Examination of non-game fish passage at road-stream crossing using mark-recapture, genetic, and PIT tag techniques

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INTRODUCTION

Government agencies are inventorying and replacing road-stream crossings, often with a goal to improve aquatic organism passage. Few studies have addressed how movement of non-game species are influenced by road-streams crossings. Agencies need simple, cost-effective techniques to verify aquatic organism passage at road-stream crossings. In early 2010 we initiated mark-recapture and genetic studies to determine movement of non-game fish species, through 20 road-stream crossings on the Daniel Boone National Forest. We also established antenna arrays to continuously monitor movement of PIT tagged fish at 3 crossings.

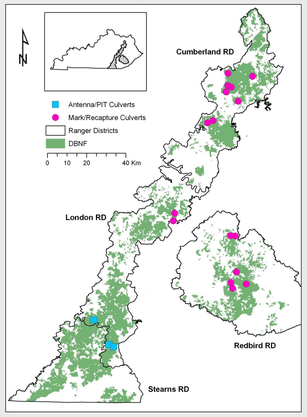

Figure 1. Road-stream crossings examined with mark-recapture and PIT antenna study site on the Daniel Boone National Forest, KY in 2010.

Preliminary results from our 3 PIT antenna sites are presented here. The sites primarily contain creek chubs (*Semotilus atromaculatus*) and Federally Threatened blackside dace (*Phoxinus cumberlandensis*). Our results examine fish movement through road-stream crossings and compare sample techniques.

SITE SELECTION

We used the National Inventory and Assessment Protocol (Clarkin et al. 2003) and passage models developed by Coffman (2005) to select sites with easy, moderate, and difficult passage for minnow species of moderate to strong swimming and leaping ability. Study sites were established at 20 crossings (Figure 1). Three sites of varying passage difficulty were chosen for PIT antennas.

METHODS

Mark-recapture: In March – April 2010, we backpack electrofished reaches A & B (Figure 2). We marked fish in reach A with a lower caudal clip, and fish in reach B with an upper caudal clip. In July – Aug 2010, we sampled reaches A, B, & C and examined all fish for caudal fin clips.

Genetics: Fin clips were preserved for genetic analysis. Lab analysis begins in 2011.

PIT antennas: At the 3 PIT antenna (Bond et al. 2007) study sites we implanted 12 mm PIT tags into all fish greater than 70 mm. The antennas ran continuously from March – September 2010, (with 2 weeks downtime due to flooding) enabling us to detect movement from reach A to reach B, and from reach B to reach C.

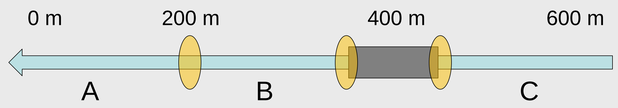

Figure 2. Typical 600 m long study area with 2 reaches downstream of the crossing (reaches A & B) and 1 reach upstream (reach C). Antennas (ovals) were installed between reaches A & B, and at the outlet and inlet of the crossing in 3 streams.

RESULTS

Higher numbers of creek chub movements were detected with PIT antennas than with mark-recapture (Table 1). We detected 39% - 49% of PIT tagged chubs moving from reach A to B at all sites. Movement of PIT tagged chubs from reach B, through the crossing, and into reach C was highest at the easy crossing (42%), declined at the moderate crossing (20%), and was lowest at the difficult crossing (0%). Most blackside dace were too small to PIT tag, but we documented some movement (Table 1).

Table 1. Movement from reach A to B, and from reach B to C as detected using mark-recapture (M-R) and antennas (PIT) at sites with low, moderate, and high passage difficultly.

Species	Passage	moved from A to B		moved from B to C	
		M-R	PIT	M-R	PIT
Creek chub	Easy	0% (0/150)	49% (24/49)	0% (0/154)	42% (14/33)
	Moderate	2% (4/207)	46% (31/68)	1% (1/214)	20% (15/74)
	Difficult	1% (1/112)	39% (13/33)	0% (0/65)	0% (0/13)
Blackside dace	Easy	0% (0/76)	no PITs	0% (0/60)	no PITs
	Moderate	0% (0/42)	100% (2/2)	0% (0/42)	63% (5/8)
	Difficult	7% (1/14)	100% (1/1)	0% (0/3)	no PITs

DISCUSSION

The PIT antenna data clearly showed fish movement undetected by mark-recapture. Mark-recapture is often attractive to biologists because it can be completed with standard equipment and moderate effort. However, mark-recapture is only capable of detecting fish movement that happens to coincide with recapture sampling.

Installation of PIT antennas requires substantial investment in equipment and time. Maintenance is daunting; however results are easy to interpret, and since monitoring is continuous there is little chance of missing fish passage events.

Genetic sampling requires relatively low effort (Hudy et al. 2010). Processing time and ease of interpretation are the biggest unknowns as we move forward with lab analysis.

Table 2. Strengths (+), weaknesses (-), and unknown (?) elements of mark-recapture (M-R), antenna (PIT), and genetic sampling.

	Equipment	Field Effort	Analysis time	Interpretation
M-R	+	+	+	-
PIT	-	-	+	+
Genetic	+	+	?	?

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