COMPARISON OF HOOP NETS TO TRAP NETS IN SAMPLING PANFISH

Jayden R. Alsleben
Aquatic Biology Program
Bemidji State University
Bemidji, MN, USA
jayden.alsleben@live.bemidjistate.edu
Faculty Sponsor: Dr. Andrew W. Hafs (andrew.hafs@bemidjistate.edu)

***Abstract*—Panfish including bluegill *Lepomis macrochirus* and black crappie *Pomoxis nigromaculatus* are gamefish species of significance found in Minnesota. Hoop nets and trap nets are two types of gear that can be used to sample these fish. Fisheries managers and anglers alike are interested in the best tactics to capture panfish. The behavior of fish, including bluegill and black crappie, change throughout the sampling season and make it difficult to assume accurate representations. Trap nets have historically been adequate in sampling near shore populations, but questions surrounding the gear have allowed other options to be pursued. The objective of this study is to compare the effectiveness of hoop nets to trap nets by analyzing the difference in catch per unit effort (CPUE), length, and proportional size distribution (PSD) of panfish. Nets were set within two weeks of each sample period. Captured panfish accounted for 96.5% of the total catch between the two nets. Black crappie CPUE significantly increased ($P < 0.01$) with hoop nets while bluegill CPUE was not significantly ($P = 0.30$) different by net type. The average lengths for bluegill captured in hoop net were longer than those captured in trap nets. Bias in gear selectivity may have produced different catch rates and size structures for each net and species. Further studies will be needed to accurately estimate the differences in each nets ability to sample panfish.**

I. Introduction

Sampling nearshore gamefish has shown to be effective in measuring population dynamics when using certain gear (Miranda and Boxrucker 2009). Depending on the type of system, gear used, and state of seasonality, certain species can be targeted to sample (Porta et al. 2020). The physical and dimensional attributes of a net can limit the ability to catch as well as create a bias (McIrney and Cross 2020). Trap or modified fyke nets have been used to capture panfish and other large nearshore species that are selective towards cover-seeking and mobile fish (Bonar et al. 2009). Hoop nets are primarily used in capturing mobile species in lotic systems but also have captured species in impoundments and lentic systems (Long et al. 2017). A suitable method of precision in specific sampling is preferred when targeting certain aspects.

Panfish including bluegill *Lepomis macrochirus* and black crappie *Pomoxis nigromaculatus* are gamefish species of significance found in Minnesota. They are the third most sought-after fish in the state (USFWS 2011). Panfish are targeted by anglers year-round and are one of the most widespread groups of fishes in Minnesota. A creel survey on Lake Osakis in 2021 found sunfish and black crappie to be the most sought-after species and the highest amount of harvested catch (Rydell 2021). Fish behavior of these species can change seasonally through abiotic and biotic factors such as temperature, spawning habits, and prey availability (Baumann 1972). Panfish have primarily been sampled for management using trap nets (McIrney et al. 2020).

The ability to capture panfish at the appropriate time can be crucial to understanding their behavior as well as correctly measuring the population (Flammang et al. 2016). It is more beneficial to target nearshore species earlier in the year but before spawning activity to ensure the most unbiased representative sample (McIrney 2020). As the season progresses fish move into deeper water and do not always provide enough numbers to measure population metrics (Long et al. 2017). Other tactics of sampling with different gear such as hoop nets have included bycatch of these species (Flammang et al. 2016). In order to be most effective in effort expounded, the gear selectivity should be closely monitored to understand what the most efficient method is. Therefore, the objective of this study is to compare the effectiveness of hoop nets to trap nets by analyzing the difference in catch per unit effort (CPUE), length, and proportional size distribution (PSD) of panfish.

II. Methods

This study was conducted on Stella Lake located in south-central Minnesota. Stella Lake is a 242 ha body of water with a maximum depth of 22.9 m. Fish were sampled in two periods, one for hoop nets and the other for trap nets. Hoop nets were used to capture fish from July 29th to August 2nd, 2024. Trap nets sampled fish from August 13th to August 14th, 2024.

Fish were sampled using standard hoop nets and standard trap nets. Hoop nets consisted of seven 0.8 m hoops with a 25 mm mesh and total length of 3.4 m. Hoop nets were set in tandem by tying the cod end of

the first net to the bridal of the second net. Small mesh bags baited with cheese were attached to the inside ring of each hoop net. Trap nets were standard double frame with 19 mm mesh. Trap nets were set with a single net by configuring the lead end to shore.

Sites for the hoop nets were determined by an effort to sample a diverse mix of habitats. Hoop nets were set both parallel and perpendicular to shore. Depths of the hoop nets ranged to sample below the maximum depth of a trap net but above the minimum oxygen threshold to ensure fish health. A total of twenty sites were selected and set with tandem hoop nets. Nets soaked for a period 24 hours and were retrieved. Fish from the first net of the tandem were sorted into one side of a live well. Fish from the second net of the tandem were sorted into the other side of the live well. Each net was recorded as separate data from a singular site.

Captured fish were then identified by species, counted, and released. The target species, black crappie and bluegill, were measured by total length in mm, counted, and released. Hoop net depth, time, and position in the water were recorded. Sites for trap nets were selected randomly from historical locations. A total of nine trap nets were set. Nets soaked for a period 24 hours and retrieved. Fish were then identified, measured, and released.

All analysis was completed through Microsoft Excel and program R. PSD was based on proposed target size structure values from Gablehouse (1984) for both target species with 95% confidence intervals (CI). Catch rates of each net type were evaluated by running a statistical analysis t-test on relative abundance by CPUE and size structure by length groups of black crappie and bluegill. Length frequency analysis was used for bluegill in both net types.

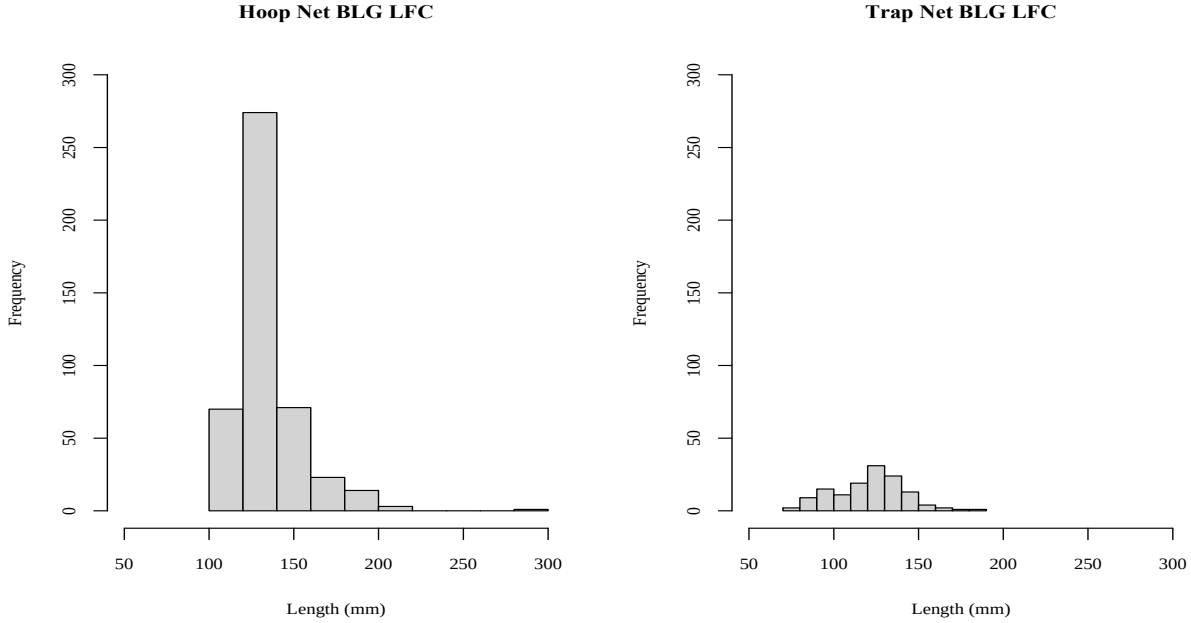

Fig 1. (Left) The relationship between length and count of bluegill captured in hoop nets from Stella Lake during July/August 2024 shown as a length frequency analysis. (Right) The relationship between length and count of bluegill captured in trap nets during sample period shown as a length frequency analysis.

III. Results

Hoop nets captured a total of 528 fish with bluegill and black crappie making up 96.5% of the catch. Trap nets captured 177 fish with bluegill (no black crappie captured) making up 74.6% of the catch. A total of 7 different fish species were captured for hoop nets while trap nets 12 different fish species.

Lengths of bluegill captured in hoop nets ranged from 112 to 284 mm and the mean ± SD length was 135 ± 18.4 mm (Figure 1). Bluegill PSD of quality size fish in hoop nets was 14.9 with a 95% CI [10.2, 19.6] (Figure 2).

Trap nets captured bluegill with lengths ranging from 72 to 189 mm with a mean ± SD length of 122 ± 20.5 mm (Figure 1). Bluegill PSD of quality size fish in trap nets was 6.2 with a 95% CI [2.0, 10.3] (Figure 2). Hoop nets had a significant relationship with longer lengths for bluegill than trap nets ($P < 0.01$). The lengths of black crappie captured in hoop nets ranged from 145 to 380 mm and the mean ± SD length was 258 ± 56.9 mm. Black Crappie PSD of quality size fish in hoop nets was 72.2 with a 95% CI [57.7, 87.0] (Figure 2). PSD is not applicable to black crappie in trap nets since the gear failed to sample the target species.

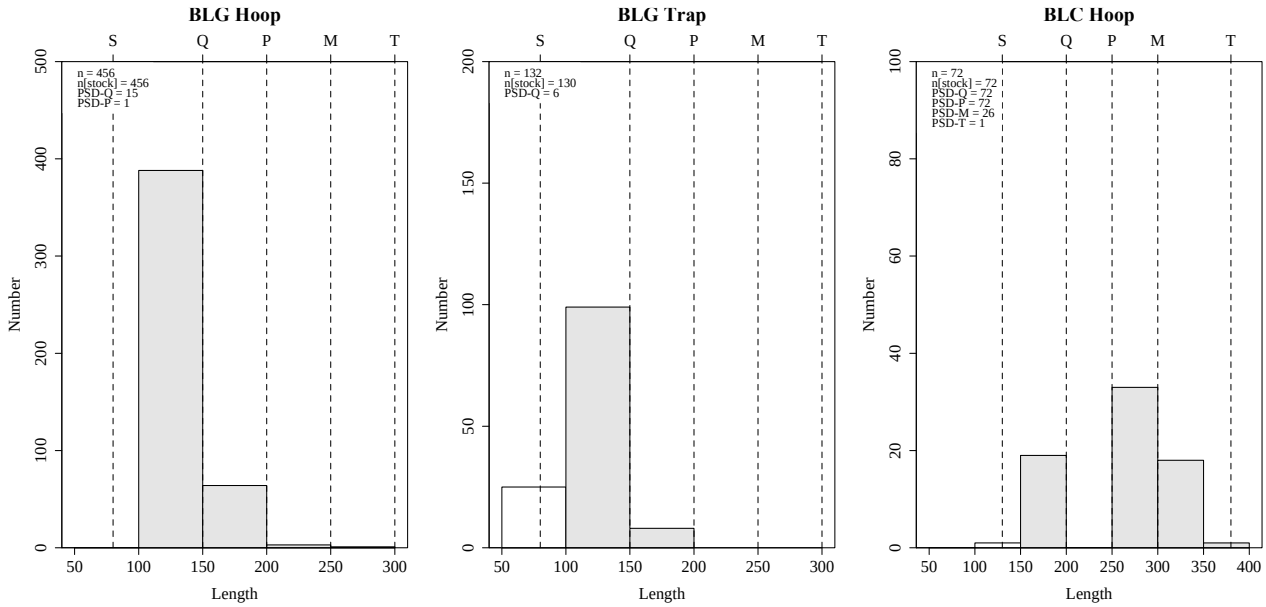

Fig. 2 Proportional size distribution (PSD) for bluegills and black crappie in hoop and trap nets from Stella Lake during July/August 2024. The dotted lines represent the minimum length for proposed target size of each species (stock, quality, preferred, memorable, and trophy).

Hoop net CPUE for black crappie was 3.6 fish/net and ranged from capturing 0 to 19 fish per net. Trap nets did not sample black crappie. Black crappie CPUE had a significantly higher catch rate for hoop nets ($P < 0.01$). Hoop net CPUE for bluegill was 22.8 and ranged from capturing 3 to 95 fish per net. Trap net CPUE for bluegill was 14.6 and ranged from capturing 3 to 34 fish per net (Figure 3). Bluegill CPUE was not significantly influenced by either net ($P = 0.30$).

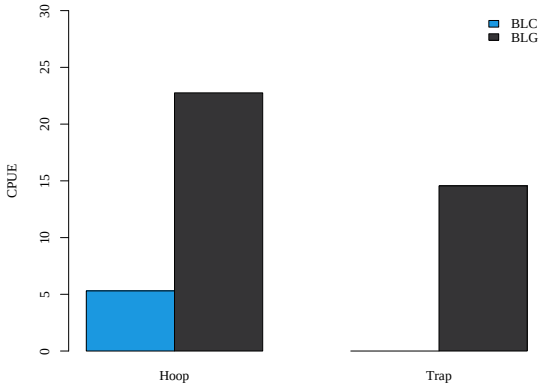

Fig. 3 A comparison of catch per unit effort for both target species across each net type from Stella Lake during July/August 2024

IV. Discussion

When deciding to select gear for appropriate sampling, biologists need to be cautious of possible bias when finding research questions. This study showed significant differences in size and numbers of fish captured similar to literature (Flammang et al. 2016). Hoop nets captured more numbers of black crappie and had a better size structure than trap nets. Bluegill CPUE was similar in both net types, but longer lengths were found in hoop nets. The bias of gear selectivity is not as clear.

For comparing the different gear types with the target species lengths, there are certain differences. When looking at the bluegill population, the PSD was low for both types of gear with hoop nets having a small advantage and more overall fish caught. Due to the minimal number of fish larger than quality length, it is apparent that the number of quality size fish is not different for this system. This similarity could be attributed to a high density and slow growing population for bluegills in this system. The black crappie population cannot be successfully evaluated with only one type of gear capturing the target species. It is worthwhile to not when examining the PSD of black crappie in hoop nets, there is a larger number of fish over preferred sized than there is below quality size.

The effort expounded to set each net type was equal. Hoop nets were set in tandem at twenty locations whereas trap nets had nine single sets. Although CPUE of bluegill was not significant for net types with different effort, literature showed hoop nets

to be more efficient in sampling panfish with less effort (Flammang et al. 2016). Mesh size also with hoop nets having a larger mesh than trap nets. The longer lengths of fish captured in hoop nets could be attributed to this where literature (Flammang et al. 2016) also found bluegill to have the largest PSD in hoop nets compared to other net types. Hoop nets were also able to be set at greater depths and around submerged aquatic vegetation. This was thought to be able to sample a greater ensemble of fish although trap nets had a greater species richness.

There are several differences between the nets that may have produced different catch rates and size of fish caught. The size of the net structure, size of the throat constriction, and bait used are ways that may produce bias. Modifying the nets to be more similar in these ways should be considered to help reduce potential bias when sampling. Further studies will be needed to accurately show the differences in hoop nets compared to trap nets in capturing panfish.

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