A SURVEY PROCEDURE FOR EVALUATING STREAM FISHERIES

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ABSTRACT

A survey procedure was developed for judging the relative quality of trout waters and used in surveying streams in National Forests in Georgia, Virginia and South Carolina.

The purpose of the survey was to provide land managers with information that would help in making decisions affecting trout streams. The procedure incorporates water quality analysis, fish population sampling, and a comparative evaluation of habitat conditions based on a stream's present and potential capability for producing wild or "native" trout fishing. Drainages surveyed ranged from one to over twenty miles in length.

INTRODUCTION

The need for stream survey methods and procedures, designed for use by land managers, is increasing due to the growing profusion of resource development projects and the complexity of management problems on public lands. Stream surveys consisting simply of fish population and water quality data do not furnish the information needed by land managers for setting work priorities and implementing management programs. Where development projects are inevitable, but not necessarily compatible with existing fishery resources, it is especially urgent that comprehensive background information be available in order that fisheries receive due consideration in the total land management program.

Items of information needed, in addition to basic fish population and water quality data, include land ownership pattern, stream morphology, vegetative conditions, sources and degree of pollution, recommendations for improvement, and an overall evaluation and rating of the stream. This paper describes a procedure for collecting, recording, and interpreting such information.

Van Deusen's (1953) system of inventorying and classifying streams by code is excellent for extensive surveys. For intensive management of smaller watersheds, however, more detailed information is needed.

Herrington and Dunham's (1967) method for sampling stream habitat characteristics is relatively expensive and recognizes only two categories (pools and riffles) for describing stream characteristics. Their two-man crew covered 2.8 miles of stream per day collecting habitat information on line transects located at quarter mile intervals. With the present technique one man can cover an average of 5-7 miles of stream in a day, making observations on the entire section examined. The system is also more inclusive since other characteristics, in addition to pools and riffles, are used in describing habitat conditions.

Burton and Odum's (1945) stream survey conducted near Mountain Lake, Virginia, showed the effect of temperature, size, and gradient on longitudinal distribution of fish. Such factors are important but are only a portion of the habitat information needed for management purposes.

Kuehne (1962) applied Horton's (1945) system of stream orders based on branching, in conjunction with longitudinal succession of fish species, to classify streams. The system worked well, but here again, information provided does

not show whether the streams were in good condition, whether improvements were needed, etc., all of which are a requisite of land management.

Lagler's (1964) "Freshwater Fishery Biology" and U. S. Forest Service guidelines (1970) present more comprehensive stream survey information and procedures. Lagler's book is directed primarily toward a discussion of the information needed on surveys. Appendix B of his book also includes sample forms used in collecting and summarizing data. The Forest Service guidelines were designed for evaluating stream habitat in the southwestern states. The guidelines describe a system for deriving a single overall grade or rating for the stream, based on separate grades assigned to pool-riffle relationship, stream bottom type, vegetation, water quality, and invertebrate organism populations. Both the above references include survey procedures similar to those in this paper, but the breakdown of stream characteristics is less complete in that only pools and riffles are recognized as categories of habitat. The present system includes flats and cascades or bedrock as categories. Both additional breakdowns are important since these occasionally make up over 30 percent of the total stream habitat type.

Procedures in this paper consider and rate not only the present condition of the stream but also the potential capabilities of the stream if under optimum management practices.

During 1969 the trout stream procedures were used to survey four redeye bass (Micropterus coosae) streams in the mountains and upper piedmont of Georgia. In general, the procedures appeared to be suitable, with little or no modification, for use on such streams.

DATA COLLECTION METHODS

Equipment needs for the habitat evaluation portion of the survey are a good set of maps or aerial photos and a set of color pencils for coding stream conditions as the stream is "walked out." U. S. Geological Survey topographic quadrangles (scale 1/24,000) worked well on areas examined. These maps contain a wealth of detail and are large enough in scale to color code sections of stream 200 feet or less in length (200 feet is .1 inch on 1/24,000 scale maps.)

This element of the survey consists of a visual estimate of stream characteristics and conditions. Such observations are made while walking, the observer stopping only long enough to record data on the map. Distance covered varies with type terrain encountered. In rugged, inaccessible terrain where a surveyor must wade the entire stream, he may cover only 1 mph, but where streams are closely paralleled by a road or trail, he may cover up to 2-3 mph.

Equipment and procedures for collecting fish and water quality data are not described in this paper, but the form used for recording data collected at sample stations is illustrated in Figure 1.

Habitat data collected can be worked up into various forms, but the one I found easiest to work with included the heading and sections 1-5 on the first of four pages, sections 6-9 on the second page, sections 10 and 11 on the third page, and section 12 on the fourth page. Figure 2 is an example of a set of completed survey forms. Data were not taken from an actual sample but are representative of streams in this locality. Instructions for completing the form are as follows:

Date - This should be the date that stream flows are estimated and field work is completed.

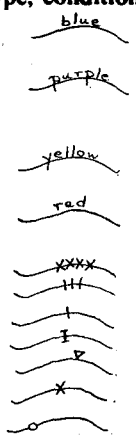
Heading - Show major drainage, stream, and counties.

1. *Size of Stream*
   a. *Length of stream above* - Mouth or other designated point.
      Total length - Total length, in miles, of private and public ownership. Where USGS maps are used, entire length of blue lines should be used to designate total length.

Fishable length - A stream is considered fishable size at a point where it averages four feet (or other arbitrary size limit) or more in width. Upper limit should be marked on map.
Average width - Estimated for the fishable length only.
Acreage - Figured from tables based upon length and estimated average width of stream. When figuring total acreage on streams less than fishable size, use an average width of three feet.

b. *Estimated flow at* - Mouth or other designated point. Volume of flow (CFS) can be figured using Embody's (1927) formula — R = WDaL or Robin and Crawford's (1954) method — R = WDaV. T
c. *Water level conditions* - State whether the water level is normal, high, low, etc. *for the time of year the survey is made.*

2. *Elevation*
   a. At mouth or other designated point.
   b. Self-explanatory. The upper limit of fishable water should be designated on map for future reference.
3. *Aspect* - General aspect of the drainage. SE, NW, E, etc.
4. *Average Gradient* - Computed using figures from upper fishable limits of mainstream to lower boundary of area checked.
5. *Ownership Pattern* - General statement showing approximate amount of private ownership, land use practices on these areas, and management implications to fisheries.
6. *Existing Stream Conditions*
   Percentages and figures shown in this section are estimated by walking or wading visual observation of the stream. Where possible, at least 50-80 percent of the fishable length of the stream should be checked. The sections actually observed are then color coded on topographic maps as to stream **bottom type, condition, etc. using** the following breakdown:



-Satisfactory pool-riffle ratio (at least 35% pools and 35% riffles).
-Less than 35% of area in good pools or other cover, 35% or more of the area in good riffles.
-More than 35% of area in good pools, less than 35% of area in good riffles.
-Less than 35% of area in good pools, less than 35% of area in good riffles.
-Debris removal needed.
-Other stream improvement needed.
-Waterfall serving as fish barrier.
-Manmade fish barrier.
-Erosion control needed.
-Sample station location.
-Upper limit of fishable water.

Changes in existing stream conditions will normally be coded only where the changing conditions affect a section of stream exceeding 200 feet in length.

a. Minimum requirements for a satisfactory pool-riffle ratio are at least 35 percent riffles and 35 percent pools (these are arbitrary limits and some biologists may prefer either lower or higher limits) in any one section of stream.
b., c., d., e. The sum of sections b.-e. should equal 100 percent. These figures are an overall estimation for the entire stream and may not represent any one section. Example — A stream might have overall figures of 50 percent pool and 50 percent riffle area and at the same

FIGURE 1

SAMPLE STATION

Drainage Chattooga River Stream Reed Creek Station Location #1 - .3 mile above mouth Elevation 2360

County Rabun Map Whetstone Length of Sample Area 500'

Width 18' Depth 8" Velocity 1.6 fps Volume 15.4 cfs

Water Level slightly below normal Color clear

Air Temp. 78 F. Water Temp. 68 F. Weather clear

Date 7/17/69 Time 1400 Method of Collection electrofishing

Water Chemistry

P.Alk.	M.O.Alk.	T.Hard.	T.D.S.	pH	O_2	CO_2	Turb.		
0 ppm	12 ppm	2 ppm	24 ppm	6.7	10 ppm	2 ppm	4 ppm		

Bottom Organisms

Insects	Diptera 7	Coleoptera -----	Odonata 1
	Plecoptera 3	Collembola -----	Lepidoptera -----
	Ephemeroptera 10	Hemiptera -----	Megaloptera -----
	Trichoptera 13		
Other	Gastropoda	Pelecypoda	Oligochaeta
	Hirudinea	Decapoda X	Amphipoda

Fish Species		Inch Classes 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Salmo gairdneri	No.			••		•		•	•							
	Wt.			1 oz		2 oz		3 oz	3 oz							
Salmo trutta	No.			•				•	•	••				•		
	Wt.			1 oz				3 oz	3 oz	15oz				14oz		
Micropterus coosae	No.				••						•					
	Wt.				5oz						12oz					
Hypentelium nigricans	No.					•	••		•	••						
	Wt.					3oz	6oz		5oz	16oz						
Moxostoma rupiscartes	No.							•	•							
	Wt.							4oz	6oz							
Hybopsis leptocephala	No.			••	••	⊠ •		••								
	Wt.			1oz	3oz	20oz		6oz								
Notropis coccogenis	No.				••											
	Wt.				2oz											
Notropis galacturus	No.					••	•									
	Wt.					3oz	2oz									
Cottus bairdi	No.	•		••	••											
	Wt.	--		1oz	2oz											
	No.															
	Wt.															

Stream Bottom Conditions in the Fish Sample Area Gradient is fairly low - Good mixture of pools and riffles - No undercut banks or overhanging brush - Considerable silt and fine inorganic material on streambottom.

FIGURE 2

STREAM SURVEY FORM — Page 1 of 4

Date 7/17/70

Drainage Chattooga River Stream Reed Creek

Counties Rabun

1. Size of Stream

a. Length of stream above: mouth

	Public	Pvt.		Public	Pvt.
(1) Total length	10.5	---	Fishable length	6.7	---
(2)			Average width	11	---
(3) Total acreage	10.2	---	Fishable acreage	8.9	---

b. Estimated flow: At .3 mile above mouth c. Water level conditions:

Width 16'
Depth 8"
Velocity 1.5 fps
CFS 15.4 cfs

Normal for July.

2. Elevation

a. At mouth 2350 b. At upper limit of fishable water 3610

3. Aspect South

4. Average Gradient 280 feet per mile or 5.3 % grade.

5. Ownership Pattern

The lower .5 mile of Reed Creek runs through old abandoned fields on private land.
Approximately 40 acres of forested land in private ownership lies immediately adjacent to the stream just above the Burrell's Ford Road. Another .4 mile of stream bisects a 120-acre tract of private land near Bill Mtn. One other small tract of private land lies in the extreme headwaters on Glade Mountain.
Exposed soil on the small tract of private land adjacent to Reed Creek, above the Burrell's Ford Road, is creating a siltation problem in the stream. The old road leading into this tract is also adding significant amounts of erosion silt to the stream.

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6. Existing Stream Conditions

a. Percent of stream with a satisfactory pool-riffle ratio	67%
b. Percent of stream in riffles	42%
c. Percent of stream in pools	48%
d. Percent of stream in flats	1%
e. Percent of stream in cascades or bedrock	9%
f. Number of waterfalls serving as fish barriers	4
g. Logging debris or other debris present	yes
h. Degree of siltation (1-10)	3

i. General statement of overall stream bottom conditions:

The stream has a fairly productive appearance in some areas. Other areas appear to be practically sterile due to prevalence of bedrock. Riffles in better areas contain a variety of gravel and rubble sizes. Heavy silting is evident throughout the section of stream checked, appearing to originate from several sources (see section 7). Occasional logging debris is scattered throughout the stream. These logs and brush are doing more good than harm by serving as cover for fish; therefore, they should not be removed.

7. Sources of Pollution

Siltation from private land.
Siltation from access road into private land.
Siltation from new system road into Burrell's Ford Road.
Siltation from recently closed log roads.

8. Other Problems (Beaver ponds, etc.)

None

9. Streambank Vegetation

a. % streambank with overstory vegetation 96%
Species Oak, Hickory, White Pine, Hemlock

b. % streambank with understory vegetation but no overstory vegetation 4%
Species Alder, Mountain Laurel

c. % streambank with no overstory and little or no shade providing understory -----

d. % of stream with bare or actively eroding banks -----

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10. Aquatic Vegetation

No rooted aquatics.
Moss and/or algae occasionally evident on rocks in stream. Overall, very little vegetation evident.

11. Stream Improvement Needed

a. Miles of stream needing debris removal	None
b. Miles of stream needing stream improvement	.4
c. Approximate number of structures needed	10
d. Miles of streambank or road needing stabilizing	1.5
e. Rough fish barrier needed	No

f. General statement of work needed and location:

11. b. The flat gradient section of stream approximately .2 mile above the Burrell's Ford Road contains practically no pools or cover for fish. Addition of approximately three small wedge dams, four deflectors, and three cover logs in this section would improve habitat considerably.

11. d. An effort is already being made to stabilize the new road. Additional effort is needed to stabilize the log roads adjacent to the stream above the Burrell's Ford Road.

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12. General Evaluation

a. Present

Biological Grade 3 Use Grade 3 Overall Grade 3

Reed Creek is presently furnishing fairly good fishing for native rainbow and brown trout, supplemented by regular stocking of hatchery fish (1200 per year) by the Game and Fish Commission. Headwaters of the stream contain native brook trout. The stream also serves as important spawning habitat for mainstream fish.

Use is light except near the two stocking points (Burrell's Ford Road and the Sims Field). Use there is moderate to heavy.

Access along other sections of the stream is limited to trails (no trails in some areas) which explains the overall light fishing pressure.

The low biological rating is based primarily on the excessive silt load in the stream.

b. Potential

Biological Grade 7 Use Grade 5 Overall Grade 6

Reed Creek, under intensive management, can become one of the better native rainbow and brown trout fisheries in this drainage. Reduction of siltation in this stream should significantly improve the resident population of trout. Since the stream is one of the few sizeable tributaries along this stretch of the Chattooga River, it is doubly important that siltation be reduced to a minimum in order to provide a high quality spawning area for mainstream trout.

Supplemental stocking of hatchery fish at the two access points should be continued but not expanded. If the roads are closed in the future, stocking should be terminated.

No additional access is needed on this stream. As soon as possible, the old road leading off the Burrell's Ford Road upstream should be closed to vehicle traffic. It can be seeded, fertilized, and used as a foot trail.

time show a low percentage of stream with a desirable pool-riffle ratio (section 6a.) due to poor interspersion of the two types. Stream bottom types are defined as follows:

Riffle - Section of stream containing gravel and/or rubble, in which surface of water is at least slightly turbulent and current is swift enough that the surface of the gravel and rubble is kept fairly free from sand and silt.

Pool - Section of stream deeper and usually wider than normal with appreciably slower current than immediate upstream or downstream areas and possessing adequate cover (through sheer depth, or other forms of cover) for protection of fish.

Flat - Section of stream with current too slow to be classed as riffle and too shallow to be classed as a pool. Stream bottom usually composed of sand or finer materials, with coarse rubble, boulders, or bedrock occasionally evident.

Cascades or Bedrock - Section of stream bottom without pools, consisting primarily of bedrock with little rubble, gravel, or other fine material present. Current usually swift.

f. Each waterfall serving as a fish barrier should be located on map.

g. Answer yes or no. Locations shown on map. Details given in section 11a.

h. Degree of siltation - Streams are graded by general observation on a scale of 1-10 (10 being the best possible condition). Figures of 5 or less indicate a definite need for corrective action.

i. This general statement should elaborate upon section b.-h. to show such aspects as availability and condition of spawning gravel, amount and effects of debris in stream, and the type and extent of sediment deposits (organic and inorganic) on the stream bottom. Special emphasis should be given to a more specific discussion of sections g. and h. Definitions of bottom materials are as follows (modified from Lagler, 1964):

Organic Material

Organic debris - undecomposed woody or herbaceous material such as leaves, twigs, logs.

Muck - completely decomposed organic material, usually black in color.

Inorganic Material

Clay - compact, sticky.
Silt - fine materials with very little grittiness.
Sand - particles smaller than fine gravel.
Fine gravel - 0.1 to 1.0 inch
Coarse gravel - 1.0 to 3.0 inches
Small rubble - 3.0 to 6.0 inches.
Large rubble - 6.0 to 12.0 inches.
Boulders - greater than 12.0 inches.
Bedrock - large masses of solid rock.

7. *Sources of Pollution* - List all sources of pollution significantly altering water quality. Include roads, developed areas, and other eroding areas, as sources of silt, if applicable.
8. *Other Problems* - This is a "catchall" paragraph to show any problems affecting fisheries not included in Number 7 (beaver problems, bridges, culverts, etc.).
9. *Streambank Vegetation* - Under a. and b. list predominant species.
10. *Aquatic Vegetation* - General statement. Give type-rooted, broad leaved, moss, algae, etc. Include general statement concerning abundance.
11. *Stream Improvement Needed*

a., b., d. - List to the nearest tenth of a mile.

a. Self-explanatory.

b. Stream improvement in the form of small pool-creating structures, cover logs, etc.
c. Self-explanatory.
d. Self-explanatory.
e. Answer yes or no.
f. General statement. Give specific details showing location, extent and type of work needed. If extensive, these projects can be summarized on a separate sheet and attached. All proposed stream improvement work should be shown on the survey maps.

12. *General Evaluation*

a. *Present*

This is the overall evaluation of the stream based upon data collected and general observations of the stream in its present condition. Include statements describing present management practices, major fish species present, type fishing provided, stocking, fishing pressure, etc.

Streams are given three numerical grades. The "biological" grade given is based upon the stream's present capacity to provide quality native or "wild" trout fishing. This grade is determined principally from the information gathered in sections 6-10 of the survey form, from fish population and water quality samples taken in the drainage, and from general information gathered from fishermen and local residents.

The "use" grade is based upon fishing pressure and actual use or recreation provided by the stream. The number of fishermen visits per acre of fishable water per year should be the criteria for this grade. In many cases where access, stocking, etc. are important factors, streams with a low biological grade will receive a higher use grade than streams with a higher biological grade.

An "overall" grade can then be given, if desired, based upon values given in the first two grades.

Grades in all three categories are based on a scale of 1-10 (10 being the highest possible grade). A biological grade of less than five indicates one or more significant limiting factors. Grade 1-3 for light use, 4-6 for moderate use and 7-10 for heavy use. Overall grading emphasis can vary according to the specific organization's management policies. If emphasis is on "put and take" fisheries the use grade may carry more weight than the biological grade, etc.

b. *Potential*

This paragraph evaluates the potential of the stream under optimum management practices, realizing that where possible, streams should be managed as native trout fisheries. A basically good stream, although given a low rating under present conditions, may be given a much higher potential rating under either grade. Grades will be given on the same basis (1-10) as in section a.

Management recommendations should be given under this section, including general objectives, species best suited for management, special regulations needed, stocking recommendations, potential uses, etc.

SUMMARY

This paper presents a method for conducting stream surveys. Emphasis is on evaluation of habitat conditions. A comparative rating system indicating both present and potential capability of streams as "native" or wild trout fisheries is included.

Procedures are simple but do require a basic knowledge of the type fishery being surveyed.

The most obvious advantage of the system is that it is relatively inexpensive

(as much as ten miles of stream were covered in one day), yet provides detailed information necessary for management of the fishery in coordination with other land management programs affecting the drainage.

The procedures have been used in surveying several headwater bass streams in northern Georgia. In general, they appear to be applicable to such streams.

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