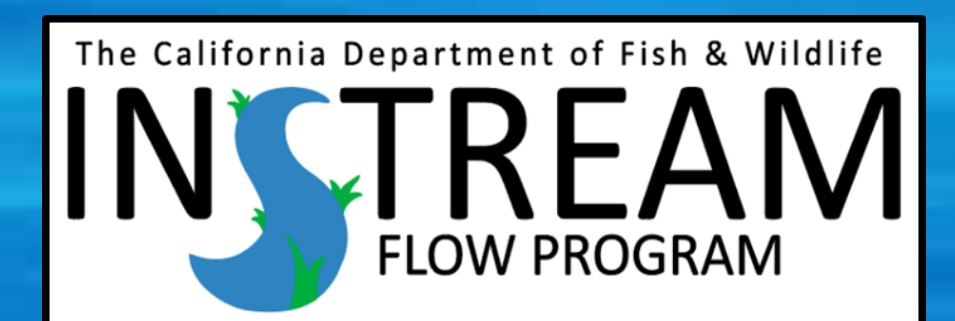# Development of Habitat Suitability Criteria for Juvenile Salmonids in the South Fork Eel River Watershed, CA

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STATEWIDE WATER PLANNING PROGRAM — CALIFORNIA DEPARTMENT OF FISH & WILDLIFE — Water Rights, Instream Flow, Groundwater

The California Department of Fish & Wildlife — INSTREAM FLOW PROGRAM

INTRODUCTION

Habitat suitability criteria (HSC) incorporate the behavioral response of a species to variability in microhabitat, such as depth, velocity, cover, and substrate. Those microhabitat features influence the use of local stream mesohabitats by different aquatic species and life stages. Typically developed within the framework of the Instream Flow Incremental Methodology (IFIM), HSC are input into hydraulic habitat models to predict how the quantity and quality of habitat changes under different flows. HSC have not previously been developed for the South Fork Eel River watershed in California.

The South Fork Eel River is among the watersheds prioritized for enhancement of instream flows, as directed by the California Water Action Plan. We developed HSC for rearing fry and juvenile Coho Salmon (*Oncorhynchus kisutch*) and steelhead trout (anadromous rainbow trout, *O. mykiss*) in Hollow Tree Creek, a relatively pristine stream within the South Fork Eel River watershed. These HSC will be used in hydraulic habitat models to develop instream flow criteria and enhance flows for the protection of juvenile salmonids in the watershed.
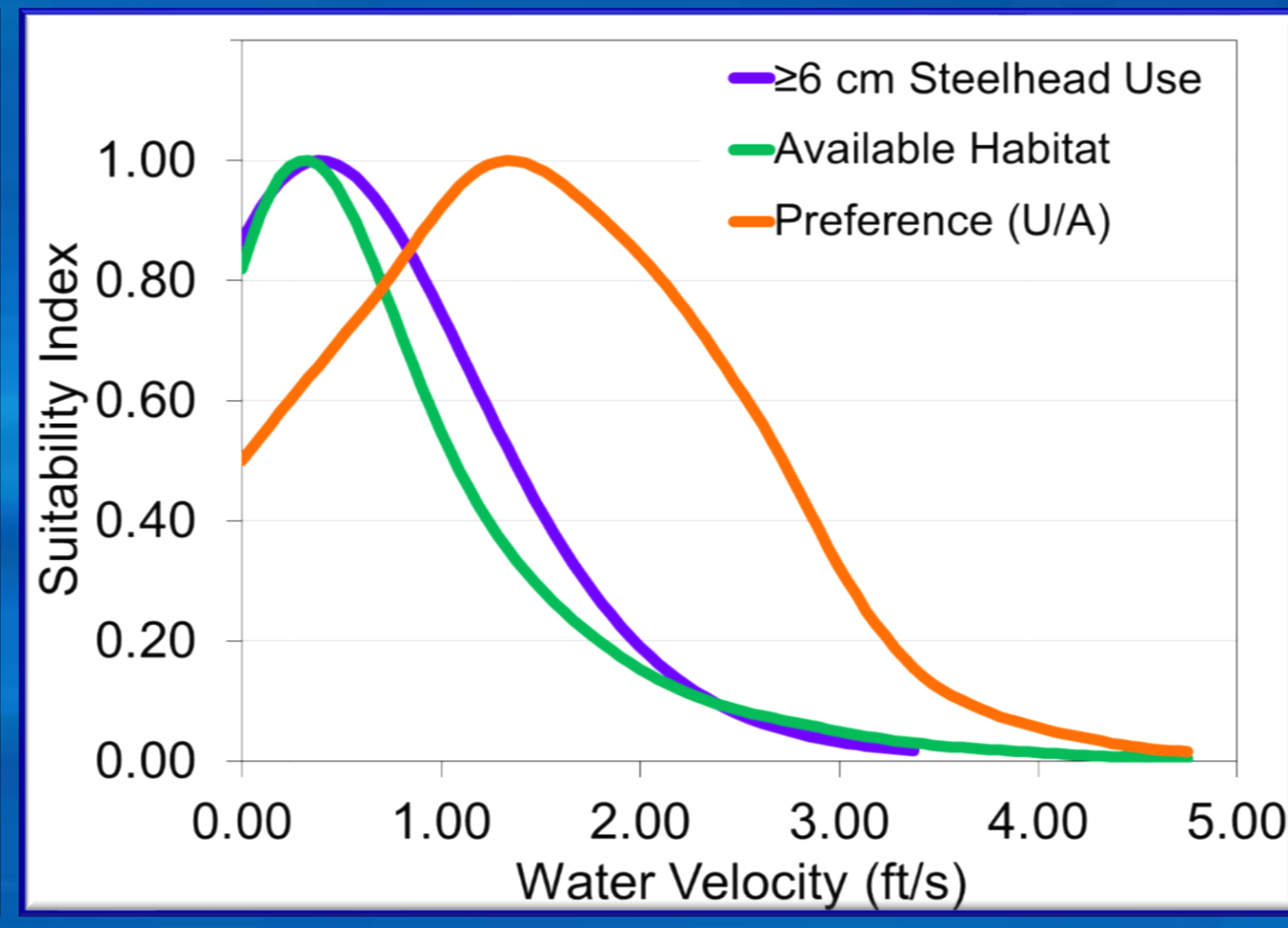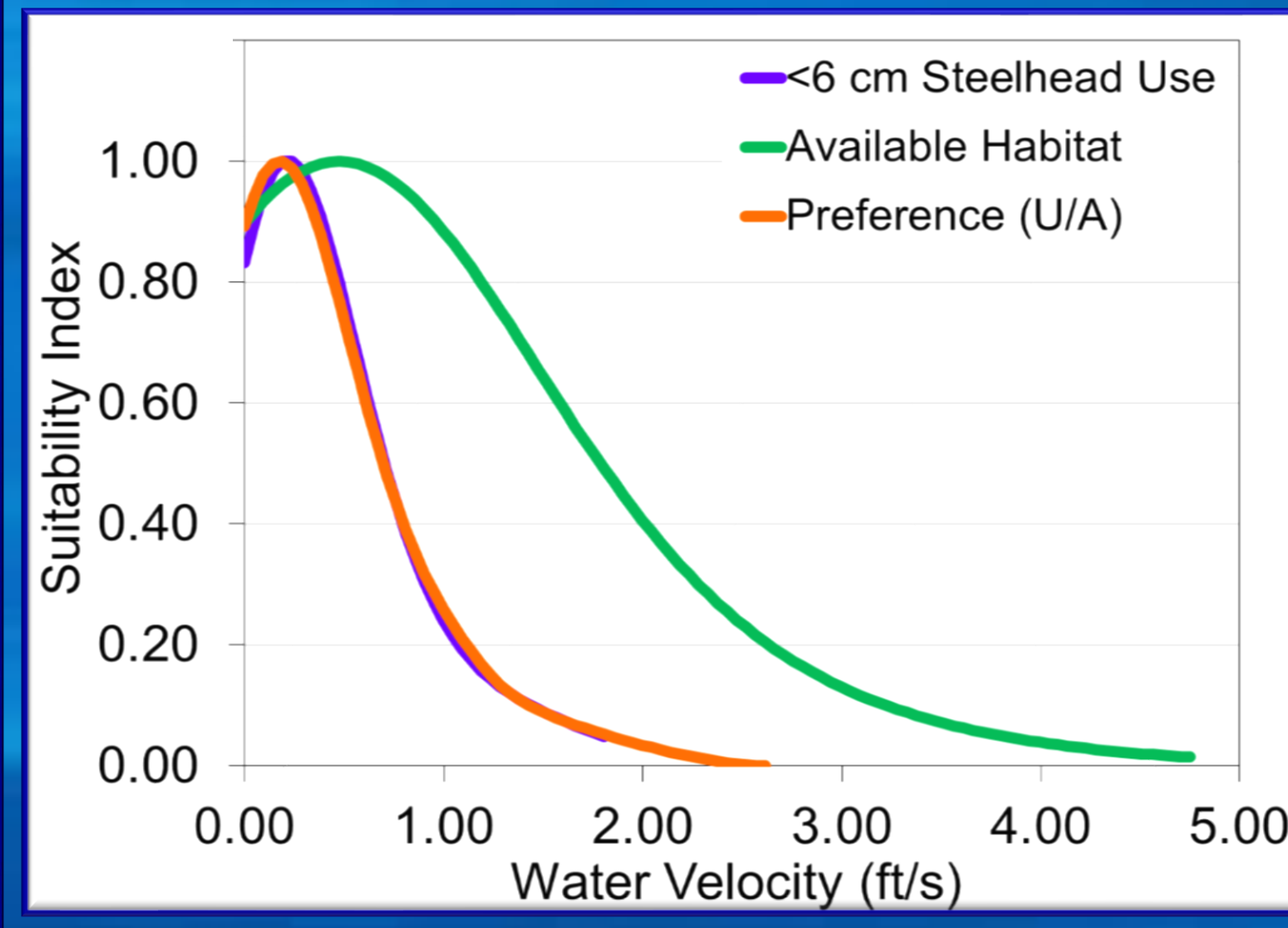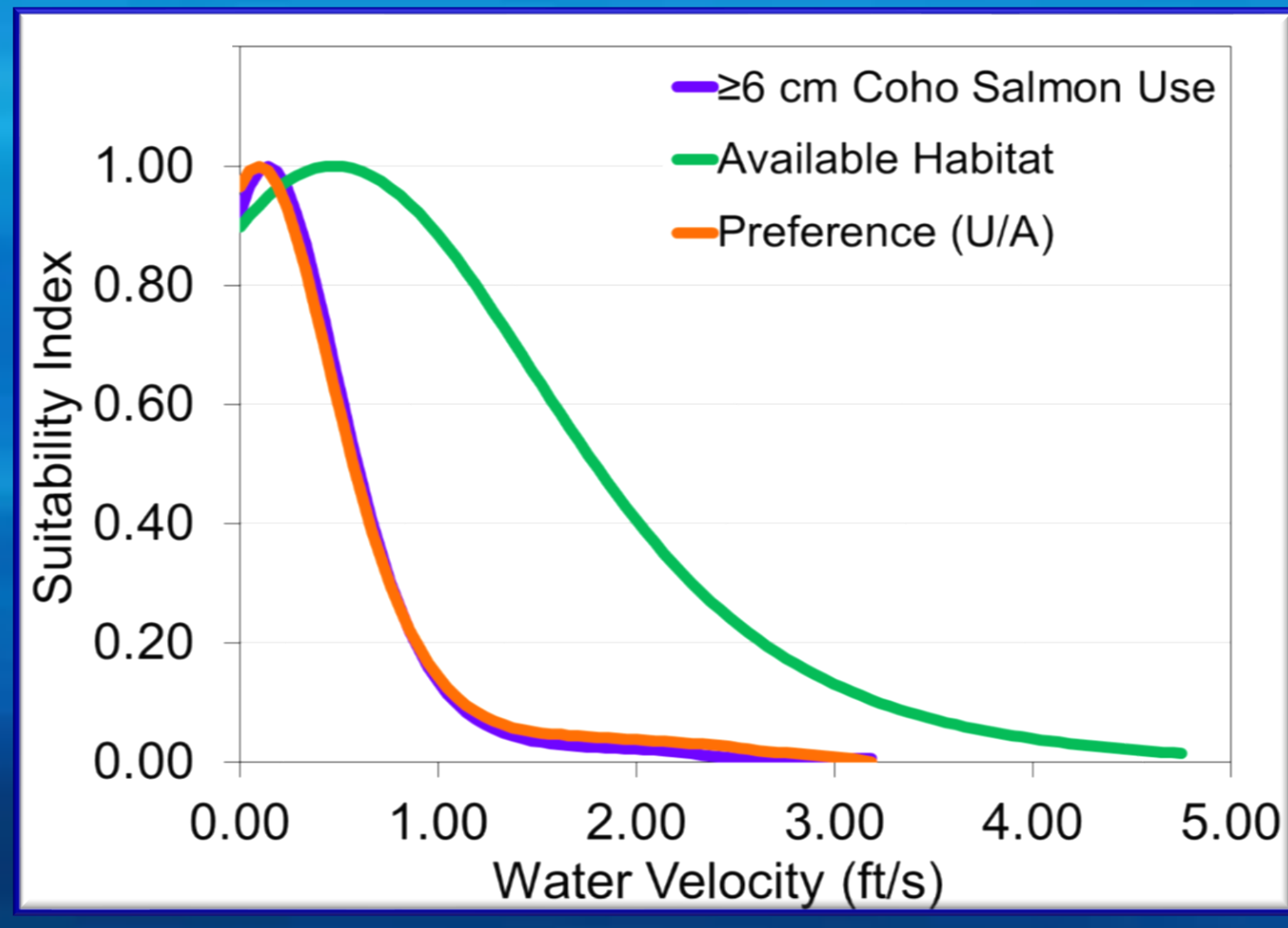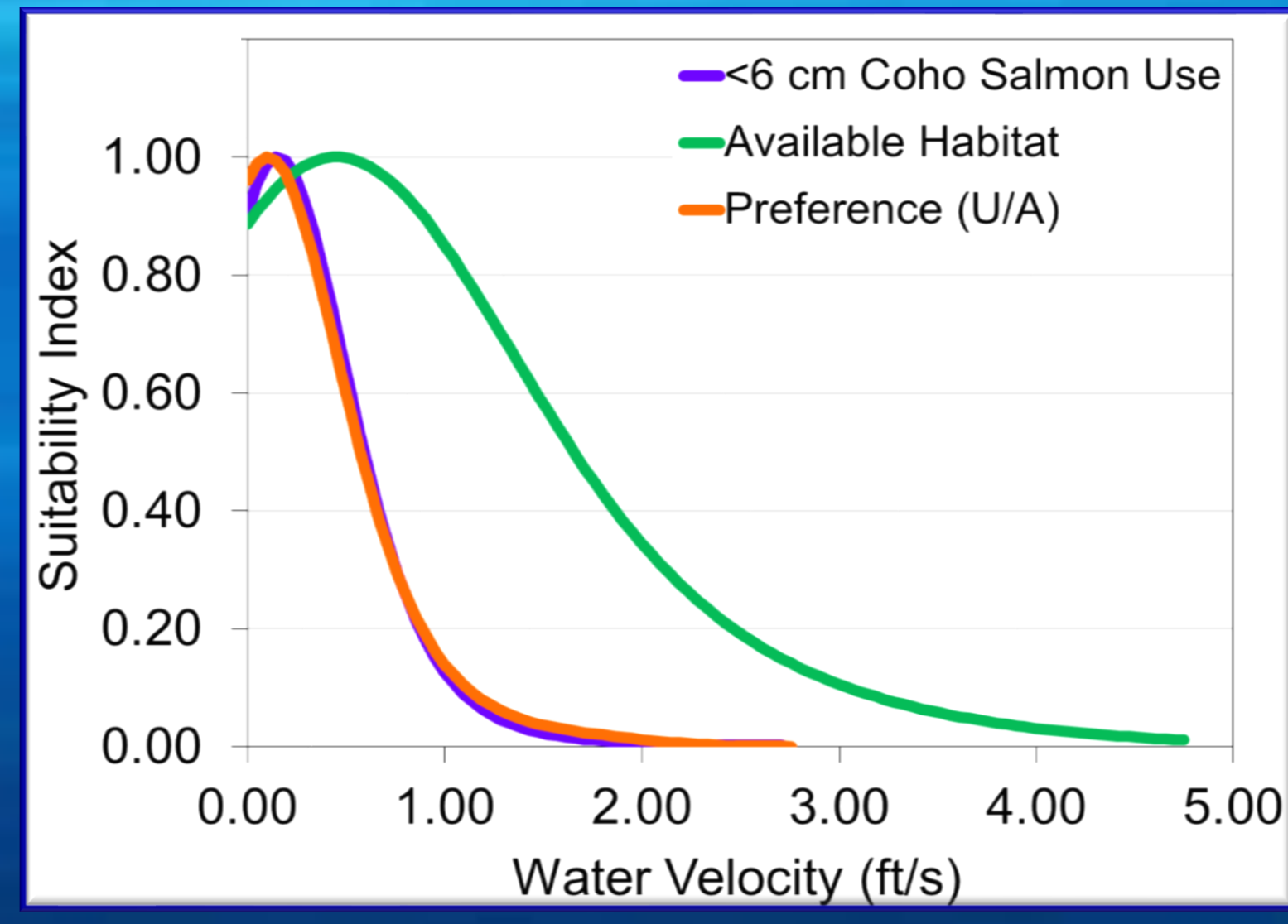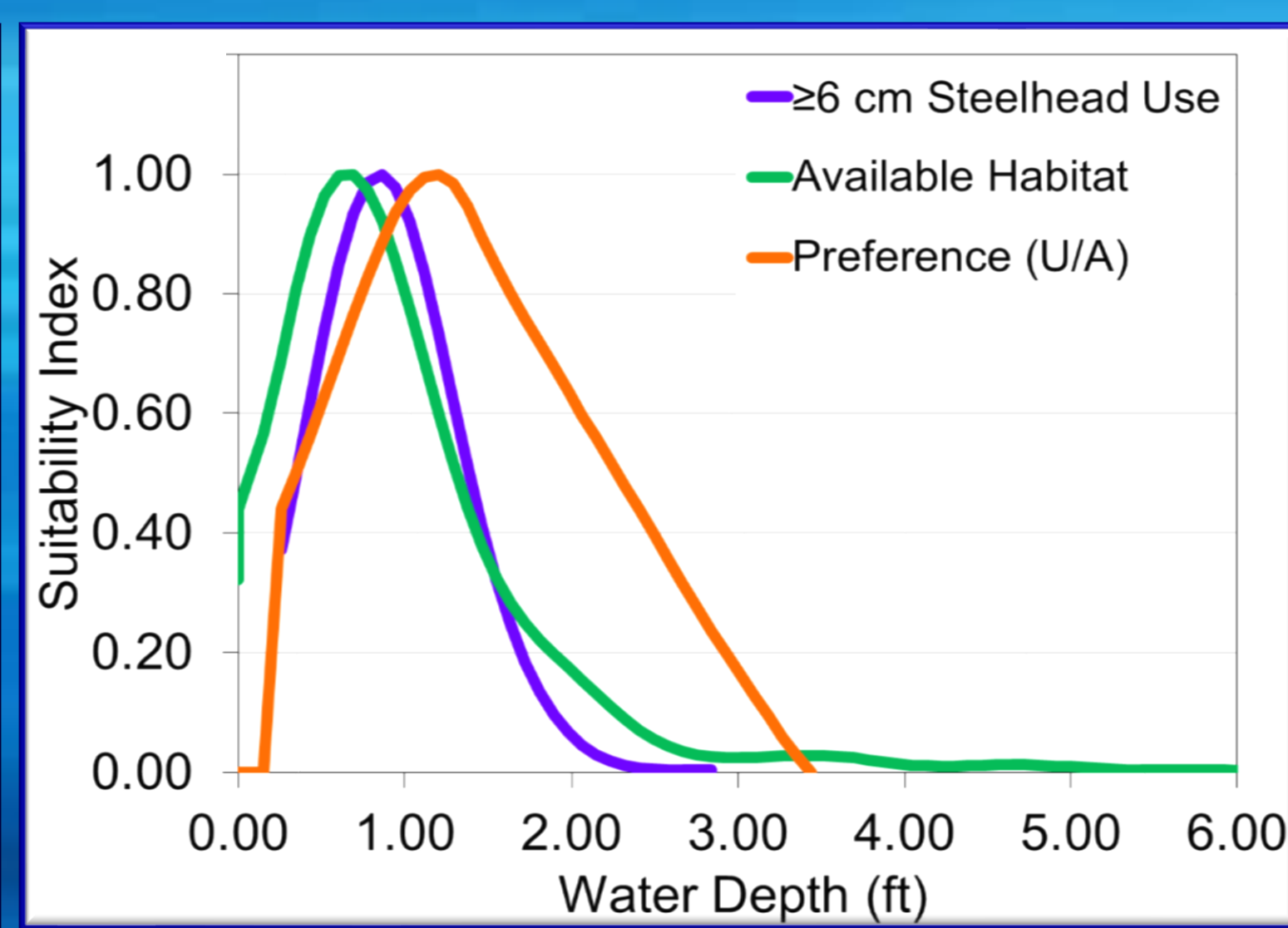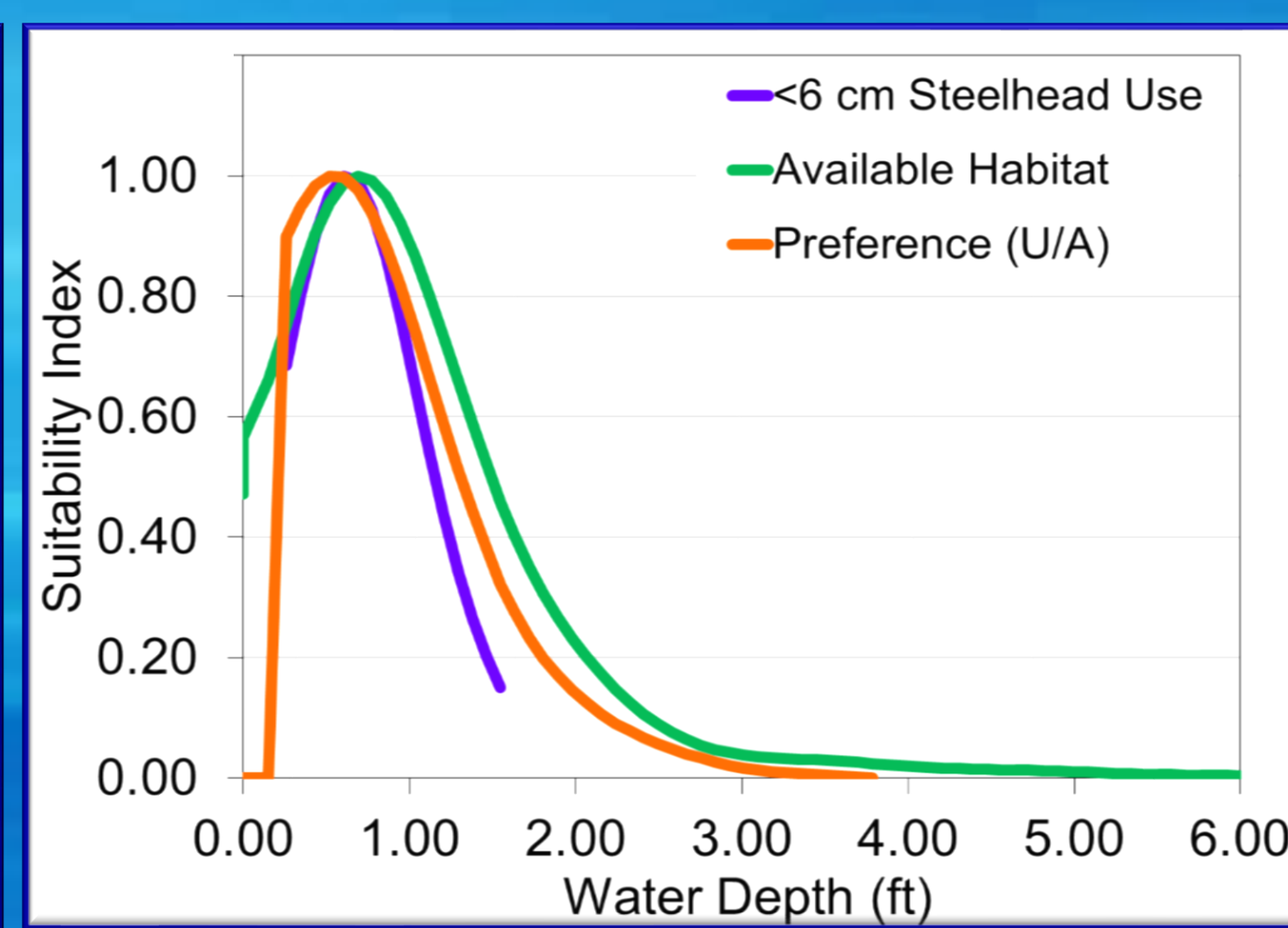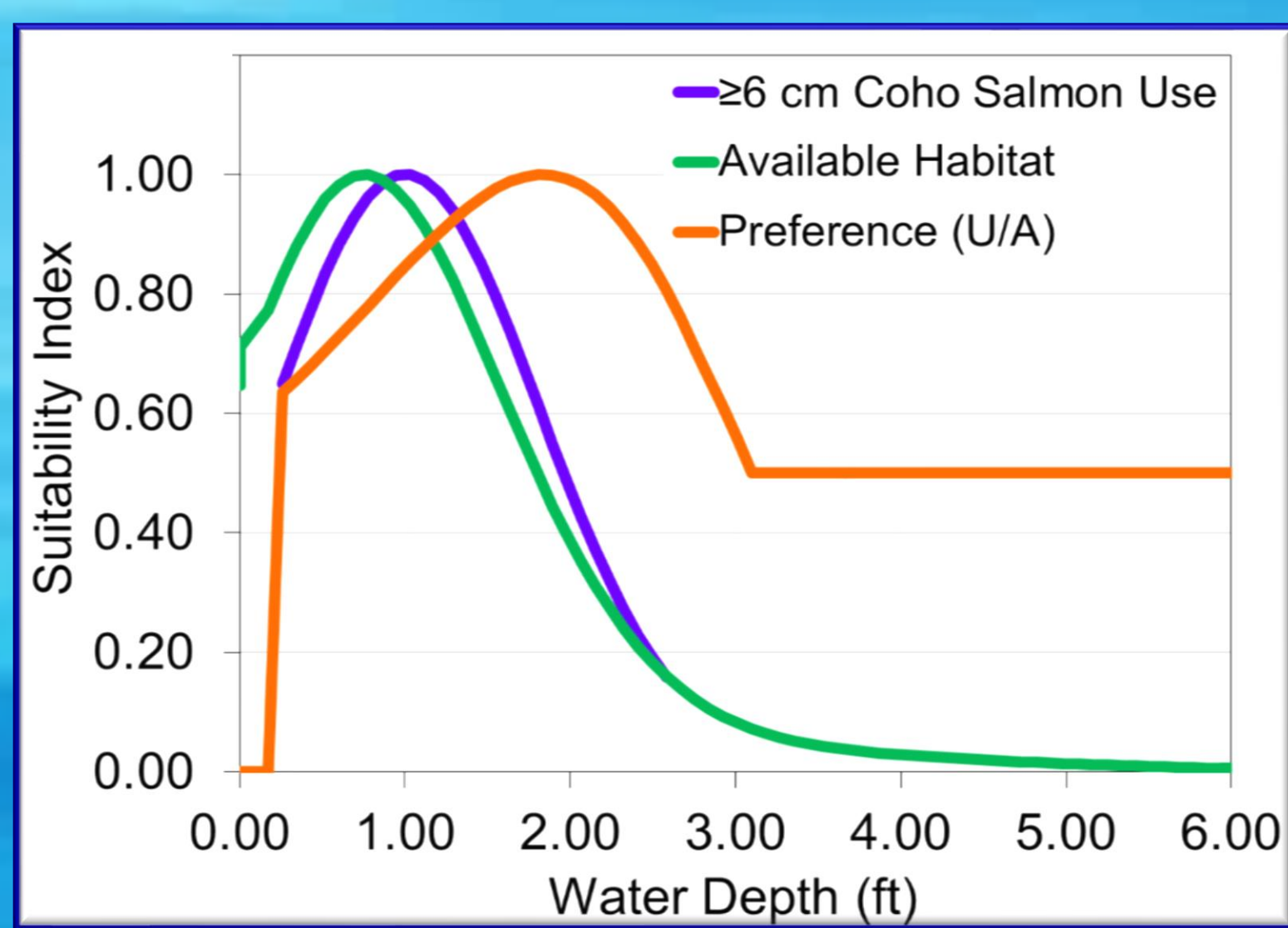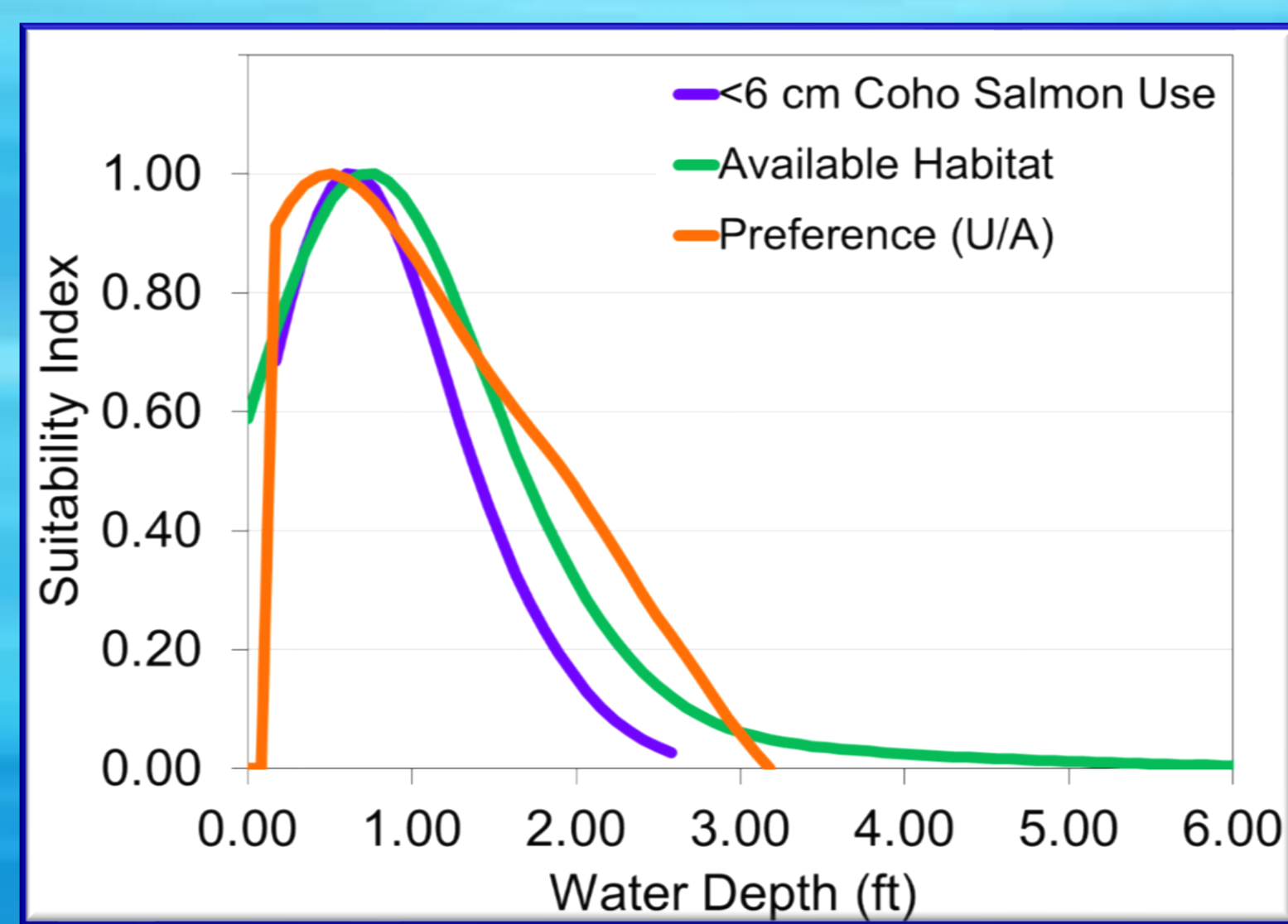
GOAL: Develop HSC for use in hydraulic habitat models in the South Fork Eel River watershed

OBJECTIVE: Evaluate fry and juvenile salmonid habitat use, availability, and preference for key microhabitat features
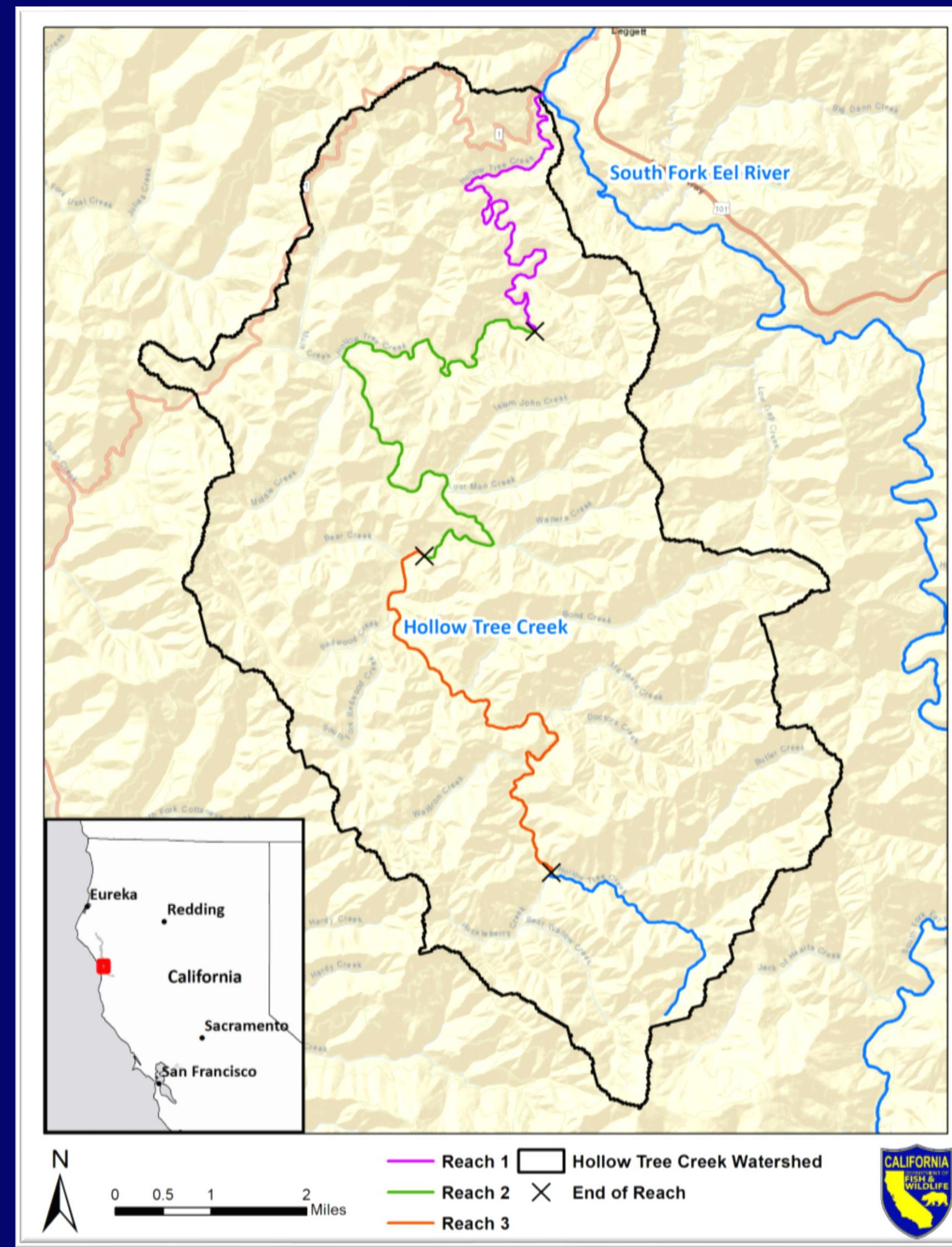
METHODS

- Habitat mapped in summer 2016; split into 3 equal reaches
- Sampling season and location: conducted in spring and summer of 2017 and 2018 in Hollow Tree Creek from the confluence with the South Fork Eel River to ~20 miles upstream with the confluence of Huckleberry Creek
- Sampling design: 5,000 sq ft (± 150 sq ft) of each mesohabitat type (riffle, pool, glide, run) sampled in each reach using a stratified random sampling design
- Snorkel surveys: snorkelers examined fish habitat use by fry (<6 cm) and juvenile (≥6 cm) Coho salmon and steelhead
- Fish observations: recorded for each undisturbed salmonid
  - Fish marker number
  - Species
  - Number of fish
  - Estimated fork length (cm)
  - Focal position
  - Fish activity
- Habitat availability data: microhabitat features (e.g., depth, velocity) collected in each sampled habitat unit following fish observations
- Data analysis: HSC curves developed in hydraulic modeling program SEFA to relate use, availability, and preference on a scale of 0 to 1.0

Map: Hollow Tree Creek Watershed, South Fork Eel River. Reach 1, Reach 2, Reach 3, End of Reach. Inset of California showing Eureka, Redding, Sacramento, San Francisco.

Preferences for <6 cm Coho Salmon:
Top: Water Depth: 0.43-0.52 ft
Bottom: Water Velocity: 0.10 ft/s

Preferences for ≥6 cm Coho Salmon:
Top: Water Depth: 1.72-1.89 ft
Bottom: Water Velocity: 0.10 ft/s

Preferences for <6 cm steelhead:
Top: Water Depth: 0.52-0.60 ft
Bottom: Water Velocity: 0.14-0.19 ft/s

Preferences for ≥6 cm steelhead:
Top: Water Depth: 1.12-1.20 ft
Bottom: Water Velocity: 1.28-1.43 ft/s

Suitability index curves for water depth (ft) and water velocity (ft/s) for <6 cm Coho Salmon, ≥6 cm Coho Salmon, <6 cm steelhead, and ≥6 cm steelhead. Each showing Use, Available Habitat, and Preference (U/A).

RESULTS

Fish habitat use and habitat availability data were collected in ~5,000 sq ft of each mesohabitat type per reach and season, maintaining an equal area sampling design. Sampling effort was stratified by season (i.e., spring and summer), mesohabitat type (i.e., riffle, pool, glide, and run), species (i.e., Coho Salmon and steelhead trout), and size class (i.e., <6 cm and ≥6 cm). Due to homogeneous features, all three reaches were combined for data analysis. In total, habitat use data were collected for 1,424 Coho Salmon and 2,130 steelhead observations. Habitat availability data were collected at 899 survey points.

Spring microhabitat features were most reflective of optimal juvenile salmonid rearing habitat. Spring flows (5.2-22.5 cfs) were greater than summer flows (0.3-3.7 cfs). Water temperatures ranged from 49 to 67°F (average 57°F) in the spring and from 57 to 70°F (average 63°F) in the summer. Summer drought conditions resulted in exceptionally low flows and limited available habitat; therefore the spring dataset was used to develop HSC.

For each species and size class, fish habitat use data were compared to habitat availability data. Preference HSC curves (Category III; Bovee 1998) were developed for water depth and mean water column velocity using the forage ratio (Use/Availability; Jowett and Davey 2007). Comparison of habitat use, availability, and preference indicated that few species or size classes selected the full range of available microhabitat features, with some preferences for limited features. Only the <6 cm size classes selected available water depths; ≥6 cm Coho Salmon and steelhead preferred deeper depths. Both Coho Salmon size classes and <6 cm steelhead preferred slower water velocities than were available, while ≥6 cm steelhead preferred faster velocities.

CONCLUSIONS

- Comparison of habitat use, availability, and preference indicated microhabitat was limiting for ≥6 cm salmonids
- Microhabitat preferences differed between most species and size classes

NEXT STEPS

Results of this study will be incorporated into the hydraulic model for Redwood Creek, another major tributary to the South Fork Eel River, for development of instream flow criteria (CDFW 2019).

REFERENCES

Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.B. Stalnaker, J. Taylor, and J. Henriksen (1998). Stream habitat analysis using the IFIM. United States Geological Survey, Biological Resources Division, Fort Collins, CO.

CDFW (2019). Instream flow evaluation: Juvenile steelhead and Coho Salmon rearing in Redwood Creek, Humboldt County. CDFW, Water Branch Instream Flow Program, Sacramento, CA. Report 19-1.

Jowett, I.G., and A.J.H. Davey (2007). A Comparison of Composite Habitat Suitability Indices and Generalized Additive Models of Invertebrate Abundance and Fish Presence–Habitat Availability. Transactions of the American Fisheries Society. 136: 428–444.