The efficiency of wire minnow traps in assessing populations of *Fundulus heteroclitus*

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Wire minnow traps are routinely used for catching *Fundulus heteroclitus* for laboratory use. These traps have also been used in an attempt to assess the population of this species. The usual assumption has been that once fish enter the trap, they will remain inside until released. This assumption has been challenged by Kneib and Craig[1], who "seeded" traps similar to ours with marked fish, and showed that a large number of fish left the trap in the course of a several-hour deployment. Layman and Smith[2] also observed but did not enumerate *F. heteroclitus* leaving a trap under laboratory conditions. One might assume that the rate at which fish leave a trap would be roughly proportional to the number in the trap at that time, but the prior experimental designs did not allow testing this hypothesis, since they had no way of knowing the number of fish in their traps over time.

To monitor fish movement through the trap entrances directly, we mounted two underwater cameras on a trap to view each entrance hole, as shown in Figures 1 and 2. We wired a solid aluminum plate to the back of each entrance to aid in discriminating between fish moving behind the entrance and through the entrance. Each camera was connected to a video recorder powered by a 12 volt battery, which imaged fish entering and leaving the trap through each entrance separately. The trap was deployed in Northeast Creek in the pool above the broken dam near the Rt. 3 bridge. At this site, the water depth fluctuation with tide is attenuated to 10-20 cm. The unbaited traps were deployed

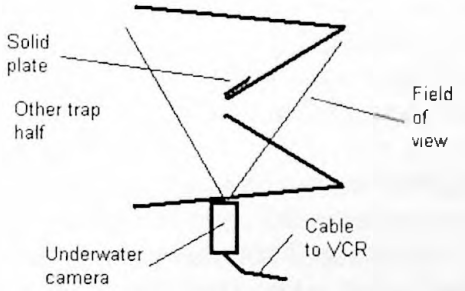

Figure 1. Schematic diagram of half of a trap with camera mounted. The other half was similarly equipped.

Figure 2. A single frame from one camera, showing a fish exiting a minnow trap, with other fish in view.

2 hours before high tide and recovered around 2 hours after high tide. The resulting 8 hours of video data per experiment were analyzed by watching the tapes and noting the time each fish entered or exited the trap, using an event-recording program written for this purpose. The data were classified into 10 minute time blocks relative to predicted high tide, with the block time assigned to the beginning of the block. From this analysis, the number of fish in the trap at the end of the run could be computed and compared to the number found in the trap, as a check on the accuracy of the counting. The error rate was computed as $(E - L - O)/(E + L)$, where E was the total number of fish seen to enter

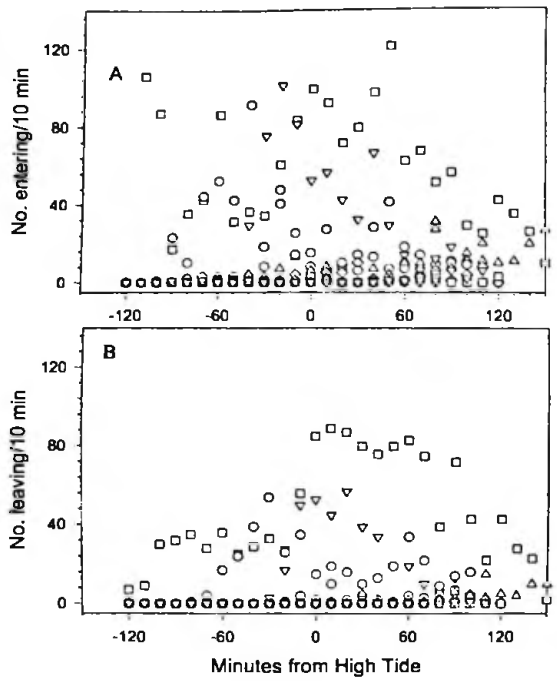

Figure 3. Fish entry (A) and exit (B) per 10 minute analysis period, as a function of tide stage. Eleven experiments, plotted with different point shapes.

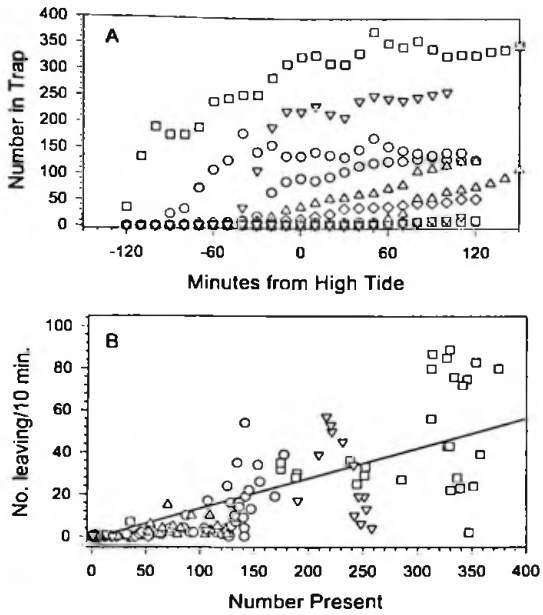

Figure 4. A. Trap contents increase around high tide. B. Number leaving trap is roughly proportional to number in trap – best fit line is (# leaving) = -2.59 + 0.151 · (# present), $r^2 = 0.655$

the trap, L the total number leaving the trap, and O the number observed in the trap when it was removed from the water. The number of fish found in the trap per deployment varied widely from 233 to runs in which no fish were caught, which were excluded from the analysis. The number of individual events (E + L) in the 11 analyzed records likewise varied from 2947 to 11, and the error rate varied from 0 to 15.15% with an overall rate of 3.99%. As expected, runs with fewer fish gave more accurate results. These wide variations are consistent with trapping records at this site.

With these data we can test the hypothesis that the number of fish leaving the trap is proportional to the number of fish in the trap, which is essentially a diffusion hypothesis. As seen in Figure 4B, there is a rough agreement with this hypothesis at higher densities. Up to about 100 fish present, there are few escapes; at higher trap contents the rate of leaving increases considerably. The slope of the line is significantly different from zero. Overall, for 3353 fish observed entering a trap, 2194 or 65% were observed to leave.

While there is considerable variability between runs, it is clear that while these traps are useful in obtaining *Fundulus* for various purposes, the trap contents do not provide an unbiased sample of the population of the creek, and should not be used for this purpose.

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1. **Kneib, R. T., and A. H. Craig**. 2001. Efficacy of minnow traps for sampling mummichogs in tidal marshes. Estuaries 24:884-893
2. **Layman, C. A., and D. E. Smith**. 2001. Sampling bias of minnow traps in shallow aquatic habitats on the eastern shore of Virginia. Wetlands 21:145-154