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An Electrofishing Raft for Sampling Intermediate-Size Waters with Restricted Boat Access

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Abstract.—Little information is readily available to fishery scientists regarding the design and construction of electrofishing rafts. I have modified some of the customary characteristics of oar-powered electrofishing rafts to create a raft that is powered by an outboard motor, is relatively light for easier transport to and from the stream, and provides easier passage through shallow waters. This raft design resulted in more effective sampling of smallmouth bass *Micropterus dolomieu* by allowing us to sample sections along a creek that were inaccessible to traditional electrofishing rafts and boats, which typically are launched from a boat trailer backed into the water. In addition, this design provided greater mobility within sampling sections, ensuring that all habitats were sampled.

Electrofishing boat design and construction have been described for aluminum boats powered by an outboard motor (Novotny and Priegel 1974) and for inflatable rafts powered by oars (Meyer and Miller 1995). Although several companies manufacture electrofishing boats, many private, state, and federal agencies still prefer constructing electrofishing boats or rafts to meet their specific sampling needs. A study of smallmouth bass *Micropterus dolomieu* initiated during 1997 on Brandywine Creek in northern Delaware resulted in modifications to the traditional oar-powered electrofishing rafts. The primary disadvantage of an oar-powered electrofishing raft is that usually only one pass can be made per section sampled, which involves the time consuming task of transporting a second vehicle downstream near the take out point. In addition, most of the rafts we examined prior to our study contained heavy internal metal frames and equipment which would make portaging to and from the stream or through riffle areas more difficult. Our objectives were to design and construct an electrofishing boat that (1) could be manually transported to and from the stream, (2) would be capable of passage through riffle areas during low flows, and (3) could be powered by an outboard motor.

The electrofishing raft was used to sample Brandywine Creek in northern Delaware, which contains 11 low-stage dams located along a 13.7-km stretch of freshwater stream. The stream bottom consists of large boulders, cobble, and gravel just below each dam, creating ideal riffle, run, and pool habitats for smallmouth bass. Just upstream of each dam, flat slopes and deep backwater areas are present that are slow-moving and silt laden. Because of the dams, stream width and depth vary considerably. Stream width ranged from 16.8 m just below the plunge pools to over 51.8 m upstream of the dams. Stream depths along the thalweg ranged from a few centimeters to over 2 m. The low stream gradient and close proximity of the dams resulted in very few whitewater areas within Brandywine Creek.

The smallmouth bass fishery in Brandywine Creek had never been sampled extensively, probably because of the lack of stream and boat access and the difficulty of sampling the creek's diverse habitats. No boat ramps exist along the creek and much of the property along the stream is privately owned. The few smallmouth bass samples collected from the Delaware portion of this creek before this study were taken with a backpack electroshocker in riffle habitats.

Electrofishing Raft Construction

Construction began with the purchase of a 4.2-m-long Zodiac Grand Raid MK II raft, which is ideal for a two-man crew (Figure 1). Launch wheels that attached to the transom also were purchased from the raft manufacturer. The launch wheels made it easier to portage for long distances and to traverse shallow riffle areas. Quick-fit, nonskid aluminum floorboards were included with the raft. The nonskid coating on the surface of the floorboards prevented the grounded metal frame of the generator from making contact with the metal floorboards and establishing a ground with the metal underneath the coating. However, there was a safety concern regarding electrical shorts; it would have been possible for electricity to ''jump'' from a short in the electrical system to the ungrounded floorboards. Generators are often

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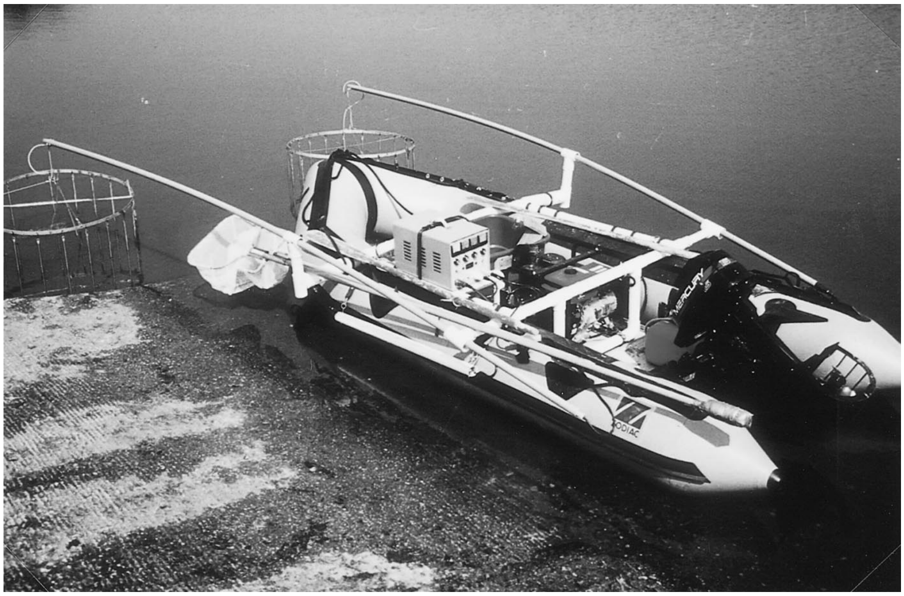

FIGURE 1.—An electrofishing raft designed for sampling intermediate-size waters with restricted boat access.

grounded to the boat in aluminum electrofishing boats. A local electrical engineer recommended grounding the generator to the floorboards by installing copper wire around the perimeter of the floor using wire lugs and connecting an additional wire from the generator ground to the copper wire, thus establishing a ground between the generator and each of the floorboards. Aluminum wire lugs were attached to the floorboards and 10-gauge copper wire was placed around the floor perimeter. The wire was coated with an anti-oxidant joint compound where it came in contact with the wire lugs.

The weight specifications of the heavier items to be placed on or inside the raft were reviewed and compared for total weight. These included the outboard motor, electronic pulsator, generator, and internal frame. The total weight of these items was important because often the gear had to be transported on foot to the streambank. In addition, we wanted to obtain the least amount of draft as possible for passage through the riffle areas.

The raft was equipped with a 15-hp (1 hp = 746 W) Mercury short shaft outboard motor that weighed 16.8 kg less than a 25-hp outboard motor. The total weight of the motor was 34 kg. A propeller guard protected the propeller and lower unit from damage in shallow depths.

Electronic pulsators from two manufacturers and various makes of 3500-W generators were compared for total weight and power output. Manufacturers offered a custom electronic pulsator and generator package (81.2 total kg), or individual electronic pulsators to be used with a user-supplied generator. The lightest generator we found was the Honda model EZ3500, which weighed 49.9 kg. Two similar electronic pulsators had quite different weights: 34 versus 10 kg. By choosing the lightest individual electronic pulsator and generator, their total weight amounted to 59.9 kg, which was 21.3 kg less than the manufacturer's package.

An internal frame was needed to support the boom poles and the electrodes. Aluminum frames from three manufacturers were assessed for weight and cost. The average weight of a basic aluminum frame was 21.8 kg, and prices varied from US$240 up to $620. Due to the low frequency of rapids in Brandywine Creek, a PVC frame provided adequate stability and strength for our needs. A custom-fit frame, constructed using 6.35-cm, schedule-40 PVC pipe, cost under $30 and weighed 19.5 kg (Figure 2). This reduced the total cost of the raft by about $200 and the total weight of the raft by a minimum of 2.3 kg. The horizontal arms that held the boom poles in place were reinforced with 5.08-cm PVC pipe to provide additional support. The frame was anchored to grommets along the top of the raft using adjustable 2.54-cm cam buckle straps. Additional holes were drilled into the frame side supports to accommodate oarlocks. A cathode was constructed using a stainless steel cable consisting of four branches. The cable was run through the

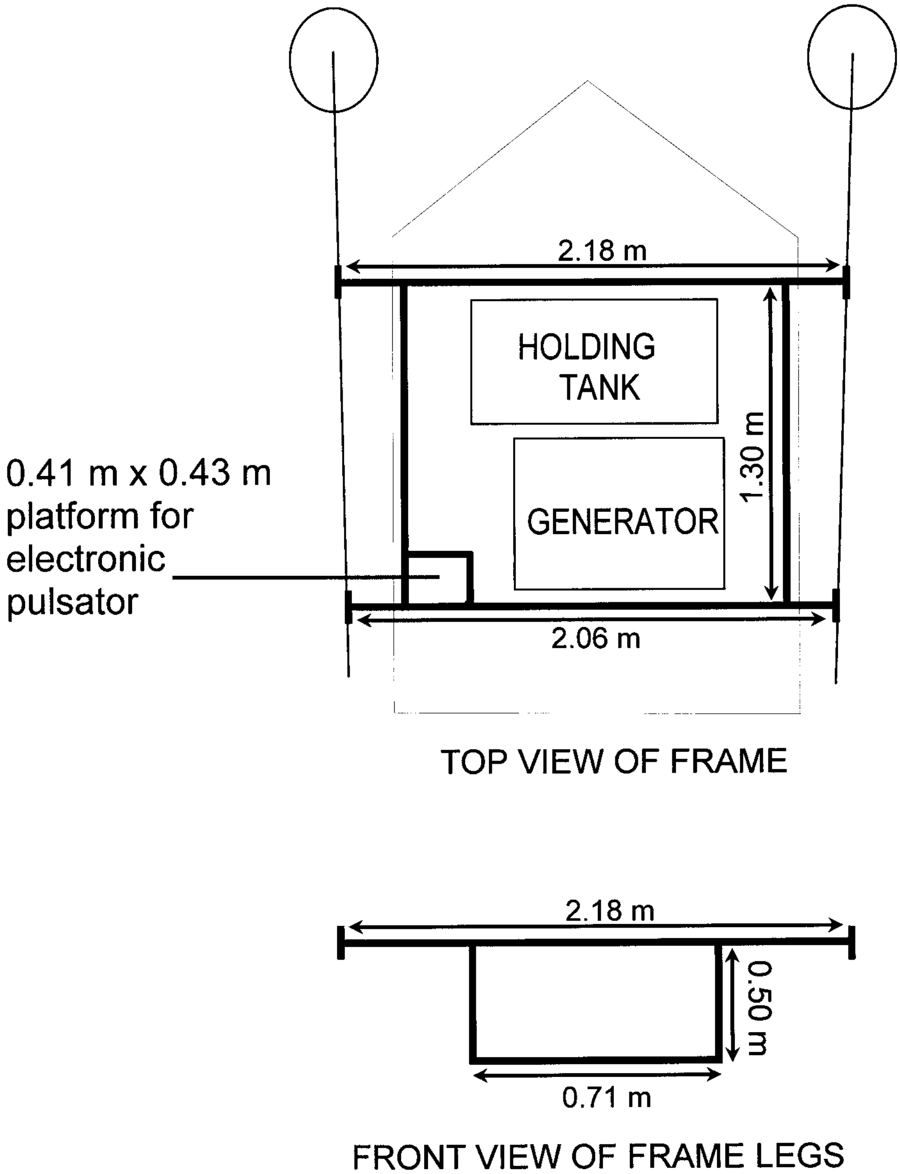

FIGURE 2.—Top view and dimensions of the electrofishing frame and front view and dimensions of the frame legs.

end of a 1.1-m-long PVC pipe, and each branch was placed through holes drilled along the length of the pipe. The cathode was hung over the side of the raft so that each branch of the cable hung into the water column perpendicular to the horizontal pipe.

The hollow fiberglass anode poles were reinforced with 5.08-cm wooden dowel rod to increase the strength of the poles to support the stainless steel electrodes. A plastic holding tank (71 × 56 × 48 cm) was used as a live well. For safety purposes, the person netting the fish in the front of the raft controlled the flow of electricity with a foot-switch. Operational and safety guidelines for electrofishing described by Murphy and Willis (1996) were routinely followed and included the use of life jackets, rubber footwear, and rubber linesman's gloves.

Results and Discussion

This electrofishing raft produced an efficient electrofishing field for sampling smallmouth bass in water with moderate conductivity (approximately 200 μS/cm) and allowed us to more effectively sample and manage Delaware's primary smallmouth bass fishery. For example, 8 d of sampling a limited number of habitats with a backpack electroshocker during the summer of 1993 resulted in 117 smallmouth bass collected within a sampling section on Brandywine Creek. In contrast, using our raft in 1998, we were able to sample all habitats within that same sampling section and collected 482 smallmouth bass in 6 d of sampling.

In 1997 and 1998, a combined total of 4,804 smallmouth bass were sampled from Brandywine Creek with the electrofishing raft (Stangl 1999). The raft was also effective for sampling other species present in the stream, including largemouth bass *Micropterus salmoides,* rainbow trout *Oncorhynchus mykiss,* rock bass *Ambloplites rupestris,* white crappie *Pomoxis annularis,* and several species of *Lepomis.*

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