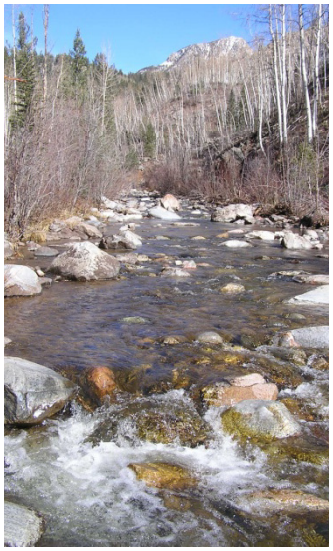
Instream Flow

NC Science Advisory Board Meeting
Raleigh, NC

March 15, 2011



Presented by:
Ty Ziegler, P.E.

What is Instream Flow or IFIM?

- **I**nstream
- **F**low
- **I**ncremental
- **M**ethodology

What is IFIM…Really???

It is a way to relate:

Changes in **River Flow**

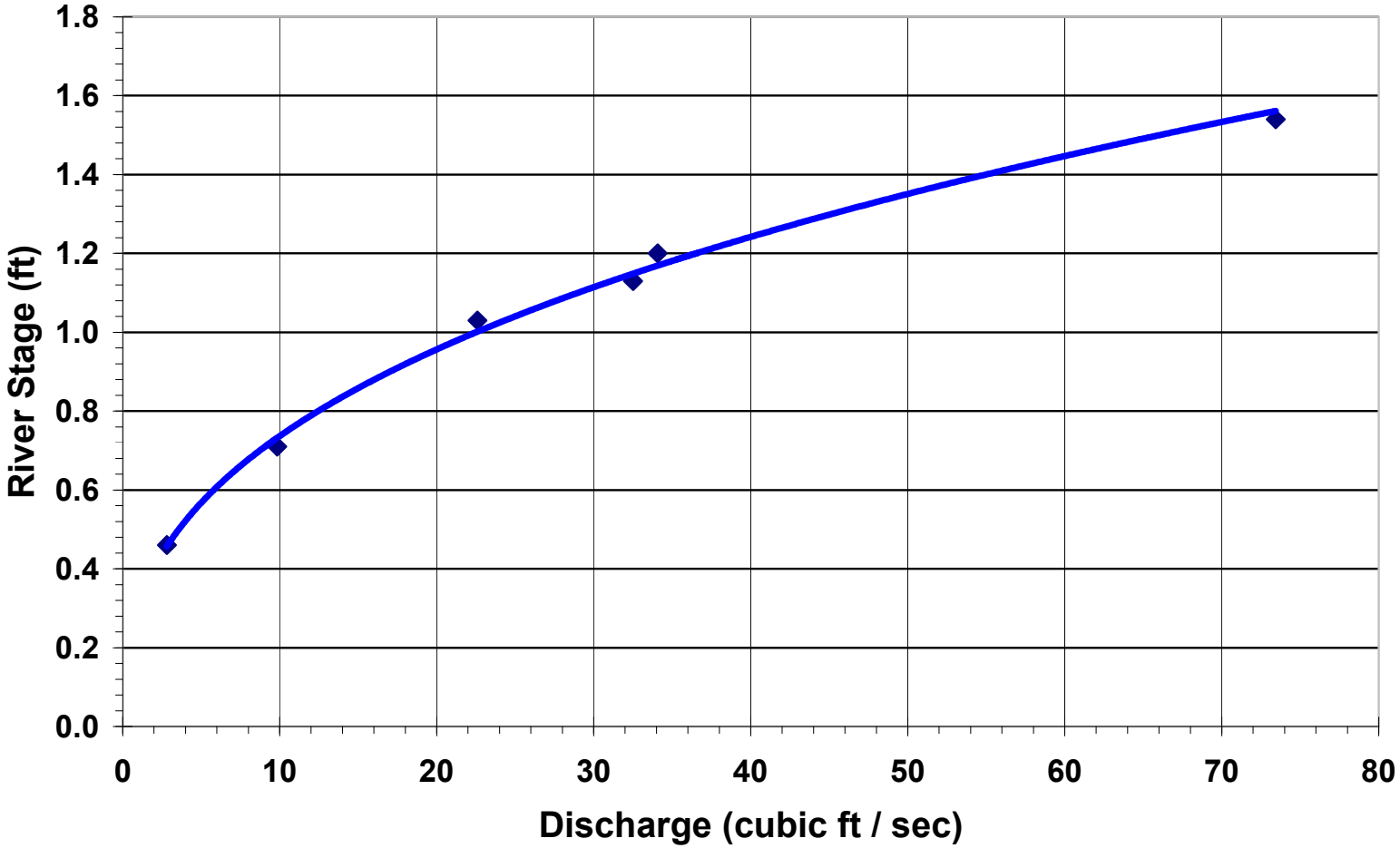
to

Changes in the Amount of **Aquatic Habitat**

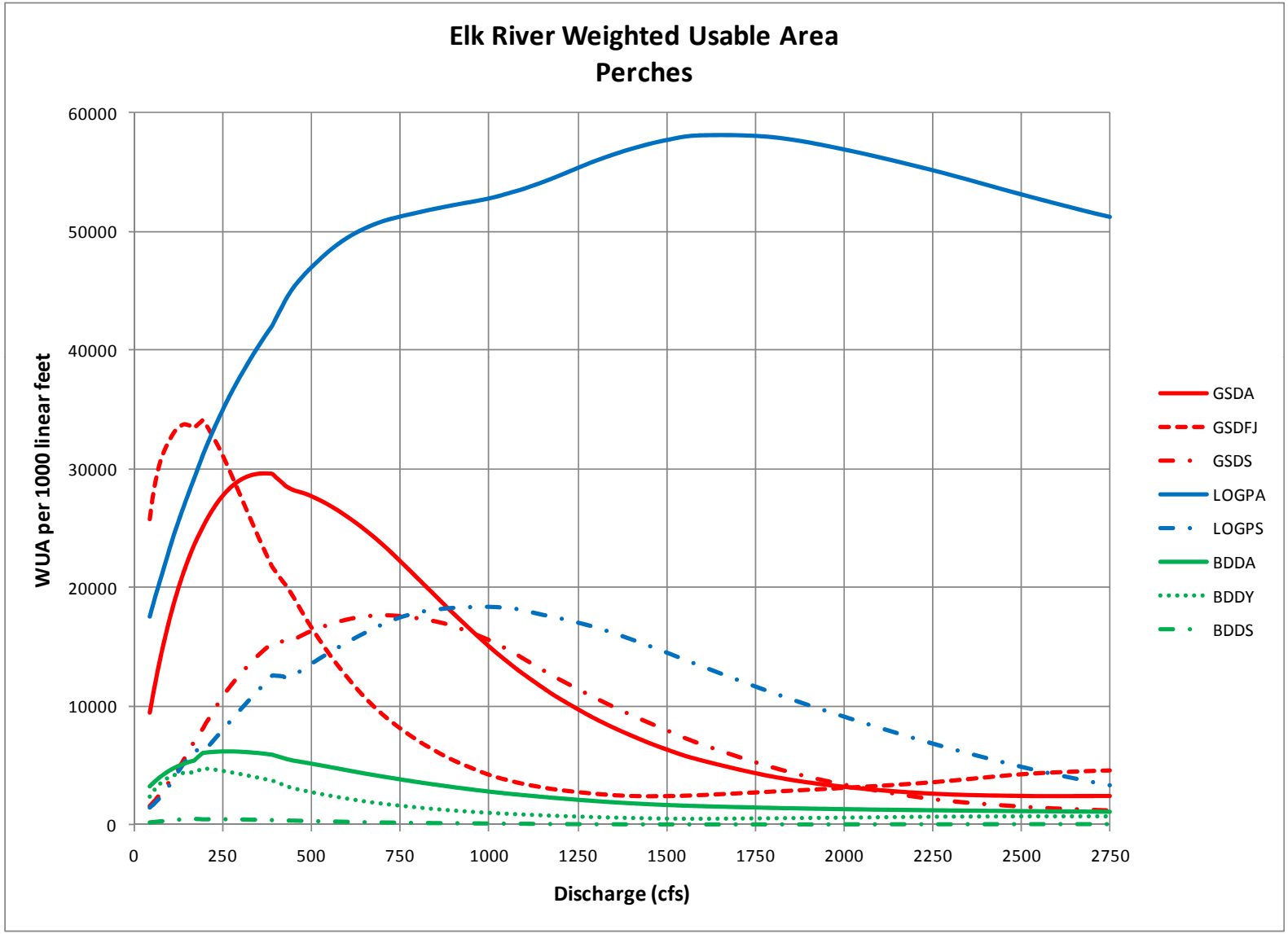
on an

Incremental Basis

Stage vs. Discharge



Habitat vs. Discharge



Aquatic Habitat

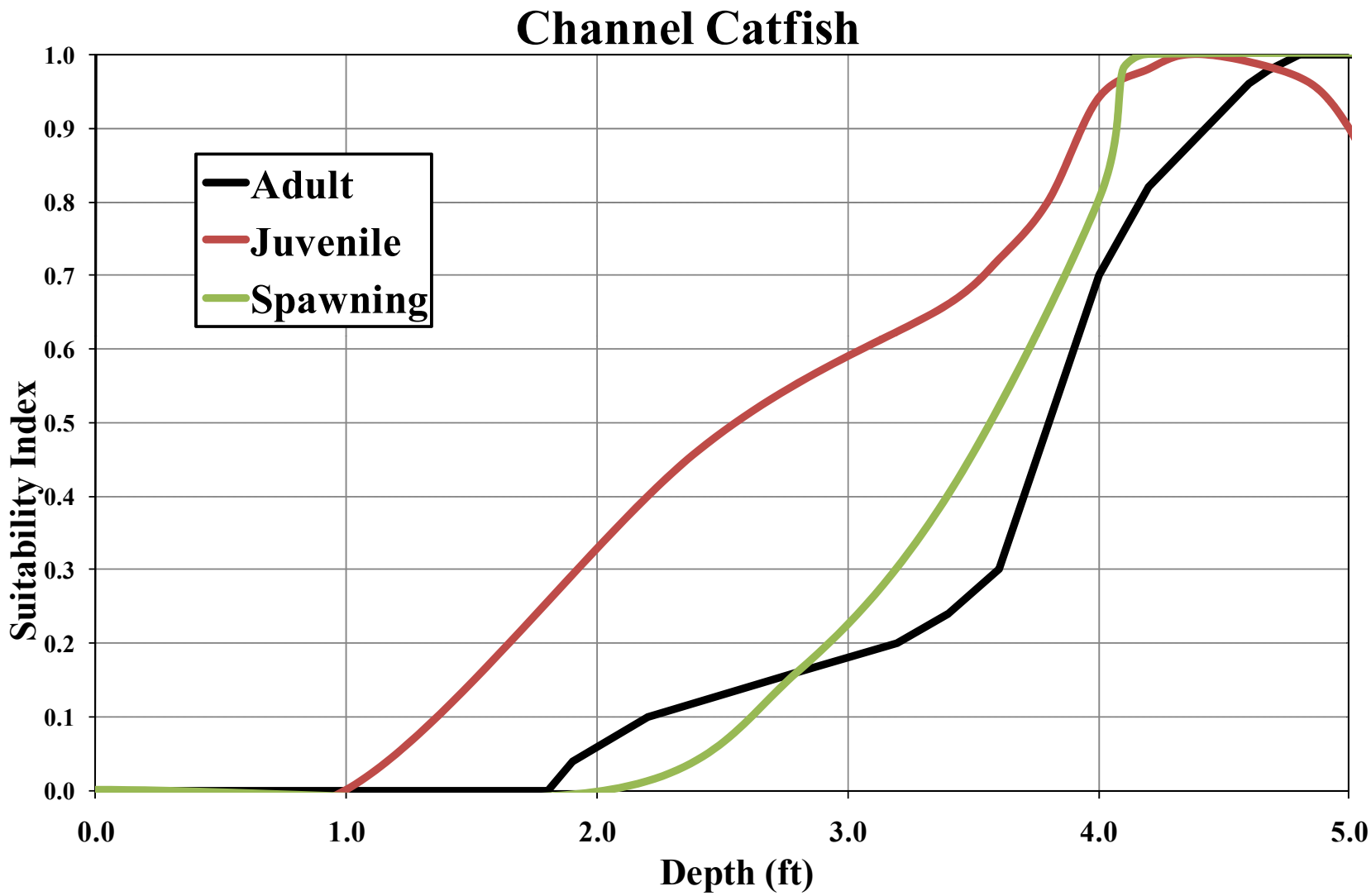
What's Important?

- Depth
- Velocity
- Substrate
- Cover (hiding spots)

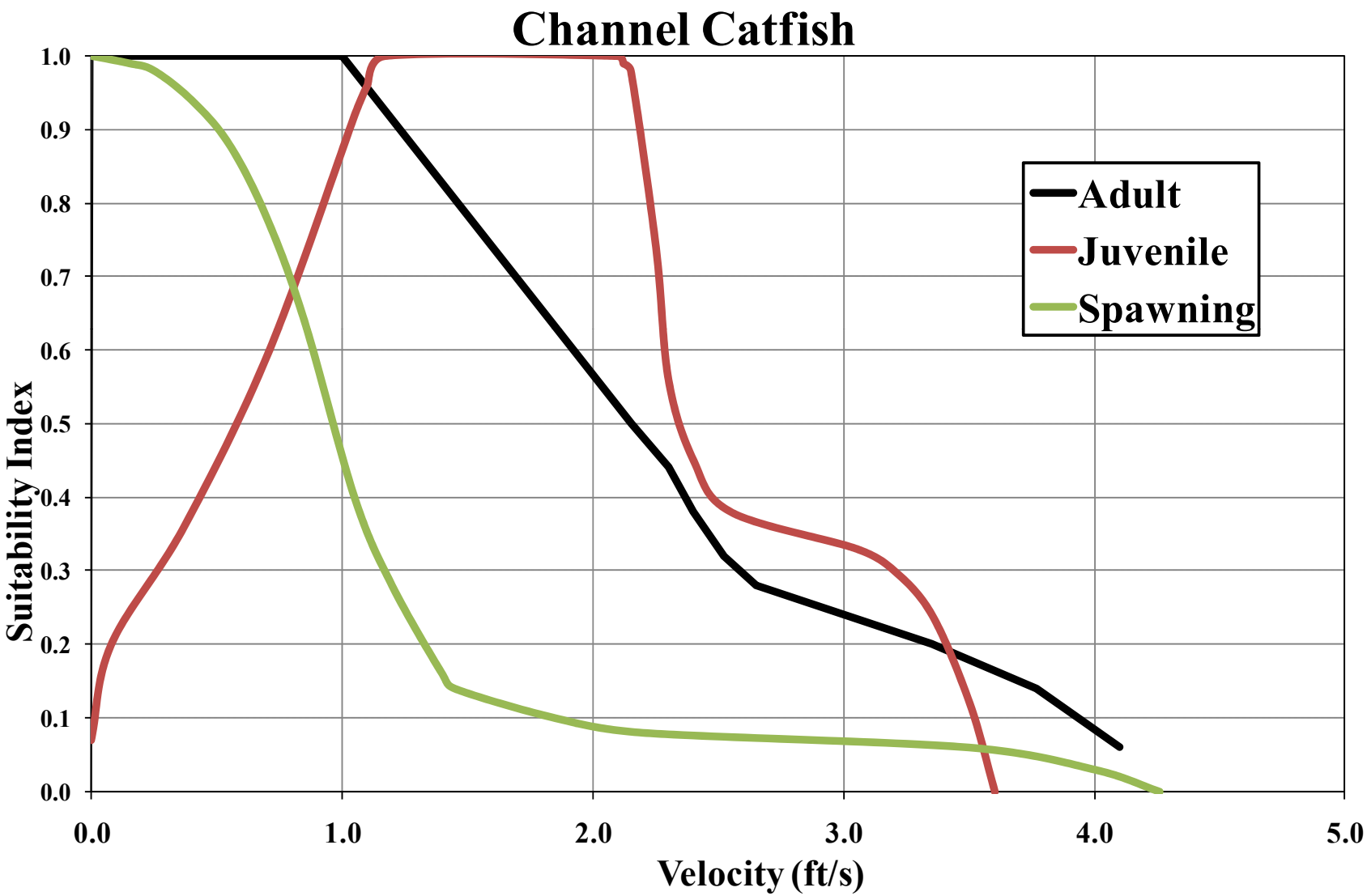
IFIM Only Considers These

- Food Availability
- Predators
- Water Quality
- Water Temperature

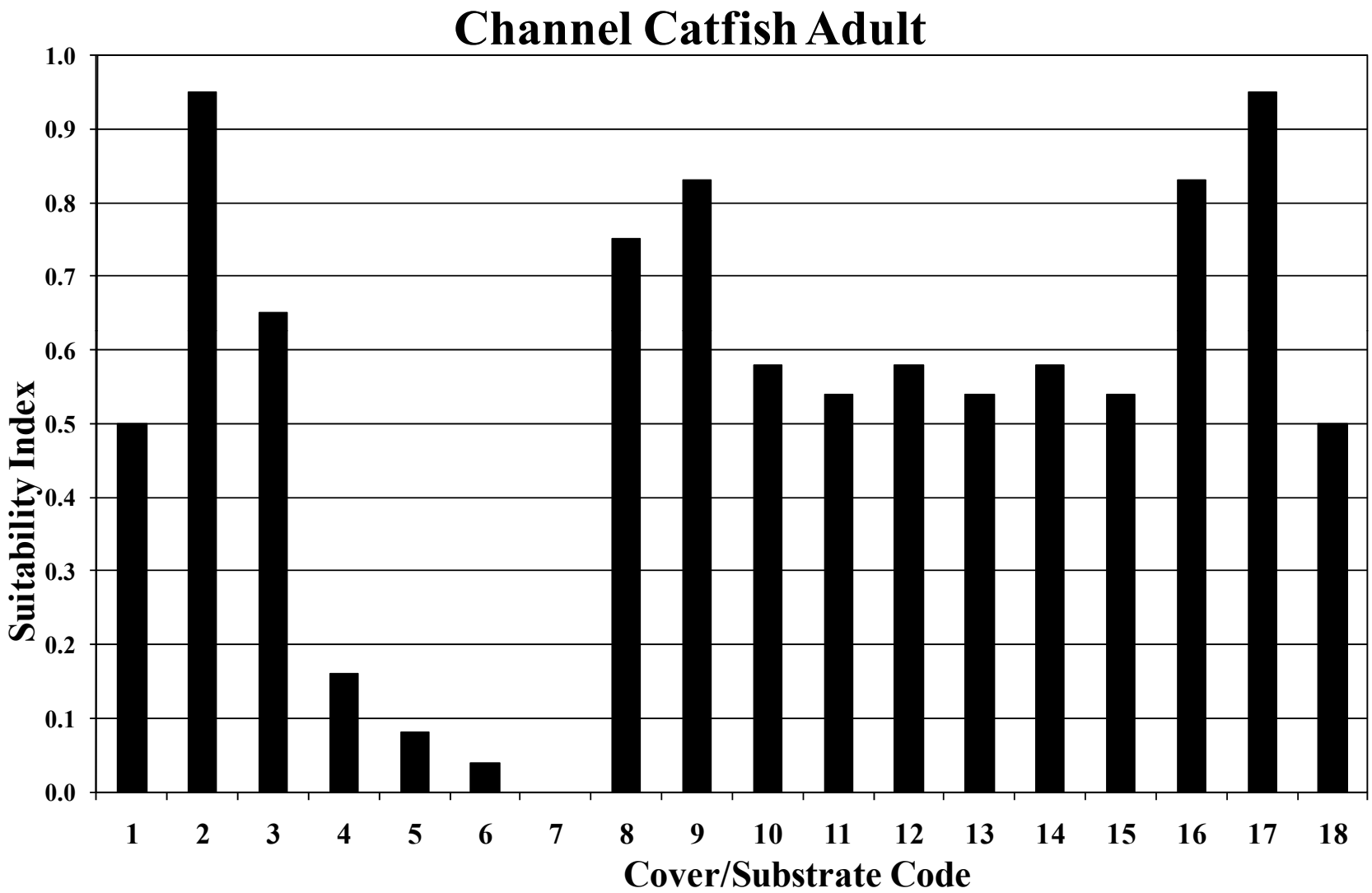
Example: Habitat Suitability Criteria - Depth



Example: Habitat Suitability Criteria - Velocity



Example: Habitat Suitability Criteria – Substrate/Cover



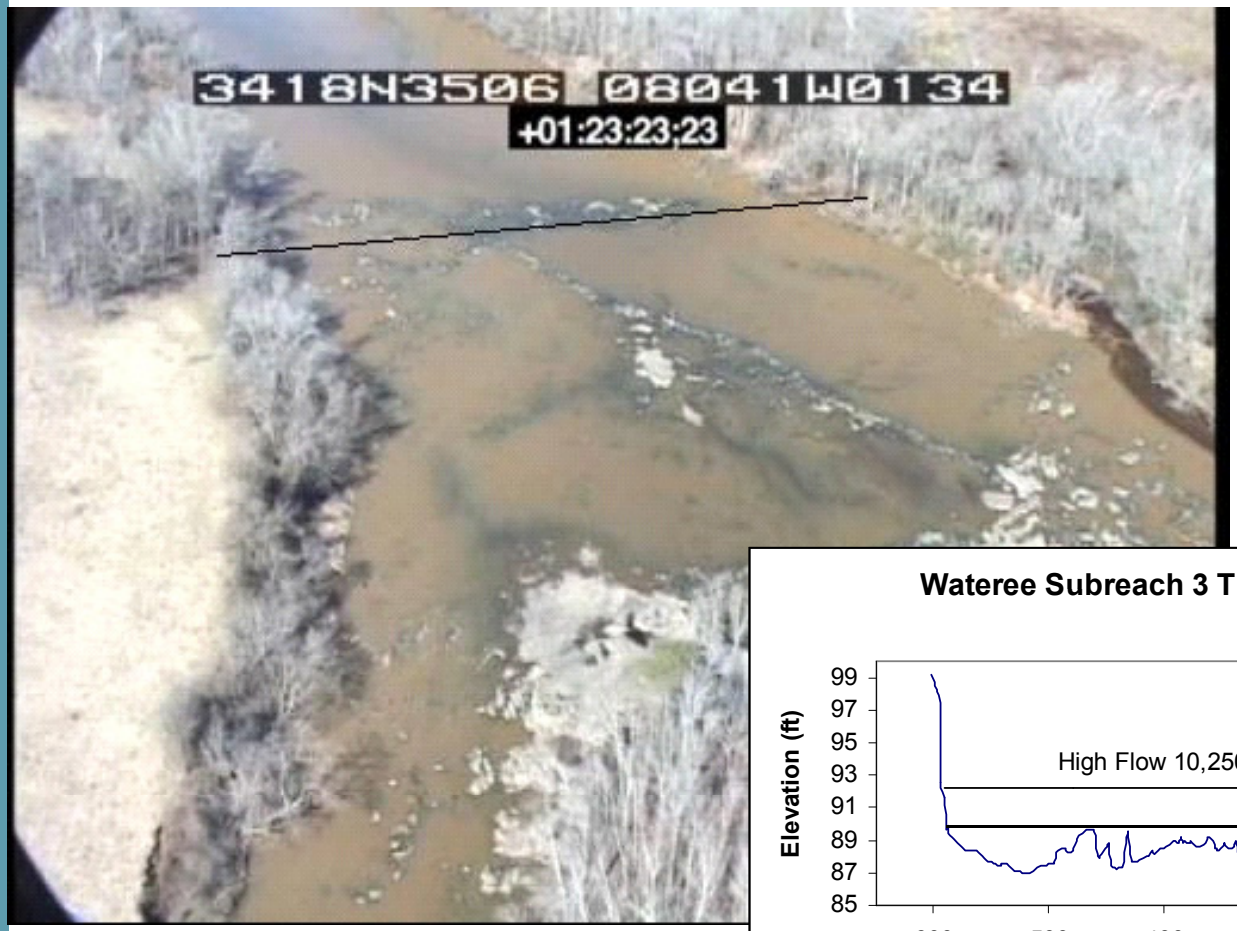
How do you start?

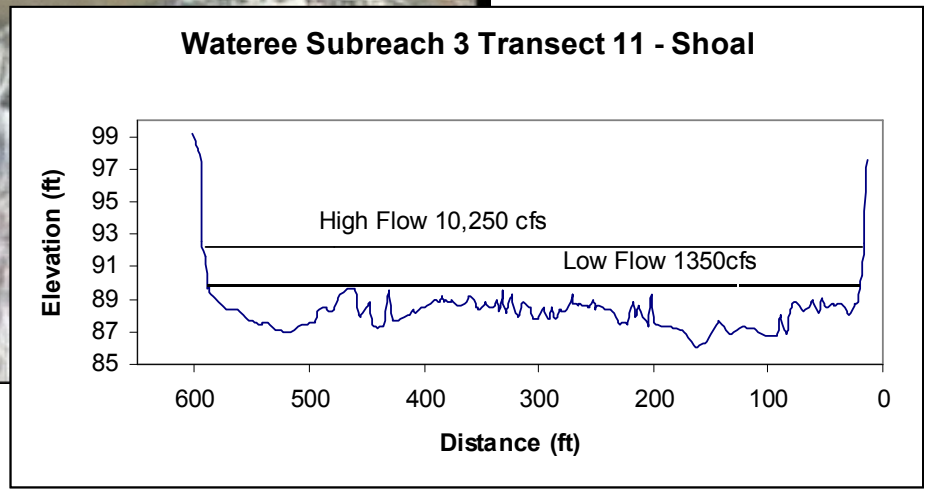
Overview of the IFIM Process

1. Field Reconnaissance & Habitat Mapping
2. Study Design
3. Habitat Weighting
4. Transect Selection & Setup
5. Flow Measurements
6. PHABSIM Modeling
7. Time Series Analysis
8. Habitat Results
9. Habitat Based Flow Determination
10. Study Report

Step 1: Field Recon & Habitat Mapping

Field Reconnaissance





Habitat Mapping (Width and Depth)

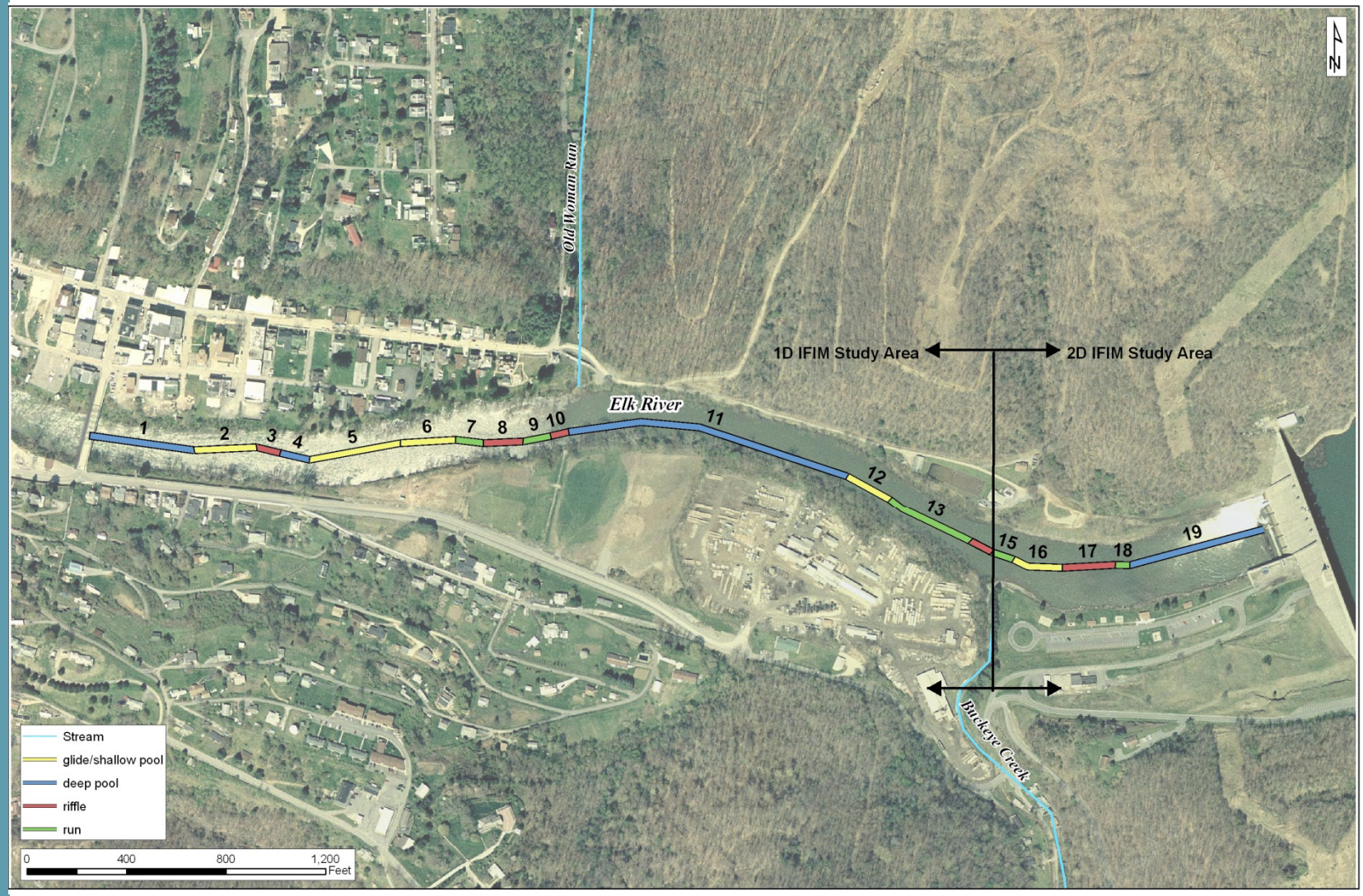
Habitat Mapping (Type)

Habitat Mapping (Species)

Habitat Mapping Results

Step 2: Finalize Study Design

Final Study Design

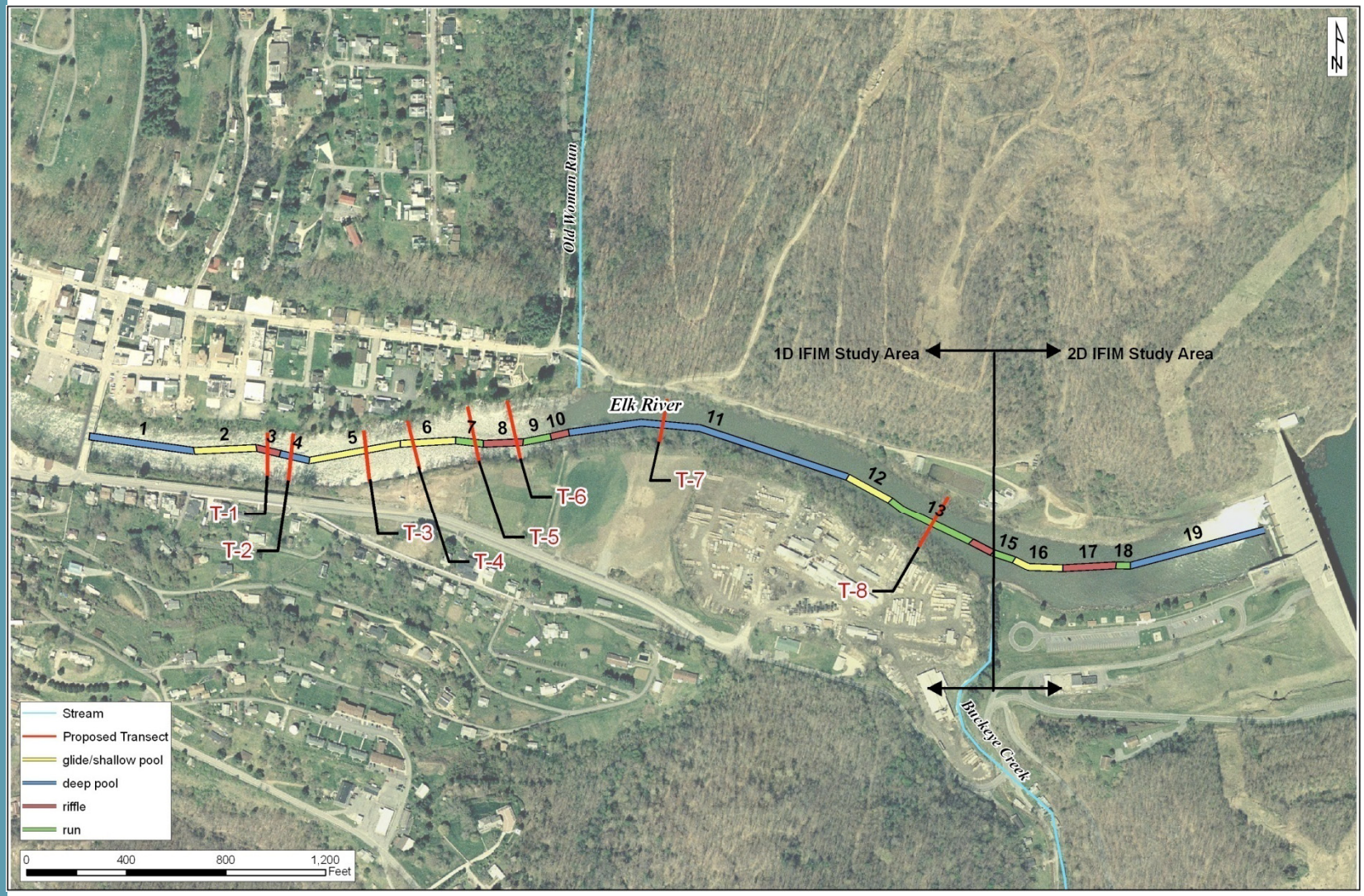


Step 3: Habitat Weighting

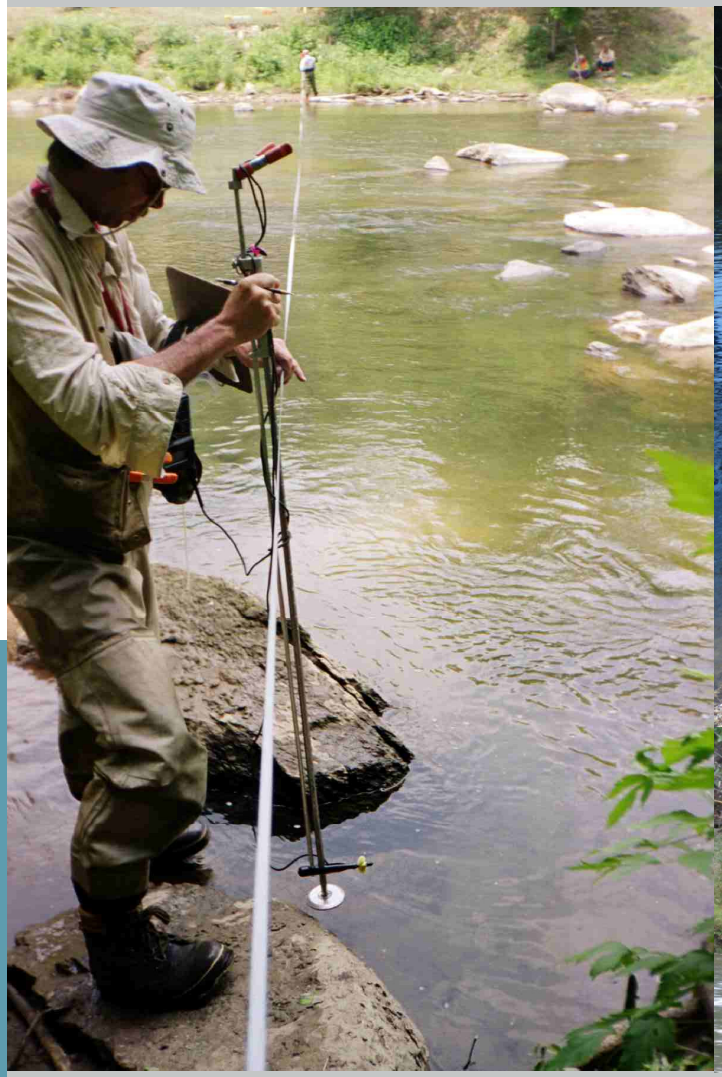
Habitat Type	Number of Occurrences	Total Length (ft)	Percent (%)
Riffle	4	431	11
Run	3	591	16
Glide / Shallow Pool	4	1,041	28
Deep Pool	3	1,701	45
Total	**14**	**3,764**	**100**

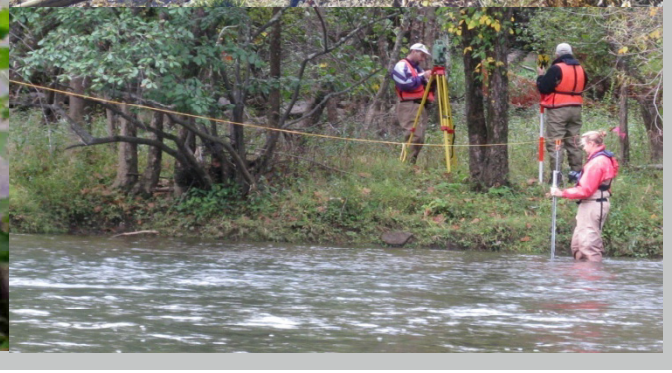
Step 4: Transect Selection

Example: Elk River

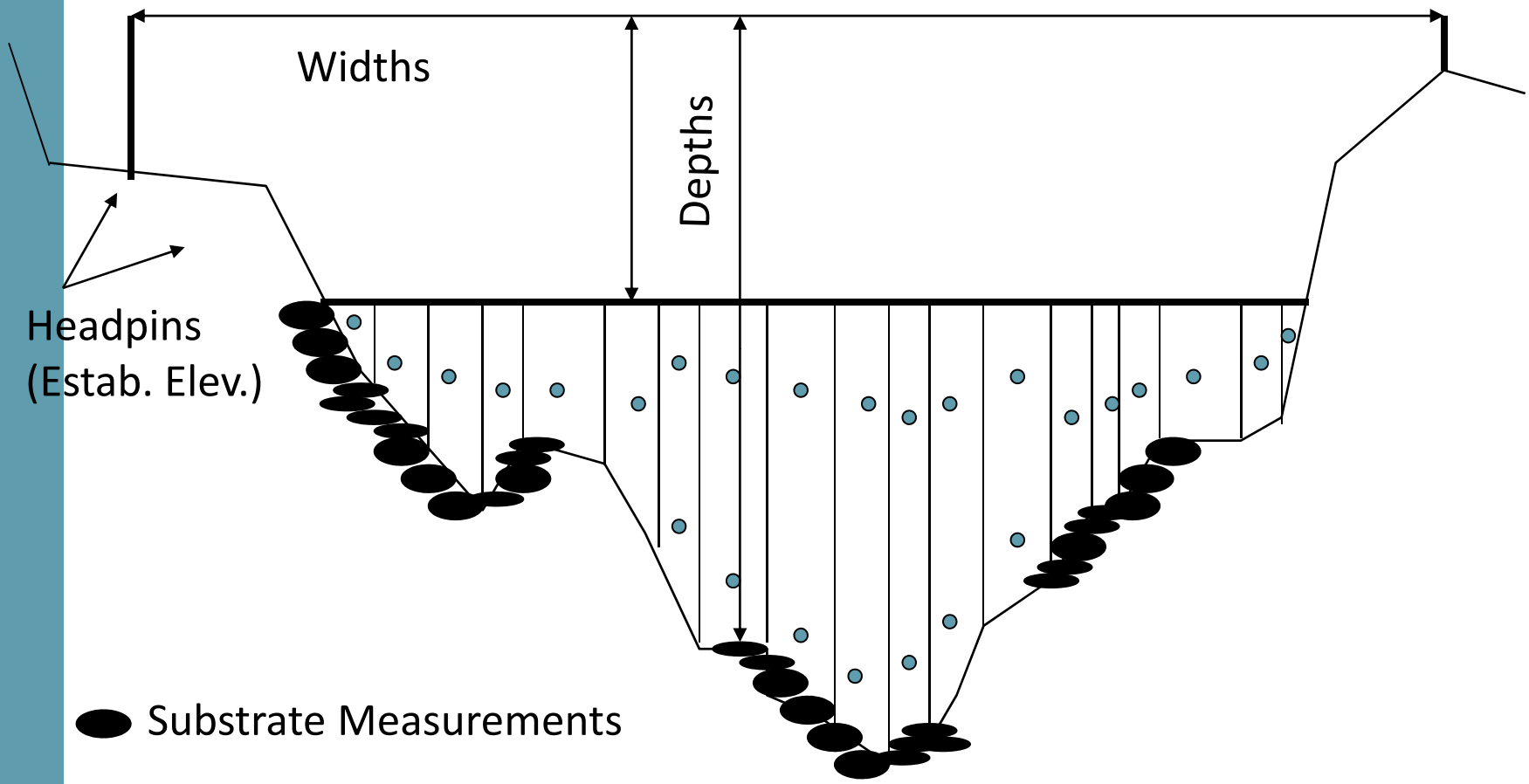


Step 5: Field Measurements





Substrate, Velocity and Depth Measurements



Substrate Measurements

Velocity Measurements

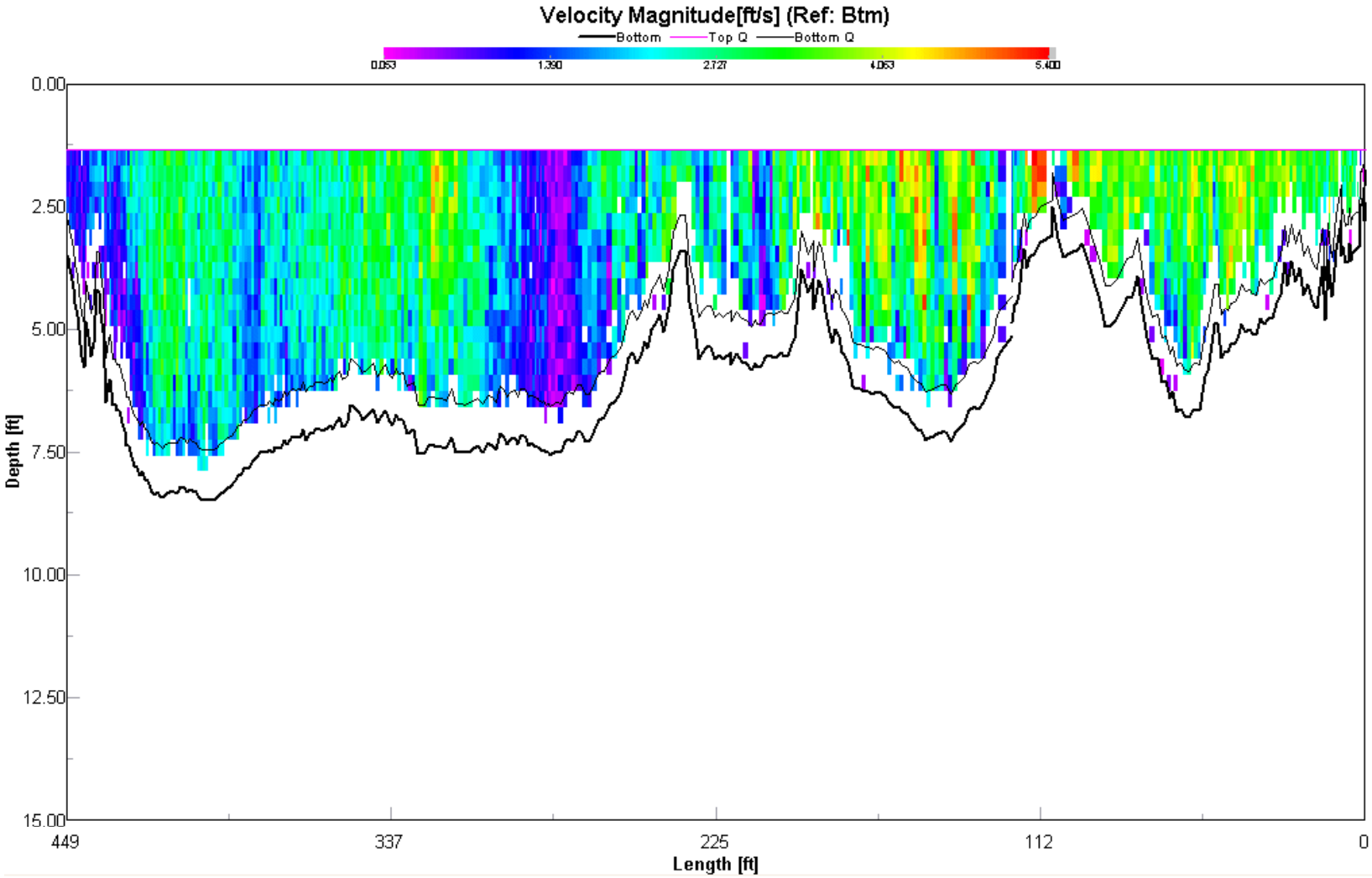
Flow = Velocity × Area

Velocity and Depth: Manual Method

Velocity and Depth: Cataraft with ADCP

Velocity and Depth: ADCP

ADCP Velocity Magnitude Profile



Velocity and Depth: Mini-Cataraft with ADCP

Velocity and Depth: Manual and ADCP Method

Distance and Elevation Measurements

IFIM studies <u>can</u> require a lot of gear….

....and a lot of people....

….but they can also be relatively low intensity efforts

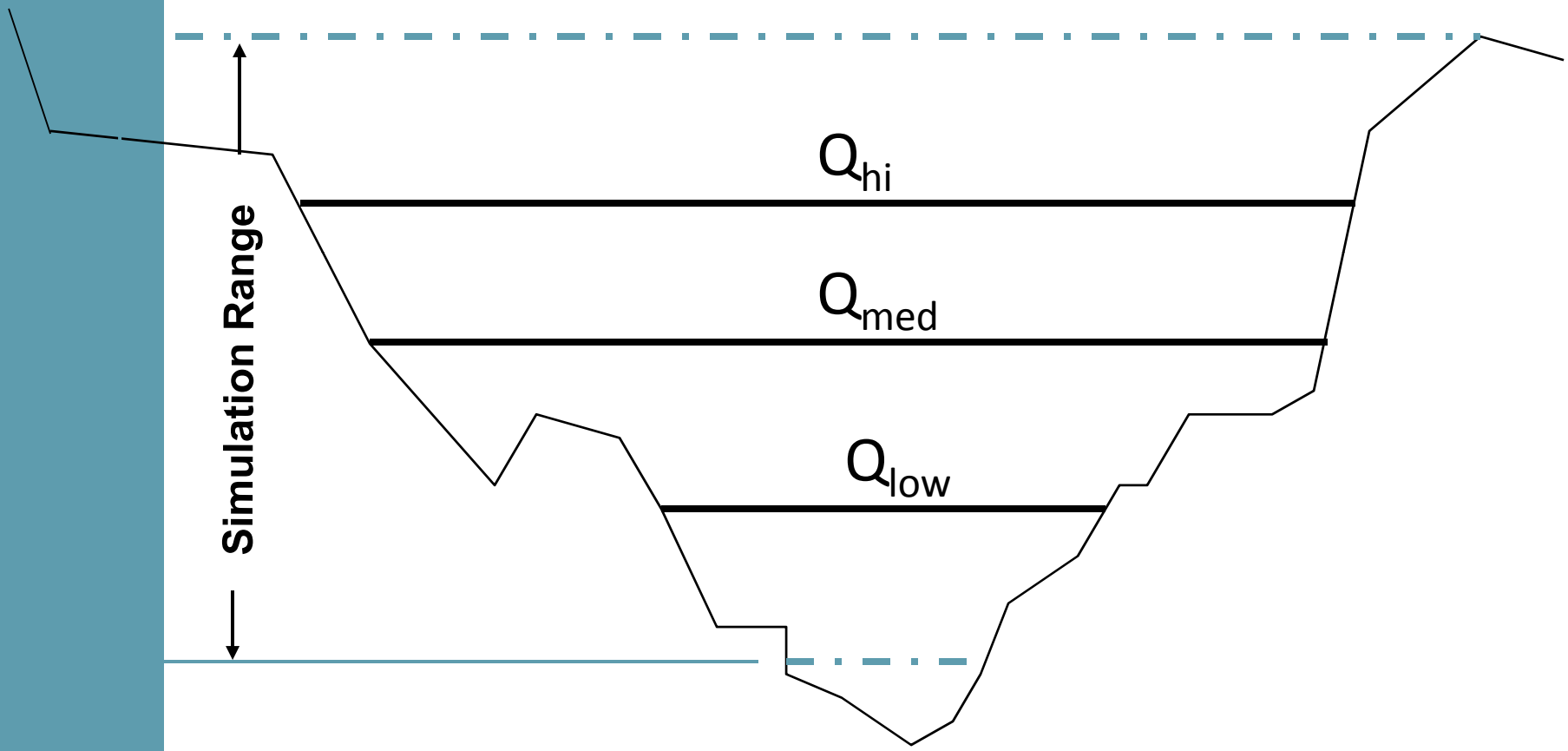
Low Flow (8 cfs)

Middle Flow (37 cfs)

Mid-High Flow (50 cfs)

High Flow (67 cfs)

Calibration vs. Simulation Flows

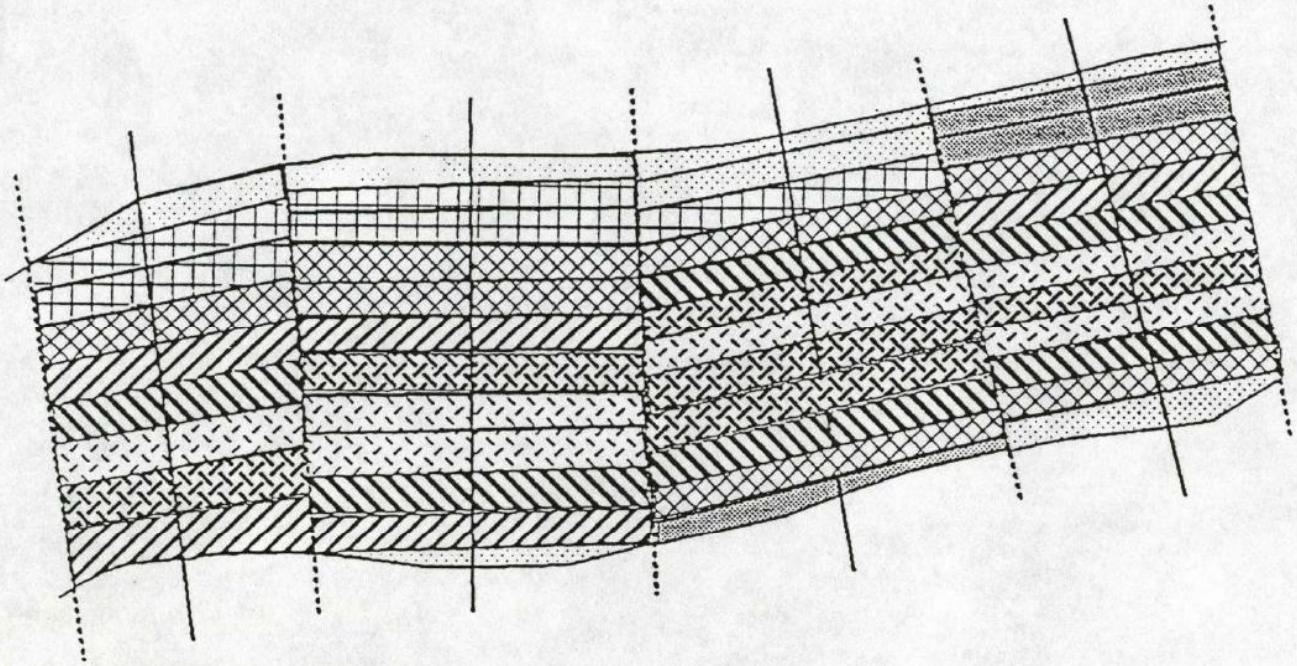


Step 6:
PHABSIM
Modeling

What is PHABSIM?

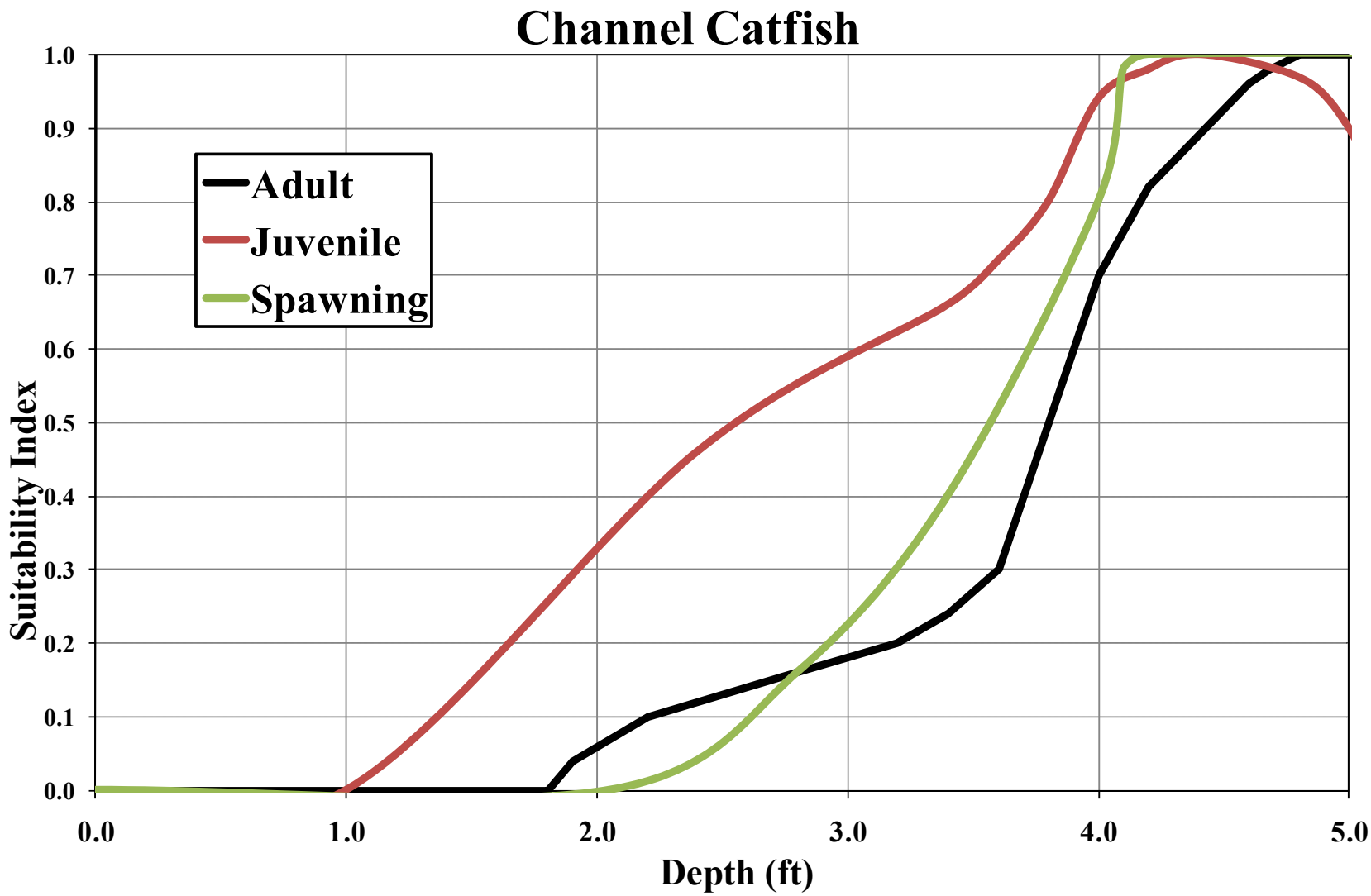
- **P**hysical
- **HAB**itat
- **SIM**ulation
- Model

Cell Habitat

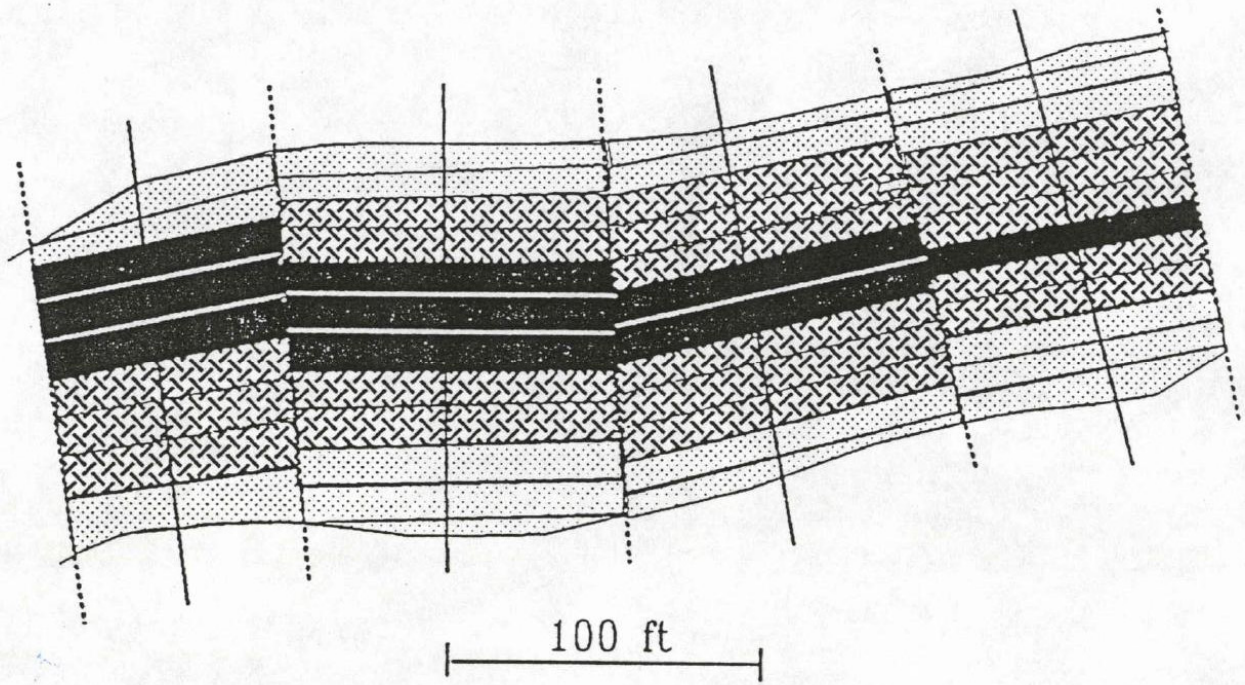


Depth	Velocity	Cover
0–0.5	0–0.5	present
0–0.5	0–0.5	absent
0.5–1.5	0–0.5	present
0.5–1.5	0–0.5	absent
0.5–1.5	0.5–1.5	present
0.5–1.5	0.5–1.5	absent
1.5–3.0	0.5–1.5	present
1.5–3.0	0.5–1.5	absent

Habitat Suitability Criteria - Depth



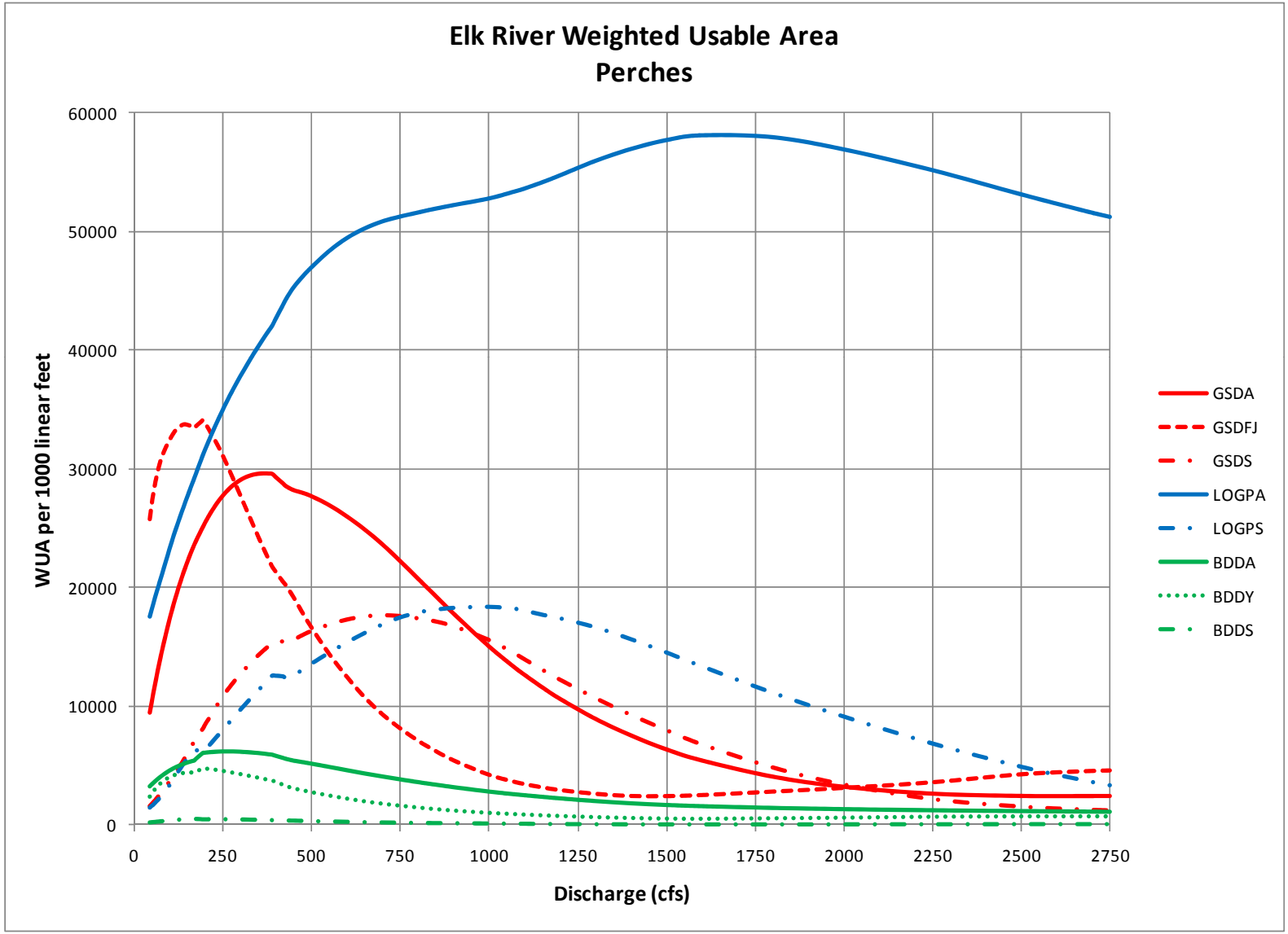
Weighted Usable Area (WUA)



Flow to Habitat Conversion

Flow (cfs)	WUA (sq ft)
100	17,797
200	45,399
400	103,250
700	160,229
850	175,466
1,000	186,424
1,300	201,513
1,600	222,192
1,900	237,339
2,200	244,524
2,425	248,115
2,500	249,012
2,800	251,654
3,250	253,453
3,700	254,366
3,850	254,003
4,000	253,375
6,000	216,044
10,000	107,434
14,000	32,198
18,500	13,367
23,000	8,345

Habitat vs. Discharge

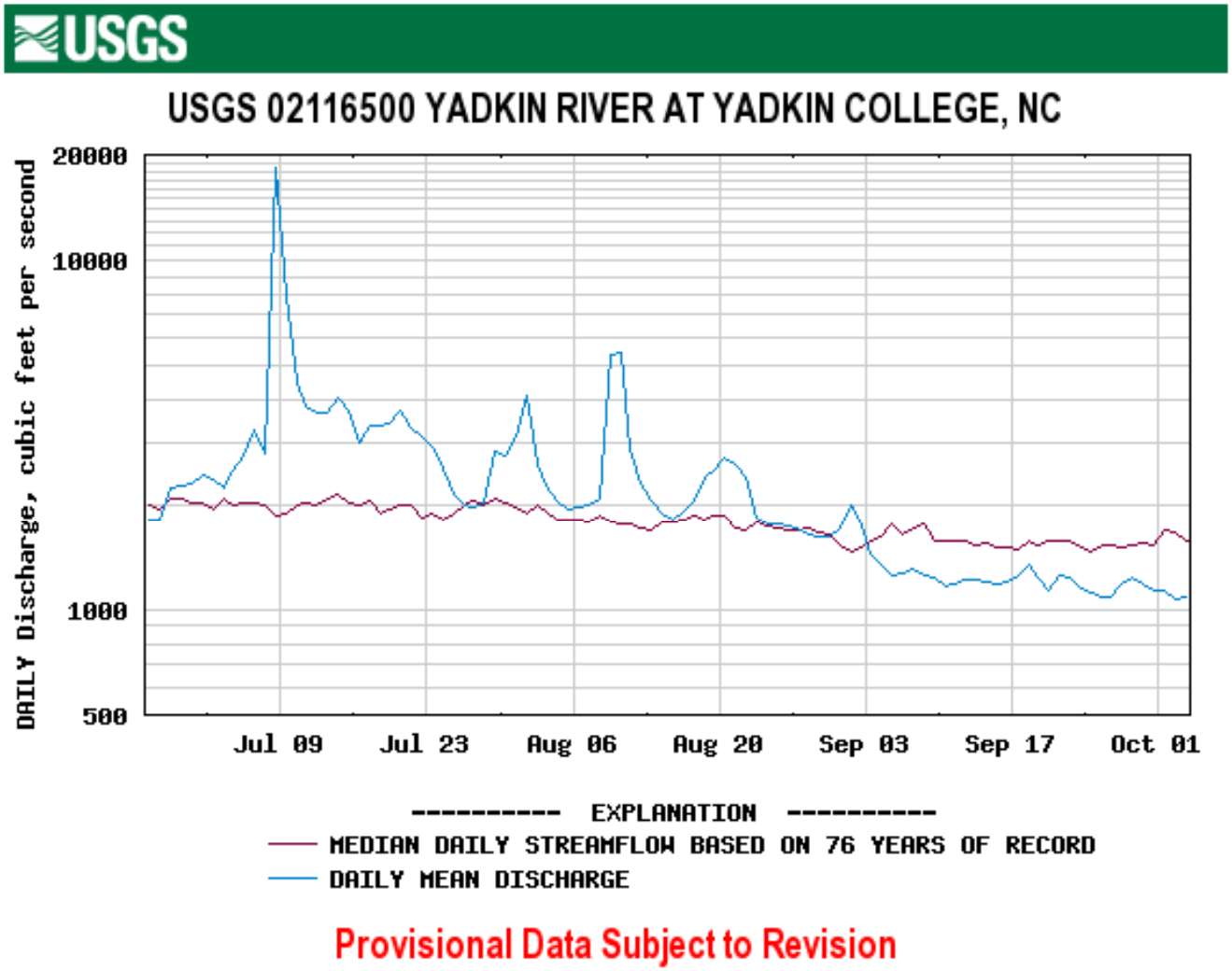


Weighted Usable Area provides the magnitude of available aquatic habitat…

…But not the frequency at which it occurs.

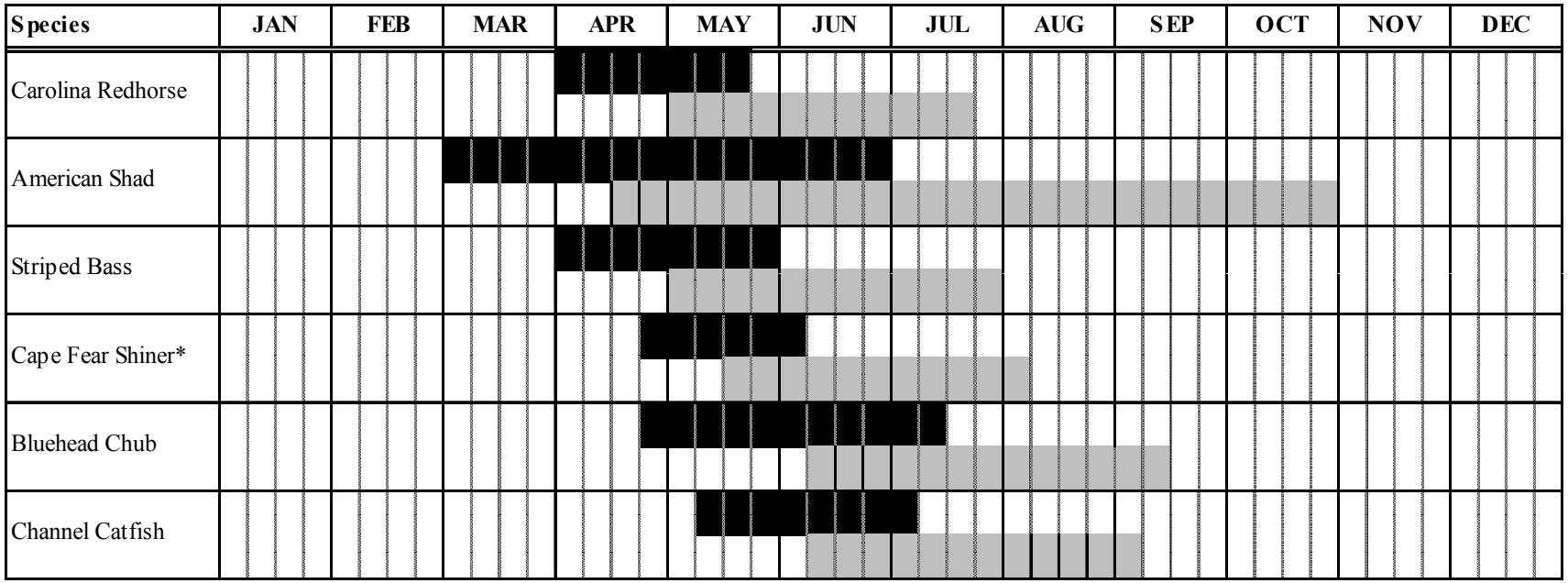
Step 7: Time Series Analysis

Time Series Analysis



Provisional Data Subject to Revision

Periodicity



Spawning

Early Life Stage (estimated to begin two-thirds of the way through the spawning period and lasting 60 days post spawn; except for Cape Fear Shiner)

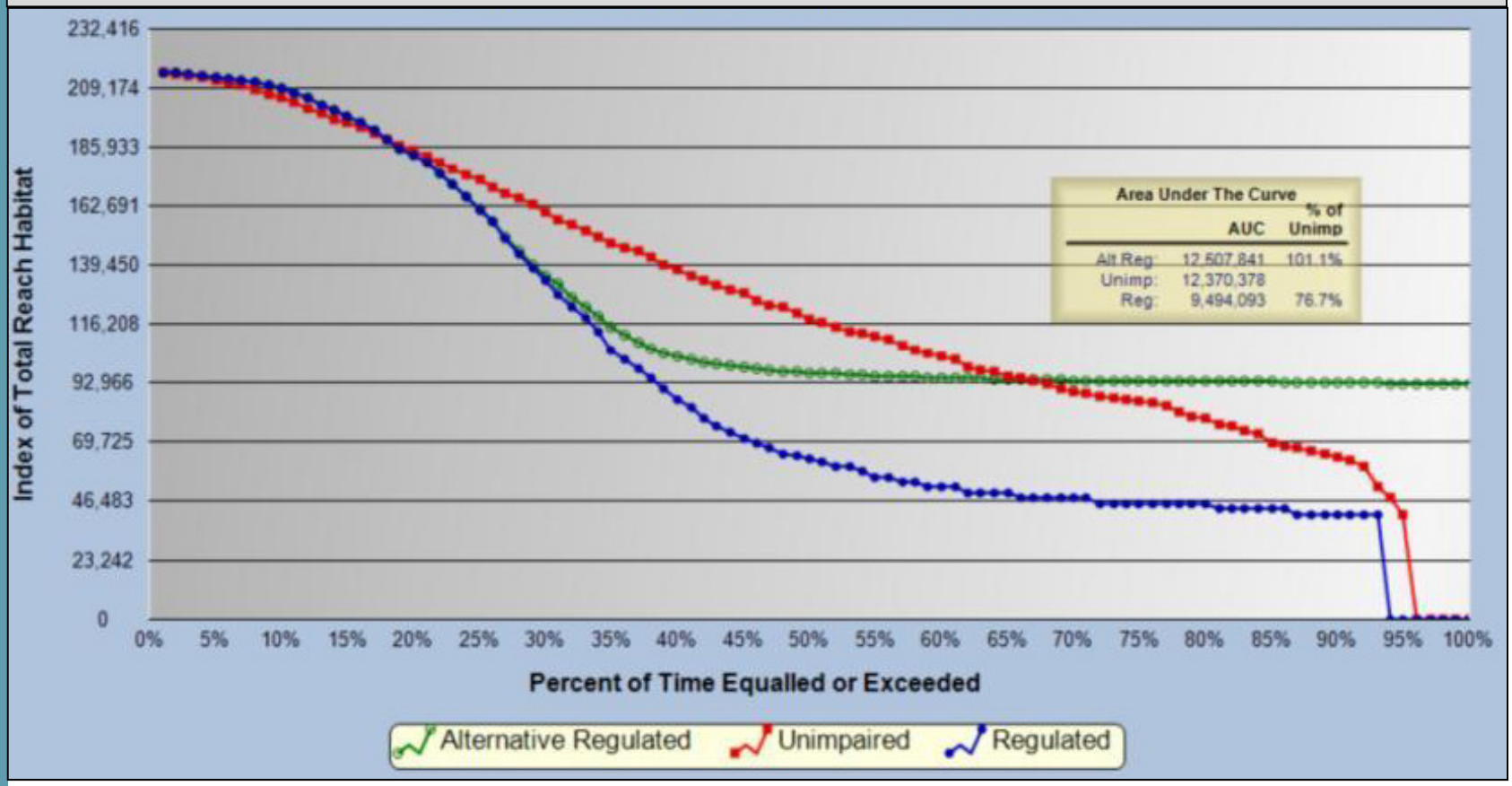
Source: Jenkins and Burkhead (1993)

* Cape Fear Shiner Source: Hewitt et al. (2009)

Step 8: Habitat Results

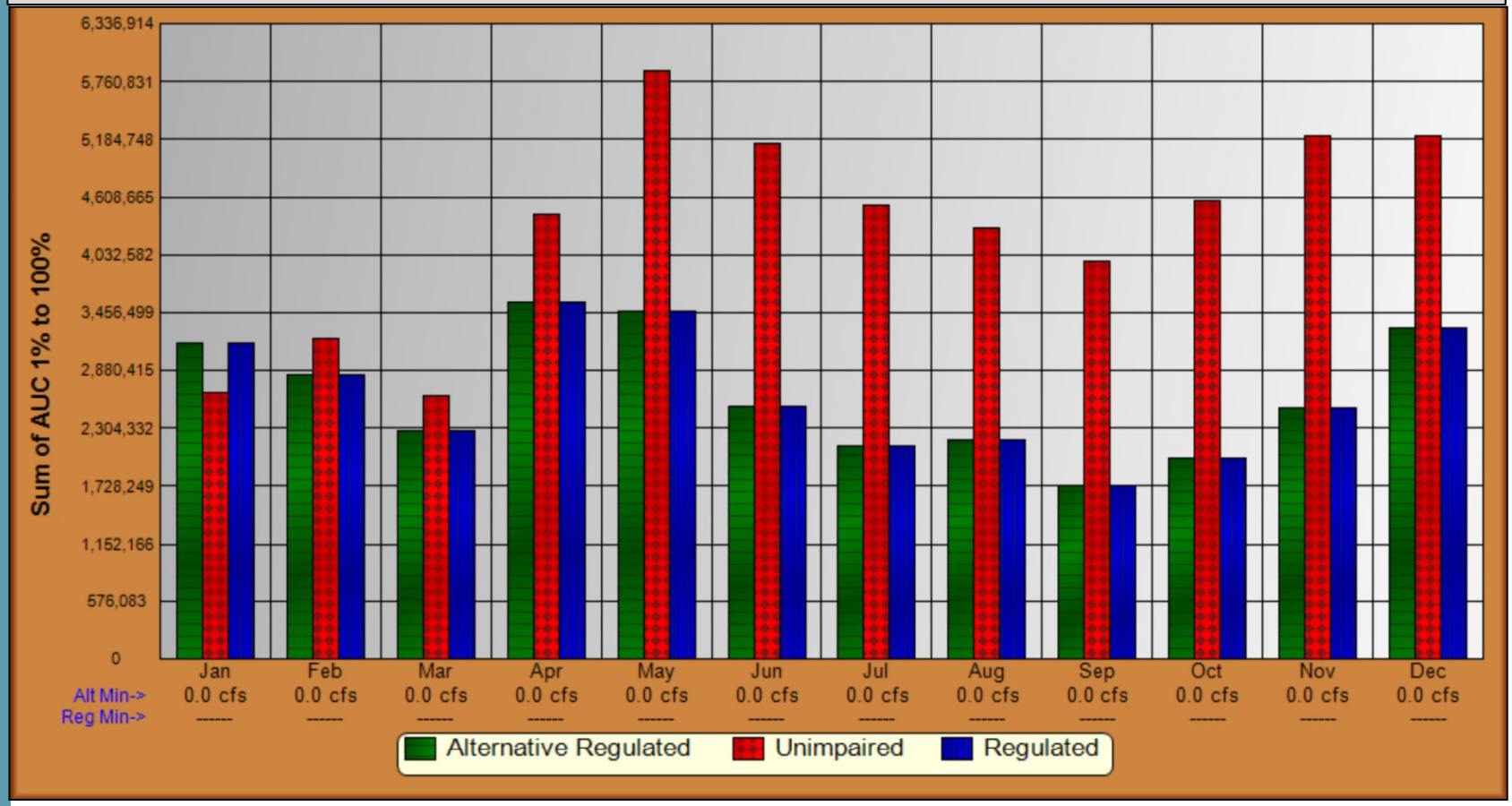
Habitat Duration Curves

Exceedance AUC 1% to 100%
Period of Record 1930-2009
Creek X Node 1 – Species Example A
August – All Water Year Types – Alternate Min Flow = 5.0

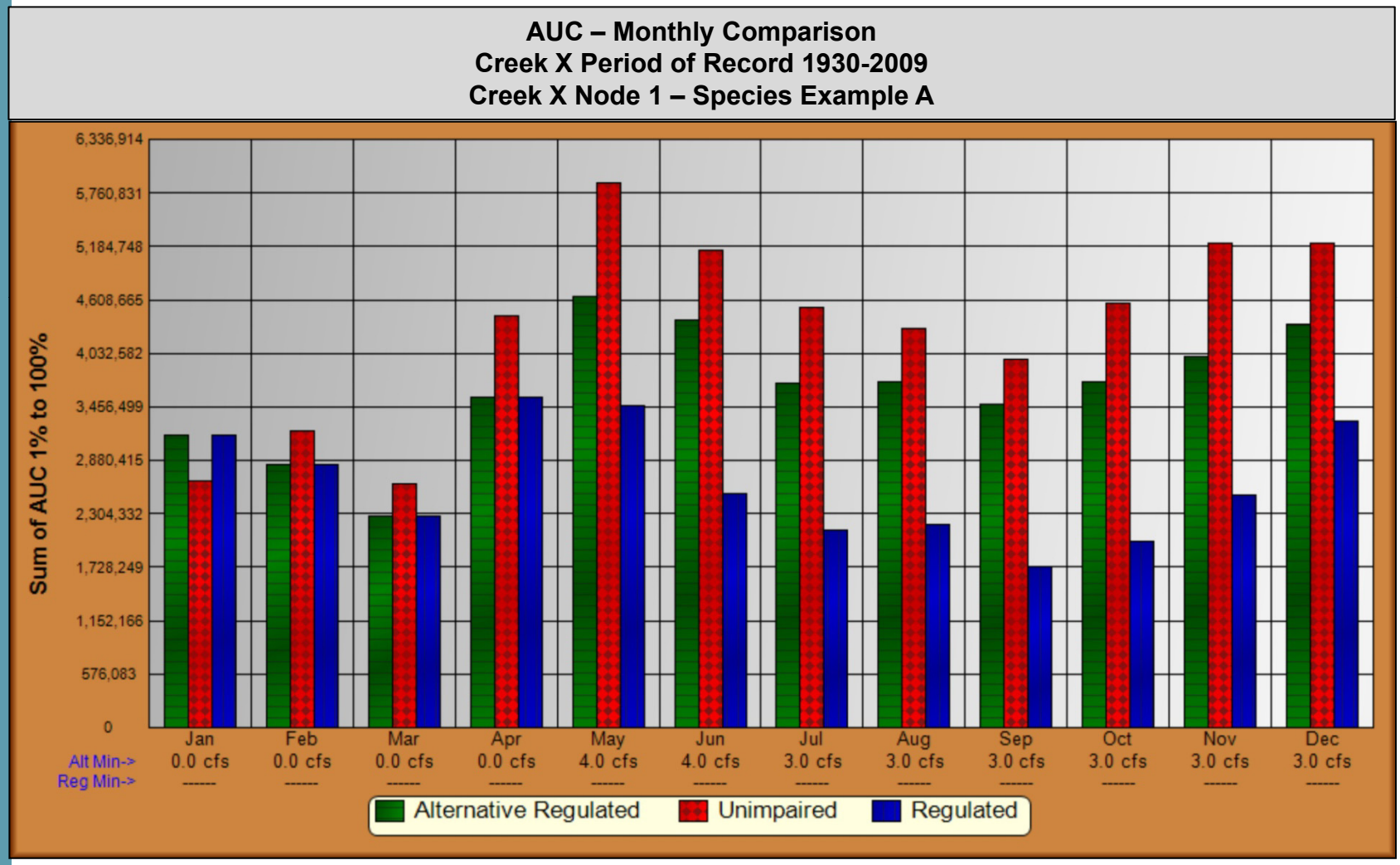


Interactive Habitat Results
Option 1: Existing Conditions

AUC – Monthly Comparison
Creek X Period of Record 1930-2009
Creek X Node 1 – Species Example A

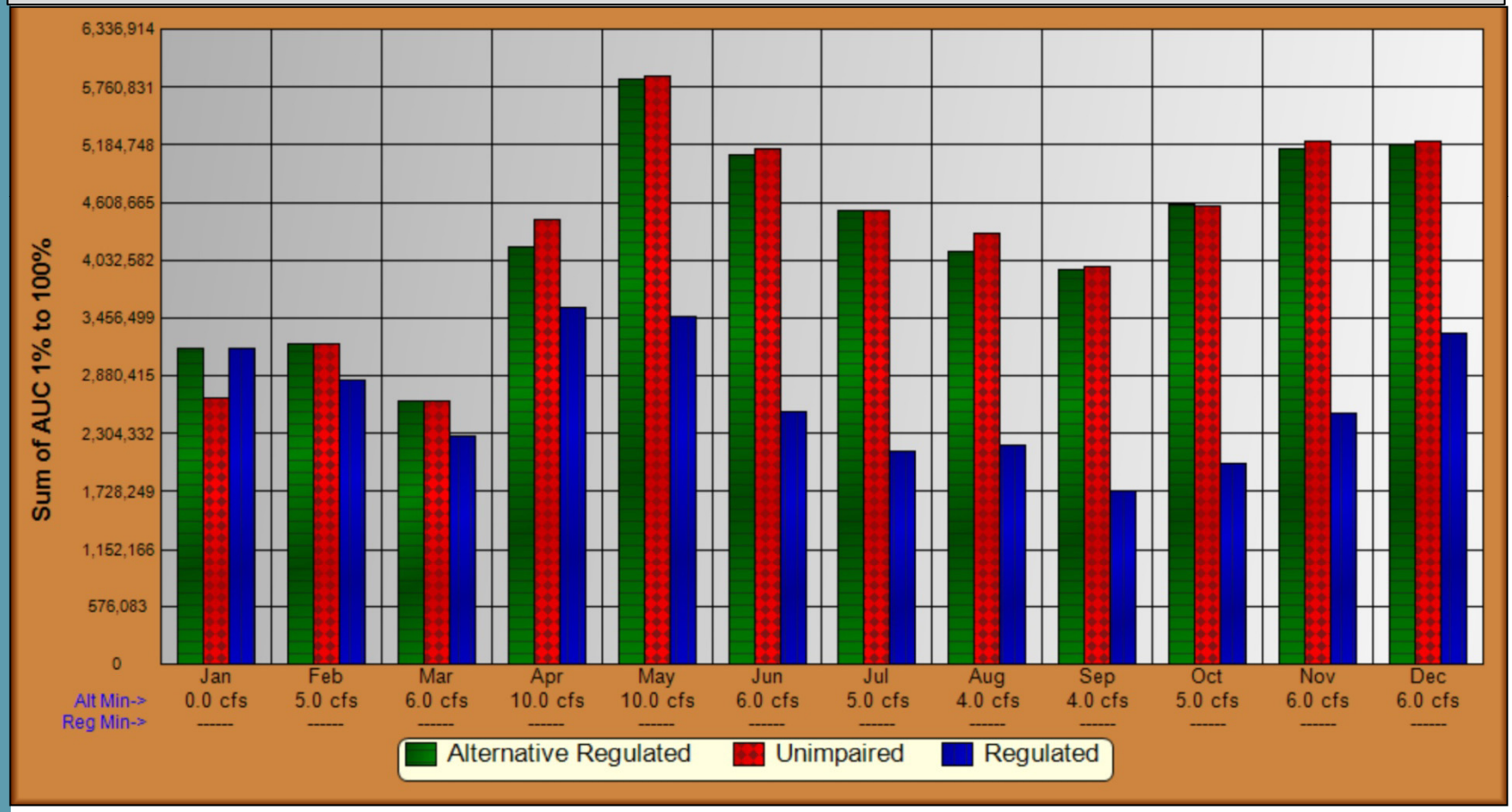


Interactive Habitat Results
Option 2: 80% Unimpaired



Interactive Habitat Results
Option 3: Match Unimpaired

AUC – Monthly Comparison
Creek X Period of Record 1930-2009
Creek X Node 1 – Species Example A



Step 9: Habitat Based Flow Determination

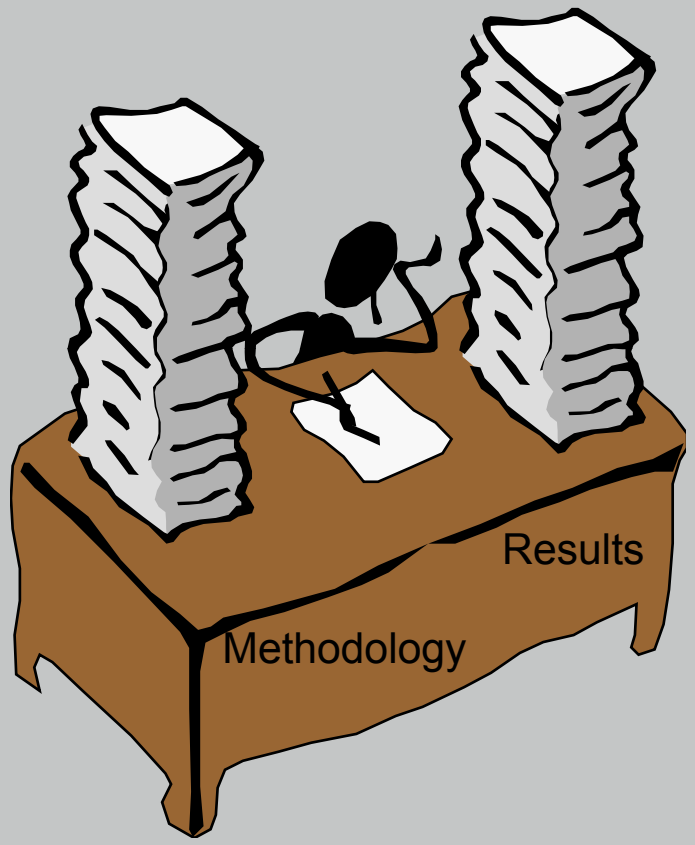
Month	Option 1	Option 2	Option 3
	Existing	80% Unimpaired	Match Unimpaired
Jan	0	0	0
Feb	0	0	5
Mar	0	0	6
Apr	0	0	10
May	0	4	10
Jun	0	4	6
Jul	0	3	5
Aug	0	3	4
Sep	0	3	4
Oct	0	3	5
Nov	0	3	6
Dec	0	3	6

Is This The Answer??

- Need to take into consideration with other studies:
  - Water Supply
  - Water Quality
  - Recreation (eg. paddling & angling)
  - Aesthetics
  - Lake Levels
  - Economics
  - Etc.

It's Part of the Answer……

Step 10: Study Report



Recap of the IFIM Process

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Questions?