BOOK REVIEWS

Unelevated Vertebrates

Snakes. Ecology and Behavior. RICHARD A. SEIGEL and JOSEPH T. COLLINS [Eds]. McGraw-Hill, New York, 1993. xvi, 414 pp., illus. Paper, $27.95 or £21.95.

Snakes might rank with birds and mammals if conventional taxonomy really reflected distinctiveness of characteristics, richness of species, and variety of lifestyles. Lacking functional limbs, the roughly 2500 species nevertheless include forms that ascend trees, that burrow beneath the Earth's surface, and that swim the seas. Big-eyed serpents glide up through the tropical canopy, their specialized cardiovascular systems compensating for gravity, and tiny blind snakes raid subterranean nests of ants by following the insects' pheromone trails. Some species with flattened, oar-like tails probably never emerge from the ocean, and the yellow-bellied sea snake is planktonic, a passive traveler on surface currents. Snake diets range from snails and centipedes to bird eggs and porcupines, and some venomous species engulf prey items more than one-and-a-half times their own mass. Most snakes simply oviposit in appropriate incubation sites, the hatchlings capable of independent living, but many species give birth to their young, and a few exhibit parental behavior.

Yet in the conferring of taxonomic prominence and the subtle benefits it conveys, anthropomorphic sympathies for warm bodies and facial gestures prevail: Snakes and turtles, having not shared an ancestor in more than two hundred million years, are together in Class Reptilia; birds are elevated to Class Aves, obscuring their close relationship to another group of "reptiles," the crocodilians. Nonetheless, despite deeply entrenched biases, snakes fascinate us. They represented healing to ancient Greeks and knowledge to the Incas; a serpent tempted Eve in the Garden of Eden, and a giant cobra shaded Buddha. Among benchmark scientific studies of these creatures are Carl Gans's work on the functional morphology of African egg-eating snakes (1952), Joseph Camin and Paul Ehrlich's research on natural selection in Lake Erie water snakes (1958), and Stevan Arnold and Albert Bennett's quantitative genetic analysis of garter snake defensive behavior (1984).

The book under review includes papers on behavioral and functional ecology of arboreal snakes (Lillywhite and Henderson), sexual dimorphism (Shine), foraging theory and predator-prey size relations (Arnold), perceptual mechanisms and behavioral ecology (Ford and Burghardt), ecology and evolution of mating systems (Duvall, Schuett, and Arnold), habitat selection (Reinert), thermal ecology (Peterson, Gibson, and Dorcas), quantitative genetics (Brodie and Garland), and strategies for conservation (Dodd). To the editors' credit, there are no duds here. Each chapter offers new findings and novel perspectives; those on arboreality, perceptual mechanisms, sexual dimorphism, and thermal biology are especially impressive as scholarly overviews of a large, cosmopolitan group of organisms. The exclusion of morphology and systematics as indicated by the volume's subtitle is curious because, as some of the authors nicely illustrate, structural peculiarities and evolutionary relationships profoundly influence the behavior and ecology of snakes. All of the chapters are relevant for workers who focus on other taxa, especially those concerned with sexual dimorphism, mating systems, habitat selection, and quantitative genetics.

The book's epilogue, on "how to combat 'lizard envy,' " is thought-provoking but somewhat miscast (phylogenetically snakes *are* lizards; an analogous title for primatologists would be "how to combat mammal envy"). Unlike certain other "lizards," snakes historically have been slighted as objects of study. Seigel urges us to focus on captive breeding biology, thermoregulation, and other topics for which snakes too can be "model" organisms. That is sound advice, especially for graduate students and those without tenure, because the approach guarantees relatively rapid results. Model organisms and systems, however, often are identified on grounds of practicality rather than any proven generality—and the very factors that favor the former may severely limit the latter. Many exciting discoveries and truly broad conceptual generalities will come instead from technical innovations (such as miniaturized radiotelemetry) and imaginative comparative studies of "difficult" organisms.

After half a century of ascendancy, its triumphant reductionism almost complete, molecular biology is fading into physical chemistry and technological applications. As emphasis inevitably shifts from mechanisms of gene regulation to integration across higher levels of organization, organisms and their environments loom as the exciting frontiers in biology. A legion of intellectually challenging, urgent problems lie in the diversity of life itself, and snakes have much to offer. Seigel and Collins's fine book points the way for future research.

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Reptilians Too

Biology of Whiptail Lizards. (Genus *Cnemidophorus.*) JOHN W. WRIGHT and LAURIE J. VITT, Eds. University of Oklahoma and Oklahoma Museum of Natural History, Norman, 1993. xvi, 417 pp., illus. $29. Herpetologists' League Special Publication no. 3. Based on a symposium, Norman, OK, Aug. 1984.

The lizard genus *Cnemidophorus* is notable for including a large number of parthenogenetic forms, many of them interspecific hybrids, and for being very successful in the deserts of the United States and Mexico. In the introduction to this collection of papers on the genus C. H. Lowe recounts the history of modern research on *Cnemidophorus* in North America and announces the advent of a new science, "cnemidophorology." The concept, however, is belied by the remainder of the book, which is solid, middle-of-the-road herpetology. The only other general chapter, by J. W. Wright on the evolution of the genus, is a rather freewheeling and disorganized discourse on the systematics, especially of its representatives in North America; the South American species are not well treated.

Among the ecological topics represented in the volume foraging gets the most attention. All species are widely ranging (as distinct from ambushing) predators; this strategy and its correlates are explored in a series of good chapters. Anderson contributes a discussion of food acquisition by C. *tigris* in California, but the conclusions are marred by a confusion between velocity and acceleration. Chapters by Etheridge and Wit and by Bowker examine the temporal activity pattern, which in general consists of a short annual season and of two short daily periods. The former chapter treats the subject from the viewpoint of foraging, the latter from that of

thermoregulation, especially as related to conservation of water. In another chapter Casas-Andreu and Gurrola-Hidalgo compare two extremely similar syntopic bisexual species in a semi-arid region in Jalisco; it is remarkable that, contrary to what is seen in the United States, there is only one daily activity period.

Garland presents an experimental study of the correlates of endurance in C. *tigris* without reaching a definite conclusion. Also inconclusive is a report by Wit and Sellers on thyroid activity related to hibernation in C. *sexlineatus* in Alabama and Georgia.

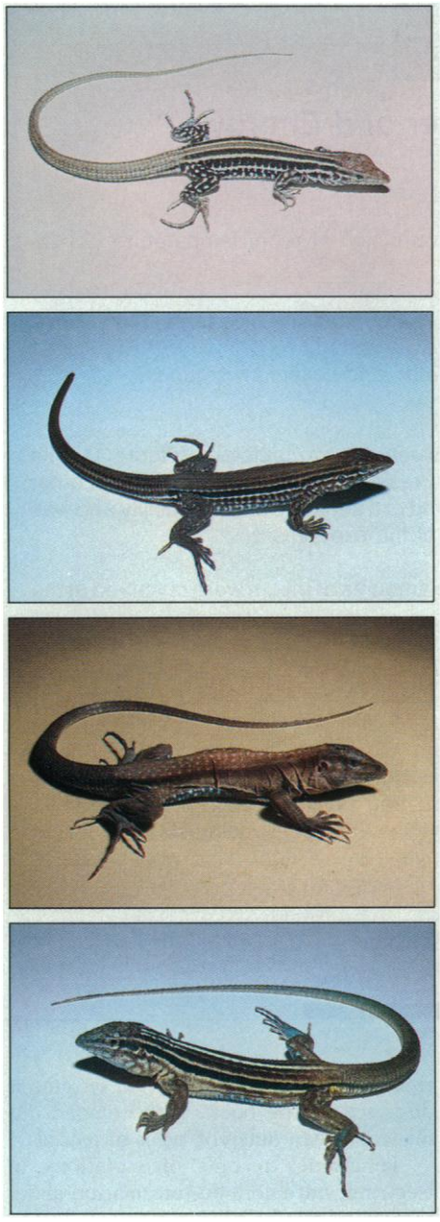
Vitt and Breitenbach study the correlates between foraging mode and a large array of life-history (including demographic) traits. From a statistical study of 52 local samples of numerous species they reach no conclusion, but suggest topics for further research.

Crews and Moore write on pseudocopulatory behavior in all-female species. Their experimental study leads them to the conclusion that post-ovulatory females (or castrated females having received progesterone) will assume male roles, being accepted by pre-ovulatory (or estradiol-treated) females. Individuals will assume both roles during the ovarian cycle. As to the function of the behavior, Crews and Moore stress that it may facilitate ovulation, with considerable demographic consequences.

Schall uses a set of five species, two of them parthenogenetic, to test Wright and Lowe's 1968 "weed" hypothesis—that parthenogenesis would become established because the high heterozygosity of hybrid females would give them an advantage in the exploitation of ecotonal and disturbed environments. His data fail to support the conjecture.

Chapters by Cuellar and by Price, LaPointe, and Atmar deal with resource partitioning among sympatric species, focusing on competitive interactions and on patterns of reproduction and including removal experiments. Cuellar finds out that his two species (C. *uniparens* and C. *tigris*) use adjacent but dissimilar habitats; where they compete, unisexual C. *uniparens* performs better than bisexual C. *tigris* and has a wider ecological valence. The study by Price *et al.* consists of a removal experiment involving two ecologically "twin" species, parthenogenetic C. *tesselatus* and its maternal parent, C. *tigris marmoratus*. Contrary to expectations, the bisexual species actually behaved more like a "weed" than the unisexual one.

An original and interesting chapter by Leuck deals with kin recognition, using diploid and triploid C. *tesselatus*. Both agonistic and benign interactions were studied. The results clearly show that the lizards recognize ploidy levels, but the mechanism remains obscure (Leuck herself favors olfaction).



Representative members of the *Cnemidophorus depii* species group. "As presently constituted the group consists of five species with 12 subspecies . . . distributed from Costa Rica to California in dry tropical, subtropical and temperate habitats." [From J. W. Wright's chapter in *Biology of Whiptail Lizards*]

Another interesting chapter is an analysis by Trauth and Fagerberg of the fine structure of the eggshell of C. *laredoensis* and its parent species C. *sexlineatus*. There is still no application for this type of data, but it is an elegant line of research.

This is a valuable book for the primary information it contains and for some of the literature reviews, but it offers no synthesis—nothing in fact that would justify the erection of "cnemidophorology" as a science. Some omissions are noteworthy, especially the lack of a well-organized treatment of systematics, a summary of parthenogenesis, and comparisons with the parallel parthenogenetic genus *Lacerta*.

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Climate Chronologies

El Niño. Historical and Paleoclimatic Aspects of the Southern Oscillation. HENRY F. DIAZ and VERA MARKGRAF, Eds. Cambridge University Press, New York, 1993. xiv, 476 pp., illus. $69.95 or £40. Based on a workshop, Boulder, CO, May 1990.

In the last decade the El Niño–Southern Oscillation (ENSO) has become recognized as perhaps the dominant mode of interannual oceanographic and climatic variability in the tropical Pacific and Indian oceans. It has also been found to contribute to global climatic anomalies both within and outside the tropics by affecting such diverse components of the climate system as sea surface temperature, tropical atmospheric convection, cloud cover, and precipitation. Climatic manifestations of the ENSO system can dramatically alter crop yields and fish harvests and bring about catastrophic monsoon rains. The ENSO system involves the pronounced east-west "seesaw" of tropical convection and atmospheric pressure (known as the Southern Oscillation) whereby a large region of convecting air over the western Pacific and Indian oceans is linked by high-altitude winds to a descending limb in the eastern Pacific. In 1966 Bjerknes named this the Walker Circulation, after Sir Gilbert Walker, who first identified it in the 1920s. ENSO has two extreme phases—El Niño (the warm phase) and Anti-El Niño (the cold phase)—and a mean period ranging from 2 to 10 years. Although its behavior during the last 50 to 60 years is well established, little is known about its prior variations. However, the pace of research aimed at reconstructing the history of the phenomenon has been increasing owing to the recognition of its wide-ranging implications for the environment and human life and the value of being able to predict its future behavior. This book brings together some of the most innovative recent