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Influence of Availability on the Feeding Habits of the Common Garter Snake, *Thamnophis s. sirtalis*[1]

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The common garter snake, *Thamnophis s. sirtalis*, is generally known as a terrestrial animal. Our particular interest in predators of fishes has, however, led us to study this reptile in relation to the aquatic habitat. We were stimulated in this by the several specimens encountered around fish rearing establishments. At such stations, large numbers of young fish, mostly trout from advanced fry to fingerling stages, are confined in portions of natural streams or in adjacent, associated waters. Repeated observations showed that this garter snake rivals the watersnake (*Natrix s. sipedon*) as a successful fish predator under these circumstances (Lagler and Salyer, 1945). This led us in turn to the study of the garter snake in relation to fish populations in natural waters.

Our materials from Michigan have been accumulating since 1930 and at present represent eighteen fish cultural establishments and thirty-one locations on the immediate shores or banks of natural lakes, ponds, and streams away from hatcheries or rearing stations. In all, 238 specimens collected during daylight hours were examined; of these eighty-seven contained no food. A random sample, 109 of the 151 individuals with

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[1] Contribution from the Department of Zoology of the University of Michigan and from the Institute for Fisheries Research of the Michigan Department of Conservation.

food averaged 644 mm. (25.4 inches) in length and ranged from 9.25 to 34.25 inches. Methods used for food analysis are the precise qualitative and quantitative ones described earlier by us (Salyer and Lagler, 1940).

Several of our colleagues and employees of the Conservation Department contributed specimens for study. Financial help was given by the Associated Fishing Tackle Manufacturers and by the American Wildlife Institute. To these individuals and agencies and the others who have assisted us, we are very grateful.

Garter snakes collected about natural waters during summer months contain mostly terrestrial earthworms, frogs, and toads in decreasing order of probably importance; fish occur only sparingly (Table 1). Of the thirty-five specimens from this habitat, only three contained fish (one also held a leech). The feeding habit in such situations, then, is predominantly related to principal animals of the marginal association, not with fishes. The earthworms utilized are terrestrial ones and without exception the frogs and toads are of adult body form; this substantiates common knowledge of the land proclivities of this snake. In contrast to this, common watersnakes from trout streams eat more than eighty percent fish and somewhat less than twenty percent amphibians, whereas about lakes they consume about fifty percent of each of these items (*op. cit.*).

Annotated list of food items for Table 1. FISHES: 1 trout unidentified to species; 3 brook trout (*Salvelinus f. fontinalis*, 40, 43, and 65 mm. long (average, 4.3 in.); 1 blacknose shiner (*Notropis h. heterolepis*); remains of 1 unidentified kind. FROGS: 9 *Rana* sp.; 1 pickerel frog (*R. palustris*); 1 wood frog (*R. sylvatica* = *cantabrigensis*); and 1 leopard frog (*R. pipiens*). All frogs were of adult body form. TOADS: 33 *Bufo americanus* of which 2 were adults and 31 in one snake were just transformed or transforming.

SALAMANDERS: remains of 1 unidentified individual. INSECTS: 1 grasshopper; 1 moth larva; 3 carabid and 1 scarab beetle; trace of 1 unidentified. EARTHWORMS: 50 land earthworms, Lumbricidae. LEECHES: 1 individual. SNAILS: remains of 1. VEGETABLE DEBRIS: Three snakes each contained a small amount (0.1 cc. or less) of plant material but this was apparently not taken as food.

At fish rearing stations striking differences appear in stomach contents of the garter snake (Table 2). The chief foods, in decreasing order of probable importance, are: fish, frogs and toads, and earthworms. A very real response in food habits may be seen here in the shift from the natural to the artificial surroundings. Watersnakes respond similarly for at such establishments more than ninety-five percent of their food is composed of fish (op. cit.). Also shown is the versatility of the feeding habit of the garter snake in that it is largely terrestrial around wild waters and significantly aquatic with the increased availability of fish at rearing stations. This is concrete evidence of certain principles of food getting and population dynamics: (1) availability is a factor in determining food habits; (2) unusual concentrations of prey organisms invite reduction of their numbers at a temporarily increased rate even if departure from usual habit or other response on the part of the predator is involved.

Annotated list of food items for Table 2. TROUT: 74 brook trout (Salvelinus f. fontinalis); 18 rainbow trout (Salmo gairdnerii irideus); 23 trout unidentified to species. Total lengths were obtained by measurement or estimated by comparison of remains with whole specimens to give an average for 108 trout of 1.84 inches, ranging from 1.13 to 3.00 inches. OTHER FISHES: 2 cyprinids; 1 tadpole madtom (Schilbeodes mollis), 3.25 inches long; and 1 mudminnow (Umbra limi). FISH REMAINS: Parts of 4 unidentified fishes. FROGS AND TOADS: 8 pickerel frogs (Rana palustris); 4 leopard frogs (R. pipiens); 2 wood frogs (R. sylvatica); 1 green frog

(R. clamitans); 1 bullfrog (R. catesbeiana); 1 hylid frog; 9 unidentified frogs (Rana spp.); 250 frog eggs in one snake; remains of 1 individual identifiable only as frog or toad; 24 toads (Bufo americanus). SALAMANDERS: Remains of 2 unidentified individuals. BIRDS: 2 unidentified in one snake. MAMMALS: 2 shrews (Soricidae); 1 meadow mouse (Microtus p. pennsylvanicus); 1 unidentified insectivore. INSECTS: remains of 14 unidentified land beetles of which 6 were larvae; 4 Rhyncophora, 1 elaterid; 2 carabids; 1 cerambycid; 1 damselfly; 3 ants (Formicidae); 2 mayflies; 1 moth larva; 1 dipteran; 1 grasshopper; 1 cicadellid; 2 aquatic nymphs; miscellaneous unidentified remains of 5 individuals. EARTHWORMS: 50 terrestrial lumbricids. SNAILS: remains of 2. CARRION: Fleshy animal remains otherwise unidentifiable.

Because of the versatility of the feeding habits of the garter snake, implications for fish management are that it be locally controlled at fish rearing stations but that it be unmolested about natural waters. Indications are that a fish culturist may record one dead fingerling trout for each garter snake collected at a rearing station. The number is more than double this for the common watersnake (op. cit.). In spite of the importance of frogs in the food of this snake, it seems improbable that the species is sufficiently numerous to affect frog production or yield where these figure in a fishery.

We have too few observations on the feeding habits of this snake to postulate the origin or evolution of this habit or to compare it with the watersnakes in this regard. We believe that it is significant, however, that when an attempt is made to capture a common garter snake in the vicinity of a stream, apparently it will take to water in its efforts to escape only when all avenues by land are blocked. Preference seems to be for terrestrial escapement if this is at all possible. Ribbon snakes (Thamnophis sauritus) are not so firmly entrenched in this habit since

they take readily to water for escape. Moreover, they have often been found in low alders and other verdure overhanging streams.

Reference Cited

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TABLE 1. FOOD OF COMMON GARTER SNAKES

FROM ABOUT NATURAL WATERS

Based on thirty-five specimens
containing 71.1 cc. of food.

Food Item	Percentage of Total Volume of Food	Number of Individuals of Each Food Item	Percentage Frequency of Occurrence
Fishes	6.2	6	11.4
Frogs	23.9	12	34.3
Toads	30.8	33	8.6
Salamanders	0.7	1	2.9
Insects	0.8	7	14.3
Earthworms	35.3	50	45.7
Leeches	2.3	1	2.9
Snails	Trace	1	2.9

TABLE 2. FOOD OF THE COMMON GARTER SNAKE

ABOUT FISH REARING STATIONS

Food Item	Percentage of Total Volume of Food[+]	Number of Individuals of Each Food Item[+]	Percentage Frequency of Occurrence[++]
Trout	40.3	115	37.9
Other fishes	2.6	4	3.4
Fish Remains	0.9	4	4.3
Frogs and toads	40.5	51[+++]	25.0
Salamanders	0.6	2	1.7
Birds	[++++]	2	0.9
Mammals	2.4	4	3.4
Insects	1.3	39	18.1
Earthworms	11.3	50	34.4
Snails	Trace	2	0.9
Crayfish	---	---	
Carrion	0.1	---	2.6

[+] Based on one hundred snakes containing 345.5 cc. of food.

[++] Based on 116 snakes including the ones used for the first two columns in this table and sixteen others which were too poorly preserved for volumetric or numerical assay.

[+++] Does not include as individuals 250 frog eggs found in one snake.

[++++] Volume records and specimens lost.