polygyny: why do females prefer older males. Amer. Natur. 123(6):873–875.

WEST-EBERHARD, M. J. 1979. Sexual selection, social competition, and evolution. Proc. Amer. Philos. Soc. 123:222–234.

WILBUR, H. M., D. I. RUBENSTEIN, AND L. FAIRCHILD. 1978. Sexual selection in toads: the role of female choice and male body size. Evolution 32(2):264–270.

WOODWARD, B., J. TRAVIS, AND S. MITCHELL. 1988. The effects of the mating system on progeny performance in *Hyla crucifer* (Anura: Hylidae). Evolution 42(4):784–794.

ZWEIFEL, R. G. 1968. Effects of temperature, body size and hybridization on mating calls of toads *B. a. americanus* and *B. woodhousii fowleri*. Copeia 1968(2): 269–285.

Accepted: 19 April 1989.

Journal of Herpetology, Vol. 24, No. 2, pp. 201-202, 1990

Relative Abundance of Marine Snakes on the West Coast of Sabah, Malaysia

ROBERT STUEBING[1] AND HAROLD K. VORIS,[2] [1]*Biology Department, Universiti Kebangsaan Malaysia, Kota Kinabalu, Sabah, Malaysia, and* [2]*Department of Zoology, Field Museum of Natural History, Chicago, Illinois 60605, USA.*

Sea snakes (Elapidae: Hydrophiinae and Laticaudinae) are abundant in the shallow seas and estuaries of Malaysia (Lim, 1979). Diversity is highest in the Malacca Straits, where 24 species have been reported (Minton, 1975), and in the Gulf of Thailand where Tu (1974) noted 11 species in a sample of 13,927 snakes taken by trawlers over three years. Voris (1964) reported 8 species from the east coast of Sabah (Island of Borneo). Most of these snakes were taken by local fisherman trawling in the shallow seas over a muddy bottom in Marudu Bay. Reported here are extensive new data on the relative abundance of several taxa of marine snakes. These data are of particular interest when compared to previous samples from other parts of Southeast Asia.

Marine snake assemblages tend to be poorly known owing to the logistical difficulties inherent in sampling them. Most studies rely on the incidental capture of snakes by commercial fishing operations, whose methods introduce several sources of error that are difficult to assess directly. Nonetheless, these are the only data available on the occurrence and relative abundance of marine snakes, and can be useful if the sampling limitations are understood.

In 1986, the Museum of Zoology at the Sabah Campus, Universiti Kebangsaan Malaysia, began to collect marine snakes with the assistance of the Sabah Fish Marketing Authority (SAFMA). The specimens were obtained from two bottom trawlers that frequented the SAFMA landing in Kota Kinabalu. The fishermen reported obtaining the snakes at night while trawling for prawns at depths of 15–25 m and from 10–50 km from the west coast of Sabah, roughly from Kota Kinabalu in the east to Labuan Island in the west. The majority of snakes came from the vicinity of Kimanis Bay, an area seasonally rich in prawns. Samples came in at irregular times during the year without detailed information regarding the area fished or specific environmental conditions. Upon receipt, specimens were bagged, frozen, and their date of collection noted. The bags of snakes were later thawed, identified, and processed for other studies.

From January 1987 through June 1988 a total of 2168 marine snakes was collected (Fig. 1). Of the 10 species in the collection, *Lapemis hardwickii* was the most abundant (77%) followed by *Aipysurus eydouxii* (6.4%), *Acrochordus granulatus* (5.9%), *Hydrophis cyanocinctus* (4.7%), and *Enhydrina schistosa* (2.4%). Five other species, *Hydrophis ornatus*, *H. caerulescens*, *H. fasciatus*, *H. spiralis*, and *Laticauda colubrina*, accounted for only about 3% of the total collection. Simpson's (1949) index of diversity for the entire sample was moderately high ($D_s = 0.61$).

Lampemis hardwickii was the most numerous species in each of the 16 months represented by collections. *Aipysurus eydouxii* and *H. cyanocinctus* ranked second in six monthly collections each, while *Acrochordus granulatus* ranked second in four collections. Generally, *A. eydouxii* predominated in samples from March through June, while *H. cyanocinctus* was most common from September–January. More than half (32 of 53) of the *E. schistosa* were collected in the September sample. Among the rarest snakes in these trawl collections was the sea-krait, *Laticauda colubrina*, which is commonly found on small, rocky islands within several km of trawling grounds.

The total number of snakes collected per month varied from 0–660, with no consistency between adjacent months. When the totals are analyzed by three month periods, no consistent pattern emerges. For example, the second quarter of 1987 produced the fewest snakes (37) while the same quarter in 1988 produced the largest sample (916).

Unfortunately, analysis of monthly variation in total numbers of snakes and relative numbers of species is necessarily limited by the non-random sampling methods employed (Dunson, 1975). Observed variation could result from alterations in trawling practices such as changes in effort, habitats (e.g., varying depths and bottom substrates) or technique, as well as potential behavioral differences among snake species that may influence catchability.

Sex was determined by dissection for 754 *Lapemis hardwickii* collected in 1987. The sex ratio for this subset was not significantly different from 1:1 (363 males: 391 females; Chi-square = 1.04, df = 1, $P > 0.05$; Han, 1988).

All sea snake species reported from the east coast of Sabah by Voris (1964) were found in this collection, except for *Kerilia jerdoni*. *Aipysurus eydouxii* is not reported on the east coast, but was seasonally abundant on Sabah's west coast.

Similarities between marine snake collections made in the Gulf of Thailand and the coast of Sabah are noteworthy. The sample of only 63 snakes from the east coast of Sabah (Voris, 1964), the Gulf of Thailand sample of 13,927 snakes (Tu, 1974), and the present sample of 2168 snakes represent 8, 10, and 11 species,

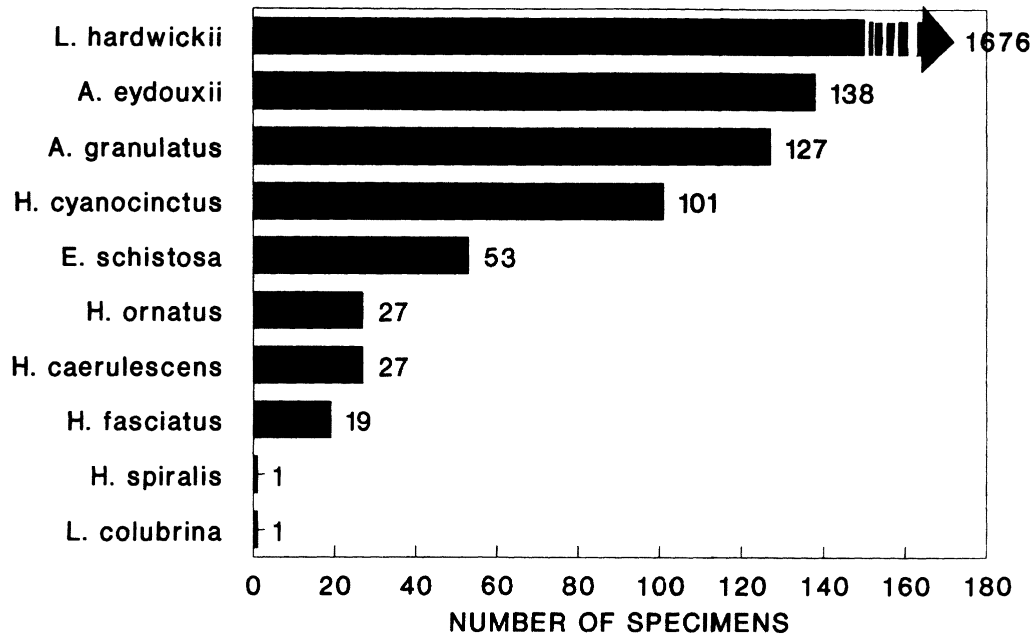

FIG. 1. Relative abundance of 10 species of marine snakes collected off the west coast of Sabah, Malaysia.

respectively. In each collection *L. hardwickii* was by far the most abundant species and *H. cyanocinctus* was second in the Thailand and east Sabah samples.

Acknowledgments.—This study was made possible in part through NSF INT-8543985. We are also grateful for the support of the Faculty of Science and Natural Resources, Universiti Kebangsaan Malaysia, Sabah Campus, and for the generous cooperation of Mr. C. N. Chong of the Sabah Fish Marketing Authority. Our thanks also go to Mr. Han Kwai Hin for his valuable assistance.

LITERATURE CITED

DUNSON, W. A. 1975. Sea snakes of tropical Queensland between 18° and 20° south latitude. *In* W. A. Dunson (ed.), The biology of sea snakes, pp. 151–162. Univ. Park Press, Baltimore, Maryland.

HAN, S. S. 1988. The reproductive ecology and diet of a sea snake (*Lapemis hardwickii* Gray, 1835) from west coast of Sabah. Unpubl. M.Sc. Thesis. Faculty of Science and Natural Resources, Universiti Kebangsaan Malaysia, Sabah Campus. 102 pp.

LIM, B. L. 1979. Poisonous snakes of peninsular Malaysia. Art Printing Works, Kuala Lumpur, Malaysia. 61 pp.

MINTON, S. A. 1975. Geographic distributions of sea snakes. *In* W. A. Dunson (ed.), The biology of sea snakes, pp. 21–31. Univ. Park Press, Baltimore, Maryland.

SIMPSON, E. H. 1949. Measurement of diversity. Nature 163:688.

TU, A. T. 1974. Sea snake investigation in the Gulf of Thailand. J. Herpetol. 8(3):201–210.

VORIS, H. K. 1964. Notes on the sea snakes of Sabah. Sabah Soc. J. (Kota Kinabalu) 2:138–141.

Accepted: 19 April 1989.

Journal of Herpetology, Vol. 24, No. 2, pp. 202–204, 1990

Non-Visual Detection of Prey Patches by the Smooth Newt (*Triturus vulgaris*)

ESA RANTA, JOHN MCMANUS, AND NIKO LEIKOLA, *Integrative Ecology Unit, Department of Zoology, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki, Finland.*

The smooth newt (*Triturus vulgaris*) is a temporary occupant of small pools and ponds in temperate areas (Steward, 1969). It enters the pools in spring to breed and feed, and leaves them in late summer. Its diet consists of a wide variety of prey taxa available in these habitats (Avery, 1968; Pellantova, 1973; Dolmen and Koksvik, 1983; Griffiths, 1986). Some prey types are more easily detected than others by a foraging newt. Freely swimming prey are visible, while bottom dwelling prey hide among the detritus and sediment. Different methods of locomotion, viz., swimming vs. crawling, are used when searching for these two major prey types. It is also possible that the newt utilizes different methods to locate profitable places while hunting for the two prey types.

During the past few years our research theme has been the foraging behavior of the smooth newt (Ranta and Nuutinen, 1985; Nuutinen and Ranta, 1986; Ranta et al., 1986, 1987). We have been interested in how the smooth newt locates prey patches and its behavior once it has encountered prey of different values. These are the target questions of the theory of optimal foraging (Stephens and Krebs, 1986). In particular, how does the smooth newt discriminate whether a specific spot is worth a more detailed search?