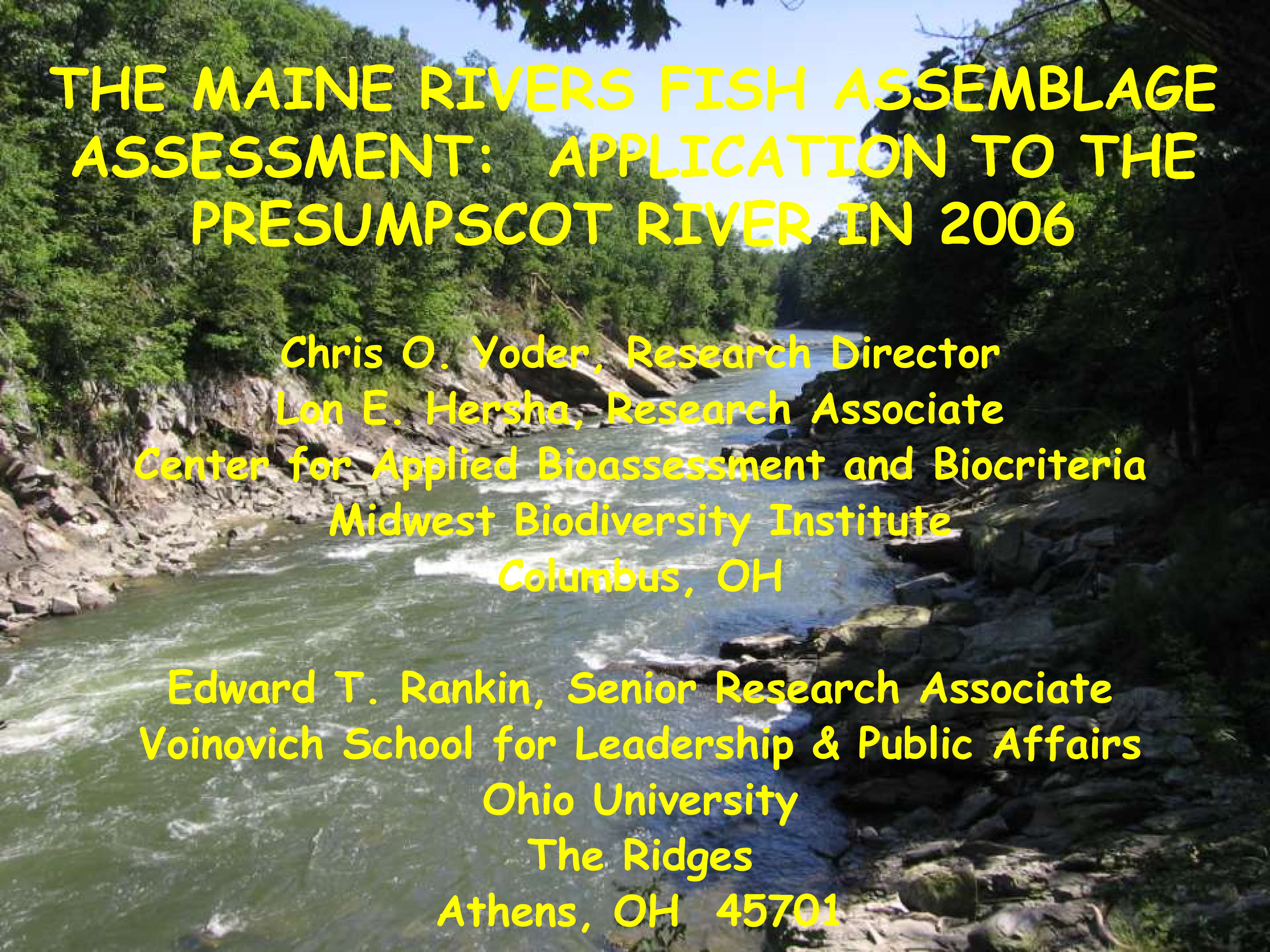

THE MAINE RIVERS FISH ASSEMBLAGE ASSESSMENT: APPLICATION TO THE PRESUMPSCOT RIVER IN 2006

Chris O. Yoder, Research Director
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Major River Basins in New England

Three Linked Projects:

1. Maine rivers fish assemblage assessment (2001-2007)
2. Connecticut R. fish assemblage assessment (2008-9).
3. Regional EMAP - New England rivers assessment (2008-9); part based on NRSA probabilistic sites draw.

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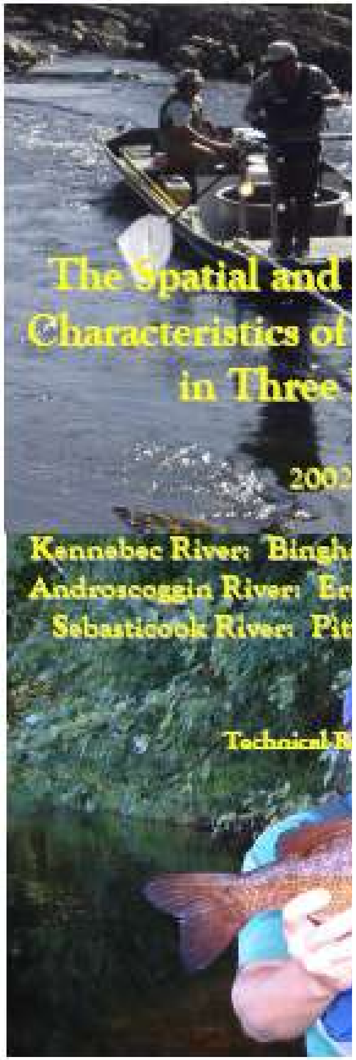

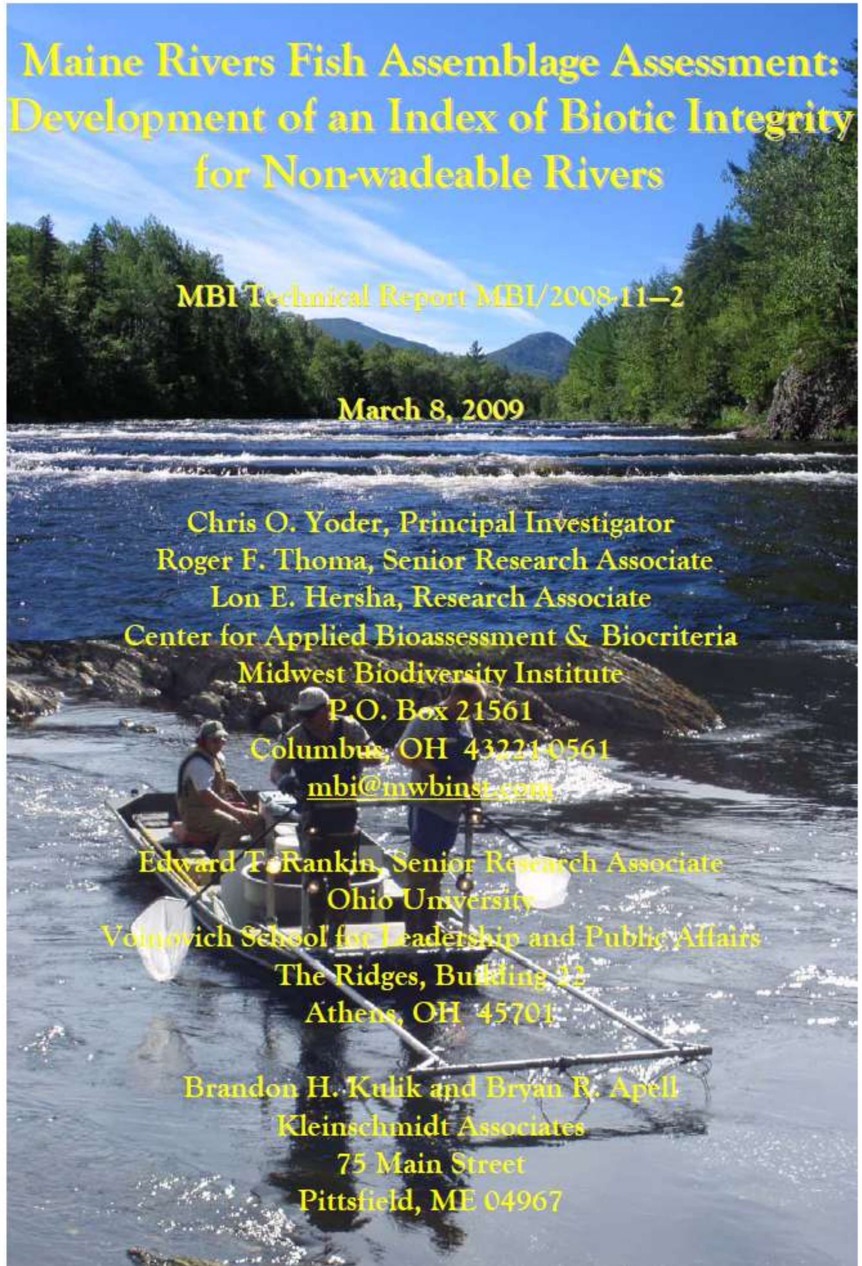

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Columbus, OH 43221-0561

blage Assessment:

rs Results
ke to Allagash
Ft. Fairfield
o to Calais
New Brunswick border

istribution Atlas

Assemblage Index for

2-06-1

& Biocriteria
itute

561

l John M. Audet

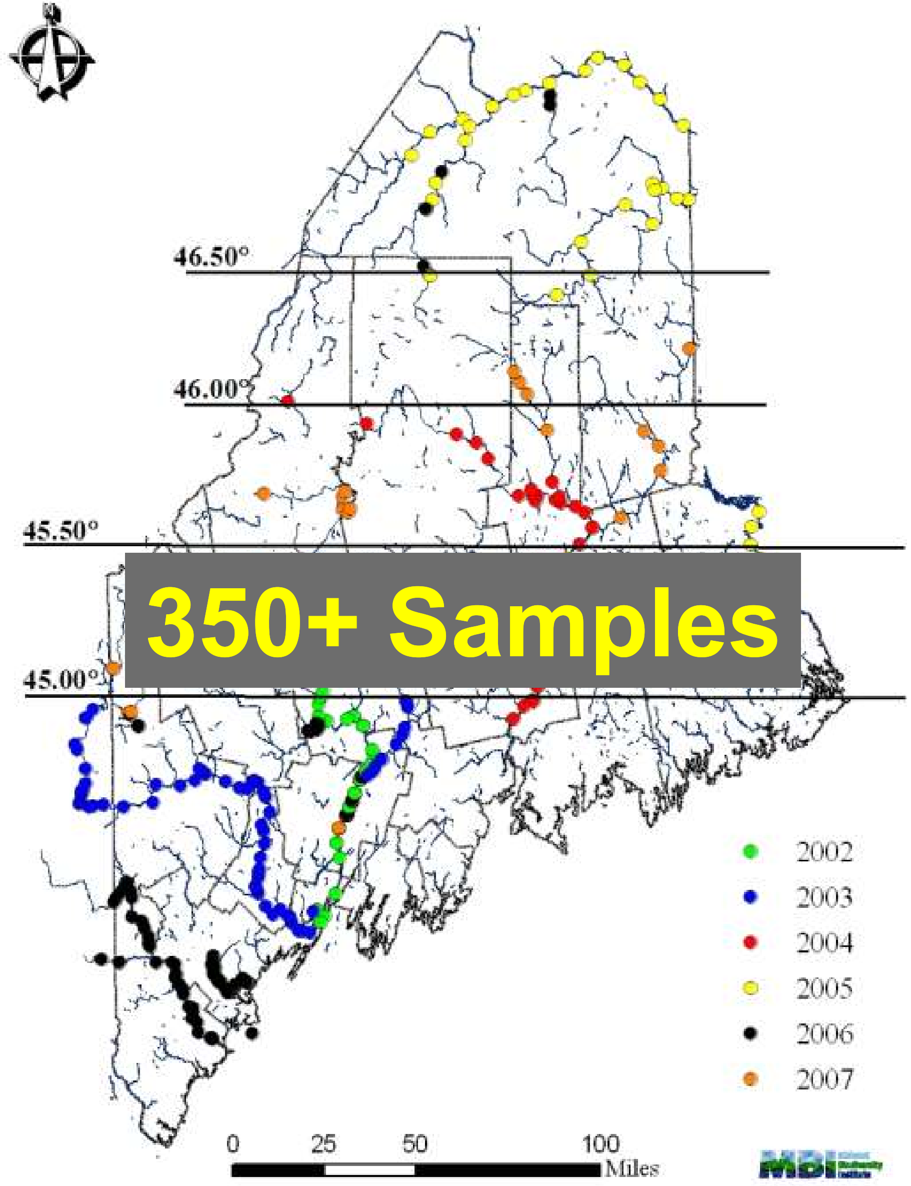
Why Knowledge of the Fish Assemblage is Important

Current Issues:

We used to say this just about Maine, but it applies to the rest of New England.

species and their respective influence.

- **Naturally Depauperate Fauna** – cold water, coastal drainages – "how will these respond?"
- **Assess Potential Conflicts with High Profile Restoration Goals** – do non-native species pose an unintentional deterrent?



Kennebec River (2002-6)

- Wyman Dam to Merrymeeting Bay (30 sites, 2 test areas)
- Follow-up Waterville to Augusta (2002-6)

Androscoggin River (2003)

- Errol, NH to Merrymeeting Bay (51 sites)

Sebasticook River (2003)

- Douglas Pond to Winslow (9 sites)

Penobscot River (2004)

- N. Br. To Hamden (40 sites); included W. Br., E. Br., 5 additional tributaries

Northern Maine Rivers (2005-6)

- St. John (14 sites), Allagash (8 sites), Aroostook (10 sites), St. Croix (12 sites)

Southern Maine Rivers (2006)

- Presumpscot R. (22 sites)
- Saco R. (32 sites)

Miscellaneous Maine Rivers (2007)

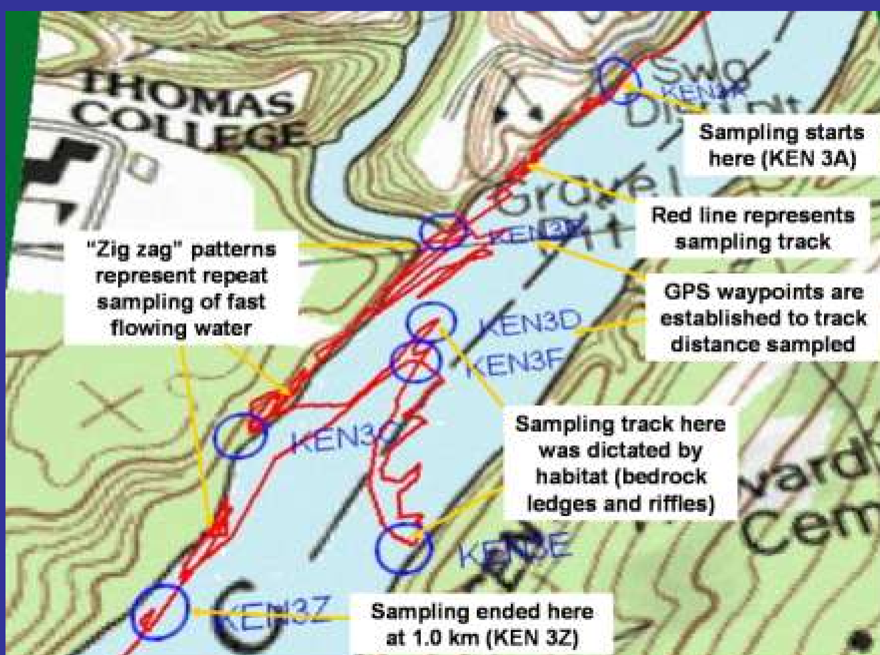
- Mattawamkeag R., Rapid R., Moose R., Moosehead Outlets, Dead R., E. Br. Penobscot (22 sites)

Sampling Methods

Standardized Approach:

- Pulsed D.C. boat electrofishing – effort indexed to distance
- Electrode array customized for Maine river conditions
- Intensive survey design – mainstem & non-wadeable tribs.
- Field water quality and habitat data
- July – September index period

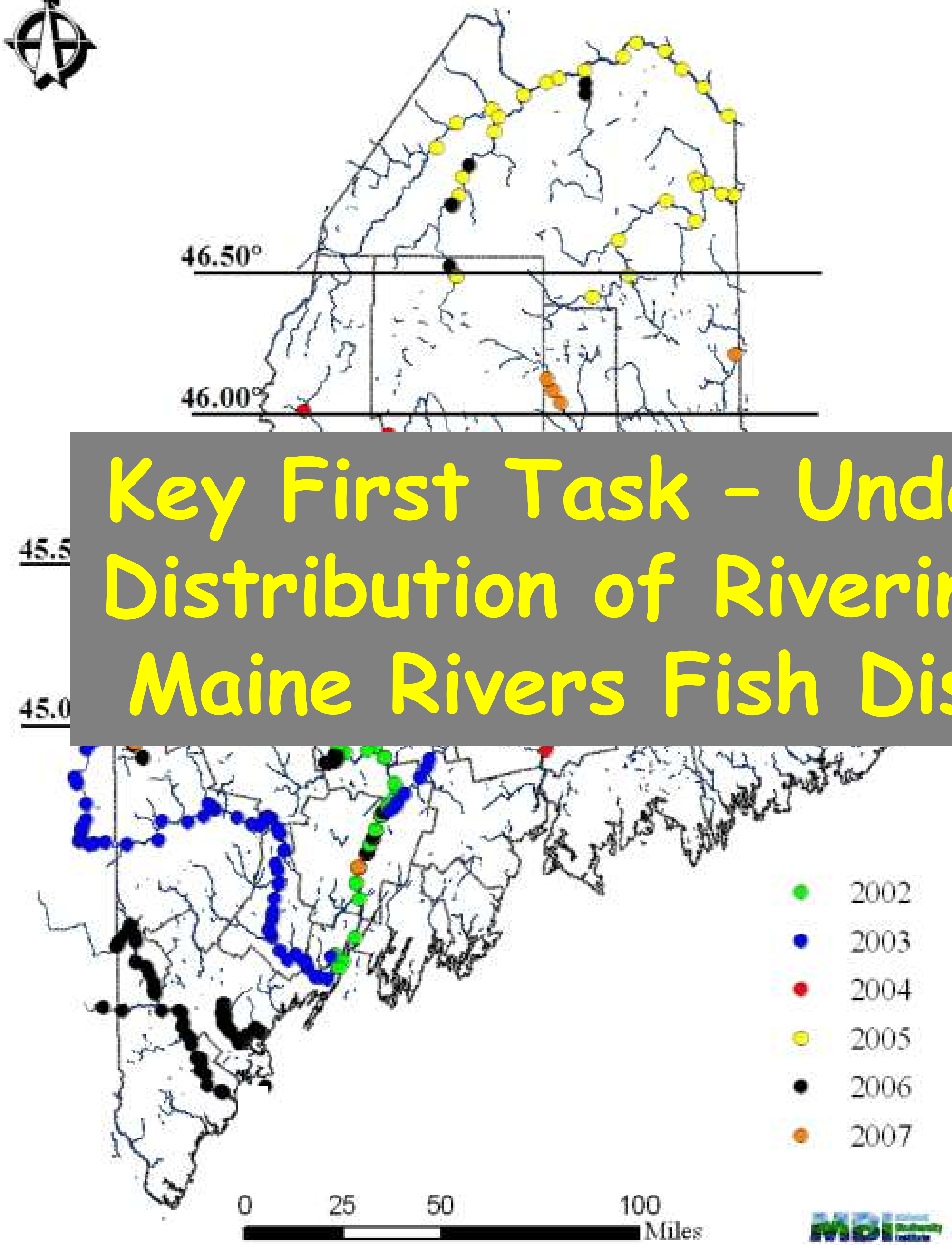
- Sampling guided by a QAPP
- Standardized sampling to yield comparable data
- All representative habitat types within each site



- Geo-referenced sample site location and sample track
- Fish are identified to species, enumerated, and weighed
- DELT anomalies recorded


Logistics: Getting the Right Equipment to a Site

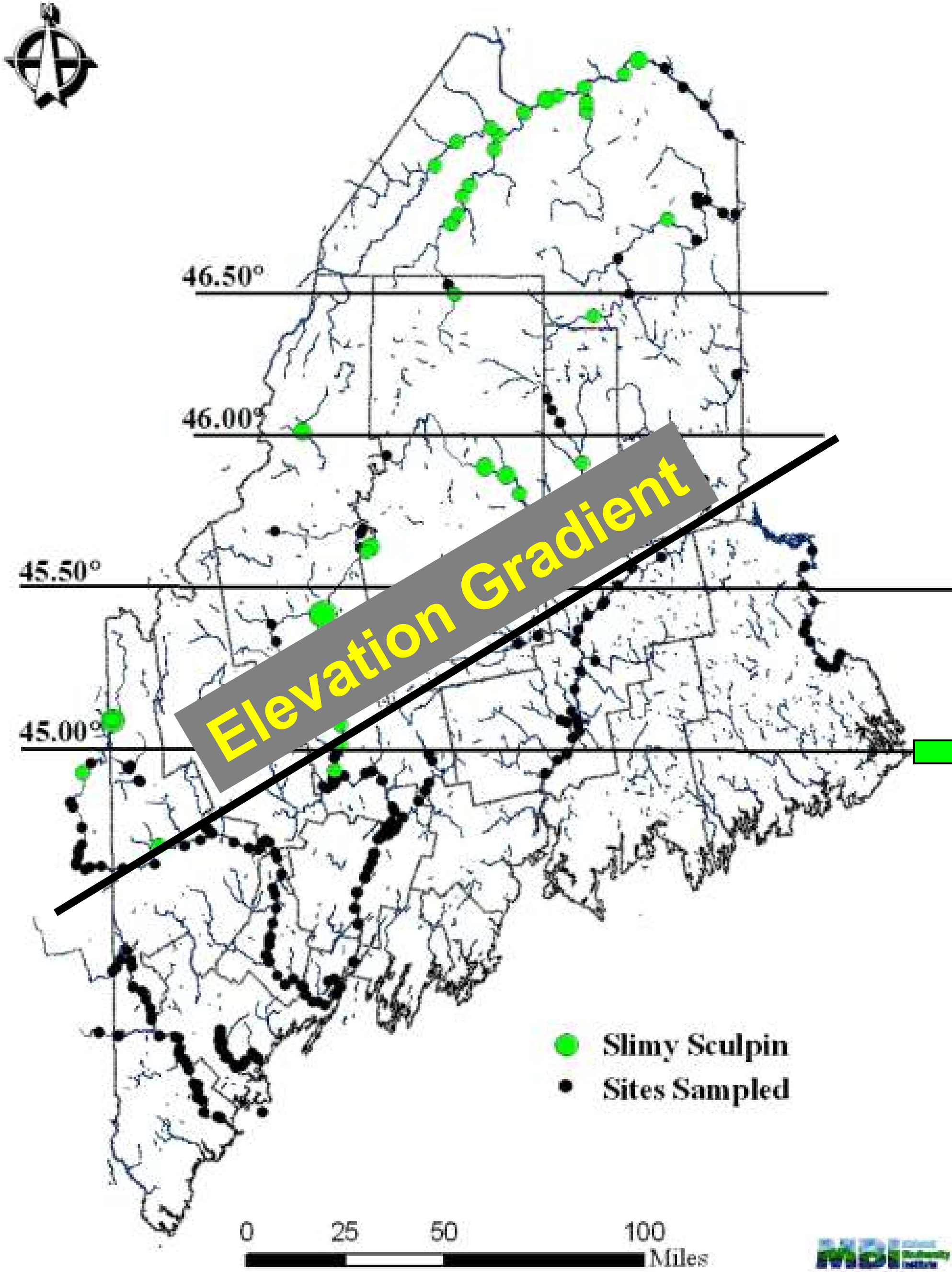

Maine Rivers Fish Assemblage Assessment: 2002-7

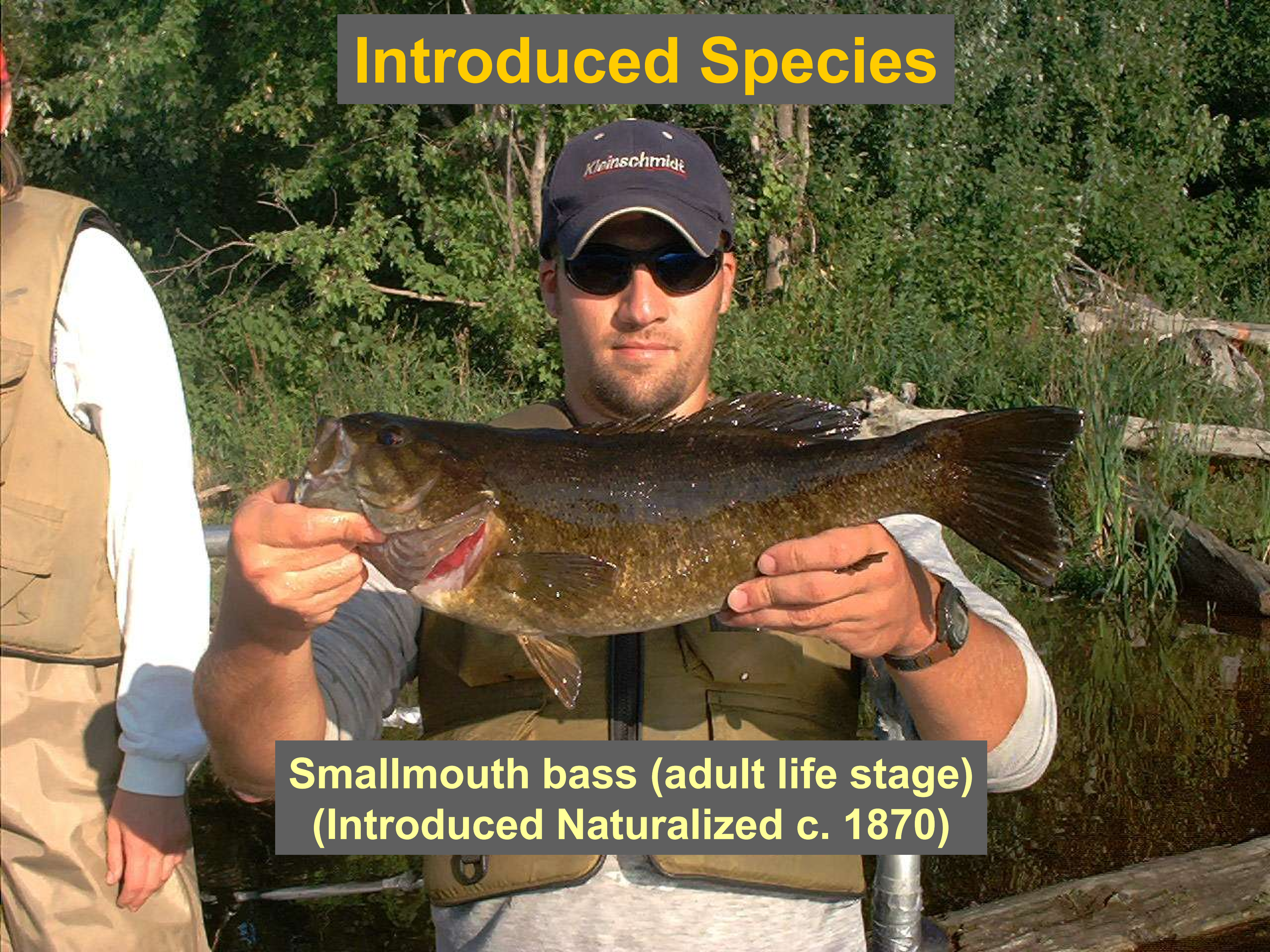


Key First Task – Understand Current Distribution of Riverine Fish Species: Maine Rivers Fish Distribution Atlas

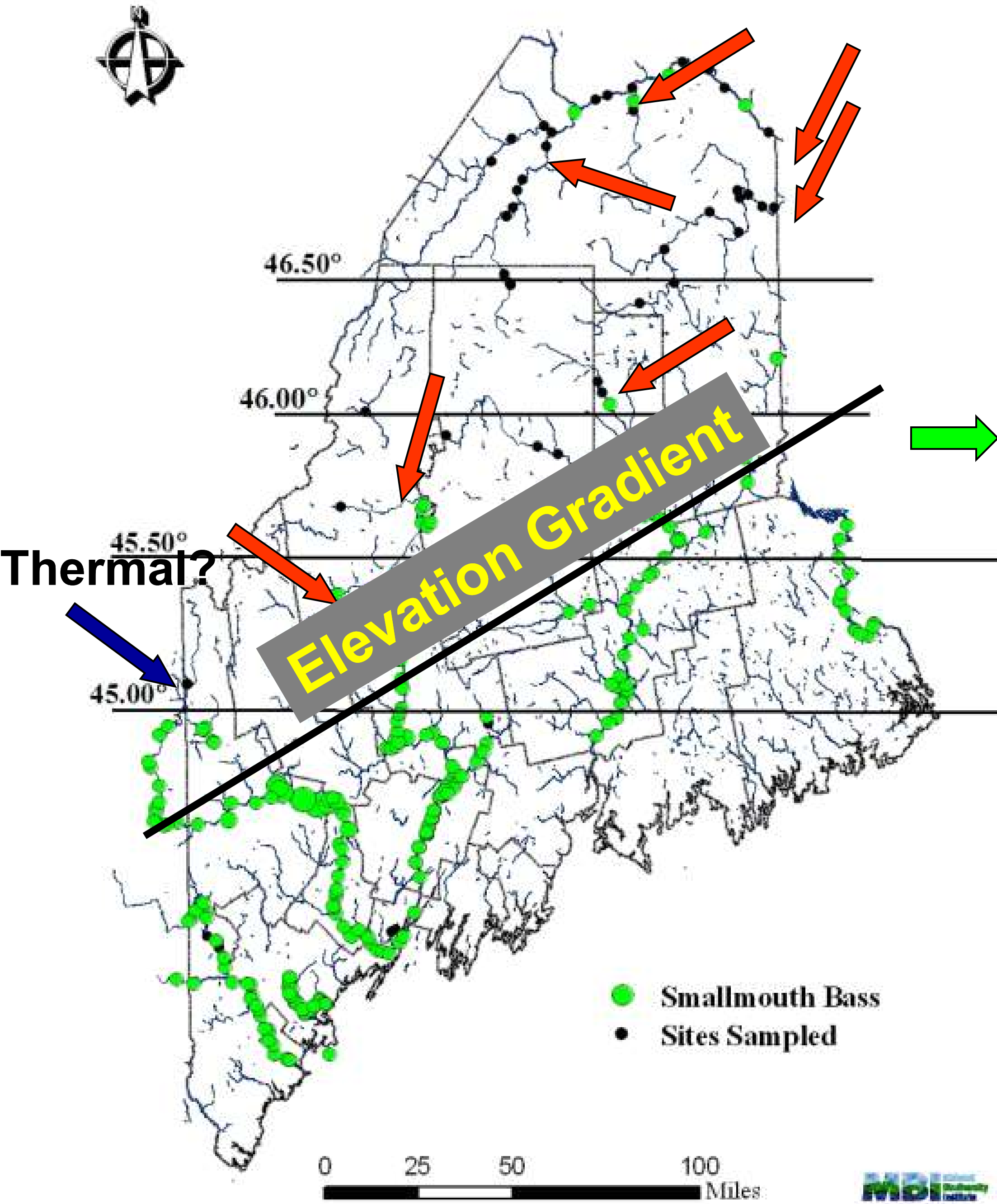
Cold Water Species: Non-Salmonids (Indigenous Natives)

Maine Rivers Fish Assemblage Assessment: 2002-7



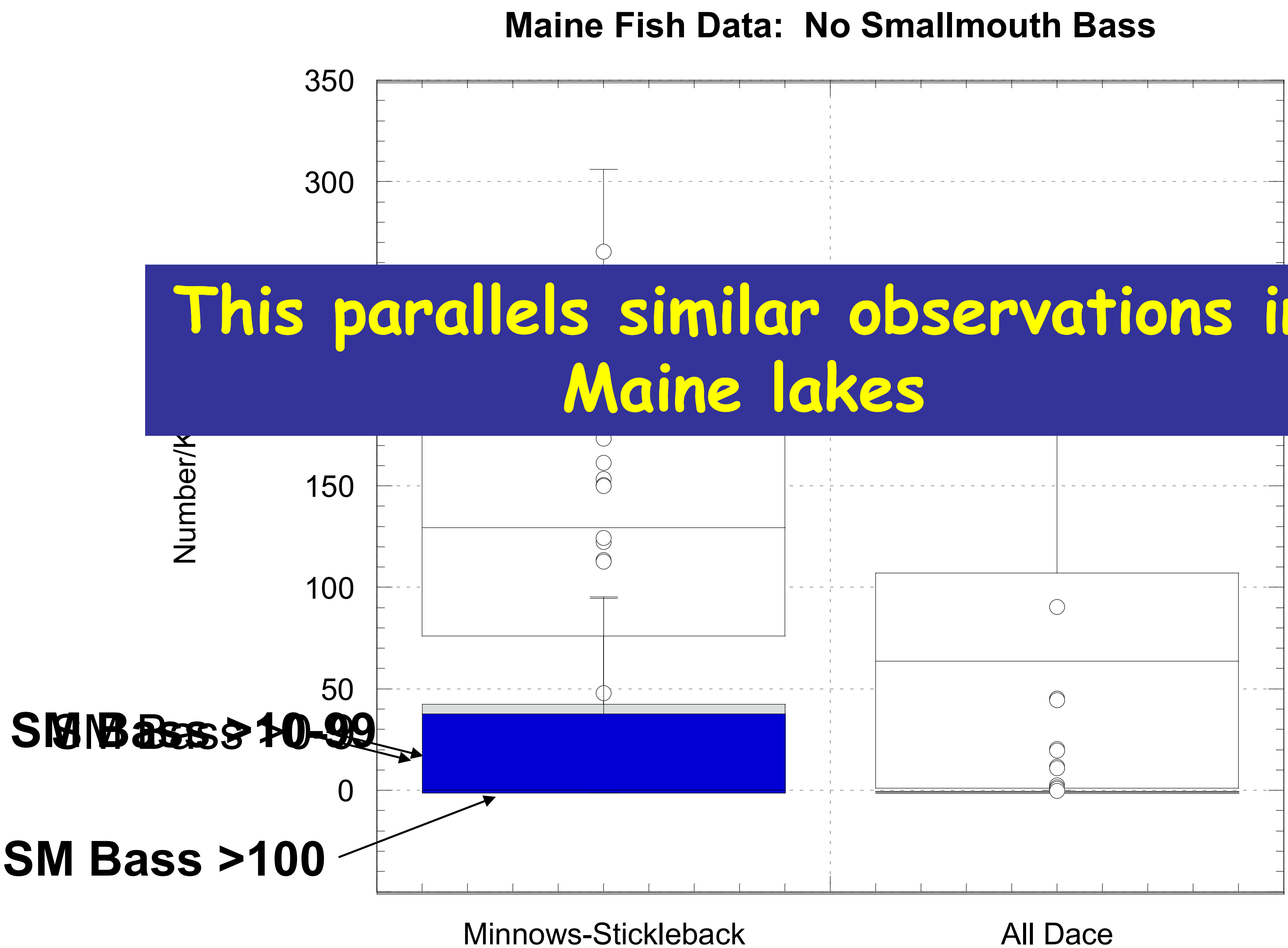

Introduced Species
Kleinschmidt
Smallmouth bass (adult life stage)
(Introduced Naturalized c. 1870)

Maine Rivers Fish Assemblage Assessment: 2002-7



Physical barriers

This parallels similar observations in Maine lakes



Detailed autecology of known and potential species – 60 species recorded thus far in Maine's rivers

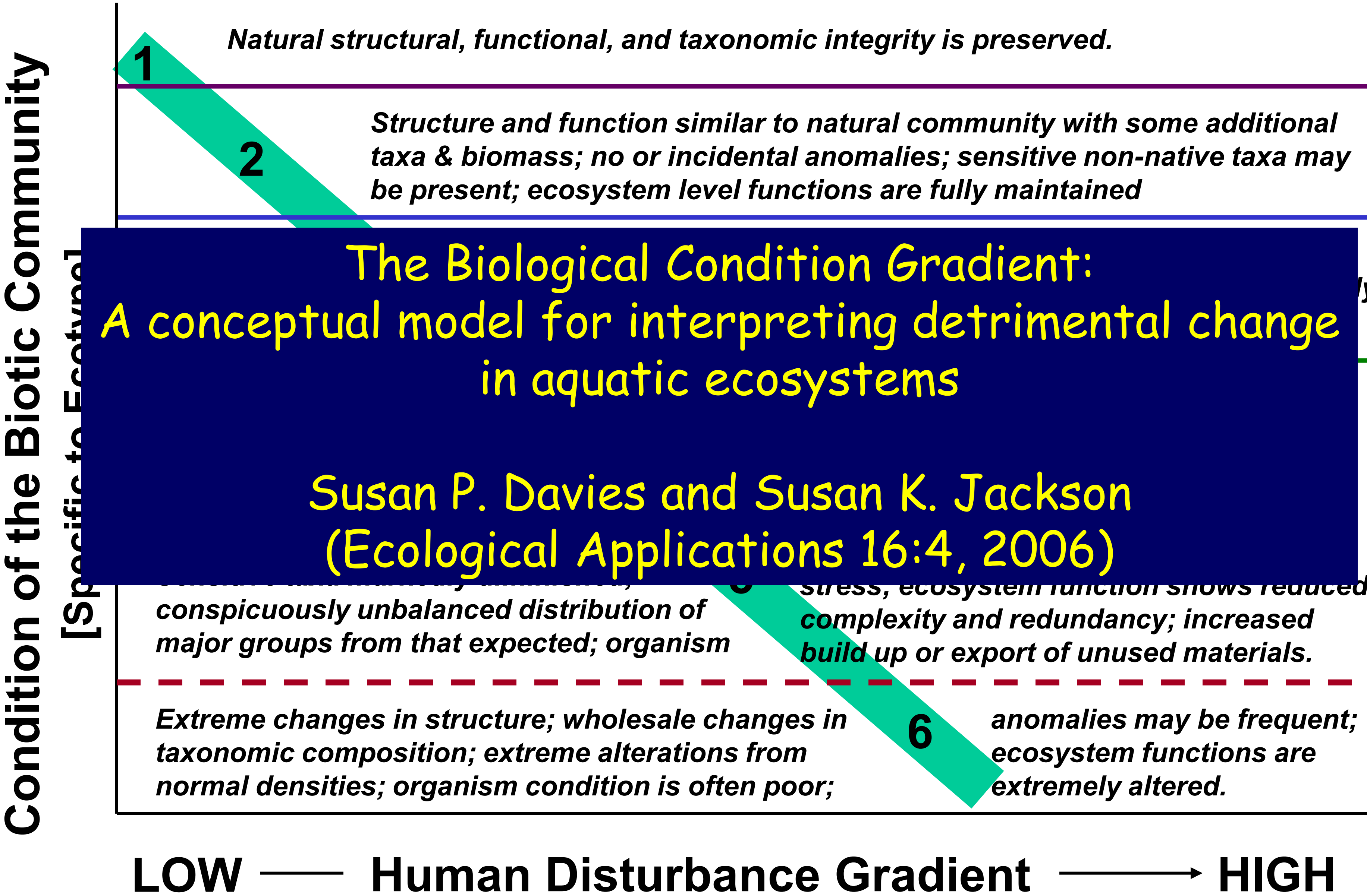
Table 1. Native, tolerance, habitat, foraging, and reproductive guild designations and other notes on the distribution and occurrence of 60 fish species documented or suspected to occur in Maine' non-wadeable rivers. Sources for guild and metric assignments appear in the footnotes (scientific nomenclature adheres to Nelson et al. 2004).

Species	Native Status[1]	Environmental Tolerance[2]	Target Fish Classification[3]	Common Habitat(s)[4]	Spatial Occurrence[5]	Thermal Guild[6]	Foraging Guild[7]	Reproductive Guild[8]	Habitat Guild[9]	Notes
Petromyzondi										
Sea lamprey *(P*										ocoetes.
Acipenseridae										
Shortnose stur										R. 2006
Atlantic sturge										2005 and
Anguillidae										
American eel (										
Clupeidae										
Blueback herri										d.
Alewife *(Alosa*										lected.
American shad *(Alosa sapidissima)*	N	M	A	R1,T1-2	C	M	P	PS	W	Mostly y-o-y, few adults collected.
Gizzard shad *(Dorosoma cepedianum)*	IC	T	[MG]	na	na	E	D	L	W	Collected in Kennebec R. in 2000.
Cyprinidae										
Lake chub *(Couesius plumbeus)*	N	I	[FD]	R1	N	S	BI	NGL	B	
Common carp *(Cyprinus carpio)*	E	T	MG	T1-2	C	E	O	V	W	Merrymeeting Bay and lower Kennebec R.
Common shiner *(Luxilis cornutus)*	N	M	FD	R1-T1	All	E	I	NGL	W	
Golden shiner *(Notemigonus crysoleucas)*	N,IS	T	MG	R2,I1	All	E	G	L	W	
Bridle shiner *(Notropis bifrenatus)*	N	I	MG	R2	S	E	I	L	W	Presumpscot R. – one location only.
Spottail shiner *(Notropis hudsonius)*	U	M	MG	T1,I1	C	E	I	L	W	
E. Blacknose dace *(Rhinichthys atratulus)*	N	S	FS	R1	N	M	BI	NGL	B	
Longnose dace *(Rhinichthys cataractae)*	N	M	FS	R1	S	M	BI	NGL	B	Collected only in upper Androscoggin R.

[1] After Halliwell (2005). N – native; E – exotic of inter-continental origin; IC – introduced of intracontinental origin; IS – introduced of interstate origin; IM – introduced and managed; U – undetermined origin.
[2] I – highly intolerant; S – sensitive (moderately intolerant); M – intermediate; P – moderately tolerant; T – highly tolerant.; sources used include Ohio EPA (1987), Whittier and Hughes (1998), Halliwell et al. (1999), Langdon (2001)
[3] After Bain and Meixler (2000) : FS – fluvial specialist; FD – fluvial dependent; MG – macrohabitat generalist; A – anadromous; [ ] - designations in brackets were not classified by Bain and Meixler (2000).
[4] R1 – high gradient riverine; R2 – low gradient riverine; I1 – impounded riverine; T1 – tidal riverine freshwater; T2 – tidal embayment brackish
[5] Spatial distribution within the state: C – primarily coastal rivers; S – primarily south of 46.000° latitude; N – primarily north of 45.500° latitude; U – ubiquitous statewide occurrence.
[6] After Hokanson (1977); S – temperate stenotherm; M – temperate mesotherm; E – temperate eurytherm.
[7] After Goldstein and Simon (1999); H – herbivore, D – detritivore, I – invertivore, BI – benthic insectivore, C – top carnivore, P - piscivore, G – generalist, O – omnivore, P – planktivore.
[8] After Ohio EPA (1987) and Hughes et al. (1998),; NGL – non-guarding lithophil [simple lithophil], LN – lithophilic nester, L – lithophil, V – vegetation, P – psammophil [sand-fine gravel], CN – cavity nester, VN – vegetation nester, PN – psammophil nester.
[9] After Hughes et al. (1998): W – water column, B – benthic, E – edge, H – hider, G – generalist

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

(10/22 draft)



The Biological Condition Gradient:
A conceptual model for interpreting detrimental change in aquatic ecosystems

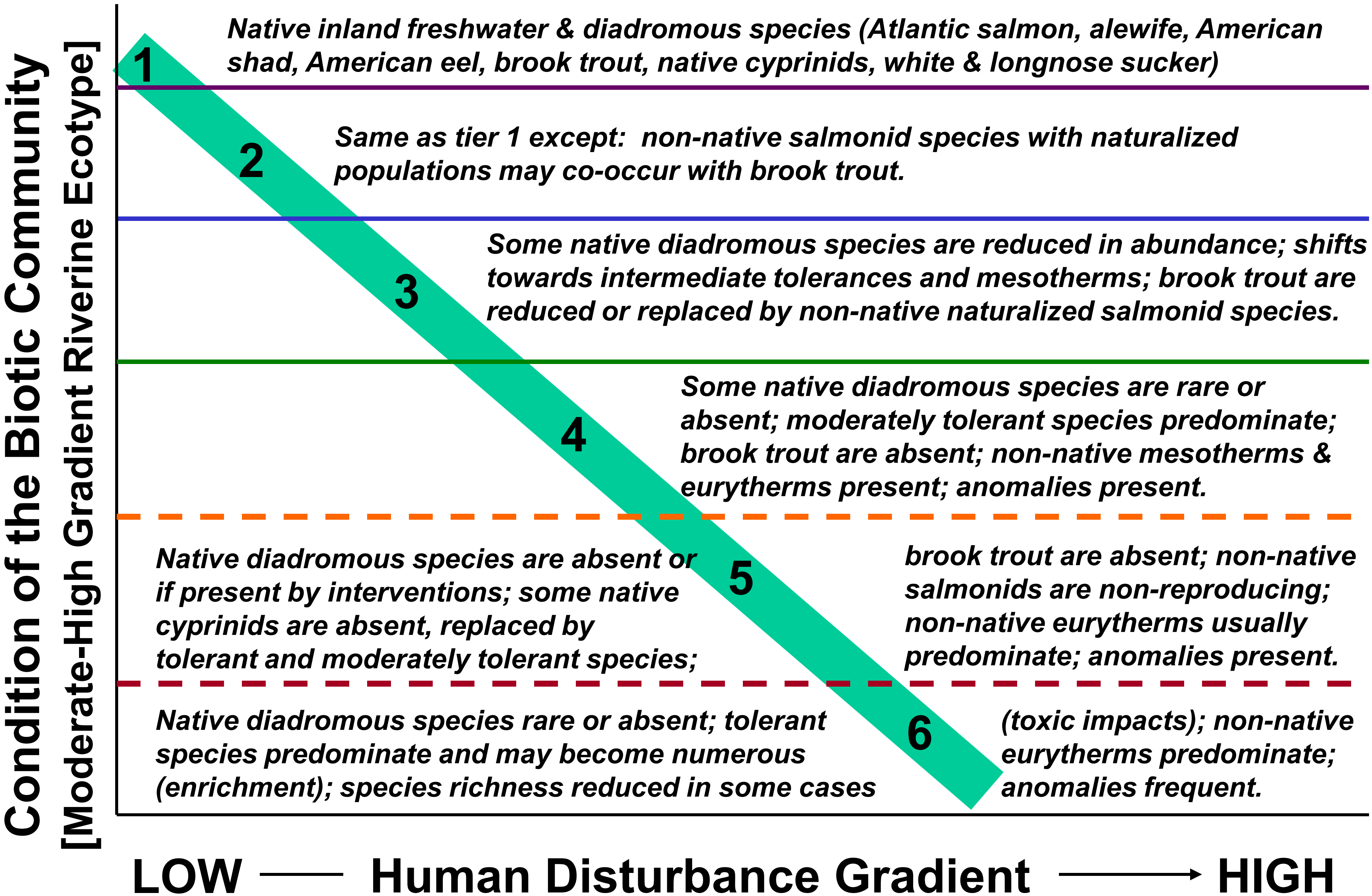
Susan P. Davies and Susan K. Jackson
(Ecological Applications 16:4, 2006)

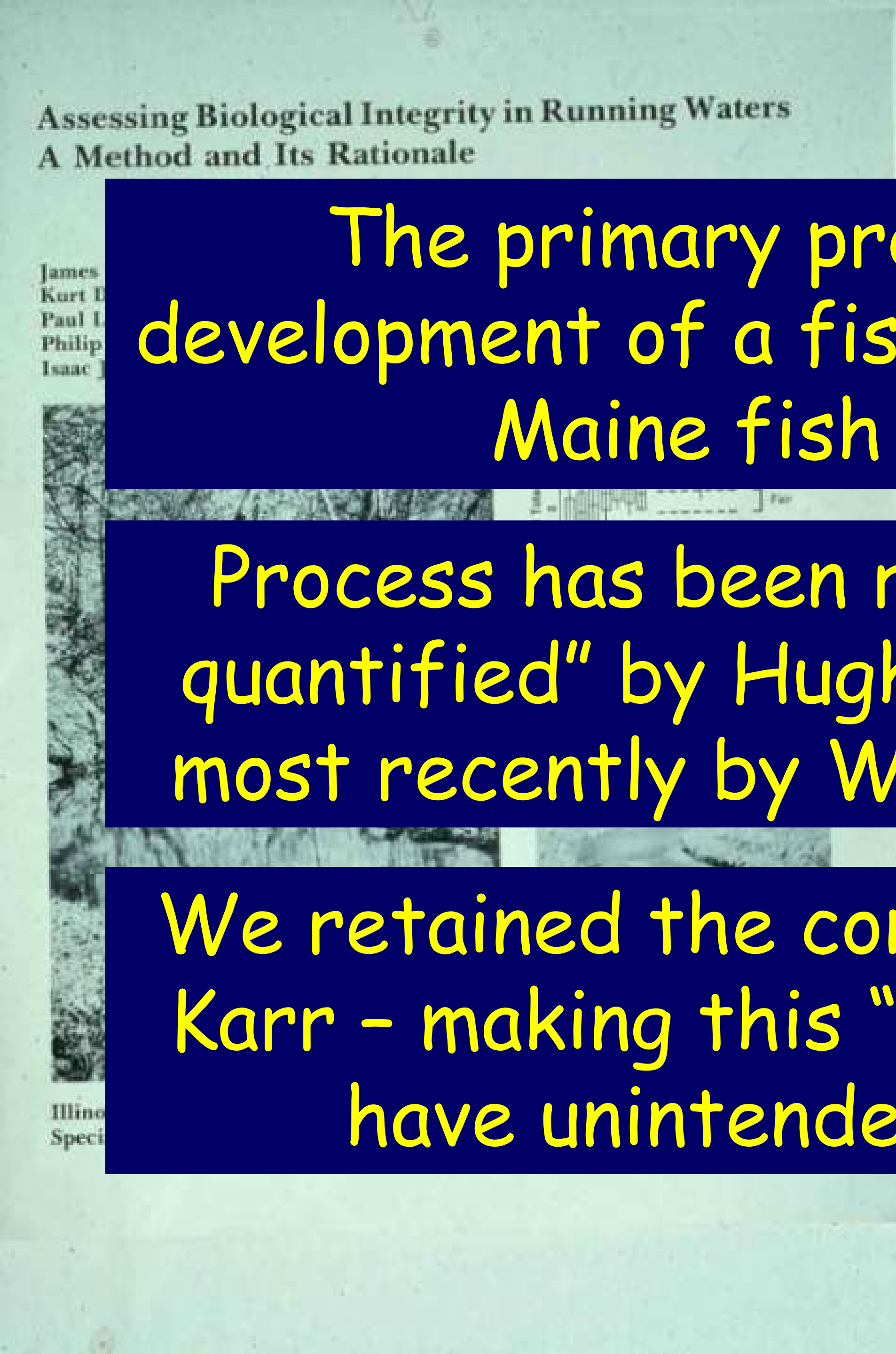
Development of tools & methods to ascertain the status of native riverine fish assemblages is a major goal of this project

Cold Water Assemblages

The “assumed baseline” for the Biological Condition Gradient applicable to Maine’s large rivers

BCG Based Conceptual Model: Maine Riverine Fish Assemblage





Guidelines for Deriving

for metric development, substitution,

history.

candidate metrics and aggregate indices.

The primary project goal is the development of a fish IBI tailored to the Maine fish assemblage

Process has been refined and "better quantified" by Hughes et al. (1998) and most recently by Whittier et al. (2007)

We retained the conceptual approach of Karr – making this "too mechanical" may have unintended consequences

“Unique” Character of the Riverine Fish Fauna of Maine

- Post-glacial ingress defined “baseline” fauna
- Maine Rivers “constrained” to Gulf of Maine.
- One brief connection to St. Lawrence & none to Connecticut & western river basins.
- Curry (2007): Late glacial impacts on dispersal and colonization of Atlantic Canada and Maine by freshwater fishes. Quaternary Research 67(2): 225-233.
- Several “warmwater” species common to this latitude in other regions are not indigenous (blackbass, pike, muskellunge, crappie).

"Traditional" IBI vs. Interim Maine IBI

"Traditional IBI Metrics:

1. Native species richness*
2. Darter Species
3. Sucker Species
4. Sunfish Species
5. %Intolerant species
6. %Tolerant species*
7. %Omnivores
8. %Insectivores
9. %Top carnivores
10. %Hybrids
11. %Diseased individuals
12. Number of individuals

Interim Maine IBI Metrics:

1. Indigenous species richness
2. Native cyprinids (less fallfish)
3. %Adult white/longnose biomass
4. %Blackbass
5. %Fluvial specialist/dependent
6. %Macrohabitat generalists
7. %Benthic insectivores
8. Temperature stenotherms
9. %Native salmonids
10. Non-guarding lithophils
11. %DELT anomalies
12. Non-indigenous species

* Metrics in white are "positive" * metrics in red are "negative"

Interim Maine Rivers IBI Metrics & Scoring

Metric	Scoring Equation	Scoring Adjustments	
		Score = 0	Score = 10
Native Species Richness	**10 * (-0.2462 + (0.0828*numspec2)))**	**<3 sp.**	**≥15 sp.**
Native Cyprinid Species (excluding fallfish)	**(10 * (0.4457 + (0.0109*allcyp_ff) - (0.00005629 * (allcyp_ff ^{2}))))**	**Eq[1]**	**Eq**
Adult white & longnose sucker biomass	**(10 * (0.3667 + (0.008*ws_lns_pb) - (0.000023592 * (ws_lns_pb^{2}))))**	**0**	**≥128 kg/km**
%Native Salmonids	**(10 * (0.9537 + (0.00000000039*nat_salm) - (0.000078892 * (nat_salm^{2}))))**	**0**	**≥20%**
%Benthic Insectivores	**10 * (0.010966*benth_pc_n)**	**0**	**≥91.2%**
%Blackbass	**10 - (10 * (-0.09684 + (0.5638*log10(blackbass))))**	**Eq**	**0**
%Fluvial Specialist/Dependent	**(10 * (0.2775 + (0.0073*fluv_pc_n)))**	**0%**	**Eq**
%Macrohabitat Generalists	**10 - (10 * (0.1017 + (0.0096*macro_gen)))**	**>90%**	**Eq**
Temperate Stenothermic Species	**(10 * (0.7154 + (0.4047*(log10(steno)))))**	**0 sp.**	**>5 sp.**
Non-guarding Lithophilic Species	**(10 * (0.2979 + (0.8975*log10(lith_ng))))**	**<1**	**>10**
Non-indigenous Species	**10 - (10 * (0.1063 + (0.3271*Non-indigenous_sp) - (0.029*(Non-indigenous_sp^{2}))))**	**≥5**	**0**
%DELT Anomalies	**10 - (10 * (0.8965 + (0.1074*log10(delta))))**	**Eq**	**0**

[1] No scoring adjustments are necessary; scoring determined by equation (Eq) across entire metric scoring range of 0-10.

Presumpscot River Study Area:
Aug.- Sept. 2006
May 2007
19 mainstem sites
3 tributary sites

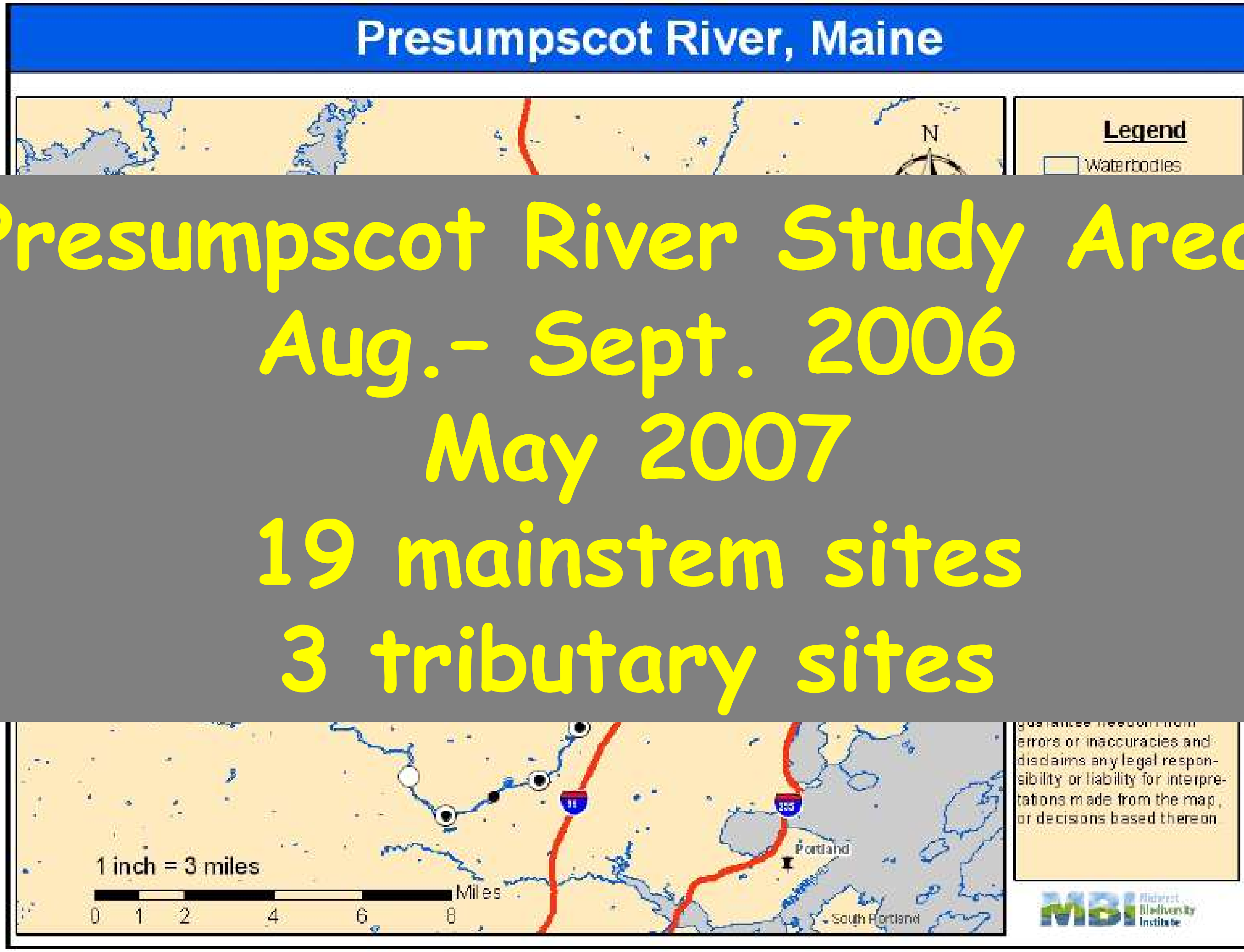
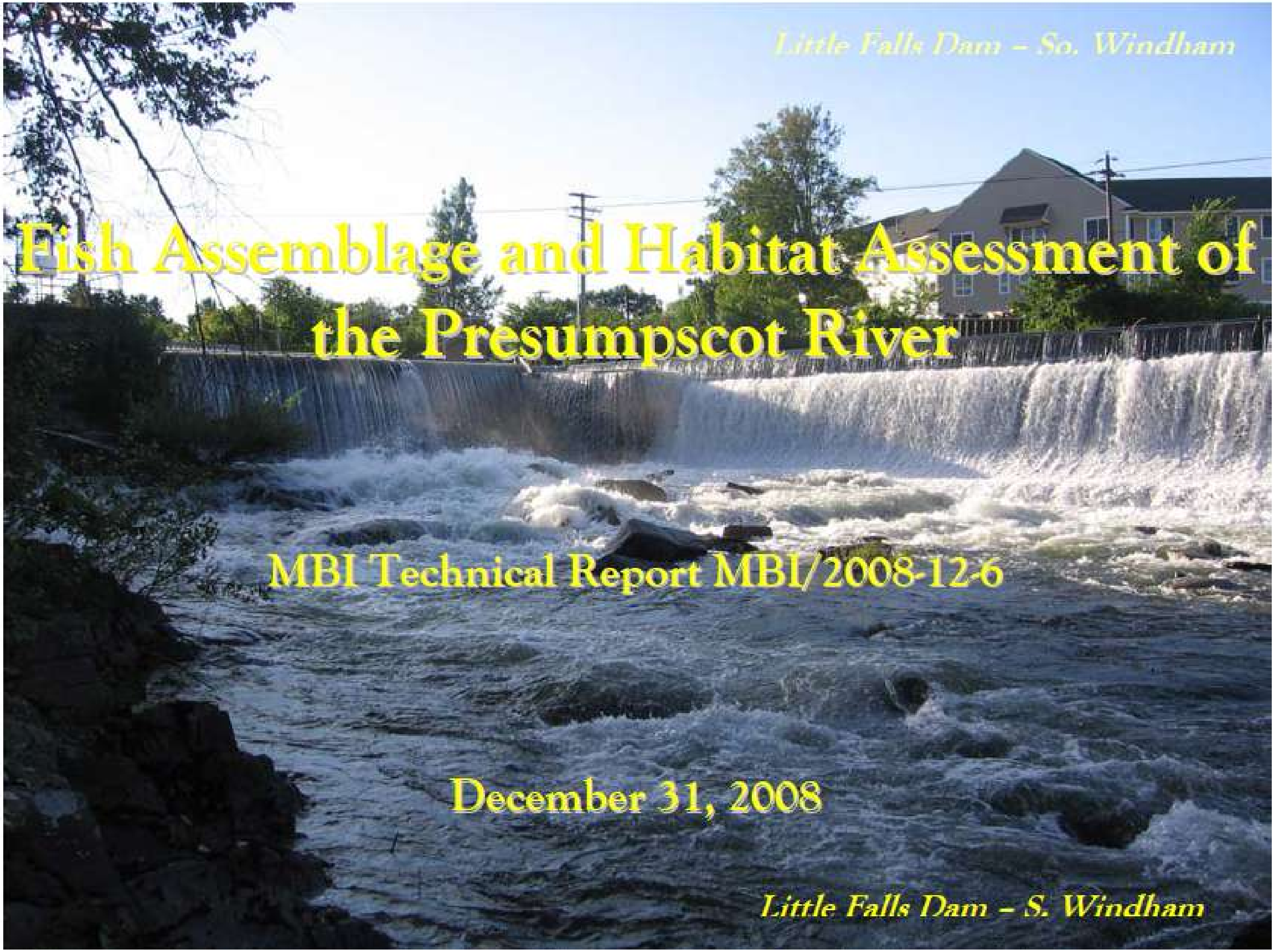


Figure 2. The Presumpscot River study area in 2006 and 2007. Open symbols represent 2006 sampling locations; closed circles represent 2007 sampling locations. Major waterbodies and interstate highways are shown.

MBI Midwest Biodiversity Institute

Center for Applied Bioassessment & Biocriteria
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, OH 43221-0561



Fish Assemblage and Habitat Assessment of the Presumpscot River

MBI Technical Report MBI/2008-12-6

December 31, 2008

TABLE OF CONTENTS

- 28 fish species; 23 indigenous, 5 non-indigenous
- American eel most numerous (numbers & biomass)
- Median 7 species/site (4-15)
- Average 199 fish/km; 18.9 kg/km
- Tribs. produced more fish (523/km)
- Macrohabitat generalists > fluvial dependent/specialist species

Qualitative Habitat Evaluation Index Field Sheet

Midwest Biodiversity Institute

QHEI Score: ____

River Code: ____ *RM:* ____ *Stream:* ____

Site Code: ____ *Project Code:* ____ *Location:* ____

Date: ____ *Scorer:* ____ *Latitude:* ____ *Longitude:* ____

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]	____	____	☐ ☐ -GRAVEL [7]	____	____
☐ ☐ -Lg BOULD [10]	____	____	☐ ☐ -SAND [6]	____	____
☐ ☐ -BOULDER [9]	____	____	☐ ☐ -BEDROCK [5]	____	____
☐ ☐ -COBBLE [8]	____	____	☐ ☐ -DETRITUS [3]	____	____
☐ ☐ -HARDPAN [4]	____	____	☐ ☐ -ARTIFICIAL [0]	____	____
☐ ☐ -MUCK [2]	____	____	☐ ☐ -SILT [2]	____	____

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]

(High Quality Only, Score 5 or >) ☐ -3 or Less [0]

SUBSTRATE ORIGIN

Check ONE (OR 2 & AVERAGE)

- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☐ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY

Check ONE (OR 2 & AVERAGE)

SILT:
- ☐ -SILT HEAVY [-2]
- ☐ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]

EMBEDDEDNESS:
- ☐ -EXTENSIVE [-2]
- ☐ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

Substrate ____ Max 20

COMMENTS: ____

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

- ____ UNDERCUT BANKS [1]
- ____ OVERHANGING VEGETATION [1]
- ____ SHALLOWS (IN SLOW WATER) [1]
- ____ ROOTMATS [1]
- ____ POOLS > 70 cm [2]
- ____ ROOTWADS [1]
- ____ BOULDERS [1]
- ____ OXBOWS, BACKWATERS [1]
- ____ AQUATIC MACROPHYTES [1]
- ____ LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)

- ☐ -EXTENSIVE > 75% [11]
- ☐ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

Cover ____ Max 20

COMMENTS: ____

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY
- ☐ -HIGH [4]
- ☐ -MODERATE [3]
- ☐ -LOW [2]
- ☐ -NONE [1]

DEVELOPMENT
- ☐ -EXCELLENT [7]
- ☐ -GOOD [5]
- ☐ -FAIR [3]
- ☐ -POOR [1]

CHANNELIZATION
- ☐ -NONE [6]
- ☐ -RECOVERED [4]
- ☐ -RECOVERING [3]
- ☐ -RECENT OR NO RECOVERY [1]
- ☐ -IMPOUNDED [-1]

STABILTIY
- ☐ -HIGH [3]
- ☐ -MODERATE [2]
- ☐ -LOW [1]

MODIFICATIONS / OTHER
- ☐ -SNAGGING
- ☐ -RELOCATION
- ☐ -CANOPY REMOVAL
- ☐ -DREDGING
- ☐ -ONE SIDE CHANNEL MODIFICATIONS
- ☐ -IMPOUNDMENT
- ☐ -ISLAND
- ☐ -LEVEED
- ☐ -BANK SHAPING

Channel ____ Max 20

COMMENTS: ____

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH

L R (Per Bank)
- ☐ ☐ -VERY WIDE > 100m [5]
- ☐ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☐ ☐ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY (*PAST 100 Meter RIPARIAN*)

L R (Most Predominant Per Bank)
- ☐ ☐ -FOREST, SWAMP [3]
- ☐ ☐ -SHRUB OR OLD FIELD [2]
- ☐ ☐ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]

L R
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION

L R (Per Bank)
- ☐ ☐ -NONE / LITTLE [3]
- ☐ ☐ -MODERATE [2]
- ☐ ☐ -HEAVY / SEVERE [1]

Riparian ____ Max 10

COMMENTS: ____

Is Sampling Reach Representative of the Stream (Y/N) Y If Not, Explain:

Lat/Long (Beg):

Lat/Long (Mid):

Lat/Long (End):

Lat/Long(X-Loc):

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Ag ☒
- Livestock ☐
- Silviculture ☒
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ________

Subjective Rating (1-10)	Aesthetic Rating (1-10)
7	7

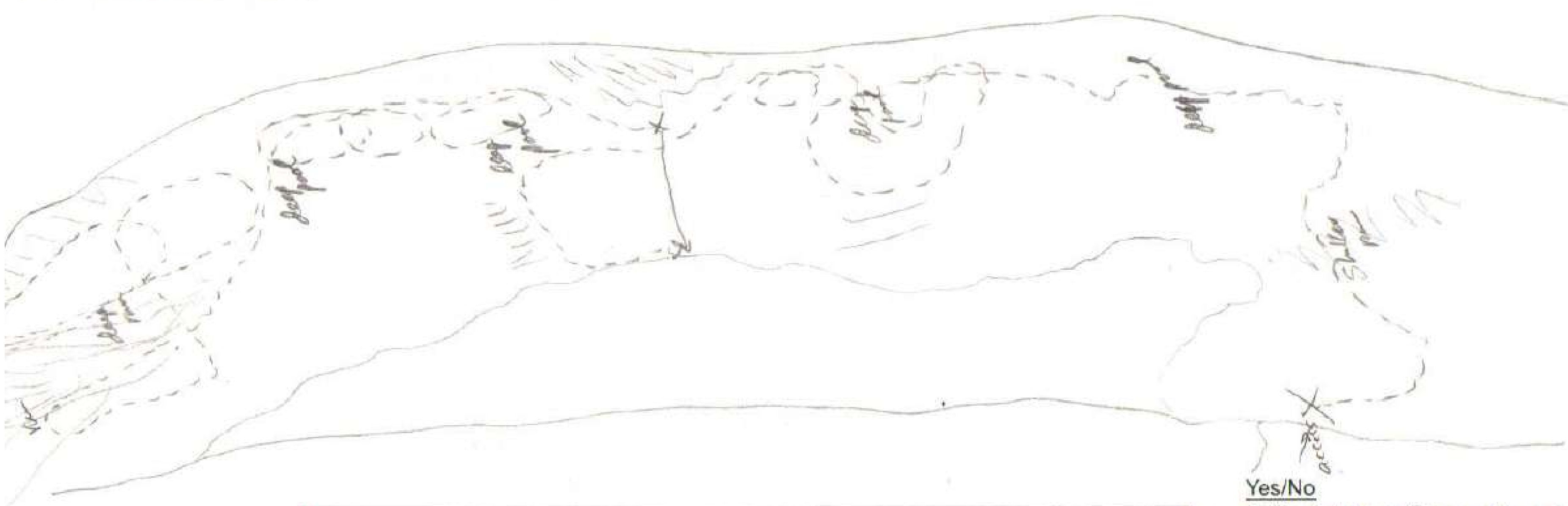
Gradient: ☐ - Low, ☒ - Moderate, ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy -% Open
First Sampling Pass	A	1.0	clear	low	100

Stream Measurements:

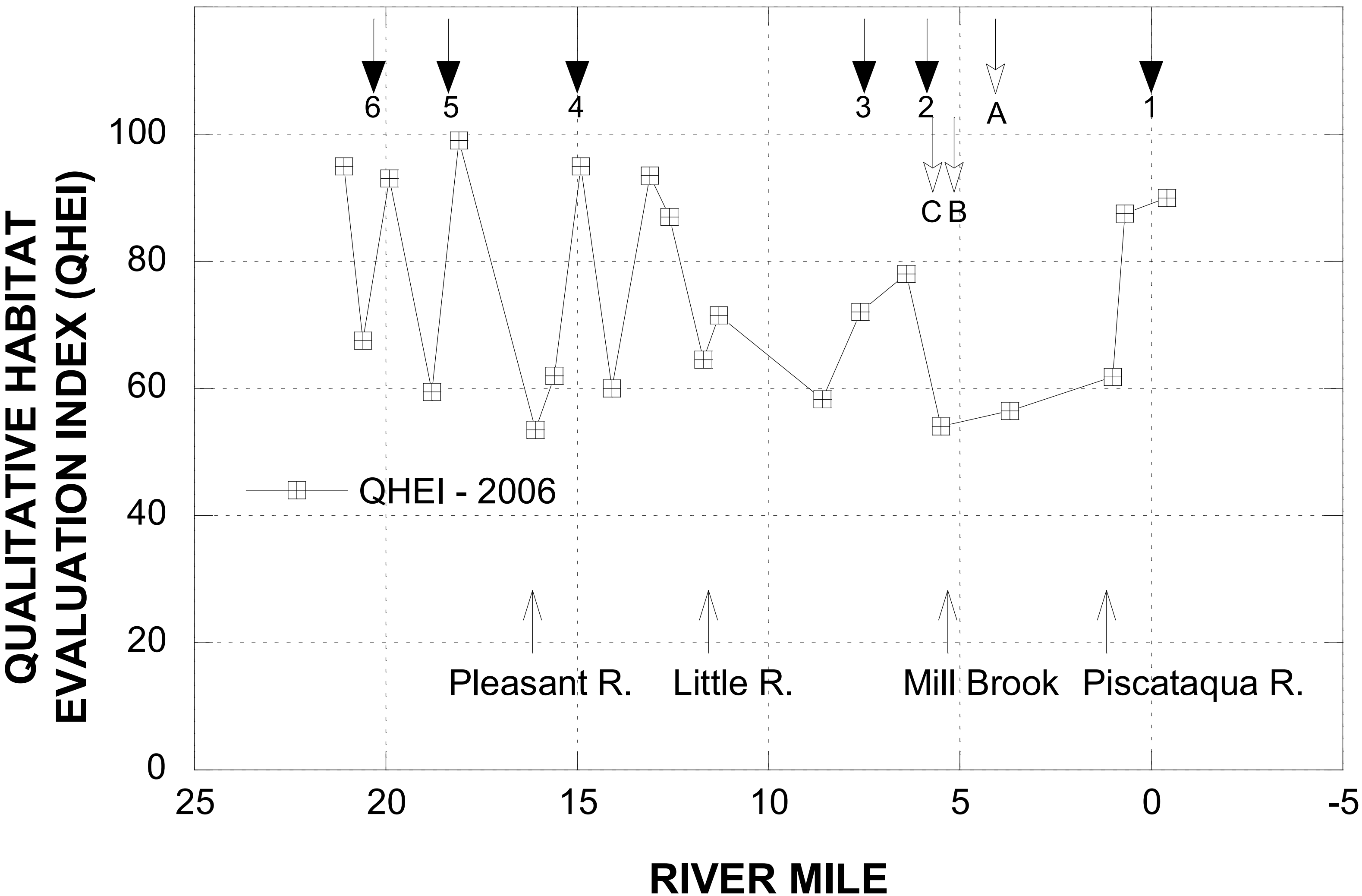
Average Width	Average Depth	Maximum Depth	Av. Bankfull Width	Bankfull Mean Depth	W/D Ratio	Bankfull Max Depth	Floodprone Area Width	Entrench. Ratio

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, Where: 0 - Cover type absent; 1 - Cover type present in very small amounts or if more common of marginal quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep/fast water, or deep, well-defined, functional pools.

Yes/No	
☐ ☐	Is Stream Ephemeral (no pools totally dry or only damp spots)?
☐ ☐	Is there water upstream? How Far: ______
☐ ☐	Is There Water Close Downstre How Far: ______
☐ ☐	Is Dry Channel Mostly Natural?



QUALITATIVE HABITAT EVALUATION INDEX (QHEI)
RIVER MILE
QHEI - 2006
6
5
4
3
2
A
1
C
B
Pleasant R.
Little R.
Mill Brook
Piscataqua R.
100
80
60
40
20
0
25
20
15
10
5
0
-5

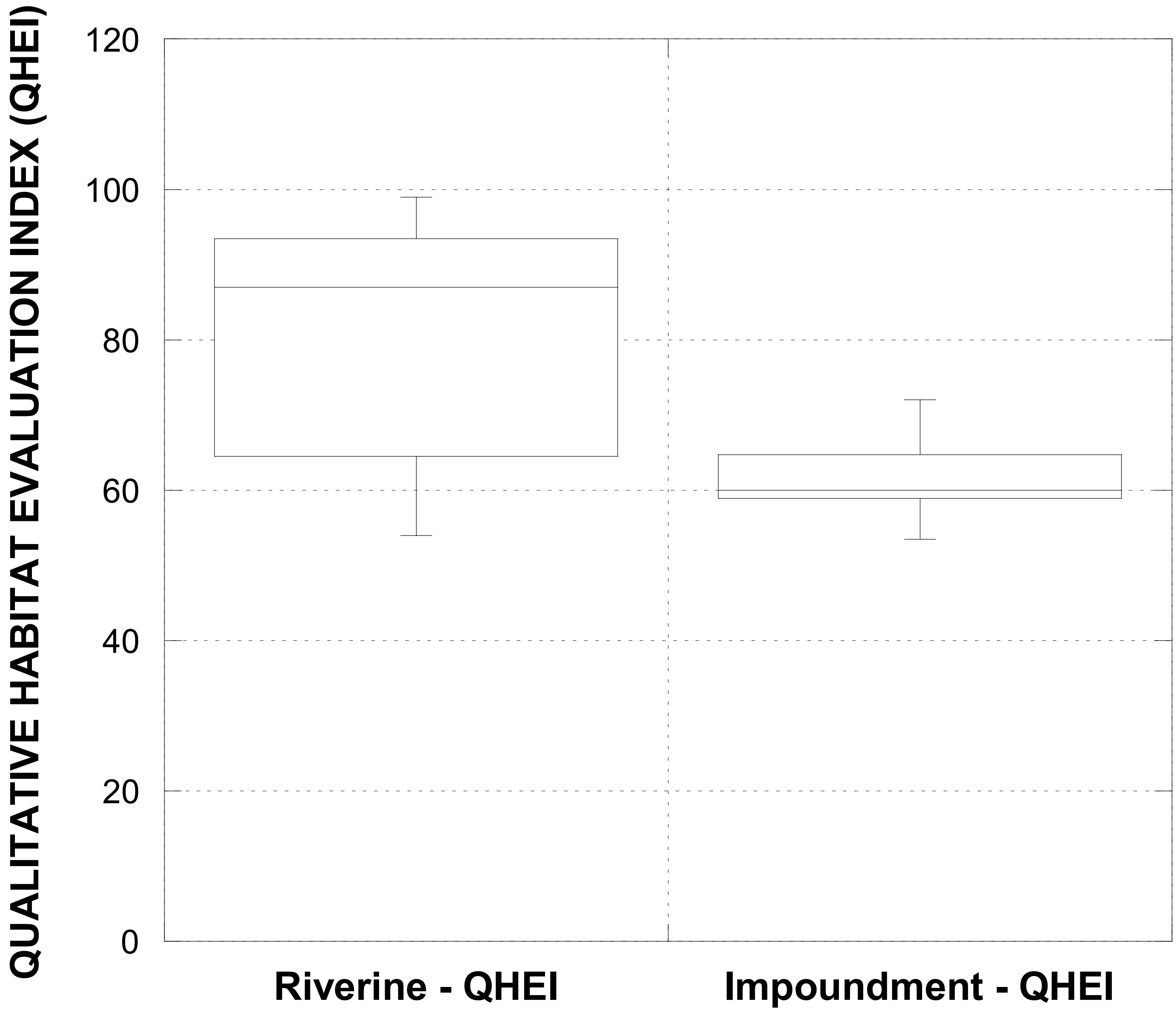
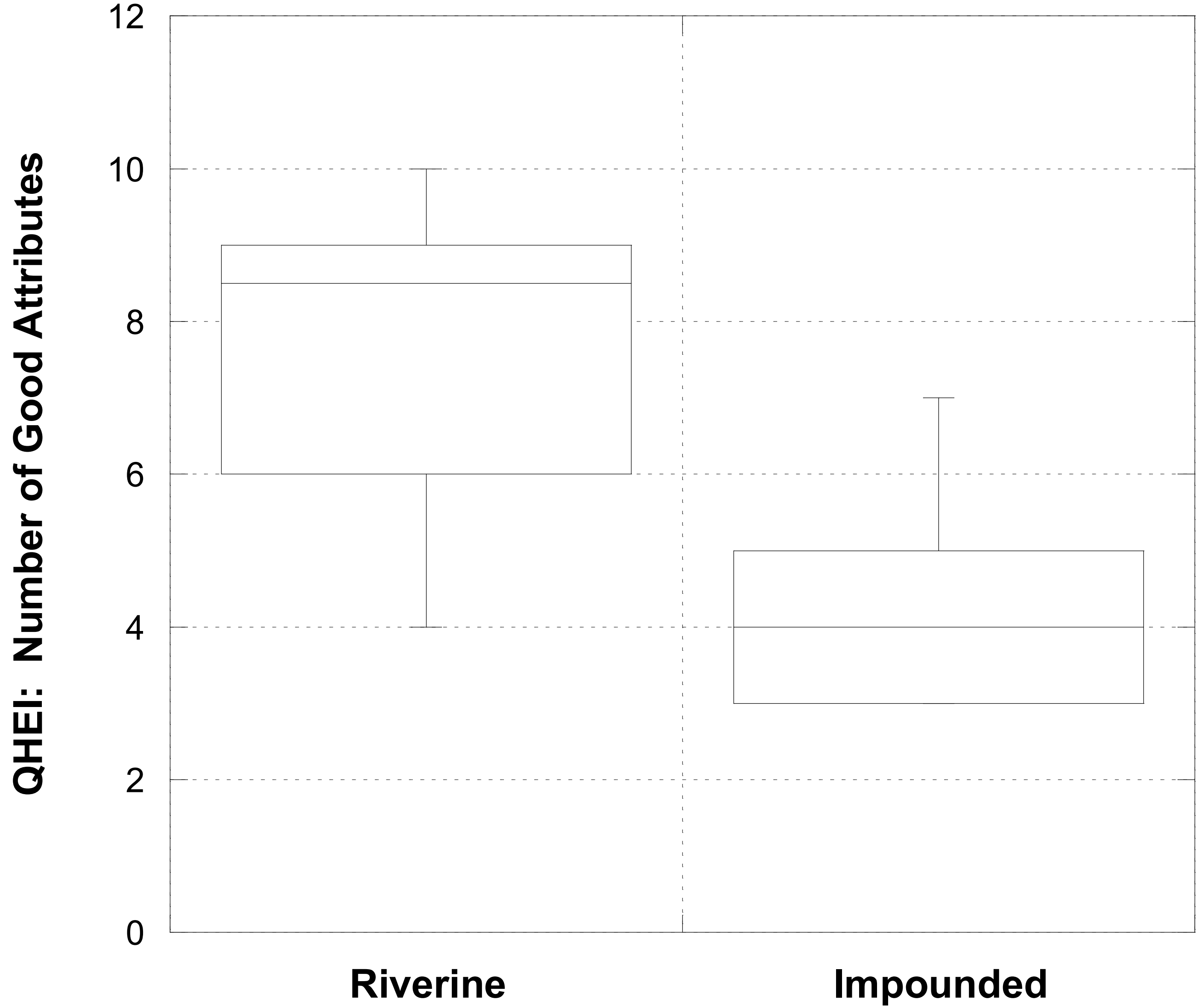
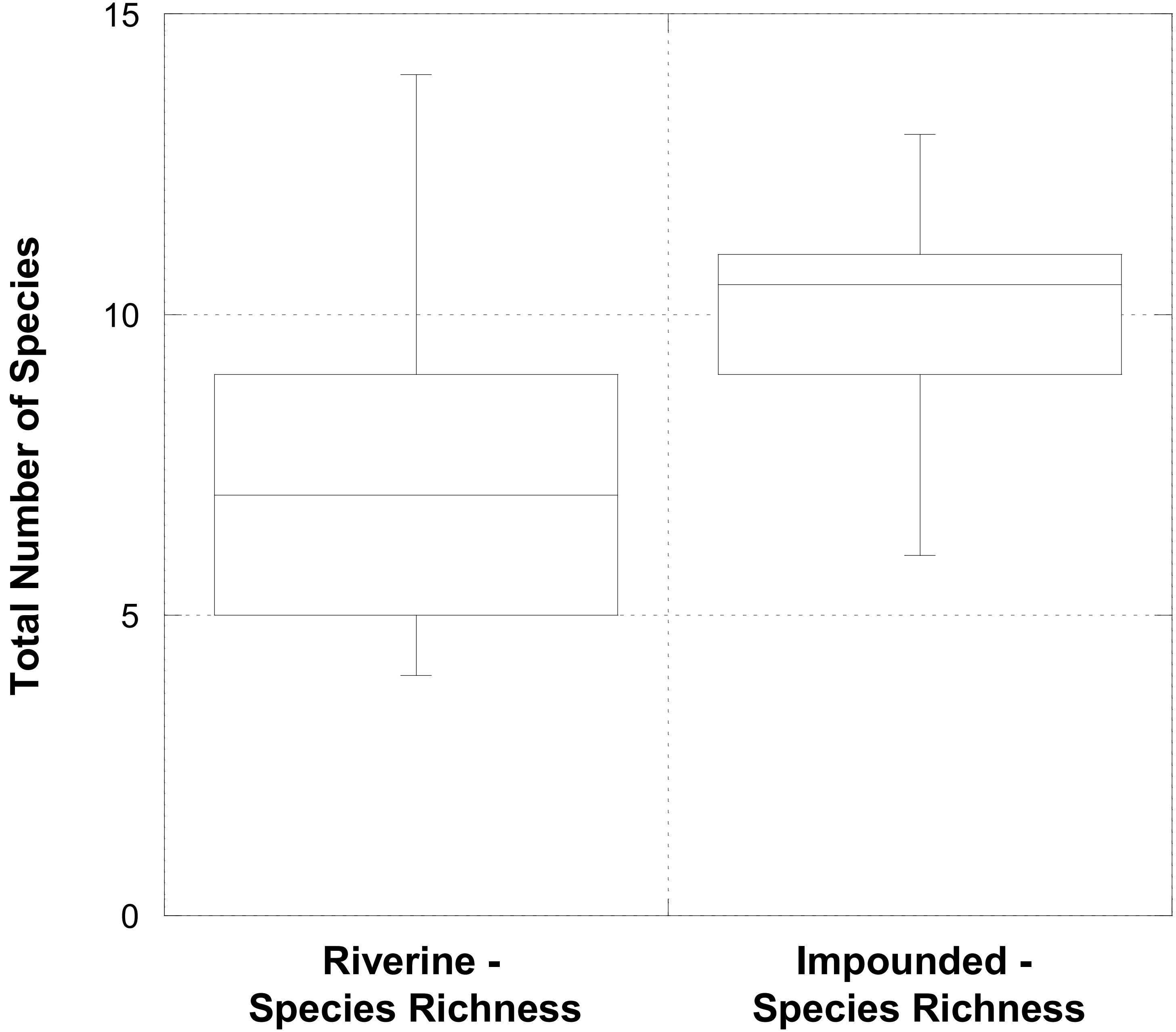

QUALITATIVE HABITAT EVALUATION INDEX (QHEI)
120
100
80
60
40
20
0
Riverine - QHEI
Impoundment - QHEI

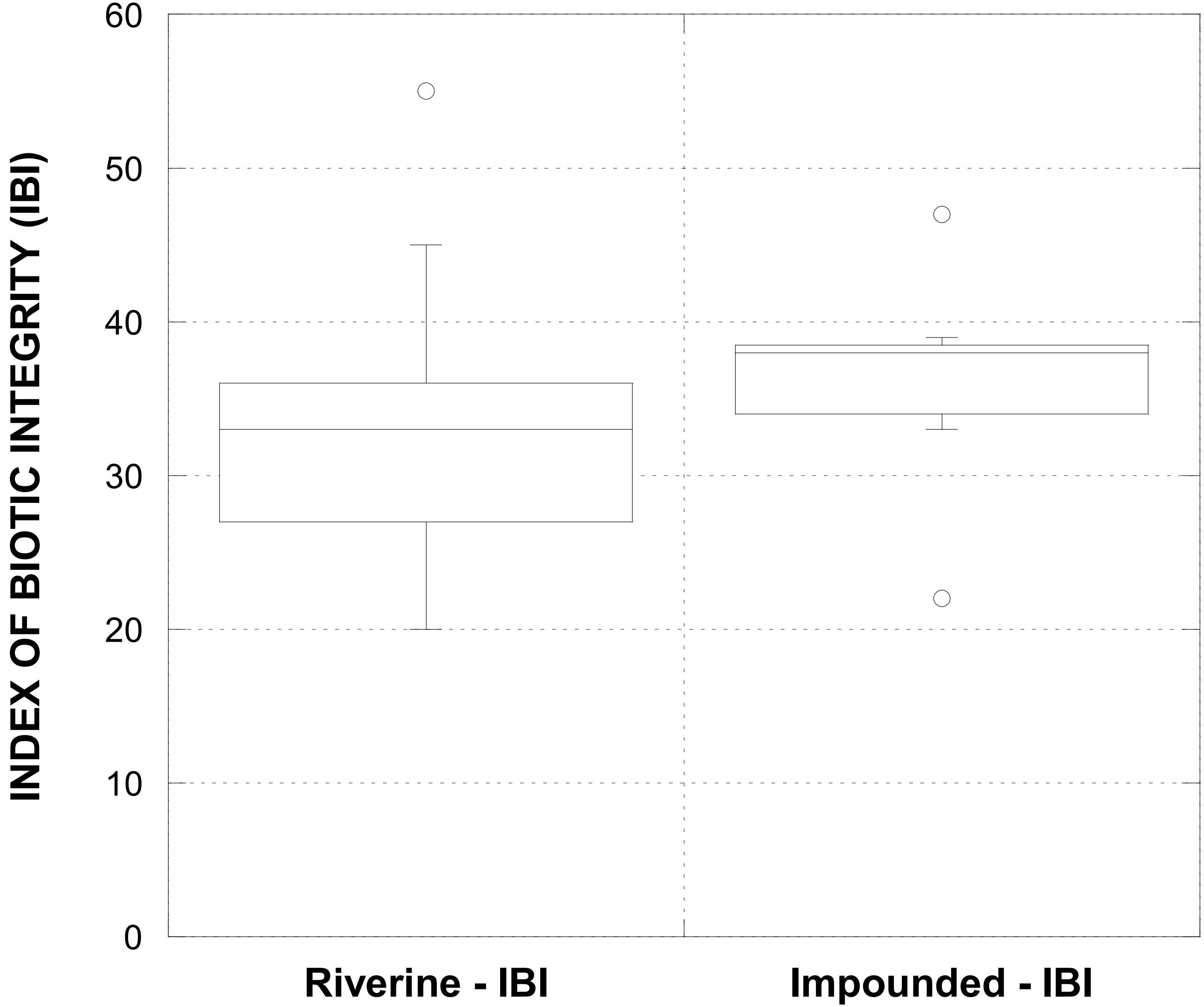
Table 5. QHEI matrix showing good and modified attributes at fish sampling locations in the Presumpscot River study area, 2006.

Key
QHEI
Components

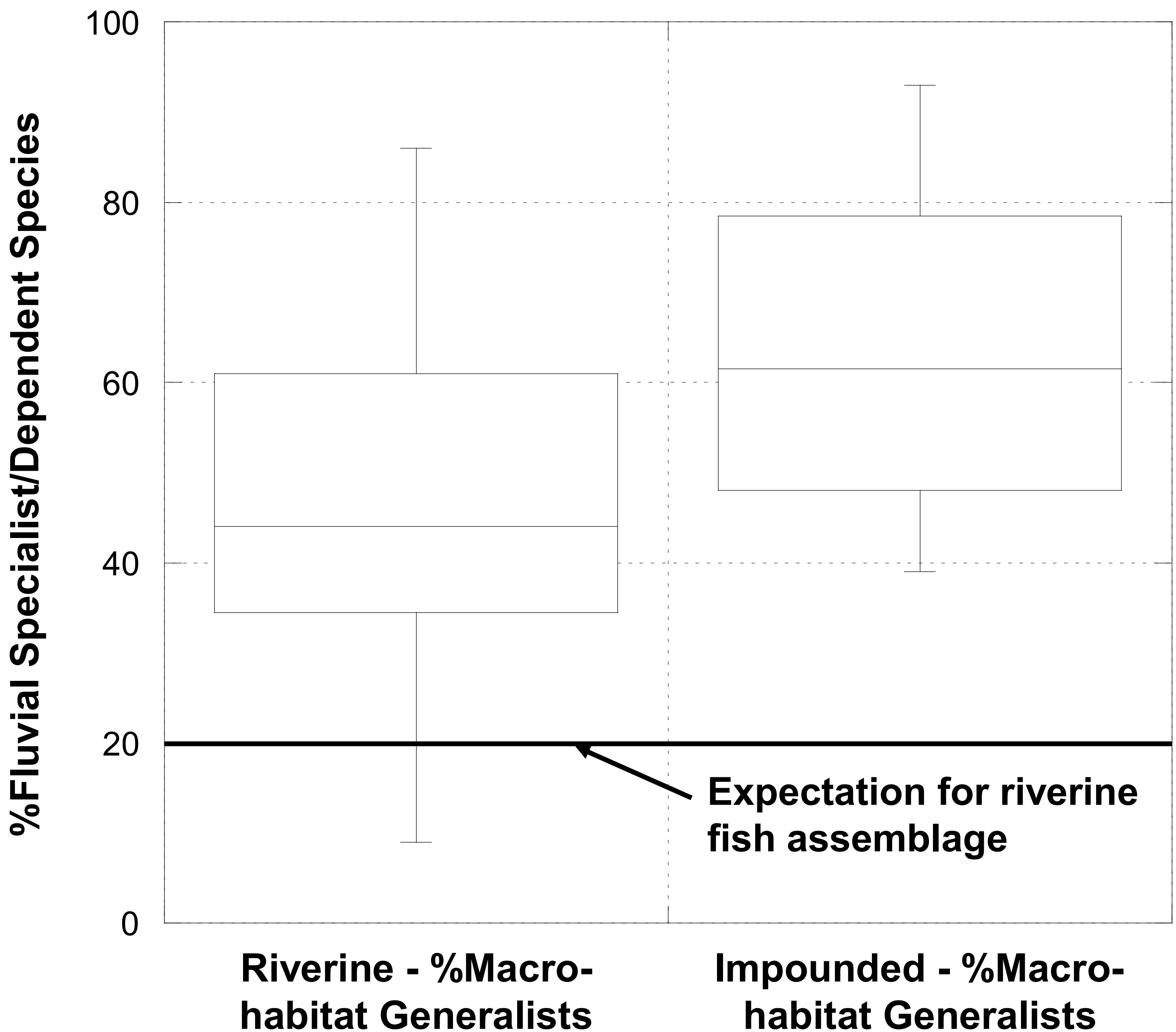
River Mile	QHEI	Gradient (ft/mile)	No Channelization/Recovered	Boulder, Cobble, Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Five or More Substrate Types	Extensive-Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 1 m	Low-Normal Riffle/Run Embeddedness	Good Habitat Attributes	Impounded	Channelized or No Recovery	Silt/Muck Substrates	Sparse or No Cover	Max Depth < 70 cm	Recovering Channel	High/Moderate Silt Cover	Fair-Poor Development	Only 1-2 Cover Types	Slow or No Flow	High-Mod Overall Embeddedness	High-Mod Riffle-Run Embeddedness	No Riffle/Run	Total Modified Attributes	Modified: Good Ratio
			Good Attributes											Modified Attributes														
(20-001) Presumpscot River																												
Year: 2006																												
21.1	**87.0**	0.00	■	■		■	■	■	■	■	■	■	9														0	0.00
20.6	**58.5**	0.00		■			■	■		■	■		5	◆						■	■					■	4	0.80
19.9	**87.0**	0.00	■	■		■	■	■	■	■	■		8														0	0.00
19.1	**52.5**	0.00		■				■		■	■		4	◆		◆					■					■	3	0.75
18.8	**54.0**	0.00		■			■	■			■		3	◆		◆				■	■		■	■		■	6	1.50
18.1	**90.0**	0.00	■	■		■	■	■	■	■	■	■	9														0	0.00
15.0	**55.0**	0.00		■			■	■		■	■		4	◆		◆					■		■			■	4	0.80
14.9	**88.0**	0.00	■	■		■	■	■	■	■	■	■	9														0	0.00
12.6	**81.5**	0.00	■	■		■	■	■	■	■	■	■	9														0	0.00
8.6	**53.0**	0.00		■				■		■	■		5	◆							■		■			■	4	1.00
7.6	**66.0**	0.00		■			■	■	■	■	■	■	7	◆							■						2	0.29
6.3	**74.0**	0.00	■	■		■	■	■	■	■	■	■	9							■							1	0.11
5.5	**52.0**	0.00	■					■		■	■		5							■	■					■	3	0.75
3.7	**41.5**	0.00						■		■	■		3							■						■	2	0.67

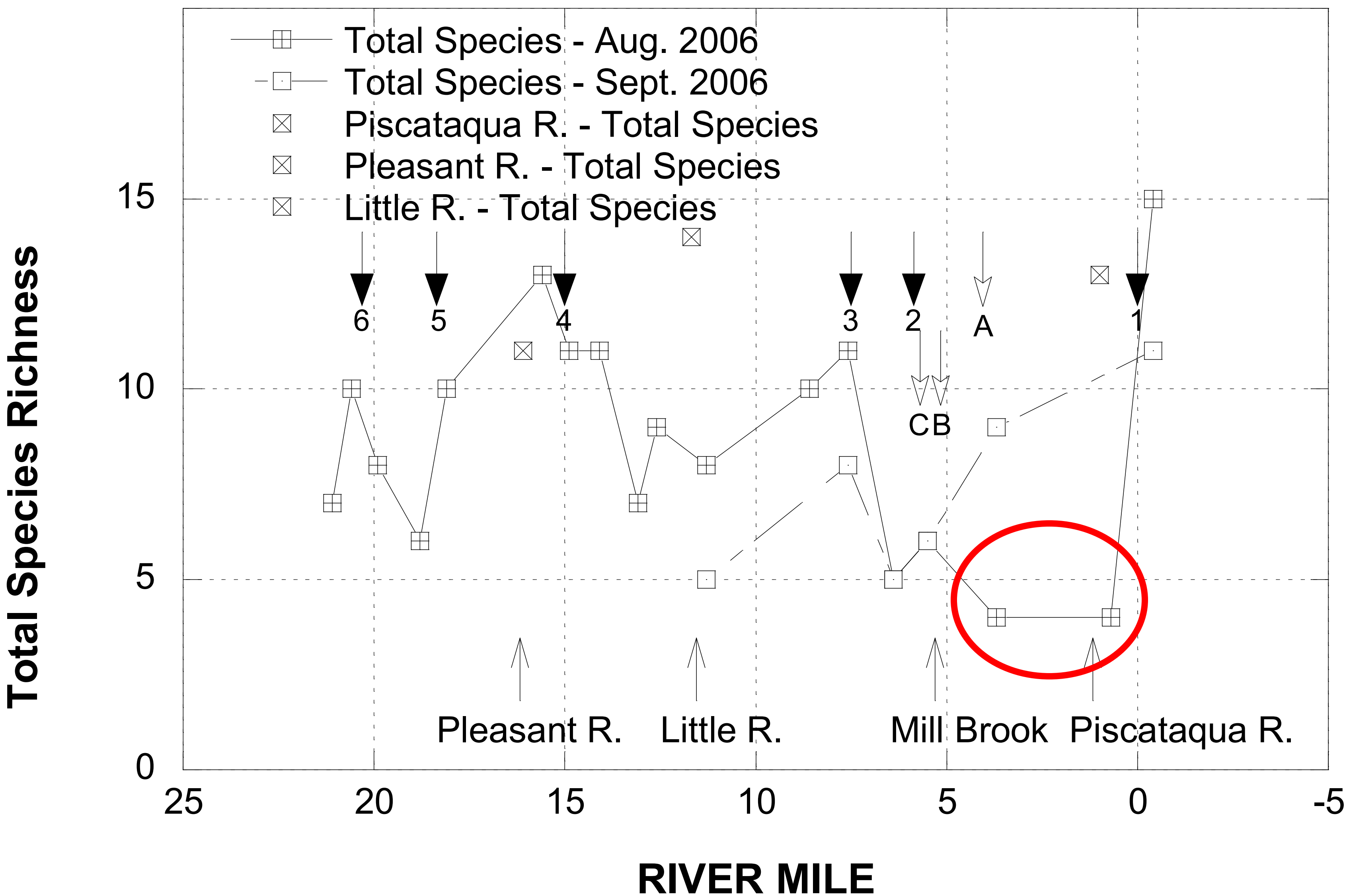

QHEI: Number of Good Attributes
12
10
8
6
4
2
0
Riverine
Impounded

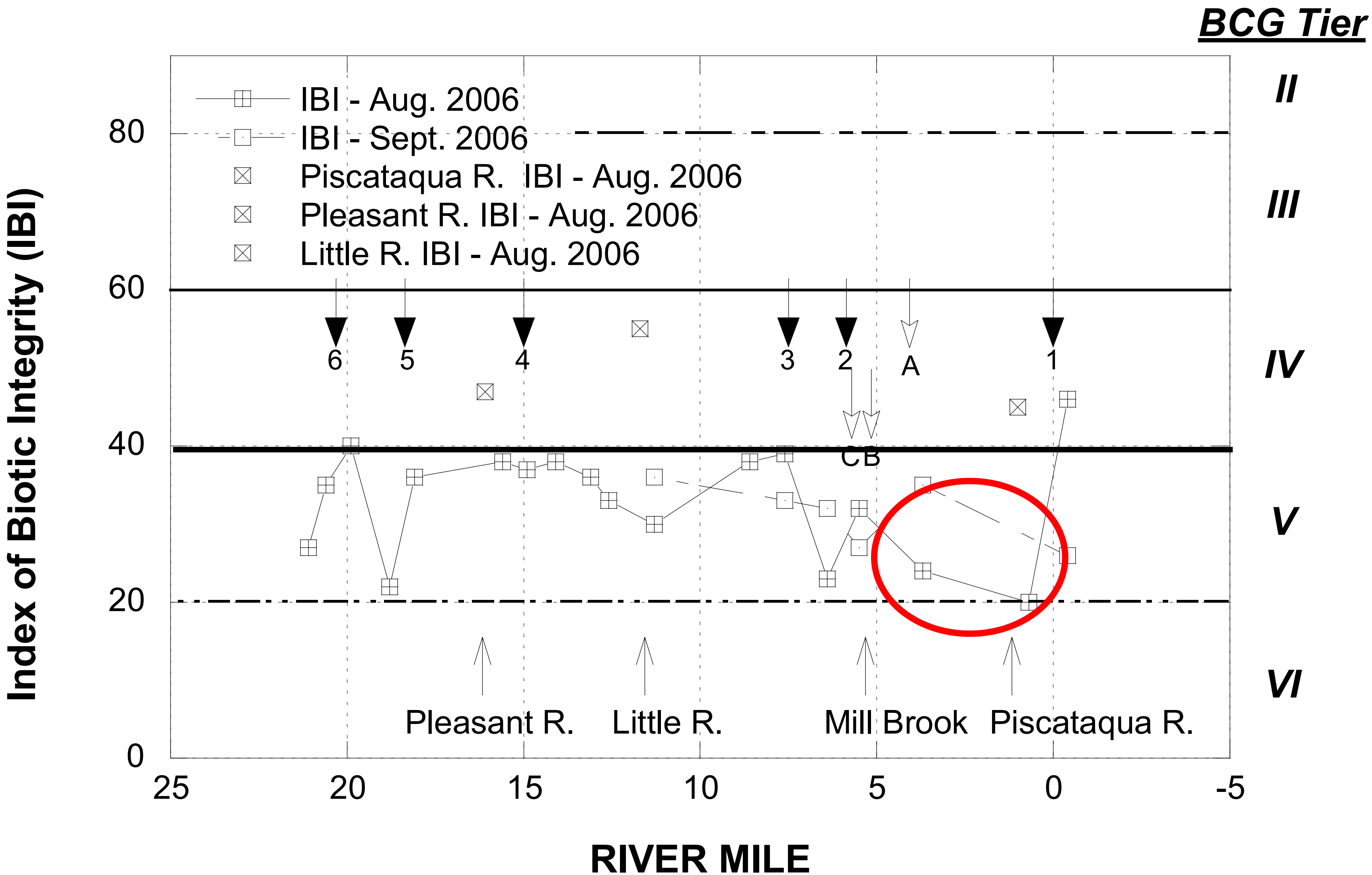

15
10
5
0
Total Number of Species
Riverine -
Species Richness
Impounded -
Species Richness



INDEX OF BIOTIC INTEGRITY (IBI)
60
50
40
30
20
10
0
Riverine - IBI
Impounded - IBI

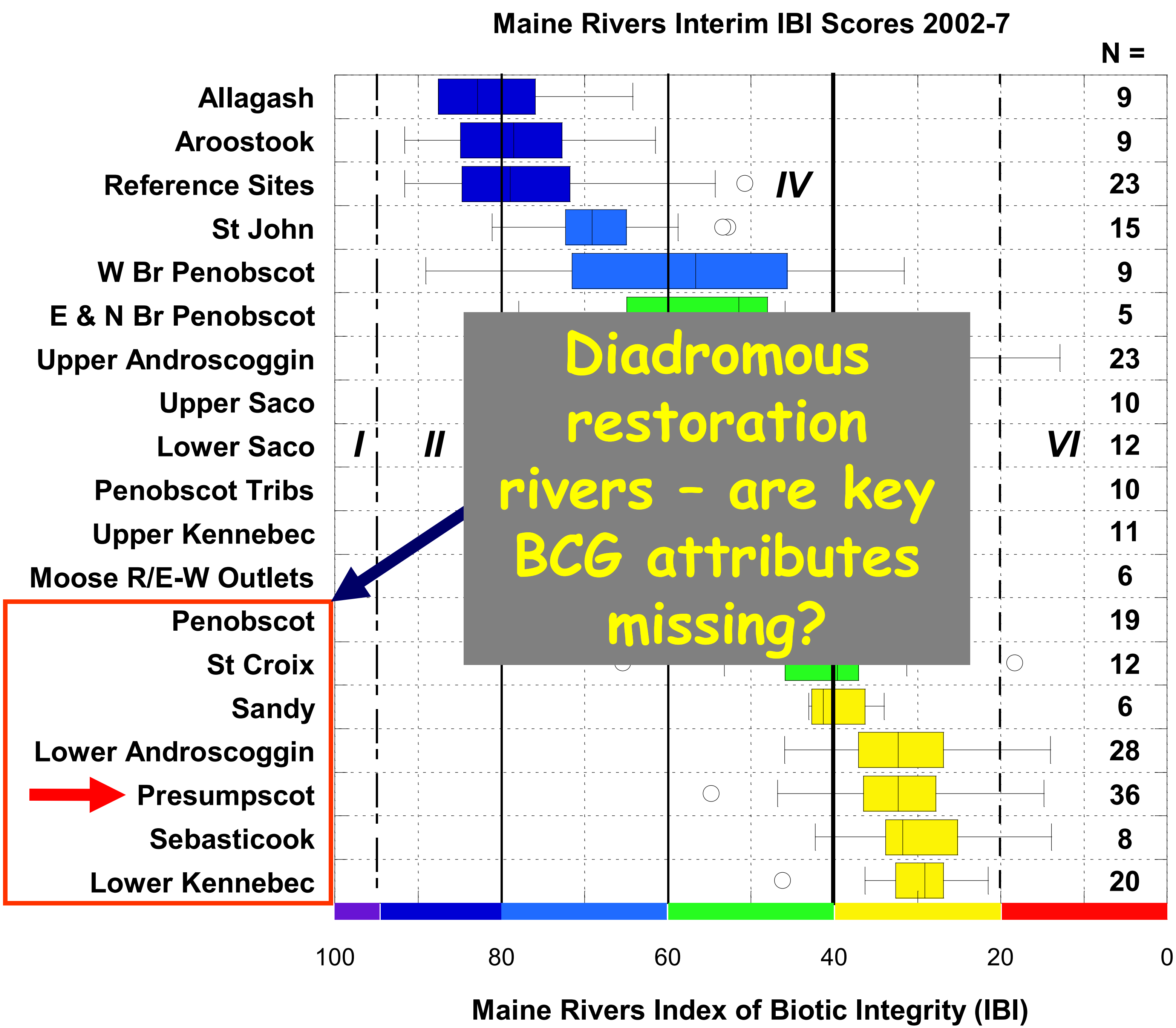

100
80
60
40
20
0
%Fluvial Specialist/Dependent Species
Expectation for riverine fish assemblage
Riverine - %Macro-habitat Generalists
Impounded - %Macro-habitat Generalists


Total Species - Aug. 2006
Total Species - Sept. 2006
Piscataqua R. - Total Species
Pleasant R. - Total Species
Little R. - Total Species
6
5
4
3
2
A
1
C
B
Pleasant R.
Little R.
Mill Brook
Piscataqua R.
15
10
5
0
25
20
15
10
5
0
-5
Total Species Richness
RIVER MILE



BCG Tier
II
III
IV
V
VI
IBI - Aug. 2006
IBI - Sept. 2006
Piscataqua R. IBI - Aug. 2006
Pleasant R. IBI - Aug. 2006
Little R. IBI - Aug. 2006
6
5
4
3
2
A
1
C B
Pleasant R.
Little R.
Mill Brook
Piscataqua R.
Index of Biotic Integrity (IBI)
RIVER MILE
0
20
40
60
80
25
20
15
10
5
0
-5

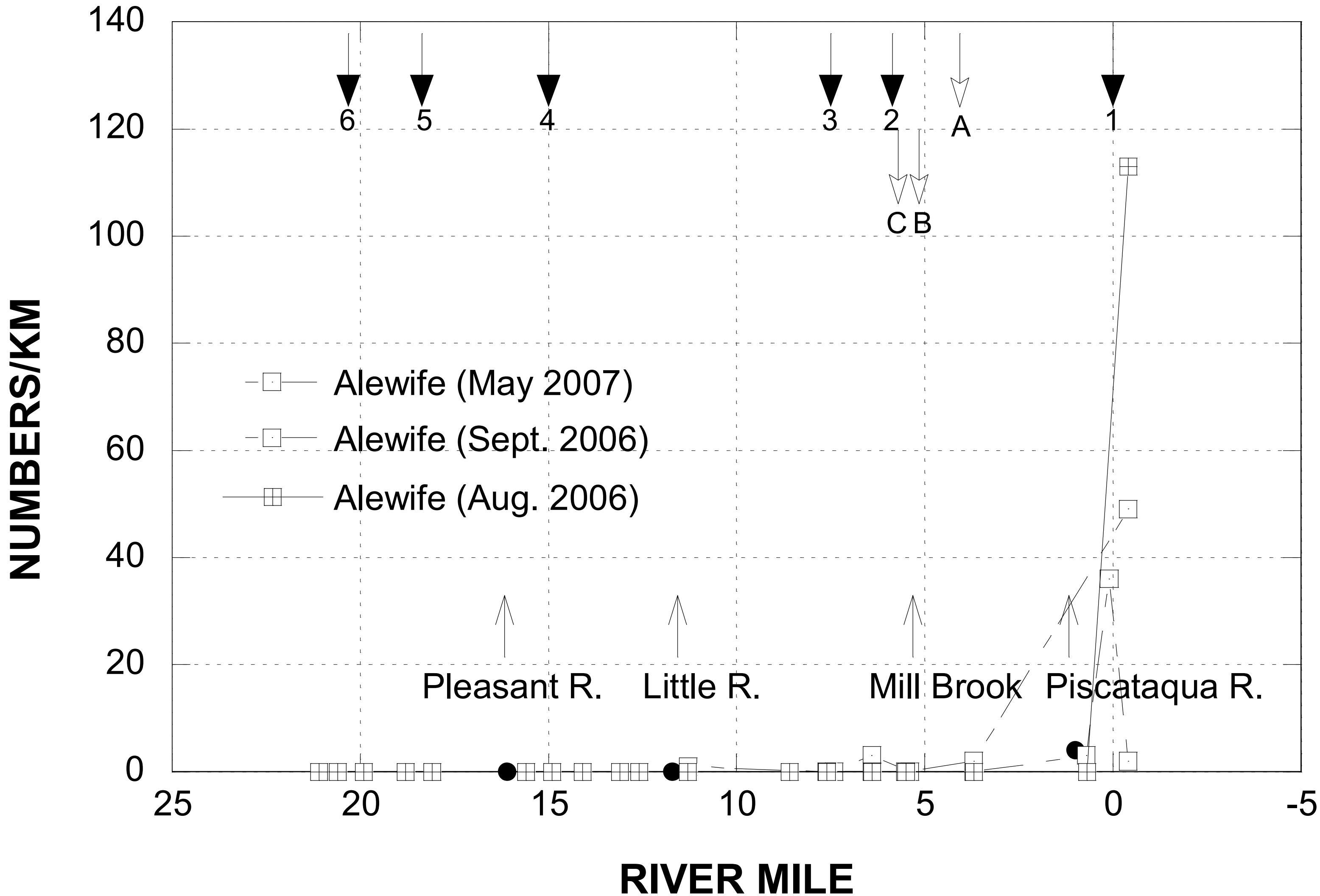
- Major wastewater discharges: Westbrook WWTP – 4.5 MGD; SAPPI – 12.5 MGD process, 12 MGD cooling.
- Visual evidence of impacts beyond permit terms & conditions
- Suspected organic enrichment & possibly thermal impacts in lower mainstem
- Maine DEP cumulative effects assessment targeted in part to this finding



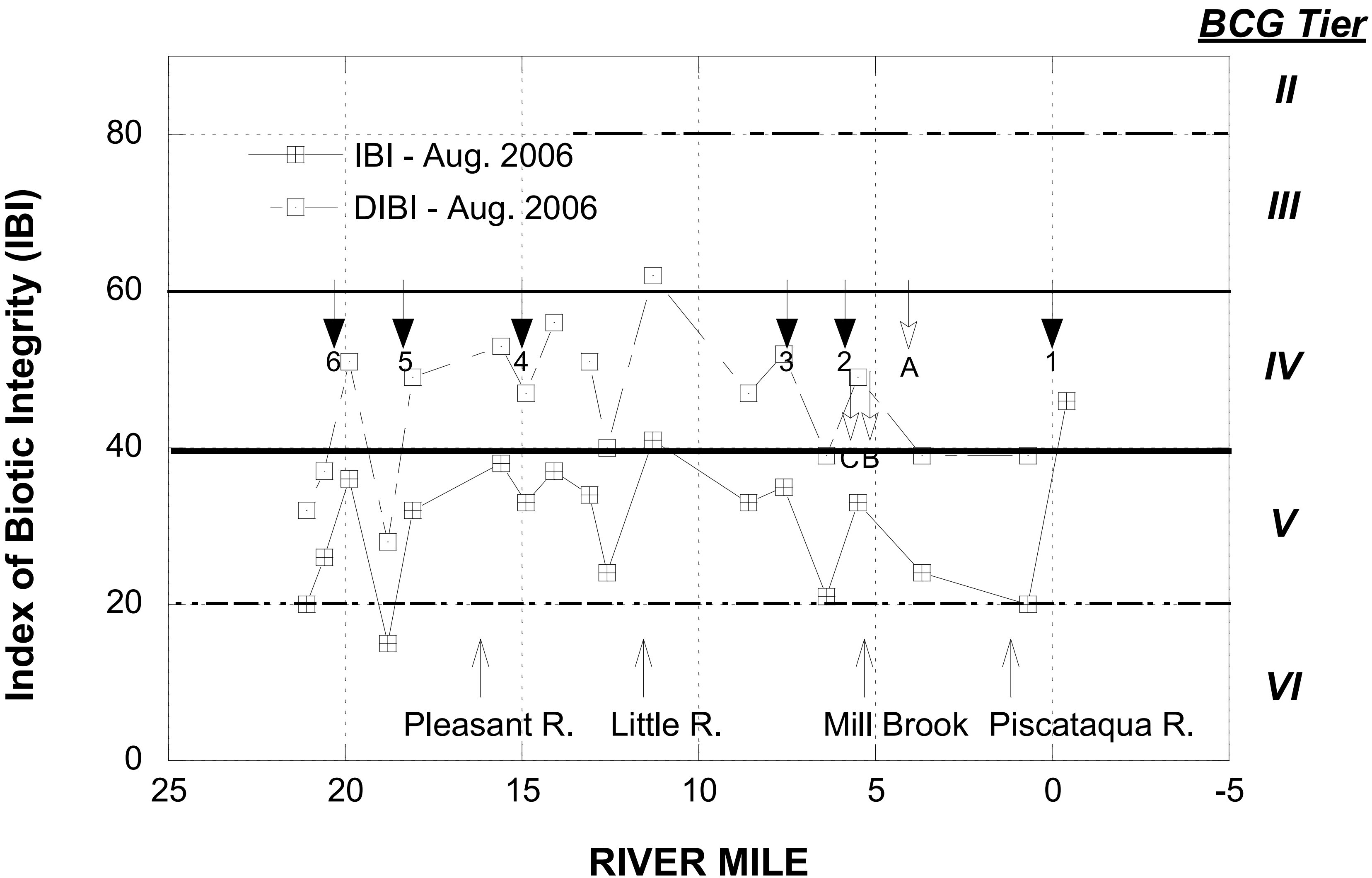
Maine Rivers Interim IBI Scores 2002-7
N =
Allagash
Aroostook
Reference Sites
St John
W Br Penobscot
E & N Br Penobscot
Upper Androscoggin
Upper Saco
Lower Saco
Penobscot Tribs
Upper Kennebec
Moose R/E-W Outlets
Penobscot
St Croix
Sandy
Lower Androscoggin
Presumpscot
Sebasticook
Lower Kennebec
9
9
23
15
9
5
23
10
12
10
11
6
19
12
6
28
36
8
20
I
II
IV
VI
Diadromous restoration rivers - are key BCG attributes missing?
100
80
60
40
20
0
Maine Rivers Index of Biotic Integrity (IBI)

Current Improvements to the Interim Maine Rivers IBI

- Diadromous species are not included except indirectly via other metrics
- Developed a set of diadromous metrics that include: #diadromous species; log rel. no. American eel; log rel. no. Clupeidae; log rel. no. Diadromous fish.
- Additive to "core" IBI – does not "penalize" rivers that do not have diadromous fish.
- Continuing data collection in lower Kennebec & Sebasticook R.



NUMBERS/KM
RIVER MILE
140
120
100
80
60
40
20
0
25
20
15
10
5
0
-5
6
5
4
3
2
A
1
C
B
Alewife (May 2007)
Alewife (Sept. 2006)
Alewife (Aug. 2006)
Pleasant R.
Little R.
Mill Brook
Piscataqua R.



BCG Tier
II
III
IV
V
VI
Index of Biotic Integrity (IBI)
RIVER MILE
IBI - Aug. 2006
DIBI - Aug. 2006
Pleasant R.
Little R.
Mill Brook
Piscataqua R.
6
5
4
3
2
1
A
C
B
80
60
40
20
0
25
20
15
10
5
0
-5

Presumpscot River Fish Assemblage Conclusions

- Fish assemblage reflects hydromodifications (impoundment & flow).
- Few sites attain BCG tier IV (minimum CWA goal).
- Anadromous species restricted to lower 7-8 miles of mainstem.
- Localized areas of "pollution" impacts – need to perform stressor diagnosis.
- Intensity of hydromodification "overwhelms" riverine characteristics – will not be resolved by fish passage alone.