THE GOLDEN TOPMINNOW, *FUNDULUS CHRYSOTUS* (CYRPINODONTIDAE), AN ADDITION TO THE FISH FAUNA OF OKLAHOMA

Centrally located in the continental United States, Oklahoma contains a diverse fish fauna including species typical of both the Great Plains and the eastern United States (Miller and Robison, 1973). Within the state, fish diversity is greatest in the southeastern region of McCurtain Co. This area, part of the northwest extension of the Gulf Coastal Plain, contains a variety of aquatic habitats, such as; streams, rivers, sloughs, oxbow lakes, and cypress swamps. Since the work of Miller and Robison (1973), the presence of other fish species has been reported within the state (Burr et al., 1979; Matthews and Robison, 1982; Miller, 1984; Robison, 1985; Rutherford et al., 1985). This note documents the addition of the golden topminnow, *Fundulus chrysotus*, to the fish fauna of Oklahoma.

Fundulus chrysotus was first collected by the author and J. Krupa in May of 1984 from a bar ditch (T7S, R24E, Sec. 14) 750 m north of the Little River, McCurtain Co., Oklahoma (Fig. 1). The bar ditch was a series of small shallow pools, dominated by a larger beaver-dammed pond in the center. These ponds had a mud bottom, varied in depth (0.5 to 1.5 m), and were lined with tall grasses, reeds, and small trees. The smaller pools contained considerable amounts of aquatic vegetation.

Two additional populations of *F. chrysotus* were found during the spring and summer of 1985. The first was located in May in a field slough (T10S, R26E, Sec. 8) 5.6 km southwest of Tom, Oklahoma, and the second was located in July in a drainage pond (T9S, R26E, Sec. 32) on the southwest side of Ward Lake, 3.5 km west of Tom.

The slough covered 1.5 ha of a field that was dominated by smartweed (*Polygonum hydropiperoides*). The southeastern corner of the slough was a 34 by 30 m cattle pond that contained a 0.5-m layer of soft mud and a dense mat of coontail (*Ceratophyllum demursum*). Maximum water depth in May was 0.5 m in the field and 1 m in the pond, but, by mid-June, the water level had dropped such that only the pond contained water. The water level of the pond continued to drop, and, by the end of July, maximum depth was approximately 0.4 m. Water temperature was 30°C in mid-May and 39°C in mid-June; pH of the pond was 7.3 in July.

Golden topminnows were collected from the slough with a 5 by 1.7 m seine in May and a drift fence set for 7 days in May, 8 days in June, and 8 days in July. The drift fence was constructed with an upright piece of hardware cloth (15.5 m long and 0.5 m high) and two pairs of funnel traps (1 m long and 0.25 m diameter) on each side of it. Organisms encountering the fence would move along it until they entered the funnel traps.

The characteristics of the collected specimens agreed with previous descriptions of the species (Brown, 1956; Pflieger, 1975). Of the 278 *F. chrysotus* collected from the field slough, 110 (39.6%) were males. The sex ratio of these specimens differed significantly from a 1:1 sex ratio (Chi-square analysis, $x^2 = 12.10$, $P < 0.001$). Standard length of sampled males ranged from 43.4 to 62.2 mm ($X = 49.2$, $SD = 3.71$, $n = 110$); standard length of females ranged from 42.8 to 67.9 mm ($X = 51.6$, $SD = 4.82$, $n = 168$). These measurements differed significantly between the two sexes (Mann-Whitney U-test, $z = 4.72$, $P < 0.001$). Figure 2 illustrates the size distribution of male and female *F. chrysotus* collected from the field slough. Shute (1980) noted a maximum standard length of 57 mm for *F. chrysotus*. Twenty-three specimens (6 males, 17 females) collected from this site in Oklahoma exceeded this value.

Golden topminnows were collected from the drainage pond with a dip net. This sample contained many smaller individuals (standard length; range of 18.0 to 43.8 mm; $X = 28.16$ mm, $SD = 6.89$, $n = 49$). Male markings were present on specimens as small as 25 mm. Those individuals less than 25 mm were considered juveniles ($X = 22.3$ mm, $SD = 1.90$, $n = 21$), while the rest of the sample (>25 mm) comprised of 17 females ($X = 32.5$ mm, $SD = 5.93$) and 11 males ($X = 32.6$ mm, $SD = 6.17$). The presence of juvenile *F. chrysotus* in the drainage pond implies that this species has reproduced in Oklahoma.

In addition to *F. chrysotus*, the field slough contained *Amia calva*, *Lepisosteus oculatus*, *Cyprinus carpio*, *Notemigonus crysoleucas*, *Ictalurus melas*, *Aphredoderus sayanus*, *Gambusia affinis*, *Elassoma zonatum*, *Centrarchus macropterus*, *Chaenobryttus gulosus*, *Lepomis macrochirus*, *Lepomis megalotis*, *Lepomis microlophus*, *Lepomis symmetricus*, *Micropterus salmoides*, *Pomoxis nigromaculatus*, and *Etheostoma gracile*. Inhabiting the drainage pond with *F.*

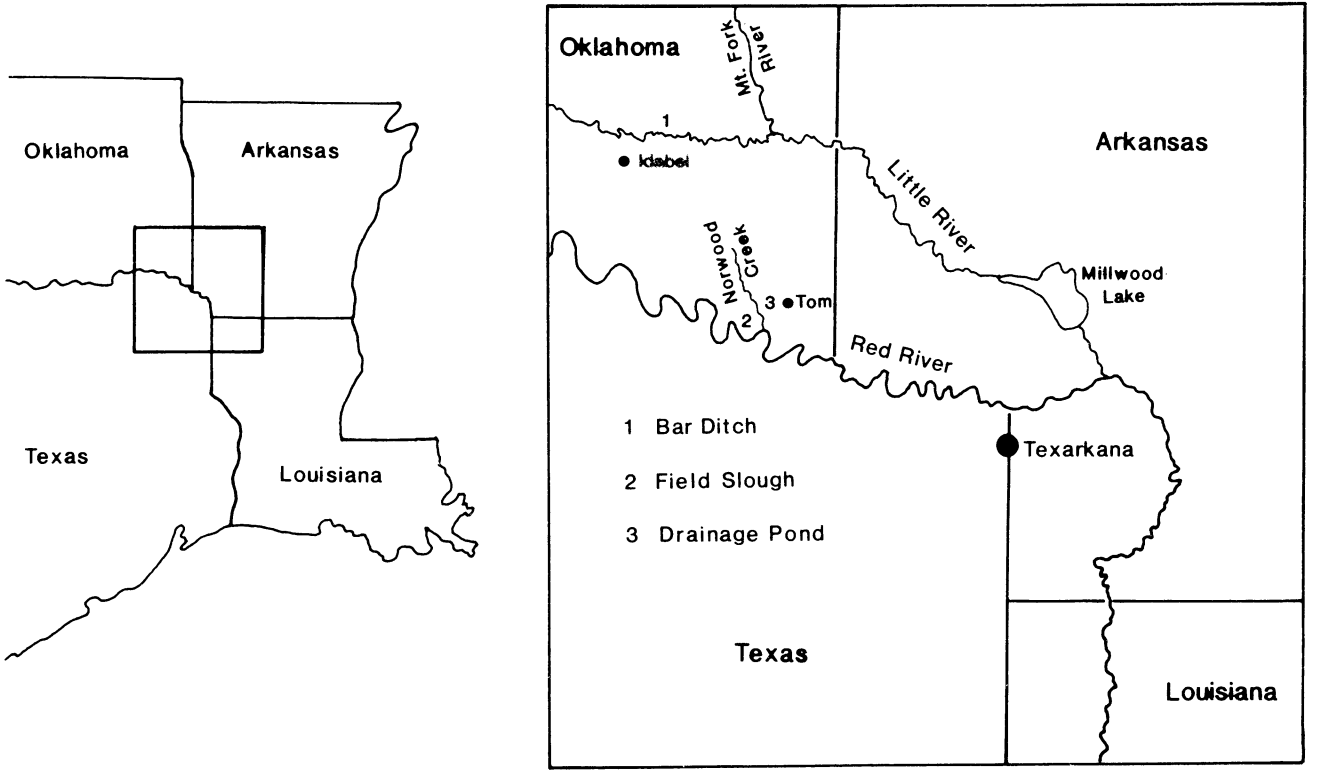

FIG. 1—Collection sites of *Fundulus chrysotus* in southeastern Oklahoma.

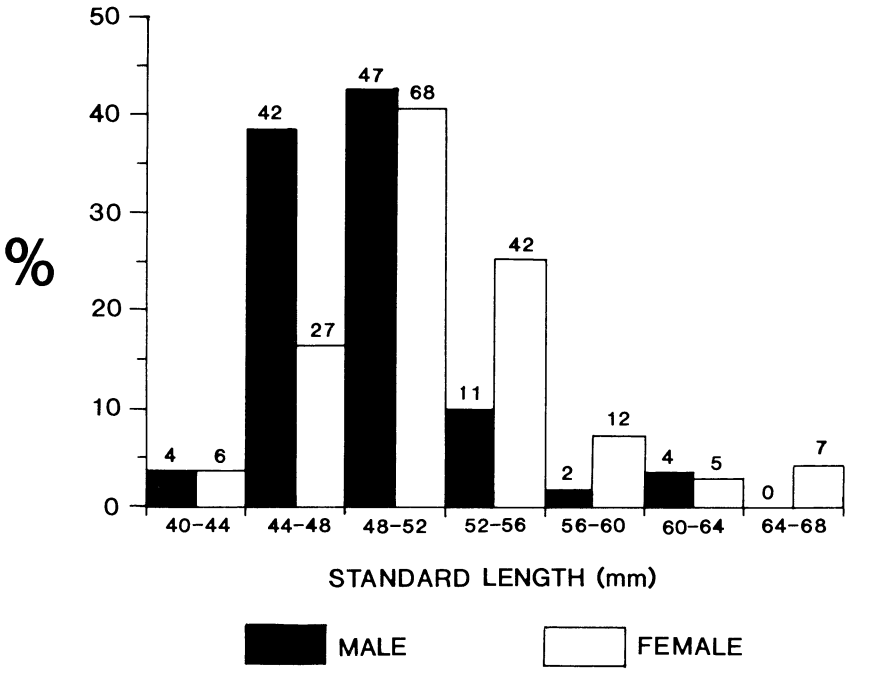

FIG. 2—The distribution of standard length of male and female *Fundulus chrysotus* collected in 1985 from a field slough, McCurtain Co., Oklahoma. The number above each bar represents sample size.

chrysotus were *Esox americanus*, *N. crysoleucas*, *C. gulosus*, *L. macrochirus*, *L. megalotis*, *L. symmetricus*, *M. salmoides*, *P. nigromaculatus*, and *Pomoxis annularis*.

The closest reported locality of *F. chrysotus* to the present records was a collection from Texarkana, Texas (Shute, 1980). The distribution of *F. chrysotus* extends from the coastal region of South Carolina, south throughout Florida, and west to the coastal region of Texas. The range extends inland along major rivers (Shute, 1980); the populations found in Oklahoma are associated with the Red River drainage system (Fig. 1). The field slough and drainage pond are linked to Norwood Creek which flows into the Red River on the southern border of McCurtain Co. The Little River, connected to the bar ditch during flood stage, joins the Red River in southwestern Arkansas.

Specimens reported here are deposited in the Stovall Museum of Science and History, University of Oklahoma. Special thanks are extended to the family of B. Ward of Tom, Oklahoma, who granted permission to work on their land and provided living accommodations during this work. I thank T. Heger and J. Graham for their assistance in collecting the specimens, H. Bart and R. Cashner for identification of specimens, and J. Krupa, M. Paulissen, and D. L. Secor for their comments on this manuscript. This work was supported by the Nongame Program of the Oklahoma Department of Wildlife Conservation.

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REPRODUCTION IN *POLEMONIUM*: INTRA- AND INTER-PLANT VARIABILITY IN SEED WEIGHTS

Increasingly, patterns of seed weight variation in plant populations have been thought to be of significant ecological importance. A positive relationship between seed size and size of seedlidngs, for example, has been well documented. Such a relationship is critical because studies of natural populations have suggested that early seedling size differences result in greater reproductive fitness. Seed size has also been shown to significantly affect germination and dispersal probabilities. Finally, tradeoffs between seed size and number of seeds produced per plant have been frequently observed.

Seed size has been assumed to be less variable than many other plant traits. This conclusion has arisen because most investigators have weighed seeds not individually but rather in large lots and have thus underestimated actual amounts of variation. By weighing seeds individually, Thompson (1984) found seeds from single plants to range as much as eightfold, and seeds from a population to range as high as 15.8 times as much.

The goal of this note is to assess the variability in seed size produced by individuals in a population of the Rocky Mountain herb, *Polemonium foliosissimum* Gray (Polemoniaceae). Fieldwork was conduced during summer 1984 at Horse Ranch Park, Gunnison National Forest, Colorado. Horse Ranch Park is a 2.4 ha meadow surrounded by aspen trees at approximately 2,743 m. *Polemonium foliosissimum* is a perennial, herbaceous species that occurs throughout the Rocky Mountain region. Its blue campanulate flowers are produced on a corymbose cyme.

Twenty *P. foliosissimum* individuals were randomly chosen from a population at Horse Ranch Park. The number of open flowers on each plant was counted every 6 days from onset of flowering (13 July 1984) to conclusion of the blooming period (18 August 1984). As shown elsewhere (Zimmerman, 1980), this sampling scheme ensured that most flowers produced by each plant were censused. A minimum of 27 ovaries were collected from each plant on 18 August 1984, and the number of developing seeds within each was counted. These counts are an accurate estimate of the female reproductive output of these flowers because previous work (Zimmerman, 1984) has suggested that seed abortion does not occur in this species. Furthermore, by not counting underformed seeds, relative to others within the same fruit, only viable seeds were censused. Fully mature seeds from each plant were collected on 15 September 1984. These seeds were collected from fully dehisced capsules. Because seeds were loose within capsules, no further seed maturation was possible. Seeds were individually weighed to the nearest 0.0001 g on a Mettler AE 160 Electronic Balance.

Total number of flowers produced by each plant was estimated by summing each of the 6-day census values. Total number of seeds produced per plant was estimated by multiplying average number of seeds per ovary by total number of flowers produced over the course of the season. Spearman rank correlation coefficients were calculated between average seed weights for each plant and total number of flowers produced by each individual, average number of seeds per ovary per plant, and total number of seeds produced by each individual.

Individual seed weights ranged from 0.0024 g to less than the lower detection limit of the balance (0.0001 g). Distribution of seed weights differed from a normal distribution by being