



Aquatic Community Monitoring at Herbert Hoover National Historic Site, 2008–2017



The downstream Heartland Inventory and Monitoring Network sample site on Hoover Creek in 2008, Herbert Hoover National Historic Site.

NPS

Aquatic community monitoring at Herbert Hoover National Historic Site, 2008–2017

Science Report NPS/SR—2024/107

Hope R. Dodd¹, David E. Bowles², J. Tyler Cribbs¹, Jeffrey M. Williams³, Cameron R. Cheri⁴

¹ National Park Service
The Heartland I&M Network
Wilson's Creek National Battlefield
Republic, Missouri

² Retired from National Park Service
The Heartland I&M Network
Wilson's Creek National Battlefield,
Republic, Missouri

³ Formerly affiliated with the Department of Biology
Missouri State University
Springfield, Missouri

⁴ Department of Biology
Missouri State University
Springfield, Missouri

Editing by Tani Hubbard
Northern Rockies Conservation Cooperative and National Park Service
Tucson, Arizona

Please cite this publication as:

Dodd, H. R. Dodd, D. E. Bowles, J. T. Cribbs, J. M. Williams, and C. R. Cheri. 2024. Aquatic community monitoring at Herbert Hoover National Historic Site, 2008–2017. Science Report NPS/SR—2024/107. National Park Service, Fort Collins, Colorado.
<https://doi.org/10.36967/2303263>

The National Park Service Science Report Series disseminates information, analysis, and results of scientific studies and related topics concerning resources and lands managed by the National Park Service. The series supports the advancement of science, informed decisionmaking, and the achievement of the National Park Service mission.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible and technically accurate.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

This report is available in digital format from the [National Park Service DataStore](#) and the [Natural Resource Publications Management website](#). If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Contents

	Page
Figures.....	iv
Tables	v
Abstract.....	vi
Acknowledgments.....	vii
Introduction.....	1
Methods.....	2
Aquatic Invertebrates.....	4
Fish Community	4
Water Quantity and Quality	5
Results.....	6
Aquatic Invertebrates.....	6
Fish Community	11
Stream Habitat	13
Discussion.....	21
Literature Cited	22

Figures

Page

Figure 1. Herbert Hoover National Historic Site and the location of the Heartland Network long-term monitoring site (thick, yellow line) and water quality site (green triangle) in Hoover Creek.	3
Figure 2. Mean invertebrate taxa richness (upper panel) and mean Ephemeroptera, Plecoptera, and Tricoptera (EPT) richness and density ratio (lower panel) in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	9
Figure 3. Mean Shannon’s diversity and evenness index (upper panel) and mean Hilsenhoff’s Biotic Index (HBI; lower panel) for invertebrates in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.	10
Figure 4. Fish species richness, fish abundance (catch per minute), and community diversity in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	12
Figure 5. Index of Biotic Integrity scores and ratings for fish communities in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.	12
Figure 6. Discharge in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	14
Figure 7. Heartland Network downstream monitoring reach on Hoover Creek within Herbert Hoover National Historic Site before (left panel) and after (right panel) the rain event during 2008 sampling.....	14
Figure 8. Mean depth and velocity at riffles (top panel) and the sample reach (bottom panel) in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	15
Figure 9. Mean substrate size and percent embeddedness at riffles (top panel) and the sample reach (bottom panel) in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	16
Figure 10. Mean percent vegetation and periphyton within riffle habitat sampled at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	17
Figure 11. Percent of fish cover types present at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	18
Figure 12. Photograph of the bank within the downstream monitoring reach on Hoover Creek, Herbert Hoover National Historic Site.	19

Tables

	Page
Table 1. Invertebrate taxa and number of individuals collected within riffles of the Heartland Network long-term monitoring reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	7
Table 2. Fish species and number of individuals collected at the Heartland Network long-term monitoring reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.....	11
Table 3. Index of Biotic Integrity metric calculations for fish communities in the Heartland Network sample reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.	13
Table 4. Percentage of total banks for categories of bank angle, percent vegetation, height, and substrate type at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.	18
Table 5. Mean water quality data ($\pm 95\%$ confidence intervals) collected at the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Data were collected hourly with calibrated data loggers.	20

Abstract

Land use changes that degrade water quality and stream habitat can negatively impact aquatic communities. Monitoring trends in aquatic community composition and habitat conditions is a robust way to assess stream integrity and health. Herbert Hoover National Historic Site (NHS) is in eastern Iowa where dominant land use consists of row-crop and grassland agriculture. A portion of an unnamed tributary of the West Branch of Wapsinonoc Creek, known as Hoover Creek, flows through the park. In 2008, the Heartland Inventory and Monitoring Network (Heartland Network) of the National Park Service (NPS) began monitoring aquatic communities (fish and invertebrates), physical habitat, and water quality at Hoover Creek within the park. This report summarizes four years of data to assess the baseline conditions of Hoover Creek within Herbert Hoover NHS.

Aquatic invertebrate taxa richness ranged from 21 to 32 among all years monitored. Three of these taxa are sensitive to poor water quality and habitat conditions. The invertebrate community was dominated by true flies in the Chironomidae family, Oligochaete worms, and mayflies in the Baetidae family. These taxa are all tolerant of poor water quality and habitat conditions. However, in 2011, the sensitive caddisfly *Ceratopsyche* was also abundant. Mean Hilsenhoff Biotic Index values indicated the invertebrate community fluctuated over time, ranging from fairly poor in 2017 to good condition in 2011. Ten fish species were collected at Hoover Creek across the four years sampled with seven of those species found in all years. All fish species collected were either moderately tolerant or tolerant to poor habitat and water quality conditions; the community was dominated by johnny darter (*Etheostoma nigrum*), creek chub (*Semotilus atromaculatus*), and blacknose dace (*Rhinichthys atratulus*). Based on the Index of Biotic Integrity developed for Iowa streams, the fish community ranged from fair condition in 2008, 2014, and 2017 to good condition in 2011.

Hoover Creek was found to have predominately fine to medium gravel substrate with high embeddedness, and banks were steep and tall and consisted of fine silt substrate. With the exception of turbidity after a rain event in 2008, water quality parameters were within state standards. The four years of stream biota data coupled with habitat data should form a good baseline for assessing changes or trends in the aquatic community and overall stream health of Hoover Creek.

Acknowledgments

We thank the many Heartland Network interns for field and lab assistance. We also thank the park staff over the years for their continued communication with the Heartland Network regarding aquatic-related concerns within Herbert Hoover NHS.

Introduction

Land use changes that degrade water quality and stream habitat are a major factor in shifts or declines of aquatic communities throughout the Midwest. Because both fish and aquatic invertebrates are relatively long-lived and sensitive to habitat and water quality alterations, these indicators can reflect cumulative impacts over several years that cannot be detected through discrete water quality sampling. Monitoring trends in aquatic community composition along with associated habitat conditions is a robust way to assess stream integrity and health. Long-term fish and aquatic invertebrate monitoring data and interpretation help park managers make sound decisions that protect the aquatic resources in parks. Although anthropogenic disturbances at the watershed scale can dramatically alter a lotic system, protecting portions of streams on publicly owned lands, such as national parks, may offer refuges for native aquatic communities.

Herbert Hoover National Historic Site (NHS), located in eastern Iowa, contains approximately 1.3 km of an unnamed tributary of the West Branch of Wapsinonoc Creek, known as Hoover Creek. Agricultural, rural residential, and urban land uses are the dominant uses in the watershed, resulting in increased frequency and magnitude of floods, bank erosion, sedimentation, nutrient inputs, and other chemical pollution that alters the water quality and habitat of Hoover Creek. Several water chemistry and quality standards (dissolved oxygen, turbidity, nitrate + nitrite as nitrogen, total Kjeldahl nitrogen, and bacteria) have been violated, resulting in the listing of Hoover Creek as an impaired stream under Section 303(d) of the Clean Water Act (Foreman 2007; Iowa Department of Natural Resources 2010).

Since 2008 the Heartland I&M Network (Heartland Network) has monitored a downstream reach of Hoover Creek near the Downey Street Bridge to collect and analyze baseline conditions of the aquatic community within the park. The specific objectives for aquatic community monitoring are to (1) determine the status and trends of aquatic invertebrate and fish diversity, abundance, and community metrics, and (2) relate the invertebrate and fish community to overall water quality and habitat conditions.

Methods

Methods and procedures used for site selection, data collection, and analyses in this report follow Heartland Network protocols for monitoring aquatic invertebrates and fish communities within wadeable streams (Bowles et al. 2021; Dodd et al. 2021). Fish, aquatic invertebrate, and related stream habitat and water quality data were collected at one 150 m reach of Hoover Creek. This reach was located near the Downey Street Bridge at the downstream end of the creek within the park (Figure 1). Samples were collected on July 7–8, 2008, July 11–12, 2011, August 12, 2014, and July 17–18, 2017.

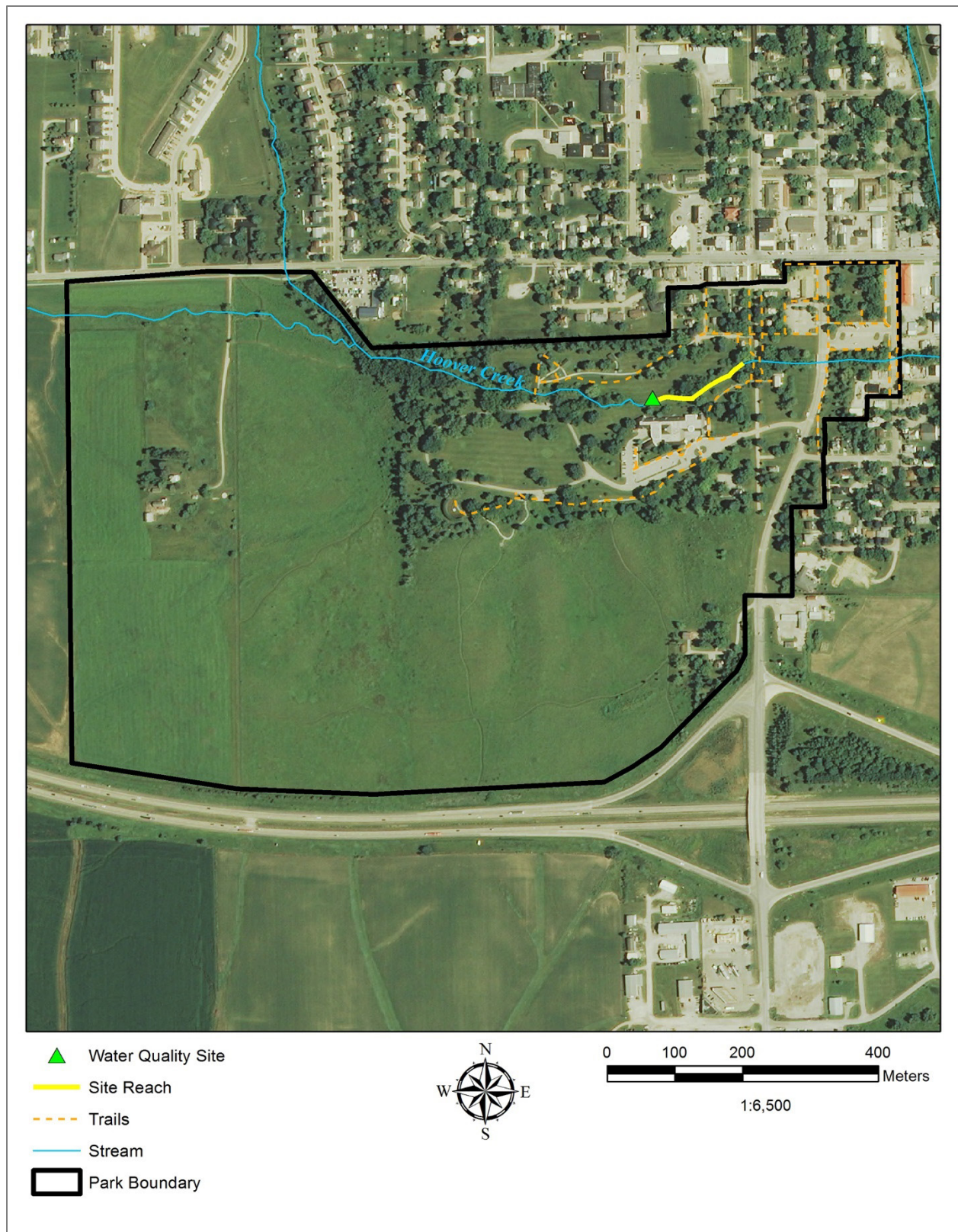


Figure 1. Herbert Hoover National Historic Site and the location of the Heartland Network long-term monitoring site (thick, yellow line) and water quality site (green triangle) in Hoover Creek.

Aquatic Invertebrates

Three benthic invertebrate samples were collected within each of three successive riffle or run channel units, resulting in nine samples for the reach. A Surber stream bottom sampler (500 μm mesh, 0.09 m^2) was used to collect the benthic samples. For each invertebrate sample, related habitat data—current velocity, depth, and qualitative habitat variables for embeddedness, periphyton, filamentous algae, and aquatic vegetation—were measured or estimated within the sampling net frame. Dominant substrate size within the sampling net frame was visually assessed using the Wentworth scale (Wentworth 1922). Benthic samples were sorted in the laboratory following a subsampling routine (Bowles et al. 2021). Taxa were identified to the lowest practical taxonomic level (usually genus) and counted.

Six metrics that reflect richness, diversity, density, and impairment were calculated for each of the nine samples within the reach. Richness metrics included taxa richness and Ephemeroptera, Plecoptera, Trichoptera (EPT) richness (number of mayfly, stonefly, and caddisfly taxa). Diversity metrics included Shannon diversity index and evenness (where 0 = no evenness and 1 = maximum evenness). The density measure included the ratio (ranging from 0 to 1) of sensitive EPT to more tolerant Chironomidae (EPT ratio = $\text{EPT density} / (\text{EPT density} + \text{Chironomidae density})$). Status of impairment was calculated using the Hilsenhoff biotic index (HBI). HBI uses both taxa abundance and tolerance values to disturbance to calculate the biotic index and ranges from 0 to 10, with 10 being most tolerant (Hilsenhoff 1988). Therefore, larger HBI values indicate greater impairment.

For invertebrate data analysis, each of the six metrics (taxa richness, EPT richness, etc.) was calculated for the nine samples collected within the reach for that year. Each metric was then averaged across the three samples collected within a riffle to obtain a riffle mean ($n = 3$ samples/riffle). The means for each of the three riffles were then averaged to calculate a mean for the reach ($n = 3$ riffles/reach). Qualitative habitat data were converted to midpoints of each category and summarized using means and 95% confidence intervals. For more detailed information on field and laboratory methods and calculation of metrics, see Bowles et al. (2021).

Fish Community

Fish and related stream habitat were sampled throughout the stream reach using standardized operating procedures (Dodd et al. 2021). Fish were collected using a pulsed direct current backpack electrofishing unit and dip nets. Fish were identified to species, measured, weighed, and inspected for diseases or abnormalities in the field. Stream habitat related to channel morphology (velocity, depth, width, and dominant substrate using Wentworth scale), fish cover (presence of cover types such as woody debris, boulders, hydrophytes, etc.) and riparian/bank habitat (bank angle, vegetation, height, and substrate categories) were collected at 11 transects within the sampled reach.

Biological metrics that reflect community richness and diversity (species richness, Simpson's Diversity Index [SI]), abundance (catch per unit effort), and overall stream integrity (Index of Biotic Integrity) were calculated. Simpson's Diversity Index is the probability that two individuals picked at random from the site are the same species. The index decreases with increasing community diversity and ranges from 0 (completely diverse) to 1 (no diversity). Because of this inverse relationship between community diversity and the Simpson's index, the inverse of Simpson's index ($1/\text{SI}$) is used

in this report with a 0 indicating no diversity and 1 indicating complete diversity. The Index of Biotic Integrity (IBI) developed by the Iowa Department of Natural Resources (Wilton 2004) was used to assess overall stream health and is calculated using 12 metrics: (1) number of native fish species; (2) number of sucker (*Catostomidae*) species; (3) number of sensitive species; (4) number of benthic invertivore species; (5) percent abundance of three dominant species; (6) percent of fish as benthic invertivores; (7) percent of fish as omnivores; (8) percent of fish as top carnivores; (9) percent of fish as simple lithophilous spawners; (10) fish assemblage tolerance index; (11) adjusted catch per unit effort (CPUE); and (12) percent of fish with deformities, eroded fins, lesions, or tumors (DELT anomalies). Each of the 12 raw metric values was scored from 0 to 10 based on formulas developed for Iowa streams. The first 11 metric scores were summed and the % DELT metric was subtracted to calculate an IBI score that ranges from 0 to 100. Based on this IBI score, the overall integrity of the stream is classified from poor to excellent: poor = 0–25; fair = 26–50; good = 51–70; and excellent = 71–100. More detailed methods on calculating the IBI metrics used in this report can be found in Wilton (2004).

Quantitative physical habitat data (i.e., width, depth, velocity) were summarized using means with 95% confidence intervals. Qualitative habitat data related to channel morphology (i.e., substrate size, embeddedness) were converted to midpoints of each category and summarized using means and 95% confidence intervals. Presence/absence of fish cover and categorical bank data (e.g., bank angle, bank vegetation, etc.) were summarized as percentage of the reach. For greater details on field methods and calculation of fish community metrics, see Dodd et al. 2021.

Water Quantity and Quality

Stream discharge and water quality were measured at the upstream end of the sample reach. Discharge was collected by taking depth and velocity readings at equally spaced intervals along a transect. Hourly water quality data (temperature, dissolved oxygen, pH, specific conductance, and turbidity) were collected using a calibrated water quality datalogger deployed upstream of the reach during sampling. Number of hourly measurements varied between years. Water quality data were summarized using means and 95% confidence intervals.

Results

Aquatic Invertebrates

A total of 45 aquatic invertebrate taxa have been collected at the Hoover Creek long-term monitoring site from 2008 to 2017 with 7% (3 taxa) being sensitive to poor water quality conditions (Table 1). Across all years sampled, the aquatic community was dominated by three taxa that are tolerant of poor water quality and habitat conditions: true flies in the Chironomidae family (24%), Oligochaete worms (15%), and mayflies in the Baetidae family (14%). The abundances of these three taxa appear to decline over time; the number of individuals was two or three times greater in earlier years for Oligochaetes and Baetid mayflies and 26 times greater for Chironomids (Table 1). However, when looking at percent composition of these taxa (number of individuals within a taxon divided by total number of invertebrates) in the community, Oligochaetes and Baetid mayflies make up about two times more of the community in later years while Chironomids make up only about a fifth of the community in later years.

Total taxa richness ranged from 21 taxa in 2011 to 32 in 2017 with highest total abundance of invertebrates in 2011 and lowest abundance in 2017 (Table 1). In 2011, the sensitive caddisfly genus *Ceratopsyche* was the most abundant taxon in the community (Table 1). Mean taxa richness ranged from 10.2 in 2014 to 12.3 in 2008 with no differences in taxa richness based on 95% confidence intervals (Figure 2, top panel). Mean EPT richness and ratio of EPT density both showed a similar up and down pattern across years with lower values in 2014 (2.7 and 0.4, respectively) and higher values in 2011 (3.8 and 0.7, respectively), but no differences in means were evident across years based on 95% confidence intervals (Figure 2, bottom panel). It is noteworthy that the uncertainty in EPT richness was over six times greater in both 2014 and 2017 (Figure 2, bottom panel, solid CI bars) than in the previous two years sampled.

Table 1. Invertebrate taxa and number of individuals collected within riffles of the Heartland Network long-term monitoring reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Sensitive taxa are those with a tolerance value less than or equal to three. N = none recorded in this taxon.

Phylum	Class	Order	Family	Genus	Sensitive Taxa	2008	2011	2014	2017
Annelida	Hirudinea	–	–	–	No	N	N	2	6
Annelida	Oligochaeta	–	–	–	No	1186	1148	145	512
Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia	No	N	N	N	2
Arthropoda	Arachnida	Trombidiformes	"Hydracarina"	–	No	40	182	61	10
Arthropoda	Crustacea	Amphipoda	Gammaridae	Gammarus	No	N	N	3	N
Arthropoda	Crustacea	Decapoda	–	–	No	18	N	N	N
Arthropoda	Crustacea	Isopoda	–	–	No	26	N	N	N
Arthropoda	Crustacea	Isopoda	Asellidae	Lirceus	No	93	216	N	3
Arthropoda	Insecta	Coleoptera	Dryopidae	Helichus	No	N	4	N	N
Arthropoda	Insecta	Coleoptera	Elmidae	–	No	N	N	N	35
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus	Yes	10	48	4	7
Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis	No	271	726	61	185
Arthropoda	Insecta	Coleoptera	Elmidae	Dubiraphia	No	11	18	3	6
Arthropoda	Insecta	Coleoptera	Hydrophilidae	–	No	N	N	N	1
Arthropoda	Insecta	Collembola	–	–	No	N	N	N	2
Arthropoda	Insecta	Collembola	Entomobryidae	–	No	N	N	1	N
Arthropoda	Insecta	Diptera	Athericidae	Atherix	Yes	N	N	N	30
Arthropoda	Insecta	Diptera	Ceratopogonidae	–	No	38	N	1	N
Arthropoda	Insecta	Diptera	Chironomidae	–	No	2629	1196	1003	101
Arthropoda	Insecta	Diptera	Empididae	–	No	N	24	N	N
Arthropoda	Insecta	Diptera	Empididae	Clinocera	No	N	N	8	N
Arthropoda	Insecta	Diptera	Empididae	Hemerodromia	No	77	268	2	7

Table 1 (continued). Invertebrate taxa and number of individuals collected within riffles of the Heartland Network long-term monitoring reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Sensitive taxa are those with a tolerance value less than or equal to three. N = none recorded in this taxon.

Phylum	Class	Order	Family	Genus	Sensitive Taxa	2008	2011	2014	2017
Arthropoda	Insecta	Diptera	Simuliidae	–	No	N	N	500	N
Arthropoda	Insecta	Diptera	Simuliidae	Simulium	No	812	94	42	3
Arthropoda	Insecta	Diptera	Tipulidae	Hexatoma	No	N	N	N	30
Arthropoda	Insecta	Diptera	Tipulidae	Tipula	No	3	68	1	N
Arthropoda	Insecta	Ephemeroptera	Baetidae	–	No	190	1294	765	3
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	No	N	N	N	176
Arthropoda	Insecta	Ephemeroptera	Baetidae	"Pseudocloeon"	No	311	40	N	N
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	–	No	N	N	7	1
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenacron	No	N	N	2	4
Arthropoda	Insecta	Odonata	Coenagrionidae	Argia	No	2	N	7	N
Arthropoda	Insecta	Trichoptera	Hydropsychidae	–	No	469	280	27	4
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Yes	46	1692	7	N
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	No	527	304	N	45
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	No	49	263	340	59
Arthropoda	Insecta	Trichoptera	Hydroptilidae	–	No	N	N	N	1
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptila	No	104	966	21	7
Mollusca	Bivalvia	–	–	–	No	N	N	N	1
Mollusca	Bivalvia	Veneroida	Corbiculidae	Corbicula	No	43	5	11	30
Mollusca	Bivalvia	Veneroida	Pisidiidae	Sphaerium	No	N	N	N	32
Mollusca	Gastropoda	–	–	–	No	N	N	N	1
Mollusca	Gastropoda	Basommatophora	Physidae	Physella	No	14	10	8	1
Mollusca	Gastropoda	Basommatophora	Ancylidae	Ferrissia	No	N	N	N	1
Nematoda	–	–	–	–	No	11	N	16	9
Total	–	–	–	–	–	6980	8846	3048	1315

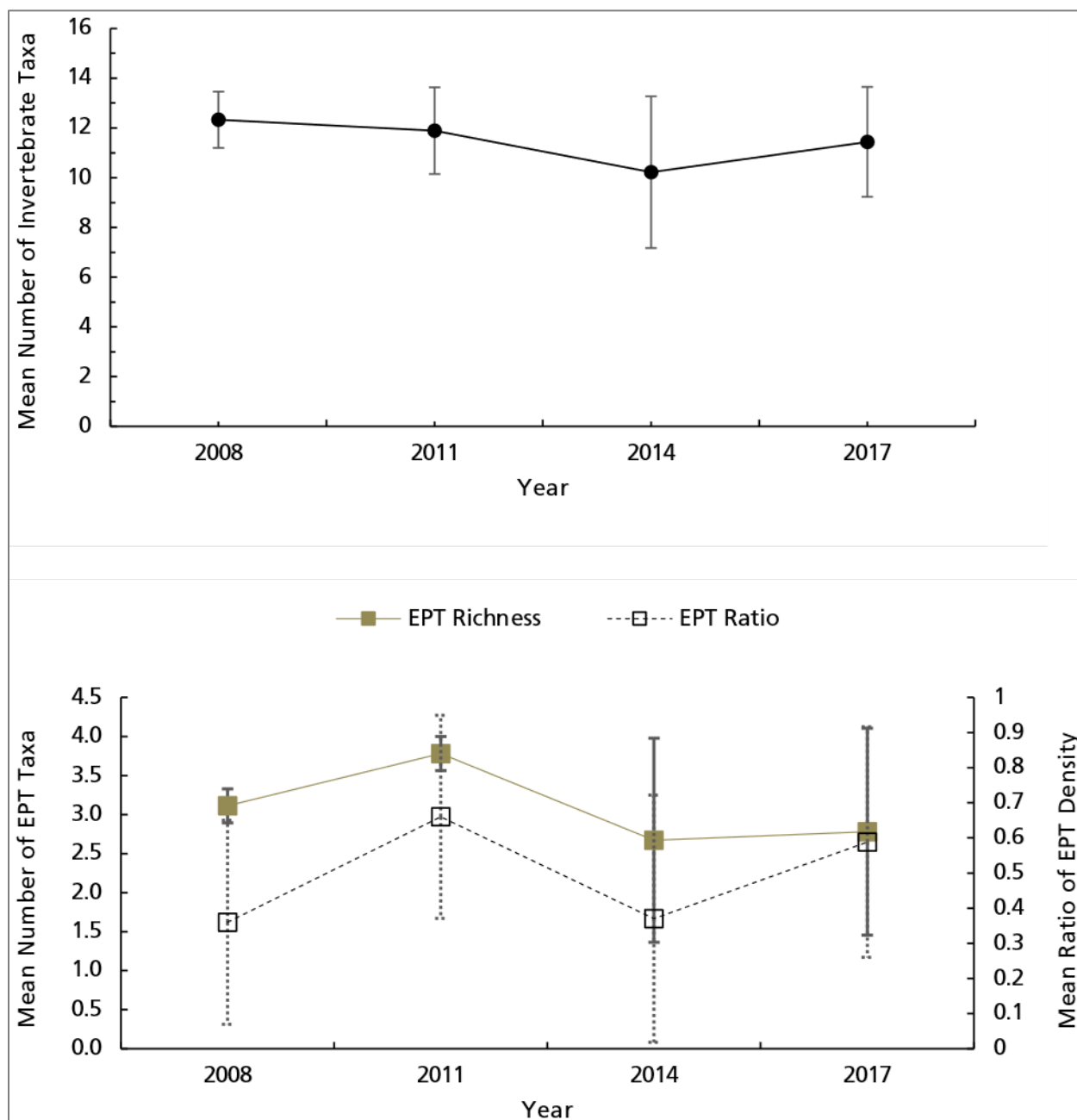


Figure 2. Mean invertebrate taxa richness (upper panel) and mean Ephemeroptera, Plecoptera, and Tricoptera (EPT) richness and density ratio (lower panel) in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Error bars represent 95% confidence intervals. N = 3 riffles sampled each year.

Mean community diversity and evenness showed only a slight up and down pattern across sample years with means found comparable across years based on confidence intervals (Figure 3, top panel). Mean HBI values (which are based on taxa abundance and tolerance values) indicated the invertebrate community fluctuated over time from good in 2011 (HBI = 5.2), where total invertebrate abundance was highest among years sampled, to fairly poor in 2017 (HBI = 6.5; Figure 3, bottom

panel). The fairly poor rating in 2017 is likely due to the low total abundance of invertebrates and larger proportion of tolerant Oligochaete worms compared to other taxa collected that year.

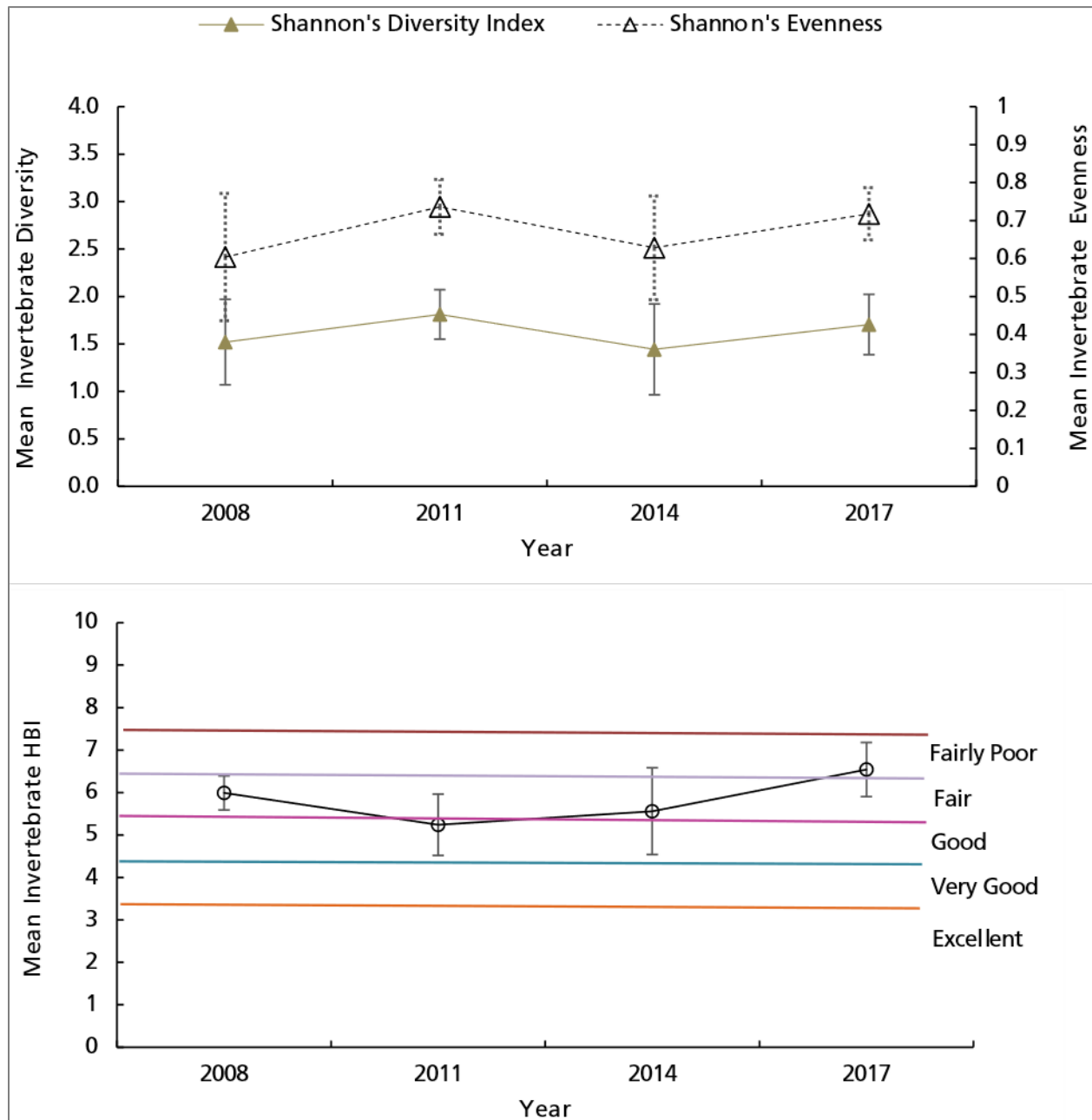


Figure 3. Mean Shannon's diversity and evenness index (upper panel) and mean Hilsenhoff's Biotic Index (HBI; lower panel) for invertebrates in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Error bars represent 95% confidence intervals. N = 3 riffles sampled each year. Horizontal lines in bottom graph represent the community rating based on HBI score.

Fish Community

A total of ten fish species were collected at Hoover Creek over the four years sampled. Seven of those species were found in all years (Table 2). All fish species collected were either moderately tolerant or tolerant to poor habitat and water quality conditions. Across all four years sampled, the community was dominated by johnny darter (*Etheostoma nigrum*), creek chub (*Semotilus atromaculatus*), and blacknose dace (*Rhinichthys atratulus*). Total fish abundance was very low in 2008 (Table 2) with two fish collected per minute compared to other years, which ranged from 10 to 13 fish/minute (Figure 4). However, species richness and community diversity were similar between 2008 and all other years (Figure 4). The low abundance in 2008 was likely due to a rain event that occurred the previous night causing high turbidity, making it difficult to see and collect the fish. Because diversity considers both species richness and their individual species abundance, the similarity in this metric across all years indicates that the 2008 fish sample was representative of the community, although the total number of fish collected was low. The stream integrity based on the fish IBI ranged from fair in 2008, with a score of 28, to good in 2011, with a score of 51 (Figure 5). The low IBI score in 2008 was due to low total fish abundance, which not only affects the scoring of the adjusted catch per unit effort (CPUE) metric, but also lowers the scoring for six additional metrics (Table 3). So, although most calculated metrics in 2008 were similar to those in other years, the low CPUE decreased the scoring of six metrics resulting in an overall lower IBI score. It's worth noting that although 2017 had a similar total IBI score (Figure 5) and similar metric calculations (Table 3) compared to other years, the percentage of DELT (deformities, eroded fins, lesions, and tumors) anomalies was 11%, which was more than three times that of previous years.

Table 2. Fish species and number of individuals collected at the Heartland Network long-term monitoring reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.

Common Name	Scientific Name	2008	2011	2014	2017
White sucker	<i>Catostomus commersonii</i>	7	13	0	4
Bigmouth shiner	<i>Notropis dorsalis</i>	2	25	4	4
Blacknose dace	<i>Rhinichthys atratulus</i>	1	87	25	52
Bluntnose minnow	<i>Pimephales notatus</i>	2	6	76	19
Central stoneroller	<i>Campostoma anomalum</i>	3	17	25	3
Common shiner	<i>Luxilus cornutus</i>	4	27	16	21
Creek chub	<i>Semotilus atromaculatus</i>	19	80	70	91
Yellow bullhead	<i>Ameiurus natalis</i>	0	0	1	0
Green sunfish	<i>Lepomis cyanellus</i>	0	0	0	1
Johnny darter	<i>Etheostoma nigrum</i>	8	114	210	23

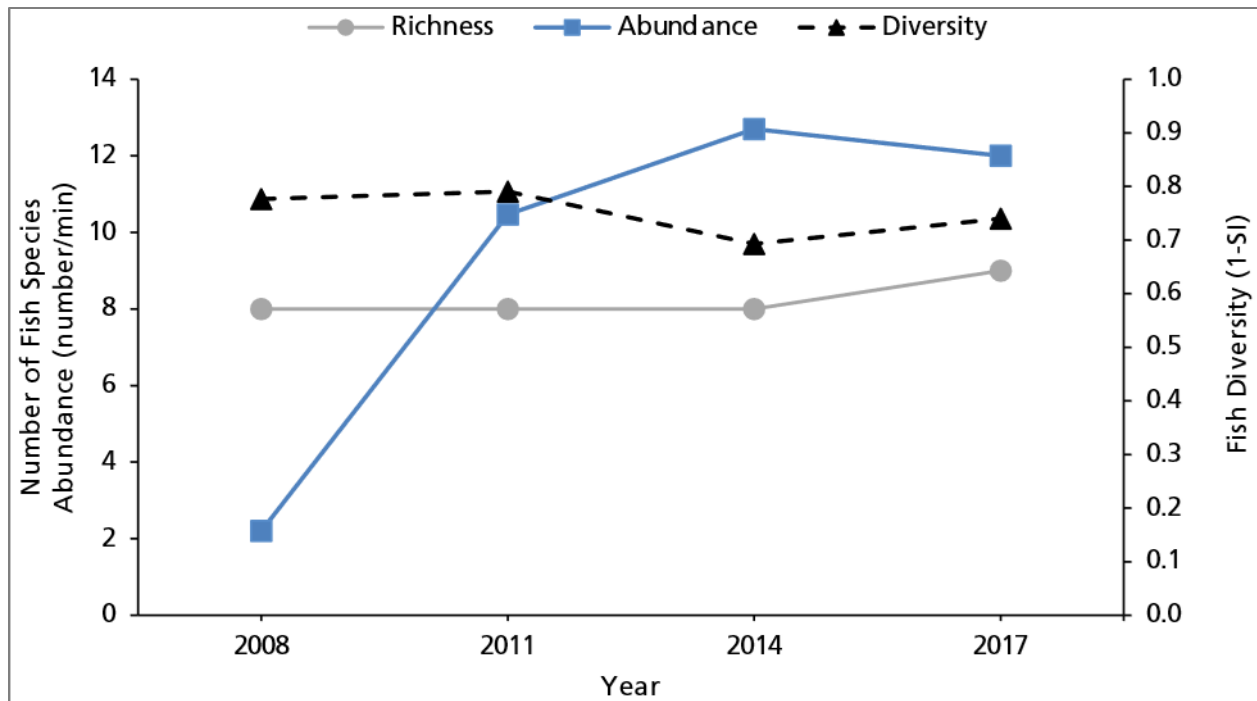


Figure 4. Fish species richness, fish abundance (catch per minute), and community diversity in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.

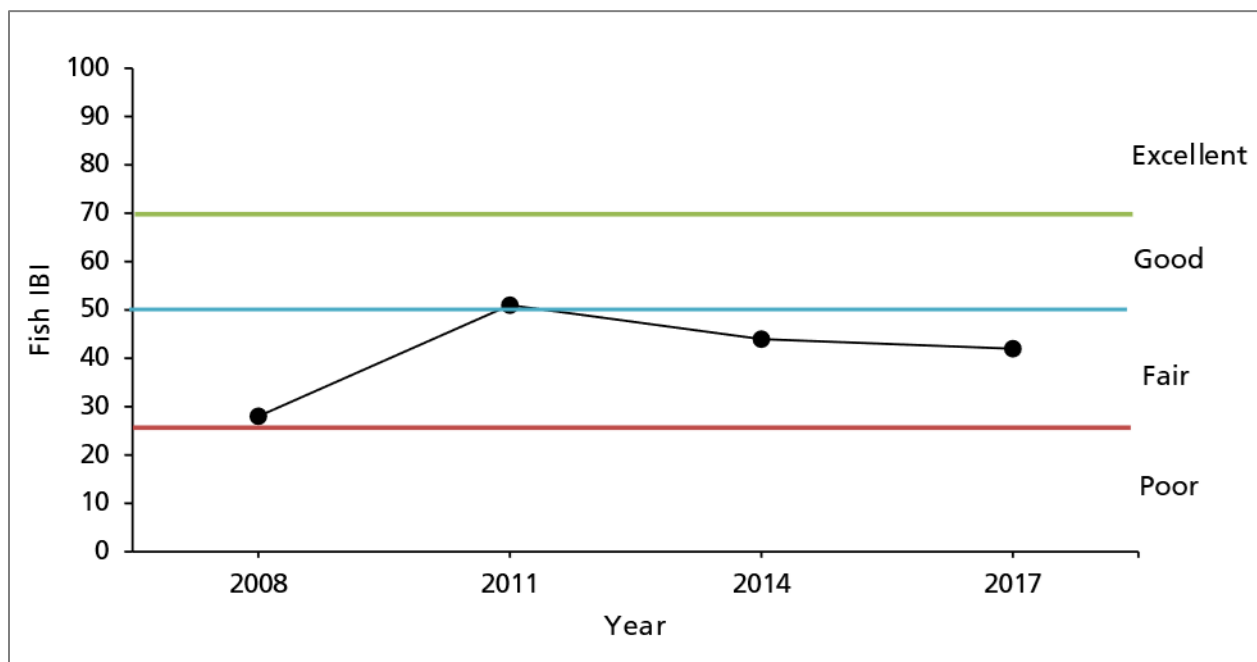


Figure 5. Index of Biotic Integrity scores and ratings for fish communities in the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.

Table 3. Index of Biotic Integrity metric calculations for fish communities in the Heartland Network sample reach in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Metrics with an asterisk are those where CPUE is factored into the scoring of that metric.

IBI Metric	2008	2011	2014	2017
Number of Native Species	8	8	8	9
Number of Sucker Species	1	1	0	1
Number of Sensitive Species	0	0	0	0
Number of Benthic Invertivore Species	1	1	1	1
% Abundance of 3 Dominant Species*	73.9	76.2	83.4	76.1
% Benthic Invertivore*	17.4	30.9	49.2	10.6
% Ominivore*	19.6	5.1	18.0	10.6
% Top Carnivore*	0.0	0.0	0.0	0.0
% Lithophilic Spawners*	0.0	0.0	0.0	0.0
Tolerance Index*	7.5	6.5	6.8	7.6
Adjusted CPUE (catch/100 ft): excludes tolerant & exotic species	4.7	52.3	56.0	20.9
% DELT Anomalies	0.0	3.0	3.5	11.0

Stream Habitat

Base stream flow (discharge) was lowest in 2014 at 0.02 m³/s and highest in 2011 at 0.08 m³/s (Figure 6). In 2008, a rain event occurred overnight between invertebrate and fish sampling events (Figure 7). During invertebrate sampling in 2008, discharge was 0.07 m³/s, while discharge the next day during fish collection was 0.17 m³/s (Figure 6). Average depth within riffles sampled for invertebrates was similar across years, while average velocity of riffles was highest in 2011 (0.41 m/s) and significantly higher than that of 2014 (0.09 m/s) based on 95% confidence intervals (Figure 8, top panel). For the sample reach, average depth and velocity were highest in 2008 (0.3 m and 0.29 m/s, respectively). Based on confidence intervals, reach depth in 2008 was significantly higher than in 2017 (0.2 m), and reach velocity in 2008 was significantly higher than in all other years sampled (Figure 8, bottom panel).

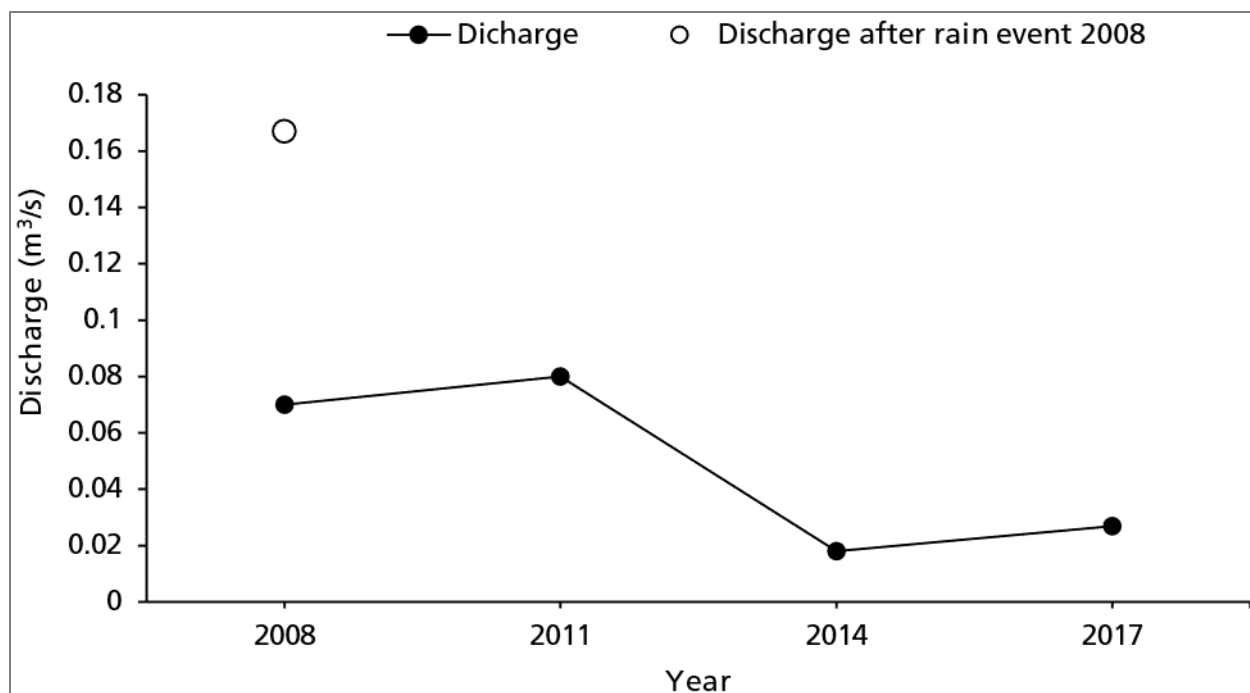


Figure 6. Discharge in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. A rain event occurred between aquatic invertebrate and fish sampling in 2008. Pre-rain event (black circle) and post-rain event (open circle) are represented for 2008. Discharge data were collected from USGS gage.



Figure 7. Heartland Network downstream monitoring reach on Hoover Creek within Herbert Hoover National Historic Site before (left panel) and after (right panel) the rain event during 2008 sampling. The rain event occurred between aquatic invertebrate and fish sampling.

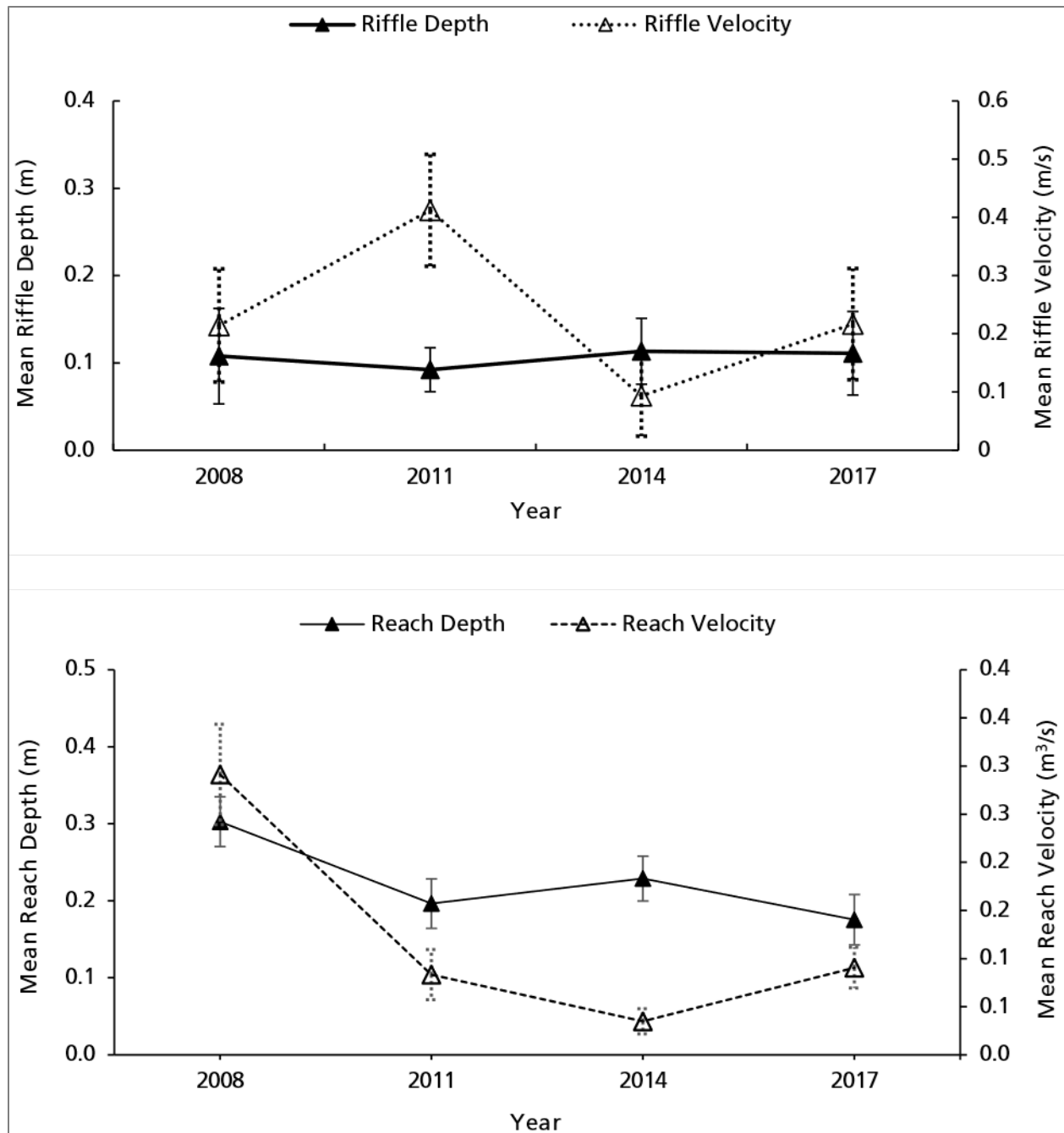


Figure 8. Mean depth and velocity at riffles (top panel) and the sample reach (bottom panel) in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Error bars represent 95% confidence intervals. N = 3 for riffles and N = 33 for the reach.

Mean substrate size and embeddedness for both riffles and the reach were similar among years sampled (Figure 9), based on 95% confidence intervals. For riffles, mean substrate ranged from 25 mm (small pebble) in 2017 to 37 mm (large pebble) in 2008 with high variability in substrate sizes in 2011 due to large substrates in one of the sampled riffles (Figure 9, top panel). When accounting for substrate sizes throughout the reach, mean substrate was much smaller ranging from 3.3 mm (fine

gravel) in 2008 and 2011 to 5.0 mm (medium gravel) in 2017, with high uncertainty in all years based on confidence intervals (Figure 9, bottom panel). Average embeddedness in riffles ranged from 32% in 2011 to 63% in 2014, while embeddedness of the substrate was higher when collected across the entire reach, ranging from 69% in 2008 to 83% in 2014.

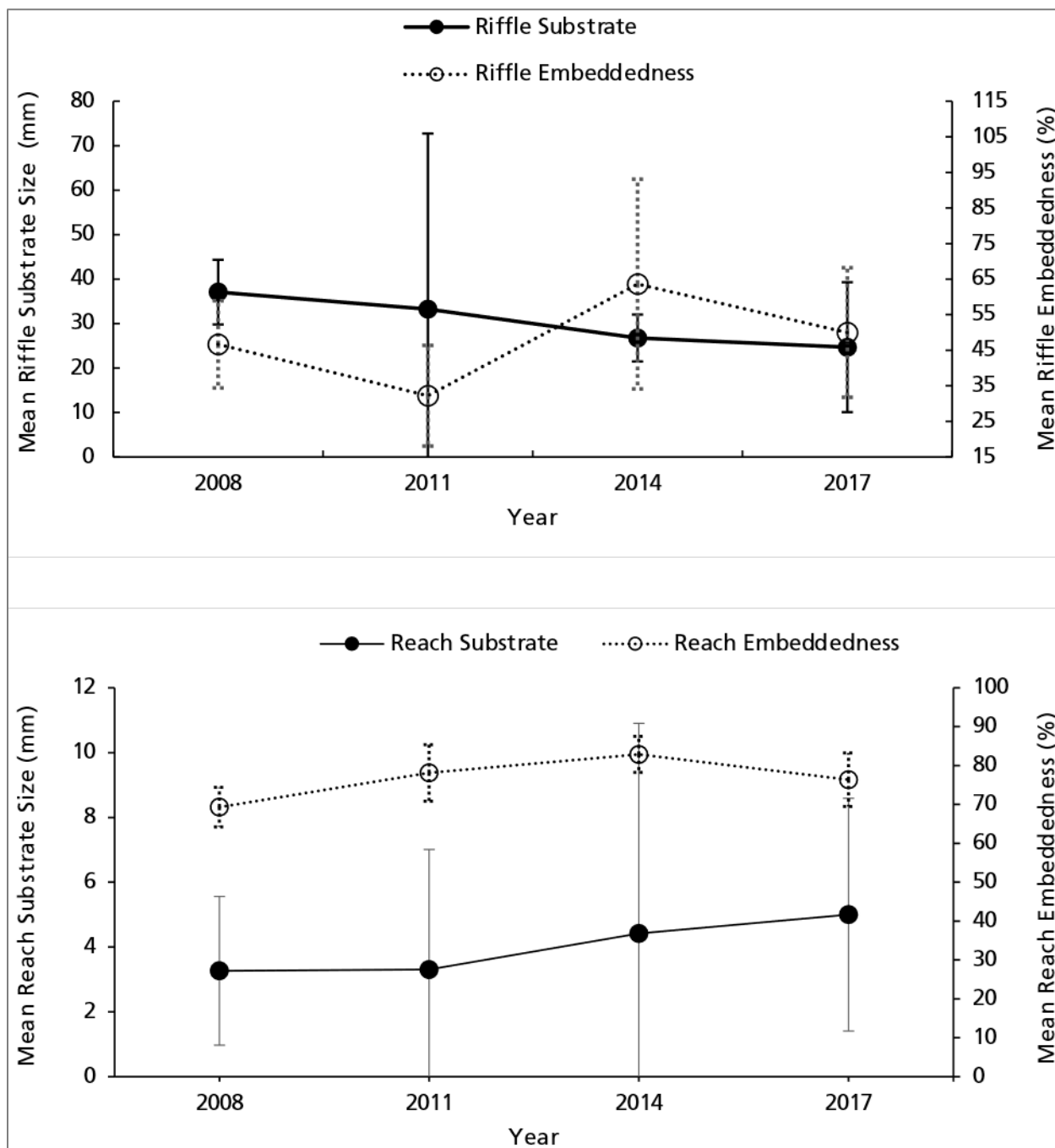


Figure 9. Mean substrate size and percent embeddedness at riffles (top panel) and the sample reach (bottom panel) in Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Error bars represent 95% confidence intervals. N = 3 for riffles and N = 33 for the reach.

Mean percent vegetation in riffles was low in all years except 2011 when vegetation was 18%, and mean periphyton was similar among years sampled with high variability in 2011 (Figure 10). Within the entire reach, mean percent cover of hydrophytes (i.e., vegetation) was low most years except for 2011 where percent occurrence of hydrophytes was 15% (Figure 11). The most dominant cover types within the reach were small woody debris and overhanging vegetation. In 2008, percent of tree roots within the reach (36%) was about twice that of other years.

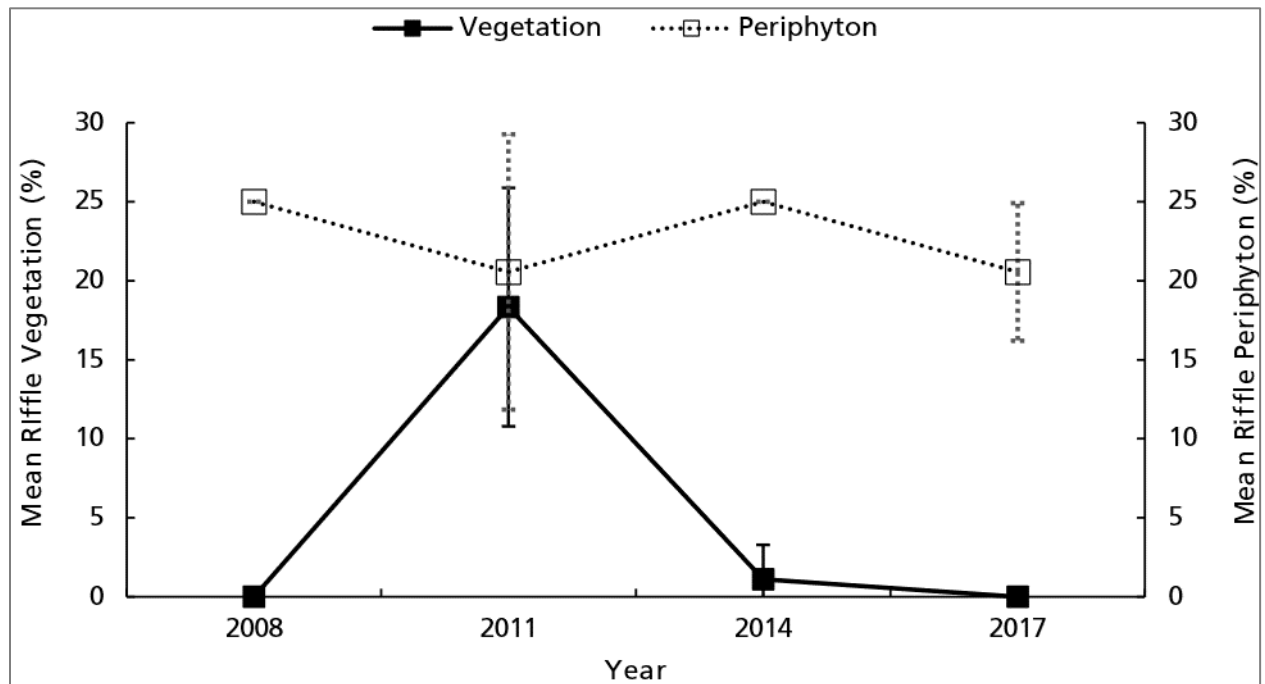


Figure 10. Mean percent vegetation and periphyton within riffle habitat sampled at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Error bars represent 95% confidence intervals. N = 3 riffles for all years.

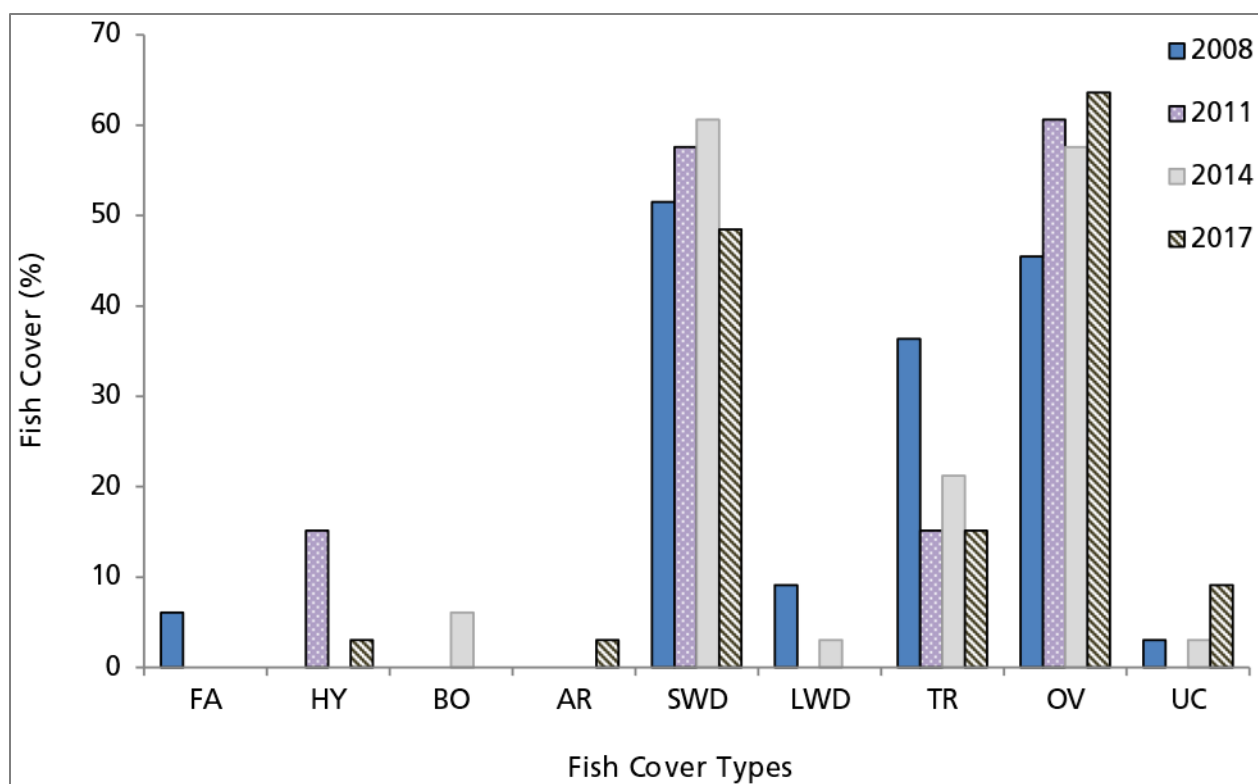


Figure 11. Percent of fish cover types present at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. FA = Filamentous algae, HY = Hydrophytes, BO = Boulder, AR = Artificial, SWD = Small Woody Debris, LWD = Large Woody Debris, TR = Trees and Roots, OV = Overhanging vegetation, and UC = Undercut bank.

Banks within the reach were characterized by tall (2–3 m), steep ($> 60^\circ$) silt banks in all years (Table 4). While most of the banks were greater than 80% vegetated, this vegetation consisted mostly of grasses/forbs within two to five meters of the water and the remaining bank was mowed lawn (Figure 7 and Figure 12).

Table 4. Percentage of total banks for categories of bank angle, percent vegetation, height, and substrate type at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.

Bank Metric	Parameter	2008 % Occurrence	2011 % Occurrence	2014 % Occurrence	2017 % Occurrence
Angle	$< 60^\circ$	18	36	5	27
	$> 60^\circ$	82	64	95	73
% Vegetation	$> 80\%$	68	90	100	91
	50–80%	32	5	0	9
	$< 50\%$	0	5	0	0

Table 4 (continued). Percentage of total banks for categories of bank angle, percent vegetation, height, and substrate type at the Heartland Network long-term monitoring reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017.

Bank Metric	Parameter	2008 % Occurrence	2011 % Occurrence	2014 % Occurrence	2017 % Occurrence
Height	<1m	0	14	0	9
	1–2m	27	72	9	59
	2–3m	73	14	86	32
	>3m	0	0	5	0
Substrate	Bedrock/Artificial	0	0	0	5
	Boulder/Cobble	0	0	0	0
	Silt	100	100	100	95
	Sand	0	0	0	0
	Gravel/Sand	0	0	0	0



Figure 12. Photograph of the bank within the downstream monitoring reach on Hoover Creek, Herbert Hoover National Historic Site.

Water quality conditions for all parameters were typical of warm water agricultural streams and were within federal and state standards (USEPA 2000; IDNR 2019) except for average turbidity in 2008

(Table 5). Due to the rain event the night before fish sampling, average turbidity in Hoover Creek was above the US Environmental Protection Agency standard of 15 NTU and the Iowa Department of Natural Resources standard of 25 NTU (Figure 1). However, turbidity prior to the rain event was below both standards. Average temperature remained below 32°C, dissolved oxygen remained above 4 mg/L (minimum concentration for fish survival) and mean pH was within 6.5–9.0 for all years. It's worth noting that water quality collection duration was between 16 and 20 hours depending on the year sampled. Thus, these water quality data are only a snapshot of the conditions in Hoover Creek.

Table 5. Mean water quality data ($\pm 95\%$ confidence intervals) collected at the Heartland Network sample reach at Hoover Creek, Herbert Hoover National Historic Site, 2008–2017. Data were collected hourly with calibrated data loggers.

Water Quality Parameters	2008 Before Rain Event	2008 After Rain Event	2011	2014	2017
Average Water Temperature (°C)	23.5 $\pm$ 0.4	20.3 $\pm$ 1.0	19.3 $\pm$ 1.0	18.4 $\pm$ 1.1	20.4 $\pm$ 1.0
Average Specific Conductance (μ S/cm)	392.5 $\pm$ 3.3	250.5 $\pm$ 21.9	509.7 $\pm$ 1.2	495.1 $\pm$ 1.4	557.8 $\pm$ 0.9
Average Dissolved Oxygen (mg/L)	8.43 $\pm$ 0.48	7.67 $\pm$ 0.14	9.73 $\pm$ 0.29	8.34 $\pm$ 0.47	7.62 $\pm$ 0.18
Average pH	8.00 $\pm$ 0.05	7.52 $\pm$ 0.13	7.79 $\pm$ 0.02	7.91 $\pm$ 0.05	8.21 $\pm$ 0.03
Average Turbidity (NTU)	6.9 $\pm$ 1.1	242.6 $\pm$ 83.9	20.1 $\pm$ 3.9	6.4 $\pm$ 1.1	17.5 $\pm$ 3.5

Discussion

The overall stream integrity and health of Hoover Creek within Herbert Hoover National Historic Site is in fair condition based on the biotic community and habitat data collected from 2008–2017. Aquatic invertebrate communities ranged from fairly poor to good condition while the fish community ranged from fair to good condition. Most invertebrate taxa and all fish taxa collected were moderately tolerant or tolerant to poor water quality and habitat conditions. Chironomids, Oligochaetes, and Baetid mayflies were the dominate invertebrates, and johnny darter, creek chub, and blacknose dace dominated the fish community. Predominately fine to medium gravel substrates were present throughout the reach with small pebble to large pebble substrate present in riffles. Embeddedness of stream substrates was high, indicating heavy siltation. Stream depth and velocity were similar among years, except for 2008 where a short rain event elevated water levels, increasing depth and velocity. This short rain event was enough to double the stream flow and increase turbidity to 35 times that of the day before. This suggests that runoff from even short-duration rain events can impact the stream habitat and water quality. Sustained rain events would have an even greater effect on the stream habitat, water quality, and biotic community.

The Heartland Network protocol specifies sampling only riffle channel units for invertebrates because this channel type typically contains more taxa and higher numbers of sensitive EPT taxa. However, it is likely that the percentage of the community made up of Chironomids and Oligochaetes is underestimated by not sampling pool channel units that have slower flows and smaller substrates. Adding a multihabitat sample to the Heartland Network methodology described in Bowles et al. (2021) will allow investigators to calculate the IOWATER Advanced Benthic Macroinvertebrate Index (Wilton 2004). Using this multihabitat method and index will allow comparisons to nearby streams sampled by the Iowa Department of Natural Resources and allow managers to directly compare the invertebrate community to Iowa reference streams, similar to the Iowa Index of Biotic Integrity used for fish communities at Hoover Creek.

The four years of biotic and habitat data collected by the Heartland Network can serve as a good baseline dataset to assess the status and future trends in fish and invertebrate communities. This baseline data will be important for tracking impacts of land use change or climate change on aquatic communities, particularly as both of these factors can impact temperatures and flooding frequency and duration, resulting in changes in water quality and stream habitat conditions.

In addition, the Heartland Network dataset can be used to evaluate how management practices implemented in the park or within the watershed affect changes in the stream community and provide insight on effectiveness of these practices at ameliorating impacts of land use or climate change.

Literature Cited

- Bowles, D. E., M. H. Williams, H. R. Dodd, L. W. Morrison, J. A. Hinsey, J. T. Cribbs, G. A. Rowell, M. D. DeBacker, J. L. Haack-Gaynor, and J. M. Williams. 2021. [Protocol for monitoring aquatic invertebrates of small streams in the Heartland Inventory & Monitoring Network: Version 2.1](https://doi.org/10.36967/nrr-2284622). Natural Resource Report NPS/HTLN/NRR—2021/2229. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/nrr-2284622>.
- Dodd, H. R., D. G. Peitz, G. A. Rowell, J. A. Hinsey, D. E. Bowles, L. W. Morrison, M. D. DeBacker, J. L. Haack-Gaynor, and J. M. Williams. 2021. [Protocol for monitoring fish communities in small streams in the Heartland Inventory and Monitoring Network: Version 2.0](https://doi.org/10.36967/nrr-2284726). Natural Resource Report NPS/HTLN/NRR—2021/2235. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/nrr-2284726>.
- Foreman, K. L. 2007. Monitoring water quality on Hoover Creek as it flows into Herbert Hoover National Historic Site, West Branch, Iowa. Iowa Department of Natural Resources, Des Moines, Iowa.
- Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. *Journal of North American Benthological Society* 7(1): 65–68.
- Iowa Department of Natural Resources 2010. [Iowa surface water classifications \(567 IAC 61.3\), September 2010](https://www.iowadnr.gov/environmental-protection/water-quality/water-quality-standards/antidegradation). <https://www.iowadnr.gov/environmental-protection/water-quality/water-quality-standards/antidegradation> (accessed October 2, 2020).
- Iowa Department of Natural Resources. 2019. [Iowa water quality standards, chapter 61](https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Quality-Standards). <https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Quality-Standards> (accessed October 2, 2020).
- US Environmental Protection Agency (USEPA). 2000. Information supporting the development of state and tribal nutrient criteria for rivers and streams in nutrient ecoregion VI. EPA 822-B-00-017. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.
- Wentworth, C. K. 1922. A scale of grade and class terms for clastic sediments. *Journal of Geology* 30: 377–392.
- Wilton, T. 2004. Biological assessment of Iowa's wadeable streams. Project Report. Iowa Department of Natural Resources, Des Moines, Iowa.

National Park Service
U.S. Department of the Interior



Science Report NPS/SR—2024/107
[https://doi.org/ 10.36967/2303263](https://doi.org/10.36967/2303263)

Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525