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Foods and Feeding of the Redfin Shiner (Notropis umbratilis) in Coles County, Illinois

Karen Denise High

Eastern Illinois University

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Date

Author
Foods and Feeding of the Redfin Shiner (Notropis umbretilis) in Coles County, Illinois

(TITLE)

BY

Karen Denise High

THESIS

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1982

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING THIS PART OF THE GRADUATE DEGREE CITED ABOVE

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ADVISER

22 Nov 1982

DATE

COMMITTEE MEMBER

3 Dec 1982

DATE

COMMITTEE MEMBER

3 Dec 1982

DATE

DEPARTMENT CHAIRPERSON
Abstract

Foods and diel feeding activities of the redfin shiner, *Notropis umbratilis*, were studied in Coles County, Illinois in September, 1981, and monthly from April through September, 1982. A total of 200 stomachs with food were examined. Diptera adults and larvae were the most frequently occurring food item (83%), and also occurred in the highest volume (49%). Coleoptera were the second most frequently occurring item (23%), and accounted for the second largest volume (11%). Larger fish consumed a wider variety of food items. Changes in foods with season were also noted.

Feeding activity on the 24-25 July was greatest in the evening (1930-2330 hrs.) and shortly after sunrise (0530 hrs.). Ephemeroptera, Coleoptera, and Hymenoptera were important items in the diet in the late afternoon. Diptera were the dominant order after dark and again at dawn.

The redfin shiner was found to be an opportunistic feeder, utilizing those foods that are most abundant and easily obtained.
Acknowledgments

I would like to thank all of the people that helped me with the field work on this project, especially my good friend Jerry Thomas. I also want to thank my mother, Ms. Elnora McCarthy for all of her support throughout my college career.
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**Introduction**

*Notropis umbratilis*, the redfin shiner, is a common cyprinid ranging throughout the east and central United States and Canada. Two distinctive subspecies are recognized in the Mississippi Valley; the subspecies occurring in Illinois is *N. u. cyanoecephalus* (Snelson and Pflieger, 1975). The redfin shiner in Illinois is statewide in distribution and extremely abundant in eastern and southern counties (Smith, 1979). It inhabits backwaters of large rivers, and pools in clear, low gradient creeks, but is tolerant of a considerable amount of turbidity and silt.

Hunter and Wisby (1961) described the reproductive behavior of this species, notably the utilization of the nests of green sunfish (*Lepomis cyanellus*) for spawning, but very little is known of its feeding habits. Forbes (1878), in his notes on the foods of Illinois fishes, listed Diptera as the food of the redfin shiner, although only a single specimen was examined. In a later study Forbes (1890) listed the foods of the genus *Notropis*, which may have included the redfin shiner, as aquatic and terrestrial insects, Entomostraca, "worms", protozoa, and plants.

This paper describes the spring, summer, and fall food habits of the redfin shiner, as well as the diel changes that occur in the feeding activity.

**Study Area**

Two sampling areas were selected based on their abundance of redfin shiners, and their accessibility to seining. Most samples were taken from Polecat Creek, a high quality stream with dissolved oxygen readings commonly at 100% saturation (Durham and Whitley, 1971).
It begins as an intermittent stream south of Kansas, Illinois and flows west through agricultural areas, receiving runoff from the surrounding land. One small stream, Dudley Branch, also feeds the creek during low water conditions. Polecat Creek empties into the Embarras River south of Charleston, Illinois. The average width is 6 meters, with the average depth less than 1 meter during low water. The gradient is moderate, with a drop of approximately 3.78 m/km. The substrate consists of bedrock, sand, and silt in the pools with gravel, rubble, and boulders on the riffles. Sandstone and shale outcrops are common. Redfin shiners were collected at two stations on the creek where county roads 2080E (Sec. 9, T12N, R10E) and 2150E (Sec. 10, T12N, R10E) cross the creek.

The second area sampled was on the Embarras River south of Charleston known locally as Walkers Ford (Sec. 3, T11N, R10E). This area was utilized due to the absence of redfin shiners in Polecat Creek in the early spring. The water quality of the Embarras River is also very good, with dissolved oxygen readings at or near 100% saturation (Durham and Whitley, 1971). It is a moderate sized river, average width 16 meters, and average depth 1.5 meters below the Charleston Dam. The substrate consists of sand and mud in the pools and backwater areas, and sand and gravel in the main channel. Within the county it flows through agricultural land with scattered timbered areas, and receives runoff from 11 streams, as well as from surface drainage.

**Methods**

Specimens were collected from Polecat Creek in September, 1981 and monthly from June to September, 1982. Samples were taken from the Embarras River in April and May, 1982. No collections were taken from
October to March due to adverse weather conditions. Diel feeding activity was determined by collections taken from Polecat Creek at intervals of 4 hours on the 24–25 July, 1982. A 10 ft., 1/4" mesh, nylon seine was used for all collections. In order to prevent regurgitation all fish were killed in a jar filled with ice, and then preserved in 10% formalin.

The standard length of each fish was later recorded to the nearest mm. The entire digestive tract was removed, and its contents were examined using a 7–30X binocular microscope. Counts of each food item were made on all stomachs with food. Percent fullness of each stomach was estimated visually by comparing the volume of the stomach with the total volume of food. The percent each item was to the total food bolus was also estimated. The percent frequency of occurrence for each item was calculated by dividing the number of fish with any given item by the total number of fish with food. A total of 200 stomachs with food were examined, with a probable error in the estimation of the volume of various food items of approximately 10%.

Visual estimates of the volume of different food items were made by the "points" method (Hynes, 1950) which assigns numbers (1, 2, 4, 7) to items in the digestive tract based on their relative volume. The degree of fullness of the tract is also ranked on a point scale of 0 (empty) to 10 (full). By taking the total number of points for each item and dividing by the total number of points available for the sample, a percentage for each item is obtained.

Results

*Notropis umbratilis* primarily ate Diptera adults and larvae, small Coleoptera, and Hymenoptera (Table 1). Generally Diptera adults,
represented mainly by the family Chironomidae, were present in small volumes, but in May there was a noticeable increase in the volume of Diptera adults, and a decrease in all other food items. Chironomidae made up the majority of the Diptera larvae with the highest volume being in April. In May, June, and July they were the dominant family of larvae, but in August and September Simuliidae were the dominant forms. Culicidae adults were also occasionally present in small numbers.

Coleoptera adults and larvae were present every month although in fewer numbers in May. Elmidae, Dytiscidae, Hydrophilidae, and Halipplidae were among the families that could be identified. Other aquatic insects occurred sporadically and in small volumes. These included Ephemeroptera nymphs, Odonata nymphs, Hemiptera adults, Neuroptera, and Megaloptera larvae. Trichoptera larvae, of the family Hydropsychidae, were one of the major food items in June.

Hymenoptera adults generally occurred in small volumes, but in August they were a major food item. Included here were ants (family Formicidae) and tiny wasps of the families Bulophidae and Braconidae. Fish scales and mucous occurred as a major item in the stomachs in July. These were determined by comparison to be redfin shiner scales and probably occurred as a result of the aggressive behavior of the breeding fish. Miscellaneous foods occurring infrequently in small volumes included cladocerans, copepods, tubificids, lepidopterans, and filamentous algae.

Analysis of the total food data indicate that both qualitative and quantitative differences existed among the length classes (Table 2). Quantitatively, the diet of the smaller fish (less than 45 mm) was dominated by Diptera adults and larvae (80% total volume), and Trichoptera larvae (10% total volume). In contrast, the diet of the larger
group (greater than 45 mm) contained many adult Coleoptera, Hymenoptera, Hemiptera, and Arachnida. Consumption of Diptera larvae decreased considerably.

Qualitatively, the diet of the larger fish was found to be more diverse than that of the smaller group. Some 18 different food categories were utilized by the larger fish whereas only 12 were consumed by the small fish.

**Diel Feeding Activity:** Stomachs examined from collections taken on the 24-25 July, 1982 reveal a marked periodicity in feeding activity, as well as in the items preyed upon. The peak activity periods were in the late evening and again at sunrise. The sample taken at 1930 hrs. contained freshly eaten food items, and 8 of 11 stomachs were greater than 70% full. Coleoptera, Ephemeroptera, Hymenoptera, and Diptera were the dominant groups at this time (Table 3).

The sample taken near midnight (2330 hrs.) contained 10 of 12 stomachs greater than 60% full. Diptera adults and larvae increased in importance, reaching a peak of 70% of the total volume. Two early morning samples were collected, one at 0430 hrs. (pre-dawn) and the other at 0530 hrs. (post-dawn). The pre-dawn sample contained 17 fish, 5 were 20 to 40% full, 5 were less than 15% full, and the remaining 7 were empty. The food items in these stomachs were very decomposed, and contained essentially the same items as the night sample. On the contrary, the post-dawn sample of 16 fish included 4 that were greater than 60% full, 5 between 25 and 40% full, and 7 less than 20% full. These food items were a mixture of freshly eaten insects in the esophagus, and very decomposed items in the rectal area. Diptera and Hymenoptera made up the majority of the volume.

The sample collected at 1130 hrs. consisted exclusively of very
decomposed foods, a high percentage of which was unidentifiable. Diptera and Lepidoptera were the major orders. Likewise, the afternoon sample contained very decomposed items, but the major food groups were different. A high percentage of this sample consisted of redfin shiner scales, with Coleoptera, Trichoptera, and Diptera being the dominant foods. At this time the breeding fish were observed in large schools over the nests of sunfish, *Lepomis* spp., and they remained in these same locations until after dark, at which time they were dispersed throughout the stream. At dawn they again began congregating over the sunfish nests.

**Discussion**

Examination of the data from Table 1 indicates that the redfin shiner is an opportunistic feeder, utilizing foods that are most abundant and easily obtained. The change from Diptera larvae in April to Diptera adults in May probably reflects the emergence of large numbers of the latter. Likewise, the utilization of terrestrial animals such as Hemiptera, Lepidoptera, Homoptera, and Arachnida support this assumption.

The utilization of large volumes of Coleoptera, as opposed to Ephemeroptera or Trichoptera is probably due to the fact that they occur more frequently in the pools and backwaters that this fish inhabits (Merritt and Cummins, 1978). Another possible explanation could be that the softer bodied insects are digested faster and thus the volumes were underestimated.

The difference observed between the food items of the larger fish and of the smaller fish is a common phenomenon reported for many fishes (Hynes, 1970). The larger fish, in most species, are better able to assimilate larger, and in many cases harder food items.

Many other factors come into play when a food habit analysis
is undertaken. The location from which the sample is taken may affect the prey composition (Cailliet, 1976). In this study the April and May samples were collected from the Embarras River, whereas the remainder were collected from Polecot Creek. A higher volume of Diptera adults and larvae were also found in the April and May samples. This then may be attributed to the change in availability of food between the two locations.

Temporal differences also affect the items preyed upon. White and Wallace (1973) found that Trichoptera constituted an important item in the diet of the spotfin shiner (Notropis spiopterus) during the daylight hours. However, the volume of this item decreased sharply after sunset, and Hymenoptera became the dominant item at night. Since the majority of the redfin shiners in this study were collected around noon, the importance of items in the diet at night may have been underestimated. These items include Ephemeroptera nymphs, Diptera, and Coleoptera adults. These data may also indicate a difference in foraging areas. The afternoon and evening samples contained more aquatic insects than the midnight or morning samples. Therefore it is assumed that the fish are foraging at or near the bottom in the late afternoon and evening, as opposed to surface feeding at other times. A possible explanation for this could be the difficulty in surface feeding presented by the late afternoon sun shining under the canopy of the trees and striking the surface of the water. At 1130 hrs., when the sun was directly overhead the water was shaded by the overhanging trees.

The peak activity period may vary from month to month as shown when the July, August, and September samples are compared. The August sample, taken at 1230 hrs. contained 10 stomachs between 75-100% full, with the remaining 5 between 30 and 60% full. On the contrary, the September sample, taken at 1200 hrs. contained 29 of the 35 stomachs less
than 20% full. This more closely resembles the pattern observed in July when the peak activity periods were dawn and dusk. No definite conclusions can be drawn from this though, since only a single sample was collected on these dates.

The investigation of food habits involves many variables. This paper has only touched upon a few of the aspects of the ecology of the redfin shiner. Further studies are needed to better understand the role that this species fills in the complex stream ecosystem.
Table 1. Percent total volume (%TV) and percent frequency of occurrence (%FO) of food items in the stomachs of *Notropis umbratilis* collected from Coles County, Illinois in 1981-1982. A-Adults
L-Larva or nymphs tr-trace (less than 1%).

<table>
<thead>
<tr>
<th>Food Item</th>
<th>April n-25</th>
<th>May n-32</th>
<th>June n-25</th>
<th>July n-81</th>
<th>August n-11</th>
<th>September n-26</th>
<th>Total n-200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%TV</td>
<td>%FO</td>
<td>%TV</td>
<td>%FO</td>
<td>%TV</td>
<td>%FO</td>
<td>%TV</td>
</tr>
<tr>
<td>Unidentified Diptera (A)</td>
<td>13 48</td>
<td>9 44</td>
<td>16 36</td>
<td>18 44</td>
<td>20 73</td>
<td>16 38</td>
<td>16 47</td>
</tr>
<tr>
<td>Chironomidae (A)</td>
<td>5 24</td>
<td>74 78</td>
<td>-- --</td>
<td>10 17</td>
<td>10 27</td>
<td>-- --</td>
<td>17 24</td>
</tr>
<tr>
<td>Chironomidae (L)</td>
<td>46 80</td>
<td>4 50</td>
<td>12 76</td>
<td>4 14</td>
<td>1 18</td>
<td>3 19</td>
<td>25 43</td>
</tr>
<tr>
<td>Simuliidae (L)</td>
<td>4 20</td>
<td>-- --</td>
<td>tr 4</td>
<td>tr 4</td>
<td>4 9</td>
<td>10 35</td>
<td>3 12</td>
</tr>
<tr>
<td>Chaoboridae (L)</td>
<td>-- --</td>
<td>tr 3</td>
<td>-- --</td>
<td>-- --</td>
<td>-- --</td>
<td>3 8</td>
<td>tr 2</td>
</tr>
<tr>
<td>Culicidae (A)</td>
<td>-- --</td>
<td>-- --</td>
<td>tr 4</td>
<td>1 2</td>
<td>6 27</td>
<td>-- --</td>
<td>1 5</td>
</tr>
<tr>
<td>Coleoptera (A%L)</td>
<td>12 8</td>
<td>2 6</td>
<td>23 52</td>
<td>13 25</td>
<td>10 36</td>
<td>7 8</td>
<td>11 23</td>
</tr>
<tr>
<td>Hymenoptera (A)</td>
<td>4 16</td>
<td>3 13</td>
<td>3 12</td>
<td>9 28</td>
<td>20 73</td>
<td>7 15</td>
<td>8 26</td>
</tr>
<tr>
<td>Trichoptera (L)</td>
<td>-- --</td>
<td>-- --</td>
<td>11 36</td>
<td>3 6</td>
<td>7 27</td>
<td>-- --</td>
<td>4 12</td>
</tr>
<tr>
<td>Ephemeroptera (L)</td>
<td>-- --</td>
<td>tr 3</td>
<td>2 24</td>
<td>5 7</td>
<td>-- --</td>
<td>-- --</td>
<td>1 6</td>
</tr>
<tr>
<td>Unidentified Insects</td>
<td>5 24</td>
<td>4 16</td>
<td>20 44</td>
<td>23 59</td>
<td>15 45</td>
<td>44 49</td>
<td>18 40</td>
</tr>
<tr>
<td>Arachnida</td>
<td>2 4</td>
<td>-- --</td>
<td>5 12</td>
<td>tr 1</td>
<td>4 27</td>
<td>3 4</td>
<td>3 8</td>
</tr>
<tr>
<td>Miscellaneous Foods</td>
<td>3 32</td>
<td>3 7</td>
<td>3 5</td>
<td>6 5</td>
<td>-- --</td>
<td>-- --</td>
<td>1 8</td>
</tr>
<tr>
<td>Redfin shiner scales</td>
<td>-- --</td>
<td>-- --</td>
<td>-- --</td>
<td>10 17</td>
<td>-- --</td>
<td>-- --</td>
<td>2 3</td>
</tr>
<tr>
<td>Algae</td>
<td>-- --</td>
<td>tr 3</td>
<td>3 16</td>
<td>tr 1</td>
<td>tr 9</td>
<td>-- --</td>
<td>tr 5</td>
</tr>
</tbody>
</table>
Table 2. The percent total volume of food items eaten by two size classes of *Notropis umbratilis* in Coles County, Illinois during 1981-1982. A-Adult  L-Larva or nymph  tr-trace (less than 1%).

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Length mm</th>
<th>23-44 mm</th>
<th>n=41</th>
<th>45-80 mm</th>
<th>n=159</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diptera (A)</td>
<td></td>
<td>38</td>
<td></td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Diptera (L)</td>
<td></td>
<td>42</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Coleoptera (A)</td>
<td></td>
<td>tr</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Coleoptera (L)</td>
<td></td>
<td>--</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hymenoptera (A)</td>
<td></td>
<td>1</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Trichoptera (L)</td>
<td></td>
<td>10</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ephemeroptera (L)</td>
<td></td>
<td>tr</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hemiptera (A)</td>
<td></td>
<td>tr</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Homoptera (A)</td>
<td></td>
<td>2</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Lepidoptera (L)</td>
<td></td>
<td>--</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Odonata (L)</td>
<td></td>
<td>--</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Megaloptera (L)</td>
<td></td>
<td>--</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Neuroptera (L)</td>
<td></td>
<td>--</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Collembola (A)</td>
<td></td>
<td>tr</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Araneida (A)</td>
<td></td>
<td>--</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Crustacea</td>
<td></td>
<td>tr</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Oligochaeta</td>
<td></td>
<td>tr</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Chilopoda</td>
<td></td>
<td>--</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Algae</td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Redfin shiner scales</td>
<td></td>
<td>--</td>
<td></td>
<td>tr</td>
<td></td>
</tr>
<tr>
<td>Unidentified Insects</td>
<td></td>
<td>4</td>
<td></td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Diel changes in the percent total volume, and percent fullness of the stomachs of Notropis umbratilis collected from Polecat Creek on 24-25 July, 1982 in Coles County, Illinois.

A-Adult  L-Larva or Nymph  tr-trace (less than 1%).

<table>
<thead>
<tr>
<th>Time (Hrs.)</th>
<th>1930</th>
<th>2330</th>
<th>0430</th>
<th>0530</th>
<th>1130</th>
<th>1530</th>
</tr>
</thead>
<tbody>
<tr>
<td>n-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Average Percent Fullness
  - 68
  - 68
  - 12
  - 30
  - 21
  - 51

- Range of Percent Fullness
  - 0-100
  - 40-100
  - 0-40
  - 0-90
  - 0-75
  - 10-90

- Number of Empty Stomachs
  - 1
  - 0
  - 7
  - 2
  - 1
  - 0

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Percent Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diptera (A)</td>
<td>14 39 32 9</td>
</tr>
<tr>
<td>Diptera (L)</td>
<td>tr 11 2 1</td>
</tr>
<tr>
<td>Coleoptera (A&amp;L)</td>
<td>18 20 20 6 8 6</td>
</tr>
<tr>
<td>Hymenoptera (A)</td>
<td>17 23 12 tr 4</td>
</tr>
<tr>
<td>Lepidoptera (L)</td>
<td>5 19 -- --</td>
</tr>
<tr>
<td>Ephemeroptera (L)</td>
<td>18 -- -- -- 3</td>
</tr>
<tr>
<td>Trichoptera (L)</td>
<td>6 -- -- -- 5</td>
</tr>
<tr>
<td>Redfin shiner scales</td>
<td>-- -- -- 2 37</td>
</tr>
<tr>
<td>Unidentified Insects</td>
<td>18 28 37 49 30</td>
</tr>
</tbody>
</table>

- Condition of Sample
  - 1-Fresh
  - 4-Very Decomposed
  - 1 2 4 18 4 4
Literature Cited


