Protocol for Monitoring Fish Communities in Small Streams in the Heartland Inventory and Monitoring Network

SOP 5: Physical Habitat Measurements, Version 1.1

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	4/7/2017 & 3/30/2020	Dodd	Moved equipment list and field sheets from SOP 1 to SOP 5; minor modifications to field sheets due to modifications to database; added QA/QC section	Make SOP a stand-alone document for field use. Reduce data entry errors by making field forms match more closely with data entry forms in database; ensure data collection is high qualiy	1.1

Habitat composition within a stream is an important component in shaping biotic communities. The type and abundance of specific habitat characteristics (*i.e.*, woody debris, substrate size, *etc*.) will influence species presence and relative abundance, as well as size structure of the populations. Because of its importance to fish, physical habitat data will be collected as part of this protocol to examine relationships between environmental conditions and biotic communities. For parks that were previously monitored using seining techniques, methodology presented below follows closely with Peitz and Rowell (2004). Habitat data collected in parks using electrofishing techniques will follow Petersen *et al.* (2008). Modifications from the original prairie fish protocol (Peitz and Rowell 2004) have been made to enhance data collection without compromising comparisons to historical data collected under this protocol.

General Procedures

Prior to collecting samples and taking habitat measurements, always complete data sheet information for park code, stream name and/or stream number, reach, date, and time. For reaches were electrofishing gear is employed, also record the reach length, transect spacing, and initials of personnel who collect the data. A crew of two to three persons will collect physical habitat data. Although the equipment used for habitat collection is the same among all nine parks (Table 1), **the methods and field sheets for collecting habitat data differ between those parks where fish are sampled using seines (PIPE, TAPR, and HOME) and those parks sampled with electrofishing gear (EFMO, GWCA, HEHO, HOSP, PERI, and WICR)**.

When collecting data, stream banks are referred to in a downstream perspective. Therefore, if the crew is working/collecting data in an upstream direction, river right is on the workers' left, and river

left is on the right. Habitat data will typically be collected immediately after fish sampling at a reach. If fish sampling takes the entire day to complete, habitat measurements can be collected in the following day or two.

Table 1. Equipment list for physical habitat data collection.

Equipment	Units of measurement	Quantity/Size
Velocity meter	meters/second	1 (second meter as backup)
Velocity meter manual		
Top-setting wading rod	centimeters	1 – 1m rod
Tape measure	meters	1 or 2 100m tape(s)
Stakes for tying off tape measure		2 (if needed)
Range finder	meters	1 with a range of 5-100m
5 gallon bucket		1
Camera		1
GPS unit		1
Data sheets for seined parks		
Reach and weather conditions form		1 per reach
Physical habitat form		1 per reach
Data sheets for electrofished parks		
Weather and reach conditions form		1 per reach
In-stream form		1 per reach
Fish cover form		1 per reach
Bank measurement form		1 per reach

Seined Parks – Habitat Data Collection

PIPE, TAPR, and HOME are the three parks where seines are used to collect fish data. Habitat is collected in conjunction with both fish and water quality sampling once every third year at all reaches (i.e., full sampling regime; see Tables 1 and 2 and Appendices 1-3 in Protocol Narrative). At PIPE and TAPR, fish data will be collected annually at a subset of reaches without collection of habitat or water quality data (see Table 2 in Protocol Narrative).

At each reach, crewmembers record the conditions of the entire reach as well as weather conditions during time of sampling (Figure1). Collection of physical habitat measurements (e.g. width, depth, substrate composition, etc.) is conducted only at sites sampled (i.e. seined areas) within the reach. In other words, locations within the reach that are not seined will not have habitat data collected. Habitat is collected at three transects per site sampled (Figure 2). They are placed at the upstream and downstream end and in the center of each site. Wetted width is measured at each transect. Velocity and depth measurements are recorded at the center of each transect. For each site seined within the reach, a GPS location should be collected.

Water Quality Measurements

For TAPR only, discrete water quality measurements (i.e., CORE 5) are recorded at the top of the habitat form for each site sampled within each reach (Figure 3). Unattended water quality measurements will be collected using a data logger at PIPE and HOME reaches (see Appendices 1 and 3 in Protocol Narrative and Table 1 in SOP 3 for locations) and at specific reaches within TAPR (see Appendix 2 in Protocol Narrative and Table 1 in SOP 3).

REACH AND WEATHER CONDITIONS FORM – SEINED PARKS

Park: _____ **Stream #**: _____ **Stream Reach :**_____

Date: _____ **Time**: _____ **State**: _____ **County**: _____

Drainage Basin: _____ **Locality**: _____

Collectors: _____ (three letter initials)

Weather (circle): clear-sunny partly cloudy cloudy raining other:_____

In stream flow for stream reach (circle): isolated pools trickle between pools flow between pools

Spring present in stream reach (circle): Yes No

General Comments (aquatic vegetation, stream bed stability, sampling effectiveness, upstream land use, mortality, disease, etc.):_____

_____

_____

_____

_____

_____

_____

Figure 1. Reach and weather condition field form for seined parks.

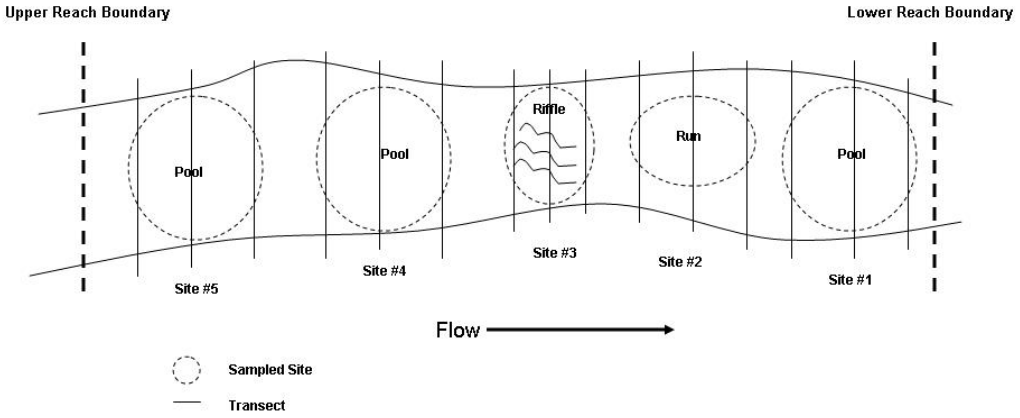

Figure 2. Placement of transects within sample sites of a seined reach.

Instream Habitat

The length of each site is measured. At each transect within the site (Figure 2), wetted width is measured; and at the middle of the transect, depth and velocity are recorded. See SOP 6 for details on collecting depth and velocity using a meter and wading rod.

Site Substrate

Percent coverage of substrate types are visually estimated from the entire site, not just along the transect. The Daubenmire cover class is recorded for each substrate type (see Figure 3 and Daubenmire 1959). Table 2 lists the description of substrate types. Site stability is categorized as stable or unstable based on substrate composition. Sites with larger substrates (high amounts of cobble, boulder or bedrock) are stable. Sites with finer substrate (high amounts of muck, silt, or sand) are unstable.

Riparian Cover and Streambank Erosion

The dominant vegetation along the right and left riparian area of the entire site is visually assessed at 5 distances from water's edge (0–25 m, >25–50 m, >50–75 m, >75– 00 m, and >100 m). Vegetation types are described in Table 3. The percentage of eroded banks (along entire site) is recorded using Daubenmire percentage classes (Figure 3). Highly eroded banks are typically vertical and lack vegetation. Stable banks have a gentle slope (<45^{o} angle) and native vegetation (such as prairie grasses, shrubs, or mature trees). Banks with manicured grasses (lawn) or domestic grasses have less stability than those with native grasses.

PHYSICAL HABITAT FORM – SEINED PARKS

Park: _____ Stream #: _____ Stream Reach: _____ Date: _____

Discrete Core 5 Water Quality (readings taken at TAPR only; PIPE and HOME use data loggers at the reach):

	Site 1	Site 2	Site 3	Site 4	Site 5
Time: (military)*					
Air temperature (°C)					
Water temperature (°C)					
Secchi visibility (cm)					
Dissolved Oxygen (mg/l)					
Conductivity (uS)					
Specific Conductance (uS)					
pH					
Sample Effort (sec)*					
# Seine Hauls*					
Seine Reach Length (m)*					

*Transfer this data to the Fish Community field sheet for each site.

Instream Habitat (maximum of 5 sites sampled within a stream reach):

	Transect	Channel Unit (Pool, Riffle, Run)*	Width (m)	Depth (cm)	Velocity (m/s)
Site 1	1				
	2				
	3				
Site 2	1				
	2				
	3				
Site 3	1				
	2				
	3				
Site 4	1				
	2				
	3				
Site 5	1				
	2				
	3				

Site Substrate (percent category)

	Site 1	Site 2	Site 3	Site 4	Site 5
Muck					
Detritus					
Silt					
Sand					
Pea-gravel					
Coarse-gravel					
Cobble					
Boulder					
Bedrock					
Hardpan/shale					
Habitat Comments:					

Percent: 0 = none, 1 = trace, 2 = 1 – 5%, 3 = 5 – 25%, 4 = 25 – 50%, 5 = 50 – 75%, 6 = 75 – 95%, 7 = 95 – 100% coverage

Riparian Corridor Cover (dominant cover type)

	Site 1	Site 2	Site 3	Site 4	Site 5
Left Bank					
0-25m					
>25-50m					
>50-75m					
>75-100m					
>100m					
Streambank Erosion %					
Right Bank					
0-25m					
>25-50m					
>50-75m					
>75-100m					
>100m					
Streambank Erosion %					

COVER TYPES: 1 = Mature woodland, 2 = Woody shrubs/saplings, 3 = Wetland/native grasses & forbes (prairie), 4 = Domestic grass, pasture, hay 5 = Park/lawn, 6 = Row crop, 7 = Road/railroad, 8 = Urban/industrial, 9 = Other (note in comments)

Figure 3. Physical habitat field form for seined parks.

Table 2. Substrate types, size ranges and description.

Substrate Type	Size Range (mm)	Description
Muck	<0.004	Fine material, remains together when squeezed between fingers – not gritty between fingers
Detritus		Fine decayed organic material, original form not distinguishable
Silt	0.004 to 0.06	Fine material, falls in pieces when squeezed between fingers – not gritty between fingers
Sand	0.06 to 2.0	Smaller than ladybug size, but visible as particles – gritty between fingers
Pea-gravel	2.0 to 16.0	Lady bug to marble size
Coarse-gravel	16.0 to 64.0	Marble to tennis ball size
Cobble	64.0 to 256.0	Tennis ball to basketball size
Boulders	256.0 to 4000.0	Basketball to car size
Bedrock	> 4000	Rock bigger than a car
Hardpan/shale		Firm, consolidated fine substrate or shale

Table 3. Codes used to identify dominant riparian vegetation cover classes.

Vegetation	Code	Description
Mature woodland	1	Large trees present, few mid-story trees or shrubs
Woody shrubs / saplings	2	Small to midsize trees, early succession trees and shrubs present. Area typical of one disturbed in the recent past
Wetland / native grasses & forbs (prairie)	3	Native or restored wetland or prairie. Diverse collections of native plants present
Domestic grass pasture / hay field	4	Dominated by one or two domesticated grasses. Grazed by livestock or hayed
Park / lawn	5	Frequently mowed or maintained vegetation
Row crops	6	Area under agricultural crop production
Road / railroad	7	Dominated by road or railroad bed, vegetation absent
Urban / industrial	8	Housing or industrial operations present, vegetation absent
Other	9	Any vegetation type or land use not defined above

Electrofished Parks - Habitat Data Collection

For parks where electrofishing gear is employed, habitat will be collected along 11 equally spaced transects perpendicular to flow to collect instream habitat, fish cover, bank stability, and bank vegetation data (Figure 4). Because weather conditions can affect water quality, physical habitat, and sampling efficiency, weather conditions are recorded on the field sheet immediately prior fish sampling (Figure 5).

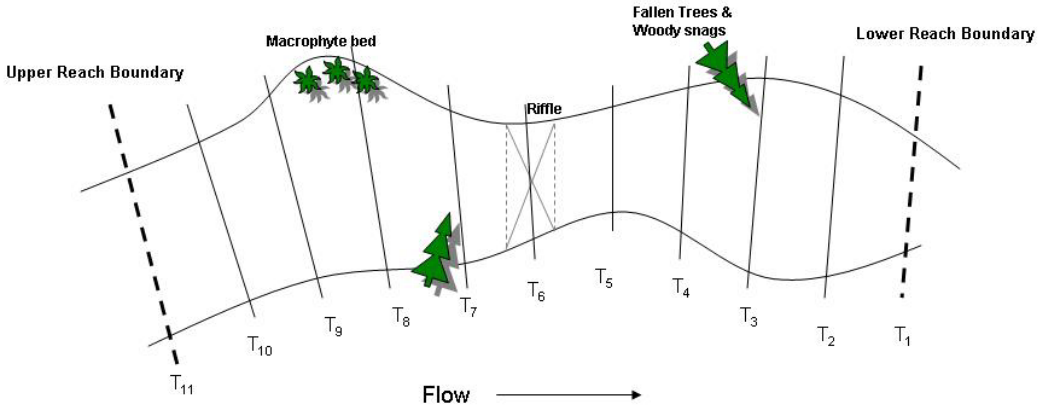

Figure 4. Transect spacing and location within a sample reach.

Instream Habitat Data

Data on channel morphometry, velocity, substrate, and canopy cover are collected at three points (middle of channel and half the distance between middle and the left and right banks; Figure 6) along each of 11 transects. At each transect, wetted width, channel unit (see Table 4 for descriptions), and pool form (if applicable) are recorded on the instream field sheet (Figure 7). At each point, depth and velocity are measured. Dominant substrate size and substrate embeddedness are visually observed within a 10 cm diameter circle around each point (Figure 6). Dominate substrate size is defined as the average substrate size within the circle using the Wentworth scale (Table 5; Figure 8; Wentworth 1922). For substrate codes 1-3, there are no boxes shown in Figure 8 by which to estimate their respective sizes because these substrates are so small. However, the general rule is that code 1 (silt or clay) feels slick between thumb and finger with no evidence of grit. Code 2 (very fine sand) has a barely perceptible gritty feel, and code 3 (fine sand) has a distinct gritty texture. For these three substrate codes, it is necessary to grab a sample from the 10 cm circle for assessment of dominate substrate. The Wentworth code is recorded on the instream field form. Canopy cover also is visually observed by looking directly overhead at each point and categorizing the percentage cover within 1 m upstream and downstream from the transect (Figure 6). If a bridge or other manmade structure is producing the canopy, this should be clearly indicated in the comments section.

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REACH AND WEATHER CONDITIONS FORM – ELECTROFISHED PARKS

Park:_____ Stream Name:_____ Stream #:_____

Date:_____ Recorder:_____

Reach Description: _____

_____

_____

_____

Weather Conditions:

Cloud cover:_____% Wind: *Calm* *Light* *Moderate* *Gusty*

Precipitation: *None* *Rain* *Sleet* *Snow* Intensity: *N/A* *Light* *Moderate* *Heavy*

Other Weather:_____

Additional Comments:_____

_____

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_____

_____

_____

Figure 5. Reach and weather conditions field sheet for electrofished parks.

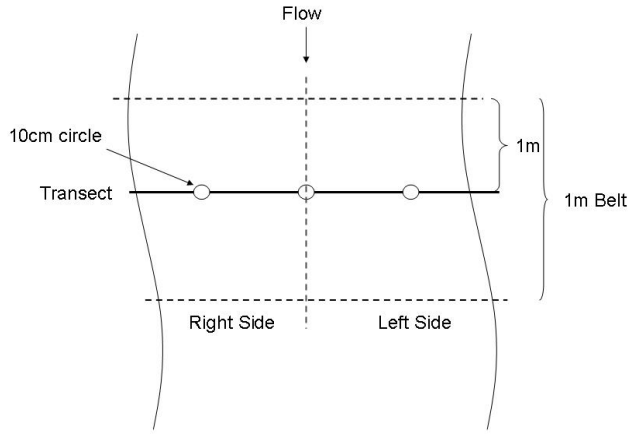

Figure 6. Location of in-stream habitat and fish cover collection at a transect.

Table 4. Description of channel units for instream habitat collection.

Channel Unit Types	Description
Riffle	An area of the stream with steepest slope and shallowest depth, often rocky substrate, and swift current. Thalweg is usually poorly defined.
Run	Differ from riffles in that depth of flow is typically greater and slope of the bed is less than that of riffles. Runs often have a well defined thalweg. Runs sometimes are referred to as races.
Riffle/Run Complex	Recorded when a portion of the channel is a riffle habitat and the other portion is run habitat. This type of habitat unit is typically formed by instream gravel bars.
Glide	Transition zone located immediately downstream from pools and upstream from riffles. The slope of the channel bed is negative while the slope of the water surface is positive. Increased velocity coming out of the pool, location at which the steeply sloped bed rising out of the pool decreases to a lesser gradient, the thalweg becomes less defined.
Pool	Relatively slow current and usually found at stream channel bends, upstream from riffles, or on the downstream side of obstructions such as boulders or fallen trees. The stream bottom is often bowl shaped and represents the deepest locations of the reach.
Pool/Glide Complex	Recorded when a pool is transitioning into a glide. Because the head of a glide is difficult to identify, use this code if unsure about the exact location of the glide.

In-stream Habitat Assessment Form - Electrofish Parks Page ____ of ____

Park: Stream Name: Stream #: Date:

Channel Length: Transect Spacing (channel length / 10): Crew:

Trans	Channel Unit	Pool Form	Width (m)	Depth (cm)	Velocity (m/sec)	Dominant ** Substrate	Embededness	Canopy Cover
1*				L M R	L M R	L M R	L M R	L M R
2				L M R	L M R	L M R	L M R	L M R
3				L M R	L M R	L M R	L M R	L M R
4				L M R	L M R	L M R	L M R	L M R
5				L M R	L M R	L M R	L M R	L M R
6				L M R	L M R	L M R	L M R	L M R
7				L M R	L M R	L M R	L M R	L M R
8				L M R	L M R	L M R	L M R	L M R
9				L M R	L M R	L M R	L M R	L M R
10				L M R	L M R	L M R	L M R	L M R
11				L M R	L M R	L M R	L M R	L M R

CHANNEL UNIT CODES		POOL FORM CODES		Embededness & Canopy Cover
GL	Glide	B	Backwater Pool	0 = Absent (0%)
RI	Riffle	F	Bluff Pool	1 = Sparse (<10%)
RU	Run/Race	I	Impoundment	2 = Moderate (10-40%)
PO	Pool	L	Lateral Pool	3 = Heavy (40-75%)
RRX	Riffle-Run complex	M	Mid-Channel Pool	4 = Very Heavy (>75%)
PGX	Pool-Glide complex	O	Obstruction Pool	(Canopy within 1m on each side of transect)

*Transects are equally spaced as determined by dividing the reach length by 10.
Transect 1 is located at the downstream end of the reach; Transect 11 is located at the upstream end of the reach
** Dominate substrate is average substrate within a 10 cm diameter circle around the point where depth is taken
Embeddness is assessed within a 10 cm diameter circle around point

Figure 7. Instream field form for electrofished parks.

Table 5. Substrate size classes used for characterizing substrate based on the Wentworth Scale.

Size Code	Particle Diameter Range (mm)	Category
1	<0.062	Silt/clay
2	0.062-0.125	Very fine sand
3	0.125-0.25	Fine sand
4	0.25-0.50	Medium sand
5	0.50-1	Course sand
6	1-2	Coarse sand
7	2-4	Fine gravel
8	4-5.7	Medium gravel
9	5.7-8	Medium gravel
10	8-11.3	Coarse gravel
11	11.3-16	Coarse gravel
12	16-22.6	Small pebble
13	22.6-32	Small pebble
14	32-45	Large pebble
15	45-64	Large pebble
16	64-90	Small cobble
17	90-128	Small cobble
18	128-180	Large cobble
19	180-256	Large cobble
20	256-362	Boulder
21	362-512	Boulder
22	512-1024	Boulder
23	>1024	Boulder
24	Bedrock	Bedrock

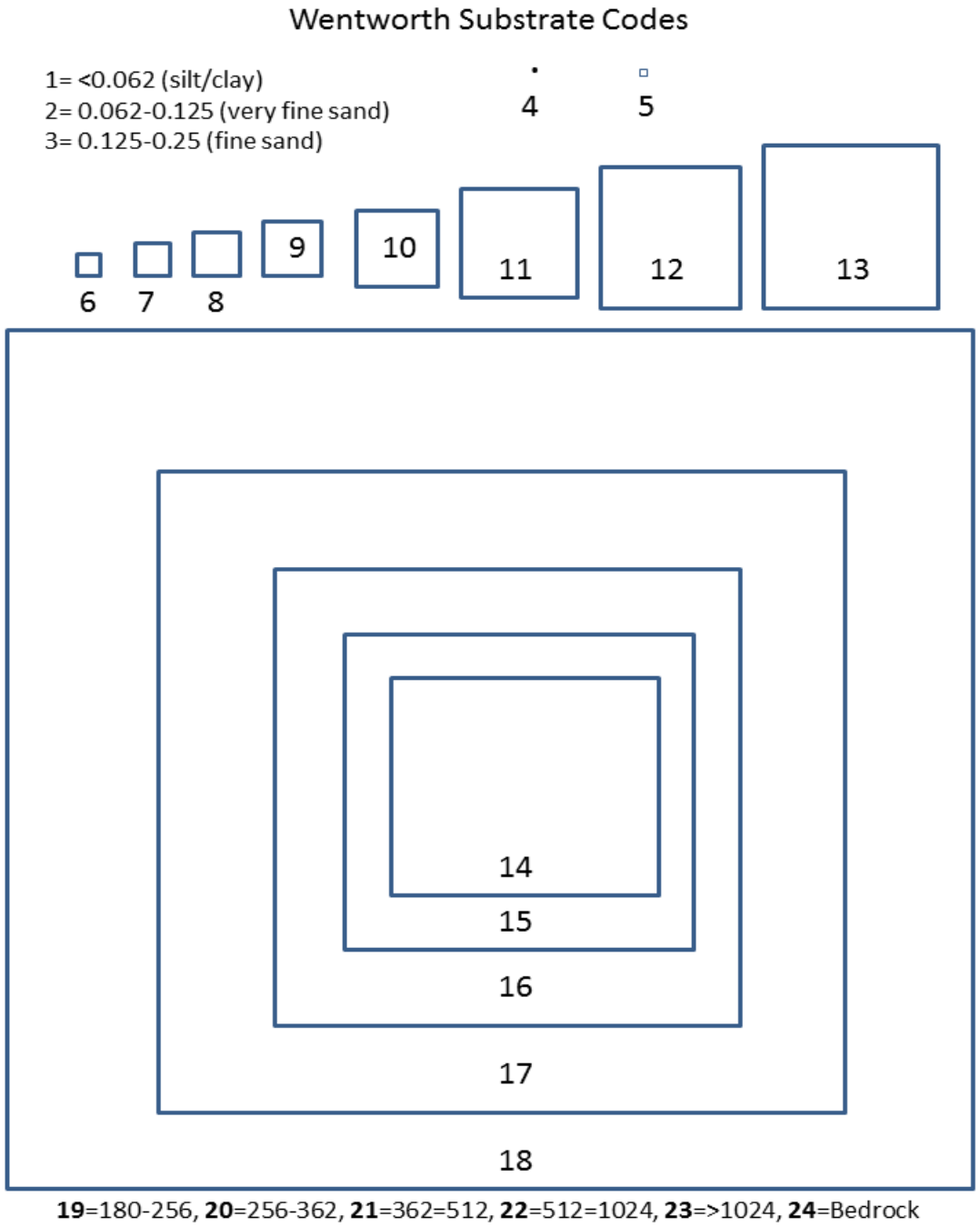

Figure 8. Wentworth code and scale used to categorize dominate substrate for instream habitat (not drawn to correct scale).

Fish Cover

It is important to document the presence of fish cover in a stream because different species have affinities for various cover types. For example, sunfish species typically inhabit woody structure or boulder fields along the banks and in pools. Therefore, a reach with several snags or large boulders will likely have a large number of sunfish.

To assess fish cover within a reach, all cover types present will be documented along each transect on the fish cover field sheet (Figure 9). Filamentous algae, hydrophytes, boulders (size 21 to 23 on the Wentworth substrate sheet, see Table 5 and Figure 8), and any artificial cover are assessed within a 10 cm diameter circle around each of the three points at a transect (Figure 6). If artificial cover (cinder blocks and car tires, for example) is present, the type of cover should be noted in the comments section. Small and large woody debris are assessed in a 1m belt along the transect (1 m upstream and 1 m downstream of transect); dividing the belt into left and right side of middle channel (Figure 6). Small woody debris is defined as being less than or equal to 10 cm in diameter at its largest end, and large woody debris is greater than 10 cm in diameter at its largest end. Fish cover along the banks is assessed within 1 m belt from the transect. Cover along the banks include trees/roots, overhanging vegetation, undercut banks, and bluffs within 5 m of wetted edge.

Bank Measurements

Characteristics of the bank and riparian areas can affect instream processes and fish habitat. For example, banks that are mostly bare with steep angles are likely to erode during high flow events, increasing the amount of fine sediment entering the stream. This, in turn, degrades habitat for benthic species (both fish and invertebrates) by burying large gravel/cobble substrates. Therefore, collection of bank stability and vegetation data may help explain fish community composition and abundance.

The bank is defined as the area of steep sloping ground bordering the stream that confines the water within the channel at normal water levels and is located between the channel and the flood plain (Fitzpatrick *et al*. 1998; see Figure 10). The flood plain is defined as a flat or gently sloping depositional area adjacent to the stream. At low flows, it may be difficult to determine the location of the bank because of the presence of bars. Bars are defined as areas usually devoid of woody vegetation, such as small trees and shrubs, but may contain grasses and contain coarse materials such as sand, gravel, or cobble. These areas will be covered by water during normal flow (that is, at flows slightly higher than low flow) and therefore, are not considered part of the bank. Each bank measurement begins at the “true” bank (that is, the area of steep slope). In some instances, the bank will begin at the wetted edge. However, if gravel or sand bars are present at a transect, these will not be included in the bank assessment, but will be noted in the comments section by recording the width of the bar from water’s edge to the bank.

Fish Cover Form -Electrofish Parks Page ____ of ____

Park: Stream Name: Stream #: Date:

Channel Length: Transect Spacing (channel length / 10): Crew:

Trans.		Fish Cover* Circle all cover types present.										Comment
1	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
2	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
3	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
4	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
5	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
6	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
7	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
8	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
9	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
10	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
11	L	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	
	M	FA	HY	BO	AR							
	R	FA	HY	BO	AR	SWD	LWD	T/R	OV	UC	BL	

Fish Cover Types*
FA = Filamentous Algae
HY = Hydrophytes & Mosses
BO = Boulders
AR = Arificial
SWD = Small Woody Debris
LWD = Large Woody Debris
T/R = Trees/Roots
OV = Overhanging Veg
UC = Undercut bank
BL = Bluff within 5m of water

Additional comments:

FA, HY, BO, AR are assessed within 10cm diameter circle around each point on transect
SWD is < 10 cm in diameter at largest end; LWD is >10 cm at largest end
SWD & LWD assessed on 1m belt along transect on left & right side of center of channel
T/R, OV, UC, BL are assessed within 1 m on either side of transect along bank

10 cm or 0.1m

Figure 9. Fish cover field form for electrofished parks.

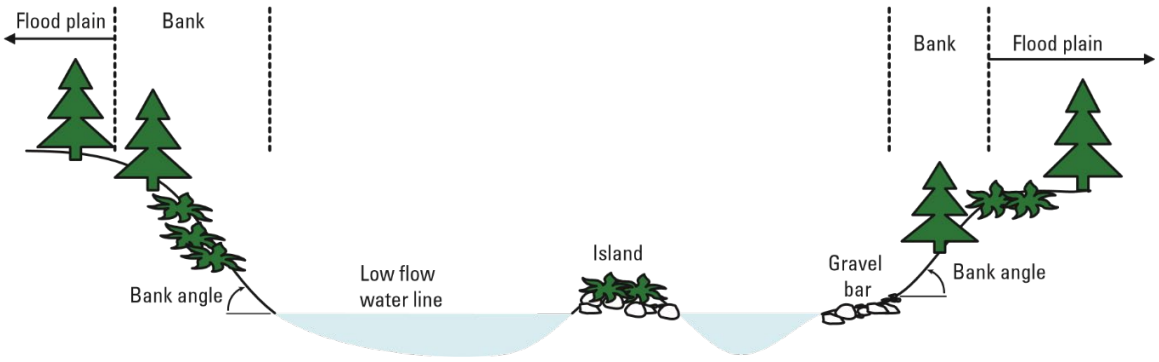

Figure 10. Illustration showing banks and floodplains of a stream.

Bank characteristics are observed at each transect. Bank stability is visually observed at the transect, and each bank characteristic is categorized (Figure 11). Bank angle and substrate are observed from the bottom of the bank (at wetted edge or at the top base of the bar, if one is present), and the category code is recorded. To assess the bank substrate, the Wentworth scale is used to define the substrate type (silt = code 1, sand = codes 2 – 6, gravel = codes 7 – 16, cobble = codes 17 – 20, boulder = codes 21 – 23), but the substrate category code on the bank data sheet (Figure 11; code of 1, 2, 5, 8, or 10) is recorded and not the Wentworth code. Percent vegetative cover, bank height, and bank cover are assessed from the bank bottom to 10 m into the bank. For bank cover, more than one cover type may be recorded if two cover types are relatively equal in abundance. Bank cover categories include large trees, small trees/shrubs, grass/ forbs, bare rock/sediment, and artificial cover. If artificial cover is present on the bank (for example, rip-rap or concrete structures), the type of cover should be noted in the comments section.

Bank Measurement Form - Electrofish Parks

Park: Stream Name: Stream #: Date:

Channel Length: Transect Spacing (channel length / 10): Crew:

		Bank Stability				Bank Cover*					
Trans.		Angle	Veg	Height	Sub	Circle Dominant (>50%) Cover					Comment
1	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
2	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
3	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
4	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
5	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
6	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
7	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
8	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
9	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
10	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	
11	L					TR	SH	GR	BA	AR	
	R					TR	SH	GR	BA	AR	

*Bank cover is assessed within 1 m on each side of transect and 10 m up the bank from wetted edge

Bank Angle, Degrees	Vegetative Cover (%)	Height (m)	Substrate	Bank Cover Types*
1 = 0 - 30	1 = >80	1 = 0-1	1 = Bedrock/Artificial	TR = Large trees (> 3 in. dbh)
2 = 31-60	2 = 50-80	2 = 1.1-2	2 = Boulder/Cobble	SH = Small trees and shrubs
3 = >60	3 = 20-49	3 = 2.1-3	5 = Silt	GR = Grass and Forbes
	4 = <20	4 = 3.1-4	8 = Sand	BA = Bare rock/sediment
		5 = >4	10 = Gravel/Sand	AR = Artificial

Bank Angles

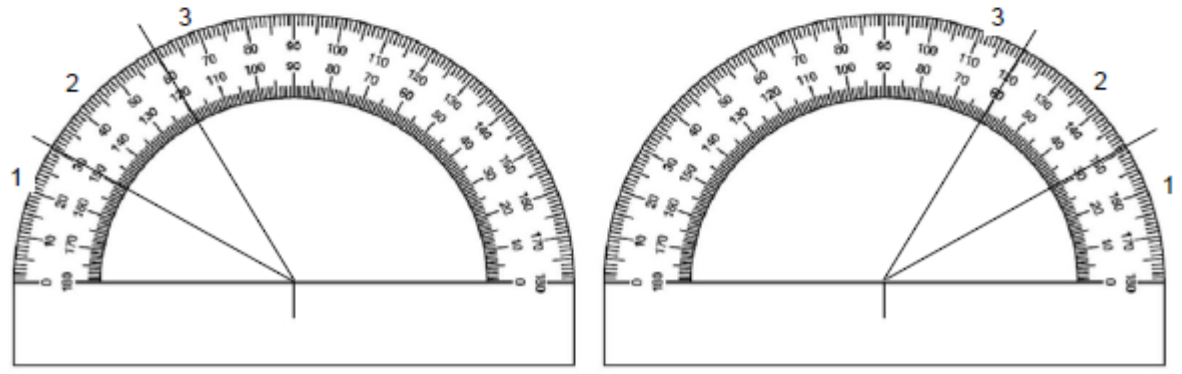

Figure 11. Bank measurement form for electrofished parks.

QA/QC Procedures for Collection of Habitat Data

Field crew leads responsible for collecting habitat data will review this SOP prior to the field season and be certified in collection of habitat data. The QA officer (project lead or previously certified crew lead) will conduct the certification. Certification entails that new crew leads responsible for assessing habitat will independently measure physical habitat and assign class codes or presence/absence to observational habitat data independently of each other and the project/certified crew lead. An agreement of 90% between the new crew leads and project/certified crew lead is required for certification. A minimum of 11 transects will be used for certification within a sample reach that has diverse channel unit types (riffle, run, glide, pool). For crew members who will assist with habitat data collection (i.e., not a crew lead), a nearby stream will be used to practice collecting habitat data under the supervision of a certified crew lead.

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