# Catch of White Crappie in Trap Nets in Relation to Soak Time and Fish Abundance

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*Abstract*: The effects of soak time and fish density on number and size of white crappie (*Pomoxis annularis*) caught with trap nets were investigated in Mississippi lakes. Catch/set (1–7 days) of large white crappie (≥200-mm total length) increased asymptotically with soak time, but that of small and medium fish (<130 and 130–199 mm, respectively) decreased after the first 2–3 days. Catch/day of all length groups of white crappie, increased sharply with soak time, peaked in 1–3 days, and decreased thereafter. These trends indicated that catch could be optimized if nets were run every 2–3 days, and that longer soak times could result in the underestimation of small and medium-size fish. Trap net samples taken within 0.4- to 2.4-ha lake enclosures prior to treatment with rotenone indicated that catch/effort in nets reflected absolute abundance of medium and large white crappie within these areas.

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In recent years many state fishery agencies have increased their effort to manage crappie (*Pomoxis spp.*) fisheries (Mitzner 1984, Colvin and Vasey 1986, Boxrucker and Ploskey 1988). Of primary concern has been the development and evaluation of sampling and assessment methodologies suitable for monitoring crappie population dynamics. Sampling is perhaps the most important and expensive component in monitoring fishery resources; consequently, efficiency of the gear and sampling design should be carefully considered (Gulland 1969).

Gear and sampling methods for the assessment of crappie populations are not well defined. The efficiency of various types of entrapment gear appears to be

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influenced by environmental variables as well as sampling techniques (Hansen 1944, 1953, Grinstead 1970, Miller 1983, Romaire and Pfister 1983, Somerton and Merritt 1986). Some midwestern state agencies have successfully sampled crappie using trap nets (Ellison 1984, Gabelhouse 1984, Mosher 1984, Colvin and Vasey 1986). Trap nets are generally preferred over electrofishers, gill nets, and hoop nets because they are highly selective for crappie and appear to provide more accurate accounts of existing length-frequency distributions (Powell et al. 1971, Yeh 1977, Boxrucker 1984). Nevertheless, problems related to assessments of white crappie populations based on trap-net sampling, such as size selectivity and variable soak times, remain undocumented.

We investigated the usefulness of trap nets for sampling white crappie populations in Mississippi lakes. Specific objectives of this study were to assess potential relationships between the soak time (duration of the set) and catch of white crappie in trap nets, and to examine the adequacy of trap net samples for determining the absolute abundance and length structure of white crappie populations. This research was funded in part by the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) through Federal Aid to Fisheries Project F-87, and by the Mississippi Agriculture and Forestry Experiment Station. We thank Unit students and MDWFP staff for their assistance in field collections, and L. D'Abramo, D. Jackson, W. Kelso, R. Robinette, F. Vasey, and anonymous referees for reviewing the manuscript.

## Methods

In 1988 white crappie populations were sampled in Columbus, Grenada, Moon, Okatibbee, and Ross Barnett lakes, Mississippi. These lakes, located in the northern half of the state, are man-made impoundments and range from 1,540 to 25,640 ha, except for Moon Lake, which is an 894-ha oxbow adjacent to the Mississippi River.

Trap nets consisted of 2 frames (0.9 x 1.8 m) with center braces and four hoops (0.76-m diameter) constructed of 6.5- to 8.0-mm diameter steel. The nets had a single slit at the mouth and a single throat between the first and second hoops. Netting material of the trap and a single 0.9 x 20-m lead consisted of 13-mm square nylon mesh; however, during the summer, the cod-end of the traps was lined with 6.5-mm square nylon mesh to avoid loss of small crappie when nets were lifted. Nets were typically set in $< 6$ m of water.

### Trap-Net Catch vs. Soak Time

We investigated the effects of soak time on the number, length, and relative weight of white crappie caught in trap nets. This part of our study was conducted in an arm of Columbus Lake that measured approximately 25 ha in surface area and 4 m in average depth. Sampling was limited to 1 arm of Columbus Lake to reduce variability resulting from potential differences in localities. Nets were set perpendicular to the shoreline evenly spaced along the contour of the arm. In March, 5 trap nets were run every day for 7 days, and another 5 nets were run only once after 7 days. This approach did not allow us to evaluate intervals of 2–6 days, so in October, we fished nets at 1–7 day intervals (5 nets/interval).

All white crappie collected were measured (total length in mm), weighed (g), and released within the area near the capture site. Catch/effort was expressed as catch/day (24-hour interval) and as catch/set (total catch over the entire fishing interval). Relative weights were computed as described by Anderson and Gutreuter (1983). Effects of soak time on catch/effort and relative weight according to length groups (small = <130 mm, medium = 130–199 mm, and large = ≥200 mm) were examined with regression analyses.

### Trap-Net Catch vs. Abundance

We also evaluated the adequacy of trap net samples to provide accurate representations of white crappie abundance and length structure. Rotenone surveys were conducted by the MDWFP in blocked-off sites (0.4–2.4 ha) in each lake over a 4-week period during late July and August. We set 2–4 trap nets in each site 1–3 days before the site was blocked off and treated with rotenone according to Davies and Shelton (1983). Nets were retrieved immediately after the block-off net was positioned and prior to the addition of rotenone. All white crappie collected in the trap nets and treated enclosures were separated into centimeter groups and counted. Trap-net collections were included in rotenone site totals.

To determine if trap-net samples reflected absolute abundance of white crappie within the treated area, we correlated average catch/effort in trap nets with catch/ha in rotenone samples. Although rotenone samples do not always reflect absolute abundance in the entire body of water (Aggus et al. 1979), a significant positive correlation would indicate that trap-net catch/effort could serve as an index of absolute abundance of crappie in the area around the trap net.

## Results and Discussion

### Trap-Net Catch vs. Soak Time

In March, catch/day of all length groups of white crappie was higher ($P < 0.1$) in the nets retrieved daily. Thus, more fish were caught when the nets were run daily and the catch summed than when the nets were run only once after 7 days. Catch/set of large white crappie was greater in the 7-day sets than in the 1-day sets ($P < 0.1$), but that of small and medium crappie were not. This suggested that small and medium fish trapped in nets during 7-day intervals could have been lost before the nets were run. Relative weights of white crappie of all length groups in 1- and 7-day nets did not differ significantly ($P > 0.1$).

In October, catch/day increased sharply with soak time, peaked, and then decreased. Peaks in catch occurred at 1 day for small white crappie and 2 days for medium and large fish (Fig. 1). These patterns indicated that most of the fish were caught in the first 1–3 days after the nets were set and that catch rates progressively decreased in nets which remained set. The decrease in catch rate in nets fished at

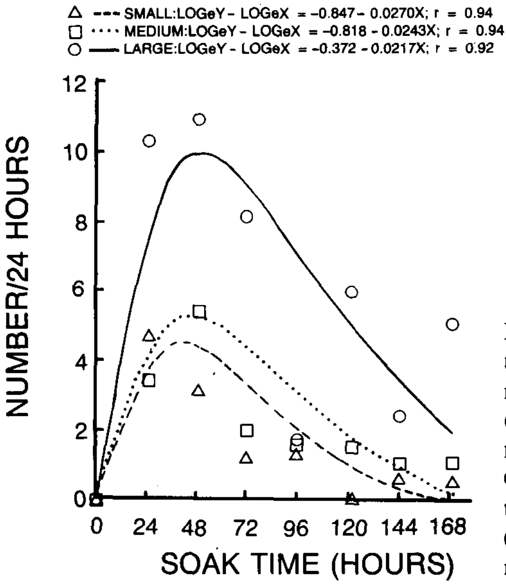


**Figure 1.** Relationships between soak time and catch/24 hours of small (<130 mm), medium (130–199 mm), and large (≥200 mm) white crappie in trap nets fished in Columbus Lake, Mississippi, October 1988. In the equations X = soak time (hours + 1) and Y = catch/24 hours (number + 1). Symbols represent arithmetic means.

intervals over 3 days could be due to the capture of most of the fish in the vicinity of a net soon after the net was set, as well as escapement, mortality, and net avoidance due to high densities of captured fish.

Catch/set of large white crappie increased with soak time with a gradual decrease in the rate of increase (Fig. 2). Similar results have been obtained in studies conducted to examine the time-related catch rates of other fishes and invertebrates in various types of entrapment gear. Relationships showing an asymptotic increase in the catch/set with soak time, like that detected for large white crappie, have been documented for the combined catch of various fish species in trap nets (Grinstead 1970) and for crabs in pot gear (Miller 1983, Somerton and Merritt 1986).

Catch/set of small and medium white crappie increased, peaked between 2–3 days, and then decreased gradually. This trend may be related to escapement and mortality. Previous studies have documented the escapement of fish in hoop nets and trap nets after 1–2 days (Hansen 1944, Patriarche 1968). Observations in our study indicated that mortality as a result of predation or other factors increased with soak time. No dead white crappie were found in nets run at 2-day intervals or less, but mortalities occurred in nets with longer soak times, averaging about 6% in nets run at 7-day intervals. Qualitative observations indicated that the stomachs of large crappies and other predators collected in the nets often contained an abundance of small and some medium-size crappie. Significant trends between relative weight and soak time could not be detected ($P > 0.1$).

These results are specific to Columbus Lake and may not apply directly to other bodies of water. Conceivably, in waters with different habitats and crappie abundances the relations between soak time and catch of white crappie may vary,

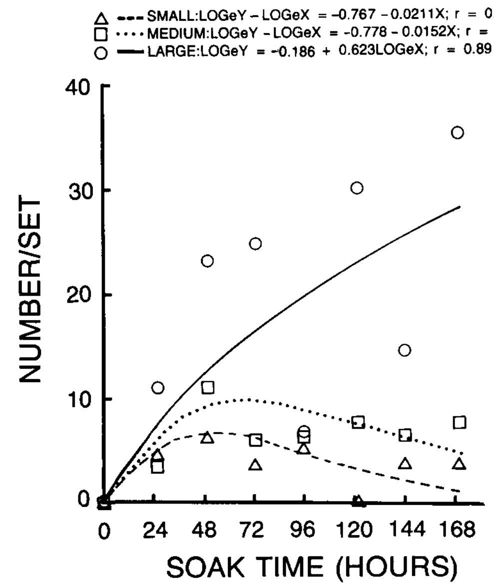


**Figure 2.** Relationships between soak time and catch/set of small (<130 mm), medium (130–199 mm), and large (≥200 mm) white crappie in trap nets fished in Columbus Lake, Mississippi, October 1988. In the equations X = soak time (hours + 1) and Y = catch/set (number + 1). Symbols represent arithmetic means.

and optimum fishing intervals could be different. For example, optimum soak time may be higher where abundance is lower. We speculate, however, that the relationships observed in Columbus Lake will pertain to a wide variety of lentic systems.

## Trap-Net Catch vs. Abundance

Length-frequency distributions generated with trap-net data were remarkably similar to those generated with rotenone data, with the exception of small fish which were underestimated by trap nets (Fig. 3). A chi-square test indicated that when small fish were excluded from analyses, there were no significant differences ($P > 0.1$) in the proportions of medium and large fish collected by the 2 sampling methods.

Significant positive relationships ($P < 0.1$) were detected between the catch/effort of medium and large white crappie in trap net samples and the abundance of white crappie in sites treated with rotenone (Fig. 4). However, correlation coefficients were low ($r = 0.67$ and 0.68 for medium and large fish, respectively) indicating that factors other than just fish abundance influenced trap net catch/effort. Soak time in these samples varied from 1–3 days and likely accounted for some of the unexplained variation. Physical variables such as water depth, basin morphometry, and substrate composition could have also influenced the catch of fish in trap nets (Hubert 1983, Boxrucker, 1984).

The inability to detect a relationship between the abundance of small crappie in trap net and rotenone samples may be due to factors related to habitat use and distribution, as well as variable soak time. Small crappie in the summer feed primarily on zooplankton (Ball 1972, O'Brien et al. 1984), and consequently may

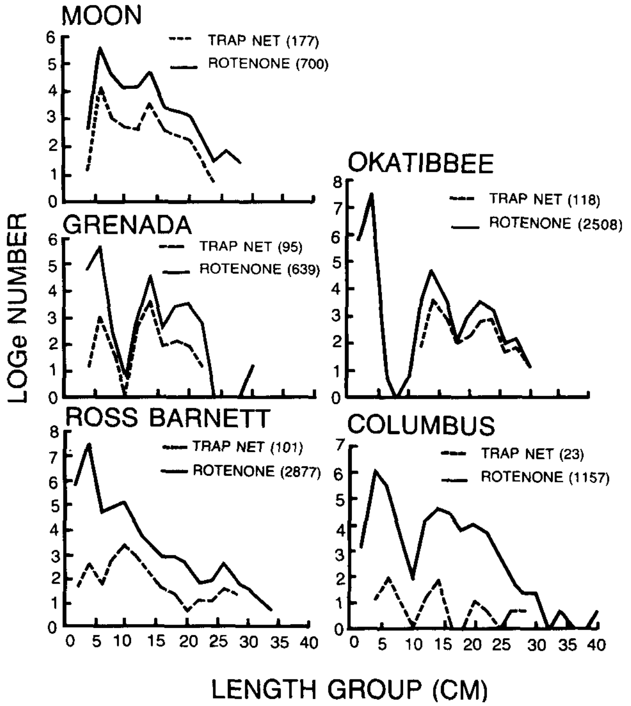


**Figure 3.** Length-frequency distributions of white crappie collected with trap net and rotenone sampling in 5 Mississippi lakes, late July and August 1988. The total number of fish collected by each method is given in parentheses.

have inhabited the photic zone of the blocked-off areas, where they were not adequately sampled by our trap nets. In nets set for more than 1–2 days possibly some small crappie escaped, were eaten by predators, or died otherwise.

### Implications to Sampling

Our results indicate that the catch of white crappie in trap nets was affected by soak time. Cumulative catch could be maximized if nets are run daily, and from a labor standpoint optimized if run at 2- to 3-day intervals. If short soak times are not feasible because of logistic constraints, long soak times could still be used to obtain samples; however, longer soak times are apt to provide samples that are biased in favor of larger white crappie. Whenever possible, soak times should be standardized, or at least reported. Catch/effort may be adjusted to reflect a standard soak time and avoid biased estimates. Adjustment models are not entirely without problems because in addition to soak time, catch/effort varies with local densities, habitat characteristics, and seasonal changes in environmental variables which influence movements (Somerton and Merritt 1986).

Trap-net catch reflected the existent length-frequency distribution of medium

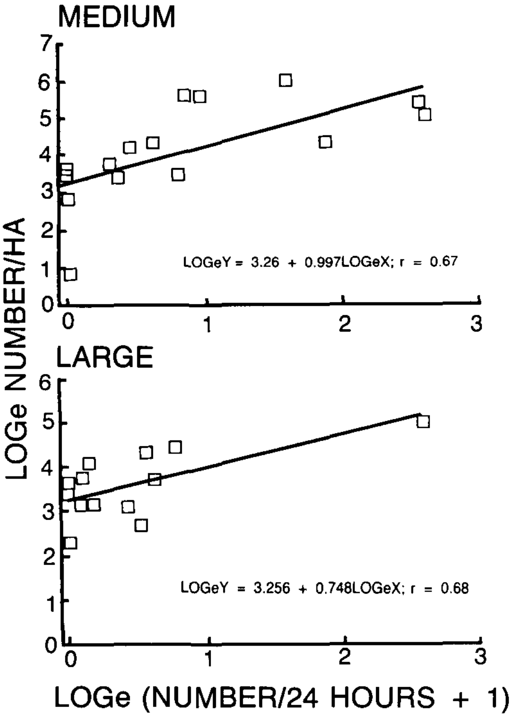


**Figure 4.** Relationships between the absolute abundance (number/ha) of medium (130–199 mm) and large (≥200 mm) white crappie collected in 15 0.4- to 2.4-ha sites treated with rotenone, and their relative abundance (number/24 hours) in trap nets fished within each site prior to treatment. Samples were taken in 5 Mississippi lakes, late July and August 1988. In the equations X = number/24 hours + 1 and Y = number/ha. Symbols represent log-transformed means.

and large white crappie. However, the degree of correlation between trap-net catch/effort and abundance as determined by rotenone sampling was low, although statistically significant. Apparently localized conditions other than density of white crappie affect catch in nets. If trap-net catch/effort is to be used as an index of abundance, sampling, whether in randomly or subjectively selected areas, should include a diversity of sets.

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