

consensus of the malacological (mollusk research) community, that this species was likely to persist in low numbers in the upper Coosa River drainage, and possibly in the Cahaba River. Surveys of Coosa River tributaries have been conducted by Service biologists, as well as Bogan and Pierson (1993a), Evans (2001), Feminella and Gangloff (2000), Johnson and Evans (2000), Pierson (1993, pers. comm. 1994), Williams and Hughes (1998), and others. Surveys of the Cahaba River have been conducted by Service biologists, Bogan and Pierson (1993b), McGregor *et al.* (2000), Shepard *et al.* (1994, 1998), and others. Despite these repeated surveys of historic habitat in the Coosa and Cahaba River drainages, no living animals or fresh shells of this species have been located in recent years (Evans 2001, Feminella and Gangloff 2000, Johnson and Evans 2000, McGregor *et al.* 2000, Pierson 1993, Shepard *et al.* 1994, 1998, Williams and Hughes 1998). Notwithstanding the results of these surveys, this species' historic range includes thousands of miles of river and stream habitat in the Mobile River Basin, and there are many miles of stream which have not been adequately surveyed. Mussels are cryptic species, living buried in the stream bottom under water, and rare mussels are difficult to locate.

Upland Combshell (*Epioblasma metastrata* (Conrad 1838))

The upland combshell is a bivalve mollusk that rarely exceeds 60 mm (2.4 in) in length. The shells are rhomboidal to quadrate in outline and are sexually dimorphic. Males are moderately inflated with a broadly curved posterior ridge. Females are considerably inflated, with a sharply elevated posterior ridge that swells broadly post-ventrally forming a well-developed sulcus (the groove anterior to the posterior ridge). The posterior margin of the female is broadly rounded and comes to a point anterior to the posterior extreme. Periostracum color varies from yellowish-brown to tawny, and may or may not have broken green rays or small green spots. Hinge teeth are well-developed and heavy. This species likely releases glochidia during late spring or early summer (Service 2000). The host fish for this species have not been identified.

The historic range of the upland combshell included portions of the Black Warrior, Cahaba, and Coosa Rivers of the Mobile River Basin and some of their tributaries in Alabama, Georgia, and Tennessee. The most recent records for the upland combshell were from the Conasauga River, Georgia,

in 1988, and from the Cahaba River, Alabama, in the early 1970s (58 FR 14330). When listed, the species was believed to be restricted to the Conasauga River in Georgia, and possibly portions of the upper Black Warrior and Cahaba River drainages. Surveys of Coosa River tributaries have been conducted by Service biologists, as well as Bogan and Pierson (1993a), Evans (2001), Feminella and Gangloff (2000), Johnson and Evans (2000), Pierson (1993, pers. comm. 1994), Williams and Hughes (1998), and others. Surveys of the Cahaba River have been conducted by Service biologists, Bogan and Pierson (1993b), McGregor *et al.* (2000), Shepard *et al.* (1994), and others. Surveys in the upper Black Warrior drainage have been done by Service biologists, Alabama Malacological Research Center, (*in litt.* 1996), Sheppard *et al.* (1998), Vittor and Associates (1993), Warren and Haag (1994), and others. However, these surveys of the Conasauga River and other historic habitat in the Coosa, Cahaba, and Black Warrior River drainages since the mussel was listed have failed to locate any evidence of the upland combshell (Evans 2001, Feminella and Gangloff 2000, Johnson and Evans 2000, McGregor 1992, McGregor *et al.* 2000, Pierson 1991a, Shepard *et al.* 1994, 1998, Vittor and Associates 1993, Warren and Haag 1994, Williams and Hughes 1998). Notwithstanding the results of these surveys, this species' historic range includes thousands of miles of river and stream habitat in the Mobile River Basin, and there are many miles of stream which have not been adequately surveyed. Mussels are cryptic species, living buried in the stream bottom under water, and rare mussels are difficult to locate.

The summary of these 11 mussel species, presented above, represents our current understanding of their historic and current range and distribution. There has been some confusion in species identification in recent reports. For example, some survey reports have identified mussel populations from Black Warrior River tributaries, Cahaba River, and Bogue Chitto Creek as fine-lined pocketbook, while others have identified the same populations as orange-nacre mucket. Although there may be some overlap in these species' current ranges, we believe that this confusion originated from collectors unfamiliar with one or both species. There is also some confusion surrounding recently rediscovered populations of clubshell in the Coosa River drainage. Some biologists believe

these populations may include painted clubshell (*Pleurobema chattanoogaense*), a form that we considered the same as southern clubshell (*Pleurobema decisum*) in the March 17, 1993, final rule listing for these 11 mussels (58 FR 14330). There is some morphological evidence that recognition of painted clubshell as a species may be warranted, however, recent genetic studies were unable to discriminate between the 2 forms. Therefore, at this time, we consider populations of clubshell in the Coosa River drainage to be southern clubshell. The distributions presented above, are based upon shell morphology as described and currently recognized in the scientific literature. Therefore, we will consider these species' current ranges as outlined above, until presented with new information.

Summary of Decline and Threats to Surviving Populations

The disappearance of these 11 mussel species from significant portions of their ranges is primarily due to changes in river and stream channels caused by dams, dredging, or mining, and historic or episodic pollution events (58 FR 14330). More than 1,700 km (1,100 mi) of large and small river habitat in the Basin have been impounded by dams for navigation, flood control, water supply, and/or hydroelectric production purposes. None of the 11 species are known to survive in impounded waters. Riverine mussels are killed during construction of dams, they may be suffocated by sediments that accumulate behind the dams; and the reduced water flow behind dams limits food and oxygen available to mussels. Many fish species that serve as hosts to mussel larvae are also eliminated by dams and impounded waters.

Other forms of habitat modification—such as channelization, channel clearing and desnagging (woody debris removal), and gold and gravel mining—caused stream bed scour and erosion, increased turbidity, reduction of groundwater levels, and sedimentation, often resulting in severe local impacts to, and even extirpation of, mussel species. Sedimentation may also eliminate or reduce recruitment of juvenile mussels (Negus 1966), and suspended sediments can also interfere with feeding (Dennis 1984).

Water pollution from coal mines, carpet mills, fabric dyeing mills, large industrial plants, inadequately treated sewage, and land surface runoff also contributed to the demise of the species in certain portions of their historic ranges. Freshwater mussels, especially in their early life stages, are extremely