

stressors probably limit fishes in streams of the Great Plains.

The silvery minnow evolved in a highly variable ecosystem, and is likely more tolerant of elevated temperatures and low dissolved oxygen concentrations for short periods than other non-native species. Although little is known about the upper tolerance limits of the silvery minnow, when water quality conditions degrade, stress increases, and fish generally die (*e.g.*, see Matthews and Maness 1979; Ostrand and Wilde 2001). Generally, it is believed that during periods of low flow or no flow, Great Plains fishes seek refugia in large isolated pools, backwater areas, or adjoining tributaries (Deacon and Minckley 1974; Matthews and Maness 1979). Fish in these refugia strive to survive until suitable flow conditions return and these areas reconnect with the main river channel. This pattern of retraction and recolonization of occupied areas in response to flow and other habitat conditions is typical of fishes that endure harsh conditions of Great Plains rivers and streams (Deacon and Minckley 1974; Matthews and Maness 1979).

Localized reductions in abundance are not typically a concern where sufficient numbers of the species survive, because river reaches can be recolonized when conditions improve. However, habitat conditions such as oxbows, backwaters, or other refugia that were historically present on the Rio Grande and Pecos River and were a component of natural population fluctuations (*e.g.*, extirpation and recolonization) have been dramatically altered or lost (Bestgen and Platania 1991; Hoagstrom 2000; BOR 2001a, 2001b). Over the past several decades, the extent of areas in the Rio Grande and Pecos Rivers that have periodically lost flow has increased due to human alterations of the watersheds and stream channels and diversion of the streamflows (Service 1994).

Variation in stream flow (*i.e.*, flow regime) strongly affects some stream fish (Schlosser 1985). For example, juvenile recruitment of some stream fish is highly influenced by stable flow regimes (Schlosser 1985; Hoagstrom 2000). When sufficient flows persist and other habitat needs are met, then recruitment into the population is high. Silvery minnows and other Great Plains or desert fishes cannot currently survive when conditions lead to prolonged recurring periods of low or no flow of long stretches of river (Hubbs 1974; Hoagstrom 2000). Fish mortality likely begins from degraded water quality (*e.g.*, increasing temperatures, p.H., and

decreasing dissolved oxygen) and loss of refuge habitat prior to prolonged periods of low or no flow (J. Brooks, pers. comm. 2001; Ostrand and Wilde 2001). For instance, a reduction of stream flow reduces the amount of water available to protect against temperature oscillations, and high temperatures from reduced water flow frequently kill fish before prolonged periods of no flow occurs (Hubbs 1990).

It is also possible that fish may subsequently die from living under suboptimal conditions or that their spawning activities may be significantly disrupted (Hubbs 1974; Platania 1993b). Such conditions are in part responsible for the current precarious status of the silvery minnow. For example, management of water releases from reservoirs, evaporation, diversion dams, and irrigation water deliveries have resulted in dewatered habitat—causing direct mortality and isolated pools that cause silvery minnow mortality as a result of poor water quality and predation from other fish and predators. Despite efforts to manage water resources to benefit the silvery minnow, periods of intermittency have and continue to occur. Portions of the middle Rio Grande were dewatered in the period 1996 through 2001 (Service 2001b; J. Smith, pers. comm. 2001). In 1996, about 34 mi (58 km) out of the 56 mi (90 km) from the San Acacia Diversion Dam to Elephant Butte Reservoir were dewatered. In 1997, water flows ceased at the south boundary of the Bosque del Apache National Wildlife Refuge, resulting in the dewatering of 14 mi (22.5 km) of silvery minnow habitat. In 1998, the Rio Grande was discontinuous within the Bosque del Apache National Wildlife Refuge, dewatering about 20 mi (32 km) of habitat. In 1999, flows ceased about 1 mi upstream of the Bosque del Apache National Wildlife Refuge northern boundary, dewatering about 24 mi (39 km) of habitat. A similar event occurred in 2000, but not to the extent of the 1999 drying. In 2001, approximately 9 combined mi (14 km) of river dried within the Bosque del Apache National Wildlife Refuge and south of San Marcial (Smith 2001). Drying occurred during the 2002 irrigation season in the Isleta and San Acacia Reaches. Between June and August 2002, approximately 25 mi of river in the San Acacia Reach and 14 mi in the Isleta Reach dried. Because of prolonged recurring periods of low or no flow through multiple years, the status of the silvery minnow has declined to alarmingly low levels (Dudley and Platania 2001, 2002a, 2002b, 2002c, 2002d, 2002e).

The primary constituent elements identified below provide a qualitative description of those physical and biological features necessary to ensure the conservation of the silvery minnow. We acknowledge that if thresholds were established as part of a critical habitat designation, they could be revised if new data became available (50 CFR 424.12(g)); however, the process of new rulemaking can take years (*see* 50 CFR 424.17), as opposed to reinitiating and completing a formal consultation, which takes months (*see* 50 CFR 402.14). Formal consultation provides an up-to-date biological status of the species or critical habitat (*i.e.*, environmental baseline) which is used to evaluate a proposed action during formal consultations. Consequently, we believe it is more prudent to pursue the establishment of specific thresholds through formal consultation.

This final rule does not explicitly state what might be included as special management for a particular river reach within the middle Rio Grande. We anticipate that special management actions will likely be developed as part of the section 7 consultation process. Special management might entail a suite of actions including re-establishment of hydrologic connectivity within the floodplain, widening the river channel, or placement of woody debris or boulders within the river channel (J. Smith, pers. comm., 2001).

It is important to note that some areas within the middle Rio Grande critical habitat have the potential for periods of low or no flow under certain conditions (*e.g.*, *see* discussion above on middle Rio Grande). We recognize that the critical habitat designation specifically includes some areas that have lost flow periodically (MRGCD 1999; Scurlock and Johnson 2001; Scurlock 1998). It is our belief that the river reach below San Acacia Diversion Dam on the middle Rio Grande is likely to experience periods of low or no flow under certain conditions, and we are not able to predict with certainty which areas will experience these conditions. We believe this area is essential to the conservation of the silvery minnow because it likely serves as connecting corridors for fish movements between areas of sufficient flowing water (*e.g.*, *see* Deacon and Minckley 1974; Eberle *et al.* 1993). Additionally, we believe this area is essential for the natural channel geomorphology (the topography of the river channel) to maintain or re-create habitat, such as pools, by removing or redistributing sediment during high flow events (*e.g.*, *see* Simpson *et al.* 1982; Middle Rio Grande Biological Interagency Team 1993). Therefore, we