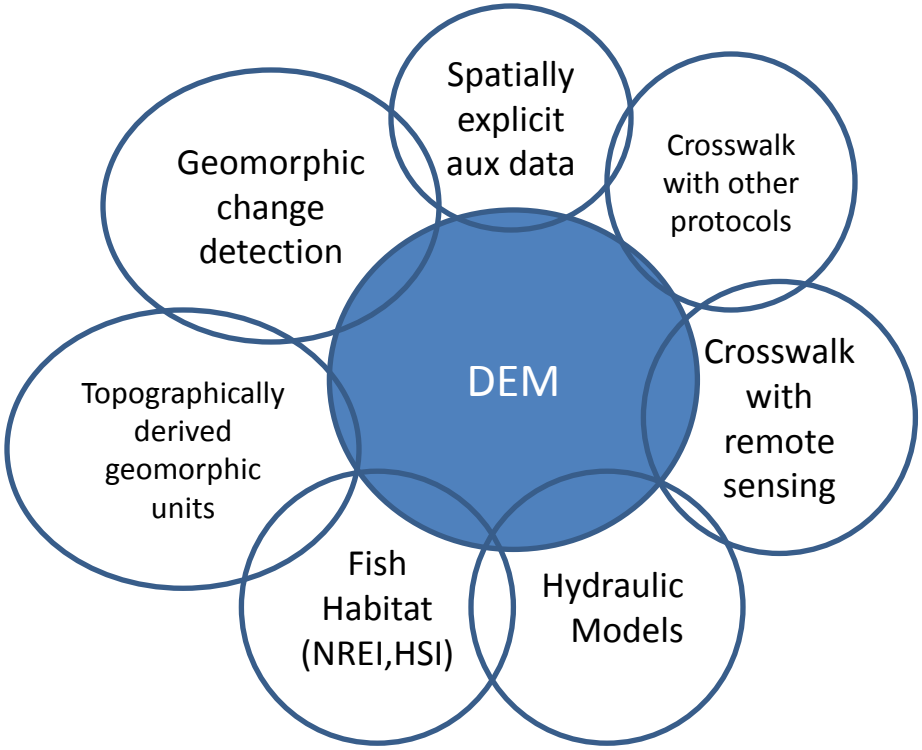
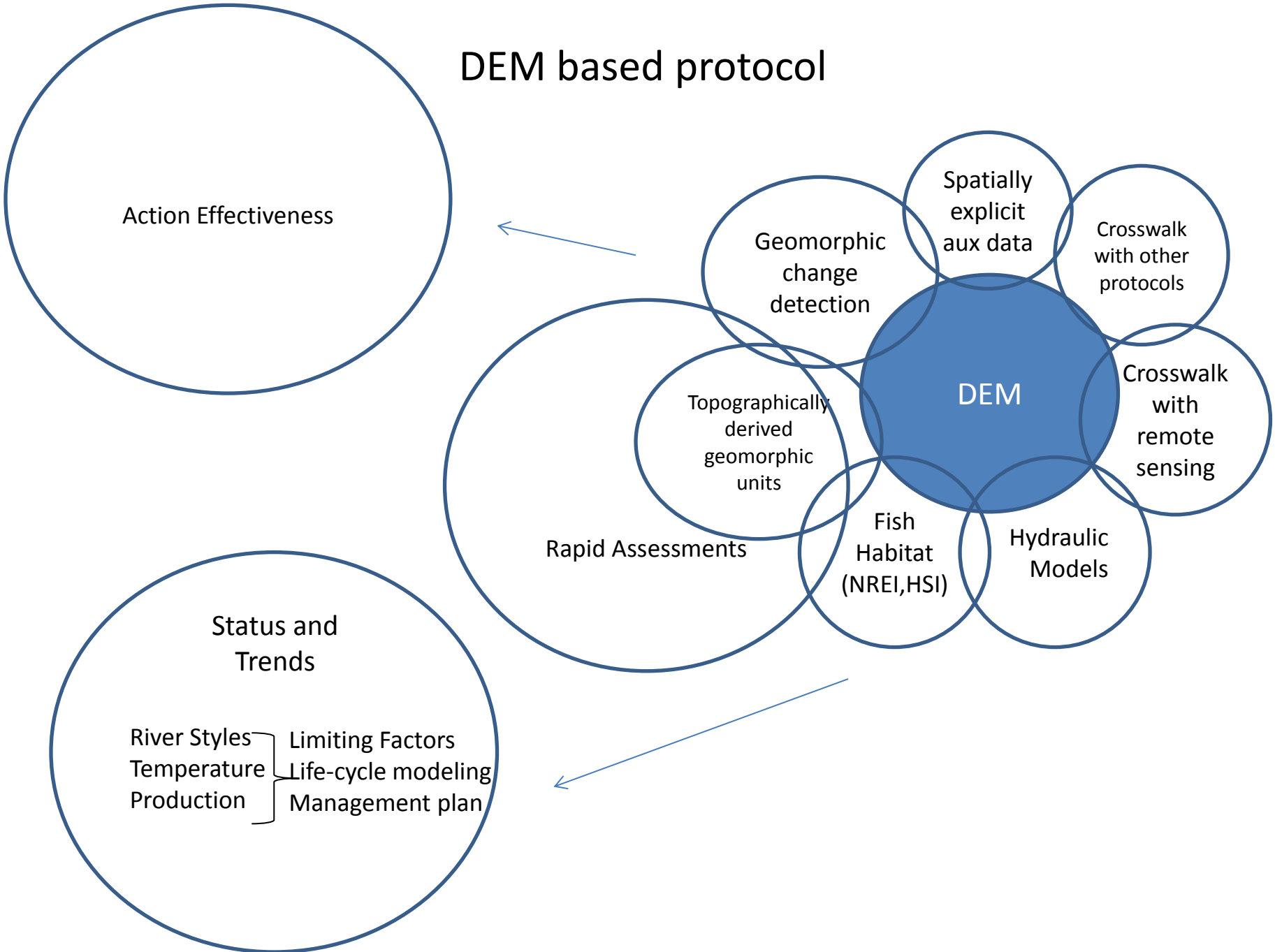
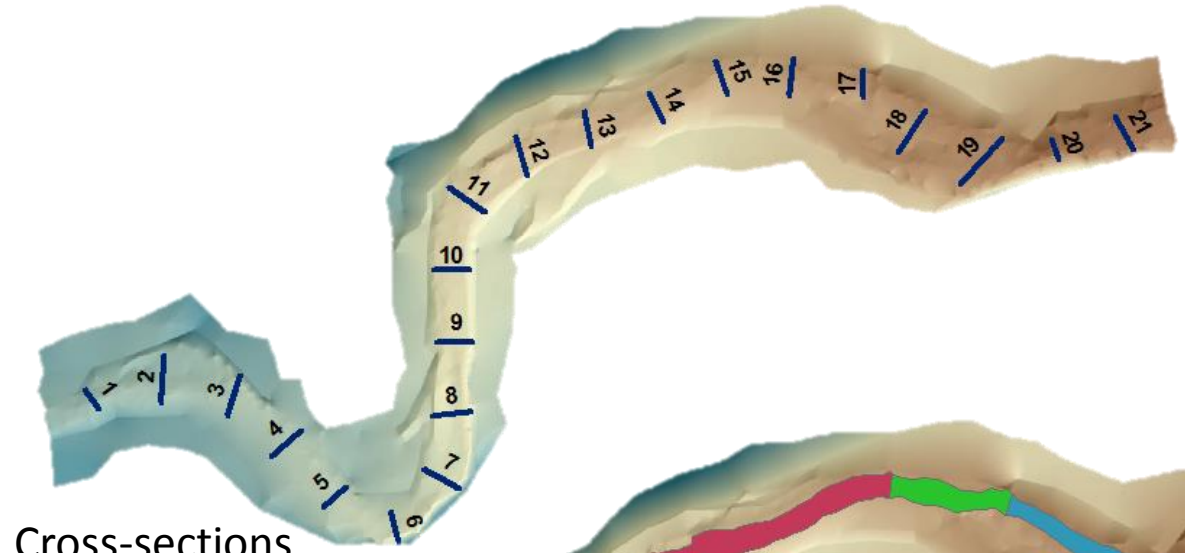
DEM based protocol



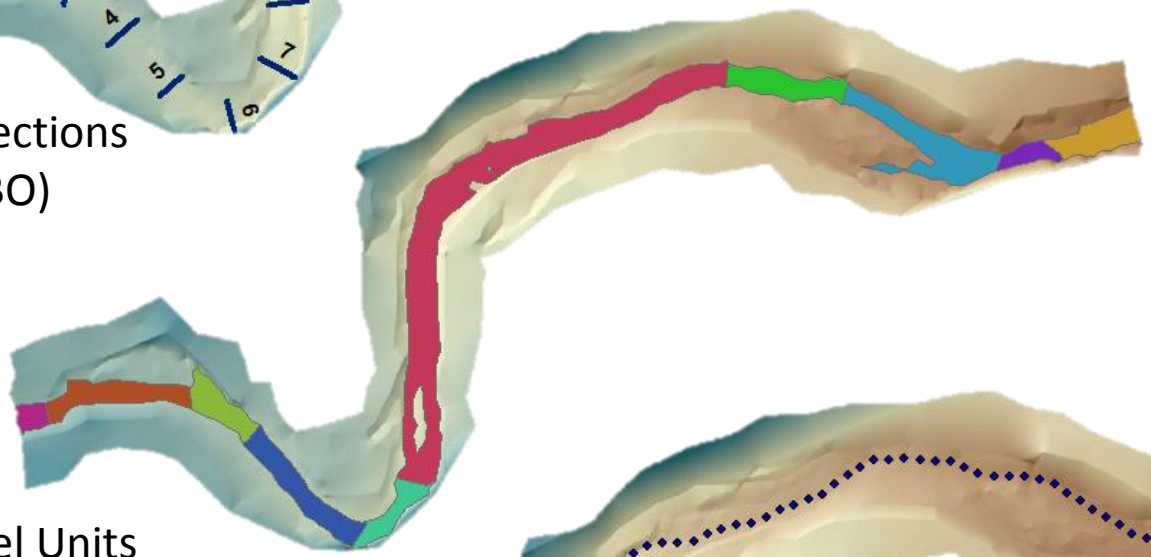
DEM based protocol



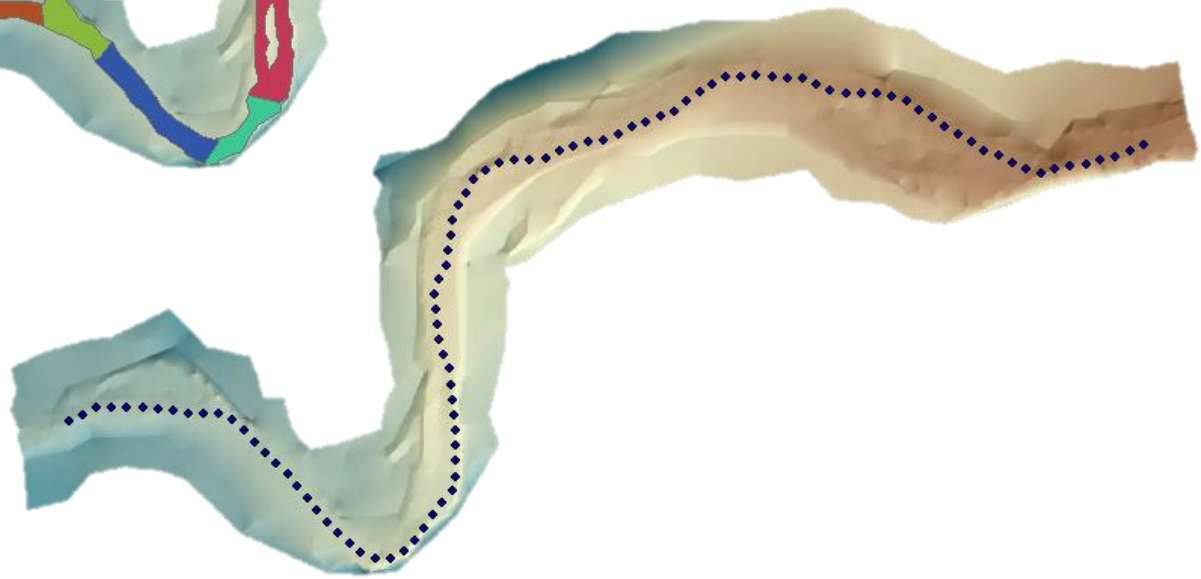
DEM based protocol



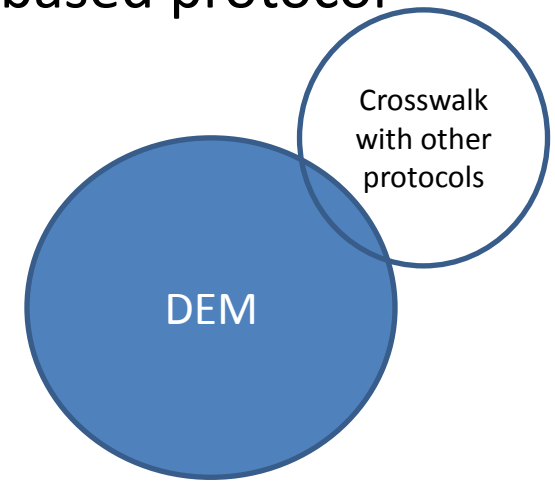
Cross-sections (PIBO)

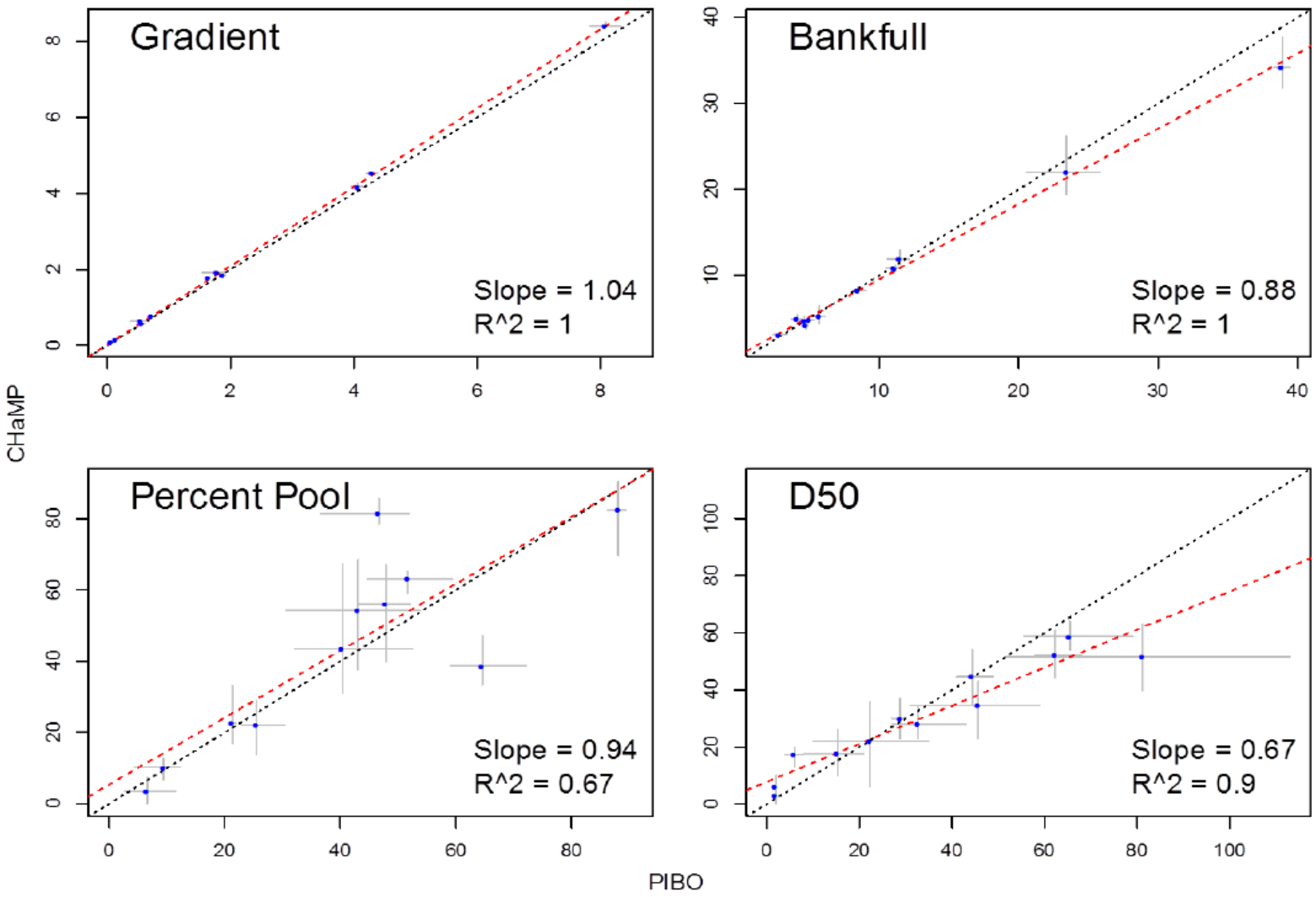


Channel Units (ODFW)

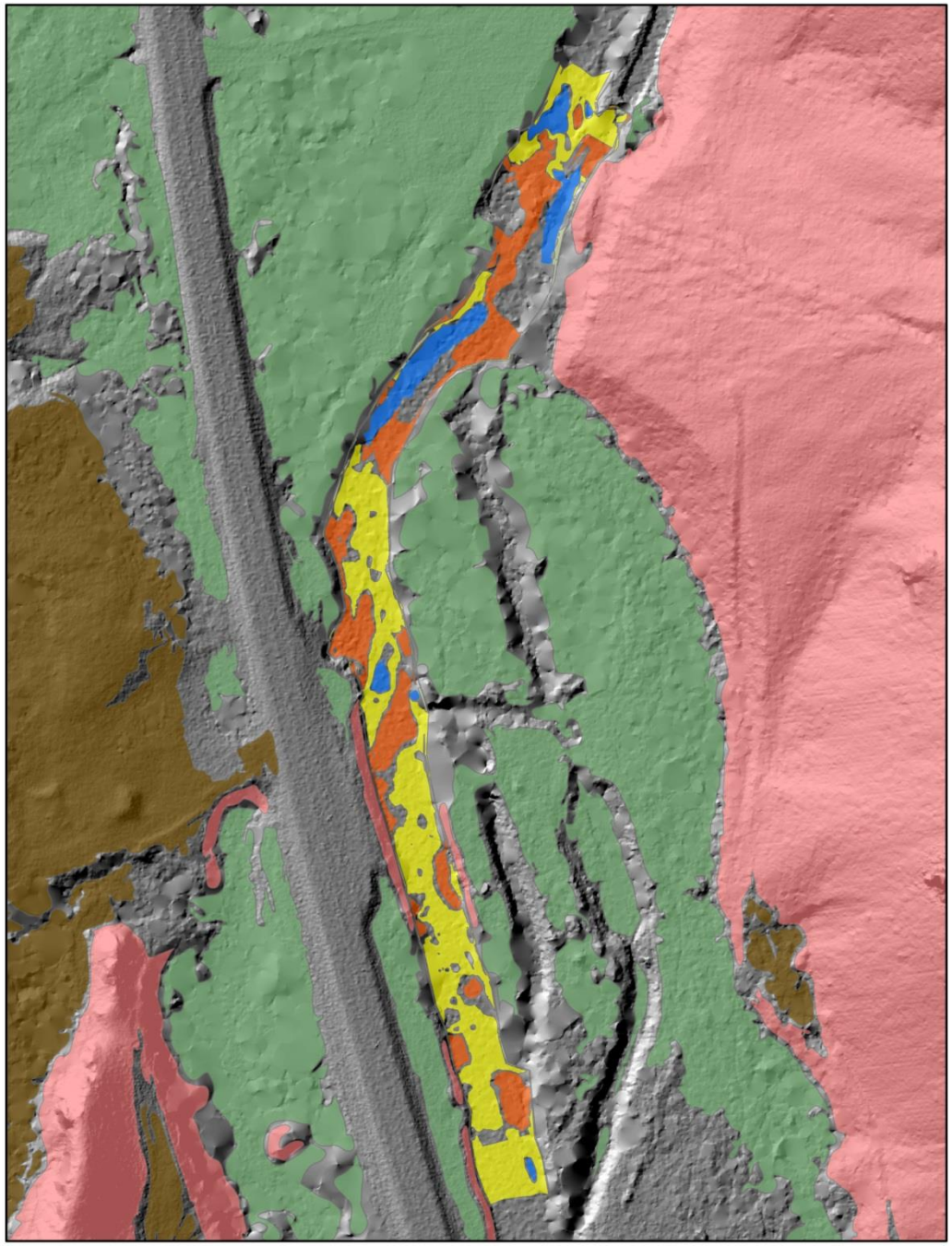


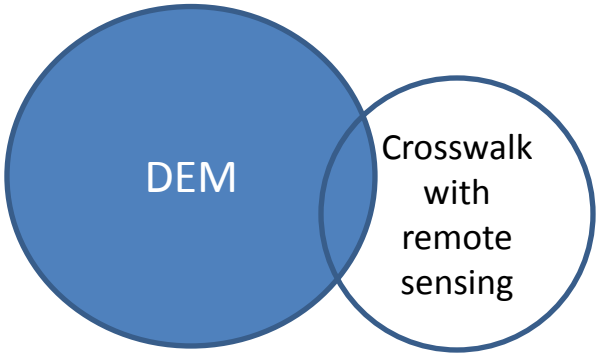
Long-profiles (EMAP)




Gradient
Slope = 1.04
R^2 = 1
Bankfull
Slope = 0.88
R^2 = 1
Percent Pool
Slope = 0.94
R^2 = 0.67
D50
Slope = 0.67
R^2 = 0.9
CHaMP
PIBO

DEM based protocol



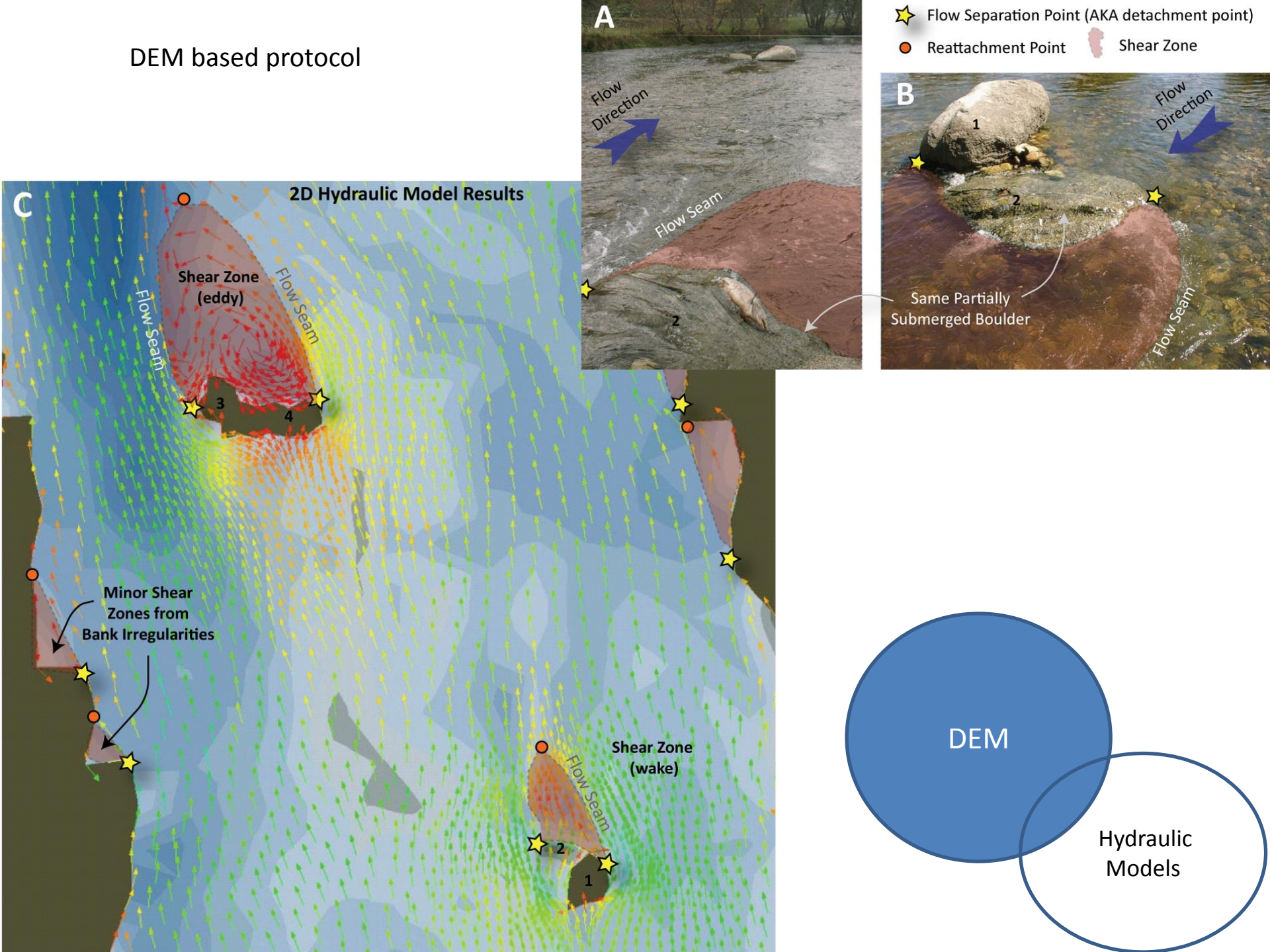


Geomorphic Units

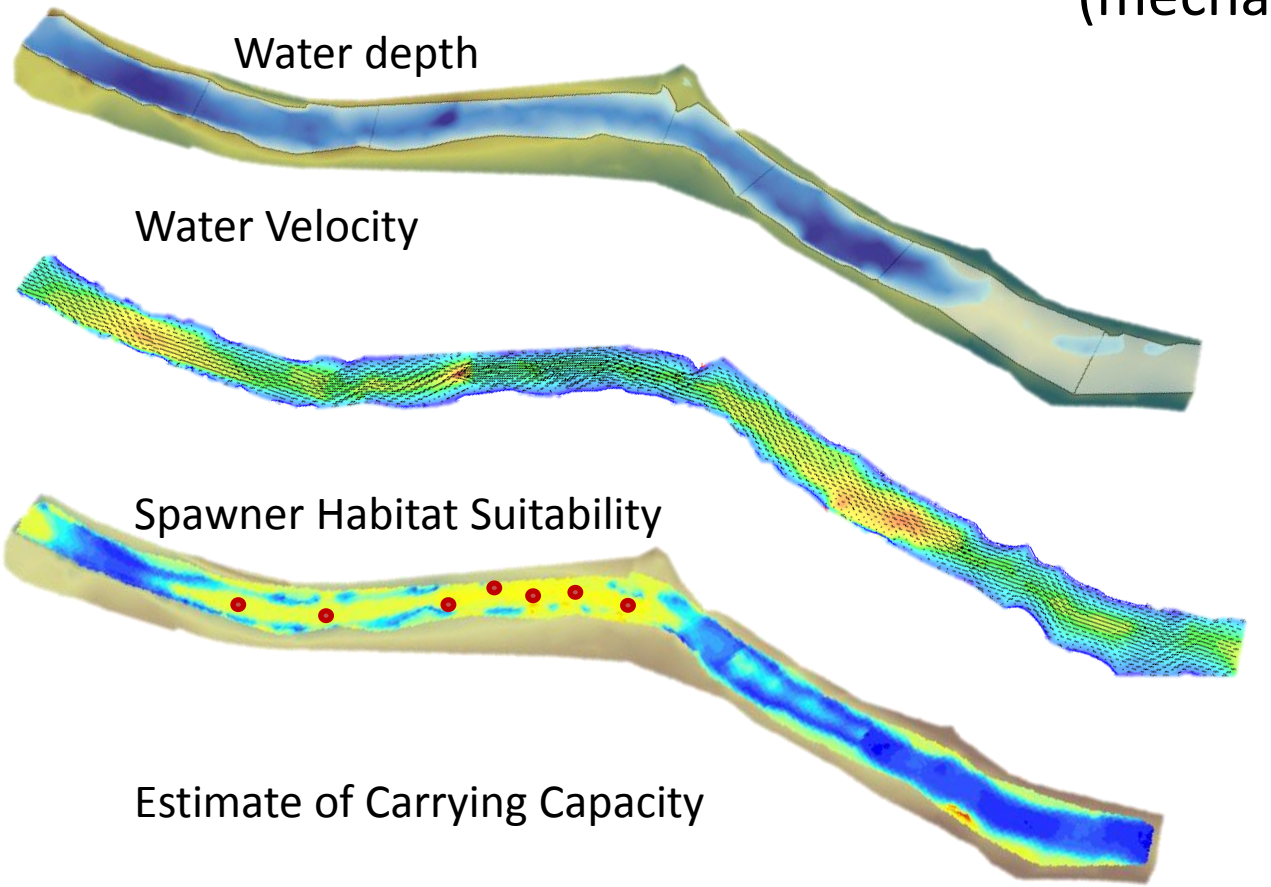
Tier 2 Units

- Active Floodplain
- Banks
- Planar Features
- Concavities
- Convexities
- Fans
- Hillslope/Uplands
- Inactive Floodplain

DEM based protocol

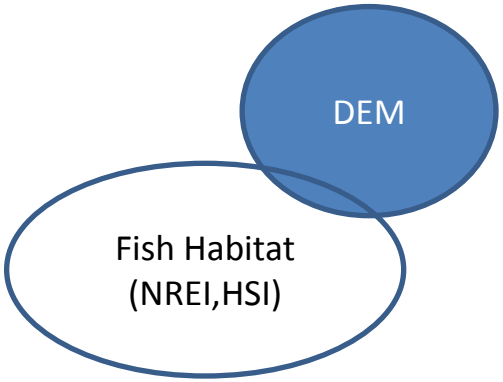


DEM based protocol→ HSI → Potential Redd Abundance (mechanistic model)



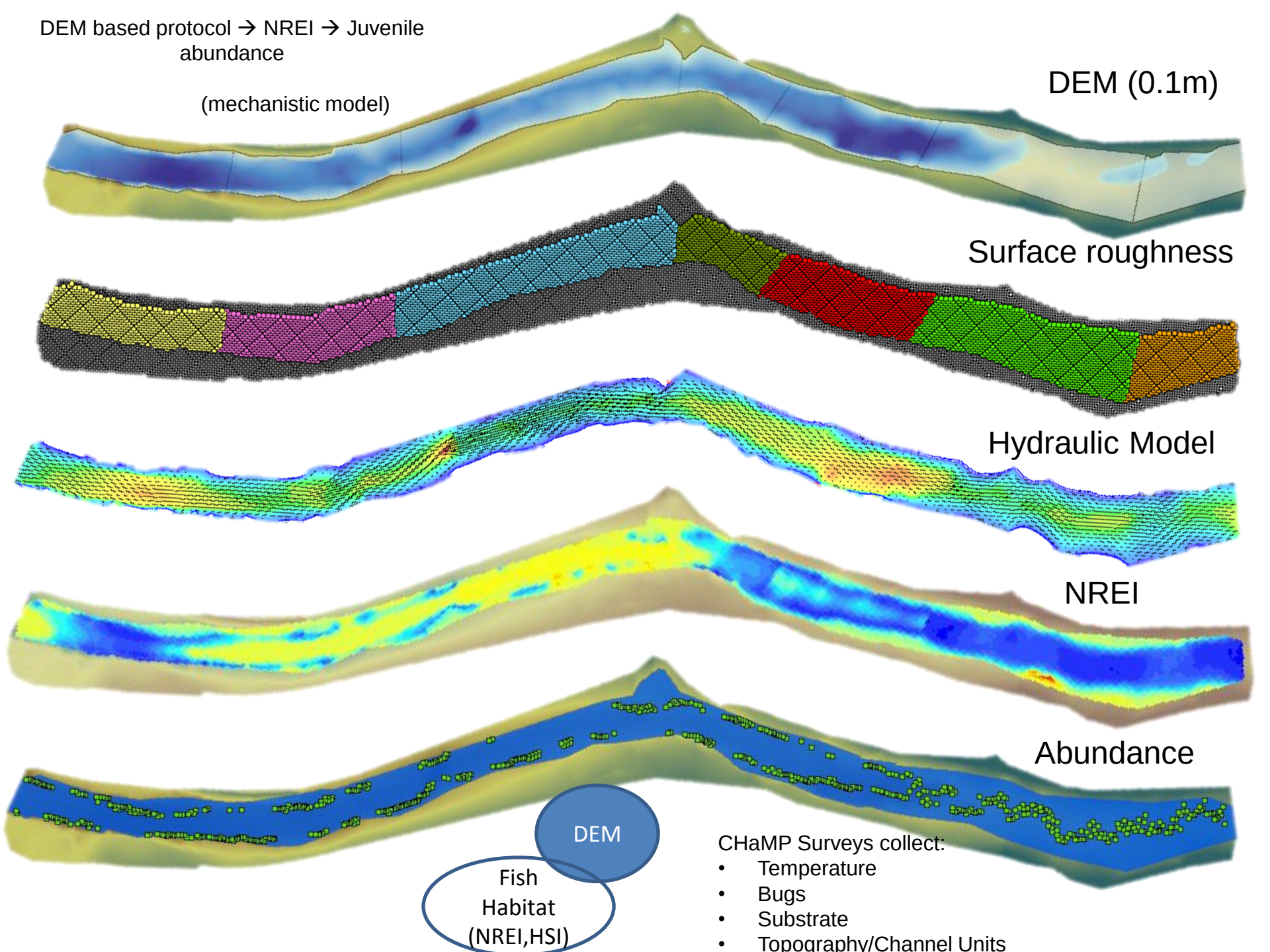
CHaMP Surveys collect:

- Substrate
- Topography/Channel Units



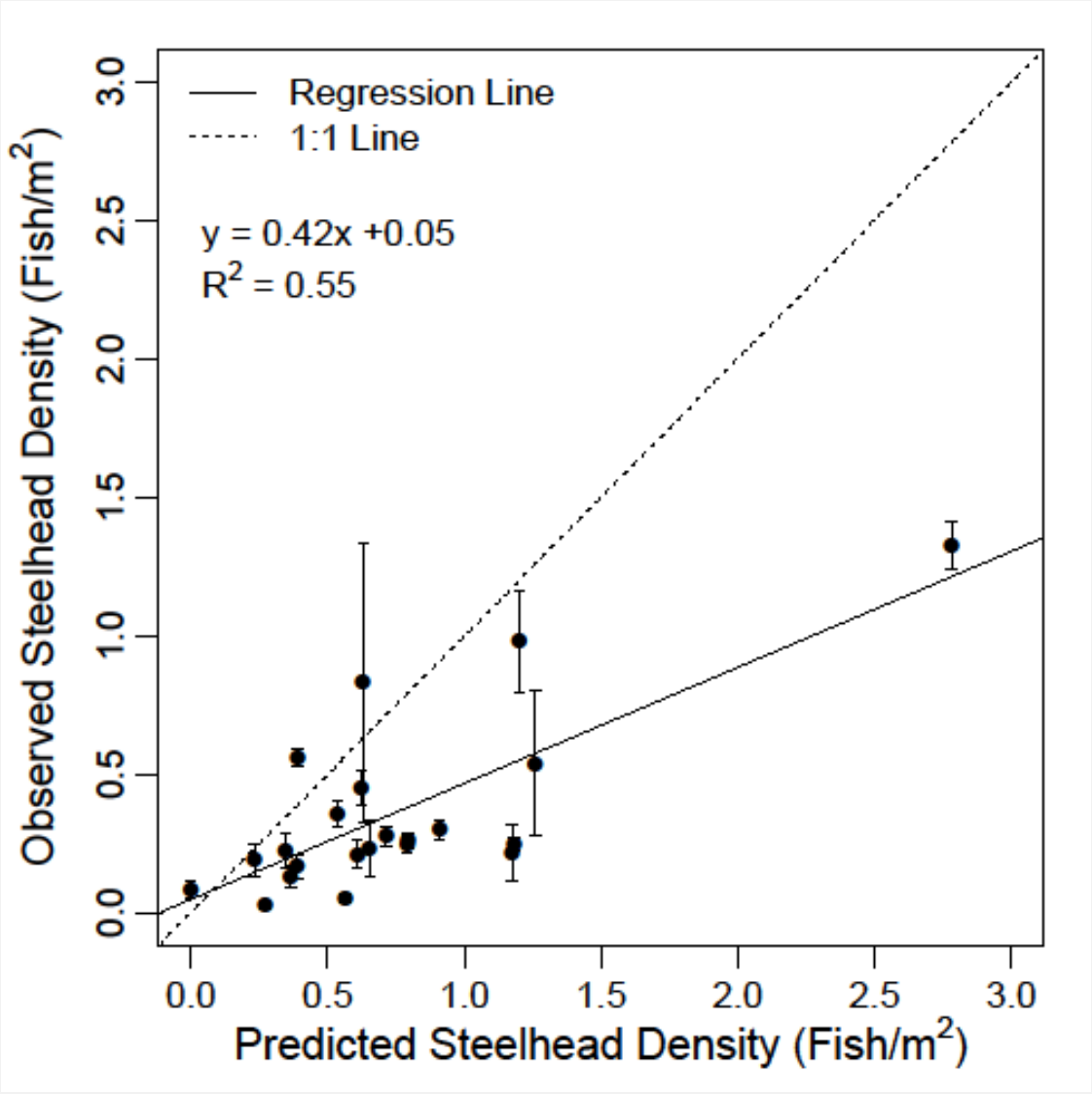
DEM based protocol → NREI → Juvenile abundance

(mechanistic model)

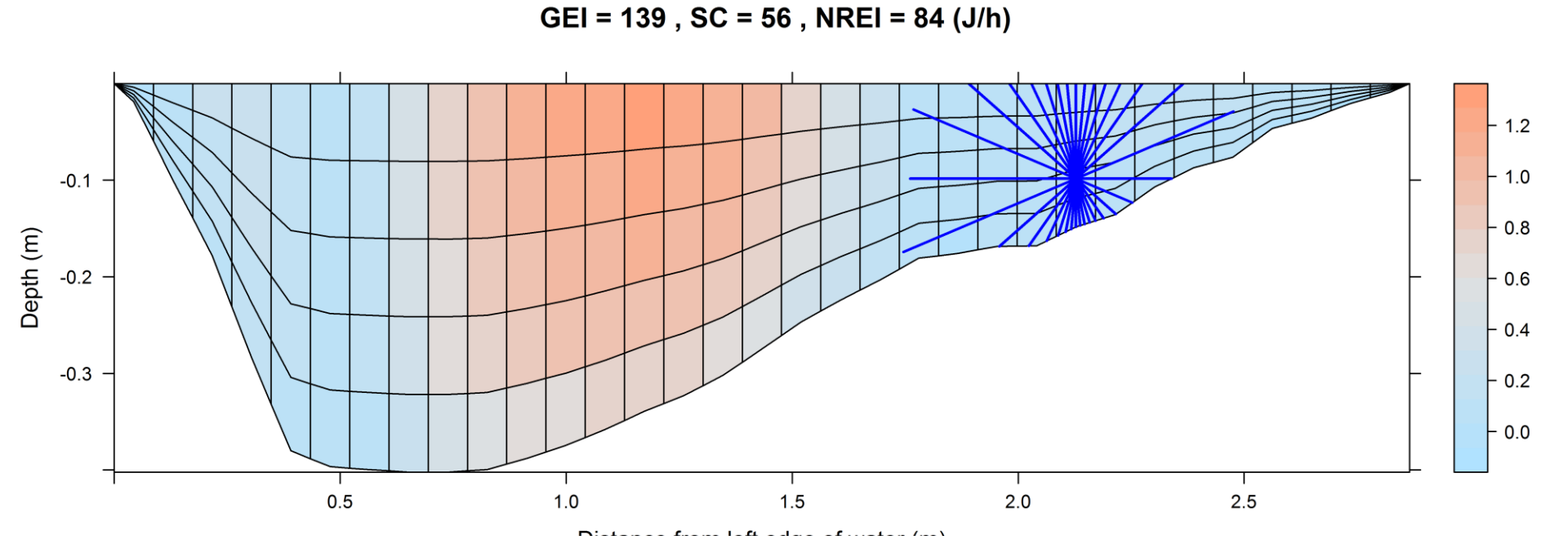


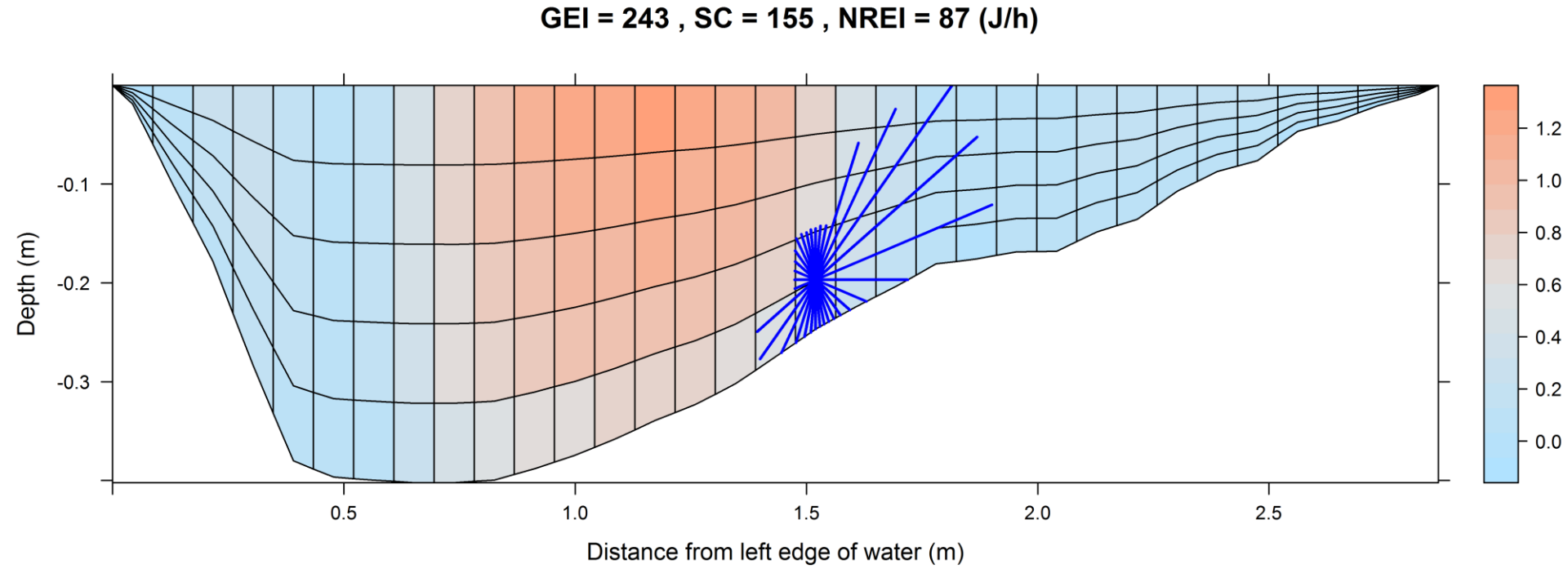
CHaMP Surveys collect:

- Temperature
- Bugs
- Substrate
- Topography/Channel Units

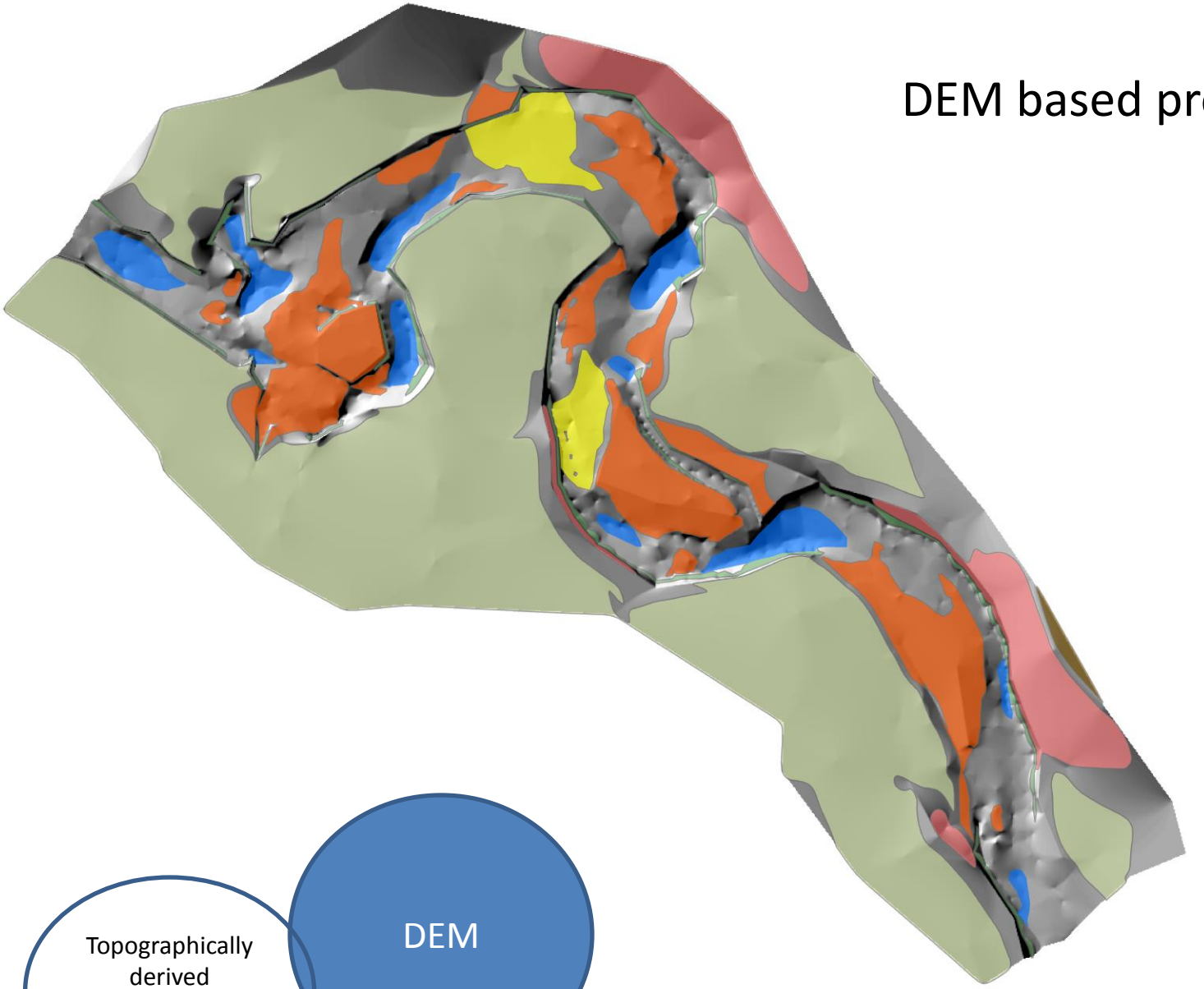

Regression Line
1:1 Line
y = 0.42x +0.05
R2 = 0.55
Observed Steelhead Density (Fish/m2)
Predicted Steelhead Density (Fish/m2)
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Wall 2013


GEI = 139 , SC = 56 , NREI = 84 (J/h)
Depth (m)
-0.1
-0.2
-0.3
0.5
1.0
1.5
2.0
2.5
1.2
1.0
0.8
0.6
0.4
0.2
0.0


GEI = 243 , SC = 155 , NREI = 87 (J/h)
Depth (m)
-0.1
-0.2
-0.3
0.5
1.0
1.5
2.0
2.5
Distance from left edge of water (m)
1.2
1.0
0.8
0.6
0.4
0.2
0.0

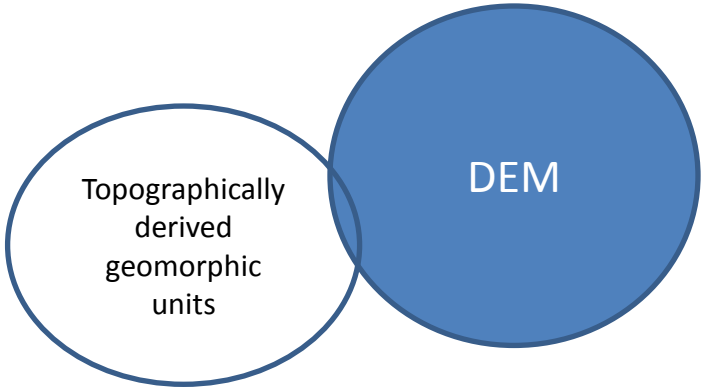
DEM based protocol



Geomrophic Untis

Tier 2

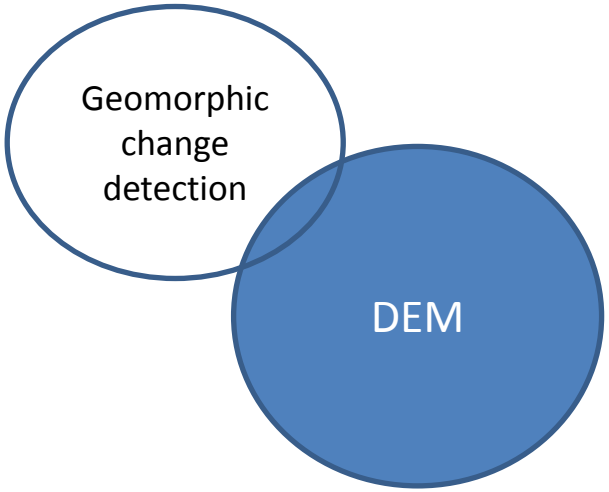
- Active Floodplain
- Banks
- Planar Features
- Concavities
- Convexities
- Fans
- Hillslope/Uplands
- Inactive Floodplain

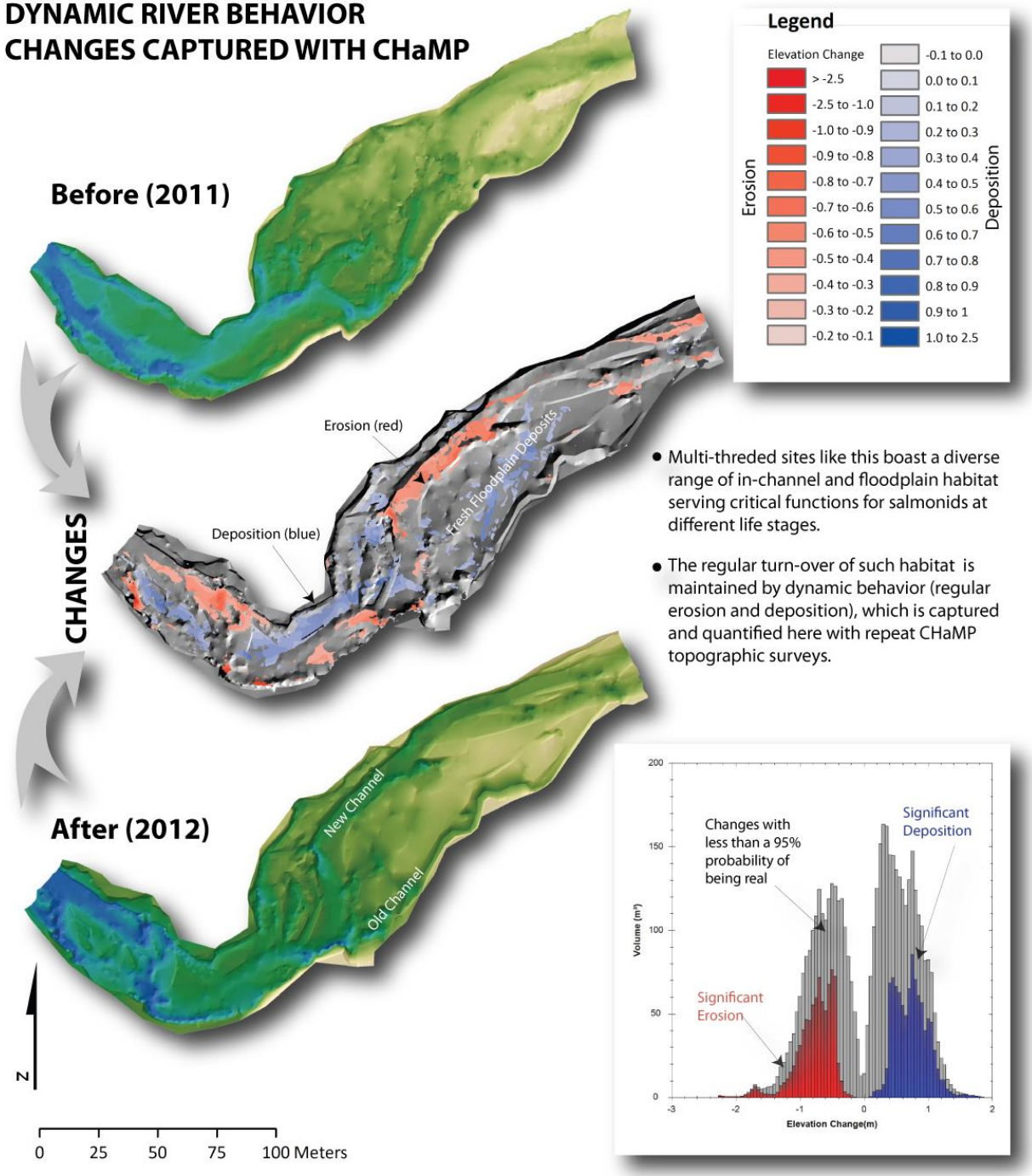


0 10 20 30 40 50 Meters

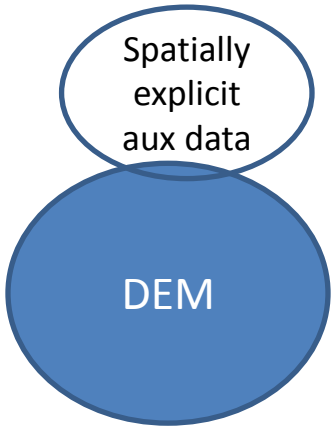
N

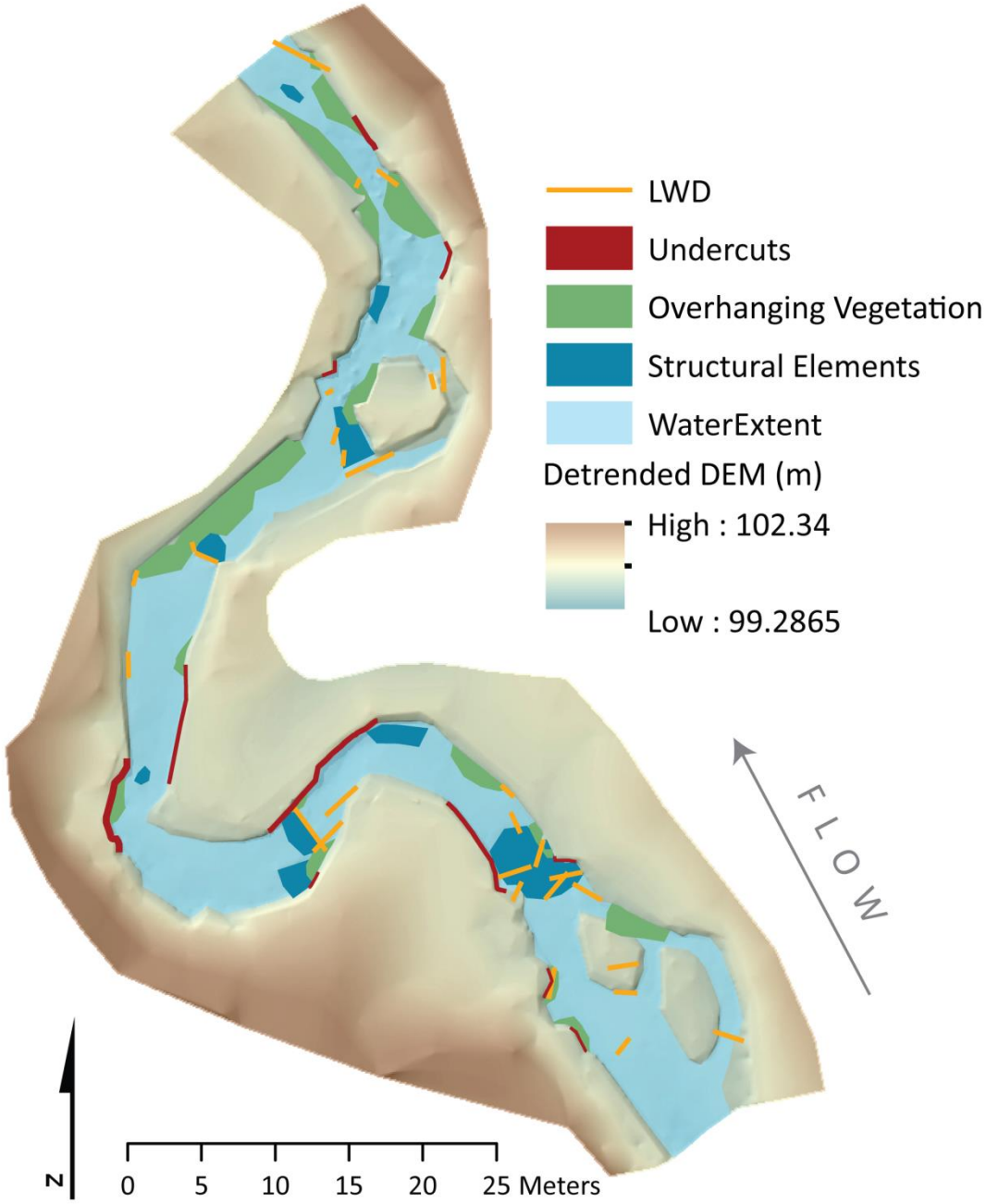
DEM based protocol



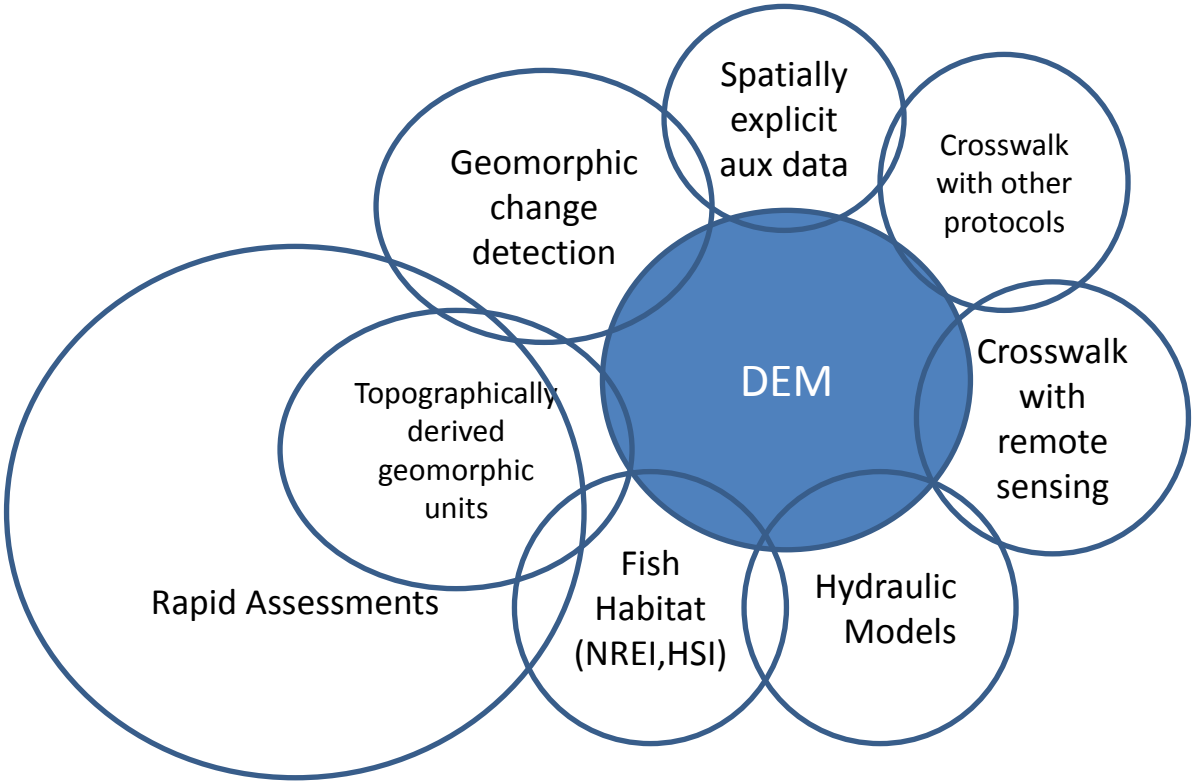


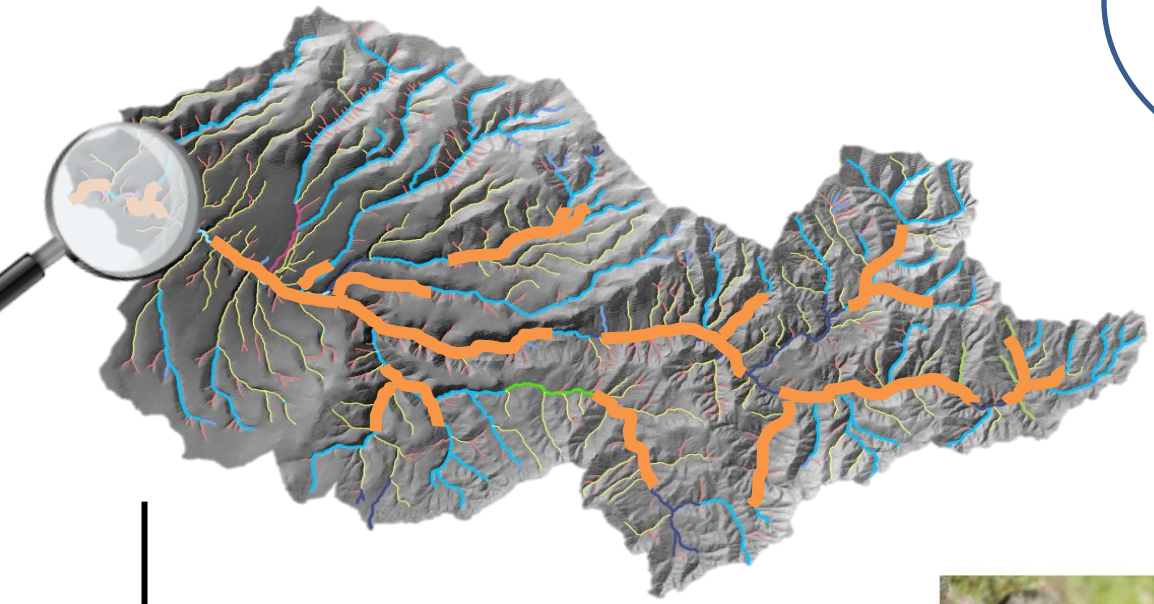
DEM based protocol

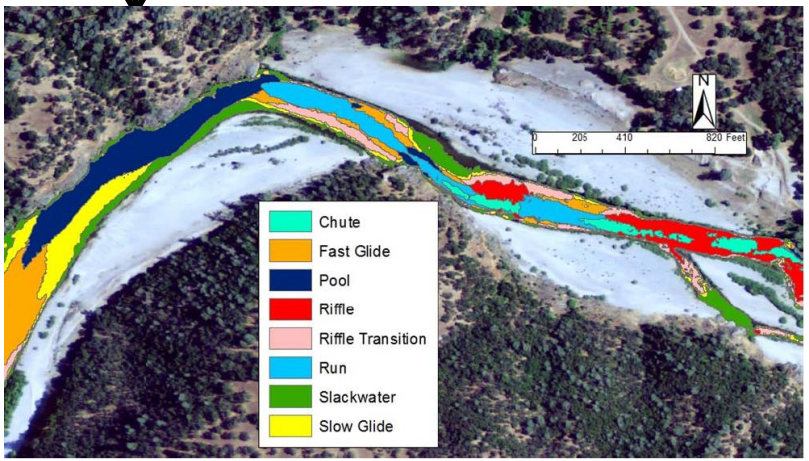




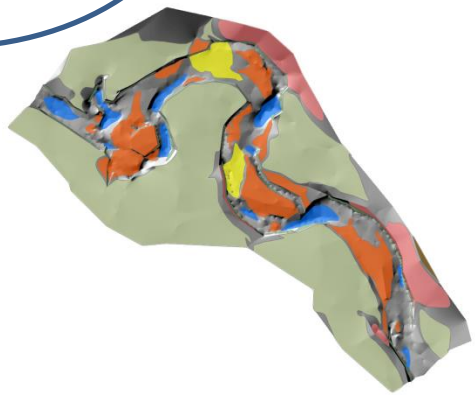
DEM based protocol

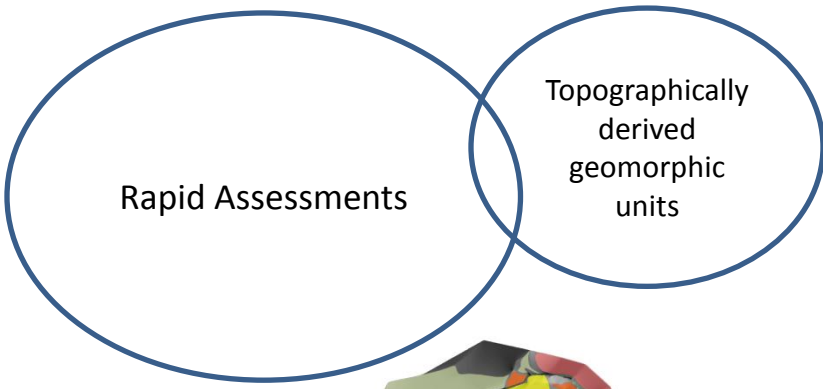






C. Torgersen in action

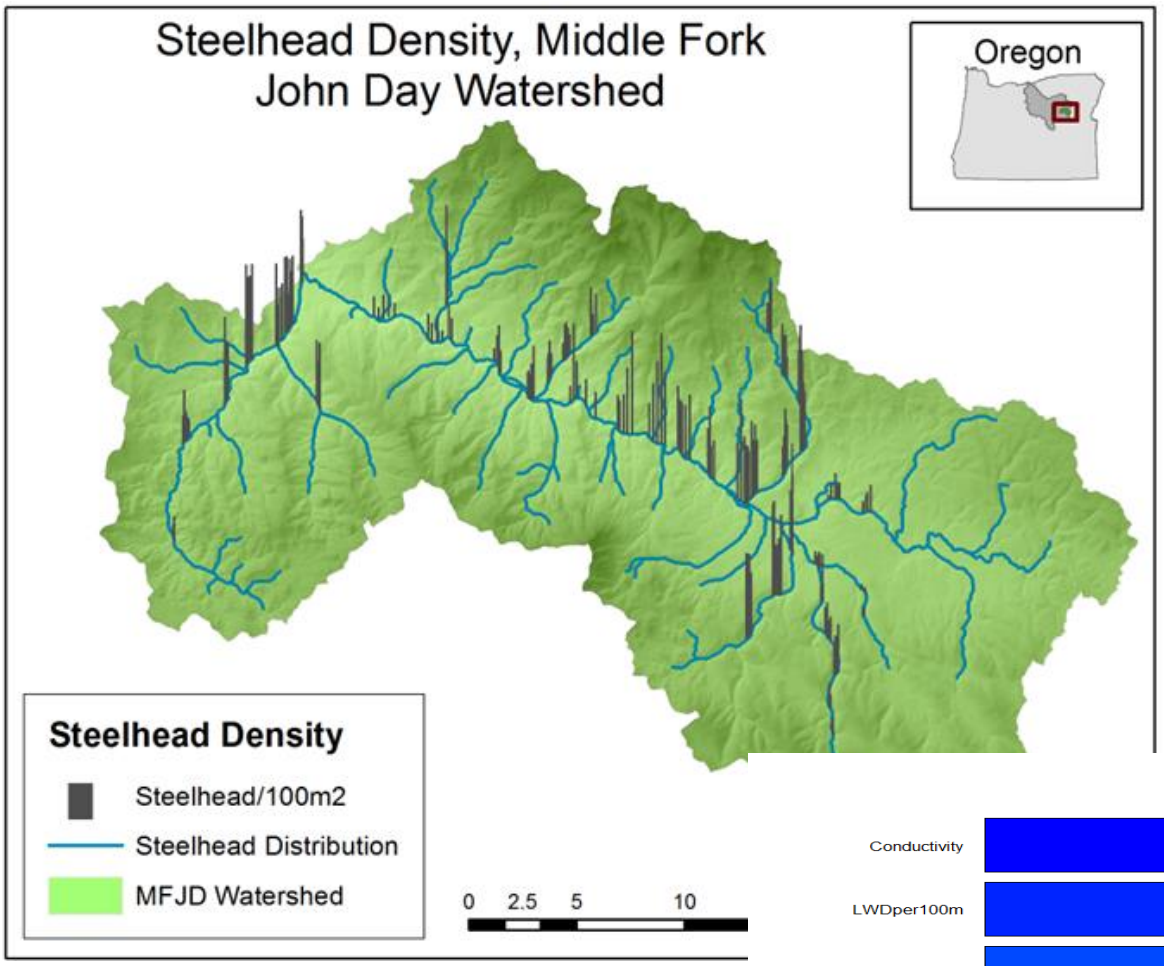


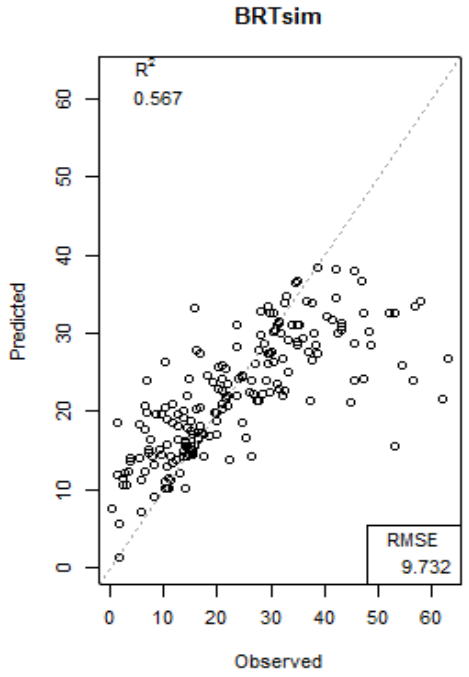


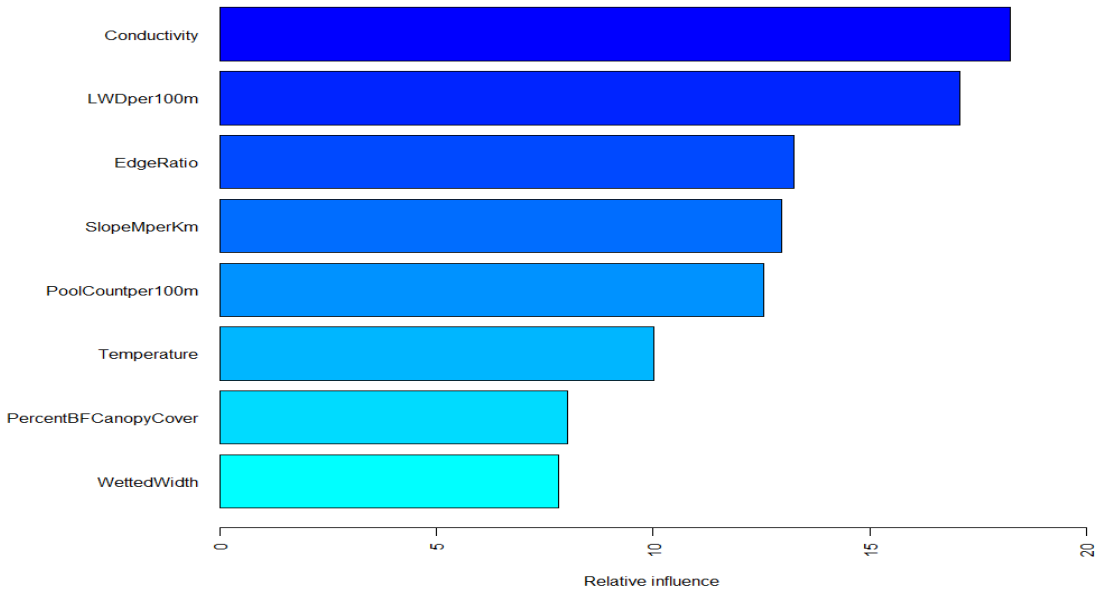
Surveys collect:

- 1-pass or snorkel counts/channel unit
- Stage independent channel units (related to depth, velocity)
- Substrate
- Fish Cover

Resolution is channel unit collected over (nearly) continuous space. ~50% of watershed sampled.



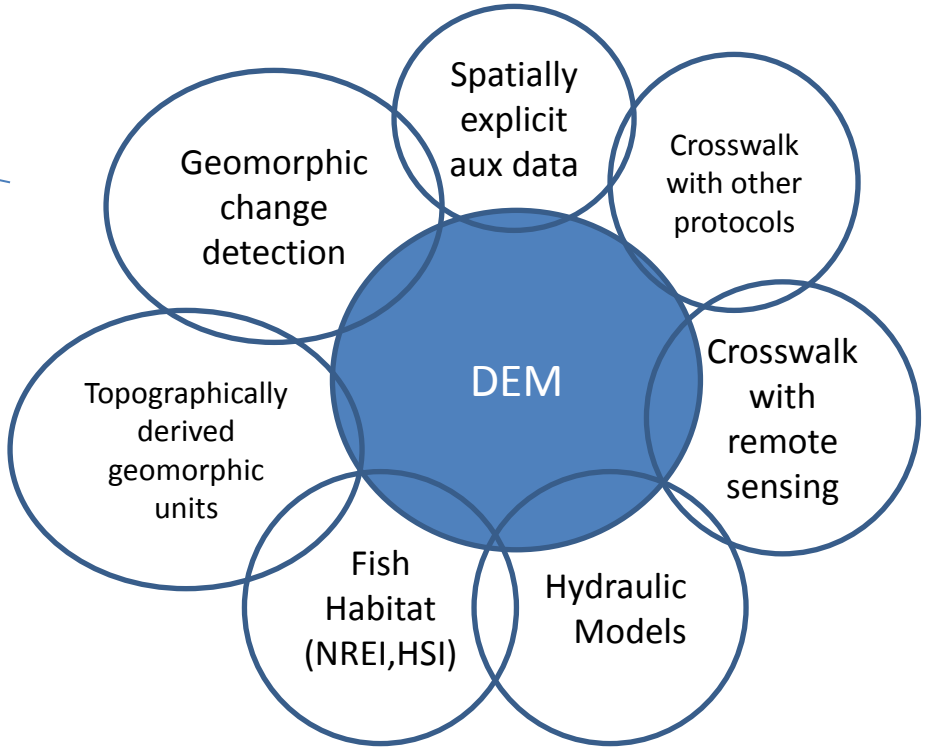




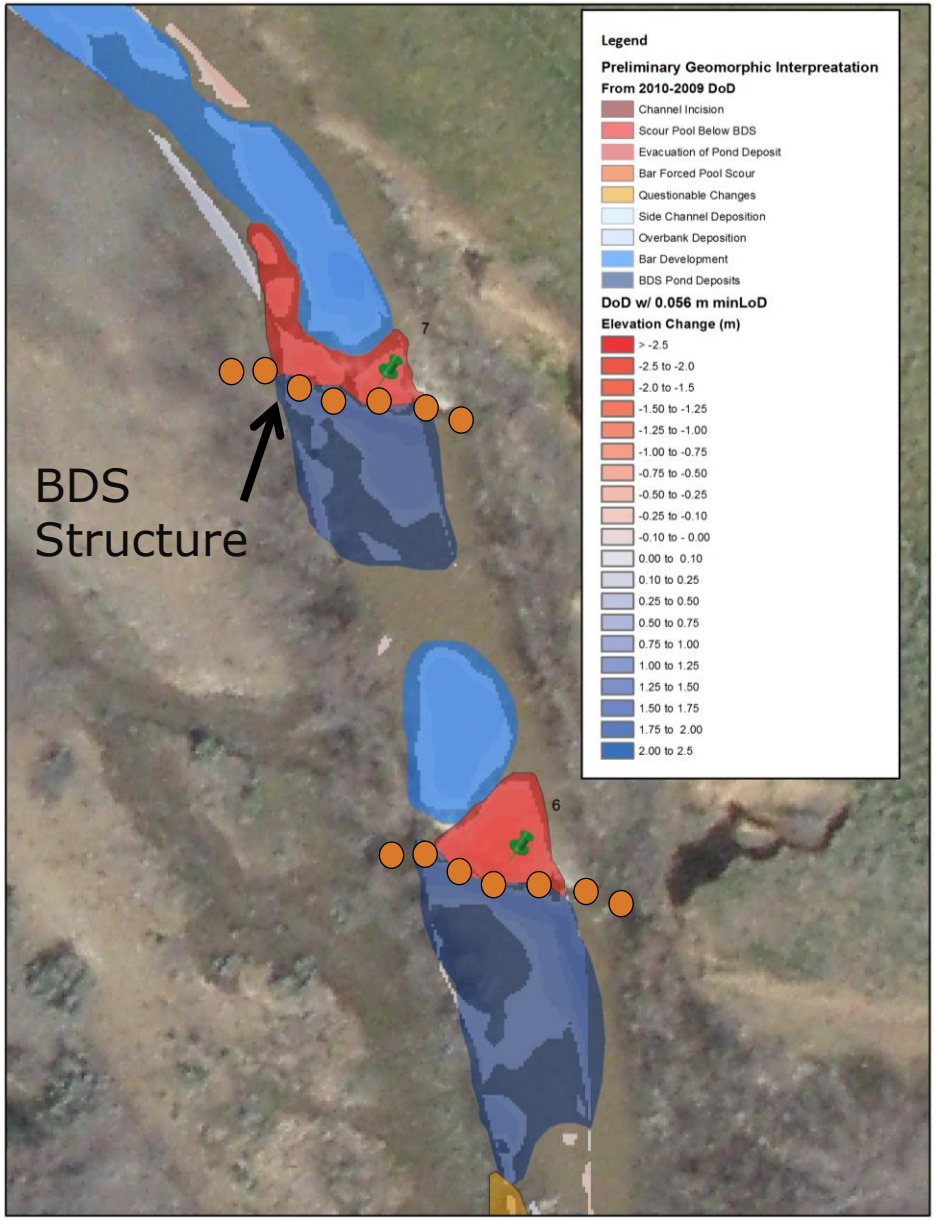
Rapid Assessment

DEM based protocol

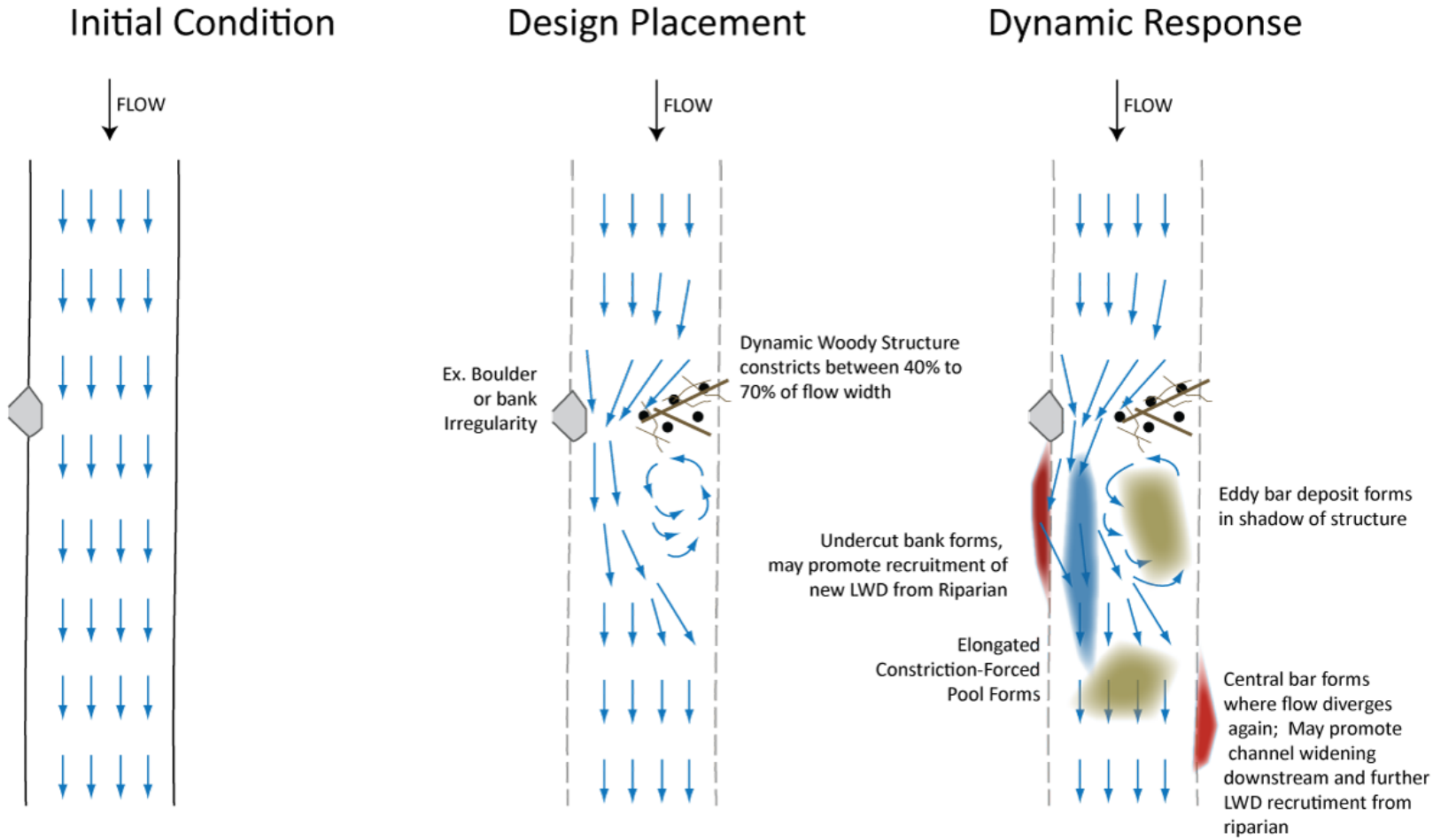
Action Effectiveness

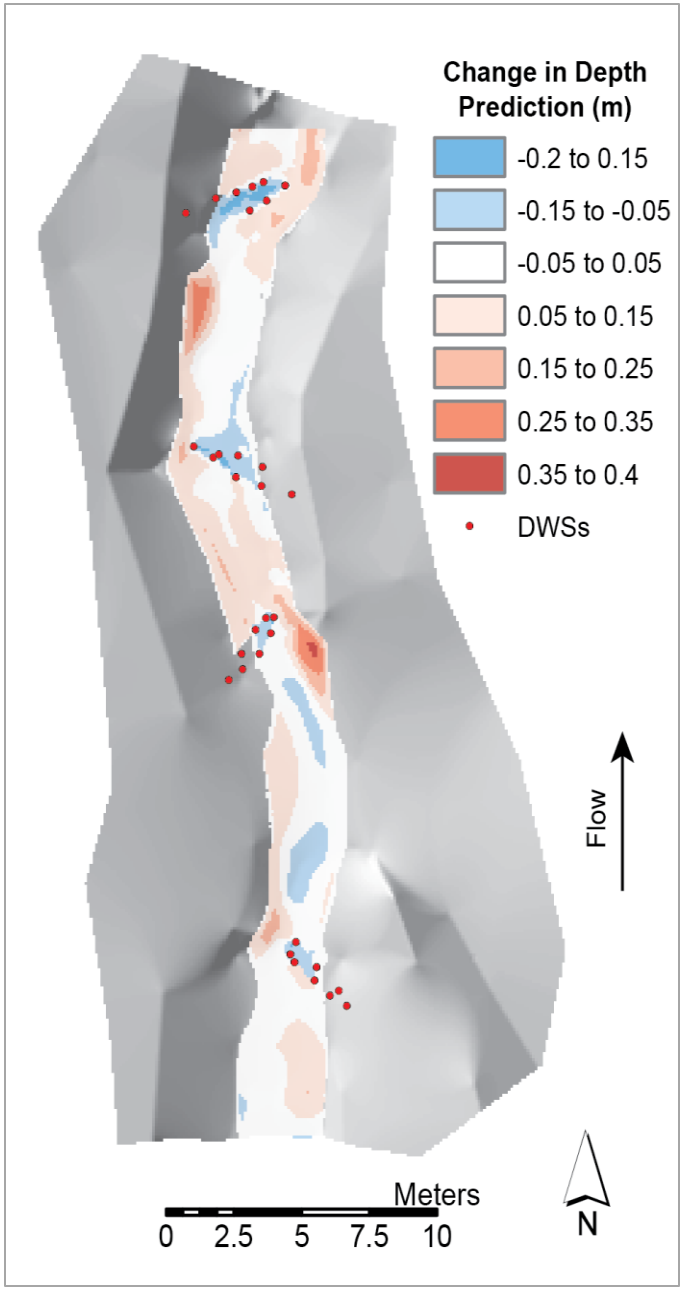


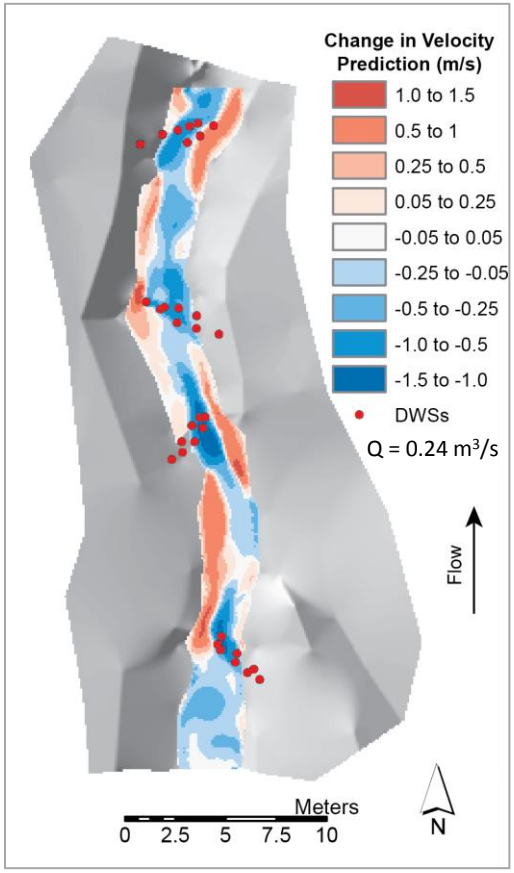
DEM of Difference

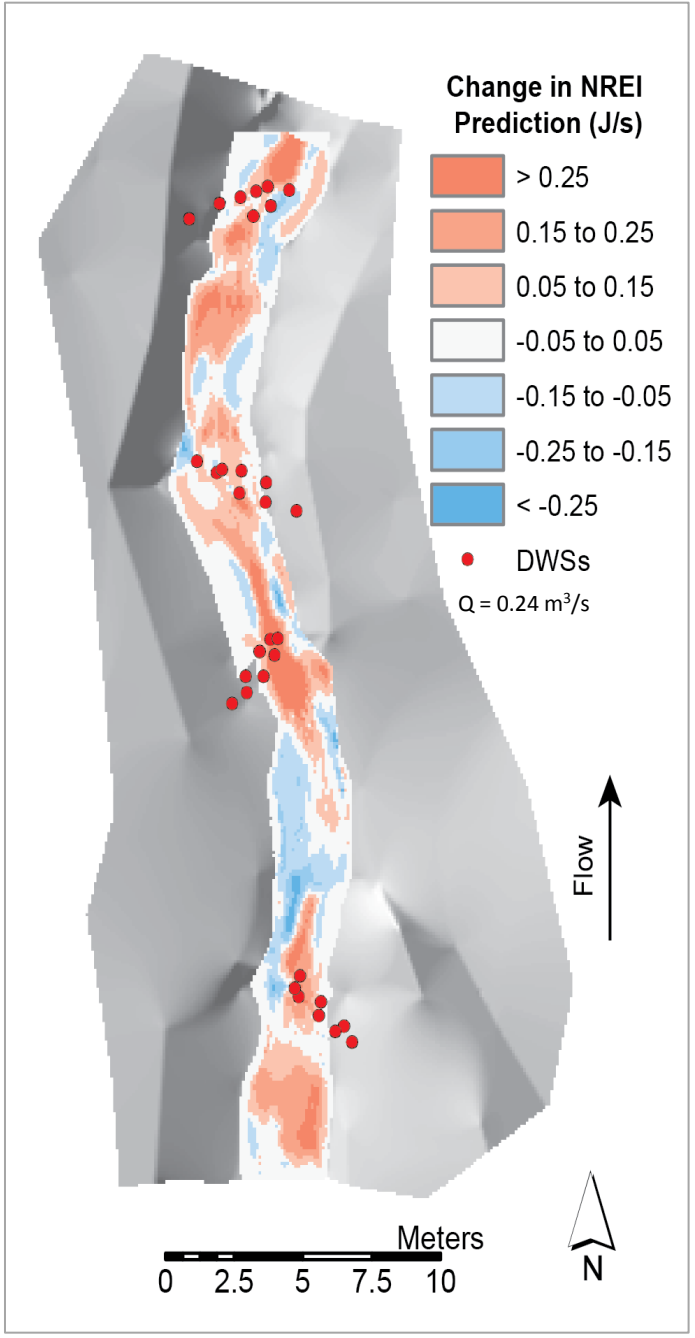


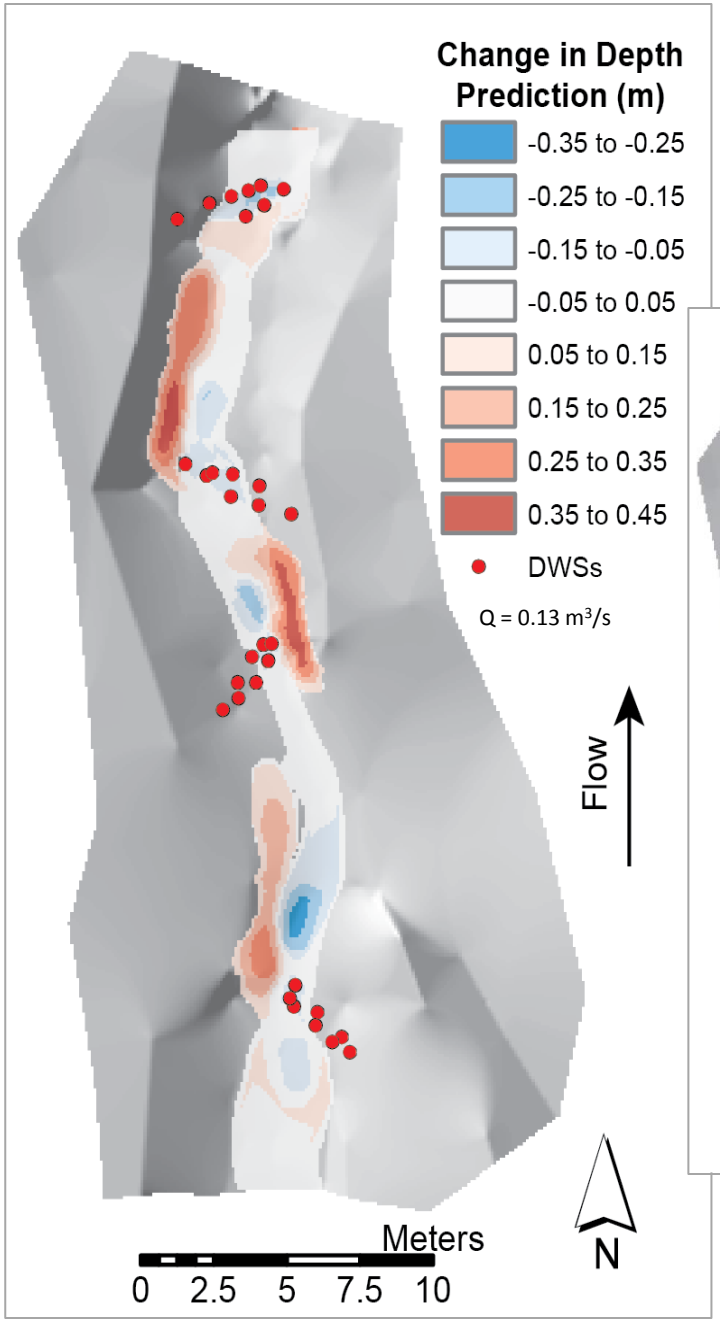
Asotin IMW
Post Assisted Log Structures
(PALS)

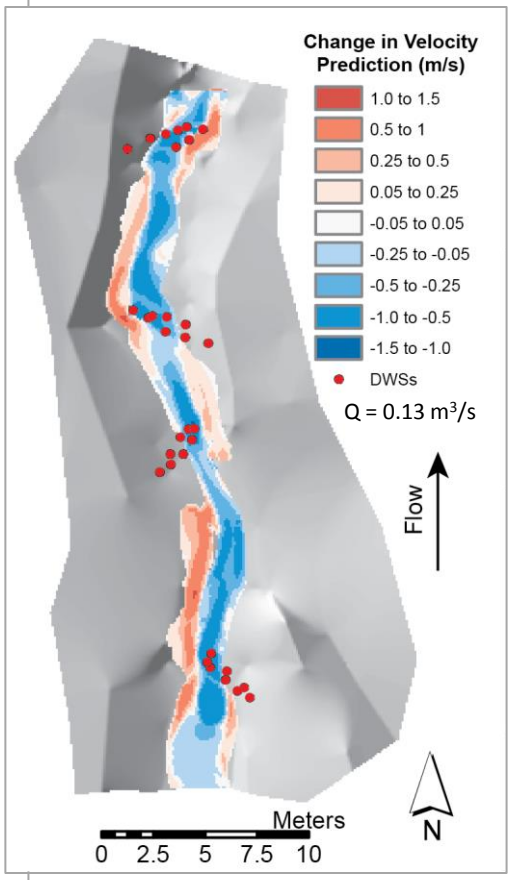

Initial Condition
FLOW
Design Placement
FLOW
Ex. Boulder or bank Irregularity
Dynamic Woody Structure constricts between 40% to 70% of flow width
Dynamic Response
FLOW
Undercut bank forms, may promote recruitment of new LWD from Riparian
Eddy bar deposit forms in shadow of structure
Elongated Constriction-Forced Pool Forms
Central bar forms where flow diverges again; May promote channel widening downstream and further LWD recrutiment from riparian
LEGEND
Velocity Vectors
Wooden Posts (driven into bed)
Woody debris of various sizes, shapes & complexity
12" to 18" diameter logs (variable length of 4' to 6' and can be handled by two people)

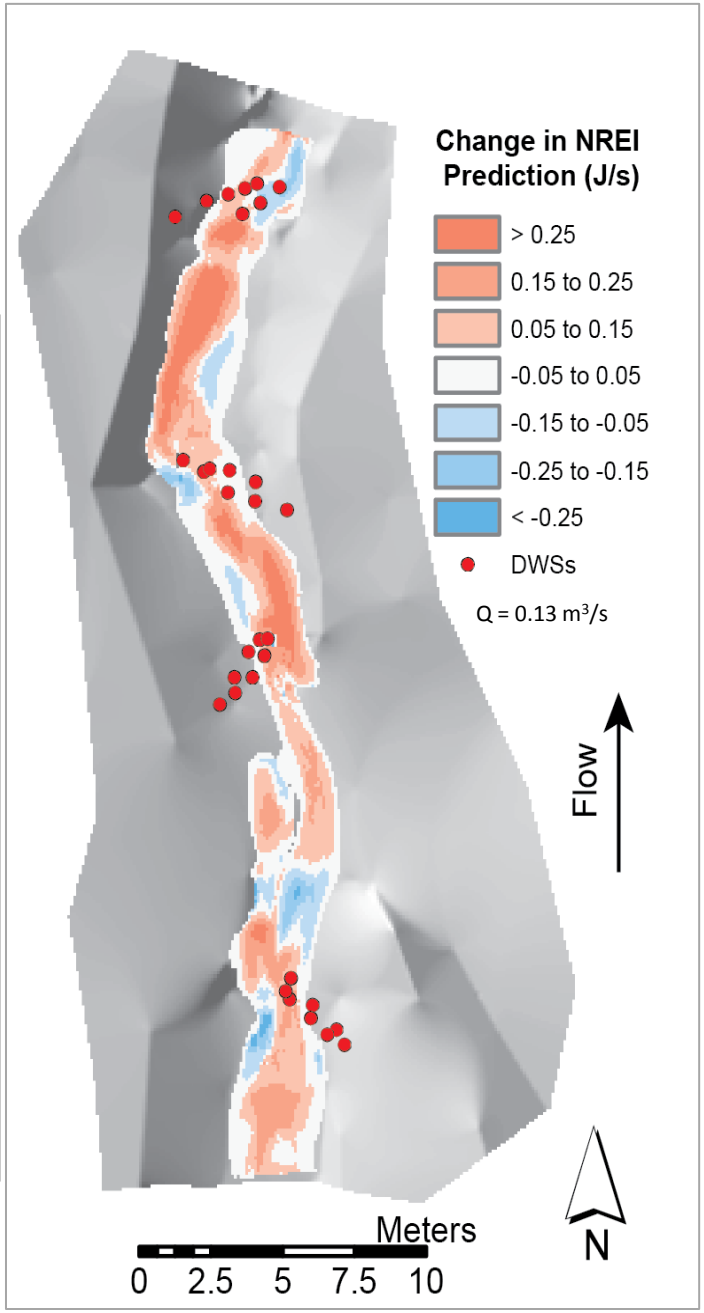

Change in Depth Prediction (m)
-0.2 to 0.15
-0.15 to -0.05
-0.05 to 0.05
0.05 to 0.15
0.15 to 0.25
0.25 to 0.35
0.35 to 0.4
DWSs
Flow
Meters
0 2.5 5 7.5 10
N


Change in Velocity Prediction (m/s)
1.0 to 1.5
0.5 to 1
0.25 to 0.5
0.05 to 0.25
-0.05 to 0.05
-0.25 to -0.05
-0.5 to -0.25
-1.0 to -0.5
-1.5 to -1.0
DWSs
Q = 0.24 m³/s
Flow
Meters
0 2.5 5 7.5 10
N

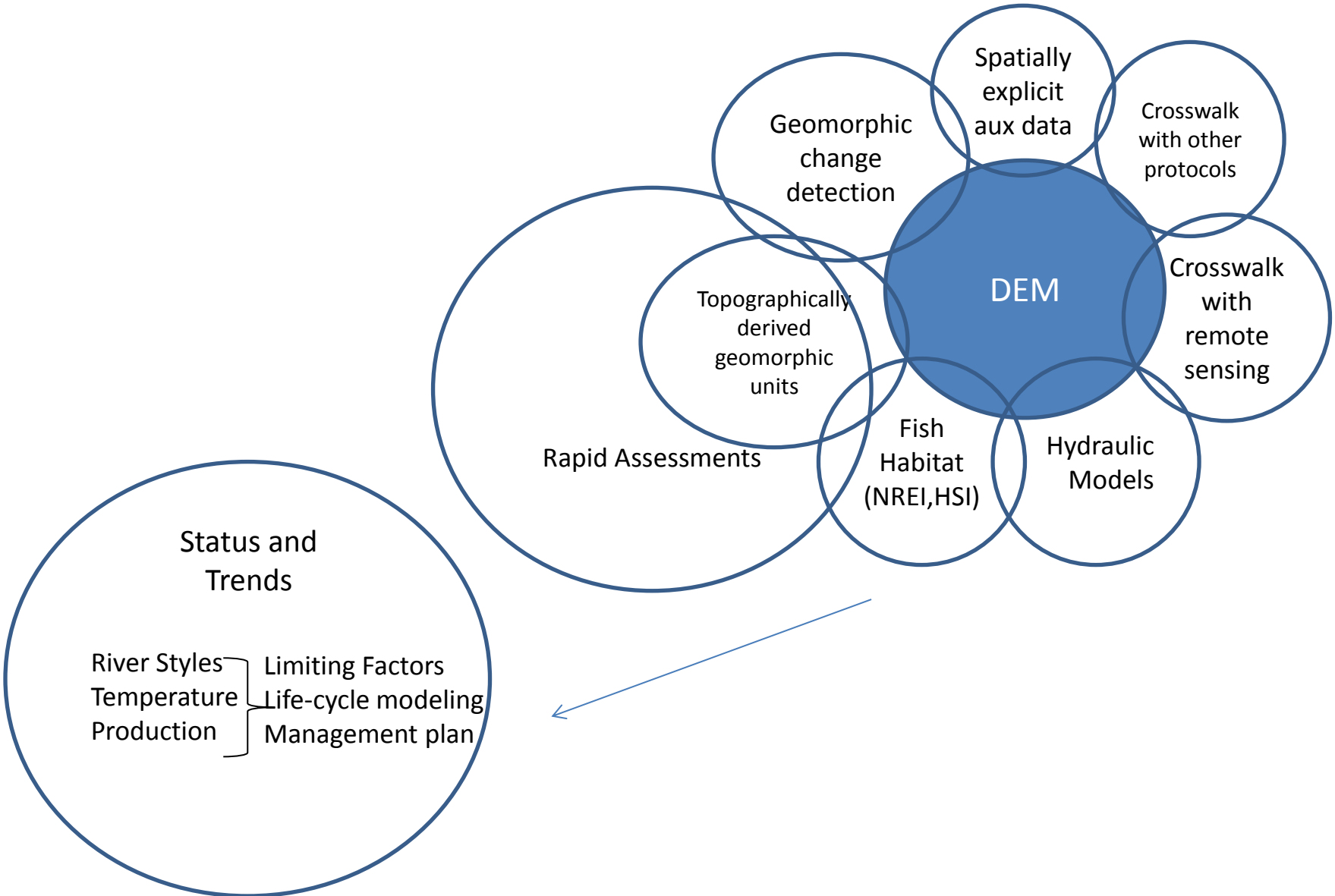

Change in NREI Prediction (J/s)
> 0.25
0.15 to 0.25
0.05 to 0.15
-0.05 to 0.05
-0.15 to -0.05
-0.25 to -0.15
< -0.25
DWSs
Q = 0.24 m³/s
Flow
Meters
0 2.5 5 7.5 10
N


Change in Depth Prediction (m)
-0.35 to -0.25
-0.25 to -0.15
-0.15 to -0.05
-0.05 to 0.05
0.05 to 0.15
0.15 to 0.25
0.25 to 0.35
0.35 to 0.45
DWSs
Q = 0.13 m³/s
Flow
N
Meters
0 2.5 5 7.5 10


Change in Velocity Prediction (m/s)
1.0 to 1.5
0.5 to 1
0.25 to 0.5
0.05 to 0.25
-0.05 to 0.05
-0.25 to -0.05
-0.5 to -0.25
-1.0 to -0.5
-1.5 to -1.0
DWSs
Q = 0.13 m³/s
Flow
N
Meters
0 2.5 5 7.5 10

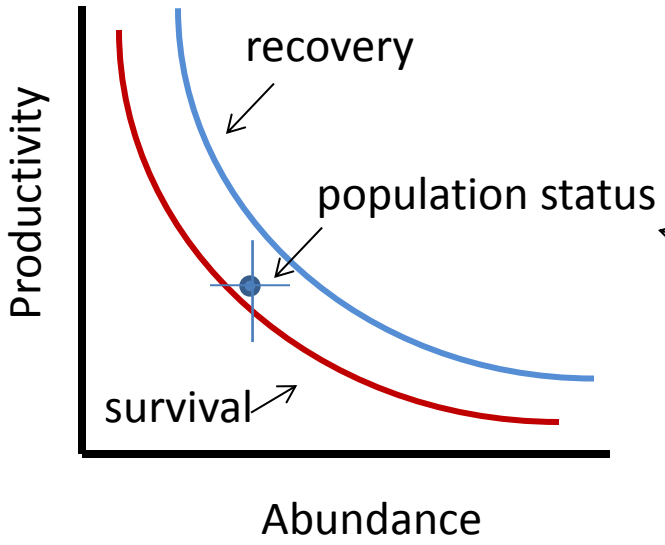

Change in NREI Prediction (J/s)
> 0.25
0.15 to 0.25
0.05 to 0.15
-0.05 to 0.05
-0.15 to -0.05
-0.25 to -0.15
< -0.25
DWSs
Q = 0.13 m³/s
Flow
N
Meters
0 2.5 5 7.5 10

DEM based protocol

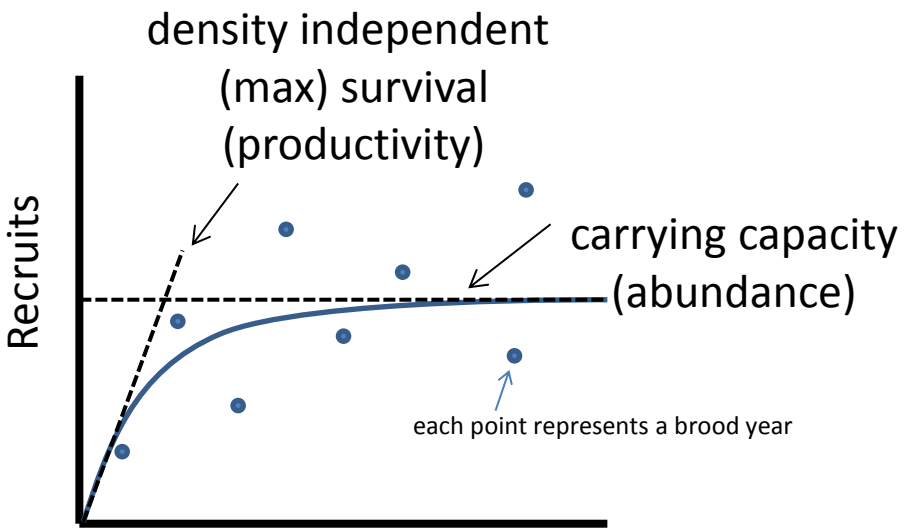


Life-cycle model basics

Viable Salmonid Population (VSP) Criteria



Beverton-Holt



$$R = \frac{pS}{1 + \frac{p}{c}S}$$

S = spawners

R = recruits

(life stage of interest-e.g. smolts. For life-cycle survival *R* are returning spawners)

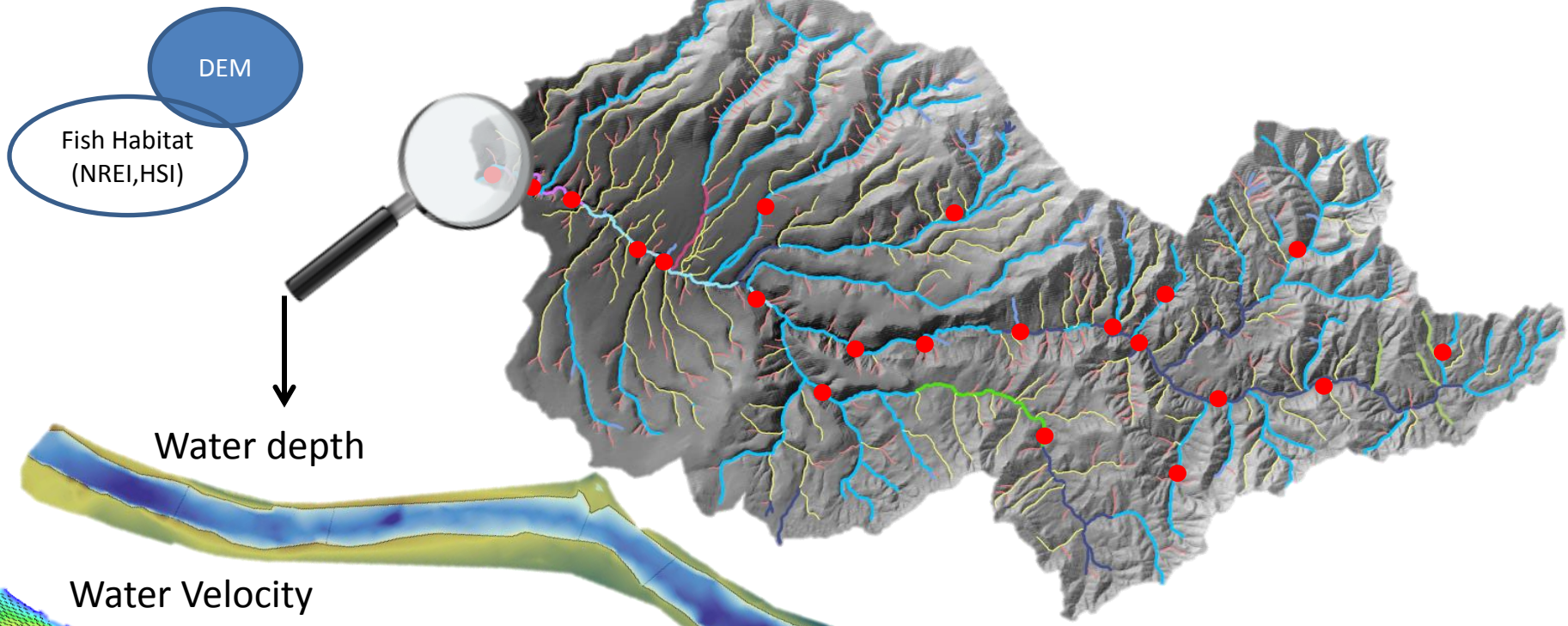
c = carrying capacity

p = productivity

(Moussalli and Hilborn 1986 demonstrated how to make this into a multistage model)

Relate this to freshwater habitat
(juveniles/spawner or smolts/spawner)

DEM based protocol → HSI → Potential Redd Abundance (mechanistic model)



Water depth

Water Velocity

Spawner Habitat Suitability

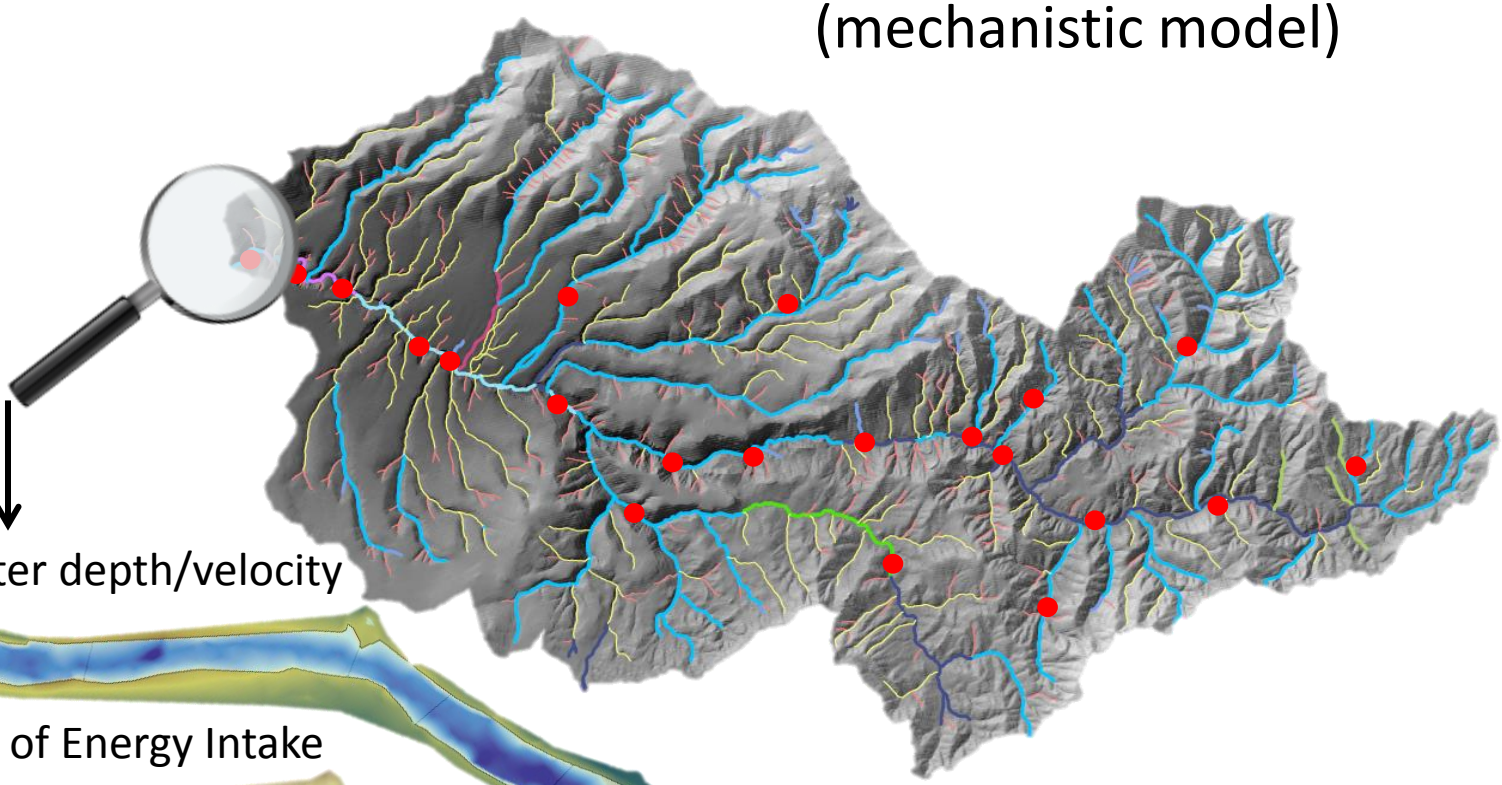
Estimate of Carrying Capacity

CHaMP Surveys collect:

- Substrate
- Topography/Channel Units

e.g. GRTS rollup to get basin level abundance of redds or adults

DEM based protocol → NREI → Juvenile abundance (mechanistic model)



Water depth/velocity

Net Rate of Energy Intake

Estimate of Carrying Capacity

DEM

Fish Habitat (NREI,HSI)

CHaMP Surveys collect:

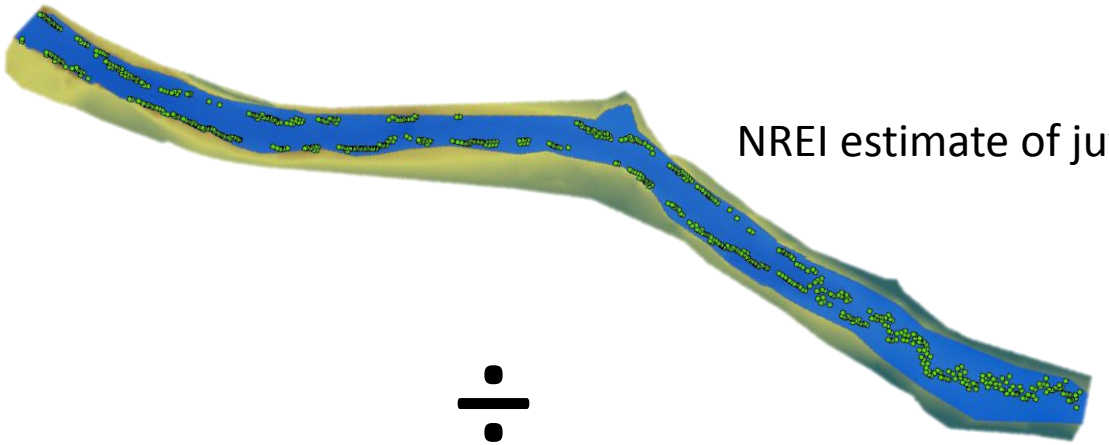
- Temperature
- Bugs
- Topography/Channel Units

e.g. GRTS rollup to get basin level abundance of juveniles

Estimation of Freshwater Survival From Habitat

=

juveniles/spawner



NREI estimate of juvenile carrying capacity

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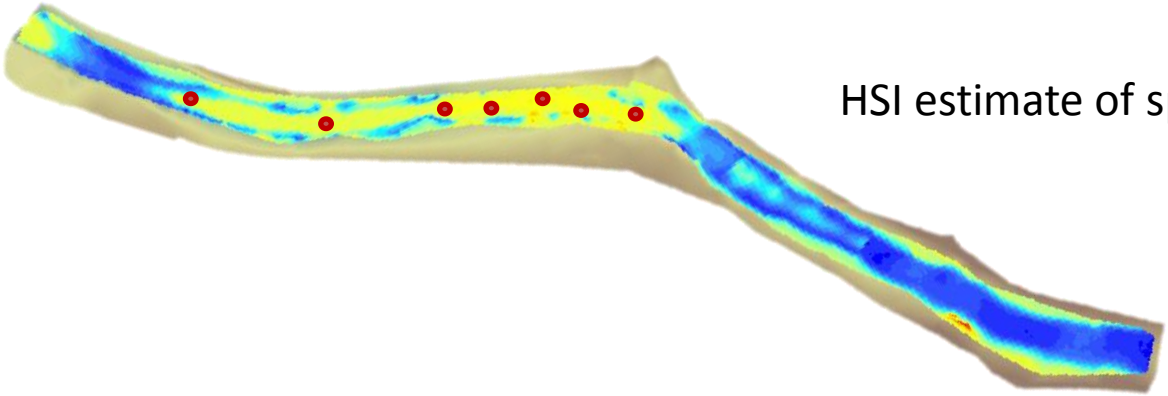
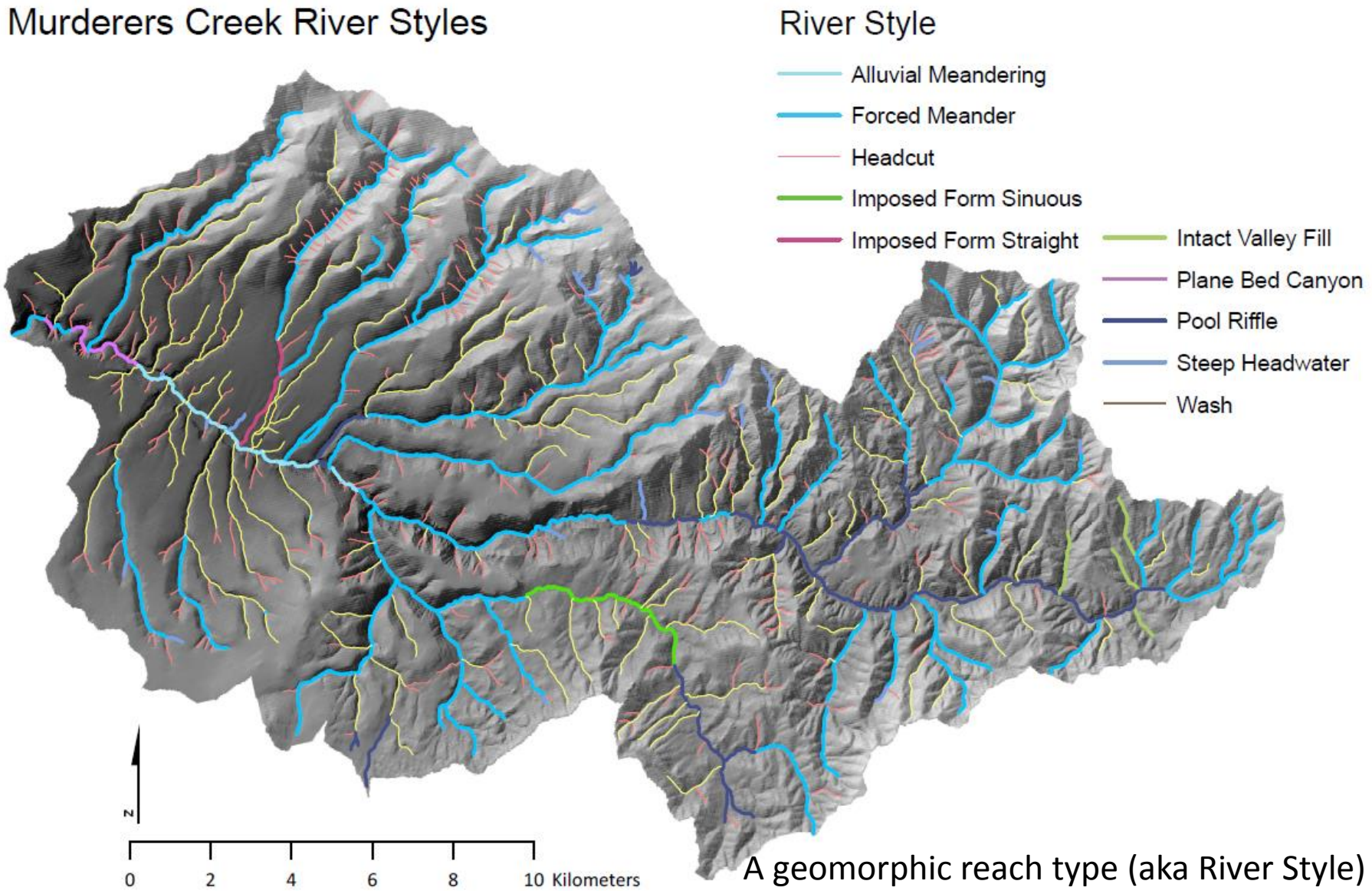


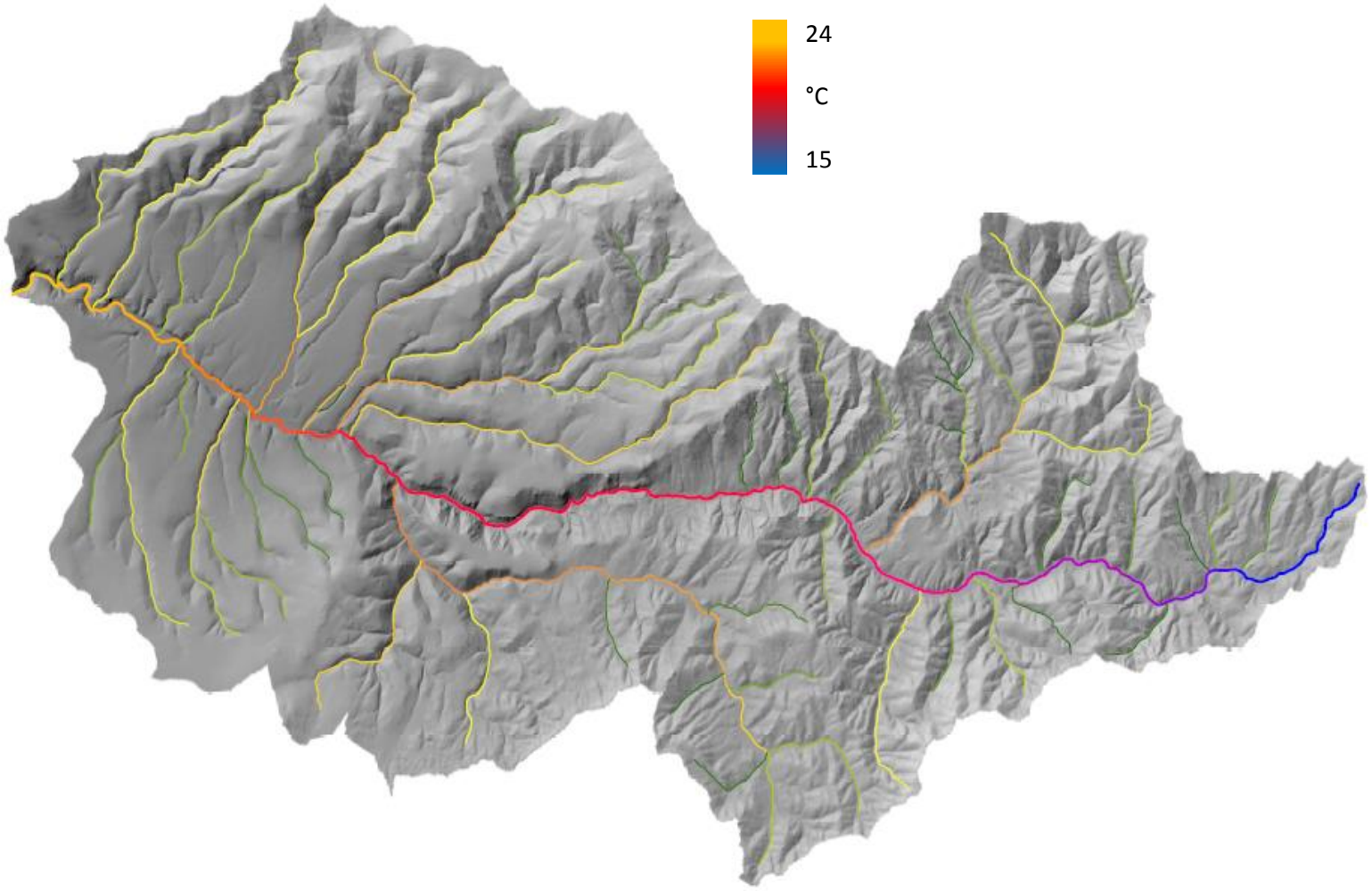
HSI estimate of spawner (redd) carrying capacity

Geomorphic Processes across a network

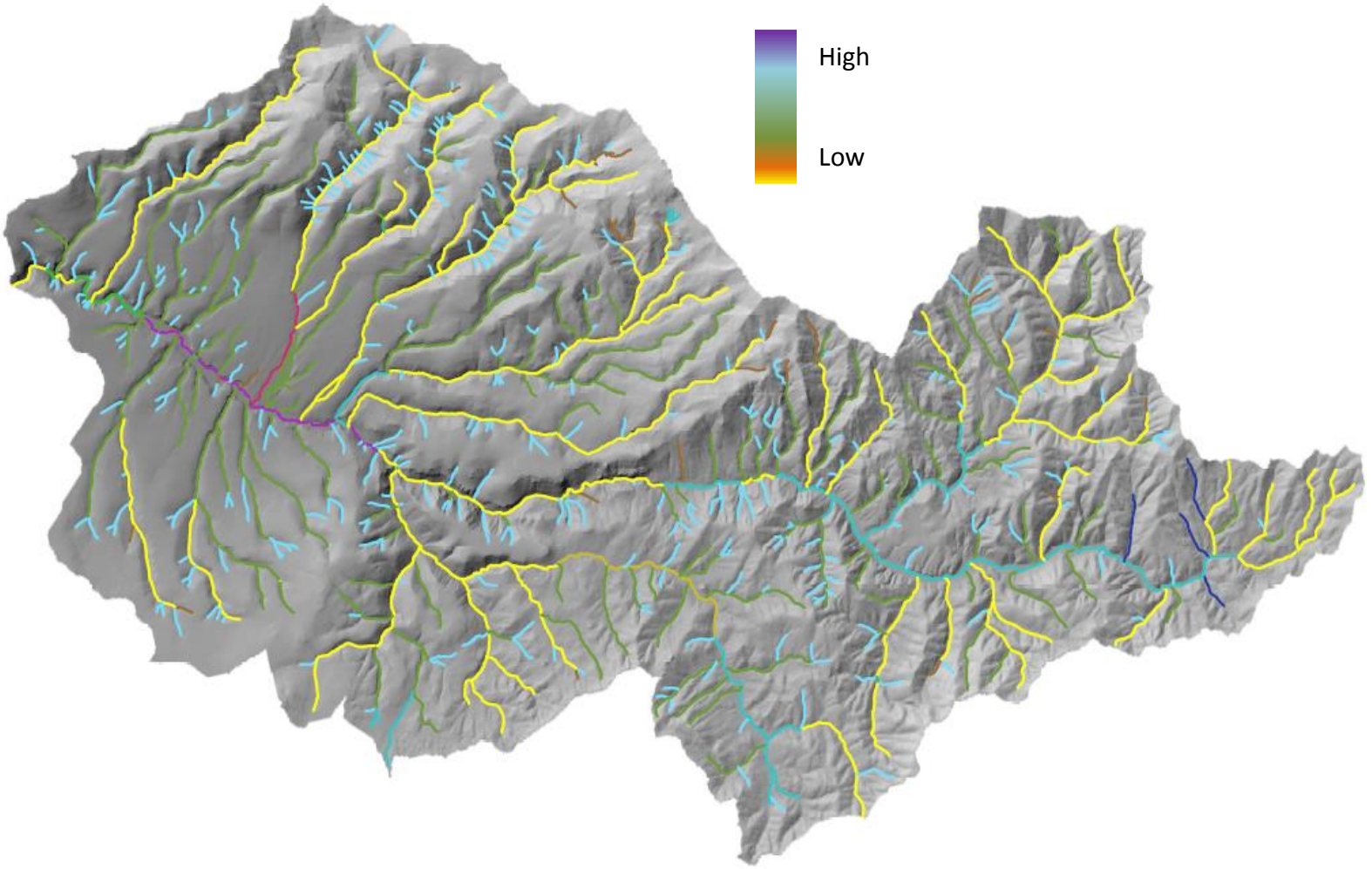


A geomorphic reach type (aka River Style)
is an assemblage of geomorphic units.
This can predicted based on larger scale controls.

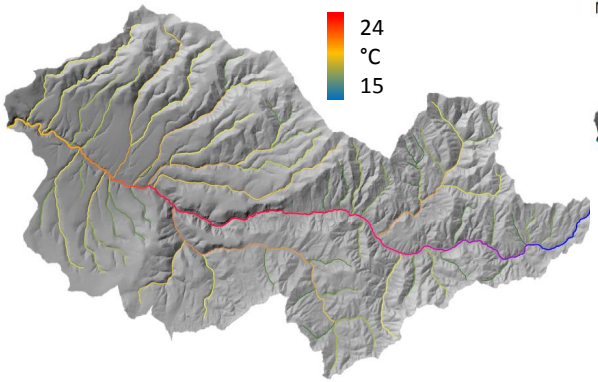
Temperature across the network

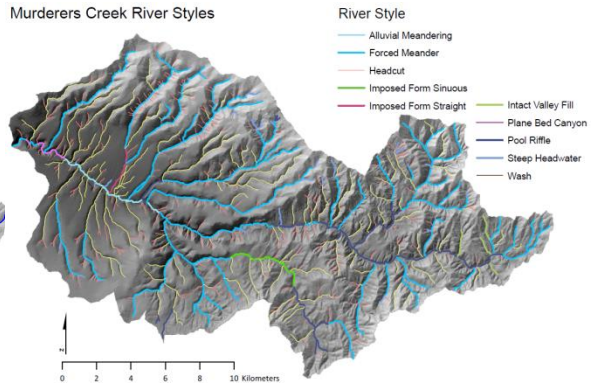


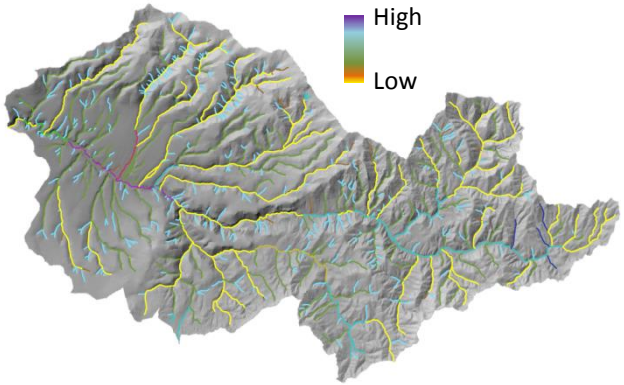
Stream productivity (~fish food) across a stream network



Juvenile steelhead production across a network



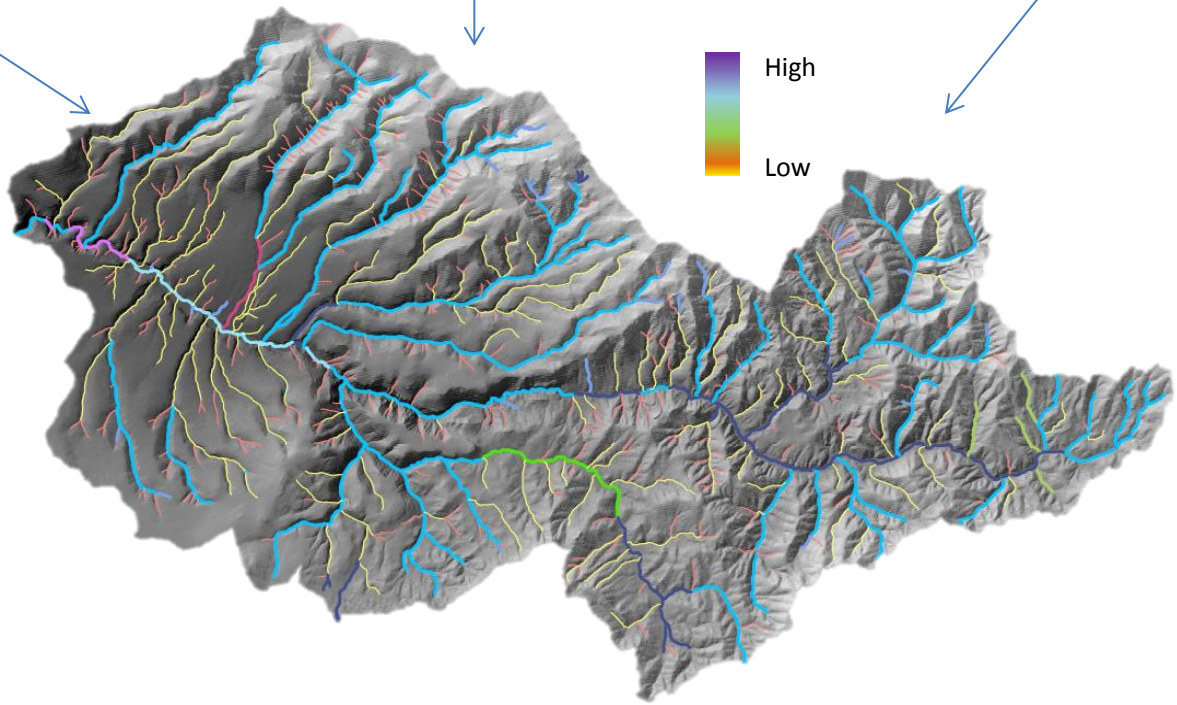




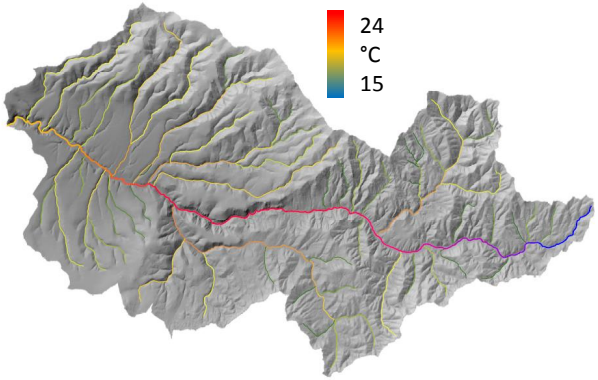
Temperature

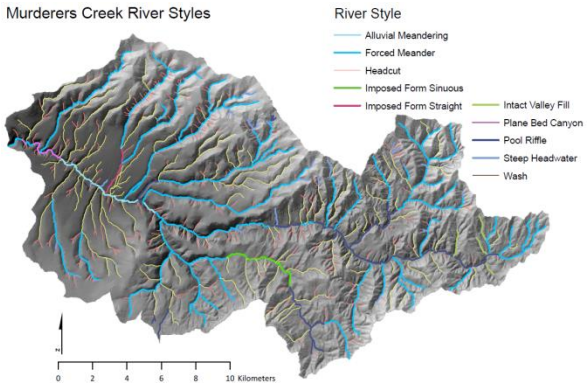
Physical Habitat

Stream Productivity



Steelhead redd distribution across a network





Temperature

Physical Habitat