ASSESSMENT OF NEUSE RIVER CATFISH POPULATIONS, 2014

Federal Aid in Sport Fish Restoration
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Final Report

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Abstract.—Ictalurids in the Neuse River were surveyed via boat-electrofishing in summer 2014. Field staff collected 263 Blue Catfish, 124 Channel Catfish, and 299 Flathead Catfish from 26 sample sites. No native ictalurids were collected or observed during sampling. High frequency electrofishing yielded a Blue Catfish mean (SD) relative abundance (CPUE; fish/h) of 23.5 (19) and a Channel Catfish CPUE of 14.4 (13). Flathead Catfish CPUE was 20.8 (12) using low frequency electrofishing. Differences in gear selectivity prohibit examination of relative abundance among the species collected. Length-frequency distributions indicated a variety of size-classes present, with the exception of 375–500 mm Blue Catfish. Total annual mortality (A) was calculated using length-converted catch-curves, indicating Channel Catfish A = 35% and Flathead Catfish A = 16%. Blue Catfish mortality was not calculated due to the polymodal length-frequency distribution. Relative weights (W_r) for all species indicated overall good condition, with few individuals displaying W_r less than 80. Results of this survey indicate significant impacts on native ictalurid populations, likely due to the robust Flathead Catfish population that has become established over the previous 30 years. Additionally, Flathead Catfish mortality is quite low despite the popularity of catfish angling in the Neuse River. Low Flathead Catfish exploitation, as inferred by mortality analysis, indicates restrictive harvest regulations are not warranted. Future surveys should investigate the current distribution of native ictalurids in the Neuse River and continue to explore the impacts of nonnative catfish on resident fish communities.

Catfish are among the most targeted species for North Carolina recreational anglers. According to the most recent survey, 30% of the total freshwater angling effort in North Carolina is expended in pursuit of various catfish species, and are second only to black bass (USFWS 2012). Rundle et al. (2004) observed angling effort on the Neuse River from Smithfield, NC downstream to the Maple Cypress boating access area was greatest for catfish (22% of total effort), followed by American Shad and Hickory Shad (15%), sunfish (13%), and Largemouth Bass (8%).

Catfish are not classified as game fish in inland waters, and may be taken in the Neuse River using hook and line, grabbling, trotlines, set-hooks, jug-hooks, and a variety of county specific special devices. Additionally, catfish are not managed with length limits and the daily creel limit is 200 in aggregate with other nongame fish. Liberal harvest regulations cause concern among some catfish anglers, as 31% of anglers in a statewide survey believed current catfish regulations are not strict enough (Responsive Management 2012).

The Neuse River contains several native catfish species that are traditionally popular with anglers, including White Catfish *Ameiurus catus*, Brown Bullhead *A. nebulosus*, Flat Bullhead *A. platycephalus*, and Yellow Bullhead *A. natalis*. Channel Catfish *Ictalurus punctatus* is considered naturalized and was absent from fish collections in the 19^{th} century (Evermann and Cox 1895). Blue Catfish *I. furcatus* populations became established after stocking in 1966 (Borawa 1982), while Flathead Catfish *Pylodictis olivaris* was absent from North Carolina Wildlife Resources Commission (Commission) electrofishing surveys in the 1980s, but rapidly became established by 1994 (Commission, unpublished data).

Management surveys of catfish in the Neuse River are infrequent, despite their popularity with anglers and the introduction of Flathead Catfish, an apex predatory catfish which can negatively affect native fish populations (Borawa 1983; Guier et al. 1984; Baumann and Kwak 2011). Although catfish were collected during IBI electrofishing sampling conducted from the mid-1990s through the mid-2000s, a Commission survey specifically targeting catfish in the Neuse River has not been conducted since 1985 (Nelson and Little 1985). An updated survey of Neuse River catfish populations was warranted given their popularity with the angling public, concerns regarding liberal regulations, and a lack of recent data. The objective of this survey was to elucidate abundance, size-structure, and mortality for catfish species in the Neuse River.

Methods

From July 9, 2014 to August 20, 2014, catfish were surveyed using a boat-mounted electrofishing unit (Smith-Root 7.5 GPP; one dip netter) at 26 sample sites during daylight hours. The sample area included the 259-km reach of the Neuse River from Clayton to New Bern, NC (Figure 1). Electrofishing effort varied 15–60 min depending on electrofishing settings and catch.

Flathead Catfish were targeted at 15 sites using 2000–3000 W with a 15-Hz pulsed DC waveform (LFE). All other catfish species were targeted at 11 sites using 5000–7000 W and a 120-Hz pulsed DC waveform (HFE). All catfish were collected as they were encountered regardless of electrofishing frequency. Electrofishing time (s), water temperature (^{o}C), dissolved oxygen (mg/L), conductivity (µS/cm), and salinity ($^{0}/_{00}$) were recorded for each sample site (Table 1). Following collection, fish were identified to species, enumerated, measured (mm; TL), and weighed (g) prior to release.

Relative abundance of each species was indexed as catch per unit effort (CPUE; fish/h) of fish greater than 200 mm TL. Mean CPUE was calculated from individual site CPUE for each species due to catchability differences between HFE and LFE (Bodine et al. 2013). Size-structure was evaluated with length-frequency distributions (25-mm size-classes). Relative weight (W_r)

was used to assess condition of individuals greater than or equal to 200 mm TL based on standard weight equations reported by Muoneke and Pope (1999) and Willis et al. (2010).

Total instantaneous mortality (Z) was derived when possible for each species (minimum = 300 mm TL) using length-converted catch-curves developed by Pauly (1984) and presented by Miranda and Bettoli (2007) in the form of:

$$\log_e(N_i) = a - bt_i'$$

where $t_i' = -\log_e(1 - [L_{mid} / L_\infty])$, L_{mid} is the midpoint of the ith length interval, and N_i is the number of fish in the ith length interval. The slope of this regression (b) represents 1 – (Z/K), so that $Z = K(1 - b)$. The estimator given by Froese and Binohlan (2000) was used to estimate L_∞ as $\log_e L_\infty = 0.044 + 0.984 \log_e L_{max}$, where L_{max} was the greatest total length collected in the 2014 catfish survey. Once L_∞ was calculated, K was derived as:

$$K = \frac{-\log_e(1 - \left[\frac{L_t}{L_\infty}\right])}{t}$$

where L_t was length at time t. Age-at-length data from catfish collected in 2007 were used to calculate L_t (Commission, unpublished data). Total annual mortality (A) was calculated as:

$$A = 1 - e^{-Z}$$

Results

Field staff collected 263 Blue Catfish, 124 Channel Catfish, and 299 Flathead Catfish from 26 sample sites. No other ictalurids were collected or observed while sampling. Daily mean water temperatures during sampling ranged 23.9–29.1°C (Table 1) and were generally within the range recommended for effective catfish sampling (Bodine and Shoup 2010). Blue Catfish mean (SD) CPUE was 6.2 (7) at sampling sites using LFE and 23.5 (19) at sites sampled using HFE (Table 2). Channel Catfish CPUE was 1.6 (2) using LFE and 14.4 (13) using HFE (Table 2). Flathead Catfish CPUE was 20.8 (12) using LFE and 3.0 (2) using HFE (Table 2).

Blue Catfish ranged 130–832 mm TL and exhibited a polymodal length-frequency distribution (Figure 2). Few 375–500 mm Blue Catfish were collected. Channel Catfish ranged 123–754 mm and exhibited a unimodal length-frequency distribution (Figure 3) with a median of 363 mm. Flathead Catfish ranged 70–1235 mm and exhibited a right-skewed unimodal distribution (Figure 4) with a median of 318 mm.

Blue Catfish mean W_r was 100 and varied relatively little among individuals throughout the size range (Figure 5). Channel Catfish mean W_r was 94 and was quite variable among individuals less than 500 mm (Figure 6). Flathead Catfish mean W_r was 94 and displayed little variation among individuals of similar size in size-classes smaller than 1,000 mm (Figure 7). Individuals greater than 1,000 mm exhibited considerable variation in W_r.

Mortality could not be calculated for Blue Catfish due to insufficient catch in 375–500 mm size-classes. Channel Catfish *Z* was 0.43, indicating a total annual mortality of 35% (Table 3). Flathead Catfish *Z* was 0.18, indicating a total annual mortality of 16% (Table 3).

Management Implications

Declines in native catfish populations are likely due to the introduction and establishment of a Flathead Catfish population in the Neuse River since Nelson and Little's (1985) survey. Borawa (1983) found White Catfish comprised 83.5% of the total weight of stomach contents from Flathead Catfish collected in the Northeast Cape Fear River. Nelson and Little (1985) collected 120 White Catfish, which comprised 53% of the total catfish catch in the Neuse River. No White Catfish were collected in 2014, indicating a significant alteration in the Neuse River catfish community since 1985. In addition, Nelson and Little (1985) collected Yellow Bullhead and Margined Madtom *Noturus insignis* which were also absent in this survey. White Catfish were last collected in Commission Neuse River IBI electrofishing sampling in 2005 in Dawson, Hancock, and Slocum creeks (Commission, unpublished data). These lower Neuse River tributaries were not sampled in this survey and may contain an isolated White Catfish population.

Mortality analysis indicates Flathead Catfish experience a low level of annual mortality despite being the trophy species in a popular catfish fishery. Mortality was similar to a previous Neuse River research project that documented Flathead Catfish *A* = 20% (Kwak et al. 2006). Channel Catfish mortality appears to be greater, and is likely due to few captures of large individuals during sampling. Channel Catfish may be outcompeted by Flathead Catfish in some locations and may not grow large enough to avoid Flathead Catfish predation. Alternatively, they may be differentially selected for harvest over other catfish species. A limitation of length-converted catch-curve analysis is the lack of a variance estimator to assess the precision of the mortality rate. Future catfish surveys should collect age-length data to allow the use of superior mortality estimators.

Whereas Bodine et al. (2013) recommended LFE for Blue Catfish sampling due to greater sampling efficiency, this survey observed a higher Blue Catfish CPUE using HFE. However, sites upstream of Goldsboro were sampled more often with HFE as high streamflow and turbidity during sampling were not conducive to effective LFE, while fewer HFE sites were conducted in downstream areas. The differential application of HFE and LFE in upstream and downstream sites confounds HFE CPUE vs. LFE CPUE and spatial analyses, as Blue Catfish display seasonal migratory patterns (Lagler 1956) that could be represented by our CPUE data. Additionally, the Blue Catfish size-distribution varied between HFE and LFE (Figure 8). Differences in gear selectivity prevent analysis of the relative contribution of each species to the catfish community. Future catfish surveys should incorporate HFE and LFE at all sites by attempting to sample during similar streamflow. Other sampling gears (e.g., hoop nets) should also be utilized.

It is unknown why few Blue Catfish were collected in the 375–500 mm size-classes. Age-at-length data from previous surveys suggest the 2010 and 2011 year-classes would comprise these size-classes (Commission, unpublished data). These year-classes potentially suffered high mortality following fish kill events from Hurricane Irene in August 2011. Alternatively, Blue

Catfish in these size-classes may utilize estuarine areas of the Neuse River that were not sampled in this survey.

Size-structure and abundance metrics indicate robust populations of Blue Catfish, Channel Catfish, and Flathead Catfish in the Neuse River. The high abundance and low exploitation of Flathead Catfish indicates restrictive harvest regulations are unlikely to produce increases in the "trophy" potential of the fishery. Further, the significant impact of Flathead Catfish on trophic dynamics in the Neuse River, and the resulting decline in native catfish populations, are a management concern. Therefore, restrictive catfish harvest regulations are not warranted at this time.

Management Recommendations

1. Maintain current harvest regulations and status as nongame species for Blue Catfish, Channel Catfish, and Flathead Catfish. Mortality analysis for Flathead Catfish indicates exploitation is low, while exploitation is likely low to moderate for Channel Catfish. Harvest restrictions are unlikely to significantly affect abundance or mortality of Flathead Catfish.

2. Utilize hoop nets as an additional sampling gear for riverine catfish populations. Hoop nets have been reported to be the most efficient gear, are significantly correlated with population density, and provide unbiased size-structure samples for Channel Catfish. Hoop nets have also been found to sample White Catfish more efficiently and collect more ictalurid species than low frequency electrofishing.

3. Investigate the current distribution of native catfish species in the Neuse River Basin. Flathead Catfish demonstrate a high salinity tolerance relative to other ictalurids and occupy many riverine habitats associated with native ictalurids, increasing the risk of extirpation. White Catfish and other bullheads may require additional protection if robust populations cannot be found.

4. By 2017, conduct a follow-up survey to collect abundance, relative species composition, age-structure, and size structure data for Neuse River catfish species. Resulting age-structure data would allow for comprehensive yield-per-recruit modeling under alternative management paradigms. Additionally, spatial trends in species composition may be elucidated.

Acknowledgements

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TABLE 1.—Neuse River water quality metrics collected during electrofishing sampling. Mean values calculated from daily mean measurements (n = 10).

Parameter	Mean	SE	Minimum	Maximum
Water Temperature (°C)	26.8	0.5	23.9	29.1
Dissolved Oxygen (mg/L)	5.9	0.2	4.7	6.5
Conductivity (µS/cm)	156.9	17.1	95.1	253.5
Salinity ($^{0}/_{00}$)	0.1	0.0	0.0	0.1

TABLE 2.—Mean (SD) CPUE by species and electrofishing setting.

Species	Catch	CPUE	
		15 Hz (n = 15)	120 Hz (n = 11)
Blue Catfish	263	6.2 (7)	23.5 (19)
Channel Catfish	124	1.6 (2)	14.4 (13)
Flathead Catfish	299	20.8 (12)	3.0 (2)

TABLE 3.—Mortality model parameter values for Channel Catfish and Flathead Catfish, as well as estimated mortality rates (Z and A).

Parameter	Channel Catfish	Flathead Catfish
L_{max}	754	1235
L_{∞}	735	1195
K	0.297	0.129
b	-0.448	-0.361
Z	0.43	0.18
A	35%	16%

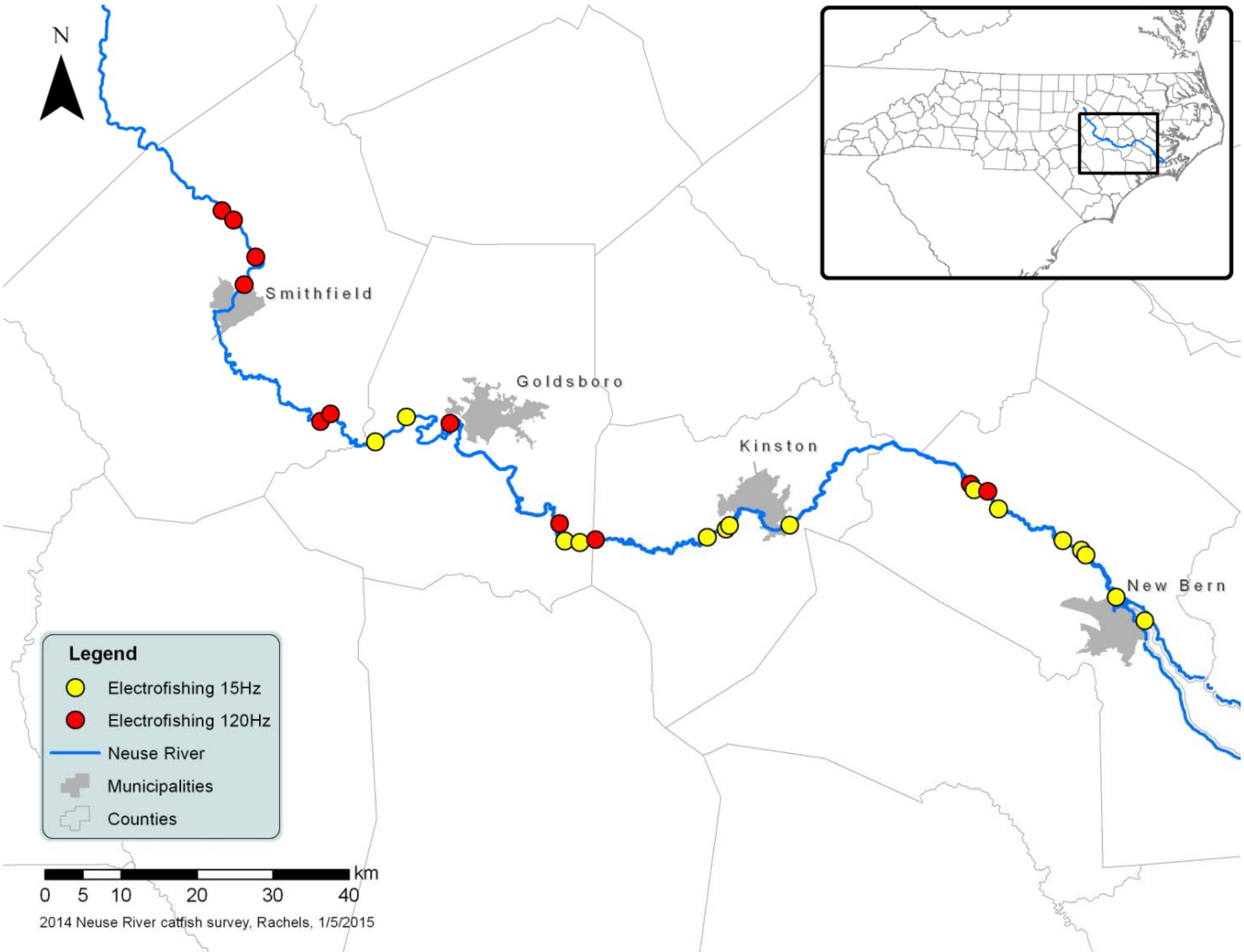

FIGURE 1.—Electrofishing sites surveyed for catfish in the Neuse River, 2014. Yellow circles denote sites sampled using 15 Hz, while red circles represent sites sampled using a 120 Hz pulsed-DC waveform.

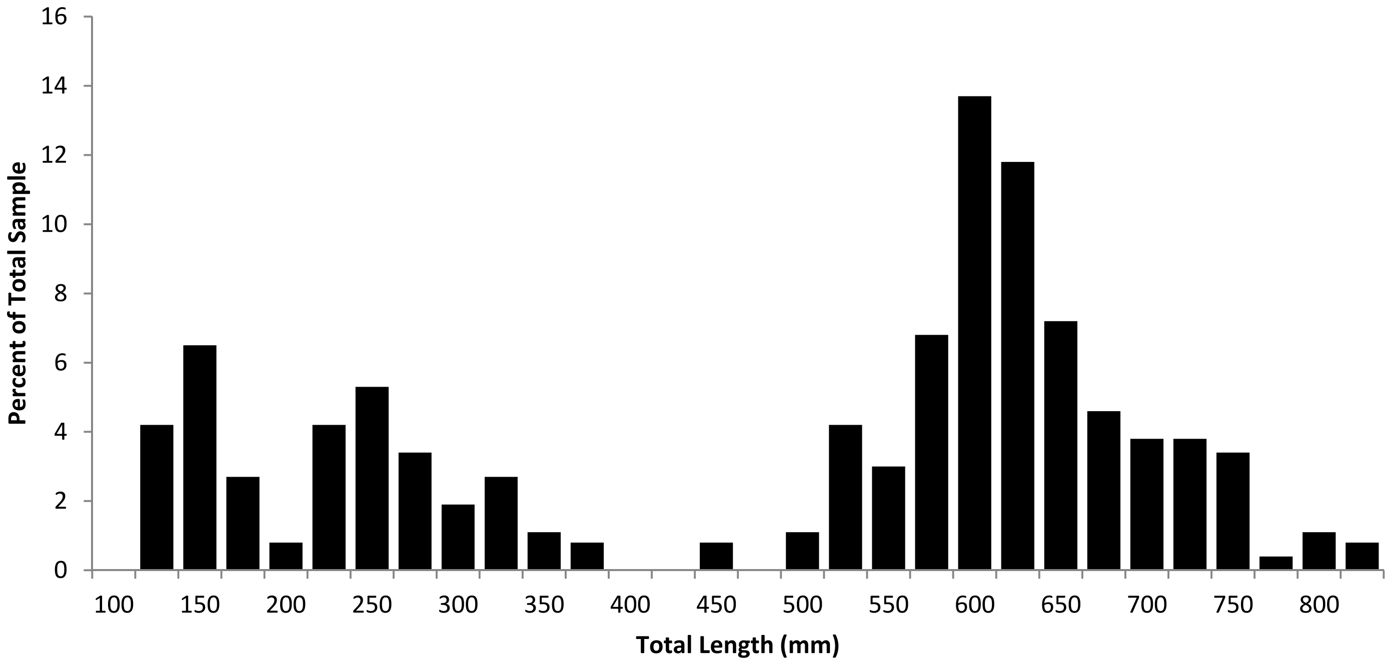

FIGURE 2.—Blue Catfish length-frequency distribution (*n* = 263) collected in the Neuse River, 2014.

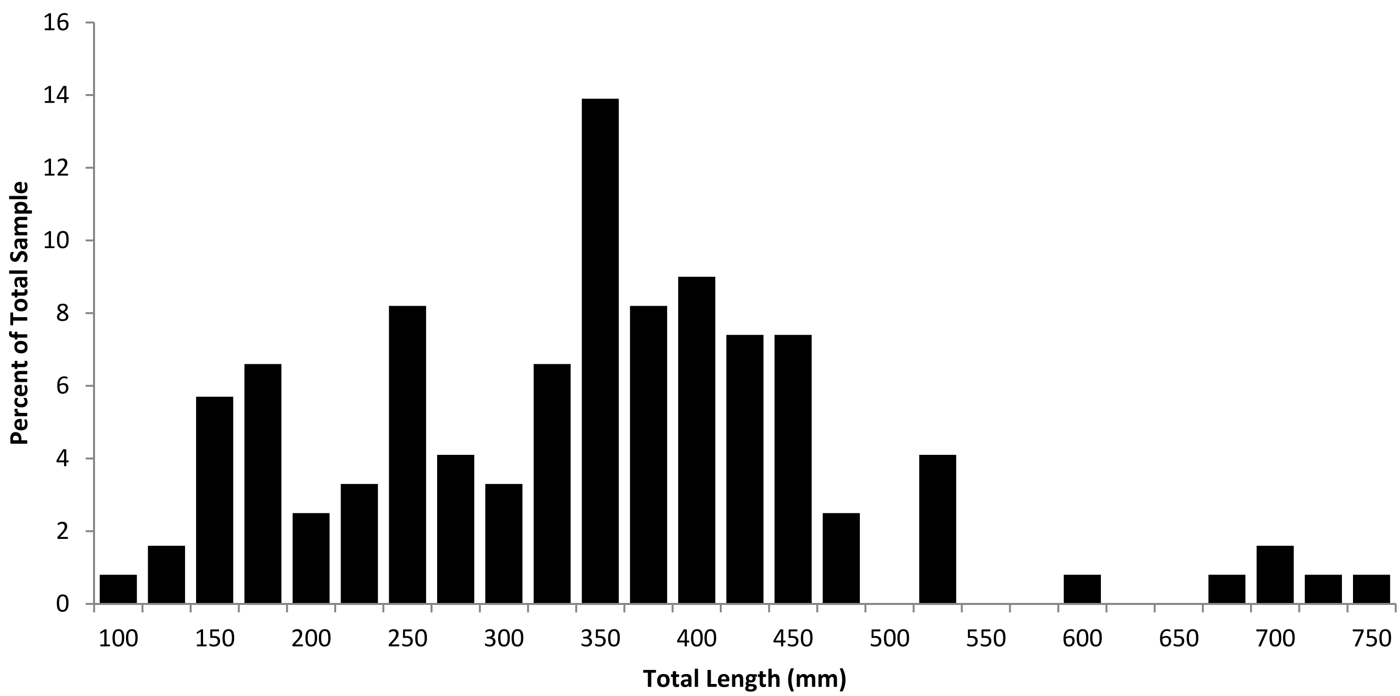

FIGURE 3.—Channel Catfish length-frequency distribution (*n* = 124) collected in the Neuse River, 2014.

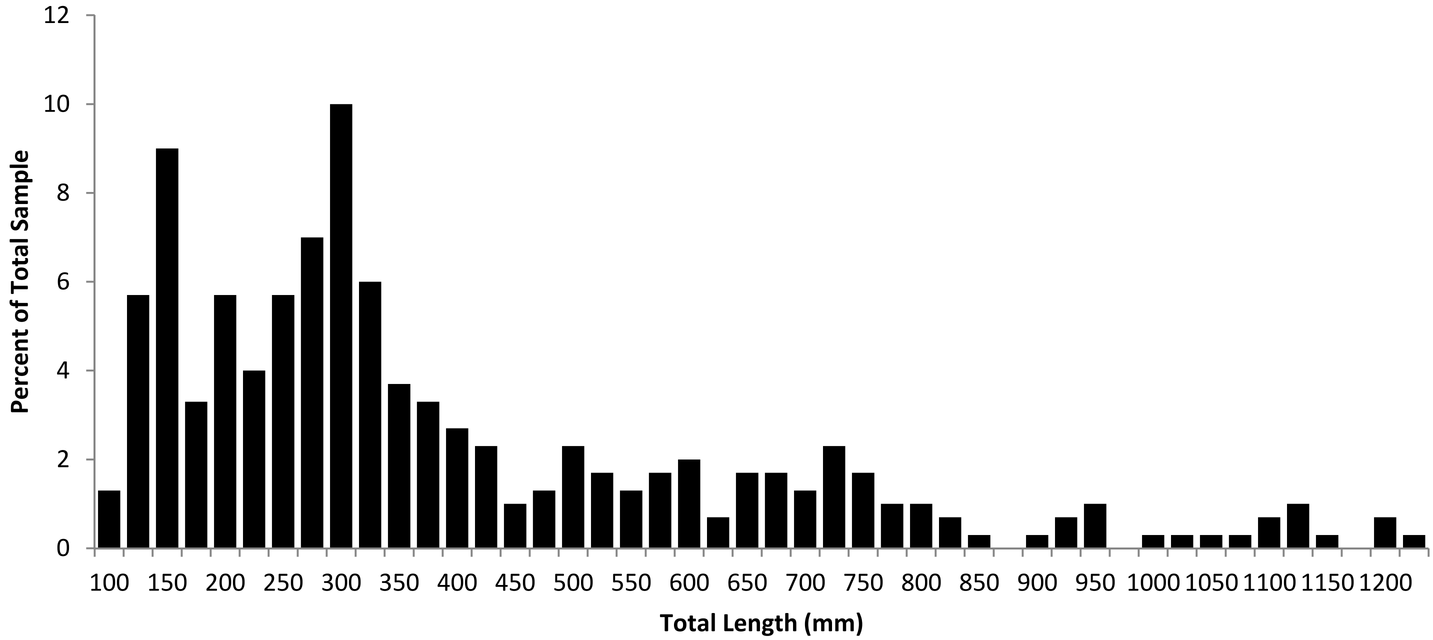

FIGURE 4.—Flathead Catfish length-frequency distribution (n = 299) collected in the Neuse River, 2014.

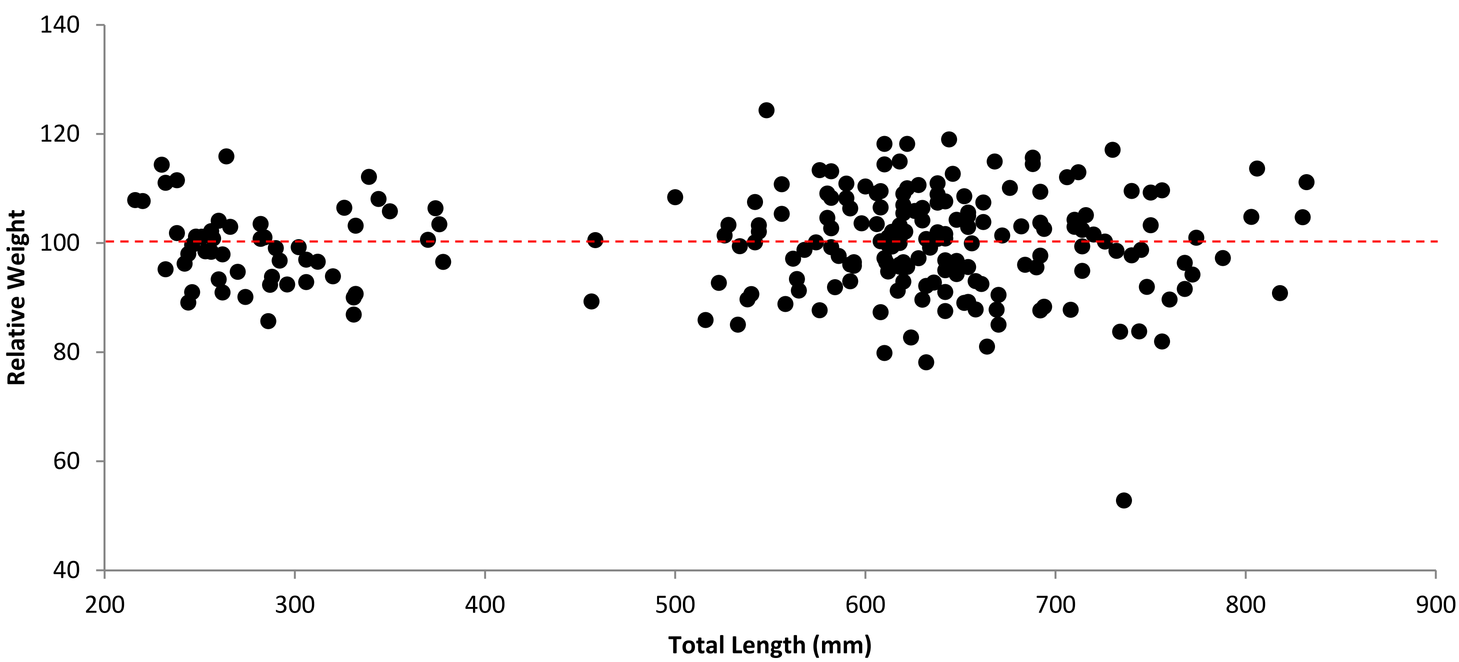

FIGURE 5.—Blue Catfish relative weights (W_r; n = 228) collected in the Neuse River, 2014. W_r was only calculated for individuals greater than or equal to 200 mm TL. The dashed line represents the 75th percentile of W_r across the species' geographical range.

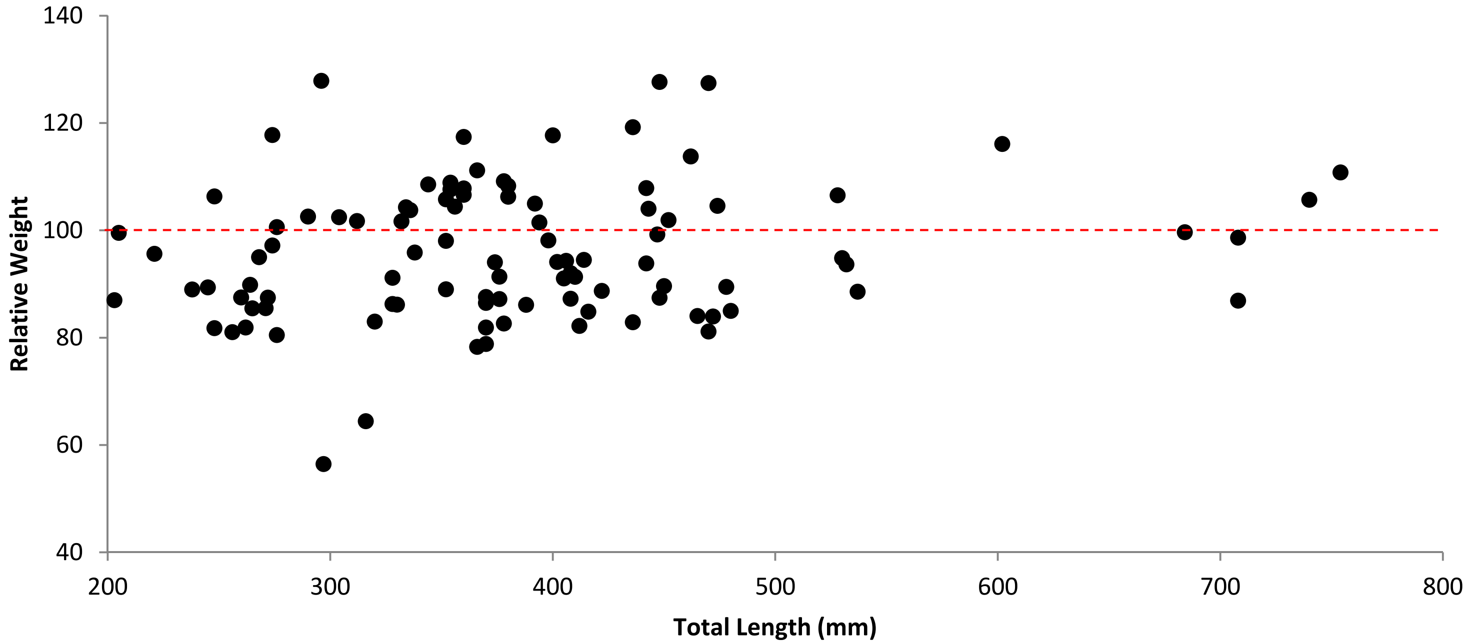

FIGURE 6.—Channel Catfish relative weights (W_r; n = 104) collected in the Neuse River, 2014. W_r was only calculated for individuals greater than or equal to 200 mm TL. The dashed line represents the 75th percentile of W_r across the species' geographical range.

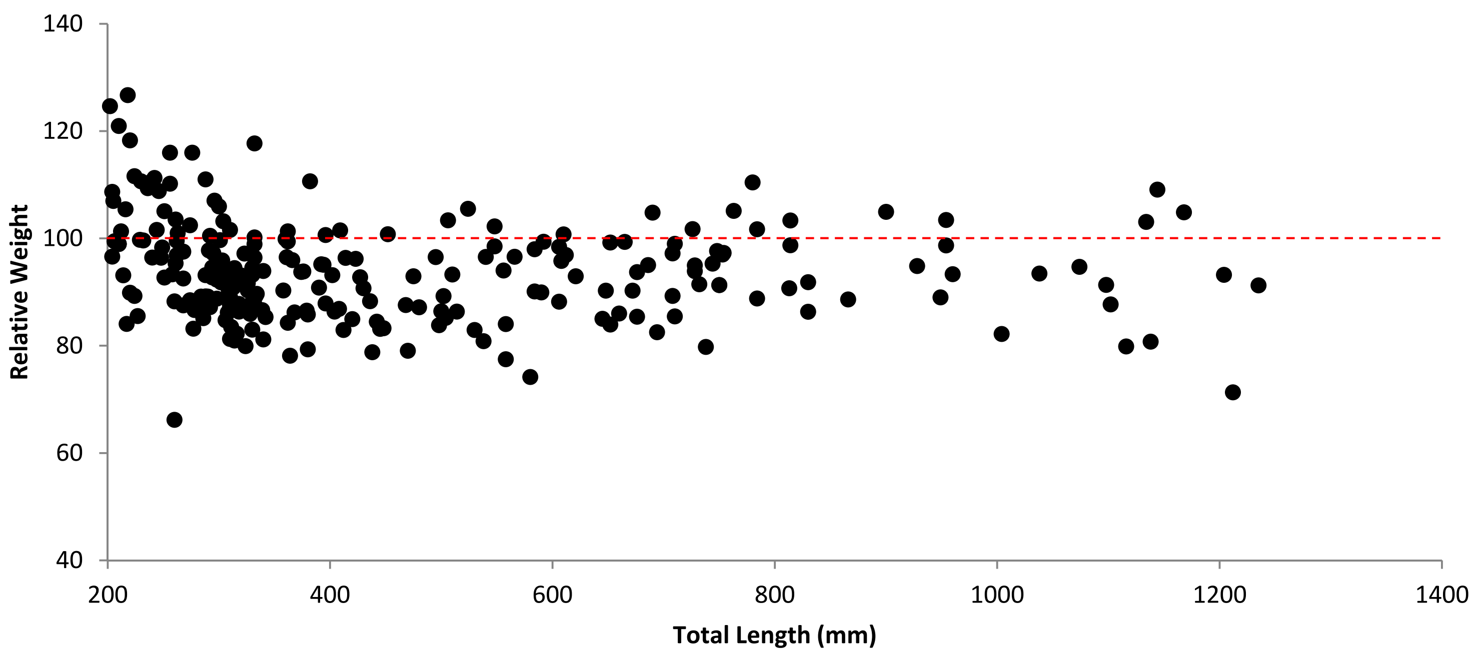

FIGURE 7.—Flathead Catfish relative weights (W_r; n = 241) collected in the Neuse River, 2014. W_r was only calculated for individuals greater than or equal to 200 mm TL. The dashed line represents the 75th percentile of W_r across the species' geographical range.

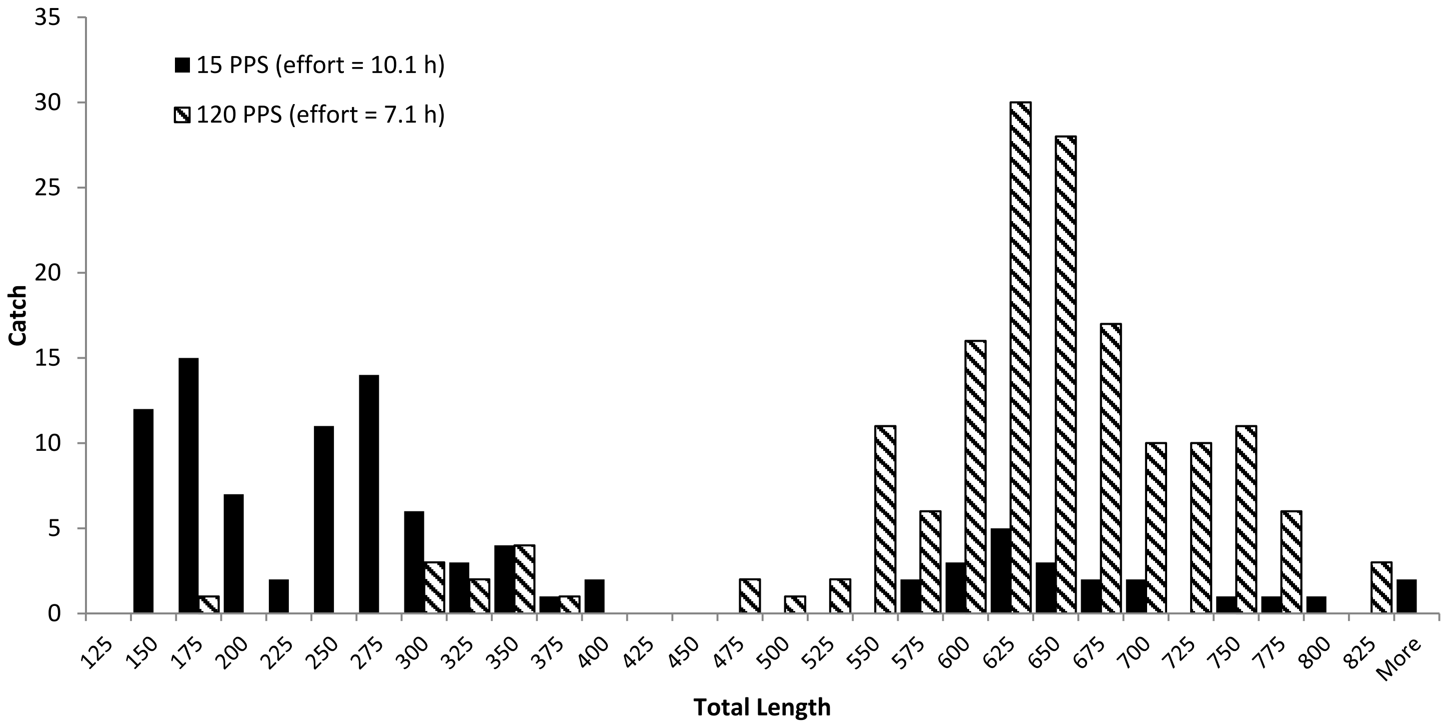

FIGURE 8.—Comparison of Blue Catfish length-frequency distributions among different sampling gears. Black bars depict fish captured using 15 Hz (*n* = 99), while black and white diagonal bars represent fish collected using 120 Hz (*n* = 164).