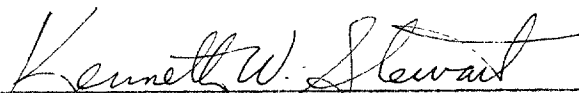

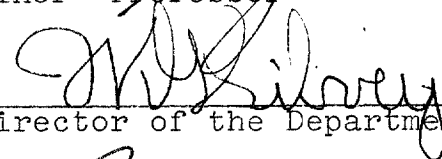


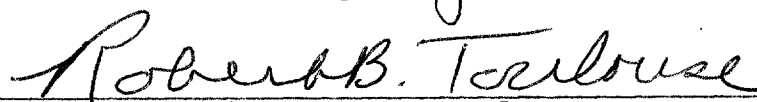
SPRING FOOD HABITS OF CORYDALUS
CORNUTUS L. IN THE BRAZOS RIVER, TEXAS

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The objective of this study was to determine the kinds and numbers of food organisms consumed by Corydalus cornutus, and to investigate its periodicity of feeding during the spring months in the Brazos River, Palo Pinto County, Texas. A total of 468 larvae were collected at two-week intervals from February 29 to May 14, 1971. Larvae were taken at opportunity during three periods of the day, 6am.-12pm., 12pm.-6pm., and 6pm.-12am. A total of 23 different food items was observed in the 121 stomachs containing food. An expedient method of dissection of the digestive tract is included.

All food items were ingested whole. The diet of the hellgrammite was exclusively insectivorous, and it appeared to feed upon most other associated aquatic insects in its environment, with the exception of Odonate naiads, which were known to occur in the study riffle. Trichoptera and Simulium larvae were taken in largest numbers. There appeared to be no expressive difference in periodicity of feeding during the major light periods. C. cornutus is cannibalistic on a very limited basis where an ample supply of food is available.

SPRING FOOD HABITS OF CORYDALUS
CORNUTUS L. IN THE BRAZOS RIVER, TEXAS

THESIS

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

By

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CHAPTER I

INTRODUCTION

Comparatively little information is available on the feeding relationships of the hellgrammite Corydalis cornutus L. in the literature. Davis(1903) stated that C. cornutus fed "on soft bodied caddis worms, Sialis larvae, very young Chauliodes larvae, younger members of their own species; and doubtless have a wide range of food habits." Kramer(1955) fed several Corydalis larvae small slivers of cooked beef in the laboratory, reporting that no chewing action was involved, and observed ingestion to be whole. After dissection of other larvae collected from the Potomac River, several small Trichoptera larvae were found intact in the crop, anterior to the proventriculus.

The objective of this study was to determine the kinds and numbers of food organisms consumed by C. cornutus, and to investigate its periodicity of feeding during the spring months in the Brazos River, Palo Pinto County, Texas.

Description of the Study Area

The study area was located at the conjunction of the Brazos River and Dark Valley Creek at the Highway 4 bridge, approximately twenty miles below the Possum Kingdom Dam in Palo Pinto County, Texas. The dam facility includes

a hydroelectric as well as a flood control function; during periods of peak energy demand and heavy rainfall, the greater discharge from the dam results in depth fluctuations of the river at the sampling area. However, due to low energy demand and low rainfall during the period of this study, there was little fluctuation.

The river itself was confined to a narrow channel approximately eleven meters wide, against the South Canyon wall. The canyon floor supported numerous clumps of Salix sp. and an intermittent covering of grasses. The riffle from which samples were taken was partially shaded by Salix sp. and Ulmus sp. during the day, and the river substrate consisted of gravel and rubble, with numerous boulders present. A United States Geological Survey gauging tower was located adjacent to the study riffle.

CHAPTER II

METHODS

Field Methods

A total of 468 larvae was collected near the U.S.G.S. gauging tower at two-week intervals from February 29 to May 14, 1971. On each date after the initial February sample, larvae were taken at opportunity during three day periods, 6 am.-12pm., 12 pm.-6 pm., and 6 pm.-12 am. Specimens were captured using an 8 X 20-ft., 1/8-inch nylon ace-mesh sein, which was positioned below the area to be sampled. Large rocks and substrate were disturbed in the area immediately upstream. Dislodged larvae drifted into the net, from which they were taken by hand. Specimens were immediately placed in 50 per cent isopropyl alcohol for transfer to the laboratory. Date, time of capture, and water temperature were recorded for each sample.

Laboratory Methods

Head capsule widths were measured to the nearest millimeter by use of rule and calipers. This information was utilized in size class distinction. The complete digestive tract was exposed by dissection of larvae pinned on a 9-cm.-diameter circular paraffin disc. Since preliminary examination of contents of the mesenteron

indicated a lack of recognizable material, only the crop and proventriculus were excised. Hereafter, this section will be referred to as the "stomach". After excision, the pharyngeal area of the remaining head capsule was examined microscopically for any additional organisms or fragments. Midway through the study, a more expedient method of removal of the appropriate section of the digestive tract was found. Only the head capsule was pinned to the paraffin disc, followed by a shallow incision around the cervical area. By grasping the base of the front legs with forceps, and pulling away from the head capsule, that portion of the digestive tract anterior to and including the proventriculus was exposed. Excised stomachs were placed in 50 per cent isopropanol.

Stomachs were subsequently opened in a petri dish of water, and contents sorted, identified, and counted using a dissecting microscope. Each stomach and its contents were retained for possible reference. Identification of organism to family, and in many cases to genus, was verified by the Aquatic Entomology Research Team of North Texas State University.

CHAPTER III

RESULTS AND DISCUSSION

Stomach analysis data are presented in Tables I and II. Of the 468 stomachs examined, 121 (25.85 per cent) contained food items.

The food of the hellgrammite consisted entirely of insects. The only exception to this was the discovery of three small pebbles which were present separately in three different animals. The insects most frequently utilized as food were caddisfly larvae, specifically those of the genera Cheumatopsyche and Hydropsyche, and Simulium larvae (Tables I and II). They occurred in 39.7, 34.7, and 31.4 per cent of 121 fed stomachs, respectively (Table I). In frequency of occurrence of total food organisms these three genera ranked again as the top three ingested, but Simulium larvae ranked first with 25 per cent, and Cheumatopsyche and Hydropsyche followed with 23.9 and 19.0 per cent, respectively (Table II). Simulium larvae also constituted the highest number of any organism found in a single stomach, a total of 20. Chironomidae larvae (12.4 per cent) and Simulium pupae (11.6 per cent) ranked fourth and fifth in per cent frequency of stomachs (Table I), and were found at equal percentages of total food organisms (Table II). Although particular families of mayfly naiads appeared at relatively low frequencies

TABLE 1. Per cent frequency of 121 Corydalus cornutus stomachs containing specific food organisms

| Organisms Eaten | Number of Stomachs | Percentage |
|-----------------------|--------------------|------------|
| Coleoptera | | |
| Elmidae | 2 | 1.7 |
| <u>Stenelmus</u> | | |
| Diptera | | |
| Chironomidae | | |
| larvae | 15 | 12.4 |
| pupae | 1 | .8 |
| <u>Simulium</u> | | |
| larvae | 38 | 31.4 |
| pupae | 14 | 11.6 |
| <u>Tabanus</u> | 1 | .8 |
| Misc. pupae | 1 | .8 |
| Ephemeroptera | | |
| Baetidae | 4 | 3.3 |
| Caenidae | 7 | 5.8 |
| Heptageniidae | 1 | .8 |
| Leptophlebiidae | 7 | 5.8 |
| Misc. | 4 | 3.3 |
| Lepidoptera | | |
| Pyralidae | | |
| <u>Elophila</u> | 3 | 2.5 |
| Megaloptera | | |
| <u>Corydalus</u> | 1 | .8 |
| cornutus | | |
| Plecoptera | | |
| <u>Neoperla</u> | 7 | 5.8 |
| clymene | | |
| Trichoptera | | |
| Hydropsychidae | | |
| <u>Cheumatopsyche</u> | 48 | 39.7 |
| <u>Hydropsyche</u> | 42 | 34.7 |
| Hydroptilidae | | |
| case | 4 | 3.3 |
| pupae | 2 | 1.7 |
| Leptoceridae | 1 | .8 |
| Limnephilidae | 1 | .8 |
| Misc. adult | 2 | 1.7 |
| Misc. pupae | 9 | 7.4 |

(Tables I and II), combined they were found in 14.9 per cent of the stomachs and occurred at a frequency of 7.1 per cent in relation to total organisms.

A presence list of organisms ingested by the hellgrammite is shown in Table II. A total of 368 organisms was removed from the 121 fed stomachs. While this information reflects the availability of food items it does not necessarily demonstrate selectivity, since the proportion of each ingested organism to total food organisms available in the environment was unknown. There was conspicuous absence of both damselfly and dragonfly naiads, known to occur in the study riffle.

In order to gain some indications of the foods utilized by the different size classes of C. cornutus based on head capsule width, the frequency of occurrence of the food items was recorded for each size class. These data are presented in Table III.

From this information it was apparent that there is little evidence of change in food habits with increased size. The 2 mm. size class provided little data, as no food was observed in any of the stomachs of this size group. Only four groups of foods were found in the 3 mm. size class, and these consisted of two genera of Trichoptera larvae, Simulium larvae, and Chironomidae larvae. The 4 mm. size class was identical to the previously mentioned size class with the exception of three minor food items being

TABLE 2. Per cent frequency of 23
dietary items in 121 Corydalis cornutus stomachs

| Organism Eaten | Number | Per cent Frequency |
|-----------------------|--------|--------------------|
| Coleoptera | | |
| Elmidae | | |
| <u>Stenelmus</u> | 2 | .5 |
| Diptera | | |
| Chironomidae | | |
| larvae | 25 | 6.8 |
| pupae | 1 | .3 |
| <u>Simulium</u> | | |
| larvae | 92 | 25.0 |
| pupae | 25 | 6.8 |
| <u>Tabanus</u> | 1 | .3 |
| Misc. pupae | 1 | .3 |
| Ephemeroptera | | |
| Baetidae | 5 | 1.4 |
| Caenidae | 8 | 2.2 |
| Heptageniidae | 1 | .3 |
| Leptophlebiidae | 8 | 2.2 |
| Misc. | 4 | 1.1 |
| Lepidoptera | | |
| Pyrilidae | | |
| <u>Elophila</u> | 4 | 1.1 |
| Megaloptera | | |
| <u>Corydalis</u> | | |
| <u>cornutus</u> | 1 | .3 |
| Plecoptera | | |
| <u>Neoperla</u> | | |
| <u>clymene</u> | 7 | 1.9 |
| Trichoptera | | |
| Hydropsychidae | 158 | 42.9 |
| <u>Cheumatopsyche</u> | 88 | 23.9 |
| <u>Hydropsyche</u> | 70 | 19.0 |
| Hydroptilidae | | |
| case | 8 | 2.2 |
| pupae | 2 | .5 |
| Leptoceridae | 1 | .3 |
| Limnephilidae | 1 | .3 |
| Misc. adult | 3 | .8 |
| Misc. pupae | 10 | 2.7 |

added. The 5 mm. size class showed an increase to twelve food types and ranked fourth in total number of organisms per size class. In comparison with the first four size classes, very little variation in food items was noticed in the 6 mm. size class; however, it was second in regard to total amount of organisms present per size class. A total of fifteen different food types was present in the 7 mm. size class. This group was third in importance of total food items ingested. The insect group with head capsule widths of 8 mm. provided the greatest variety of food types, particularly in diversity of species. Four food items were found exclusively in this size class. These included Chironomidae pupae, Elophila larvae, Hydroptilidae pupae, and a Leptoceridae larva. This size class also exhibited the greatest frequency of organisms present in stomachs. The remaining groups of size classes provided little data. Size class 9 mm. provided a total of eleven stomach items, being similar to the 4 mm. size class. Size class 10 mm. had no food present in any of its stomachs and size class 11 mm. contained only two food organisms. One must also consider that the total number of stomachs examined for these two size classes was very low.

Periodicity of feeding for C. cornutus is indicated in Table IV. No trends in peak feeding periodicity are exhibited when comparison is made of percentages of fed stomachs for the same time periods in different months.

TABLE 3. Frequency of occurrence of major foods of 121 *Corydalis cornutus* size classes

| Size Class | Number of Stomachs Examined | Percentage Containing Food | Coleoptera-Stenelmus | Diptera Chironomidae Larvae | pupae | Stimulium Larvae | pupae | Tabanus | Misc. pupae | Ephemeroptera | Baetidae | Caenidae | Heptageniidae | Leptophlebiidae | Misc. | Lepidoptera-Bliphila | Megaloptera-C. cornutus | Plecoptera-N. clymene | Trichoptera Hydropsychidae Chumatopsyche | Hydropsyche | Hydroptilidae case | pupae | Leptoceridae | Limnephilidae | Misc. adult | Misc. pupae | | |
|------------|-----------------------------|----------------------------|----------------------|-----------------------------------|-------|---------------------|-------|---------|-------------|---------------|----------|----------|---------------|-----------------|-------|----------------------|-------------------------|-----------------------|--|-------------|-----------------------|-------|--------------|---------------|-------------|-------------|---|--|
| 2 mm. | 3 | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 mm. | 50 | 12.1 | | 1 | | 3 | | | | | | | | | | | | | | 1 | 4 | | | | | | | |
| 4 mm. | 83 | 15.7 | | 2 | | 9 | 1 | | | | | | | 1 | | | | | 7 | 3 | | | | | | | 1 | |
| 5 mm. | 86 | 29.0 | | 3 | | 16 | 3 | | | | 1 | 1 | | 1 | | | | 1 | 18 | 18 | 1 | | | | 1 | | 2 | |
| 6 mm. | 68 | 33.9 | | 5 | | 12 | 6 | | | 1 | 3 | 1 | | 2 | | | | 2 | 21 | 13 | 2 | | | | | | 2 | |
| 7 mm. | 65 | 32.3 | | 3 | | 30 | 11 | 1 | | 1 | 1 | 1 | | 3 | | | 1 | 1 | 5 | 8 | | | | | 2 | | 1 | |
| 8 mm. | 63 | 42.9 | | 11 | | 20 | 4 | | | 1 | 3 | 1 | | 1 | | 4 | | 2 | 32 | 21 | 5 | 2 | 1 | | | | 4 | |
| 9 mm. | 33 | 15.2 | | | | 2 | | | | | | | | | | | | 1 | 4 | 3 | | | 1 | | | | | |
| 10 mm. | 12 | - | | | | | | | 2 | | | | | | | | | | | | | | | | | | | |
| 11 mm. | 5 | 20.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 468 | 25.9 | 2 | 25 | 1 | 92 | 25 | 1 | 1 | 5 | 8 | 18 | 4 | 4 | 1 | 4 | 1 | 7 | 88 | 70 | 8 | 2 | 11 | 3 | 10 | | | |

TABLE 4. Periodicity of feeding in C. cornutus

| Food Organism | Feb | March | | April | | | May | | | |
|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 12-- 6pm | 6am 12pm | 12-- 6pm | 6pm 12am | 6am 12pm | 12-- 6pm | 6pm 12am | 6am 12pm | 12-- 6pm | 6pm 12am |
| Coleoptera | | | | | | | | | | |
| <u>Stenelmus</u> | | | | | 1 | | | | | 1 |
| Diptera | | | | | | | | | | |
| Chironomidae | | | | | | | | | | |
| larvae | 2 | 1 | | | | | 1 | 15 | | 6 |
| pupae | | | | | | | | | | 1 |
| <u>Simulium</u> | | | | | | | | | | |
| larvae | 33 | 13 | | 6 | 2 | 15 | 6 | 15 | 1 | 1 |
| pupae | 12 | 1 | | | 1 | 1 | 2 | 3 | | 5 |
| <u>Tabanus</u> | | 1 | | | | | | | | |
| Misc. pupae | | | | | | 1 | | | | |
| Ephemeroptera | | | | | | | | | | |
| Baetidae | 1 | 2 | | | | | 1 | 1 | | |
| Caenidae | | | | | | | 1 | 5 | | 2 |
| Heptageniidae | | | | | | | 1 | | | |
| Leptophlebiidae | 1 | | | | 3 | 1 | | 3 | | |
| Misc. | 1 | 1 | | | 1 | | 1 | | | |
| Lepidoptera | | | | | | | | | | |
| <u>Elophila</u> | | 1 | | | | | | | 1 | 2 |
| Megaloptera | | | | | | | | | | |
| <u>C. cornutus</u> | 1 | | | | | | | | | |
| Plecoptera | | | | | | | | | | |
| <u>N. clymene</u> | | 1 | | | | | | 2 | 1 | 3 |
| Trichoptera | | | | | | | | | | |
| Hydropsychidae | | | | | | | | | | |
| <u>Cheumatopsyche</u> | 8 | 2 | 2 | 3 | | 1 | 12 | 32 | 14 | 14 |
| <u>Hydropsyche</u> | 10 | 4 | | 3 | 2 | 11 | 3 | 10 | 6 | 31 |
| Hydroptilidae | | | | | | | | | | |
| case | | | | 3 | | | | 1 | | 4 |
| pupae | | | | | | 1 | | 1 | | |
| Leptoceridae | | | | | 1 | | | | | |
| Limnephilidae | | | | | | | | | | 1 |
| Misc. adults | 2 | 1 | | | | | | | | |
| Misc. pupae | 1 | 2 | | 1 | | | 1 | 5 | | |
| Stomachs with contents (%) | 44.4 | 16.5 | 31.3 | 19.5 | 18.0 | 19.1 | 26.1 | 41.8 | 23.8 | 23.9 |
| Total stomachs | 36 | 79 | 16 | 46 | 39 | 42 | 46 | 67 | 21 | 76 |

Similarly, the same comparisons on an individual food item basis show no peak feeding periodicity (Table IV). Usinger (1956) stated that in the closely related Chauliodes "the fiercely predacious larvae feed chiefly in the dark and will eat almost anything that they can subdue, including their own kind." It appears from the data in Table IV that this is not the case for Corydalus cornutus.

Summary

Analysis of 121 stomachs of the hellgrammite, C. cornutus, from the Brazos River in Palo Pinto County, Texas, during a period between February 29 and May 14, 1971 prompted the following conclusions:

- (1) The diet of C. cornutus is exclusively insectivorous and its prey is ingested whole.
- (2) C. cornutus feeds on most aquatic insects occurring in its environment, with the exception of Odonate naiads; the diet consists of twenty-three different food items.
- (3) Trichoptera and Simulium larvae were taken in largest numbers by the 121 stomachs containing food.
- (4) There appears to be no expressive difference in time of feeding based on samples from both light and dark periods.
- (5) C. cornutus is cannibalistic on a very limited basis when an ample supply of other food organisms is available.

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