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AMPHIBIAN & REPTILE CONSERVATION

THE INTERNATIONAL JOURNAL DEVOTED TO THE WORLDWIDE PRESERVATION AND MANAGEMENT OF AMPHIBIAN AND REPTILIAN DIVERSITY

Amphibian Declines

Rattlesnake Roundups

Herpetofauna in the Wildlife Trade and Nature

PREMIERE ISSUE

BLUE CHAMELEON VENTURES

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PANTHER CHAMELEON, a dazzling adult male from northwestern Madagascar

What is *BLUE CHAMELEON VENTURES?*

Bill and Kathy Love operate the business based near Ft. Myers in southwest Florida. We specialize in providing quality photography for books, magazines, calendars, web sites, signs, slideshows, and all forms of commercial advertising. Our area of expertise is herpetology - reptiles and amphibians, and also invertebrates. A huge stock of color slides is available. Or, we'll be glad to discuss taking new shots of animals, displays, or other subjects needed to illustrate your next project.

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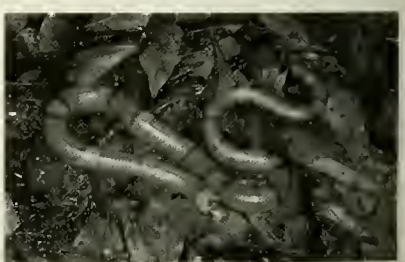

Captive - bred hypomelanistic Honduran Milk snake, a new inheritable trait that really glows!

ERRATUM SHEET (AMPHIBIAN & REPTILE CONSERVATION VOL 1 NO. 1)

To increase the accuracy of the journal and reduce the number of errors a new policy is now in place. This policy was not followed in the first issue due to time constraints. All authors will now receive galley proofs once their article has been edited and the layout completed. These proofs will be reviewed one last time by the author(s). All errors should be brought to the attention of the editor as soon as possible.

The following journal corrections should be noted.

1) Page 3. Masthead.
   a) The premiere issue (Vol. 1 No. 1) are now $12 each.
   b) Back issues are $9 each (exception, Vol. 1 No. 1).
2) Page 10. In the Key Words section the word Viridi_ should be spelled Viridis.
3) Page 16. Under the photo caption the word *Plethedon* should be spelled *Plethodon*.
4) Page 20. The third sentence of the body of the article should read "Inbreeding depression may adversely affect small populations by unmasking recessive deleterious alleles and reducing heterozygosity."
5) Pages 24-26. Column.
   a) The personal communication on page 25 (Groombridge 1994) was not attributed to Dr. Brian Groombridge of the World Conservation Monitoring Centre (WCMC), Cambridge, England.
   b) The WCMC database, referred to in the column, is in fact the CITES database of trade records. WCMC have developed and maintain it on behalf of the CITES Secretariat.
   c) By comparing export records and import records, and checking against known countries of origin, it is in fact possible to get some idea of the extent of misreporting.

The up-dated information for this particular article was provided by Brian Groombridge on November 8, 1996.

NOTE - The most up-to-date Writer's Guidelines and Manuscript Preparation instructions can always be found at the Amphibian & Reptile Conservation website at: http://www.byu.edu/~arcon/

AMPHIBIAN & REPTILE
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On the Cover

A male Golden toad *(Bufo periglenes)* at the Monteverde Cloud Forest Reserve, Costa Rica. Sadly, there have been no confirmed sightings of Golden toads seen since May of 1989, when a single male was seen. No one knows why this species disappeared from its pristine forest surroundings, far from human activities.

Golden toad photographs generously donated by Michael and Patricia Fogden, Natural History Photographers, Kinbuck, Dunblane, Perthshire FK15 9JU, Scotland, UK. Tel/fax: +44 1786 822069.

Contents

Scope: *Amphibian & Reptile Conservation (ISSN 1083-446X)* is an international peer reviewed journal devoted to the worldwide preservation and management of amphibian and reptilian diversity. Audience: *Amphibian & Reptile Conservation* is intended for a wide readership from the amateur to the professional and is therefore written with abstracts, explanatory text, full references, ample photographs, tables, figures, diagrams, and other illustrations to help elucidate the text. Focus: *Amphibian & Reptile Conservation* concentrates on publishing timely information in the form of feature articles, reviews, reports, short communications, columns, commentaries, book reviews, and news and notes. Frequency: *Amphibian & Reptile Conservation* is published quarterly in the spring, summer, fall, and winter. Publisher: Amphibian & Reptile Conservation, 2255 North University Parkway No. 15, Provo, Utah 84604-7506 USA. Subscriptions: Annual subscription rate categories are individual subscription $18.00 (US) and institutional $36.00 including postage. All subscriptions outside the United States include $7.00 for shipping (individual $25 and institutional $43). *Amphibian & Reptile Conservation* is distributed to every country in the world (subscribers worldwide) and delivery is guaranteed. Contributions: Contributions to the journal are accepted. These resources are used to further the conservation efforts of reptiles and amphibians and the goals of the journal. Categories include friends of *ARC* $40, supporting $50, contributing $100, patron $250, sustaining $500 and founder (includes lifetime subscription to *Amphibian & Reptile Conservation*) $1,000. All other contributors receive four issues of *Amphibian & Reptile Conservation*. Back Issues: Back issues are available from the publisher for $8 each. The premiere issue can be purchased for $10. Payment: All journal orders must be prepaid in US currency drawn on a US bank or with an international money order. Communications: It is recommended that all correspondence be conducted via electronic mail (e-mail) whenever possible. All other correspondence should be directed to *Amphibian & Reptile Conservation, 2255 North University Parkway No. 15, Provo, Utah 84604-7506 USA*. E-mail: ARC@byu.edu. URL:http://www.byu.edu/~arcon/ Postmaster: Please send change of address to publisher (*Amphibian & Reptile Conservation, 2255 North University Parkway No. 15, Provo, Utah 84604-7506 USA*) six weeks prior to move. Production: Manufactured and printed in the United States of America.

Figure 1. Nine male Golden toads *(Bufo periglenes)* at a breeding pool, Monteverde Cloud Forest, Costa Rica. Photo generously donated by Michael and Patricia Fogden.

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The Elucidation of Amphibian Declines

Are Amphibian Populations Disappearing?

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Key Words
Population declines, extinction, conservation, research, monitoring, amphibians

Abstract
Information regarding most amphibian declines is anecdotal and natural fluctuations in amphibian population size are not uncommon. However, biologists can no longer find amphibians in regions where they were once numerous, and have directly observed population declines and species extinction. Inventory and monitoring programs are being established worldwide in order to assess the status of amphibian populations and to attempt to identify causes of declines. Factors that may be contributing to local amphibian declines include natural population fluctuations, natural succession and other changes in vegetation, introduced predators and competitors, pathogens, excessive collecting, toxic compounds, and habitat destruction. Climate disturbance, pollutants, and increases in UV-B radiation have been implicated in some well documented regional amphibian losses. These factors may decrease amphibian population size by causing mass mortality, reducing the ability of individuals to produce viable offspring, and/or by inhibiting dispersal of individuals. A loss of amphibians will have a significant impact on the state of the environment, as well as a decline in our cultural heritage and human well-being. Both biologists and concerned citizens have vital roles in amphibian conservation. A brief list of possible citizen actions to help protect amphibious life is presented here.

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Amphibian populations worldwide seem to be declining. Even the causal observer can not find frogs, toads, and other amphibians as numerously as they once could. Within the few short decades of our lifetimes, a wide variety of amphibians seem to have been disappearing. Population declines and species extinction dot the pages of personal journals. Biologists now search harder than ever, asking "why" and hoping to find the answers so that future generations don't have to be told what they are missing.

Finding answers is no easier than finding frogs. There is ample evidence that humankind has greatly impacted the distribution and abundance of animal and plant species worldwide through extensive habitat alteration and degradation. Such observations can be made daily, and by non-biologists. What we need to know, however, is how specific land uses impact the population dynamics of amphibians, and at what spatial and temporal scales. We also need to know what the loss of amphibians means for the continued functioning of ecosystems. Ultimately, we need to know what the disappearance of amphibians signifies for human well-being.

The paucity of data

Unfortunately, information regarding most amphibian declines is anecdotal. For several species, range reductions are well documented, but local population declines are less evident. For most species, studies only provide fragmentary pictures of populations on population trends.

Research on amphibian ecology has historically lagged behind that of other vertebrate groups because amphibians are often difficult to study and funding is harder to obtain. Those concerned about the loss of Neotropical migratory birds can reference broad ranging, standardized datasets from numerous monitoring programs. Several of these datasets span multiple decades; one was initiated as early as 1900. However, long-term (decade or longer) monitoring programs exist for only a few amphibian species and only at specific sites. Amphibian population dynamics can typically be described as "boom or bust;" natural

fluctuations may be the rule rather than the exception. Thus, only very long-term datasets are useful in validating suspected trends and elucidating the mechanisms of amphibian population declines.

The first worldwide effort to assimilate data and hypothesize the causes and consequences of amphibian declines was held in Irvine, California in 1990 (Blaustein and Wake 1990). Since this meeting, an international investigatory team, entitled the Declining Amphibian Populations Task Force (DAPTF) of the Species Survival Commission (SSC), International Union for the Conservation of Nature (IUCN), has been formed and working groups have been designated to address potential causes (*e.g.*, toxins, UV-B radiation, pathogens) and geographic regions. The findings of working groups and individual scientists are published quarterly in the DAPTF newsletter, *Froglog*, making information readily available. Conservation organizations, naturalist societies, and regional agencies have been successful in establishing local amphibian inventory and monitoring programs that often effectively utilize a massive volunteer work force. County- and continent-wide initiatives, such as the North American Amphibian Monitoring Program (NAAMP), are in various stages of design, testing, and implementation.

What we do know

Amphibian populations can fluctuate greatly between years; variations in moisture, predation, competition, disease, and catastrophic events may greatly influence population size. Populations may suffer great losses. Yet, if the same populations experience "good years" that result in many surviving offspring, the long-term population trend may be stable. Long-term stability may also be attained if amphibians from other locations recolonize sites where populations have been annihilated. For example, Norman Weitzel and Howard Panik observed Pacific chorus frogs *(Pseudacris regilla)* in Nevada and found that in 80% of the years between 1975 and 1989 frogs produced offspring that became members of the next generation. The population was annihilated from the breeding pond ten times by natural disturbances that included flash floods, stream dry-ups, and sudden increases in water temperature. Yet, after each local extinction event, this population was soon reestablished by colonizing chorus frogs.

Extremely long-term datasets are required to distinguish between natural population fluctuations and anthropogenically induced declines. Joseph Pechmann and his colleagues monitored populations of one species of frog and three species of aquatic-breeding salamanders in the southeastern U.S. for twelve consecutive years. They found no evidence of drastic declines for any species, although the populations sizes did fluctuate. However, biologists Michael Reed and Andrew Blaustein recently reanalyzed Pechmann's data as well as that from four other long-term studies using a statistical tool called power analysis. All these studies, analyzed by this method, indicated no declines. While the datasets from these studies were not extensive enough to reveal statistical evidence of a decline, the lack of decline in populations of these amphibians could not be supported. Thus, even with twelve years worth of scientifically rigorous data, the status of these amphibian populations cannot be definitively assessed.

Amphibians cannot be found in many of the locations where they were once numerous. Yellow-legged frogs, red-legged frogs, spotted frogs, leopard frogs, western toads, cricket frogs, and tiger salamanders are a few of the North American amphibians dwindling in the number of sites of occurrence and population size. The amphibian queue for listing under the United States' federal Endangered Species Act has become so long that species ruled as justified for protection are precluded from it for years by stacks of preceding paperwork.

Herpetologists have witnessed the vanishing of amphibian populations, and even entire species. Biologists Stephen Corn and James Fogleman conducted an exceptional study, documenting six populations of the leopard frog *(Rana pipiens)* in Colorado for the decade 1973-1982. In 1973 only a single population failed to reproduce. For frogs this may not be unusual, but by 1981 no leopard frogs could be found at any of the sites. The study ended with a total absence of *R. pipiens* in the region.

The golden toad *(Bufo periglenes)* of Costa Rica, so named because of the male's bright orange color, never failed to show up for its annual spring breeding orgy (see Figure 1, page 4) from the early 1970s through 1987. Martha Crump and her colleagues counted 1500 individual adult golden toads in 1987, but noted that only 29 tadpoles metamorphosed and joined the population. From 1988 to 1990 these biologists located only 11 toads. *Bufo periglenes* has not been seen at the study site since.

In Australia, just north of Brisbane, a bizarre little frog was discovered in 1973. The gastric brooding frog *(Rheobatrachus silus)*, so named because it swal-

lowed and brooded its young in its stomach, was an immediate wonder to science and a potential boon for physiologists interested in finding cures for ulcers and possibly other gastric disorders in humans. A loss of worldwide significance, the frog has not been seen since 1979, leaving little clue as to what caused its extinction. Strangely enough, its natural habitat was found in seemingly pristine tropical forest, far from routine human disturbance.

Why are amphibians declining?

Could the above mentioned frogs have succumbed to natural, localized climatic disturbances such as drought ... been the victims of opportunistic pathogens ... suffered from a yet, undetected global atmospheric phenomenon? Could the little known golden toad and gastric brooding frog merely be sitting it out underground, awaiting what they consider more favorable conditions?

It is difficult to generalize as to the causes of amphibian disappearances. Not every amphibian population, nor every species, is declining. And, those that are declining are doing so at varying rates and scales. Figuring out what is happening to amphibians and why is exasperatingly difficult and exhaustingly time consuming.

Locally, factors that may be contributing to amphibian declines include natural population fluctuations, natural succession and other changes in vegetation, introduced predators and competitors, pathogens, excessive collecting, toxic compounds, and habitat destruction. Climate disturbance, pollutants (particularly those associated with acid deposition and pesticides), and increases in UV-B radiation have been implicated in some well documented regional amphibian losses (see reviews by Barinaga 1990; Wyman 1990; Blaustein and Wake 1990; Tyler 1991; Phillips 1994; Blaustein and Wake 1995).

Unfortunately, there may be a significant time lag between the negative influence of a factor on amphibians and evidence of a population decline. Prospecting for cause and effect relationships is, therefore, exceptionally difficult even in contemporary studies. Diagnosis is further complicated because factors can act in concert and their relationship is rarely obvious. For example, frogs have been observed to die of an infection caused by a common, widespread microbe called *Aeromonas hydrophilla* that is not normally pathogenic. Any number of other factors may inhibit frogs' immune systems, making them susceptible to infection.

Three general hypotheses illustrate the mechanisms by which various factors can cause the extinction of amphibian populations, and eventually species:

1) Mass Mortality hypothesis

A factor or combination of factors influences amphibians in such a manner as to induce mortality of individuals, sometimes entire populations. Different factors may contribute to mortality at varying points in amphibian development. However, the decline of many populations is not merely a problem of producing viable offspring. It is apparent that some factors are influencing adult survivorship because many of the rapid declines are occurring in periods far shorter than the animals' life span.

2) Reduction of Fitness hypothesis

One or more sublethal factor(s) reduces the ability of individual amphibians to produce viable offspring (*i.e.*, "fitness"). This eventually leads to population declines and even population- and species-level extinction. Genetic variation, growth rate, size at maturity, longevity, and physiological constraints all influence the fitness of amphibians. Some amphibians have such specific conditions for breeding that even subtle environmental changes can result in the failure of a population to breed.

3) Failure to Rescue hypothesis

The observed declines are primarily driven by the failure to reestablish populations following local extinction. Typically, when a local population goes extinct, the habitat is colonized by amphibians dispersing from nearby sources (this reestablishment is termed the "rescue effect"). Under this scenario, changes in the chemical or structural environment prevent amphibians from dispersing widely.

Several biological characteristics of amphibians are likely to impede recolonization following local extinction: (1) physiological limitations (particularly water requirements) make it difficult, even impossible, for amphibians to persist in or travel through suboptimal habitat; (2) amphibians tend to have small home ranges, many move only short distances, and rarely "wander"; and (3) amphibians, especially the adults of many species are extremely faithful to a specific location, or set of locations, and are unlikely to abandon sites even if they can no longer breed there.

The specific means (*e.g.*, physiological processes) by which these general mechanisms operate are not well understood and are rarely investigated. In part, this is due to the fact that solving the puzzle requires the cooperation of experts across disciplines as diverse as geology and genetics. Regretfully, most biologists are highly specialized and rarely trained or encouraged to work with colleagues from other fields. When they have, however, pieces of the puzzle fall into place. For example, and interdisciplinary team in Oregon led by Andrew Blaustein is now able to illustrate how stratospheric ozone depletion may lead to amphibian population decline. It works like this: Ultraviolet-b radiation penetrates the Earth's thinning, protective ozone shield and beams its way to earth where it comes in contact with amphibian eggs. The high-level and/or prolonged exposure to radiation causes damage to eggs' DNA (the genetic information template) molecules, which in turn results in the death of cells and thus tadpoles do not develop. As adult frogs die and are not replaced by new generations, the population declines and eventually goes extinct. Blaustein and the other investigators further learned that different amphibian species have varying amounts of photolase, an enzyme that can repair DNA damage. The declining Cascades frog is low in photolase, while the coexisting and successful Pacific chorus frog has good DNA repair capabilities; extra copies of photolase genes secure protection.

The impact of amphibian declines

A loss of amphibians will have a significant impact on the state of the environment. Amphibians are vital components of the world's ecosystems. Amphibians comprise one-quarter of all vertebrate species on earth and sometimes constitute the highest percentage of vertebrate biomass in a given area. This measure may be positively correlated with a species' contribution to ecosystem function; *i.e.*, it is one indication of the organisms' importance to maintaining the system's integrity. Amphibians consume aquatic vegetation, invertebrates and other vertebrates, and are eaten by numerous predators. Therefore, amphibians play multiple, vital roles in the food chain of ecosystems.

Amphibians are apparently declining even in seemingly pristine, protected areas worldwide. Because of these trends, many biologists are pondering whether amphibian declines should be interpreted as a warning signal; that is to say that the disappearance of amphibians indicates that something is gravely amiss in the biosphere. Because amphibians have permeable gills, skin, and eggs; have diverse life histories; are widely distributed and occupy a variety of habitats, their population dynamics may qualify as reliable gauges of environmental health (if only we can learn to interpret the signals).

Frogs are totems of luck for numerous native culture; many hunting poisons, ceremonial hallucinogens, and medicinal drugs are amphibian products. Amphibians are chemical factories and the compounds they produce may hold cures to all sorts of ills, including AIDS and cancer. If you've had painkillers administered recently, you may have a frog or two to thank. For an excellent review of amphibian contributions to medicine, see Grenard's (1994) *Medical Herpetology.*

You can make a difference

Approximately 5,000 amphibians have been described by science, with additional descriptions being cataloged at a rate of 1 to 2 percent a year. The rate of loss is immeasurable; we don't know how many amphibians have come and gone without recognition.

The amphibian decline "crises" demands that the status of amphibian populations be rapidly assessed and that where declines are apparent, mechanisms be identified, managed, and recovery programs established. This is much more easily stated than accomplished. There are far more amphibians than biologists investigating their declines. Funding is hard to come by, particularly for the long-term studies that are critical to understanding amphibian population dynamics. Also, time is not on the side of the amphibian population dynamics—human population and resource consumption continue to increase, rapidly changing the landscape that amphibians have been evolving in for roughly 350 million years.

Yes, there is hope. Amphibian populations have rebounded and sites have been recolonized following massive die-offs. Maintenance and recovery of environmental quality, and the restoration of fragmented landscapes will enable amphibians to persist.

As a citizen concerned about amphibians, your role in amphibian conservation is as critical as that of any highly trained biologist. The following is a very brief list of the many actions that you can take to help protect amphibians, and maintain their vital roles in the circle of life.

• Become a volunteer assistant for a local amphibian monitoring pro-

gram or research project. Contact your regional wildlife agency for information on studies in your area.

• Enlighten other people to the wonders and plight of amphibians by harnessing your enthusiasm and knowledge. Talk to children, the media, local officials, and the voting public.

• Support legislation that promotes healthy, intact ecosystems.

• Fight legislation that weakens control of pollution and land development.

• Encourage government agencies to fund long-term research projects on amphibians.

• Respect your wetlands by keeping them healthy. Do not pollute them with unnatural refuse such as litter and harmful chemicals (*e.g.*, petroleum products and pesticides).

• Organize routine cleanup projects.

• Admire amphibians in the wild; don't keep them as pets (animals kept for research, in legitimate conservation breeding projects, and as educational displays such as in zoological parks and aquariums are not considered pets and contribute to the conservation of species).

By joining forces, biologists and concerned citizens around the world can become a very powerful lobby for the conservation of amphibians. And amphibians, inventoried and monitored by these people, may be a powerful gauge for ensuring the protection of all life.

References

Barinaga, M. 1990. Where have all the froggies gone? *Science* 24: 1033-1034.

Blaustein, A.R. 1994. UV repair and resistance to solar UV-B in amphibian eggs: A link to population declines? *Proceedings of the National Academy of Sciences (USA)* 91: 1791-1795.

Blaustein, A.R. and Wake, D.B. 1990. Declining amphibian populations: A global phenomenon? *Trends in Ecology and Evolution* 5: 7.

Blaustein, A.R. and Wake, D.B. 1995. The puzzle of declining amphibian populations. *Scientific American* 272(4): 52-57.

Corn, P.S. and Fogleman, J.C. 1984. Extinction of montane populations of the northern leopard from *(Rana pipiens)* in Colorado. *Journal of Herpetology* 18: 147-152.

Crump, M.L., Hensley, F.R., and Clark, K.L. 1992. Decline of the golden toad: Underground or extinct? *Copeia* 1992: 413-420.

Grenard, S. 1994. *Medical Herpetology.* Reptile and Amphibian Magazine, Pottsville, Pennsylvania. 139 pp.

Pechmann, J.H.K. and Wilbur, H.M. 1994. Putting declining amphibian populations in perspective: Natural fluctuation and human impacts. *Herpetologica* 50: 65-84.

Pechmann, J.H.K., Scott, D.E., Semlitsch, R.D., Caldwell, J.P., Vitt, L.J., and Gibbons, J.W. 1991. Declining amphibian populations: The problem of separating human impacts from natural fluctuations. *Science* 253: 892-895.

Phillips, K. 1994. *Tracking the Vanishing Amphibians.* St. Martin's Press, New York. 244 pp.

Reed, J.M. and Blaustein, A.R. 1995. Assessment of "non-declining" amphibian populations using power analysis. *Conservation Biology.* In Press.

Tyler, M.J. 1991. Declining amphibian populations—a global phenomenon? An Australian perspective. *Altyes* 9: 43-50.

Weitzel, N.H. and Panik, H.R. 1993. Long-term fluctuations of an isolated population of the Pacific chorus frog *(Pseudacris regilla)* in northwestern Nevada. *Great Basin Naturalist* 53: 379-384.

Wyman, R.L. 1990. What's happening to the amphibians? *Conservation Biology* 4: 350-352.

While the Bird Conservation Specialist for the Smithsonian Institution's Migratory Bird Center, Jamie K. Reaser coauthored her first book, Bring Back The Birds: What You Can Do To Save Threatened Species *(Stackpole Press 1995). In 1993 Dr. Paul Ehrlich, presented Jamie with the opportunity to pursue her interest in amphibians through formal investigation as his doctoral student at Stanford University. Both Jamie and Dr. Paul Ehrlich are interested in what amphibian population trends might indicate about the health status of the biosphere.*

One of Jamie's greatest rewards of her work with amphibians is the opportunity to mentor undergraduate students who are interested in amphibian ecology and conservation. An open invitation is extended to those interested to visit her at Stanford University.

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Rattlesnake Roundup in Kansas: A Brief History

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Key Words
Rattlesnake roundups, commercialization, prairie rattlesnake, Kansas, conservation, legislation, poaching, Crotalus viridi

Abstract
Organized hunting ("roundups") of rattlesnakes for commercial profit has occurred for 50 or more years in several states in the U.S. For a long period, such roundups went unnoticed by wildlife agencies, biologists, and herpetologists. In recent years, there has been increasing concern that such intense and largely unregulated hunting could have an adverse effect on wild populations of rattlesnakes. There have been few conclusive studies on the topic. The first organized rattlesnake roundup to occur in Kansas was held in September of 1992 in the small town of Sharon Springs, and it is the intent of this paper to outline a series of events which occurred in the first, formative years of the roundup. Prior to the introduction of rattlesnake roundups into Kansas, all native amphibians and reptiles were protected from commercial interests by state law. The first roundup had little economic benefit for the participants, as all carcasses were either given or thrown away. Before the second roundup (held less than a year later) the organizers of the roundup succeeded in changing state wildlife laws to accommodate their economic interests. The objections and recommendations of the Kansas Department of Wildlife & Parks (KDWP), conservation organizations, and professional biologists were essentially ignored so that a select few might profit from commercial use of rattlesnakes. It became clear that economic gain for the roundup promoters and vendors held a higher priority than sound wildlife management. The legalized sale of rattlesnakes and their parts, including meat for human consumption, raised new concerns regarding meat inspection laws in Kansas. Shortly before the third roundup, the Kansas Department of Health and Environment (KDHE) informed the roundup organizers that their practice of selling uninspected meat was illegal. Nonetheless, the sponsors sold rattlesnake meat the following weekend. Clearly, the roundup organizers intended to violate the law as long as there was money to be made. The roundup organizers were never prosecuted and no fines were levied. Although a rattlesnake roundup has taken hold and continues to prosper in Kansas, it is clear that without the efforts of biologists and concerned citizens the situation would be much worse. Many of the more malicious aspects of the roundup have been tempered as a direct result of the efforts of relatively few individuals and organizations.

Word travels fast in the Kansas Herpetological Society (KHS). All were astounded and appalled that the unthinkable was on the verge of occurring right here in our very own herpetologically enlightened state. It can't happen here. Bad things, you know, always happen somewhere else. Yet there, in giant black type on ugly electric yellow paper, was the announcement: "Kansas's First Ever Rattlesnake Roundup!" It was to be held in Sharon Springs, Kansas—spitting distance from Colorado—on Labor Day Weekend 1992. We were all too familiar with the broad-ranging destructiveness of rattlesnake roundups in other states: the unregulated taking of wild animals for commercial profit, the use of gasoline to flush snakes out of shelters, the neglect and abuse of captive animals, and the perpetuation of antisnake sentiment. This roundup was advertised as a fundraiser; a family oriented event with the added benefit of "controlling overpopulation" of rattlesnakes which, sponsors claimed,

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cause immeasurable damage to humans and domestic animals in western Kansas.

Hosting a rattlesnake roundup was not an idea that citizens of Sharon Springs conceived on their own. Members of the sponsoring organizations had friendly ties with James White, owner of the "Fangs and Rattlers Show" from Granbury, Texas. In fact, one woman from Sharon Springs served as a bridesmaid in White's wedding—a wedding that took place in a snake pit. Sharon Springs was looking for a fund-raiser, and James White was looking for another gig. The snakes, they believed, were free for the taking. A rattlesnake roundup in Sharon Springs was the perfect solution. Herpetologists did not agree.

At the time, Kansas law prohibited the sale of any wild reptile or amphibian, including prairie rattlesnakes, and limited possession to five animals. The roundup sponsors did plan a few tricks to bypass these existing laws, such as giving away rattlesnake meat, provided that the recipient purchased a bun on which to eat it. Many herpetologists concerned about the rattlesnake roundups were confident that the state's wildlife agency would not stand for such attempts to circumvent the law. Several of these herpetologists sent token letters of concern to various individuals and agencies, and returned responses ranged from reassurance to hostility. Kansas Herpetological Society (KHS) representatives made several vain attempts to educate roundup sponsors and to shape the event into something less destructive. Nonetheless, the roundup commenced as planned.

An estimated 2000 people attended the roundup; among them were KHS members Henry and Virginia Fitch and Travis Taggart, who had been contracted by the Kansas Department of Wildlife & Parks (KDWP) to collect data on the size and reproductive condition of captured snakes. This data collection alone provided little information about the effects of the roundup. Other KHS members in attendance to observe and report on the activities of the roundup included Dr. David Edds of Emporia State University, Randall Reiserer, and David Reber of the University of Kansas. Several veterans of Oklahoma's roundups were also in attendance, to help in the "snake pit" and to guide groups in search of prairie rattlesnakes. A total of 75 prairie rattlesnakes were turned in (Edds 1992), 18 of which were born at the roundup. All 75 were ultimately killed. The snake meat sales trick failed, and most of the meat was either given away or thrown away, as were all other snake parts. The roundup did earn a substantial amount of money, through assorted trinket vendors, snake products from other states, food service, and tickets to the "Fangs and Rattlers Show," direct from Granbury, Texas. The "Fangs and Rattlers Show" was typical roundup entertainment, the announcer cajoling the crowd while the pit crew performed daredevil tricks, most of which involved unnecessary rough treatment of the animals. Children were invited to pet loosely restrained rattlesnakes, and dangle inflated balloons into the pit in hopes of enticing a strike. Overall, a carnival-like atmosphere pervaded and, with current laws prohibiting the sale of wild caught prairie rattlesnakes, the snakes themselves were not the central money maker. Those of us in attendance at the roundup remained confident that the roundup organizers would lose interest and move on to something less destructive. The thought that existing laws could be legislated moot never crossed our minds.

DAVID L. REBER

One of the sideshow type tricks shown at the "Fangs and Rattler" show.

Enter Sheila Frahm, Senate majority leader representing the Sharon Springs area. Senator Frahm began her political career as a member of the Sharon Springs local school board. Unknown to us, Senator Frahm had also attended the first roundup, even helping to weigh the snakes. Then, during the 1993 legislative session, she introduced a bill (Senate Bill 137) that, if passed, would not only allow the sale of prairie rattlesnakes, but would raise the limit from 5 to 30, and remove all management authority from the Department of Wildlife & Parks. Once again we thought: it can't happen here. We all assumed that our enlightened legislature would never pass such an anticonservation bill. Still, KHS and numerous herpetologists provided testimony against the bill, as did the

Kansas Wildlife Federation, the Kansas Audubon Council, the Topeka Zoo, the Sedgwick County Zoological Society, the Kansas Chapter of the Sierra Club, and even the Kansas Department of Wildlife & Parks (KDWP). Apparently politics, not prudence, drove the issue, as the bill passed with little opposition. There was some success for conservationists; the final bill was altered to place regulation of the roundup back into the hands of KDWP.

Before KDWP could enact regulations, a second roundup was held in the spring of 1993, less than one month after Senate Bill 137 became law. A springtime roundup was recommended by representatives of Oklahoma and Texas roundups. This, combined with the generous bag limit allowed by the legislature, resulted in over 170 snakes being taken—more than double the number of the first roundup (Western Times 1993). Senator Frahm and her daughter Chrissy were in attendance and, in recognition of her "heroic" efforts, Frahm was presented with her very own snake bucket and tongs.


DAVID L. REBER

Another one of the sideshow type tricks shown at the "Fangs and Rattler" show.

Shortly after the second roundup, KDWP began the long process of developing regulations for commercial use of prairie rattlesnakes. Initially, KDWP asked Oklahoma officials for advice on the issue, in spite of the fact that Oklahoma roundups target a different (and much more prolific) species, the western diamondback. Roundup organizers lobbied KDWP, asking for no possession limit, a year-round season, and no restrictions on the open area. KHS (1993) president Dr. David Edds attended virtually every meeting of the Wildlife & Parks Commission, recommending that KDWP reset the possession limit at 5 snakes, limit the open area to only the counties surrounding Sharon Springs, and limit the open season to the roundup weekend. Many others addressed the Commission as well, advocating moderation in light of the glaring lack of sound biological information. In spite of their testimony, each draft of the regulations proved more lenient. Furthermore, when herpetologists attended, the issue was often removed from the meeting agenda, as if the Commission were attempting to push regulations through without input from the scientific community. Again, politics drove the issue.

It was decided by the KHS that their position statement must be reinforced using the available scientific literature and published, for permanent record and to assist policymakers. Thus, a position paper was written, totaling 11 pages and 43 references. The paper included recommendations for regulating the roundup—recommendations aimed at promoting sportsmanship and a sustainable yield of *Crotalus viridis*. A copy of the paper was provided to each member of the Wildlife & Parks Commission, as well as to the Department Secretary, Theodore Ensley. At the final ruling in January of 1994, conservationists were extremely disappointed. The lenient draft regulations passed with few modifications. The only successes were lowering the possession limit from 30 to 20, limiting the open season to a 30 day period prior to the roundup, and limiting the open area to the western third of the state (approximately one half of the prairie rattlesnake's range in Kansas). One major loophole remained: the sponsoring organizations were not subject to a possession limit. Thus, one person could conceivably catch their limit, sell their catch to the roundup sponsors, then head back for more, effectively circumventing the existing possession limit. KDWP defended the regulations as a compromise between interest groups.

Clearly, arguments based on the biology of the prairie rattlesnake and sound wildlife management were not taken seriously. The bottom line was money, and a way to touch the bankbooks of the roundup sponsors was badly needed if their plans were to be altered. KHS discovered that the Kansas Department of Health and Environment (KDHE) has strict regulations pertaining to the butchering and sale of meat. Essentially, both the butchering facility and the meat itself must be inspected and passed by KDHE before any meat can be sold. A letter was sent by KHS to KDHE immediately, along with an explanation of the past butchering process and an advertising flyer for the upcoming roundup. KDHE repre-

Prairie rattlesnake *(Crotalus viridus)* which was taken at a roundup in 1992 (it can be assumed that it was slaughtered—possibly fashioned into an item such as a hatband).

sentatives contacted the roundup organizers, explained meat processing and sales laws, and informed them of the penalties for violating those laws.

The third roundup was held in May of 1994. The take totaled over 300 animals, again doubling the previous year's take (Fitch 1994). KDWP's research indicated most of these snakes had been stockpiled for extended periods, despite the open season having been only one month. Virtually every snake exhibited dermal rotting, lesions, abrasions, lacerations, or paralysis, and most were severely emaciated (Taggart 1994). Some were dead, presumably having been crushed under the accumulated mass of snakes in small containers. Owing to the poor condition and small size of the prairie rattlesnakes, and the tediousness of butchering small, tough-skinned snakes, the roundup sponsors purchased a number of western diamondback rattlesnakes to butcher and sell. The butchering facility, located in a livestock wash area at the local fairgrounds, had been cleaned up a bit (members of the audience were no longer invited to ceremoniously behead snakes with a rusted hatchet, for example); however, they continued to illegally butcher and sell uninspected meat. The violations were reported to KDHE. In spite of prior warnings, the roundup sponsors pleaded ignorance and received only a letter of reprimand—no fine was levied. KDHE officials did state, however, that a second offense would be prosecuted.

The Kansas Herpetological Society has always encouraged conservation of amphibians and reptiles in Kansas. Laws protecting wildlife from commercialization had provided a strong foundation for these efforts, but the advent of the rattlesnake roundup has weakened that foundation considerably. It will be an arduous task to regain what we once had, but it can be done. Efforts to date have resulted in many significant improvements, and have buffered many of the more negative aspects of the roundup. Some of the more malicious aspects of the first roundup have been diminished or eliminated altogether. For example, at the first roundup the butcher shop offered spectators a chance to swing the hatchet. This was done ceremoniously, and was portrayed as insidious revenge on the rattlesnake. By the third roundup, the "ceremony" was gone, and the butchering was nothing more and nothing less than butchering. Direct negative effects on children have also been reduced slightly. At the first roundup, children were invited to participate (for a fee, of course) in the torment of rattlesnakes via "balloon fishing". Children waved

inflated balloons over the heads of rattlesnakes while the pit attendant stomped at the snakes in an effort to elicit a strike. The "balloon fishing" activity has now been eliminated. Furthermore, the roundup sponsors no longer advertise the event as a means of "controlling overpopulation" of rattlesnakes. Nor do they continually deride the animals as the scourge of the prairie. Overall, these small improvements add up to an event that is much less pernicious to young minds than it might have been. However, there have been some less-than-honest attempts to pacify the conservation community. For the third roundup, the sponsors had designated several areas totaling 88 square miles as "rattlesnake preserves" where hunting of rattlesnakes was not allowed. Further investigation revealed that these areas were nothing more than land for which the owners had denied permission to trespass. Thus, the roundup sponsors did not in fact designate "rattlesnake preserves," but simply capitalized on inaccessible land as a public relations gimmick.

Some headway has been made with respect to regulating the roundup. Although a 20 snake limit is still far too high, and a 30 day season far too long, it is likely that, without the efforts of many herpetologists and conservationists, the sponsors would have been granted their request of no possession limit and a 12 month season. In addition, the entire state of Kansas would likely have been opened to the roundup, despite the fact that prairie rattlesnakes only live in the western half. Having no limit on where rattlesnakes could be collected throughout the state could have placed other species, including the state-protected timber rattlesnake, at risk. Much has been accomplished, yet there is still much to be done.

Several changes have occurred since the third roundup. Senator Frahm is now Lieutenant Governor Frahm. Because she has lost her powerful position in the legislature, she has much less ability to persuade other legislators, and less power also with the KDWP. In addition, she is now subject to more intense scrutiny than in the past, and thus she may be less apt to promote anticonservation measures. Also, there is some question about the location of the fourth roundup, as it is rumored it will move to the nearby town of Colby, Kansas, the hometown of Sheila Frahm. Whether these changes are good or bad is largely up to the conservation community, and how it acts concerning them. There are several trump cards yet to be played, but in the long run it is the grassroots effort that will keep the snakes in the grass—where they belong.

References

Edds, D. 1992. Observations on the 1992 Sharon Springs Rattlesnake Roundup. *Kansas Herpetological Society Newsletter*, No. 90.

Fitch, H.S. 1994. The Sharon Springs rattlesnake roundup. April 29-May 1, 1994. *Unpublished report to Kansas Department of Wildlife & Parks.* 10 pages.

Taggart, T. 1994. Letter to Robert F. Hartmann, Investigation and Inventory Supervisor, Kansas Department of Wildlife & Parks. *Kansas Herpetological Society Newsletter*, No. 98.

Western Times, The. 1993. Large Crowd Attend Rattlesnake Hunt. *The Western Times*, May 6, 1993.

David L. Reber earned a BS in Systematics and Ecology from the University of Kansas in 1991. He then pursued graduate work at the University of Kansas in the School of Education, and in 1995 received a Kansas Teaching Certificate for middle and secondary level science. During his graduate work, David was voted president-elect of the Kansas Herpetological Society (KHS), of which he had been a member since 1980. During his three years on the KHS executive council, he has focused the society's efforts on conservation issues including, but not limited to, rattlesnake roundups. He now teaches at the Natural Heritage Center, Inc., where he is also associate director, and at Raintree Elementary School in Lawrence, Kansas.

In 1985, he saw a photograph of a young field biologist with four bullsnakes in her lap; he later married her. Alison L. Reber earned a bachelor's degree in Environmental Studies from the University of Kansas in 1994. She has been an active member of KHS, is coauthor of the KHS Position Paper Regarding Rattlesnake Roundups, and has coordinated many efforts to reduce the impact of commercial taking of prairie rattlesnakes in Kansas. Alison has provided hundreds of children with hands-on natural history experiences, often emphasizing herpetology. In early 1995, she founded the Natural Heritage Center, Inc. (NHC), a nonprofit children's science education center in Lawrence, Kansas, which she now directs. She also teaches at Raintree Montessori School in Lawrence. Alison is a firm believer in the power of education. Both authors hope that early, positive experiences with nature will help people make wiser decisions regarding our natural resources.

For further reading about rattlesnake roundups the authors suggest the Kansas Herpetological Society Position Paper Regarding Rattlesnake Roundups, *(Kansas Herpetological Society Newsletter, No. 96: 9-20, 1994),* The Sweetwater Rattlesnake Roundup: A Case Study in Environmental Ethics, *by Jack Weir (Conservation Biology, Volume 6, Number 20), and* Driving Out the Dread Serpent, *by Ted Williams (Audubon, September 1990).*

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Effects of Timber Harvesting Practices on Peaks Of Otter Salamander *(Plethodon hubrichti)* Populations

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Abstract

The Peaks of Otter salamander (Plethodon hubrichti) *is endemic to a small portion of the Blue Ridge Mountains in Virginia. Much of its range lies within a high timber producing area owned by the National Forest Service. Comparisons of salamander abundance on replicated transects in recent clearcuts, older clearcuts, recent shelterwood sites, and mature sites revealed no significant differences. However, recent clearcuts, supported consistently fewer salamanders than other sites. Salamanders in mature sites consumed significantly more soft-bodied prey than in other sites. Numbers of hard-bodied prey did not differ among sites. Timber harvesting practices do not eliminate this species but may diminish population size and diet quality.*

Key words

Plethodon hubrichti, *timber harvesting, populations, Peaks of Otter salamander, conservation, ecology, natural history, Virginia*

Introduction

The entire range of the Peaks of Otter salamander *(Plethodon hubrichti)* is limited to an approximately 19 kilometers (km) long portion of the Blue Ridge Mountains in Bedford and Botetourt Counties, Virginia (Highton 1986; Pague and Mitchell 1991). Its habitat is limited to elevations above 443 meters (m) in deciduous forest and densities are highest in areas containing mature hardwoods. Logging impact on terrestrial salamanders has resulted in complete extirpation of local populations of other terrestrial plethodontids and in population fragmentation with probable genetic and demographic consequences (Ash 1988; Buhlmann, *et al.* 1988; Dodd 1989, 1991; Petranka, *et al.* 1993, 1994). If long-term conservation of the Peaks of Otter salamander is to prevail it will require that populations not be severely impacted by timbering practices that lead to local extinctions.

Several kinds of timber operations (clearcuts, shelterwood cuts, group selection cuts) and potential, defoliation by gypsy moths may affect the salamander's forest floor habitat. Drying of leaf litter and humus layers due to canopy removal (Pough, *et al.* 1987; Dodd 1991; Dupuis, *et al.* 1995) limits salamander movements and the ability to forage. Jaeger (1990) and Jaeger and Barnard (1981) clearly show that Red-backed salamanders *(Plethodon cinereus)* foraged less and consumed fewer prey in dry periods than in wet periods. If the canopy in a logged site is eliminated and the forest floor becomes relatively drier (as compared to a forested site), then we would expect salamanders to be able to forage less often and obtain fewer prey. Lowered prey consumption may affect other aspects of their life history. Assessments of the impact of timber harvesting practices on terrestrial salamanders such as the Peaks of Otter salamander are necessary for biologists and resource managers interested in its conservation and in the economic uses of the forest.

In this preliminary report on a multiyear study, we address the following objectives: (1) To compare the size of *P. hubrichti* populations in sites that have received four different types of timber management,

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Table 1. Average numbers (+/- one standard deviation and range) of Peaks of Otter salamanders in replicates of three types of timber management and mature forest stands in fall 1994 and spring 1995.

Treatment	No. Replicates	Fall 1994	Spring 1995
Recent clearcut	6	4.7 +/- 4.6 (0-12)	4.0 +/- 3.8 (0-8)
Older clearcut	6	8.0 +/- 9.2 (0-25)	3.7 +/- 4.0 (0-9)
Shelterwood	5	8.0 +/- 10.8 (1-27)	3.2 +/- 2.9 (0-7)
Mature	6	8.8 +/- 5.0 (1-15)	7.3 +/- 5.8 (3-17)
Overall		7.4 +/- 7.7	4.6 +/- 4.3

and (2) To elucidate prey use patterns of populations in the various treatments.

Materials and Methods

A total of 23 transects were established 16-18 June 1994 in the following treatment categories: recent (4-5 years) clear cuts (number (n) = 6), 12-18 year old clearcuts (n = 6), 2-4 year old shelterwood cuts (n = 5), and mature (>80 years old) hardwood sites (n = 6). There were too few separate shelterwood cuts in the area to obtain a sixth site.

At each site, we established a 1 x 50 m transect by flagging woody vegetation and by placing wire flagging in the ground at every 10 meters. Each transect remained permanent from season to season, except for two that were vandalized during the winter of 1994-1995. These were reestablished in the exact locations of the original transects in spring 1995. All transects were separated from each other by a different type of stand, roads, or a distance >100 meters.

Searches for Peaks of Otter salamanders were conducted in fall 1994 (12 September to 17 October) and spring 1995 (9 May to 3 June) at night during or just after rain when the forest floor was wet. Transects were selected in random order each night surveys that were conducted and each was walked slowly by 1-2 people using headlamps. All salamanders during the spring sampling season were released at their capture locations within a few minutes; in the fall sampling period they were released

A topotype specimen of a Peaks of Otter salamander (*Plethedon hubridhti*). Bedford County, Virginia.

A Peaks of Otter Salamander (*Plethodon hubrichti*). Bedford County, Virginia.

several days later (see below).

During the fall sampling period, we obtained stomach contents by stomach flushing salamanders (Fraser 1976). Prey were preserved in alcohol in individually labeled vials for later analysis. All salamanders were released within 5 m of their original capture locations 2-4 days after collection. In the laboratory, we identified 96% of prey items to order and where possible, to family following Borrer, *et al.* (1989). Remaining prey were identified to phylum or class.

Results

Population sizes varied among stand types and between the fall and spring seasons (Table 1). Numbers of salamanders ranged from 0 at a recent clearcut site to 27 at a shelterwood site. In the fall, the average number of salamanders in recent clearcuts was nearly half that in the other stand types. However, the wide variation in numbers of salamanders within stand types, especially for shelterwood cuts, resulted in no significant differences (ANOVA, $F = 0.35$, $P = 0.792$).

The spring assessment yielded fewer salamanders compared to the previous fall season (Table 1). The spring trend in numbers per stand type was similar to that for the fall sample except for the lower counts in the shelterwood and older clearcut sites. The average number of salamanders within mature stands was higher than those in clearcuts and shelterwood cuts (Table 1). However, the variation in numbers of salamanders in stand types did not differ significantly (ANOVA, $F = 1.10$, $P = 0.372$).

We found 949 taxonomically identifiable prey items in the stomachs of 80 salamanders from 20 sites. Ants *(Hymenoptera)* and collembolans *(Collembola)* made up 54.6% of all individual prey items in salamander stomachs. Of these, ants comprised 32.2% of the sample and collembolans 67.8%. We compared the numbers of ants and collembolans separately among the four stand types with Kruskal-Wallis tests. There was no significant difference in the numbers of ants (hard-bodied prey, Jaeger 1990) consumed among the four stand types ($H = 2.102$, $df = 3$, $P = 0.552$) (Figure 1a). In contrast, there was a significant difference among the numbers of collembolans (soft-bodied prey, Jaeger 1990) consumed ($H = 16.794$, $df = 3$, $P < 0.001$) (Figure 1b). Multiple comparison tests showed that salamanders from mature stands ate more collembolans than salamanders from the old clearcuts ($z = 2.68$, $P < 0.05$) and the shelterwood cuts ($z = 3.93$, $P < 0.05$).

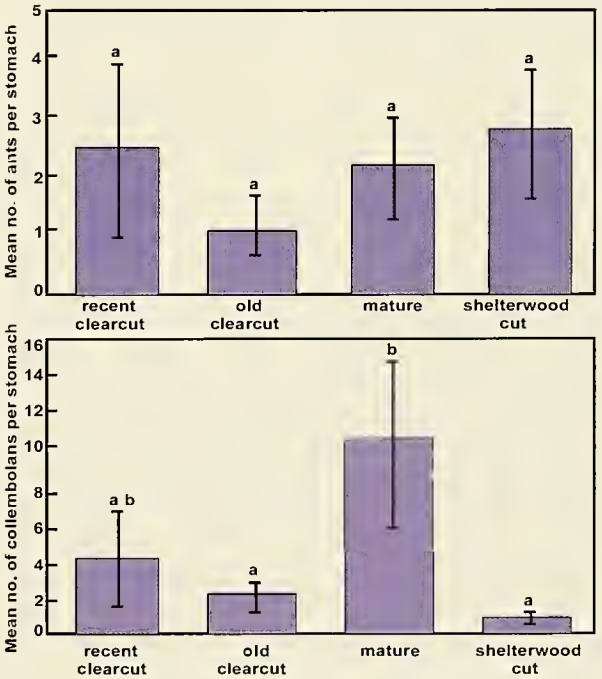

Figure 1. Average number of ants (a) and collembolans (b) per stomach in Peaks of Otter salamanders in four forest stand types. The distribution of the letters refers to statistical results (see text).

Discussion

Population sizes of terrestrial salamanders are variable and depend on a wide range of factors. These include soil depth, soil temperature, soil moisture, aspect, slope angle, underground shelter availability, nest site availability, number of surface cover sites for territories, prey quality and abundance, predator abundance, and presence of known competitors *(Plethodon cinereus)* (Buhlmann, *et al.* 1988; Dodd 1991; Wicknick 1995). Clearing of the canopy vegetation and the majority of understory trees, a common result from clearcutting, changes the physical environmental characteristics (*e.g.*, soil and log moisture) of the area (Heatwole 1962; Blymyer and McGinnes 1977; Dodd 1989, 1991; Dupuis, *et al.* 1995). Loss of individual salamanders occurs directly from logging operations that include road building, the use of skidders and other heavy equipment, and mechanical site preparation (Dodd 1991). Individuals not directly impacted by the immediate logging operation are probably subjected to stresses associated with reduced or altered prey resources and changes in the physical characteristics of the soil/litter ecosystem. We would thus expect to find reduced numbers of Peaks of Otter salamanders in such areas.

Shelterwood cuts allow a possible solution to the problems attached to clearcutting. Unfortunately, shelterwood operations that leave a small basal area (*i.e.*, as few canopy trees) act identically to clearcuts and they produce similar effects on salamanders. Our data show that the numbers of Peaks of Otter salamanders in shelterwood cuts ranged from one to 27, the largest range of variation in any of the stand types. The numbers of Peaks of Otter salamanders in shelterwood sites were, on average, 10-66% lower than in adjacent mature sites. The wide variation may be related to the number of standing trees remaining. Thus, different levels of shelterwood cuts may have dramatically different effects on Peaks of Otter salamanders because of the interaction between the amount of basal area remaining and the quality of the habitat present before and after the operation takes place.

Population sizes in our study were, on average, consistently higher in mature sites that had not been logged in 80 or more years when compared to recent and older clearcuts and shelterwood cuts. The high variation in number of salamanders within stand types complicates the interpretation of these data. The lack of statistical significance does not mean that there are no detrimental effects caused by these logging practices. Such effects may not be detectable at the population level because of historical factors (*e.g.*, past logging history and habitat quality), and differences in relative abundances due to slope angle and aspect. The size of the impacted area and its proximity to mature stands containing large populations may influence the length of time for *P. hubrichti* populations to achieve prelogging levels.

The effects of logging may be more clearly elucidated by analysis of diet quality. The quantity of collembolans consumed by Peaks of Otter salamanders was significantly higher in mature stands than in recent clearcuts and shelterwood cuts. Collembolans are soft-bodied prey (Jaeger 1990) which presumably pass through *P. hubrichti* digestive tracts quickly and with high assimilation efficiency, as do other soft-bodied prey such as termites in the congener *P. cinereus* (Gabor and Jaeger 1995). Differences in diet quality among stand types suggests that there may also be differences in salamander growth and reproduction. Mature sites, therefore, appear to offer a higher quality habitat to Peaks of Otter salamanders than timbered sites because they presumably have a more intact and functional soil/litter ecosystem due to the types and quality of downed woody debris, canopy shelter that affects the thermal and moisture regime, and higher prey quality. Results from our forthcoming analyses of data on prey quality and availability in wet and dry years will provide a detailed assessment of differential affects of stand types at the individual level.

Conclusions

The preliminary results of our study allow several tentative conclusions. Peaks of Otter salamander populations are not always completely eliminated from a site within their range by timber operations of clearcutting and shelterwood cutting. They are reduced 45-47% by clearcutting and 10-66% by shelterwood cutting, as compared to populations in adjacent mature sites. Salamanders in mature sites may obtain a higher quality diet than those in sites treated by some form of timber management. Peaks of Otter salamander populations remain at varying levels of risk from timber management depending on the type of harvesting practice used. Such practices undoubtedly cause small scale geographic variation in growth, diet, reproduction, and population recruitment.

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References

Ash, A.N. 1988. Disappearance of salamanders from clearcut plots. *Journal of the Elisha Mitchell Scientific Society* 104: 116-122.

Blymyer, M.J. and McGinnes, B.S. 1977. Observations on possible detrimental effects of clearcutting on terrestrial amphibians. *Bulletin of the Maryland Herpetological Society* 13: 79-83.

Borrer, D.J., Triplehorn, C.A., and Johnson, N.F. 1989. *An Introduction to the Study of Insects, 6th edition.* Saunders College Publishing, Philadelphia, Pennsylvania. 875 pp.

Buhlmann, K.A., Pague, C.A., Mitchell, J.C., and Glasgow, R.B. 1988. Forestry operations and terrestrial salamanders: Techniques in a study of the Cow Knob salamander, *Plethodon punctatus*, pp. 38-44 in Szaro, R.C. *et al.* (editors). *Management of Amphibians, Reptiles, and Small Mammals in North America.* USDA Forest Service General Technical Report RM-166. 458 pp.

Dodd, C.K., Jr. 1989. Status of the Red Hills salamander is reassessed. *Endangered Species Technical Bulletin* 24: 10-11.

Dodd, C.K., Jr. 1991. The status of the Red Hills salamander, *Phaeognathus hubrichti*, Alabama, USA, 1976-1988. *Biological Conservation* 55: 57-75.

Dupuis, L.A., Smith, J.N.M., and Bunnell, F. 1995. Relation of terrestrial-breeding amphibian abundance to tree-stand age. *Conservation Biology* 9: 645-653.

Fraser, D.F. 1976. Empirical evaluation of the hypothesis of food competition in salamanders of the genus *Plethodon*. *Ecology* 57: 458-471.

Gabor, C.R. and Jaeger, R.G. 1995. Resource quality affects the agonistic behaviour of territorial salamanders. *Animal Behaviour* 49: 71-79.

Heatwole, H. 1962. Environmental factors influencing local distribution and activity of the salamander, *Plethodon cinereus*. *Ecology* 43: 460-472.

Highton, R. 1986. *Plethodon hubrichti. Catalogue of American Amphibians and Reptiles.* 393.1-393.2.

Jaeger, R.G. 1990. Territorial salamanders evaluate size and chitinous content of arthropod prey, pp. 111-126 in Hughes, R.N. (editor). *Behavourial Mechanisms of Food Selection.* Springer-Verlag, Heidelberg. 886 pp.

Jaeger, R.G. and Barnard, D.E. 1981. Foraging tactics of a terrestrial salamander: Choice of diet in structurally simple environments. *American Naturalist* 117: 639-664.

Pague, C.A. and Mitchell, J.C. 1991. *Plethodon hubrichti* Thurow, Peaks of Otter Salamander, pp. 436-437 in Terwilliger, K. (coordinator). *Virginia's Endangered Species.* McDonald and Woodward Publication Co., Blacksburg, Virgina. 672 pp.

Petranka, J.W., Brannon, M.P., Hopey, M.E., and Smith, C.K. 1994. Effects of timber harvesting on low elevation populations of southern Appalachian salamanders. *Forest Ecology and Management* 67: 135-147.

Petranka, J.W., Eldridge, M.E., and Haley, K.E. 1993. Effects of timber harvesting on southern Appalachian salamanders. *Conservation Biology* 7: 363-370.

Pough, F.H., Smith, E.M., Rhodes, D.H., and Callazo, A. 1987. The abundance of salamanders in forest stands with different histories of disturbance. *Forest Ecology and Management* 20: 1-9.

Wicknick, J.A. 1995. Interspecific competition and territoriality between a widespread species of salamander and a species with a limited range. *Ph.D. Dissertation, University of Southwestern Louisiana, Lafayatte, Louisiana.* 152 pp.

Joseph C. Mitchell received his Ph.D. from the University of Tennessee in 1982. Presently, he is an Adjunct Professor in the School of Continuing Studies at the University of Richmond and self-employed. Dr. Mitchell has published over 100 papers and magazine articles, as well as two books. Dr. Mitchell was the past secretary for the Herpetologists' League and is now the president-elect.

Jill A. Wicknick received her Ph.D. from the University of Southwestern Louisiana in 1995. She also holds a postdoctoral degree from the same institution. Dr. Wicknick specializes in the behavioral ecology of salamanders. Dr. Wicknick has published in herpetological journals and the highly respected journals Animal Behavior *and* Ecology.

Carl D. Anthony received his Ph.D. from the University of Southwestern Louisiana in 1995. Dr. Anthony is finishing his postdoctoral appointment at USWLA under Robert Jaeger and will serve as an Assistant Professor at John Carroll University starting Fall 1996. Carl specializes in salamander behavioral ecology and parasitology. Dr. Anthony has published in herpetological journals as well as the journal Ecology.

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Population Biology and Herpetological Conservation: A Cautionary Note

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Abstract
Common endangered species conservation management practices, such as translocations and captive breeding and release of individuals, tend to mix populations. This mixture is most often assumed to be beneficial because it increases effective population size and may also increase genetic variation. However, when populations are adapted to different local conditions, mixing populations can dilute local adaptation and could theoretically result in population declines. Resource managers should therefore be careful when the mixture of populations is considered, particularly in low dispersing species that are prone to local adaptation, such as salamanders.

Key Words
Demographics, gene flow, conservation, populations, management, inbreeding depression, amphibian, reptile

Major concerns for small population management

There are two major concerns in the conservation of small populations: genetic and demographic factors. The genetic factors are inbreeding depression and the loss of genetic variation through genetic drift. Inbreeding depression threatens and reducing small populations with the possibility of unmasking recessive deleterious alleles and a reduction in heterozygosity. Each of these factors can, in turn, affect individual fecundity and consequently reduce population growth. When genetic variation is lost, a population may decline because of its potential inability to track environmental shifts (Frankel and Soulé 1981; Lande and Barrowclough 1987). Demographic factors, such as the allee affect, where a population is so small that individuals have difficulty finding mates, can also severely affect small popu-

JAMIE K. REASER

lations. These factors are becoming more widely recognized as tantamount to species extinction's (Lande 1988; Schemske, *et al.* 1994).

There is some debate about whether genetic or demographic factors should be the primary focus in the study and management of small populations. However, the conservation programs that deal specifically with threatened or endangered populations are often solutions to both problems. These management schemes include: movement corridors between nature reserves, captive breeding and release of individuals, and translocations of individuals between populations. All of these strategies tend to enhance gene flow, or the movement of individuals and the integration of their genes, among populations.

The issue of Gene Flow

All of these potential solutions, therefore, are based upon the assumption that gene flow is beneficial to managed populations. Population genetic theory indicates that gene flow can act as a "creative force" by maintaining genetic variation and increasing effective population size and thus combating the negative consequences of inbreeding depression and demographic stochasticity (Slatkin 1987). However, there has been little consideration of the potential detrimental effects that gene flow may have on populations despite the theory and empirical data to support such effects. For example, high levels of gene flow among populations with different environments (and consequently different selection regimes) can swamp local adaptation and drive populations to adapt to the average of local conditions (Wright 1951; Slatkin 1987); therefore, populations are not well adapted. Associated with this swamping of local adaptation can be a reduction in fitness, which is known as outbreeding depression (Templeton 1986). In the long-term, gene flow can also preclude subpopulation differentiation and eventually prevent speciation by maintaining genetic contact (Mayr 1963, 1969).

Along with many examples of the enhancement of gene flow resulting in the decline of managed populations (see Greig 1979), there are also examples of gene flow acting as an evolutionary constraint for natural amphibian and reptile species. A well-known reptilian example is the Lake Erie water snake, *Nerodia sipedon*. Banded snakes were found to be more cryptic (and much more common) in the wooded areas of the mainland surrounding Lake Erie, and unbanded snakes were more common and cryptic in the open, rocky areas of the islands (Camin and Ehrlich 1958; King 1992). Varying degrees of banding have consistently been found in the juvenile island populations, despite its selective disadvantage (Camin and Ehrlich 1958; King 1987). Observations of snake dispersal and recent estimates of gene flow indicated that individuals were dispersing from the mainland to the islands (King 1987). Quantitative genetic analyses indicated that color pattern was largely genetically determined and that selection, in the absence of gene flow, was strong enough to eliminate the noncryptic (or banded) morph on the islands (King 1993*a*). King recently concluded that gene flow from the mainland population was overwhelming the effect of selection, which caused an observed decline in population fitness (King 1987, 1993*a*, 1993*b*).

One amphibian example comes from research on the stream-breeding salamander, *Ambystoma barbouri*. In some streams that are deep enough to support permanent pools, *A. barbouri* larvae face a major selection pressure that comes from predatory green sunfish, *Lepomis cyanellis*. In these streams the optimal larval strategy entails reduced activity level to remain inconspicuous and avoid predation (Sih, *et al.* 1988; Kats, *et al.* 1988). In other shallow streams, a key selection pressure is habitat ephemerality, where the optimal larval strategy entails increased activity level to feed rapidly in order to reach a large enough size to metamorphose before the stream dries up (Petranka and Sih 1987). Recent work has shown that gene flow is high enough between these two population types to swamp local adaptation (Storfer, *unpublished data*). Additional data indicate that this gene flow has caused adaptation to the average of local conditions because a number of behavioral (*i.e.*, refuge use, escape response) and life history assays (*i.e.*, stage at hatching) associated with predator avoidance have been shown not to differ significantly between two populations (one with fish, the other ephemeral) connected by gene flow (Storfer, *unpublished data*). Even so, isolated populations do differ significantly in those traits associated with fish avoidance. Therefore, gene flow may be swamping local adaptation in some populations of *A. barbouri* and making them potentially more susceptible to fish predation.

Management implications

Gene flow can play a major role in the management of threatened or endangered species. In particular, it is important for conservation biologists and resource managers to gain a better understanding of gene flow as a constraining force. That is, there is

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enough uncertainty about whether gene flow acts as a disrupter of local adaptation to warrant caution toward management plans that include the enhancement of interpopulation connection and gene flow. Gene flow can be a particularly important issue for amphibian species. For example, salamanders have typically low levels of gene flow, thus making populations naturally subdivided (Larsen *et al.* 1984; Slatkin 1985). Enhancement of gene flow for conservation purposes may therefore not be warranted based upon the fact that natural historical associations may not exist between the populations. It is therefore important to conduct more studies of gene flow in amphibian and reptile species, especially since techniques of measuring gene flow have become more and more accessible (see Slatkin 1985). Studies of gene flow provide insight into population structure and historical associations between populations helping resource managers to avoid mixture of populations without high levels of gene flow, exhibited by many amphibians species in nature.

It is essential to conduct ecological surveys of habitat types and major selection pressures that affect species which are management candidates, such as limiting resources (*i.e.*, prey, space, nest sites, etc.), major predators, and intrinsic habitat differences (*i.e.*, climatic differences). These brief surveys would not slow critical conservation decisions, yet they would provide extremely valuable information so that populations that are most ecologically alike could be those that are mixed (when such management may be warranted). Without such data, resource managers cannot be sure that mixing populations will not negatively affect the very populations that they are trying to save.

References

Camin, J. and Ehrlich, P. 1958. Natural selection in water snakes, (*Natrix sipedon L.*) on islands in Lake Erie. *Evolution* 12: 504-511.

Frankel, O.H. and Soulé, M.E. 1981. *Conservation and Evolution.* Cambridge University Press. Cambridge, United Kingdom. 327 pp.

Greig, J.C. 1979. Principles of genetic conservation in relation to wildlife management in South Africa. *South African Journal of Wildlife Restoration* 9: 57-78.

Kats, L.B., Petrauka, J.W., and Sih, A. 1988. Antipredator responses and the persistence of amphibian larvae with fishes. *Ecology* 69: 1865-1870.

King, R.B. 1993*a*. Color pattern variation in lake Erie water snakes: Prediction and measurement of natural selection. *Evolution* 47: 1819-1833.

King, R.B. 1993*b*. Color pattern in lake Erie water snakes: Inheritance. *Canadian Journal of Zoology* 71: 1985-1990.

King, R.B. 1992. Lake Erie water snakes revisited: Morph and age specific variation in relative crypsis. *Evolutionary Ecology* 6: 115-124.

King, R.B. 1987. Color pattern polymorphism in the lake Erie water snake, *Nerodia sipedon insularium. Evolution* 41: 241-255.

Lande, R. 1988. Genetics and demography in biological conservation. *Science* 241: 1455-1460.

Lande, R. and Barrowclough, G.F. 1987. Effective population size, genetic variation, and their use in population management, pp. 87-125 in Soulé, M.E. (editor). *Viable Populations for Conservation.* Cambridge University Press, Cambridge, United Kingdom. 189 pp.

Larsen, A., Wake, D.B., and Yanev, K.P. 1984. Measuring gene flow among populations having high levels of genetic fragmentation. *Genetics* 106: 293-308.

Mayr, E. 1963. *Animal Species and Evolution.* Harvard University Press, Cambridge, Massachusetts. 797 pp.

Mayr, E. 1969. *Principle of Systematic Zoology.* McGraw-Hill, New York, New York. 428 pp.

Petranka, J.W. and Sih, A. 1987. Habitat duration, length of the larval period and the evolution of a complex life cycle of an amphibian. *Evolution* 41: 1347-1356.

Schemske, D. *et al.* 1994. Evaluating approaches to the conservation of rare and endangered plants. *Ecology* 75: 584-606.

Sih, A., Petranka, J.W., and Kats, L.B. 1988. The dynamics of prey refuge use: a model and tests with sunfish and salamander larvae. *American Naturalist* 132: 463-483.

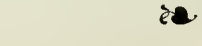
Slatkin, M. 1985. Gene flow in natural populations. *Annual Review of Ecology and Systematics* 16: 393-430.

Slatkin, M. 1987. Gene flow and the geographic structure of natural populations. *Science* 236: 787-792.

Templeton, A.R. 1986. Coadaptation and outbreeding depression, pp. 105-116 in Soulé, M.E. (editor). *Conservation Biology: The Science of Scarcity and Diversity.* Sinauer Associates, Sunderland, Massachusetts. 584 pp.

Wright, S. 1951. The genetical structure of populations. *Annals of Eugenics* 15: 323-354.

After a brief stint as a Fish and Wildlife Biologist for the US Fish and Wildlife Service in 1992, Andrew Storfer began work as a graduate student in the Center for Ecology, Evolution and Behavior at the University of Kentucky. Since that time, he has been studying the evolutionary effects of gene flow in a stream-dwelling salamander that is endemic to Kentucky. His research incorporates aspects of genetics, population ecology and behavior in an unusually integrative project. Andrew expects his Ph.D. in May of 1997.



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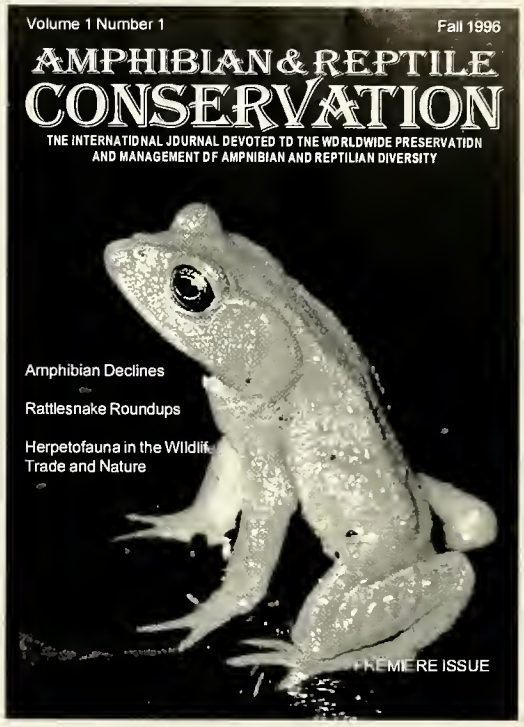

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Herpetofauna in the Wildlife Trade and Nature: On the Difficulty of Estimation

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Key Words
Population estimation, numbers, wildlife trade, reptiles, amphibians

Abstract
Due to the complexity of animal populations both in the wild and the marketplace, it is difficult for scientists to estimate the actual numbers. Obstacles in the marketplace include: illegal activities, inefficient estimation procedures, and understaffed monitoring agencies. Most experts agree that the existing numbers often times are estimated extremely low. All numbers should be used with caution. Further research and tighter controls are called for.

One of the first things we learn as children is the art of counting. As adults, counting large numbers is replaced by complicated estimation techniques. Large numbers of variables makes estimation difficult. Nowhere is this more true than when trying to measure the trade in reptiles and amphibians and its impact on wild populations.

Simply, the problem is that reliable numbers of how many animals are being sold, collected, or in the wild do not exist. At least, numbers which are precise.

Take for example the seemingly simple act of estimating how many animals are sold in a given year. Any well run business has this statistic but is reluctant to make it public unless it is somehow mandated by law. This is especially true of some dealers and collectors of live animals who are afraid of a sudden surge in a certain species attracting the unwanted attention of their competition, scientists, conservationists or law enforcement officers (Enge 1994).

So ruling out the passing of new laws, for example, how does one find out how many reptiles and amphibians are sold within the United States? Currently the only numbers on pet herpetofauna in the U.S. that exist are guesses made by two recent pet industry surveys (American Pet Products Manufacturers 1994, American Veterinary Medical Association 1992). They estimate in the United States there are between one to four million reptiles and amphibians kept as pets.

Not only is this number too broad to be usable, surveys failed to ask specific questions that would supply data which would be more useful. They asked pet owners if they owned a snake or a turtle. If they had asked, more specifically, what species owners had then scientists could better estimate how many amphibians and reptiles are caught and sold each year and their impact on wild populations.

One would have better luck trying to find the numbers of herpetofauna being sold into and out of the United States. At least there exists established trade data bases; LEMIS, or The Law Enforcement Management Information System run by the U.S. Fish & Wildlife Service and a count of CITES animals traded, put out

Greek tortoises from Jordan in their original shipping crates. The shipper of these turtles had a CITES permit for a specific number of animals. But as many CITES shipments do, this shipment had 43 more animals than allowed, so the excess animals were confiscated. Due to infrequent inspections most "padded" shipments go through, indicating that official CITES numbers do not reflect actual number traded.

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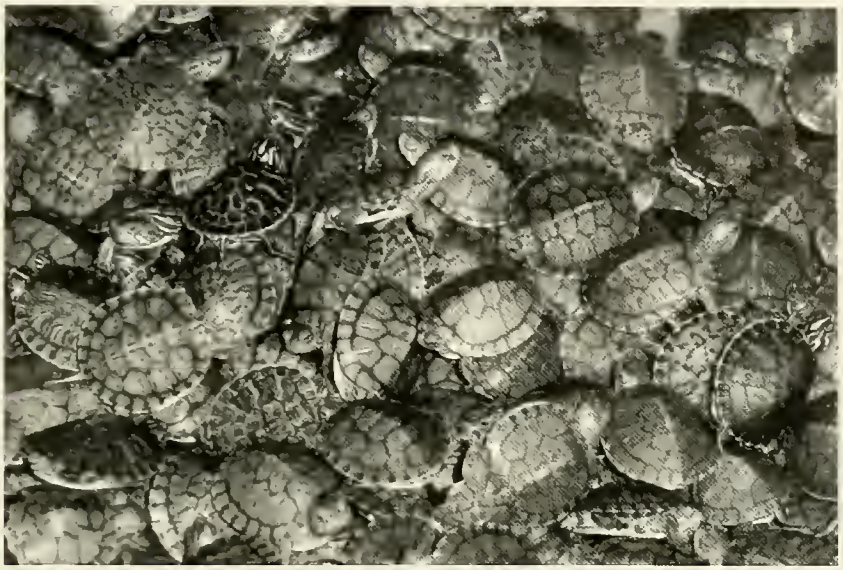
by England's World Conservation Monitoring Centre (WCMC).

LEMIS shows that the U.S. either imports or exports up to ten million live or dead reptiles and amphibians per year. But even here there are problems. LEMIS doesn't include all species. The all mysterious category of non-CITES reptiles includes hundreds of thousands of animals, of unknown species, each year. Entire families of lizards such as skinks, agamas and geckos are only listed by their common family name. And then certain reptiles, like *Graptemys* and *Apalone* are listed only by genus. (The situation for these two genera improved last year with the addition of several species for both). This forced the wildlife officer entering the data to list numerous species and subspecies together, thus losing valuable data. Documents are most often wrong. The right thing would be to open each crate and count each animal, something which few Fish & Wildlife Inspectors have the time to do unless they are suspicious of some wrongdoing (Luiijf 1994).

The WCMC collects the numbers submitted by CITES countries of just CITES listed animals which have been traded. Though the species listing is more exact, the problem here is that WCMC has no enforcement or checking ability. It's purely an honor system. So a local CITES officer who is allowing a lot of CITES animals out, and doesn't want to attract attention, might just fudge his country's numbers (Groombridge 1994).



Baby sliders in a Florida dealer's shop awaiting shipment. It is estimated that over 6 million of these were shipped out of the US last year alone.

One common gap that both these databases share is that there is no record keeping of the animals' ages (Anderson 1994). When it comes to reptiles, especially turtles, this is very important information since collection of adults does more harm to a wild populations than of hatchlings (Congdon 1994).

Counting is also a problem when keeping track of wild populations. Examples exist of population studies which have proven inaccurate because they didn't take into account the animal's natural habits. This resulted in scientists looking for animals where they were least likely to find them (Gibbons 1993).

We also know that populations often naturally increase or decrease tremendously, and only long-term population studies take that into account and more accurately measure a population's trend (Gibbons 1993).

Another problem is who does the collecting. My favorite example of this is a story about *Carettochelys inculpta*. It originally was believed to be a very rare species. It turned out that the scientists who first discovered this animal were totally dependent on natives to collect their specimens. They asked the natives to bring back any turtle they caught when they would go upriver. The problem was that the natives like to eat *Carettochelys* and so gave the scientists only the bad tasting turtles (Pritchard 1993).

Now does this mean that these numbers are useless? No. Even if the numbers are incomplete they are useful. Most herpetologists believe the numbers are way too low, (Enge 1994) describing live animal shipments that are smuggled through customs with invoices listing the boxes' contents as light bulbs and so they are never seen by Wildlife officers (Luiijf 1993).

And like the canary in the mines, LEMIS and WCMC data can act as a warning to trade activities, excessive or illegal. Large numbers, even of just lizards or softshells, suddenly being reported can indicate to conservationists and scientists that further study or action is necessary.

Recently, Togo and Ghana was reporting to WCMC an incredible amount of reptiles being exported, more than those small

countries could possibly collect. This tipped off wildlife officials to investigate. They discovered that Togo and Ghana was laundering animals illegally collected from other countries (Ventura 1994).

But still we have to figure out how best to estimate amphibians and reptiles, both collected and traded (these two numbers are usually different because animals do die in transit, or are kept for personal use by the collector). The U.S. Fish & Wildlife Service needs to be encouraged to improve LEMIS so it reflects the biological and natural history of the animals being counted. Every shipment should be opened and counted. And any animal traded should be on that system. Herpetologists and conservationists need to conduct their own surveys of what is being sold in pet shops.

As for counting amphibians and reptiles in the wild, an excellent reference is *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians* (Heyer *et al.* 1994). Though I look forward to an edition on reptiles, this book, with its detailed studies of different collection and recording techniques, should give anyone doing population studies on reptiles help on how to formulate a useful, comparable, population study.

Simply: You can't save what you don't know you have.

A typical storage set up for small snakes at a Florida dealer. A common marketing technique of animal dealers is to under-list the amount of animals available in their mail order catalogs—by as much as 90 %. This creates the illusion of rarity and thus boosts demand for the animal.

References

Anderson, Mary. 1994. Personal Communication. September. Independent Researcher, Roanoke, Virginia.

American Pet Products Manufacturers Association. 1994. *1994 National Pet Owners Survey*, pp. 180-197. American Pet Products Manufacturers Association, Searsdale, New York.

American Veterinary Medical Association. 1992. *The Veterinary Service Market for Companion Animals, 1992*, pp. 103-106. Center for Information Management, American Veterinary Medical Association, Scaumburg, Illinois. 120 pp.

Bright, E. 1994. An analysis of U.S. Fish & Wildlife reptile and amphibian numbers in their LEMIS system. *Unpublished manuscript.*

Conant, R. and Collins, J.T. 1991. *A Field Guide to Reptiles and Amphibians Eastern/Central North America.* 3rd Edition. Peterson Field Guide Series. Houghton Mifflin Company, Boston. 450 pp.

Congdon, J.D., Dunham, A.E., and Van Loben Sels, R.C. 1993. Delayed sexual maturity and demographics of Blanding's turtles *(Emydoidea blandingii)*: Implications for conservation and management on longlived organisms. *Conservation Biology* (2): 387-399.

Enge, K.M. 1994. *Herptile Use and Trade in Florida.* Florida Game and Fresh Water Commission Nongame Wildlife Program Final Performance Report, Tallahasse, Florida. 102 pp.

Gibbons, J.W. 1993. Measuring declines and natural variation in populations of turtles: spatial lessons from longterm studies. Presentation at *Conservation, Restoration, and Management of Tortoises and Turtles an International Conference.* July, Purchase, New York.

Groombridge, L. 1994. Personal Communications. World Conservation Monitoring Centre, Cambridge, United Kingdom.

Heyer, W. R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.C., and Fraser, M.S. 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians.* Smithsonian Institution Press, Washington, DC.

Luiijf, W. 1993. The role of CITES in controlling tortoise trade. Presentation at *Conservation, Restoration, Management of Tortoises and Turtles and International Conference.* July, Purchase, New York.

Pritchard, Dr. P.C.H. 1993. Personal Communications. Vice Preseident, Florida Audubon Society, Casseberry, Florida.

Ventura, J. 1994. Personal Communication. Supervisory Wildlife Inspector, U.S. Fish & Wildlife Service, Port of New York, John F. Kennedy Airport.

Warwick, C. 1994. Personal Communications. People's Trust for Endangered Species, Surrey, England.

Allen Salzberg's interests in environmental issues began back in 1965 after he saw his first wild turtle. Mr. Salzberg has written numerous articles on the environment for magazines including Health, Outside, *and* The New York Times. *Recently, he completed a report titled* The Preliminary Report: Live Freshwater Turtle & Tortoise Trade in the United States *for the US Humane Society and Humane Society International. He is presently working on updating and expanding that report to include all reptiles. With his wife, Anita Baskin Salzberg, he has cowritten a children's book on turtles for "all those kids like me back in 65."*

ANNOUNCEMENTS

New Organization: African Herpetofaunal Biodiversity Programme (AHBP)

The AHBP is a new and developing programme designed to identify, assess, inventory, and monitor conservation areas in Africa and Madagascar. Since herpetofaunas' remains much neglected with only the crocodilians and, to a degree, the chelonians receiving major attention reptiles and amphibians will be a major focus of the AHBP. In order to proceed further, it is necessary to elect a coordinating committee, find a home for the programme (at present, Pietermaritzburg, South Africa), and to prepare initiatives to secure start-up funding and project linkages. Help is also needed in setting up a permanent list server site to promote communication between collaborators, adding new members to the administrating committee, and assisting with other projects. All those interested or who can help are urged to contact Lynn Raw, PO Box 200, Merrivale, 3291, South Africa. Tel: +27-331-460796, fax: +27-331-460895, e-mail: Raw@zoology.unp.ac.za. Presently, e-mail and a mailing list (AFRIHERP-L) are being used to aid communication between AHBP members. To subscribe to the mailing list send this e-mail message (subscribe AFRIHERP-L "Your name") to: listproc@wcmc.org.uk. To post messages to the list send them to: Afriherp@wcmc.org.uk. The list administrator is Lynn Raw. The AHBP "Interim" Committee members are: Lynn Raw (South Africa), Chairman (coordinating facilitator); Ivan Ineich (France), Secretary; Craig Hassapakis (United States), Public Relations Officer; Preston Hardison (United States), Data Management Officer; Neil Burgess (Denmark), Mapping; Michael Lambert (United Kingdom), Project Coordinator, and Martin Kundrat (Slovak Republic) Project Coordinator.

Dr. Ian R. Swingland named Professor of Conservation Biology

Dr. Ian R. Swingland has been named Professor and Chair of Conservation Biology at the Durrell Institute of Conservation and Ecology (DICE), University of Kent, Canterbury, England. Following many years of field work on Aldabra giant tortoises, Dr. Swingland was also the Director of the First World Congress of Herpetology, held in Canterbury in 1989, instrumental in the formation of the IUCN/SSC Tortoise and Freshwater Turtle Specialist group, and has worked for the past six years on the development of DICE. DICE now has an international program of postgraduate training in conservation biology, drawing students from around the world for a unique Masters of Science (M.Sc.) degree in Conservation Biology.

MEETINGS

Third World Congress of Herpetology, 2-10 August, 1997

For more information contact: c/o Czech Medical Association, J.E. Purkyne, Congress Department, PO Box 88, Sokolská 31, 120 26, Praha 2, Czech Republic. Tel: (++42-2) 296889 (or) (++42-2) 249151195, fax: (++42-2) 294610 (or) (++42-2) 24216836. The web site address is: http://www.gli.cas.cz/herpet/

Conference to be Hosted in Vietnam: Conservation and Biodiversity of Amphibians and Reptiles of Tropical Rain Forests

The proposed site for the conference is Hanoi, Vietnam, sometime in 1998. Those interested should contact one of the following: Dr. Harold Heatwole, Department of Zoology, Box 7617, North Carolina State University, Raleigh, North Carolina 27695 USA. Tel: (919) 515-2741, fax: (919) 515-5327; Dr. Natalia Ananyeva, Department of Herpetology, Zoological Institute, St. Petersburg 199034, Russia. E-mail: anv@zisp.spb.su; Dr. Cao Van Sung, Institute of Ecology and Biological Resources, Nghia Do, Tu Liem, Hanoi, Vietnam. Tel: 361 440, fax: (844) 361 196, e-mail: sung@iebr.ac.vn

CALL FOR INFORMATION

Live Reptile and Amphibian Trade Database

Information for a database for analysis is being gathered on the trade in live reptiles and amphibians. The purpose of the database is to monitor the live trade and issue occasional reports and suggestions on how to improve the trade, making it more humane and environmentally sound (one recent use was to get the North American box turtle listed as an CITES II species). Notes of anecdotes, stories of people handling herpetofauna for the live animal trade would be useful additions to the database. These include copies of articles or papers on the trade's effect on wild populations, stories of arrests, or visits to turtle farms. Include other topics which are relevant, whether favorable for the trade or not. Farming of amphibians and reptiles and sustainable harvesting stories are also appreciated, as well as suggestions of how to improve the trade. Send information to: Allen Salzberg, 6787 Booth Street 5B, Forest Hills, New York 11375. Tel/fax: (718) 275-3307, e-mail: Asalzberg@aol.com

BOOKS RECEIVED

Murphy, J.B., Adler, K., and Collins, J.T. (editors). 1994. *Captive Management and Conservation of Amphibians and Reptiles*. Society for the Study of Amphibians and Reptiles, Ithaca, New York. 408 pp.

Musgrave, R.S. and Mary A.S. 1993. *State Wildlife Laws Handbook*. Government Institutes, Inc., Rockville, Maryland. 840 pp.

Cogger, H.G., Cameron, E.E., Sadlier, R., and Eggler, P. 1993. *The Action Plan for Australian Reptiles*. Australian Nature Conservation Agency, Canberra, ACT. 254 pp.

Shine, R. 1991. *Australian Snakes: A Natural History*. Cornell University Press, Ithaca, New York. 223 pp.

Roughgarden, J. 1995. *Anolis Lizards of the Caribbean: Ecology, Evolution, and Plate Tectonics*. Oxford University Press, New York. 200 pp.

Stebbins, R.C. and Cohen, N.W. 1995. *A Natural History of Amphibians*. Princeton University Press, Princeton, New Jersey. 316 pp.

Hudson, R., Alberts, A., Ellis, S., and Byers, O. 1994. *Conservation Assessment and Management Plan for Iguanidae and Voranidae*. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota.

IUDZG/CBSG (IUCN/SSC). 1993. *The World Zoo Conservation Strategy: The Role of the Zoos and Aquaria of the World in Global Conservation*. Chicago Zoological Society, Brookfield, Illinois. 76 pp.

Wiese, R.J. and Hutchins, M. 1994. *Species Survival Plans: Strategies for Wildlife Conservation*. American Zoo and Aquarium Association, Wheeling, West Virginia. 64 pp.

Slavens, F. and Slavens, K. 1994. *Reptiles and Amphibians in Captivity, Breeding-Longevity and Inventory, Current January 1, 1994*. Slaveware, Seattle, Washington. 532 pp.

Hunter, Jr., M.L., Albright, J., and Arbuckle, J. (editors). 1992. *The Amphibians and Reptiles of Maine*. Maine Agricultural Experimental Station Bulletin 838. 188 pp.

LITERATURE

Cree, A., *et al.* 1995. Reproduction of a rare New Zealand reptile, the tuatara *Sphenodon punctatus*, on rat-free and rat-inhabited islands. *Conservation Biology* 9(2): 373-383.

Kiesecker, J.M. and Blaustein, A.R. 1995. Synergism between UV-B radiation and a pathogen magnifies amphibian embryo mortality in nature. *Proceedings of the National Academy of Sciences (USA)* 92(24): 11049-11052.

Durbin, J., Rajafetra, V., Reid, D., and Razandrizanakanirina, D. 1996. Local people and project Angonoka—conservation of the ploughshare tortoise in north-western Madagascar. *Oryx* 30(2): 113-120.

Kaiser, H. 1994 The conservation status of Lesser Antillean frogs. *Herpetological Natural History* 2(2): 41-56.

Daugherty, C.H., Patterson, G.B., and Hitchmough, R.A. 1994. Taxonomic and conservation review of New Zealand herpetofauna. *New Zealand Journal of Zoology* 21(4): 317-323.

Brown, D. 1994. Transfer of Hamilton's frog, *Leiopelma hamiltoni*, to a newly created habitat on Stephen's Island, New Zealand. *New Zealand Journal of Zoology* 21(4): 425-430.

Towns, D.R. 1994. The role of ecological restoration in the conservation of Whitaker's skink *(Cyclodina whitakeri)*, a rare New Zealand lizard (Lacertilia: Scincidae). *New Zealand Journal of Zoology* 21(4): 457-471.

Herpetological Conservation. This new publication is a book-length monograph series on the conservation of amphibians and reptiles. *HC* is published approximately once per year and will concentrate on a single subject. For information contact Paul Stephen Corn, Editor, National Biological Service, Aldo Leopold Wilderness Research Institute, 709 East Beckwith Avenue, PO Box 8089, Missoula, Montana USA. Tel: (406) 542-4190, fax: (406) 543-2663, e-mail: Steve_Corn@nbs.gov.

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EDITORIAL

Finally, I am proud to announce the first issue of *Amphibian & Reptile Conservation*!!! The work has been under construction now for over 1 1/2 years with many improvements and refinements being added. It is my hope that this publication will become a valuable tool for conservation and in educating people about the need to preserve our herptofauna heritage.

It was my vision to publish a journal about amphibian and reptile conservation that would appeal to as many people as possible while consisting of the best science available. In the past this would have meant publishing a science journal with limited appeal in the private sector. I have always believed that both could be accomplished together, a readable science journal that the public could better understand and enjoy. I think I have accomplished this vision by creating a journal style with elements of a magazine (color photos and pleasing graphic design), scientific information (original data, scientific article format, and respected science authors), and a newsletter type section for all other useful information. The result will be a stronger more educated public who have more time, money, and enthusiasm to contribute to conservation; something that is often in short supply in the conservation community. The professional scientific conservation community is a limited resource and is often strained to its limits. Conservation is too important of an area to limit to these hard working individuals. There is power in numbers. By increasing our readership and their education we will have a greater impact toward helping others do something about the conservation efforts of amphibians and reptiles. Let's not take a back seat to our commitment to educating ourselves and others about what is being done in the field of herpetological conservation. Make a commitment now to become a subscriber to *ARC* and contribute by writing articles, reporting your research finds, loaning your prized photographs, and telling others of this exciting new venue for conservation. What better way is there than this to show your commitment and support for reptile and amphibian conservation?

All of the good will and individual effort in the world will not make *ARC* a success without your help, support, and valuable feedback. What is being done in your part of the world to conserve its herpetofauna? Why not drop *ARC* a line and tell us. Now with computers and the Internet *ARC* is only an e-mail away!

It is my hope that through *Amphibian & Reptile Conservation* we can all unite and make a big difference toward the conservation efforts of amphibians and reptiles worldwide, as well as all life.

With sincere hopes,

Craig Hassapakis

DEDICATION

This journal is dedicated in honor of my grandparents, Alla Mae "Mona" and Lawton Lail "Grandad" Hendricks. Our rides through the countryside, their special friendship and unfailing support for all my projects will never be forgotten.

Lawton Lail "Grandad" Hendricks (1911 - 1976)

Alla Mae "Mona" Hendricks (1914 -)

AMPHIBIAN & REPTILE
CONSERVATION
THE INTERNATIONAL JOURNAL DEVOTED TO THE WORLDWIDE PRESERVATION
AND MANAGEMENT OF AMPHIBIAN AND REPTILIAN DIVERSITY

Scope

Amphibian & Reptile Conservation (ARC) is an international peer reviewed journal devoted to the worldwide preservation and management of amphibian and reptilian diversity.

Goals

The primary goals of *Amphibian & Reptile Conservation* are to:

- Provide a forum for scientists and others to publish data pertinent to amphibian and reptile conservation.
- Report on herpetological conservation efforts worldwide.
- Assure the protection of all taxa of amphibians and reptiles, particularly those in immediate need.
- Report on the numbers of animals (individuals, populations, and species) in captivity, the wildlife trade, and nature.
- Increase our knowledge of the biology of species.
- Build a network of individuals to expand conservation efforts.
- Continue the growth of the journal.

CALL FOR AUTHORS

Amphibian & Reptile Conservation invites authors to submit manuscripts of high quality for publication which inform, explain, report new discoveries, offer solutions, present new information, and summarize research, projects, and areas of interest. Manuscripts may cover any aspect of amphibian and reptilian biology with an emphasis on conservation. *ARC* is particularly interested in manuscripts dealing with topical reviews, zoo biology, population status (both in captivity and nature), rare, threatened, and endangered species, human exploitation, resource management, geographic distribution, herpetofaunal diversity, area checklists, exploration and discovery, all areas of conservation biology (from such topics as economics and politics to field biology and techniques) and articles which relate animals to specific geographical locations and countries (*e.g.*, The Endangered Frogs of Costa Rica and The Lizard Fauna of Madagascar with Particular Emphasis on Threatened Species).

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WRITER'S GUIDELINES AND MANUSCRIPT PREPARATION

General Information

Amphibian & Reptile Conservation is intended for a wide readership from the amateur to the professional. The study of conservation addresses a tremendous variety of disciplines and occupations, experts in one area may not be knowledgeable in others. Contributors are therefore encouraged to present their subject matter in simple, lucid, and concise terms, appealing to amateur herpetologists, the general public, and scientists. Articles should include abstracts, explanatory text (especially statistical and mathematical methodologies), full references, ample photographs, tables, figures, diagrams, and other illustrations to help elucidate the text, whenever possible. All contributions should be submitted to *Amphibian & Reptile Conservation* exclusively. If accepted, papers and all other contributions become copyright of *Amphibian & Reptile Conservation*. Full horizontal journal size measures 8 x 10.75 inches.

Comments

Comments are invited to ensure that *Amphibian & Reptile Conservation* is the best journal possible. Feedback is very important. We appreciate submission of comments, suggestions for improvements and/or corrections.

Publication Categories

All contributions should be designed to one of the following categories (see below Feature and Scientific Articles, Departments [Short Communications, Commentaries, Book Reviews, News and Notes - Brief Reports, Announcements, Meetings, Calls for Information, Books Received, Literature, and Forthcoming], Editorial, and Column) for publication. However, new sections to the journal are encouraged. Proposals should be discussed with the editor directly.

FEATURE AND SCIENTIFIC ARTICLES

Feature and Scientific Articles and other submissions listed in the Departments section should follow the submission format listed below, unless otherwise stated. Feature articles maybe popular science articles and reviews. Scientific articles include scientific contributions which report new information based on original research and reviews summarizing areas of research. Please label contributions as Feature, Scientific, Review, Commentary, Popular or combination (*i.e.*, Review [Popular]) in the upper left hand corner of the title page. All articles should also contain the following information and conform to the format below.

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The title page of the manuscript should consist of a single page and should include the complete title of the paper; the names of the authors and their affiliations, address (include extra 4 digit zip code *e.g.*, 94305-1901), fax and telephone numbers as well as e-mail addresses (when available. If no e-mail is available please indicate by stating "No e-mail available"); a short title (no more than 40 characters including spaces) to be used as a running header on top of nontitled pages; and the name of the person to whom editorial correspondence, page proofs, and reprints requests should be sent. Please write the total word count of the article in the upper right hand corner.

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A brief abstract (generally not exceeding 5% of the length of the text), intelligible without reference to the main body of the text, should be provided to appear at the head of the paper. At least six key words and/or phrases (to be used for subject matter indexing) should appear on a separate line directly following the abstract.

Table of Contents

Provide a table of contents.

Manuscripts

Authors submitting manuscripts should send three paper copies, double-spaced, and on one side of standard letter-sized paper, 21.5 x 28 centimeters (8.5 x 11 inches). Manuscripts should be submitted in electronic media and postal mailed along with the three paper copies to *Amphibian & Reptile Conservation*. The next best submission method is to send manuscripts through the "Internet" (see Internet Submissions). Refer to this issue of *Amphibian & Reptile Conservation* for examples of style. For further assistance on the proper style and format of manuscripts (not described in these guidelines), consult *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers* (6th edition, 1994, Council of Biology Editors, Inc., 11 South LaSalle, Suite 1400, Chicago, Illinois 60603, USA).

Submissions

Final versions of all submissions to the journal should be on 3 1/2 inch computer disks or Iomega Zip disks suitable for IBM compatible computers. Please label all disks with the name of the software (*e.g.*, Microsoft Word 6.0). ASCII is preferred but Microsoft Word and Word Perfect are also acceptable formats to submit manuscripts. Authors should feel free to suggest at least one referee qualified to judge the work objectively. Submission of electronic illustrations is strongly encouraged, but not required (see Illustrations below). All authors receive one copy of the journal free.

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The Internet provides the quickest method for submitting contributions to *ARC*, especially near deadlines. This is also the preferred method to communicate directly with the editor, submit proposals, and quickly review manuscripts for possible publication. Pictures can also be retrieved over the Internet as encoded files. These are then decoded by the editor for reviewing. Decoder/encoder programs (*i.e.*, WINCODE) can be downloaded to your computer as shareware (free of charge) via the Internet. Please contact a computer consultant or the editor for specific details on how to send and retrieve encoded internet messages and under what conditions to make such arrangements.

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> Lande, R. and Barrowclough, G.H. 1987. Effective population size, genetic variation, and their use in population management, pp. 87-125 in Soulé, M.E. (editor). *Viable Populations for Conservation*. Cambridge University Press, Cambridge, United Kingdom. 189 pp.
>
> Mittermeier, R.A., Werner, T.B., and Lees, A. 1996. New Caledonia—a conservation imperative for an ancient land. *Oryx* 30(2): 104-112.
>
> Stebbins, R.C. and Cohen, N.W. 1995. *A Naturol History of Amphibions*. Princeton University Press, Princeton, New Jersey. 316 pp.

Acknowledgments

Limit acknowledgments to individuals and organizations who contributed directly to researching and funding. Keep them as brief as is consistent with courtesy.

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A brief biography of the author is included at the end of each article. Information provided should be limited to titles, academic positions, employment, past and recent research projects, and details containing brief descriptions of the authors and the overall research projects within which the published work has been carried out. This will provide readers with an outline of the structure and objectives of the research teams, or groups responsible for the work.

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Not all sections of the Departments section will appear in each issue of *Amphibian & Reptile Conservation* and new sections will be added as warranted.

Short Communications

Papers shorter than four pages should be prepared as Short Communications.

Commentaries

Commentaries are explanatory or illustrative, systematic series of comments or opinions based on critical notes or observations.

Book Reviews

Book Reviews are critical evaluations on books. Publishers requesting that their book(s) be reviewed should contact the editor. Whenever possible two copies should be sent with a written request to review. Persons wanting to review books should contact the editor with a proposal.

News and Notes

News and Notes is the newsletter section of the journal. Submissions should be confined to timely news of interest to the herpetological conservation community. These contributions will be placed in one of the following subsections.

Brief Reports

Brief Reports should be fashioned after the "Briefly Section" in the Journal of the Fauna & Flora Preservation Society (London), *Oryx*.

Announcements

Announcements are important timely reports of activities in the herpetological conservation community and should be reported here.

Meetings

Meetings includes references to upcoming conferences, symposiums, and workshops.

Calls for Information

Calls for Information is a service provided to researchers. It is intended to elicit contributions from others and to further the effort.

Books Received

Books Received is a listing of books received for review. It will include full bibliographic data and (sometimes) brief comments.

Literature

Literature cites important works which directly (or indirectly) relate to the conservation of amphibians and reptiles. Recent literature is most often listed but other important literature such as classical works may be also included.

Forthcoming

Forthcoming brings attention to future articles solicited or in press in *Amphibian & Reptile Conservation*.

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The editorial is a topical subject commentary which is usually written by the editor. On occasion, guest editorials may be solicited.

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Columns are assigned by the editor. Potential contributors should contact the editor for consideration.

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A Natural History of Amphibians

ROBERT C. STEBBINS AND NATHAN W. COHEN

This is a book for all readers who want to learn about amphibians. It draws on many years of classroom teaching, laboratory experience, and field observation by the authors. Robert Stebbins and Nathan Cohen lead readers on a fascinating odyssey as they explore some of nature's most interesting creatures, interspersing their own observations throughout the book.

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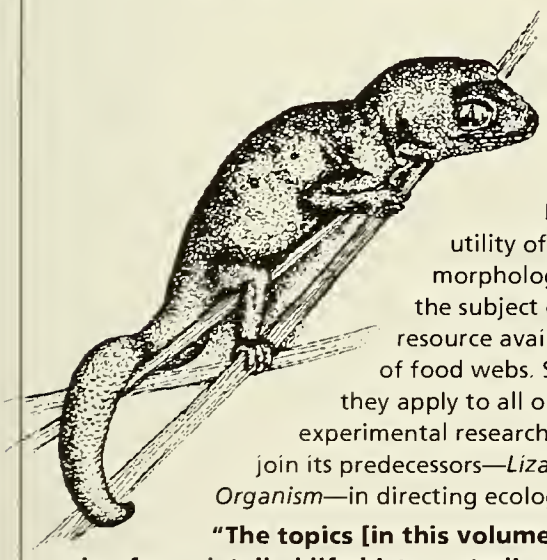

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