Occurrence of Golden Topminnow, *Fundulus chrysotus*, in the San Marcos River, Texas

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Abstract - Within the western extent of its range, *Fundulus chrysotus* (Golden Topminnow) is generally restricted to coastal drainages of Texas, with few reported occurrences inland. We report a new record of Golden Topminnow in the upper San Marcos River of Texas. The occurrence of Golden Topminnow could represent a natural range expansion or incidental introduction to the area. Future monitoring of the population within the San Marcos River (Guadalupe River basin) is needed to confirm if the species becomes established.

Fundulus chrysotus (Günther) (Golden Topminnow) is native to North American coastal drainages of the Gulf of Mexico and Atlantic Ocean, ranging from South Carolina in the east to Texas in the west (Hubbs et al. 1991). Golden Topminnow is generally associated with slackwater habitats (i.e., backwaters and pools; Etnier and Starnes 1993, Page and Burr 1991) and submergent vegetation (Shute 1980, Warren 2020), feeding primarily at the surface on invertebrates (e.g., water beetles [Haliplidae], midges [Chironomidae]; Goldstein and Simon 1999, Hunt 1953). Its reproductive season is April through September (De Vlaming et al. 1978, Foster 1967, Hellier 1967), with Golden Topminnow depositing multiple batches of eggs with adhesive threads on plants and substrates (Foster 1967, Leitholf 1917, Pflieger 1975). Age-0 fish grow rapidly, reaching 30 mm (SL) within 3 months, and can become sexually mature within 10 months (Foster 1967). Life span of Golden Topminnow is 2 years (Foster 1967). Populations are considered stable throughout its range (Warren 2020, Warren et al. 2000).

In Texas, Golden Topminnow is distributed among low-gradient water bodies from the Red River drainage to the Nueces River drainage (Hendrickson and Cohen 2015, Martin et al. 2012). Within eastern Texas, Golden Topminnow is widely distributed in coastal and inland waters from the Red River drainage to the San Jacinto River drainage (Hendrickson and Cohen 2015). Farther west, however, reported occurrences of Golden Topminnow are generally restricted to the low-gradient termini of the Brazos, Colorado, Guadalupe, and Nueces rivers; smaller coastal freshwater rivers (e.g., Lavaca River); bays; and estuaries. Similar to other fundulids (e.g., *Fundulus grandis* Baird & Girard [Gulf Killifish] and *Fundulus similis* (Baird & Girard) [Longnose Killifish]; Warren et al. 2020) within coastal drainages of Texas, Golden Topminnow is euryhaline and reported to inhabit waters up to 20 ppt for brief periods of time (Brockmann 1974, Griffith 1974, Kilby 1955). A reproducing population has been reported in Bird's Creek (DeWitt County, TX), a small tributary of Sandies Creek that flows into the Guadalupe River (Tulane University accession number: TU176086; Whiteside and Berkhouse 1992). Bird's Creek is located ~200 river km upstream from the mouth of the Guadalupe River, and this population represents the most inland occurrence of this species in the western portion of its range (Brazos River to Nueces River).

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In October 2020 on 2 separate occasions, we captured a Golden Topminnow in the upper San Marcos River (Hays County, TX; Fig. 1). The upper San Marcos River is defined as the 8-km reach of the river upstream from the San Marcos River confluence with the Blanco River (Kollaus et al. 2015). Baseflow of the upper San Marcos River (1994–2021: median daily flow = 5.0 m^3/s, min–max = 2.2–176 m^3/s; USGS Station 08170500) is primarily from spring outflows of the Edwards Aquifer, which provide year-round 20–24 °C water temperatures (Groeger et al. 1997). We captured the first Golden Topminnow (total length = 38 mm) with a dip net on 12 October 2020 from City Park (29°53'1.8954"N, 97°56'6.666"W) within the City of San Marcos, TX. We used a seine to capture the second specimen (total length = 31 mm) on 23 October 2020 from Veteran's Plaza (29°52'59"N, 97°56'06"W), about 200 m downstream from City Park. We identified the specimens based on dorsal fin posterior to anal fin, mottled body with irregular spots or barring, lack of subocular bar, 10 anal fin rays, and 32 to 36 scales in the lateral series (Craig and Bonner 2019, Hildebrand and Towers 1928). We deposited both specimens in the Texas Natural History Collections - Ichthyology (TNHCI) at University of Texas (Hendrickson et al 2021a, b). Both specimens were taken from areas with dense vegetation (80– 90% vegetative cover), consisting primarily of *Zizania texana* Hitchc. (Texas Wild-rice) and *Hygrophila polysperma* (Roxb.) T. Anderson (Indian Swampweed), at a depth of about 0.5 m and current velocity of 0.01 m/s. Co-occurring species in adjacent dip nets and seine hauls were *Dionda nigrotaeniata* (Cope) (Guadalupe Roundnose Minnow), *Notropis amabilis* (Girard) (Texas Shiner), *Astyanax mexicanus* (De Filippi) (Mexican Tetra), *Gambusia affinis* (Baird & Girard) (Western Mosquitofish), *Gambusia geiseri* Hubbs & Hubbs (Largespring Gambusia), *Poecilia latipinna* (Lesueur) (Sailfin Molly), *Lepomis auritus* (L.) (Redbreast Sunfish), *Lepomis macrochirus*

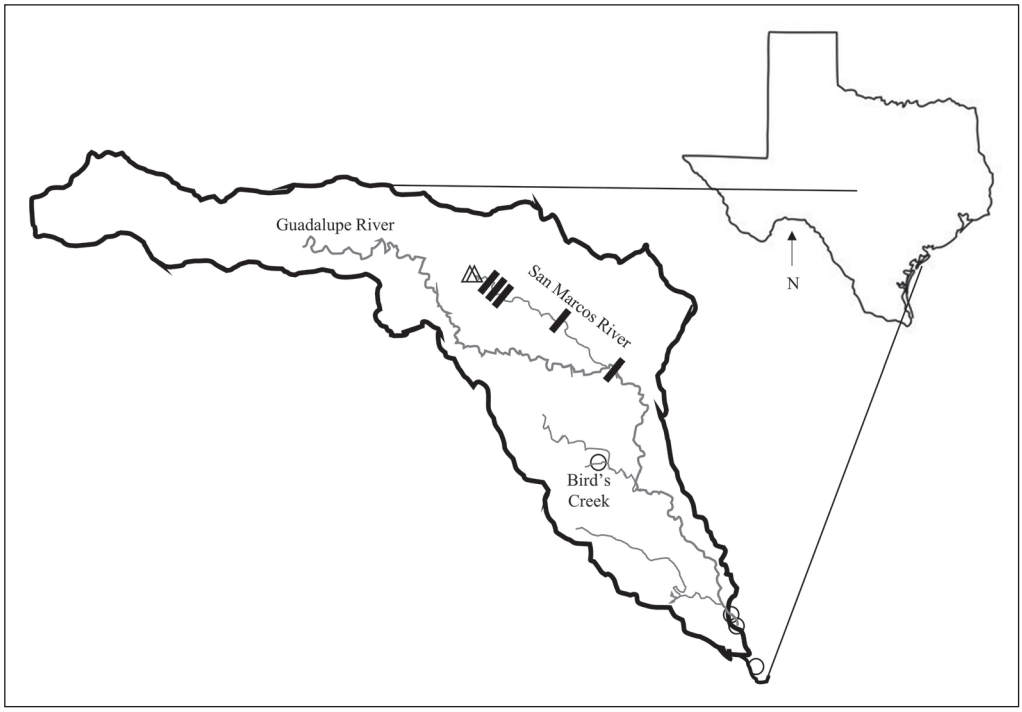

Figure 1. Current locations of Golden Topminnow within Guadalupe River basin of Texas. Open circles denote previously reported collections, and open triangles denote new collections reported herein during October 2020. Bars represent large hydroelectric and flood control dams >3 m in height.

Rafinesque (Bluegill Sunfish), *Lepomis miniatus* (Jordan) (Redspotted Sunfish), *Lepomis megalotis* (Rafinesque) (Longear Sunfish), and *Etheostoma fonticola* (Jordan and Gilbert) (Fountain Darter).

Collections of Golden Topminnow were notable in that these collections are the first report of the Golden Topminnow in the upper San Marcos River, which is 230 river km upstream from the nearest known population in Bird's Creek in the lower reach of the Guadalupe River. Upper San Marcos River is separated from Bird's Creek by 5 larger (i.e., >3 m in height), hydroelectric and flood control dams and several smaller (<3 m in height) weir-type dams on the Guadalupe River. New records of native species are occasionally reported, attributed to range expansions (Martin et al. 2012), species occurring within an area but being previously undetected (Craig et al. 2015), incidental introductions (Gallaway et al. 2008), or illegal dumping of aquarium organisms (Edwards 2001).

Golden Topminnow is reported to be expanding westward along the Texas coast (Martin et al. 2012), whereas other Texas fishes (e.g., *Phenacobius mirabilis* (Girard) [Suckermouth Minnow]; Wilde and Bonner 2000) expand their range upstream with changes in habitat conditions. However, range expansion from the lower Guadalupe River seems unlikely given the distance and number of instream barriers between the lower reach of the Guadalupe River and the upper San Marcos River. Recently, the potential for fish dispersion by endozoochory (i.e., internal transport of eggs via migratory waterfowl's digestive system) was illustrated by studies which found that viable eggs of *Cyprinus carpio* L. (Common Carp; Lovas-Kiss et al. 2020) and of 2 South American fundulids (*Austrolebias minuano* Costa & Cheffe and *Cynopoecilus fulgens* Costa; Silva et al. 2019) passed through the digestive system of waterfowl. Considering that Golden Topminnow egg development occurs in vegetation near the water surface (Warren 2020), where waterfowl commonly feed, transport via endozoochory is plausible.

Detectability issues are thought to have hindered accurate range descriptions of Golden Topminnow distributions in Arkansas and Missouri (McAllister et al. 2006, Wills et al. 1998). The upper San Marcos River fish community has been extensively sampled since the 1890s (Kollaus et al. 2015) and intensively sampled for the federally endangered Fountain Darter since 2000 (e.g., twice a year at multiple sites, using multiple gear types; BIO-WEST 2020); therefore, Golden Topminnow is unlikely to have been previously undetected within the upper San Marcos River. However, other portions of the San Marcos River and various tributaries between the upper San Marcos River and lower Guadalupe River have been sampled less (Perkin and Bonner 2011), thereby allowing the possibility of an existing and undetected population nearer to the upper San Marcos River than the population at Bird's Creek.

Incidental introductions (e.g., bait-bucket release, transfer via aquatic vegetation introductions) and illegal releases of aquarium organisms are reported sources of recent introductions of *Notropis blennius* (Girard) (River Shiner; Patrikeev et al. 2005), *Lucania goodei* Jordan (Bluefin Killifish; Gallaway et al. 2008), *Hypostomus plecostomus* (L.) (Suckermouth Catfish), and Sailfin Molly (Edwards 2001) in Texas. Likelihood of Golden Topminnow being transported as bait is unknown, but the species can be purchased through online aquarium hobbyist sites.

It is unclear if the 2 Golden Topminnows collected in the upper San Marcos River represent a natural population expansion or resulted from human-mediated transport. Continued monitoring of the upper San Marcos River will determine if the population becomes established. Reporting of new species occurrences, regardless of the mechanisms, provides documentation necessary to quantify expansion of species ranges related to climate-

mediated environmental changes (Fujiwara et al. 2019), assess fish community dynamics through time (Magurran et al. 2010), especially in urban streams (Kollaus et al. 2015), and monitor native fish range expansions as potential indicators of habitat degradation (Scott and Helfman 2001).

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