# Comparison of 3 Seines in Alabama Small Impoundments

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*Abstract*: The performance of 3 seines was evaluated in 6 state-owned public fishing lakes in Alabama. The catch of bluegill fry (*Lepomis macrochirus*) and young of year (YOY) largemouth bass (*Micropterus salmoides*) in a 4.6-m (short) seine and an experimental 9.1-m (medium) seine was compared. The catch of intermediate bluegills (8–13 cm TL) in the medium seine was subsequently compared to their catch in a 15.2-m (long) seine. The medium seine was similar to the short seine for collecting bluegill fry. The medium seine generally required fewer hauls but more work to achieve the same level of precision when collecting YOY bass. The long seine was more effective at collecting intermediate bluegills than the medium seine. The experimental medium seine would provide no advantage over the short and long seines if used to conduct routine balance checks. However, it would be useful for determining the presence of YOY bass in lakes with low bass abundance, provided the sampling agency is able to allocate more time toward sampling these type impoundments. Management agencies should consider the low precision of seining when choosing a small impoundment sampling program. Alternate sampling methods might be more appropriate.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 49:195–204

Small impoundments provide a significant contribution to recreational fishing in the southeastern United States by supporting up to 40% of the fishing pressure and 35% of angler days in some states (Flickinger and Bulow 1993). Small impoundments in the South have historically been managed to produce sustained annual yields of harvestable-size largemouth bass and bluegills (Swingle 1950). Management techniques are primarily based upon a determination of population balance. The concept of balance was initially proposed by Swingle (1950) and later elaborated upon by Anderson (1973, 1976). A population is considered to be balanced if it provides sustained annual yields of

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harvestable-size fish in proportion to the fertility of the water. Determination of balance is often based upon interpretation of seine hauls using a 4.6-m minnow seine and a 15.2-m bag seine (Swingle 1956). This technique consists of determining presence or absence of recently hatched bluegills and YOY largemouth bass using the minnow seine. The bag seine is used primarily to quantify abundance of intermediate-size (8- to 13-cm) bluegills.

Problems associated with using this method have been recognized, and various modifications have been incorporated into management programs (Brown 1962, Anderson 1976). A recently proposed alternative technique is use of a 9.1-m bag seine (W. Davies, pers. commun.). The original intent was to combine the characteristics of the minnow and bag seines into 1 gear that could be used where it was impractical to use the bag seine, but would sample the population at least as efficiently as the minnow seine. The objective of this study was to evaluate the performance of this experimental (9.1-m) seine in comparison to the minnow (4.6-m) and bag (15.2-m) seines for determining population balance in small impoundments.

The author acknowledges several people who helped conduct this study. Keith Floyd, P. Ekema, D. Darr, D. Catchings, S. Smith, J. Paul, J. Haffner, J. Piper, J. McHugh, T. Madigan, J. Addison, L. Johnson, M. Newman, K. Weathers, and F. Hamilton assisted with data collections. Robert Betsill and M. Van Den Avyle provided statistical advice and R. Luebke, J. McHugh, B. Reeves, M. Van Den Avyle, and 3 anonymous reviewers made suggestions that improved the quality of this paper.

## Methods

Seining was conducted in June 1993 at 6 Alabama state-owned public fishing lakes (Table 1). These lakes, ranging in size from 15 to 49 ha, are part of Alabama's "State Lakes" program and were chosen because their fish communities represent the various conditions typically encountered in small impoundments containing largemouth bass and bluegill populations. Each lake is managed intensively to provide high densities of bluegills along with sustainable

**Table 1.** Descriptive information on 6 lakes used in seine comparison study.

| Lake | Surface area (ha) | Mean depth (m) | Watershed type | Population status |
|---|---|---|---|---|
| Dekalb | 49 | 4.6 | Mixed hardwood/pine | Balanced/competitive Spp.[a] |
| Middle Clay | 15 | 3.4 | Pine | Balanced |
| Fayette | 24 | 2.0 | Pine | Balanced/crappie present |
| Dallas | 41 | 1.7 | Mixed hardwood/pine | Unbalanced/bluegill crowded |
| Monroe | 38 | 1.5 | Mixed hardwood/pine | Balanced |
| Crenshaw | 22 | 2.1 | Pine | Balanced/crappie present |

[a]Competitive species include crappies (*Pomoxis* spp.) and green sunfish (*Lepomis cyanellus*).

yields of largemouth bass. This includes a regular fertilization program similar to that described by Reeves and Harders (1983). Harvest is monitored and regulated with creel limits, and when required, length limits. Management decisions are based on seining data assessments, described by Swingle (1956), creel data, and the use of electrofishing to estimate proportional stock density, relative weight and relative stock density (Anderson 1976, Wege and Anderson 1978, Gablehouse 1984).

Three types of seines were used to sample each lake. Catch rates of bluegill fry and YOY largemouth bass were compared between a 4.6- x 1.2-m (0.32-cm mesh) (hereafter referred to as short) seine and a 9.1- x 1.8-m (0.95-cm mesh), with a 1.8-$m^3$ bag (0.32-cm mesh) (hereafter referred to as medium) seine. The medium seine was subsequently compared to a 15.2- x 1.8-m (0.95-cm mesh) (hereafter referred to as long) seine to evaluate their respective catch of intermediate bluegills.

Quadrant hauls of each seine were used to sample 15 randomly selected sites at each lake. A quadrant haul consisted of anchoring one end of the seine at the shoreline, pulling the other end perpendicular from shore to its full length, then making a sweeping arc back to the bank. Three non-overlapping adjacent hauls, 1 with each seine, were conducted at each site. Fish were identified and measured individually and summarized by 2.5-cm groups. Analyses included only largemouth bass and bluegills.

Swingle (1956) considered a largemouth bass and bluegill population to be "balanced" if short seine samples collected in early summer contained recently hatched bluegills <2.5 cm total length (TL) and at least 1 YOY largemouth bass <10.2 cm TL in every 3 seine hauls. Also, the long seine should yield 5–30 intermediate bluegills/haul. Consequently, to evaluate the short and medium seines, I compared their catch of bluegill fry and YOY bass. To evaluate relative performance of the long and medium seines, I compared catch of intermediate bluegills in the long seine to that in the medium seine. Each evaluation was done by comparing 3 quantities: 1) average number of the target species collected per seine haul; 2) coefficient of variation (CV = standard deviation divided by mean of the untransformed catch data); 3) the percentage of seine hauls that captured at least 1 fish.

A factorial design from the SAS Institute (1990) general linear models procedure was used to determine if average number of fish collected varied among seines. For both comparisons, the lake-seine interaction was significant, therefore, seines were compared using *t*-tests done separately for each lake. Data were transformed using a $\text{Log}_e(X + 1)$ transformation, where X was number of fish/seine haul.

Relative precision was evaluated by determining the CV among replicate samples for each lake and seine. The CV was used to estimate number of hauls (N) required by each seine to achieve a coefficient of variation of the mean catch rate (standard error divided by the mean) of 0.25 using the equation $N = (CV/0.25)^2$. The amount of effort (E) in hours for a 2-person crew to complete

($N$) hauls was calculated using the equation E = ($N$(s)/3600), where s = average number of seconds to pull the seine and process fish (calculated from seine hauls at 2 of the 6 lakes).

The percentage of seine hauls having at least 1 fish was compared among the short and medium seines using chi-square analyses done separately for each species. Comparisons were not made for intermediate bluegills collected by the long and medium seines because the long seine is used to quantify their numbers and is not dependent on presence or absence data.

Catch rates of intermediate bluegills were adjusted between the long and medium seines using least squares linear regression. $Log_e$ of catch in the medium seine was regressed against $Log_e$ of catch in the long seine. All statistical analyses were considered significant at the $P \leq 0.05$ level.

## Results

### Short vs. Medium

The medium seine caught significantly more YOY bass than the short seine, but numbers of bluegill fry were usually similar between methods (Table 2). Comparisons were significant for YOY bass at 5 of the 6 lakes. The medium seine caught significantly more bluegill fry at only 1 lake. Neither seine collected bluegill fry at Dallas County Lake, which had a "bluegill crowded" population.

The medium seine was more precise than the short seine for collecting YOY bass, but neither gear was consistently more precise for bluegill fry (Table 2). Coefficients of variation were greater for the short seine in 5 of 6 lakes for YOY bass and 3 of 5 lakes for bluegill fry.

The short seine was more efficient than the medium seine at collecting bluegill fry and YOY bass (Table 2). The medium seine required an average of 3.9 times as long to pull and process the fish as the short seine. The amount of labor required to collect bluegill fry in the short seine was 0.4–3.7 hours (10–94 hauls) and 2.7–21.2 hours (18–141 hauls) for the medium seine. For YOY bass, effort ranged from 0.3 to 5.6 hours (7–144 hauls) for the short seine and from 0.9 to 8.6 hours (6–57 hauls) for the medium seine.

Relative ability of the 2 seines to detect the presence of YOY bass or bluegill fry varied among lakes (Table 3). The medium seine was more likely than the short seine to detect YOY bass at Middle Clay and Dallas County Lakes. Both seines collected an average of 1 or more YOY bass/3 hauls at every lake, except the short seine at Dallas County Lake. For bluegill fry, the only lake where a difference was evident was Middle Clay Lake, where 100% of the medium-seine hauls caught fry versus only 60% of the short-seine hauls.

### Long vs Medium

The long seine collected more intermediate bluegills, and was usually more precise and more efficient than the medium seine. The long seine caught more bluegills at every lake, with 4 of the 6 comparisons significant (Table 4). Coeffi-

**Table 2.** Comparisons of number, precision and required effort (E) for bluegill fry and YOY largemouth bass collected by short and medium seines.

| | | Bluegill fry | | | | | YOY bass | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake | Seine | Mean[ab] | (SD) | CV | *N* | E (hours) | Mean[ab] | (SD) | CV | *N* | E (hours) |
| Dekalb | short | 18.9 | (45.8) | 2.42 | 94 | 3.7 | 8.1 | (6.8) | 0.84 | 12 | 0.5 |
| | medium | 25.3 | (42.6) | 1.68 | 46 | 6.9 | 33.3* | (21.4) | 0.64 | 7 | 1.1 |
| Middle clay | short | 3.7 | (4.6) | 1.24 | 25 | 1.0 | 8.4 | (11.8) | 1.40 | 32 | 1.2 |
| | medium | 27.1* | (29.5) | 1.09 | 19 | 2.9 | 15.3* | (13.2) | 0.86 | 12 | 1.8 |
| Fayette | short | 9.1 | (7.0) | 0.77 | 10 | 0.4 | 1.8 | (2.2) | 1.22 | 24 | 0.9 |
| | medium | 9.7 | (13.6) | 1.40 | 32 | 4.8 | 10.8* | (7.4) | 0.69 | 8 | 1.2 |
| Dallas | short | 0 | | | | | 0.1 | (0.3) | 3.00 | 144 | 5.6 |
| | medium | 0 | | | | | 0.8* | (1.5) | 1.88 | 57 | 8.6 |
| Monroe | short | 78.0 | (138.4) | 1.77 | 51 | 2.0 | 3.2 | (2.4) | 0.75 | 9 | 0.4 |
| | medium | 78.1 | (81.6) | 1.04 | 18 | 2.7 | 5.5 | (4.8) | 0.87 | 12 | 1.8 |
| Crenshaw | short | 0.9 | (2.1) | 2.33 | 87 | 3.4 | 18.1 | (11.4) | 0.63 | 7 | 0.3 |
| | medium | 20.7 | (61.2) | 2.96 | 141 | 21.2 | 49.2* | (30.1) | 0.61 | 6 | 0.9 |

[a]Values for the mean and standard deviation (SD) are shown for the original rather than transformed data.
[b]Means followed by an asterisk were significantly different ($P \leq 0.05$) using transformed data.

**Table 3.** Number of seine hauls collecting at least 1 fish for bluegill fry and YOY largemouth bass collected in short and medium seines. Chi-square values were not calculated when both seines collected fish in every haul or in 0 hauls. Chi-square tests followed by an asterisk were significant ($P \leq 0.05$).

| | | Bluegill fry | | YOY bass | |
|---|---|---|---|---|---|
| Lake | Seine | 0 | ≥1 | 0 | ≥1 |
| Dekalb | short | 5 | 10 | 0 | 15 |
| | medium | 5 | 10 | 0 | 15 |
| | | $\chi^2$ (1 df) = 0.0 ($P$ = 1.00) | | | |
| Middle clay | short | 6 | 9 | 4 | 11 |
| | medium | 0 | 15 | 0 | 15 |
| | | $\chi^2$ (1 df) = 7.5 ($P$ = 0.01)* | | $\chi^2$ (1 df) = 4.6 ($P$ = 0.03)* | |
| Fayette | short | 2 | 13 | 3 | 12 |
| | medium | 1 | 14 | 1 | 14 |
| | | $\chi^2$ (1 df) = 0.4 ($P$ = 0.54) | | $\chi^2$ (1 df) = 1.2 ($P$ = 0.28) | |
| Dallas | short | 15 | 0 | 14 | 1 |
| | medium | 15 | 0 | 8 | 7 |
| | | | | $\chi^2$ (1 df) = 6.1 ($P$ = 0.01)* | |
| Monroe | short | 1 | 14 | 2 | 13 |
| | medium | 0 | 15 | 1 | 14 |
| | | $\chi^2$ (1 df) = 1.0 ($P$ = 0.31) | | $\chi^2$ (1 df) = 0.4 ($P$ = 0.54) | |
| Crenshaw | short | 11 | 4 | 0 | 15 |
| | medium | 7 | 8 | 0 | 15 |
| | | $\chi^2$ (1 df) = 2.2 ($P$ = 0.14) | | | |

**Table 4.** Comparisons of number, precision, and required effort (E) for intermediate-size bluegills (8–13 cm) collected by long and medium seines.

| Lake | Seine | Mean[ab] | (SD) | CV | $N$ | E (hours) |
|---|---|---|---|---|---|---|
| Dekalb | long | 22.1* | (18.7) | 0.85 | 12 | 2.4 |
| | medium | 6.8 | (7.6) | 1.12 | 20 | 3.0 |
| Middle clay | long | 9.7* | (5.7) | 0.59 | 6 | 1.2 |
| | medium | 2.9 | (2.4) | 0.83 | 12 | 1.8 |
| Fayette | long | 2.5 | (2.1) | 0.84 | 12 | 2.4 |
| | medium | 1.7 | (1.4) | 0.82 | 12 | 1.8 |
| Dallas | long | 243.3* | (171.6) | 0.71 | 8 | 1.6 |
| | medium | 120.4 | (102.3) | 0.85 | 12 | 1.8 |
| Monroe | long | 109.7 | (147.3) | 1.34 | 29 | 5.8 |
| | medium | 41.3 | (40.1) | 0.97 | 15 | 2.3 |
| Crenshaw | long | 21.2* | (20.5) | 0.97 | 15 | 3.0 |
| | medium | 8.3 | (10.7) | 1.29 | 27 | 4.1 |

[a]Values for the mean and standard deviation (SD) are shown for the original rather than transformed data.
[b]Means followed by an asterisk were significantly different ($P \leq 0.05$) using transformed data.

cient of variation values were lower for the long seine at 4 of the 6 lakes, and thus required fewer samples at these lakes to achieve similar levels of precision. Also, it was generally more efficient than the medium seine despite requiring an average of 1.3 times as long to pull and process fish. The amount of labor required to collect fish in the long seine ranged from 1.2 to 5.8 hours (6–29 hauls), compared with a range of 1.8 to 4.1 hours (12–27 hauls) for the medium seine. The relationship between the 2 seines was best described by the regression equation, $\text{Log}_e Y = -0.0071 + 0.7174\ \text{Log}_e X$, ($P < 0.0001$; $r^2 = 0.53$), where X and Y were the number of intermediate bluegills collected by the long and medium seines, respectively.

## Discussion

### Short vs Medium

Swingle's method of pond analysis is based upon a determination of presence or absence of bluegill fry and YOY bass collected by the short seine. In that respect, the most important criterion to compare is the ability of the 2 seines to detect at least 1 bluegill fry/haul and at least 1 YOY bass/3 hauls.

There appeared to be no difference in the ability of the 2 seines to collect bluegill fry. The medium seine displayed a greater ability to detect these fish at only 1 lake. This seine also sampled twice as much area as the short seine but collected similar numbers of bluegill fry, indicating these fish were probably oriented near the littoral zone and were equally vulnerable to capture by both seines.

There was no difference in the ability of the 2 seines to collect at least 1 YOY bass/3 hauls. Both seines collected at least 1 fish/3 hauls at every lake except the short seine at Dallas County Lake. This lake contained the lowest bass abundance, suggesting the medium seine may be more effective at collecting these fish in lakes where their numbers are low. The medium seine did collect greater numbers of YOY bass at 5 of the 6 lakes, indicating these fish were located further away from shore, or were less able to avoid capture by this seine.

These results indicated there was no difference in the ability of the 2 seines to determine population balance in these lakes. However, the medium seine may be more effective at collecting YOY bass in ponds with low bass abundance.

### Long vs Medium

Swingle's method of pond analysis uses the long seine to quantify the abundance of intermediate bluegills and suggests it should collect 5–30 of these fish/haul. In this study, the long seine was expected to collect more fish because it sampled a greater area. The regression equation relating catch of the 2 seines indicates the medium seine must collect from 3 to 11 intermediate bluegills per haul in order to be agreeable with Swingle's interpretation of balance using the long seine. The long seine was also more precise and required less effort to

achieve this precision than the medium seine. Consequently, no advantage would be gained by using the medium seine to collect intermediate bluegills.

Previous studies have evaluated effectiveness of the short seine. Reynolds and Simpson (1978) suggested it was useful for assessing reproduction and potential recruitment of young bluegill and bass if used in early summer when these fish are <80 mm long. However, they reported high sampling variability.

Previous evaluations of long seines have reported relatively low sampling efficiency. Brown (1962) examined collection of intermediate-size bluegill with this seine and concluded at least 4 hauls in different locations should be done when using it to assess population balance in Alabama ponds. Ploskey et al. (1990) evaluated the seine in Kansas reservoirs and concluded that it effectively sampled only fish <140 mm TL.

Bayley and Austen (1987) evaluated the performance of a 9.1- x 1.6-m minnow seine with 0.64-cm mesh in small impoundments. They reported seine efficiencies were higher for small fish, but minnow seines were inadequate for assessing recruitment and estimating abundance.

No studies were found evaluating relative performance of these seines in the same impoundments. This study agrees with those of Brown (1962), Reynolds and Simpson (1978), and Ploskey et al. (1990) in that precision was low. Coefficient of variation values were >59% for every seine-lake combination. The variability in precision suggests a particular seine may be more efficient in certain lakes and types of populations. Ploskey et al. (1990) suggested poor sampling effectiveness in their study was associated with low abundance of fishes vulnerable to seining. This also appeared to be true for YOY bass in this study but not for bluegills. Highest CV's for bass collected by the short and medium seines were at Dallas County Lake, which had the lowest bass abundance.

### Management Implications

The medium seine would offer an advantage over the short and long seines only if it proved to be more effective or provided similar results with less effort. This study indicated the medium seine was similar to the short seine and less effective than the long seine at collecting bluegill fry and intermediates. Though more precise than the short seine at collecting YOY bass, it required greater effort to achieve this precision. The original intent of the medium seine was to combine the characteristics of and replace the need to use both the short and long seines. The question of which gear requires less effort depends upon sampling objectives. The minimum number of hauls required by the medium seine to achieve precision levels recommended for management studies was less than the combined number required by the other 2 at 5 of the 6 lakes. However, the minimum effort (hours) required by the medium seine to achieve these precision levels was greater than the combined effort required by the other 2 at 5 of the 6 lakes. Also, most biologists with experience seining small impoundments can determine population balance by analyzing the catch of bluegill fry and YOY

bass in the short seine. Consequently, many small impoundment balance checks do not require use of the long seine. Because the medium seine requires more effort than the short seine, no advantage would be gained by using the medium seine to conduct routine balance checks.

Use of the medium seine may be warranted in situations where bass are the target species. Many state agencies conduct annual bass spawn checks or assess stocking success of bass in small impoundments. The medium seine could provide a more effective method of sampling in ponds with low numbers of bass, provided the agency is willing to allocate more time toward sampling these type impoundments.

Swingle's method of pond analysis is a subjective method relying more on presence or absence of fish than specific numbers. However, the low seining precision reported in this study indicates many management programs are not adequately sampling small impoundments when using only seine collections. Management agencies should consider the low precision of seining when choosing a sampling program for small impoundments. These results suggest alternative sampling methods might be more appropriate.

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