Pigeon River Habitat

A report on the Pigeon River Fisheries Habitat Survey

July 2011

Michigan Trout Unlimited

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Purpose

Many coldwater streams in Michigan, including the Pigeon River, lack comprehensive fish habitat data. Fisheries habitat data was collected, summarized, and discussed in the context of prioritizing restoration and protection efforts in the Pigeon River, with an emphasis on coldwater fish habitat. Habitat mapping was used because it provides a comprehensive habitat inventory for the entire Pigeon River.

Introduction

The Pigeon River is a high quality trout stream located in northern Michigan. It is 42 miles long and the watershed is approximately 88,000 acres, draining a total of about 80 miles of stream. The Michigan Department of Natural Resources has divided the Pigeon River into three valley segments distinguished by water temperature. At the headwaters the river is cold, the middle section is cold-transitional, and the lower portion is cool (Table1, Table 2).

Table 1. Description of Pigeon River Valley Segments.

Section Name	Site Description
Cold	Bean Trail to Old Vanderbilt Club
Cold-Transitional	Old Vanderbilt Club to Forest Rd. 14
Cool	Forest Rd. 14 to Mullet Lake

Table 2. Michigan stream and river temperature classification criteria. Temperature ranges are based on mean July water temperature (°F).

Classification	Temperature Range
Cold	<63.5 °F
Cold-Transitional	63.5-67.1 °F
Cool	67.1-69.8 °F
Warm	>69.8 °F

The Michigan DNR and Trout Unlimited deployed 6 continuous water temperature loggers in the Pigeon River in 2010. The loggers recorded water temperature hourly between June and September (Table 3). The recorded mean July temperatures aligned with water temperature estimates in most cases. The only exceptions were at Webb Rd. and M-68. Webb road is very close to the bottom edge of the cold-transitional section, but it still located in the cold-transitional area. The mean July temperature at Webb Road fell in the cool range (Table 2, Table 3). At M-68 the river is classified as cool, the 2010 mean July temperature at M-68 fell in the warm range (Table 2, Table 3). Water temperatures in most of the river are suitable for trout.

Prior to this survey there was very little current fish habitat data available for the Pigeon River. The habitat data that does exist is either from a very small portion of the stream (DNR Status and Trends Data upstream of Elk Hill) or is outdated (comprehensive habitat surveys by the USGS 1970). A current comprehensive survey of habitat conditions in the Pigeon River was not available. It is important to note that fish habitat data is only one of the tools used to identify factors that may be limiting a coldwater fishery.

Information on in-stream habitat is critical when fisheries habitat restoration and protection priorities are being set. It is important to understand what types of habitat are available and what may be lacking throughout the entire river. The goal of habitat mapping is to determine if any in-stream fisheries habitat variables are limiting the coldwater fish population, including the impacts of road stream crossings and barriers. Looking at in-stream impacts (excess fine sediment, wide shallow stream etc.) will help with the prioritization of restoration and protection projects.

Table 3. 2010 Pigeon River water temperature data. Data downloaded and summarized by Tim Cwalinski.

Location	Month	Average (°F)	Max (°F)
Pigeon River - Old Vanderbilt Rd	June	58	67
	July	63	70
	Aug	62	68
Pigeon River - below SOM	June	61	67
	July	67	71
	Aug	66	71
Pigeon River - Elk Hill	June	62	77
	July	62	71
	Aug	63	72
Pigeon River - Tin Bridge	June	61	68
	July	66	71
	Aug	64	69
Pigeon River - Webb Rd	June	62	71
	July	68	74
	Aug	67	74
Pigeon River - M68 Hwy	June	63	73
	July	71	78
	Aug	69	77

Habitat mapping differs from many types of habitat monitoring in that fisheries habitat in the entire Pigeon River was surveyed. This survey included; delineating the river channel into bedform types (run, riffle, or pool), recording the length location and mean width of each bedform unit; and the characterization of the amounts of in-stream fish habitat (aquatic vegetation, woody debris, and deep water) and streambed substrate composition in each bedform unit.

Each of these variables is important to the health of a coldwater fish community. A variety of bedform structures are needed for a healthy fishery. For example, riffles with coarse substrate are used for spawning and deep pools provide cover. Bottom substrate heterogeneity is also important in providing a variety of food sources. A variety of substrate types (gravel, cobble, silt, wood, leaf packs, etc.) provides habitat for a diverse macroinvertebrate community and thus a variety of food sources for coldwater fish. Areas that can hold and hide fish are also important. Woody debris, deep water, and aquatic vegetation are examples of fish habitats which provide cover. Trout and other fish can seek refuge from predators in these areas.

Habitat mapping data collected on the Pigeon River in 2010 is summarized in this report. Trends in bedform composition, substrate composition, and fish habitat structure were compared for the three valley segments in the Pigeon River. In addition, the impact of the Song of the Morning Ranch Dam was highlighted, the impact of each road stream crossings was assessed, areas with below average quantities of woody debris were identified, and erosion sites were noted.

Data Examples

The question remains, how much of each type of substrate is needed, how much fish cover is required for a healthy fishery, and how much bedform diversity is enough. We do not have hard numbers to answer these questions for coldwater streams in Michigan. What we do know is that substrate diversity is important, as is the presence of in-stream habitat. With this in mind we are looking at in-stream habitat to identify clear problems.

A healthy stream will have diverse bedform structure with ample run, riffle, and pool habitat. The river will not be dominated by one bedform type (Figure 1). River A has a good balance of bedform types, whereas River B is dominated by run habitat with little riffle or pool habitat available. The dominance of run habitat in river B is a sign of a problem.

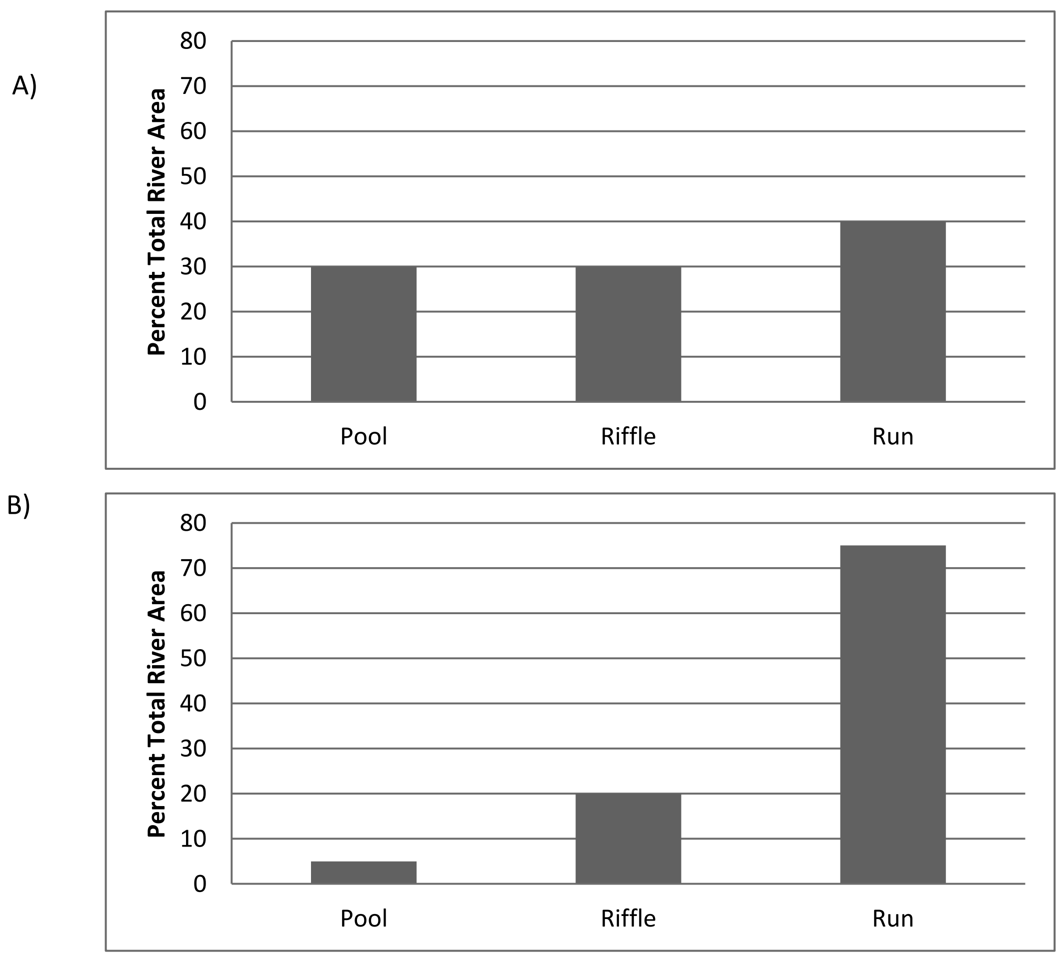


Figure 1. Hypothetical bedform composition data for a healthy balanced river (A) and a river lacking bedform heterogeneity (B).

A variety of substrate types are also present in a healthy river. It is especially important that fine sediments (sand, silt, clay) do not dominate a river bottom. Erosion is a major source of pollution to our waterways, an overabundance of fine sediment can be a sign that there is an erosion problem in the watershed (Figure 2). A healthy river will have a balance of substrate types (Figure 2). River A has a good balance of fine and hard substrate; whereas river B is dominated by clay, silt, and sand with little hard substrate present.

A)

B)

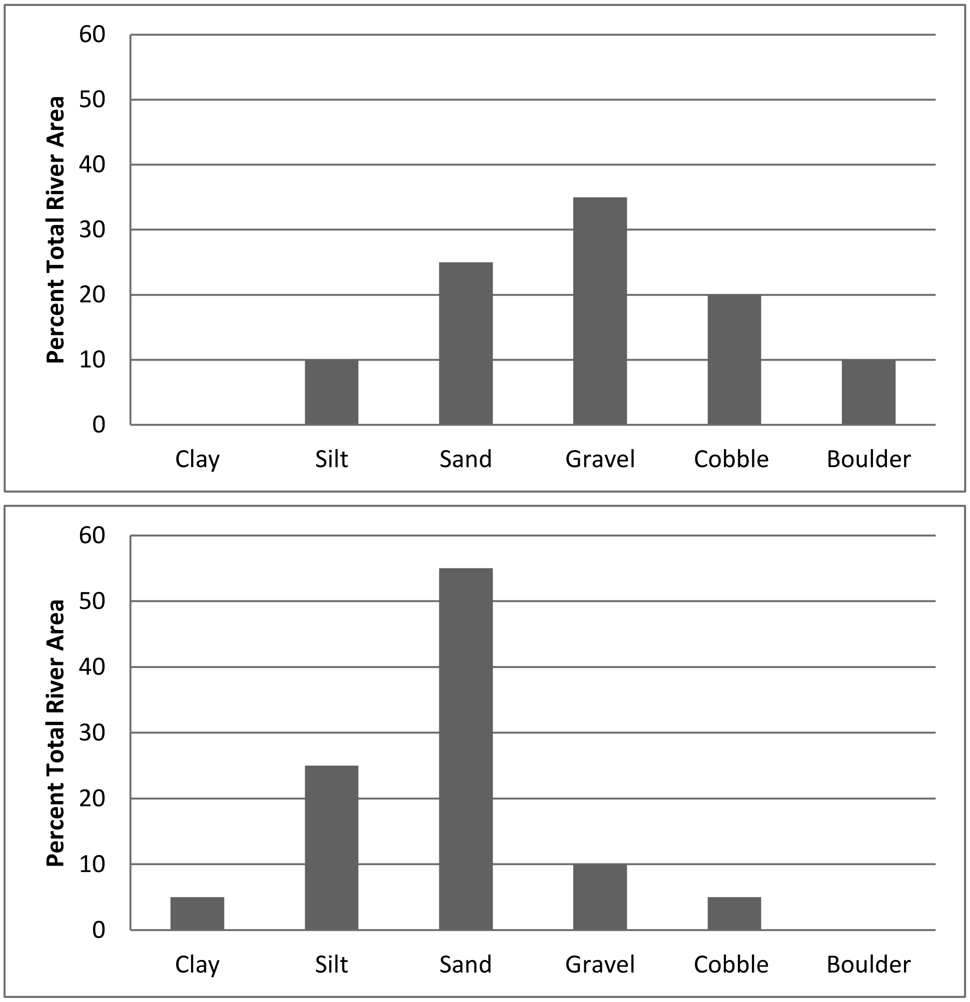
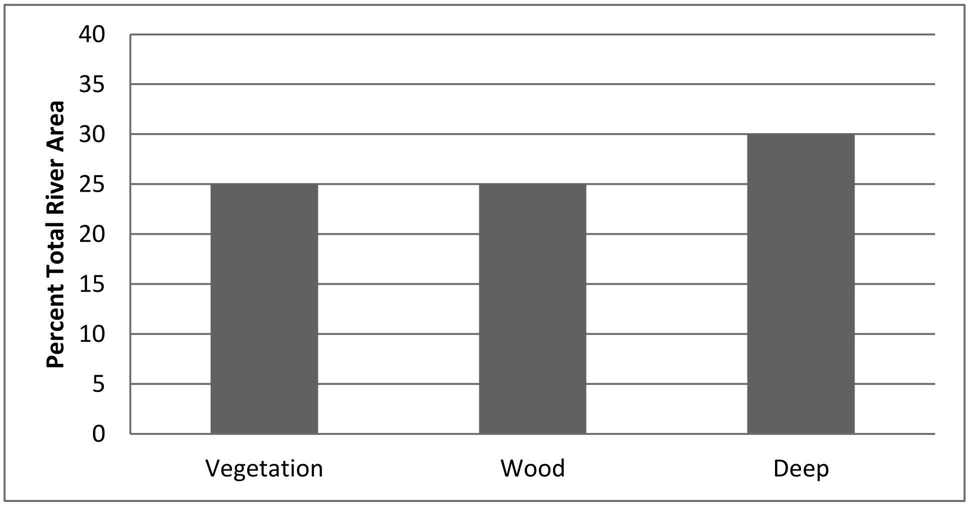


Figure 2. Hypothetical substrate composition data for a healthy river (A), and a river with excess fine sediment (B).

In-stream habitat diversity is also an important portion of what makes a stream ideal for coldwater fish. Fish need a variety of places to seek cover from predators including aquatic vegetation, woody debris, and deep water. A variety of in-stream habitat in much of the river is important, a lack of in-stream habitat, diversity and quantity, is a problem for fish (Figure 3). River A has abundant, diverse in-stream fish habitat (80%); whereas, river B has sparse in-stream habitat available (25%).

A)



B)

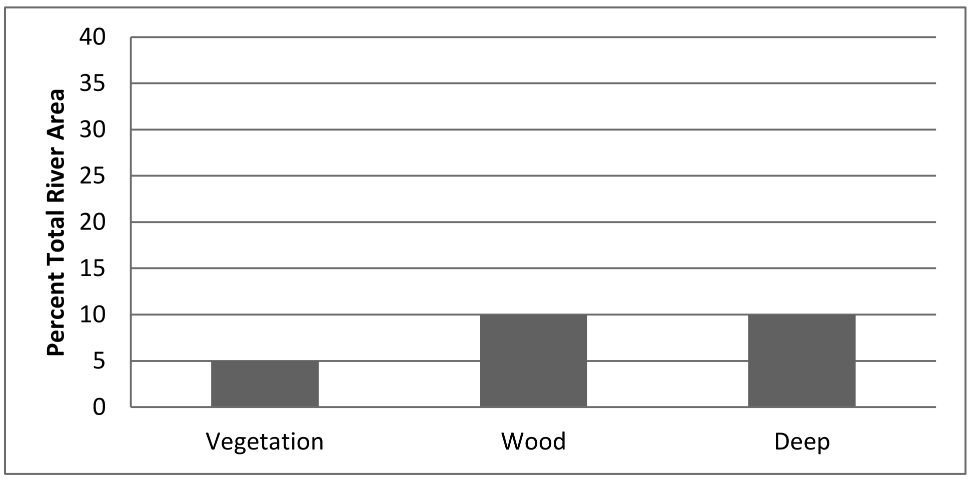


Figure 3. Hypothetical in-stream habitat data for a river with good diverse habitat (A), and a river lacking in-stream habitat (B).

Graph A in Figures 1-3 depict a healthy river, ideally each river mapped will have data similar to that seen in the A graphs. Graph B in Figures 1-3 depict problems we are looking for when analyzing habitat data for coldwater streams. When we see data similar to that in the B graphs we know that the river is in need of restoration.

Methods

This survey was conducted by Matt Breck, who was a Huron Pines AmeriCorps member serving with the Headwaters Chapter of Trout Unlimited and volunteers from the Headwaters Chapter of Trout Unlimited. Matt and volunteers were trained in habitat mapping methods by Michigan Trout Unlimited Aquatic Ecologist Kristin Thomas. All mapping was completed in May (15, 26-28), July (14-16, 20, 21, 23, 26-29) August (2, 6, 9, 12, 16, 31) and October (12-13, 15) of 2010. It is important that habitat is not mapped during times of high flow because high flow can make it difficult to distinguish bedform delineations. USGS stream flow data for the Pigeon River at

Sturgeon Valley Road is provided for each sampling day (Table 4). Sampling day discharge only exceeded the monthly mean on two occasions (Table 4).

Table 4. Pigeon River at Sturgeon Valley Road USGS Stream Gauge discharge estimates for days when habitat was sampled and monthly mean discharge estimates.

Date	USGS Discharge Estimate (CFS)	Monthly Mean
5/15, 5/26 – 5/28	75, 52, 51, 50	68
7/14-7/16, 7/20, 7/21, 7/23, 7/26 – 7/29	56, 53, 51, 49, 48, 60, 58 ,53, 52, 53	56
8/2, 8/6, 8/9, 8/12, 8/16, 8/31	53, 49, 54, 55, 50, 51	57
10/12, 10/13, 10/15	56, 56, 57	64

Training included instruction on how to determine bedform delineation, substrate classification, and practice visually estimating percent of streambed. Stream diagrams were used to practice estimating the percent of streambed occupied by substrate types and fish cover. Volunteers estimated substrate composition and fish cover for each diagram. A key with a grid and actual percentages were then provided. This exercise was used to help volunteers visually estimate percent of stream bottom.

Bedform delineation and qualitative observations were derived through independent visual observations and evaluations. Bedform delineation involved the categorization of the stream into bedforms (run, riffle, pool, rapid, Table 5). The length and widths (top and bottom) of each bedform section were measured. Latitude and longitudes were recorded at the top and bottom of each bedform section using a handheld GPS. Measurements of bedform lengths and widths were made with a Nikon Laser Rangefinder (+/- 0.5 yard accuracy) or a tape measure.

Quantitative streambed substrate composition measurements were made through visual estimation. The percent of each bedform segment occupied by clay, silt, sand, gravel, cobble, or boulder was estimated visually. Substrate classification followed Michigan DNR and Wolman size classes for sand, gravel (all sizes combined), and cobble (all sizes combined) (Table 6). The amount of streambed in each bedform section covered by woody debris, aquatic vegetation and deep water (>2.5 ft.) was also visually estimated. The amount of wood, vegetation, and deep water was expressed as a percent of streambed area (5% increments). The maximum depth present in each bedform section was also recorded.

Table 5. Bedform delineation explanation.

Bedform	Description
Run	Fast or slow current, unbroken water, average depth.
Riffle	Swift current, turbulent broken water, shallower than average depth.
Pool	Slow or no current, unbroken water. Generally about 1.5 times deeper than average depth.
Rapid	Swift current, very turbulent, broken water. Large boulders or bedrock often breaking the surface.
Waterfall	The majority of the stream flow over a ledge or cliff.

Table 6. Substrate classes used to denote substrate composition.

Particle	Description
Clay	Very fine sticky texture. Easily forms ribbons when rolled in hand, generally reddish or gray in color.
Silt	Very fine texture. Smooth, silky feel when handled.
Sand	Crumbles readily when handled. Single sand grains are apparent.
Gravel	Rocks 1/16 to 2 ½ inches in diameter
Cobble	Rocks 2 ½ to 10 inches in diameter.
Boulder	Rocks greater than 10 inches in diameter.
Bedrock	Solid rock surface, not the tops of boulders.

Size classes follow MI DNR and Wolman pebble count categories all gravel and cobble categories are combined.

The Pigeon River was divided into 22 habitat mapping sites (Table 7). In most cases access points dictated the beginning and end of each site.

Table 7. Descriptions of the 22 Pigeon River sites.

Site Name	***Site Description***
Pigeon Site 1	Bean Trail to Axford Farms
Pigeon Site 2	Axford Farms to Gornick Trail
Pigeon Site 3	Gornick Trail to Old Vanderbilt Rd. Bridge
Pigeon Site 4	Old Vanderbilt Rd. Bridge to the Meadows
Pigeon Site 5	The Meadows to MacMullin's Bridge
Pigeon Site 6	MacMullin's Bridge to Old Vanderbilt Club
Pigeon Site 7	Old Vanderbilt Club to Dam Impoundment
Pigeon Site 8	Song of the Morning Ranch to Sturgeon Valley Rd.
Pigeon Site 9	Sturgeon Valley Rd. to Route 78
Pigeon Site 10	Route 78 to Pigeon River Headquarters
Pigeon Site 11	Pigeon River Headquarters to Pigeon River Campground
Pigeon Site 12	Pigeon River Campground to Elk Hill Campground
Pigeon Site 13	Elk Hill Campground to Elk Point
Pigeon Site 14	Elk Point to Hideaway
Pigeon Site 15	Hideaway to Tin Bridge
Pigeon Site 16	Tin Bridge to Pine Grove Campground
Pigeon Site 17	Pine Grove Campground to Webb Road Bridge
Pigeon Site 18	Webb Road Bridge to Forest Road #14
Pigeon Site 19	Forest Road #14 to Pigeon River Road Bridge
Pigeon Site 20	Pigeon River Road Bridge to Afton Road Bridge
Pigeon Site 21	Afton Road Bridge to M68 Bridge
Pigeon Site 22	M68 Bridge to Mullet Lake

Habitat data for the entire river was summarized and then smaller sections were assessed. Valley segments defined by the Michigan DNR were used for further analysis (Table 8). These segments are used in the Water Withdrawal Assessment Tool.

Table 8. Description of the three Pigeon River sections used for analysis.

Section Name	**Site Description**
Cold	Bean Trail to Old Vanderbilt Club
Cold-Transitional	Old Vanderbilt Club to Forest Rd. 14
Cool	Forest Rd. 14 to Mullet Lake

Smaller sections were also analyzed to assess the impacts of road stream crossings and areas lacking woody debris. In addition, sections were created to capture up and downstream impacts of the Song of the Morning Ranch dam. It is important to note that the Song of the Morning Ranch dam impoundment was not surveyed, site seven ended at the impoundment and site eight began downstream of the dam.

Habitat features for each section were summarized (Table 9). To summarize the data the mean percent for each variable (except bedform) was calculated (i.e. the mean percent of sand in each section

For all other analyses, percent of total streambed was used for analysis. For example, to determine what percent of the Pigeon River is run, riffle, and pool the total area of run, riffle, and pool was calculated and then expressed as a percent of total streambed area. To calculate the area of each bedform section the mean bedform section width (top width + bottom width/2) was multiplied by bedform section length. Percent substrate and habitat was calculated by expressing the percent substrate or habitat as an area (i.e. (percent gravel/100)*bedform section area). The total area of sand, gravel, cobble etc. was then summed and expressed as a percent of total stream or section area. Thus, each percent presented on a graph represents the proportion of total stream bed occupied by that in-stream habitat element as estimated for this study.

The deepest point in each bedform section was also recorded. This allowed for the calculation of minimum width to depth ratio. We were unable to calculate width to depth ratio in the traditional format because we do not have a mean depth for each bedform section (width to depth ratio = bankfull width/mean depth). Therefore, we calculated minimum width to depth ratio = wetted width/maximum depth. This calculation results in a smaller number than a traditional width to depth ratio; thus, it is referred to as minimum width to depth ratio.

Table 9. Fisheries habitat summary data for The Pigeon River. Percentages and proportions are mean values for all bedform segments in the river as a whole and each section, not percentages by area as presented elsewhere.

		Whole River	Cold	Cold-Transitional	Cool
Total Length (ft.)		234,586	43,121	134,496	56,969
Width (ft.)	*Mean*	35	33	33	40
	Range	8-86	8-73	10-86	22-70
Proportion Run Bedform		0.47	0.47	0.34	0.61
Proportion Riffle Bedform		0.38	0.43	0.44	0.29
Proportion Pool Bedform		0.14	0.1	0.22	0.1
% Area Deep Water (>2.5 ft.)	*Mean*	23	15	21	32
	Range	0-100	0-100	0-100	0-80
% Woody Debris	*Mean*	23	29	17	23
	Range	0-85	5-85	0-60	5-60
% Aquatic Vegetation	*Mean*	21	26	13	25
	Range	0-75	0-75	0-65	5-60
Total Section - % Clay	*Mean*	0.3	0.3	0.3	0.3
	Range	0-35	0-5	0-35	0-20
Total Section - % Silt	*Mean*	11	6	10	17
	Range	0-70	0-50	0-70	0-45
Total Section - % Sand	*Mean*	35	37	27	40
	Range	0-100	0-100	0-100	0-85
Total Section - % Gravel	*Mean*	42	50	51	24
	Range	0-100	0-100	0-100	0-60
Total Section - % Cobble	*Mean*	12	7	11	17
	Range	0-65	0-30	0-60	0-65
Total Section -% Boulder	*Mean*	1	0.1	1	3
	Range	0-30	0-5	0-20	0-30

Results and Discussion

Analysis was performed on all 22 sites separately and on 3 larger sections of river. Analysis of the 22 Pigeon River sites was used to identify natural changes in river habitat. The impact of the Song of the Morning Ranch Dam is evident in river morphology. The dam is located at the beginning of site 8. Sites 5-7 are dominated by run habitat, more so than almost any other section of river (Figure 4). This overabundance of run is a result of the disruption to the natural flow of the river caused by the dam and the impact it has on the slope of the river. The impact to river morphology can clearly be seen beyond the impoundment (Figure 4).

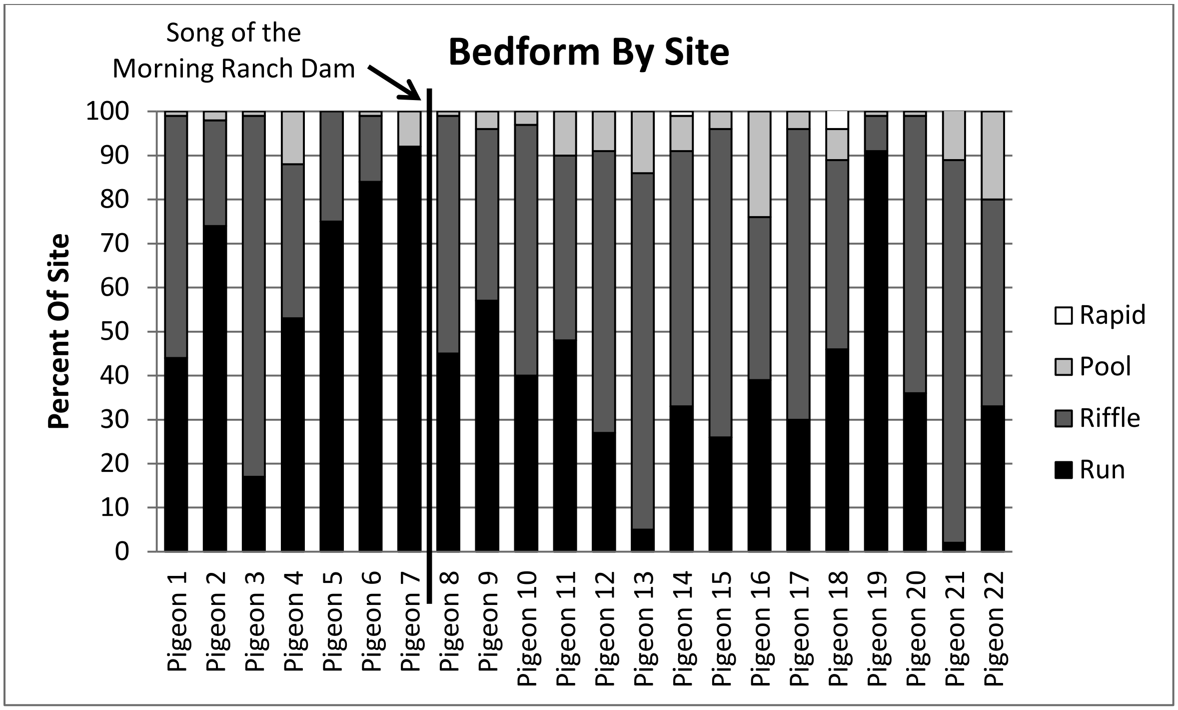


Figure 4. Bedform delineation for the Pigeon River.

Pigeon River Analysis: Whole River

The Pigeon River as a whole has a good amount of riffle and run (Figure 5a). There is not an abundance of pool habitat throughout the river; however, there is a sizeable amount of deep water which may provide adequate habitat for larger fish (Figure 5b). Substrate in the Pigeon River is dominated by gravel (44%) with sand (27%) and cobble (16%) also accounting for a large portion of the substrate (Figure 5c). On average about 60% of the river bottom provides fish habitat (21% deep, 21% woody debris, and 21% aquatic vegetation). The most obvious impairment to the Pigeon River is the Song of the Morning Ranch Dam. The dam is having an impact on the morphology of the Pigeon River, which can be seen in the increased percentage of run in the sites above the dam (Figure 4).

Analysis of the river as a whole appears to indicate the biggest impairment is the disruption in natural flow regime due to the Song of the Morning Ranch Dam. It is difficult to say if the river needs more fish cover (woody debris, aquatic vegetation, deep water), as data which relates coldwater fish density to amount of in-stream habitat is not available at this time. We know that trout need cover; it is less clear how much fish habitat is needed to eliminate habitat as a limiting factor.

Research has been done to verify that temperature, catchment size, and 90% exceedence flow have a substantial impact on fish community (Zorn et al. 2009, Zorn and Wiley 2004). However, at this time there is not research available which relates the amount, or quality, of in-stream habitat, or substrate to fisheries population density. Some work has been done to determine if the addition of woody debris has positive impacts on fisheries populations (Roni and Quinn

2001, Bryant 1983), but has not looked at how much wood is needed. It is our intent to develop habitat and fisheries data sets that can be used determine the degree to which in-stream habitat, substrate, and bedform impact fisheries populations in Michigan.

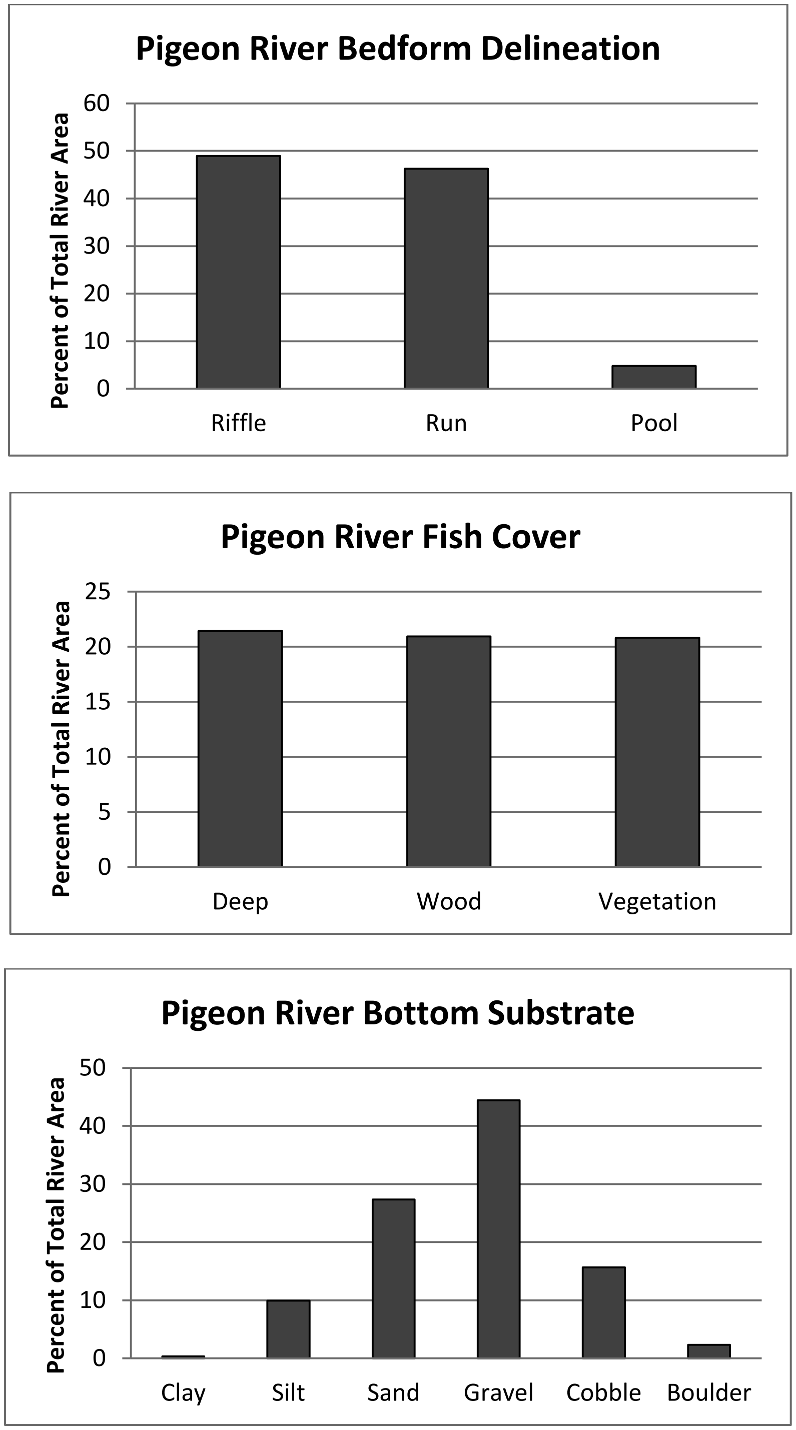


Figure 5. Pigeon River bedform delineation, fish cover, and bottom substrate for the river as a whole.

Data Analysis by Valley Segments

The Pigeon River was divided into three smaller sections based on the valley segments created for the water withdrawal assessment tool (WWAT). The three valley segments will be referred to by their temperature classification in the WWAT. The uppermost segment (Bean Trail to Old Vanderbilt Club) is cold, the middle segment (Old Vanderbilt Club to Forest Rd. 14) is cold-transitional, and the lowermost segment (Forest Rd. 14 to Mullet Lake) is cool.

A common issue throughout the three valley segments is a lack of pool habitat. The greatest percentage of pool habitat is 6% in the cold-transitional section, the cold and cool sections have 2% and 4% respectively (Figure 6a). Although there is a clear lack of pool habitat available, there is substantially more deep water habitat available in cold, cold-transitional, and cool sections (14%, 23%, 23%, Figure 6a). Thus, there does appear to be some deep habitat available for larger fish in spite of the relative lack of pool habitat. The cold section has less deep water than the two downstream sections; this is expected as the cold section is in the upper reaches of the watershed and is a smaller headwaters type stream. Headwaters areas are often small streams with well vegetated banks. The river gets larger, and deeper as it travels downstream. There appears to be adequate riffle habitat in all sections (Figure 6a).

In-stream woody debris and aquatic vegetation seem to be relatively abundant in the cold section (Figure 6b). We would expect to see abundant woody debris and aquatic vegetation in this small, shallow, well vegetated headwaters section. The middle cold-transitional section seems to be lacking in in-stream habitat compared to the other stream sections. Again, this is expected as this section is where the Song of the Morning Ranch Dam is located. The disruption in flow caused by the dam creates a wide, shallow, monotonous stream channel with less habitat heterogeneity than other sections of river. The disruption in flow caused by the dam also limits wood recruitment upstream of the dam. The decrease in stream flow caused by the dam limits the ability of the river to move wood upstream of the dam, effectively limiting wood recruitment. When the dam is removed we would expect to see the habitat in this section improve. The cool section seems to have a relatively good mixture of habitat types available (Figure 6b).

The stream bottom is dominated by hard substrate in all three valley segments (Figure 6c). Sand is the most common substrate type in the cool section; however, when hard substrate types (gravel, cobble, boulder) are combined hard substrate is dominant (55%, Figure 6c). This cool section seems to have good substrate heterogeneity with a mixture of silt, sand, gravel, cobble, and boulder. Overall, it appears that each valley segment has adequate hard substrate available. The cold segment does have a higher than average percentage of sand (37%), but again, hard substrate is dominant (54%).

When habitat and substrate are analyzed at the valley segment level it appears as though the Pigeon River has a diverse and balanced mixture of available in-stream habitat and substrate. Overall, hard substrate is dominant. Looking at some smaller sections of river and at specific stressors may help us to determine if there are any high priority restoration needs and if so where they are located.

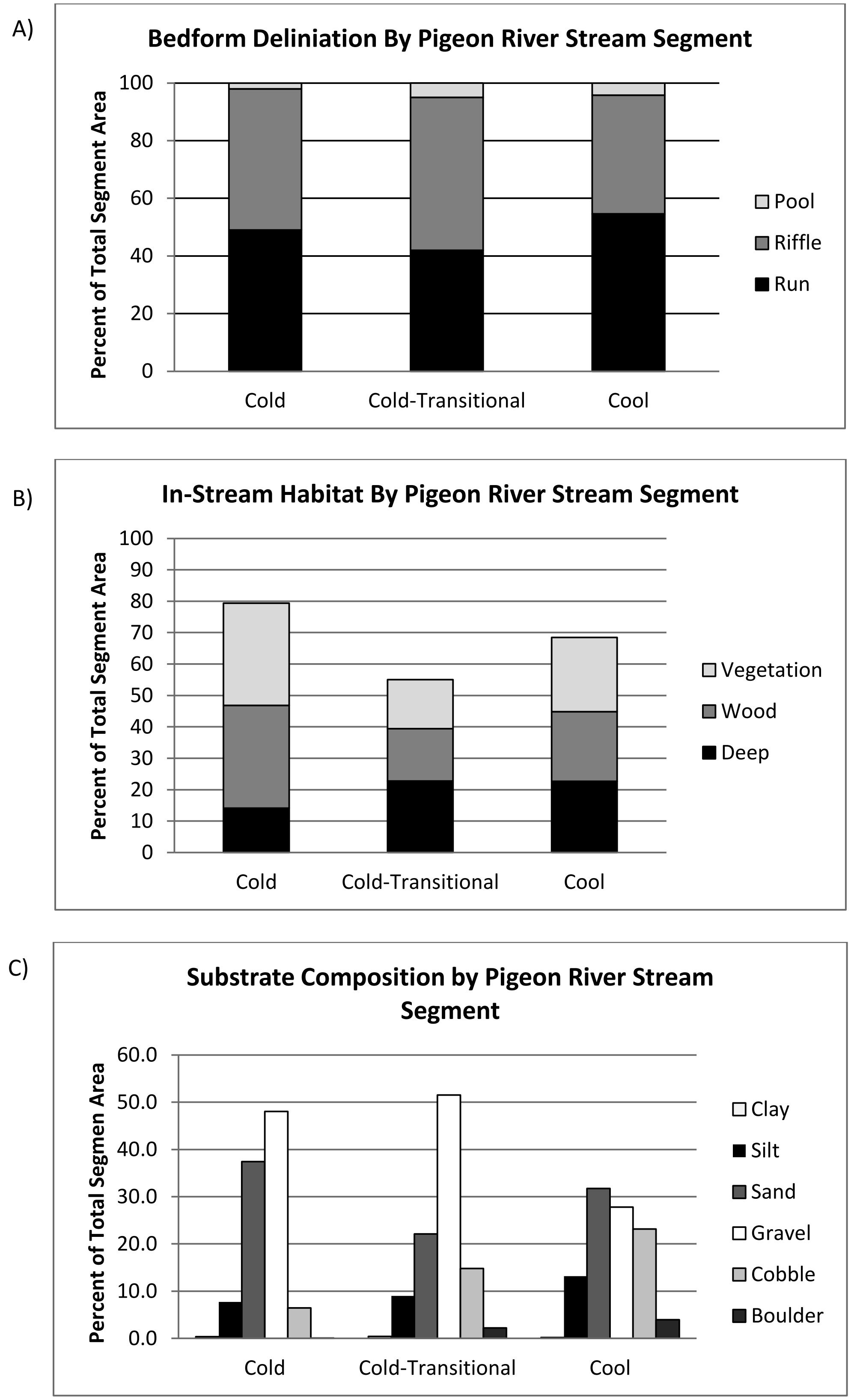


Figure 6. Bedform delineation, in-stream habitat, and substrate composition for Pigeon River Valley Segments.

In-Depth Analysis

Song of the Morning Ranch Dam

The Song of the Morning Ranch Dam is clearly the highest priority for restoration in the Pigeon River watershed. The impact of the dam can be seen in the bedform delineation of the river (Figure 4). The dam has caused excessive run habitat for a long stretch upstream (Figure 4). In addition, the impact of bottom sediment is clear. The dam stops the transport of sediment downstream leading to an increase in fine sediment upstream of dam (Figure 7). Dam removal will help restore the natural flow regime of the river and restore fish passage. As the river reestablishes channel habitat diversity, bedform and substrate diversity, will increase due to the change in slope.

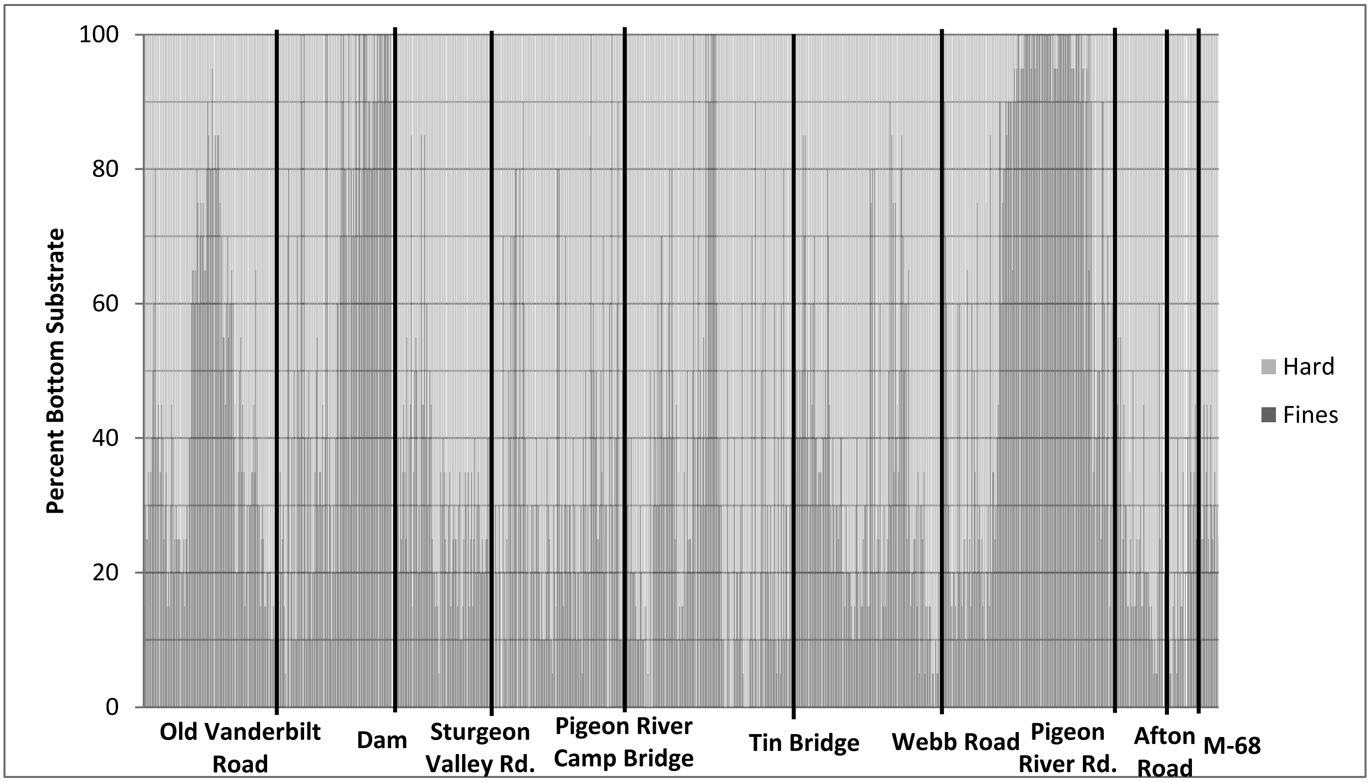


Figure 7. Substrate composition (fine - clay, silt, sand and hard - gravel, cobble, boulder) for the Pigeon River. Lines indicate road stream crossings and the Song of the Morning Ranch Dam.

Road Stream Crossing Analysis

Habitat mapping data can be used to assess the impact a road stream crossing is having on in-stream habitat. The bedform structure, substrate composition, and stream width immediately up and downstream of a road stream crossing can identify problems with the crossing. For example, immediately upstream of an undersized crossing the river will likely be wider than average and shallow with fine substrate (Figure 8). A high minimum width to depth ratio indicates a wide shallow stream (i.e. 24 feet wide/2 feet deep = a minimum w/d of 12) whereas a low minimum w/d indicates a deeper, narrower stream (i.e. 12 feet wide/3 feet deep = a minimum w/d of 4). In this instance, the bedform will be dominated by run or pool and the width to depth ratio will be high because the undersized crossing is acting as a barrier to flow. This backs up stream flow creating slow run or pool habitat. The reduction in stream flow allows any fine sediment being transported to drop out of the water column, increasing fine sediment upstream of the undersized crossing.

Substrate composition data can also be utilized to identify potential erosion problems at road stream crossings. An increase in fine sediment at the crossing, and possibly downstream, compared to the upstream reference section can be an indicator of an erosion problem at the crossing (Figure 9). Field verification that the crossing is the erosion source is also needed.

To analyze road stream crossings we looked at the bedform structure, stream width and substrate composition (fine – sand, silt clay and hard – gravel, cobble, boulder) in an upstream section, sections immediately up and downstream of the crossing, and a downstream section. The immediately up and down stream sections were chosen to capture the impacts of each road stream crossing, therefore, the sections are not a consistent length (between 0.25 and 1.5 miles). The up and downstream reference reaches are between 0.5 and 3 miles in length, reference sections were selected to be as long as possible without overlapping with up or downstream crossings. The Afton Rd. and M-68 crossing reference sections are shorter than others because the crossings are close together.

A road stream crossing inventory was also completed in 2010. This inventory was completed by a Huron Pines AmeriCorps member serving with the Headwaters Chapter of Trout Unlimited. Of the crossings presented in the report (located on the main stem of the Pigeon River), only the Pigeon River Campground Bridge crossing was identified as a priority site through this inventory.

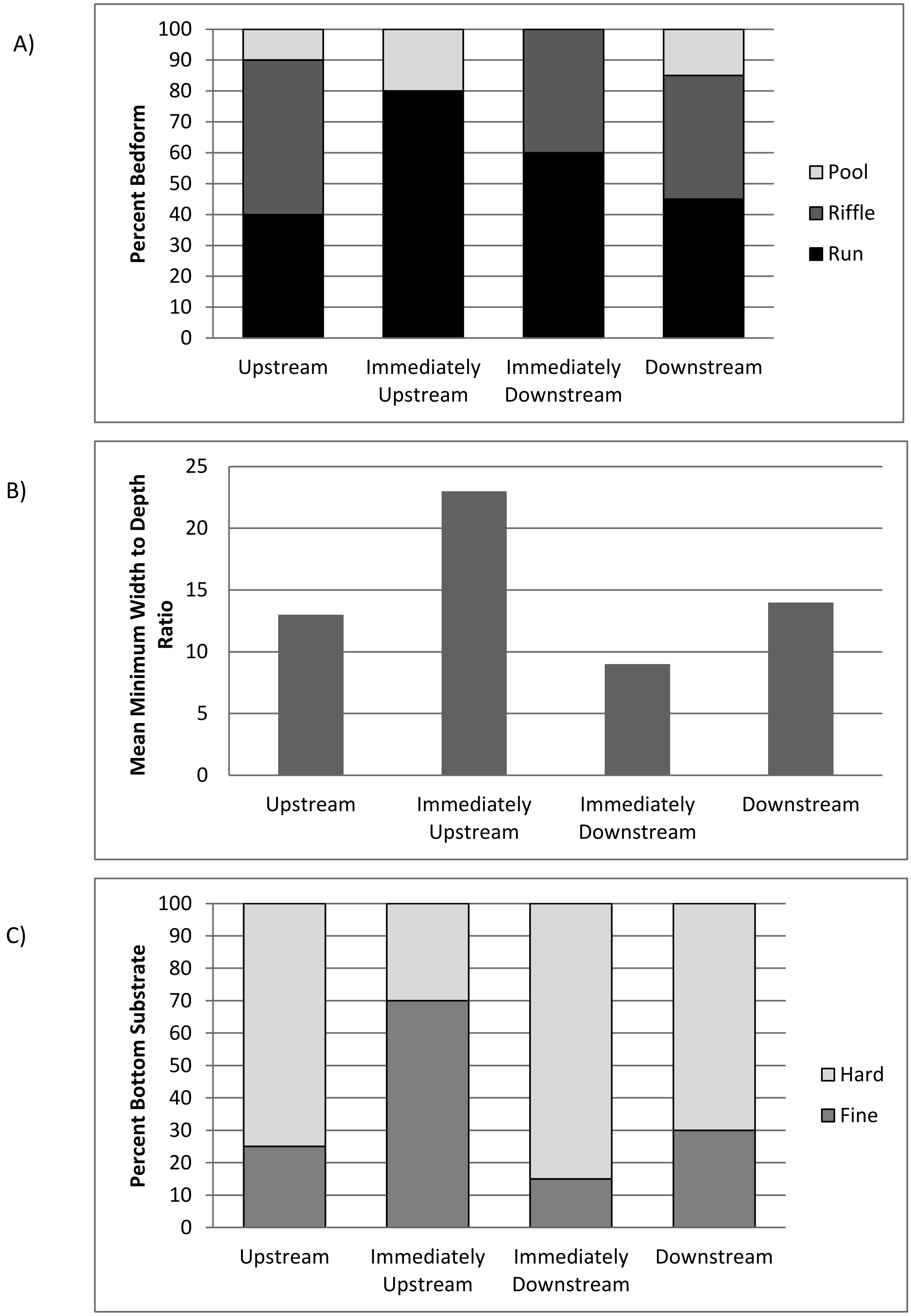


Figure 8. Hypothetical data depicting an undersized road stream crossing. A) Percent bedform upstream, immediately upstream, immediately downstream, and downstream of a hypothetical road stream crossing. B) Mean minimum width to depth ratio upstream, immediately upstream, immediately downstream, and downstream of of a hypothetical road stream crossing. C) Substrate composition (Fine – clay, silt, sand and hard – gravel, cobble, boulder) surrounding a hypothetical road stream crossing.

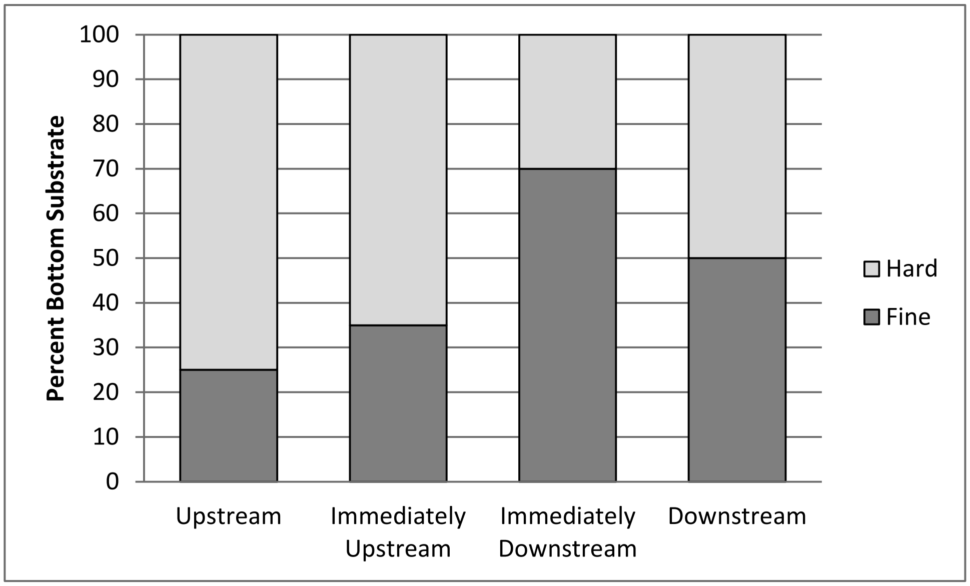


Figure 9. Hypothetical data depicting a road stream crossing at which fine sediment is entering the stream. The fine sediment category contains clay, silt, and sand. The hard sediment category contains gravel, cobble, and boulder substrates.

Old Vanderbilt Road

GPS N 45.07.683 W 84.30.382

Crossing Size

The Old Vanderbilt Road Bridge does not appear to be undersized. The stream immediately above the crossing is dominated by riffle habitat. In addition, the stream does not appear to be overly wide and shallow immediately upstream of the crossing (Figure 10). Mean width and minimum width to depth ratio are relatively consistent in all sections.

Substrate Composition and Erosion

The Old Vanderbilt Road Bridge does not seem to be a substantial source of fine sediment. The streambed is dominated by hard substrate immediately up and downstream of the crossing (Figure 10). There is an increase in fine sediment in the downstream reference section compared to the upstream reference. However, it is important to note that the Song of the Morning Ranch Dam is located downstream of Old Vanderbilt Road. The increase is fine sediment is most likely due to a reduction in the slope of the river because of the dam which reduces the velocity of stream flow leading to fine sediment deposition.

Management Implications

The Old Vanderbilt Road Bridge does not seem to be degrading in-stream habitat at this time. It has not been identified as a priority project site.

Sturgeon Valley Road

GPS N 45.09.365 W 84.27.947

Crossing Size

The Sturgeon Valley Road Bridge does not appear to be undersized. There is a large proportion of run habitat immediately upstream of the Sturgeon Valley Road Bridge; however, the mean minimum width to depth ratio directly upstream of the bridge is consistent with the upstream section (Figure 11) indicating that the crossing is not undersized.

Substrate Composition and Erosion

The Sturgeon Valley Road Bridge does not appear to be a significant sediment source. Hard substrate is dominant in all four sections of river (Figure 8). Fine substrate occupies between 13 and 39% of the stream bottom.

Management Implications

The Sturgeon Road Bridge does not appear to be undersized or a sediment source at this time. It has not been identified as a priority project site.

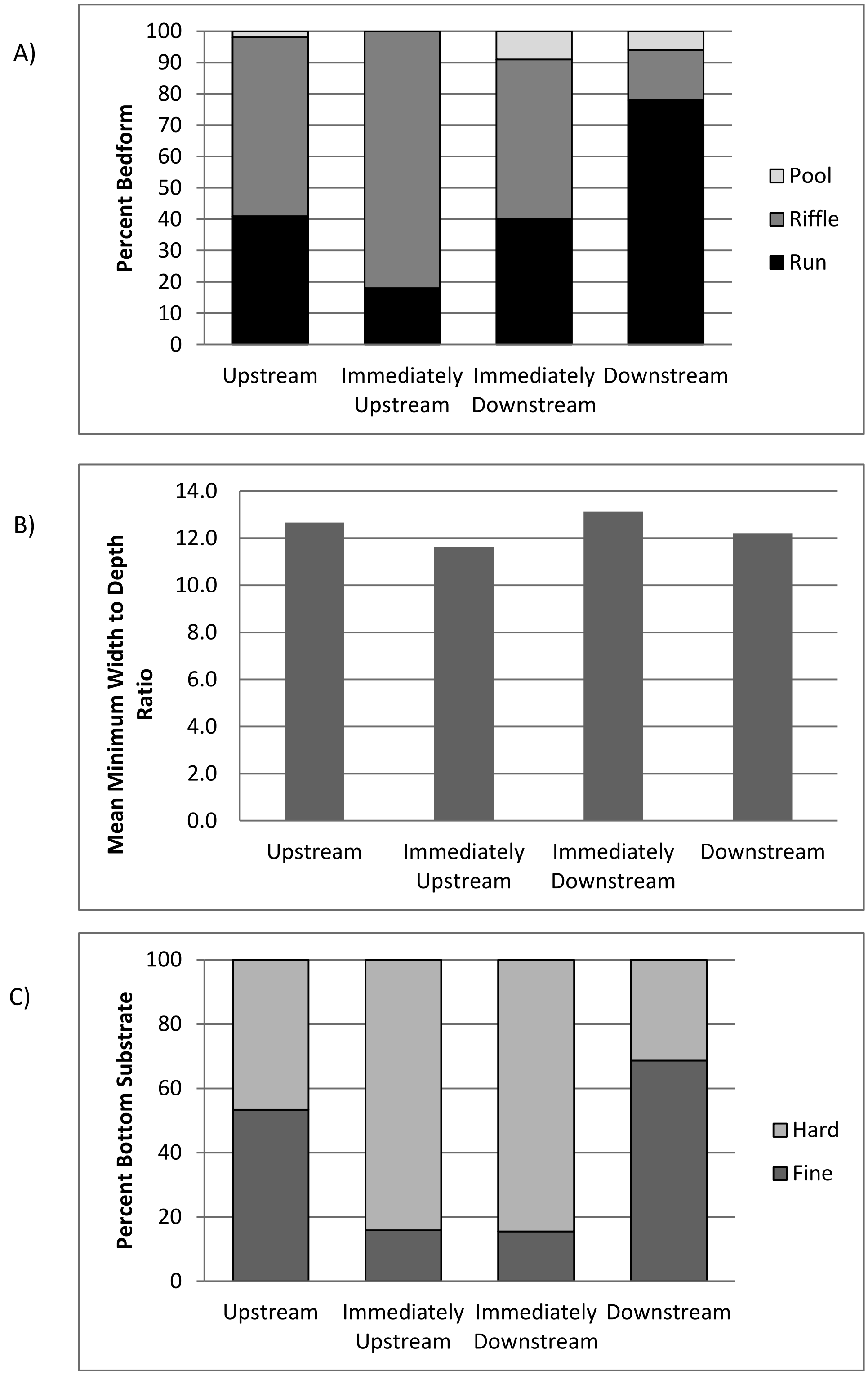


Figure 10. Old Vanderbilt Road Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

Pigeon River Campground

GPS N 45.10.666 W 854.25.558

Crossing Size

It appears that the Pigeon River Campground bridge may be restricting stream flow to some extent. Run and pool habitat are prevalent immediately upstream of the bridge as compared to the upstream section (Figure 12). In addition, riffle habitat is dominant immediately downstream of the bridge, indicating a possible flow impediment. The minimum widths to depth ratios are not what would be expected for an undersized crossing; however, further investigation is warranted.

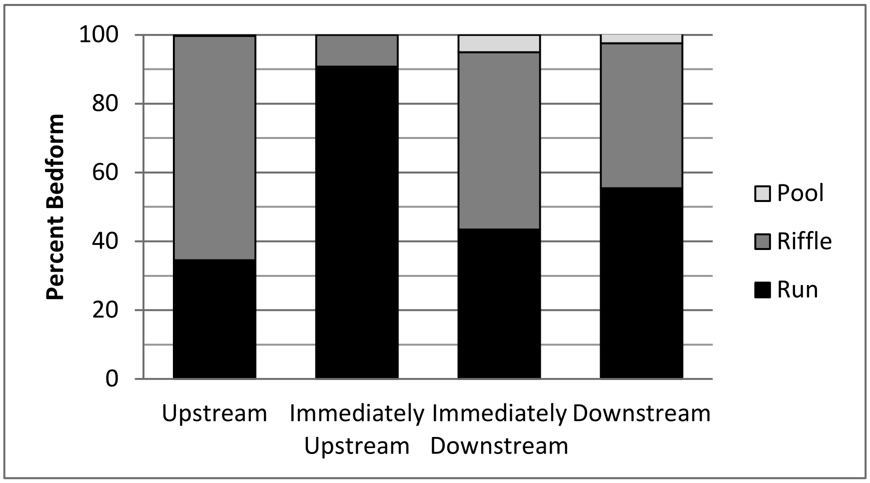
Substrate Composition and Erosion

All study sections are dominated by hard substrate. There is more fine substrate immediately upstream of and downstream of the crossing than in other sections (Figure12). The percent fines increases from 23% upstream to 45% downstream. It is possible that fine substrate is being added to the river at the crossing and is settling out onto the stream bed downstream. This crossing was identified as a potential erosion problem in the road stream crossing inventory. Three stream bank erosion sites were identified between the Pigeon River Campground crossing and Elk Hill (end of downstream section).

Management Implications

The Pigeon River Campground Bridge may be undersized and/an sediment source to the Pigeon River. From the data shown here we cannot definitively determine if an increase in fine sediment downstream of the bridge is due to erosion at the crossing or from stream bank erosion sites. However, if this crossing is selected as a potential project we can further analyze the data to determine where fine sediment is located in relation to erosion sites and the stream crossing. It is important to note that the road stream crossing inventory classified this bridge as being in poor condition. It was listed as a moderate priority for improvement. The Pigeon River Campground Bridge has been identified as a possible project site. A site visit should be conducted to verify that this bridge is a priority for improvement.

A)



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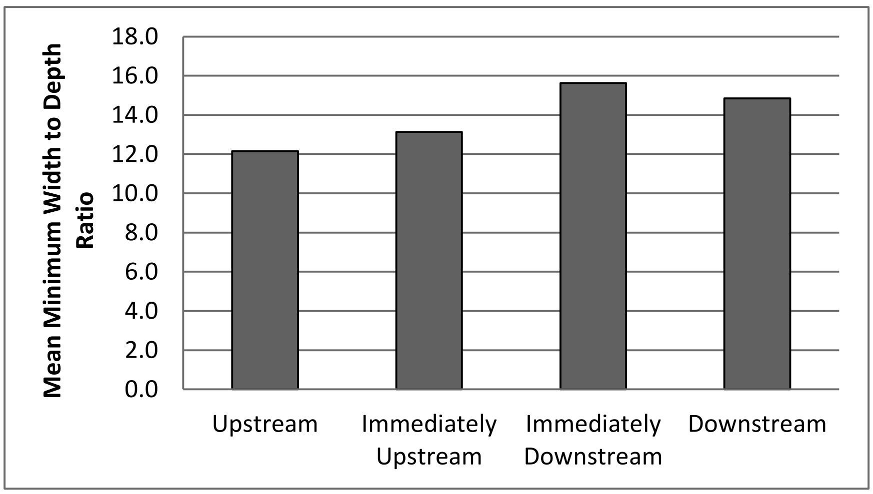

C)

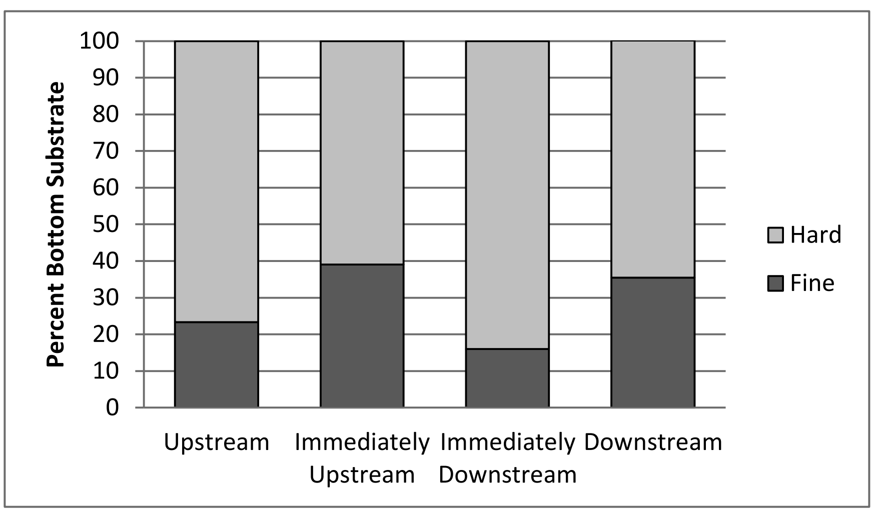

Figure 11. Sturgeon Valley Bridge Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

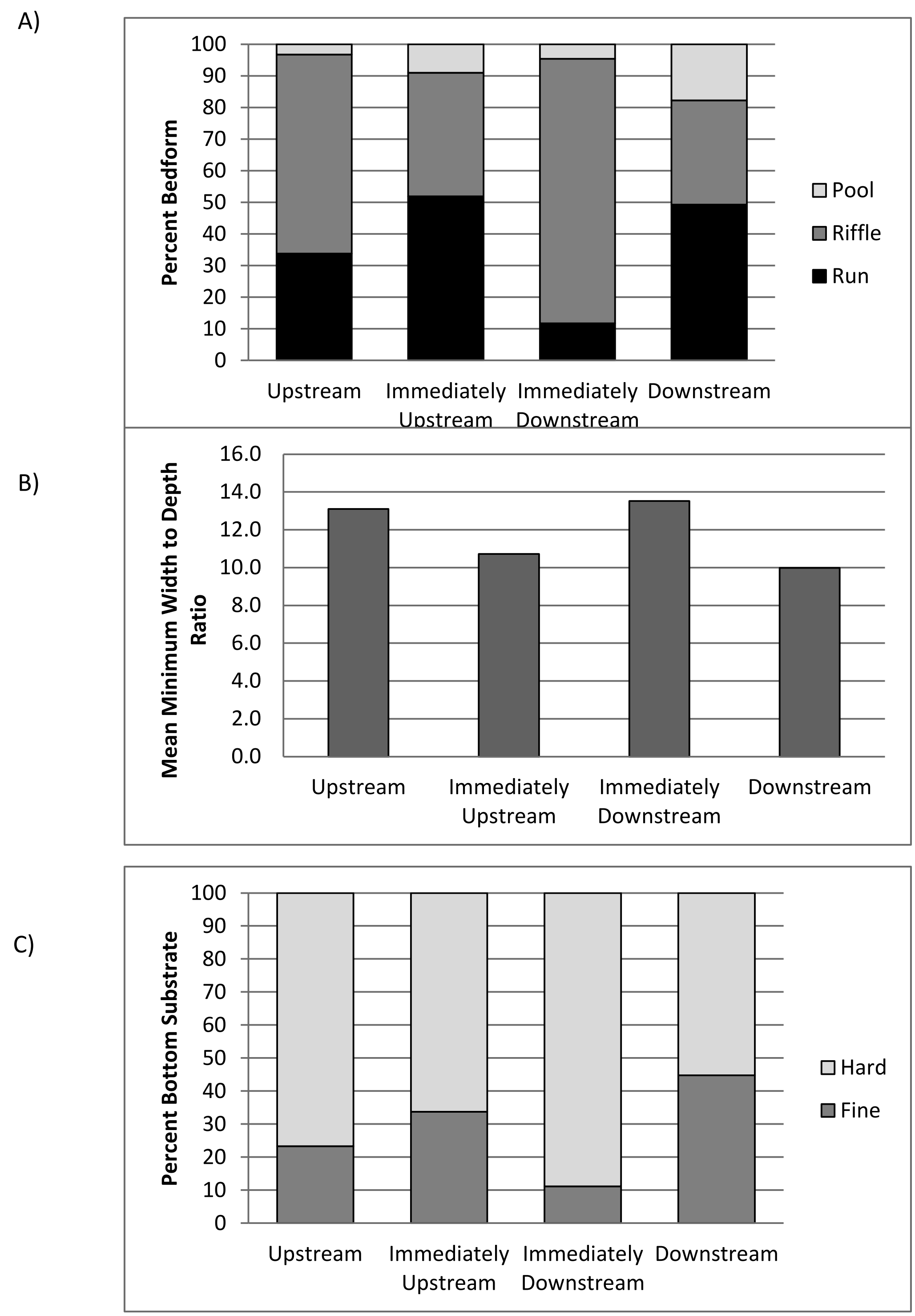

Figure 12. Pigeon River Campground Road Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

Tin Bridge

GPS N 45.13.459 W 84.25.729

Crossing Size

There does not appear to be a problem with the size of the Tin Bridge road stream crossing. The bedform structure does not indicate a problem with bridge size, nor does the mean minimum width to depth ratio (Figure 13).

Substrate Composition and Erosion

Tine Bridge does not appear to be a significant sediment source. Hard substrate is dominant in all sections except the immediately downstream sections (Figure 13). The immediately downstream section is also nearly half pool habitat, which may explain the increase is fine sediment. Fine sediment is not elevated downstream of the crossing.

Management Implications

Tin Bridge does not appear to be undersized or a significant erosion source. The crossing has not been identified as a priority project site.

Webb Road

GPS N 45.16.322 W 84.27.602

Crossing Size

The Webb Road crossing does not appear to be undersized. Riffle habitat is dominant immediately up and downstream of the Webb Road crossing (Figure 14). Minimum width to depth ratio is elevated immediately upstream of the crossing (Figure 14). However, when the high minimum width to depth ratio is considered with the prevalence of riffle habitat it is clear that the crossing is not undersized.

Substrate Composition and Erosion

The Webb Road crossing does not appear to be a significant sediment source. Hard substrate is dominant in all four stream sections (Figure 14). The sections immediately above and below the Webb Road crossing have less than 30% fine substrate. Fine substrate is slightly higher in the downstream sections, but it does not appear that erosion is a problem at this crossing.

Management Implications

The Webb Road crossing appears to be adequately sized and does not appear to be an erosion source. It has not been identified as a priority project site.

Pigeon River Road

GPS N 45.19.826 W 84.29.691

Crossing Size

The Pigeon River Road Bridge appears to be adequately sized. Run habitat is dominant in all four river sections, especially the two upstream sections (Figure 15). Minimum width to depth ratio increases in a downstream directions (Figure 15). These two pieces of information indicate that the crossing is properly sized.

Substrate Composition and Erosion

The Pigeon River Road crossing does not appear to be a significant sediment source. The percent of fine substrate decreases in a downstream direction (Figure 15). The upstream section is dominated by fine substrate. There is an overabundance of fine sediment upstream of the Pigeon River Road crossing; however this is not due to impacts from the crossing. Six erosion sites were identified between Webb Road Bridge and Forest Rd. 14, upstream of Pigeon River Road.

Management Implications

The Pigeon River Road crossing does not appear to be undersized or an erosion problem. It has not been identified as a priority project site.

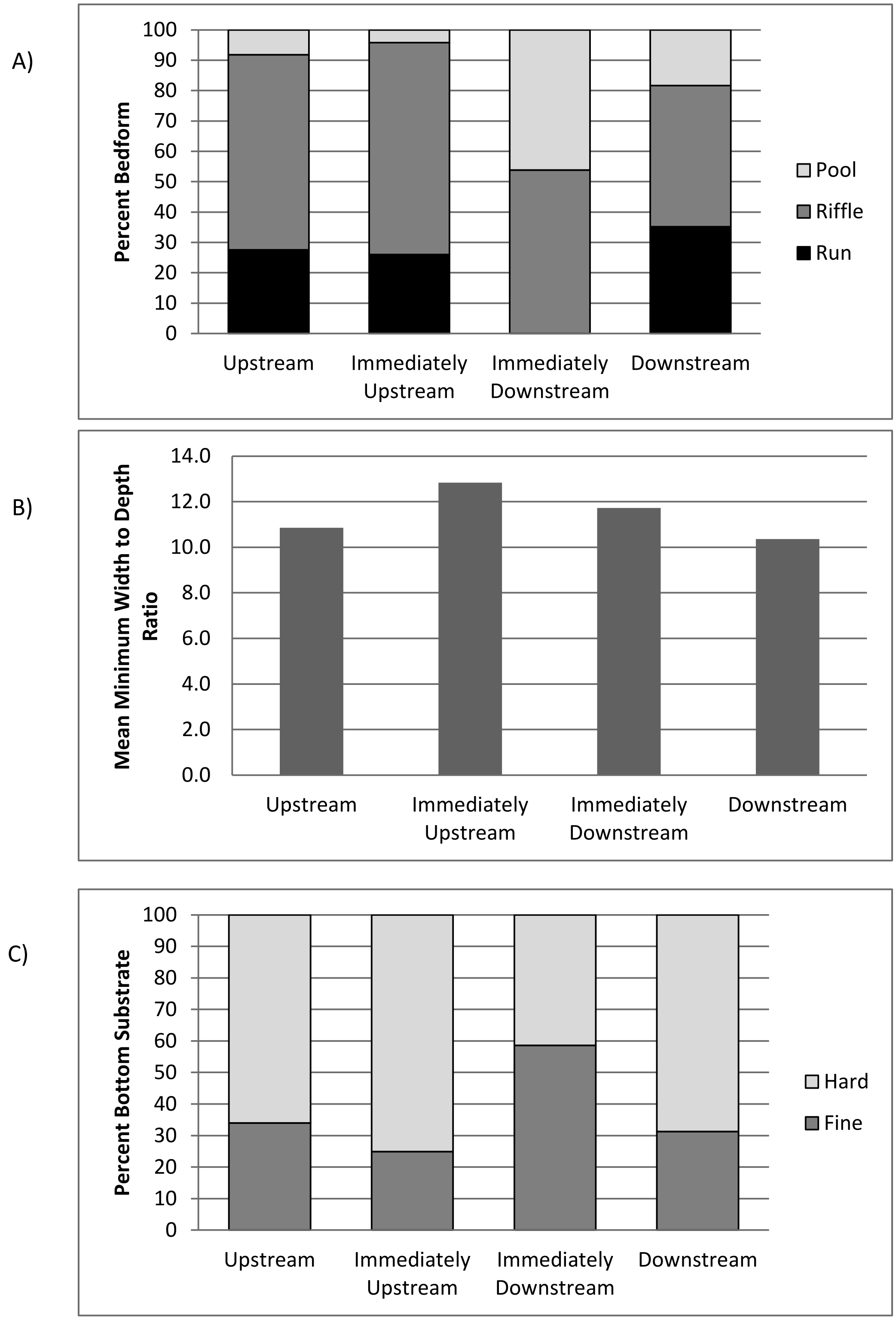

Figure 13. Tin Bridge Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

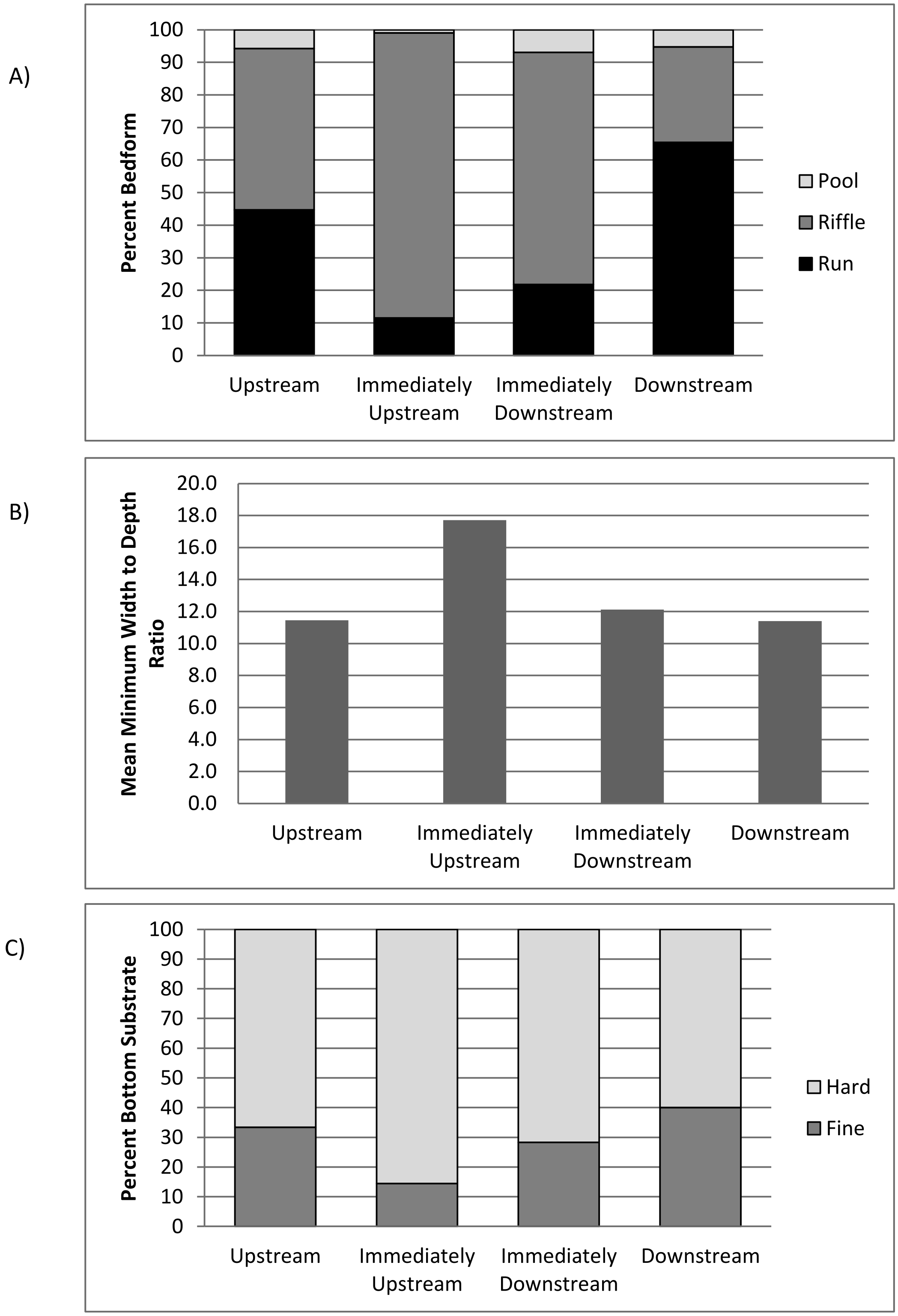

Figure 14. Webb Road Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

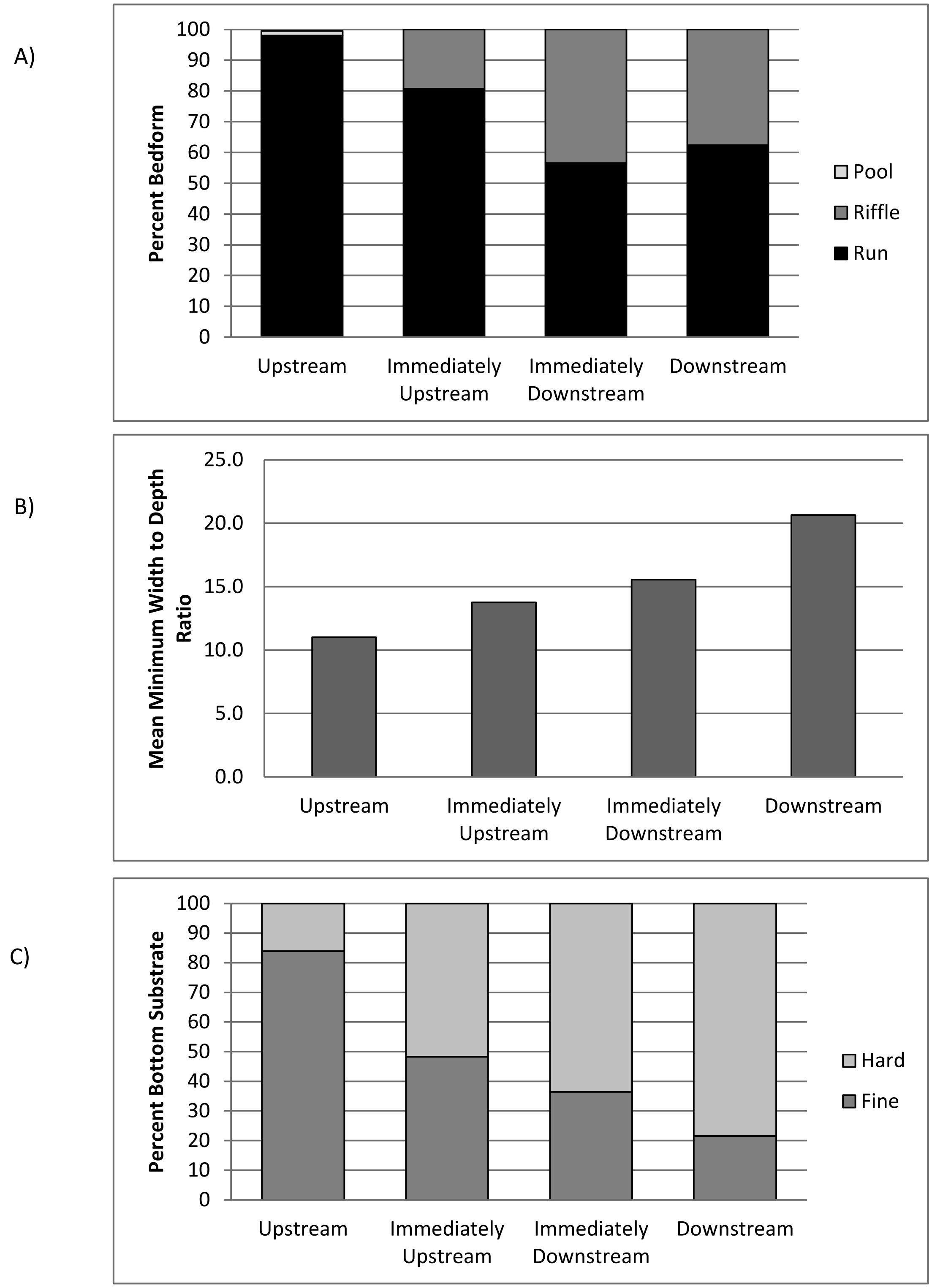

Figure 15. Pigeon River Road Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

Afton Road

GPS N 45.21.835 W 84.30.437

Crossing Size

The crossing does not appear to be undersized. Riffle Habitat is dominant above, at, and below the Afton Road Bridge (Figure 16). Additionally, the minimum width to depth ratio is relatively consistent immediately above, below, and downstream of the crossing, upstream the river appears to be wider and shallower (Figure 16).

Substrate Composition and Erosion

It does not appear that significant erosion is occurring at the Afton Road crossing. Hard substrate is dominant in all river sections (Figure 16). Fine substrate peaks immediately upstream of the crossing at 30%.

Management Implications

The Afton Road crossing does not appear to be undersized or a sediment source. It has not been identified as a priority project site.

M-68

GPS N 45.22.465 W 84.30.892

Crossing Size

Bedform structure and minimum width to depth ratio around the M-68 crossing do not point to a problem with bridge size (Figure 17). Riffle habitat is dominant upstream, immediately upstream, and immediately downstream of the crossing.

Substrate Composition and Erosion

Hard substrate is dominant above, below, and at the crossing (Figure 17). There is slightly more fine sediment immediately downstream and downstream of the crossing than upstream (30% downstream 15% immediately upstream). However, there is also more pool habitat downstream of the crossing; therefore the increase is fine sediment is most likely a natural variation in the river bottom.

Management Implications

The M-68 bridge does not appear to be undersized or a significant sediment source. It has not been identified as a priority project site.

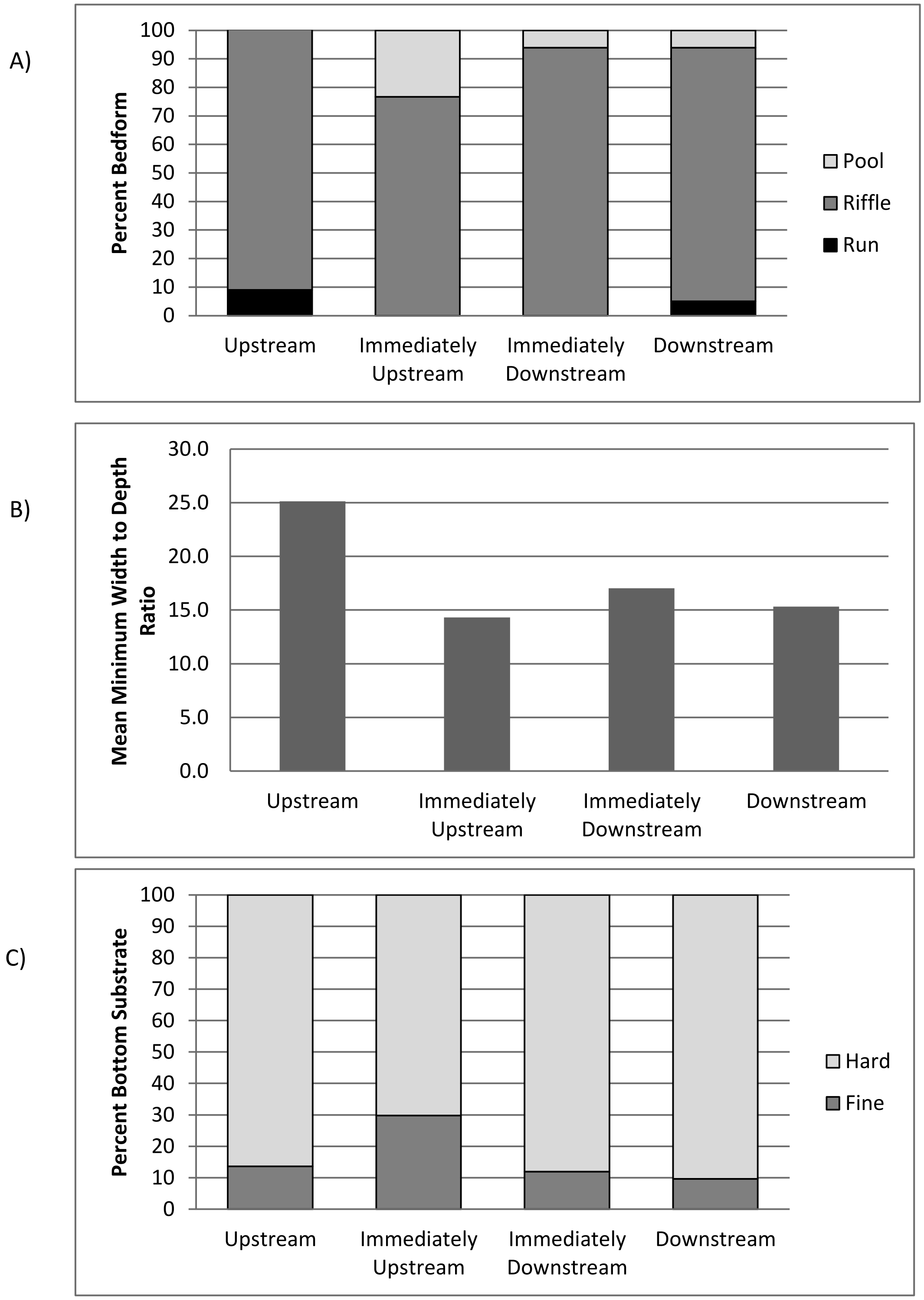

Figure 16. Afton Road Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

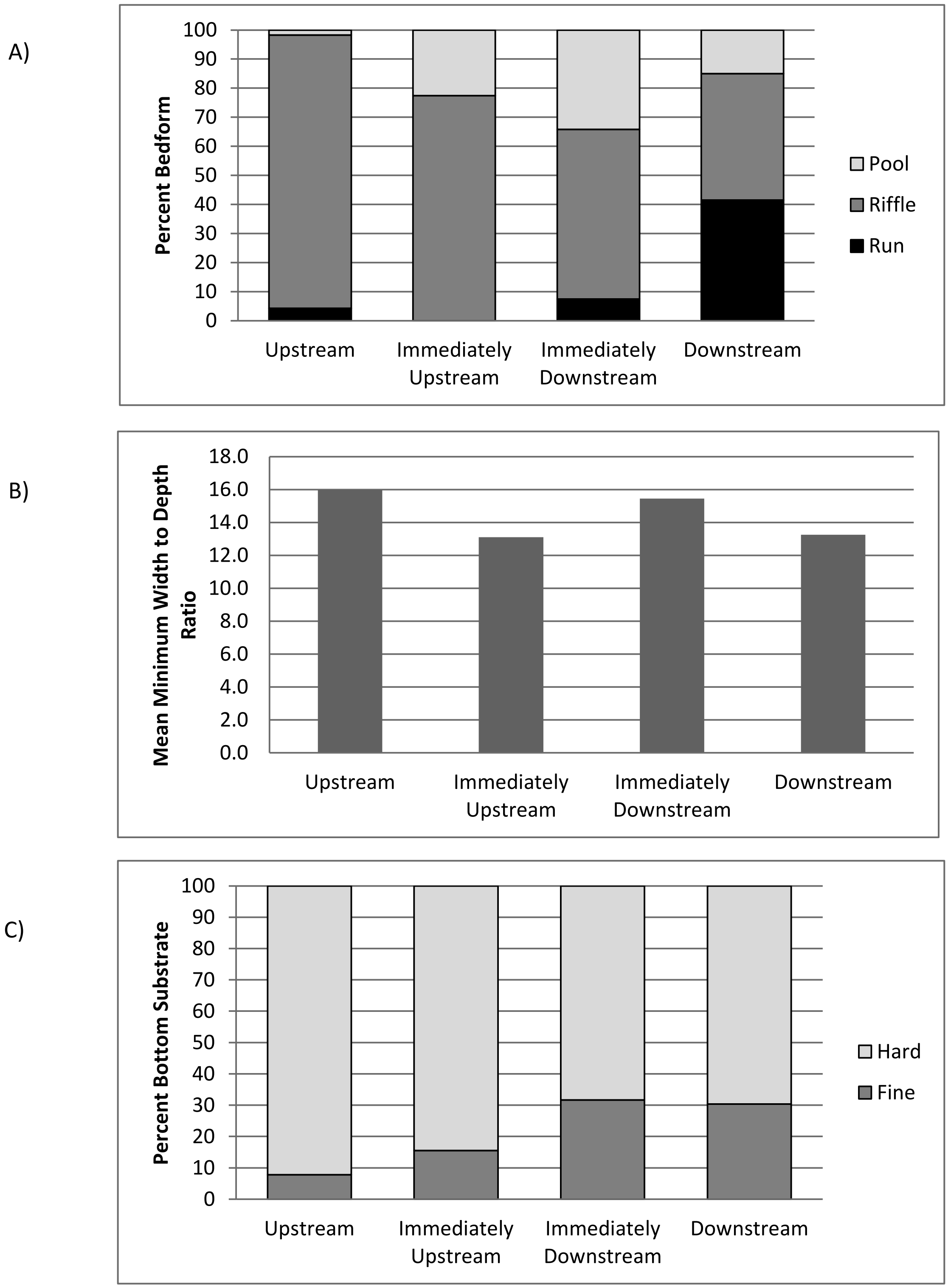

Figure 17. M-68 Road Stream Crossing. A) Percent bedform in up and downstream references reaches and immediately up and downstream of the crossing. B) Mean minimum width to depth ratio upstream of crossing, immediately upstream, immediately downstream, and downstream. C) Fine (clay, silt, sand) and hard (gravel, cobble, boulder substrate composition upstream, downstream and at (immediately up and downstream) the crossing.

Erosion Sites

Several erosion sites were identified through the Pigeon River habitat survey. Repairing erosion sites does not seem to be the highest priority for the Pigeon River as there is a large amount of hard substrate available at present (Table 7, Figure 5c). The impact of the Song of the Morning Ranch Dam is evident in the number of erosion sites located downstream of the dam. Water released from the impoundment is hungry. Released water has energy to move sediment, but contains little or no sediment, thus the energy is often expended on erosion of the stream banks and channel, which explains the high number of erosion sites downstream of the dam. The reason for a high number of erosion sites between Webb Road and Forest Road #14 and below M-68 is less clear. However, fine sediment does not seem to be a high priority issue in the mainstem of the Pigeon River.

Table 7. Location of erosion sites identified during habitat mapping.

Location	Number of Erosion Sites Identified
Song of the Morning Ranch to Sturgeon Valley Rd.	5
Pigeon River Headquarters to Pigeon River Campground	1
Pigeon River Campground to Elk Hill Campground	3
Hideaway to Tin Bridge	2
Tine Bridge to Pine Grove Campground	3
Pine Grove Campground to Webb Road Bridge	1
Webb Road Bridge to Forest Road #14	6
Afton Road Bridge to M68 Bridge	1
M68 Bridge to Mullet Lake	5

Woody Debris Analysis

Estimates of percent woody debris in each section were used to identify areas in the Pigeon River that may have substantially less than average percent woody debris (20%). Several areas which may benefit from the addition of large woody debris were identified (Table 8).

In order to better determine where wood is needed within each site, percent wood for each bedform section within each site was graphed. This information allows us to identify areas that are devoid of wood and would benefit from additional woody debris (Figure 18).

At this time we know that fish bennefit from the addition of woody debris to a stream. However, we do not fully understand the exact relationship between percent woody debris and fish population and size structure. We hope to continue to collect data that will help us better understand this relationship. For now, we know woody debris is benneficial so we are looking for places in the river that have lower than average percentages of woody debris. In the future, we hope to have a better idea about what percent of a healthy, thriving coldwater stream contains woody debris.

Table 8. Percent of streambed area estimated to be occupied by woody debris. Sections with 10 or less percent wood are highlighted.

Site	Percent Wood
Bean Tr. To Axford Farms	27
Axford Farms to Gornick Tr.	50
Gornick Tr. To Old Vanderbilt Rd.	31
Old Vanderbilt Rd. To Meadows	25
Meadows to McMullin's Bridge	14
McMullin's Bridge to Old Vanderbilt Club	16
Old Vanderbilt Club to Rte. 90	15
Old Vanderbilt Club to Impoundment	11
Song of Morning Ranch to Sturgeon Valley Rd.	19
Sturgeon Valley Rd. to Rte. 78	10
Rte. 78 to Pigeon River Headquarters	10
Pigeon River HQ to Pigeon River Camp	16
Pigeon River Camp to Elk Hill Camp	10
Elk Hill Camp to Elk Point	23
Elk Point to Hideaway	9
Hideaway to Tin Bridge	9
Tin Bridge to Pine Grove Camp	23
Pine Grove Camp to Webb Rd.	20
Webb Rd. to Forest Rd. #14	17
Forest Rd. #14 to Pigeon River Rd.	27
Pigeon River Rd. to Afton Rd.	19
Afton Rd. to M68	14
M68 to Mullet Lake	21

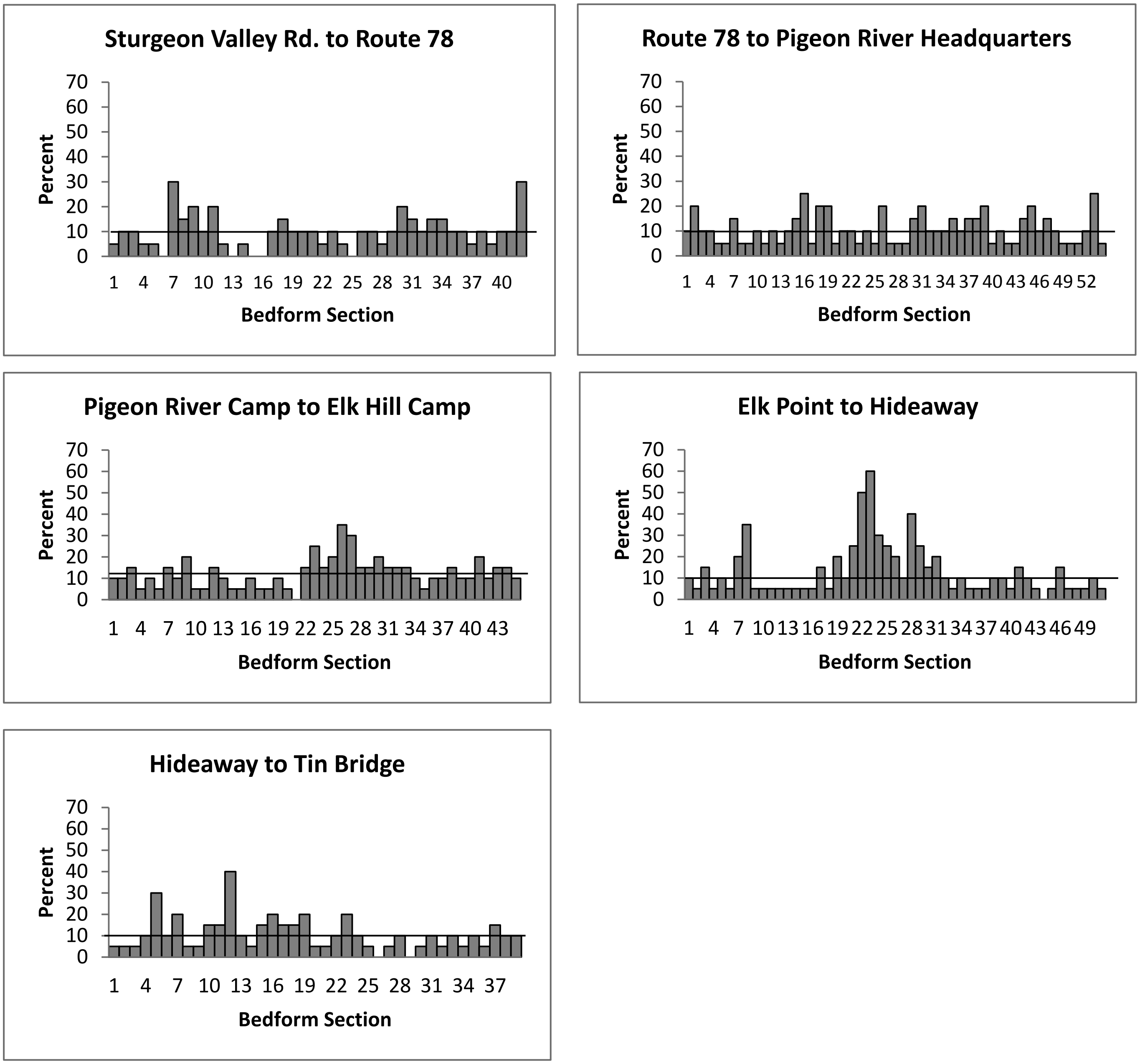

Figure 18. Percent river bottom occupied by wood by bedform section in sites with 10% wood or less.

Management Implications and Recommendations

Status of the River

The habitat data presented in this report is documentation of the status of in-stream habitat in the Pigeon River in 2010. Documentation of Pigeon River habitat is especially important because the Song of the Morning Ranch dam is in the process of removal. The data presented here documents what Pigeon River habitat looked like before dam removal.

Project Identification

Data gathered during habitat mapping can be used to prioritize restoration projects in a watershed. Complete removal of the Song of the Morning Ranch Dam is the highest priority project in the Pigeon River watershed. Negative impacts of the dam were clear in almost every habitat parameter analyzed.

The Pigeon River does not seem to have any critical habitat problems other than the dam. It is true there are sections of river that would benefit from the addition of woody debris; there are imperfect road stream crossings, and some erosion sites. The Pigeon River campground crossing is the highest priority crossing on the mainstem. But, overall, the river has a good amount of in-stream fish habitat and has a large percentage of hard substrate (gravel, cobble, and boulder). Analysis of tributaries is the next step in identifying priorities for the Pigeon River. We know from the 2010 road stream crossing inventory that there are several crossing on tributary streams that are priorities for repair.

Planning and Management

Presently, there is little information available to indicate how in-stream habitat impacts coldwater fisheries. The habitat mapping data gathered on the Pigeon River will help this question to be answered. A fisheries population estimate will be conducted on the Pigeon River in 2011. This population estimate will allow us to begin comparing fisheries populations to in-stream habitat present. Definitive conclusions about how much wood, gravel, deep water etc. is needed for a healthy fishery will not be drawn from the Pigeon River alone. However, data we have collected in the Pigeon River will help us begin to answer these questions. The goal is to get to a point where we understand how in-stream habitat availability impacts coldwater fish populations in Michigan so we can confidently identify projects that will improve coldwater fisheries.

In addition, data gathered through habitat mapping will act as before data for any projects completed on the Pigeon River. It is essential that monitoring also be conducted after projects are completed so we can determine if the projects had the intended impact on the stream. Project evaluation will help gauge the success of projects and fine tune restoration methods.

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