U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Popenaias popei

Common Name:

Texas Hornshell

Lead region:

Region 2 (Southwest Region)

Information current as of:

03/01/2013

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: New Mexico, Texas
- **US Counties**:County information not available
- **Countries**: Mexico

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: New Mexico, Texas
- **US Counties**: Eddy, NM, Brewster, TX, Terrell, TX, Val Verde, TX, Webb, TX
- **Countries**: Mexico

Land Ownership:

In New Mexico, riparian land ownership along the Black River includes private, State, and Federal (Bureau of Land Management) landowners. In Texas, (Rio Grande and Devils River) populations are adjacent to private land. However, the Rio Grande Wild and Scenic River is managed and administered by the National Park Service. It is presumed, but not confirmed, that there are additional extant populations within the Big Bend reach of the Rio Grande in Texas, where riparian land ownership includes private, State (Texas Parks and Wildlife Department and Texas General Land Office), and Federal (National Park Service) landowners.

Lead Region Contact:

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Biological Information

Species Description:

Shells of Texas hornshell are trapezoidal, compressed, gently rounded posteriorly, and generally dark brown to dark green (Howells 1996a, p. 93). Maximum length has been reported as 116 millimeters (mm) (4.5 inches (in.)) (Howells 1996a, p. 93).

Taxonomy:

The Texas hornshell (Popenaias popeii) is a member of the freshwater mussel family Unionidae. It was originally described as Unio popeii by Lea in 1857, but was later placed in the genus Elliptio by Ortmann (1912) and afterward given its own subgenus within the genus Elliptio (Frierson 1927). Subsequently, Heard and Guckert (1970) elevated Popenaias to genus and created a new subfamily, Popenaiadinae, for the genera Cyrtonaias and Popenaias. Popenaiadinae was dropped on the basis that its diagnostic criteria represented species-specific rather than phylogenetically significant characters (Heard 1974). Currently, Texas hornshell is classified in the unionid subfamily Ambleminae (Campbell et al. 2005, p. 144) and is considered a valid taxon by the scientific community (Turgeon et al. 1998, p. 36). Data collected and analyzed under an ongoing genetics study including individuals from Texas and New Mexico reveal a single species across all populations (Hoeh 2009).

Habitat/Life History:

Texas hornshell are found where small-grained substrata (clays, silts, sands, and gravel) collect in undercut riverbanks, crevices, shelves, and at the base of large boulders (Lang 2006, p. 8). Within these macrohabitat types, Texas hornshell occur singly or aggregated in shallow water microhabitats that serve as flow refugia (Strayer 1999) during large volume discharge periods associated with annual precipitation events (Lang 2001). These macrohabitat types are found in the Black River, New Mexico; a shallow, narrow stream that runs over travertine bedrock. In the Rio Grande, they are found under large boulders or beneath limestone ledges where clay seams provide a stable substrate (Burlakova and Karatayev, 2011 p. 2).

Adult freshwater mussels are filter-feeders, siphoning algae, bacteria, detritus, microscopic animals, and dissolved organic matter (Fuller 1974, pp. 221-222, Silverman et al. 1997, p. 1862; Nichols and Garling 2000, p. 874-876; Christian et al. 2004, p. 109). For their first several months, juvenile mussels employ foot (pedal) feeding and are thus suspension feeders that feed on algae and detritus. Mussels tend to grow relatively rapidly for the first few years, and then slow appreciably at sexual maturity when energy is being diverted from growth to reproductive activities. Large, heavy-shelled riverine species, like Texas hornshell, tend to have longer life spans, commonly exceeding 20 years (Anthony et al. 2001, p. 1354).

Texas hornshell have separate sexes, and spawning occurs from January through September in the Black River in New Mexico (Lang 2001; Smith et al. 2003). Females produce ova that are held in a modified gill

chamber. Ova are fertilized by sperm, which are released into the water column by males and then taken in through the incurrent siphon of the female. Developing zygotes are held in brood pouches of the gills (marsupia) for 4 to 6 weeks (Smith et al. 2003).

Female Texas hornshell release larvae, called glochidia, in a sticky mucous mass or string, called a conglutinate, between May and July each year (Smith et al. 2003). Glochidia are obligate parasites on fish and attach to the gills, fins, or head of appropriate host species where they encyst and feed off of the hosts body fluids. Laboratory studies have indicated that P. popeii is a host generalist (e.g., Lang 2001, 2004, 2009; Levine et al. In Review, p. 6). However, three species of fish the river carpsucker (Carpoiodes carpio), gray redhorse (Moxostoma congestum), and red shiner (Cyprinella lutrensis) represented 80 percent of all individual fishes infested with Texas hornshell glochidia and carried over 99 percent of estimated glochidia in a recent study (Lang 2010, p. 19). Completely metamorphosed juveniles are recruited into the free-living benthic-dwelling community once released from the host fish (Trdan and Hoeh 1982, p. 381).

Based on our current knowledge of habitat and life history characteristics of the Texas hornshell, important characteristics of habitat appear to include: 1) freeflowing streams with undercut riverbanks, crevices, shelves, or large boulders that provide the flow refuges preferred by the species, and 2) water with no or low levels of pollutants.

Historical Range/Distribution:

Historically, Texas hornshell is known to have occurred in the lower portion of the Pecos River in New Mexico, in the Rio Grande from San Francisco Creek (in the Big Bend reach, Brewster County, Texas) downstream throughout the Lower Rio Grande (Brownsville, Texas), in major tributaries of the Rio Grande in Texas, and southward to the Río Pánuco drainage of San Luis Potosí, México (Metcalf 1982; Taylor 1983; Neck and Metcalf 1988; Howells et al. 1996).

In New Mexico, this species was common in the lower Pecos River from North Spring River, Roswell, Chaves County (Cockerell 1902) south to Texas, including the Black and Delaware Rivers in Eddy County (Taylor 1983; NMDGF 2007). Live specimens were taken from the lower Pecos River near Carlsbad, New Mexico, as late as 1937 (Metcalf 1982). Umbonal shell fragments of fossilized Texas hornshell were collected from the Pecos River on the Salt Creek Wilderness of the Bitter Lake National Wildlife Refuge (Chaves County) and the Delaware River (Eddy County) in 1996 (Lang 2001).

Texas historically held an abundant and diverse assemblage of freshwater mussels, with 52 species (of the over 300 native taxa in the United States) present in the waters of the State (Howells et al. 1996, p. 1; Howells et al. 1997). Dramatic declines have been documented in the past 2 decades, to a level of such significance that many rivers and streams no longer support any native freshwater mussel populations (Howells et al. 1997). Early records show Texas hornshell in the Pecos River, Ward County, Texas (Strecker 1931) and near the Rio Grande confluence in Val Verde County, Texas (Metcalf 1982). In the Rio Grande in Texas, collections indicate the species historically occurred from San Francisco Creek in the Big Bend area, Brewster County, downstream to Brownsville, near the Gulf of Mexico (Howells et al. 1996, p. 93). Historical collections also confirm the presence of Texas hornshell in the Devils River and Las Moras Creek, tributaries to the Rio Grande (Howells et al. 1996, p. 93). Live specimens from these areas in Texas were reported by Strecker (1931).

Historical collections in Mexico are from the Río Salado (type locality) and two disjunct drainages, Ríos Pánuco and Valles (in the state of San Luis Potosí), some 805 kilometers (km) (500 miles (mi)) south of the Rio Grande basin (Hinkley 1907; Ortmann 1912). Unfortunately, scientific understanding of freshwater mussels located in Mexico is especially poor and aspects of classification, biology, and distribution remain confused. Therefore, the historical distribution of Texas hornshell in Mexico cannot be fully determined.

Current Range Distribution:

The Texas hornshell has declined notably throughout its historical range. The species is confirmed to be extant in the Black River in New Mexico and the Devils River and Rio Grande in Texas (Howells and Ansley 1999; Howells 2001; Howells 2004; Strenth et al. 2004; Burlakova and Karatayev 2008, 2011, p. 5; Miller 2008, 2009).

The Texas hornshell is restricted to about 12 percent of its known historical range in New Mexico (Lang 2009) and represents the last remaining native freshwater mussel in New Mexico, as all other mussels (seven species) considered native in the State have been extirpated (Metcalf 1982, Lang and Mehlhop 1996). Since 1996, a population of Texas hornshell has been confirmed in the Black River (western tributary of the Pecos River), New Mexico, from Black River Village downstream to the U.S. Highway 285 bridge crossing, in Eddy County (Lang 2001). This population is considered isolated from the Texas populations as they are hydrologically separated by large dams and reservoirs and numerous small diversions. Prior to 1996, live Texas hornshell had not been reported in New Mexico since the 1930s (Metcalf 1982). The population occurs in approximately 14 km (8.7 mi) of the Black River between two low-head dams (Lang 2001). This section of the Black River has permanency of flow, adequate water quality, and suitable substrates that provide habitat conditions for the persistence of this relict population.

In the Rio Grande, Texas hornshell is known from downstream of Big Bend National Park and near Laredo, in Webb County, Texas (Burlakova and Karatayev 2011, p. 1).

Freshwater mussel surveys were initiated in the lower Pecos River in Texas in 1995 and monitoring surveys are ongoing sporadically, but to date have not located any shells of Texas hornshell. Despite numerous collection efforts in the 1990s, no evidence of living freshwater mussels was documented in these areas (Howells 1994, 1996a, 1996b, 1997, 1998, 1999, 2001, 2003, 2004; Howells et al. 1996; Howells and Ansley 1999).

The distribution of the species in Texas and Mexico was reviewed in Strenth et al. (2004). Dead shells of Texas hornshell were recently located in the Río Sabinas of northern Chihuahua, Mexico; and from two tributaries of the Colorado River in central-west Texas (Llano River, Llano County and South Concho River, Tom Green County). However, no evidence was found indicating there are extant populations of Texas hornshell in these locations (Strenth et al. 2004).

Population Estimates/Status:

In 1998, 32 sites along approximately 161 km (100 mi) of the Rio Grande downstream of Big Bend National Park in Texas and Mexico were surveyed by the Texas Parks and Wildlife Department (TPWD) (Howells and Ansley 1999; Howells 2001). Although no live Texas hornshell were observed, three of five valves collected were of recently dead specimens. In addition, Big Bend National Park began conducting searches for mussels starting in 2005 and has found 48 dead Texas hornshells, many of them recently dead, in the Rio Grande in Big Bend National Park, and in the lower canyons area of the Rio Grande Wild and Scenic River downstream of the Park (Skiles 2008). This information indicates there are likely extant populations in this reach of the Rio Grande. Extensive collections in the Rio Grande Basin in Texas and in the Rio Conchos Basin in Mexico by TPWD provided no evidence of any other extant populations (Howells 1994, 1995, 1996a, 1996b, 1997, 1998, 1999; Howells et al. 1997). However, in March 2008, two live Texas hornshell were discovered in the Devils River and one in the Rio Grande in the Rio Grande Wild and Scenic River segment downstream of Big Bend National Park (Miller 2008; Burlakova and Karatayev 2008). In March 2011, one live individual was found in a survey of five sites in the Devils River (Burlakova and Karatayev 2011, p. 1), and a large population was discovered in the Rio Grande near Laredo, in Webb County, Texas. Using mark-recapture techniques and extrapolation over the area inhabited by the species, this population is estimated to contain over 8,700 individuals in multiple age classes and is the largest Texas hornshell population known (Burlakova and Karatayev 2011, p. 2).

In the Black River, Levine (2009) analyzed 10 years of mark-recapture data and reported that this population appeared stable with active recruitment of juvenile mussels into the breeding population, exhibited variable annual growth increments (0.1 to 12.4 mm (0.0039 to 0.49 in)) between years, and showed an inverse relationship between survival and discharge with survivorship varying from 60 to 90 percent among years (Lang 2009). However, at one monitoring location significant population declines have been observed and no Texas hornshell have been collected since 2002. The decline is attributed to changes in physical habitat in the river channel caused by large flood events in 2000 that scoured the river bed and eliminated the mussels (Lang 2004). Intensive searches by the New Mexico Department of Game and Fish (NMDGF) in other portions of the Black River and nearby locations in the Delaware River and Pecos River have not revealed additional populations in this region (Lang 2001).

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

The decline in freshwater mussel populations, including the Texas hornshell, in New Mexico and Texas can be directly attributed to human actions that modify physical conditions in streams, such as dams, water impoundment and diversion, certain flood control practices, water pollution, increased siltation and sedimentation, and climate change. These practices often result in fundamental changes in the riverine physical environment and water quality that make it uninhabitable by native mussels. This has led to the decline of all freshwater mussels in the Rio Grande basin (Howells 2003).

An example of the decline in mussel populations due to habitat loss is demonstrated at Fort Clark Springs, the headwaters of Las Moras Creek, in Bracketville, Kinney County, Texas (Howells et al. 1997). Prior to 1900, the spring had an abundant and diverse community of mussels (over twenty species of mollusks reported), including Texas hornshell (Taylor 1967). Murray (1975) reported the extirpation of the species due to mechanical removal of native vegetation, and conversion of the spring to a swimming pool by paving the banks and chlorinating the water. Examination of the area by TPWD in 1995 found no evidence of any native mussels (Howells et al. 1997).

Water Impoundment - Impoundments result in the dramatic modification of riffle and shoal habitats, and the resulting loss of mussels, especially in larger rivers. Dams interrupt most of a river's ecological processes by modifying flood pulses; controlling impounded water elevations; altering water flow, sediments, nutrients, and energy inputs and outputs; increasing depth; decreasing habitat heterogeneity; and decreasing stability due to subsequent sedimentation (Williams et al. 1992; Collier et al. 1996).

The reproductive process of riverine mussels is generally disrupted by impoundments making the Texas hornshell unable to successfully reproduce and recruit under reservoir conditions or in tailwater habitats below dams and diversions. In addition, dams can seriously alter downstream water quality and riverine habitat (Collier et al. 1996), and negatively impact tailwater mussel populations. These changes include thermal alterations immediately below dams; changes in channel characteristics, habitat availability, and flow regime; daily discharge fluctuations; increased silt loads; altered host fish communities; and blocking migration patterns of host fishes.

Major impoundments within the historical range of Texas hornshell include Brantley Dam in New Mexico and Red Bluff Dam in Texas on the Pecos River, and Amistad and Falcon dams in Texas on the Rio Grande. Numerous other smaller impoundments and diversion dams exist within the historical range of the species. Significant mussel populations, including Texas hornshell, were lost in the lower Pecos River canyon reaches and lower Devils River of Texas due to inundation by Amistad Reservoir, completed in 1968 (Metcalf 1982; Howells et al. 1996; Howells 2001). Falcon Reservoir on the Rio Grande is suspected to have eliminated mussel habitat when it was built in 1953. Construction of McMillan Dam in the early 20th century, replaced

by Brantley Dam in 1988, may account for extirpations from the Pecos River near the Seven Rivers confluence, Eddy County, New Mexico.

There is a low-water diversion dam proposed for the Rio Grande near Laredo, Texas (Rio Grande Water Planning Group 2010, p. 475), just downstream of the recently discovered large Texas hornshell population. The depths proposed for the dam (between 8.3 and 14.1 meters (27.2 and 46.2 feet)) would be sufficient to inundate the population (Burlakova and Karatayev 2011, p. 7). The Texas hornshell cannot tolerate the inundation and subsequent siltation that such an impoundment would cause. To date, no decision has been made on the dam.

Water Diversion - Human consumption of river water for agricultural irrigation and municipal use has also contributed to the degraded state of the aquatic ecosystems that no longer support Texas hornshell populations within the species historical range (Howells 2001). For example, in the upper watershed of the Rio Grande in New Mexico, flows have severely declined, often to the point of ceasing to flow during the irrigation season, resulting in ecological changes that severely limit native fauna persistence. Although this portion of the Rio Grande is not within the Texas hornshells historical range, groundwater withdrawals and surface water diversions in this part of the river affect the amount of water that reaches downstream habitats for the species. Increased surface water diversions for municipal use in Las Cruces, New Mexico, and El Paso, Texas, will likely lead to less water for instream flows in the Rio Grande below El Paso, within the range of Texas hornshell.

Alterations to Channel Morphology - The channel morphology and flow regimes of the Rio Grande and Pecos River have been severely modified over the past century for flood control, water supply, and border maintenance through channelization, levee construction, destruction of native riparian vegetation, dredging, water diversion, and groundwater pumping (Howells 2001; NMDGF 2007). The invasion of the exotic riparian salt cedar (Tamarisk spp.), along with levees, have fortified the river banks. Flood control dams upstream have curtailed the annual peak flows and resulted in sediment rich, narrow river channels that no longer interact with the floodplain and do not provide natural riverine processes to support native biotic communities, including mussels such as the Texas hornshell (Layzer et al. 1993).

Water Quality - The release of pollutants into streams from point and nonpoint sources have immediate impacts on water quality conditions and may make environments unsuitable for habitation by mussels. In addition, Regional groundwater depletion can cause losses in stream flows that result in higher concentrations of pollutants and pollution can also arise from groundwater contaminants (Hennighausen 1969; Metcalf 1982; Quarles 1983; Taylor 1983; NMDGF 1988; Williams et al. 1993; Neves et al. 1997). Much of the riverine habitat within the historical range of Texas hornshell has experienced tremendous increases in salinity levels as a result of agricultural returns to the rivers (Howells 2001). Recent studies indicate that Texas hornshell show behavioral signs of physiological stress, followed by death, at a salinity of 7.0 parts per thousand (ppt). Within the occupied area of the Black River, salinity is about 0.9 ppt, but increases significantly downstream of the Carlsbad Irrigation District Dam near the confluence with the Pecos River to 2.8 ppt. Additionally, salinity levels in the Pecos River downstream of the Black River confluence range from 6.0-7.0 ppt (Lang 2001).

Oil and gas industry operations (exploration, transfer, storage, and refining) are ongoing in the Black River basin and lower Pecos River valley of New Mexico and Texas. Such extraction activities are known to contaminate ground- and surface-waters (Jercinovic 1982, 1984; Longmire 1983; Boyer 1986; Rail 1989; Martinez et al. 1998), and represent a current threat to extant Texas hornshell populations (Eisler 1987; Havlik and Marking 1987, p. 11; Green and Trett 1989; Neves et al. 1997). Contaminants contained in point and nonpoint discharges can degrade water and substrate quality and adversely impact mussel populations. The effects are especially profound on juvenile mussels, which can readily uptake common contaminants such as ammonia and chlorine. Glochidia also appear to be very sensitive to certain toxicants, such as heavy metals. Even at low levels, certain heavy metals, such as copper, may inhibit glochidial attachment to fish hosts (Havlik and Marking 1987).

Increased siltation and sedimentation - Siltation and general sedimentation runoff have been implicated in the decline of stream mussel populations across the United States. Scouring in upstream areas often results in excessive deposition of silt downstream, infilling larger substrates and eliminating mussel habitats. Sources of silt and sediment include overgrazing, which began in the mid-1800s; removal of terrestrial plants and replacement with nonnative vegetation; complete clearing of riparian vegetation for agricultural, silvicultural, or other purposes; poorly designed and executed highways and bridges; and construction, mining, and other practices that allow exposed earth to enter streams (Howells 2001). Specific impacts on mussels from silt and sediments include clogged gills, which reduce feeding and respiratory efficiency, impair reproductive activity, disrupt metabolic processes, reduce growth rates; substrate instability; and the physical smothering of mussels under a blanket of silt (Houp 1993).

Cumulative impacts of certain land-use practices (e.g., removal of native vegetation; prolonged overgrazing; nonpoint source runoff pollution of sediments, toxic chemicals, and hydrocarbons) within the watershed of the Black River have increased erosion and sedimentation in the river, exacerbated drainage basin entrenchment, increased pulse-discharge of pollutants into the system, and altered stream channel morphology and substrate composition (Lang 2001). These environmental changes have profound effects on the long-term viability of mollusk populations, overall health of aquatic ecosystems, and stability of low flow habitat typically colonized by Texas hornshell (Fuller 1974; Neves et al. 1997; Strayer 1999; NMDGF 2007). Pulse discharge of large storm flows in the Black River represent a primary cause of natural mortality of localized populations of Texas hornshell (Lang 2006). Large pulse discharges scour streambeds and appear to dislodge Texas hornshell from their habitats (Lang 2009).

Climate Change - Climate change could be another cause of threats to water quantity and habitat maintenance for this aquatic species. The potential effects of future climate change could reduce overall water availability in New Mexico, Texas, and northern Mexico and compound the threat of declining flows. Modeling efforts evaluating climate change in Texas have only recently been initiated (for example, CH2M HILL 2008; Jackson 2008; Mace and Wade 2008). As with many areas of North America, the range of the Texas hornshell is projected to experience an overall warming trend over the next 50 to 100 years (Texas Water Development Board 2008). Although precipitation models vary substantially, with some even predicting increased precipitation annually, a consensus is emerging that evaporation rates are likely to increase significantly (CH2M HILL 2008; Jackson 2008). Many models are also predicting that seasonal variability in flow rates is likely to increase with more precipitation occurring in the wet seasons and more extended dry periods (CH2M HILL 2008, Jackson 2008, Mace and Wade 2008). A greater likelihood for more extreme droughts was identified as a potential impact to water resources (CH2M HILL 2008).

All climate change modeling has inherently large uncertainties due to the incorporation of many variables that are difficult, if not impossible, to accurately predict (Jackson 2008; Texas Water Development Board 2008). As a result, it is unknown how much effect future climate change may have on the aquatic resources that serve as habitat for the Texas hornshell. If climate trends result in increased drought, then it could exacerbate declining flows for the hornshell.

Therefore, based on our evaluation of current riverine conditions, pollution by point and nonpoint source contaminants, changes in channel morphology and flow regimes, oil and gas activities, and ongoing groundwater pumping for municipalities, we conclude that the Texas hornshell is threatened by present and potential destruction, modification, or curtailment of its habitat and range.

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

The Texas hornshell is not a commercially valuable species, but it may be increasingly sought by collectors due to its rarity. This species inhabits relatively small stream lengths in the Black River in New Mexico and the Rio Grande and Devils River in Texas, and except for one, its populations are small. Although scientific collecting is not thought to represent a significant threat and the State of New Mexico regulates collecting through its permit process, localized populations could be affected by overcollecting in the future. However,

at this time, the Texas hornshell is not threatened by overutilization for commercial, recreational, scientific, or educational purposes.

C. Disease or predation:

The occurrence of disease in mussels is virtually unknown, and little is known about predation on the Texas hornshell. Muskrats (Ondatra zibethicus) are known to prey upon live Texas hornshell, as evidenced by freshly fragmented valves strewn along vegetated riverbank margins (Lang 2001). Dragonfly nymphs (Anisoptera) have also been observed to prey on the gills of living Texas hornshells (Levine 2009). However, at this time, disease and predation are not known to be significant threats to Texas hornshell populations.

D. The inadequacy of existing regulatory mechanisms:

Under the Wildlife Conservation Act, the State of New Mexico has listed the Texas hornshell as an endangered species since 1983. Protection under New Mexicos Wildlife Conservation Act is limited to take (harass, hunt, capture, or kill any wildlife, or attempt to do so), with no regulatory protection of occupied or potential habitats. The recovery plan for Texas hornshell issued by the State of New Mexico (NMDGF 2007, pp. 1-66) does not provide any additional regulatory mechanisms, but it is expected to improve the status of the species as it is implemented. Additionally, the Texas hornshell is considered a Species of Greatest Conservation Need in the New Mexico Comprehensive Wildlife Conservation Strategy (NMDGF 2006).

The State of Texas listed the Texas hornshell as a threatened species in 2009. Section 68.002 of the Texas Parks and Wildlife (TPW) Code and Section 65.171 of the Texas Administrative Code prohibits the direct take of a threatened species, except under issuance of a scientific collecting permit. Enforcement of this permit requirement is difficult. Take is defined in Section 1.101(5) of the TPW Code as collect, hook, hunt, net, shoot, or snare, by any means or device, and includes an attempt to take or to pursue in order to take. However, this law does not provide any protection for Texas hornshell habitat, nor would it protect it from the proposed low-water diversion dam on the Rio Grande. Moreover, there are no statutory requirements under the jurisdiction of the State of Texas that serve as an effective regulatory mechanism for reducing or eliminating the threats that may adversely affect Texas hornshell or its habitat, nor are there any requirements under the Texas State statutes to develop a recovery plan that will restore and protect existing habitat for the species. Therefore, the species does not have a recovery plan, conservation plan, or conservation agreement in Texas.

Texas has established 28 no-harvest mussel sanctuaries throughout the State (Howells et al. 1997). However, none occur within the Rio Grande or Pecos River basins. In December 2008, the U.S. Fish and Wildlife Service designated a 10(j) nonessential experimental population area for the Rio Grande silvery minnow in the Big Bend area of Texas. Because the Rio Grande silvery minnow will be treated as a threatened species within Big Bend National Park and the Rio Grande Wild and Scenic River, and will thus receive some protections under section 7 of the Endangered Species Act, this may provide some tangential regulatory protection for Texas hornshell where it shares riverine habitat with the minnow. There are no other listed fish species in this section of the Rio Grande.

Based on our evaluation, we conclude that protections from existing regulatory mechanisms are not adequate to limit or alleviate the threats to the Texas hornshell.

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

Introduction of exotic bivalves, namely the Asian clam (Corbicula fluminea), quagga mussel (Dreissena bugensis), and zebra mussel (D. polymorpha), to surface waters of New Mexico and Texas could threaten extant Texas hornshell populations through potential competitive exclusion for space and resources (Williams et al. 1993; Neves et al. 1997). Of these, only the Asian clam is known to already be present in many locations within the historical range of Texas hornshell (Howells 1999). However, there is little

evidence that this particular nonnative can cause changes in native mussel populations (Strayer 1999). Therefore, we cannot conclude that nonnative species are currently a threat to Texas hornshell.

Additionally, a critical component of the life history of freshwater mussels is the availability of fish hosts for developing glochidia. The fish communities of the rivers and streams within the historical range of Texas hornshell have been drastically altered, primarily by changes in habitat conditions (Treviño-Robinson 1959; Smith and Miller 1986; Miller et al. 1989; Hubbs 1990; Edwards and S. Contreras Balderas 1991). Over the last century, the decline of many native fishes, and even the extinction and extirpation of some species, could indirectly have affected mussel populations through the loss of necessary hosts to complete the mussel reproductive cycle and may represent a potential threat to the Texas hornshell. However, we do not have sufficient information to know whether this is a current threat or the extent to which this could potentially threaten the Texas hornshell in the future.

Therefore, based on our evaluation, the Texas hornshell is not believed to be threatened by other natural or manmade factors (e.g., competition with nonnatives or the declining availability of fish hosts necessary for completing the life cycle of Texas hornshell).

Conservation Measures Planned or Implemented :

The Texas hornshell is listed as endangered in New Mexico, threatened in Texas, and is a high priority species in the Wildlife Action Plans of New Mexico and Texas (TPWD 2005; NMDGF 2006).
NMDGF has ongoing studies in the Black River for Texas hornshell, including determination of ecological fish hosts, observing life history parameters, survivability of juveniles, monitoring habitat, and analyzing population dynamics (Lang 2006, Lang 2009).

NMDGF has formed a State recovery team for this species and completed the Texas Hornshell Recovery Plan (Recovery Plan) for the population in New Mexico in August 2007 (Carman 2007). The Recovery Plan provides information about necessary conservation efforts to remove the need to list the species in New Mexico. The Recovery Plan does not include populations outside of New Mexico. NMDGF is leading the following ongoing efforts related to implementation of the Recovery Plan including, but not limited to:

- Development of a Candidate Conservation Agreement with Assurances with private landowners;
- Working with New Mexico Environment Department to strengthen water quality requirements in the Black River and nominate it for Outstanding National Resource Water;
- Funding (along with the Natural Resources Conservation Service) private landowners for habitat protection. NMDGF has contracts with three New Mexico landowners to fence lands to prevent illegal trespass and dumping, which introduces toxic substances into the Black River;
- Funding the Albuquerque BioPark for captive rearing investigations for Texas hornshell. Appropriate habitat in the captive containers has been established and hornshells were taken from the wild and brought to the BioPark in the summers of 2008 and 2010;
- Continuing research on host fish relationships;
- Genetics research on the species (Carman 2008);
- Reintroduction of the Texas hornshell into the Delaware River, in cooperation with the Bureau of Land Management and the Service.

The Bureau of Land Management (BLM) recently published a draft Environmental Assessment for the reintroduction of the Texas hornshell to the Delaware River (BLM 2013, entire). Reintroduction of the hornshell and a host fish species, the gray redhorse, is likely to occur in spring 2013.
Big Bend National Park began conducting searches for mussels starting in 2005 and plans to continue searches as funding allows in the Rio Grande in Big Bend National Park and in the lower canyons area of the Rio Grande Wild and Scenic River downstream of the Park (Skiles 2008). In addition, TPWD has established a volunteer mussel watch program for interested individuals to report mussel shell collections and monitor some known populations in the State of Texas.

The Service is currently placing new focus on the aquatic conservation of the Big Bend reach of the Rio Grande due to our efforts to reestablish the Rio Grande silvery minnow there. We are working on forming a collaborative group with our Federal, State, private, and nongovernmental partners in Texas to plan and accomplish riparian and aquatic ecosystem restoration projects. This effort will result in additional conservation measures for the river that could benefit Texas hornshell.

Summary of Threats :

The Texas hornshell is threatened by habitat alterations such as stream bank channelization, impoundments, and diversions for agriculture and flood control; in particular, the proposed low-water diversion dam in the Rio Grande near Laredo, Texas, would eliminate the most robust population of the species. Additionally, contamination of water from the oil and gas industry, alterations in the natural riverine hydrology, and increased sedimentation from prolonged overgrazing and loss of native vegetation threaten the species and its habitat. Because of the nature and magnitude of the threats and the rarity of the species, we find that the Texas hornshell is warranted for listing throughout its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

Long-term conservation measures are needed to facilitate and accomplish cooperative efforts between resource management agencies and private landowners in both New Mexico and Texas. Implementation of the recovery plan and completion of a Candidate Conservation Agreement with Assurances with interested private landowners could further the conservation of this species in New Mexico. Development of Best Management Practices for the Black River watershed is recommended by a proactive consortium of diverse land-use interests, led by NMDGF, whose primary objective is to protect the long-term sustainability (ecology and economy) of the region. A similar planning and implementation process needs to be initiated for the populations in Texas.

The relocation of Texas hornshell into the Delaware River in New Mexico should continue to be pursued. Riparian improvements have restored the river and habitat is once again suitable for the species. The Service and NMDGF will continue to work with the Bureau of Land Management to return Texas hornshell to the Delaware River.

Continued monitoring efforts are needed throughout former and occupied sites in Texas to better define the species distribution and status in the Big Bend and Laredo reaches of the Rio Grande, in the Devils River, and in the Llano and South Concho Rivers of central Texas.

The Service should continue pursuing Candidate Conservation Agreements with interested parties for Texas hornshell populations in Texas.

Priority Table

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	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

No change in listing priority number.

Magnitude:

Until March 2008, the only known extant populations of Texas hornshell were in New Mexicos Black River and the Rio Grande near Laredo, Texas. However, in March 2008, two previously unknown localities were confirmed in Texas one in the Devils River and one in the mainstem Rio Grande within the Rio Grande Wild and Scenic River segment downstream of BBNP. The primary threats to this species are habitat alterations such as stream bank channelization, impoundments (including the proposed low-water diversion dam near Laredo, Texas, that would eliminate the population), and diversions for agriculture and flood control; contamination of water by the oil and gas industry; alterations in the natural riverine hydrology; and increased sedimentation from prolonged overgrazing and loss of native vegetation. Although riverine habitats throughout the species known occupied range are under constant threat from these ongoing or potential activities, numerous conservation actions to benefit the species are underway in New Mexico, including the completion of a State recovery plan for the species. Conservation actions are beginning in Texas.

Imminence :

Past riverine habitat alterations have already occurred and resulted in the much reduced distribution of this species. Demands for water from the Rio Grande and Pecos River basins are ongoing and continue to increase and make future habitat degradation likely. No decision has been made on the proposed low-water diversion dam.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Confirmed populations of Texas hornshell exist in a limited portion of the species' historical range and are

threatened with extinction; however, there are no immediate increases in threats likely to result in extinction. The proposed low-water diversion dam on the Rio Grande has not yet been approved; if it is approved we will reevaluate whether emergency listing is warranted. Recent surveys have shown the population in the Rio Grande to be large and robust, and the Black River population appears to be stable. NMDGF completed a State recovery plan for the species in 2007. The Service is currently placing new focus on aquatic species and habitat conservation in the Big Bend reach of the Rio Grande due to our efforts to reestablish the endangered Rio Grande silvery minnow. This will result in additional conservation measures for the river that could benefit Texas hornshell.

Description of Monitoring:

NMDGF has conducted extensive studies of the Texas hornshell populations and habitats in the Black River since 1997 and plans on continuing this activity (Lang 2006; Carman 2008). Mark-recapture studies began in 1997, and are continuing, in order to document population changes in occupied habitat in New Mexico (Lang 2001, 2005, 2006; Berg and Levine 2006, pp. 1-7) and in the Rio Grande near Laredo, Texas (Burlakova and Karatayev 2011, p. 1).

Tom Miller (2008) from Laredo State University has been conducting mussel surveys in the Rio Grande basin in Texas for several years, resulting in the recent discovery of extant specimens of the species in two new locations in Texas. Additionally, Big Bend National Park has been conducting mussel bank surveys and found a significant number of recently dead Texas hornshell in the Rio Grande lower canyons area downstream of Big Bend National Park in February 2008 (Skiles 2008, 2009). Burlakova and Karatayev (2008; 2011, pp. 17) have also been surveying mussels in Texas in the Rio Grande and Concho River basins. These recent discoveries will likely lead to increased survey and monitoring efforts in Texas (Miller 2008).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

New Mexico,Texas

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Jay E. Nicholopoulos 05/21/2013
Date

Concur: 10/28/2013
Date

Did not concur: _____ _____
Date

Director's Remarks: