Efficiency of Removing Food Items from Walleyes Using Acrylic Tubes

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ABSTRACT

The use of acrylic tubes is a common nonlethal method for sampling stomach contents of fishes; however, the effectiveness of the method for sampling food habits of walleyes (*Stizostedion vitreum*) has not been assessed. The purpose of this study was to determine the efficiency of acrylic tubes for sampling stomach contents of walleyes sampled from Glen Elder Reservoir, Kansas (1999-2000). We found that percent recovery by number and weight was generally above 50% for most prey taxa and was similar between small (< 380 mm) and large (≥ 380 mm) walleyes. These relatively poor recovery rates were not related to prey type, length of prey, or walleye length. We suggest that researchers test the efficiency of tubing in their study system or use a more efficient method, such as stomach flushing, to nonlethally sample walleye stomach contents.

INTRODUCTION

The analysis of food habits is an important component of fisheries research and management. In conjunction with other population assessment techniques, dietary studies provide information on activity levels and selective predation (Bowen 1996). Traditionally, researchers have sacrificed fish to remove stomach contents, but several nonlethal methods have been developed to limit mortality of sensitive species or to avoid poor public relations (Kamler and Pope 2001). One of the most commonly used techniques is the use of clear acrylic or glass tubes.

White (1930) was the first to use tubes to remove stomach contents from fish (brook trout, *Salvelinus fontinalis*). The technique has been used on various species including yellow perch (*Perca flavescens*; Forney 1974), percichthyids (*Morone* spp.; Gilliland et al. 1981), black basses (*Micropterus* spp.; Van Den Avyle and Roussel 1980, Gilliland et al. 1981, Cailteux et al. 1990), and white crappies (*Pomoxis annularis*; Gilliland et al. 1981, Guy and Willis 1993). The use of glass and acrylic tubes has also been used extensively to study food habits of walleyes (*Stizostedion vitreum*) and walleye × sauger (*S. canadense*) hybrids (Forney 1974, Leeds 1988, Santucci and Wahl 1993). Despite the popularity of this method, we are unaware of any studies that have evaluated

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their efficiency for sampling walleye food habits. The purpose of this study was to evaluate the effectiveness of acrylic tubes for the removal of walleye stomach contents and to determine if efficiency was related to prey taxa (type and size) or size of walleye.

METHODS

Walleyes were sampled monthly (June, July, August, October 1999; January and March 2000) from Glen Elder Reservoir with experimental gill nets fished at six fixed sites. Gill nets were set at sunset and retrieved at 1-2 hr intervals to reduce digestion and regurgitation of prey items. Length (mm) was measured for each walleye and stomach contents were removed using a stomach tube.

Stomach tubes consisted of a series of four acrylic tubes, each 47-cm long with outside diameters of 11 mm, 14 mm, 19 mm, and 27 mm, and wall thicknesses of 1 mm. The largest tube that would fit through the esophagus of each fish was used. Most walleyes less than 400 mm were sampled using the 19-mm tube, while larger fish were sampled using the 27-mm tube. The tube was inserted as far as possible and then filled to about 25% of its length with distilled water (11 - 67 ml). After sealing the open end of the tube with a thumb or palm of the hand, the fish was inverted three times. The tube was then removed by holding the fish in a vertical position (i.e., head angled downward) while keeping a tight seal on the tube to promote suction. Stomach contents were then fixed in 10% formalin. We continued to sample with the tube until three successive cycles of the process failed to produce additional prey items. We generally failed to collect additional stomach contents after the forth or fifth cycle; however, we had to repeat the process up to 12 times for several walleyes. After three successive cycles without additional prey items, we used the tube as a gastroscope to examine the stomach for additional prey items (Kamler and Pope 2001). If additional prey were observed, they were removed using long-handled forceps. The stomach was then removed at the junctions with the esophagus and small intestine and fixed in 10% formalin. Even though we sacrificed all fish, tubes were tapered inward (approximately 45°) to ease insertion and reduce the chance of puncturing the stomach. We did not observe any punctured or torn stomachs resulting from the tubing process. All stomach contents were removed from the formalin and preserved in 95% ethanol prior to laboratory analysis. Prey items were identified to species for fishes, genus or species for zooplankton (later grouped by order), and family for Insecta using keys provided by Merritt and Cummins (1984) and Eddy and Underhill (1978). All prey items were measured to the nearest 0.01 mm using an image analysis system, and prey fishes and insects were weighed to the nearest 0.001 g. Weight of cladocerans was estimated using length-weight conversions in Dumont et al. (1975) and Smock (1980).

Tubing efficiency was determined by calculating the percent recovery by number and weight for small (< 380 mm) and large (≥ 380 mm) walleyes. These lengths were chosen because they represent the size when walleyes are available for harvest by anglers. Although fish were sampled during different months, months were pooled because preliminary analyses indicated that efficiency was unrelated to time of year. The effect of prey length was assessed by comparing mean lengths of recovered and residual prey items using paired t-tests. We adjusted P-values using a Bonferroni adjustment for multiple comparisons (Kuehl 1994). The effect of walleye length on tubing efficiency was assessed by regressing percent recovery (by number and weight) on walleye length. All statistical analyses were conducted using SAS (SAS 1996).

RESULTS

We sampled 73 walleyes (241 mm to 671 mm) with acrylic tubes, and all but 13 fish contained prey items. Percent recovery by number and weight were highly variable among taxa (Table 1). Extremes in percent recovery were due to the presence of larval gizzard shad (*Dorosoma cepedianum*; 100% recovery) and white bass (*Morone chrysops*; 0% recovery) in two separate walleye stomachs. Disregarding these two extremes, percent recovery by number for all taxa was generally greater than 50% for both small and large walleyes. Percent recovery by weight was above 50% for chironomids, cladocerans, freshwater drum (*Aplodinotus grunniens*), and gizzard shad consumed by large walleyes. However, 50% recovery by weight for small walleyes was only attained for gizzard shad. Despite the apparent trend of higher recovery rates for large walleyes, percent recovery by number and weight were not significantly different between length groups ($P > 0.05$). When all walleyes were combined, percent recovery was above 55% for all prey tax. Approximately 60% of all prey items and 63% of the total weight were recovered using acrylic tubes.

Table 1. Mean percent recovery by number and weight using acrylic tubes for small (< 380 mm), large (≥ 380 mm), and all walleyes sampled from Glen Elder Reservoir, Kansas (June 1999 to April 2000). Numbers in parentheses represent one standard error. No significant differences were found between small and large walleyes for all prey taxa ($P > 0.05$).

	Length group		
Metric and taxa	Small	Large	All walleyes
Percent by number			
Chironomidae	33.3 (33.3)	75.0 (25.0)	57.1 (20.2)
Cladocera	43.8 (25.8)	63.9 (13.9)	58.8 (12.0)
Freshwater drum	a	92.6 (7.4)	92.6 (7.4)
Gizzard shad	72.7 (12.6)	54.4 (6.2)	59.7 (5.7)
Gizzard shad larvae	100 (0)	a	100 (0)
White bass	a	0 (0)	0 (0)
Unidentified fish	50 (0)	25.0 (16.4)	27.8 (14.7)
All taxa	59.6 (10.6)	60.0 (4.9)	59.9 (4.5)
Percent by weight			
Chironomidae	33.3 (33.3)	75.0 (25.0)	57.2 (20.1)
Cladocera	36.2 (23.7)	63.4 (13.9)	56.6 (11.9)
Freshwater drum	a	99.3 (0.7)	99.3 (0.7)
Gizzard shad	74.4 (13.2)	54.9 (7.6)	60.6 (6.7)
Gizzard shad larvae	100 (0)	a	100 (0)
White bass	a	0 (0)	0 (0)
Unidentified fish	17.8 (17.8)	25.0 (16.4)	24.2 (14.5)
All taxa	63.8 (11.6)	62.4 (5.6)	62.7 (5.1)

[a] No prey items were sampled from walleyes.

Mean length of fishes (freshwater drum and gizzard shad) collected from tubes and residual stomach contents were not significantly different ($P > 0.05$). For example, mean length of gizzard shad sampled from small walleyes using tubes was 97.6 mm (SE = 3.4), while those remaining in the stomach averaged 98.9 mm (3.7). Larger walleyes inherently have a longer stomach that may have inhibited collection of prey items using tubes; however, percent recovery by number and weight were not correlated with walleye length, except for percent recovery by weight of chironomids (Table 2).

Table 2. Correlation coefficients (*r*) and *P*-values for regressions of percent recovery by number and weight using acrylic tubes on walleye length for fish sampled from Glen Elder Reservoir, Kansas (June 1999 to April 2000).

	Percent recovery by number		Percent recovery by weight	
Prey taxa	*r*	*P*	*r*	*P*
Chironomidae	0.96	0.03	0.22	0.78
Cladoceran	0.44	0.14	-0.43	0.23
Freshwater drum	0.28	0.64	-0.34	0.56
Gizzard shad	0.11	0.53	0.16	0.46

DISCUSSION

We found that percent recovery by number and weight using acrylic tubes was poor. Van Den Avyle and Roussel (1980) found that only one fish (a largemouth bass, *Micropterus salmoides*) out of 266 largemouth bass, smallmouth bass (*M. dolomieu*), and spotted bass (*M. punctulatus*) contained food items after acrylic tubes were used. Similar results were reported for largemouth bass in Florida lakes where percent recovery by weight was over 80% (Cailteux et al. 1990). Gilliland et al. (1981) found that recovery by weight was over 90% for percichthyids and 75% for white crappies. Lower recovery rates for white crappies was attributed to the small down-turned pouch at the posterior end of their stomach. The cause of poor recovery in our study in unknown; however, similar to centrarchids, walleye stomachs end posteriorly as a blind sac (Craig 2000), which may partially explain the poor recovery observed in this study. Similar difficulties in removing prey fishes from walleyes using tubes have been observed in Lake Oahe, South Dakota (S. Lynott, Kansas Department of Wildlife and Parks, personal communication). Van Den Avyle and Roussel (1980) and Gilliland et al. (1981) used tubes varying from 4 - 51 mm (outside diameter). Although the tubes used in our study may have been inadequate for large walleyes, it is unlikely that a tube much bigger than 27 mm could be inserted into the stomach of large fish without causing substantial trauma to the esophagus and stomach. In addition, poor recovery was not related to walleye length for any of the prey taxa examined.

Nearly all prey taxa, except white bass, were sampled using acrylic tubes. Thus, tubes may be adequate for assessing presence or absence of prey items in the diet. However, such assessments provide little information relative to the amount of effort required to obtain the samples (Bowen 1996). Acrylic tubes are an appealing method due to the minimal amount of equipment and time required to obtain samples, but researchers should not rely solely on data from tubed stomach contents until the efficiency in their system has been evaluated. We suggest that a form of gastric lavage or stomach flushing be used to nonlethally sample walleye stomachs (Kamler and Pope 2001). This method has been widely used on walleyes and nearly all studies have found complete recovery of stomach contents (Seaburg 1957, Slipke and Duffy 1997, Kamler and Pope 2001).

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