able delay of five hours. Prior to placing the samplers in the river at Stations 1 and 2, it was noted that numerous larval chironomids were floating on the water in the containers. It was likely that these samplers contained fewer test organisms than the samplers placed at the other stations earlier. However, the average number of chironomids on the samplers below five of the pollution outfalls was noticeably lower than the average number on the samplers at the uppermost stations. One sampler was lost at each of Stations 3, 7 and 11. Both samplers were lost at Station 5 during each of the test periods.

DISCUSSION

It appears that this inexpensive technique of bioassay can be useful in determining the effects of pollution on chironomids.

The results of the preliminary tests offer supporting evidence that waste materials emptied into the Black Warrior River by the complex of industries near Tuscaloosa, Alabama adversely affects fish food organisms in more than nine miles of the stream.

It is recommended that the following practices be followed to help reduce biased results when this bioassay method is attempted.

1. Locate a pond containing a dense population of chironomids, or other non-burrowing insect larvae, as close as possible to the area to be tested.
2. Insure that each sampler is submersed in the transporting container and if the container is sealed, allow sufficient air space in the container to provide adequate oxygen for the organisms.
3. Do not permit excessive jolting or excessive temperature changes while transporting samplers from pond to test area.
4. Avoid unnecessary delay while transporting samplers.
5. Use adequate number of samplers at each sampling station. Loss of some samplers appears inevitable.

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A TAG COMPARISON STUDY OF LARGEMOUTH BASS IN THEIR NATURAL ENVIRONMENT

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ABSTRACT

One thousand three hundred and forty-six largemouth bass were captured, tagged, and released in nineteen bodies of water throughout the State of Florida. Spaghetti, Petersen disc, and Monel metal strap tags were the principal tags employed. All fish caught by anglers were returned to the Game and Fresh Water Fish Commission for information regarding growth rates of which negative data was obtained. Comparisons were made of the percent returns of each of the three tags represented, plus the Spaghetti tag was compared in two different locations on the fish. The external effects on the recaptured fish showed

either slight or heavy infections caused by the initial tag wound or by irritations of mechanical, chemical or biological origin. This study was made in conjunction with the Florida State-wide Fish Tagging Program sponsored by the Schlitz Brewing Company.

INTRODUCTION

If some of the population dynamic studies are to be performed successfully in the future, highly efficient methods of marking great numbers of fish must be available. It must be of such that it does not interfere with the fish's normal habits or restrict his movements. At the present time much is left to be desired in this field.

This study was not set up to find a "cure-all" tag, but to compare three different tags in a natural environment and to establish which of the three is best suited in Florida waters.

For the past five years the Joseph Schlitz Brewing Company has sponsored the Florida State-wide Fish Tagging Program by offering large rewards for the return of fish by the angler. This in turn guarantees high returns of recaptured fish by the fisherman.

METHODS

The State was divided into four contest zones. Each zone officially opened during different months with the contest running for three consecutive months. The months were chosen to coincide with the major fishing seasons in each area of the State, and to permit the tagging crews to cover the entire State in a systematic manner. The contest dates were:

Zone I—February 1 to April 30, 1965
Zone II—April 1 to June 30, 1965
Zone III—May 1 to July 31, 1965
Zone IV—June 1 to August 31, 1965

Three types of tags were used: the Monel metal strap tag, the Petersen tag, and the Spaghetti tag. The Monel tags were placed in two locations in the mouth—on the maxillary and the pre-maxillary. The Petersen disc tags were placed in the hypural plate of the caudal, approximately three scales anterior to the origin of the caudal rays in the first scale row, above the lateral line (as described by Kirkland, 1962). The Spaghetti tags were placed in the pre-maxillary and in the flesh around the second soft-ray spine of the dorsal fin, one scale row below the dorsal outline of the fish.

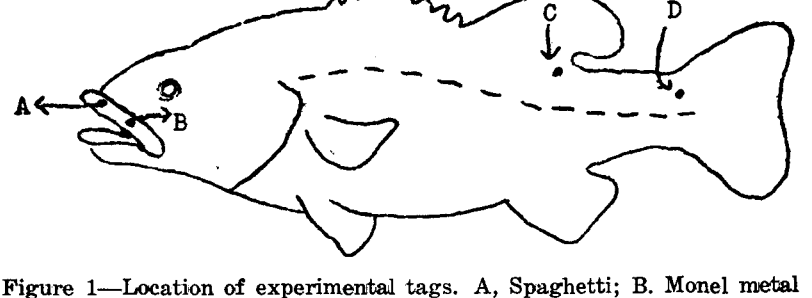

Figure 1—Location of experimental tags. A, Spaghetti; B. Monel metal strap tag; C, Spaghetti tag; D, Petersen disc tag.

All tags were identified by the word "Schlitz," a prefix letter, and a number which identified the individual fish. The prefix letter designated the zone in which the fish were released and the year they were tagged.

The fish were collected for tagging by the use of a boat-mounted electro-fishing gear, powered by a 230-Volt AC Generator.

The majority of the fish collected were tagged and released in the same lake, however, in some cases, because of the inefficiency of the electric shocker to work in certain bodies of water, some fish had to be

collected in one lake and transported to others. When this occurred, fish were collected in waters that were somewhat similar in environmental conditions and within a few miles distance of each other. This helped prevent mortality from drastic envionmental changes, and injury from excessively long distance transportation. Also, most of the transporting of fish was done at night which, in the past, we have found to be more successful.

The waters selected for the tagging study are comprised of lakes, rivers, and canals, in that order of occurrence. They were selected to show a cross-section of the major type of fishing waters that are represented in each zone throughout the State of Florida.

To obtain the most accurate data, all length measurements were taken in total length and to the nearest millimeter. Later this proved to be misleading because the caudal fin of the recaptured fish tends to dry out and break off due to freezing and extensive handling by the angler. Weights were of secondary importance and the fish were weighed to the nearest 1/20 of a pound. Most fish were collected for tagging during the early part of the spawning season, and were returned by anglers a short time later. This fact alone would make weight data show negative results in a short term program because of the loss of weight during the reproduction periods. The length and weight measurements were recorded for each fish within a short period of time after recapture.

Tagged fish, when caught by a fisherman, were taken to the local Schlitz Wholesaler where the fish was wrapped (in freezer paper) and stored in a freezer until periodic pick-ups could be made by employees of the Game and Fresh Water Fish Commission.

The fish were then weighed while still frozen to prevent any loss in weight when thawing. It was necessary to wait until the fish thawed out completely to obtain its length. To eliminate any chance of error, all weight and length measurements were taken by the author at the time of tagging and again after recapture.

Information was recorded as to the physical condition or degree of irritation of the area around the tag. One of four different values was placed upon the tag area of the fish:

Tag sore healed over
Tag sore unhealed—no noticeable infection
Tag sore unhealed—inflamed or slight infection
Tag sore unhealed—heavily infected.

TAG RETURNS

During the Tagging Program a total of 1,346 largemouth bass were tagged and released in nineteen different bodies of water.

Table I. Number of Largemouth Bass Tagged and Recaptured.

	Tagged	Returned	Percent Return
Monel	545	72	13.2%
Petersen	313	29	9.3%
Spaghetti	488	65	13.3%
Total	1,346	166	12.3%

Monel and Spaghetti tags exhibited almost identical percent returns, with 13.2% and 13.3% of the fish being returned by the anglers, while the Petersen disc tags provided only 9.3% return. The difference in percent return is unknown—it certainly is not a simple answer. Chadwick (1963), states that Disc dangler tag returns during the first four months after tagging indicated that bass are caught at a lower return rate immediately after tagging. This could also apply to Petersen disc tags since their structures are almost the same and are applied in generally the same manner. At this time it is not known if the over-all percent return at the end of one year for the Petersen tag will be the same as the Spaghetti and Monel tags. Also, the Petersen tags show a higher percent of heavy infection around the tag than do Monel or Spaghetti tags, which would result in higher mortality rates.

A grand total of 166 bass was returned for the three types of tags

exhibiting a 12.3% return. The three-month percent return for Monel and Spaghetti tags of 13.2% and 13.3% corresponds closely with past data (Wegener and Clugston, 1964), which a 13.5% return was shown on Monel tags.

There was no appreciative difference between the percent returns of the Spaghetti tags placed in two locations on the fish. Two hundred and seventy-six were tagged in the pre-maxillary and 212 were tagged in the dorsal location. They exhibited a 13.0% and 13.7% return, respectively.

SIZE FREQUENCY

The percentages for each size groups of largemouth bass tagged were fairly close for all three types of tags represented.

Table II. Length Frequency of Tagged and Returned Fish.

Length in mm.	No. Tagged	Percent Tagged	No. Returned	Percent Returned
- 200	7	0.5%	—	—
201 - 300	469	34.8%	45	27.1%
301 - 400	577	42.9%	88	53.0%
401 - 500	206	15.3%	23	13.8%
501 - 600	79	5.9%	10	6.0%
601 -	8	0.6%	—	—
TOTAL	1,346		166	

There was no significant difference between the size of the fish tagged and those returned. This was true for all three kinds of tags. By adding the percent tagged of the 201 to 300 mm. and the 301 to 400 mm. size groups, we find 77.7% of the bass represented. By doing the same for the returns of the two size groups we find 80.1% of the bass represented.

Only seven fish were tagged in the 200 mm. or less class, and eight fish were tagged in the 601 mm. and over class. They produced no returns, which is to be expected because of the small number tagged.

GROWTH RATES AND FREEZER SHRINKAGE

All growth rates in both length and weight showed a negative figure for the three-month period of the Tagging Program. Table III shows that negative growth data is directly proportional to the size groups of the fish. The larger the fish, the larger the loss in length and weight.

No comparable difference was sighted between the pre-maxillary

Table III. Mean Negative Growth Rate.

	Untagged Bass put in Freezer		Monel		Petersen		Spaghetti	
Length in mm.	Avg. Length	Avg. Weight	Avg. Length	Avg. Weight	Avg. Length	Avg. Weight	Avg. Length	Avg. Weight
201 to 300	—3.4	—.02	— 4.3	—.03	— 7.3	—.08	— 6.6	—.1
301 to 400	—4.2	—.04	— 8.8	—.1	— 8.9	—.3	— 8.1	—.17
401 to 500	—5.6	—.05	— 9.8	—.44	—19.0	—.35	— 8.4	—.47
501 to 600	—5.0	—.15	—12.8	—.55	—15.6	—.6	—12.0	—.47
MEAN TOTAL	—4.2	—.04	— 7.6	—.14	—11.0	—.3	— 7.9	—.2

and the dorsal tagging location of the Spaghetti tag with relation to growth rates for all size groups.

Using the expression "a rule of thumb" was needed to predict or compensate for at least part of the losses which occur in length and weight due to freezing. It was found in our studies that shrinkage does show a direct relationship to length groups. This is the reason for trying to establish "a rule of thumb." Sixty fish, ranging from 217 mm. and .25 pounds, to 600 mm. and 8.0 pounds, were collected by the electric shocker. With as little excess handling as possible, the fish were wrapped in freezer paper and frozen for two weeks, after which they were removed, weighed, and measured in the same manner as described in preceding paragraphs. The resulting data showed a "rule of thumb" could not be established. A definite loss in length and weight did occur during the freezing process, however, this does not account for all the losses which are shown in our study (Table III). Even in a short-term study the negative length and weight growth data should not be present. In an experiment by Kimsley (1956), fish were tagged for two years and grew only about one-third of their normal weight and length gain as compared to growth gain of untagged fish. It is very unlikely that fish shrink in length over a duration of time, especially while tagged, although the data does indicate that no growth took place in three months and possibly some negative growth in length occurred.

There is no doubt that freezer shrinkage does affect the fishes' length and weight, but this does not make up for all negative data. Also, the use of total length in measuring the fish may have some bearing on the over-all results because of the drying out of the caudal fin rays which in turn would tend to shrink. The fish were measured only a short time after thawing, before they dehydrated. One other factor remains of which we have no control — the extensive handling of the fish by the fishermen. Since large rewards are offered for returns of recaptured tagged fish, the angler is reluctant to place them on a stringer in the water for fear of losing the fish or the tag. Consequently, the fish is left out of the water to dry out and dehydrate. If this program is to continue in the future, fork length, standard length, or some other means of measurements will have to be used to try and arrive at a suitable method of obtaining growth data.

EXTERNAL PHYSICAL EFFECTS

Since the tags were removed by the Schlitz Wholesaler, we were unable to examine the fish while the tag was still attached. However, the fish were returned to the Florida Game and Fresh Water Fish Commission and visual observations were made of the tag area which revealed the external effects the tag had upon the fish.

Most all fish had various degrees of tag sores caused either by the initial tag wound or irritation of mechanical, chemical, or biological origin. The cause of these irritations is not completely known, but the obvious causes in many cases were mechanical rubbing of the tag against the fish, infection by micro-organisms, and possibly chemical reactions of the fishes' tissue to the tag.

Table IV. Comparisons of the Degree of Irritation Caused by Monel, Petersen, and Spaghetti Tags.

Degree of Irritation	Monel Percent	Petersen Percent	Spaghetti Percent
Healed Over	1.7	—	2.2
Unhealed (no infection)	14.0	11.1	23.9
Slight Infection	50.9	38.9	52.2
Heavy Infection	33.3	50.0	21.7

(Data taken from 120 fish)

The percentages of the healed over condition were quite small in the Monel and Spaghetti tags, and not present in the Petersen. Out of a total of one hundred and twenty returns, only two fish were com-

pletely healed and showed no ill effects of the presence of the tag. At least 50% of the Monel and Spaghetti tags had a slight infection and 50% of the Petersen tags had a heavy infection. It was not possible to measure the mortality rate in this study, but data indicates that undoubtedly higher morality occurred to the Petersen tagged fish. The total percent return of the Petersen tags was lower than the Monel and Spaghetti tags.

The pre-maxillary and dorsal locations used in the tagging process for Spaghetti tags exhibited various results of degree of irritation, although, as shown in Table V, the pre-maxillary far exceeds the dorsal location.

Table V. Comparison of the Degree of Irritation Caused by Spaghetti Tag in Two Locations.

Degree of Irritation	Pre-maxillary (Percent)	Dorsal (Percent)
Healed Over	4.5	—
Unhealed (no infection)	18.2	28.0
Slight Infection	63.6	44.0
Heavy Infection	13.6	28.0

For each type of tag and all size groups the average number of days released was approximately the same. Petersen tags had the shortest average release time of 47 days; Spaghetti had 54, and Monel had 53 average days released. The mean average days released for all three types of tags was 51 days. (See Table VI.)

There was a difference noted as to external physical conditions around the tag, and the number of days released, as follows:

Table VI. Average Number of Days Released

Degree of Irritation	Monel	Petersen	Spaghetti
Healed Over	*42	—	*44
Unhealed (no infection)	61	46	46
Slight Infection	52	49	57
Heavy Infection	52	48	72

* Only one fish returned

The Monel and Petersen tags are comparable to the number of days released and the physical condition or degree of irritation around the tag with exception to the Monel tags where unhealed (no infection) condition has an average of 61 days released.

Spaghetti tags show an upward trend of the average days released to the degree of irritation present. The healed over condition had an average release of 44 days, whereas the heavy infected condition had an average release of 72 days; a 28-day average elapse time between the healed over and heavy infected condition. This gives some indication that the longer the duration of time after tagging, the more drastic the degree of heavy infection in the tagged area. It will be interesting to see the results of an extended time duration and the degree of irritation and infection present, which is not possible at this time.

SUMMARY

An evaluation of the Monel, Petersen, and Spaghetti tags was made to see which one is the best suited for Florida waters. None of the three tags represented was the answer to the ideal tag, however, the Spaghetti tag gave the most favorable results.

The total percent returns for Monel and Spaghetti tags were 13.2% and the 13.3%, respectively, while the Petersen had only a 9.3% return.

The Spaghetti tags showed a lesser degree of irritation to the fish than did the Monel or Petersen tags. Petersen tags had a larger percentage of heavy infection in the area around the tag.

Negative growth data was obtained on all fish. A freezer shrinkage study showed a definite loss in length and weight, however, not enough to compensate for the negative data which occurred in the

tagging study. No "rule of thumb" could be established with relationship to length and weight losses as a result of freezing.

Spaghetti tags located in the pre-maxillary had only 13.6% heavy infection, where the dorsal had 28.0%. One must conclude that Spaghetti tags located in the pre-maxillary are the best suited for Florida waters.

This study will be extended over a longer period of time to verify the results obtained and to further evaluate these tags.

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COMMERCIAL FISHERIES RESEARCH AND DEVELOPMENT

Act of 1964 (PL 88-309)

By I. B. Byrd

Federal Aid Coordinator

United States Department of Interior

Bureau of Commercial Fisheries

St. Petersburg Beach, Florida

Presented Before

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With

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The primary purposes of the Commercial Fisheries Research and Development Act of 1964 are to allow Federal-State cooperation in carrying out projects designed for the research and development of commercial fisheries resources of the nation; and to supplement and increase the amounts of state funds appropriated for commercial fisheries.

State funds used for matching monies must be additional funds for research and development projects and not funds diverted from existing commercial fishery projects. However, regulations provide that it will not be necessary for a state to use new funds to match the federal