Life History and Ecology of the Slider Turtle

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In memory of Donald Tinkle

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Contents

Foreword

Truth is stranger than fiction. No cliché is more appropriate for the ecological research programs on the Savannah River Plant (SRP) in the Upper Coastal Plain of South Carolina. The initial sponsoring agency, the Atomic Energy Commission; its successor, the Department of Energy (DOE); and Du Pont, the SRP's management company, are commonly thought of in association with environmental degradation, not with habitat and wildlife conservation. Yet at the SRP these organizations manage one of the largest nature reserves in the Southeast and sponsor a major program for long-term studies of plant and animal ecology.

In establishing the Savannah River Ecology Laboratory (SREL) as an adjunct research organization to a nuclear facility, the intent was obviously to foster a research program to examine and understand the ecological impact such a facility has on natural environments. Such research has remained a major thrust of SREL; however, the ecologists have had the freedom and foresight to expand their studies into life history and population biology of the local animals and plants, thereby placing the thermally disturbed or other environmentally altered populations and communities in proper perspective. Turtles have been major research animals at SREL for the past two decades. There are any number of reasons why they are particularly appropriate species for monitoring the effects of thermal effluents in natural systems, but certainly a primary reason is Whit Gibbons. Whit is a naturalist with wide-ranging interest; nevertheless, turtles and turtle ecology are a constant to which his attention is frequently focused. The presence of turtles in the thermally polluted lakes and streams certainly in no way hindered his enthusiasm or DOE's interest in the study of SRP turtles. Thus, turtle ecology has become a mainstay of SREL's program, and Whit and his colleagues have contributed greatly to our knowledge of turtle life history and population ecology as well as to the biology of other amphibians and reptiles.

Many species of turtles have been studied on the SRP, none more extensively than *Trachemys scripta*. The data extend across 21 years and encompass three major and many minor populations of sliders. These data provide the core for this book, both for retrospection and for planning future research paths. Few animal populations have been studied for such a long time, and the data for even fewer are summarized and integrated into a single publication. This feature alone makes this book a landmark study in animal biology; however, the contents of the book encompass the entire spectrum of slider biology, from fossil history and slider systematics to population genetics and parasitology. The breadth of this book is evident from a quick glance at its table of contents. What is not evident, though, is the intellectual thread that ties together many of the research objectives and researchers in this book.

The intellectual link is Fred Cagle. Turtles fascinated him as well, and his earliest publications centered on turtle natural history. As it so happens, *Trachemys scripta* was one of the more abundant turtles in Cagle's research area. The eventual result was the publication of his *Life History of the Slider Turtle, Pseudemys scripta troostii* (Holbrook), which may be considered a scholarly precursor of this multiauthored book (that link, however, is coincidental). The intellectual link was forged by Cagle's commitment to detailed studies of life history and population ecology. Turtles remained a lifelong research interest, but he became increasingly convinced of the necessity for a thorough inventory of life history and population characteristics of any animal studied. Not surprisingly, Cagle was only one of several mid-twentieth-century ecologists who advocated a more rigorous and holistic approach to animal ecology. He promulgated this commitment to the herpetological community in 1953 with the publication of "An Outline for the Study of Reptile Life History." More important, he instilled this holistic approach to reptilian ecology in his students, and in one, Don Tinkle, it took particularly deep root. Reptilian ecology, indeed ecology and evolutionary biology, was profoundly influenced by Tinkle's research and ideas. The range of ecological and evolutionary concepts in this book is due in no small measure to the way Don Tinkle thought about reptile ecology and life history. Although it was not intended to be, this book can be viewed as a memorial to Cagle and Tinkle for their pioneering research in life history and population biology studies of reptiles.

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Preface

In one sense this book had its beginning about 20 years ago on July 21, 1967, when I captured my first slider turtle on the Savannah River Plant (SRP) in South Carolina. I would have had a hard time beginning the writing at that time, or even choosing the title, because actually I did not know what species I had caught. Although I had captured 1,001 painted turtles during the previous three years in Sherriff's Marsh in Michigan and was familiar with red-eared sliders by benefit of an Alabama childhood, I had never seen the eastern subspecies of the common pond slider. During the remainder of that summer, however, with the capture of other regional species of turtles for comparison, and with the aid of Roger Conant's *A Field Guide to Reptiles and Amphibians of the United States and Canada East of the 100th Meridian* and Archie Carr's *Handbook of Turtles,* I became confident that I was dealing with what was then called *Chrysemys scripta* by some herpetologists and *Pseudemys scripta* by others.

A rationale for initially selecting turtles as study organisms is that they have certain life history characteristics that make them demographically distinct when compared with lizards, the most thoroughly studied group of reptiles. The main life history qualities that all turtles possess, in contrast to most lizards or other animals, are extended longevity and delayed maturity. These two factors alone qualify the group for attention by ecologists and demographers. Turtles also have a variety of other traits that make them ideal for life history and demographic studies, such as being relatively easy to capture, handle, and mark for permanent identification. Among the most useful determinations that can be made on individuals of many freshwater species, including slider turtles, without harm to the animal, are quantifications of body size, age, sex and state of maturity of both sexes, and reproductive condition of females.

The SRP in South Carolina, where the majority of the populations mentioned in this book are located, has been an ideal site for establishing long-term field research efforts because of the protection from public disturbance that results from the tight security of a defense site. This book will reveal some of the research advantages and insights that can accrue from long-term field studies of specific natural populations in such a situation.

As a herpetologist interested in turtles, I could not have fallen upon better times with a better species. The U.S. Atomic Energy Commission (AEC), the source of most of my research support, wanted to know how thermal effluent from nuclear reactors affected environments and their natural inhabitants. Anyone could have convinced the commission, as we did, that slider turtles were a species worth looking into because the evidence was soon clear that turtles in this group not only survived but actually thrived in polluted waters, including waters heated to temperatures unsuitable for most native flora and

fauna. Fortunately for us, and I hope for other researchers, the AEC recognized that in order to conduct studies that demonstrated effects on organisms from industrial operations, the scientist must also examine populations of the same species under natural conditions. One must observe natural phenomena when and where there are no effects before industrial, domestic, or agricultural impacts can be ascertained. Thus, we were allowed, even encouraged, to pursue ecological research on slider turtles in thermally unaffected habitats on the SRP and in other geographic regions, in addition to those receiving heated water from reactors.

Although I am not an expert in theoretical biology, mathematical modeling, or statistics, I have been able to deal with these areas through the help of numerous associates and collaborators. And with the help of willing students, technicians, and others, I have been able to catch turtles. During the two decades following the capture of my first slider turtle, we have collected an average of more than 3 turtles per day (3.4 per day as of December 1987). Of these 24,754 turtles representing more than a dozen species, 46% (11,297) have been slider turtles. Some were new individuals, but more and more were turtles that had been caught before. Naturally, the length of time between the first and last capture of some individuals increased, so almost every year we broke the previous year's record for time between captures. It became apparent that not only were we documenting that individuals lived for several years, but we were also gradually compiling records in several populations with large proportions of individuals whose ages we knew precisely. Many of these were older individuals and represented a situation unusual for most studies of long-lived animals. That is, a fairly good representation of the age structure was available for some populations, including individuals in the older age classes.

As a matter of course, we collected data applicable to understanding the life history and ecology of turtles, most of it without experimental or theoretical design. We just took measurements that seemed like they might provide some level of enlightenment to the knowledge and information about turtles. I am afraid that today's highly experimentally minded, theoretically based scientific approach discourages this type of behavior among young scientists. A challenge to this attitude is that if all scientists had waited for the right hypothesis or question before making their observations, our core of information and fundamental knowledge in biology would be a structure too weak for most theory to stand on. I take the stand that the simple collection of data for its own sake, even though a specific hypothesis of theory is not addressed, can sometimes be valuable. Charles Darwin demonstrated this, and I feel certain that an impressive array of other scientific advancements could be brought forth as examples of how observational data can advance and set a crucial foundation for much of biology.

One distinction between most long-term research projects and short-term studies is that the latter often have a single hypothesis that is being tested or a specific question that is being asked. Long-term projects are different in that the investigator probably did not begin the research with the intent of extending it beyond a few years at most. Therefore, a study that has lasted for many years may provide the empirical evidence needed to address certain biological issues, although the study was not designed initially with such issues in mind.

After about 13 or 14 years of capturing, marking, and recapturing turtles, we began to recapture individuals that we knew were more than 20 years old by virtue of their having been at least 6 or 7 when they were first captured.

Somehow the approach of the 20-year mark clicked as a milestone, and I decided that I should compile the information we had on sliders and other turtles into a form that would be useful to other interested ecologists. Although we published several papers in which older, known-age individuals were capitalized upon, it seemed that a book on the subject might be in order.

The importance of long-term ecological studies of animal populations has been recognized, as in Don Tinkle's *BioScience* article in 1979, yet fewer than 15% of the life history studies of natural populations are based on research of more than three years (according to a survey of studies of natural populations of animals published in *Ecology* and *Ecological Monographs* from 1980 to 1984). Short-term studies often result in interpretations and conclusions about a particular species without the benefit of comparative data in different years or under different environmental conditions, so the extent of natural variability may not be recognized. Local environmental conditions in an area have been shown to have dramatic effects on important life history features for a variety of organisms. However, given the limited time span of most population studies, it is difficult to identify the level of variability that can occur within the same population at different times and under different environmental conditions. An awareness of this variability would appear to be critical in the formulation of life history theory.

An initial objective of this book was to examine the variability in selected life history attributes in natural populations of a long-lived animal species that has been studied for a relatively long period of time. The findings reported were to be based primarily on 20 years of continual surveillance of several populations of a freshwater turtle. The primary study species was the yellow-bellied slider turtle (*Trachemys scripta*). However, life history data were also gathered on other turtles that resided with the slider turtle in the Upper Coastal Plain of South Carolina. These included the chicken turtle (*Deirochelys reticularia*), cooter (*Pseudemys floridana*), eastern mud turtle (*Kinosternon subrubrum*), snapping turtle (*Chelydra serpentina*), and stinkpot (*Sternotherus odoratus*). Comparable information was also gathered on the painted turtle (*Chrysemys picta*) from population studies conducted in southern Michigan between 1964 and 1987. Data from these studies are used when appropriate for comparison with findings about slider turtles.

As I began to consolidate my own data and consider what I might contribute about slider turtles in particular and the ecology of turtles in general, I came to realize that although I had more data of this sort than most other investigators who did long-term mark-recapture studies on long-lived species, there were many gaps in what my associates and I could say. Therefore, I elected to invite other ecologists who had worked with slider turtles to contribute chapters to augment my own work. I was pleased that of the 17 individuals who were invited to submit chapters, only one declined outright because of other commitments. If this book is indeed a contribution to the knowledge and understanding of sliders and other turtles, it will be in great part because of the efforts of these individuals.

A major value of the analysis, synthesis, and interpretation of the data taken in these studies should be the addition to our base of information on the ecology and life history of turtles as a significant group of modern-day reptiles. Also, I hope that the empirical evidence from these studies will provide the basic ingredients to successfully support or refute many of the theoretically derived impressions that population ecologists have about natural populations

of animals. Collectively, the studies on the SRP and those from other areas by other investigators should provide a definitive foundation for ecological studies of freshwater turtles in particular, with general applicability to marine or terrestrial species. A final product of these presentations should be the identification of the most critical questions that should now be asked in the study of turtles.

J. WHITFIELD GIBBONS

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A major acknowledgment should be given to a group of people who are part of an organization that has had three different names since I first became associated with it. The parent organization was known as the U.S. Atomic Energy Commission. In 1974 the name was changed to the Energy, Research and Development Administration. The final product is what we know as the U.S. Department of Energy. This trinomial organization has done more to support basic ecological work than almost any other government agency. The data on freshwater turtles presented in this book could not have been collected for the most part without its help and the encouragement of certain individuals. I would particularly single out Bill Osborne, who operated as a scientist within their ranks and, as far as I can tell, was supportive of the turtle research from the very beginning. Many others (the names have changed more often than the agency's) have also provided the background support necessary to conduct these studies, and it is only proper that we should occasionally bring them from behind the scenes to indicate our appreciation. Notable among them have been Heyward Hamilton and Helen McCammon. Special thanks also go to the people at the Department of Energy's Savannah River Operations Office for their assistance with logistical and administrative tasks over the years. These include Karl Herde, Liz Goodson, Don Day, Bill Wisenbaker, Dick Jansen, and Steve Wright as well as many others.

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