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# EFFECTS OF EFFLUENTS FROM TROUT HATCHERIES ON THE BENTHOS AND FISH IN RECEIVING STREAMS

*by*
*Kim W. Primmer*[1]
*and*
*James P. Clugston*
*U.S. Fish & Wildlife Service*
*Georgia Cooperative Fishery Unit, School of Forest Resources*
*University of Georgia, Athens, Georgia*

## ABSTRACT

This study evaluated the effects of discharges from three southeastern trout hatcheries on the benthic organisms and fish in the receiving streams. The U. S. Fish and Wildlife Service hatcheries were at Suches, Georgia; Walhalla, South Carolina; and Brevard, North Carolina. Although effects differed somewhat for each hatchery, the numbers and kinds of both benthos and fish generally increased immediately downstream from the hatchery outfalls. Pollution intolerant benthic organisms were not lost from the fauna below the hatchery outfalls. No detrimental changes in the fish communities were apparent.

## INTRODUCTION

Trout hatcheries sometimes produce water pollution. Liao (1970) cited examples of such pollution and named three kinds of pollutants that are discharged from fish hatcheries: (1) fish fecal material and unused fish food, (2) chemicals and drugs normally used for disease and parasite control, and (3) pathogenic bacteria and parasites. Since the first of these occurs continuously throughout most of the year, it is of most concern; the other two kinds may sometimes be serious, but occur only sporadically.

Mackenthun (1966) suggested that an accurate picture of the effects of pollution on the aquatic life of a stream can be obtained by comparing the kinds and numbers of aquatic animals found in unpolluted and polluted sections of a stream. Benthic macroinvertebrates are particularly useful because their habitat preference and low motility causes them to be affected directly by a pollutant (Wilhm 1967). We determined the effects of discharges from three southeastern trout hatcheries on the aquatic organisms in the receiving streams by comparing the kinds and numbers of benthic organisms and fish upstream and downstream from the hatcheries.

[1]Present address: Georgia Department of Natural Resources, Calhoun, Georgia.

## STUDY AREAS

The three streams sampled were Rock Creek at the Chattahoochee Forest National Fish Hatchery, Suches, Georgia; East Fork Chattooga River at the Walhalla National Fish Hatchery, Walhalla, South Carolina; and Davidson River, Pisgah Forest National Fish Hatchery, Brevard, North Carolina. The size of the streams and their basic water quality at the time of fish collections are summarized in Table 1. During fiscal year 1972 the pounds of trout produced and pounds of food used, respectively, at the three hatcheries were as follows: Chattahoochee, 120,079 and 188,984; Walhalla, 136,276 and 184,289; and Pisgah Forest, 255,029 and 247,791 (Stearns, personal communication)[1]. In 1971 it was reported that none of these hatcheries were contributing biodegradable materials in quantities sufficient to violate state standards for dissolved oxygen, but they were contributing significant amounts of enriching nutrients to the effluent stream (Tebo, personal communication)[2].

Table 1. Physical and chemical characteristics of stream waters near three southeastern U.S. Fish and Wildlife Service trout hatcheries.

| | Chattahoochee Forest | | | | Walhalla | | | | Pisgah Forest | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | | Downstream | | Upstream | | Downstream | | Upstream | | Downstream | |
| | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 |
| Characteristics | 8-27 | 3-14 | 8-27 | 3-14 | 9-13 | 3-18 | 9-13 | 3-18 | 9-21 | 3-17 | 9-21 | 3-17 |
| Water temperature (°C.) | 18 | 9 | 19 | 10 | 14 | 6 | 12 | 6 | 16 | 7 | 16 | 7 |
| pH | 7.1 | 7.0 | 6.6 | 6.6 | 6.9 | 6.7 | 6.7 | 6.7 | 6.8 | 6.6 | 6.5 | 6.5 |
| Dissolved oxygen (ppm) | 8.0 | 10.2 | 8.4 | 9.6 | 8.8 | 10.6 | 7.8 | 9.8 | 8.6 | 10.2 | 7.0 | 9.2 |
| Total alkalinity (ppm) | 15 | 10 | 20 | 10 | 20 | 15 | 15 | 15 | 10 | 10 | 15 | 15 |
| Hardness (ppm) | 2.5 | 10 | 2.5 | 5 | 0.7 | 5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 |
| Turbidity (JTU's) | 0 | 0 | 0 | 2 | 5 | 1 | 3 | 1 | 1 | 2 | 1 | 3 |
| Conductivity (umhos at 25 C) | 12 | 12 | 15 | 22 | 12 | 12 | 14 | 14 | 15 | 15 | 20 | 19 |
| Total dissolved solids | 15.6 | 15.5 | 18.0 | 22.5 | 15.7 | 15.5 | 17.1 | 17.0 | 18.0 | 18.0 | 21.4 | 21.5 |
| Flow (C.F.S.) | 10.9 | 12.0 | 16.7 | 18.4 | 15.3 | 17.9 | 17.1 | 20.1 | 18.1 | 26.4 | 26.2 | 38.2 |
| Average width (m) | 5.7 | | 7.5 | | 4.2 | | 9.6 | | 10.8 | | 12.0 | |
| Average depth (m) | 0.5 | | 0.5 | | 1.0 | | 2.5 | | 0.5 | | 0.5 | |

## METHODS

### *Benthos*

Collections were made at three stations in each of the three streams. Distances of the stations from the effluent outfalls varied slightly between streams because of the terrain and accessibility. In general, benthos collections were made 0.25 to 0.5 mile upstream from the hatchery (Station 1), 500 to 700 feet downstream from the outfall (Station 2) and 2 to 4 miles downstream from the outfall (Station 3). Substrates at the three stations within each stream were similar. Those at Walhalla and Pisgah Forest hatcheries were primarily rubble and gravel and those at Chattahoochee Forest hatchery were mainly sand, silt, and detritus.

Table 2. Number of benthic taxa at different stations in the receiving streams of three southeastern trout hatcheries. Station 1 was upstream from the hatchery, Station 2 was just below the effluent outfall, and Station 3 was 2 to 4 miles downstream from the hatchery.

| | Station 1 | | Station 2 | | Station 3 | | Total |
|---|---|---|---|---|---|---|---|
| Hatchery | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | taxa |
| Chatahoochee Forest | 13 | 13 | 12 | 18 | 15 | 14 | 34 |
| Walhalla | 17 | 17 | 25 | 22 | 13 | 23 | 41 |
| Pisgah Forest | 28 | 23 | 34 | 29 | 25 | 21 | 42 |

Six samples were taken along a transect across the stream at each station. A 1 foot x 1 foot Surber sampler was used for all stations near the Walhalla and Pisgah Forest hatcheries and a 6 inch x 6 inch Ekman dredge at all stations of the Chattahoochee hatchery (because of the difference in bottom substrate). A number 30 mesh sieve was used to separate the macroinvertebrates from the smaller organisms. Organisms usually were identified to the taxonomic level necessary to separate them from all other taxa — usually only to order or family but occasionally to genus and species.

We used a computer program (Cairns and Dickson 1971) to calculate benthos mean diversity (d) and redundancy (r), based on the following formulas:

$$d = - \quad (ni/N)\log2(ni/N)$$

$$dmax = (1/N)\,[\log2N! - S\log2(N/S)!]$$

$$dmin = (1/N)\,|\log2N! - \log2[N - (S - 1)]!|$$

$$r = \frac{dmax - d}{dmax - dmin}$$

where N is the number of individuals in S species and Ni is the number of individuals in the i th species. Diversity indices are based on the observation that undisturbed environments support communities having many species with no particular species in great abundance. Redundancy is an expression of the dominance of one or more species (Wilhm and Dorris 1968).

Weber (1973) classified many benthos organisms into three categories according to their ability to withstand stress in the environment: tolerant (usually associated with high organic contamination), facultative (with a wide range of tolerance), and intolerant (not associated with even moderate reductions in dissolved oxygen). Within the limits of our identifications, we attempted to place each organism in one of the three categories and apply the indicator-organism concept.

### *Fish*

Since fish sometimes congregate immediately below a hatchery outfall to feed on waste food, we limited fish population studies to two sites in each stream somewhat removed from the outfall — 0.25 to 0.5 mile upstream and 0.25 to 1.5 miles downstream. The downstream sites were between benthos Stations 2 and 3. All sampling was with a 600 volt alternating-current electrofishing device; 300 feet of stream were sampled at each site. Each fish sample was summarized in terms of number of fish collected per hour of electrofishing.

Fish and benthos samples were collected at the described sites in September 1971 and March 1972. Basic water quality data were obtained with a Hach Chemical Kit[3] at benthos Stations 1 and 2.

## RESULTS

*Benthos*

A total of 51 kinds of macroinvertebrates were collected from the three hatchery streams — 34 at Chattahoochee Forest, 41 at Walhalla, and 42 at Pisgah Forest (Table 2). The total taxa collected was higher at Station 2 than at Stations 1 or 3 in two of the streams, but decreased from Station 2 to Station 3 at the Chattahoochee Forest in the fall of 1971. Differences in numbers of taxa between stations within streams resulted from the collection of a few organisms representing additional families at the stations with higher numbers (Table 3).

The total number of organisms collected increased 40-fold from Station 1 to Station 2 in both fall and spring at Chattahoochee Forest and 280-fold in fall and 77-fold in spring at Walhalla Hatchery (Table 3). The number also increased at Pisgah Forest, but the difference was only sixfold in the fall and twofold in spring. The number of organisms at Station 3 of each stream in both seasons was similar to that at Station 1 in each stream.

Oligochaeta were the most numerous animals collected but were abundant only at the stations immediately below the outfalls at Chattahoochee Forest and Walhalla (Table 3) Chironomidae were the most abundant organism at the other stations except for Elmidae in 1971 at Pisgah Forest Station 1. Chironomidae also were more numerous at the outfall stations than at the others. There was no obvious trend for a specific taxon to be more abundant in one season than in the other. The only obvious instance of a reduction in numbers from the upstream station to the station at the outfall involved the Heleidae in the Chattahoochee Forest stream. Although the changes in numbers within specific taxa from station to station often appeared to be very large, the high variance among the six samples at most sites precluded the detection of significant differences.

[2]C. J. Stearns, U. S. Fish and Wildlife Service, Atlanta, Georgia.
[3]L. B. Tebo, U. S. Environmental Protection Agency, Athens, Georgia.

[4]Reference to trade names does not imply Government endorsement of commercial products.

Table 3. Number of benthic organisms of different taxa collected from the receiving streams of three U.S. Fish and Wildlife Service trout hatcheries, September 1971 and March 1972. Station 1 was upstream from the hatchery, Station 2 was just below the effluent outfall, and Station 3 was 2 to 4 miles downstream from the hatchery. Six samples were taken along a transect across the streams at each Station with a Surber sampler (Walhalla and Pisgah Forest) or an Ekman dredge (Chattahoochee Forest). (A single asterisk indicates a difference from the next station upstream on the same date significant at the 95% level; two asterisks indicate significance at the 99% level.)

| | CHATTAHOOCHEE FOREST | | | | | | WALHALLA | | | | | | PISGAH FOREST | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Taxa | Station 1 | | Station 2 | | Station 3 | | Station 1 | | Station 2 | | Station 3 | | Station 1 | | Station 2 | | Station 3 | |
| | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 |
| Turbellaria | | 4 | | 20 | | | | | 34 | 3 | | | 4 | | 8 | 2 | 4 | |
| Nematomorpha | | | | 4 | 4 | | | | | | | 2 | | | 3 | | | |
| Nematoda | 16 | 8 | | 28 | 4 | | | | 9 | 1 | | 2 | | 2 | 1 | 1 | | 1 |
| Oligochaeta | 92 | 60 | 44786 | 30868 | 156** | 292 | 16 | 35 | 36006 | 11611* | 9 | 104* | 3 | 18 | 116** | 127 | 26** | 15 |
| Isopoda | | | | | | | | | 27 | | | | | | | | | |
| Decapoda | | | | | | | 1 | | | | | | | | | | | |
| Hydracarina | | | 4 | | | | 1 | | | 1 | | | | | | 1 | | |
| Collembola | | 4 | 4 | | | | | | | | | | | | | | | |
| Megaloptera | | | | | | | | | | | | | | | | | | |
| Corydalidae | | | | | | | 1 | | | | | | 1 | | | | 1 | |
| Plecoptera | | | | | | | | | | | | | | | | | | |
| Peltoperlidae | 8 | | | | | | | | | | | | | 2 | 5 | | | |
| Nemouridae | | | | | | | 1 | | | | | | | | | | | |
| Perilidae | | 4 | | | | | | 2 | | | | 7 | 1 | | 3 | | | 2 |
| Perlodidae | 12 | | | | | 20 | | | 1 | | | | 9 | 4 | 3 | 3 | 1 | 2 |
| Chloroperlidae | | | | | | 4 | | | | | | 3 | | 4 | | | | |
| Ephemeroptera | | | | | | | | | | | | | | | | | | |
| Ephemeridae | 8 | 4 | 8 | 20 | | | 24 | 1 | 46 | 15 | | 5 | 2 | 4 | 2 | 3 | 12 | 3 |
| Baetiscidae | | | | | | | | | 1 | | | | | | 1 | | | |
| Baetidae | | 4 | | 48 | | 36 | 1 | 21 | 1 | 121* | 10 | 18* | 10 | 20 | 15 | 33 | 6 | 14 |
| Heptageniidae | | | | | | 4 | 5 | 12 | | 2 | 1 | 13 | 17 | 20 | 2 | 6 | 37 | 22 |
| Odonata | | | | | | | | | | | | | | | | | | |
| Calopterygidae | 8 | | | | 4 | | | | | | | | | | | | | |
| Gomphidae | | | | 8 | | | 3 | | 2 | 6 | | 1 | 1 | | | 1 | | |
| Cordulegasteridae | 4 | | 8 | | | | 3 | | 10 | 9 | | | | | | | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hemiptera | | | | | | | | | | | | | | | | | | |
| Corixidae | | | | | 4 | | | | | | | | | | | | | |
| Coleoptera | | | | | | | | | | | | | | | | | | |
| Hydrophilidae | | | | | | | | | | | | | 1 | | | 1 | | |
| Psephenidae | | | | | | | | | | | | 1 | 2 | | 1 | 2 | 1 | |
| Elmidae | | | | | 16 | 12 | | 1 | 3 | | 11 | 3 | 108 | 22 | 105 | 48 | 22 | 17 |
| Diptera | | | | | | | | | | | | | | | | | | |
| Blepharoceratidae | | | | | | | | | | | | | | | | 1 | | 1 |
| Simuliidae | | | | 4 | | | | | 3 | 1 | | | 6 | | 41 | 2 | 2 | 4 |
| Chironomidae | 848 | 136 | 1976 | 1288 | 576 | 600 | 76 | 58 | 5305* | 1364 | 103* | 472 | 99 | 340 | 1395 | 586 | 163 | 494 |
| Tipulidae | | | 4 | 4 | 12 | 12 | 1 | 6 | 7 | 69 | 2 | 18 | 2 | 12 | 10 | 116 | 11 | 52 |
| Psychodidae | | | | | | | | | 1 | | | | | | | | | |
| Heleidae | 104 | 364 | 12 | 28 | | 152 | | 9 | 8 | 11 | | 25 | | 12 | 7 | 5 | 6 | 2 |
| Stratiomyiidae | 4 | | | 8 | 8 | | | | | | | | 1 | | | | 1 | |
| Rhagionidae | | | | | 4 | | | 2 | | 1 | 1 | | 3 | 1 | 6 | 2 | 1 | 2 |
| Tabanidae | | 8 | 4 | 4 | 4 | | | | 15 | 2 | | | | | 2 | | | |
| Anthomyiidae | | | | | | | | | | 1 | | | | | | | | |
| Empididae | | | | 4 | | | | 2 | 1 | 9 | | 9 | 9 | 2 | 18 | 26 | | 12 |
| Trichoptera | | | | | | | | | | | 1 | 2 | 4 | 2 | 10 | 2 | 3 | |
| Rhyacophilidae | | | | | | | 5 | 8 | | 1 | 7 | 17 | 17 | 17 | 9 | 22 | 1 | 11 |
| Hydroptilidae | | | | | | | | | | | | | 1 | | | 2 | | |
| Hydropsychidae | | | | 16 | | | 1 | 2 | 7 | 1 | 13 | 3 | 52 | 9 | 601 | 176 | 34 | 56 |
| Psychomyiidae | 40 | 48 | 36 | 8 | 12 | 32 | 1 | 3 | 30 | 9 | 4 | 6 | 6 | 1 | 7 | 3 | 2 | 4 |
| Molannidae | | | | | | | | | | | | | | | | | 8 | |
| Brachycentridae | | | | | | 4 | | | | | 22 | 1 | 37 | 30 | 2 | 8 | 15 | |
| Leptoceridae | | 12 | | | | 8 | | 3 | | | | 2 | 1 | 28 | 8 | 1 | 2 | 3 |
| Limnephilidae | | | | | 20 | 4 | 2 | 4 | | | | 4 | 28 | 21 | 34 | 7 | 145 | 12 |
| Pulmonata | | | | | | | | | | | | | | | 1 | | | |
| Ancylidae | | | | 4 | | | | | 23 | | | | 7 | 4 | 31 | 10 | 8 | 8 |
| Pelecypoda | 32 | 152 | 352* | 116 | 8 | 16 | 8 | 5 | 1092* | 196 | 3 | 143 | 1 | 43 | 13 | 5 | 5 | |
| Total number | 1176 | 808 | 47194* | 32480 | 832 | 1196 | 150 | 174 | 42632 | 13440 | 187 | 861 | 433 | 618 | 2461 | 1202 | 516 | 737 |

The diversity indices show trends similar to those described for kinds of organisms and total numbers (Table 4). Mean diversity increased for Station 3 in all streams except for the spring samples at Pisgah National Forest. The benthic organisms were least affected by the hatchery effluent in this receiving stream than in the others.

Table 4. Mean diversity (d) and redundancy (r) for bottom fauna at different stations in the receiving streams of three southeastern trout hatcheries. Station 1 was upstream from the hatchery, Station 2 was just below the effluent outfall, and Station 3 was 2 to 4 miles downstream from the hatchery.

| Hatchery and date | Station 1 | | Station 2 | | Station 3 | |
|---|---|---|---|---|---|---|
| | d | r | d | r | d | r |
| Chattahoochee Forest | | | | | | |
| Fall, 1971 | 1.62 | 0.58 | 0.34 | 0.91 | 1.60 | 0.61 |
| Spring, 1972 | 2.34 | 0.39 | 0.35 | 0.92 | 2.14 | 0.45 |
| Walhalla | | | | | | |
| Fall, 1971 | 2.50 | 0.48 | 0.78 | 0.83 | 2.36 | 0.39 |
| Spring, 1972 | 3.07 | 0.26 | 0.77 | 0.83 | 2.31 | 0.51 |
| Pisgah Forest | | | | | | |
| Fall, 1971 | 3.40 | 0.32 | 2.09 | 0.60 | 3.07 | 0.37 |
| Spring, 1972 | 2.74 | 0.43 | 2.59 | 0.49 | 2.05 | 0.55 |

Most of the benthic organisms were in the pollution tolerant and facultative categories and were not useful as indicator organisms. The taxa collected that could be classified as intolerant and potentially useful as indicators of pollution, on the basis of the classification published be Weber (1973), were Hydracarina, Perlodidae (*Isoperla* sp.), Rhyacophilidae, Hydroptilidae, Psychomiidae (*Psychomyia* sp.), and Brachycentridae. These were few in number and appeared to be distributed randomly among the stations of the three hatcheries. There appeared to be no loss of pollution intolerant organisms below the outfalls.

*Fish*

Fourteen species of fish were collected from the three hatchery streams — 6 in the Chattahoochee Forest stream, 4 at Walhalla, and 11 at Pisgah Forest (Table 5). In all cases except one there was an increase in number of species from the upstream to the downstream station. Each spring sample at Chattahoochee Forest provided three species. Two species were collected upstream but not downstream from a hatchery; long-nose dace (*Rhinichthys cataractae*) at Pisgah Forest and banded sculpin (*Cottus* carolina) at Chattahoochee Forest. The number of fish collected per hour of electrofishing was larger at the downstream than at upstream station in all three streams.

Table 5. Species and number of fish collected by electrofishing, and number collected per hour in 300 foot sections of the receiving streams of three southeastern trout hatcheries, September 1971 and March 1972.

| | Chattahoochee Forest | | | | Walhalla | | | | Pisgah Forest | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | | Downstream | | Upstream | | Downstream | | Upstream | | Downstream | |
| Species | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 | 1971 | 1972 |
| *Ichthyomyzon hubbsi* | | | | | | | | | | | | 1 |
| *Salmo gairdneri* | | 2 | | 3 | | 1 | | 1 | 55 | 13 | 10 | 6 |
| *Salmo trutta* | | | | | 23 | 16 | 39 | 44 | | 2 | | 2 |
| *Salvelinus fontinalis* | | | | | | | 2 | | | | 1 | 1 |
| *Campostoma anomalum* | | | | | | | | | | | 5 | 4 |
| *Notropis coccogenis* | | | 1 | | | | | | | | | |
| *Rhinichthys atratulus* | | | | | | | | | 21 | 9 | 53 | 40 |
| *Rhinichthys cataractae* | | | | | 3 | | 50 | 13 | | 1 | | |
| *Semotilus atromaculatus* | 7 | 10 | 21 | 88 | | | | | | | | |
| *Hypentelium nigricans* | | | 7 | 13 | | | | | 1 | | 11 | 5 |
| *Moxostoma erythrurum* | | | 3 | | | | | | | | | |
| *Etheostoma swannanoa* | | | | | | | | | | | 4 | 2 |
| *Etheostoma flabellare* | | | | | | | | | 5 | 2 | 7 | 4 |
| *Cottus carolinae* | | 2 | | | | | | | 113 | 62 | 124 | 53 |
| Total fish | 7 | 14 | 32 | 104 | 26 | 17 | 91 | 58 | 195 | 89 | 215 | 118 |
| No species | 1 | 3 | 4 | 3 | 2 | 2 | 3 | 3 | 5 | 6 | 7 | 10 |
| No. fish/hour | 5.6 | 14.0 | 25.6 | 83.2 | 17.3 | 17.0 | 109.6 | 46.4 | 101.6 | 76.1 | 172.0 | 118.0 |

## DISCUSSION

Our study has shown that the effluents from three southeastern trout hatcheries altered the aquatic communities in the receiving streams. Although the amount of alteration differed in the different streams, in general there was an increase in variety of both benthos and fish downstream from the hatchery outfalls. A loss of intolerant species below the outfall did not seem to occur. The abundance of benthos and fish also increased downstream from the hatcheries. The increase in abundance without a reduction in taxa suggests moderate enrichment but not at levels sufficient to decrease dissolved oxygen to stress levels or to appreciably alter substrate characteristics.

Wilhm and Dorris (1968) found mean diversity (d) to be less than 1 for heavily polluted areas, 1 to 3 in areas of moderate pollution, and greater than 3 in clean water. On the basis of these criteria, it appears that the streams above the hatcheries were "moderately polluted" and that the streams below Chattahoochee Forest and Walhalla were "heavily polluted." Although total taxa and numbers of organisms in selected taxa increased below the outfalls, the change in diversity in this study probably can be attributed to changes in distribution of individuals among the taxa, and not to a reduction in number of taxa. The numbers of benthic organisms and the diversity indices at the most downstream sections returned to levels similar to those found upstream from the hatcheries. This probably results from the utilization of the nutrients and their dilution as they are carried downstream.

Studies on the effects of fish hatchery discharges on natural systems have been limited. Szluha (1974) found mean production rates of periphyton to be seven times greater in 1971 and five times greater in 1972 below the Jordan River (Michigan) National Fish Hatchery than at a control station above the discharge. However, his data suggested that oxygen concentration was not affected significantly by the hatchery effluent.

Lindsay (1971) and Hinshaw (1973) both examined the effect of fish hatchery effluents on the benthos in receiving streams in a manner similar to that in the present study. Neither reported on the fish communities. Lindsay who sampled six hatchery streams in six north-central states, including the Jordan River, Michigan, found no restriction on benthos diversity (number of species) in the six streams. He did not discuss numbers of organisms or changes in standing crop downstream from the outfalls. However, tabular data in his appendix show, assuming his collecting effort was the same at each station, a reduction in total organisms downstream from some hatcheries and an increase immediately below the outfalls for other hatcheries.

Hinshaw (1973), who reported on the physical and chemical characteristics and bottom fauna in six Utah hatchery streams, found differences in all streams, depending on the quality of the water before hatchery use, and the amount and kinds of feed used in each hatchery. Coliform counts increased significantly after water use at four of the hatcheries, and the biological oxygen demand increased significantly at five of the hatcheries. On the basis of his benthos data, Hinshaw believed that the hatchery effluent benefited (enriched) two of the streams but degraded the other four. Although he felt that enrichment may be desirable from a fishery point of view, he suggested that it may be undesirable from public health and water quality standpoints.

The effect a hatchery can have on the stream receiving its effluent thus varies considerably, and ranges from beneficial to detrimental. It appears the southeastern hatchery streams in this study were beneficially enriched. Because of the variability of results and the potential problems outlined by Liao (1970), we believe that streams receiving a hatchery effluent should be biologically examined periodically to determine if degradation is taking place.

[1]C. J. Stearns, U. S. Fish and Wildlife Service, Atlanta, Georgia.
[2]L. B. Tebo, U. S. Environmental Protection Agency, Athens, Georgia.

[3]Reference to trade names does not imply Government endorsement of commercial products.

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# WATERS CREEK — A TROPHY TROUT STREAM

*by*

*Russell H. England*
*Georgia Department of Natural Resources*
*Game and Fish Division*
*Clarkesville, Georgia*
*and*
*Joseph R. Fatora*
*Georgia Department of Natural Resources*
*Game and Fish Division*
*Gainesville, Georgia*

## ABSTRACT

A 4.3 km section of Waters Creek in Lumpkin County, Georgia, was managed for trophy trout with supplemental feeding under restrictive regulations, including 22 inch minimum size. Complete creel data for 3 years reveal a mean daily pressure of 31.9 anglers, and an annual mean catch rate of 0.18-0.24 fish/hr. Total anglers decreased 13.5% and total hours increased 18.0% 1972-1973. Trip length increased from 3.1 to 4.7 hr 1972-1974. An analysis of variance of catch rate means provided evidence of differences in catch rates with total daily effort. The mean catch rate of 0.51 fish/hr at 26-50 hr daily effort was significantly higher than catch rates at higher pressure. The cumulative frequency distribution of trophy catch rates was influenced by initial stockings. The mean standing crop (44.7 kg/ha) between feeding points and high density of sub-legal fish at feeding points indicate that natural recruitment may sustain the fishery. The program cost is comparable to cost of management of a put-and-take stream under equal pressure.

## INTRODUCTION

Trout fishing in Georgia is limited to the mountainous area of a few northern counties. Although many streams in this area provide excellent fishing for stream-reared trout, and many others are heavily stocked, the average angler has had little opportunity to catch a trophy-size trout. With this in mind, members of the Chattahoochee Chapter of Trout Unlimited appraoched state fisheries biologists with the idea of designating a stream for the production of trophy trout.

[1]A contribution of Dingell-Johnson Federal Aid to Fish Restoration Project F-25-2.