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DIET OF SOME COMMON INSECTS IN THE SOUTH LLANO RIVER

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Many studies of stream and lake food webs have been prompted by interest in monitoring pollution levels and determining the mode by which pesticides enter and affect ecosystems (Ricklefs, 1973). A more recent thrust in food web studies has been generated by increased interest in biodiversity, conservation, restoration, and management (Cohen et al., 1990; Pimm, 1991; DeAngelis, 1992). Although invertebrate-dominated food webs are prevalent in nature, the vast majority of food webs that have been published are dominated by vertebrates, in part because predator-prey relationships can be established relatively easily for larger conspicuous animals. A remarkable exception is the arthropod dominated below-ground detrital food web studied by Moore et al. (1988).

The South Llano River (SLR) in Kimble County, Texas, has high insect species diversity, with more than 100 taxa (Herrmann, 1992). Two of the most common groups of predators in the benthic food web of the SLR are creeping water bugs (Hemiptera: Naucoridae) and hellgrammites (Megaloptera: Corydalidae). As part of a larger study dealing with the structure and dynamics of the benthic food web of the SLR, a series of feeding trials were performed with three naucorid species; in addition, stomach contents were analyzed for hellgrammites. Herein, we report the results of those investigations.

TABLE 1. *Prey consumption, as determined by feeding trials, of the three most common species of naucorids from the South Llano River, Kimble Co., Texas. Prey are ranked according to relative size, from the smallest (top) to the largest (bottom).*

Prey taxon	*Limnocoris Lutzi* 6.8 ± 0.11[1]	*Cryphocricos hungerfordi* 8.4 ± 0.13[1]	*Ambrysus circumcinctus* 8.7 ± 0.15[1]
Traverella presidiana	+	+	+
Tricorythodes sp.	+	+	+
Leptohyphes sp.	+	+	
Stenelmis sp.	+		
Thraulodes gonzalesi		+	+
Fallceon guilleri		+	+
Heptagenia sp.		+	+
Chimarra sp.	+	+	+
Macrelmis texanus	+	+	+
Petrophila sp.		+	+
Hydropsychidae		+	+
Isonychia sicca		+	+

[1]Mean total length ± SE (tip of typlus to tip of abdomen, n = 15).

Naucorids.—Although the family Naucoridae consists mostly of tropical aquatic insects, these animals are prominent members of stream communities throughout the southwestern United States (Polhemus, 1984). The SLR harbors the greatest assemblage of naucorids in the United States, totaling eight species. Four of the five genera that occur in this country inhabit the SLR (Sites and Willig, 1991). Abundant species within riffle habitats are *Ambrysus circumcinctus* Montandon, *Cryphocricos hungerfordi* Usinger, and *Limnocoris lutzi* La Rivers (Sites and Willig, 1991). Although naucorids are suspected to be important predators in lotic communities (Stout, 1981), little is known about their ecology and life history (Sites and Nichols, 1990; Sites and Willig, 1991). A European species, *Ilyocoris cimicoides*, is one of the few naucorids for which any report on prey has been published (Venkatesan and Cloarec, 1988). Records of feeding habits of any species of naucorid for the United States are rare (Polhemus, 1984).

Feeding trials were conducted in June and July, 1991, with 15 feeding trials conducted per naucorid species. All specimens used in a trial were collected at the same time from the same locality. In each trial, one adult naucorid was placed in a five-liter aquarium that contained a single large rock (circumference between 15 and 25 centimeters). The naucorid was introduced 30 minutes before the prey, and the feeding trial was terminated 24 hours later. Potential prey species were presented in pairs, and in a minimum of three different trials. Each individual of prey and predator species was used only once. If a naucorid did not consume any prey items, the data from that trial were discarded.

Considerable overlap in prey characterizes the diets of the three naucorids (Table 1). *Limnocoris lutzi* consumed six different prey items in three major taxonomic groups. The first consisted of mayfly nymphs (Ephemeroptera) in three genera (*Traverella, Tricorythodes,* and *Leptohyphes*). The larvae of two riffle beetles (Elmidae) comprised the second group; both (*Stenelmis* and *Macrelmis*) are abundant in riffles. Larvae of the caddisfly *Chimarra* represented the third prey group. The length of the largest prey item that was consumed by *L. lutzi* did not exceed the length of *L. lutzi*. The other two naucorid species (*C. hungerfordi* and *A. circumcinctus*) exhibited similar diets, and unlike the situation for *L. lutzi*, some prey items were larger than the predatory naucorids (Table 1). These larger prey were a lepidopteran larvae (*Petrophila* sp.), a trichopteran larvae (*Hydropsyche* sp.), and a mayfly nymph (*Isonychia sicca*). Venkatesan and Cloarec (1988) found that predation rates for *Ilyocoris*

TABLE 2. *Stomach contents analysis for three size categories [mean length from tip of clypeus to tip of abdomen ± SE (N)] of* Corydalus cornutus *from the South Llano River, Kimble Co., Texas. Numbers indicate the frequency of each prey item in the foregut of each size category of hellgrammites. Prey are ranked according to relative size, from the smallest (top) to the largest (bottom).*

	Size category		
Prey taxon	30.1 ± 2.1 (6)	36.7 ± 3.2 (9)	44.0 ± 2.9 (14)
Fallceon guilleri	3	3	2
Polycentropus sp.		2	1
Hydropsychidae	2	2	
Limnocoris lutzi	1	1	
Cryphocricos hungerfordi		1	1
Ambrysus circumcinctus			3
Petrophila sp.	2		4
Isonychia sicca		2	3
Erpetogomphus sp.			2
Tabanus sp.		2	1

cimicoides decreased with increasing prey size. These authors hypothesized that increases in body size of prey imply an increase in handling time, making the processing of the prey more time consuming. However, larger prey provide more energy, thus requiring fewer prey items. If this hypothesis is correct, then *C. hungerfordi* and *A. circumcinctus* spend less time searching and more time handling prey, whereas *L. lutzi* spends more time searching and less time handling prey.

Corydalids.—The family Corydalidae occurs in a wide variety of aquatic habitats, ranging from spring sweeps and streams, to lakes and ponds. Corydalid larvae are predators of other aquatic invertebrates and small vertebrates. The morphology of the mouth parts, accentuated by robust mandibles, indicates that corydalids are specialized predators. The genus *Corydalus* is an engulfing predator, and in lotic-erosional and depositional streams, this genus is adapted to cling to, and climb among, the substrate (Evans and Neunzig, 1984). The life history and population energetics of *Corydalus cornutus* in central Texas is known (Stewart et al., 1973; Brown and Fitzpatrick, 1978; Epperson and Short, 1987; Short et al., 1987). It exhibits a one-year life cycle with 11 larval instars. Females typically oviposited two egg masses between late May and August. Eclosion occurred some 13 days after oviposition, with larval growth slowing and eventually stopping by November. Considerable inter-stream variation characterizes the development of *C. cornutus*, and this variation is attributed to differences in thermal attributes (Short et al., 1987). Annual production for this species in Texas is one of the highest reported for a predatory species. Estimates ranged between 1.62 and 22.9 grams of dry mass per square meter per year, comparable values to those of primary consumers in desert streams (Epperson and Short, 1987; Short et al., 1987). The diet for a population of *C. cornutus* in the Brazos River, Palo Pinto, Texas, comprised over 20 prey taxa in at least seven insect orders (Steward et al., 1973). The most prevalent groups in the diet were caddisflies (Hydropsychidae) and black flies (Simuliidae).

In the shallow riffles of the SLR, *C. cornutus* is the top arthropod consumer; it feeds at all consumer trophic levels of the food web (Camilo and Willig, unpublished data). Stomach content analysis of 30 individuals (Table 2), corroborates that *Corydalus* consumes prey from a variety of trophic levels, (that is herbivore, *Fallceon guilleri* (Baetidae); intermediate predator, *Cryphocrycos hungerfordi*; and high predator, *Tabanus* sp.). In addition, two individuals were found with algae in the midgut, but this material probably was ingested accidentally, along with other prey. The diet for *C. cornutus* in the SLR overlaps more than 90 percent

with that reported from the Brazos River (Stewart et al., 1973) in terms of species compostion. Cannibalism was prevalent in the Brazos River population; however, we did not detect this phenomenon in the SLR. In the Brazos River, as well as in the SLR, *C. cornutus* did not consume the caddisfly *Chimarra*, even though it is common in the study area and easily subdued, given its size. Our observations are consistent with the hypothesis of Moore et al. (1988) that most top predators of arthropod dominated food webs are omnivores. Moreover, naucorids and corydalids are omnivores *sensu* Pimm and Lawton (1978) in that they feed at more than one trophic level. Pimm and Rice (1987) found that prevalent omnivory, like what we observed in the SLR, reduces the system stability (that is return times of population densities after disturbance are greater, thus increasing the probability of extinction). They also concluded that multi-life-stage models (consuming different prey items at different life stages), or life history omnivory, reduces stability, but less so than does strict omnivory. Adults of each species of naucorid consumed a wide array of prey, including primary consumers and higher trophic levels. Different instars of *C. cornutus* consumed the same prey species (Table 1; Stewart et al., 1973), and might be constrained only by prey size (Camilo and Willig, unpublished data).

We thank the Texas Tech University Center at Junction for providing laboratory space and logistic support. J. A. Back, D. P. Herrmann, M. McGinley and R. W. Sites critically reviewed the manuscript, for which we are grateful. B. Henry (University of Texas—Pan American), provided the identification of the Ephemeroptera. Support was provided by a grant from the State of Texas Higher Education Coordinating Board, Advanced Research Program and Supplement for Minorities (grant number 003644-081).

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RECORDS OF FIVE SPECIES OF SMALL MAMMALS FROM WESTERN TEXAS

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In the course of field work in 1991 and 1992, parties or individuals asssociated with The Museum at Texas Tech University obtained specimens of five species of mammals that are noteworthy from a distributional point of view. These are detailed below.

Cryptotis parva parva (Say, 1823).— A male (testes 4 x 2 mm) of this diminutive shrew (TTU 62341), which was captured in a Sherman live trap set in mesquite grassland at a place 3 mi. S and 5 mi. E Claude on 19 August 1992, provides the first record of *C. parva* from Armstrong County (see Owen and Hamilton, 1986). This specimen, along with a male (TTU 61632, testes 4 x 2 mm) from 13 mi. E. Canyon, Randall County, trapped on 1 July 1992 on rocky substrate near a yucca plant, aids in better defining the known distribution of this relatively rare species on the northern part of the Llano Estacado.

Another least shrew was taken by A. F. Laemmerzahl in a Sherman trap set 3 mi. N and 9 mi. E Justiceburg, Garza County, in open mesquite grassland. This locality, which is not far off the Llano to the east, represents a new county record for *C. parva* and the southernmost along the western edge of its known range in Texas. A female (TTU 61916), this shrew carried five fetuses that measured 6 mm in crown-rump length on 2 August 1992. We took a male (TTU 62373, testes 5 x 3 mm) at this same locality, on 27 August 1992, in mesquite grassland with abundant broomweed and scattered *Opuntia*.

Finally, two specimens from Lubbock County were brought in by house cats as follows: TTU 62339, unknown sex, from 5 mi. E New Deal, taken on 20 July 1992 by Jean Nichols; TTU 62340, male, from 1 mi. W Acuff, obtained on 20 August 1992 by Venita Davis.