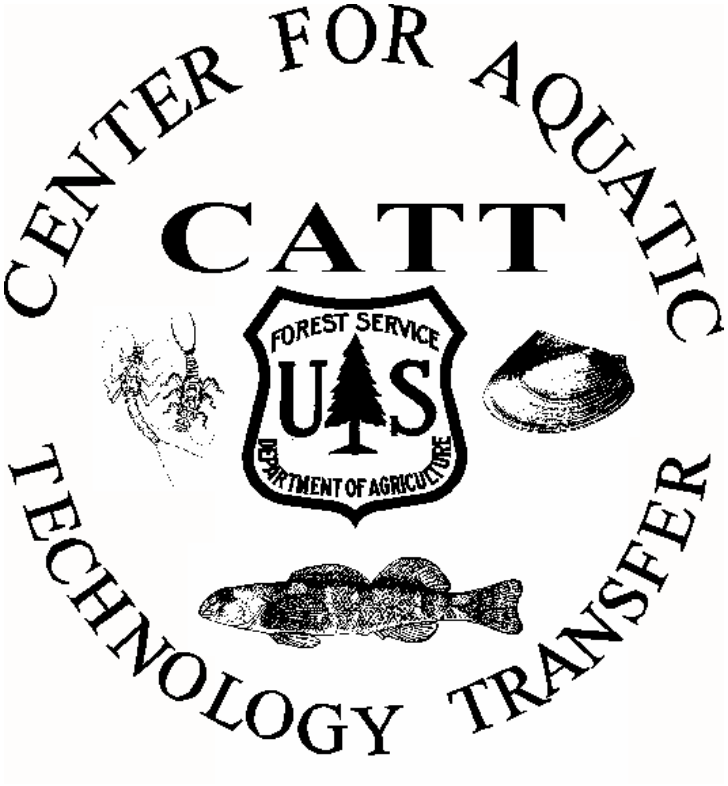
Summary of Alabama Stream Habitat and Fish Inventories on the Bankhead, Conecuh, and Talledega National Forests, 2007



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Introduction

In February 2007 the National Forest in Alabama (NFA) requested assistance from the USDA Forest Service, Southern Research Station, Center for Aquatic Technology Transfer (CATT) in development of a Forest-level stream monitoring program. Biologists and hydrologists from the CATT, NFA, Daniel Boone National Forest, and Regional Office met following the Southern Region Fish meeting in Asheville, NC in April 2007 to discuss the monitoring framework and sample design. The CATT and NFA produced a manual (Appendix A-C) based on these discussions. In spring 2007, the NFA requested assistance with implementation of their stream monitoring program. Fish assemblage and stream habitat data were to be collected forest-wide in a standardized manner, entered into the NRIS water module, and analyzed using Regional protocols (Leftwich 2007). The CATT deployed 1 biologist and 6 technicians to the Bankhead and Conecuh National Forest and the Oakmulgee, Shoal Creek, and Talledega Ranger Districts on the Talledega National Forest from July 21 to 26, 2007 to quantify stream habitat conditions and provide associated fish assemblage information.

Methods

Site Selection

Sites were selected in accordance with a stratified random sampling design. Personnel from the NFA randomly selected 10 6th level Hydrologic Unit Codes (HUC) from a set of all HUCs containing National Forest System (NFS) property. Next, a single National Hydrography Dataset (NHD) stream reach was randomly selected from each of the 10 HUCs (Appendix A). The NHD is a digital spatial dataset of water surface features, such as streams, that uniquely identifies stream segments or "reaches". The reach identification number changes based on three rules (USGS 2000). One, the underlying feature rule breaks reaches between these feature types: stream/river, artificial path, canal/ditch, and pipeline. Two, the confluence-to-confluence rule breaks reaches based on confluences, heads (stream source), and mouths (stream enters large water body). Three, the branched path rule breaks reaches at areal features (e.g. lake, pond, swamp, marsh) thus avoiding the need to define flow channels within the areal feature. NFA stream reaches had to meet the following criteria: 1) drains an area 13-26 km^2; 2) was at least partially on NFS managed lands; 3) suitable for sampling (i.e. accessible, perennial, wadable). Habitat attributes were recorded throughout the length of the reach (or that portion managed by NFS); sites for fish sampling were centered in the reach.

Habitat Inventory

A two-person crew performed a customized stream habitat inventory based on the basinwide visual estimation technique (BVET) (Dolloff et al. 1993). Either full length of the NHD reach or that part on NFS lands was inventoried. We measured or estimated the following attributes (Appendix C):

- Type of habitat unit
- Length of habitat unit
- Substrate
- Large wood
- Photographs
- GPS coordinates

In addition, we noted stream features including:

- Waterfalls
- Tributaries
- Side channels
- Braided channels
- Seeps (springs)
- Landslides
- Bridges
- Fords
- Dams
- Culverts

Fish Inventory

A six-person crew using a DC backpack electrofisher collected fish assemblage information. Sample reaches were centered within the NHD reach. If the average wetted width was less than or equal to 3.0 m or greater than or equal to 7.5 m the reach length was 120 m or 300 m, respectively (Appendix A). In all other cases sample reach length was 40 times the average wetted width. Average wetted width was calculated by taking width measurements in 1-2 riffles or runs within each reach. We did not move reaches to avoid road or trail crossings. Crews attempted to apply standard effort of approximately 1 sec/m^2 of electrofishing habitat. We recorded the following data (Appendix B):

- Species name
- Counts of adult, age-0, and voucher specimens
- Sample reach length, electrofishing time (sec), and voltage
- GPS coordinates of start and end location

Results

The CATT and Alabama National Forest personnel completed habitat and fish inventories on 10 streams (Table 1). We electrofished a total of 1.7 km and inventoried habitat on a total of 10.3 km of stream. The data collected by the CATT can be used to describe stream condition on the NFA and serve as a baseline for future comparisons.

Data Availability

Summer 2007 habitat and fish data are ready for migration into the Natural Resource Information System Water Module Version 1.2.3 (NRIS). We formatted the data according to the Regional NRIS

Water migration template and transferred it to Leigh McDougal, the Regional NRIS migration coordinator. As data are migrated into NRIS Water the CATT will coordinate development of custom query and reporting tools for the NFA. In the interim, the CATT is available to assist with data analysis and report preparation. John Moran, NFA Fishery Biologist, received a copy of all data in electronic format.

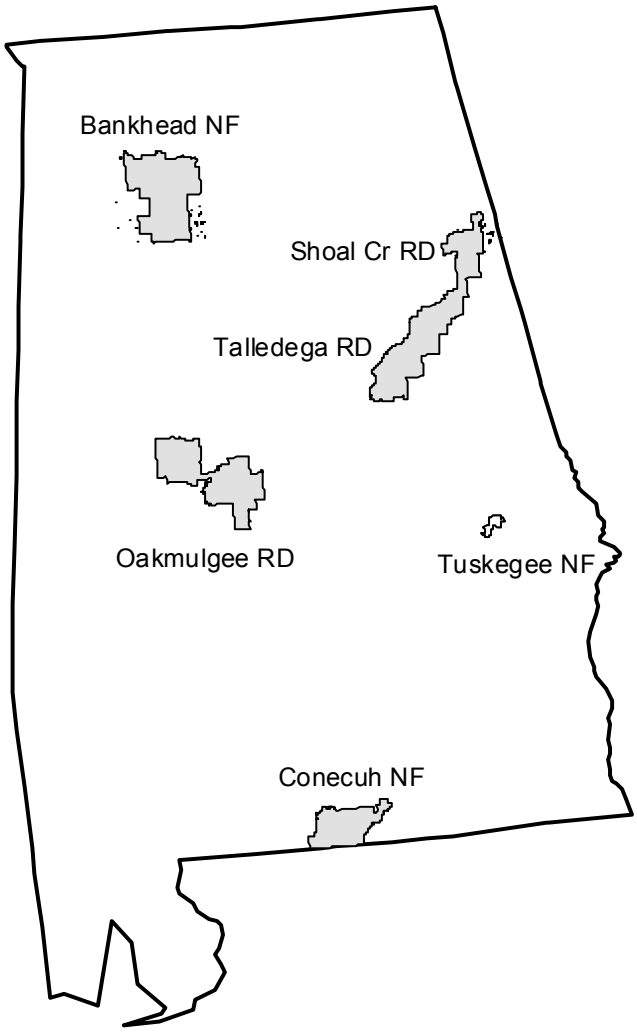

Figure 1. National Forests and Ranger Districts in Alabama. The CATT visited the Bankhead and Conecuh National Forest and the Oakmulgee, Shoal Creek, and Talledega Ranger Districts on the Talledega National Forest (shaded in grey) in summer 2007.

Table 1. Stream distance inventoried for fish and habitat, and the average width of the 10 sample sections.

District	Stream	Avg Width (m)	Efish (m)	BVET (m)
Bankhead	Brushy Creek	4.6	184	539
Bankhead	Cane Creek	5.8	231	375
Bankhead	Rockhouse Creek	5.8	233	1,289
Conecuh	Five Runs Creek	8.0	300	3,281
Conecuh	Miller Creek	3.2	130	434
Oakmulghee	Elliotts Creek	1.8	120	635
Oakmulghee	Honeysuckle Creek	2.5	120	1,365
Shoal Creek	Little Shoal Creek	3.3	133	489
Talledega	Emauhee Creek	2.4	120	767
Talledega	Garing Creek	2.9	120	1,077
		Total	1,691	10,252

Literature Cited

Dolloff, C. A., D. G. Hankin, and G. H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. General Technical Report SE-83. Asheville, North Carolina: U.S. Department of Agriculture, Southeastern Forest Experiment Station.

Roghair, C. N., J. D. Moran, and C. A. Dolloff. 2007. Characterization of substrate and large wood within selected stream reaches on the National Forests in Alabama. Unpublished Report. Blacksburg, Virginia: U.S. Department of Agriculture, Forest Service, Center for Aquatic Technology Transfer.

U.S. Geological Survey. 2000. The national hydrography dataset concepts and contents [Online], http://nhd.usgs.gov/techref.html

Appendix A: Field Methods for Site Selection and Reach Layout

Site selection

- Randomly select ten 6th level HUCs from a set of HUCs containing NF property. From each of those HUCs randomly select a single NHD reach.

- NHD reaches must meet the following criteria:
    - Basin size upstream of reach = 13-26 km^2
    - Reach is at least partially on NFS managed lands
    - Suitable for sampling (i.e. accessible, perennial and wadeable)

- Sites are selected by John Moran, the NFA Fishery Biologist; John provides CATT with a list of selected reaches and GPS coordinates locating the center points of reaches

- Habitat attributes are recorded for each entire reach

- Reaches for fish sampling were centered on the NHD reach; lengths of fish sample reaches varied from 120-300 m

Fish Reach Layout

- Locate 1 – 2 riffles or runs and determine the average wetted width by making several measurements and computing the average. Measure width perpendicular to thalweg.

    - If the average wetted width is less than or equal to 3.0 m, then the reach length will be 120 m
    - If the average wetted width is greater than or equal to 7.5 m, then the reach length will be 300 m
    - If the average wetted width is between 3.0 and 7.5 m, then reach length is 40-times the average wetted width, example: average wetted width = 5 m; reach length = 5 x 40 = 200m

- Hang a double orange flag at the downstream end of the reach. Attach topofil from a hipchain and walk to the midpoint of the reach, hang a single orange flag, then continue to the end of the reach and hang another single orange flag

- Record the average wetted width and reach length on the datasheet

- Reaches will not be moved to avoid road or trail crossings – moving reaches violated the assumptions of the stratified random sample design and invalidates statistical analysis. Document these features fully with photos and written descriptions

- Always begin reaches at the downstream end of a defined habitat unit, end points should be at the exact distance as described above

- In large streams make sure the reach includes all of a fast water habitat unit and all of a slow water habitat unit

Appendix B: Field Methods for Electrofishing Inventory

Electrofishing Objectives:

1) determine relative abundance
2) determine catch-per-unit-effort (CPUE)

Note: we are not attempting to estimate population size or density for individual species, only assessing the fish assemblage.

Electrofishing Methods:

Based on sampling strategies discussed and approved by R8 and SRS personnel in March, 2005:

- single-pass electrofishing with backpack DC unit
- one shocker, 3 netters
- no blocknets
- electrofishing effort will be equal to 1.0 seconds for each 1.0 m^2 of wetted area
    - note: this will standardize our effort and remove the potentially confounding effect of changes in wetted width relative to the bankfull channel width in wet or dry years
    - protocol derived from Warren et al. based on electrofishing effort in Mississippi streams
- fish older than age-0 will be counted and released at the site, except for a voucher specimen for unidentified species; **threatened and endangered species lists will be reviewed before sampling**
- record age-0 fish presence for each species, if possible
- keep all relic mussel shells encountered; note location where found in habitat data
- keep a voucher specimen of each form I male crayfish species captured, **review threatened and endangered species lists before sampling**

Appendix C: Field Methods for Habitat Inventory

Methods for Characterization of Substrate and Large Wood Within Selected Stream Reaches on the National Forests in Alabama

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2007

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Introduction

In summer 2007, resource managers on the National Forest in Alabama (NFA) requested that the USFS Center for Aquatic Technology Transfer (CATT) conduct stream inventories to characterize stream habitat and fish assemblages within selected stream reaches. Personnel of NFA randomly selected 10 6th level HUCs from a set of all HUCs containing NFS property. Next, a single NHD stream reach was randomly selected from each of the 10 HUCs. Stream reaches had to meet the following criteria: 1) reach drains an area 5-10 mi^2; 2) reach is at least partially on NFS managed lands; 3) reach suitable for sampling (i.e. accessible, perenneal, wadable). The fish sample site was centered on the middle of the randomly selected stream reach. Habitat attributes were recorded for the entire reach (or that managed by the NFA). Our goal was to provide the NFA with information needed to assess the effectiveness of management strategies outlined in the NFA Forest Plan.

We developed this document to guide classroom and field instruction and to serve as post-training reference for field crews. It includes an overview of the inventory, defines habitat attributes, instructs how and when to measure attributes, and provides reference sheets for use in the field. Each trainee should receive a copy of this manual and is encouraged to take notes in the spaces provided.

References cited in this manual:

Armantrout, N. B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Bethesda, Maryland.

Bunte, K., and S. R. Abt. 2001. Sampling surface and subsurface particle-size distributions in wadable gravel- and cobble-bed streams for analyses in sediment transport, hydraulics, and streambed monitoring. General Technical Report RMRS-GTR-74. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Dolloff, C. A., D. G. Hankin, and G. H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. General Technical Report SE-83. Asheville, North Carolina: U.S. Department of Agriculture, Southeastern Forest Experimental Station.

Hankin, D. G., and G. H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences 45:834-844.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, Colorado.

Rosgen, D.L., and L. Silvey. 1998 Field Guide for Stream Classification, Wildland Hydrology Books, Pagosa Springs, Colorado.

Outline of Habitat Inventory

The inventory is comprised of the following steps:

1) Enter 'header' information in the data sheet
    - 'Header' information includes date, stream, start location, crew, etc. and is vital for future reference

2) Navigate to downstream end of NHD reach or NFS boundary using GPS or maps
    - Note that this is not the same as the downstream end of the fish sampling reach

3) Proceed upstream recording attributes for each habitat unit and stream features as encountered
    - Locate and mark downstream and upstream ends of fish sample reach when encountered

4) End at upstream end of NHD reach or NFS boundary
    - Note that is not the same as the upstream end of the fish sampling reach

The following sections describe the BVET habitat inventory in detail:

Section 1: Getting Started – equipment lists, header information, starting the inventory

Section 2: Habitat Attributes – definitions, how to estimate or measure, when to record

Section 3: Wrapping Up – what to do when the inventory is completed

Section 4: Summary

Section 5: Field guide, random number tables, equipment checklist

Section 1: Getting Started

Equipment List

hipchain	clipboard
extra string for hipchain	BVET manual and field guide
datalogger	felt bottom wading boots or waders
GPS unit	bug spray
topographic map	water
camera	water filter
backpack	lunch
pencils	1st aid kit
flagging	rain gear
markers	toilet paper
waterproof backup datasheets	radio/cell phone

The crew consists of two individuals, the 'observer' and the 'recorder'. The observer wears the hipchain. The recorder wears the data logger and carries other equipment in the backpack. The duties of each individual are listed below.

Duties

Observer	**Recorder**
Designate habitat units	Classify and count large wood (LW)
Measure distance	Photo-documentation
Classify substrates	Document stream features
Identify stream features	Record data

Although the crew has assigned duties, they should not hesitate to consult with each other if they have questions or feel that a mistake may have been made. Working as a team will provide the best possible results.

Header Information

Header information is vital for future reference. Take the time to record all categories completely and accurately.

Stream Name	Full name of stream
District	National Forest District name
Quad	USGS 1:24,000 quadrangle name
Date	Record date(s) of inventory
Recorder	Full name of recorder
Observer	Full name of observer
GPS	record at start and end locations; AL standard: UTM, NAD 1983, zone 16N
Location	Detailed written description of start point, include landmarks, road #, etc.
Notes	Record signs of activity in area, water conditions, other pertinent information

Starting the Inventory

After the crew has organized their gear and recorded all the header information they are ready to begin the habitat inventory. Proceed to the start point and record the GPS waypoint number in the comments section for the first habitat unit. The observer should enter the stream slightly downstream of the starting point, tie off the hipchain, progress upstream to the starting point, reset the hipchain to zero and begin walking upstream through the first habitat unit. As the observer moves upstream they scan the wetted stream channel to determine the most common substrates and also scan the channel for stream features. When they reach the upstream end of the habitat unit they stop, report the distance, then turn to face the unit and report the dominant and subdominant substrate classes.

As the observer moves upstream through the unit, the recorder follows behind, tallying the amount of large wood (LW) in the habitat unit. The recorder assigns a number to the habitat unit, scans the channel for stream features, and tells the observer to document features if they miss them.

The crew continues upstream recording data for every habitat unit and stream feature encountered.

Be sure to record the start and end of the fish sample reach with GPS waypoints and as OTR features in the habitat data.

Section 2: Stream Attributes
Unit Type (see abbreviations)
Definitions:*

Unit Type	Abbreviation	Definition
Riffle	**R**	**Fast water, turbulent, gradient <12%**; shallow reaches characterized by water flowing over or around rough bed materials that break the surface during low flows; also **include rapids** (turbulent with intermittent whitewater, breaking waves, and exposed boulders), **chutes** (rapidly flowing water within narrow, steep slots of bedrock), and **sheets** (shallow water flowing over bedrock) if gradient <12%
Cascade	**C**	**Fast water, turbulent, gradient ≥12%**; highly turbulent series of short falls and small scour basins, with very rapid water movement; also **include sheets** (shallow water flowing over bedrock) and **chutes** (rapidly flowing water within narrow, steep slots of bedrock) if gradient ≥12%
Run	**RN**	**Fast water, non-turbulent, gradient <12%**; deeper than riffles with little or no surface agitation or flow obstructions and a flat bottom profile
Pool	**P**	**Slow water, surface turbulence may or may not be present, gradient <1%**; generally deeper and wider than habitat immediately upstream and downstream, concave bottom profile; **includes dammed pools, scour pools, and plunge pools**
Glide	**G**	**Slow water, no surface turbulence, gradient <1%**; shallow with little to no flow and flat bottom profile
Underground	**UNGR**	Stream channel is dry or not containing enough water to form distinguishable habitat units

*modified from Armantrout (1998)

How to estimate:
Habitat units are separated by 'breaks'. Breaks can be obvious physical barriers, such as a debris dam separating two pools or a small waterfall separating a pool and riffle, or may be less obvious transitional areas. Questions often arise as to whether a break is substantial enough to split two habitat units and where the exact location of the break occurs. When in doubt, the observer should consult with the recorder and the team should 'think like a fish'. To determine if a break should be made, consider whether a fish would have to make an effort to move across the break and into the next habitat unit. If not, then it is probably a single habitat unit.

The channel may have both pool and riffle type habitat in the same cross-sectional area. Determine the predominant habitat type and record it as the unit type. For example if an area contains both pool and riffle, but the majority of the flow is into and out of the pool habitat, then call a pool.

Questions also often arise as to the minimum size of individual habitat units. Generally, if a habitat unit is not at least as long as the wetted channel is wide, then do not count it as a separate habitat unit. This rule may need to be adjusted for streams wider than 5 m. Use best professional judgment in such cases; strive for consistency. See section 2.1 for a list of features that should also be recorded while performing the inventory.

When to record: every habitat unit

Unit Number (#)

Definition:
Count of habitat units of similar types, used to determine location of paired sample units.

How to estimate:
When counting habitat units, group pools and glides (slow water) together, and group riffles, runs, and cascades (fast water) together. For example, consider the following sequence of habitat units:

Pool – Riffle – Pool – Pool – Riffle - Cascade – Riffle - Glide – Riffle – Pool – Run – Pool – Riffle

Habitat units in this sequence would be counted in the following manner (similar types are shaded same color):

Unit Type	Unit Number
P	1
R	1
P	2
P	3
R	2
C	3
R	4
G	4
R	5
P	5
RN	6
P	6
R	7

In the above example, the crew has counted six slow water (pool/glide) units and seven fast water (riffle/run/cascade) units.

When to record: every habitat unit; features such as falls, tributaries, side channels, culverts, are recorded as encountered and are not numbered.

Distance (m)

Definintion:
Length in 0.1 m increments from the start of the inventory to the upstream end of the habitat unit or distance from the start of the inventory to upstream end of a feature, used as spatial reference for data analysis and to locate features in the future.

How to estimate:
The observer walks upstream following the thalweg with a hipchain measuring device. When they reach the upstream break between habitat units or the upstream end of a feature they stop and report the distance to the recorder.

Care should be taken to keep the hipchain string over the thalweg, especially around bends and meanders. If the hipchain should break, retreat to the location where the break occurred, tie off the hipchain, and continue. If the hipchain is reset for any reason be sure to note it in the comments.

When to record: every habitat unit and feature

Dominant and Subdominant Substrate (1-9)

Definitions:

Dominant Substrate: size class of stream bed material that covers the greatest amount of surface area within the wetted channel of the habitat unit.

Subdominant Substrate: size class of stream bed material that covers the 2nd greatest amount of surface area within the wetted channel of the habitat unit.

How to estimate:

The following size classes are used to categorize substrates*. The substrate 'Number' is entered into the dominant and subdominant substrate columns on the datasheet.

Type	Number	Size (mm)	Description
Organic Matter	1		dead leaves, detritus, etc. – **not live plants**
Clay	2		sticky, holds form when rolled into a ball
Silt	3		slippery, does not hold form when rolled into a ball
Sand	4	silt – 2	grainy, does not hold form when rolled into ball
Small Gravel	5	3-16	sand to thumbnail
Large Gravel	6	17-64	thumbnail to fist
Cobble	7	65-256	fist to head
Boulder	8	>256	larger than head
Bedrock	9		solid rock, parent material, may extend into bank

** these size classes are based on the modified Wentworth scale*

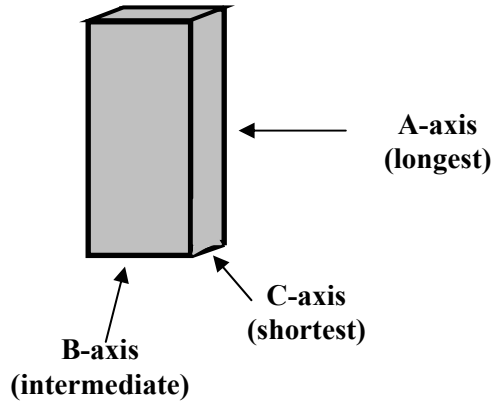
The observer walks through the unit mentally assessing the substrate. At the upstream end of the habitat unit the observer stops, turns to face the unit, and determines the dominant and subdominant substrate classes.

Estimate substrate size along the intermediate axis (b-axis) of the three axes. The b-axis determines what size sieve the particle could pass through. Remember that your eyes are naturally drawn to larger size substrates. Be careful not to bias your estimate by focusing deferentially on the large size substrate.

Some units will contain a mixture of particle sizes. Consult with the recorder and use your best professional judgment to choose the dominant and subdominant sizes.

In units where the substrate is covered in moss, algae, or macrophytes classify the underlying substrate and make note of the plant growth in the comments. Only call organic substrate where leaves or other detritus are the dominant or subdominant feature of the stream bottom.

When to record: every habitat unit



Large Wood (1-4 and rootwad)

Definition:
Count of dead and down wood within the bankfull channel of a habitat unit.

How to estimate:
The recorder classifies and counts LW as they walk through the habitat unit. LW counts are grouped by the size classes listed below:

Category	Length (m)	Diameter (cm)	Description
1	1-5	10-55	short, skinny
2	1-5	>55	short, fat
3	>5	10-55	long, skinny
4	>5	>55	long, fat
RW	rootwad	rootwad	roots on dead and down tree

Only count wood that is:
- > 1.0 m in length and > 10.0 cm in diameter
- within the bankfull channel
- fallen, not standing dead

- Count rootwads separately from attached pieces of LW
- Estimate the diameter of LW at the widest end of the piece
- A piece that is forked, but is still joined counts as only one piece of LW
- Count each piece once; count pieces that span more than one habitat unit in the unit where it was first encountered
- Enter the total count for each size category into the appropriate column on the datasheet

Where to estimate: every habitat unit

Photo (photo number)

Definition:
Photograph of stream feature.

How to measure:
Take photo facing upstream with observer holding wading rod in picture. Be sure to get entire width (and length if possible) of habitat unit or crossing feature in the photo.

Where to measure: stream features

Features

Definition:
Points on a stream that could potentially serve as landmarks, may be natural or manmade.

How to measure:
Record the distance to the upstream end of a feature; record distance of **all features** (both stream and crossing features) in the regular habitat datasheet; also record additional measurements for crossing features in the crossing datasheet and take a photograph of all crossing features.

Be sure to record the start and end of the fish sample reach as OTR features in the habitat data.

Where to record: wherever found

Channel Feature	Abbreviation	What to Record
Waterfall[1]	**FALL**	Distance, estimated height
Tributary	**TRIB**	Distance, average wetted width, into main channel on left or right (as facing upstream)
Side channel[2]	**SCH**	Distance, average wetted width, whether it is flowing into or out of main channel on left or right (as facing upstream)
Braid[3]	**BRD**	Distance at start and distance at end; continue with normal inventory up channel with greatest discharge
Seep (Spring)	**SEEP**	Distance, left or right bank (as facing upstream), size, coloration
Landslide	**SLID**	Distance, left or right bank (as facing upstream), estimated size
Other	**OTR**	Distance, description of feature, *example:* start of fish sample reach; Big Gap campground on left; alligator slide here, etc.

1 must be vertical with water falling through air to be a waterfall and not a cascade, do not record unless >1m high
2 two channels, continue with normal inventory up channel with most volume
3 three or more channels intertwined, continue with normal inventory up channel with most volume

Crossing Feature	Abbreviation	What to Record*
Bridge	**BRG**	Distance, width, height, road or trail name and type (gravel, paved, dirt, horse, ATV, etc.), photo
Ford	**FORD**	Distance, road or trail name and type (gravel, paved, dirt, etc.), photo
Dam	**DAM**	Distance, type, condition, estimated height, dam use, name of road or trail, if applicable; include beaver dams, photo
Culvert	**V**	Distance, road or trail name, type, # of outlets, diameter/width, height, material, perch (distance from top of water to bottom lip of culvert, natural substrate (present or absent through length), photo

* photograph all crossing features with person and wading rod for scale, record 'Y' in 'Photo' column

We cannot stress enough the importance of fully and accurately describing features. This means getting out a quadrangle map and finding road, trail, and tributary names and recording them in 'Comments' and taking the time to describe the location of features in relation to landmarks found on quadrangle maps.

Take photos of all crossing features!

Section 3: Wrapping Up

End the inventory where:

- Forest Service property ends
- End of NHD reach is encountered

Record the following in the Comments:

- Time and date
- Reason for ending the inventory
- Detailed written description of location using landmarks for reference
- GPS waypoint number from Garmin

When you return to home base:

- Immediately download the data and check file to be sure all data downloaded
- Check header information to be sure it is complete
- Note in all files if more than one file was used during the inventory
- Save to the computer and create a backup copy
- Document any photographs
- If using paper, make a photocopy of the data and store in secure location
- Record on master list that inventory is complete, with data and names of crewmembers

Section 4: Summary

Before starting: 1) fill in header information; 2) record the GPS waypoint number at the start of the reach

Record for every habitat unit:

- Unit Type
- Unit Number
- Distance
- Dominant Substrate
- Subdominant Substrate
- Large Wood

Record the start and end of the fish sample reach with GPS waypoints and as OTR features in the habitat data.

Record features and full feature descriptions wherever they are encountered. Photograph all crossings!

When end of inventory is reached, record reason for ending, date, and time, be sure data is saved in safe location, and record inventory start and end points on master maps.

Section 5: Field Guide, Random Numbers Table, Equipment Checklist

Record for every habitat unit:

Unit Type: pool, riffle, run, cascade, glide, feature (see below)
Unit Number: group pools & glides; group riffles, runs, cascades
Distance: (m) at upstream end of unit
Dominant Substrate: (1-9) covers greatest amount of surface area in unit
Subdominant Substrate: (1-9) covers 2nd most surface area in unit
Large Wood: (1-4, RW) count of dead and down wood in the bankfull channel

Note: Be sure to record the start and end locations of the fish sample reach with GPS and as an OTR feature in the habitat data.

Unit Types

Riffle (R) fast water, turbulent, gradient <12%; includes rapids, chutes, and sheets if gradient <12%
Cascade (C) fast water, turbulent, gradient ≥12%, includes sheets and chutes if gradient ≥12%
Run (RN) fast water, little to no turbulence, gradient <12%, flat bottom profile, deeper than riffles
Pool (P) slow water, may or may not be turbulent, gradient <1%, includes dammed, scour, and plunge pools
Glide (G) slow water, no surface turbulence, gradient <1%, shallow with little flow and flat bottom profile
Underground (UNGR) distance at upstream end, why dry

Features – don't forget to photograph!

Waterfall (FALL) distance, height
Tributary (TRIB) distance, width, in on L or R
Side Channel (SCH) distance, width, in or out on L or R
Braid (BRD) distance at downstream and upstream ends
Seep or Spring (SEEP) distance, on left or right, amount of flow
Landslide (SLID) distance, L or R, est. size and cause
Other (OTR) record distance, describe feature in comments
Crossing Features: Photograph and record the following:
Bridge (BRG) distance, height, width, road or trail name & type
Dam (DAM) distance, type, est. height, road or trail name &type
Ford (FORD) distance, road or trail name & type
Culvert (V) distance, type (pipe, box, open box, arch, open arch), size, material, natural substrate, perch (top of water to culvert) road or trail name

Substrates

1. **Organic Matter**, dead leaves detritus, etc., not living plants
2. **Clay**, sticky, holds form when balled
3. **Silt**, slick, does not hold form when balled
4. **Sand**, >silt-2mm, gritty, doesn't hold form
5. **Small Gravel**,3-16mm, sand to thumbnail
6. **Large Gravel**, 17-64mm, thumbnail to fist
7. **Cobble**, 65-256mm, fist to head
8. **Boulder**, >256, > head
9. **Bedrock**, solid parent material

Large Wood

1. <5m long, 10-55cm diameter
2. <5m long, >55cm diameter
3. >5m long, 10-55cm diameter
4. >5m long, >55cm diameter

RW: rootwad – count separately from attached LW, record in comments, do not record wood <10cm diameter, <1m length

End inventory

Where NHD reach ends or NFS boundary is encountered. Record time of day, detailed description of location, and GPS waypoint number at endpoint, and be sure all header info is filled in on datasheets.

Equipment Checklist

hipchain
extra string for hipchain
datalogger
GPS unit
camera
backpack
pencils
flagging
markers
waterproof backup datasheets
clipboard
field guide on waterproof paper
topographic maps
water
water filter
lunch
first aid kit
hardhats
high-viz vests
radio/cell phone
toilet paper
felt bottom wading boots
bug spray
raingear

Fill in as much header info as possible before leaving for the site, or on the way there