Short-term Retention of Floy Anchor Tags by Stream-dwelling Smallmouth Bass

Maureen G. Walsh, *Oklahoma Cooperative Fish and Wildlife Research Unit, Department of Zoology, 404 Life Sciences West, Oklahoma State University, Stillwater, OK 74078*

Dana L. Winkelman, *U. S. Geological Survey, Biological Resources Division, Oklahoma Cooperative Fish and Wildlife Research Unit, 404 Life Sciences West, Oklahoma State University, Stillwater, OK 74078*

Abstract: We conducted 2 short-term experiments to address Floy anchor tag (model FD-68B) retention in stream-dwelling smallmouth bass *(Micropterus dolomieu)* over 3 to 4 months. One experiment used stream-dwelling smallmouth bass held in an experimental pond, and the other was conducted on smallmouth bass in a northeastern Oklahoma stream. Tag retention in the pond over a period of 3 months was 100%, while tag retention in the field was 76% through 1.5 months and dropped to 48% through 4 months. Mean lengths were similar between smallmouth bass that lost and retained tags at both time periods. Increased structural complexity of the stream environment or density related problems caused by low water conditions may have contributed to lower tag retention in stream-dwelling smallmouth bass. Estimating tag retention in a pond environment may overestimate actual tag retention by stream-dwelling smallmouth bass and should be used with caution.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 56:38–43

Marking fish is an important technique employed by fisheries investigators to track growth, movement, and survival, as well as estimate population size (Hilborn et al. 1990). Development of a gun-style applicator and anchor tag (Dell 1968) allowed quick application of tags to large numbers of fish. Ease of tag application and relatively low cost have made anchor tags popular, but the assumption that tags are not lost is rarely met, and tag loss must be corrected for when estimating parameters based on tagging data (McFarlane et al.1990, Muoneke 1992).

Use of Floy anchor tags is widespread in fisheries management, and a variety of studies on tag suitability and retention have been conducted on recreationally important fish taxa: salmonids (Mourning et al. 1994, Brewin et al. 1995), moronids (Waldman et al. 1991, Muoneke 1992), ictalurids (Hale et al. 1983, Timmons and Howell 1995), and clupeids (Bulak 1983). As part of an ongoing study of stream-dwelling smallmouth bass in northeastern Oklahoma, we have tagged over 200 smallmouth bass in Brush Creek, Delaware County, Oklahoma, with anchor tags since May 2000. We intend to incorporate tag retention into our survival models; however, among

black bass species, evaluation of anchor tag performance has focused on largemouth bass *(Micropterus salmoides)* (Wilbur and Duchrow 1973, Tranquilli and Childers 1982). Although morphological similarities between largemouth and smallmouth bass imply similar retention rates, this has not been directly tested. In particular, habitat differences between largemouth bass and stream-dwelling smallmouth bass could influence tag retention. The objective of this study was to evaluate retention of Floy FD-68B anchor tags by smallmouth bass in northeastern Oklahoma streams.

The authors thank D. Fenner, C. Sager, and M. Willis for assistance with field work. Financial support for this publication was provided by the Federal Aid in Sport Fish Restoration Act under Project F-41-R of the Oklahoma Department of Wildlife Conservation and Oklahoma State University through the Oklahoma Cooperative Fish and Wildlife Research Unit (cooperators: Oklahoma Department of Wildlife Conservation, Oklahoma State University, U.S. Fish and Wildlife Service, U.S. Geological Survey Biological Resources Division, and the Wildlife Management Institute).

Methods

We conducted 2 short-term experiments to address tag retention: 1 experiment was conducted on smallmouth bass in a northeastern Oklahoma stream and 1 experiment used stream-dwelling smallmouth bass held in an experimental pond. In both studies, Floy FD-68B anchor tags (orange in the stream study, pink in the pond study) were applied to smallmouth bass on the left side near the anterior of the soft dorsal fin with a Floy Mark III regular pistol grip gun and regular needle. Tags were inserted at a 45-degree angle, and positioning of the anchor firmly behind pterygiophores was tested by manually rotating and pulling the tag gently.

Stream Experiment

Brush Creek is a small (mean width, 8.9 m), spring-fed stream that originates at a large natural spring and extends approximately 8 km before draining into Lake Eucha. In October 2001, we sampled 7 pool habitats on Brush Creek with boat mounted electrofishing equipment for the specific purpose of collecting and marking smallmouth bass for this study. We tagged 63 smallmouth bass (156–376 mm) with anchor tags and removed the third anal spine as a secondary mark. We resampled 5 of these pools in December 2001 and February 2002 in conjunction with sampling for other research goals, resulting in tag retention estimates for 1.5 and 4 months. Due to logistic constraints, the stream sampling interval did not match the 3-month sampling interval of the pond experiment.

Pond Experiment

We transplanted stream-dwelling smallmouth bass into an experimental pond to estimate tag retention in a closed population. To avoid influencing the smallmouth bass population that we were studying in Brush Creek, we collected fish for the pond experiment from Beaty Creek. Beaty Creek is located within the same watershed as

Brush Creek and drains into Lake Eucha approximately 800 m from the confluence of Brush Creek and Lake Eucha. In January 2001 we sampled a large bedrock pool on Beaty Creek and collected 20 smallmouth bass (175–304 mm TL) with boat-mounted electrofishing equipment. We transported the fish to the Oklahoma Cooperative Fish and Wildlife Research Unit Pond Facility at Lake Carl Blackwell, Stillwater, Oklahoma, tagged fish with anchor tags, and stocked fish into a 0.10-ha experimental pond (maximum depth, 1.4 m). We evaluated 3-month Floy anchor tag retention when the pond was drained and the experiment terminated in April 2001.

Analyses

We used *t*-tests ($\alpha = 0.05$) to compare the mean lengths of smallmouth bass tagged in the field and pond studies and mean lengths of smallmouth bass that lost and retained anchor tags in both December 2001 and February 2002. We used a X^2 test of independence ($\alpha = 0.05$, df = 1) to evaluate the relationship between tagging environment (stream vs. pond) and tag retention at 1.5 and 4 months. Although we did not examine fish in the pond experiment at 1.5 months, we know that tag retention was 100% because tag retention in the pond was 100% at 4 months. We compared the 4-month tag retention estimate in the stream to the 3-month estimate in the pond experiment, assuming that tag retention in the pond would have remained at 100% for an additional month.

Results and Discussion

In December 2001, we recaptured 25 smallmouth bass in Brush Creek (181–375 mm TL) that had either tags or anal spine clips. Of these, 19 retained both the anchor tag and anal spine clip and 6 had a clipped anal spine but had lost their anchor tag, resulting in 76% tag retention over the 1.5-month interval since tagging. In February 2002, we recaptured 23 smallmouth bass (201–369 mm TL) that had either tags or anal spine clips. Of these, 11 retained both the anchor tag and anal spine clip and 12 had a clipped anal spine but had lost their tag, resulting in 48% anchor tag retention over the 4-month interval since tagging. Our results indicate potentially high rates of tag loss in stream-dwelling smallmouth bass over a relatively short time span that could bias population size and survival estimates and reinforces the importance of applying a secondary mark (Tranquilli and Childers 1982) to help quantify and correct for tag loss.

After terminating the pond experiment, we recovered all 20 fish that had initially been tagged and stocked into the pond. All fish retained their anchor tag, indicating 100% tag retention over 3 months. Due to sampling constraints, smallmouth bass collected from Beaty Creek and tagged for the pond experiment (mean ± SD, 212 ± 35 mm) were smaller than smallmouth bass tagged in the stream experiment (251 ± 50 mm, $P = 0.0018$). The size difference could complicate comparison of tag retention between the pond and stream experiments. However, in the stream experiment, mean lengths were similar between smallmouth bass that retained and lost tags in both December and February (Table 1, $P > 0.1273$), indicating that tag retention was

Table 1. Comparison of mean lengths and length ranges between smallmouth bass that retained and lost anchor tags after 1.5-month and 4-month time intervals in the stream experiment, and mean length and length range for smallmouth bass in the pond experiment.

Time interval	Total length (mm)				*P*-value
	Tag retained		Tag lost		
	Mean (SD)	Range	Mean (SD)	Range	
Stream experiment					
1.5 months (Dec 01)	272 (49)	181–355	304 (52)	231–375	0.1508
4 months (Feb 01)	259 (34)	221–317	289 (54)	201–369	0.1273
Pond experiment	212 (35)	175–304	NA	NA	NA

not size dependent for the range of sizes tagged. Additionally, although mean size differs, the size distributions overlap. Tag retention was dependent on tagging environment (stream vs. pond) at 1.5 months ($X^2_{0.05,1} = 5.551$) and comparing the 4-month stream estimate to the 3-month pond estimate ($X^2_{0.05,1} = 14.467$). We do not believe that the difference in length between smallmouth bass in the 2 experiments was responsible for the observed differences in tag retention.

Additionally, we do not believe that differential tag loss between the experiments in this study can be attributed to improper tag attachment, as tags in both situations were attached by the same individual in the same way. Failure of tags (separation of vinyl tubing from monofilament anchor) was a problem in earlier studies of Floy tag retention (Wilbur and Duchrow 1973, Tranquilli and Childers 1982), but this problem has been corrected and was not observed in this or other recent studies (Gurtin et al. 1999). We did not observe any inflammation or infection at tag insertion in tagged fish in either experiment. Exclusion of these common sources of tag loss leads us to believe that habitat-related differences are responsible for the lower tag retention by stream-dwelling smallmouth bass.

Smallmouth bass in Brush Creek are typically found in pool habitats characterized by bedrock boulders and/or logs and woody debris. Given the use of cover by smallmouth bass in the stream environment, anchor tags would be more susceptible to entanglement than in the experimental pond environment, which contained no structure. The high anchor tag retention by smallmouth bass that we observed in the pond experiment seems to be more similar to retention rates of largemouth bass, which are generally found in lentic habitats, than to those observed for stream-dwelling smallmouth bass. However, it is possible that in a natural lentic environment, presence of aquatic vegetation or woody debris could contribute to tag loss.

Three-month tag retention by largemouth bass held in experimental ponds (Wilbur and Duchrow 1973) was lower than our 3-month results with smallmouth in an experimental pond, but greater than our 4-month anchor tag retention in Brush Creek (Table 2). Our results show a generally lower tag retention rate by stream-dwelling smallmouth bass than largemouth bass in ponds or reservoirs held over similar or longer time periods (Table 2).

Table 2. Comparison of Floy anchor tag retention estimates between smallmouth bass (SMB) in the current study and largemouth bass (LMB) in previous short- and long-term studies. All but 1 study used Floy FD-68B anchor tags (see footnote b).

Anchor tag retention	Species	Size (mm TL)	Time span	Habitat	Method	Source
76%	SMB	181–375	1.5 months	Stream	Double-mark study	Current study
88%	LMB	Not Reported	3 months	Pond	Direct observation	Wilbur and Duchrow (1973)
100%	SMB	175–304	3 months	Pond	Direct observation	Curent study
48%	SMB	201–369	4 months	Stream	Double-mark study	Current study
82%[a]	LMB	203–292	6+ months	Pond	Direct observation	Tranquilli and Childers (1982)
88%–92%	LMB	140–443	1 year	Reservoir	Double-mark study	Gurtin et al. (1999)[b]
80%	LMB	≥305	5 years	Reservoir	Angler returns	Keefer and Wilson (1993)

a. Retention rate if tag separation had not occurred.

b. Study used Floy FD-94 anchor tags.

Another explanation of differential tag loss may be that fish density contributed to higher tag loss in the stream. Wilbur and Duchrow (1973) suggested that tags might be mistaken for food items in areas of high water clarity and attributed tag loss to density-dependent agonistic encounters between fish. This was not observed in our pond experiment, probably because smallmouth bass were stocked at low density (200/ha). However, drought and low water typically limit habitat in Brush Creek. These conditions would likely increase the density of smallmouth bass in pools, increasing encounters among smallmouth bass and between smallmouth bass and other fish species.

Our results indicate that estimating tag retention in a pond environment may overestimate actual tag retention by stream-dwelling smallmouth bass and should be used with caution. Anchor tag retention in smallmouth bass may be influenced by habitat and studies to evaluate tag retention by stream-dwelling fishes should be conducted *in situ*, or in similar habitats, to more accurately estimate anchor tag retention.

Literature Cited

Brewin, M. K., L. L. Stebbins, and J. S. Nelson. 1995. Differential losses of Floy anchor tags between male and female brown trout. North Am. J. Fish. Manage. 15:881–884.

Bulak, J. S. 1983. Evaluation of Floy anchor tags for short term mark-recapture studies with blueback herring. North Am. J. Fish. Manage. 3:91–94.

Dell, M. B. 1968. A new fish tag and rapid, cartridge-fed applicator. Trans. Am. Fish. Soc. 97:57–59.

Gurtin, S. D., M. L. Brown, and C. G. Scalet. 1999. Retention of Floy FD-94 anchor tags and effect on growth and condition of northern pike and largemouth bass. J. Freshwater Ecol. 14:281–286.

Hale, M. M., J. E. Crumpton, and D. J. Renfro. 1983. Tag retention and survival of Floy-tagged and fin-clipped white catfish and channel catfish in hatchery ponds. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 37:385–390.

Hilborn, R., C. J. Walters, and D. B. Jester, Jr. 1990. Value of fish marking in fisheries management. Am. Fish. Soc. Symp. 7:5–7.

McFarlane, G. A., R. S. Wydoski, and E. D. Prince. 1990. Historical review of the development of external tags and marks. Am. Fish. Soc. Symp. 7:29.

Mourning, T. E., K. D. Fausch, and C. Gowan. 1994. Comparison of visible implant tags and Floy anchor tags on hatchery rainbow trout. North Am. J. Fish. Manage. 14:636–642.

Muoneke, M. I. 1992. Loss of Floy anchor tags from white bass. North Am. J. Fish. Manage. 12:819–824.

Timmons, T. J. and M. H. Howell. 1995. Retention of anchor and spaghetti tags by paddlefish, catfishes, and buffalo fishes. North Am. J. Fish. Manage. 15:504–506.

Tranquilli, J. A. and W. F. Childers. 1982. Growth and survival of largemouth bass tagged with Floy anchor tags. North Am. J. Fish. Manage. 2:184–187.

Waldman, J. R., D. J. Dunning, and M. T. Mattson. 1991. Long-term retention of anchor tags and internal anchor tags by striped bass. North Am. J. Fish. Manage. 11:232–234.

Wilbur, R. L. and R. M. Duchrow. 1973. Differential retention of five Floy tags on largemouth bass. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 26:407–413.