National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
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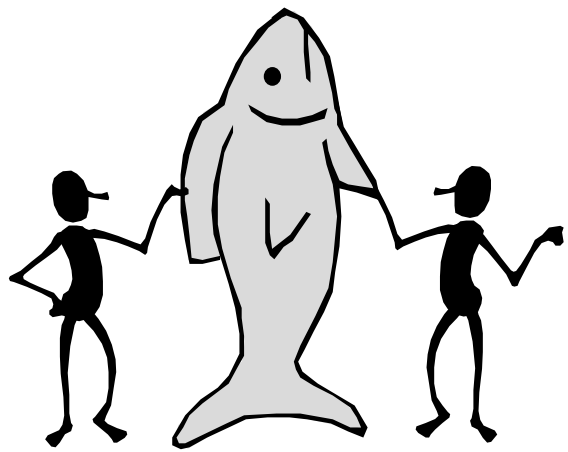
# LR 101

# *Section 4e: Methods for Sampling Fish in Large Rivers*

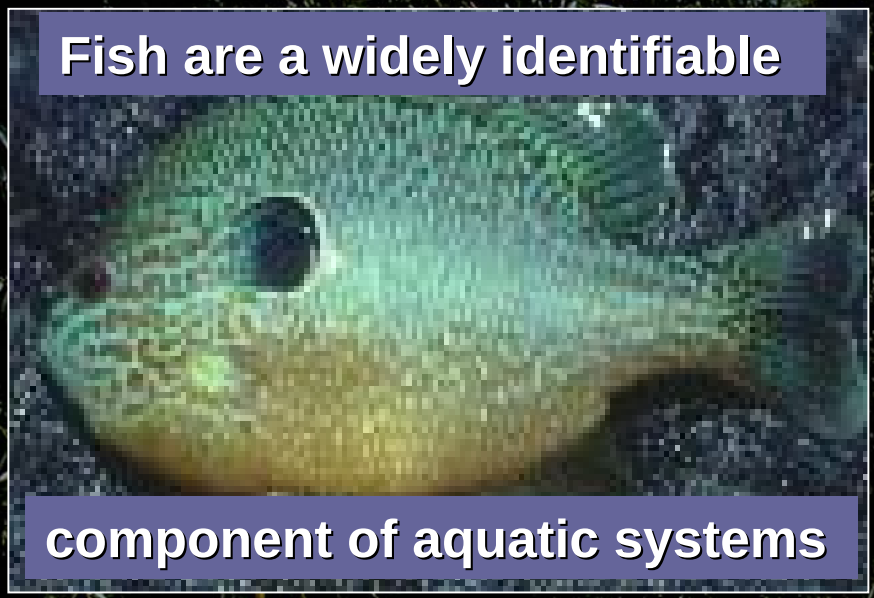

***Presented by***

**Joseph E. Flotemersch, USEPA, Office of Research & Development**


I’m healthy,
I’m healthy,
let me go…

Fish are a widely identifiable



component of aquatic systems

Many are valued for their recreational uses

Most species, however, are obscure

And comprise the second most endangered group of animals

# Characteristics of Vertebrates (e.g., Fish) that make them useful indicators

1) **Accurate environmental assessment of health**
2) **Visibility**
3) **Standardized use and interpretation**
4) **Extensively used in large river programs around the world**
5) **Long history of development and use in assessment; thus a strong body of literature from which to draw** Ref: Simon 1999
6) **Historical knowledge of distribution**

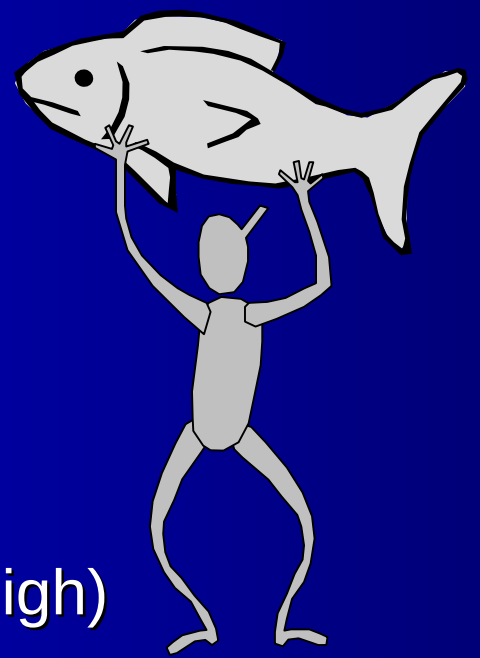
# Fish (Vertebrates)

Important program development questions

- **Which sub-habitats**
- **What reach length**
- **What time of day**
- **Which methods (single vs. multiple gear)**
- **Field identification (knowing what to take back to the lab)**
- **What is the final indicator**

# Fish (Vertebrates)
# Common Sampling Approaches

- **Active sampling methods**
  - Electrofishing
  - Seining
- **Passive sampling methods**
  - Nets (hoop, fyke, gill, trap, etc.)
    - Specific applications
      - Electrofishing prohibited
      - Target Species
      - Prohibitive conductivity (low and high)



# Fish (Vertebrates)
# Active Sampling Methods


Electrofishing – Widely considered the most comprehensive and effective ***single*** method for collecting river fishes

# Electrofishing Examples

***Wisconsin***

**1 mile shoreline; daytime; 3000 W, 60 Hz; 1 netter (17 mm mesh); downstream**

***EPA – EMAP (Western Rivers)***

**80X width shoreline; daytime; 2500 W, 120 Hz; 1 netter (1/4" mesh); downstream**

***Ohio***

**500m shoreline; daytime; 5000 W, 120 Hz; 1 netter (1/4" mesh); downstream**

***ORSANCO (Ohio R.)***

**500m of shoreline; nighttime; 5000 W, 120 Hz; 1 netter (1/4" mesh); downstream**

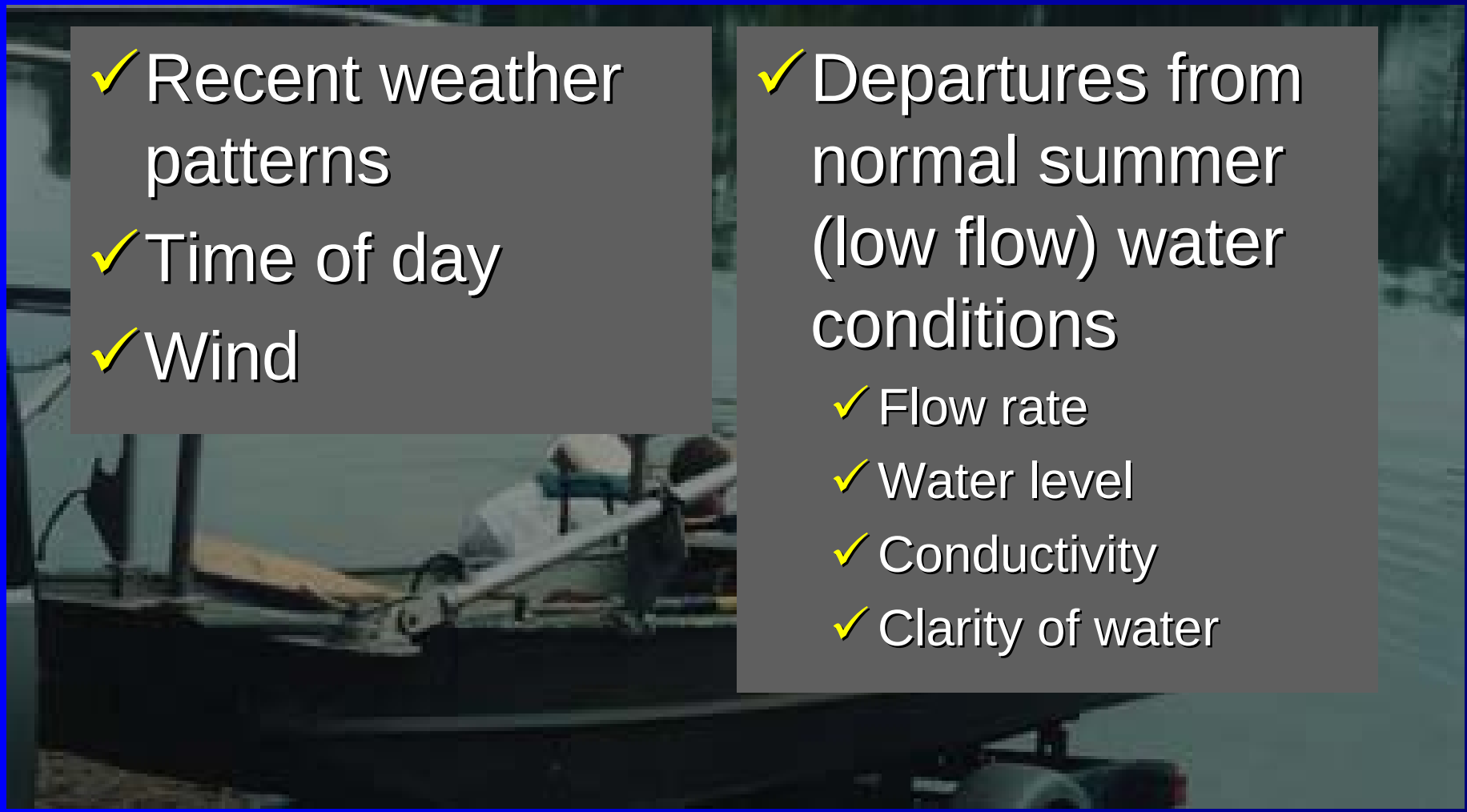
# May require an array of equipment to cover all encountered systems.

# Human factors
## influencing electrofishing performance

- ✓ Equipment
  - ✓ Configuration
    - ✓ Boat size
    - ✓ Electrode array
    - ✓ Setting
    - ✓ Equipment condition
- ✓ Crew experience
  - ✓ Especially crew leader
  - ✓ Skill of boat driver
  - ✓ Historical focus

- ✓ Physical skill and capacity
- ✓ Attention to detail
- ✓ Skill in fish identification
- ✓ Training

# Environmental factors
## influencing electrofishing performance

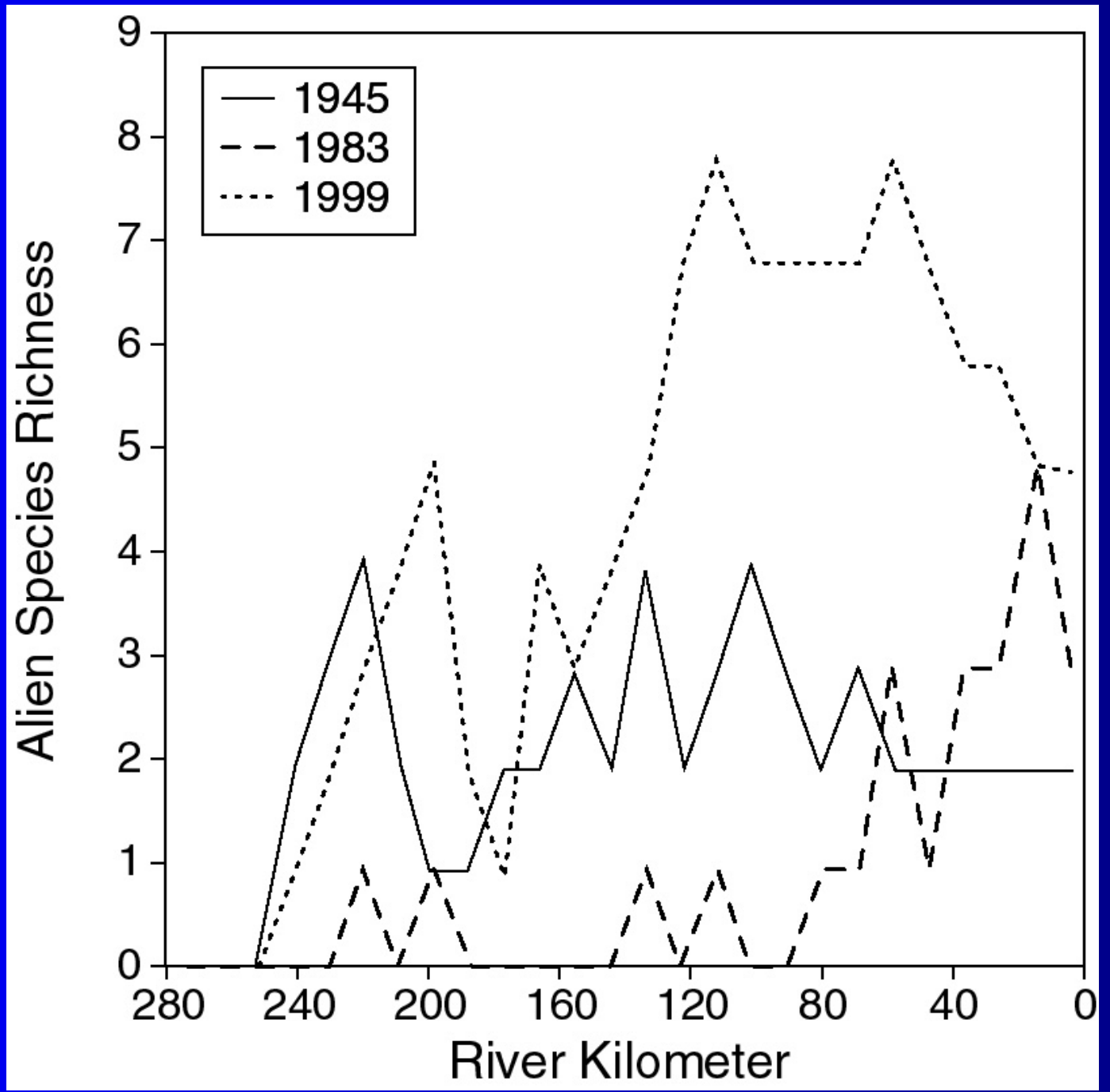


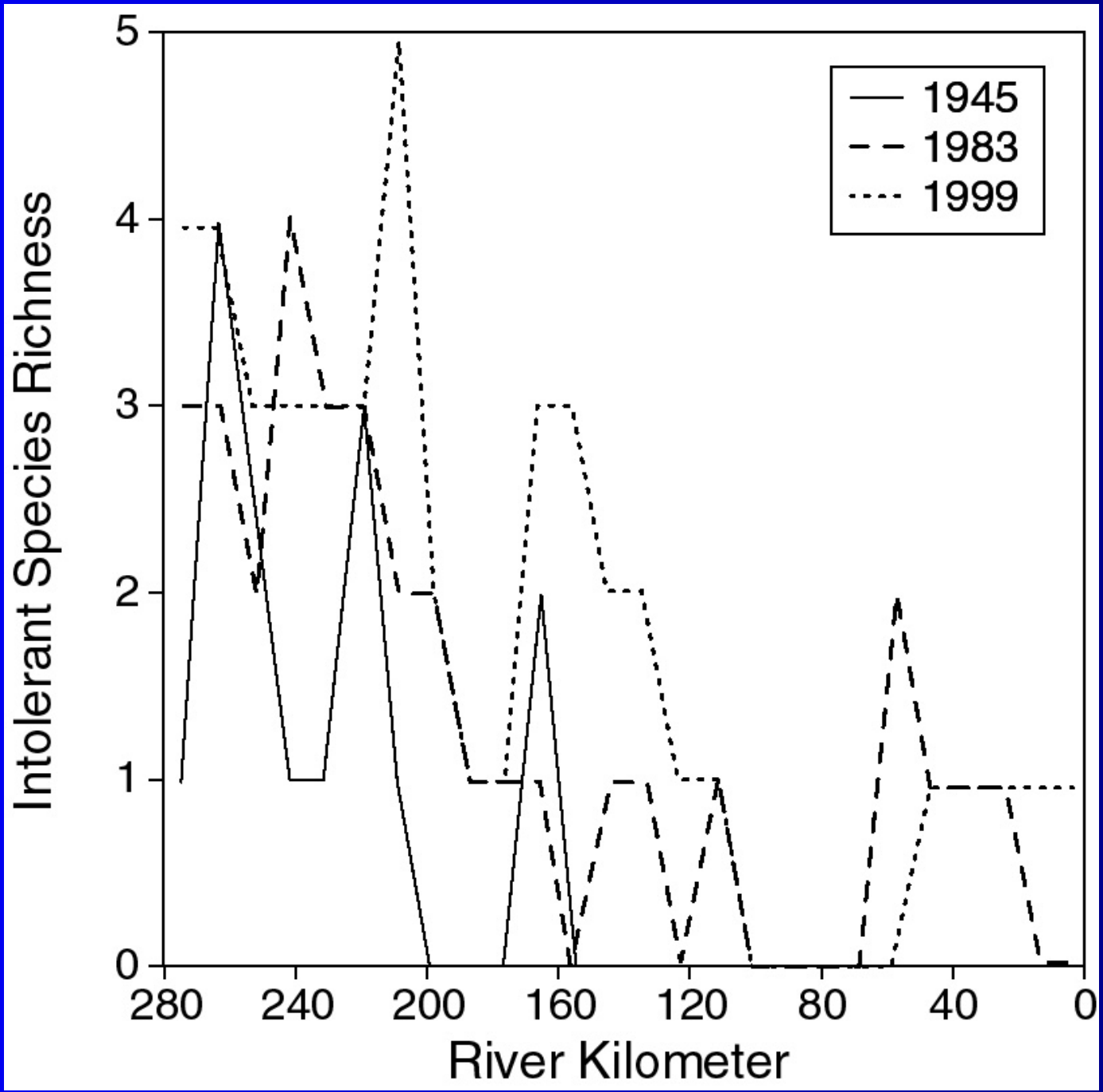
- ✓ Recent weather patterns
- ✓ Time of day
- ✓ Wind

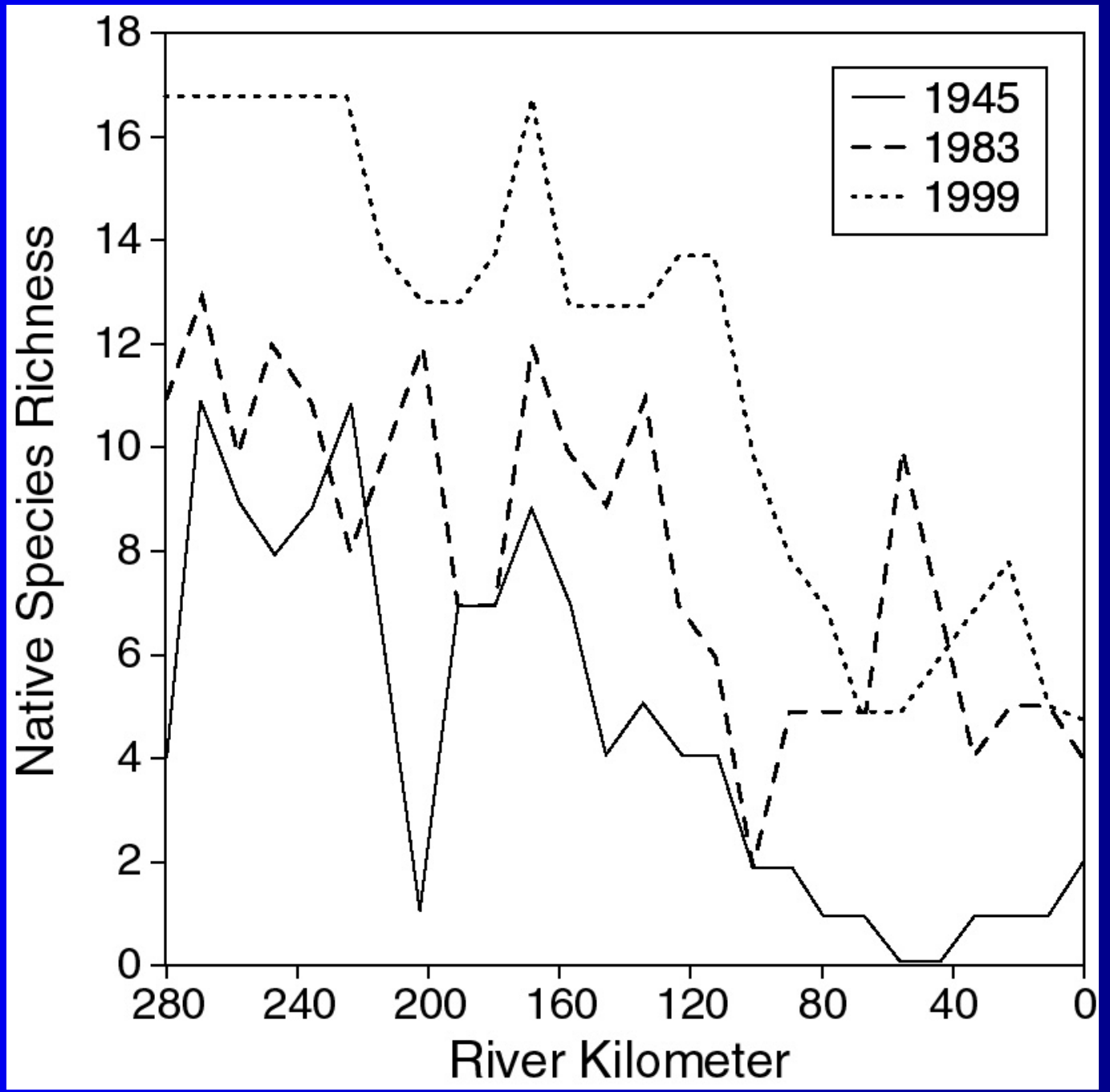
- ✓ Departures from normal summer (low flow) water conditions
  - ✓ Flow rate
  - ✓ Water level
  - ✓ Conductivity
  - ✓ Clarity of water

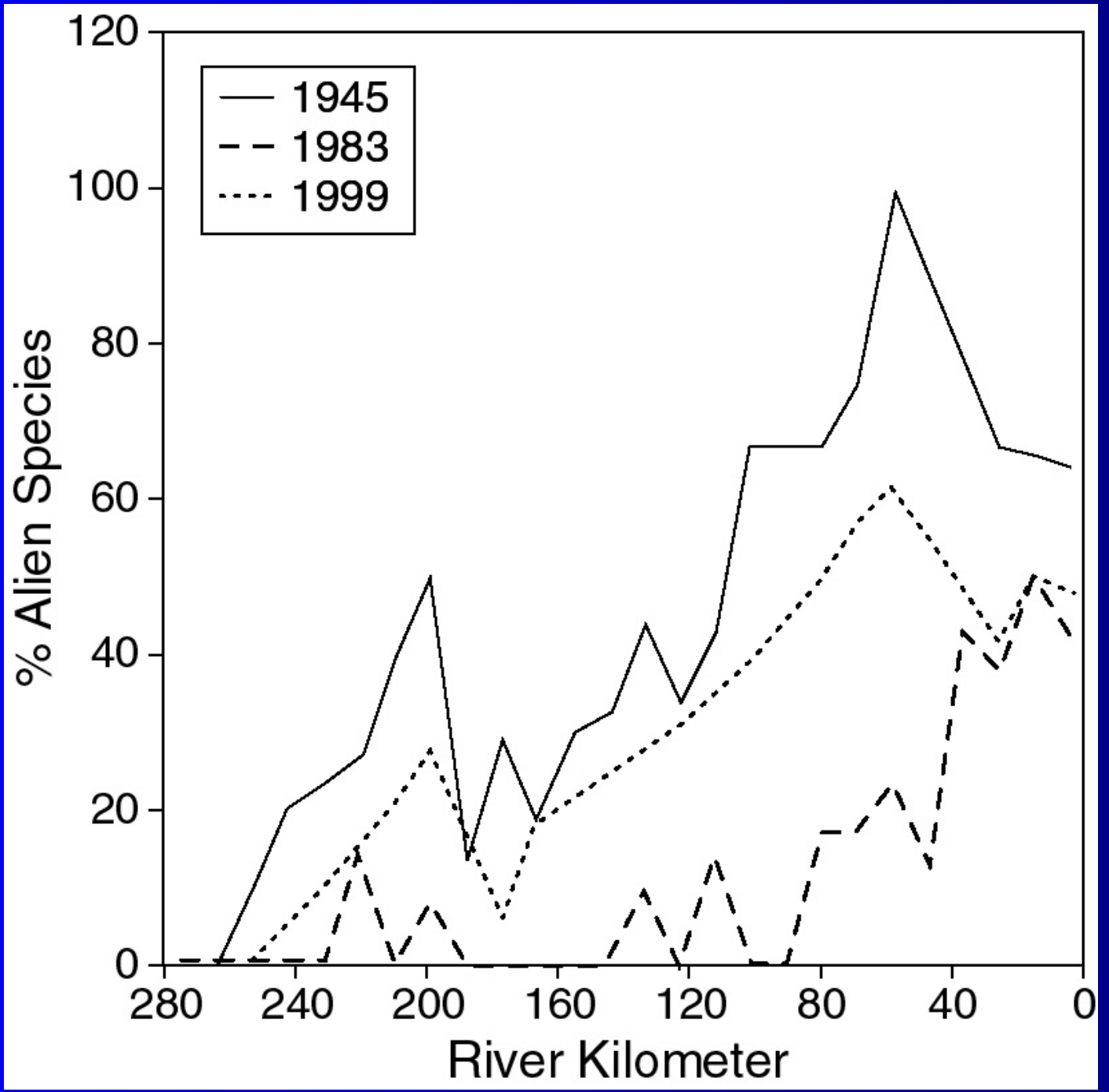
# Recent Electrofishing Sample Design Research

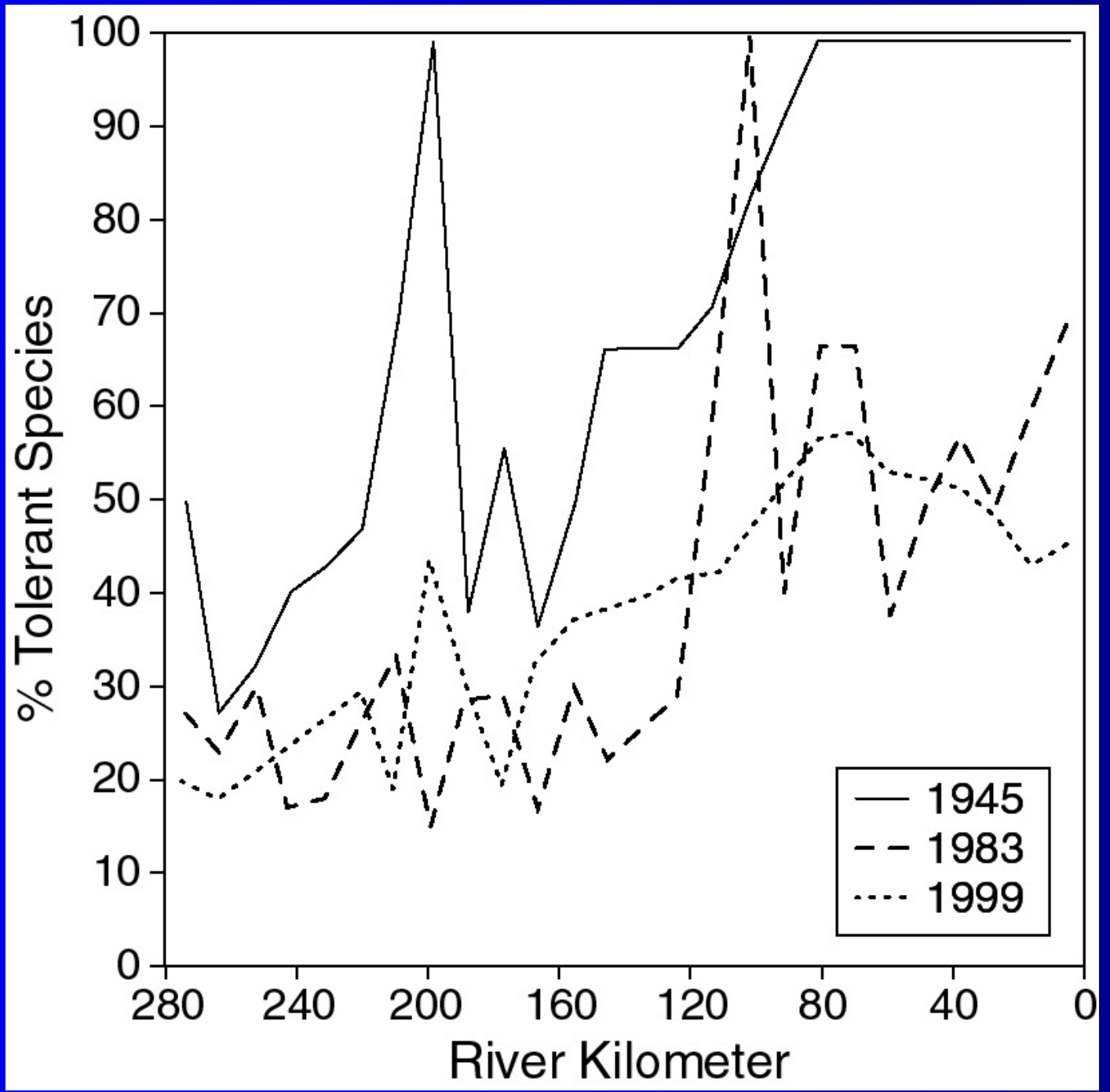

Phil Kaufmann, USEPA, Corvallis, OR.
Bob Hughes, Dynamac, Corvallis, OR.

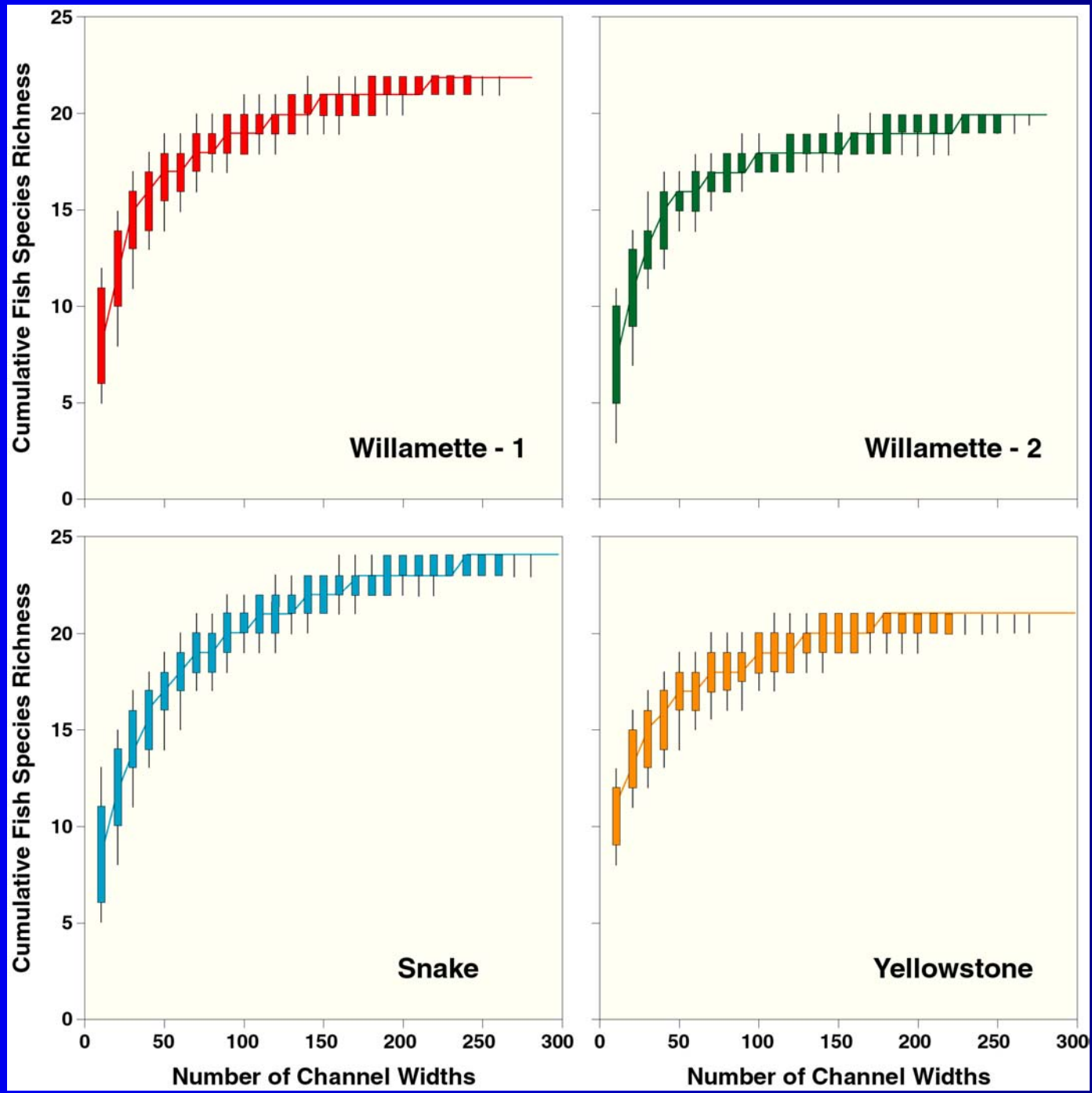

1945
1983
1999
Alien Species Richness
River Kilometer
0
1
2
3
4
5
6
7
8
9
280
240
200
160
120
80
40
0


Intolerant Species Richness
River Kilometer
1945
1983
1999
0
1
2
3
4
5
280
240
200
160
120
80
40
0


Native Species Richness
River Kilometer
1945
1983
1999
0
2
4
6
8
10
12
14
16
18
280
240
200
160
120
80
40
0


1945
1983
1999
% Alien Species
River Kilometer
120
100
80
60
40
20
0
280
240
200
160
120
80
40
0


% Tolerant Species
River Kilometer
100
90
80
70
60
50
40
30
20
10
0
280
240
200
160
120
80
40
0
1945
1983
1999


Cumulative Fish Species Richness
25
20
15
10
5
0
Willamette - 1
Willamette - 2
Snake
Yellowstone
0
50
100
150
200
250
300
Number of Channel Widths
Number of Channel Widths

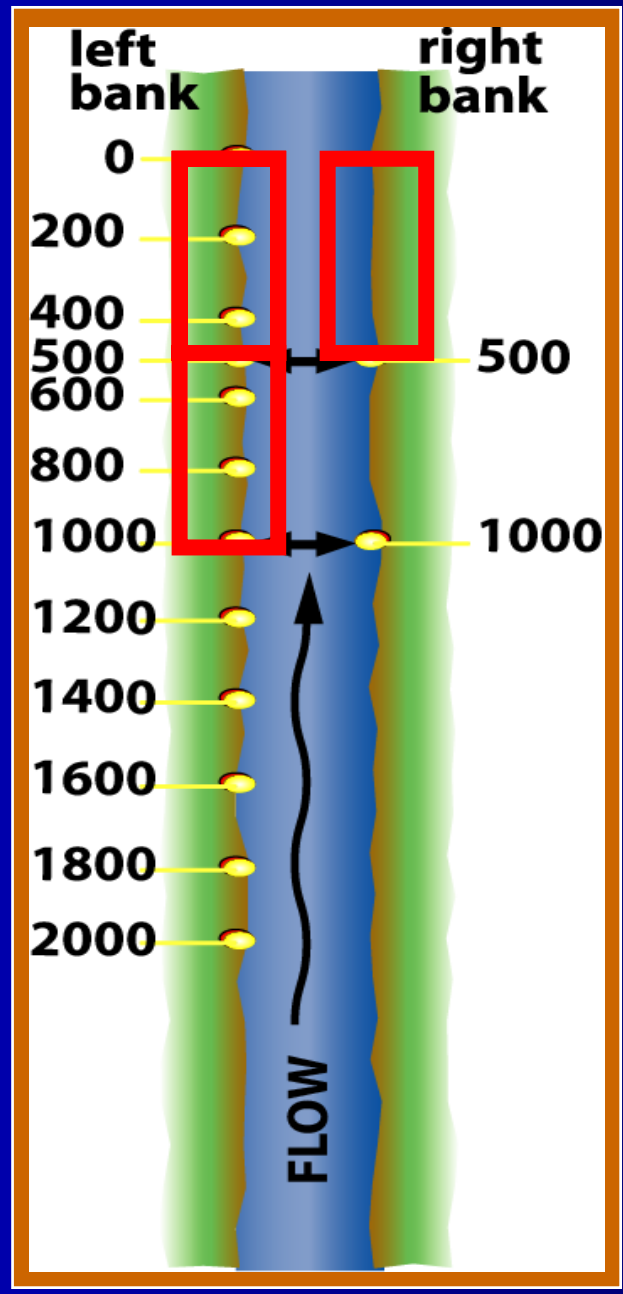
| | Willamette-1 | Willamette-2 | Snake | Yellowstone |
|---|---|---|---|---|
| Species Observed | 22 | 20 | 24 | 21 |
| Number of Individuals | 470 | 445 | 580 | 564 |
| No. Species Occurring Once | 2 | 2 | 2 | 2 |
| No. Species Occurring Twice | 2 | 2 | 2 | 1 |
| True Species Richness (TSR) | 23 | 23 | 25 | 22 |
| Channel-widths for 80% TSR | 92 | 77 | 105 | 79 |
| Channel-widths for 90% TSR | 164 | 138 | 182 | 166 |
| Channel-widths for 95% TSR | 220 | 186 | 240 | 240 |
| Channel-widths for 100% TSR | 294 | 250 | 316 | 348 |

# Recent Electrofishing Sample Design Research

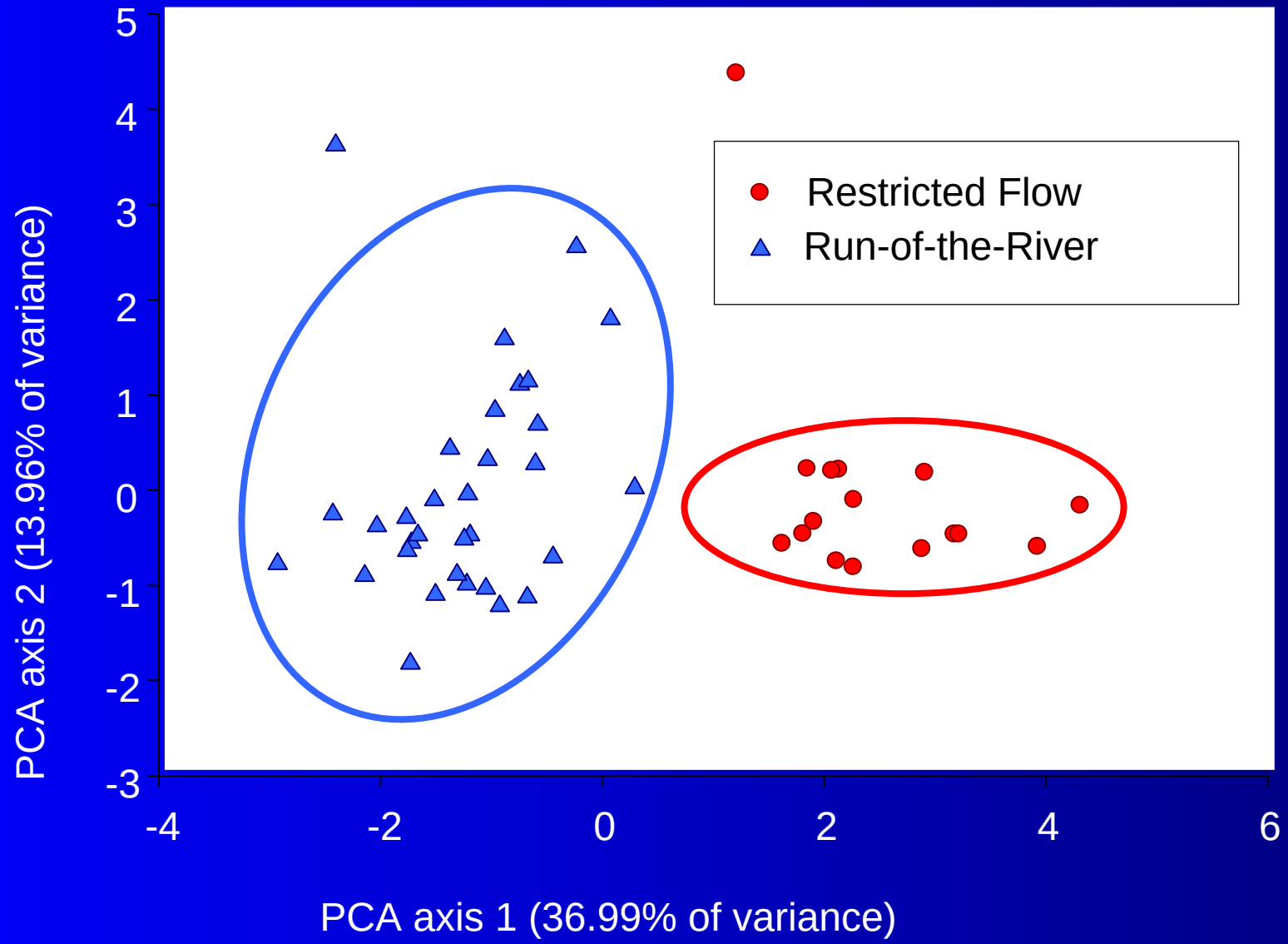
## Field Sampling Methods Comparison Notes
(East-Central Rivers)

Joseph E. Flotemersch and Karen A. Blocksom,
USEPA, Office of Research & Development,
Cincinnati, OH.

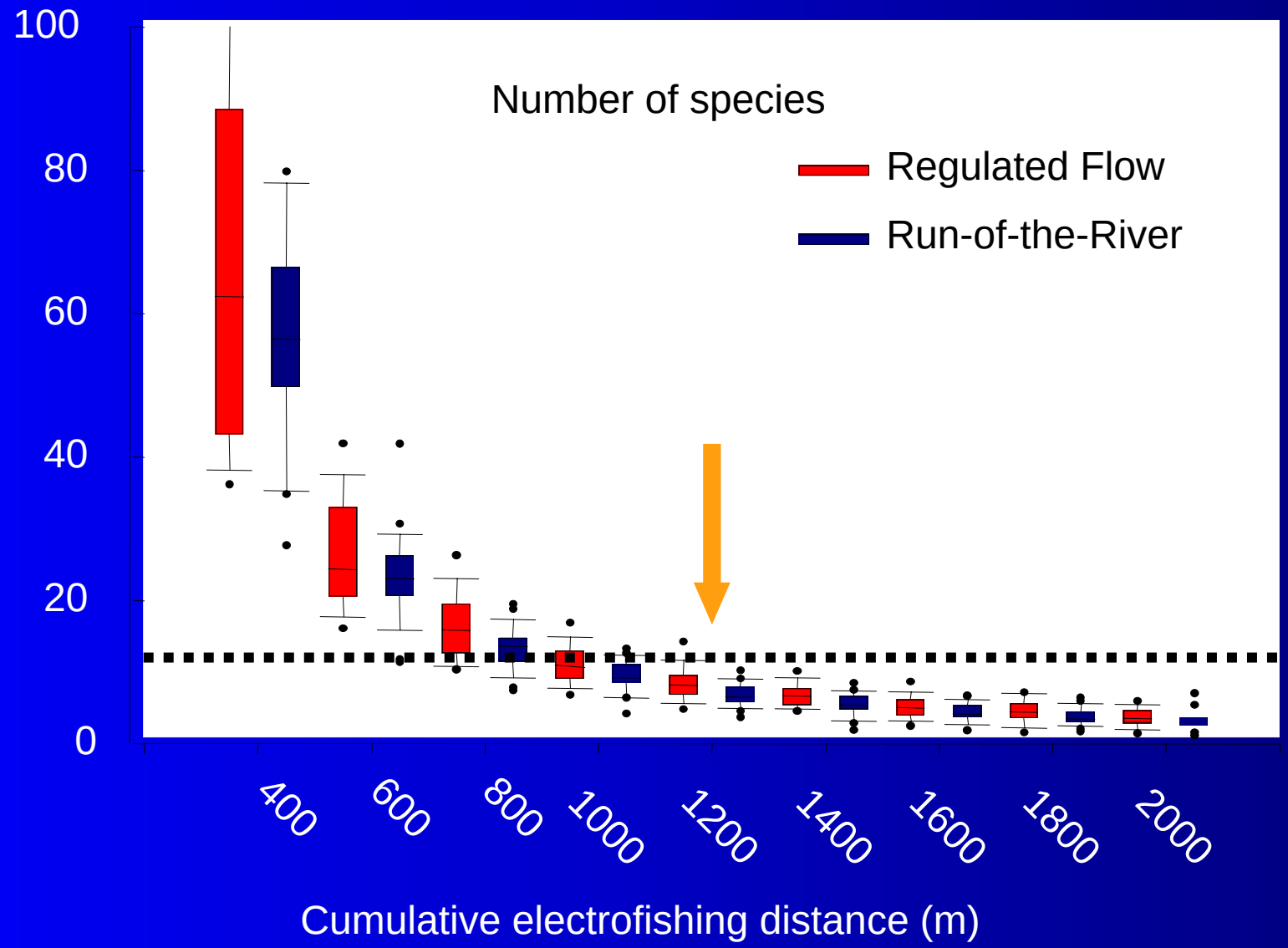
- Single experimental design
- Testing of multiple designs
- Testing of distance effects on metrics
- Collected >28,000
- Electrofished 180 km



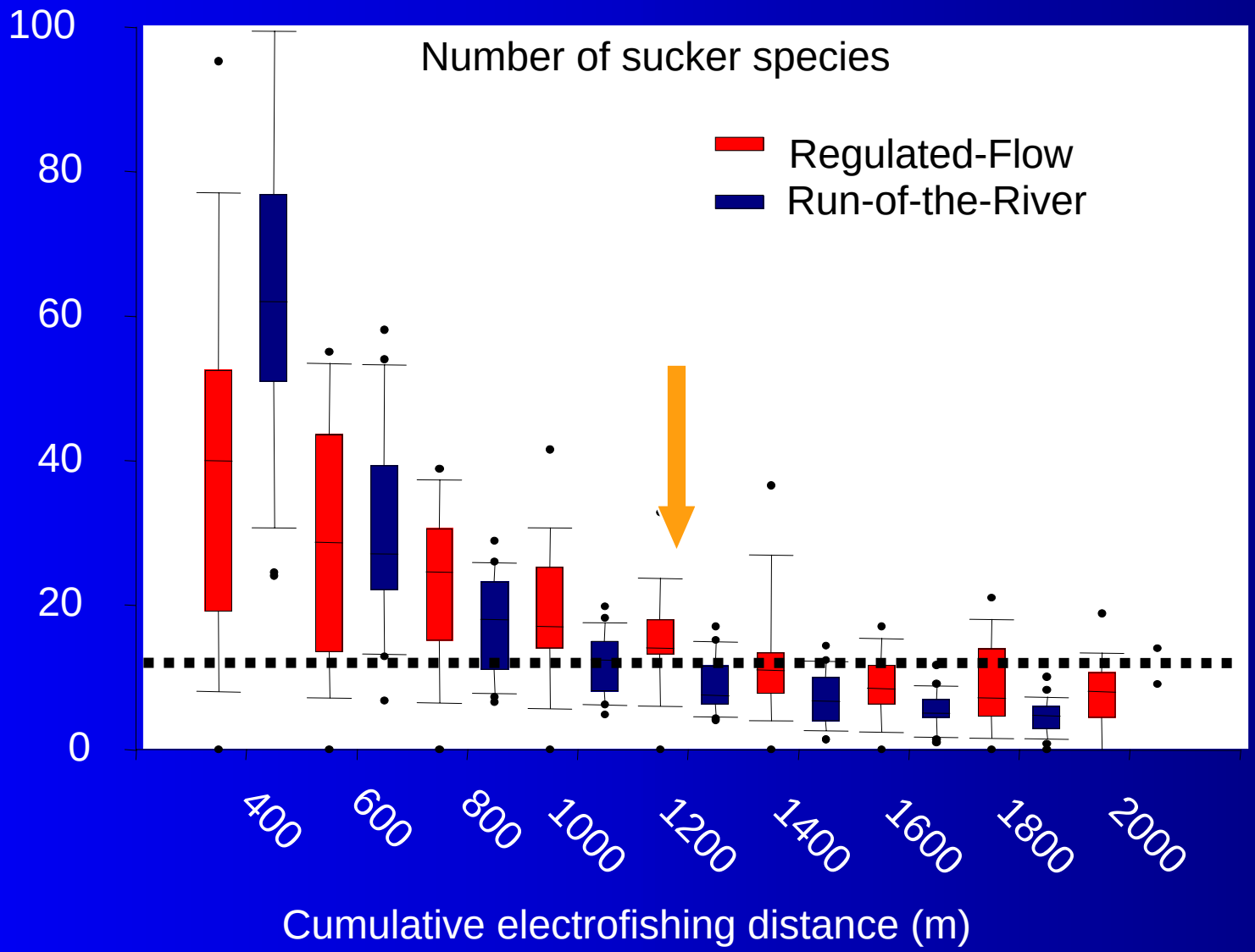
# Principal Component Analysis



# Monte Carlo Simulations



# Monte Carlo Simulations

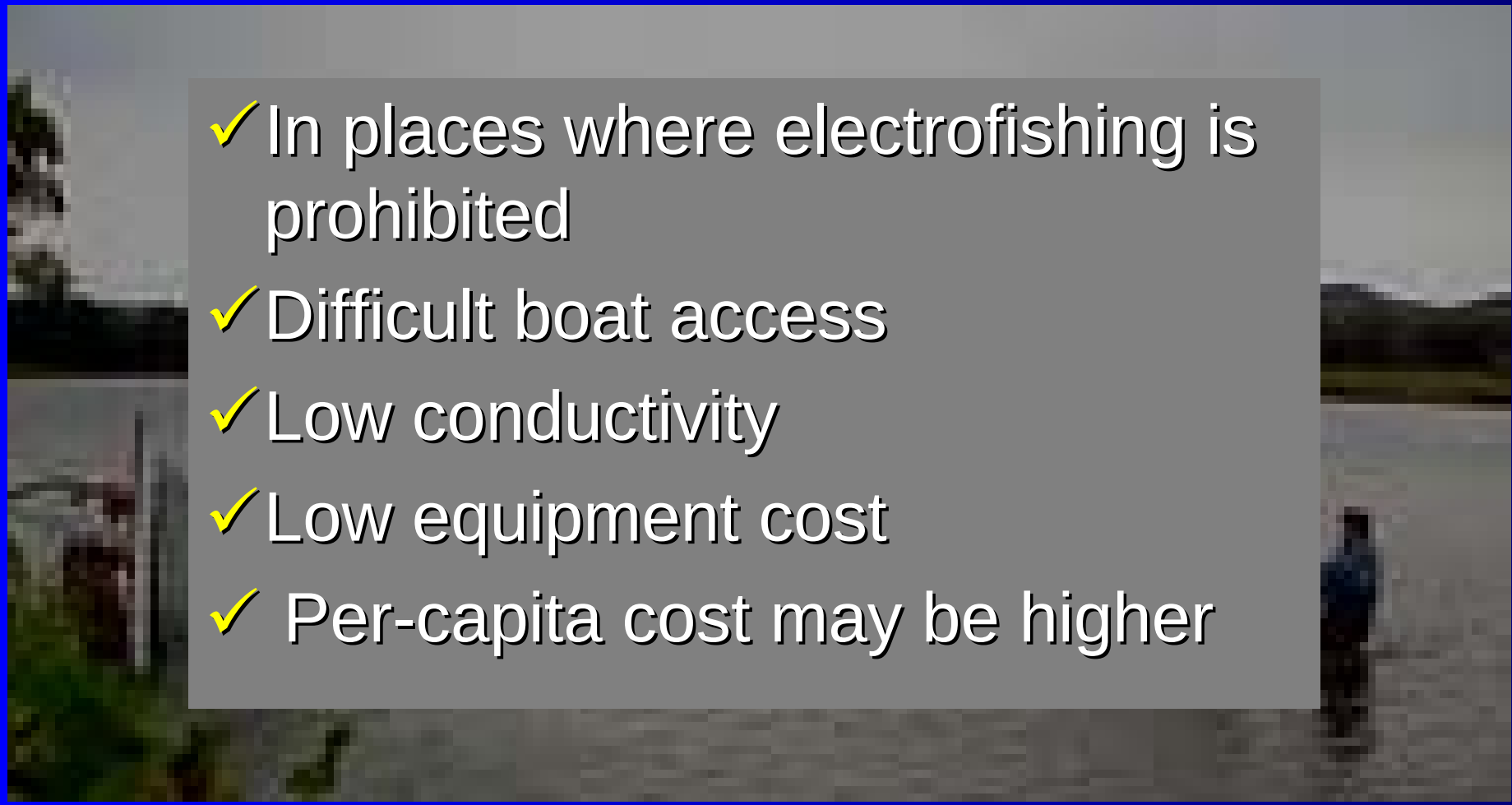


# Overview of Conclusions…

- Degree of impoundment plays a critical role in characterizing sites.
  - Metrics did not perform the same across sites of differing impoundment status (e.g., free-flowing vs. impounded).
    - May categorize by degree of impoundment
  - Different designs may be required to adequately describe different categories of systems.
    - Shallow systems – daytime electrofishing
    - Deeper, impounded systems – night electrofishing
    - Distance required may also vary

Ref: Flotemersch & Blocksom, submitted

# Active Sampling Methods: Seining



- ✓ In places where electrofishing is prohibited
- ✓ Difficult boat access
- ✓ Low conductivity
- ✓ Low equipment cost
- ✓ Per-capita cost may be higher

# Active Sampling Methods: Seining

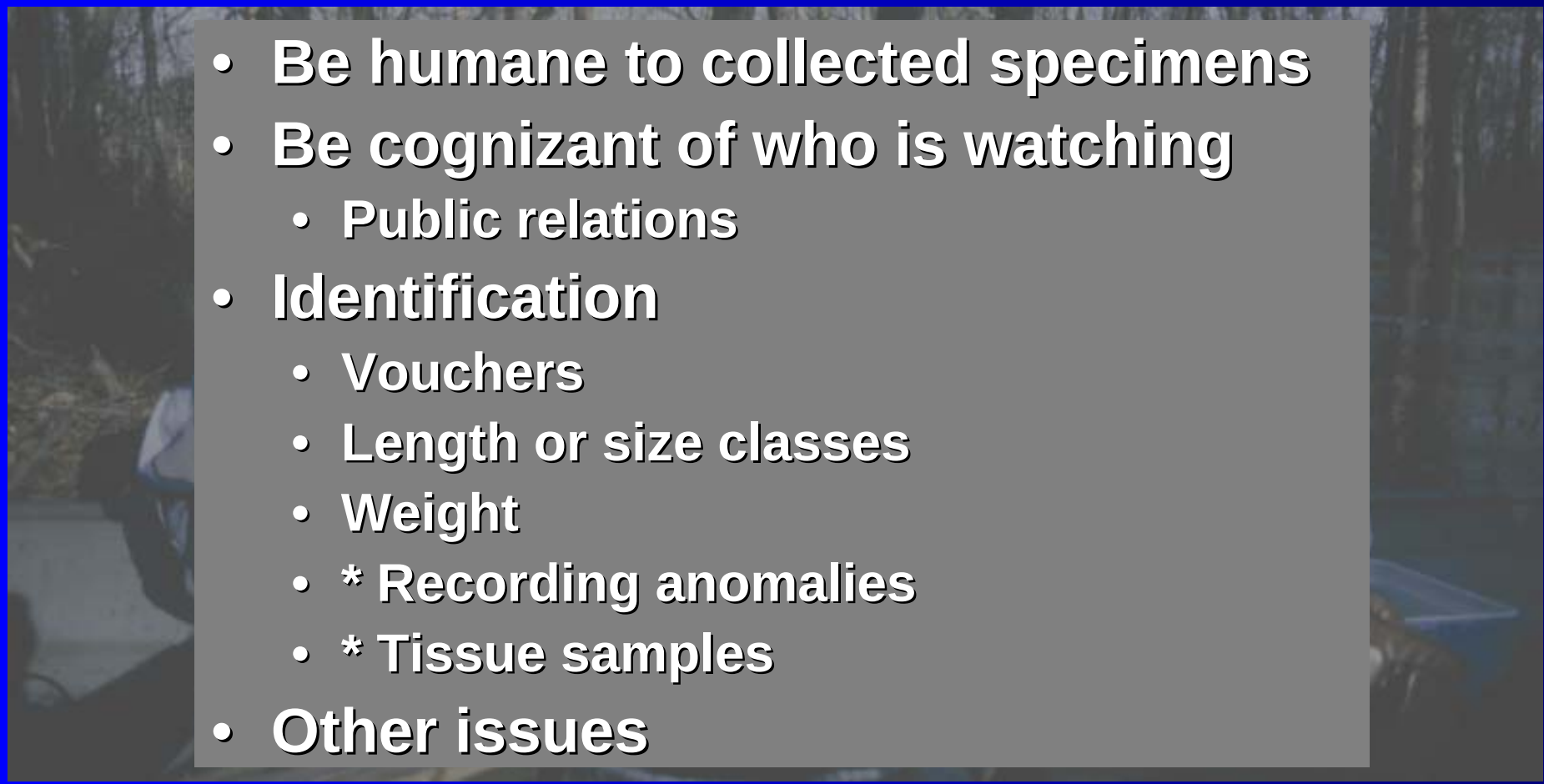
- Selective
  - Small (species and juveniles)
  - Schooling (normally inhabit shallow water areas)
  - Slower

Horse seining, Columbia River, Oregon

# Passive Fish Sampling Methods
## Nets: Hoop, Fyke, Trap, Gill, Etc.

- Advantages
  - Simple in design and construction
  - No electrical equipment to fail
  - Require little specialized training
  - Yield fairly precise data (relative abundance)
- Disadvantages
  - Selective (species, size, sex)
  - Require multiple trips to a site
  - Cannot pull fish out of cover
  - Spatial coverage is limited (Ref: Hubert 1992)

# Field and Laboratory Processing of Fish



- Be humane to collected specimens
- Be cognizant of who is watching
  - Public relations
- Identification
  - Vouchers
  - Length or size classes
  - Weight
  - * Recording anomalies
  - * Tissue samples
- Other issues

# External Anomalies:

Deformities, Erosions, Lesions, Tumors (DELT) anomalies

- Effective communicator of degraded quality
- Useful in sites degraded by multiple and cumulative stresses
- Reliable indicator condition
- Occurrence may be part of the recovery
- Important diagnostic tool
- Includes parasites (Ref: Sanders et al. 1999)

# Fish Tissue Sampling

- Fish Tissue
  - Commonly used indicator of contaminant risk
  - Strong connection to resource use and exposure
  - Standard methods exist
- Important questions
  - How to sample?
  - What to sample?
  - Which analytes to consider?