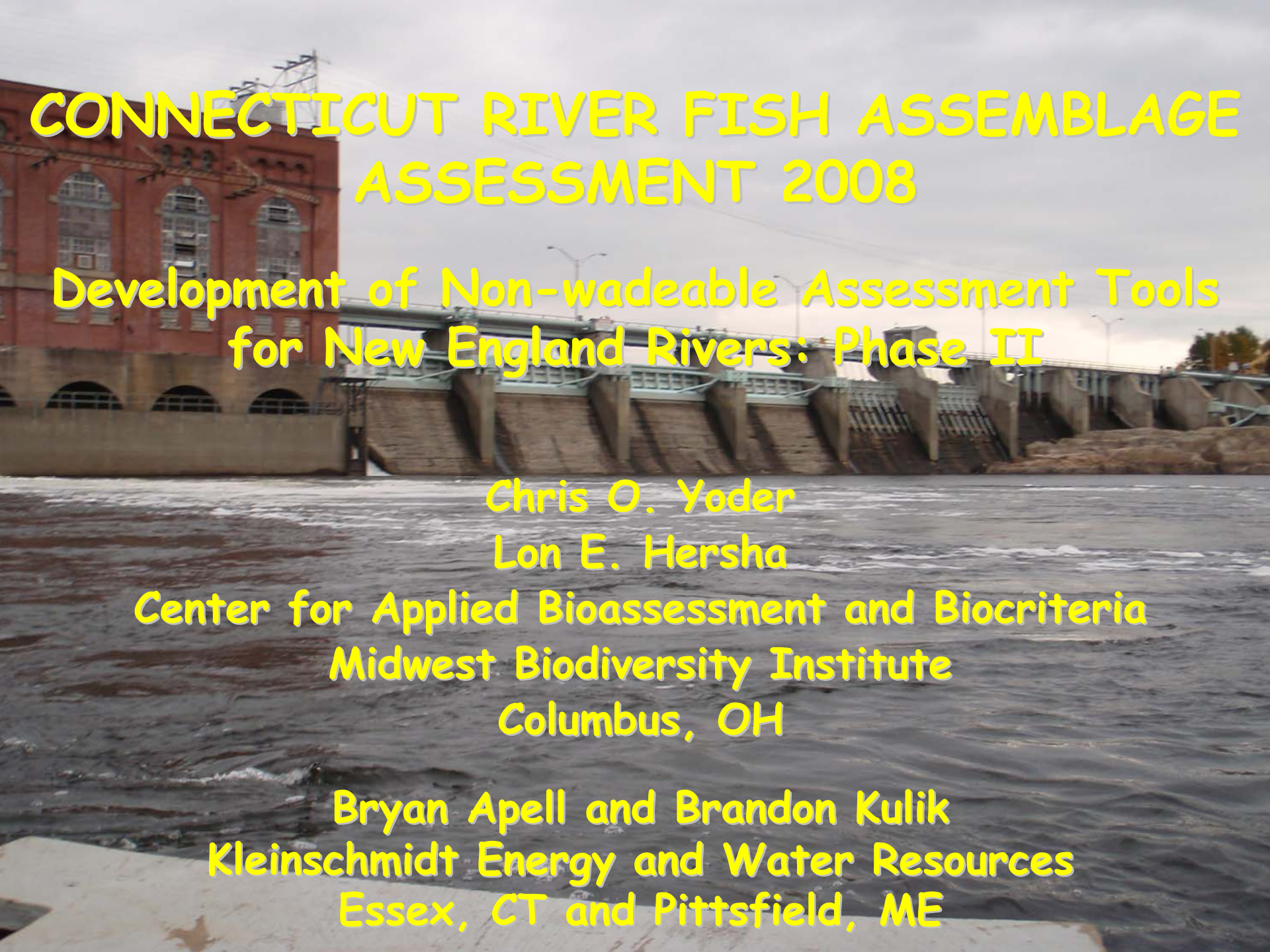


CONNECTICUT RIVER FISH ASSEMBLAGE ASSESSMENT 2008

Development of Non-wadeable Assessment Tools for New England Rivers: Phase II

Chris O. Yoder
Lon E. Hersha
Center for Applied Bioassessment and Biocriteria
Midwest Biodiversity Institute
Columbus, OH

Bryan Apell and Brandon Kulik
Kleinschmidt Energy and Water Resources
Essex, CT and Pittsfield, ME

Major River Basins in New England

Su

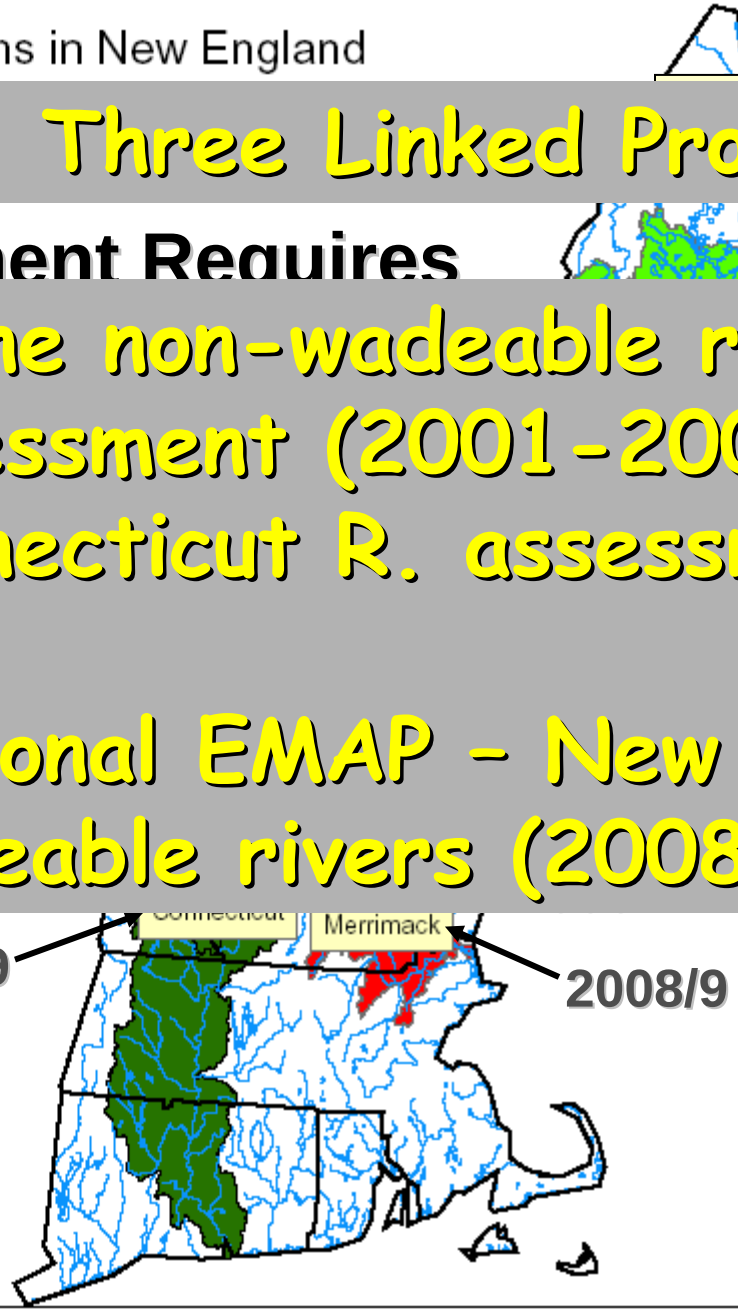
Development Requires

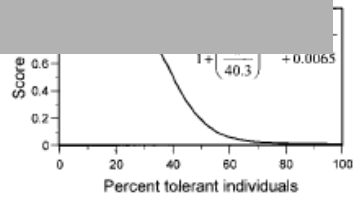
a

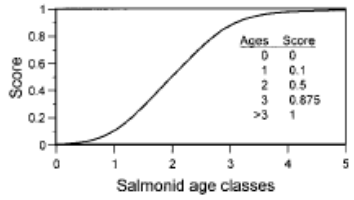
Da

Three Linked Projects:

1. Maine non-wadeable rivers assessment (2001-2008)
2. Connecticut R. assessment (2008-9).
3. Regional EMAP – New England non-wadeable rivers (2008-10).







Why Knowledge of the Fish Assemblage is Important

Current Issues:

- **Limited Knowledge of Extant Fauna** – limited mostly to managed species (especially trout and salmon); need to document relative abundance of co-occurring native and alien species and their respective influence.
- **Naturally Depauperate Faunas** – cold water, coastal drainages – "how will these respond?"
- **Assess Potential Conflicts with High Profile Restoration Goals** – do non-native species pose an unintentional deterrent?

Sampling Methods

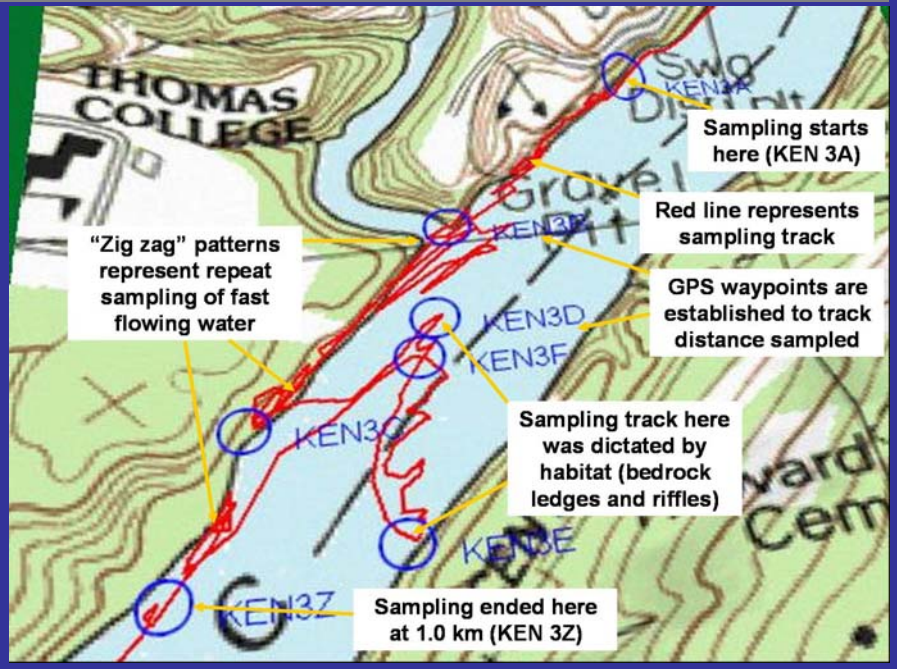
Developed & Tested in Maine

Standardized Approach:

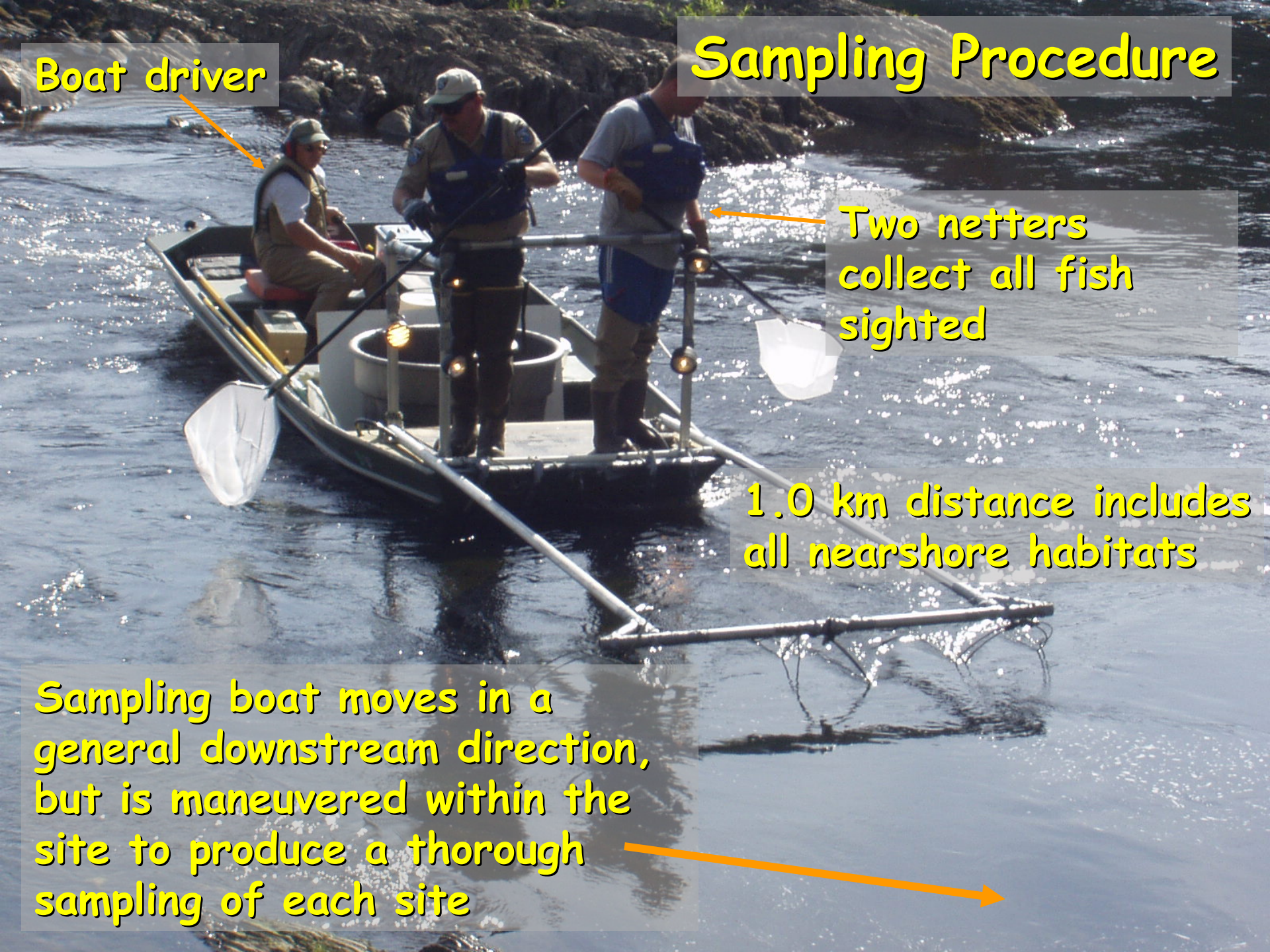
- Pulsed D.C. boat electrofishing – effort indexed to distance
- Electrode array customized for Maine river conditions
- Intensive survey design – mainstem & non-wadeable tribs.
- Field water quality and habitat data
- July 1 – September 30 index period

Raft added in 2005

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

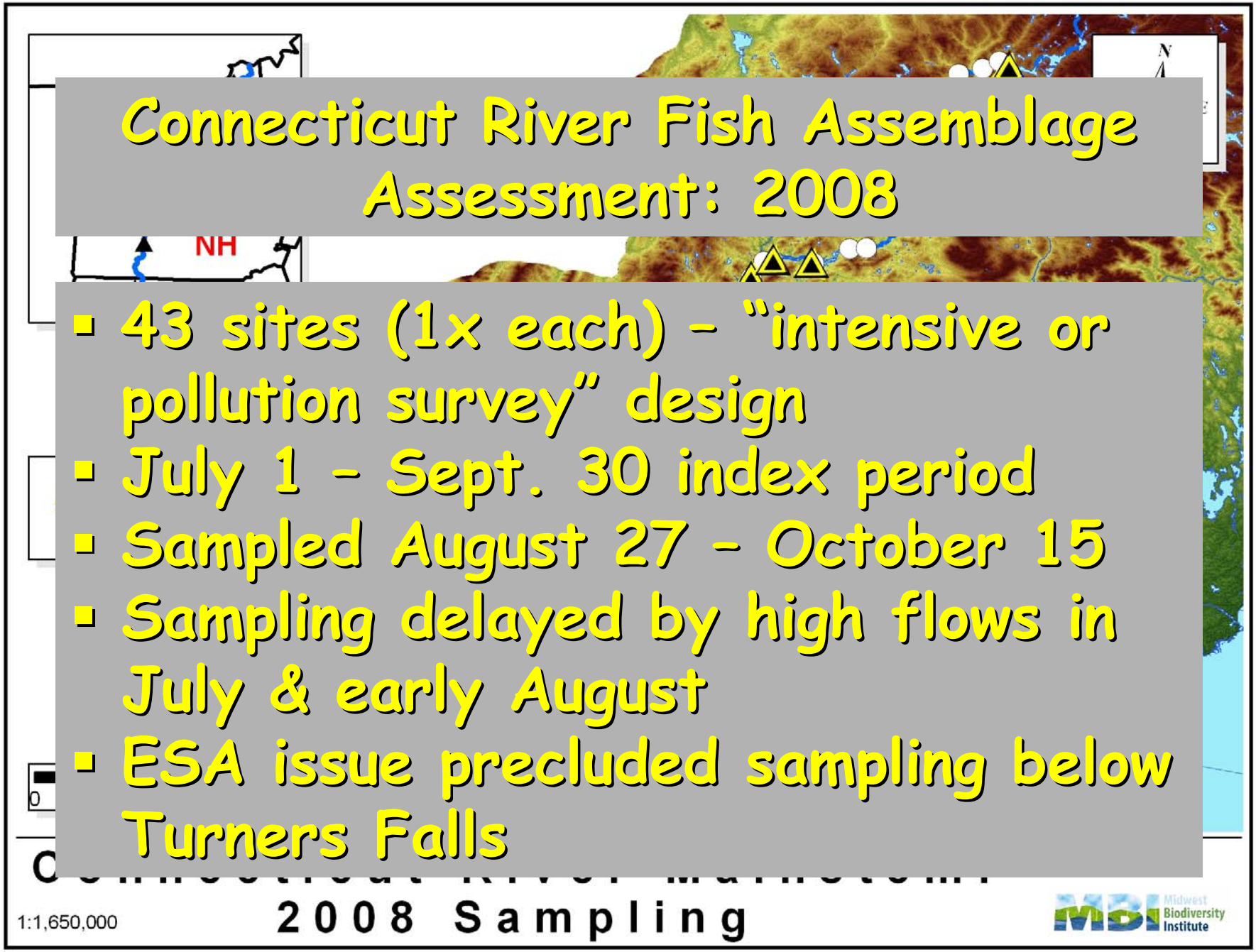


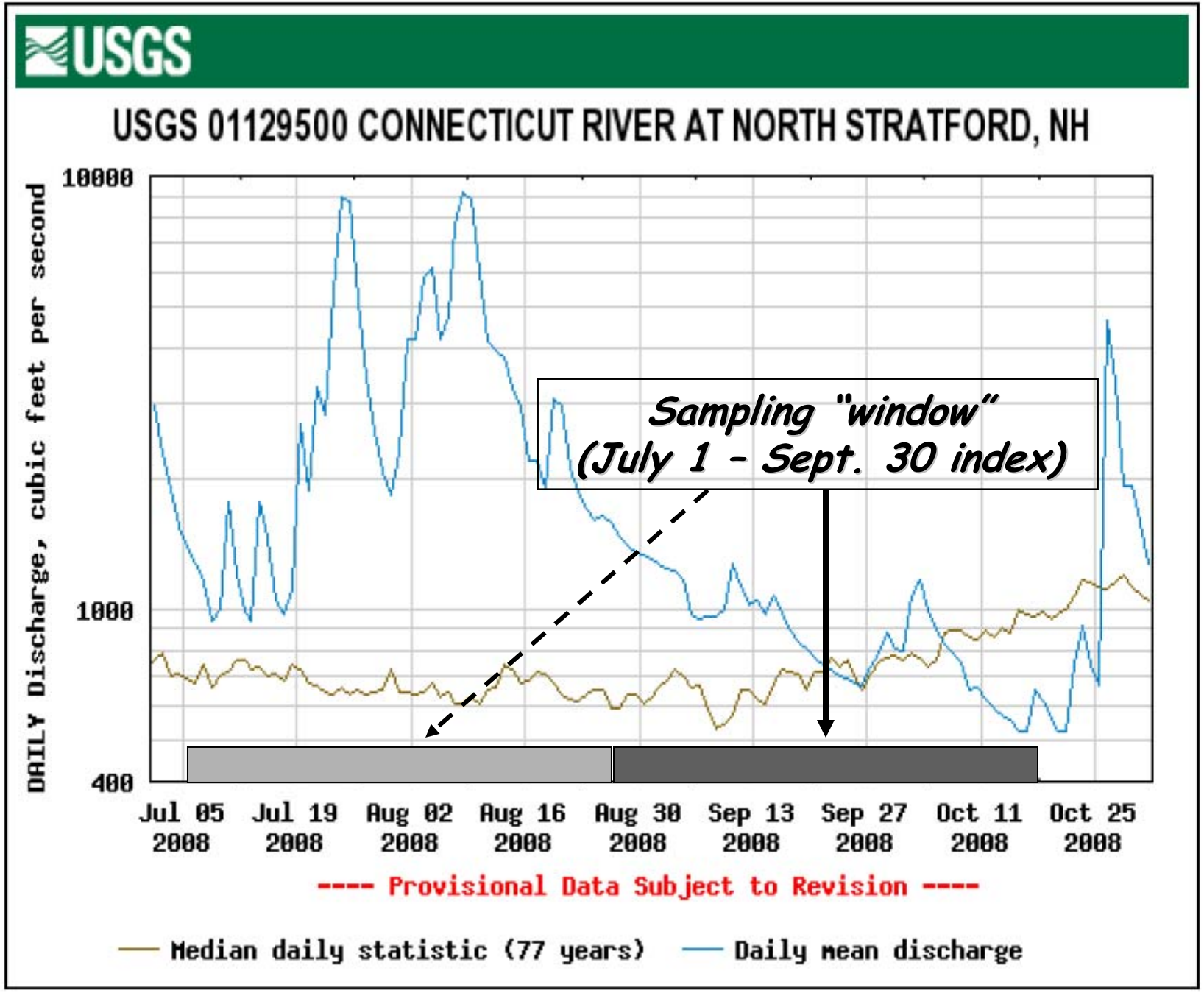
- Geo-referenced sample site location and sample track
- Fish are identified to species, enumerated, and weighed
- DELT anomalies recorded


Sampling Procedure
Boat driver
Two netters collect all fish sighted
1.0 km distance includes all nearshore habitats
Sampling boat moves in a general downstream direction, but is maneuvered within the site to produce a thorough sampling of each site

Connecticut River Fish Assemblage Assessment: 2008

- 43 sites (1x each) – "intensive or pollution survey" design
- July 1 – Sept. 30 index period
- Sampled August 27 – October 15
- Sampling delayed by high flows in July & early August
- ESA issue precluded sampling below Turners Falls




USGS
USGS 01129500 CONNECTICUT RIVER AT NORTH STRATFORD, NH
DAILY Discharge, cubic feet per second
10000
1000
400
Sampling "window"
(July 1 - Sept. 30 index)
Jul 05 2008
Jul 19 2008
Aug 02 2008
Aug 16 2008
Aug 30 2008
Sep 13 2008
Sep 27 2008
Oct 11 2008
Oct 25 2008
---- Provisional Data Subject to Revision ----
Median daily statistic (77 years)
Daily mean discharge

Qualitative Habitat Evaluation Index Field Sheet

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		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:
(High Quality Only, Score 5 or >)
☐ -4 or More [2]
☐ -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]
EMBEDDED NESS:
☐ -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)
____ UNDERCUT BANKS [1]
____ OVERHANGING VEGETATION [1]
____ SHALLOWS (IN SLOW WATER) [1]
____ ROOTMATS [1]

TYPE: Score All That Occur
____ 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): 7

Aesthetic Rating (1-10): 7

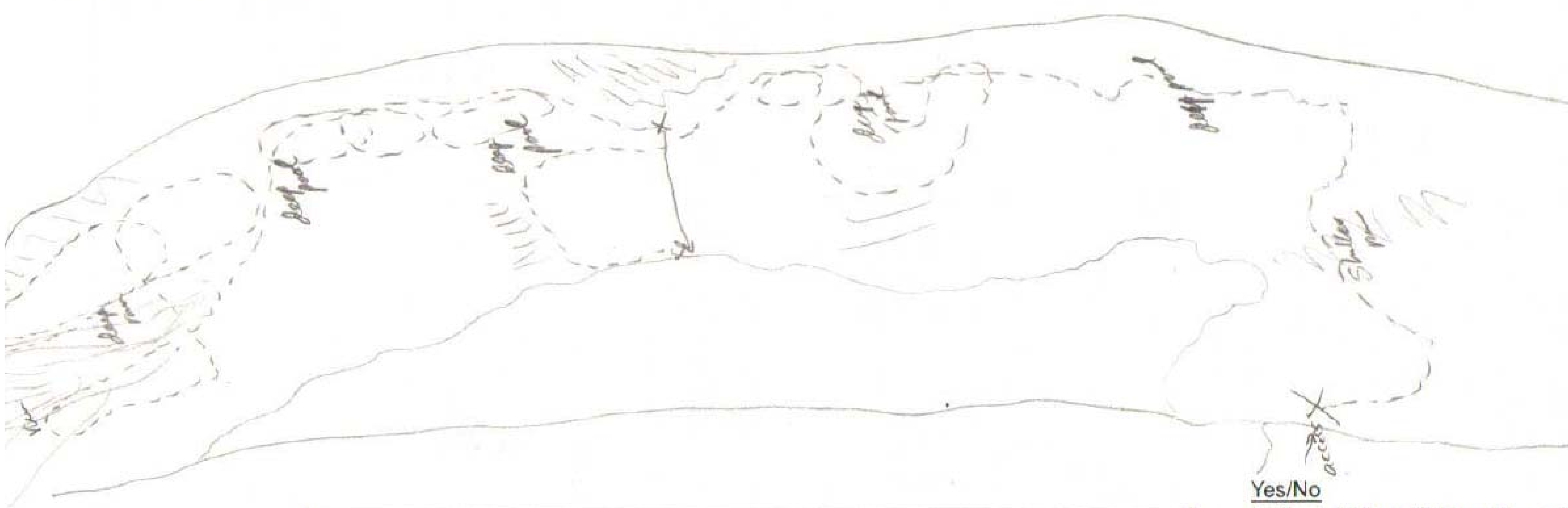
Gradient: ☐ - Low, ☒ - Moderate, ☐ -High

	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

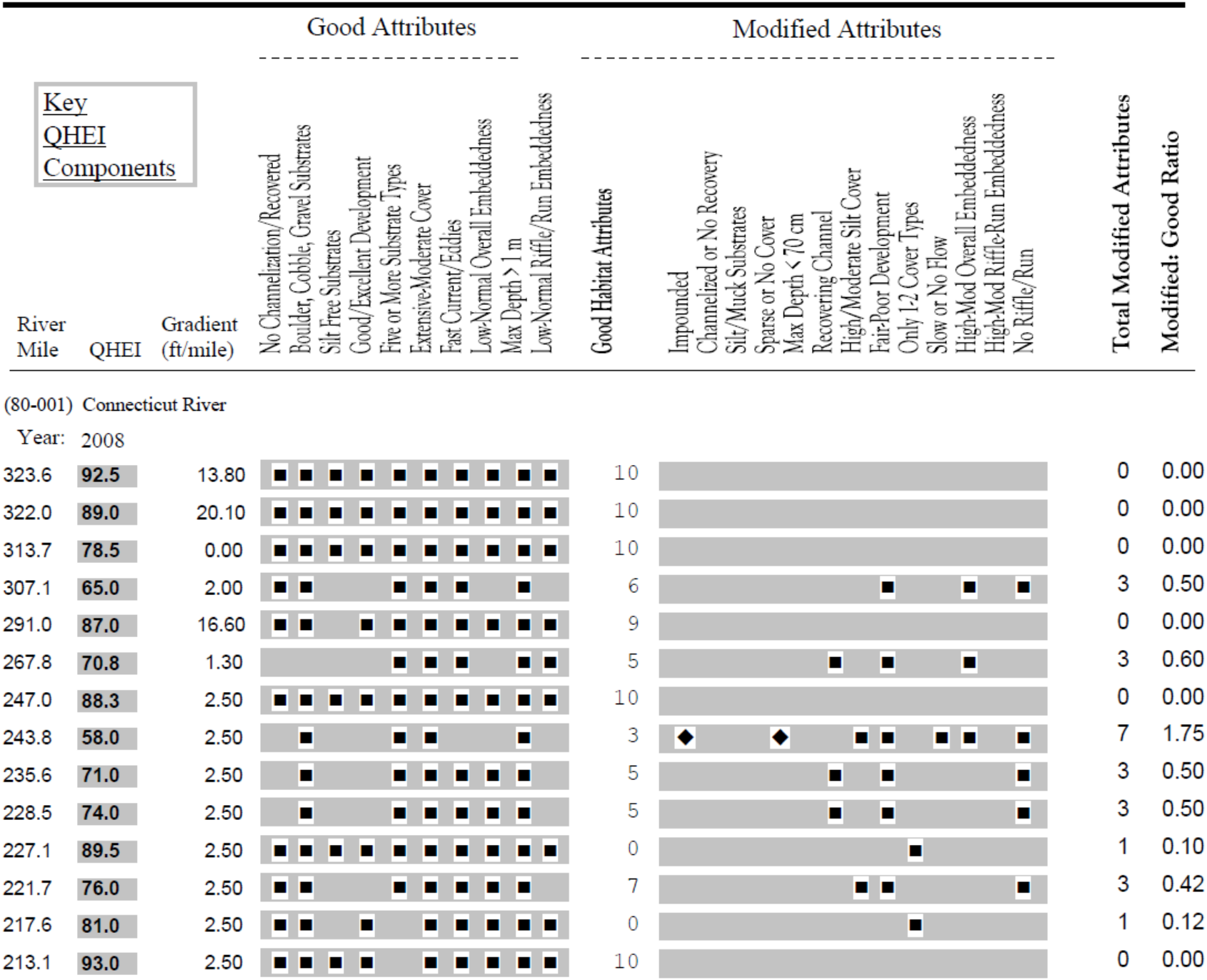
Stream Drawing:



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.

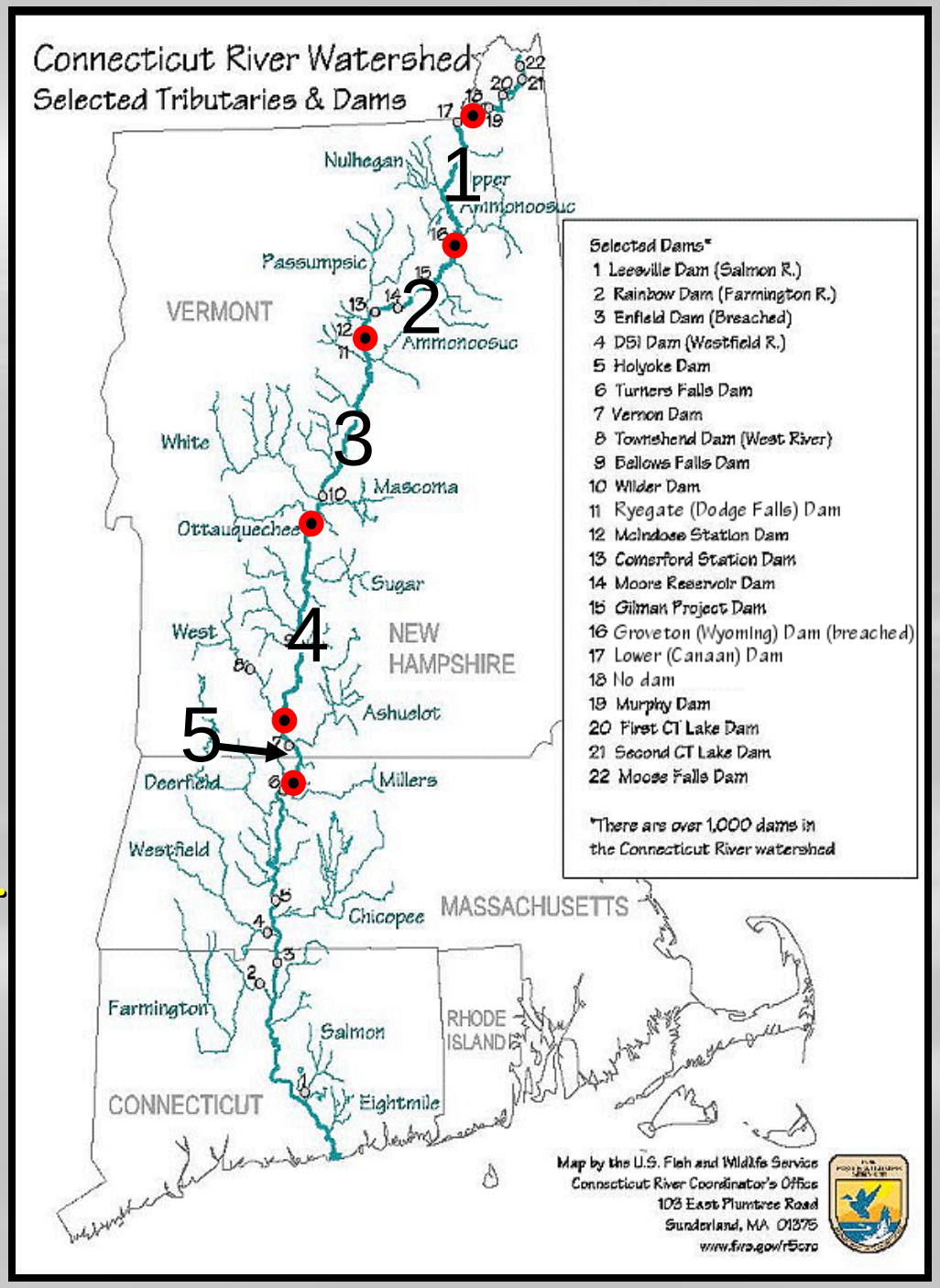
Yes	No	
☐	☐	Is Stream Ephemeral (no pools totally dry or only damp spots)?
☐	☐	Is there water upstream? How Far: ______
☐	☐	Is There Water Close Downstre[am]? How Far: ______
☐	☐	Is Dry Channel Mostly Natural?

Table 1. QHEI scores and metric values for sites in the Connecticut River during 2008.



Study Area Organization

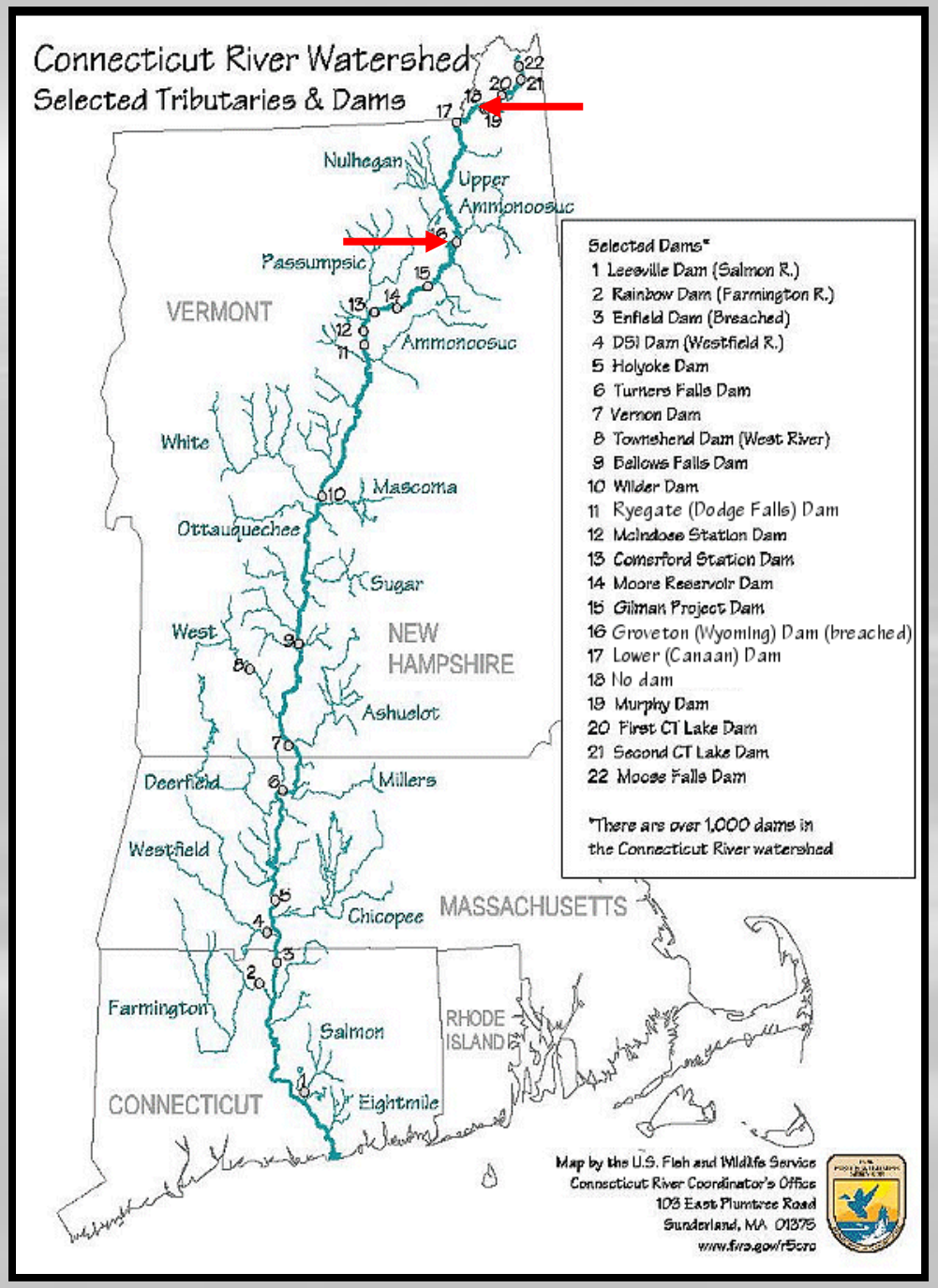
- Zone 1: Murphy Dam (Pittsburg, NH) – Wyoming Dam (Guildhall, VT)
- Zone 2: Wyoming Dam – McIndoe Dam (McIndoe Falls, VT)
- Zone 3: McIndoe Dam- below Wilder Dam (Grafton County)
- Zone 4: Wilder Dam – West River confluence
- Zone 5: West River Confluence – Turners Falls Dam Impoundment (Turners Falls, MA)



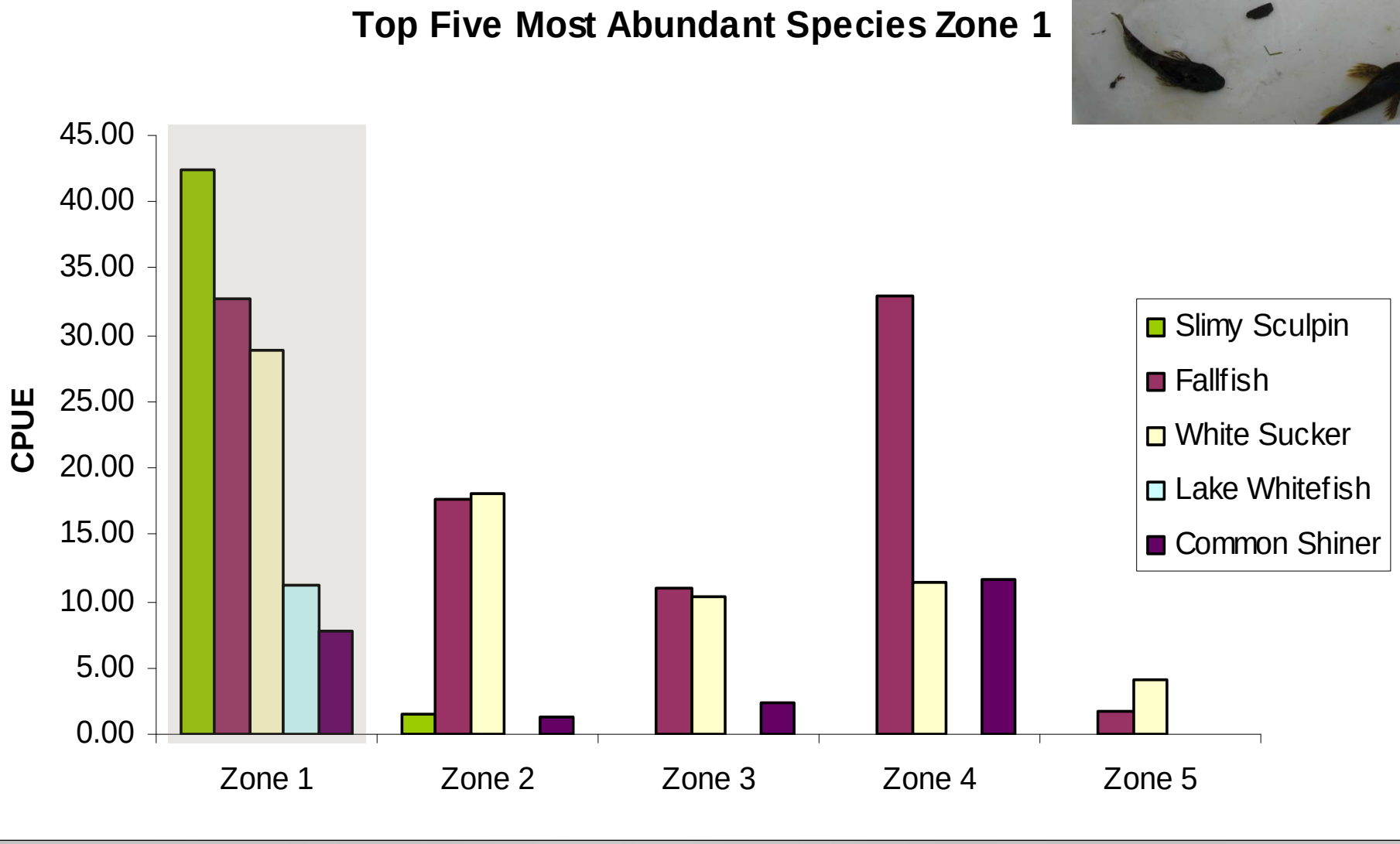
Zone 1

Murphy Dam – Wyoming Dam

- 21 species
- Pre dominated (biomass) by stenothermic species including;
  - Atlantic salmon
  - Brook trout
  - Brown trout
  - Slimy sculpin
  - Burbot
  - Rainbow trout



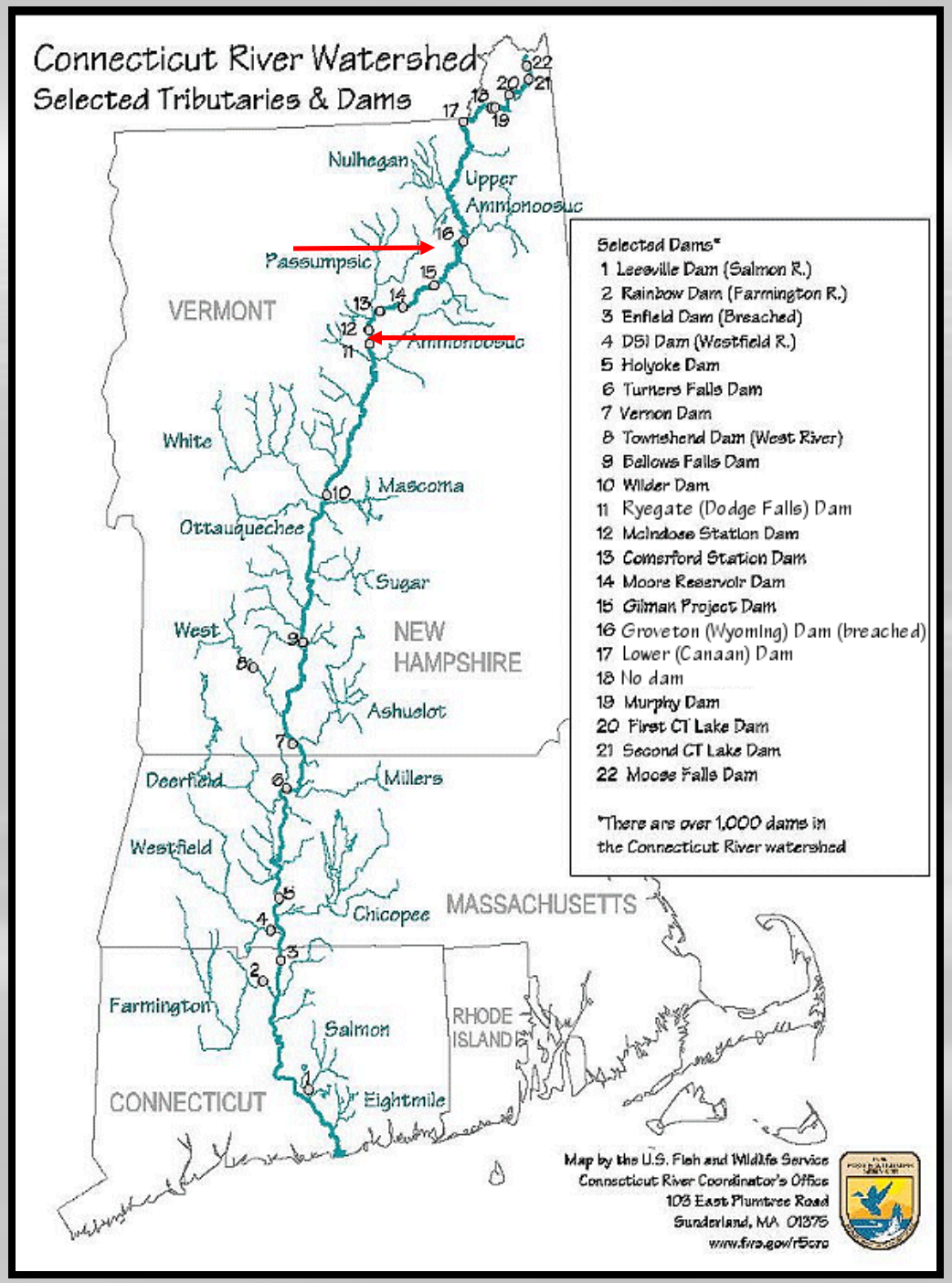
Zone 1


Top Five Most Abundant Species Zone 1
CPUE
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Slimy Sculpin
Fallfish
White Sucker
Lake Whitefish
Common Shiner

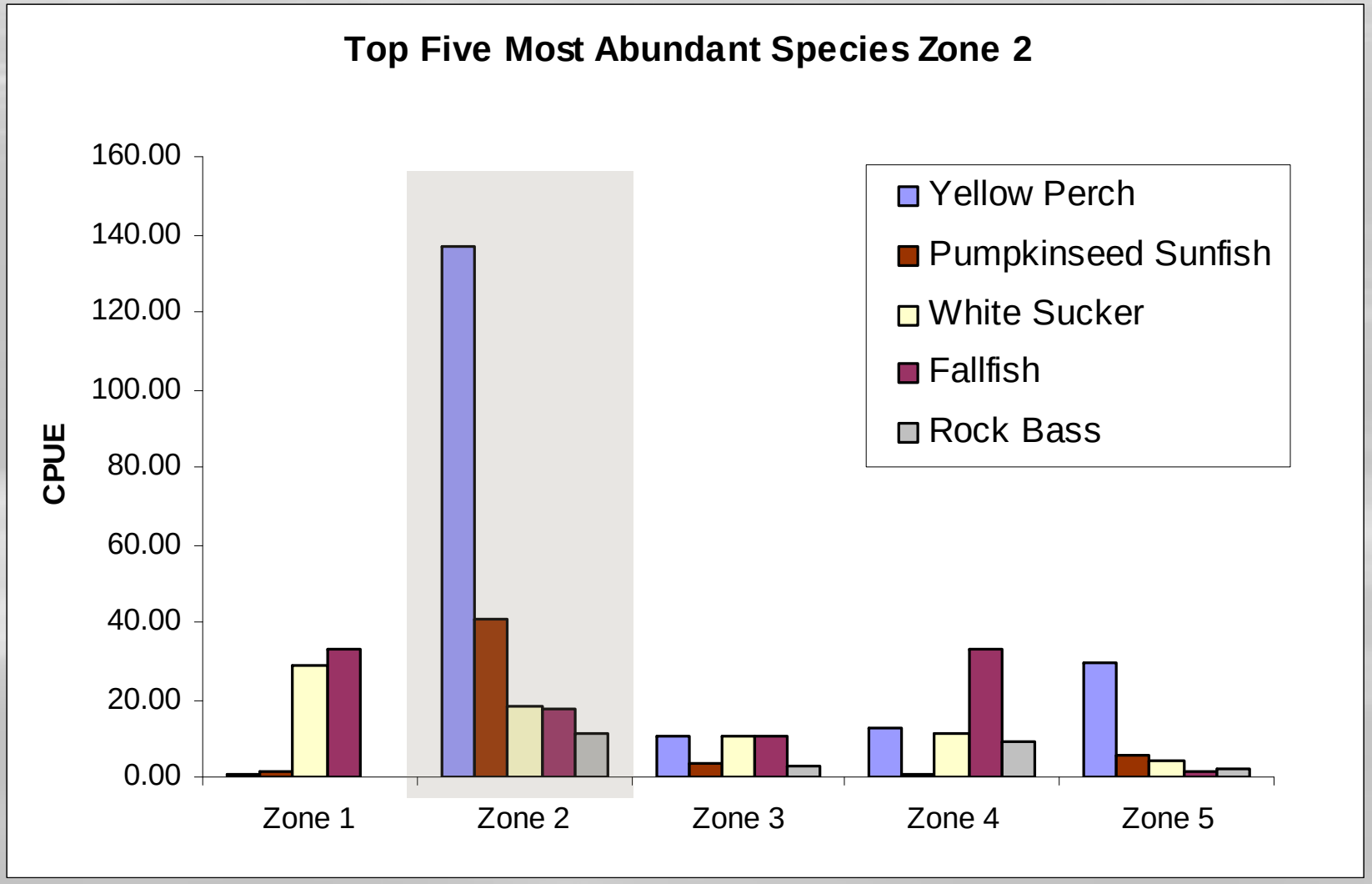
Zone 2

Wyoming Dam – McIndoe Dam

- 25 species
- Transition zone
- Reduction in stenothermic species (CPUE)
- Increase in mesothermic and eurythermic sp.
- Impounded habitat effects



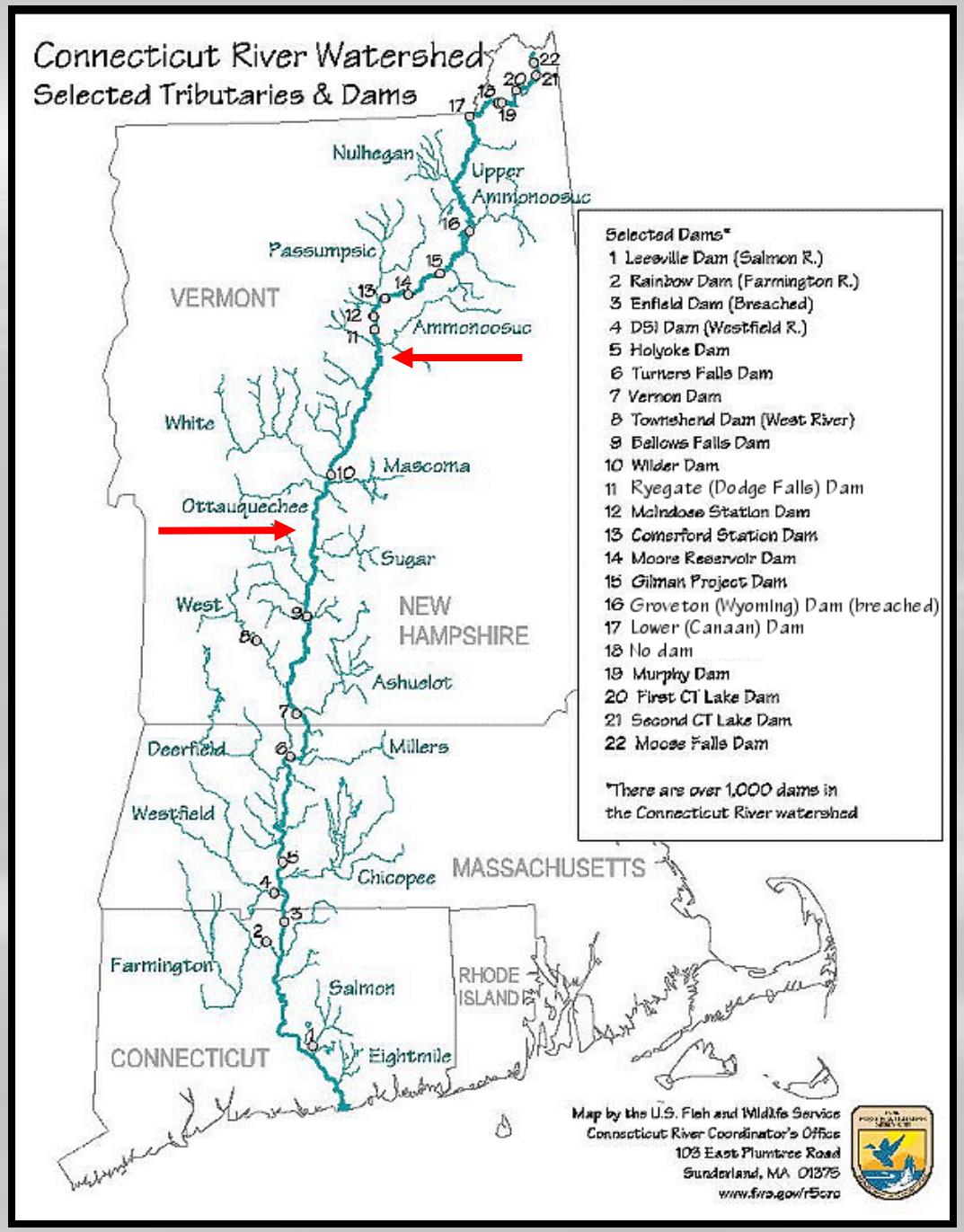
Zone 2


Top Five Most Abundant Species Zone 2
CPUE
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Yellow Perch
Pumpkinseed Sunfish
White Sucker
Fallfish
Rock Bass

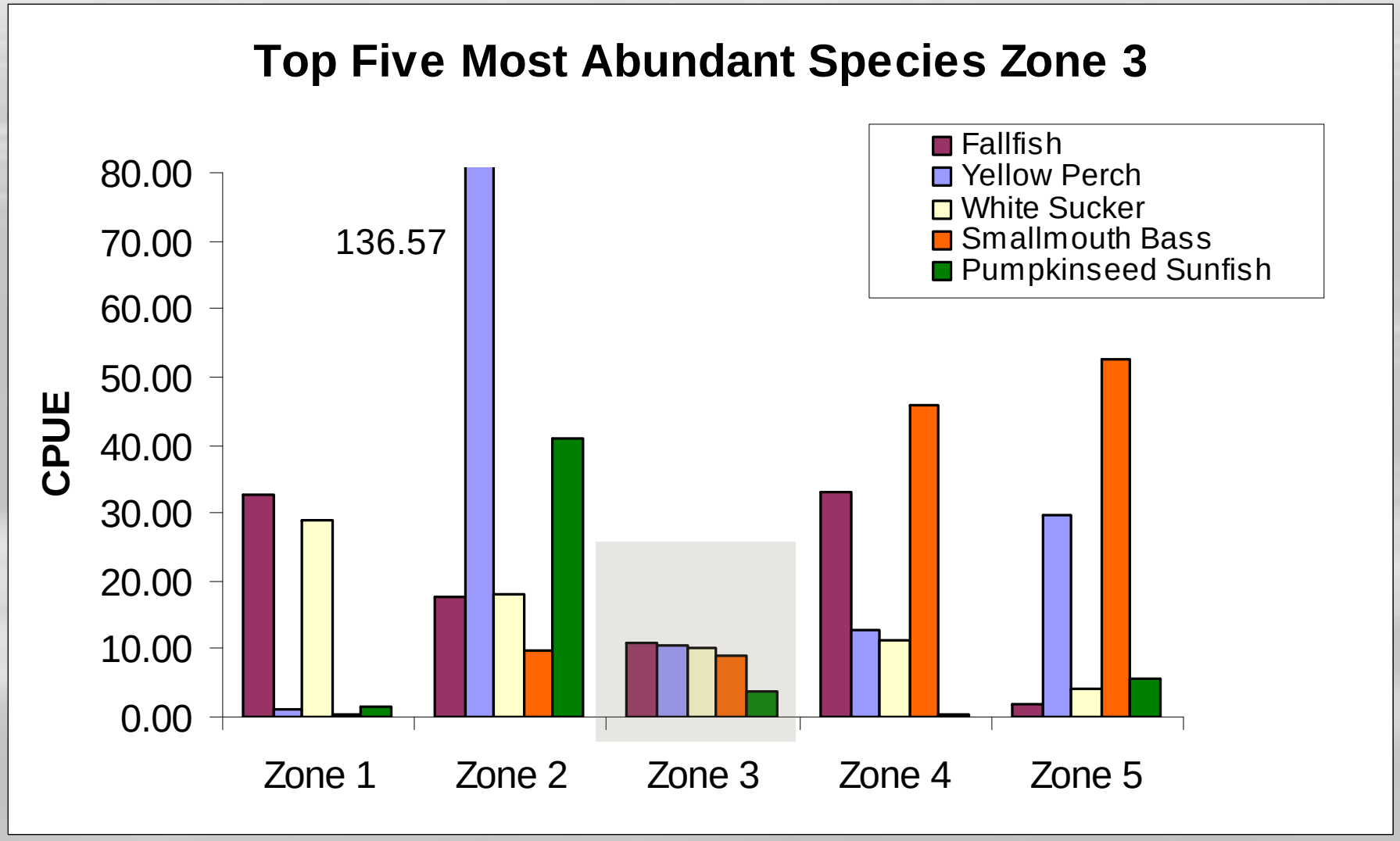
Zone 3

McIndoe Dam-Wilder Dam

- 21 species
- Predominated by mesothermic & eurythermic sp.
- Stenothermic species are absent
- First appearance of diadromous species (sea lamprey)



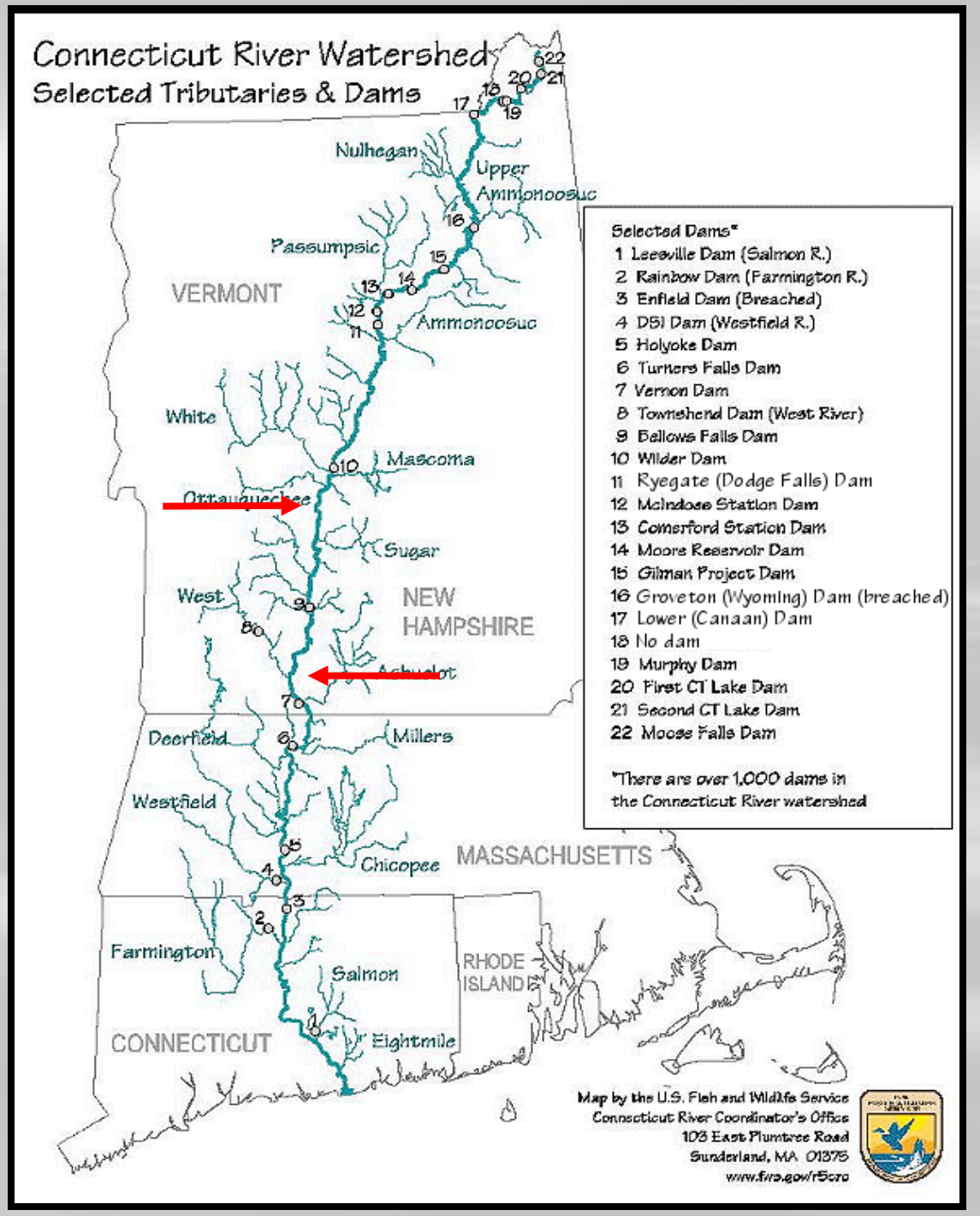
Zone 3


Top Five Most Abundant Species Zone 3
Fallfish
Yellow Perch
White Sucker
Smallmouth Bass
Pumpkinseed Sunfish
CPUE
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
136.57
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

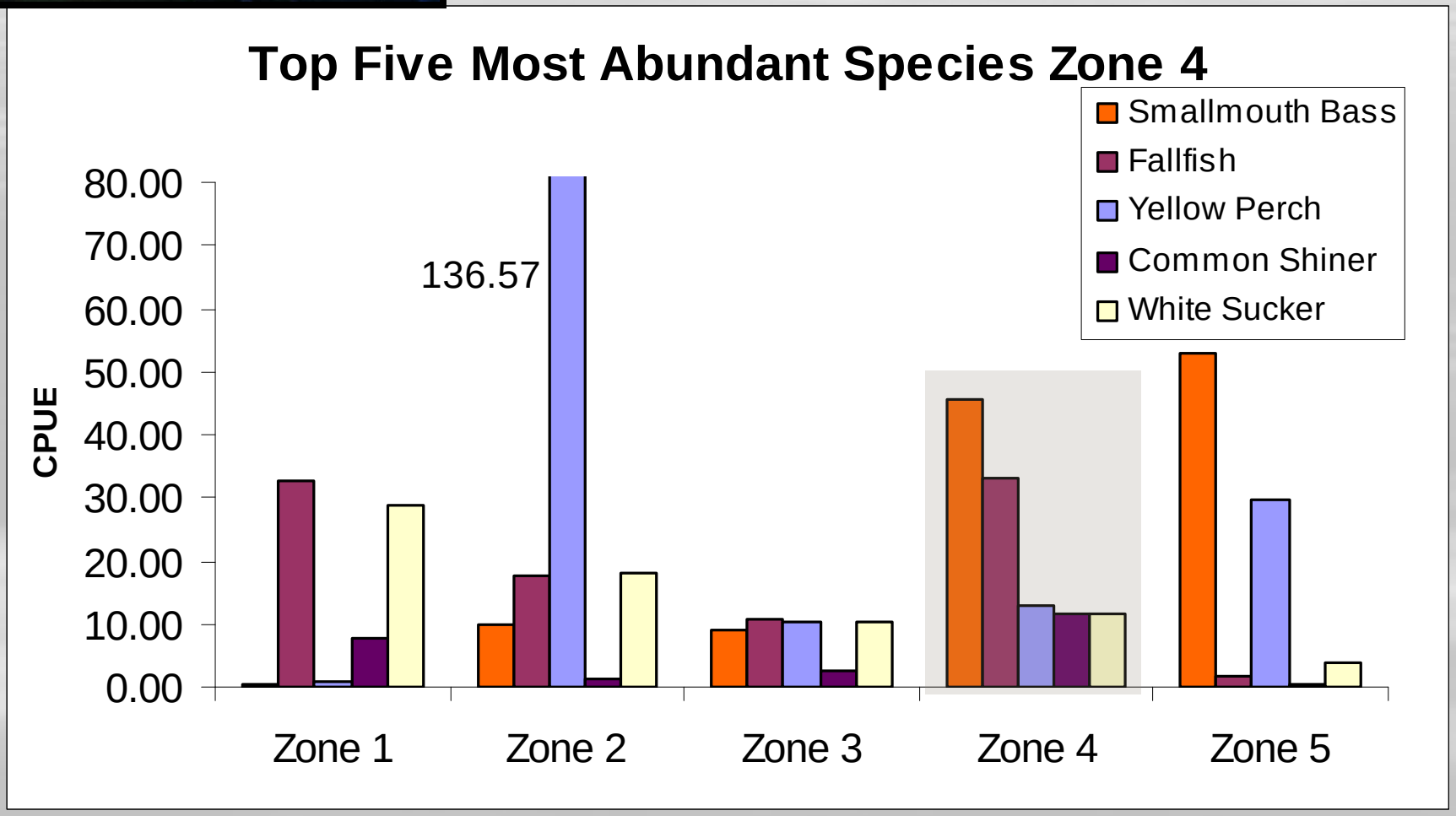
Zone 4

Wilder Dam- West River

- 27 species
- Assemblage predominated by Centrarchids
- American shad (y-o-y)



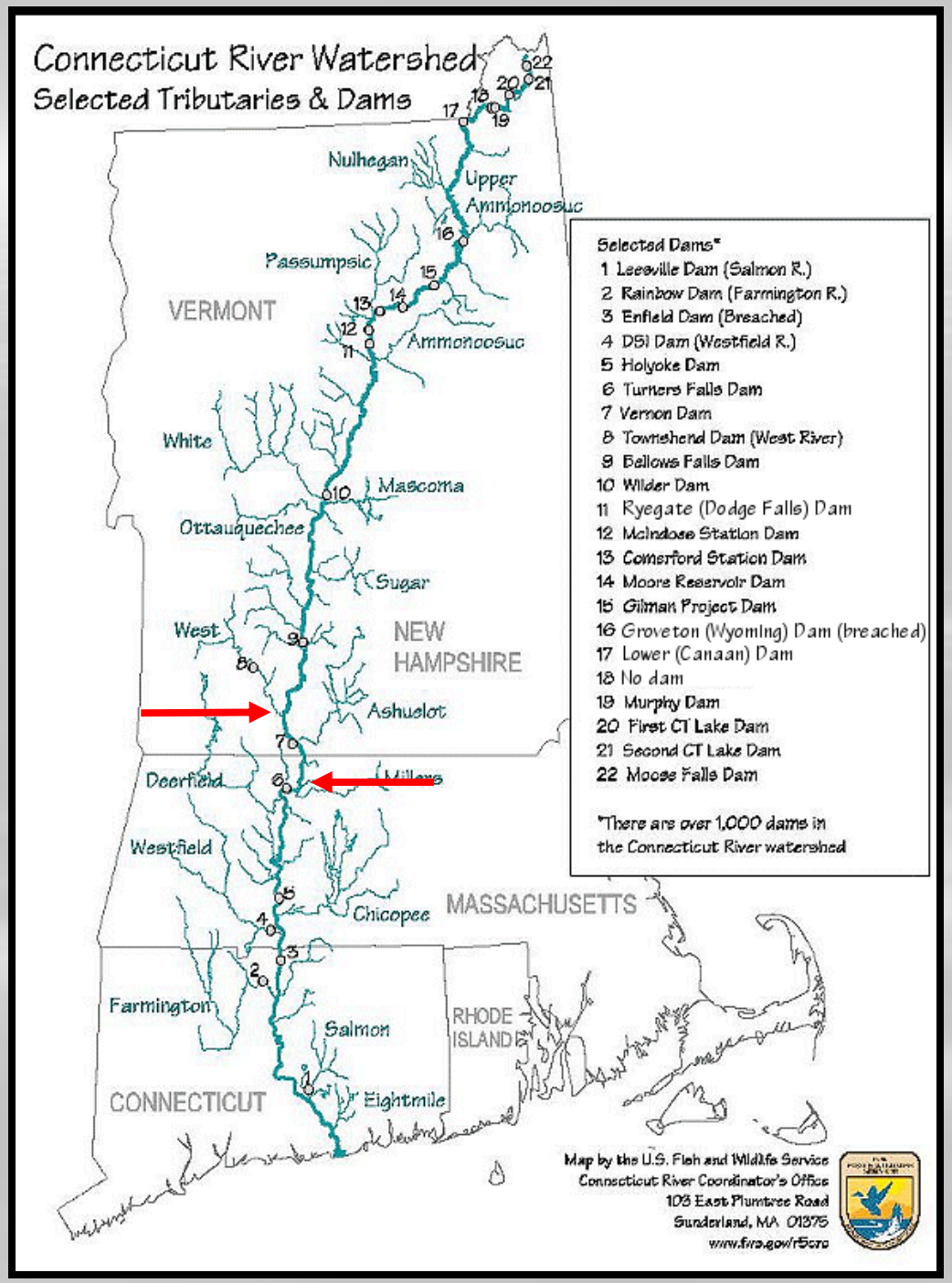
Zone 4


Top Five Most Abundant Species Zone 4
Smallmouth Bass
Fallfish
Yellow Perch
Common Shiner
White Sucker
CPUE
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
136.57
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

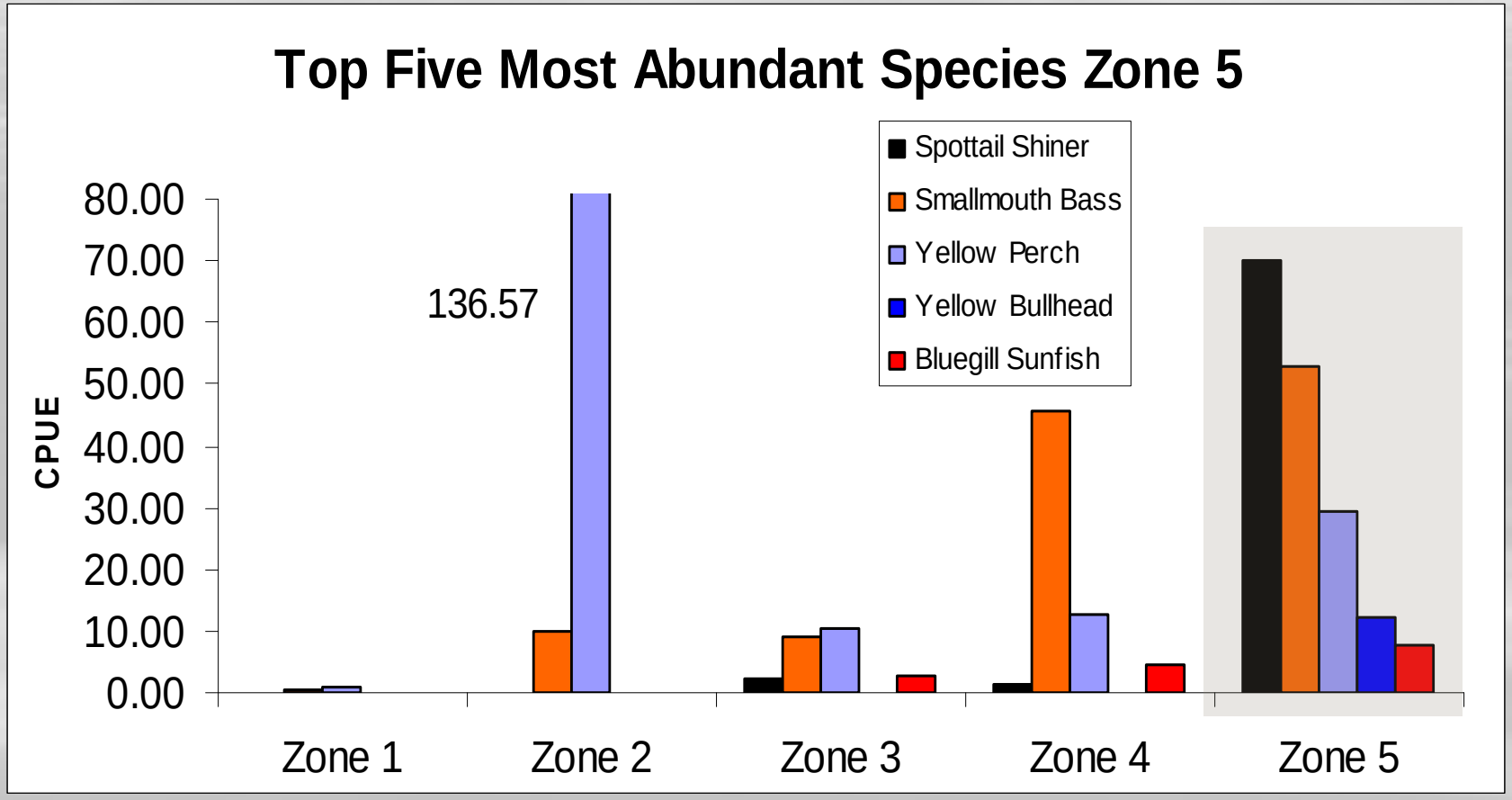
Zone 5

West River– Turners Falls Impoundment

- 19 species
- Increase in diadromous species:
  - American eel
  - American shad
  - Sea lamprey



Zone 5

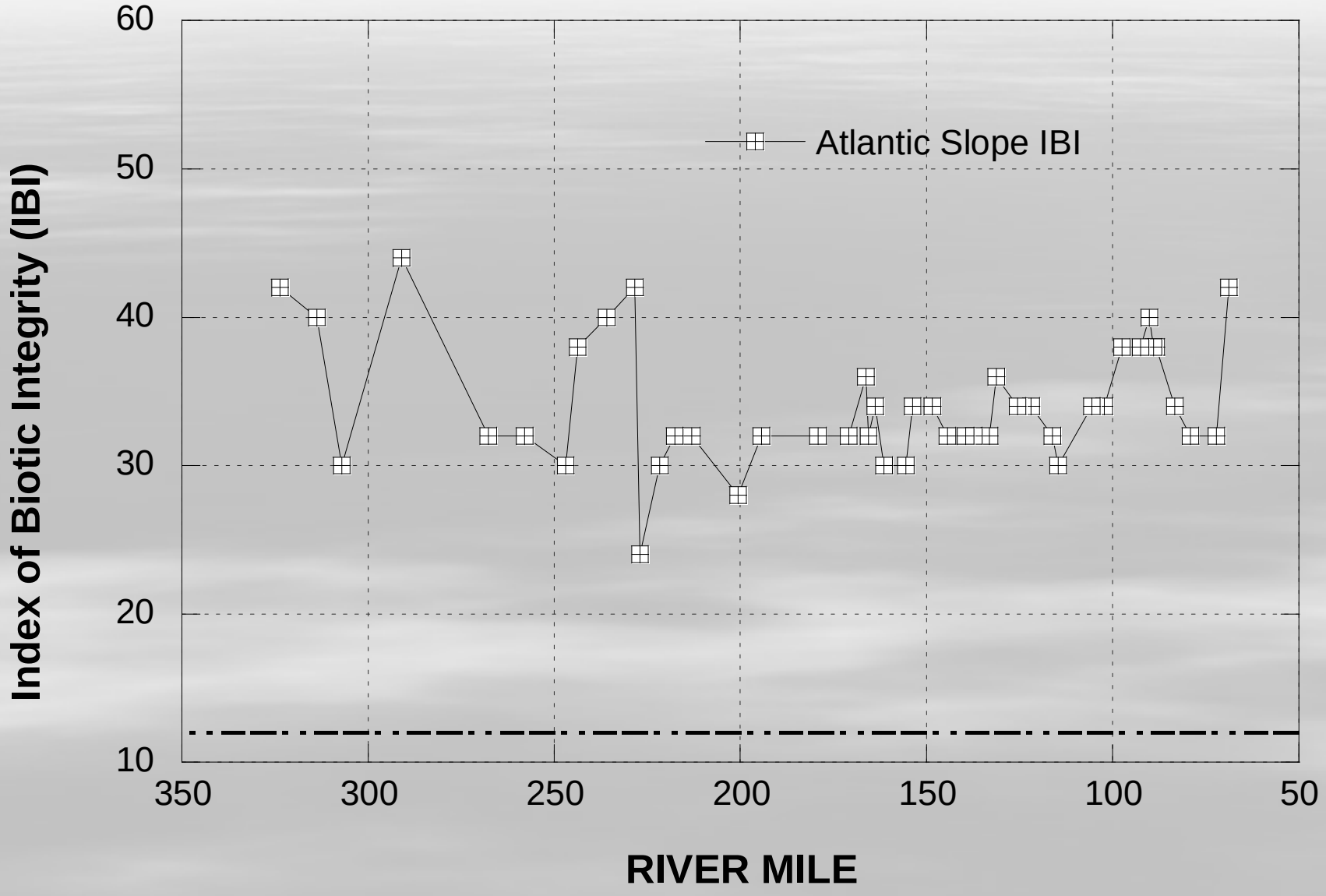

Top Five Most Abundant Species Zone 5
Spottail Shiner
Smallmouth Bass
Yellow Perch
Yellow Bullhead
Bluegill Sunfish
CPUE
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
136.57
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5

Patterns?

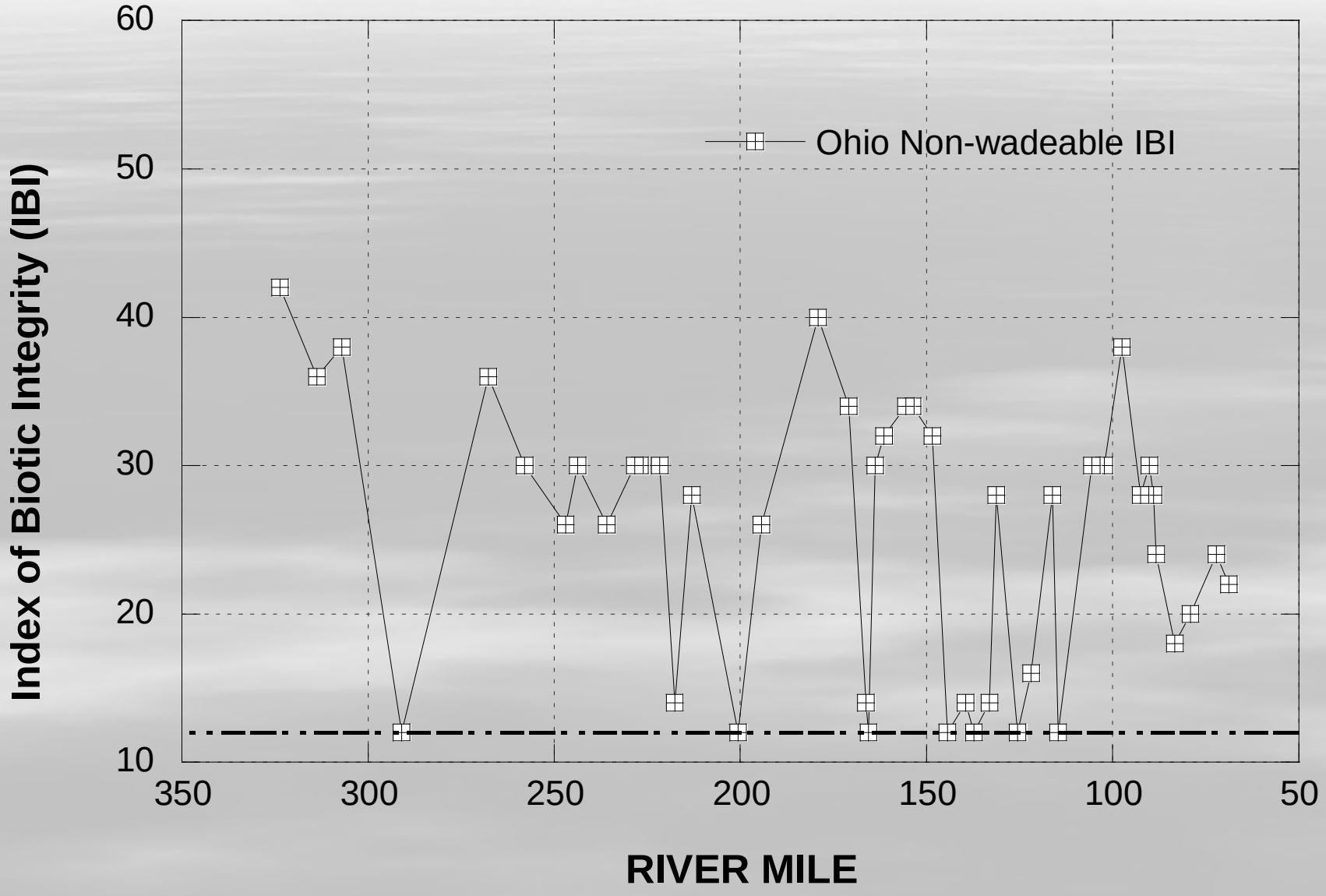
- Generalist and eurythermic species on the rise
- Effects of blackbass?
- % increase in CPUE in Zone 2
  - Smallmouth bass 3000%
  - Pumpkinseed 3100%

- Brook trout absent & other stenothermic species severely reduced in zones 3-5.
- CPUE reductions (%) in Zone 2
  - Salmon 57%
  - Brown trout 83%
  - Rainbow trout 62%
  - Slimy sculpin 96%

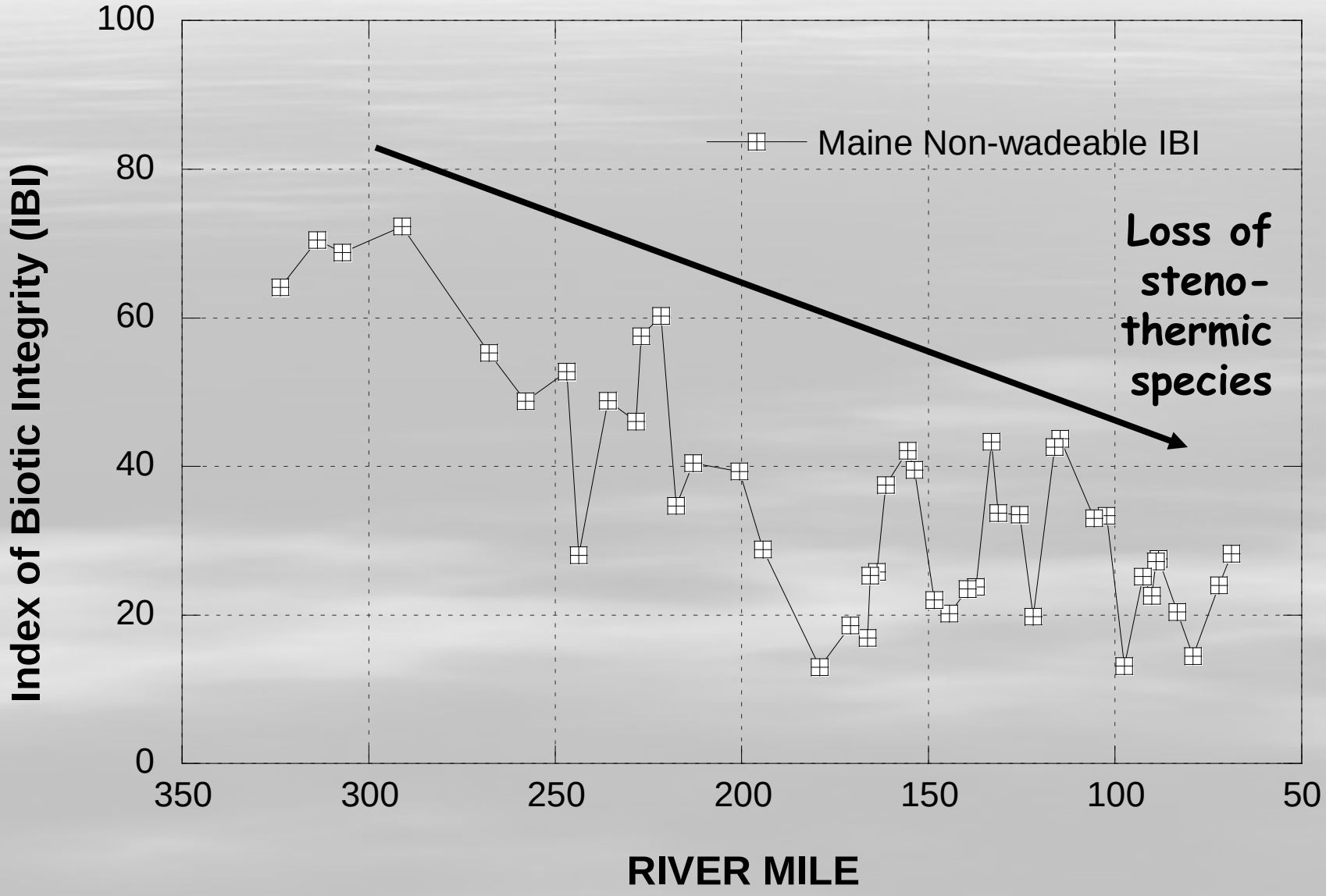
Atlantic Slope IBI – Daniels et al. (2003)



Ohio Non-Wadeable IBI – Ohio EPA (1987)



Maine Non-Wadeable IBI – Under Development



Maine & Connecticut Rivers Assemblage Results Comparison: 2002-8

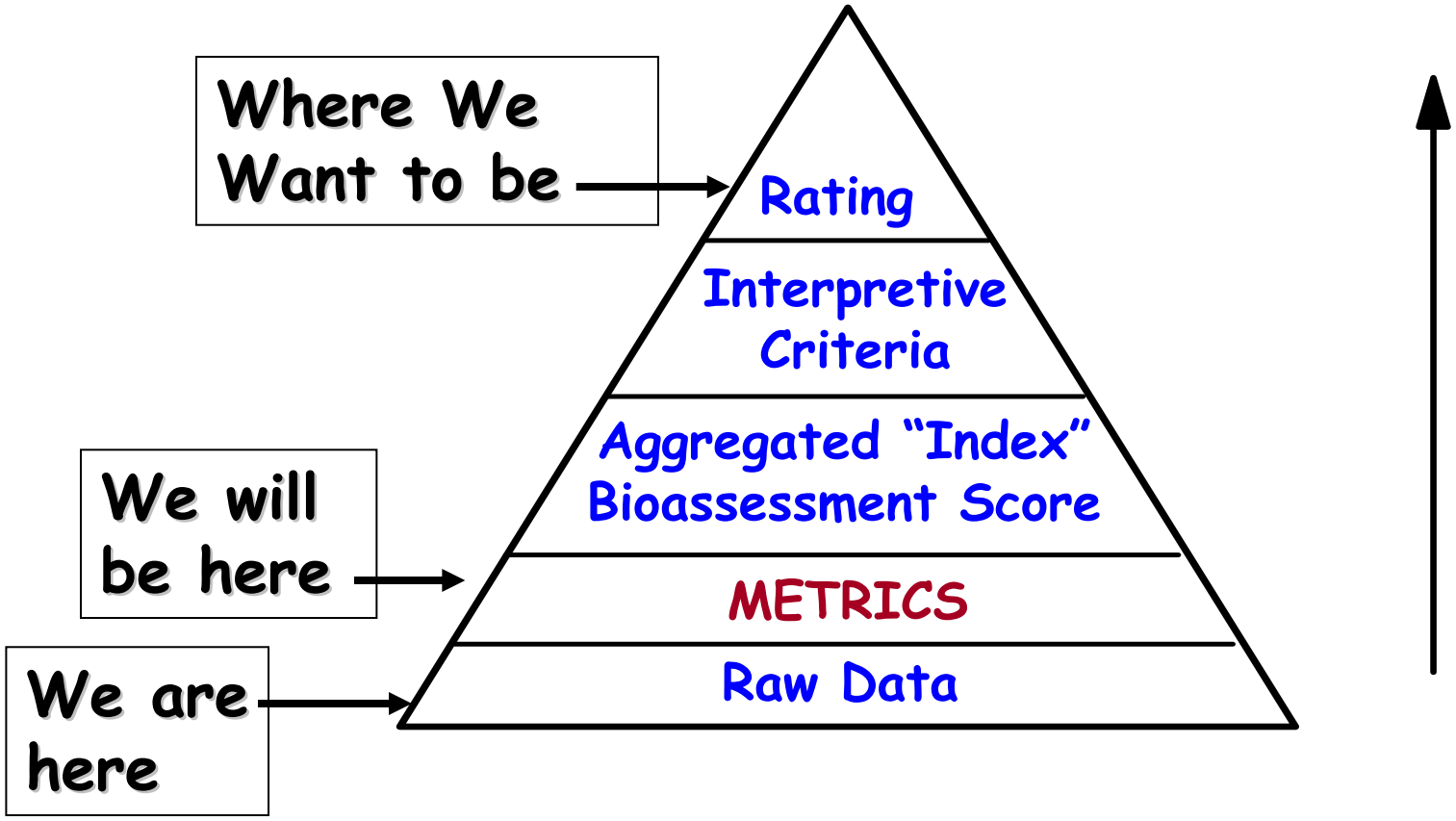
River	Species	Intro.	No/Km	Kg/km	Effort (km)
Kennebec	37	9	437	56.8	132.1
Androscoggin	32	12	598	31.4	97.0
Penobscot	31	6	335	19.8	42.8
St. John	18	2	211	12.5	14.5
Aroostook	22	0	311	15.2	9.3
Allagash	19	1	413	10.6	6.3
Connecticut	41	5*	157	6.1	51.9
Scioto R. (OH)	82	6*	603	157	107.8

* - 5 as hybrids

Checklist of Fish Assemblage Development Tasks:

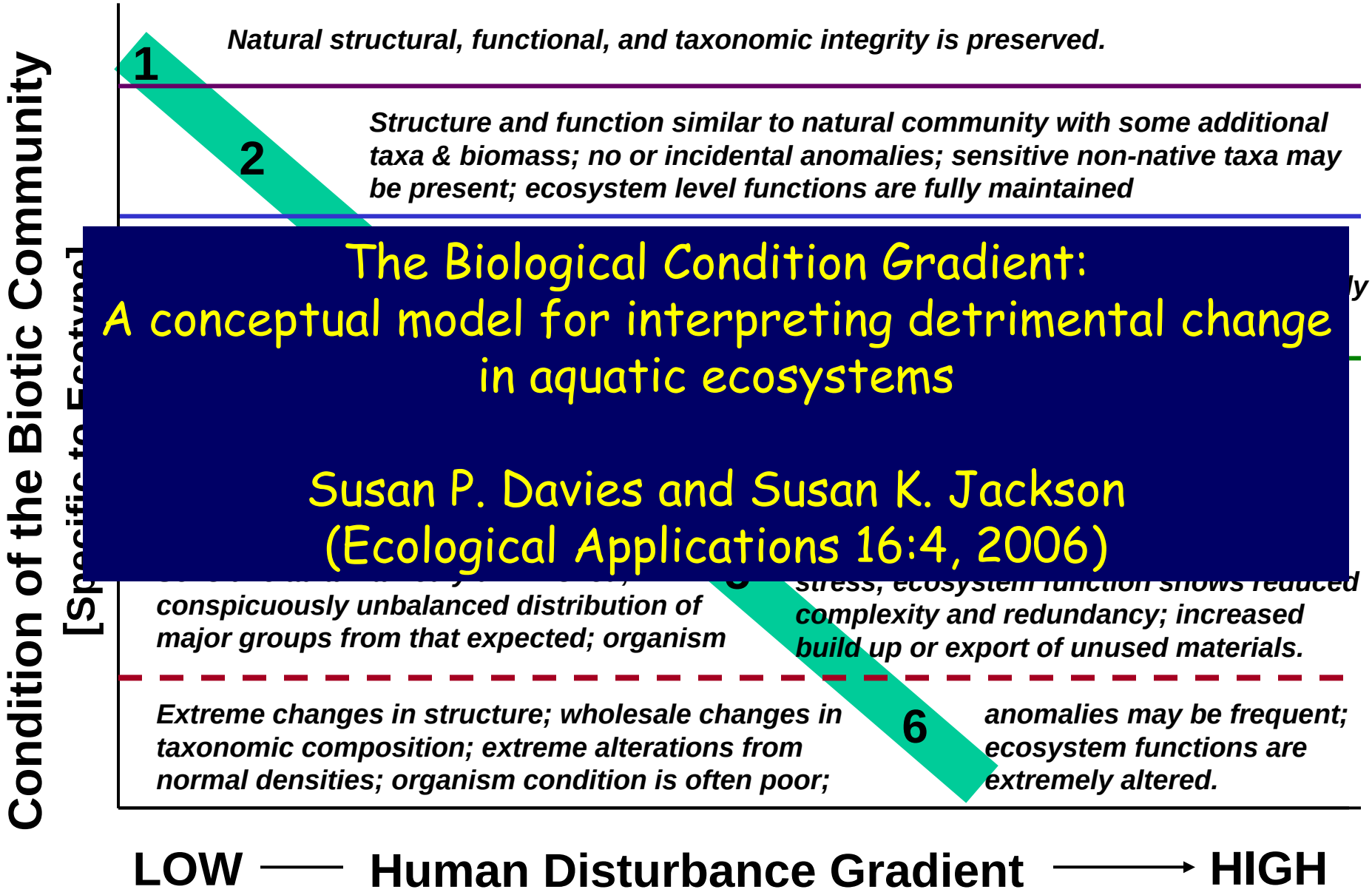
- Develop an effective & systematic sampling method (2001-3 in Maine)
- Develop a sufficient spatial & temporal database (2008-9)
- Autecology of extant fauna & metric development (started in 2005-6; add new sp.)
- Identify riverine ecotypes (2009)
- Establish "reference condition" – BCG (2009-10)
- Derive and test IBIs with reference and independent test sites (2009-10)

Data Manipulation Hierarchy of Field Collected Biological Samples: New England Non-wadeable IBIs



Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

(10/22 draft)

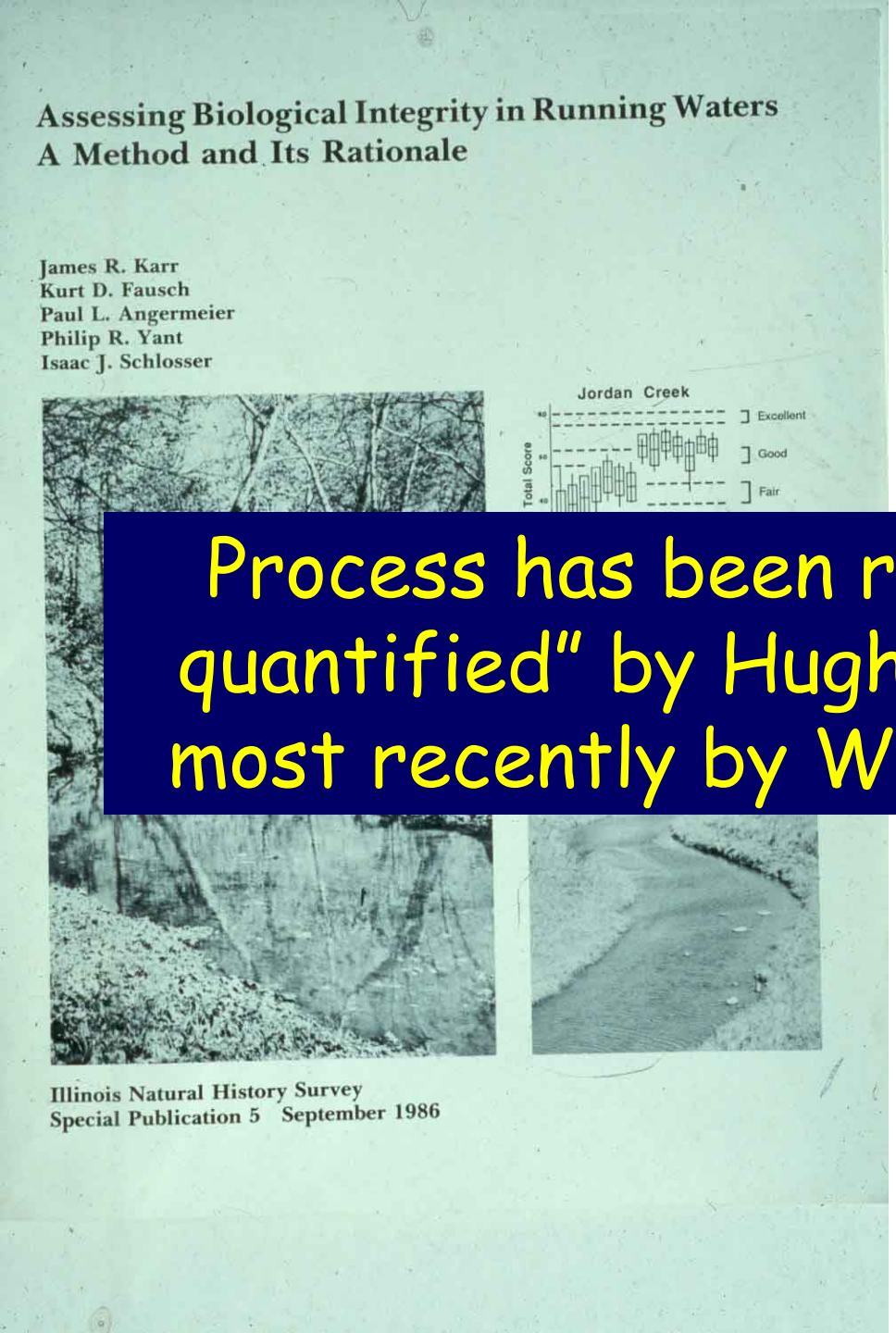


The Biological Condition Gradient: A conceptual model for interpreting detrimental change in aquatic ecosystems

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

Cold Water & Mixed Assemblages

We need an "assumed baseline" for the Biological Condition Gradient applicable to NE large rivers



Guidelines for Deriving Regionally Relevant "IBI Type" Assessment Tools

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

- Karr et al. (1986) provides guidance for metric development, substitution, [illegible] natural history.
- Requires an extensive database from consistent sampling of both reference condition and a gradient of human disturbance.
- Requires extensive testing of candidate metrics and aggregate indices.