Diel (24 Hour) Monitoring of Fish Cut Bait and Catch on Freshwater Trotlines

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Management Data Series
No. 302
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INLAND FISHERIES DIVISION
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ACKNOWLEDGMENTS

We would like to thank Todd Driscoll, Ray Lenderman, and Joe Moorhead for assistance with data collection and Donovan Patterson, Greg Binion, Todd Driscoll, Zachary Olsen, and Joel Anderson for critical reviews of the manuscript and editorial help. Funding for this study was provided in part by Federal Aid in Fish Restoration Grant F-221-M to the Texas Parks and Wildlife Department.

ABSTRACT

Freshwater trotlines are popular passive fishing gears used primarily for catching catfish. Here we report the diel dynamics of bait retention and catch rates of trotlines over 24 h. Trotlines were set at different times (morning, evening) and at different seasons (winter at B.A. Steinhagen Reservoir, summer at Sam Rayburn Reservoir). Bait retention was highest for trotlines set in the cooler temperatures at B.A. Steinhagen Reservoir (median time on the hook was longer than 24 h) compared to the warmer summer sets at Sam Rayburn (median = 12.5 h). Further, summer morning set trotlines had a shorter bait duration (median time on the hook was 8 h) compared to summer evening set trotlines (median = 15 h). We found that set time did not affect total catch rates, but that total catch was highest within the first 12 h of trotlines being set. Information gained here may be beneficial to both fishery managers and anglers interested in knowing how long fish cut bait is effective with freshwater trotlines and suggests that short-duration trotline sets (daily soak times) is a best use method to maximize catch.

INTRODUCTION

Trotlines are passive fishing gears consisting of a submerged mainline stretched between two structures combined with a series of droplines spaced equally along the mainline each ending with a baited hook. Once the trotline is set and baited, anglers can leave it unattended until they are ready to harvest their catch. Unfortunately, the timing of when to check the trotlines for catch or bait removal isn't well known and subject to numerous factors. Ideally, the goal of the angler should be to maximize efficiency by reaching "gear saturation" which is defined as when fish density is so high that the number of unoccupied, baited hooks nears zero before the gear is retrieved (Ricker 1975).

Most research conducted with gears similar in design to trotlines are marine studies conducted with longlines (Kume and Joseph 1969; Løkkeborg and Pina 1997; Poisson et al. 2010). During a 24 h period, marine species appear to have preferential times to feed on baited longline hooks. With any baited hook there are both olfactory and visual cues that serve to attract fauna. Whereas the olfactory cues of fresh bait are most effective immediately after the gear has been deployed, it takes some time for those cues to reach resident fauna and visual cues only work for fauna already in the area (Løkkeborg and Johannessen 1992). As fish cut bait serves as an effective olfactory attractant. A conceptual model (Løkkeborg et al. 2014) suggests that there should be an optimal time after deployment wherein the bait is still attractive, and its scent has dispersed to the widest extent. Therefore, investigating bait presence and catch rate for a set duration starting soon after different set times may give some insights into how long baits are effective with this gear. Another factor worth investigating is season as temperature can affect the activity of the fish being sought (Muoneke 1991; Kuklinski and Boxrucker 2008) as well as the degradation of the bait (Kitchell et al. 1975; Minshall et al. 1991). Taken collectively, research has shown that both the timing and season of gear set should be considered as factors that may influence overall bait retention and catch. Therefore, we explored how set period (morning, evening) and/or season (summer, winter) affected bait retention and catch rate. Obviously, numerous biotic and abiotic factors seemingly play some role in how efficient trotlines fish. Gathering some basic insights into how long aquatic natural baits retain on hooks can give fishery managers and anglers a better perspective on how long (duration) a trotline should be fished.

METHODS

Our experiment investigated bait retention and total catch following trotline deployment over one 24 h diel cycle with different timings of set (morning and evening) during a one-day summer and a one-day winter trial. We deployed four commercially sold trotline kits (Magic Bait, Big Catch®) two in the morning (0800) and two in the evening (1900) for each of two seasons (winter and summer) resulting in $N = 8$ trotlines utilized in the study. Each 45.7-m trotline had 25 evenly spaced 30-cm droplines (every 1.2 m) with 5/0 circle hooks (Eagle Claw® 5/0 circle-sea hooks with shiny Sea Guard finish). Each hook was baited with a single piece (2.5

cm^2 in size) of fresh Common Carp *Cyprinus carpio* as bait. Every fifth dropline was marked with a different-colored zip-tie on the mainline to help minimize data recording errors. Trotlines were spaced at least 154 m apart and tied off to existing sunken timber at water surface (top set). Every 2 h for 24 h we noted bait retention, and fish catch. For each fish captured we noted the hook on which it was captured and the species. We ran summer trials (August 2018) at Sam Rayburn Reservoir (45,090 ha) and winter trials (March 2019) at B.A. Steinhagen Reservoir (4,324 ha). Both Sam Rayburn Reservoir and B.A Steinhagen support recreational catfish fisheries; however, the predominant catfish species for each reservoir were Channel Catfish *Ictalurus punctatus* and Blue Catfish *Ictalurus furcatus*, respectively. Since Blue Catfish have been shown to be more productive in winter months; B.A. Steinhagen Reservoir was chosen winter sets, whereas Sam Rayburn Reservoir was chosen for our summer season sets due to it being dominated by Channel Catfish and having less competition with Blue Catfish. These selections were made to maximize our opportunities for total catch and bait removal with our selected seasons.

We used a General Linear Model (GLM procedure in SAS Enterprise Guide version 8.2, SAS Institute., Cary, North Carolina) to compare total catch of fishes by species within 24 h (diel) as a function of season (summer, winter), set time (morning, evening) and time from set (within first 12 h, within last 12 h). We also ran a survival analysis (LIFETEST procedure in SAS) to compare bait retention (hours bait stayed on hook) as a function of set time. All comparison-wise differences were deemed significant at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Water temperatures averaged 30°C (SD = 0.5) for the summer sample and 12°C (SD = 0.8) for the winter sample. Bait retention on hooks was significantly higher in the winter than the summer sample (Log-Rank test: $\chi^2 = 101.05$, df = 1, $P < 0.001$). Median bait retention in the summer was 12.5 h (95% CI = 10, 14). In contrast, we were unable to determine the median bait retention for the winter as 88% of the bait remained on hooks at the end of the 24-h trials (Figure 1). In the summer, there was a significant difference (Log-Rank test: $\chi^2 = 5.765$, df = 1, P = 0.016) in bait retention between morning and evening sets. Median retention in the summer evening sets was 15 h (95% CI = [13,15]), compared to 8 h in the summer morning sets (95% CI= [6,12]). The reduced median bait retention observed during the day compared to the night may be due to a multitude of factors (i.e. forage and/or predator activity around bait, bait durability on hook). He (1996) observed an increase in bait predation of longline hooks during the daylight as opposed to nighttime hours. Visual cues are understandably more evident during the daytime when compared to night, making visually enticing baited hooks more susceptible. In contrast, most baits were retained regardless of the time set in the winter (i.e., 92% retention for the evening and 84% for the morning; Log-Rank test: $\chi^2 = 1.556$, df = 1, P = 0.212). Temperature-related breakdown of cut bait has been reported by High (1980) and He (1996) in which both authors concluded that the mechanical properties of fish flesh (cut bait) is more prone to break down when temperatures are high. Similarly, as shown in this study, the cut bait itself may not be breaking down as quickly when water temperatures are cooler as compared to warmer temperatures.

We caught five species during the summer [Channel Catfish ($N = 6$), Bowfin *Amia calva* ($N = 2$), Black Bullhead *Ameriurus melas* ($N = 2$), Blue Catfish ($N = 1$) and Common Snapping Turtle *Chelydra serpentina* ($N = 1$)], compared to the three species caught during the winter [Blue Catfish ($N = 5$), Bowfin ($N = 2$), and Channel Catfish ($N = 1$)]. However, catch comparisons were not significantly different between seasons [$\mu_{Summer} = 3.0$ (SE = 1.22) $\mu_{Winter} = 2.0$ (SE = 0.58); $F = 1.60$, $df_{num} = 1$, $df_{denom} = 4$, $P = 0.2746$). No significant differences in catch were reported between morning or evening sets when fresh fish cut bait was used [$\mu_{Morning} = 3.3$ (SE = 1.03) $\mu_{Evening} = 1.8$ (SE = 0.75); $F = 3.60$, $df_{num} = 1$, $df_{denom} = 4$, $P = 0.1306$)]. Catch rates did not differ between set timing or season, however this may be due to the lack of sufficient replications between different seasons due to utilization of different reservoirs. Aquatic organisms were caught in higher abundance within the first 12 h of trotline sets compared to the last 12 h [$\mu_{First} = 3.8$ (SE = 0.75) $\mu_{Last} = 1.3$ (SE = 0.63); $F = 10.0$; $P = 0.0341$; Table 1)]. This is most likely attributed to the effectiveness of the fish cut bait early in the set because cut bait loses its ability to attract organisms with time due to diminishing scent (Løkkeborg and Pina 1997; Steffensen et al. 2013).

CONCLUSION

Examining what factors influence catches on a baited trotline within the first 24 h gives fishery managers insight on when trotlines are most effective and may determine when aquatic organisms are most vulnerable. We found that bait retention on hooks was greatest during cooler water temperatures (winter) and we also found cut bait is most effective within the first 12 h, but under cooler temperatures baits may attract fishes beyond 24 h due to longer retention on hooks. This suggests there are benefits to daily trotline checks to both replace missing baits and maximize catch rates. We acknowledge that this study has limitations due to the limited number of replicates, and different reservoirs being utilized for separate seasons. While this may have some bearing on total catch rates, we feel that the information about bait retention and 24 h catch is a good first step into this area of research. In the future, a more thorough investigation of seasonal catch rates within individual reservoirs may be warranted.

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Table 1. Total catch of aquatic fauna for trotlines ($N = 8$) for two morning and two evening set trials in two separate seasons (summer, winter) monitored for 24 h. Day when captured represents those fauna captured during daylight hours (sunrise to sundown); and night when captured represents fauna captured during nighttime hours (sundown to sunrise).

Season	Set Time	When Captured		Day : Night Ratio
		Day	Night	
Summer	Morning	7	3	1.2 : 1
	Evening	0	3	
Winter	Morning	3	1	1 : 1
	Evening	1	3	

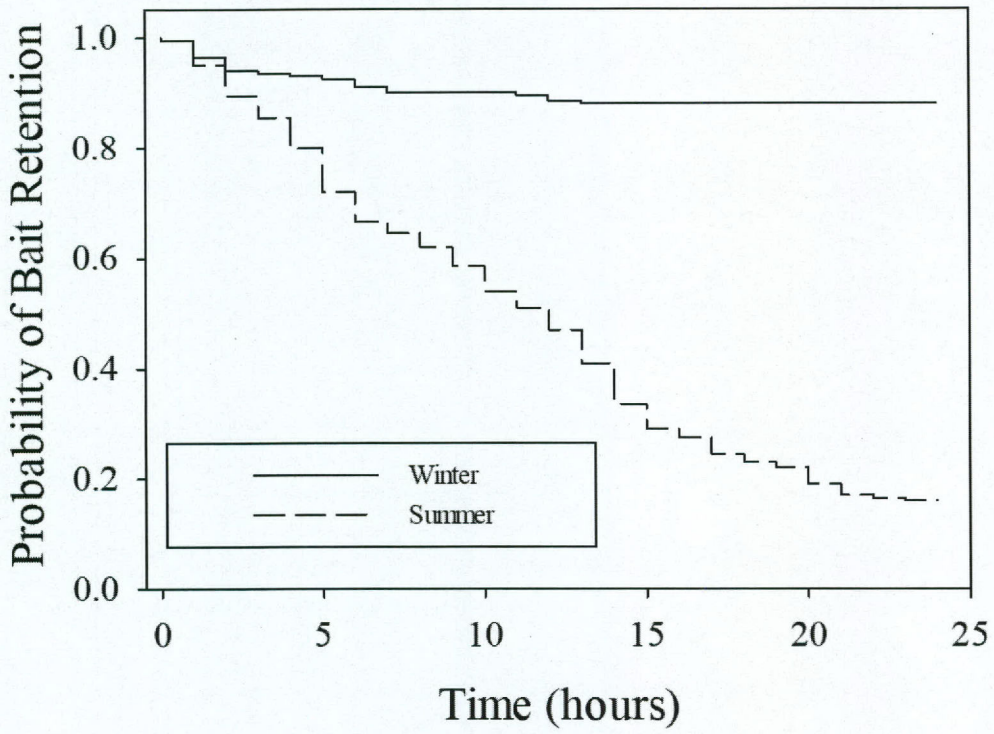

Figure 1. Kaplan-Meier product-limit estimation of bait retention on circle hooks between summer and winter. Results are pooled over both morning and evening sets. Hooks were monitored every 2 h for 24 h. A total of 100 hooks were baited in the summer (of which 84 were censored), and 100 were baited in the winter (of which 12 were censored).

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