occurs when somatic growth ceases at reproductive maturity, but many species of turtles continue to grow after maturity. Most authors suggest that this indeterminate growth pattern is selected for because it provides either increased fecundity or increased survivorship. We examined relationships between body size and clutch size in the common Snapping turtle, Chelydra serpentina and the Wood turtle, Glyptemys insculpta. We tested whether (a) body size was correlated with clutch size, (b) growing adult females experienced an increase in clutch size relative to non-growing females and (c) adult growth rates account for observed ranges of adult body size. We found support for (a) but not for (b) and (c). We found a positive correlation between adult body size and survivorship. Models derived from life table data suggest that growth after maturity is selected for because it enhances survivorship not fecundity.

THE EFFECT OF P,P'-DDE ON SEX DETERMINATION OF THE COMMON SNAPPING TURTLE (Chelydra s. serpentina)

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Recent evidence indicates that DDT and some of its metabolites are capable of altering reproductive and endocrine function in wildlife. Studies have shown that exposure to endocrine-disrupting compounds during embryonic development can alter the sexual differentiation process. We tested the hypothesis that p,p'-DDE causes feminization of the common snapping turtle (Chelydra s. serpentina), a species with temperature dependent sex determination (TSD), during embryonic development. Eggs from 8 clutches (total tested = 237) were incubated at a male-producing temperature (26oC). At stage 14 of embryonic development p,p'-DDE was applied topically at 4 concentrations and estrogen (estradiol- 17ß) was applied as a positive control. Application of estrogen induced female development at this temperature, yet application of p,p'-DDE did not affect sex determination at the exposure levels used. Residue analysis indicated that the amount of p,p'-DDE detected in the embryos was considerably less than the concentrations applied. However the amounts that penetrated the embryos were comparable to levels which have been found in eggs from moderately contaminated sites. These results indicate that p,p'-DDE does not cause the feminization of snapping turtles during embryonic development at levels that exist in the environment.

EFFECTS OF SELECTIVE LOGGING ON RED-BACKED SALAMANDER ABUNDANCE

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An increased awareness of the importance of amphibians in forest ecosystems has led to the initiation of monitoring projects to detect population declines. Decreases in the relative

abundance of amphibian populations have been noted in clearcuts, but few studies have examined the effects of selective logging on amphibian populations. Since one of the aims of selective logging is to mimic natural occurrences (such as windthrow), amphibians such as red-backed salamanders (Plethodon cinereus), which rely on downed woody debris for nesting sites and cover, may not be affected. Field experiments comparing red-backed salamander abundance and the characteristics of downed woody debris between logged and unlogged forest stands were conducted over a two year period in Algonquin Park, Ontario. We found no significant difference between the total amount of downed woody debris surface area in logged and unlogged stands. We also found that red-backed salamander abundance did not differ between the logged and unlogged stands. However, we did find that individual pieces of debris in the unlogged areas were generally larger and more decayed than in the logged areas. These two characteristics of downed woody debris are important aspects of suitable red-backed salamander habitat, and their limited presence in logged areas could be of long-term importance.

DO LARGER PAINTED TURTLES IN A NORTHERN POPULATION (Chrysemys picta marginata) HAVE A THERMOREGULATORY ADVANTAGE OVER SMALLER ONES?

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Nesting behavior of a northern population of Midland Painted Turtle (Chrsemys picta marginata) is monitored annually as a part of a long term mark-recapture program with northern freshwater turtles in Algonquin Park, Canada. Females from three ponds are captured, measured, and marked prior to the nesting period. The ponds are monitored for the duration of the six week long nesting period. Clutches are collected for measurement and reburied at marked locations. Weather data are collected daily both by the Algonquin Wildlife Research Station and the Ontario Ministry of Natural Resources. We used this data to control for air temperature in testing our hypothesis: larger turtles nest earlier in the season and show a greater tendency to produce a second clutch than smaller turtles.