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REPORT

STATEWIDE FISHERIES INVESTIGATIONS

F-21-1, STUDIES I through IV
July 1, 1968 through June 30, 1969

STATE GAME AND FISH COMMISSION

270 Washington Street, S. W.
Atlanta, Georgia 30334

F-21-1

STUDY I

POND MANAGEMENT INVESTIGATIONS

STUDY II

RESERVOIR LIMNOLOGICAL INVESTIGATIONS

STUDY III

SMALLMOUTH BASS STREAM INVESTIGATIONS

STUCY IV

TROUT STREAM INVESTIGATIONS

Annual Progress Report

Statewide Fisheries Investigations

F-21-2

January 1 - December 31, 1969

Study No. I

Pond Management Investigations

Job No. I

AQUATIC WEED CONTROL

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oject No.: F-21-2

b No.: 1, Aquatic Weed Control

riod Covered: January 1, 1969 - December 31, 1969

mmary: 2,4-D Amine applied gravity flow successfully eliminated Parrots ather at the rate of two gallons per acre. Aquion was partially successful controlling needlerush applied gravity flow at the rate of two gallons : acre; however, without proper fertilization, the needlerush growth was parent before the fall of the year. Pithophora sp. was partially con- olled with Karmex using the gravity flow method at the rate of 1½ pounds acre in five situations. Kuron controlled Potamogeton sp. applied by spray method at the rate of one gallon to 40 gallons water on a marginal atment. Cattails were completely controlled using one pound to five lons of water sprayed directly on the cattails. Karmex failed to have effect on Microcystis sp. using the gravity flow method at the rate of pound per 10 acres of water. Microcystis sp. was controlled using 2/3 nd per acre of copper sulfate.

ective: The objective is to find chemical, biological and ecological hods of weed control in aquatic environments.

kground: Undesirable aquatic vegetation is detrimental to fish production. ients used in fish production are taken up by aquatic weeds and reduces production. This makes it necessary to control various undesirable tic weeds that reduces fish production. This problem has received ntion in Georgia for about 15 years with approximately 100 herbicides

ng tested on about 50 different aquatic weeds. About 75% of these chemi-
ls were rejected for various reasons.

2,4-D Amine has been used in Georgia for control of Myriophyllum
siliense since 1956. The spray method was used and proved to be suc-
sful. The gravity flow method was developed and has been used since 1960
y successfully. Winter treatments are now being evaluated using the
vity flow method.

Aquion has only been used during this report period in Georgia on
llerush. Karmex has been used since 1964 for control of Pithophora sp.
ults have been erratic and inconclusive.

Karmex has been tested and used for control of duckweed since 1964 in
gia. Control has been good. Methods of application and concentration
now being tested.

Kuron has been used for control of Potamogeton sp. using the spray
od for marginal treatment only one time as far as can be determined.
arginal treatments prove successful, large ponds could be treated with
le expense.

Microcystis sp. was treated once with Karmex at the rate of 0.1 pounds
surface acre and was completely unsuccessful. It would be desirable to
Karmex for algae control rather than copper sulfate. Copper sulfate
varying results depending upon the lime content of the water.

edures: Procedures and methods used were primarily the gravity flow
od. The gravity flow method consists of allowing the herbicide to drain
the pond from the container as the boat is propelled through the water,
g the herbicide in a container in the boat and throwing the chemical in
water from the bank. The spray method was used also. The spray method

nsists of using a power-driven piston pump that will apply the chemical rayed directly on the weeds as the boat moves through or by the weed bed. e droplet sizes were adjusted through the nozzle of the spray hose to get even distribution. The use of the varying amounts of lime to change e water chemistry is being explored to determine if it is possible to ntrol various weeds by manipulating the water chemistry.

ocedures: In the Klepenski pond, 2,4-Dichlorophenoxyacetic acid was own in from the bank. The pond was about 50% iced over and about 50% ested with Parrot-feather, Myriophyllum brasilienese. The kill was plete and no regrowth was apparent during 1969. This indicates that lier in the year, weed treatment may be desirable.

Silvex, 2-(2,4,5-Trichlorophenoxy) propionic acid, was sprayed on amogeton sp. at Murphy's pond in early June. This was a marginal treat- t and no kill was apparent for about two months. There was about 10% ginal infestation in a 12 acre pond. No kill was apparent for about e months and suddenly the weed disappeared.

Karmex, Diuron (3-(3,4-dichlorophenyl)-1, 1-dimethy lunea, helps control ophora sp. but it will kill the plankton, and oxygen depletion will cause sh kill. Care has to be exercised when using this method.

Observations continue to be made on the various species of weeds under ous ecological conditions. The objective of this is to alter the habitat control weeds without the use of herbicides. It has been noted that lerush, Eleocharis acicularis, will grow only in acid soils. Water ese soils need lime plus fertilizer to produce a plankton growth in ond. After the addition of lime, the needlerush will usually disappear. er, when lime is added, fertilizer is also added. It is a point of

eculation whether the change in the water chemistry killed the needlerush a result of the addition of lime or the results of plankton growth. In , event, the end results are the same.

Microcystis sp. has either become a problem or has been present for ıy years and not recognized. Water analysis is being carried out to help ermine some of the factors involved in high densities of the Microcystis sp. m preliminary investigations, it is obvious that Microcystis sp. blooms e a definite effect on the condition of a pond.

Three ponds with heavy Microcystis sp. blooms were observed, and oxygen perature records kept during the months of October and November. One d was treated with one pound per acre of copper sulfate, another with pound per acre copper sulfate, and the third left untreated. In the d treated with one pound per acre, the Microcystis sp. died slowly causing appreciable oxygen depletion. In the untreated pond, the Microcystis sp. d suddenly, apparently due to cold weather. There was a serious oxygen letion, from an average of 10 ppm to 2.0 ppm. A 1/2 pound per acre per sulfate treatment was found to be insufficient for controlling the rocystis sp. bloom. When the remainder of the Microcystis sp. bloom l in this pond, an oxygen depletion occurred; however, it was less serious ı in the untreated pond.

It was also observed that a few fish died in each of these ponds during y concentrations of Microcystis sp. This has been reported elsewhere.

Heavy blooms of Microcystis sp. cause extreme supersaturation of the r layers of water with oxygen. Also, where Microcystis sp. is well- blished, it appears to be almost a pure culture. Several samples examined in which no other species of algae and no zooplankton were

nd. It has been reported that some varieties of Microcystis sp. are ic. It appears that pure cultures of this can be detrimental to other toplankton and zooplankton. It also appears that fish are also adversly ected by this algae. If Microcystis sp. does kill fish food organisms midge larvae have definately been observed dead around the shoreline ponds infested, this algae may be very harmful. Further work will be done rding this.

mmendations: Early in the year, treatment should be investigated oughly. For example, if Parrot-feather, which starts growth in the er part of November, can be effectively controlled during the winter, advantages will be that fertilization can start on schedule and there will be a danger of an oxygen depletion.

Continued treatment of needlerush using Aquion should be carried out.

ex should be tried at lower concentrations using the gravity flow method spray method to determine if duckweed can be controlled with concentrations enough not to kill the phytoplankton.

Kuron should be used for marginal treatment using the spray and gravity methods on as many species as possible to determine its effectiveness.

Karmex and copper sulfate should be used to control Microcystis sp. as many simplified techniques and varying concentrations as possible. erbicides should also be used in mixtures and separately as possible to methods to control filamentous algae.

Application	Pond Owner	Predominant Vegetation	Method of Application	Chemical	Amount	Percent Kill	Percent Regrowth
January	Stephen Klepenski	1. Parrots feather	Gravity flow	2,4-D Amine	2 gals.	100	
March	Malatchee Farms	2. Needlerush	Gravity flow	Aquion	2 gals./A	90	100
April	Walt Cannon	Pithophora sp.	Gravity flow	Karmex	1½ lb/A	90	100
May	Fred Kelly	3. Duckweed	Gravity flow	Karmex	1½ bl/A	100	
May	Mr. Levie	Duckweed	Gravity flow	Karmex	1½ lb/A	100	
May	W. S. Robinson	Duckweed	Gravity flow	Karmex	1½ lb/A	100	
June	R. D. Jones	Duckweed	Gravity flow	Karmex	1½ lb/A	100	
June	Fred Murphy	Potamogeton sp.	Spray	Kuron	1 gal/40 gal. water	100	
July	A. J. Morris	Duckweed	Gravity flow	Karmex	1 lb/A	100	
August	Clarance Holcomb	Duckweed	Gravity flow	Karmex	2 lbs.	100	
		Filamentous algae				100	
September	A. M. Anderson	Pithophora sp.	Gravity flow	Karmex	1/2 lb/A		
repeat			Gravity flow	Karmex	1 lb/A	50	
October	Freeman Hart	Microcystis sp.	Gravity flow	Karmex	1 lb/10A.	0	
October	Freeman Hart	Microcystis sp.	Gravity flow	$CuSO_4$	2/3 lb/A	100	
October	Mac Jordan	Microcystis sp.	Gravity flow	$CuSO_4$	1 lb/A	100	
November	Mrs. J. Allen Payne	Duckweed	Gravity flow	Karmex	1.5 lb/A	100	

1. Parrots feather, *Myriophyllum brasiliense*
2. Needlerush, *Eleocharis acicularis*
3. Duckweed, *Lemna* sp.

Annual Progress Report

Statewide Fisheries Investigations

F-21-2

January 1 - December 31, 1969

Study No. I

Pond Management Investigations

Job No. 2

PARTIAL POISONING SMALL IMPOUNDMENTS

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Job Progress Report

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ect No.: F-21-2

No.: 2, Partial Poisoning Small Impoundments

od Covered: January 1, 1969 - December 31, 1969

ary: Rotenone has effectively manipulated bass and bluegill populations. tstanding undesirable effect is rotenone kills all sizes of fish and the t is to kill the smaller and intermediate size bluegill to bring a pond balance. Under certain situations, rotenone was used to acheive tem- y balance. Fintrol is now being tried to partially replace rotenone.

Fintrol (Antimycin) was used to control and manipulate fish population g 1969. Concentrations varied depanding upon the desired results. concentrations killed smaller bass and bream first and as the concen- on was increased, larger fish were killed. The method of approach rectly dependent upon the pH. During 1968 Fred Watson's pond had a nine early in the morning and Fintrol wasn't effective. The Bluebird ad a pH of seven all day and the approximate same concentration gave ly different results. The desirable situation is for the pH to be about in the morning and raise during the day to nine. The Fintrol should lied early in the morning and as the pH rises, it will neutralize the l and stop the kill. Results have been very good when properly applied, ally in controlling sunfish in catfish ponds. Concentration appeared to ate sunfish without effecting the catfish. Rechecks in the past indicate introl can be used more effectively than rotenone under a wider variety litions. The intent is to compare Fintrol with rotenone.

ground: The dynamics of fish populations in Georgia farm ponds have been tigated for several years to determine methods of management best suited e state. Evaluations were made through seining, rotenone samples, complete kills and measuring the fish, catch records, and response to fishing ure. This work was done in a portion of the approximately 60,000 farm in Georgia, averaging 3.5 acres each, but varying from one to 40 acres. significantly smaller than one acre are not considered manageable s of water for the bass-bluegill combination. Approximately one-half e freshwater fishing in Georgia is done in farm fish ponds, according sults from the Demographic Survey Division (1961). This makes it ative that sound management be carried out in this type fishery.

One of the major problems encountered in Georgia ponds in an unbalanced population caused by an over abundance of intermediate size bluegills. nced populations are those unable to produce succeeding annual crops of table fish (Swingle, 1945, 1950, 1956). Hooper and Crance (1959) ed an average catch of 193.4 pounds per acre in a balanced pond, com- to an average catch of 132.7 pounds per acre in unbalanced ponds. s a decrease of over 30% catch by weight the years the ponds were nced due to the crowding of intermediate bluegills. These ponds re- prompt attention.

ad the unbalanced condition been allowed to remain, a further decrease ning success probably would have occurred.

onds discussed in this report, unless otherwise indicated that channel l were present, were stocked with hatchery raised bluegills (*Lepomis mac-us*), shellcrackers, (*Lepomis microlophus*) and largemouth bass

ropterus salmoides) as recommended by Swingle (1949, 1951, 1952). were fertilized at the rate recommended by Swingle and Smith (1947) pt for the addition of lime which is often required in Georgia, er and Montgomery (1957) and Thomaston and Zeller (1961). The bluegill shellcrackers are referred to collectively as bream in this report. This -bream combination has proven to be entirely successful in Georgia when management in carried out.

Swingle (1952) listed some common causes on pond failures, such as not ing the existing fish population before stocking hatchery fish, adding other than hatchery fish, high mortality of hatchery fish after they are ed, and removal of the largemouth bass before spawning. The migration sh into ponds both before and after adding fish from the hatchery, and Hester, 1956) and ponds incorrectly stocked because of errors in ting the acreage on the fish application caused failures. Hall (1958) ted incorrect stocking in Kentucky due to errors in reporting acreage e fish application. Due to prestocking checks conducted in Alabama, (1961) reported 80% of 114 ponds were successful. This is in contrast % of 80 ponds being successful that were not checked prior to stocking and Hester, 1956). Overstocking or understocking of bass and/or bream cause pond failures (Swingle, 1951). Failure or unbalance is generally ble to an error in management in Georgia. A primary cause of a d bream population is an excess removal of adult or catchable size hen the pond is initially opened for fishing. Although an excessive l is possible in an old established population, apparently it is more occur in a new pond.

In many situations the best procedure to correct an unbalanced fish ation would be the elimination of the entire population and restocking. is undesirable, if the pond can be made to produce satisfactory fishing her means, since it would be out of production for approximately eighteen s. Swingle, Prather and Lawrence (1953) reduced the intermediate ill population by marginal, sectional and spot poisoning, with rotenone, ailed to do so by seining because of the time involved. Hooper and e (1960) corrected over-crowded bream populations by partial poisoning labama stateowned lakes, ranging from 32 to 80 acres. Seining has not uccessful in Georgia with the pond at its normal water level. Success ossible when the water level was lowered sufficiently to congregate the o that a significant catch was possible. Removal by baskets was un- sful although no emphasis was placed on this phase of management because inary results were discouraging.

n overcrowded intermediate bluegill population can be restored to balance, n adequate poundage of these are removed and sufficient bass are present added. The reduction of a crowded bream population will result in a ary improvement in fishing even though balance is not accomplished. undage of intermediate bream that should be removed will vary for each tion. A certain poundage removal is not a factor to be sought. The ing fish is the important factor. The sooner corrective action is taken tore balance, the easier it is accomplised. The length of time required establish a balanced population has varied from one to three years, gh success is not assured at any time. Supplemental restocking of bass t beneficial unless there was a reduction of the intermediate bream. ue of this is still doubtful because, unless the population is adjusted

the existing bass will spawn, the introduced bass fry will usually
ar (Thomaston, 1962).

ve: The objective is to evaluate the existing management recommendations ise new techniques for restoring balance to small impoundments, primarily nds.

es: The gravity flow method was used primarily. The gravity flow onsists of pouring the rotenone in the water near the edge as the boat ong near the shoreline. The rotenone was usually applied about 20 m the shoreline and at the rate of one gallon per 600 yards of shore- the shallow water, not over four feet deep.

trol was applied by the gravity flow method. The Fintrol was mixed in allon can and poured into the water as the boat was propelled over the ttempts were made to get a fairly even distribution.

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kson: Fintrol was used beginning with .1 ppb with no satisfactory until the concentration was raised to 1.5 ppb. However, at this time, bluegills were killed and the pond was left with a crowded bass situation.

ggins: The results in this pond were apparently unsatisfactory with an ent kill of bluegills.

p: The first concentration was .17 ppb, and the results were poor. when the concentration was increased to .34 ppb, the kill was good. cided to remove more bluegills and .36 ppb was applied with poor The reason in unknown.

Watson: The pond was treated with Fintrol at .24 ppb to .65 ppb with no at all. Investigations revealed that the pH was .9 or above at all , and Fintrol will not work in this pH range. The pond was drained and ied the results.

Cheek: This pond was considered extremely satisfactory after treatment, ishing considered excellent during 1969.

Truenell: This pond (1.6 acres) was stocked with channel catfish and infested with bluegills. The intent was to remove the bluegill without ng any channel catfish. It appeared that this was done satisfactorily ppb of Fintrol.

Truenell's seven acre pond was treated under the same conditions except of Fintrol was used. Many scale fish were killed, but the results are ered unsatisfactory.

rd: This pond was treated with .6 ppb to reduce the intermediate blue- opulation. The results were an apparent over-kill. This is attributed onstant pH of seven all day and night. From work done on this project e literature, apparently Fintrol should be applied in lesser quantities his under these conditions. Fintrol will break down when the pH rises. it appeared that the kill in this pond was more than needed, potassium genate was applied and stopped the kill.

ld Trice: This pond was crowded with intermediate bluegills with cat- The intent was to remove a large portion of the intermediate bluegills otenone and remove the catfish with trotlines and baskets. The removal bluegills by rotenone appeared to be adequate after four applications the gravity flow method and a partial shoreline treatment. The removal fish will be in progress for several months and will be elevated later.

mendations: Invesitgations should be continued concentrating on various iques using rotenone. Insufficient data is available on Fintrol to come / conclusions. However, this work should be continued to determine its in fish management.

POND OWNER	SIZE	A/F	TIME	TEMP	pH	Th	PPB	FINTROL USED	DATE	APPARENT RESULTS	1969 RECHECK
Walt Jackson	1.75	7	7:00	84°		25	.1	100 grams	6/12/68	poor	
Walt Jackson	1.75	7	7:00				0.6	50 cc	7/30/68	good	
Aster Riggins	4.9	19	7:00				.25	500 grams	8/9/68	good	
L. H. Harp	11.0	56	3:00				.17	1000 grams	8/27/68	poor	
L. H. Harp	11.0	56	9:00	69/72°			.34	2000 grams	9/30/68	good	
L. H. Harp	11.0	56	9:00	69°	7.1		.36	750 cc	10/8/68	poor	
Fred Watson	6.0	20	10:30	75°	9.0		.24	600 grams	9/18/68	poor	
Fred Watson	6.0	20	10:00	76°	9.0		.36	900 grams	9/23/68	poor	
Fred Watson	6.0	20	11:00	76°	9.0		.4	125 cc	10/1/68	poor	
Fred Watson	6.0	20	9:45	74°	9.0		.6	175 cc	10/7/68	poor	
Fred Watson	6.0	20	7:10	72°	9.3		.65	200 cc	10/15/68	poor	
Hugh Cheek	1.3	3.6	7:30	70°	6.3	20	.51	23 cc	1/17/68	good	
Walt Jackson	1.75	7	7:30	40°	7.1	28	1.0	90 cc	1/16/69	poor	
Walt Jackson	1.75	7	7:15	54°	7.1	28	1.5	135 cc	1/31/69	good	
J. W. Trusnell	1.6		7:00		6.9		4.0	480 cc	9/3/69	good	
J. W. Truenell	7.0		8:00		6.9		4.0	1372 cc	9/19/69	fair	
Bluebird	6.0		11:00		7.0		.6	211 cc	10/1/69	fair	

The terms poor, fair and good are used now as indications of immediate results only.

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Annual Progress Report

Statewide Fisheries Investigations

F-21-2

January 1 - December 31, 1969

Study No. I

Pond Management Investigations

Job No. 3

FERTILIZATION METHODS AND TECHNIQUES

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Job Progress Report

Georgia

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t No.: F-21-2

.: 3, Fertilization Methods and Techniques

Covered: January 1, 1969 - December 31, 1969

: The efficiency of fertilization programs are definitely improved ng lime treatment in ponds with soft water. The amounts of fertilization d for optimum plankton production have also been significantly reduced treated ponds. Statewide investigations of fertilization problems initely established lime treatment as a necessary supplement to pond zation programs in Georgia.

with a total water hardness below 15 ppm, and calcium oxide content of soil below 1000 pounds per acre, should be limed for maximum fertili- results and phytoplankton production. Agricultural lime applied at e of one ton per acre will increase total water hardness approximately and calcium oxide of bottom soils approximately 1000 pounds per acre. from lime applied at rates listed above will last 2-4 years. Hydrogen not a reliable measure of the need for lime unless extremes of acidity ountered. Nutrient measurements of phosphorus and potassium do not significant changes following lime treatment. Such changes are believed ; however, measurement techniques are believed inaccurate for pond oils. This is also true for hydrogen ion measurements in pond bottom Hydrated or slaked lime is effective for correction of low total hard- pond waters although frequent applications are necessary. This form is completely soluable and apparently supplies a direct source of ed calcium in the water for phytoplankton growth. Apparently as much as

ounds per acre of agricultural lime applied in the pond is necessary there are any significant results and 2000 pounds per acre has corrected ions. Methods of applications and types of lime vary depending upon ituation.

ound: Swingle and Smith (1947) demonstrated that phytoplankton production ited by the availability of nitrogen, phosphorus and potassium. However, and Montgomery (1957), found that calcium is a limiting factor of tivity in soft waters.

fertilizer is applied in the absence of calcium ions, nitrogen, phos- and potassium become bound by the colloidial complex and therefore, are d unavailable. Calcium ions furnished to the aquatic habitat by tural lime have a greater affinity for the colloidal material than do ments N, P, and K. Therefore, these elements are replaced on the complex presence of calcium ions and are made available.

ston and Zeller (1961) concluded that phytoplankton production is ed by the addition of lime. Bowling (1963) conducted an investigation rmine if this increase in phytoplankton production brought about a ent increase in benthic production.

orgia a satisfactory phytoplankton growth cannot be produced in some nds with the amount of fertilizer recommended by Swingle and Smith The normal pond fertilizer requirement is 6-12 applications per year 2 or its equivalent. This varies with the section of the state, soil water quality, construction of the pond and other related factors. ponds, four to six applications of fertilizer at one bag per acre, a good phytoplankton growth. In others, amounts up to one ton per

uld not produce a significant amount of plankton. Upon investigation immediately determined that ponds with reduced phytoplankton growth ightly acid and low in total hardness. This condition was corrected addition of various types of lime.

nytoplankton production and its correlation with water hardness and oxide concentrations in bottom soils, the relationship between ankton density and fish production is generally acknowledged by fishery

verage total hardness increase in ponds, using agricultural lime at the one ton per acre, was 15 ppm. Results lasted from two to four years. ion alone is not a satisfactory measure of the need for lime. rdness of the water was found to be the best and most reliable for lime needs.

timum fertilization results, the total hardness range should be 20 ppm . From 10-20 ppm results were varied, and belwo 10 ppm fertilization were unsatisfactory.

e: The objective was to find simplified and effective techniques for limestone to farm ponds and to determine reasons why after fertilization m ponds do not develop plankton growth.

es: The procedures for applying limestone to ponds varies with each n. It would be desirable to spread the lime evenly over the entire his is virtually impossible when using agricultural lime because of it and amount involved. When the lime trucks can be driven all the d the pond, the lime is blown in with a special type blower. Quite here is only one or two places that a truck can get near the water nder these conditions, the lime is either blown in at the access

loaded in a boat and spread over the lakes.

use of this problem of applying the lime, an alternate method is being he lime is spread on the watershed where it will wash into the lake. scovered that when crop or pasture land on the watershed frequent ons of lime, the water was usually high enough in lime content. ated lime is usually applied by broadcasting it over the surface of from a boat. Since only about 50 pounds per acre is recommended, been satisfactory.

and Discussions: Where lime is applied directly in the water, it has y to encrust and only a small amount is actually available in solution. e is applied to the watershed, it washes into the pond with rain and ters in small amounts, readily available for use. At McDuffie Fish lime was applied to the watershed by truck at approximately two acre. Results showed this method to be successful and considerably enient than direct application. Observations made indicate that sufficient amounts of lime are added to the watershed, the resulting ease is satisfactory for plankton growth. This has also been where lime was added to farm land without regard for the pond. rtain cases, no phytoplankton bloom established after several applications fertilizer. In May, 33 pounds per acre of 33 per cent ammonium re added in one application. A Phytoplankton bloom was established ued until winter.

tions: Research on methods of lime applications and fertilizer use continued.

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Study No, I

Pond Management Investigations

Job No. 4

SMALL IMPOUNDMENT INVENTORY

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Job Progress Report

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: 4 Job Title: Small Impoundment Inventory

Covered: January 1, 1969 to December 31, 1969

: A total of 218 ponds were inventoried in the Central Region during The most frequent cause of unbalanced fish populations were found to n fish infestations. Twenty-five per cent of the ponds checked for ardness were found to need lime. Weed problems were found in 42 per the ponds checked. Duckweed was the species most frequently encountered veed problem investigations.

ind: Since this is the first year this job has been included in the outline, previous data are not available for comparison. The need inventory has been recognized for some time. It is hoped that this y will provide data on species of aquatic weeds present, frequency infestations, fertilization success, and species of fish present. on and analysis of such data over a long period should provide wledge of environmental factors effecting the above conditions.

es: To determine the frequency of weed infestation, species of weeds , fertilization success, species of fish present and conditions causing central Georgia.

es: Data were collected by field biologists while answering pond quests received in the Central Region. Pond check cards (see figures) were completed each time a pond was visited. Data were then compiled form and included at the end of the narrative for this job.

s: A total of 218 ponds were checked during 1969 in the Central Ponds were checked for balance, weeds or management problems as d. In many cases, ponds were found to have a combination of the roblems. Twenty-three per cent of all ponds checked were checked n once. Of the ponds seined for balance, 27 per cent were found a balanced condition while 20 per cent were found in an unbalanced It was found that the primary causes of an unbalanced fish population estations of rough fish (re: species other than bass, bluegill, shell- or channel catfish) and a crowded bluegill population.

re were 102 ponds that were checked for total hardness. Of this total, ent were found to need lime. Ponds are classed low in lime content otal hardness is found to be below 20 parts per million.

d problems were found in 42 per cent of the ponds checked. Twenty-five of weeds were found and 18 different weed combinations were noted in nds. It is interesting to note that duckweed was most frequently ponds checked for weed problems during 1969.

following tables contain data collected during the Small Impoundment in 1969.

	Central and Eastern	Central and Western	Total
Number of ponds checked	146	72	218
Number of checks made	214	72	286
Percentage checked more than once	32	--	23
Ponds seined	47	14	61
Ponds balanced	27	10	37
Ponds Unbalanced	20	4	24
Why?	1-crowded bass, 7-crowded bluegill, 9-rough fish, 3-insecticide.	1-crowded bluegill 2-rough fish, 1-prior fish kill and rough fish	1 crowded bass 8-crowded blue-gill 11-rough fish 3-insecticide 1-prior fish kill and rough fish
Fertilization experiments	If lime applied to watershed, not needed in pond P_2O_5 not successful in certain ponds; 20-20-5 not always effective; NH_3NO_3 added successfully to Johnnie Smith's pond	None	
Ponds Checked for Total Hardness	75	27	102
Ponds needing lime	38 (26%)	17 (24%)	55 (25%)
Ponds with weed problems	41 (28%)	50 (69%)	91 (42%)

Species of Weeds Present in Ponds in Central Region 1969

al and Eastern		Central and Western	
eed	12 ponds	Duckweed	9 ponds
erush	4	Coontail	6
entous algae	4	*Chara* sp.	4
hora sp.	3	Parrot-feather	4
.ls	3	Needlerush	4
sp.	3	Filamentous algae	3
ss	3	*Najas* sp.	3
rn watergrass	3	*Potamogeton* sp.	2
ystis sp.	3	*Nymphaea* sp.	2
ort	2	*Brasenia* sp.	2
-feather	2	Cattails	2
geton sp.	2	Marsh-Purselene	1
lilies	1	Bladderwort	1
rass	1	Southern watergrass	1
a sp.	1	Bullrush	1
ia sp.	1	*Microcystis* sp.	1
nilfoil	1	*Rhizoclonium* sp.	1
a sp.	1	Cutgrass	1
wort	1	*Nuphar* sp.	1

Plant Combinations Present in Ponds in the Central Region in 1969

and Eastern	Central and Western
eton sp. - Cutgrass	Coontail-Needlerush
ush-Duckweed	Cattails-Cutgrass-*Chara* sp.
ush-Pennywort	*Brasenia* sp. - Coontail
Watergrass-Pennywort-*Nitella* sp.	*Potamogeton* sp.-*Nymphaea* sp.-Filamentous algae
watergrass-Duckweed	Nuphar sp.-Parrot-feather-Coontail
ous algae-Duckweed	Coontail-Duckweed
ous algae-Duckweed	Parrot-feather-*Brasenia* sp.
.- Filamentous algae	*Najas* sp.-Filamentous algae
ort-Parrot-feather	*Potamogeton*-*Rhizoclonium* sp.
	Marsh Purselane-Coontail-*Nymphaea* sp.
	Needlerush-Duckweed

by: W. Wayne Thomaston

Annual Progress Report

Statewide Fisheries Investigations

F-21-1

July 1, 1968 - June 30, 1969

Study No. II

Reservoir Limnological Investigations

Job No. II-I

RESERVOIR LIMNOLOGICAL INVESTIGATIONS - LAKE ALLATOONA

Technical Personnel:

Donald Johnson

Danny Roddenberry

Tommy Jenkins

Prepared by:

Donald Johnson

Approved by:

Leon Kirkland
Federal Aid Coordinator

JOB PROGRESS REPORT

State: Georgia

Project No.: F-21-1 Project Title: Statewide Fisheries Investigations

Job No.: II-I Job Title: Reservoir Limnological Investigations

Period Covered: July 1, 1968 to June 30, 1969

Summary: Limnological investigations were conducted on Lake Allatoona during calendar year 1968. The data collected for Lake Allatoona is shown in tables. Data for Lake Burton and Lake Blue Ridge were collected in calendar year 1969. This data will be presented in report F-21-2.

Background: Lake Allatoona was formed through the impoundment of the Etowah River and the Reservoir extends across Bartow, Cobb, and Cherokee counties in Northwest Georgia. The lake was built in 1949 and covers 19,200 acres with 270 miles of shoreline. The normal summer level elevation is 840 feet above sea level.

Objectives: To collect water temperature and dissolved oxygen data in Lake Allatoona in calendar year 1968.

Procedures: Standard Limnological procedures including the determination of temperature and oxygen profiles were taken. Temperature and dissolved oxygen data was collected from Lake Allatoona in the calendar year 1968. Two stations were sampled on Lake Allatoona. One sample was collected in the spring and one sample was taken in the fall.

Table 1. Temperature and Dissolved Oxygen Data Taken On Lake Allatoona

At Station No. 1 on Sept. 14, 1968

Depth (Feet)	Water Temp. (Fahrenheit)	D.O.	pH
Surface	76.5	6.0	7.0 - 7.5
10	76	6.0	--
20	76	5.8	--
30	75	4.7	--
40	75	4.3	--
50	73	4.1	--
60	72.5	4.1	--
70	71.0	4.0	--
80	71.0	3.8	--
90	69.0	3.5	--

Table 2. Temperature and Dissolved Oxygen Data Taken on Lake Allatoona at Station No. 2 on Sept. 14, 1968

Depth (Feet)	Water Temp. (Fahrenheit)	D.O.	pH
Surface	77.0	5.5	7.0 - 7.5
10	76.0	5.2	--
20	76.5	5.0	--
30	74.0	4.7	--
40	74.0	4.5	--
50	73.5	4.9	--
60	73.0	4.3	--
70	71.0	4.1	--
80	69.5	4.0	--
90	69.0	3.7	--

Table 3. Temperature and Dissolved Oxygen Data Taken on Lake Allatoona At Station No. 1 on May 18, 1968

Depth (Feet)	Water Temp. (Fahrenheit)	D.O.	pH
Surface	71.0	8.4	7.0 - 7.5
10	69.5	8.0	--
20	66.0	7.9	--
30	65.5	7.4	--
40	64.0	7.0	--
50	62.0	6.9	--
60	61.0	6.5	--
70	60.0	6.7	--
80	58.0	6.0	--
90	56.0	5.2	--
100	55.0	5.0	--

Table 4. Temperature and Dissolved Oxygen Data Taken on Lake Allatoona At Station No. 2 on May 18, 1968

Depth (Feet)	Water Temp. (Fahrenheit)	D.O.	pH
Surface	71.0	8.6	7.0 - 7.5
10	69.0	8.1	--
20	67.5	7.6	--
30	63.0	6.4	--
40	61.0	6.0	--
50	60.0	5.9	--
60	60.0	5.3	--
70	58.0	4.5	--
80	56.5	3.0	--
90	54.0	2.1	--

Findings

The Limnological data collected on the above Reservoirs are shown in Tables 1, 2, and 3. Station #1 was at dam site and station # 2 was located two (2) miles upstream from dam site.

Annual Progress Report

Statewide Fisheries Investigations

July 1, 1968 - June 30, 1969

Study No. II

Smallmouth Bass Investigations

Job No. I

EVALUATION OF SMALLMOUTH BASS INTRODUCTIONS

Technical Personnel:

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Jess Kinsey

Betty DeFoor

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Approved by:

Leon Kirkland
Federal Aid Coordinator

JOB PROGRESS REPORT

State: Georgia

Project: F-21-1 Project Title: Statewide Fisheries Investigations

Period Covered: July 1, 1968 to June 30, 1969

Summary: Smallmouth bass (micropeterus dolomievi) have been introduced into eight (8) streams in North Georgia. The size range varied from one (1) to two (2) inch fingerlings in the spring to twelve (12) to fourteen (14) inch sub-adults in the fall. Survival of the sub-adults has been good with several being reported in the creel of fishermen.

Project report F-17-R-3 contains the physical description, location, pool-riffle ratio and area maps for the individual streams and reference to F-17-R-3 should be made for this material.

Background: Eight (8) streams in North Georgia were selected as the study streams. These streams are Chattahoochee River, Etowah River, Coosawatee River, Tallapoosa River, Dog River, Talking Rock Creek, Chickamauga Creek, and West Armuchee Creek.

Introductions are made each spring of one (1) to two (2) inch fry and each fall of twelve (12) to fourteen (14) inch sub-adults. The hatchery operations and rearing of this species is and will continue to be an integral part of the project. The physical description and location of each was presented in F-17-R-3 and will not be reported here.

Objectives: To evaluate the introductions of smallmouth bass into the eight (8) study streams, with the hopeful intent being the establishment and recruitment of smallmouth bass into the fishery.

To collect physical and biological data pertinent to the establishment of smallmouth bass, and to develop criteria necessary for the successful

introduction of this species.

Procedures: Smallmouth bass have been introducted into eight (8) study streams. These streams are Talking Rock Creek, West Armuchee Creek, Chickamuaga Creek, Dog River, Tallapoosa River, Coosawatee River, Etowah River, and Chattahoochee River.

Project Personnel collect and evaluate the water temperature, dissolved oxygen, total hardness, and other limnological data considered essential to the project. Bottom fauna data has been collected, however, its evaluation is incomplete.

Evaluations of the introductions of smallmouth bass, food availability, competetive species, and food habit studies on competetive species have been done. This evaluation is done by rotenone samples, seining, shocking equipment, and sand filled firecrackers.

Arrowhead Hatchery is used to rear fry and sub-adults for introductions into the streams.

Findings

The findings are reported in the following pages. Findings are reported on an individual stream basis and whenever permissible in a combined nature.

Findings

Limnological data is reported on individual streams. Parts of the limnological data reported in F-17-R-3 was in error due to chemical deterioration. This error was evident on the purchase of new chemicals. The new chemicals and results were checked against chemicals and results obtained by the State Water Quality Laboratory. The data present in the following tables are the corrected values.

Table 1. Talking Rock Creek Limnological Data

Station	Date	Water Temp.	D.O.	T.H.	pH
1	Jan. 28, 1969	36.0	10	23	7.0 -7.5
1	Feb. 14, 1969	41.0	10	22	7.0 - 7.5
1	Mar. 13, 1969	37.0	11	18	7.0 - 7.5
1	Apr. 1, 1969	52.0	10	21	7.0 - 7.5
1	May 7, 1969	61.0	9	22	7.0 - 7.5
1	June 9, 1969	66.0	10	20	7.0 - 7.5
1	July 22, 1969	80.0	8	21	7.0 - 7.5
1	Aug. 19, 1969	74.0	7	21	7.0 - 7.5
1	Sept. 18, 1969	75.0	6	20	7.0 - 7.5
1	Oct. 6, 1969	63.0	9	19	7.0 - 7.5
1	Nov. 12, 1969	53.0	4	22	7.0 - 7.5
1	Dec. 5, 1969	33.0	4	20	7.0 - 7.5
2	Jan. 28, 1969	38.0	10	26	7.0 - 7.5
2	Feb. 14, 1969	40.0	10	24	7.0 - 7.5
2	Mar. 13, 1969	37.0	11	27	7.0 - 7.5
2	April 1, 1969	50,0	11	26	7.0 - 7.5
2	May 7, 1969	59.0	8	24	7.0 - 7.5
2	June 9, 1969	65.0	9	22	7.0 - 7.5
2	July 22, 1969	77.0	8	28	7.0 - 7.5
2	Aug. 19, 1969	73.0	8	25	7.0 - 7.5

Table 1 . Continued

Station	Date	Water Temp.	D.O.	T.H.	pH
2	Sep. 18, 1969	74.0	8	26	7.0 - 7.5
2	Oct. 6, 1969	63.0	9	23	7.0 - 7.5
2	Nov. 12, 1969	54.0	6	26	7.0 - 7.5
2	Dec. 5, 1969	35.0	4	24	7.0 - 7.5
3	Jan. 28, 1969	36.0	12	35	7.0 - 7.5
3	Feb. 14, 1969	41.0	11	37	7.0 - 7.5
3	May 7, 1969	61.0	9	36	7.0 - 7.5
3	June 9, 1969	63.0	10	38	7.0 - 7.5
3	July 22, 1969	76.0	7	33	7.0 - 7.5
3	Aug. 19, 1969	73.0	9	36	7.0 - 7.5
3	Sep. 18, 1969	74.0	8	37	7.0 - 7.5
3	Oct. 6, 1969	64.0	10	33	7.0 - 7.5
3	Nov. 12, 1969	54.0	6	38	7.0 - 7.5
3	Dec. 5, 1969	36.0	5	35	7.0 - 7.5
4	Jan. 28, 1969	33.0	9	33	7.0 - 7.5
4	Mar. 13, 1969	35.0	11	31	7.0 - 7.5
4	July 22, 1969	71.0	9	33	7.0 - 7.5
4	Sep. 18, 1969	73.0	9	34	7.0 - 7.5

Table 2 Coosawatee River Limnological Data

Station	Date	Water Temp.	D.O.	T.H.	pH
1	Jan. 28, 1969	40.0	10	10	6.5 - 7.0
1	Feb. 14, 1969	43.0	9	11	6.5 - 7.0
1	Mar. 13, 1969	46.0	10	10	6.5 - 7.0
1	Apr. 1, 1969	53.0	10	9	6.5 - 7.0
1	May 7, 1969	59.0	10	6	6.5 - 7.0
1	June 9,1969	66.0	10	12	6.5 - 7.0
1	July 22,1969	75.0	7	9	6.5 - 7.0
1	Aug. 19,1969	72.0	6	9	6.5 - 7.0
1	Sep. 18,1969	72.0	7	6	6.5 - 7.0
1	Oct. 6,1969	66.0	9	9	6.5 - 7.0
1	Nov. 12,1969	52.0	5	10	6.5 - 7.0
1	Dec. 5,1969	36.0	4	9	6.5 - 7.0
1	Dec. 30,1969	39.0	4	9	6.5 - 7.0

Table 3 Dog River Limnological Data

Station	Date	Water Temp.	D.O.	T.H.	pH
1	Jan. 15, 1969	44.0	10	12	7.0 -7.5
1	Feb. 28, 1969	47.0	10	11	7.0 - 7.5
1	Mar. 21, 1969	54.0	10	14	7.0 - 7.5
1	Apr. 25, 1969	57.0	9	11	7.0 - 7.5
1	Jun. 26, 1969	73.0	7	12	7.0 - 7.5
1	Jul. 24, 1969	76.0	7	12	7.0 - 7.5
1	Aug. 27, 1969	78.0	8	12	7.0 - 7.5
1	Sep. 12, 1969	73.0	9	11	7.0 - 7.5
1	Oct. 8, 1969	62.0	8	12	7.0 - 7.5
1	Dec. 31, 1969	49.0	5	11	7.0 - 7.5
2	Jan. 15, 1969	45.0	8	12	7.0 - 7.5
2	Feb. 28, 1969	47.0	10	11	7.0 - 7.5
2	Mar. 21, 1969	54.0	9	14	7.0 - 7.5
2	Apr. 25, 1969	58.0	7	10	7.0 - 7.5
2	Jun. 26, 1969	73.0	7	12	7.0 - 7.5
2	Jul. 24, 1969	76.0	7	12	7.0 - 7.5
2	Aug. 27, 1969	78.0	8	10	7.0 - 7.5
2	Sept. 12, 1969	75.0	9	11	7.0 - 7.5
2	Oct. 8, 1969	62.0	8	11	7.0 - 7.5
2	Dec. 31, 1969	48.0	5	12	7.0 - 7.5

Table 4. Chickamauga Creek Limnological Data

tion	Date	Water Temp.	D.O.	T.H.	pH
1	Jan. 10, 1969	42.0	9	92	6.5 - 7.0
1	Feb. 13, 1969	45.0	9	90	6.5 - 7.0
1	Mar. 4, 1969	48.0	9	90	6.5 - 7.0
1	Apr. 16, 1969	56.0	7	92	6.5 - 7.0
[illegible]	May 19, 1969	68.0	10	88	6.5 - 7.0
[illegible]	June 3, 1969	71.0	10	92	6.5 - 7.0
[illegible]	Aug. 20, 1969	76.0	8	90	6.5 - 7.0
[illegible]	Sept. 18, 1969	66.0	5	90	7.0 - 7.5
[illegible]	Nov. 12, 1969	52.0	4	90	7.0 - 7.5
[illegible]	Dec. 5, 1969	37.0	5	94	7.0 - 7.5
[illegible]	Feb. 13, 1969	43.0	9	92	7.0 - 7.5
[illegible]	Mar. 4, 1969	46.0	10	88	7.0 - 7.5
[illegible]	Apr. 16, 1969	56.0	7	92	7.0 - 7.5
[illegible]	May 19, 1969	68.0	8	92	7.0 - 7.5
[illegible]	June 3, 1969	70.0	10	92	7.0 - 7.5
[illegible]	Aug. 20, 1969	76.0	8	92	7.0 - 7.5
[illegible]	Sept. 18, 1969	68.0	5	88	7.0 - 7.5
[illegible]	Nov. 12, 1969	52.0	5	94	7.0 - 7.5
[illegible]	Dec. 5, 1969	38.0	5	94	7.0 - 7.5

Table 4 Continued

Station	Date	Water Temp.	D.O.	T.H.	pH
3	Jan. 15, 1969	42.0	8	12	7.0 - 7.5
3	Feb. 28, 1969	46.0	9	11	7.0 - 7.5
3	Mar. 21, 1969	56.0	10	12	7.0 - 7.5
3	Apr. 25, 1969	58.0	9	11	7.0 - 7.5
3	Jun. 26, 1969	73.0	7	11	7.0 - 7.5
3	Jul. 24, 1969	74.0		12	7.0 - 7.5
3	Aug. 27, 1969	76.0	8	10	7.0 - 7.5
3	Sep. 12, 1969	75.0	7	11	7.0 - 7.5
3	Oct. 8, 1969	63.0	7	11	7.0 - 7.5
3	Dec. 31, 1969	48.0	4	12	7.0 - 7.5
4	Feb. 28, 1969	47.0	9	12	7.0 - 7.5
4	Aug. 27, 1969	76.0	8	11	7.0 - 7.5
4	Oct. 8, 1969	62.0	8	11	7.0 - 7.5

Table 4. Continued

Station	Date	Water Temp.	D.O.	T.H.	pH
3	Jan. 10, 1969	40.0	7	94	6.5 - 7.0
3	Feb. 13, 1969	43.0	10	94	6.5 - 7.0
3	Apr. 16, 1969	58.0	9	96	6.5 -7.0
3	May 19, 1969	68.0	8	90	6.5 - 7.0
3	June 3, 1969	71.0	9	96	6.5 - 7.0
3	Aug. 20, 1969	78.0	9	94	6.5 - 7.0
	Sep. 18, 1969	68.0	5	94	7.0 - 7.5
3	Nov. 12, 1969	52.0	5	94	7.0 - 7.5
3	Dec. 5, 1969	37.0	4	96	7.0 - 7.5
4	Feb. 13, 1969	43.0	9	91	6.5 - 7.0
4	Apr. 16, 1969	58.0	9	92	6.5 - 7.0
4	May 19, 1969	68.0	8	92	6.5 - 7.0
4	Aug. 20, 1969	78.0	8	93	6.5 - 7.0

Table 5. Tallapoosa River Limnological Data

Station	Date	Water Temp.	D.O.	T.H.	pH
1	Jan. 15, 1969	45.0	6	12	6.5 - 7.0
1	Feb. 28, 1969	48.0	9	12	6.5 - 7.0
1	Apr. 25, 1969	56.0	8	12	6.5 - 7.0
1	June 26, 1969	73.0	9	12	6.5 - 7.0
1	Aug. 27, 1969	78.0	9	12	6.5 -7.0
1	Sept.12, 1969	73.0	10	12	6.5 - 7.0
1	Oct. 8, 1969	64.0	10	11	6.5 - 7.0
2	Jan. 15, 1969	43.0	9	10	6.5 - 7.0
2	Feb. 28, 1969	47.0	9	11	6.5 - 7.0
2	Apr. 25, 1969	57.0	6	10	6.5 - 7.0
2	June 26, 1969	73.0	7	14	6.5 - 7.0
2	Aug. 27, 1969	78.0	8	11	6.5 - 7.0
2	Sept.12, 1969	73.0	10	11	6.5 - 7.0
2	Oct. 8, 1969	64.0	9	12	6.5 - 7.0
3	Jan. 15, 1969	45.0	6	12	6.5 - 7.0
3	Feb. 28, 1969	48.0	8	11	6.5 - 7.0
3	Mar. 21, 1969	50.0	9	10	6.5 - 7.0
3	Apr. 25, 1969	57.0	6	10	6.5 - 7.0
3	June 26, 1969	73.0	7	12	6.5 - 7.0
3	July 24, 1969	76.0	7	14	6.5 - 7.0
3	Aug. 27, 1969	78.0	8	11	6.5 - 7.0
3	Sept.12, 1969	72.0	9	11	6.5 - 7.0

Table 5. Continued

Station	Date	Water Temp.	D.O.	T.H.	pH
3	Oct. 8, 1969	63.5	9	12	6.5 - 7.0
3	Dec. 31, 1969	48.0	5	10	6.5 - 7.0
4	Mar. 21, 1969	50.0	9	10	6.5 - 7.0
4	Apr. 25, 1969	57.0	6	9	6.5 - 7.0
4	June 26, 1969	72.5	8	12	6.5 - 7.0
4	July 24, 1969	76.0	7	14	6.5 - 7.0
4	Aug. 27, 1969	78.0	9	11	6.5 - 7.0
4	Sep. 12, 1969	72.5	10	10	6.5 - 7.0
4	Oct. 8, 1969	64.0	9	10	6.5 - 7.0
4	Dec. 31, 1969	48.0	5	14	6.5 - 7.0

Table 6. West Armuchee Creek Limnological Data

Station	Date	Water Temp.	D.O.	T.H.	pH
1		43.0	5	72	6.5 - 7.0
1	Feb. 17, 1969	47.0	10	74	6.5 - 7.0
1	Mar. 20, 1969	48.0	11	74	6.5 - 7.0
1	Apr. 16, 1969	56.0	9	72	6.5 - 7.0
1	May 6, 1969	60,0	9	75	6.5 - 7.0
1	June 2, 1969	65.0	10	74	6.5 - 7.0
1	July 22, 1969	66.0	7	70	6.5 - 7.0
1	Aug. 20, 1969	75.0	8	72	6.5 - 7.0
1	Sep. 18, 1969	66.0	4	75	6.5 - 7.0
1	Oct. 13, 1969	64.0	5	--	--
1	Nov. 12, 1969	55.0	4	70	6.5 - 7.0
1	Dec. 5, 1969	41.0	4	75	6.5 - 7.0
2	Jan. 8, 1969	43.0	6	72	6.5 - 7.0
2	Feb. 17, 1969	47.0	10	72	6.5 - 7.0
2	Mar. 20, 1969	48.0	10	74	6.5 - 7.0
2	Apr. 16, 1969	56.0	9	74	6.5 - 7.0
2	May 6, 1969	61.0	10	74	6.5 - 7.0
2	June 2, 1969	67.0	7	74	6.5 - 7.0
2	July 22, 1969	71.0	6	72	6.5 - 7.0
2	Aug. 20, 1969	76.0	10	74	6.5 - 7.0
2	Sep. 18, 1969	70.0	8	74	6.5 - 7.0
2	Oct. 13, 1969	73.0	5	--	--
2	Nov. 12, 1969	55.0	5	70	6.5 - 7.0
2	Dec. 5, 1969	38.0	4	74	6.5 - 7.0

Table 6. Continued

Station	Date	Water Temp.	D.O.	T. H.	pH
3	Jan. 8, 1969	44.0	6	70	6.5- 7.0
3	Feb. 17, 1969	47.0	10	74	6.5 - 7.0
3	Mar. 20, 1969	46.0	9	75	6.5 - 7.0
3	Apr. 16, 1969	56.0	10	74	6.5 - 7.0
3	May 6, 1969	61.0	10	74	6.5 - 7.0
3	June 2, 1969	67.0	7	74	6.5 - 7.0
3	July 22, 1969	71.0	7	72	6.5 - 7.0
3	Aug. 20, 1969	75.0	10	74	6.5 - 7.0
3	Sep. 18, 1969	71.0	6	74	6.5 - 7.0
3	Oct. 13, 1969	63.0	5	--	--
3	Nov. 12, 1969	56.0	5	72	6.5 - 7.0
3	Dec. , 1969	39.0	5	74	6.5 - 7.0
4	Jan. 8, 1969	44.0	6	74	6.5 - 7.0
4	Apr. 16, 1969	56.0	9	74	6.5 - 7.0
4	June 2, 1969	67.0	7	76	6.5 - 7.0
4	July 22, 1969	71.0	7	76	6.5 - 7.0
4	Oct. 13, 1969	63.0	7	--	6.5 - 7.0
4	Dec. 5, 1969	39.0	6	71	6.5 - 7.0

Findings

Introductions were made during the spring and fall. Fry smallmouth (1 - 2") were stocked during the spring and in larger numbers. Sub-adults were reared at Arrowhead Hatchery and stocked in the fall. The stocking locations are the same as shown in the maps in report F-17-R-3 with some new locations. Maps are being prepared to include all stocking points.

The following list of introductions is on a calendar year basis to provide continuity of data with the smallmouth rearing operations of Arrowhead Hatchery. Project F-17-R-3 contains some of the introductions made under F-21-1.

Table 7. Smallmouth Bass Introductions Into Streams

Stream	Number	Av. Length (Inches)	Total Wgt. (lbs.)	Date Stocked
Talking Rock Creek	5,000	1½ - 2	5.0	May 27, 1969
Talking Rock Creek	600	7.0	42.7	Oct. 14, 1969
Coosawattee River	10,000	1½ - 2	9.9	May 27, 1969
Coosawattee River	600	7.0	42.3	Oct. 15, 1969
West Armuchee Creek	5,000	1½ - 2	5.0	May 28, 1969
West Armuchee Creek	500	6.0	30.8	Oct. 10, 1969
West Armuchee Creek	300	8.0	23.7	Oct. 31. 1969
Chickamauga Creek	550	7.0	--	March 4, 1969
Chickamauga Creek	5,000	1½ - 2	5.1	May 20, 1969
Chickamauga Creek	600	7.0	41.9	Oct. 17. 1969
Dog River	500	7.0	--	Mar. 7, 1969
Dog River	10,000	1½ - 2	9.9	May 21, 1969
Dog River	550	8.0	45.3	Oct. 10, 1969
Tallapoosa River	900	7.0	--	Nov. 14, 1968
Tallapoosa River	10,000	1½ - 2	10.0	May 21, 1969
Tallapoosa River	600	8.0	48.5	Oct. 16, 1969
Etowah River	500	6.0	--	Mar. 10, 1969
Etowah River	5,000	1½ - 2	5.0	May 25, 1969
Etowah River	500	10.0	49.6	Dec. 23, 1969

Table 7. Continued

Stream	Number	Av. Length (Inches)	Total Wgt. (lbs.)	Date Stocked
Chattahoochee River	500	6.0	--	Mar. 10, 1969
Chattahoochee River	5,000	1½ - 2	4.9	May 25. 1969
Chattahoochee River	500	10.0	49.9	Dec. 23. 1969
Euharlee Creek	500	5.0	33.0	Oct. 9, 1969
Euharlee Creek	200	6.0	15.1	Dec. 24, 1969
Ruff Creek	8,000	2.0	--	June 6. 1968

Food Habit Studies

Sixteen (16) largemouth bass (micropterus salmoides) and forty-seven (47) redeye bass (micropterus coosae) were collected and the stomach contents examined. Examination of the largemouth bass which ranged from ten (10) inches to eighteen (18) inches revealed the presence of crayfish, spot-tail shiners, sculpins, hogsucker, threadfin shad, bluegill and other members of the sunfish family.

Examination of the redeye bass which ranged from four (4) inches to eight (8) inches revealed crayfish, sculpins, spot-tail shiners, sunfish fry and invertebrates.

The redeye bass fingerlings present a major obstacle to the fingerling smallmouth bass. Stomach analysis revealed vital food items required for successful introduction of fingerling smallmouth.

Bottom Fauna Studies

Bottom Fauna collections have been taken, however, identification is incomplete. The orders and families which have been identified are listed below. These are present in each of the streams in the project.

Order	Family	Genus
Odonata	Gomphidae	Gomphus
	Coenagrioidae	Agria
Plecoptera	Isoperlidae	Isoperla
Coleoptera	Gyrinidae	
	Elmidae	
	Psephenidae	
Diptera	Chironomidae	

Findings

EVALUATION OF INTRODUCTIONS

The primary purpose of this study was to evaluate the introductions of smallmouth bass. Rotenone samples were attempted during the project period with inconclusive results. Cold water plus water velocity allowed fish to escape the rotenone. This method of sampling was discontinued due to the poor results.

A short in the shocking equipment prevented its use, however, new shocking equipment has been purchased and will be in operation soon.

Sand filled firecrackers and seining with a 15 ft. seine provided excellent results on the availability of food, but proved ineffective in killing or producing fish of any size.

Small fish of the following species were collected; sunfish, hog sucker, spot-tail shiner, shad, and various members of the minnow family by use of the firecrackers and 15 ft. seine.

One four inch smallmouth was taken by a sand filled firecracker from the West Armuchee Creek.

Verified creel reports show eight (8) smallmouth taken from West Armuchee Creek (10 - 12 inch group) three (3) from the Tallapoosa River (9-12 inch group), and two (2) from the Dog River (8 - 10 inch group).

Annual Progress Report

Statewide Fisheries Investigations

F-21-1

July 1, 1968 - June 30, 1969

Study No. IV

Trout Stream Investigations

Job No. 1

EVALUATION OF DEVELOPMENT ON TROUT STREAMS

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EVALUATION OF DEVELOPMENT ON TROUT STREAMS

Summary: Data on physicochemical water properties, macrobenthic opulations, and fish populations obtained during the report period n Hoods Creek and Walnut Fork in conjunction with the research roject evaluating the effects of various stream habitat-alteration tructures and erosion control measures on the stream system are resented. A detailed discussion of the sampling methods and aterials is presented. Mean velocity averaged 0.52 fps in typical iffle areas in October and 0.77 fps in December. Total discharge as 2.46 and 9.14 cfs on Hoods Creek and 3.10 and 10.26 cfs on alnut Fork in October and December, respectively, at the stations mmediately above the confluence. Dissolved oxygen concentrations veraged 11.2, 11.6, and 11.0 ppm on Hoods Creek, and 11.8, 12.5, nd 11.2 ppm on Walnut Fork above the mouth of Hoods Creek during ovember, December, and January, respectively. Mean pH was 6.8 nd total hardness less than 4 ppm $CaCO_3$ during December on both treams. Carbon dioxide concentrations averaged 2 ppm on Hoods reek in November. Daytime stream temperatures varied from 39.7° nd 40.8°F in December to 64.8° and 66.3°F in June on Hoods Creek nd Walnut Fork, respectively. Mean annual specific conductance veraged 111.2 and 98.0 micromhos/cm, adjusted to a reference emperature of 25°C, in Hoods Creek, and Walnut Fork above the outh of Hoods Creek, respectively. Specific conductance varied n a definite annual pattern, lower during the winter, and decreased

with progression upstream. Fish population sampling revealed a paucity of sexually-mature trout in the streams in the fall and a poor recruitment the following spring. Three artificial spawning devices on Hoods Creek below the barrier falls were utilized by spawning brown trout. All three redds in the devices contained viable eggs and two of the three inspected near the time of emergence contained healthy prolarvae. The benthos samples, thermograph data, and inorganic silt deposit data were not analyzed in time for inclusion in this report, and will be presented in the F-21-2 annual project report. A discussion of proposed treatments of certain of the field data is presented, particularly the need to zone the stream system on the bases of habitat conditions and species composition to make valid temporal and spatial population comparisons.

Background: This project evaluating the effects of various stream habitat-alteration structures and erosion control measures on habitat conditions and fish and benthos populations in the Hoods Creek - Walnut Fork watershed was initiated in fiscal year 1966-67. A description of the study area, background data on the watershed, a summary of the 1960-1967 creel census data, and the data on physicochemical water properties, fish populations, and benthos populations obtained during fiscal years 1966-1967 and 1967-68, were presented in Final Report for Project No. F-17-R under Work Plan III, Job No. 1 (Survey of Trout Streams). This progress report presents data obtained during this report period on fish populations, macrobenthos populations, and physicochemical water properties.

Job No. IV-1

The results of the creel census conducted on Hoods Creek and Walnut Fork during the report period in conjuction with this project are presented under Job No. XV-2, Trout Stream Creel Census, and omitted in this report.

Development work on the streams was initiated during fiscal year 1967-68. A report on the work accomplished that report period was presented in the Final Report for Project No. F-17-R under Work Plan III, Job No. 3 (Trout Stream Development Investigations). This included the construction of 24 artificial spawning areas and 9 tributary silt traps, plus the initiation of watershed erosion abatement practices. The development work accomplished during this report period, terminating the development work on the project streams, is presented in the Final Report for Job No. IV-2, Experimental Development on Trout Streams. The development work this report period consisted of the installation of 31 stream-alteration structures, 8 culverts, and 1 bridge, plus the continuation of erosion control procedures. Erosion control this fiscal year included--in addition to bridge and culvert construction on small feeder streams and spring drainages flowing across the Hoods Creek access road--repair of water brakes, draining and filling of mudholes, and spreading gravel on steep grades of the access roads, and fertilizing and seeding raw areas at construction sites and along the access roads to fescue. Although the erosion control procedures implemented this fiscal year, including maintenance of the access roads and silt traps, construction and maintenance of bridges and culverts, and establishment of a ground cover on raw areas, are contained in the

› description for this job, it was felt that this work was more ɟically and coherently reported with the stream-alteration ɩstruction project under Job No. IV-2, and omitted here.

ıjectives: To evaluate the effects of accelerated stream develop- ıt, including artificial spawning areas and stream-alteration :uctures, and erosion abatement, including road stabilization, :ablishment of a ground cover, and installation of tributary .t traps, on the habitat conditions, fish fauna, and macrobenthos the Hoods Creek - Walnut Fork stream system.

:hods: A total of 21 sampling stations were established 'ore the initiation of regular sampling and have been used through- : the study for fish population sampling, macrobenthos sampling, ι physicochemical water property measurements. Ten sampling ..tions are located on Hoods Creek, ten on Walnut Fork above its ı.fluence with Hoods, and one on Walnut below the confluence of ı: study streams.

Fish population sampling was conducted by introducing cresol ·o the stream at the upstream terminus of the 500-foot sampling ꜟtion. Affected fish were collected by dip net and placed into ꜟs of clean stream water for processing. All fish observed but ꜟ retrieved were recorded. Collected fish were identified to ꜟcies, total length measured to the nearest 0.1 inch, and weight ꜟsured in grams. Fish were returned to the stream after processing. ꜟulation sampling was conducted biannually, once in the fall and ꜟe in the spring after the winter's spawn has emerged from the redds.

ɔb No. IV-1

Bottom macrofauna samples were collected at monthly intervals : each sampling station using a square-foot Surber bottom sampler. ıe sample was obtained per sampling station. Samples were ·eserved in ethyl alcohol until processing. Benthic organisms will ː identified to order, and genus where practical. Biomass of the ·nthic fauna will be determined on numerical, volumetric, and ·avimetric (wet weight and dry weight) bases.

Water chemistry samples were collected at irregular intervals ·ring the report period, one sample per sampling station. Dissolved ·ygen was determined by a modified azide-Winkler method with drop ·unt titration. Dissolved oxygen could be determined to the nearest ·.2 ppm using this method. Total hardness was determined by the ·TA method. Carbon dioxide content was determined by adding 0.1% ·enolphthalein indicator solution to a 25 ml sample and titrating ·th 0.0227N NaOH until formation of a light pink color persisting ·r at least 30 seconds. Hydrogen-ion values were determined using · direct current colorimeter and wide-range indicator (pH 4.0 to ·.0). The maximum deviation of the colorimeter is within ± 2 per ·nt full scale, or approximately ± 0.1 pH for the transmittance ·ter scale used. The above water chemistry determinations were ·tained using reagents and the colorimeter contained in the Hach ·del DR-EL Portable Water Engineer's Laboratory.

Conductivity measurements were obtained at monthly intervals · each sampling station using an Industrial Instruments (Beckman) ·pe RB2 portable battery-operated Solu Bridge conductivity meter. ·is particular model utilizes a center reading galvanometer as

:e null indicator, with a manual-adjustment temperature compensator ich must be set to the value of the solution temperature. When e temperature compensator is adjusted for the solution temperature d the bridge is balanced, the specific conductance in micromhos/cm, rrected to the reference temperature of 25^{o}C, can be read directly om the conductivity scale.

Velocity and volume of flow were measured at irregular intervals ring the report period at selected stations on both study streams ch a pygmy Price-type vertical-axis current meter having a single-volution contact. This instrument is manufactured by Arline ecision Instruments. The velocity was calculated from the number impulses counted during an elapsed time period by the following ibration formula:

$$V = 0.956N + 0.046,$$

all values of N,

where: V = velocity in fps, and

N = impulses per second.

constant record of air and water temperature was obtained during report period by a Weather Measure Corporation Model T601 two-nt thermograph installed on Hoods Creek immediately above its fluence with Walnut Fork. The two sensors are mercury-filled, stic-covered, steel capillaries terminating in stainless steel bes. The recording mechanism is a 1.5 vdc clock drive with ay drum rotation. The instrument was enclosed in a sheet steel sing to discourage vandalism.

Estimates of the volume of silt deposits in five selected pools on Hoods Creek and five on Walnut Fork were obtained by measuring the depth of the deposit at three points, one at the midpoint and one on each side of the midpoint halfway to the edge of the deposit, on three transverse transects spaced in the same manner as the measuring points. The longitudinal length of the deposit was measured, and a freehand sketch of the surface of the deposit was drawn on a grid. Thus an estimate could be obtained of the surface area covered by the deposit. Combined with the depth measurements, an estimate of total deposit volume was then obtained. These measurements will be taken at yearly intervals. In a similar manner, estimates of the volume of silt impounded by the tributary silt traps were obtained to evaluate their efficacy in reducing stream siltation.

Trout eggs or fry were collected by placing a screen, constructed of aluminum window screening fastened to two poles, downstream of the redd and raking through the redd to dislodge eggs or fry. Suitable spawning areas were also checked in this manner to locate undistinguishable redds.

Results: *Velocity and volume of flow*--Discharge measurement data were obtained at five stations on Hoods Creek, five on Walnut Fork above the mouth of Hoods Creek, and one on Walnut Fork below the mouth of Hoods Creek, on October 29, 31, and November 1, 1968, before the winter rains replenished the low flows resulting from the exceptionally hot dry summer and early fall of 1968 (Table 1).

Table 1. Discharge measurement data, obtained with a pygmy Price meter in section control areas of shallow riffles or bedrock, for Hoods Creek and Walnut Fork in Rabun County, Georgia, in early fall 1968, following an exceptionally hot dry summer. Stations 1-5 (October 29) are located on Hoods Creek, 6-10 (October 31) on Walnut Fork above the mouth of Hoods Creek, and 11 (November 1) on Walnut Fork below the mouth of Hoods Creek (stations numbered consecutively upstream).

Station No.	1	2	3	4	5	6	7	8	9	10	11
Cross-sectional Width (ft)	13.0	13.8	9.0	3.6	14.5	20.7	14.0	12.0	10.6	3.0	15.0
Mean Cross-sectional Depth (ft)	0.43	0.36	0.31	0.43	0.40	0.33	0.50	0.37	0.31	0.17	0.50
Cross-sectional Area (sq ft)	5.59	4.89	2.78	1.53	5.75	6.74	6.95	4.30	3.16	0.50	7.45
Number of Vertical Sections	12	13	9	7	14	20	14	11	10	9	15
Observation Depth	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maximum Point Velocity (fps)	0.73	0.83	1.16	1.27	0.33	0.73	0.68	0.91	0.84	1.78	1.54
Mean Velocity (fps)	0.37	0.31	0.60	0.63	0.13	0.38	0.41	0.55	0.43	1.23	0.70
Horizontal Angle Coefficient	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Discharge (cfs)	2.46	1.40	1.68	1.05	0.88	3.10	2.85	2.50	1.60	0.66	5.50
Estimated Daily Discharge (acre-ft/day)	4.87	2.77	3.33	2.08	1.74	6.14	5.64	4.95	3.17	1.31	10.89

Job No. IV-1

Flow measurements were taken in areas of the stream under section control during low-water conditions, consisting mainly of shallow riffles. The widths and depths of the sample stations are listed in Table 1. The mean stream width was 11.7 ft and the mean depth 0.37 ft (4.5 in) in these riffle areas, which were fairly typical of riffle areas throughout the stream system. The maximum point velocity recorded was 1.78 fps, observed at the uppermost station on Walnut Fork where the stream gradient is high. Mean velocity varied from 0.13 to 1.23 fps, averaging 0.52 fps. Total discharge at the mouth of Hoods Creek was 2.46 cfs, with Walnut Fork exhibiting a slightly higher volume of flow, 3.10 cfs, above the mouth of Hoods Creek. The combined volume of flow of the confluent streams was measured at 5.50 cfs. Since the stage was changing very little during this period, estimates of the daily discharge were extrapolated from the instantaneous flow volumes. This was estimated to be approximately 10.9 acre-ft/day for the combined flow of the two streams. Both streams exhibit low flows in their upper sections during extended dry periods, less than 1.5 cfs. Flows were less than 1 cfs at the upstream termini of fish-producing water on both streams.

Discharge measurement data were obtained for the five stations on each creek above the confluence on December 23-24, 1968, after the flow became fairly stable following several days of sustained rainfall (Table 2). The maximum point velocity recorded during these series of measurements was 2.40 fps, with the mean velocities averaging 0.77 fps, varying from 0.52 to 1.05 fps. Total discharge

Table 2. Discharge measurement data, obtained with a pygmy Price meter in section control areas of shallow riffles or bedrock, for Hoods Creek and Walnut Fork in Rabun County, Georgia, in early winter 1968-69. Stations 1-5 are located on Hoods Creek, 6-10 on Walnut Fork above the mouth of Hoods Creek, an 11 on Walnut Fork below the mouth of Hoods Creek (stations numbered consecutively upstream). Measurements were taken at Stations 1-10 on December 23-24 following several days of sustained rainfall; and at Station 11 on January 3 after the water level receded.

Station No.	1	2	3	4	5	6	7	8	9	10	11
Cross-sectional Width (ft)	22.5	19.0	22.0	12.0	8.5	20.6	13.8	24.0	16.0	5.0	16.0
Mean Cross-sectional Depth (ft)	0.54	0.48	0.45	0.47	0.46	0.57	0.70	0.55	0.43	0.36	0.71
Cross-sectional Area (sq ft)	12.13	9.15	9.90	5.60	3.84	11.51	9.68	13.20	6.90	1.83	11.12
Number of Vertical Sections	22	19	22	12	8	20	14	12	16	10	19
Observation Depth	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maximum Point Velocity (fps)	1.29	2.40	1.45	1.80	1.59	2.29	1.03	0.76	1.07	1.11	1.56
Mean Velocity (fps)	0.73	0.93	0.72	1.05	0.83	0.78	0.74	0.52	0.54	0.90	1.04
Horizontal Angle Coefficient	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Discharge (cfs)	9.14	10.58	7.94	6.50	3.14	10.26	7.18	7.00	4.96	1.79	10.71
Estimated Daily Discharge (acre-ft/day)	18.10	20.95	15.72	12.87	6.22	20.31	14.22	13.86	9.82	3.54	21.21

as 9.14 and 10.26 cfs on Hoods Creek and Walnut Fork, respectively, t the stations immediately above the confluence. This is a volume f flow for the confluent streams of 19.40 cfs, or 3.5 times that bserved in late October. Discharge measurements were taken on alnut Fork below the mouth of Hoods Creek on January 3, 1969, after he flow receded. The volume of flow of the confluent streams was .71 cfs, or roughly 21.2 acre-ft/day, approximately half the flow bserved after the heavy rainfall on December 23-24, but still twice he volume of flow observed in late October.

emical Properties--Dissolved oxygen measurements were obtained at he ten sampling stations on Hoods Creek, the ten on Walnut Fork bove the mouth of Hoods Creek, and the station on Walnut Fork below he confluence of the study streams during November and December 968 and January 1969 (Table 3). Dissolved oxygen averaged 11.2, .6, and 11.0 ppm during November, December, and January, respectively, n Hoods Creek; and 11.8, 12.5, and 11.2 ppm during the same periods n Walnut Fork. Below the confluence, dissolved oxygen concentrations ere 11.2, 12.0, and 11.0 ppm during November, December, and January, espectively. Dissolved oxygen measurements on the two streams anged from 10.6 to 13.8 ppm during the three-month interval. Dissolved oxygen concentrations were slightly higher on Walnut Fork han on Hoods Creek during this period.

Hydrogen-ion measurements were obtained at the ten stations on oods Creek, and three stations--one downstream and two upstream of he mouth of Hoods Creek--on Walnut Fork, in late December 1968 Table 4). The mean pH value was 6.8 for the two streams. Total

Job No. IV-1

Table 3. Dissolved oxygen (ppm) at 10 stations on Hoods Creek and 11 stations on Walnut Fork in November and December 1968 and January 1969--A on Hoods Creek and B on Walnut Fork, numbered consecutively upstream; Station 11 is on Walnut Fork below the mouth of Hoods Creek.

	Month		
Station No.	Nov	Dec	Jan
1A	12.2	11.8	11.4
2A	10.8	10.8	11.2
3A	11.4	12.0	11.2
4A	11.6	11.2	11.2
5A	10.8	12.8	11.0
6A	11.6	11.0	10.8
7A	10.8	11.0	11.2
8A	11.2	12.4	10.6
9A	10.8	11.2	10.6
10A	10.8	11.6	10.6
Mean	11.2	11.6	11.0
1B	12.2	--	11.8
2B	13.8	12.4	11.0
3B	12.6	12.6	11.4
4B	11.2	--	10.8
5B	11.0	--	11.0
6B	12.0	--	10.6
7B	11.0	--	11.5
8B	11.0	--	11.0
9B	11.2	--	11.4
10B	12.0	--	11.2
Mean	11.8	12.5	11.2
11	11.2	12.0	11.0
Aggregative Mean	11.5	11.8	11.1

Job No. IV-1

Table 4. pH values at 10 stations on Hoods Creek (Station 1A-10A, December 23), 2 stations on Walnut Fork above the mouth of Hoods Creek (Station 2B and 3B, December 24), and one station on Walnut Fork below the mouth of Hoods Creek (Station 11, December 23) in December 1968--stations on Hoods Creek and Walnut Fork above the confluence numbered consecutively upstream.

Station No.	pH
1A	6.8
2A	6.8
3A	6.8
4A	6.8
5A	6.7
6A	6.8
7A	6.6
8A	6.7
9A	6.7
10A	6.7
Mean	6.7
2B	6.8
3B	6.8
Mean	6.8
11	6.8
Aggregative Mean	6.8

ardness, determined from measurements obtained at the sampling tations on Hoods Creek and Walnut Fork during December 1968, veraged less than 4 ppm $CaCO_3$ in both streams (Table 5). The otal hardness was below the sensitivity of the method employed. arbon dioxide concentrations averaged 2 ppm on Hoods Creek in ovember 1968, determined from analysis of water samples from the en stations on the stream (Table 5).

r and Stream Temperatures--The weekly autographic records of r and stream temperatures at the mouth of Hoods Creek obtained th the two-probe thermograph were not analyzed in time for clusion in this report. These data will be compiled and presented the F-21-2 annual project report. However, water temperature ta obtained with a mercury stem thermometer, for the purpose of justing the temperature compensator when taking conductance adings, provide an estimate of the annual variation of the day-me water temperatures on the two streams (Table 5, Figure 1). ytime water temperatures varied from a low of 39.7°F in December 68 to a high of 64.8° in June 1969 on Hoods Creek, with a similar ttern exhibited by Walnut Fork, a low of 40.8°F in December to a gh of 66.3° in June. Extremes of individual measurements ranged om 38 to 65°F on Hoods Creek and 40 to 68°F on Walnut Fork. In neral, water temperatures were slightly higher on Walnut Fork an on Hoods Creek.

ecific Conductance--Specific conductance, an indication of the nized molecules of dissolved solids in the stream water, veraged 111.2 and 98.0 micromhos/cm, adjusted to a reference

Table 5. Summary of physicochemical data for Hoods Creek and Walnut Fork for the report period July 1968-June 1969.

Hoods Creek	Jul	Aug	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Jun	Extremes
Daytime Water Temp. (^{o}F)	62.1	62.3	49.0	40.6	39.7	46.0	42.5	44.3	49.8	64.8	38-65
Spec. Cond. (µmhos/cm) 1/	133.8	135.3	121.9	113.3	105.0	95.5	95.7	100.6	94.9	115.8	85-145
DO (ppm)	--	--	--	11.2	11.6	11.0	--	--	--	--	10.6-12.8
pH	--	--	--	--	6.7	--	--	--	--	--	6.6-6.8
Total Hard. (ppm $CaCO_3$)	--	--	--	--	<4	--	--	--	--	--	- <4 -
CO_2 (ppm)	--	--	--	2	--	--	--	--	--	--	2-4
Mean Riffle Vel. (fps)	--	--	0.41	--	0.85	--	--	--	--	--	0.13-1.05
Total Disch. (cfs) 2/	--	--	2.46	--	9.14	--	--	--	--	--	--

1/ Corrected to a reference temperature of 25°C.

2/ Volumes of flow at the mouth of Hoods Creek and for Walnut Fork immediately above the mouth of Hoods Creek.

Table 5. Continued.

Walnut Fork 3/	Jul	Aug	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Jun	Extremes
Daytime Water Temp. (°F)	62.5	59.7	45.0	42.7	40.8	46.1	41.7	44.8	50.7	66.3	40-68
Spec. Cond. (μmhos/cm) 1/	117.7	113.2	103.7	93.5	93.0	89.1	84.9	87.0	90.5	107.4	78-120
DO (ppm)	--	--	--	11.8	12.5	11.2	--	--	--	--	10.6-13.8
pH	--	--	--	--	6.8	--	--	--	--	--	- 6.8 -
Total Hard. (ppm $CaCO_3$)	--	--	--	--	<4	--	--	--	--	--	- <4 -
Mean Riffle Vel. (fps)	--	--	0.60	--	0.70	--	--	--	--	--	0.38-1.23
Total Disch. (cfs) 2/	--	--	3.10	--	10.26	--	--	--	--	--	--

1/ Corrected to a reference temperature of 25°C.

2/ Volumes of flow at the mouth of Hoods Creek and for Walnut Fork immediately above the mouth of Hoods Creek.

3/ Above the mouth of Hoods Creek.

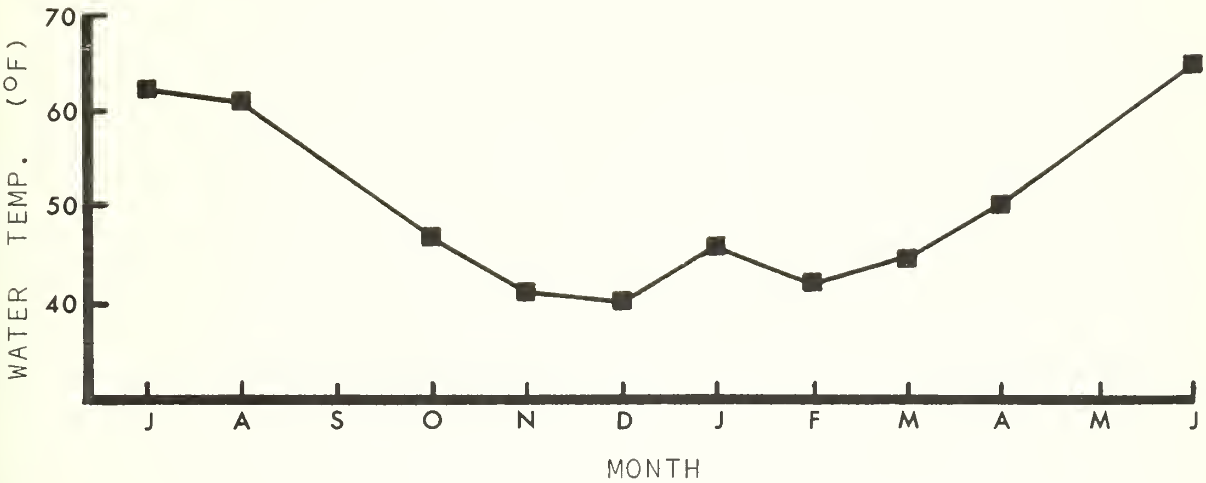

Figure 1. Variation of mean daytime water temperature (°F) during the report period July 1968 - June 1969 on Hoods Creek and Walnut Fork determined from temperature data collected at monthly intervals at 21 stations.

temperature of 25 °C, in Hoods Creek, and Walnut Fork above the mouth of Hoods Creek, respectively, on a composite mean of the annual-station-means basis. However, specific conductance varied from this mean value in two distinct patterns--conductance varied in a definite annual cycle, and conductance decreased with progression upstream. Specific conductance varied from a high of 135.3 micromhos/cm in August 1968 to a low of 94.9 in April 1969 on Hoods Creek, with an essentially similar pattern exhibited by Walnut Fork, a high of 117.7 in July 1968 to a low of 84.9 in February 1969 (Table 5, Figure 2). Conductance in both streams increased, from the low values observed during the winter, to June 1969. Extremes of individual readings ranged from 85 to 145 micromhos/cm and 78 to 120 micromhos/cm on Hoods Creek and Walnut Fork, respectively. While the annual patterns were essentially similar on both Hoods Creek and Walnut Fork (Figure 2), Walnut Fork consistently exhibited a lower specific conductance than Hoods Creek during the report period.

Specific conductance decreased with progression upstream on both Hoods Creek and Walnut Fork above the confluence (Table 6, Figure 3). Mean annual conductance decreased from 116.4 to 102.1 micromhos/cm on Hoods Creek, from 102.2 to 91.7 on Walnut Fork, from Station 1 immediately above the confluence upstream to Station 10. This general pattern of an upstream decrease was evident in each set of monthly readings; however, specific conductance was consistently higher on Hoods Creek (Table 6). The specific conductance of Walnut Fork below the confluence was affected by the

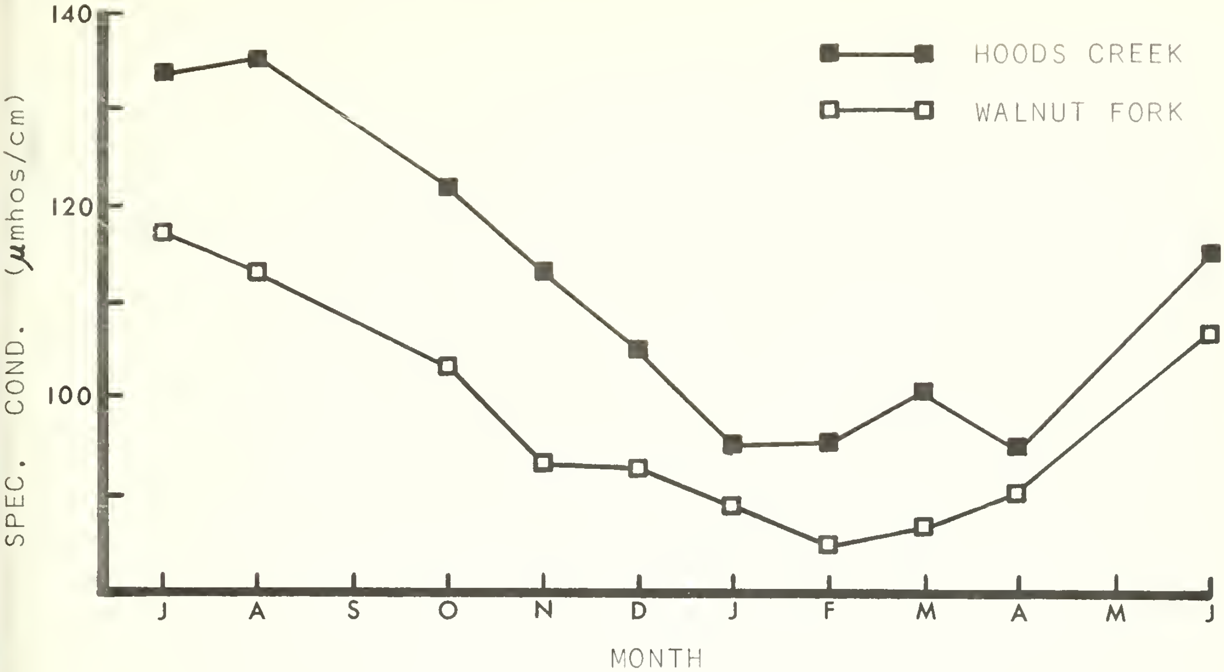

Figure 2. Variation of mean specific conductance (micromhos/cm), corrected to a reference temperature of 25°C, during the report period July 1968 - June 1969 on Hoods Creek and Walnut Fork determined from conductivity readings at monthly intervals at 10 stations on each stream above the confluence.

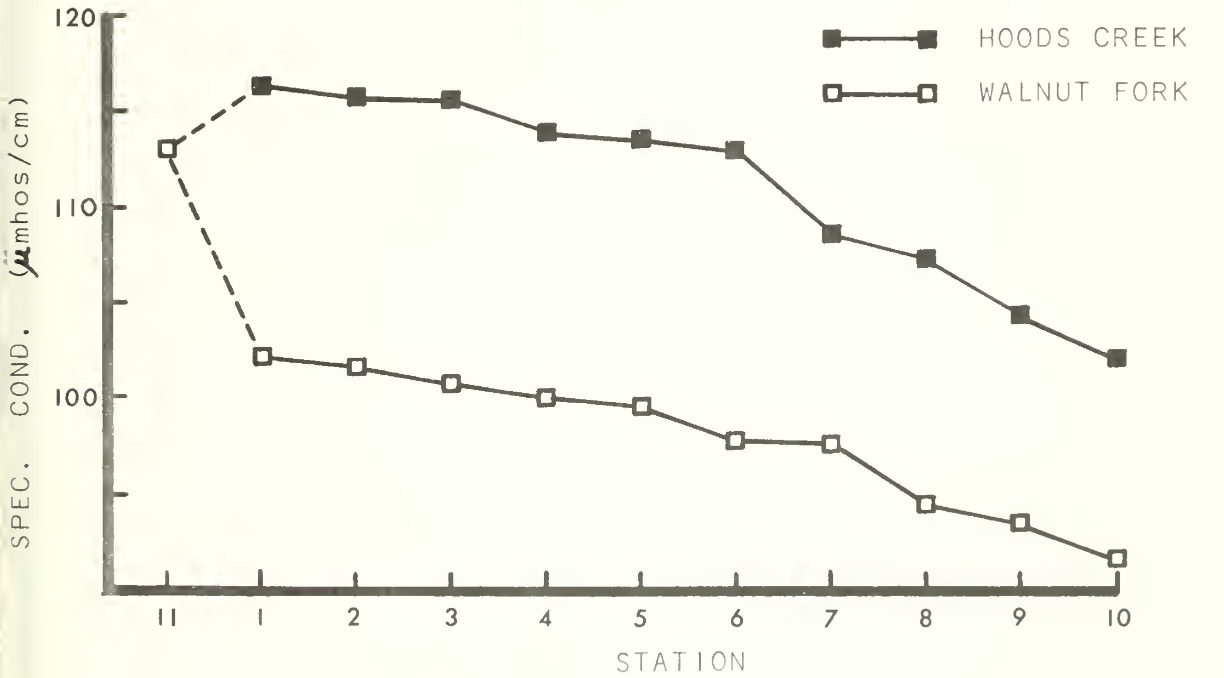

Figure 3. Decrease with progression upstream of mean specific conductance (micromhos/cm), corrected to a reference temperature of 25°C, during the report period July 1968 - June 1969 on Hoods Creek and Walnut Fork. (Plotted points are annual means for Stations 1-10 numbered sequentially upstream on both streams above the confluence, and for Station 11 below the confluence.)

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able 6. Specific conductance (micromhos/cm), corrected to a reference emperature of 25°C, at ten stations on Hoods Creek (Stations 1A-10A), en stations on Walnut Fork above the mouth of Hoods Creek (1B-10B), nd 1 station on Walnut Fork below the mouth of Hoods Creek (Station 11), rom July 1968 to June 1969 (stations on Hoods Creek and Walnut Fork bove the confluence numbered consecutively upstream).

	Jul	Aug	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Jun	Station Means
1A	140	145	125	118	115	100	100	105	98	118	116.4
2A	145	142	125	118	112	98	98	105	98	118	115.9
3A	140	140	125	118	118	98	98	105	98	118	115.8
4A	140	140	125	118	105	98	98	100	98	118	114.0
5A	140	135	125	118	110	98	98	100	95	118	113.7
6A	140	135	124	118	108	98	95	100	95	118	113.1
7A	125	132	120	110	102	95	94	100	95	115	108.8
8A	125	131	120	110	100	90	94	98	92	115	107.5
9A	122	128	115	105	95	90	92	98	90	110	104.5
10A	121	125	115	100	85	90	90	95	90	110	102.1
1B	120	117	105	100	90	92	90	90	100	118	102.2
2B	120	120	105	100	96	90	88	90	92	118	101.9
3B	120	115	105	100	92	92	88	90	92	115	100.9
4B	118	112	108	95	98	90	88	90	91	110	100.0
5B	118	112	108	95	98	90	85	90	90	110	99.6
6B	118	110	108	90	95	90	85	90	88	105	97.9
7B	118	115	108	90	91	88	85	85	88	110	97.8
8B	115	109	100	90	90	88	82	85	88	98	94.5
9B	115	110	100	90	90	87	80	80	88	95	93.5
10B	115	112	90	85	90	84	78	80	88	95	91.7
11	135	135	125	110	115	100	98	98	98	118	113.2

concentration of dissolved solids in each of the confluent streams. The higher concentrations of dissolved solids in Hoods Creek were diluted by mixing with the flow of Walnut Fork, with its lower concentrations, to produce a confluent flow with a mean annual specific conductance of 113.2 micromhos/cm, a value lower than that at the mouth of Hoods Creek, but higher than Walnut Fork immediately above the confluence (Figure 3).

Macrobenthic Populations--Analysis of the Surber bottom samples could not be accomplished in time for inclusion in this report. Samples have been collected at the ten stations on Hoods Creek, the ten stations on Walnut Fork above the mouth of Hoods Creek, and the station on Walnut Fork below the confluence, on a monthly basis throughout this report period. These data on benthic macrofauna will be presented in the F-21-2 annual project report.

Trout Mortality Due to Predation--The only instance of trout mortality due to nonpiscian predation observed during the report period was by a northern water snake, *Natrix sipedon sipedon*, encountered on Hoods Creek on July 24, 1968, with a partially ingested stocked rainbow trout, approximately 9-10 inches in length, that it had apparently captured. The *Natrix* immediately disgorged the fish when discovered and attempted to escape. Whether this trout was healthy prior to its capture, or whether it was sick or injured, imparing its ability to escape predation, is unknown; however, *Natrix* have the ability to capture healthly trout. This has been the only *Natrix* observed along the study

stream: they are not considered to be important contributors to trout mortality by predation.

Eastern belted kingfishers, *Megaceryle alcyon alcyon*, are fairly common along both Hoods Creek and Walnut Fork during the warmer months. These avian piscivores may be important predators on trout, particularly on the smaller size classes.

Fish Populations--No statement can be made concerning temporal or spatial comparisons of standing crop of stream-reared fish until the completion of the stream system habitat mapping and zoning. The consideration of each stream or long sections of stream as autonomous entities for the purpose of determining temporal changes in standing crop or spatial relationships of standing crop of the two streams presents an invalid description due to the extreme variation in ecological conditions.

However, information on certain aspects of the dynamics, structure, and composition of the fish populations in Hoods Creek and Walnut Fork can be readily obtained from the population data collected during the report period. The fall sample was taken at five stations on Hoods Creek and four stations on Walnut Fork above the mouth of Hoods Creek on November 7,8, and 13, 1968 (Table 7). The sampling rate was decreased to lessen any deleterious effects on spawning fish but still provide a reliable estimate of the existing population. Several stocked hatchery-reared rainbow trout were taken in the sample: these comprised not only a significant percentage of the sexually mature rainbow in the sections sampled,

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Table 7. Results of the fish population sampling with cresol at 5 stations on Hoods Creek and 4 stations on Walnut Fork above the mouth of Hoods Creek, November 7, 8, and 13, 1968 (LP indicates left pelvic fin clip, the fin clip used on rainbow trout stocked during the 1968 fishing season; T = trace).

Station No.	Species	Length (inches)	Weight (grams)
Hoods Creek			
1A	*Salmo trutta*	8.5	120
	Salmo trutta	7.8	74
	Salmo trutta	4.3	11
	Salmo trutta	4.0	10
	Salmo gairdneri	3.9	9
	Hypentelium nigricans (8)	5.0-8.9	504
	Total - trout species		224
	Total - non-trout species		504
	Total		728
3A	*Salmo trutta*	4.4	11
	Salmo trutta	3.9	9
	Salmo trutta	3.4	4
	Salmo gairdneri (LP)	10.0	170
	Salmo gairdneri (LP)	9.8	141
	Salmo gairdneri (LP)	9.1	90
	Salmo gairdneri (LP)	8.9	94
	Salmo gairdneri	3.8	9
	Hypentelium nigricans	1.5	T
	Etheostoma sp.	2.5	2
	Total - trout species		528
	Total - non-trout species		2
	Total		530
5A	*Salmo gairdneri*	5.3	24
	Salmo gairdneri	4.5	15
	Salmo gairdneri	4.1	11
	Salmo gairdneri	4.0	12
	Salmo gairdneri	4.0	11
	Salmo gairdneri	3.8	9
	Total		82

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Table 7. Continued.

7A	*Salmo gairdneri* (LP)	10.0	143
	Salmo gairdneri	6.5	50
	Salmo gairdneri	5.5	38
	Salmo gairdneri	5.4	36
	Total		267
9A	*Salmo trutta*	12.1	320
	Salmo trutta	5.1	22
	Total		342
<u>Walnut Fork</u>			
1B	*Salmo gairdneri* (LP)	9.6	98
	Salmo gairdneri (LP)	9.1	110
	Salmo gairdneri	4.3	15
	Salmo gairdneri	4.3	13
	Salmo gairdneri	3.9	10
	Salmo gairdneri	3.5	9
	Salmo trutta	5.1	21
	Hypentelium nigricans	6.5	40
	Catostomus commersoni	8.0	78
	Total - trout species		276
	Total - non-trout species		118
	Total		394
3B	*Salmo gairdneri*	8.8	120
	Salmo gairdneri	7.5	80
	Salmo gairdneri	7.4	82
	Salmo gairdneri	5.5	31
	Salmo gairdneri	4.8	11
	Salmo gairdneri	4.8	10
	Salmo gairdneri	4.3	14
	Salmo gairdneri (2)	4.3	15
	Salmo gairdneri	4.3	13
	Salmo gairdneri	4.2	15
	Salmo gairdneri	4.2	16
	Salmo gairdneri	3.9	14
	Salmo gairdneri	3.9	13
	Salmo gairdneri	3.9	10
	Salmo gairdneri (2)	3.5	7
	Total		473

Table 7. Continued.

5B	*Salmo gairdneri*	5.9	40
	Salmo gairdneri (2)	4.5	20
	Salmo gairdneri	4.5	16
	Salmo gairdneri (3)	4.0	14
	Salmo gairdneri (2)	3.9	12
	Salmo gairdneri	3.9	8
	Salmo gairdneri	3.9	7
	Salmo gairdneri	3.8	14
	Salmo gairdneri (2)	3.8	11
	Salmo gairdneri	3.6	10
	Salmo gairdneri	3.0	9
	Salvelinus fontinalis	6.8	66
	Total		298
7B	*Salmo gairdneri* (2)	3.9	11
	Salmo gairdneri	3.3	8
	Total		30

but of all three trout species. Brown trout were the dominant salmonid in the lower two stations sampled on Hoods Creek, disregarding the stocked rainbow. The bulk of the weight in the lower station (1A) was comprised of hogsuckers. This species is definitely a significant member of the fish fauna in the lower sections of both streams. The largest fish taken in the series of samples, a 12.1 inch brown trout, came from Station 9A on Hoods Creek. Hoods Creek has brown trout its entire length. The two samples at Stations 3B and 5B on Walnut Fork in the long flat section above the lower cascades yielded numerous young-of-the-year (age-group O). This many fish remaining from the previous winter's hatch indicated a heavy spawn in this section of the stream. The stream here has a low gradient and a good pool-riffle ratio, with an abundance of good spawning sites and nursery areas.

The spring sample was taken June 24-26, 1969, at all stations on both streams (Table 8). No rainbow stocked during the previous season (1968) were recovered, indicating very poor survival of the fish not brought to creel. The number of stocked fish brought to creel in 1968 was estimated at 571 of the 1175 stocked, leaving 604 unharvested rainbow in the study streams. Brown trout and hogsuckers were again the predominant species in the lower sections of both streams in the spring samples. Several brown trout fingerlings were taken at Station 2A. The sampling stations above the cascades on Hoods Creek yielded very few fish: only one fingerling, unidentified and not recovered, was observed. The samples in the flat stretch above the cascades on Walnut Fork (3B-6B) revealed few

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ꞌable 8. Results of the fish population sampling with cresol at) stations on Hoods Creek (Stations 1A-10A), 10 stations on Walnut ɔrk above the mouth of Hoods Creek (1B-10B), and 1 station on ılnut Fork below the mouth of Hoods Creek (Station 11), on June 24-5, 1969 (RP indicates right pelvic fin clip, the fin clip used on ıinbow trout being stocked during the 1969 fishing season; NR ıdicates fish observed but not recovered, weights were estimated ːom available length-weight data; T = trace).

ation No.	Species	Length (inches)	Weight (grams)
ods Creek			
1A	*Salmo trutta*	6.6	48
	Salmo trutta	6.5	50
	Salmo trutta	2.7	2
	Salmo gairdneri	2.5	2
	Hypentelium nigricans	8.9	114
	Hypentelium nigricans	8.5	102
	Hypentelium nigricans	7.5	68
	Hypentelium nigricans	1.8	T
	Hypentelium nigricans (NR)	8.0	80
	Total - trout species		102
	Total - non-trout species		364
	Total		466
2A	*Salmo trutta*	3.0	3
	Salmo trutta	2.7	2
	Salmo trutta	2.4	2
	Salmo trutta (2)	2.3	1
	Salmo trutta	2.2	1
	Salmo gairdneri (RP) (12)	8.8-10.9	2274
	Salmo gairdneri	1.9	T
	Hypentelium nigricans	8.3	86
	Total - trout species		2284
	Total - non-trout species		86
	Total		2370
3A	*Salmo trutta*	6.6	50
	Salmo trutta	6.6	42
	Salmo trutta	3.0	2
	Salmo trutta	2.5	2
	Hypentelium nigricans	8.2	92
	Hypentelium nigricans	5.3	24
	Hypentelium nigricans (NR)	5.0	25
	Total - trout species		96
	Total - non-trout species		141
	Total		237

b No. IV-1

ble 8. Continued.

4A	*Salmo trutta*	9.3	122
	Salmo trutta	5.7	40
	Salmo trutta	3.1	4
	Salmo trutta (NR)	9.0	130
	Salmo gairdneri (RP)	10.2	150
	Unidentified trout (NR)	7.5	75
	Unidentified fingerling (NR) (2)	--	2
	Unidentified (NR)	7.5	75
	Hypentelium nigricans (NR)	6.0	40
	Total - trout species		525
	Total - non-trout species		115
	Total		640
5A	No fish observed		
6A	*Salmo gairdneri*	10.0	170
	Salmo gairdneri	8.2	100
	Salmo gairdneri (NR)	9.0	130
	Unidentified fingerling (NR)	--	2
	Total		402
7A	*Salmo gairdneri*	8.2	106
	Total		106
8A	*Salmo gairdneri*	6.6	50
	Salmo gairdneri (NR)	9.0	130
	Salmo gairdneri (NR)	7.0	60
	Total		240
9A	No fish observed		
10A	*Salmo trutta*	9.0	130
	Total		130

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able 8. Continued.

lnut Fork

11	*Salmo trutta*	7.0	60
	Salmo trutta	2.8	2
	Salmo gairdneri (RP)	9.3	140
	Salmo gairdneri	2.6	2
	Salmo gairdneri (2)	2.2	1
	Salmo gairdneri (NR)	7.0	60
	Unidentified fingerling (NR) (2)	--	2
	Total		270
1B	*Salmo trutta*	2.5	2
	Salmo gairdneri (RP) (6)	8.9-10.9	1166
	Hypentelium nigricans	7.0	52
	Total - trout species		1168
	Total - non-trout species		52
	Total		1220
2B	*Salmo gairdneri*	3.0	2
	Total		2
3B	*Salmo gairdneri* (RP)	10.5	184
	Salmo gairdneri (RP)	10.2	180
	Salmo gairdneri	6.7	62
	Salmo gairdneri	2.2	2
	Total		428
4B	*Salmo gairdneri* (RP)	9.8	160
	Salmo gairdneri (RP)	9.7	152
	Salmo gairdneri (RP)	6.8	64
	Salmo gairdneri	7.3	72
	Salmo gairdneri	6.3	50
	Salmo gairdneri	6.1	48
	Salmo gairdneri	5.5	38
	Salmo gairdneri	5.2	30
	Salmo gairdneri (NR-RP) (2)	10.0	175
	Salmo gairdneri (NR)	5.0	25
	Total		989

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able 8. Continued.

5B	*Salmo gairdneri*	7.8	80
	Salmo gairdneri	6.9	60
	Salmo gairdneri	2.8	3
	Salmo gairdneri	2.6	2
	Salvelinus fontinalis	8.5	122
	Total		267
6B	*Salmo gairdneri*	7.9	84
	Salmo gairdneri	6.2	48
	Salmo gairdneri	5.4	30
	Salmo gairdneri	5.0	20
	Salmo gairdneri	2.9	4
	Salmo gairdneri	2.9	2
	Salmo gairdneri	2.7	3
	Salmo gairdneri	2.6	2
	Salmo gairdneri	2.5	2
	Salmo gairdneri (NR)	8.5	110
	Salmo gairdneri (NR)	5.0	25
	S. gairdneri fingerlings (NR) (2)	--	2
	Total		334
7B	*Salmo gairdneri*	6.4	55
	Salmo gairdneri	5.5	30
	Salmo gairdneri	5.2	31
	Salmo gairdneri	2.4	2
	Salmo gairdneri (NR) (2)	5.0	25
	Salvelinus fontinalis	9.1	145
	Total		313
8B	No fish observed		
9B	*Salvelinus fontinalis*	3.5	10
	Salvelinus fontinalis (2)	3.3	8
	Salvelinus fontinalis	2.6	2
	Salvelinus fontinalis (NR) (2)	3.0	5
	Total		38

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ble 8. Continued.

10B	*Salvelinus fontinalis*	7.9	87
	Salvelinus fontinalis	7.6	80
	Salvelinus fontinalis	7.3	62
	Salvelinus fontinalis	4.6	14
	Salvelinus fontinalis	4.5	14
	Salvelinus fontinalis	3.8	12
	Salvelinus fontinalis	2.8	3
	Salvelinus fontinalis	2.6	2
	Salvelinus fontinalis	2.3	1
	Salvelinus fontinalis	1.8	T
	Salvelinus fontinalis	1.7	T
	Salvelinus fontinalis (NR)	7.0	60
	Salvelinus fontinalis (NR)	3.0	5
	Salvelinus fontinalis (NR) (3)	2.5	2
	Salvelinus fontinalis (NR)	2.0	1
	Total		347

young fish in the population, indicating a poor spawn the previous winter. The sample at 10B revealed that the brook trout stocked in the headwaters of Walnut Fork in 1965 have become well established and are reproducing.

Length frequencies of stream-reared trout in the November 1968 population sample indicated a high percentage of age-group 0 fish in the total stream-system population (Table 9). Most of the young rainbow trout were from 3.5 to 4.4 inches TL by this time (Figure 4). Taking the stream system as an entire unit, rainbow were the predominant fish both numerically and by weight. The sample revealed a paucity of sexually mature fish that would provide next year's recruitment. Only a few trout in 4500 feet of stream were possible breeders.

Length frequencies of the stream-reared trout in the June 1969 population sample indicated a very sparse recruitment to the rainbow population (Table 10, Figure 4). Age-class I (spawned 1968) had reached a minimum size of 5.0 inches TL, while age-class 0 fish averaged 2.5 to 2.9 inches TL by June. The brown trout fared a little better, while brook trout recruitment in the established population in Walnut Fork was good. Only one fingerling of the spring spawning hogsucker was recovered, while several adult fish appeared in the sample. Young hogsuckers apparently move downstream out of the area.

Utilization of Artificial Spawning Devices--Three of the artificial spawning devices on Hoods Creek below the barrier falls were utilized

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able 9. Length frequencies of stream-reared rainbow, brown, and rook trout collected in population sampling at 9 stations on Hoods reek and Walnut Fork in November 1968 (first figure under species olumns is the number of individuals, figures in parentheses are he total weight in grams of all individuals in the size group).

Inch Group	Rainbow	Brown	Brook
3.0-3.4	2(17)	1(4)	
3.5-3.9	20(204)	1(9)	
4.0-4.4	14(192)	3(32)	
4.5-4.9	6(92)		
5.0-5.4	2(60)	2(43)	
5.5-5.9	3(109)		
6.0-6.4			
6.5-6.9	1(50)		1(66)
7.0-7.4	1(82)		
7.5-7.9	1(80)	1(74)	
8.0-8.4			
8.5-8.9	1(120)	1(120)	
12.0-12.4		1(320)	
Total	51(1006)	10(602)	1(66)

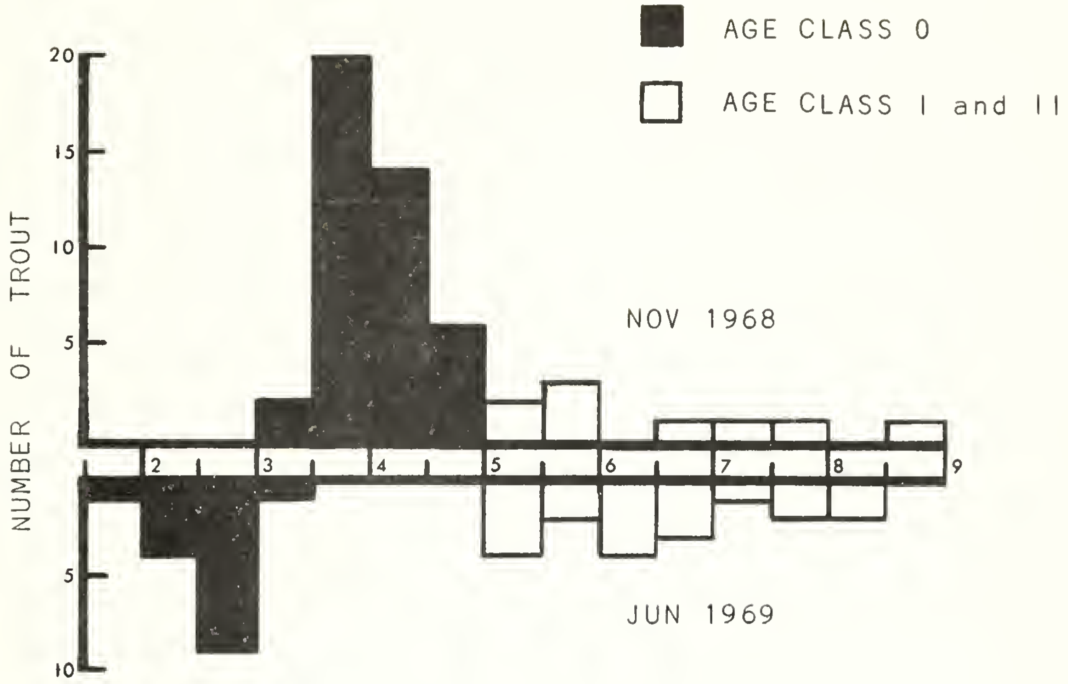

Figure 4. Histogram of length frequencies (total length in inches) of stream-reared rainbow trout in population samples on Hoods Creek and Walnut Fork in November 1968 (9 stations, 4500 feet) and June 1969 (21 stations, 10,500 feet).

ɔ No. IV-1

ɔle 10. Length frequencies of stream-reared rainbow trout, brown ɔut, brook trout, and hogsuckers collected in population sampling 21 stations on Hoods Creek and Walnut Fork in late June 1969 irst figure under species columns is the number of individuals, ɡures in parentheses are the total weight in grams of all individuals the size group).

Inch Group	Rainbow	Brown	Brook	Hogsucker
1.5-1.9	1(T)		2(1)	1(T)
2.0-2.4	4(6)	4(5)	1(1)	
2.5-2.9	9(22)	5(10)	3(7)	
3.0-3.4	1(2)	3(9)	2(16)	
3.5-3.9			2(22)	
4.0-4.4				
4.5-4.9			2(28)	
5.0-5.4	4(111)			1(24)
5.5-5.9	2(68)	1(40)		
6.0-6.4	4(201)			
6.5-6.9	3(172)	4(190)		
7.0-7.4	1(72)	1(60)	1(62)	1(52)
7.5-7.9	2(164)		2(167)	1(68)
8.0-8.4	2(206)			2(178)
8.5-8.9			1(122)	2(216)
9.0-9.4		2(252)	1(145)	
9.5-9.9				
10.0-10.4	1(170)			
Total	34(1194)	20(566)	17(570)	8(538)

by brown trout during the spawning season of 1968-69. The redds in these three devices contained viable eggs. Two were inspected just prior to emergence and were found to contain healthy prolarvae. None of the other spawning devices had been utilized. More detailed data on the usage of spawning devices during the 1968-69 spawning season will be presented in the F-21-2 annual project report.

Location of Redds--Data on the locations and physical characteristics (*i.e.*, velocity of flow, gravel size) of the redd sites on the study streams will be presented in F-21-2 annual project report.

Inorganic Sediment Deposition in Pools--Estimates of the volume of inorganic sediment deposits were obtained for five pools on each study stream during January 1969. These data were not analyzed in time for inclusion in this report and will be presented in the F-21-2 annual project report.

Sediment Impoundment by Tributary Silt Traps--Estimates of the volume of sediment impounded by the tributary silt traps on the small feeder streams in the Hoods Creek watershed were obtained during January 1969. These data were not analyzed in time for inclusion in this report and will be presented in the F-21-2 annual project report.

Discussion: Since this is an interim report, and the field data have not been completely analyzed and interpretted, no conclusions will be presented at this time. However, a discussion of proposed treatments of certain of the field data is presented below.

Job No. IV-1

After the completion of the stream and watershed mapping, the total discharge data for the various sampling stations on both creeks will be used to comput flow in csm (cubic feet per second per square mile, calculated by dividing the flow in cfs by the drainage area in square miles) to compare the rates of flow on the two creeks and at the various stations with their respective drainage areas.

The thermograph recordings will be analyzed to provide the following data on air and stream temperatures: daily maximum temperatures, daily minimum temperatures, mean daily temperatures (average of the daily maximum and minimum temperatures), daily ranges (difference between the daily maximum and daily minimum temperatures), mean monthly maximum temperatures, mean monthly minimum temperatures, mean monthly temperatures (average of the mean monthly maximum and mean monthly minimum temperatures), monthly ranges (difference between the monthly maximum and monthly minimum temperatures), mean annual temperature (average of the mean monthly temperatures), annual range (difference between the highest and lowest temperature recorded during the year), hours of the day when maximum and minimum temperatures occur, lag periods of increase or decrease of stream temperature with change in air temperature, effect of air temperatures on stream temperatures, and rates of temperature changes.

The specific conductance data will be further analyzed to calculate regression equations for the decrease in conductance with increasing distance upstream from the confluence of the study

streams for both Hoods Creek and Walnut Fork.

The Hoods Creek - Walnut Fork stream system will be divided into ecological zones based on stream habitat conditions, species composition, and isolating topographic features--such as barrier falls--which prevent recruitment to the population through upstream ingress. Isolating topographic features also prevent egress through upstream movement and establishment of certain species in some sections of the stream. This appears to be the only valid method to compare fish populations, both temporally and spatially, to determine if changes or differences in standing crop and population composition exist or have occurred. The length and weight data obtained during population sampling will be analyzed to determine seasonal variation of the coefficient of condition.

Acknowledgements: Senior Biological Aide Carlton Nichols and Biological Aide Jefferson Houck collected or assisted in the collection of most of the field data during the report period. Messrs. Cecil Brown, Farish Kilby, and James Turpin assisted in certain phases of the field work. Mrs. Wanda Jackson typed the manuscript and related project work. Mrs. Elaine Fatora kindly reviewed the manuscript.

Final Report

Statewide Fisheries Investigations

F-21-1

July 1, 1968 - June 30, 1969

Study No. IV

Trout Stream Investigations

Job No. 2

EXPERIMENTAL DEVELOPMENT ON TROUT STREAMS

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Experimental Development On Trout Streams

ımmary: A total of 31 stream-alteration structures were constructed ı Hoods Creek and Walnut Fork during the fiscal year, including 13 plash dams, 2 digger logs, 3 double-wing deflectors, 2 single-wing eflectors, and 11 rock deflectors. Eight culverts and one bridge ere constructed on small feeder streams and spring drainages flowing cross the Hoods Creek access road to reduce localized road degradation. ater breaks were repaired and gravel was spread on the steep grades the Hoods Creek access road to decrease extensive roadbed deterioation. Mudholes resulting from diverted spring seepages were drained ıd filled with gravel. Road maintenance was performed on the Walnut ork access road where feasible. Raw areas at construction sites, .ong the access roads, and at the stream crossings were fertilized ıd seeded to fescue.

ıckground: A project to evaluate the effects of various stream ıbitat-alteration structures and erosion control measures on ıbitat conditions and fish and benthos populations in the Hoods eek - Walnut Fork watershed was initiated in fiscal year 1966-67. e background data on this watershed and the data on physicochemical ter properties, fish populations, and benthos populations obtained ıring fiscal years 1966-67 and 1967-68 were presented in the Final eport for Project No. F-17-R under Work Plan III, Job No. 1 (Survey

ob No. IV-2

f Trout Streams). The data collected during this report period on ish populations, macrobenthos populations, and physicochemical ater properties are reported under Job No. IV-1, Evaluation of evelopment on Trout Streams. The results of the creel census conducted on Hoods Creek and Walnut Fork during the report period in onjunction with this project are presented under Job No. XV-2, Trout tream Creel Census.

Development work was initiated during fiscal year 1967-68. A eport on the work accomplished was presented in the Final Report or Project No. F-17-R under Work Plan III, Job No. 3 (Trout Stream evelopment Investigations). This included the construction of 24 rtificial spawning areas and 9 tributary silt traps. Seeding of aw areas was implemented to control watershed erosion. Log barriers mpounding silt were removed. The development work accomplished uring this report period terminates the development work on the two treams.

bjectives: (a) To construct approximately 30 stream habitat-lteration structures on the project streams.

(b) To continue implementation of erosion control measures in e project watershed by construction of bridges and culverts on the cess roads and by seeding raw areas.

esults: A total of 31 stream-alteration structures were constructed n the project streams during the latter half of this report period, 5 on Hoods Creek and the remaining six on Walnut Fork (Table 1). f this total, 13 are splash dams constructed of 10-13 inch diameter

Table 1. Measurements of components of stream-alteration structures constructed on Hoods Creek and Walnut Fork in fiscal year 1968-69.

Stream	Structure No.[1]	Structure Type	Log Size Length (feet)	Log Size Diameter (inches)	Wire Length (feet)[2]
Hoods	1A	Splash Dam	30	12	26
Hoods	2A	Splash Dam	28	13	25
Hoods	3A	Splash Dam	30	11	27
Hoods	4A	Double-wing Deflector	17 23	12 12	-- --
Hoods	5A	Splash Dam	26	13	24
Hoods	6A	Splash Dam	30	12	26
Hoods	7A	Splash Dam	28	11	25
Hoods	8A	Splash Dam	27	12	24
Hoods	9A	Splash Dam	25	13	22
Hoods	10A	Splash Dam	26	10	23
Hoods	11A	Digger Log	22	11	--
Hoods	12A	Rock Deflector	--	--	--
Hoods	13A	Rock Deflector	--	--	--
Hoods	14A	Splash Dam	30	12	27
Hoods	15A	Rock Deflector	--	--	--
Hoods	16A	Rock Deflector	--	--	--
Hoods	17A	Splash Dam	22	10	18
Hoods	18A	Double-wing Deflector	18 16	11 12	-- --
Hoods	19A	Rock Deflector	--	--	--
Hoods	20A	Rock Deflector	--	--	--
Hoods	21A	Rock Deflector	--	--	--
Hoods	22A	Rock Deflector	--	--	--
Hoods	23A	Rock Deflector	--	--	--
Hoods	24A	Rock Deflector	--	--	--
Hoods	25A	Rock Deflector	--	--	--
Walnut	1B	Splash Dam	24	13	21
Walnut	2B	Single-wing Deflector	14	12	--
Walnut	3B	Digger Log	24	11	--
Walnut	4B	Double-wing Deflector	18 16	11 13	-- --
Walnut	5B	Single-wing Deflector	18	14	--
Walnut	6B	Splash Dam	23	12	--[3]

1/ Structures numbered consecutively upstream: A-numbered structures are located on Hoods Creek; B-numbered structures on Walnut Fork.

2/ 1" x 2" mesh galvanized hardware cloth in 5 ft. width used to seal splash dams.

3/ Plank seal constructed of 6 2" x 12" x 8' boards and 15 2" x 8" x 8' boards.

logs 22-30 feet in length and, with one exception, sealed with 1 x 2 inch mesh galvanized hardware cloth (Figures 1 and 2). The last splash dam constructed was sealed with wooden planking of overlapping 2 x 12's and 1 x 8's (Figure 3). Seven additional log structures were erected, including two digger logs, three double-wing deflectors (Figure 4), and two single-wing deflectors. Eleven deflectors constructed of large rocks were built on Hoods Creek (Figure 5).

Eight culverts were constructed on small feeder streams flowing across the Hoods Creek access road during this report period; most during the first half of the fiscal year (Table 2). Small feeder streams and springs, that had never been bridged or where old culverts had clogged and deteriorated, were flowing across the access road, or in some instances had become diverted down the roadbed, causing excessive deterioration of the road and subsequently contributing to siltation of the stream. Five V-type culverts constructed of 2 x 12 planking were installed (Figure 6). One hollow log was installed as a culvert. Two corrugated 12-inch-diameter metal pipes were installed during October 1968 on two feeder streams with volume of flow too high for V-type plank culverts (Figure 7).

One additional bridge was constructed during May 1969 over a feeder stream flowing across the Hoods Creek access road (Table 2, Figure 8). This crossing presented a problem, due to the resulting perennial mudhole, that was compounded by a spring seepage diverted down the road, causing roadbed erosion. A log abutment bridge floored with planking was erected, gravel spread on the bridge approaches, and areas left raw by construction seeded to fescue.

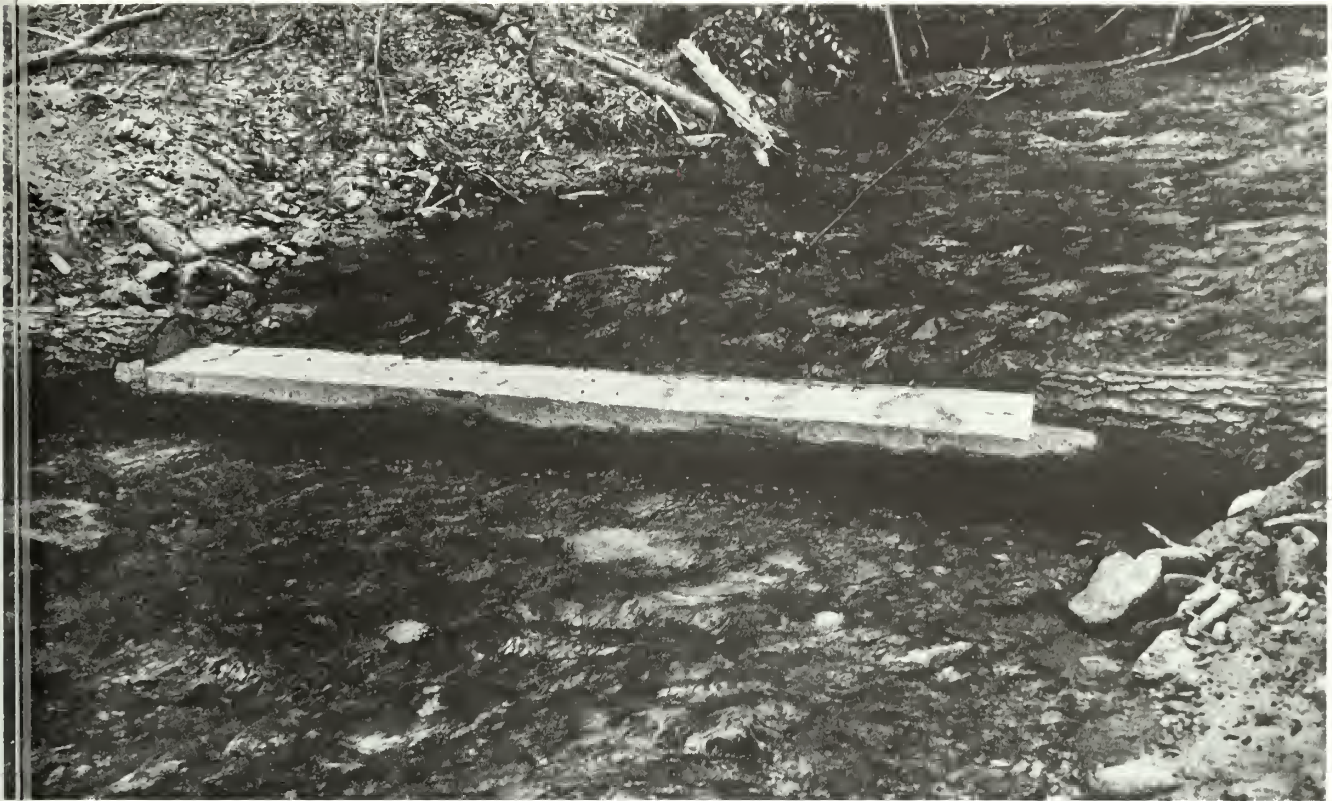

Figure 1

Hewed log of a partially completed splash dam, embedded in the stream banks of Hoods Creek, ready for the wire seal

Figure 2

Completed splash dam on Hoods Creek

Figure 3

Plank-seal splash dam on Walnut Fork constructed June 1969

Figure 4

Double-wing deflector on Hoods Creek

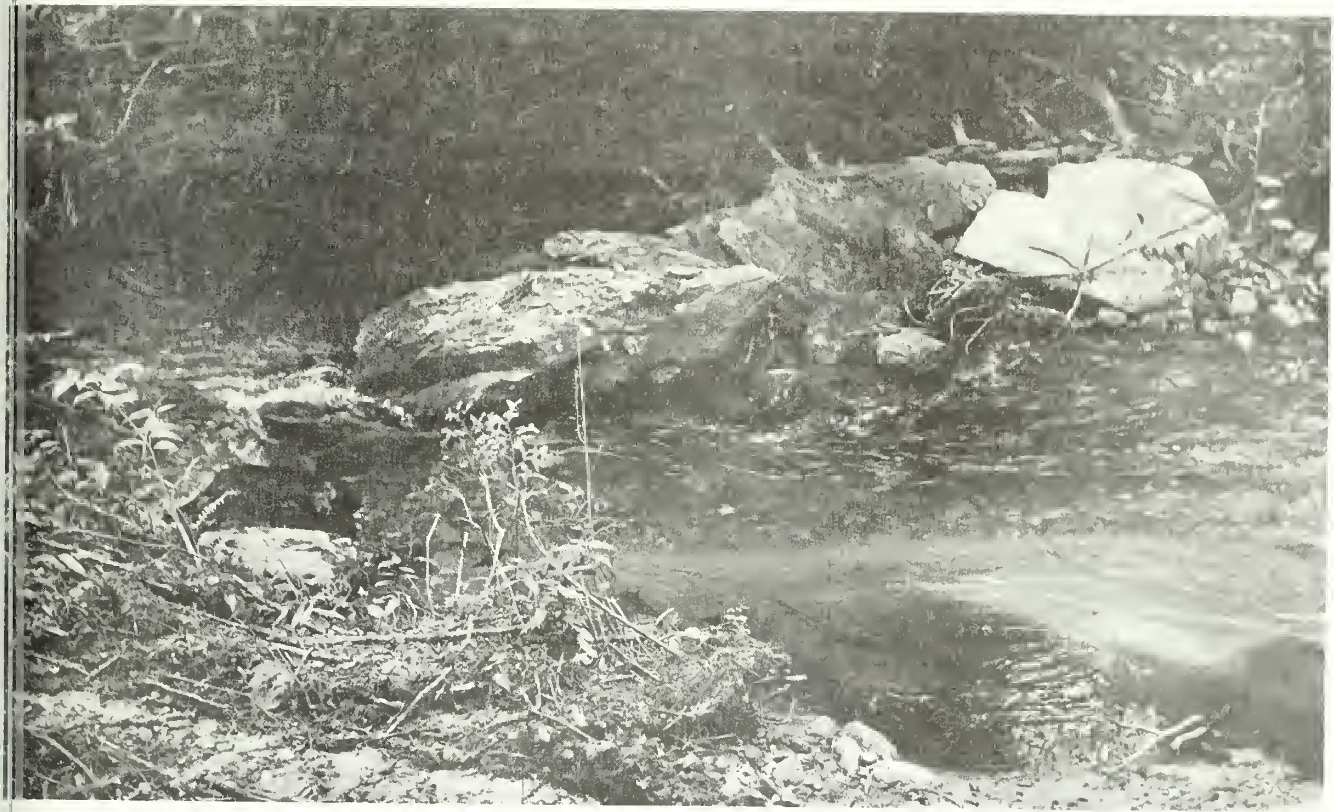

Figure 5

Rock deflector on Hoods Creek

Figure 6

V-type plank culvert on the Hoods Creek access road, installed to carry the flow of a spring drainage

ıble 2. Raw materials used in bridge and culvert construction on
ıe Hoods Creek access road in fiscal year 1968-69.

Structure Type	Raw Materials: Average	Raw Materials: Total	No. Structures
rrugated Pipe Culvert	1 12" dia. corrugated metal pipe (12' length)	2 12" dia. corrugated metal pipes (12' length)	2
llow Log Culvert	1 14" dia. hollow log (13.5' length)	1 14" dia. hollow log (13.5' length)	1
type Plank Culvert	2 2" x 12" x 16' planks (64 bd. ft.)	8 2" x 12" x 16' and 2 2" x 10" x 12' planks (296 bd. ft.)	5
g Abutment Bridge	Bridge #1 5 6" to 13" dia. logs (10' length) 2 2" x 10" x 12' boards 1 2" x 6" x 8' boards Bridge #2 1/ 2 12" dia. logs (12' length), 2 10" dia. logs (7' length) 3 2" x 12" x 8' boards 4 2" x 8" x 8' boards 2 2" x 10" x 8' boards Bridge #3 1/ 2 9" and 10" dia. logs (10' length) 4 2" x 12" x 4' boards	11 6" to 13" dia. logs (7' to 12' length) Lumber-197 bd. ft.	3

ob No. IV-2

able 2. Continued.

og Runway Bridge 2/	1 10" dia. log (20' length) 3 12" to 14" dia. logs (14' length)	4 10" to 14" dia. logs (14' to 20' length)	1

' Originally constructed fiscal year 1966-67 but rebuilt during is report period to accommodate loaded gravel trucks.

' Constructed fiscal year 1966-67 but listed here to include .l structures on the Hoods Creek access road.

Figure 7

Corrugated metal pipe culvert on the Hoods Creek access road

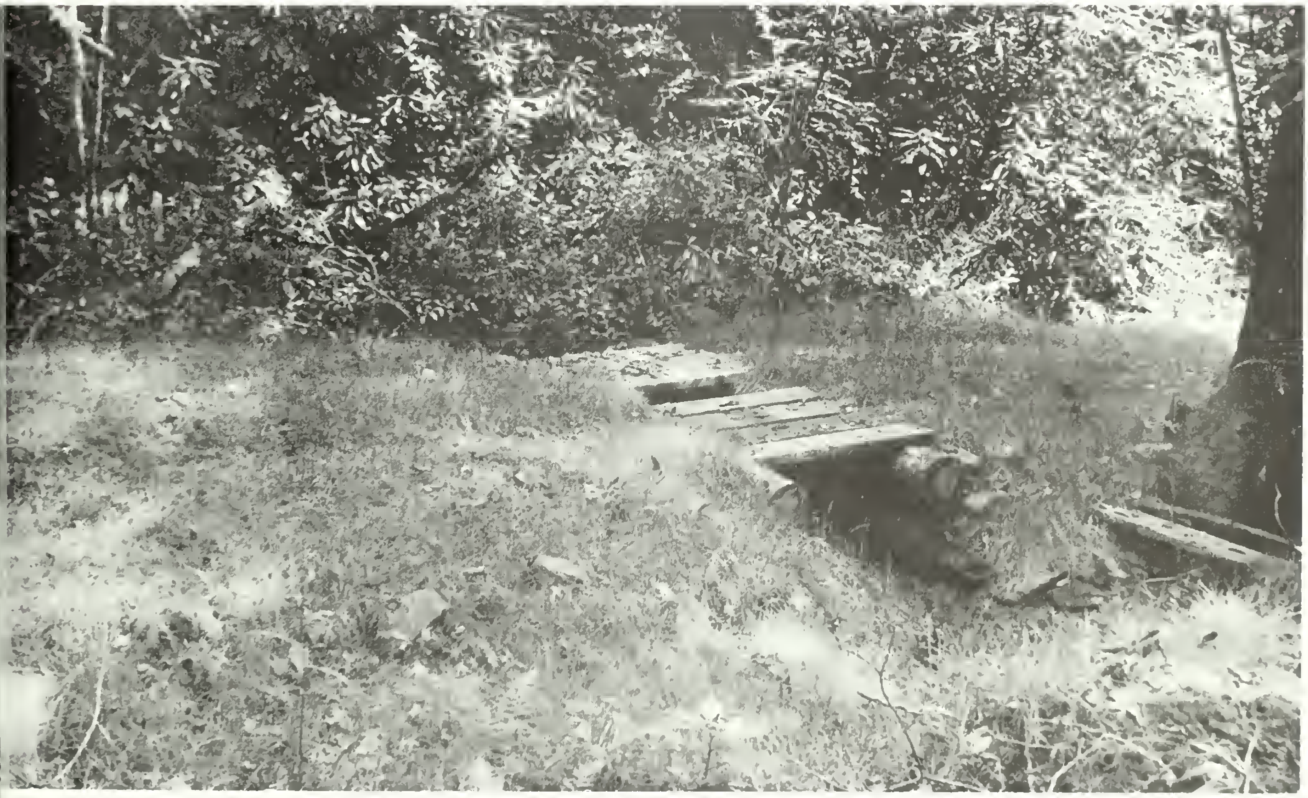

Figure 8

Log-and-plank bridge over a feeder stream on
the Hoods Creek access road constructed May 1969

Two bridges, constructed in fiscal year 1966-67, had to be strengthened to accommodate loaded gravel trucks.

Gravel was spread on steep grades and in mudholes on the Hoods Creek access road in an attempt to control erosion of the roadbed. During August 1968, 125 tons of crusher-run gravel were spread on the lower section of the road. During September and October 1968, approximately 240 cubic yards of creek gravel were trucked to the Hoods Creek road, about half of which was spread on trouble areas on the upper section of the road, and the other half stockpiled for later use. Numerous mudholes on the Hoods Creek access road were drained and filled with gravel to decrease road deterioration and erosion. Water breaks were constructed on steep grades of the Hoods Creek road. Several trouble spots were repaired with gravel on the Walnut Fork access road during the report period, although this road was in much better condition generally than the Hoods Creek road. Pittman-Robertson project personnel cooperated during maintenance activities on the peripheral road that follows the ridgeline around the head of the Hoods Creek watershed by repairing deteriorated water breaks and culverts and reseeding the roadbed.

A short side road, crossing Walnut Fork at two fords and rejoining the main road, was closed during early July 1969, by blocking at both ends with earth mounds, to decrease streambank deterioration at the crossing sites. Raw areas along the access roads and around stream structure construction sites were fertilized and seeded during June and early July 1969 after the termination of development work. Approximately 800 pounds of fertilizer were

applied to the newly seeded areas as well as areas seeded previously. Raw areas around construction sites, along the access roads, and at the stream crossings were seeded with 155 pounds of fescue.

Discussion: The stream-alteration structures constructed on Hoods Creek and Walnut Fork during the latter half of this report period will be evaluated at periodic intervals throughout this study to determine their efficacy in creating pools and providing cover for trout. The majority of the structures were erected on Hoods Creek in order that Walnut Fork could be maintained more in its natural state as a basis for comparison. All the artificial spawning areas were constructed on Hoods Creek, except one on the lower section of Walnut Fork. Thus, the major emphasis was placed on Hoods Creek as far as the development work was concerned. Five stream-alteration structures were placed on Walnut Fork to create pools and cover in an area on its middle section composed largely of shallow riffles. Trouble was experienced on Hoods Creek in locating stream structures. Care was taken to place structures in locations where productive riffle areas would not be destroyed. Rocks were used in many instances on the upper section as deflectors and as cover. While the percentage of pools is good in most sections of Hoods Creek, many of these are scoured out of bedrock, or have become silted in, resulting in shallow pools with poor cover and shifting bottoms.

The eight culverts and one bridge constructed on Hoods Creek will decrease localized erosion and road degradation problems, particularly where this was aggravated by flow diverted down the roadbed. Plank culverts used in this project are relatively

inexpensive to construct and serve quite well in draining a small flow from a spring. The old logger's trick of using a hollow log for a culvert provides a long-lasting inexpensive drain, if hollow trees are readily available. The bridges, with the exception of the plank flooring, were constructed of logs; and, thus, the main expense was the labor time.

Mudholes, usually caused by spring drainages diverted to a low spot in the road, when drained and filled with gravel also decrease localized road degradation. Stabilizing raw areas around stream structure construction sites and road maintenance sites will lessen stream siltation as these areas develop a good ground cover. However, the steep grades on the Hoods Creek access road, coupled with their close proximity to the stream, will always be a source of silt pollution trouble (Figure 9). Spreading gravel on these grades to decrease roadbed deterioration and repairing water breaks are short-term measures that require periodic repetition. Siltation of Hoods Creek has increased with the development work implemented the last two fiscal years. It remains to be determined if the silt load will decrease with the termination of this accelerated development work and the accomplishment of feasible road stabilization. However, the steep grades and numerous fords (Figure 10) will continue to contribute to the siltation of the streams.

Acknowledgements: Senior Biological Aide Carlton Nichols supervised the road stabilization work and the location and construction of stream-alteration structures. Biological Aide Jefferson Houck

Figure 9

Road degradation on a steep grade of the Hoods Creek access road

Figure 10

Deteriorated stream crossing on the Hoods Creek access road.
The bank to the right of the road has been planted to fescue.

operated heavy equipment and assisted in other construction and maintenance activities. Messrs. Cecil Brown, Farish Kilby, and James Turpin assisted in certain phases of the construction work. Mrs. Wanda Jackson, Secretary, typed the first through final drafts of the manuscript. Mr. Ted Borg was responsible for the photographic work connected with the report. Mrs. Elaine Fatora reviewed the manuscript.