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[Article]

Use of Prepositioned Grid Electrofishers for the Collection of Robust Redhorse Broodstock

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Abstract.—We investigated the potential of prepositioned grid electrofishers as a means of collecting broodstock for the rare robust redhorse *Moxostoma robustum*. We found that combined with visual observation, this technique allowed for the efficient capture of fish in breeding condition. We were able to harvest eggs in the field and bring only fertilized eggs into the hatchery. There was no need to induce spawning hormonally. Although their use is limited by water depth and clarity, prepositioned grid electrofishers used in conjunction with visual observation warrants further consideration as an effective tool for the collection of reproductively active broodstock for conservation purposes.

For an increasing number of endangered and threatened fish species, captive propagation and release of individuals has become an integral part of their conservation and recovery (Olney et al. 1994; Bowles 1995). Typically, this requires the capture and transport of adult broodstock to holding facilities where they are hormonally induced to spawn (Piper et al. 1982; Branchaud and Gendron 1993). Hormone injections are often necessary because of the difficulty in acquiring females that are ready to spawn at the time of capture (Piper et al. 1982; Branchaud and Gendron 1993; Szabó 2003). This process, while effective, is relatively time consuming (Branchaud and Gendron 1993; Zohar and Mylonas 2001; Szabó 2003). Further, the removal of broodstock is a potentially disruptive process that may affect natural reproduction of that population by disturbing spawning aggregations or simply reducing the number of individuals spawning. There are also concerns that artificial selection starting with broodstock selection and continuing in the hatchery environment may produce progeny that are not equivalent to counterparts produced through natural reproduction (Doyle 1983; Busack and Currens 1995; Ford 2002).

The robust redhorse *Moxostoma robustum* offers a good example of the difficulties associated with broodstock collection. Robust redhorse is a large riverine catostomid whose known distribution is currently restricted to the Altamaha, Savannah, and Pee Dee river systems in Georgia, South Carolina, and North Carolina (Bryant et al. 1996; Wirgin et al. 2001). The core conservation goal of establishing genetically distinct refugial populations (Nichols 2003) requires the collection of broodstock from specific locations. Robust redhorses form spawning aggregations in shallow water over main-channel gravel bars during the spring. Males establish territories on the bars, but females in spawning condition do not spend much time there. Like most species of redhorse *Moxostoma* spp., robust redhorse spawns in triads consisting of a single female flanked by two males (Page and Johnston 1990; Jenkins and Burkhead 1993). Therefore, collections made using boat electrofishers over these gravel bars are composed of mostly male fish. Females are generally collected from nearby staging areas after considerable effort. The impact of these repeated passes on the behavior of spawning adults is unknown, but reduced egg viability due to exposure to electric fields has been noted in other species, such as razorback sucker *Xyrauchen texanus* (Muth and Ruppert 1996), Atlantic salmon *Salmo salar* (Godfrey 1957), brook trout *Salvelinus fontinalis* (Godfrey 1957), cutthroat trout *Oncorhynchus clarkii* (Dwyer and Erdahl 1995), and pink salmon *O. gorbuscha* (Marriott 1973).

Prepositioned grid electrofishers may offer an alternative method of broodstock collection. Prepositioned grids are most frequently employed to

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sample discrete areas to determine microhabitat relationships of stream fishes (Bain et al. 1985; Bowen and Freeman 1998; Walsh et al. 2002). Their effectiveness is limited to shallow (<1 m), clear-water habitat (Bain et al. 1985; Dewey 1992; Fisher and Brown 1993), which is used by many species of conservation concern, such as catostomids and salmonids, while spawning. We investigate the use of grid electrofishers in conjunction with visual observation to reduce effort and enable the capture of reproductively active females with selected males for streamside spawning of broodstock.

Methods

We positioned six grid electrofishers in an area where active spawning of robust redhorse was observed two days previous. Grid electrofishers were similar in design to those of Fisher and Brown (1993) and consisted of two 5-m lengths of copper mesh wire spaced 1.25 m apart by means of polyvinyl chloride pipe. We placed each unit perpendicular to the current at a depth of 0.5–1.5 m and anchored the units in position with 1-m × 1.5-cm reinforcement-bar stakes. We spaced the grid electrofishers 1–2 m apart, resulting in a coverage area of approximately 55 m^2. We deployed grid electrofishers between 0930 and 1000 hours and did not disturb them for approximately 60 min prior to sampling. When spawning activity was observed from shore, we activated specific grid electrofishers for 30–60 s and attempted to collect all fish. Grid electrofishers were operated at approximately 670 V and less than 4 A using 60 Hz pulsed DC.

Upon capture, we weighed (0.05 kg), measured (mm, total length), and determined the sex for each individual. Milt was expressed from males into 75-mL sterile vials and held on ice in the dark. Eggs were expressed from females into 2-L plastic trays. After collection, eggs were divided into three aliquots, and the milt from separate males was used to fertilize each. Milt was added to dry eggs and mixed using mild agitation. After 1 min, river water was added, and the eggs were allowed to water harden. Eggs were then rinsed and placed in plastic bags filled with river water and oxygen. Bags were sealed and placed in insulated shipping boxes for transport to the hatchery. Eggs were incubated, and hatching success was determined.

We returned to the study area and collected robust redhorse as part of our routine sampling on three additional dates. We deployed the electrofishing grids as described above but did not wait for spawning activity to be observed before activating them.

TABLE 1.—Collection date, grid number, and number of male and female robust redhorses captured per event by grid electrofishers on the Savannah River, 2004.

Collection date	Grid number	Number collected	
		Male	Female
04 May	5	3	0
	1	4	2
	4	3	1
	4	3	1
	1	4	2
05 May	4	3	3
09 May	4	4	0
	1	3	0
	4	2	0
	1	1	1
14 May	4	4	1
	4	1	0
	1	0	1

Results and Discussion

At least 10 robust redhorses were observed in the study area upon our arrival on 4 May 2004. Although deploying the grid electrofishers displaced these fish, they returned to locations within several meters of their previous locations within a few minutes. An additional 10 individuals entered the study area after we deployed the grid electrofishers, and at least another 15 robust redhorses were observed outside the area of influence of the electrofishing grids. Spawning activity was observed almost continuously within the area covered by the grid electrofishers from 1000 to 1500 hours, when the study was terminated. Three of the six grids were operated a total of five times, and a minimum of three fish were collected during each event (Table 1). Spawning activity was not observed in the remaining three grids. Individuals in other portions of the study area did not appear to be disturbed during the operation of a grid. All fish collected were in the running-ripe condition. Female robust redhorses were collected during four of the five events on that date. All fish recovered fully and were released alive after the procedure. Fry were successfully produced from each cross and are being reared at the Dennis Wildlife Center in Bonneau, South Carolina. Additional female and male fish in breeding condition were collected during subsequent visits to the study area (Table 1), but no eggs or sperm were collected.

The use of prepositioned grid electrofishers was an effective method for the collection of robust redhorse in breeding condition. The use of these grids has several advantages over traditional boat electrofishing methods for broodfish collection. Although a sufficient quantity of males in spawning condition generally can be captured regardless of collection method, females collected using other methods often require hormone injections (Branchaud and Gendron 1993; Barret 1997). We were able to harvest eggs from every female robust redhorse we collected without injecting hormones to induce spawning. Grid electrofishers also reduce the amount of artificial selection by allowing the female to select her mates. In many cases, we collected breeding triads and produced embryos that were at least initially genetically similar to those that would have been produced naturally. This does not alleviate concerns of domestication occurring during rearing within hatcheries (Doyle 1983; Busack and Currens 1995; Ford 2002). However, it can potentially address concerns of artificial selection occurring due to human broodstock selection.

We were able to capture our target number of females with less effort using grid electrofishers (approximately 5 min of pedal time). We were also able to choose areas of the spawning ground from which to collect broodfish selectively and were able to leave the remainder undisturbed. This is consistent with the findings of Bain et al. (1985) and Fisher and Brown (1993), who documented minimal disturbance outside the area encompassed by an active grid electrofisher. However, using prepositioned grid electrofishers in areas of actively spawning fish raises the same concern as other electrofishing techniques. While the effects of electrofishing on fish embryos and larvae are largely unknown (see Snyder 2003 for review), several studies suggest the potential for reduced viability as a result of exposure to electric fields (Godfrey 1957; Lamarque 1990; Muth and Ruppert 1996). Minimizing the affected area and duration of exposure should be top priorities if broodstock collection on active spawning grounds cannot be avoided. Therefore, use of grid electrofishers in conjunction with visual observation under some circumstances warrants further consideration as an effective tool for the collection of reproductively active broodstock for conservation purposes.

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