THE PROS AND CONS OF HABITAT MODELING AS A PLANNING TOOL

PRESENTED TO:
NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
ECOLOGICAL FLOWS SCIENCE ADVISORY BOARD

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CHAPEL HILL, NORTH CAROLINA

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WHAT'S AN AQUATIC HABITAT MODEL?

In general, an aquatic habitat model for the purpose of determining ecological flows is a tool that creates an index relationship between flow and some measure of hydraulic habitat.

All aquatic habitat models assume a correlation between target species abundance or biomass and the hydraulic habitat index.

Different models use different methods, variables, and degrees of complexity.

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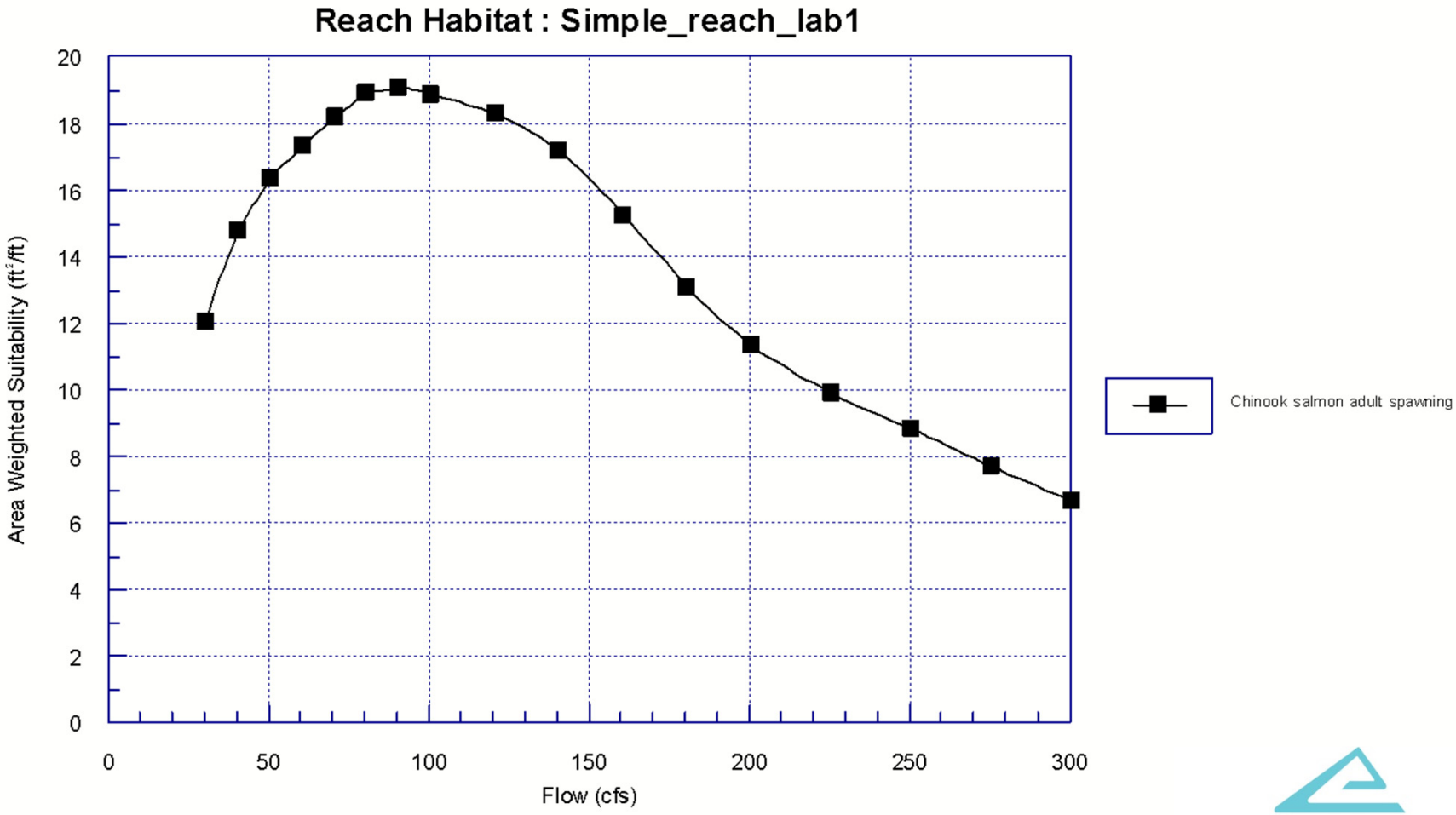
EXAMPLE OF PHYSICAL HABITAT INDEX



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WHAT TOOLS ARE OUT THERE?

- MesoHABSIM
- Expert Habitat Mapping
- Demonstration Flow Assessment
- Hydraulic Habitat Modeling
  - PHABSIM
  - RHABSIM
  - RHYHABSIM
  - CASiMiR
  - River2D
  - EVHA
  - PHABSIM WIN 2002
  - RSS
  - SEFA

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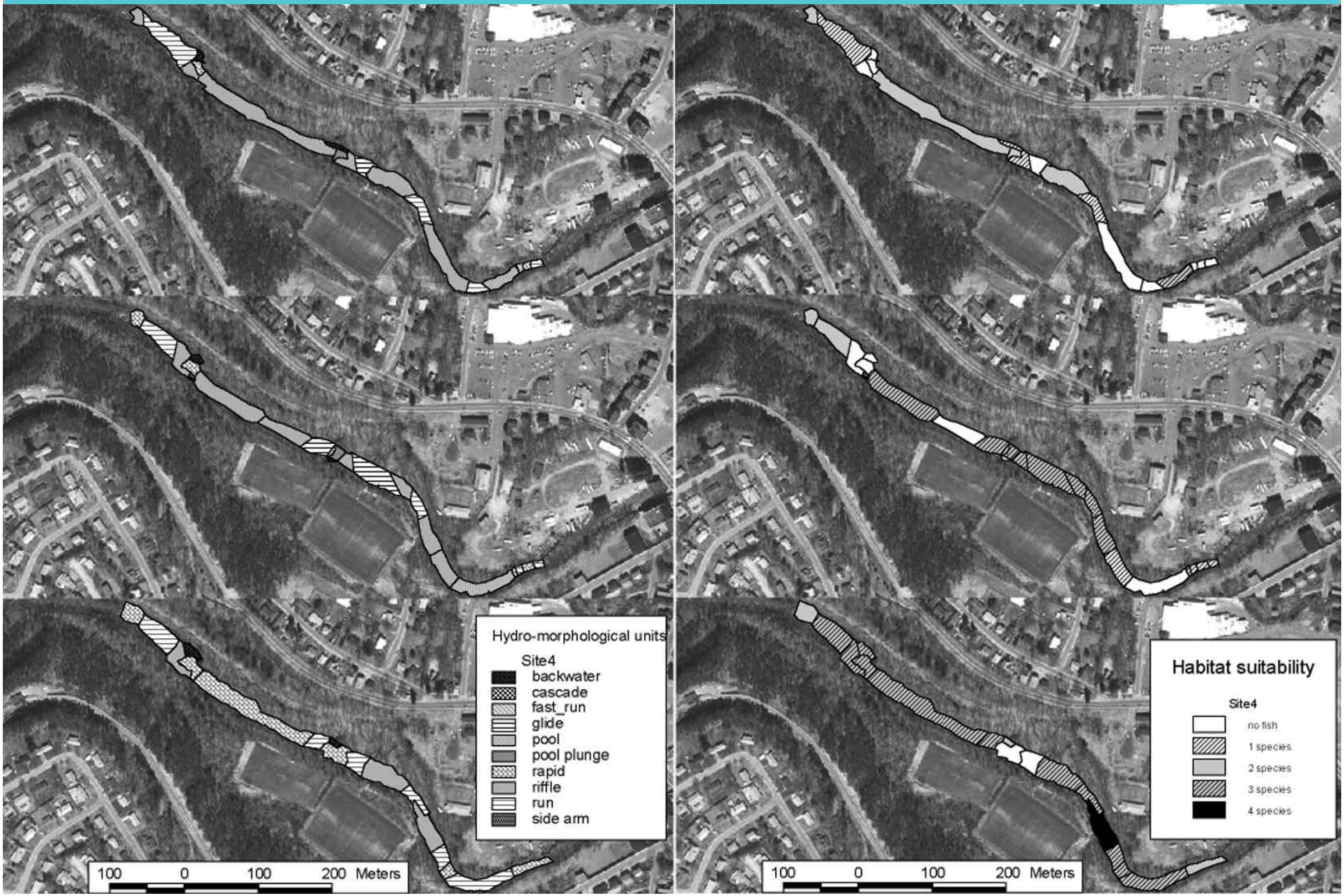
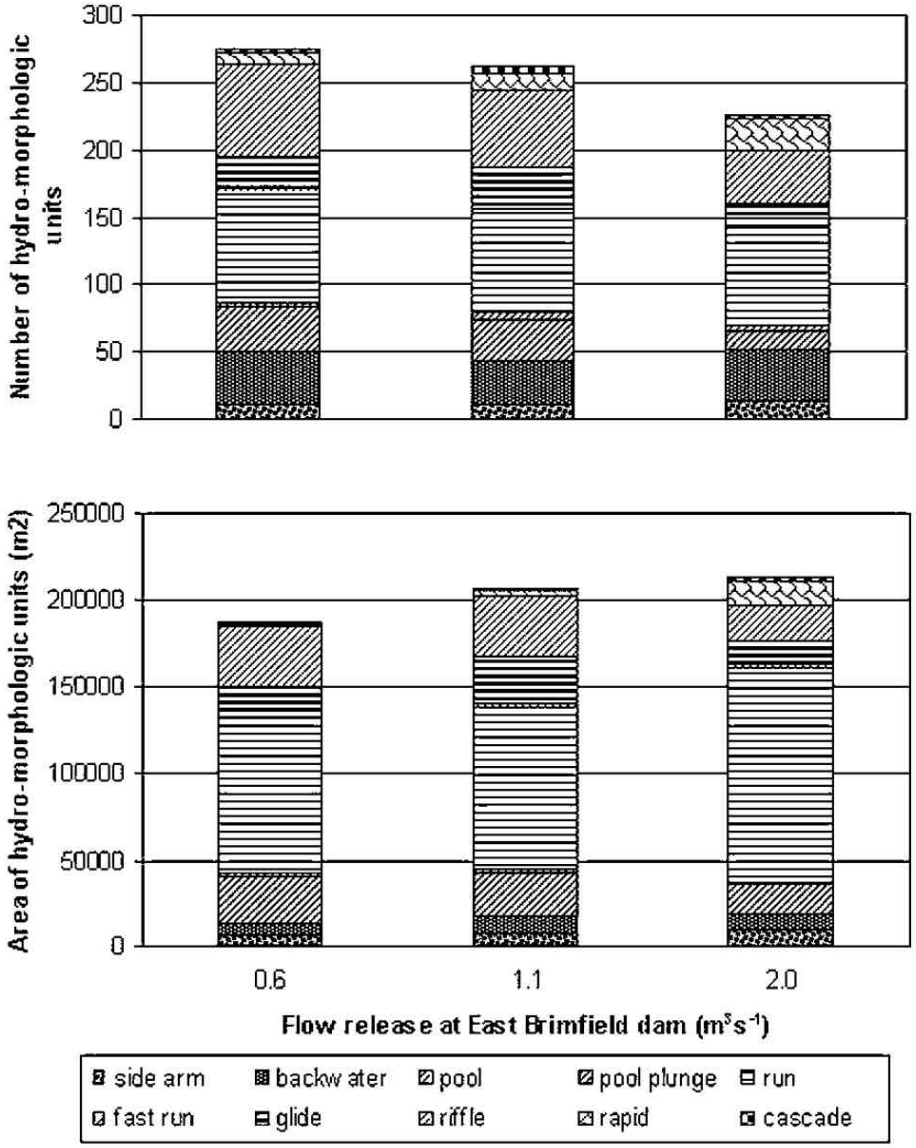
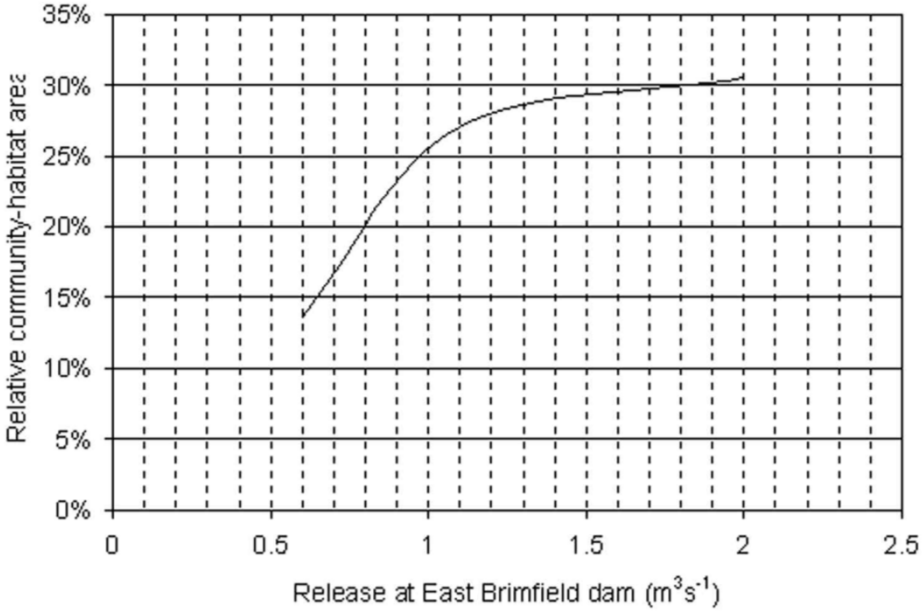
MesoHABSIM (Parasiewicz 2001)



MesoHABSIM (Parasiewicz 2001)





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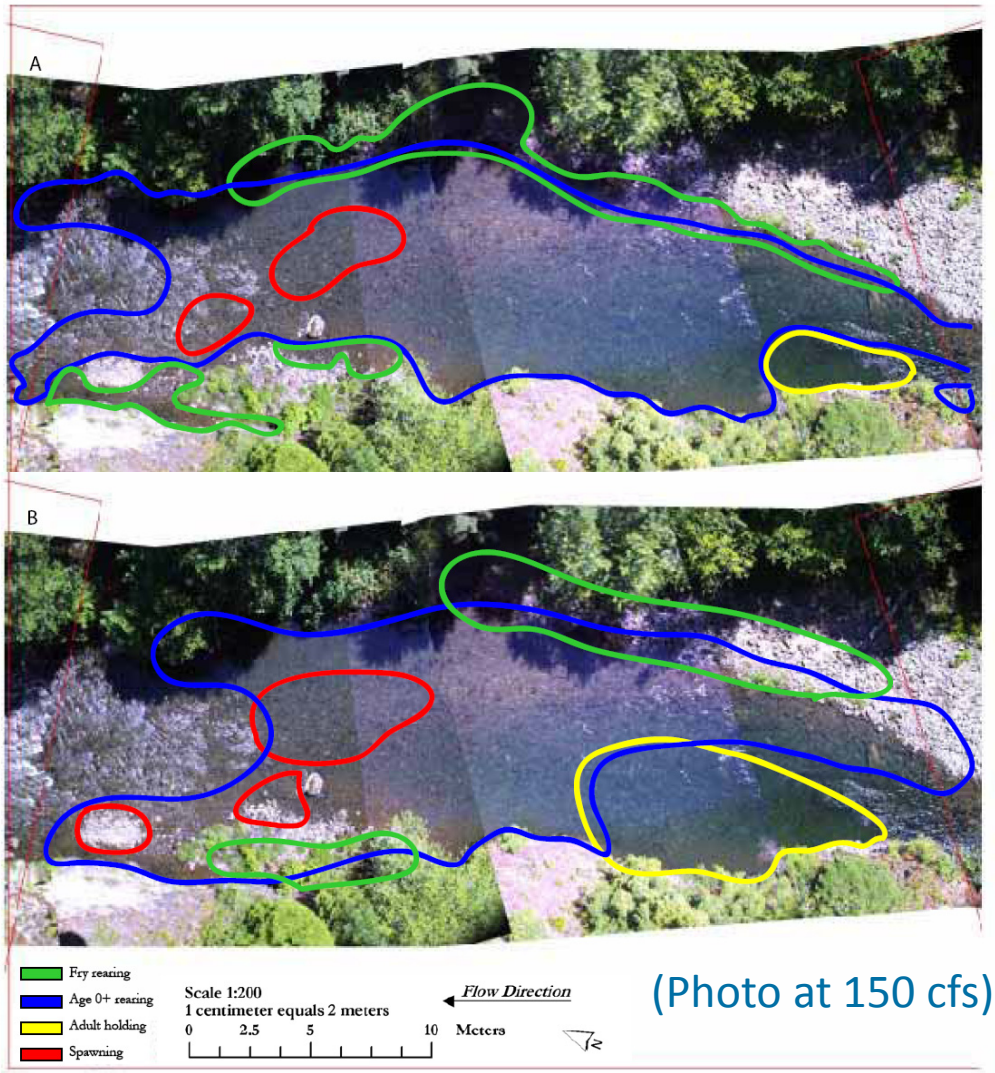
EXPERT HABITAT MAPPING (McBain & Trush



Habitat at 150 cfs

Habitat at 200 cfs

(Photo at 150 cfs)

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DEMONSTRATION FLOW ASSESSMENT
(Railsback and Kadvany 2008)

- Step 1 – Frame the Decision
  - Clearly define the instream flow decision process
- Step 2 – Develop Conceptual Models of Flow Effects
  - Develop a shared understanding of important flow mechanisms
- Step 3 – Select Habitat Metrics
  - Define the specific measures to be observed and quantified
- Step 4 – Design and Conduct Field Observations
  - Observe and quantify or rate the selected habitat metrics
- Step 5 – Analyze Results
  - Rank alternative flows by the quantity or value of the metrics
- Step 6 – Negotiate Instream Flows

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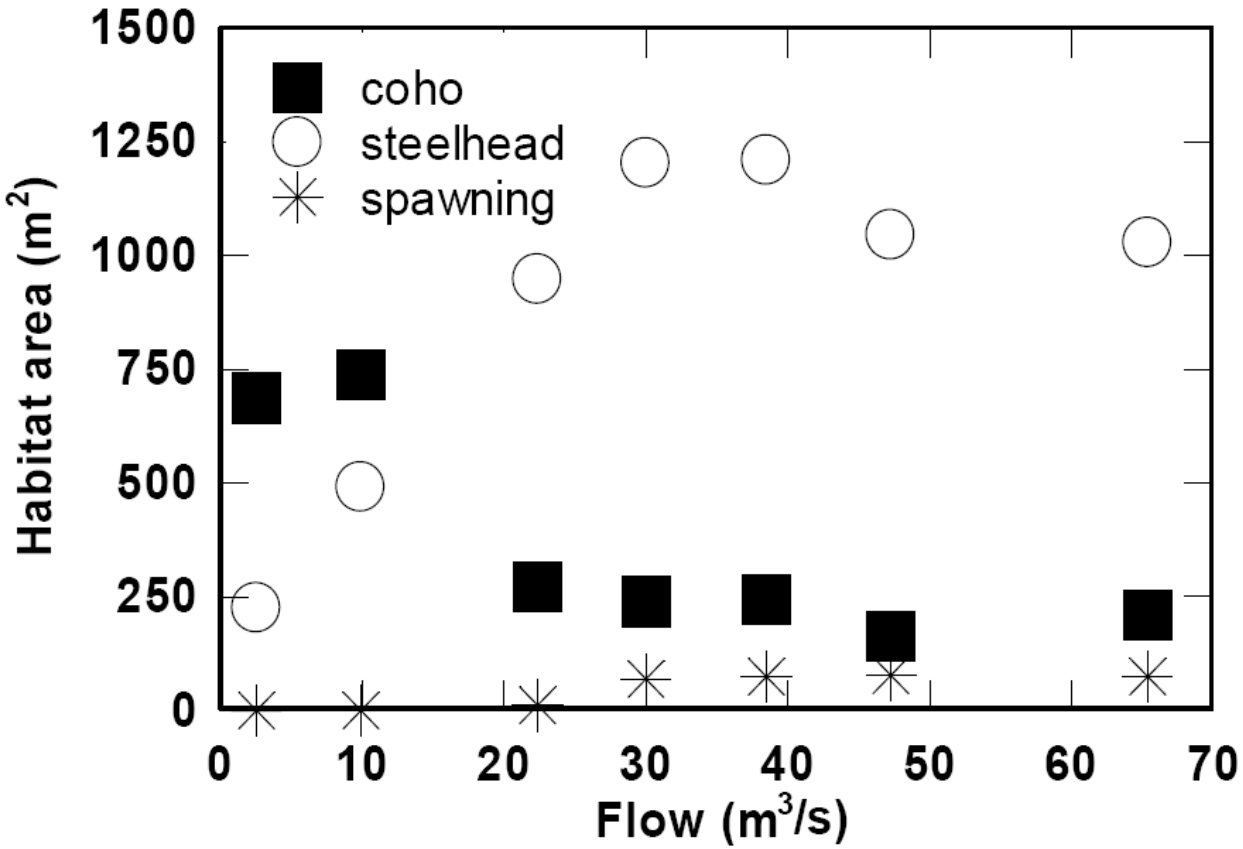
DEMONSTRATION FLOW ASSESSMENT

(Railsback and Kadvany 2008)



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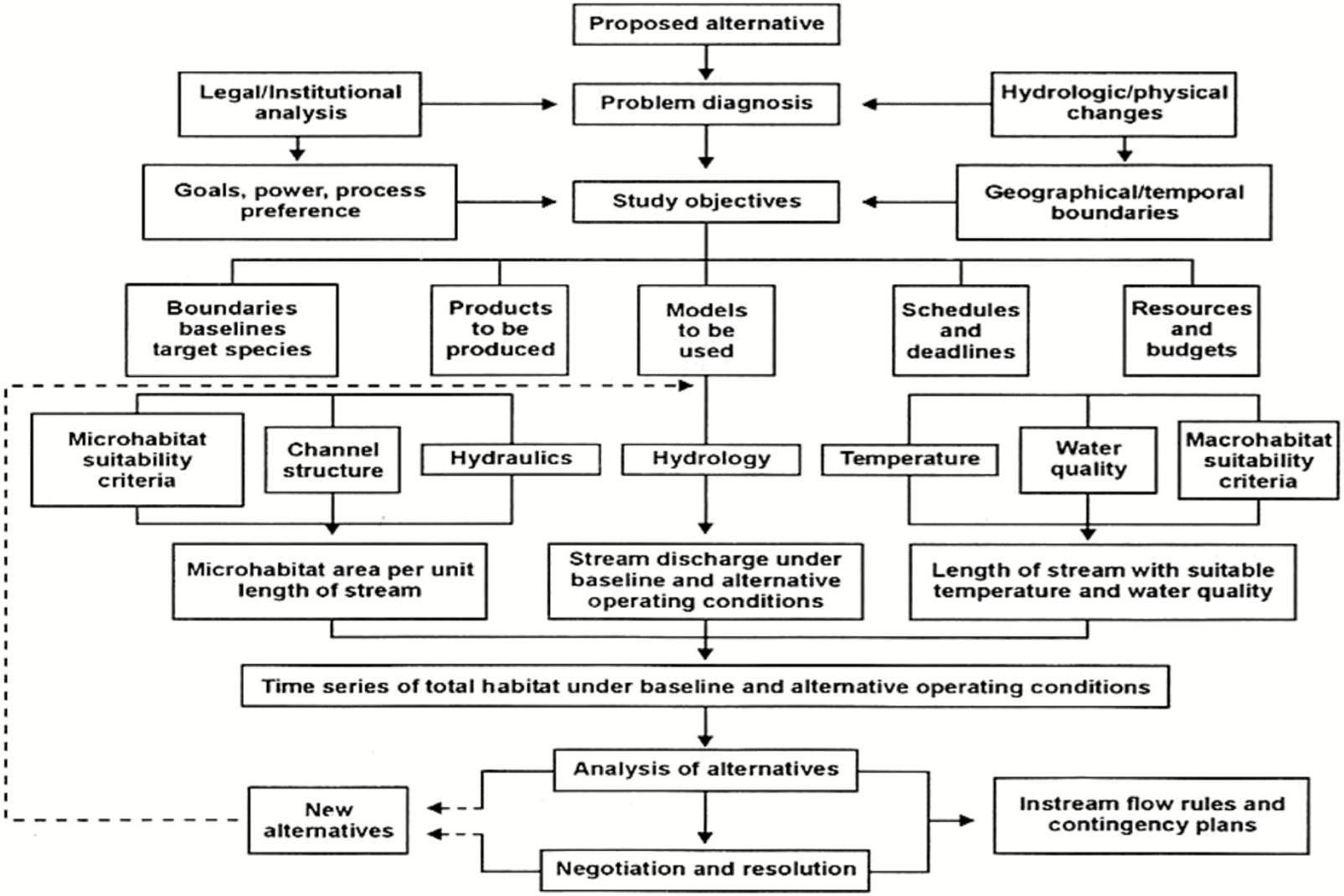
INSTREAM FLOW INCREMENTAL METHODOLOGY
(Bovee et al. 1998)



PHABSIM! (Bovee and Milhous 1978)

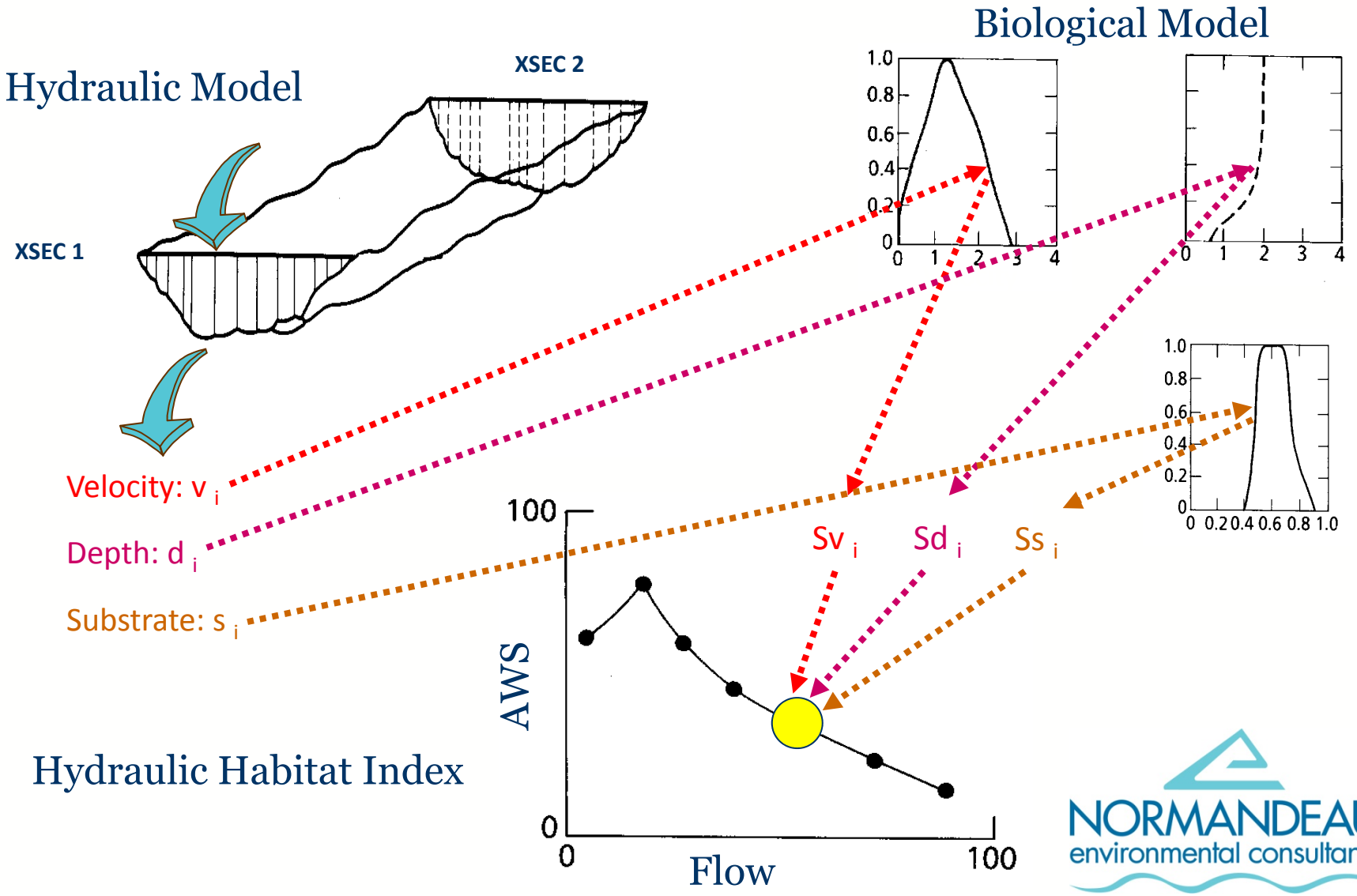
Microhabitat suitability criteria

Channel structure

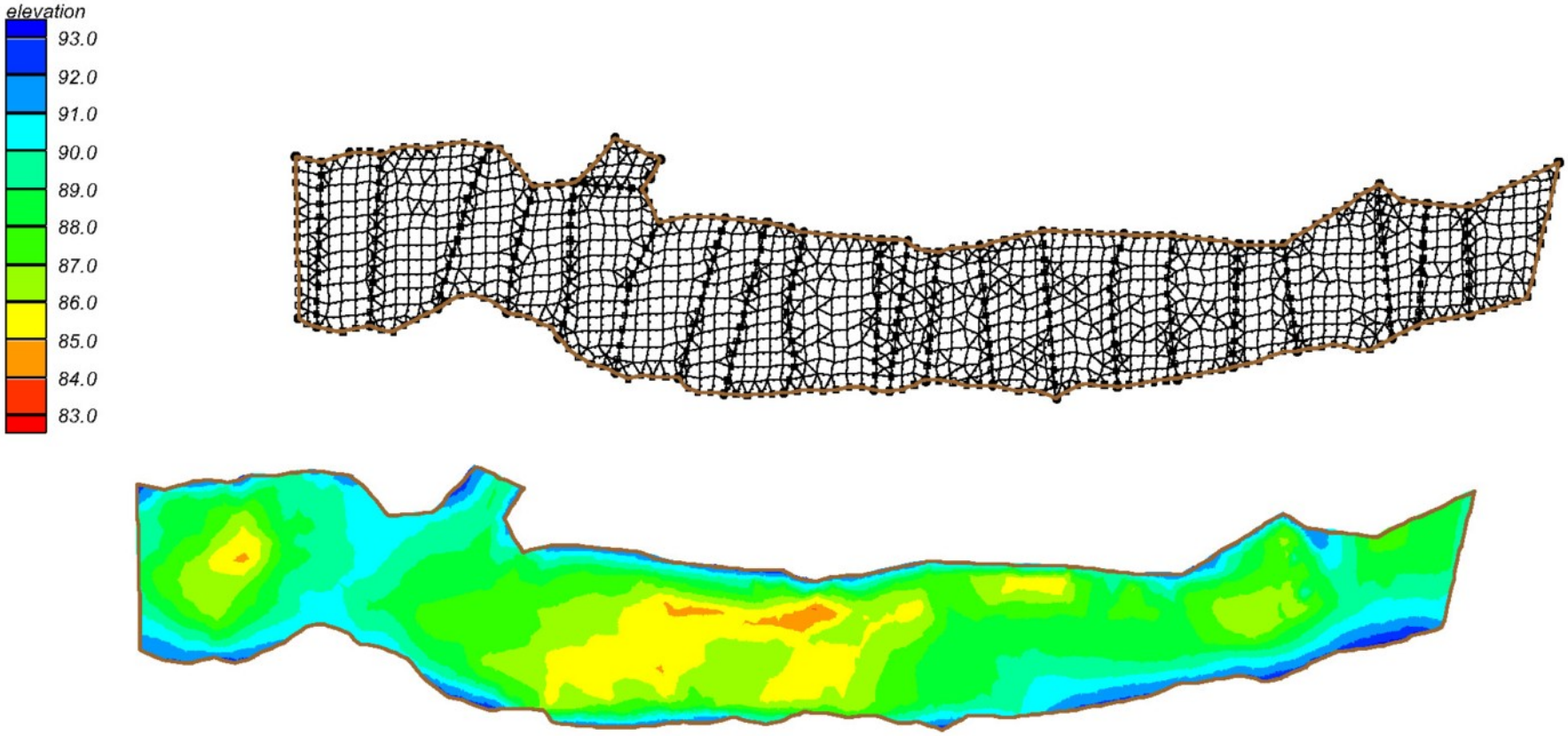
Hydraulics

Microhabitat area per unit length of stream

1-D HYDRAULIC HABITAT



2-D HYDRAULIC HABITAT



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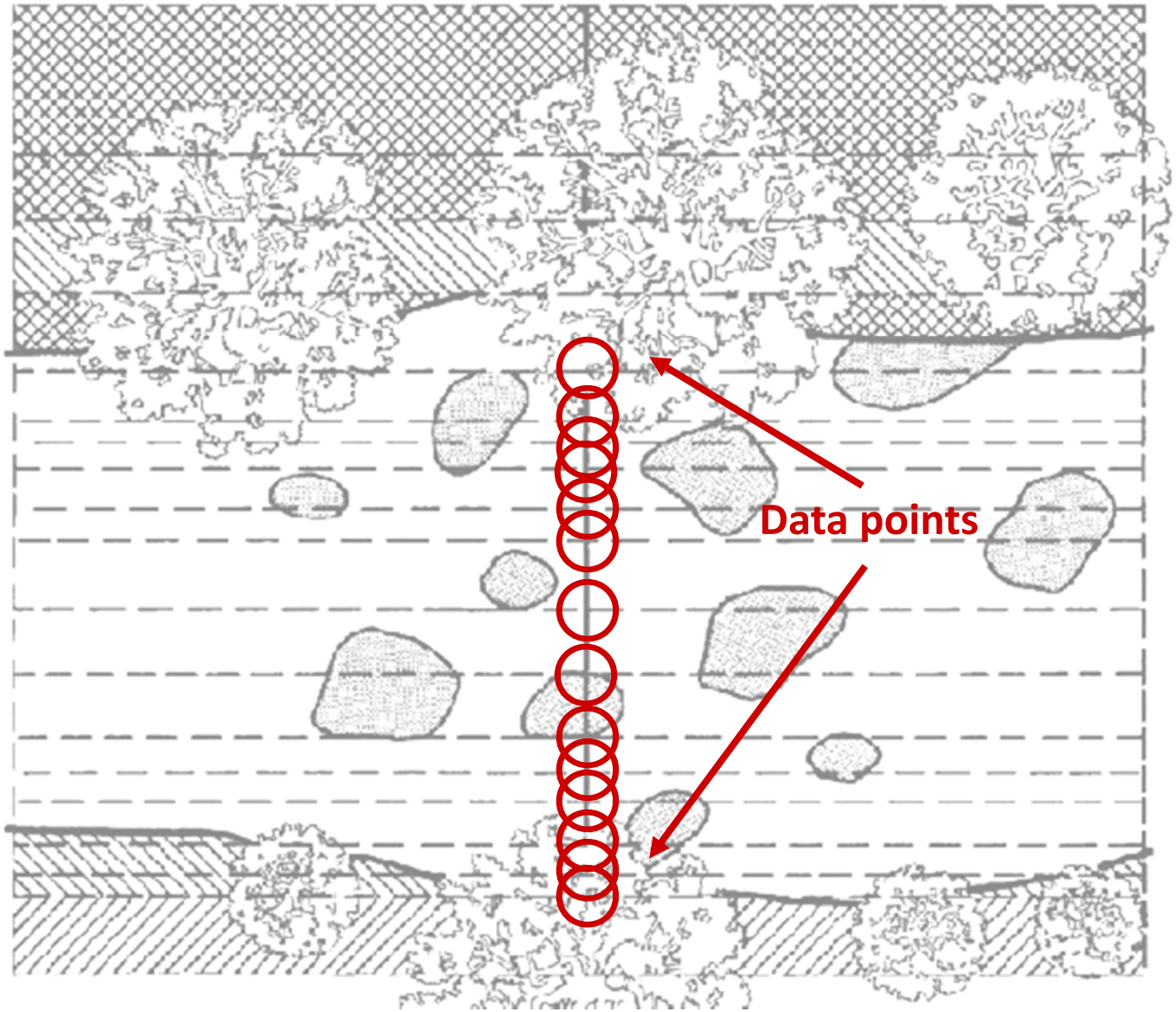
1-D HABITAT REPRESENTATION



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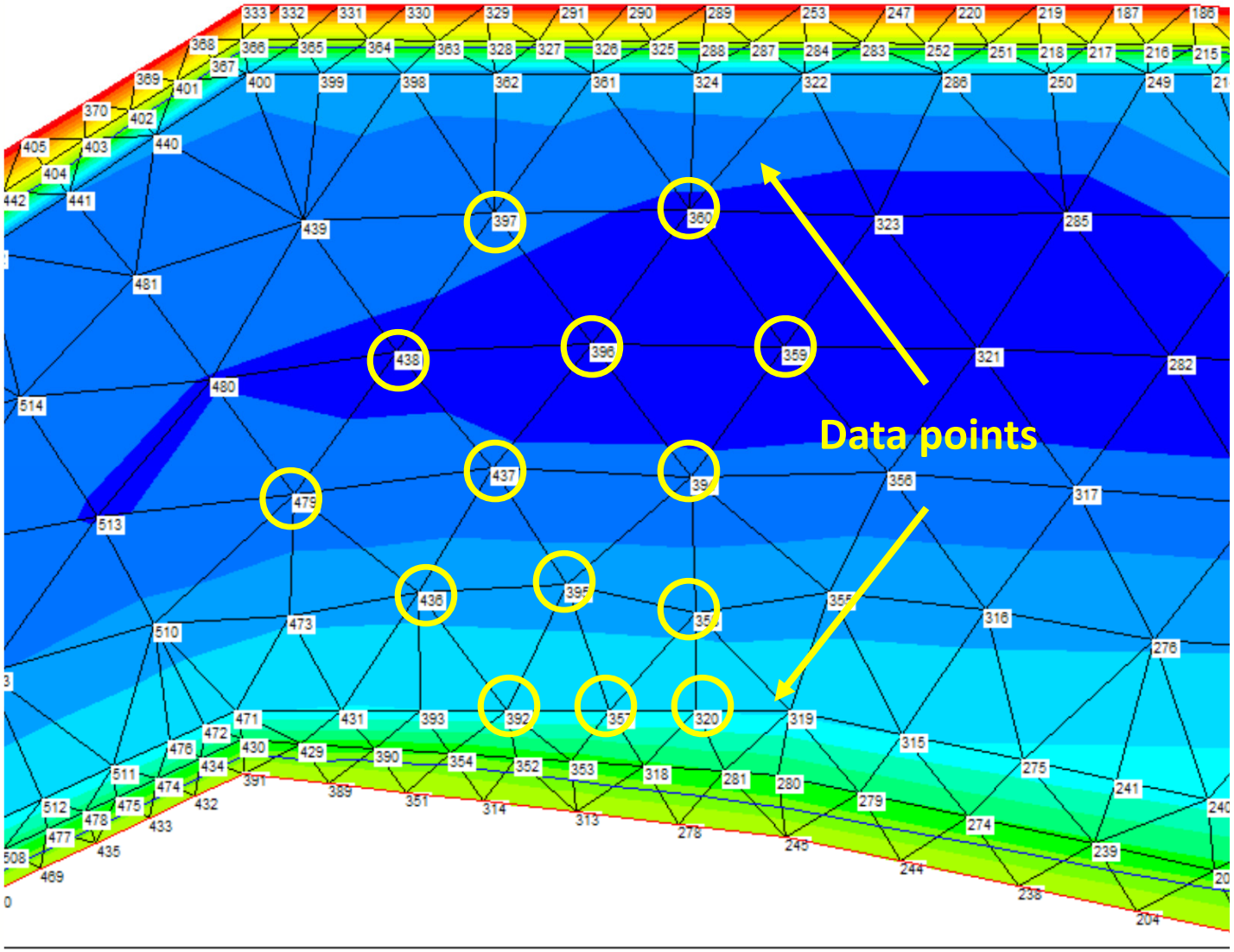
2-D HABITAT REPRESENTATION



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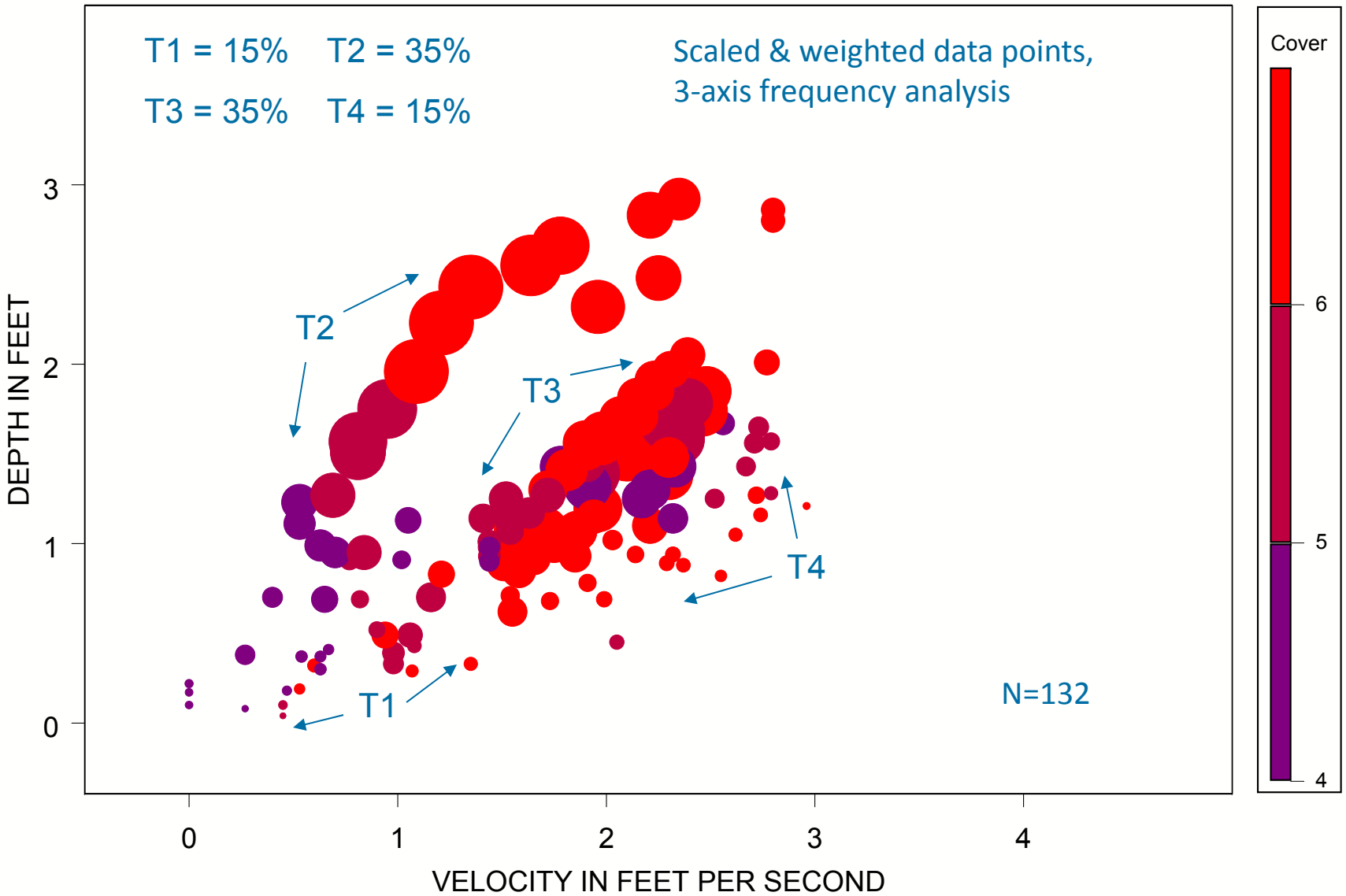
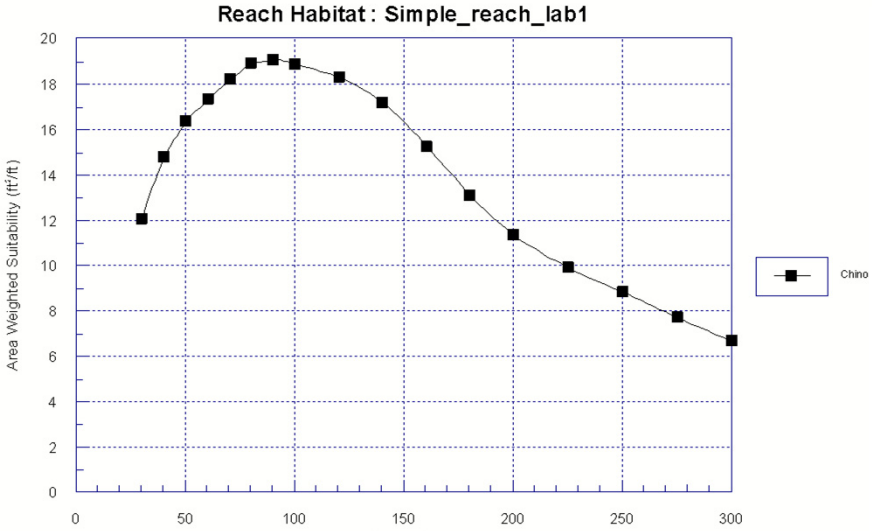
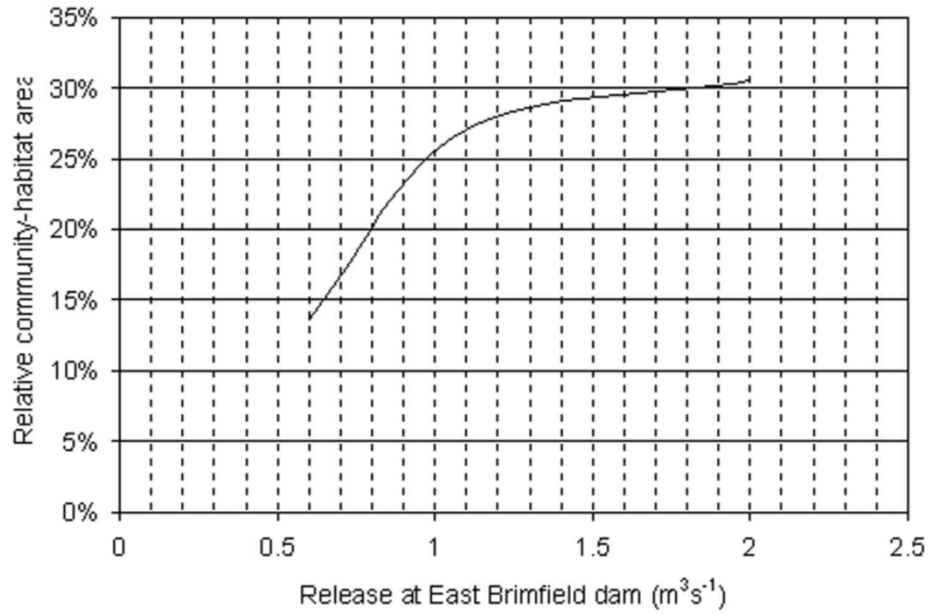
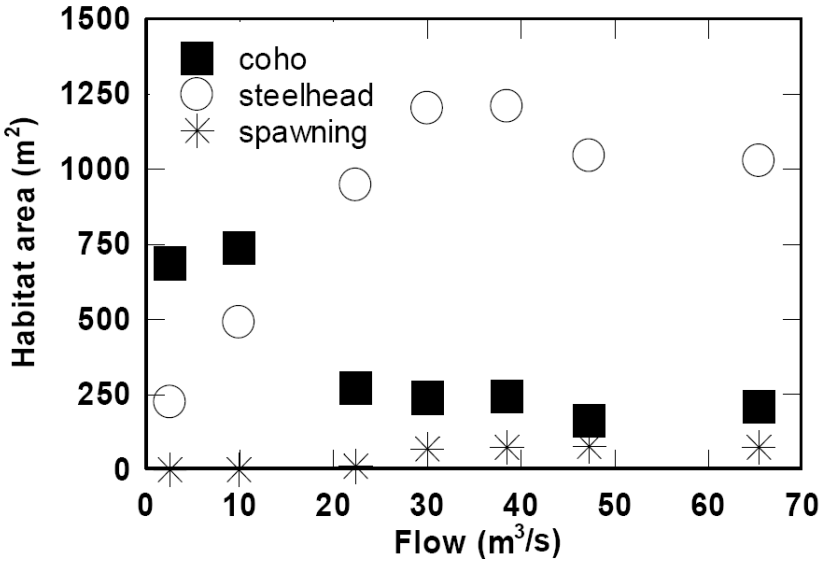
Data Points Scaled by Suitability and Weight



ALL METHODS GIVE HABITAT INDEXES







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SO WE HAVE A CURVE…

- The Usual Options:
  - Peak of the Curve
  - Percentage of Peak of the Curve
  - Habitat Time Series
  - Habitat Duration
  - Rule Making
  - Negotiation
  - Settlement/Order/Litigation

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THE QUESTIONS THEN…

- Do these habitat models have any validity?
- What are the pros of habitat models?
- What are the cons of habitat models?

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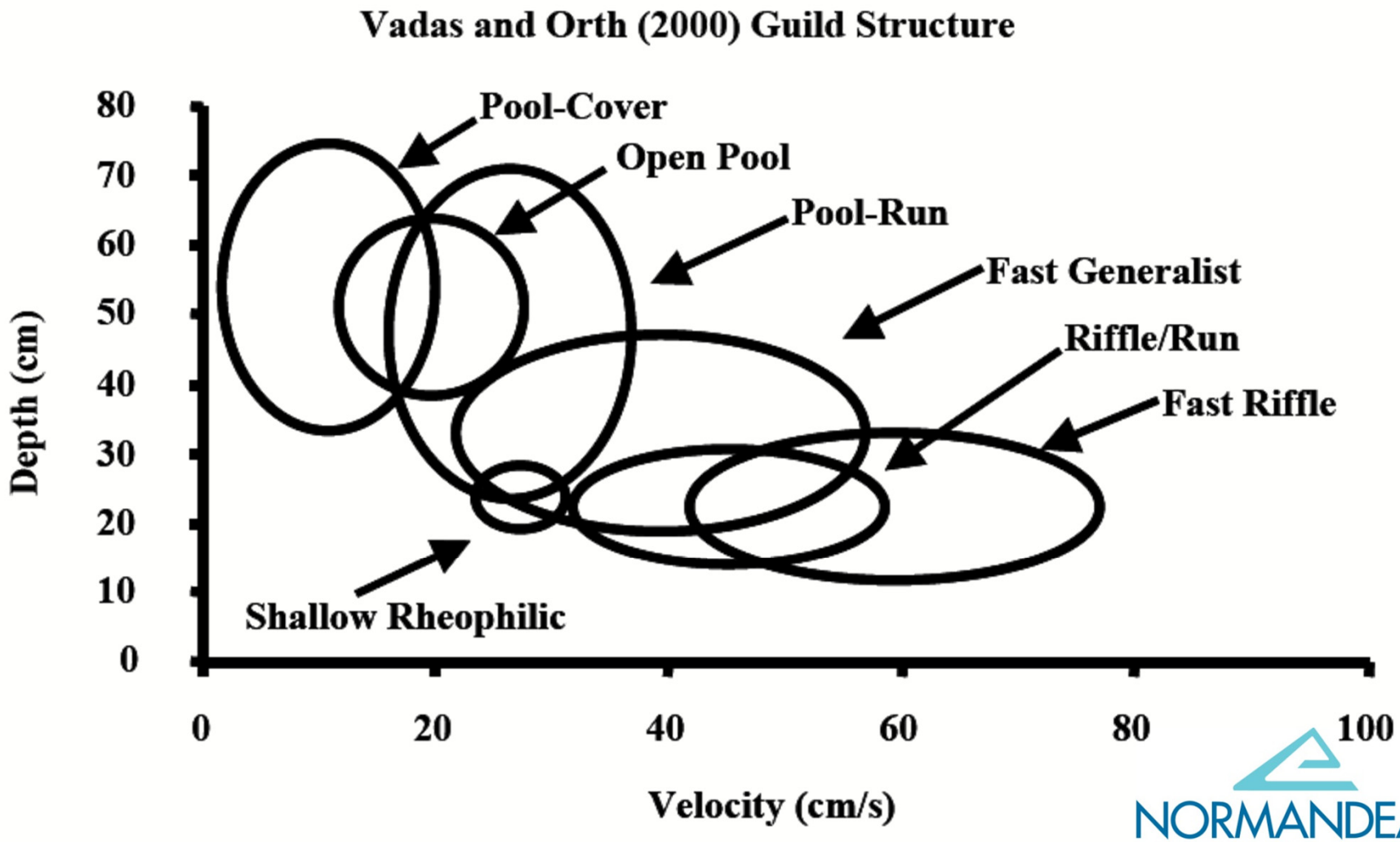
AQUATIC SPECIES USE DIFFERENT HABITAT TYPES



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POSITIVE EVALUATIONS OF MODELS

- Most validation studies show that velocity, depth, and substrate or cover variables do correlate with biomass
- The existence of empirical models argues that habitat suitability varies with flow
- The common experience of practitioners is that habitat index curves do describe observed habitat conditions

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THE PROS FOR HABITAT MODELING…

- Longevity
  - Still here after 35 years of experience
- Popularity
  - Most common method in U.S. and worldwide
- Defensibility
  - No court challenge has been successful
- Reviewability
  - Results can be independently reviewed

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THE CONS FOR HABITAT MODELING…

- Insufficient validation for many species
  - Only trout and smallmouth bass studied
- Costly and time consuming
  - Cost: $10K-500K+ Time: 1 month-2 years
- Intensive field data requirements
  - Channel topography, suitability criteria
- High technical knowledge
  - You need to know what you're doing

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CRITIQUES ARE GENERALLY OFF-BASE

- Focus often on:
  - Lack of validation studies
  - Lack of instantaneous responses
  - Non-statistical sampling strategies
  - Details instead of big picture
- Few reviewers understand the models
- No reviewer has ever said the results are ecologically inaccurate

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THE BOTTOM LINE

- "There is a there there."
- Proper understanding and use of habitat models is critical.
- Habitat models are <u>not</u> fish position models, they are <u>frequency analyses</u>.

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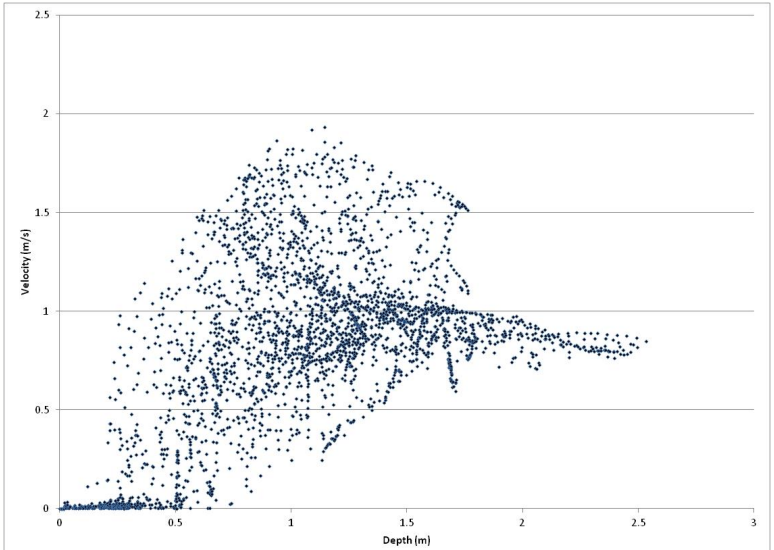
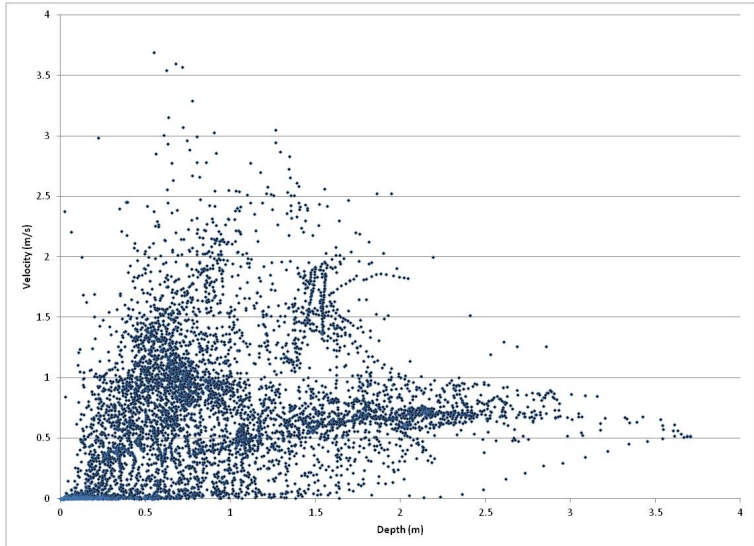
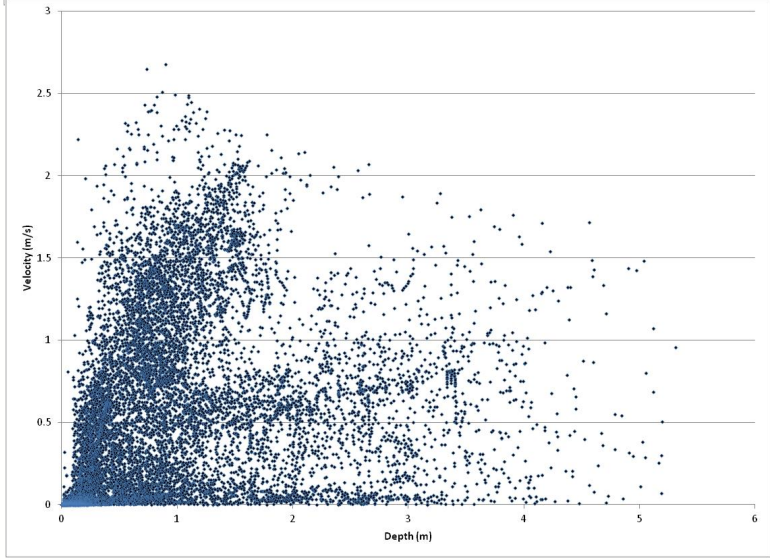
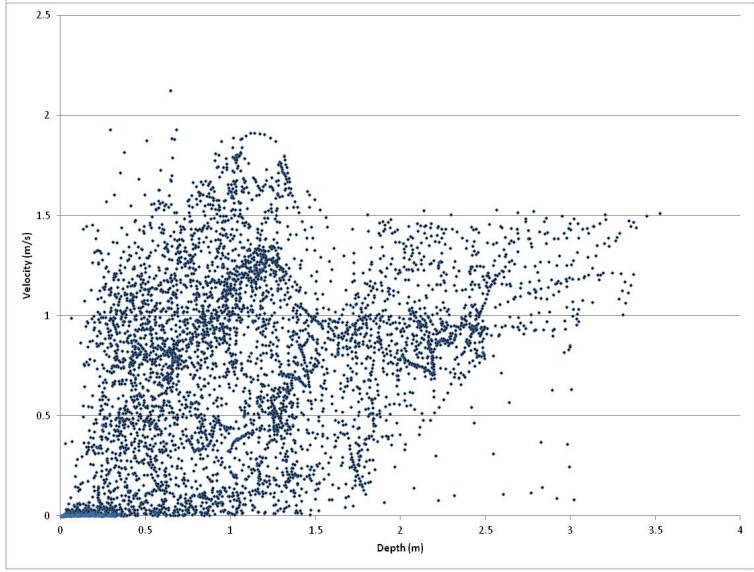
MODELS AS FREQUENCY ANALYSIS









QUALIFIERS

- Suitability criteria (HSC) drive the models – hydraulics are minor in comparison
- Site-specific HSC are much better than generic HSC
- Validation procedures for HSC rarely work
- Professional judgment HSC can work if done with expert knowledge
- Results <u>must make sense</u>!

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APPLICATION TO STREAM CLASSIFICATION

- There is an additional relationship between habitat suitability and physical stream characteristics than only to hydrologic patterns or characteristics
- Evidence:
  - Washington Toe-of-Bank Method
  - Hatfield and Bruce Meta-Analysis
  - Payne AFS BioEngineering Meta-Analysis

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RECOMMENDATION

- Continue with hydrologic classification process
- Supplement with physical characteristics
  - Channel width
  - Channel gradient
  - Channel elevation
  - Pool/riffle ratio
  - Predominant substrate type
  - Others?

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QUESTIONS AND DISCUSSION…

"Look, we've got to improve our habitat-modeling algorithms if we want to make more accurate wild-ass guesses."

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