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Prey Selection by the Rough Skinned Newt (*Taricha granulosa*) in Two Pond Types

Abstract

The stomach content analyses of the rough skinned newt, *Taricha granulosa,* from a permanent pond indicate a higher degree of prey diversity than found in a sample taken from a temporary pond. There is a highly significant correlation between snout-vent length (SVL) and head width within samples. There are also significant differences in SVL and head width between samples.

Introduction

The prediction of feeding strategies which might be exhibited by groups of organisms is an active area of interest in population biology. A particular aspect of interest is whether a particular predator may be considered a food generalist or a food specialist, and what environmental or behavioral factors influence this choice of feeding activity (Emlen, 1973). Intuitively one might expect that the prey utilized by a predator would directly reflect the abundance and diversity of prey available. However, most modelers predict that when a predator has an abundant amount of prey available, there will be a tendency towards specialization, and that when resources are limiting, the predators will become generalists in their food selection (Emlen, 1966; Schoener, 1971; Pulliam, 1974). These authors also suggest that when a predator is confronted with a heterogenous environment the generalist will be favored. An essential point concerning these predictions and models is that they are useful if they lend themselves to field or *in vivo* verification (Menge, 1972).

Emlen (1973) has succinctly outlined how specialization might be adopted by a predator. If a wide variety of prey is made available to an animal, the more abundant (here I am equating abundance with ease of capture) will be captured. Presumably, because this prey is eaten more often, the predator will become more efficient in its capture and ingestion. This specialization for a particular prey type would then be maintained as long as the prey was abundant. When the density of prey is reduced the predators will switch to a generalist type of strategy. Menge (1972) was able to verify several of these predictions in his work with the starfish *Leptasterias hexactis.*

The mechanism for this switch has been debated by several authors. Emlen (1973) believed that the predator will initiate selection of an alternate prey when those prey begin to outnumber the preferred prey. Pulliam (1974) believed that the switch is independent of the alternate prey density, and that it is purely a function of the availability of the preferred prey. Schoener (1971) has suggested that the presence or absence of hunger may be the cue for a switch towards generality. In consideration of these ideas we can ask if a predator considered to be a generalist would in fact select a specialist type of feeding strategy under the proper conditions. If one did find differing strategies being utilized by a particular organism, would there also be a corresponding shift in body size, as suggested by Schoener (1969), who felt that if prey were abundant a large predator would be favored and conversely, if prey were limiting, would the smaller size be favored?

In this study I have investigated intraspecific variation in feeding strategies in natural populations by comparing the prey selection used by the rough skinned newt, *Taricha granulosa.* This species is considered, as are other newts, to be a generalist type of carnivore feeding on virtually all soft prey with which it comes in contact and which will fit into its mouth (Pimentel, 1952; Porter, 1973; Beatty *et al,* 1976). The adult newt has an annual terrestrial phase and an aquatic phase with the latter being spent in either permanent ponds, temporary ponds, or slow-moving streams. These animals return to the same pond (or stream) each year (Twitty, 1966), which would suggest that these organisms should exhibit a feeding behavior or strategy which exemplifies the selective pressures associated with the prey availability of their respective ponds.

Permanent ponds are usually characterized as being relatively stable, having a high species diversity, and having low faunal density levels. In contrast, the temporary ponds should be less stable, exhibit less species diversity, and have high faunal density levels. This latter aspect reflects the high biotic potential often associated with temporary ponds (Welch, 1952).

In this study I have asked the following questions. Do populations of *T. granulosa* exhibit interpopulational differences in feeding strategies—eutropy versus stenotropy? If different strategies can be shown, do they reflect the nature of the pond—the presence or absence of high prey diversity?If there are differing strategies, are there any corresponding morphological differences, *e.g.,* snout-vent length (SVL) or head width, exhibited by these animals?

Methods and Materials

Ponds: Two ponds were sampled near Corvallis, Oregon during February 1975. The permanent pond was part of a series of abandoned fish ponds over 20 years old located approximately 13 km north of Corvallis. The temporary pond, which was dry during the summer months, was a quarry seep located approximately 25 km southwest of Corvallis. The permanent pond was approximately 15x50 m with a depth of 1.5 m whereas the temporary pond was 15 m in diameter with a depth of 0.5 m.

Samples: Fifty adults were taken from each pond and immediately fixed in FAA to preserve the stomach contents.

Data: For each specimen sex was determined, and SVL and head width were measured. The stomachs were removed and their contents identified down to the major groups; *i.e.,* sub-class for crustaceans, order for insects, and class for the other phyla. The numbers of each prey type were recorded.

Statistical Analysis: The Shannon-Wiener index from information theory was used to calculate diversity (H′) where $H' = -\sum_{1}^{s} p_i \ln p_i$. S is the number taxa or species types and p_i is the proportion of the total number of individuals belonging to the ith species. Pielou's J′ was used to standardize the diversity values where $J' = H'/H_{max}$ and

$H_{max} = \ln S$. Comparisons were made between samples with respect to the means of their SVL and head widths. Correlation coefficients for SVL and head widths within each sample were computed.

Results

Data from the stomach contents are presented in Table 1. Two significant points are that initially a greater number of both prey types and prey numbers were found in the temporary pond's sample; secondly, the greatest differences between the samples appear to be the number of Ostracoda and amphibian eggs. However, these data do not reflect the relative diversity values for the samples.

Table 2 presents both the results of the diversity analyses and the statistical comparisons between samples. The permanent pond sample clearly has a more diverse prey fauna, as indicated by its evenness value $J' = 0.597$, than the temporary pond sample with $J' = 0.371$. A highly significant ($p < 0.01$) positive correlation was found between SVL's and head widths. Significant differences were also found between the SVL's of the different pond samples ($p < 0.05$) and between the head widths ($p < 0.01$).

TABLE 1. Stomach contents of newts taken from a permanent pond and a temporary pond. Number of newts sampled from each pond = 50.

Prey*	Permanent No. prey items	Permanent % of all prey	Temporary No. prey items	Temporary % of all prey
Ostracoda	160	59.5	1821	69.1
Diptera (L)	25	9.3	5	0.2
Amphibian eggs	15	5.6	479	18.2
Nematoda	12	4.5	12	0.5
Gastropoda	12	4.5	67	2.5
Oligochaeta	7	2.6	3	0.1
Ephemoptera (L)	6	2.2	—	—
Arachnida	4	1.5	—	—
Coleoptera (L)	4	1.5	3	0.1
Diptera	4	1.5	3	0.1
Trichoptera (L)	3	1.1	81	3.1
Hymenoptera	3	1.1	1	0.0
Collembola	—	—	61	2.3
Copepoda	—	—	53	2.0
Branchiopoda	—	—	22	0.8
Hirudinea	—	—	8	0.3
Isopoda	1	0.4	1	0.0
Coleoptera	1	0.4	7	0.3
Odonata	—	—	2	0.1
Lepidoptera (L)	—	—	1	0.0
Unidentified	12	4.5	6	0.2
Total	269		2636	
No. of prey types (S)	15		19	
No. of empty stomachs	5		0	

* (L) denotes larvae

TABLE 2. Diversity measurements and selected morphological measurements for newts taken from a permanent pond and a temporary pond. See text for discussion of diversity values. Data are expressed in millimeters as mean ± standard deviation. Number of animals sampled from each pond = 50.

Statistic	Permanent	Temporary	t
Diversity			
H′	1.616	1.093	
H-max	2.708	2.944	
J′	0.597	0.371	
Morphology			
SVL	68.67±3.71	70.69±4.37	2.49*
Head width	15.80±0.91	16.60±1.29	3.58**
r	.582**	.683**	

* $p<0.05$
** $p<0.01$

Discussion

The results reveal that the two populations of *T. granulosa* have utilized different diversities of prey. However, they do not allow me to state that the temporary pond dwellers were in fact specializing since their prey selection may only reflect the diversity of prey available—and this parameter was not measured. A generalist will select items in proportion to their encounter rate, but the specialist will pick and choose with each new encounter. I would speculate that the newts do in fact eat virtually any potential prey item with which they come in contact. However, they may be specialized in their ability to locate areas of high prey density. Neish (1970) has shown that *T. granulosa* is very efficient in using scent to locate high concentrations of prey. This factor could account for the large numbers of ostracods and amphibian eggs found in the temporary pond sample.

One very significant aspect of the results is the differences in body size and head widths found between the two samples. The increased body sizes and correlated head widths found in the temporary ponds may be a reflection of the large concentrations of prey available in these ponds. Schoener (1969) has suggested that with an abundant amount of prey available to a predator, selection should favor a larger sized predator. The results I have presented may very well give credence to this hypothesis. The next logical step would obviously be to initiate a systematic comparison of newt populations inhabiting permanent and temporary ponds. One would then have to determine if there existed any correlations between pond type and body size. In order to conduct this study properly, the direct comparisons between pond types must be restricted geographically since there may be either clinal or geographical phenotypic variations in the body sizes which are independent of pond types and which would subsequently bias any observations.

In summary I have shown that there was a difference in the diversity of utilized prey between samples taken from a permanent pond and those taken from a temporary pond. I have not demonstrated that there was a true difference in feeding strategies. Finally, I believe that the differences in body size may be a reflection of the relative abundance of prey in the respective ponds.

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