Modification of a Passive Gear to Sample Paddlefish Eggs in Sandbed Spawning Reaches of the Lower Yellowstone River

Jon A. Firehammer* and Dennis L. Scarnecchia

(Pasch et al. 1980; Wallus 1986; Hesse and Mestl

FIGURE 1.—Map of the lower Yellowstone and Missouri rivers, Montana and North Dakota (top) and inset showing the locations along the Yellowstone River (solid circles) where acipenseriform eggs were sampled during 2000–2002. Rectangular boxes on the enlarged aerial photos designate the areas in which egg collectors were deployed; the stippled areas indicate the locations of gravel–rubble shoals within sample sites. The distance scale applies to the aerial photos.

secured between complementary 0.60 × 0.75 m angle-iron frames. Each mat was equipped with a 4.5–5.0-kg rebar grapple anchor and a buoyed hauling line. Mats were deployed at rkm 13.5, 21.5, and 25.5 in the spring of 2000. The use of this mat design was permanently discontinued after June 16 because many of the mats were buried by sand or silt and could not be retrieved.

In 2001 and 2002, a tubular type of collector was constructed that would minimize prolonged contact with the river bottom and reduce the possibility that fine sediments would bury the collector. A single strip of furnace filter material (0.75 m wide) was fitted and secured around an open-ended PVC cylinder 0.75 m long × 0.15 m diameter. A 4.5–5.0-kg anchor was secured to one end of the tube with a 0.20-m-long anchor line, and a buoyed hauling line was attached to the other end of the tube. The intent of this design was to suspend the collector off the riverbed while maintaining a sampling position near the bottom of the water column. To determine the effectiveness of the newly designed tubes, only rkm 13.5 was sampled in 2001 and rkm 9.5 and 13.5 in 2002.

Three to five egg collectors were deployed equidistantly as a set across the river channel. Depending on the apparent size of the potential egg deposition area, two or three sets, separated by distances of 200–300 m, were deployed within each site. Depth and channel position were recorded for each deployed collector. Every 2–5 d, collectors were retrieved and examined for presence of eggs. Acipenseriform eggs, identified by color and size, were removed and preserved in 80% ethanol. Collectors were then rinsed thoroughly before redeployment into the river. Because sturgeon (*Scaphirhynchus* sp.) were also present in the study area, the eggs collected were sent to the National Fish and Wildlife Forensics Laboratory in Ashland, Oregon, for species identification. Mitochondrial DNA sequences from a region of the cytochrome *b* gene were obtained from eggs and compared with reference sequences from paddlefish, pallid sturgeon *S. albus*, and shovelnose sturgeon *S. platorhynchus*. The genetic methods and analyses used 142ggss5(o5)-374.esdedsepa41.)416ss

Because it was assumed that intensity of spawning activity may vary over time and between sites, the candidate set included models with spatial parameters (*m* and *k*, or λ) unique to each site and sample period,

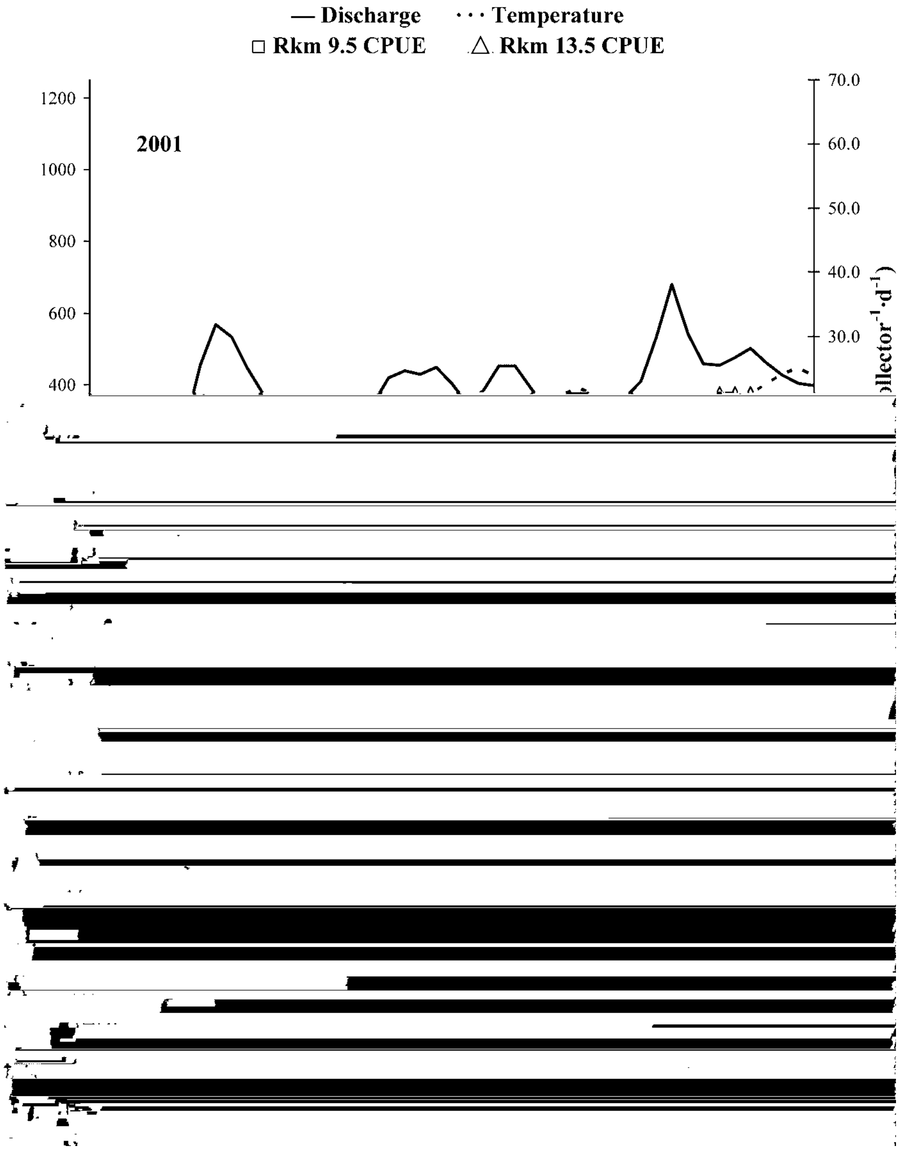
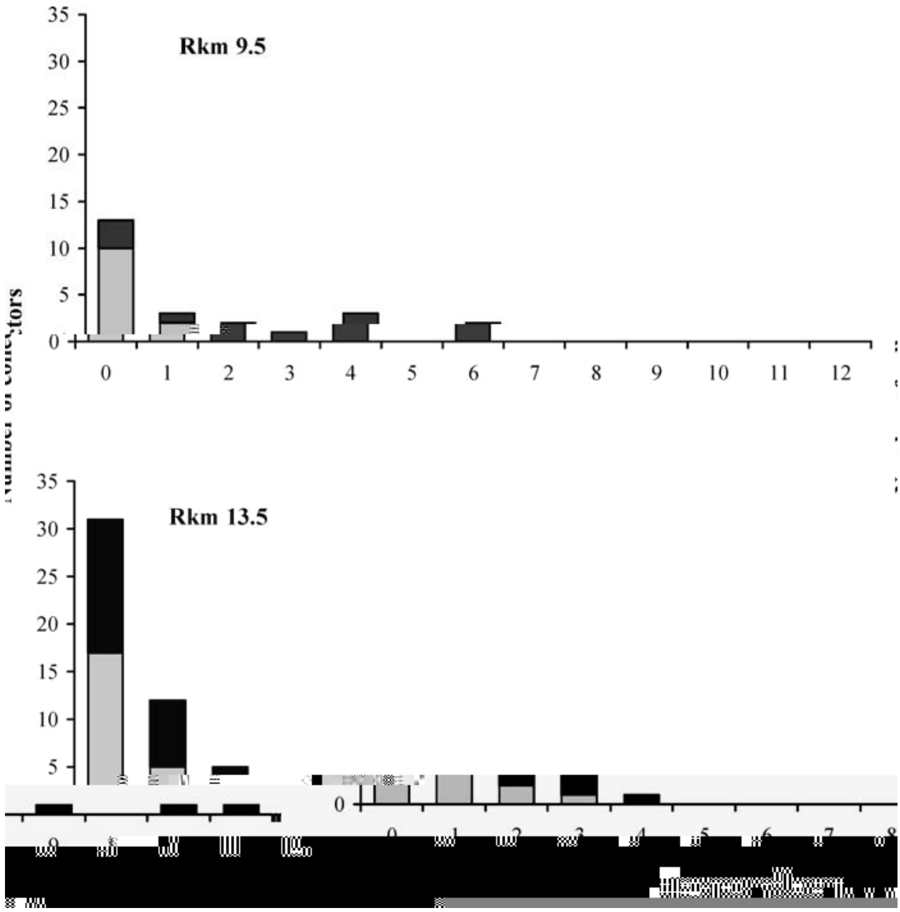


FIGURE 2.—Catch per unit effort (CPUE) of acipenseriform eggs at rkm 9.5 and 13.5 in relation to Yellowstone River discharge and temperature during the spring of 2001 and 2002. The number of symbols along each horizontal CPUE bar indicates the duration of the sample period in days.

collected eggs at that site. At rkm 9.5, 9 of the 11 (82%) tubes with eggs were retrieved along the thalweg near the west bank and accounted for 94% of eggs collected at that site. Estimates of mean egg counts over collection periods in 2002 were low, ranging between 0.42 and 3.55 eggs/collector for distribution models that received support in model selection (Table 3). Fewer than four eggs were found on 27 of the 36 (75%) tubes that had collected eggs at both sites in 2002 (Figure 3).

A clumped distribution of eggs was suggested by the finding of nine or more eggs on several tubes in combination with a lack of eggs on many tubes during collection periods in 2002 (Figure 3). Accordingly, the three models that received support as "best" in model selection were fit by a negative binomial distribution (Table 3). Conversely, large ΔAIC_c values calculated for Poisson models provided strong evidence against a random distribution of eggs. In addition, though selected models did not support a difference in mean



FIGURE

egg counts between sites, the second best model indicated a higher degree of clumping at rkm 13.5 ($k = 0.74$) than at rkm 9.5 ($k = 1.58$).

Discussion

The tubular collectors deployed during 2001 and 2002 along the lower Yellowstone River proved to be a viable passive technique for collecting paddlefish eggs in spawning reaches characterized by predominantly sandy substrate. Tubes were successfully retrieved over 95% of the time, whereas the mats often became buried and were difficult to dislodge from the riverbed. Paragamian et al. (2001), in their efforts to document white sturgeon spawning events in the Kootenai River, Idaho, also found that egg mats became buried by shifting sand during high-flow events. Although mats that are temporarily buried may later be recovered, the sample design and interpretation of results are compromised. Tubes collected eggs during both years of deployment, whereas eggs were not found on retrieved mats in 2000. However, the effectiveness of the two types of collectors could not be directly compared because they were not deployed in concert. The discontinuation of sampling by mid-June of 2000 may have prevented the collection of eggs by mats in that year. Nonetheless, the sampling efficiency of mats that become covered by shifting sands decreases, whereas tubes suspended off the bottom retain an exposed surface area for egg attachment.

The collection and genetic confirmation of eggs at rkm 9.5 and 13.5 support the existence of spawning and egg deposition habitat for paddlefish within this stretch of the lower Yellowstone River. These results are consistent with previous larval collections, as paddlefish have been regularly collected along the lower 30 rkm with high densities found around rkm 13.5 (Gardner 1993, 1995, 1996). On the other hand, our positive results might be attributed only to interception of drifting eggs and not to egg deposition, as suggested by the high percentage of eggs collected along the thalweg. However, the finding of eight eggs on a retrieved egg mat, which presumably lay flush with the riverbed, supports the supposition of egg deposition at rkm 13.5. Additionally, the presence of cobble and bedrock at this site would provide suitable attachment sites for adhesion of eggs. The role of other physical characteristics at rkm 13.5, such as eddy currents that might facilitate egg deposition and adhesion, needs further investigation (Sulak and Clugston 1998; Perrin et al. 2003).

The clumped distribution of eggs collected at both sites also provides evidence that paddlefish spawned in the vicinity of deployed tubes. It is difficult to tactic in a spatially unpredictable reproductive environment such as the lower Yellowstone River (den