TRAWL NET TOTAL CATCH—*Continued*
(Thirty Hauls)—*Weight in Grams*

| *Species* | *May, 1953* | | *May, 1956* | |
|---|---|---|---|---|
| | *No.* | *Wt.* | *No.* | *Wt.* |
| Spotted Sunfish (Stump-knocker) | 13 | 338.92 | .. | ..... |
| Redbreast | 3 | 184.44 | .. | ..... |
| Warmouth | 6 | 529.07 | 1 | 13.3 |
| Blue-spotted Sunfish | 3 | 5.81 | .. | ..... |
| Channel Cat | 2 | 75.30 | 174 | 19,421.90 |
| White Catfish | 13 | 638.11 | 38 | 6,015.25 |
| Southern Brown Bullhead | 2 | 686.20 | 7 | 1,926.5 |
| Yellow Bullhead | 1 | 50.07 | .. | ..... |
| Gizzard Shad | .. | ..... | 1 | 179.30 |
| Threadfin Shad | .. | ..... | 46 | 310.95 |
| Golden Shiner | 12 | 197.26 | 14 | 444.60 |
| Rainwater Killifish | 24 | 9.10 | .. | ..... |
| Red Minnow | 2 | 1.09 | 4 | 9.00 |
| Red-finned Killifish | 2 | .52 | .. | ..... |
| Pugnose Minnow | 8 | 11.16 | .. | ..... |
| Caledonian (Bullhead Minnow) | 11 | 114.85 | 3 | 58.90 |
| Freshwater Glass-minnow | 19 | 10.07 | 17 | 10.20 |
| American Eel | 4 | 314.18 | 4 | 1,289.30 |
| Needlefish | .. | ..... | 3 | 471.60 |
| Croaker | 1 | 31.04 | 107 | 1,181.00 |
| Spot | .. | ..... | 27 | 402.00 |
| Anchovy | 1 | 4.86 | 381 | 999.78 |
| Ladyfish (Ten Pounder) | .. | ..... | 14 | 15.30 |
| Hogchoker | 15 | 100.30 | 52 | 380.27 |
| Glut Herring | .. | ..... | 232 | 127.70 |
| Pipefish | 2 | 1.57 | 5 | 7.20 |
| Largemouth Goby | 5 | 3.62 | 5 | 4.20 |
| Crawfish | .. | ..... | 9 | 39.40 |
| Freshwater Shrimp | .. | ..... | 110 | 40.50 |
| Blue Crab | .. | ..... | 7 | 1,564.00 |
| Grapsoid Crab | .. | ..... | 11 | 4.90 |
| TOTAL | 317 | 9,196.46 | 1,367 | 44,435.66 |


## ACKNOWLEDGMENT

Acknowledgment is due Mr. Roy E. Sams and Mr. Joseph S. Houston, who completed field and laboratory work on the 1953 trawl net program.

Also thanks are due the several Florida fishery technicians who aided in the field work in May, 1956.

Mr. Edward Crittenden, Project Leader of the Lake and Stream Survey is due credit for having worked up much of the data presented here.


# PRELIMINARY EXPERIMENTS ON THE USE OF SPAGHETTI TAGS


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So-called "spaghetti" tags of vinylite tubing were first developed and used by the California Department of Fish and Game for tagging tuna (Wilson, 1953). This type of tag appears to offer many advantages over tags presently in use and it was deemed worthwhile to give it a trial on fresh-water fish.

The tag is made from ten-inch sections of one-sixteenth inch diameter white vinylite tubing and pertinent information is written on both sides of the middle section of the tag with a special ink. The tubing designated as No. 20 white XTE-30, was obtained from C. D. LaMoree, 1325 San Julian Street, Los

Angeles, California, at a cost of ninety cents per hundred feet in amounts in excess of 1,000 feet. The ink used for writing on the tubing is Number 104N5A4 vinylite black obtained from California Ink Company, 2939 East Pico Boulevard, Los Angeles, California.

The needle for applying the tag is made of six-inch sections of hollow 0.120 inch outside diameter steel tubing. The inside diameter of the steel tubing is sufficiently large for the one-sixteenth inch vinylite tubing to be inserted. A steel wire having a slightly larger outside diameter than the inside diameter of the steel tubing is driven a short distance into one end of the hollow tubing, and is then ground to a fine point, making a hollow needle. The hollow steel tubing was obtained from J. M. Tull Metal and Supply Company, P. O. Box 4628, Atlanta 3, Georgia. The steel tubing was turned over to the Mechanical Engineering Department of North Carolina State College and they fabricated the needles.

## METHODS

Five-acre Indian Camp Lake on the Sandhills Wildlife Management Area has for several years been used for holding brood stock for the warm-water hatcheries in North Carolina. This lake is readily drained by removal of dam boards in a chimney on the dam. When completely drained only a small shallow stream remains and most of the fish are forced through the outlet structure in the dam and may be collected in a concrete basin on the downstream side of the dam.

Indian Camp Lake was drained during September, 1955 and approximately 800 bass from eight to ten inches in total length obtained. These fish were at the end of their second summers growth and were obviously emaciated and in very poor condition. Approximately eighty of these fish were held in an earthen raceway at the U. S. Fish and Wildlife Service Hatchery at Hoffman for a period of one week before tagging and restocking.

On September 21, 1955, a lot of fifty fish were taken at random from the raceway and used for the tagging experiment. These fish were tagged as follows: controls 10 fish, Number 1 strap tag applied to left opercle—10 fish, Number 3 strap tag applied to mandible—10 fish, spaghetti tags with ends tied together in overhand knot—10 fish, spaghetti tags with each end knotted and not tied together—10 fish.

The plastic tubing is inserted through the musculature of the back just under the posterior end of the dorsal fin. It does not appear necessary, or advisable, to insert the tags deeper than ⅛" below the dorsal surface.

In tagging tuna in California a figure eight knot is generally used to tie the ends of the tag together. The bass used in this experiment were considerably smaller than tuna taken for tagging and the less bulky, although not so neat, overhand knot was used. The plastic is stretched tight making as small and firm a knot as possible.

## RESULTS

When Indian Camp Lake was drained on September 11, 1956 a total of forty-two fish were recovered from the fifty originally stocked the previous year. Only sixteen of the original forty tagged fish were recovered.

TABLE I

RECOVERY OF TAGGED BASS AFTER TWELVE MONTH PERIOD IN INDIAN CAMP LAKE

| Total Stocked—50 | | Total Recovery—42 |
|---|---|---|
| | *Tagged* | *Recovery* |
| *Strap Tags:* | | |
| Opercle | 10 | 0 |
| Mandible | 10 | 7 |
| *Spaghetti:* | | |
| Ends Tied | 10 | 7 |
| Ends Knotted | 10 | 2 |
| *Controls* | 10 | Unknown (26 Untagged) |
| | 50 | 16 |

When the fish were stocked it was thought that it would be possible to distinguish the controls from fish which had lost tags by the observation of scars or markings on the latter. Of the 26 fish recovered without tags only two showed evidence of tagging scars. One had obviously lost a metal strap tag from the opercle and the other had shed a spaghetti tag.

No fish with metal strap tags in the opercle were recovered and only two of the fish with knotted end spaghetti tags were recovered. These two tags were very loose and the knot was easily pulled through the wound.

Seven of the ten bass tagged with No. 3 metal strap tags on the mandible were recovered. The tag on all of these fish was firmly in place and the tissues of the mandible was beginning to grow up and over the tag. It appeared that with continued growth the tag would become overgrown and not be visible to a fisherman. Although there was minor irritation in the thin tissue on underside of mandible the tagging site appeared to be in excellent condition.

Seven of the ten bass tied with spaghetti tags were recovered. Although there was some irritation and erosion of the tissue around the outside of the holes made by the tags, all were firmly in place and it required considerable force to pull them loose from the fish. The tissue inside the wound had grown fast to the plastic tubing on one of these fish.

All the bass recovered appeared to be healthy, vigorous fish and exhibited excellent growth over the one-year period they were in Indian Camp Lake. The growth increment of the seven recovered spaghetti tagged bass was significantly higher than for the seven jaw tagged bass recovered ($t = 2.26$, $t\ .05 = 2.18$). The average increment for the spaghetti tagged fish was 3.6 inches compared with 3.0 inches for the jaw tagged bass.

TABLE II

TWELVE MONTH GROWTH INCREMENT OF TAGGED BASS

| *Tag Number* | *Original Length (Inches)* | *Length at Recapture (Inches)* | *Increment* |
|---|---|---|---|
| *Tied Spaghetti Tags* | | | |
| 149 | 9.3 | 12.3 | 3.0 |
| 150 | 9.6 | 13.0 | 3.4 |
| 151 | 9.3 | 13.8 | 4.5 |
| 152 | 10.1 | 14.2 | 4.1 |
| 153 | 9.6 | 12.8 | 3.2 |
| 154 | 9.0 | 12.6 | 3.6 |
| 155 | 8.5 | 11.9 | 3.4 |
| Total | 65.4 | 90.6 | 25.2 |
| Mean | 9.34 | 12.94 | 3.60 |
| *Jaw Tags* | | | |
| 581 | 9.9 | 12.8 | 2.9 |
| 582 | 10.5 | 13.3 | 2.8 |
| 584 | 9.7 | 12.7 | 3.0 |
| 588 | 9.1 | 11.9 | 2.8 |
| 596 | 10.2 | 13.3 | 3.1 |
| 597 | 9.8 | 12.4 | 2.6 |
| 598 | 9.9 | 14.0 | 4.1 |
| Total | 69.1 | 90.4 | 21.3 |
| Mean | 9.87 | 12.91 | 3.04 |

## DISCUSSION

The strap tag on the opercle and the knotted spaghetti tags are obviously not usable.

The recovery of the bass with jaw tags and tied spaghetti tags, after one year in the lake, was very good considering the condition of the fish tagged, the amount of handling, and possible losses during draining of the lake. Includ-

ing tagging, each bass was handled four times and made two short trips in a hatchery truck before being restocked in Indian Camp Lake.

The tied spaghetti tag appears to offer a number of advantages compared with the jaw tags. The spaghetti tag is highly visible to the fisherman and will continue visible after almost unlimited growth of the bass, while it appears that the jaw tag may be overgrown and become unobservable after a couple of seasons growth.

The spaghetti tag apparently did not interfere with growth while evidence indicates that just the opposite may be true of the jaw tag.

In marking and recovery experiments the fish for tagging and the recoveries often come from fish taken in gill and trammel nets. The use of Peterson disk tags in work of this nature may make the fish more susceptible to recapture, while, because of its location on the body and its construction, the spaghetti tag would minimize this effect. In the course of largemouth bass netting and recovery experiments on an impounded power reservoir in North Carolina the spaghetti tag was used. All bass were taken with experimental gill nets and trammel nets. In two instances of tagged bass being recovered in gill nets there was no indication that the tags had any effect on the recapture.

When the use of spaghetti tags was first considered it was thought possible that the white tags trailing over the back of the fish would attract other bass and they would strike at the material. The water in Indian Camp Lake is comparatively clear and schools of tagged and untagged bass were observed swimming together on several occasions. Apparently no attention was paid to the tags on some of the individuals. There was no indication on the recovered spaghetti tagged fish that the tags had been attacked by other fish.

Tied tags of hollow, white vinylite tubing appear to have a minimum effect on survival and growth of largemouth bass, and have several advantages in use as demonstrated.

## LITERATURE CITED

Wilson, R. C. 1953. Tuna marking, a progress report. California Fish and Game, 39(4) :429-442.

# ALGAE CONTROL IN WARMWATER HATCHERY PONDS [1]

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## ABSTRACT

Control of *Hydrodictyon reticulatum* Lagerh. and *Pithophora oedogonia* Wittr. in warmwater hatchery ponds using copper sulfate, sodium arsenite and abietylamine acetate is discussed. Some of the disadvantages of these chemicals as algicides for hatchery use are presented. A method of controlling the above species of vegetation in hatchery ponds using abietylamine acetate is described and recommended for use where either copper sulfate or sodium arsenite has not given satisfactory results.

## INTRODUCTION

Increased use of organic and inorganic fertilizer in the culture of fingerling largemouth black bass and bluegills has rendered more acute the problem of controlling or eliminating undesirable forms of plant growth in recent years. Surber (1943) and O'Donnell (1943) describe objectional algal growths occurring in hatchery ponds. More recently Lawrence (1954) has described the increase in occurrence of the branched alga *Pithophora* sp. in farm ponds located in the southeast.

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