Herpetological Conservation and Biology 1(1):68-70
Submitted: June 20, 2006; Accepted: July 18, 2006

A PERSONAL GLIMPSE INTO NATURAL HISTORY AND A REVISIT OF A CLASSIC PAPER BY FRED R. CAGLE

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***Abstract*.—Herein, I provide perspectives on natural history studies and discuss the importance of a contribution by Fred Cagle to herpetology. Having studied the natural history of many amphibians and reptiles for 35 years, I recognize the importance of developing a research strategy prior to beginning work. Cagle's manuscript is a detailed outline of what directions an investigator can take when developing a research strategy in natural history. His thorough approach provides any interested scientist a bounty of questions worthy of scientific study.**

Key Words.—natural history; herpetology; reptile; life history

My editorial colleagues and I feel that it is appropriate in this inaugural issue of *Herpetological Conservation and Biology* that we revitalize awareness about natural history studies. Thus, our first Special Features Article is a reintroduction of the seminal paper on the science of natural history by Fred R. Cagle (1953). We provide a PDF based on the permission of The Editor, Tulane Studies in Zoology and Biology. (To obtain an original copy, contact: http://www.museum.tulane.edu/pubs/tszb.html.) Here, I draw upon several of my own research experiences and recollections as a way of recasting the essence of natural history questions as summarized by Cagle (1953).

First, I note that Cagle (1953) introduced his article by encouraging systematists to not ignore the growing field of ecology and vice versa. Later, Greene and Losos (1988) also emphasized the combined role of systematists, as well as natural historians in preserving biodiversity and changing the public image of field biology. Only through the bridging of various modern biological disciplines, from molecular ecology and genetics to biogeography and field ecology, can the urgent needs of global conservation be adequately addressed.

Cagle (1953) outlined many avenues to investigate reptilian life histories. He provided a lengthy hierarchical list of primary, secondary, tertiary, quaternary, and even pentacular-level questions. The first two primary questions address identifying the species at hand, and the next six can be roughly divided into the categories of reproduction and population dynamics. Primary questions 9 and 10 examine seasonal and daily activity patterns, whereas 11 and 12 address food habits and group behavior, respectively. This litany of questions occupies the first 17 pages of the article; the Literature Cited includes 114 citations (the last 6 pages). Cagle used many citations involving research techniques that were borrowed from other zoological disciplines and were not necessarily applicable to reptiles—a remarkable vision on his part to learn from other sources. One of his most noteworthy statements still resonates today: *"A serious report on a life history should be the result of a planned, long term, research project.*"

As a field researcher of amphibians and reptiles for 35 years, I have studied most aspects of herpetological natural history (e.g., geographic variation, distribution, life history, reproductive cycling, movement patterns, food habits, etc.). Furthermore, I have investigated amphibians and reptiles in the laboratory by incorporating histological and electron microscopic analyses. For example, some life history questions related to the timing of reproductive events (e.g., phenophases) can actually be addressed more effectively at the tissue and organ level (see comments below) than through field studies. A lesson here might be that a useful strategy prior to beginning work as a biologist is to become multidisciplinary in your technical and research skills (by combining lab as well as field techniques) and consider answering "Cagle's questions" from several investigational directions and viewpoints.

My devotion to the study of amphibians and reptiles began when I was a zoology undergraduate student enrolled in the Natural History of the Vertebrates taught by Dr. Douglas A James during the late 1960s at the University of Arkansas at Fayetteville. I can still vividly recall my first class field trip. We went to a local farm pond that was a breeding site for Spotted Salamanders (*Amybstoma maculatum*). The excitement generated by the students while seining for and finding these salamanders in the cool darkness of a January night was pivotal in leading me into a career in science with a specialty in herpetology. It was "natural history" that caught my interest then and holds it even now.

Upon entering graduate school in 1971 and following the advice of my advisor, Dr. James M. Walker, I selected field ecology of lizards as a starting point for my fledgling herpetological career. I grew up chasing Eastern Collared Lizards (*Crotaphytus collaris*) in cedar glade habitats in northern Arkansas, and a chance to conduct thesis work on this colorful saurian was my good fortune. My initial literature search prior to starting my field investigation yielded two 'must have' articles: Fitch (1956) and Cagle (1953). The first introduced me to the natural history and published literature on this spectacular lizard, and the second provided a plethora of literature and techniques and also detailed those important questions that could be pursued within the context of any reptilian natural history study. It was one of Cagle's tertiary questions (p. 40) that most grabbed my attention: *"How many groups or young (eggs) are produced each year?"*

This question forced my thesis work into the lab for a seasonal histological analysis of ovaries to identify atretic follicles, corpora lutea, and corpora albicantia (see Trauth 1978) and, eventually, lead me into an academic career as a comparative reproductive anatomist (histo-herpetologist). However, I still like to think of myself as a field herpetologist.

The first two of Cagle's primary questions remain as critical reminders to all scientists studying wide-ranging species: "*What are*

the morphologic characteristics of the population to be studied?" (p. 32) and "*What is the geographic range*?" (p. 34). These became apparent to me when I was examining the external morphology of three known subspecies of racers (genus *Coluber*) that were known to occur throughout Arkansas during the mid-1990s (Conant and Collins 1991). I just happened to observe that several of my photographic color slides of adult snakes from eastern Arkansas revealed specimens that exhibited rather well-defined, dark, postocular stripes. This morphological feature led to the discovery of a fourth geographic race of this species, the Blackmask Racer (*C. constrictor latrunculus*), which presumably had extended its range northward and westward from Louisiana and Mississippi, respectively, and now apparently occupies much of the Delta of eastern Arkansas (Trauth 1997; Trauth et al. 2004).

Another instance in which these two questions became relevant was in an analysis of the geographic variation in Ringneck Snakes (*Diadophis punctatus*) in Arkansas. When Upton et al. (1995) named a new coccidian parasite from a specimen of the Prairie Ringneck Snake, *D. p. arnyi*, from western Arkansas, I also recorded the presence of the Mississippi Ringneck Snake, *D. p. stictogenys*, in close geographic proximity to the infected snake. This observation prompted me to conduct a state-wide morphological analysis of Ringneck Snakes that resulted in the discovery that the range of *D. a. stictogenys* extends well into the Interior Highlands of Arkansas (Trauth 1996) and is not restricted to the Gulf Coastal Plain and Delta as was previously understood (Conant and Collins 1991).

I utilized one of Cagle's tertiary questions, *"How do the eggs vary in size, volume and weight in each clutch?"* (p. 41), during a study of lizard nesting sites and egg clutch characteristics (Trauth 1983). By unearthing numerous egg clutches of the Six-lined Racerunner (*Aspidoscelis sexlineata*) from its nesting habitats and by analyzing egg volumes, I determined a variety of life history traits for this species, such as egg volume at the time of oviposition, the length of the nesting season, the change in egg- clutch mass during the incubation period, and the number of clutches deposited per nesting season. This line of research also led me to examine eggshell morphology in this species using electron microscopy (EM; Trauth and Fagerberg 1984), and that experience served as a springboard for many later EM studies.

These selected examples illustrate why the questions posed by Cagle (1953) and by his subsequent outline on amphibians (Cagle 1956) are timeless and, thus, greatly beneficial to all young herpetologists as starting points for career research. Cagle's life-history questions were acquired from many previous investigators and, not surprisingly, included valuable suggestions from a timely paper by Fitch (1949).

While preparing these introductory remarks about the significance of natural history in contemporary herpetological studies, I have also chosen to revisit two notable literature sources. First, there can be no better review articulating the importance of retaining research in natural history than Greene and Losos (1988). Their message to the scientific community resounds clearly and profoundly today: get personally involved in educating society about what field biologists and systematists do or witness the demise of public support for field biology. If by some chance you are unfamiliar with Mitchell (1979), then you are probably not fully aware of how to become actively engaged in studying herpetological natural history on a temporal basis. He summarized an important concept that literally drives herpetologists into the field to perform observational studies in natural history. Our understanding of how the elements of the biotic and physical worlds interact on an annual cycle is tied into the concept of phenology, which is defined as the seasonal sequence or timing of life cycle events. Practitioners involved in herpetological conservation and biology continually add to an ever-increasing phenological database and utilize this knowledge to detect and decipher variations in life history patterns. Natural history studies normally focus on where animals occur and what they do (Greene 1994). To declare oneself a natural historian in herpetology in today's academic environment (specifically, the post-graduate job market), however, can be a risky stand, given the perception by many biologists that natural history research is either outdated or unessential. Critics argue that observational studies lack the scientific rigor seen in experimental, hypothesis-testing research. The most often asked question is why life history phenomena of natural populations should be studied by today's scientists anyway.

There are in fact a multitude of obstacles blocking this type of research. At present, extramural funding sources for field biologists are overwhelmingly in the areas of applied and/or technical field research, and what research is fundable often becomes the primary dictator of the direction or line a biologist's academic research pursuits follow. Granting agencies, potential employers, and even academic colleagues may argue that funding opportunities in natural history are nil, and by following this avenue of research, one will assuredly enter, research-wise, a 'black hole' or a 'dead end street'. Moreover, faculty researchers may sometimes be obligated to seek funding opportunities in step with their institution's stated mission and goals, which must meet the financial notion of cost-benefit research or fall within a most-appropriate grantsmanship activity. In accordance, graduate students entering herpetology generally pursue research options and degrees under scientists who offer the most competitive research stipends. Ultimately, the major focus of contemporary, cutting-edge research in herpetology has shifted away from the biology of organisms to understanding these entities as only mere models useful for conceptual study. This new reality is clearly evidenced in the primary literature of recent decades, which is now directed largely toward molecular genetic studies.

The editors of *HCB* are keenly aware of the ongoing conflict and increasing distance between molecular and natural history biologists. There are certainly many present-day ecological issues that may draw our immediate attention away from observational field investigations in herpetology. And yet, it is not surprising that many of the same fundamental questions, as outlined by Cagle many years ago, are totally relevant today. **Cagle remains an important landmark paper for reptilian study, which every herpetology student should read.** These questions require an understanding of basic biological phenomena, and as conditions change, their answers must be continually reexamined. By providing this special feature, the editorial staff hopes to enlighten novices and, at the same time, rekindle the imaginative spirit of veteran experienced herpetologists about the continued importance and application of natural history techniques in all of our herpetological pursuits.

Acknowledgments.—I thank Henry L. Bart, Jr., Editor, Tulane Studies in Botany and Zoology, for his assistance in obtaining permission to use F.R. Cagle's paper in a PDF format. Also, I thank J. Trauth, R. Bruce Bury, Malcolm L. McCallum and two anonymous reviewers for their comments on the manuscript.

LITERATURE CITED

Cagle, F.R. 1953. An outline for the study of a reptile life history. Tulane Studies in Zoology and Botany 1:31-52.
_____. 1956. An outline for the study of an amphibian life history. Tulane Studies in Zoology and Botany 4:79-110.
Conant, R., and J.T. Collins. 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd Edition. Houghton Mifflin Company, Boston, Massachusetts, USA.
Fitch, H.S. 1949. Outline for ecological life history studies of reptiles. Ecology 30:520-532.
_____. 1956. An ecological study of the Collared Lizard (*Crotaphytus collaris*). University of Kansas Publications Museum of Natural History 8:213-274.
Greene, H.W. 1994. Systematics and natural history, foundations for understanding and conserving biodiversity. American Zoologist 34:48-56.
_____, and J.B. Losos. 1988. Systematics, natural history, and conservation. BioScience 38:458-462.
Mitchell, J. 1979. The concept of phenology and its application to the study of amphibian and reptile life histories. Herpetological Review 10:51-54.
Trauth, S.E. 1978. Ovarian cycle of *Crotaphytus collaris* (Reptilia, Lacertilia, Iguanidae) from Arkansas with emphasis on corpora albicantia, follicular atresia, and reproductive potential. Journal of Herpetology 12:461-470.
_____. 1983. Nesting habitat and reproductive characteristics of the lizard *Cnemidophorus sexlineatus* (Lacertilia: Teiidae). American Midland Naturalist 109:289-299.
_____. 1996. Subspecific recognition in Arkansas Ringneck Snakes (*Diadophis punctatus*). Proceedings of the Arkansas Academy of Science 50:145-147.
_____. 1997. First records for the Blackmask Racer (*Coluber constrictor latrunculus*) in eastern Arkansas. Journal of the Arkansas Academy of Science 51:174-177.
_____, and W.R. Fagerberg. 1984. Ultrastructure and stereology of the eggshell in *Cnemidophorus sexlineatus* (Lacertilia: Teiidae). Copeia 1984:826-832.
_____, H.W. Robison, and M.V. Plummer. 2004. The Amphibians and Reptiles of Arkansas. University of Arkansas Press, Fayetteville, Arkansas, USA.
Upton, S.J., C.T. McAllister, S.E. Trauth, and L.D. Gage. 1995. A new species of *Eimeria* (Apicomplexa) from the Prairie Ringneck Snake, *Diadophis punctatus arnyi* (Serpentes: Colubridae), from Arkansas. Acta Protozoologica 34:217-220.

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