COMPARISON OF ROTENONE AND ELECTROFISHING POPULATION ESTIMATES TO LAKE DRAINING

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Abstract: The results from cove rotenone sampling and electrofishing population estimates for largemouth bass (*Micropterus salmoides*) were compared with the total largemouth bass populations obtained through draining of Sherwood Lake, a 67 ha impoundment in southeastern West Virginia. Rotenone samples over-estimated all size groups of largemouth bass (fingerling, intermediate and harvestable) both in number and weight. Electrofishing (Schnabel population estimates) more closely represented the numbers and weight of largemouth bass recovered at the lake draining. Schnabel estimates were 10,096 (7,870-14,079) while total draining produced 9,224 bass. Electrofishing standing crop was estimated at 151 fish/ha and 8.3 kg/ha while draining totals were 138 fish/ha and 9.9 kg/ha.

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Fish population studies are conducted annually on most small impoundments in West Virginia to determine species composition, reproductive success, and age and growth. Methods of collecting these data include use of rotenone, gill nets, trap nets, seines, and electrofishing gear. Population studies presently employed generally do not indicate true standing crops but are considered to be consistent and indicative of changes or trends that may be occurring. There is a need to know which sampling method provides the most reliable data. Knowing the answer will facilitate small impoundment sampling programs. Therefore, a study was initiated to determine which collecting method was most practical to attain these goals.

Sherwood Lake is located in Greenbrier County, West Virginia, approximately 40.2 km northeast of White Sulphur Springs in the Monongahela National Forest. It was formed by impounding Meadow Creek, a tributary to Anthony's Creek, in 1958 under a cooperative agreement between the West Virginia Department of Natural Resources and the U.S. Forest Service. It was first opened to fishing in 1959. Surface area is 67 ha, maximum depth 7 m, shoreline length 5.4 km, and drainage area 1,627 ha. The water is relatively infertile and slightly acid.

The lake was drained in the fall of 1977 to repair the outlet structure. This provided West Virginia Department of Natural Resources with an opportunity to compare collecting methods with actual lake population data. Cove rotenone sampling and electrofishing were conducted prior to draining. This study compares the results of 2 sampling methods for the largemouth bass population with total counts obtained through draining and recovery of the fish population.

METHODS

Rotenone

Two coves were rotenoned on 7 September 1977 prior to draining. Coves were blocked with 19 mm bar mesh blocking nets and emulsified rotenone was applied. Cove I was 0.5 ha with an average depth of 1.5 m and Cove II was 0.8 ha with an average depth of 1.4 m. Rotenone was applied to the surface and pumped into the deep water of the coves at a rate of 1.3 ppm and 0.8 ppm, respectively. Live and dead fish were marked and released into each sample area prior to rotenone application. The number of marked fish recovered was used to estimate percentage recovery within the sample area. Marked live fish were used to adjust for fish escaping from the area, while marked dead fish estimated fish not recovered.

Fish were picked up for 3 days after rotenoning. Lengths, weights, and numbers were recorded.

Electrofishing

Largemouth bass were collected between 2000-4000, 7-15 September 1977 by traversing the shoreline with boat-mounted electrofishing gear. Fish were marked, measured to the nearest total length and weighed to the nearest gram. The marked fish were randomly released along the shoreline.

Zweiacker (1972) compared various types of electrofishing population estimates in an Oklahoma impoundment and concluded that Peterson and DeLury estimates were not as accurate as the Schnabel estimate due to smaller sample size and wide confidence limits. Therefore, a multiple type (Schnabel) census was conducted and 95% confidence limits calculated (Ricker 1975) on Sherwood Lake. Population estimates were made for each of three length groups: (1) less than 125 mm (young-of-the-year), (2) 125-200 mm, and (3) greater than 200 mm; estimates were also made for combined length groups.

Draining

Recovery structures consisting of 25.4 mm wire mesh were built and installed across the raceway below the outlet structure. Lake draining began 6 September with a drawdown of approximately 15 cm per day. Draining was concluded 13 October 1977 except for normal water flow in the stream channel. Fish were removed by seine and dip net from the enclosed area, sorted to species, counted, measured, and weighed. At this time no attempt was made to determine the population of bass remaining in the stream channel. However, electrofishing population estimates were conducted during April-May 1978, after the lake had refilled and prior to restocking. Draining total were adjusted to compensate for bass remaining in the lake.

RESULTS

Rotenone

A total of 39 live and 134 dead bass were stocked behind blocking nets prior to rotenoning. Forty-six percent of the "live" fish were recovered while 84% of the "dead" fish were recovered after rotenoning. Table 1 summarizes the recovery rate of marked fish by size group. Using these recovery rates the adjusted standing crop increased from 16.0 to 33.8 kg/ha.

Rotenone standing crop estimates for fingerling, intermediate, and harvestable size groups were 9.2, 5.5, and 19.1 kg/ha, respectively. The largest difference between rotenone and draining was within the fingerling size group. This could be attributed to the loss of the small bass through the wire screens, predation, or fish left in the stream channel after draining.

Electrofishing

A total of 1,073 bass were marked and 38 recaptured. Population estimates for fish less than 125 mm, 125-200 mm, and greater than 200 mm were 10,268, 641, and 1,638, respectively for a total of 12,547. A population estimate made by combining all size groups indicated 10,096 fish (C.I. 7,870-14,079).

Total bass standing crop was estimated at 151 fish/ha and 8.3 kg/ha.

Draining

Actual draining figures for Sherwood Lake are presented in Tables 2 and 3. These data were adjusted for fish remaining within the channel as revealed by April-May 1978 electrofishing. The adjusted total was 9,224 bass recovered of which 6,215 were 125 mm or less, 1,109 were 126-200 mm and 1,900 were greater than 200 mm. Total standing crop was 138 fish/ha and 9.9 kg/ha. Draining produced 1.1, 1.0, and 7.8 kg/ha, respectively (Table

Table 1. Summary of largemouth bass stocked prior to rotenoning.

Size group	*Number stocked*		*Number recovered*		*Percent recovered*	
	Live	Dead	Live	Dead	Live	Dead
Fingerling (0-125 mm)	4	87	2	71	50%	82%
Intermediate (126-200 mm)	18	35	8	31	44%	89%
Harvestable (> 200 mm)	17	12	8	10	47%	83%

Table 2. Comparison of largemouth bass population estimates by rotenone and electrofishing with lake draining at Sherwood Lake.

	Rotenone		*Electrofishing*		*Draining*	
Size group	*Actual*[a]	*Adjusted*[b]	*N*	(95% C.I.)	*Actual*[c]	*Adjusted*[d]
Fingerling (0-125 mm)	41,416	82,830	10,268	(6,960-19,572)	6,175	6,215
Intermediate (126-200 mm)	5,490	13,500	641	(396- 1,686)	1,082	1,109
Harvestable	3,135	6,670	1,638	(1,155- 2,813)	1,649	1,900
Combined	50,490	103,000	10,096	(7,870-14,079)	8,906	9,224

[a]Rotenone Actual - expanded from September 8-11, 1977 fish collected.
[b]Rotenone Adjusted - expanded from actual with corrections for escape from area and/or non-recovery.
[c]Draining Actual - October 11-13, 1977 fish collected
[d]Draining Adjusted - actual plus bass remaining in channel (April-May 1978) population estimate.

3). Draining totals for bass were within the 95% confidence limits of the electrofishing (Schnabel) estimate.

Population estimates were determined for bass remaining in the lake after refilling and prior to restocking. A total of 118 bass were marked and 16 recaptured, resulting in a population estimate of 318 (C.I. 213-622). Using data obtained from the April-May 1978 population estimates and adding to the draining totals, the adjusted standing crop was increased from 8.4 to 9.9 kg/ha.

Standing crop comparisons were made using the 3 methods described and rotenone estimates were consistently higher for all 3 size groups (Table 3). When comparisons were made between electrofishing (Schnabel) population estimates and actual draining by size groups, only the fingerling (0-125 mm) size group fell below the confidence limits, 6,215 actual and 10,268 estimated (C.I. 6,860-19,572) (Table 2). This was probably due to the loss of small bass through the large mesh screen during draining. Draining produced 1,109 bass in the intermediate size group (126-200 mm) while the estimated number was 641 (C.I. 396-1,686). The best estimate was from the harvestable size group (> 200 mm). Actual numbers were 1,900 while the estimate was 1,638 (C.I. 1,155-2,813).

Table 3. Comparisons of largemouth bass standing crop estimates by rotenone, electrofishing and draining at Sherwood Lake.

	Weights (kg/ha)				
	Rotenone		*Electrofishing*	*Draining*	
Size group	*Actual*	*Adjusted*	(*Schnable estimate*) *Actual* (95% C.I.)	*Actual*	*Adjusted*[a]
Fingerling (0-125 mm)	4.6	9.2	1.3 (1.0-2.6)	1.1	1.1
Intermediate (126-200 mm)	2.4	5.5	0.6 (0.4-1.6)	1.0	1.0
Harvestable (> 220 mm)	9.0	19.1	6.4 (4.5-10.9)	6.3	7.8
Total	16.0	33.8	8.3 (5.9-15.1)	8.4	9.9

[a]Adjusted weights for draining obtained from April-May 1978 population estimates.

DISCUSSION

There have been few studies conducted to evaluate the accuracy of fish population estimates with actual numbers of fish present. Generally, these show rotenone sampling over-estimates bass standing crops while electrofishing studies have only compared species composition.

Lewis (1971) compared cove rotenone samples with lake draining in 4 West Virginia impoundments and found in 2 of the 4 lakes that rotenone over-estimated total standing crop of bass by 40% and 536%, while in 2 lakes standing crop estimates were underestimated by 40% and 61%. In similar studies in 2 Indiana lakes, Barry (1967) found rotenone sampling over-estimated bass standing crops by 22-25% when compared to draining results and Sandow (1970) comparing bass population estimates in a Georgia lake with draining found cove rotenone samples over-estimated bass standing crop by 45%. Crandall et al. (1976) stated that rotenone sampling was effective in capturing most centrarchids but provided low estimates of relative abundance for largemouth bass.

Sherwood Lake cove rotenone samples were similar to the above studied in that they over-estimated largemouth bass total standing crop by almost 4-fold. Rotenone population and standing crop estimates misrepresented all size groups of bass (Tables 2 and 3).

Crandall et al. (1976) used marked fish within a treated rotenone area to estimate percentage recovery of fish and found high returns (67-86%). This suggests that rotenone standing crop estimates may be accurate in some cases. Percentage live marked bass returns in Sherwood Lake were 46% and suggests underestimates of standing crops and the need to adjust data. The high percentage of returns in Crandall's study may have been influenced by the species marked. According to Carter (1957) the inability to recover all fishes and the relative susceptibility of certain species to rotenone are factors which prevent accurate quantitative measurements.

Few studies have been conducted comparing electrofishing populations estimates with total lake drawdown. Barry (1967) compared species composition by electrofishing to lake draining. Electrofishing showed bass to be considerably more abundant than draining estimates. Electrofishing indicated bass comprised 32% of the total number and

46% of total weight while draining percentages were 1% and 16%, respectively. Bennett and Brown (1968) using similar procedures found electrofishing gave a reliable picture of species composition but over-estimated centrarchids (bass) importance.

At Sherwood Lake a total of 1,073 bass were marked and 22.4% recaptured for a population estimate of 10,096 (C.I. 7,870-14,079) bass. Estimates for the fingerling size group (0-125 mm) revealed 10,268 (C.I. 6,960-19,572) while draining produced 6,215 fingerling bass. Possible reasons for low numbers collected during draining in this size group were (1) predation during drawdown, (2) loss of small bass through screens during collecting and (3) an undertermined number of small bass left within the stream channel. The estimate for intermediate size group (126-200 mm) was 641 (C.I. 396-1,686) and draining totals were 1,109. The best estimate was from the harvestable size group (over 200 mm) 1,638 (C.I. 1,155-2,813). Draining resulted in 1,900 harvestable bass (Table 2).

Electrofishing standing crop estimates for fingerling, intermediate, and harvestable bass were 1.3 (C.I. 1.0-2.6), 0.6 (C.I. 0.4-1.6), and 6.4 (C.I. 4.5-10.9) kg/ha, respectively. Total weight estimates was 8.3 kg/ha (C.I. 5.9-15.1). Draining totals were 1.1, 1.0, and 7.8 kg/ha for each size group, respectively, and fell within the confidence limits of electrofishing estimates. Draining produced 9.9 kg/ha of bass. Rotenone standing crop totals were 9.2, 5.5, and 19.1 kg/ha for each size group, respectively, and total weight 33.8 kg/ha (Table 3). Rotenone overestimated total standing crop more than 3-fold.

In summary, electrofishing was the most reliable method of obtaining bass population and standing crop estimates.

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