CANDIDATE AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Notropis buccula* Cross

COMMON NAME: smalleye shiner

LEAD REGION: 2

INFORMATION CURRENT AS OF: March 5, 2002

STATUS/ACTION (Check all that apply):
_X_ New candidate
___ Continuing candidate
___ Non-petitioned
___ Petitioned - Date petition received: _____
___ 90-day positive - FR date: _____
___ 12-month warranted but precluded - FR date: _____
_____ Is the petition requesting a reclassification of a listed species?
___ Listing priority change
Former LP: ___
New LP: ___
Latest Date species first became a Candidate: _____
___ Candidate removal: Former LP: ___ (Check only one reason)
___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___ F - Range is no longer a U.S. territory.
___ M - Taxon mistakenly included in past notice of review.
___ N - Taxon may not meet the Act's definition of "species."
___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Fish: Cyprinidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Texas

CURRENT STATES/ COUNTIES (optional)/TERRITORIES/COUNTRIES OF OCCURRENCE:
Texas

LEAD REGION CONTACT (Name, phone number): Susan Jacobsen, (505) 248-6641

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BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Description

The smalleye shiner (*Notropis buccula*) is a small (35 to 44 millimeter (1.4 to 1.7 inches (in)), pallid minnow endemic to the Brazos River Basin in Texas. Adult smalleye shiners have a long snout (greater than the distance from anterior tip of mandible to posterior tip of maxillary), eight principal dorsal fin rays, seven principal anal fin rays, and eight pelvic fin rays (Cross, 1953). This species was originally described as a subspecies of the Red River shiner (*N. bairdi*), an endemic of the Red River system in Texas and Oklahoma, and subsequently elevated to species status (Hubbs, 1957).

As with other fishes of the family Cyprinidae, the smalleye shiner can prove difficult to separate from closely related congeners. Moss and Mayes (1993) found this confusion in historic collections to be most common with *N. potteri*, *N. shumardi*, and *N. stramineus*. For the identification of the smalleye shiner, it was determined that *N. shumardi* differs in body shape, depth of the caudal peduncle, and fin ray counts. *N. potteri* is distinguished from the smalleye shiner through a comparison of tooth count (0,4-4,0 in *N. buccula*), squamation patterns, and the smalleye shiner's posteriorly broadened upper lip. The report of *N. stramineus* from the Brazos River (Anderson et al., 1983) may be erroneous, due to the lack of supporting records (Moss and Mayes, 1993). Although geographically separated, the smalleye shiner is apparently closely related to *N. bairdi* and the federally threatened *N. girardi*, which occurs in the Canadian River in Texas, and may share life history characteristics of these native prairie fishes.

Habitat

Smalleye shiners require habitats almost identical to those of several other obligate riverine fishes native to Texas prairie streams (e.g., *N. oxyrhynchus*). Preferred habitat includes fairly shallow water (38 to 82 centimeters (15 to 32 in) in depth) in broad, open sandy channels with a moderate current (Moss and Mayes, 1993). Ostrand (2000) found abiotic factors associated with smalleye shiner habitat to include specific conductance < 30 mS, relatively high current velocity (> 0.20 m/s)(0.65 feet/s) and high turbidity (> 41 NTU). Within their preferred habitat, smalleye shiners are most often found using the center of the channel, avoiding the shallow depth and slow velocity of the stream edges (Moss and Mayes, 1993). Their diet consists mainly of aquatic insects, dominated by dipterans, and sand/silt suggesting they forage among the substrate (Marks et al. 2001). Although very little is known about the life history of this species, they are thought to be short-lived and spawn in early spring and summer (Moss and Mayes, 1993). Additional life history traits may be similar to those of congeners that inhabit prairie streams such as *N. girardi*, *N. bairdi*, and *N. oxyrhynchus,* which are thought to spawn primarily during flood events (Moore, 1944; Moss and Mayes, 1993).

The Brazos River watershed extends from eastern New Mexico southeasterly to the Gulf of Mexico. The basin is approximately 1,030 kilometers (km)(640 miles(mi)) in length, encompasses approximately 118,103 square kilometers (45,600 square mi) (Dunn and Raines, 2001), ranges in width from 1.6 to 193 km (1.0 to 120 mi), and drains all or portions of 69 counties in Texas (Cronin et al., 1973) and three counties in New Mexico. The predominant land use within the basin is agriculture, dominated by cotton, corn, and sorghum, and open rangeland

(Dunn and Raines, 2001). Within the Middle Brazos River Basin, a large percentage of agriculture consists of concentrated animal feeding operations (CAFOs) (Armstrong, 1998).

The Brazos River is a typical prairie stream. The main stem originates in the upper reach from the confluence of the Salt and Double Mountain Forks. This upper region of the watershed is highly variable with regard to flow and often becomes intermittent, forming isolated pools within the channel (Echelle, et al., 1972; Ostrand, 2000; Ostrand and Wilde, 2001). The river traverses through the Edwards Plateau Ecosystem and extends southeastward through the East Texas and Texas Gulf Coast Ecosystems (U.S. Fish and Wildlife Service, 1994).

Since the early 1900s, significant reservoir construction has occurred within the Brazos River Basin. By 1986, 1,165 minor and 13 major reservoirs, three of which occur on the main stem of the Brazos River, were listed in the Texas Natural Resource Conservation Commission's (TNRCC) dam inventory (Dunn and Raines, 2001). From 1941 to 1969, the rate of reservoir construction increased substantially and included Possum Kingdom Reservoir in 1941, Whitney Reservoir in 1951, and Granbury Reservoir in 1969, which are located on the main stem Brazos River, as well as six other major reservoirs within the watershed (Dunn and Raines, 2001). A new reservoir, Alan Henry Reservoir, impounded the Double Mountain Fork of the Brazos River in October 1993 (Wilde and Ostrand, 1999), to serve as a future water supply for the City of Lubbock (Llano Estacado Water Planning Group, 2001). The effects of reservoir construction in the Brazos River Basin since 1953 have resulted in significant temporal changes to its fish assemblage (Anderson et al., 1995; Hubbs et al., 1997; Wilde and Ostrand, 1999).

Historic Distribution

The smalleye shiner historically occurred throughout the Brazos River proper, the Double Mountain and Salt Forks of the Upper Brazos River drainage and within the Lampasas River, a tributary of the Brazos (Moss and Mayes, 1993). The type locality is from the main stem Brazos in Palo Pinto County, where 14 specimens were collected in 1952 (Cross, 1953). A population may exist in the Colorado River above Buchanan Reservoir (Hubbs et al., 1991) and is presumed to be introduced; however, information on the status of this population is lacking.

Moss and Mayes (1993) conducted an extensive study of the distribution of the smalleye shiner and sharpnose shiner (*N. oxyrhynchus*) within the Brazos River Basin. The study included a review of known museum, university, and other collections (from 1951 to 1986) to determine the historical distribution of both species. Their review indicated the smalleye shiner historically occurred at nine main stem sites, six sites on the Double Mountain Fork of the Brazos River, 14 sites on the Salt Fork of the Brazos River, one site on the North Fork Double Mountain Fork, and one site on the Lampasas River. The collections included specimens from the Upper, Middle, and Lower Brazos River systems (Texas Parks and Wildlife Department, 1996), ranging from the upper reach of the North Fork Double Mountain Fork in Garza County, Texas, to the southernmost site in Brazos County, Texas.

Of the known historical records of smalleye shiners from the Brazos River Basin examined by Moss and Mayes (1993), 24 collections were taken from the Upper Brazos River drainage, the

majority of which were located on the Double Mountain and Salt Forks of the Brazos River. The Double Mountain Fork collections (one sample from 1978 and five from 1986) consisted of 351 specimens collected from sites in Garza, Kent, Fisher, Stonewall, and Haskell Counties. The Salt Fork collections (two samples from 1951, one from 1953, one from 1960, one from 1968, one from 1984, and eight from 1986) contained 492 specimens collected from locations in Kent, Stonewall, Knox, Baylor, and Young Counties. Main stem records from the Upper Brazos consisted of a single specimen collected in 1986 from one site in Young County, and 26 specimens collected from three sites (one from 1951 and two from 1952) in Palo Pinto County. The Palo Pinto County collection includes the holotype and paratypes from the original description.

The remaining nine historical records reviewed by Moss and Mayes (1993) included 16 specimens collected from one site on the Middle Brazos River (Bosque County) in 1952, and 79 specimens collected at eight sites between 1940 and 1976 from the Lower Brazos River (Bell, Brazos, and Burleson Counties). The Lower Brazos specimens include the sample from the Lampasas River in Bell County.

Current Distribution

Moss and Mayes' (1993) assessment of the declining distribution of the smalleye shiner within the Brazos River Basin was based on the historical records compared with their sampling of the basin from October 1988 through August 1991. Sampling sites were selected based on all known localities of the smalleye shiner within the basin (37 sites), most of which (26 sites) were located in the Upper Brazos River Basin, including 24 sites upstream of Possum Kingdom Reservoir. From these upstream samples, a total of 2,388 smalleye shiners were collected from nine sites on the Salt Fork (Kent, Stonewall, Knox, Baylor, and Young Counties), four sites on the Double Mountain Fork (Garza, Kent, Fisher, and Stonewall Counties), three sites on the North Fork Double Mountain Fork (Garza County), and one site on Croton Creek (Kent County), a tributary of the Salt Fork. Two samples taken from the main stem Brazos downstream from Possum Kingdom Reservoir in Palo Pinto County and collections made on two sites on the Clear Fork of the Brazos River (Shackelford and Fisher Counties) did not include smalleye shiners. The smalleye shiner has apparently never been documented from the Clear Fork.

The remaining 11 sampling sites were located within the Middle (Parker and Falls Counties) and Lower Brazos River Basin (Milam, Brazos, Washington, Austin, Fort Bend, and Bell Counties), which included two sites on the Lampasas River. No smalleye shiner was discovered among the collections made at these sites.

Although the smalleye shiner is currently one of the dominant fishes at certain sites within the Upper Brazos drainage and historically occurred within the Middle and Lower Brazos River, it has apparently been extirpated from the basin downstream of Possum Kingdom Reservoir. Ostrand (2000) estimated the current population of smalleye shiners within the Upper Brazos to represent 17% of the fish assemblage. Surveys were conducted at two sites on the North Fork Double Mountain Fork (Garza County), three sites on the Double Mountain Fork (Garza, Kent, and Fisher Counties), five sites on the Salt Fork (Kent and Stonewall Counties), and three sites

on the Brazos River proper (Knox County). Smalleye shiners were present at all 13 sites (6,558 collected) where they represented one of the seven dominant species within the study area (Ostrand, 2000).

The few recent surveys that have been made within the Middle and Lower Brazos do not provide evidence of the persistence of the smalleye shiner within this region. A survey from the Lampasas River (Lampasas and Bell Counties) for the purpose of conducting an index of biotic integrity was completed in 1998 (Armstrong, 1998). From two sites on the Lampasas River, a total of twenty-two species of fish were identified. No smalleye shiners were collected. The smalleye shiner has apparently not been collected from the Lampasas River since 1951.

Winemiller and Gelwick (1999) conducted an assessment of stream integrity in 1998 using fish collected within the Middle and Lower Brazos River, including many of the river's tributaries. Six sites utilized in the study were on the main stem Brazos River in McLennan, Falls, Robertson, Washington, and Fort Bend Counties. These collecting efforts produced 53 species of fish; however, no smalleye shiners were collected.

Most recently, a survey was conducted specifically for sharpnose shiner in the Middle (Falls County) and Lower Brazos River (Austin, Brazos, Fort Bend, and Robertson Counties), including two sites on the Lampasas River, in 2000 and 2001. The sharpnose shiner is an endemic fish of the Brazos River that utilizes similar habitats of the smalleye shiner. The results of the survey indicated that no smalleye shiners were present within this portion of their historical range (Wilde and Bonner, unpublished).

The population of smalleye shiners within the Upper Brazos River drainage (upstream of Possum Kingdom Reservoir) is apparently stable. Downstream from the reservoir, the shiner has not been collected since 1976 and in all likelihood is completely extirpated representing a reduction of approximately 64% of its historical range.

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. **If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change**):

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>.

The most significant threat to the existence of the smalleye shiner is the present and continued modification of its habitat attributable to anthropogenic factors. These factors include reservoir construction, irrigation and water diversion, sedimentation, industrial and municipal discharges, and agricultural activities.

Reservoirs

River impoundments adversely affect downstream fisheries by altering temperature regimes, flow rates, substrate, water quality, and nutrient availability (Anderson et al., 1983). The downstream effects of impoundments often create a benign habitat within the channel, restricting its use to

those species that proliferate in deep, incised channels. The significant changes to fish assemblages, including the local extinction of species, produced by downstream effects have been well documented (Gore and Bryant, 1986; Anderson et al., 1983). Reservoirs also fragment riverine habitat prohibiting the completion of the life cycle for those species that require an unimpeded stream for spawning and/or migration.

The downstream effects of reservoirs have altered the habitat within the Brazos River, impacting the fish assemblage. The Morris Sheppard Dam, which impounds Possum Kingdom Reservoir, incorporates hydroelectric generators, which utilize stored water through releases from the dam dependent on pool elevation and local power needs. These hypolimnial releases have modified the thermal regime up to 120 km (75 mi) downstream and along with the associated chemical modifications are likely responsible for the extirpation of at least four species of fish in the downstream reach (Anderson et al., 1983). In addition to the thermal and chemical alterations affecting fish assemblages, flow regime regulated by dams restricts habitat availability for many fish species (Bain et al., 1988). The marked decrease in fish diversity and decrease in abundance of cyprinids documented within the Brazos River Basin are also likely due to habitat modifications such as reservoir construction (Anderson et al., 1995).

Changes in channel morphology and substrate have also taken place within the Brazos River due to major impoundments. Restriction of natural stream flow and sediment transport often contributes to channel incision and widening. The transport of sand through the Brazos River system has decreased in part due to reservoirs (Mathewson and Minter, 1981; Dunn and Raines, 2001). Mathewson and Minter (1981) suggested that the major reservoirs trap approximately 76% of all sand produced within the Brazos River Basin.

Collections made by Moss and Mayes (1993) revealed a distinct difference between the fish assemblage upstream and downstream from Possum Kingdom Reservoir. They suggested that the effects of reservoir construction on the downstream channel have modified the habitat, excluding many native prairie minnows while generalist cyprinids have prospered. Anderson et al. (1983) noted the change created by the construction of the reservoir from sandy bottom and high turbidity (typical smalleye shiner habitat) to clear, gravel bottom habitat for a distance of 30 km (19 mi) downstream from the Morris Sheppard Dam. Within this reach, seven species not normally found in the non-impacted reaches of the Brazos River (i.e., upstream from the reservoir), including two exotic species, had invaded the modified channel (Anderson et al., 1983).

In addition to the impacts of Possum Kingdom Reservoir on the Brazos River, two other impoundments occur on the main stem Brazos. Granbury Reservoir, approximately 258 km (160 mi) downstream from Possum Kingdom, and Whitney Reservoir, approximately 92 km (57 mi) downstream from Granbury, have also contributed to the modified habitat within the Middle and Lower Brazos River, which is most likely no longer suitable for the smalleye shiner.

Reservoir construction on rivers also affects instream habitat and biotic communities upstream of the impoundment, which may include the extirpation of obligate riverine fish (e.g, Winston et al., 1991). Ecological imbalances can occur when facultative riverine fish propagate in reservoirs

and disperse into upstream reaches (Winston et al., 1991). Impoundments also present a barrier, preventing upstream migration and/or dispersal, and may cause local extirpations in upstream areas (i.e., headwaters) subject to drought or other natural disturbances (Wilde and Ostrand, 1999).

A study of the effects of the recently constructed Alan Henry Reservoir on the Double Mountain Fork of the Brazos River (Garza County) on prairie stream fish was performed by Wilde and Ostrand (1999). This segment of the Double Mountain Fork is in a semi-arid region (precipitation 46-71 cm/yr) where flow is intermittent and dependent on rain events. During the absence of flow, the stream is characterized by isolated pools that provide the only habitat for fish until the next rain event, which may not occur for several months. Following the impoundment of the river, the upstream reach showed a dramatic change in the fish assemblage, including a decrease in cyprinids and increase in abundance of cyprinodontids (Wilde and Ostrand, 1999). This study indicated that one species of fish has been extirpated from the upstream reach, and another, the smalleye shiner, has been significantly reduced in numbers, and may soon be extirpated. The disappearance of the fish is attributed to the lack of reproduction and/or survival occurring in isolated pools combined with the inability of the downstream population to recolonize the area due to the barrier created by the impoundment.

Future Reservoir Development

As required by Senate Bill 1 (enacted by the 75th Texas Legislature in 1997), Water Planning Regions within the State of Texas have developed and finalized Regional Water Plans for the purpose of addressing future water needs. The Regional Water Plans are to be incorporated into an overall State Water Plan addressing water management, development, and conservation for the 50-year period from 2000 to 2050.

The majority of the Brazos River Basin falls within the Regions G (Brazos) and O (Llano Estacado) Water Planning Areas. Among the water management strategies detailed in the Region G Water Plan six potential major reservoirs are included as feasible for providing water supply for the region. The potential major reservoirs listed in the plan are as follows:

- Breckenridge Reservoir (= Reynolds Bend), would be located in Throckmorton County and impound the Clear Fork of the Brazos River just downstream from the confluence with Paint Creek and is anticipated to store 600,000 acre feet of water;

- South Bend Reservoir, would be located in Young County immediately upstream from the confluence of the main stem and the Clear Fork of the Brazos River, capturing flow from both channels, and storing up to 745,800 acre feet of water;

- Paluxy Reservoir in Somervell County, would impound the Paluxy River, a tributary of the Brazos, and store 99,700 acre-feet of water;

- Bosque Reservoir, would be located in Bosque County on the North Bosque River, a tributary of the Brazos, approximately 6.4 km (4 mi) upstream from the City of Meridian and

would store 102,900 acre-feet of water;

- Millican Reservoir, which was originally authorized by the U. S. Congress in 1968 and has subsequently been studied for feasibility at two sites on the Navasota River; the Panther Creek site located approximately 21 km (13 mi) southeast of the City of Bryan (Brazos, Madison, and Grimes Counties) would store 1,973,000 acre-feet of water, and the Bundic Dam site, located between SH 21 and US 79 (Brazos, Robertson, Madison, and Leon Counties) would store 228,000 acre-feet of water;

- and Little River Reservoir, would be located in Milam County on the Little River just upstream from the confluence with the Brazos River and would store between 180,000 and 903,000 acre-feet of water.

In addition to these major reservoirs, the Region G Water Plan lists three minor reservoirs (estimated firm yields from 100 to 1,000 acre-feet/year) that would impound tributaries within the Brazos River Basin for water supply needs for the Cities of Throckmorton, Woodson, and Cisco.

Included in the Region G Water Plan are five off-channel reservoirs for water supply projects. An off-channel reservoir would divert water from a primary stream during high flows to a reservoir for storage. The off-channel reservoirs are Meridian, Somervell, Groesbeck, Little River, and Peach Creek. Of these reservoirs, Meridian and Somervell are alternatives considered for the Bosque and Paluxy Reservoirs, respectively. The water rights for Groesbeck Reservoir have been obtained and authorize the diversion of 2,500 acre-feet of water per year from the Navasota River in Limestone County. Peach Creek Reservoir would serve Brazos County by the impoundment of Peach Creek and water diversion from the Navasota River for the storage of 14,511 acre-feet. The newly proposed Little River Off-Channel Reservoir would be constructed on Beaver Creek, a tributary of the Little River, and store 202,500 acre-feet of water.

The water management strategies for the Region O Planning Area include the construction of Post Reservoir on the North Fork Double Mountain Fork of the Brazos River in Garza County. Post Reservoir has been authorized by the TNRCC, with a permit expiration date in 2008, and would impound 57,420 acre-feet of water.

An additional reservoir, not included in the Regional Water Plans, is under consideration by Knox, Nolan, Fisher, Stonewall, Haskell, and Kent Counties for future water supply. The proposed Double Mountain Fork Reservoir is in the initial stages of planning with potential dam sites located on the Double Mountain Fork upstream from the confluence with the Salt Fork in Stonewall County (Freese and Nichols, 2001).

The historical habitat within the Middle and Lower Brazos River has effectively been converted from habitat that once supported the smalleye shiner to habitat comprised of thermal, physical, and morphological parameters no longer suitable to the shiner, largely resulting from impoundments within the basin. Although the last known record of the fish from the main stem downstream of Possum Kingdom Reservoir occurred over twenty years ago, remnant populations

may still exist in areas of suitable habitat. However, the suitable habitat remaining may be fragmented to the extent that any surviving populations are no longer viable. The continued effects of the existing impoundments coupled with the potential future water management strategies outlined in the Regional Water Plans seriously discount the possibility of recovery of the shiner in the Middle and Lower Brazos River.

Within the Upper Brazos River system, smalleye shiners are most common within the higher order streams (Ostrand, 2000) with suitable flow and conductivity. The flow within the headwater reaches of the Double Mountain and Salt Forks is intermittent and often restricted to large pools within the channel. Under the harsh conditions that accompany the non-flow periods, smalleye shiners are among the first species to be eliminated within the pools (Ostrand and Wilde, 2001).

The isolated pools of the Upper Brazos tributaries are unlikely suitable for successful reproduction of the smalleye shiner (Wilde and Ostrand, 1999). Its persistence in these upper reaches is most likely the result of recolonization from populations occurring downstream during times of normal flow (Wilde and Ostrand, 1999; Ostrand and Wilde, 2001). However, the headwaters may be significant to the reproductive success of the shiner. Reproduction may be triggered by flood events, allowing shiners to move into the headwaters where eggs would be released and transported by currents downstream to perennial areas (Wilde, pers. comm.). Reservoir construction on the Upper Brazos tributaries would create a barrier between the base population and the upper reaches, preventing recolonization and potentially reducing reproductive success.

The headwaters of the Double Mountain Fork of the Brazos River in Garza County were isolated from the downstream reach in 1991 by the construction of the John T. Montford Dam, which impounds Alan Henry Reservoir. Upstream of the reservoir, the once common smalleye shiner has apparently disappeared following the completion of the dam (Wilde and Ostrand, 1999). A similar situation could occur on the Double Mountain Fork downstream of Alan Henry Reservoir and on the North Fork Double Mountain Fork, should the Double Mountain Fork and Post Reservoir projects be implemented. The potential direct impacts to the shiner resulting from construction of these reservoirs include 1) the inundation of occupied habitat, 2) the local extinction of upstream populations, and 3) the loss of habitat downstream from the dams due to the modification of necessary abiotic components (flow regime, thermal regime, substrate, conductivity, etc.).

Chloride Control Reservoirs

The streams of the Upper Brazos River Basin are characterized by natural salts that originate within the salt and gypsum terrain and an underlying brine aquifer within this region. Because the salt entering the Brazos River in this area limits its use as a practical water supply, several studies on the feasibility of salt control have been conducted (e.g., Johnson et al., 1982).

Options within the Region G Water Plan for the control of naturally occurring chlorides include deep well injection of recovered brine from the aquifer and the construction of Kiowa Peak

Reservoir for the disposal of recovered brine. The Kiowa Peak Reservoir would be located on North Croton Creek just upstream from the confluence with the main stem Brazos (Stonewall and King Counties) and have a storage capacity of 659,650 acre-feet. The original design and study on Kiowa Peak was done by the U.S. Army Corps of Engineers and included the two additional salt retention reservoirs - Dove, located on Haystack Creek (Stonewall and King Counties), and Croton, located on Croton Creek in Stonewall and Kent Counties (Johnson et al., 1982).

The smalleye shiner evolved to prosper in the saline and turbid conditions naturally occurring in the Brazos River. The various chloride control projects proposed for the Upper Brazos for the conversion of the natural saline waters to a quality available for human consumption would modify the chemical characteristics conducive to smalleye shiner habitat. Additionally, those projects that require the construction of brine retention reservoirs may also inundate shiner habitat and reduce instream flows to the major tributaries (i.e., the Salt Fork), as well as the Brazos River proper.

Existing Reservoir Enhancement

An alternative to water management within the Brazos River Basin is expanding the available yield in an existing reservoir by increasing the conservation pool level, water diversion to temporary storage, and construction of a new embankment downstream from the current one. Within the Brazos River Basin, Region G projects related to existing reservoir supply include increasing the storage of Leon Reservoir (conservation pool raise) in Eastland County, water diversion from California Creek into Stamford Reservoir (Haskell County), water diversion from Sweetwater Creek into Sweetwater Reservoir (Nolan County), water diversion from Battle Creek into Cisco Reservoir (Eastland County), and increasing the storage in Fort Phantom Hill Reservoir (new downstream embankment) in Jones County. These projects would contribute to the documented effects impoundments cause to river systems, especially regarding flow regime, within the existing range of the smalleye shiner.

Discharges and Sedimentation

In 1996, 329 domestic facilities (i.e., municipal wastewater) and 172 industrial facilities held permits by the state (TNRCC, 1996) within the Brazos River Basin. Permits held by domestic and industrial facilities allow for the discharge of treated and untreated effluent into the basin. Within the Upper Brazos River drainage alone, the sum of permitted facility discharges is more than 6,670 million gallons of effluent per day (U.S. Fish and Wildlife Service, unpublished data). These discharges modify water quality and add to the continued alteration of the Brazos River channel, affecting its morphology and substrate composition. Adverse conditions within the channel, such as low dissolved oxygen, causing fish kills result from these discharges when sewage facilities fail.

Sediment entering streams via stormwater runoff is the primary source of impairment to surface waters in the United States (Zweig, 2000). The predominant land use within the Brazos River Basin is agriculture. The practices that accompany agricultural operations, including harvesting,

tilling, and native vegetation clearing contributes to sediment entering the Brazos River system and the conversion of the natural substrate to silt and mud bottom. This source, along with other development projects involving significant
earth disturbance resulting in excessive sedimentation within the Brazos River, reduces the available habitat for the smalleye shiner.

In 1996, 282 agricultural facilities (i.e., CAFOs) were permitted by the state (TNRCC, 1996) within the Brazos River Basin. The wastes associated with CAFOs are typically high in nutrients (i.e., nitrogen and phosphorus compounds) and historically discharges of these wastes to surface water bodies have resulted in degraded water quality and wildlife mortality (Baker et al., 1998). CAFOs are not permitted to discharge into Waters of the United States except during severe weather events that exceed in intensity a 25-year rainfall event in a 24-hour period. In addition, during periods of intense rainfall and high flooding, retention structures can fail and lead to severe pollution to water bodies that results in fish kills due to the inability of the watershed to filter or dilute the heavy nutrient load. Although discharge from CAFOs is not allowed by permit under normal conditions, unlawful discharge does occur. For example, from 1993 to 1998, the Environmental Protection Agency (EPA), under the Clean Water Act, documented 24 discharges from permitted CAFOs into Waters of the United States in Texas. Thirteen of these discharges were caused by chronic storm events and reported to the EPA, the remaining eleven were illegal discharges.

From 1992 to 1999, the Texas Parks and Wildlife Department investigated over 60 fish kills attributable to anthropogenic causes (sewage discharge, oil spills, fertilizers, pesticides, etc.) and resulting in approximately 1,100,000 mortalities within the Brazos River Basin (Texas Parks and Wildlife, 2002).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

There is no current information that would suggest smalleye shiners are over utilized for commercial, recreational, scientific, or educational purposes. Minnows of the genus *Notropis* are undoubtedly used as bait fishes and are probably harvested in the commercial bait industry. Commercial bait harvesters are required to obtain a permit and report annually on the species and numbers collected. However, the permit does not restrict the quantity of nongame fishes that can be harvested, and furthermore, the list of nongame fishes allowed for harvest under the permit specifies "*Notropis spp*.," which is likely the most detail submitted in an annual report. Currently, four permits have been issued for the harvest and sale of minnows from the Brazos River. Only two permittees reported a harvest in 2001. The impacts the commercial bait industry may have on the smalleye shiner are unknown.

C. Disease or predation.

The impact of disease or predation on the smalleye shiner is not known. The State introduces game fish within the Brazos River and its impoundments, including some exotic species, which likely prey on smalleye shiners. However, the extent of the effects of predation has not been determined.

D. The inadequacy of existing regulatory mechanisms.

State law does not provide protection for the smalleye shiner. There are no regulatory mechanisms for persons harvesting these minnows for use as bait fish, with the exception of a State fishing license and Nongame Fish Permit. Permitted individuals are not restricted in quantity for bait fish harvests. See also the discussion under A. above.

E. Other natural or manmade factors affecting its continued existence.

In recent years, the Brazos River has experienced massive blooms of golden algae (*Prymnesium parvum*) resulting in several fish kills. The alga kills by way of toxins released into the water that have a lethal effect on gill-breathing animals. Although little is known about the causes of golden algal blooms, as with many other algae, they may be triggered by excessive nutrient loading from point source and non-point source events such as industrial and municipal discharges and runoff from agricultural operations. The effects of the golden algae may be insignificant, but further information is necessary.

Within the Lower Brazos River, sand and gravel operations have mined the channel for many years (Dunn and Raines, 2001). The significance of the effects of these operations to the smalleye shiner is not known.

The current limited distribution of the smalleye shiner within the Upper Brazos River Basin makes it vulnerable to catastrophic events occurring in this region. The shiner maintains populations within the harsh conditions of this area and can recover from droughts, provided the conditions of its habitat remain suitable. Catastrophic events such as the introduction of competitive species or prolonged drought would increase the likelihood of extinction.

The potential for the introduction of competitive species is high due to the reports of such unintentional introductions by anglers and commercial bait fishermen. For example, the Red River shiner (*N. bairdi*) was apparently introduced into the range of the threatened Arkansas River shiner, and may seriously threaten its status. The Red River shiner is currently not known from the Brazos River, however, the probability of introduction is high, since the Red River Basin is immediately to the north of the current population of smalleye shiners. Currently, there is no evidence that introduced species within the Brazos River effectively compete with the smalleye shiner.

BRIEF SUMMARY OF REASONS FOR REMOVAL OR LISTING PRIORITY CHANGE: N/A

FOR RECYCLED PETITIONS: N/A

a. Is listing still warranted? ___
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? ___
c. Is a proposal to list the species as threatened or endangered in preparation? ___
d. If the answer to c. above is no, provide an explanation of why the action is still

precluded.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners):

The smalleye shiner occurs in rivers, which are owned by the State of Texas. The majority of the riparian land ownership within the documented range of the shiner is private, with minor areas owned by the State (Parks), and Federal (Corps of Engineers) governments.

PRELISTING (Describe status of conservation agreements or other conservation activities): None

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

Anderson, A. A., C. Hubbs, K. O. Winemiller, and R. J. Edwards. 1995. Texas freshwater fish assemblages following three decades of environmental change. Southwest. Nat. 40(3):314-321.

Anderson, K. A., T. L. Beitinger, and E. G. Zimmerman. 1983. Forage fish assemblages in the Brazos River upstream and downstream from Possum Kingdom Reservoir, Texas. J. Freshwater Ecol., 2:81-88.

Armstrong, M. A. 1998. A fishery survey of the middle Brazos River basin in north-central Texas. U S. Fish and Wildlife Service, Region 2, 72 pp.

Bain, M. B., J. T. Finn, and H. E. Booke. 1988. Streamflow regulation and fish community structure. Ecology, 69(2):382-392.

Baker, D. L., J. D. Lusk, and C. M. Giggleman. 1998. Phase II Contaminants Investigation of Buffalo Lake National Wildlife Refuge, Texas 1993-1994. U.S. Fish and Wildlife Service, Arlington, Texas, 35 pp.

Brazos G Regional Water Planning Group. 2001. Brazos G Regional Water Planning Area, Regional Water Plan, prepared by HDR Engineering, Inc. for the Texas Water Development Board.

Cronin, J. G., C. R. Follett, G. H. Shafer, and P. L. Rettman. 1973. Reconnaissance investigation of the ground-water resources of the Brazos River Basin, Texas. Texas Water Commission Bulletin 6310, 152 pp.

Cross, F. B. 1953. A new minnow, *Notropis bairdi buccula*, from the Brazos River, Texas. Tex. J. Sci., 5:252-259.

Dunn, D. D. and T. H. Raines. 2001. Indications and potential sources of change in sand

transport in the Brazos River, Texas. United States Geological Survey Water-Resources Investigations Report 01-4057, 32 pp.

Echelle, A. A., A. F. Echelle, and L. G. Hill. 1972. Interspecific interactions and limiting factors of abundance and distribution in the Red River pupfish, *Cyprinodon rubrofluviatilis*. Amer. Mid. Nat. 88:109-130.

Freese and Nichols. 2001. Aspermont Economic Development Corporation analysis of potential dam sites in Stonewall County, Draft Memorandum Report, 64 pp.

Gilbert, C. R. 1980. *Notropis buccula* Cross, smalleye shiner. p. 242 in D.S. Lee et. al. *Atlas of North American Freshwater Fishes*. N. C. State Mus. Nat. Hist., Raleigh, *i-x* + 854 pp.

Gore, J. A. and R. M. Bryant. 1986. Changes in fish and benthic macroinvertebrate assemblages along the impounded Arkansas River. J. Freshwater Ecol., 3(3):333-345.

Hubbs, C. 1957. A checklist of Texas fresh-water fishes. Texas Game and Fish Commission, Inland Fisheries Series 3:1-11.

Hubbs, C. L., R. J. Edwards, and G. P. Garrett. 1991. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. Tex. J. Sci. 43(4) Supplement, 56 pp.

Hubbs, C. L., E. Marsh-Matthews, W. J. Matthews, and A. A. Anderson. 1997. Changes in fish assemblages in east Texas streams from 1953 to 1986. Tex. J. Sci. 49(3) Supplement:67-84.

Johnson, J. L., R. H. Wiley, R. DeArment, B. Spain, and B. Alexander. 1982. Brazos Natural Salt Pollution Control Project, Texas. U. S. Department of the Interior, Fish and Wildlife Service, Region 2, Area 1, Austin, Texas, 41 pp.

Llano Estacado Water Planning Group. 2001. Llano Estacado Water Planning Area Regional Water Plan. Prepared by HDR Engineering, Inc. for the Texas Water Development Board.

Marks, D. E., G. R. Wilde, K. G. Ostrand, and P. J. Zwank. 2001. Foods of the smalleye shiner and sharpnose shiner in the upper Brazos River, Texas. Tex. J. Sci., 53(4)327-334.

Mathewson, C. C. and L. L. Minter. 1981. Impact of water resource development on the hydrology and sedimentology of the Brazos River, Texas with implications on shoreline erosion. Bull. Assoc. Eng. Geol 18(1):39-53.

Moore, G. A. 1944. Notes on the early life history of *Notropis girardi*. Copeia 4:209-214.

Moss, R. W. and K. B. Mayes. 1993. Current status of *Notropis buccula* and *Notropis*

oxyrhynchus in Texas. River Studies Report 8, Texas Parks and Wildlife Department, Austin, 125 pp.

Ostrand, K. G. 2000. Abiotic determinants of fish assemblage structure in the upper Brazos River, Texas. Unpublished PhD dissertation, Texas Tech Univ., Lubbock, 101 pp.

Ostrand, K. G. and G. R. Wilde. 2001. Temperature, dissolved oxygen, and salinity tolerences of five prairie stream fishes and their role in explaining fish assemblages. Trans. Am. Fish. Soc., 130:742-749.

Texas Parks and Wildlife Department. 1996. Survey Report for the Brazos River, 1994. Statewide Freshwater Fisheries Monitoring and Management Program, Federal Aid in Sport Fish Restoration Act Project F-30-R, 38 pp.

Texas Parks and Wildlife Department. 2002. Pollution Response Inventory and Species Mortality (PRISM) Database. Compiled by Texas Parks and Wildlife Department Kills and Spills Team, Resource Protection Division, Austin, Texas.

Texas Natural Resource Conservation Commission. 1996. The state of Texas water quality inventory, 13th Edition, Volume 2, 711 pp.

U. S. Fish and Wildlife Service. 1994. An Ecosystem Approach to Fish and Wildlife Conservation: An Approach to More Effectively Conserve the Nation's Biodiversity, 14 pp.

Wilde, G. R. personal communication. Texas Tech University, Lubbock, Texas.

Wilde, G. R. and T. H. Bonner. Unpublished. Texas Tech University, Lubbock, Texas; Southwestern State University, San Marcos, Texas.

Wilde, G. R. and K. G. Ostrand. 1999. Changes in the fish assemblage of an intermittent prairie stream upstream from a Texas impoundment. Tex. J. Sci., 51(3): 203-210.

Winemiller, K. O. and F. P. Gelwick. 1999. Assessment of ecological integrity of streams in the Brazos-Navasota River watershed based on biotic indicators. Final Project Report to the Brazos River Authority, 32 pp.

Winston, M. R., C. M. Taylor, and J. Pigg. 1991. Upstream extirpation of four minnow species due to damming of a prairie stream. Trans. Am. Fish. Soc., 120:98-105.

Zweig, L. D. 2000. Effects of deposited sediment on stream benthic communities. Master of Science Thesis, University of Missouri-Columbia, 150 pp.

LISTING PRIORITY (place * after number)

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5*
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Pat Langley April 25, 2002
Acting Regional Director, Fish and Wildlife Service Date

Concur: Steve Williams June 3, 2002
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks: _____

_____

_____

Date of annual review: _____
Conducted by: _____

Comments: _____

_____

_____

(rev. 1/02)