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OBSERVATIONS ON BREEDING MIGRATIONS OF AMBYSTOMA TEXANUM

In Kansas, Ambystoma texanum migrates to breeding sites after rains during late February or early March (Collins, 1974). This paper provides new information on various aspects of migration and reproduction in a Kansas population that I observed in 1974 and 1975.

Salamanders were collected from a one-mile stretch of blacktopped road (31st Street between Louisiana and Haskell Streets) in Lawrence, Douglas County, Kansas. Search of the road began soon after dusk on each day in which precipitation had occurred and for several days afterward from February through May. Salamanders were preserved and tagged within three hours of collection. Direction of travel, sex, and snout-vent length was recorded for each animal. In the laboratory, sizes of oviducts, ovarian eggs, opistonephric ducts, and testes were measured with an ocular micrometer or vernier calipers. Number of ovarian eggs were counted and stomach contents were examined. Statistical tests follow Sokal and Rohlf (1969).

Salamanders traveled to the low-lying fields of the Wakarusa River floodplain south of the road and then returned to the north side after breeding. The pattern of direction of travel in both years was an increasing percent of northerly directed salamanders as the season progressed (Table 1). The first appreciable rain of the year occurred on 6 March 1975 when 75 salamanders were collected traveling south. Successive collections showed an increasing percent traveling north. On a comparable date one year earlier, most salamanders were oriented north as was the case with successive collections. Salamanders had migrated south earlier as evidenced by eggs developed to yolk-plug stage found at the breeding site on 2 March. However, the road was searched on four previous occasions beginning on 12 February and no salamanders were seen. Collins (1974) found eggs in the same population as early as 25 January. No sexual differences were noted in timing or direction of travel.

	Date	n	% traveling north
1974	4 Mar	24	63
	28 Apr	17	82
	29 Apr	12	92
1975	6 Mar	75	0
	26 Mar	19	32
	7 Apr	19	74
	13 Apr	13	77

Table 1. Chronological changes in direction of travel.

Table 2 shows various statistics for pre- and post-reproductive animals. All males were mature judging from size of reproductive organs, swollen cloacas, and presence of spermatophores. Two females (SVL - 45, 46 mm) were judged immature based on undeveloped ovaries and small oviducts (0.20, 0.15 mm). Mean snout-vent length of 77 males was 74.0 $\pm$ 0.58 mm (range 60-85) whereas in 74 mature females it was 79.1 $\pm$ 0.53 (range 69-88). The difference in size is significant ($t = 6.48$; $P < 0.001$). Sex ratio was not significantly different from 1 : 1 ($X^2 = 0.06$; $P > 0.50$). Pre-ovulatory females had uniform eggs 1.4-1.7 mm in diameter. Number of ovarian eggs ($\bar{x}$ = 658 $\pm$ 24) ranged from 341-896 and was correlated with snout-vent length $\hat{Y} = -1282 + 24.1x$ ($P < 0.001$). Regression of sizes of ovi-

	n	Number traveling N or S		Percent with food in stomachs	Width of oviduct (mm)	Width of opistonephric duct (mm)	Testis area (mm)
FEMALES							
pre-ovulatory	38	1	37	18.4	2.5±0.62	--	--
post-ovulatory	35	31	4	40.0	0.9±0.03	--	--
MALES							
pre-reproductive	56	0	56	12.5	--	1.2±0.03	33.5±1.30
post-reproductive	19	19	0	36.8	--	0.6±0.04	20.7±1.12

Table 2. Comparison of various statistics between pre-reproductive and post-reproductive A. texanum. Reproductive status of males was determined a priori by direction of travel. Testes approximated a flat, ribbon shape. As an index of testis size, area was computed by multiplying length by greatest width for each testis. Oviducts were measured near the middle of their length.

ducts, opistonephric ducts, testes, and swelling of male cloacas occurred after reproduction. One post-ovulatory female traveling south on 13 April 1975 contained 58 eggs in the left oviduct; the right oviduct, measuring 1.4 mm in diameter, was empty. A significantly higher ($P < 0.05$; Sokal and Rohlf 1969, p. 607) percent of both post-reproductive males and females contained food in the stomach compared to pre-reproductive animals. Apparently, sexually active A. texanum feed little as is true for A. maculatum (Shoop, 1967). Earthworms were the most frequent food item, being found in 34 of 35 stomachs. One stomach contained a centipede and two other stomachs contained, in addition to earthworms, fragments of a beetle, a weevil, and a spider.

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Book Reviews

THIS BROKEN ARCHIPELAGO: CAPE COD AND THE ISLANDS, AMPHIBIANS AND REPTILES. By James D. Lazell, Jr., with photographs by Martin C. Michener, 1976. Demeter Press, Quadrangle/The New York Times Book Company, N.Y., N.Y. xi + 260 pp. $12.50.

The 37 species of amphibians and reptiles known from Cape Cod and its associated islands are presented to the readers of this book with true affection by the author. This is not only a systematic treatment, but a chronology of the author's, and his friends', adventures as herpetologists in the field. The emphasis is on the living animals, where they occur and what they do. The outstanding feature throughout is Lazell's ability to develop a genuine fondness for the small, sometimes slimy, secretive, and mostly misunderstood members of these two vertebrate classes. The book is a first attempt, excepting Roger Conant's field guide, to assess the herpetology of this area. The text is easily read, often humorous, interesting, informative, and sometimes caustic in its attack on individuals, professional and amateur alike. His pointed comments refer primarily to field collecting for museum specimens and taxonomic considerations. One explanation for some rather heavy language may be the author's affiliation with the Massachusetts Audubon Society, but nowhere are his biases totally unfounded.

Chapters 1 and 2 discuss the land and the sea, respectively, describing in understandable detail the glacial origins of the area, the dynamic interactions of land, wind, ice and water. Terms such as knobs, terminal moraines, kettles, pamets and tombalos are so vividly defined that they would be easily remembered, even without the fine habitat photographs. These, and similar terms throughout the text, are also italicized for easy reference. Seral stages of vegetation, subclimaxes and ecotones are described for each island group to contrast the diversity of community types in the area. Of even greater importance, in Chapter 2, the all pervasive role of the sea in shaping the coastal land masses, and cyclicly controlling temperature and salinity, is described.

Chapters 3 through 7 describe the herpetofauna. Each chapter begins with a brief overview of the general origin, distribution and systematics of the order being introduced. In several individual species accounts problems of general biological interest concerning such varied topics as genetics, physiology, and zoogeography are presented. Examples include a discussion of DNA and the genetics of polymorphism in Plethodon cinereus, the peculiar distribution of Notophthalmus viridescens in this area and the hypothesis of a correlation of distribution and the salinity of breeding sites, the taxonomic question of recognizing Notophthalmus instead of Triturus as the real generic name, the nagging question of where Hyla crucifer goes during the "off" season, and why do many herpetologists exhibit what Dr. Lazell terms "ignorance" of the literature concerning systematic revisions? Explaining to a non-biologist the role of DNA in the genetic polymorphisms of Plethodon required considerable insight and writing talent. Lazell does a fair job in about 3 pages. Those who would recognize the simplified, and basically erroneous, statement that "a gene that doesn't work is called recessive" may criticize it. But, in his context we could do much worse in explaining that gene's contract to a dominant one. I do take exception to his view of introgression as "hybrids...so well adapted to new conditions that they out breed either parental stock" (p. 108). His statement, in my opinion, refers to a hybrid swarm. Introgression more properly refers to backcrossing of the F1's by either parental populations. As to "ignorance," Dr. Lazell rightly points out the problems, but does little to indicate solutions (quite unexpected from a Massachusetts Audubon member). If one recognizes how immense was the genus (in this case Natrix), and how variable, then one must admit that a proper definition requires a monographic study of no small effort. With reference to Ed Malnate's study of the genus Natrix, such an effort has split out Natrix from three other genera, and most have accepted the split in principal (including McDowell). Douglas Rossman, an extremely thorough worker, has now separated New World from Old World Natrix, the former designated Nerodia and the latter Natrix. The original Natrix complex, thus pared down, might now be ready for a reexamination of Nerodia-Natrix-Thamnophis affinities. Classifications are slow to change--and in many cases should be. Lumping often obscures problems. Witness the long standing myth of the singular, wide ranging Rana pipiens, or the Natrix sipedon-fasciata complex as a single species group. Surely the lumping of Thamnophis with Nerodia requires more than Lazell's "footnote." The irony of the argument is that while Thamnophis may be Natrix they may not at all be Nerodia!

One recurring theme throughout the book concerns the author's almost fanatic aversion to collecting museum specimens, and the seemingly