Application of Electrofishing in the Calculation of Biological Indices to Assess Stream Quality

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QDC Level 3 Fish and Habitat

Per Ohio EPA fish sampling protocol*, electrofishing is the only acceptable method of fish collection

SportYak method

The "Rollerbeast"

(*Biological Criteria for the Protection of Aquatic Life, Volume III: Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities)

Electrofishing systems

➢ Boat

➢ Wading longline

➢ Wading backpack

Electrofishing system - Longline

Biological Field Assessment Protocol Summary

✓ Sample 150-200 m stretch for wadeable streams, cover all available habitat, and process fish at end

✓ Headwater streams: less than or equal to 20 mi sq drainage area; conduct QHEI and IBI

✓ Mainstem streams: greater than 20 sq mi drainage area; conduct QHEI, IBI and MIwb (incorporates Shannon Diversity Index)

✓ Note: Primary headwater streams of less than or equal to 1 sq mi drainage area use HHEI and HMFEI
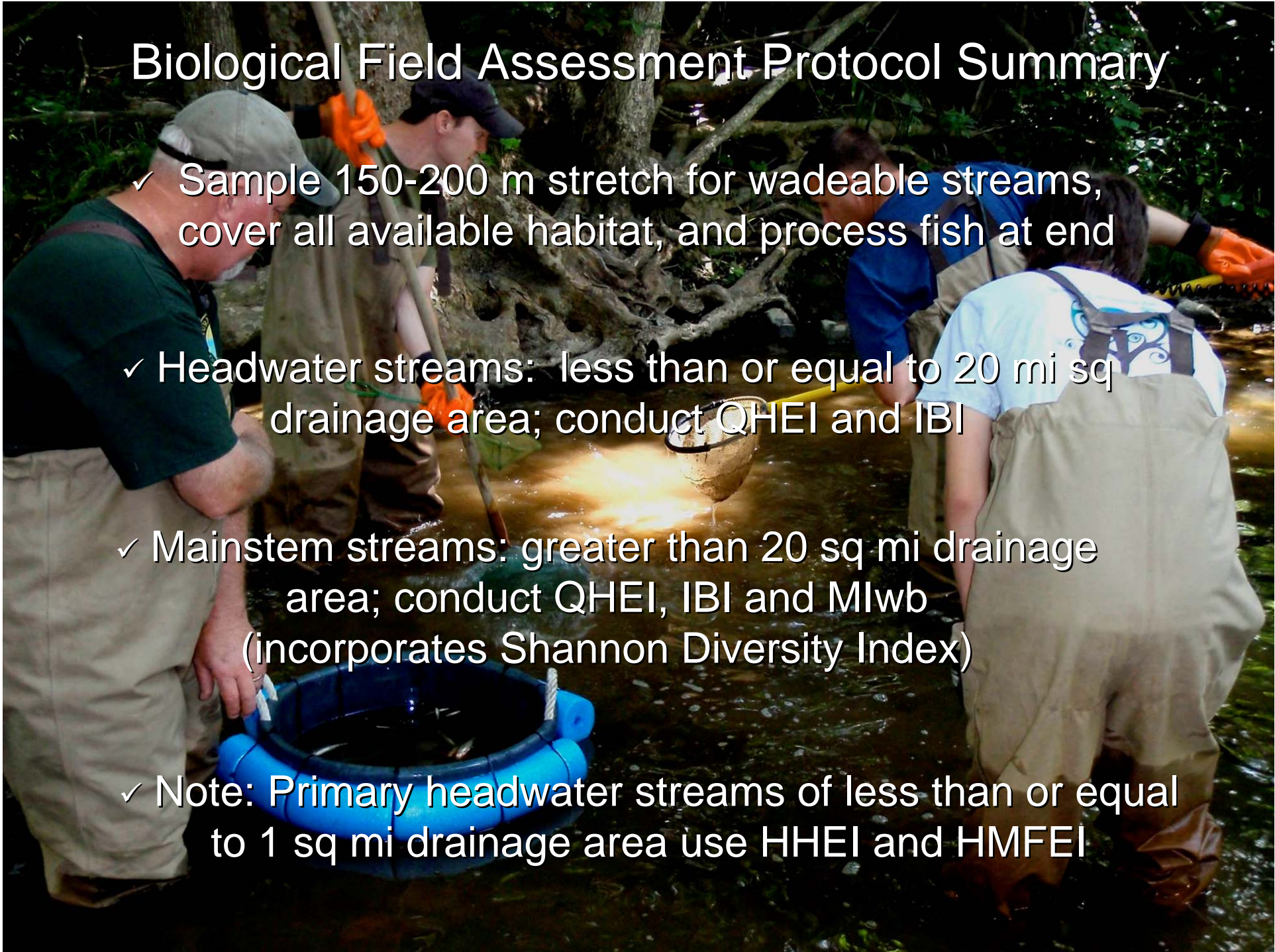
Data collection and processing

Identify all fish to species, sort, count, and record numbers (and weights, too, if conducting MIwb)

Each species has a five digit FINS code: first two designate family, next three species (mottled sculpin, *Cottus bairdi*, is 90-002)

Data Summary

Mike Durkalec QDC Level 3 Fish test site: East Fork Vermilion River RM 2.3 (immediately upstream of Green Rd. bridge)

Date: 23 Sept 2008   Dist. Fished: 0.2 km

Common name	Species code	Feed Guild	Tolerance	IBI Group	Breed Guild	Number of Fish	Relative Number	% by Number	Relative Weight (kg)	% by Weight	Ave Weight (g)
Rainbow Trout	25-002			E	N	2	3.00	0.38	0.02	0.14	5.00
Northern Hog Sucker	40-015	I	M	R	S	4	6.00	0.75	0.65	6.03	108.50
White Sucker	40-016	O	T	W	S	46	69.00	8.66	7.84	72.58	113.60
Bigeye Chub	43-007	I	I	N	S	6	9.00	1.13	0.04	0.38	4.60
Blacknose Dace	43-011	G	T	N	S	14	21.00	2.64	0.04	0.33	1.71
Creek Chub	43-013	G	T	N	N	50	75.00	9.42	0.22	2.03	2.92
Striped Shiner	43-025	I		N	S	18	27.00	3.39	0.46	4.24	16.94
Spotfin Shiner	43-032	I		N	M	1	1.50	0.19	0.00	0.04	3.00
Silverjaw Minnow	43-039	I		N	M	3	4.50	0.56	0.00	0.04	1.00
Bluntnose Minnow	43-043	O	T	N	C	12	18.00	2.26	0.04	0.39	2.33
Central Stoneroller	43-044	H		N	N	77	115.50	14.50	0.36	3.37	3.16
Rock Bass	77-003	C		S	C	1	1.50	0.19	0.02	0.21	15.00
Largemouth Bass	77-006	C		F	C	1	1.50	0.19	0.01	0.13	9.00
Green Sunfish	77-008	I	T	S	C	9	13.50	1.69	0.17	1.60	12.78
Johnny Darter	80-014	I		D	C	83	124.50	15.63	0.17	1.57	1.36
Greenside Darter	80-015	I	M	D	S	10	15.00	1.88	0.06	0.51	3.70
Rainbow Darter	80-022	I	M	D	S	92	138.00	17.33	0.24	2.25	1.76
Mottled Sculpin	90-002	I			C	102	153.00	19.21	0.45	4.12	2.91
Total:						531	796.5			10.80	
Number Species:						18					
Number Hybrids:						0					

Summarize in spreadsheet, including species designations of feed guild, pollution tolerance, breed guild, and relative numbers (fish per 0.3 km) which will be used in IBI calculation
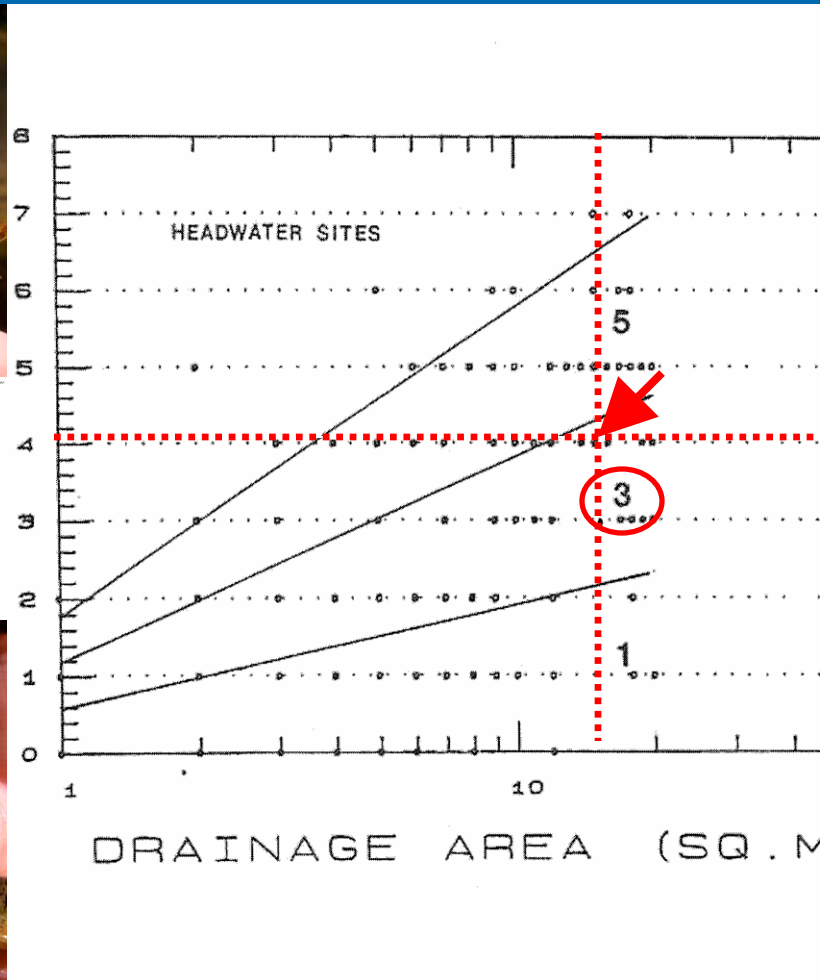
Headwater IBI calculation

Includes 12 metrics* from three categories that exhibit predictable gradients in quality:

➢ *Species composition*: *total native, darter/sculpins, headwater, minnows, sensitive, and % tolerant*

➢ *Trophic composition*: *% pioneering, % omnivores, and % insectivores*

➢ *Fish condition*: % DELT anomolies, relative number (minus tolerants), and simple lithophils

(*Note: several of these metrics change slightly for larger streams)

Headwater IBI calculation: darter/sculpin species metric example

Each metric assigns values of 1, 3, or 5

Headwater IBI calculation: summary worksheet

What does this mean?

Narrative Quality Ranges for Ohio's Biocriteria

	IBI			MIwb		ICI
	Boat	Wading	Headwater	Boat	Wading	All
IP						
Exceptional	48-60	50-60	50-60	>9.5	>9.3	46-60
Very Good	44-47	46-49	46-49	9.1-9.5	8.9-9.3	42-44
Good	38-43	40-45	40-45	8.7-9.0	8.1-8.8	30-40
Marg Good	34-37	36-39	36-39	8.2-8.6	7.6-8.0	26-28
Fair	26-33	28-35	28-35	6.4-8.1	5.9-7.5	14-24
Poor	16-25	18-27	18-27	5.0-6.3	4.5-5.8	2-12
Very Poor	12-15	12-17	12-17	0.0-4.9	0.0-4.4	0
EOLP						
Exceptional	48-60	50-60	50-60	>9.5	>9.3	46-60
Very Good	44-47	46-49	46-49	9.1-9.5	8.9-9.3	42-44
Good	40-43	38-45	40-45	8.7-9.0	7.9-8.8	34-40
Marg Good	36-39	34-37	36-39	8.2-8.6	7.2-7.8	30-32
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Very Poor	12-15	12-17	12-17	0.0-4.9	0.0-4.4	0
WAP						
Exceptional	48-60	50-60	50-60	>9.5	>9.3	46-60
Very Good	44-47	46-49	46-49	9.1-9.5	8.9-9.3	42-44
Good	40-43	44-45	44-45	8.6-9.0	8.4-8.8	36-40
Marg Good	36-39	40-43	40-43	8.1-8.5	7.9-8.3	32-34

MIwb calculation

Additionally performed on streams with watershed size >20 sq mi

Modified Index of Well-Being (Iwb)

$$I_{wb} = 0.5 \ln N + 0.5 \ln B + \bar{H} \text{ (no.)} + \bar{H} \text{ (wt.)}$$

where:

N = relative numbers of all species excluding species designated "highly tolerant" (Appendix B, Table B-3).

B = relative weights of all species excluding species designated "highly tolerant" (Appendix B, Table B-3).

$\bar{H}$ (no.) = Shannon diversity index based on numbers.

$\bar{H}$ (wt.) = Shannon diversity index based on numbers.

Shannon Diversity Index

$$\bar{H} = - \sum \frac{(n_i)}{N} \log_e \frac{(n_i)}{N}$$

where;
n_i = relative numbers or weight of the ith species
N = total number or weight of the sample

MIwb calculation

Mike Durkalec QDC Level 3 Fish test site: East Fork Vermilion River RM 2.3 (immediately upstream of Green Rd. bridge)

Date: 23 Sept 2008

Shannon Diversity Index/Modified Index of Well Being Calculations

Common name	P (number)	lnP (number)	"-(P*lnP) (number)	Relative Number	P (weight)	lnP (weight)	"-(P*lnP) (weight))	Relative Weight (kg)
Rainbow Trout	0.003766478	-5.581614841	0.021023031	3.00	0.001388889	-6.579251212	0.009137849	0.02
Northern Hog Sucker	0.007532957	-4.88846766	0.036824615	6.00	0.060277778	-2.808791771	0.169307726	0.65
White Sucker	0.086629002	-2.446120625	0.211904988	N/A	0.725777778	-0.320511402	0.232620053	N/A
Bigeye Chub	0.011299435	-4.483002552	0.050655396	9.00	0.003833333	-5.564020532	0.021328745	0.04
Blacknose Dace	0.026365348	-3.635704692	0.095856621	N/A	0.003333333	-5.703782483	0.019012608	N/A
Creek Chub	0.094161959	-2.362739016	0.222480133	N/A	0.020277778	-3.898229683	0.079047435	N/A
Striped Shiner	0.033898305	-3.384390263	0.114725094	27.00	0.04236111	-3.161524555	0.133925689	0.46
Spotfin Shiner	0.001883239	-6.274762021	0.011816878	1.50	0.000416667	-7.783224016	0.00324301	0.00
Silverjaw Minnow	0.005649718	-5.176149733	0.029243784	4.50	0.000416667	-7.783224016	0.00324301	0.00
Bluntnose Minnow	0.02259887	-3.789855371	0.085646449	N/A	0.003888889	-5.549631809	0.021581901	N/A
Central Stoneroller	0.145009416	-1.930956599	0.280006889	115.50	0.033749999	-3.388774879	0.11437115	0.36
Rock Bass	0.001883239	-6.274762021	0.011816878	1.50	0.002083333	-6.173786104	0.012862054	0.02
Largemouth Bass	0.001883239	-6.274762021	0.011816878	1.50	0.00125	-6.684611728	0.008355765	0.01
Green Sunfish	0.016949153	-4.077537444	0.069110804	N/A	0.015972221	-4.136904238	0.06607555	N/A
Johnny Darter	0.156308851	-1.855921413	0.290096944	124.50	0.015694443	-4.154448547	0.065201758	0.17
Greenside Darter	0.018832392	-3.972176928	0.074805592	15.00	0.005138889	-5.270918392	0.027086664	0.06
Rainbow Darter	0.173258004	-1.752973444	0.30371668	138.00	0.022499999	-3.794240007	0.085370397	0.24
Mottled Sculpin	0.192090395	-1.649789208	0.316908661	153.00	0.04125	-3.188104168	0.131509297	0.45
		H (numbers):	2.24	600.00		H (weight):	1.20	2.49

MIwb = (0.5*LN(P26))+(0.5*LN(S26))+O26+S26

MIwb: 6.73

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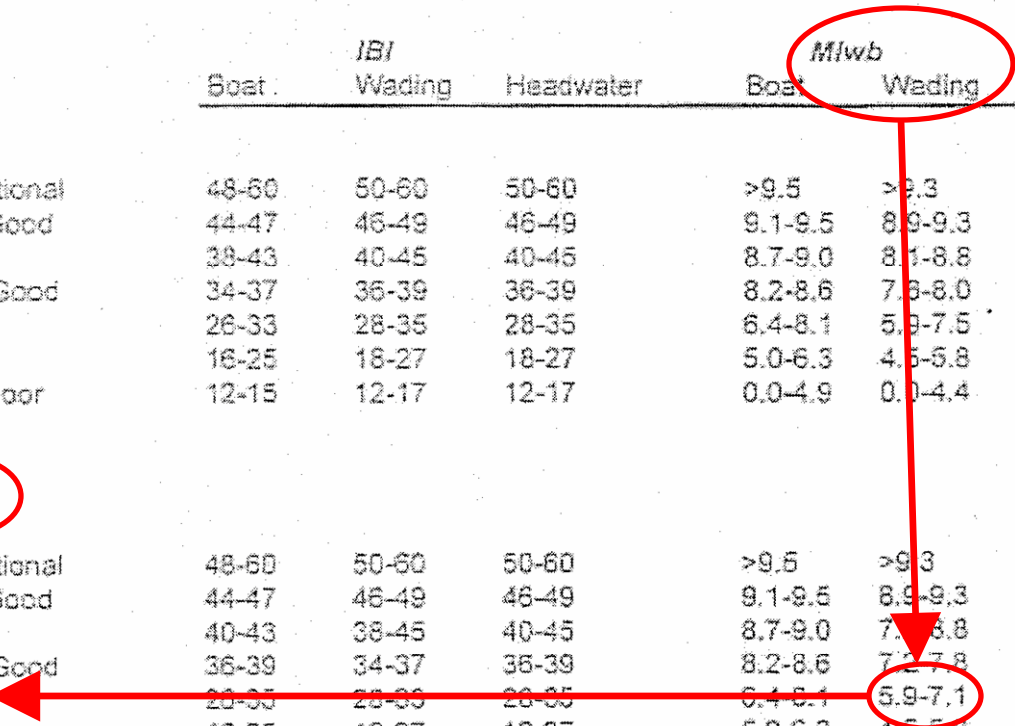
What can this data be used for?
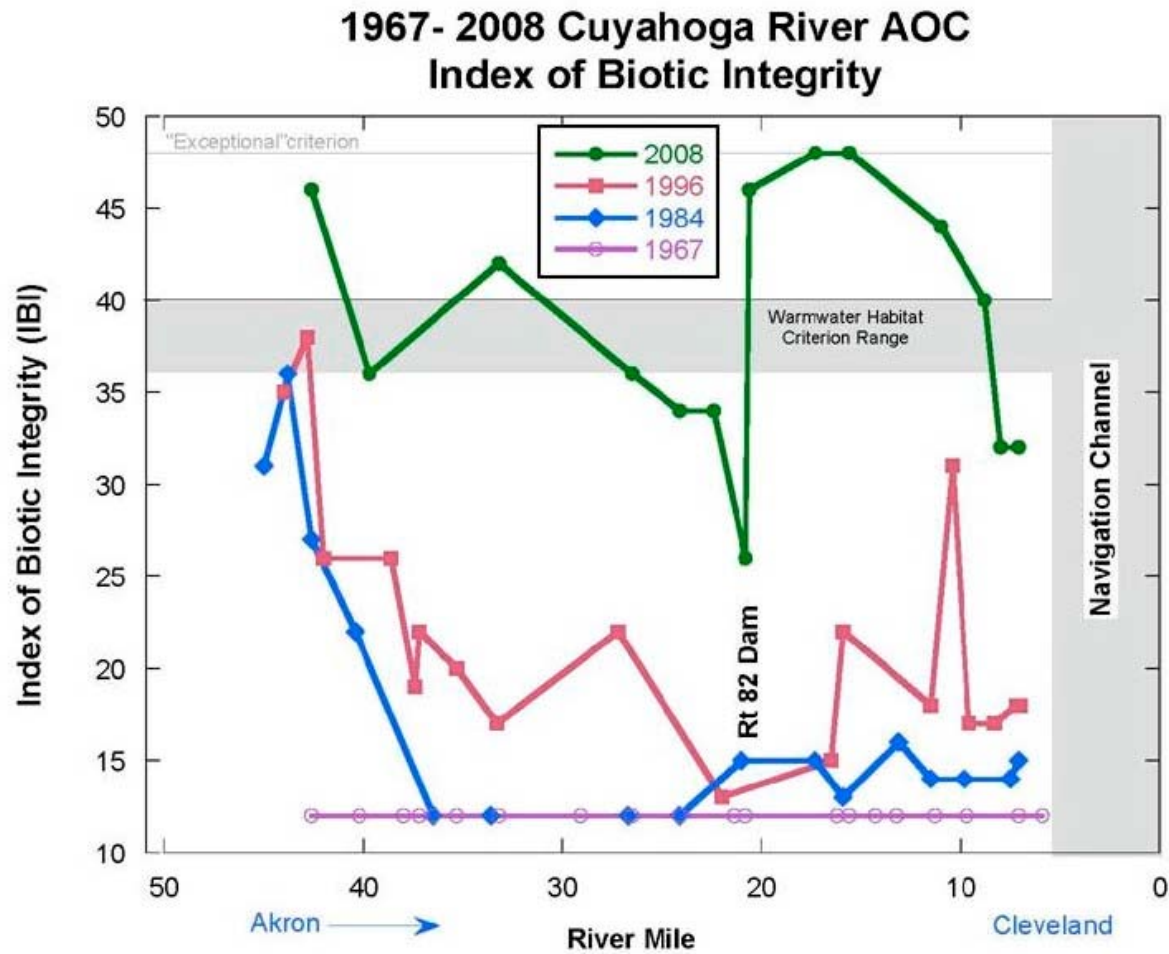
Application at Cleveland Metroparks:
Real Estate/Conservation Easement info

➢Wellman Property: good quality tributary of the Chagrin River which has restoration potential

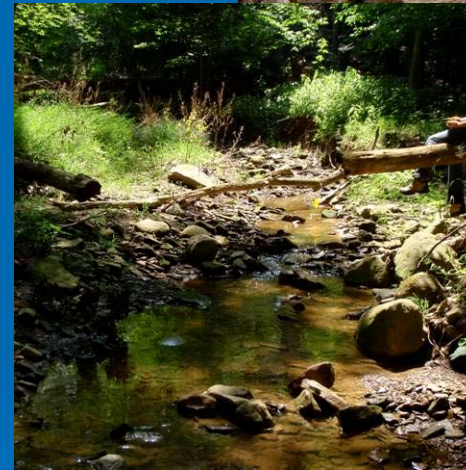➢Camp Bradlo: high quality tributary of the East Branch Rocky River (previous example)
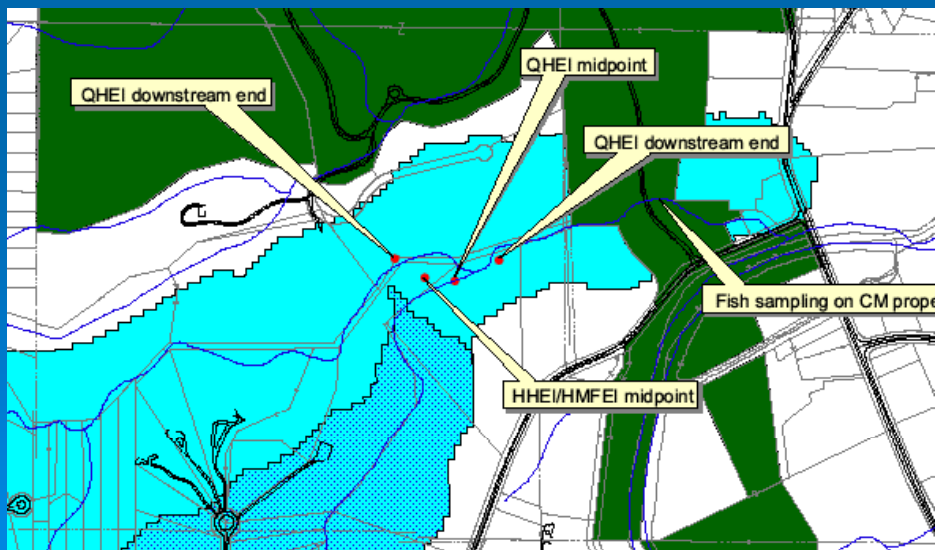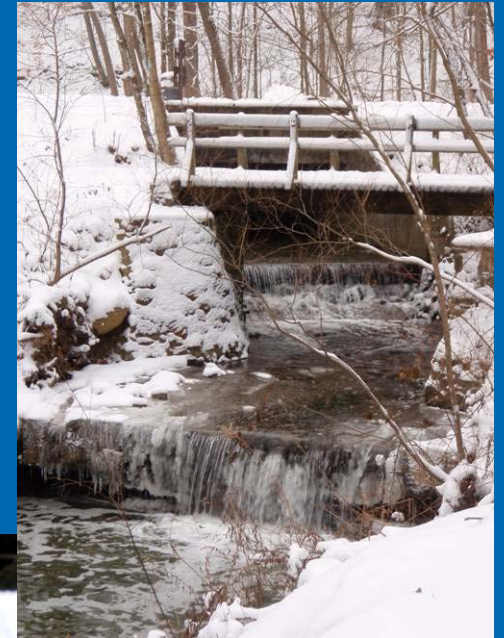
Application at Cleveland Metroparks: Seeking other project funding

➢Baldwin Creek: IBIs conducted upstream and downstream of a dam as supporting information for a restoration grant

Application at Cleveland Metroparks:
Assessing impacts to streams at target sites

Upstream   Downstream

Application at Cleveland Metroparks: Integrated WQ monitoring

➢Plays an important role in filling gaps in data collected by other agencies (ie: OEPA, NEORSD) in our waters

➢Also integrates with ongoing wetland and primary headwater stream longitudinal studies

Application at Cleveland Metroparks: Giving credibility to data we collect

Ohio Credible Data Law was passed and signed by the Governor in 2003, and program rules written by OEPA were effective as of March 24, 2006

Sec. 6111.52. The director of environmental protection shall use **only level three credible data** to conduct any of the following activities:

- *(A) Developing, reviewing, and revising use designations in water quality standards;*
- *(B) Developing a statewide water quality inventory or other water assessment report;*
- *(C) Identifying, listing, and delisting waters of the state for the purpose of section 303(d) of the Federal Water Pollution Control Act;*
- *(D) Determining whether a water of the state is supporting its designated use or other classification;*
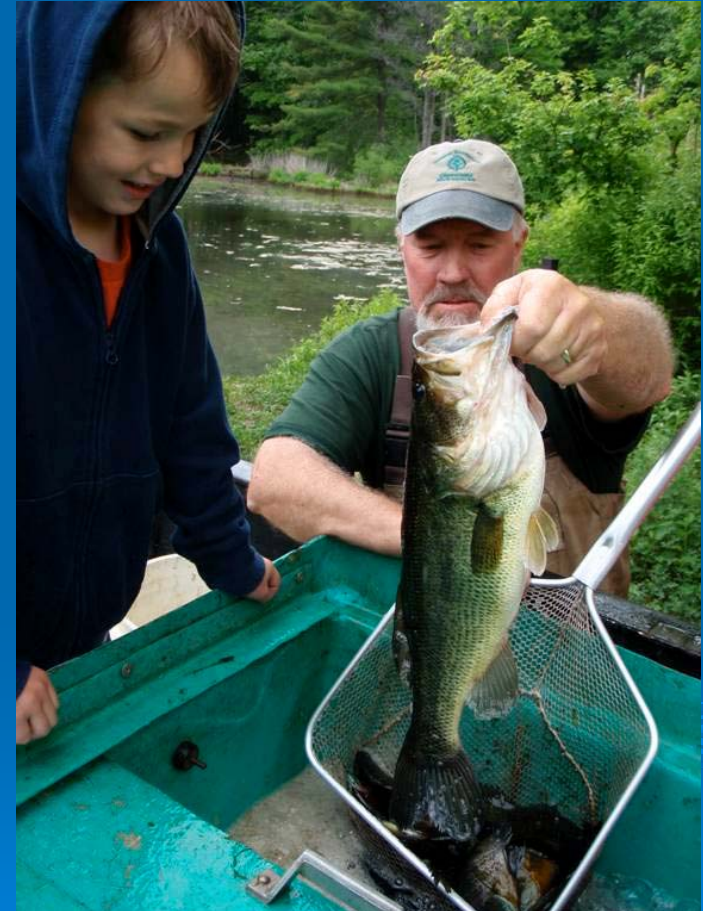- *(E) Establishing a total maximum daily load for a water of the state.*

Other recent uses for our electrofishing equipment: Removal of invasive fish species
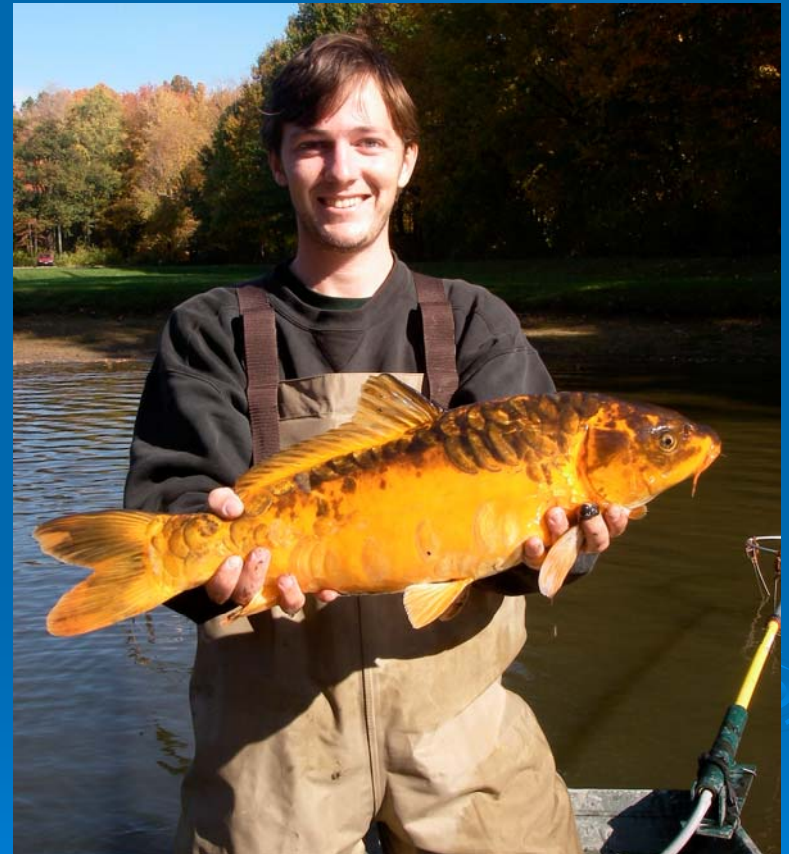
Other recent uses for our electrofishing equipment:
Training and Education opportunities

Other recent uses for our electrofishing equipment: Transfer of fish from non-fishing to public fishing areas

Special Project:

Virginia Kendall Lake
Fish Collection and Transfer

V.K. Lake in the Cuyahoga Valley National Park

Fish collected on three dates in April-May 2009

Fish collected on three dates in April-May 2009

Fish collected on three dates in April-May 2009

Fish collected on three dates in April-May 2009

Fish collected on three dates in April-May 2009

Nearly $300 in largemouth bass in this photo alone

They certainly weren't all that large...

But they all have value for our Park District anglers

Date (2009)	Largemouth Bass - avg. 1 pound	Sunfish – bluegill and pumkinseed 4-6"	Sunfish – bluegill and pumkinseed 6-8"	White Crappie Over 6"	Approximate Value (Appendix B)
15 Apr	50	300	200	25	$1,833.75
13 May	150	700	500	75	$4,866.25
19 May	300	1,200	800	175	$8,831.25
Total	500	2,200	1,500	275	$15,531.25

Where did all these fish end up?

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Contact information:
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