

# Grass Carp Reproduction in the Lower Trinity River, Texas

by

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## Introduction

Grass carp (*Ctenopharyngodon idella*) were first introduced into research facilities in Alabama and Arkansas in 1963 (Stevenson 1965; Sutton 1977). Their presence in North America and subsequent releases or escapes in open waters prompted concern about possible reproduction in the United States. Stanley (1976) predicted grass carp would spawn in the Mississippi River valley but thought success would be minimal. Stanley, Miley, and Sutton (1978) indicated that large, long rivers or canals with high volumes ( $>400 \text{ m}^3/\text{s}$ ) and fast flow rates ( $>0.8 \text{ m/s}$ ) were needed for successful spawning. Pflieger (1978) suggested that the abundance of grass carp in the middle Mississippi River was too great to result solely from escapement. Indeed, only 2 years later, Conner, Gallager, and Chatry (1980) reported collection of Cyprinid larvae they identified as grass carp in the Mississippi River of Arkansas and Louisiana. Shortly thereafter, Leslie, Van Dyke, and Nall (1982) demonstrated egg hatching could occur at flow rates down to  $0.23 \text{ m/s}$ , thus dramatically expanding the potential locations and occasions where grass carp might successfully spawn.

Collection of grass carp larvae within the Mississippi Basin continued. Zimpfer, Bryan, and Pennington (1987) found larvae and predicted successful recruitment. Pflieger and Grace (1987) found juvenile grass carp stranded on a desiccated flood plain in Missouri. Brown and Coon (1991) also reported collection of grass carp larvae in the Mississippi River and four of its tributaries in Missouri.

In Texas, the first legal stockings of grass carp occurred in 1981 and 1982 at Lake Conroe, Montgomery and Walker Counties, on the San Jacinto River System in southeastern Texas (Martyn et al. 1986). By 1983, several large grass carp had been collected in the adjacent Trinity River (Trimm et al. 1989). Over the next few years, other grass carp were taken in the San Jacinto River below Lake Conroe, in and below Lake Houston downstream on the San Jacinto River, in Trinity Bay in the mouth of the San Jacinto River, across Trinity Bay in the mouth of the Trinity River, and up the Trinity River itself (Trimm et al. 1989). Continued commercial catches of grass carp in the Trinity River as well as occasional collections of juvenile grass carp in Trinity Bay prompted concern that reproduction may be occurring in the lower Trinity River.

Trimm et al. (1989) dismissed the collection of a  $<100\text{-mm}$  juvenile grass carp taken near Baytown, TX, as probably an illegally stocked escapee. They further noted ichthyoplankton collections in the Trinity River by Menn and Pitman (1986) in 1984 and 1985 during possible spawning periods failed to collect either grass carp eggs or larvae. However, most grass carp are stocked at sizes substantially larger than  $100 \text{ mm}$  to avoid predation losses. Further, collections made by Menn and Pitman (1986) were essentially surface tows that could have missed grass carp eggs where turbulence was not sufficient to force the eggs to the surface. Additionally, relatively short duration of incubation and yolk sac periods at warmer temperatures, prior to active swimming and net avoidance, suggested sampling

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intervals of more than a few days could fail to detect a significant spawn. The objectives of this study are to determine if grass carp reproduce and recruit to juvenile stages in the lower Trinity River and to characterize the adult population in the lower Trinity River in terms of size, sex, age, fecundity/reproduction, ploidy, and food habits.

## Methods

Ichthyoplankton samples were collected from three stations on the lower Trinity River at three sites: Farm to Market Road 787 (FM 787), U.S. Highway 90 (Hwy 90), and Interstate Highway 10 (I-10) (135, 58, and 0 km above Trinity Bay, respectively) (Figure 1) during spring and summer of 1992 and 1993 when surface water temperatures were between 18 and 30 °C. An 0.5-m 560 micron mesh net was used to take three tows at each station once a week. During each tow, the net was allowed to sink to the river bottom, then secured approximately 1.0 m above the river bottom before being retrieved. Samples were taken from the bridge at FM 787 and from a boat approximately 0.5 miles upstream from Hwy 90 and I-19. Additional tows were taken during summer 1993 in backwater areas off the lower Trinity River in an effort to collect larvae that may have moved to calmer water to feed. All samples were preserved using a 10-percent formalin solution and stained with rose bengal to facilitate subsequent specimen removal. Grass carp eggs and larvae were identified at the Texas Parks and Wildlife Department (TPWD) Heart of the Hills research laboratory, with larval identifications confirmed by Dr. Darrel Snyder, University of Colorado Larval Fish Laboratory, Fort Collins.

A 5-kw boat-mounted electrofisher was used to sample for juvenile grass carp off the main river channel during summer 1993. Also, fish kill investigations and sampling records from the Texas Natural Resource Conservation Commission and the TPWD Resource Protection Division were examined for records of juvenile grass carp in the Trinity/San Jacinto Bay area. Adult grass carp were collected by

commercial fishermen using 2.4- × 9.1-m hoop nets with 7.6-cm mesh. Between 30 and 50 nets were fished continuously from April 1993 through April 1994 at different locations in side channels of the lower Trinity River above I-10. Each fish was measured to the nearest millimeter total length and weighed to the nearest 10 g. Sex was determined by internal examination and gonads removed and weighed. Age was determined from cross-sectioned otoliths. Blood samples were taken as soon as possible after capture and ploidy determined using a Coulter counter. The alimentary tract was removed from each fish, cut into three equal sections, and preserved in 3-percent formalin prior to examination.

## Results

During May and June of 1992, 691 grass carp eggs were collected at FM 787 and Hwy 90; however, no grass carp larvae were collected during 1992. June 1993 sampling yielded 17 grass carp eggs as well as 1,500 grass carp larvae. All grass carp eggs and larvae collected in 1993 were taken on the same day, with eggs collected at FM 787 and Hwy 90 and larvae collected at I-10. Progressive development was seen in eggs taken from the upper and middle stations both years. No eggs or larvae were taken from backwater samples.

Although adult grass carp were seen and collected during backwater electrofishing, no juvenile grass carp were collected. However, fish kill records from TPWD Resource Protection Division show 65 juvenile grass carp between 102 and 178 mm total length (TL) taken from a bayou off the Houston Ship Channel in fall and winter 1993. In addition, one juvenile grass carp (65 mm TL) was collected from the Houston Ship Channel (downstream from the TPWD collection sites) (Figure 1) by the Texas Water Commission in July 1993.

Preliminary results from adult grass carp taken by commercial anglers in the lower Trinity River indicate a length range of 680- to 1,064-mm TL with a mean length of 856 mm,

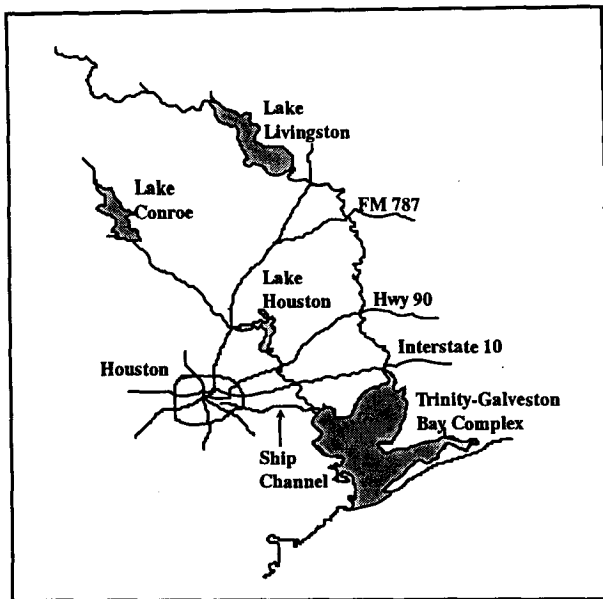


Figure 1. Map of upper Trinity-Galveston Bay Complex including lower Trinity and San Jacinto rivers, Texas

a weight range of 3,400 to 13,630 g with a mean weight of 6,958 g. Sex ratio was 62 percent females and 38 percent males. The age range was from 4 to 9 years with a mean age of 6 years. Peak gonadal weight occurred in June. Eighty-six percent of fish tested were diploid with 14 percent triploid. Many gut samples were empty. For gut samples containing food items, terrestrial detritus (leaves, sticks, etc.) was the most consistent item, with duckweed (*Lemna* spp.) the most common aquatic plant species found. One fish, captured in December 1993, contained large amounts of filamentous algae, the majority being water net (*Hydrodictyon* spp.). Fragments of grass (*Graminae* spp.) and rush (*Scirpus* spp.) were found in small amounts in some samples. Although some invertebrates were found (chironomid larvae and hemiptera), these occurrences were rare and were associated with samples containing large quantities of duckweed.

### Discussion

Collection of grass carp eggs, larvae, and small juveniles from the lower Trinity River and Trinity Bay system indicates that successful grass carp recruitment as well as spawning, egg development, and hatching occur in the

Trinity River, Texas. Although stocking grass carp has recently been allowed under permit in Texas, legally stocked triploid and illegally stocked diploid grass carp are generally 150- to 200-mm TL or larger at the time of stocking.

Ploidy and age information from the adult grass carp population in the lower Trinity River indicate that at least a portion of the population are escapees from illegal stockings. No saltwater vegetation was found in gut samples, indicating grass carp were feeding on vegetation in the immediate area in which they were captured. More work needs to be done concerning the link between the Trinity River grass carp population and cord grass predation in the San Jacinto Bay.

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