RECOVERY OF MARKED FISH IN COVE ROTENONE SAMPLES

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ABSTRACT

The use of fin-clips and dart tags for determining recovery efficiency in summer cove rotenone samples was compared. Using a standardized cove sampling methodology, fin-clipped fish were recovered from 69 coves at an overall rate (%) of 52.4±4.7 (2 S. E.), while in 21 coves 73.6±3.0% of the dart-tagged fish were recovered. As the sample season progressed recovery efficiencies for fin-clipped fish showed a consistent improvement, however, neither seasonal nor year-to-year means was as high as dart-tagged estimates. End of season values with both marking methods showed a recovery efficiency of about 70 percent in the reservoirs surveyed.

Rotenone has been used for centuries by South American and Malaysian natives to stupefy fish so they can be caught more easily (Leonard 1939). The chemical has been employed extensively as a fish-sampling agent throughout the U.S., but the development and refinement of rotenone as a quantitative sampling tool have been primarily in the lower midwest and southern U.S. (Hall 1974). Rotenoning was (and may still be) the only sampling method used by all 14 state fisheries agencies in the Southern Division of the American Fisheries Society (Hall 1962).

One of the major limitations of rotenone sampling has been the incomplete recovery of fish in the cove. Some of the factors responsible for this are: failure to kill all the fish in the water body, predation on dead and dying small fish by predator species (Krumholz 1950), failure of dead fish to surface (Brown and Ball 1943), and the failure to retrieve many of the small fish. To estimate the completeness of recovery in rotenone samples, Henley (1967) rotenoned 11 coves, collected all fish each day for three days and, using divers equipped with SCUBA gear, systematically examined the cove bottom. This study showed that a three-day pickup produced an average of 74 percent of the number and 95 percent of the biomass of fish in the coves. For a two-day pickup of fish the numbers and biomass recovery values were 66.8 and 84.7 percent, respectively (Henley 1967). Several investigators have used the recovery of marked fish, released into the sample cove prior to rotenoning, as a means of determining completeness of recovery (Ball 1948, Krumholz 1950). These studies showed recovery percentages ranging between 23 and 91 percent. This high variability has caused some workers to question the validity of inferences made from cove rotenone data.

Beginning in 1961 TVA biologists released marked fish into coves prior to poisoning in order to estimate recovery. Prior to 1972 all fish were marked by clipping the upper corner of the caudal fin. This process has been continued in some coves, however, in 1972 dart tags (Floy ®) were used to mark fish in a group of coves. In this study, the two marking techniques were compared and the variability in recovery percentages examined.

MATERIALS AND METHODS

Cove rotenone samples were made during the summer months (June-September) by teams composed of one or two experienced fishery biologists and five or six summer aides who were usually inexperienced in cove rotenone methodology. At least two teams were used to take samples.

Field procedures for sampling and collection of data followed methods used throughout the southeast (Hall 1974). Coves were blocked with 1 cm mesh block nets and then treated with 5 percent emulsifiable rotenone to give a concentration of 1 ppm. Since few fish were found on the third day, a two-day pickup was used. A boat-mounted electroshocker was used in coves away from the sampling area to collect fish for marking. The usual goal was to collect 100 individuals of a variety of species. The fish were marked and released well inside the block net (Hall 1974). Most marked fish were more than 125 mm long. Because of high loss due to handling, shad (Dorsoma spp.) were not marked, [because of high losses due to handling].

RESULTS AND DISCUSSION

Between 1961 and 1974 Tennessee Valley Authority fishery biologists released marked fish into 91 coves prior to sampling; fin-clips were used for 69 samples, while dart-tags were used in the remaining 22 samples. The recovery rate of fin-clip samples was 52.4± 4.7% (±2 S.E.) (Table 1), whereas the 22 coves containing dart-tagged fish had a mean recovery of 71.6 ± 4.5% (Table 2). No pattern in recovery of fin-clipped fish through the years was observed, and the within year variance (S^2) was usually high (Table 1). The single exception was 1969 when percent recovery was high (67.5) and the variance low (40.2). During the 1969 series all personnel involved were fishery biologists experienced in recognition of fin-clipped fish and with cove rotenone procedures. In other years, there were usually only two experienced fisheries biologists present during sampling. The lowest percent recovery (66.3%) and the highest variance (230.2) of dart-tagged fish occurred in 1974. These values resulted from poor recovery for a single sample (35%), due to a large hole in the block net (≅ 1 by 2 meters). Deletion of this sample from the 1974 data set results in a percentage recovery similar to the other years (71.9% ± 5.6%, and variance = 47.5).

Examination of the individual samples revealed no relationship between percentage recovery and total number of fish in the sample. This suggests that marked fish were not "overlooked" in large samples.

These samples also showed neither a relationship between the number marked and percent recovered nor between percent recovered and water temperature. The apparent seasonal increase in percent recovery of fin-clipped fish (Figure 1) is associated with a high degree of variability in the early summer samples and probably reflects the ability of the crew to discern a fish with the top portion of the caudal fin removed. When experienced fishery biologists conducted the studies (e.g., 1969, Table 1), recovery rates are uniformly high and variance is low. The 1969 data also indicated that fin-clip recoveries can be as high as dart-tagged recovery percentages (Table 2). However, if fin-clips are used, experienced workers should inspect the fish for marks.

Table 1. Summary by year of percent recovery of fin-clipped fish in cove rotenone samples.

Year	*Number Samples*	*Water Temp. C* $\bar{X}$	*Water Temp. C* *±2SE*	*Water Temp. C* S^2	*Total Marked*	*Total Recovered*	*Percent Recovered* $\bar{X}$	*Percent Recovered* *±2SE*	*Percent Recovered* S^2
1974	13	27.6	± 3.4	8.8	775	380	49.5	±14.0	632.7
1972	16	26.0	± 0.9	2.9	607	338	52.6	± 8.3	276.9
1971	7	26.2	± 1.2	2.4	402	243	63.5	±12.4	269.2
1970	11	28.2	± 1.0	2.1	601	361	54.4	±11.2	344.6
1969	4	28.2	± 0.9	0.8	496	332	67.5	± 6.3	40.2
1963	9	27.3	± 1.0	2.2	797	304	36.0	±12.4	346.0
1962	7	26.5	± 0.2	0.2	492	264	53.0	±11.4	228.7
1961	2	26.2	± 4.3	9.2	193	116	62.9	±31.1	483.6
TOTAL	69	26.8	± 0.5	3.5	4,363	2,338	52.4	± 4.7	381.1

Table 2. Summary by year of percent recovery of dart tagged fish in cove rotenone samples.

Year	*Number Samples*	*Water Temp. C* $\bar{X}$	*Water Temp. C* *±2SE*	*Water Temp. C* S^2	*Total Marked*	*Total Recovered*	*Percent Recovered* $\bar{X}$	*Percent Recovered* *±2SE*	*Percent Recovered* S^2
1974	(7) 6[1]	25.6	± 3.1	16.3	515	350	(66.3) 71.9	(± 11.5) ± 5.6	(230.2) 47.5
1973	8	25.9	± 1.4	3.7	725	542	75.0	± 3.2	20.3
1972	7	27.4	± 1.5	2.2	594	442	73.2	± 6.7	79.3
TOTAL	(22) 21	26.1	± 1.3	7.8	1,834	1,334	(71.6) 73.7	(± 4.5) ± 3.0	(135.3) 48.5

1. Values with bad sample (gear failure) included are in parenthesis.

Because shad and fish less than 125 mm were not marked, the percentages recovered probably overestimate the recovery efficiency. Exclusion of the sample that had a hole in the block net, produces a mean recovery of dart-tagged fish of 73.4 percent. This value is slightly higher than Henley's (1967) estimate of the percent of the fish recovered (66.8%) in a two-day pickup, where most of the unrecovered fish were shad smaller than 75 mm in length. Neither of these groups were tagged in our cove samples which may explain the higher recovery. In early summer collections of many of young-of-the-year fish are smaller than 35 mm and would pass through the mesh (≅ 6mm) of the dip nets.

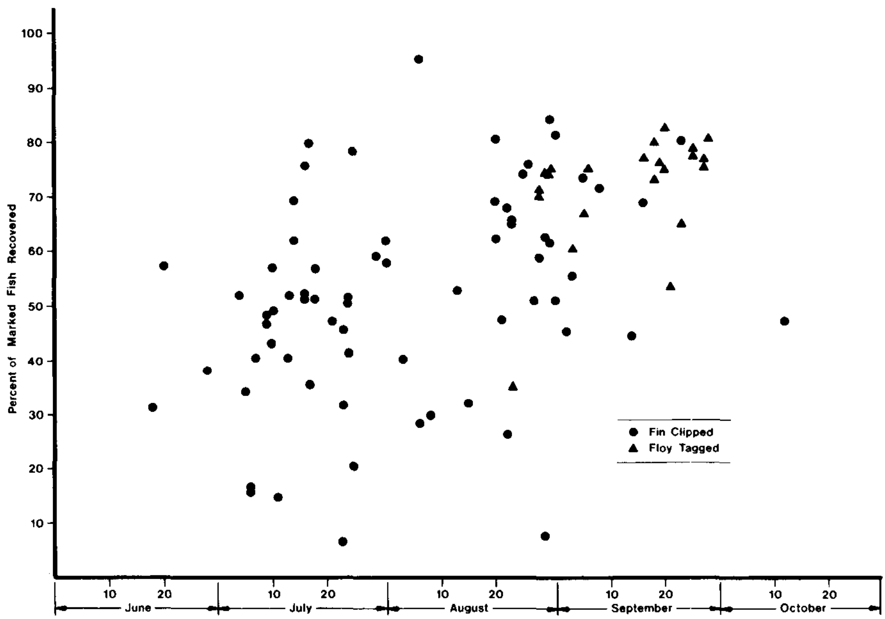

Figure 1. Plot of percent recovery of marked fish versus date of sample for fin-clipped and dart-tagged fish.

Unrecovered marked fish may have failed to surface, however, since Henley (1967) recovered near 95 percent of the biomass in coves and because shad and fish smaller than 125 mm total length were not used in this study, we suspect that some of the marked fish escaped from our coves. We would anticipate a higher recovery if fish residing in the cove were marked, particularly if they were marked after the block net was set.

SUMMARY

1. The mean recovery rate of fin-clipped fish in 69 cove rotenone samples was 52.4% while mean recovery of dart-tagged fish in 22 coves was 71.6%.
2. Recovery of fin-clipped fish appeared related to crew experience.
3. Consistent recovery percentages and low variability of dart-tagged samples make this the preferred marking method.
4. End of season recovery values with both marking methods showed about 70 percent recovery.

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CHANNEL CATFISH CULTURE: STATE OF THE ART 1976

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ABSTRACT

The perfection of culture techniques for the channel catfish (Ictalurus punctatus) *has been aided by the commercial demand for fingerlings, by the fact that the catfish is "precocial" by the time the yolk sac is absorbed, is not cannibalistic, and readily utilizes artificial feeds early in life. Several techniques have been developed for producing catfish fingerlings, but the method that appears most acceptable for the production of large numbers of fingerlings is by the pond spawning/trough incubation technique. The principal advantages of this method are that it makes possible a high survival of fingerlings and control of density in the rearing ponds. Where it is desired to mate selected individuals, the aquarium method or the pen method are particularly attractive. There is interest in tank rearing of fingerlings; however, due to the characteristics of the channel catfish, the authors question that this method will have any advantage over the pond method. Most parasitic diseases of catfish fingerlings are well understood, but their control has been adversely affected by legal restrictions on the use of chemotherapeutics. Currently there is need for further investigation, especially in genetics, economics of feeds, and techniques for maintaining desirable environmental conditions.*

A warmwater fish farming industry based on the channel catfish (*Ictalurus punctatus*) commenced to develop in the late 1950's. Inasmuch as the particular requirements of the industry, i.e., a warm climate and large quantities of ground water, are best met in the lower Mississippi River valley, this area is the center of the industry. In addition to being used for food, the channel catfish is produced in a much wider geographic area to support recreational fishing. For this purpose it is stocked in ponds and reservoirs, and in recent years farm-raised fish have become important for use in commercial "put-and-take" operations.

One of the weaknesses of the channel catfish as a species for use in commercial fish farming in the United States is the fact that it grows little, if at all, at temperatures below 21 C. Thus in much of this country the catfish grows for less than six months of the year. However, this does not detract from its importance for use in producing recreational fishing outside the area where it is grown as a food fish. Another undesirable trait of the channel catfish is its requirement for a high protein feed. A less serious negative trait of the species is its low fecundity. Despite these weaknesses, the channel catfish has emerged as the principal commercially produced warmwater food fish in the United States. In addition to its being a high quality food fish, the channel catfish is adapted to pond conditions, readily accepts prepared feeds, and control of its reproduction is feasible.

The development of culture techniques for the channel catfish has been favored by the commercial demand for fingerlings, and by certain attributes of the fish itself. Of particular interest is the fact that, unlike many other warmwater fishes, the egg of the channel catfish contains a large amount of yolk material. As soon as the yolk sac is absorbed, the young fish readily accepts artificial feed. Of particular importance in culture is the fact that the channel catfish is not significantly cannibalistic at any stage.

There is a great deal of variation in the facilities and procedures used in producing channel catfish fingerlings. We will describe facilities and outline procedures that appear to represent a reasonable state of the art. Other general discussions on fingerling production have been given by Crawford (1958), Martin (1967), and Giudice (1972). Another general discussion of the culture of the species is the Second Report to the Fish Farmers (Meyer et al. eds. 1973).

Ponds in which catfish are spawned, as well as those in which fingerlings are raised, should be 0.4 to 0.8 ha in size, with a minimum depth of 1 m and a maximum depth of 1.2 to 1.5 m. They should have a piped water supply and be designed to permit gravity draining.

A satisfactory hatching facility consists of troughs approximately 3 m long, 60 cm wide, and 25 cm deep, with several covered, wire baskets supported 2.5 cm above the bottom. The baskets are 25 cm wide, 41 cm long, and 5 cm deep. Extending the length of the trough is a shaft equipped with paddles that rotate between the baskets in which the eggs are