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Geographic Distribution and Historical Trends of Fish Species Within the Trinity River Basin, Texas

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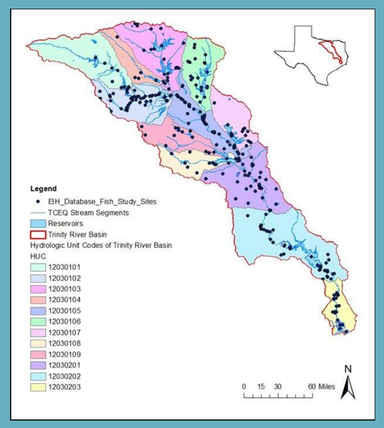

Figure 1: Location of published and unpublished fish studies archived in the EIH Trinity River database that were used to document the historical distribution of fish species in the Trinity River basin.

Introduction

During 2007-09 we conducted a project funded by the Trinity River Authority (TRA) and others to evaluate spatial and temporal trends in Trinity River fish populations and communities. A comprehensive database was developed to accomplish this project. We combined and analyzed existing government and published data sets on Trinity River Basin fish populations. An Access® OBDC compliant database and EndNote® annotated bibliography were created. In addition, an ArcGIS® spatial database was developed to expedite spatial analysis. A total of 382 publications and records were examined ranging from 1892 to 2009. A total of 134 species were documented within the basin. The database contains location and time of collection, gear used, effort, species collected or observed, catch or CPUE and numbers of species/taxa. This database and accompanying analysis was used to support recent ecological instream flow analyses of the Trinity River conducted by the Trinity-San Jacinto River and Galveston Bay, Basin and Bay expert Science Team (BBEST) in support of SB3 initiatives associated with the Galveston Bay watershed (Guillen et al. 2009). Selected species were identified as "focal species" of concern by BBEST in consultation with TPWD for further analysis of instream flow needs.

Historical Fish Species Distribution and Trends

Our literature review identified numerous fish collections and taxa spanning the entire watershed, sub-watersheds, and ecoregions (Figure 1). There was a clear gradient in the number of species collected, with the highest numbers being collected above and below the Dallas Fort Worth area (Figure 2). Fish collections started in the mid-1950's and continued through 2000's, although listings of fish in the basin go back to late 1800's (Evermann and Kendall 1892). However, fish collecting activity appeared to be largely absent during the mid-1970's through mid-1980's (Figure 3). We have no immediate explanation for this pattern. However, it does appear that earlier collections were associated with fisheries studies conducted primarily in reservoirs.

1950-1970s

The period during the early 1970's was marked by such poor water quality (anoxia and hypoxia) that few fish survived in the upper portions of the Trinity River (Land et al. 1998; TPWD 1974). As water quality improved fish would move into areas but would soon perish when oxygen levels dropped due to additional "black rises". During the period between 1970 and 1985, a total of 13 fish kills were documented in the Trinity River from a reach just downstream from Dallas to Lake Livingston (Davis 1987; Dickson et al. 1991; Land et al. 1998).The source of much of this pollution was believed to come from faulty sanitary sewer collection systems and improperly designed wastewater plants. (Dickson et al. 1991). Only four species of fish were collected by the TPWD during 1972-74. They included smallmouth buffalo, gizzard shad, common carp, and yellow bass. Four of the six surveys yielded no fish from this reach of the river. Two of the species, gizzard shad and common carp, generally are classified as tolerant taxa and could be expected to tolerate the water-quality conditions in this reach in the 1970's. Further downstream beyond the confluence with the East Fork of the Trinity, conditions were more favorable in areas with increased dissolved oxygen and numbers of fish species ranged between 4 to 13 species per collection (Smith 1974). During this same time, further downstream near the headwaters of Lake Livingston, the number of fish species collected had increased to between 16 to 22 (Provine 1974).

1980s

By the late 1980's water quality had begun to recover due to improvements in wastewater treatment and new regional treatment capacity (Wells 1991). The TPWD collected 11 species of fish from this reach in 1987 (Kleinsasser and Linam 1989; Land et al. 1998). Although the 1987 survey yielded more species than the 1972-74 surveys, the TPWD still considered the species richness low and attributed the condition to the fishes' exposure to ammonia nitrogen and heavy metal toxicity associated with wastewater-treatment plant effluents (Davis 1991; Kleinsasser and Linam 1989; TPWD 1974). Alternately, (Anderson et al. 1995) described major shifts in fish communities in the Trinity Basin between 1953 and 1986, with reductions in catfish, darter species and increases in tolerant silversides and Gambusia affinis. They indicated that one of the major causes of these declines were the construction of dams and exotic species introductions. These patterns in fish community changes from fluvial specialists to tolerant generalists have been observed in many large rivers which have been impounded and channelized (Rinne et al. 2005).

1990s to Present

By the mid 1990's as a result of improved water quality, fish communities had recovered substantially in the area below Dallas (Land et al. 1998). The USGS conducted fish-community surveys on the reach at Trinity River downstream from Dallas during 1993-95 (Land et al. 1998). The methods used by the USGS were identical to the methods used by the TPWD in 1987. A cumulative total of 25 species of fish were collected in this reach during the 3-year period. Several game species were collected including largemouth bass, white crappie, and white bass. None of these game species were collected in the reach during the 1972-74 or 1987 surveys. Two darter species, bigscale logperch and slough darter, also were collected. The presence of these indigenous species suggests a return of this reach to more natural conditions. Other species characteristic of warm-water southeastern streams including alligator, spotted, and longnose gars and flathead, blue, and channel catfish were frequently collected during the 1993-95 survey. None of the gar or catfish species were reported in the reach downstream from Dallas in the 1972-74 or 1987 TPWD surveys. Kiesling and Flowers (2002) found that tributaries were very important for maintaining overall Trinity River mainstem fish community. These tributaries were often less disturbed in terms of water quality and hydrology. Portions of the West Fork of the Trinity River below Eagle Mountain and Lake Worth Reservoir had exceptionally diverse fish communities. The lower Trinity River above Lake Livingston also had higher number of species and a less disturbed flow regime.

Focal species identified by BBEST and TPWD for further instream flow analysis were widely distributed within the basin (Figures 4-6). However, some species such as paddlefish had very limited distributions, primarily in the lower mainstem river. Blackspot shiner and dusky darter collections were largely limited to tributaries. These distributions reflect their preferred habitats (e.g. fluvial specialist, mainstem residents).

Figure 2. Species richness of fish taxa reported during each study within the Trinity River basin.

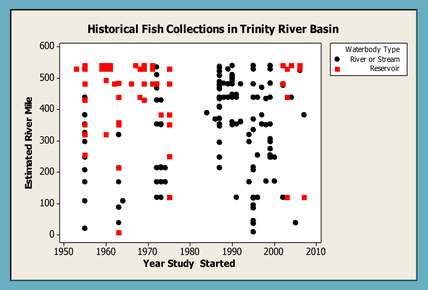

Figure 3. Location of fish collections obtained from literature review. Data from reservoirs and fish kills included.

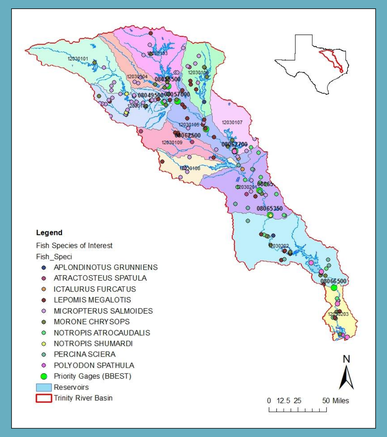

Figure 4. Spatial distribution of focal fish species used in instream flow evaluations in relation to priority gage sites within Trinity River basin. Period of record 1953-2007.

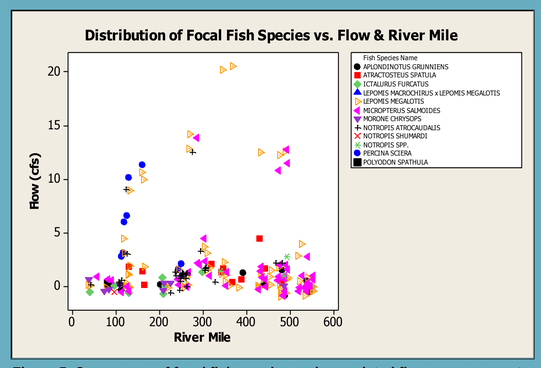

Figure 5. Occurrence of focal fish species and associated flow measurements. Excludes fish kill and reservoir data. Period of record 1953 to 2007. (jitter added to data display)

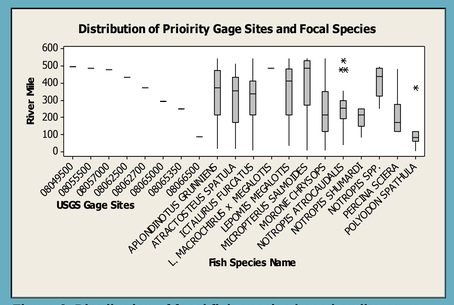

Figure 6. Distribution of focal fish species based on literature review within the Trinity River Basin. Period of record 1930-2009 (excluding reservoir sites).

Conclusions

The Trinity River has a diverse fish community that should be protected from future stressors including water diversions, habitat degradation, and water pollution. Potential bias and problems associated with construction of the database and subsequent analysis included uncertain taxonomy, collection site bias, gear selectivity and flow selective sampling. Changes in water quality and construction of reservoirs have influenced the abundance and diversity of resident fish fauna. The Trinity River is the most fragmented river basin in Texas due to the high number of reservoirs (Chin et al. 2008). However many of the same fish species recorded as early as the late 1800's are still present in the basin.

Guillen, G.J., J. Wrast and D. Ramirez. 2009. Ecological Overlay for the Trinity River for support of Development of Instream Environmental Flow Recommendations. Prepared for: Trinity River Authority and Texas Water Development Board In Cooperation with the Trinity River Authority. Houston, TX.

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