Tag Retention of Hallprint® Dart Tags and Tag-induced Mortality in Largemouth Bass

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Abstract: Tag retention and tag-induced mortality were evaluated for 2 sizes of Hallprint® dart tags injected in largemouth bass (*Micropterus salmoides*). Mean tag retention rates of 98% for larger (81 mm) PDB dart tags and 78% for smaller (69 mm) PDT dart tags were observed during a 15-month study in Lake Blanchester, Florida. Significantly higher tag loss ($P \leq 0.05$) of PDT tags was attributed to a more flexible and shorter (12-mm) barb (anchor) compared to the larger and longer (18-mm) barb on the PDB tag. Estimated tag-induced mortality was 13% for bass 260–299 mm using smaller tags, and 18% for bass ≥300 mm TL using larger tags, over a 3-month period in a hatchery pond. However, there were no significant differences ($P > 0.05$) in mortality rates between control and tagged fish for 3 size groups. The larger tags with 98% tag retention and no significant tag-induced mortality are recommended for long-term tagging studies in bass ≥300 mm.

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External physical tagging, as described by McFarlane et al. (1990), has been one of the most common methods for fishery scientists to mark fish for determination of movement, growth, exploitation, and mortality when anglers are used for tag reporting. McFarlane et al. (1990) reported of over 900 studies on fish tagging published between 1884 and 1986, physical tags were used in 65% of the studies. Chadwick (1963) outlined the following 4 qualities tags must possess to obtain valid results from their use: 1) they must not affect mortality, 2) they must not affect the fish's vulnerability to fishing gear, 3) they must not be shed and 4) they must be easily recognizable and contain sufficient instructions so the person catching the fish will see and know what to do with the tags.

Ideally, the type of tag used for an exploitation study should meet the requirements outlined by Chadwick (1963) or the parameters should be evaluated

to provide correction factors to adjust tag-return data. Wydoski and Emery (1983) outlined a much broader number of basic considerations for choosing an appropriate external tag. The T-bar anchor tag has been frequently used for largemouth bass due to the ease of application, but poor retention rates (0%–82%) have been reported by several investigators (Wilbur and Duchrow 1972, Gilbert and Hightower 1981, Tranquilli and Childers 1982). Abdominally-implanted internal anchor tags have been used in largemouth bass with good success (Weathers et al. 1990) and provide an easily observed tag location. A negative aspect of this tag design is the abdominal insertion site opens the peritoneal cavity to possible infection. When using internal anchor tags on striped bass (*Morone saxatalis*) in the Hudson River, Mattson et al. (1990) found 11% of the tag returns had the anchor protruding from the body cavity and 13% had sufficient tag abrasion to render the tag illegible.

Mather (1963) designed the first dart tag in 1954, a miniature harpoon with a metal head attached to a plastic streamer. This early prototype evolved to a dart tag with a nylon head designed by Yamashita and Waldron (1958). Hallprint®, Ltd., developed this tag into the modern version of a nylon dart tag. Even though it had not been tested previously on largemouth bass, we elected to use the Hallprint dart tag because of problems associated with other tag designs. The dart tag met preliminary criteria for a good external tag: it was easy to read, quick to use, had a data tube that did not distort or separate from the barb, and was highly visible to anglers.

The objectives of this study were to determine the amount of tag retention and tag-induced mortality when using 2 sizes of Hallprint dart tags in largemouth bass.

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Methods

Hallprint dart tags are constructed of a nylon shaft with a barbed end that serves as an anchor. A vinyl tube is molded to the shaft and is used for displaying agency information. Two sizes of dart tags were evaluated. The barb on the smaller PDT dart tag was 12 mm long with a 6.5-mm opening, while the barb on the larger PDB dart tag was 18 mm long with a 10-mm opening. The tag nomenclature, PDT and PDB, are manufacturer's codes for the type and size of each tag. The length of the tags used in this study were 69 mm (PDT) and 81 mm (PDB).

Dart tags were injected with a hollow stainless steel needle commercially available from Hallprint, Ltd. The needle was bevelled to a sharp edge at the insertion end. Each tag was inserted directly beneath the dorsal fin at a 45-

degree angle to the horizontal axis of the body so the tag extended in a posterior direction adjacent to the body. The tag barb was injected beyond the pterygiophores so the tag was anchored between 2 bones.

Lake Blanchester (Lake County, Fla.) was selected for the tag retention study since it is a private, 45-ha lake with very little angling pressure that could affect results. Local anglers were notified of the study and asked not to remove tags from bass they caught and released.

To evaluate tag retention of Hallprint dart tags, 409 largemouth bass (≥250 mm) were captured by electrofishing, given identifiable fin-clips for the tag size and month, tagged, and released in Lake Blanchester from October 1990 to February 1991. Sampling for recaptures of tagged fish began November 1990 and continued through March 1992. Bass were collected monthly during the first 3 months of the study (Nov 1990–Jan 1991) and quarterly thereafter. Total length (mm) and weight (g) were recorded for all bass collected. When sampling for tag recaptures, each bass was examined for tags, identifiable fin clips, and physical abnormalities (swelling, infection, etc.) at the tag insertion site on the fish.

During the first 2 months of tagging, all bass ≥250 mm were tagged below the spinous dorsal fin with the larger PDB tags, since they anchored more securely than the smaller tags. During these tagging efforts, however, the tag insertion needle for the larger tag seemed too large for smaller bass (<300 mm), and we became concerned about excessive stress during tagging. Beginning in February 1991, all smaller bass (250–299 mm) were tagged below the soft dorsal fin with the smaller PDT dart tag.

Fifty-one tagged and 30 untagged (control) largemouth bass collected from Lake Talquin were given identifiable fin clips to distinguish size groups and stocked into a 0.2-ha hatchery pond at the Blackwater Fisheries Research and Development Center to evaluate initial and long-term tagging mortality. Tagged and control groups were equally divided among 3 size groups (260–299 mm, 300–399 mm, ≥400 mm). Smaller PDT dart tags were injected below the soft ray dorsal fin for the 260- to 299-mm group, and the larger PDB dart tags were injected beneath the spinous dorsal fin for all bass ≥300 mm TL. Fish were examined at 1 and 3 months after stocking by draining the study pond. The difference in mortality between tagged and untagged fish was considered the measure of tag-induced mortality.

Pearson's χ^2 test was used to compare differences ($P \leq 0.05$) in tag loss (mean of quarterly values) between the 2 tag sizes and to test for differences in mortality between tagged and untagged largemouth bass in our hatchery pond. *T*-tests were used to compare differences ($P \leq 0.05$) in mean relative weight (Wr) between tagged and untagged fish collected from Lake Blanchester.

Results and Discussion

Tag retention of the larger PDB Hallprint dart tags averaged 98% and ranged from 93% to 100% during quarterly samples over the 15-month study

Table 1. Retention of large (PDB) and small (PDT) Hallprint dart tags in largemouth bass (LMB), Lake Blanchester, Florida, December 1990–March 1992.

	N fin-clipped LMB sampled		*N* fin-clipped LMB sampled that had lost tags		Tag retention (%)	
Months from initial tagging	Large tags	Small tags	Large tags	Small tags	Large tags	Small tags
1	14	0	1	0	93	
2	47	0	1	0	98	
3	43	2	0	0	100	100
6	27	6	0	3	100	50
9	40	8	1	2	98	75
12	26	7	1	1	96	86
15	23	0	0	0	100	
Overall	220	23	4	6	98	78

period in Lake Blanchester (Table 1). Average retention of the smaller tags was 78%, ranging from 50% to 100%. There was no apparent increase in tag loss with time, suggesting most tag loss occurred shortly after the fish were tagged. Smaller tags showed a significantly ($P \leq 0.05$) higher tag loss (quarterly mean = 22%) than the larger tags (quarterly mean = 2%). Therefore, the larger tags were reliable for tagging largemouth bass ≥300 mm, because they exhibited high mean tag retention rates (98%). Smaller dart tags were less reliable due to lower tag retention (78%).

In the hatchery pond during the mortality study, tag retention was 92% for smaller tags in 260- to 299-mm ($N = 13$) bass and 100% for larger tags in ≥300-mm bass ($N = 26$) after 3 months. These results were similar to those from Lake Blanchester.

The barb on the small PDT tag was fairly flexible and its width (6.5 mm) did not allow the tag to anchor as securely between pterygiophores of 260- to 299-mm bass. Therefore, we recommend PDT tags be improved by changing to a metal barb head or reinforced barb (metal inside nylon) to provide a stiffer flex to the barb.

Hallprint dart tags apparently did not affect the Wr of larger bass during this study. The only significant difference ($P \leq 0.05$) in Wr between tagged and untagged bass ≥300 mm occurred on 1 sampling date for fish in the 380- to 419-mm size group; the tagged group had the higher Wr (Table 2). For the smaller bass (260–299 mm), however, Wrs were significantly lower ($P \leq 0.05$) for tagged bass on 2 sampling dates. Tagged fish with lower Wrs consisted primarily (90%) of individuals that had been tagged with the larger tags. Added stress of the large needle and the larger tag probably contributed to lower condition in the smaller bass.

Cystic growth or inflammation was visible to various degrees at tag insertion sites on bass collected from Lake Blanchester, probably due to continual tag movement. Three of the bass observed with severe inflammation were sent

Table 2. Mean relative weight (Wr) for 5 size groups of tagged and untagged largemouth bass collected during 4 quarterly samples from Lake Blanchester, Florida, November 1990–March 1992. Missing numbers represent instances where there was insufficient data for analysis. Wrs followed by different letters were significantly different ($P \leq 0.05$).

Months from initial tagging	Group	260–299 mm		300–339 mm		340–379 mm		380–419 mm		≥420 mm	
		Wr	*N*	Wr	*N*	Wr	*N*	Wr	*N*	Wr	*N*
6	Untagged	71	4	74	8	73	9				
	Tagged	68	4	75	7	77	6				
9	Untagged	79A	27	78	38	78	13	80	6	92	3
	Tagged	68B	6	74	22	77	14	85	5	80	3
12	Untagged	85A	98	82	51	81	33	79A	5		
	Tagged	74B	4	78	18	79	12	91B	6		
15	Untagged			79	44	80	31	82	3		
	Tagged			77	21	81	10	87	6		

Table 3. One- and 3-month survival of largemouth bass tagged with small (PDT) and large (PDB) Hallprint dart tags in a 0.2-ha hatchery pond.

Total length (mm)	*N*	Group	Tag	*N* (%) that survived			
				1 month		3 months	
260–299	17	Tagged	PDT	16	(94)	13	(77)
	10	Control		10	(100)	9	(90)
300–399	17	Tagged	PDB	16	(94)	13	(77)
	10	Control		10	(100)	9	(90)
≥400	17	Tagged	PDB	16	(94)	13	(77)
	10	Control		10	(100)	10	(100)
Total	51	Tagged		48	(94)	39	(77)
	30	Control		30	(100)	28	(93)

to the Florida Department of Agriculture and Consumer Services, Kissimmee Diagnostic Laboratory, for examination. Diagnosis indicated the skin contained mild-to-moderate acute and chronic inflammation. The muscle at the anchor site displayed no gross inflammatory reaction, but did contain mild-to-moderate fibroplasia.

Forty-eight (94%) of 51 bass tagged with a dart tag survived after 1 month in the hatchery pond and 39 (77%) survived after 3 months (Table 3). Each of the 3 size groups had the same survival. Untagged bass (controls) had an overall 3-month survival of 93%. Tag-induced mortality was 13% for 260- to 299-mm bass (smaller tag) and 18% for ≥300-mm bass (larger tag). However, there were no significant differences ($P > 0.05$) between control and test groups for any size group at 1 or 3 months. Tag-induced mortality from larger tags was not evaluated for smaller bass (<300 mm TL) and should be determined prior to using PDB tags on smaller bass, particularly since condition appeared to have been reduced in this size group.

Tranquilli and Childers (1982) observed no mortality of largemouth bass tagged with FLOY FD-68 B anchor tags in a 191-day pond experiment. Wilbur and Duchrow (1973) reported 7% mortality of largemouth bass with a similar anchor tag, but they suggested this mortality may have been caused by otters and ospreys which frequented the hatchery site. Weathers et al. (1990) observed no statistically significant mortality of largemouth bass tagged for 30 days with abdominally-implanted internal anchor tags. At 90 days, however, mortality rates were 37% for tagged largemouth bass and 20% for controls. Differences in mortality between tagged and control fish in our study were similar to those reported by Weathers et al. (1990). Our determination of tag-induced mortality and tag retention rates of Hallprint dart tags can be used to develop correction factors for future exploitation studies.

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