An Estimation of Salmonid Habitat Capacity in the Upper Mainstem Eel River, California

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Introduction

Anadromous salmonid populations in northern California's Eel River watershed have been impacted by two dams along the upper mainstem Eel River that make up the Potter Valley Project (PVP). Current populations of Chinook Salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) in the upper mainstem Eel River are declining due to habitat loss and degradation, and they are in need of recovery. In anticipation of the upcoming FERC 50-year license renewal of the PVP in 2022, this project provided an estimation of potential salmonid habitat and its capacity for steelhead trout and Chinook salmon in the upper mainstem Eel River watershed above the impassable Scott Dam.

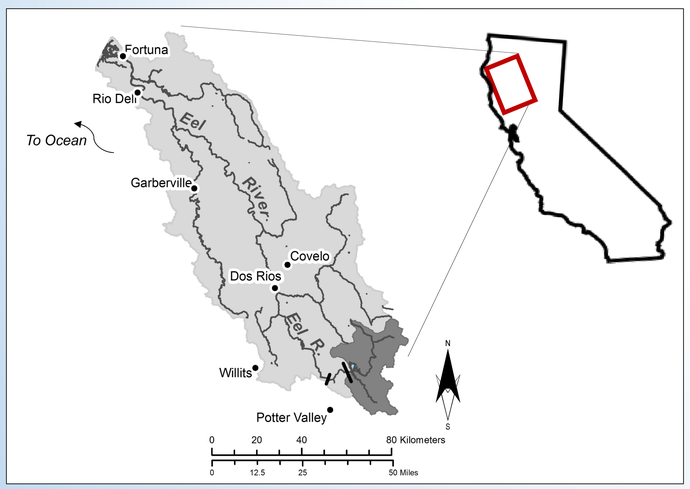

Figure 1. The Eel River watershed is located in northwestern California. Along the mainstem Eel River are two dams (black lines), and the study area is located upstream of Scott Dam (shaded in dark gray).

Methods

Geospatial analyses were conducted for mapping and quantifying potential spawning and rearing habitat for Chinook and steelhead. Streams within the study area were stratified into Reach Types, and survey locations were generated using GRTS methods. Stream habitat typing was conducted for field data collection, and these data were used as parameters in the Unit Characteristic Method modeling approach for estimating potential capacity for maximum salmonid production of juveniles and spawning adults.

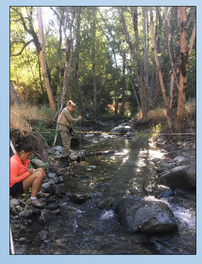

Figure 2. Undergraduate students Ariel Dasher and Erik Daniels measure streamflow.

Figure 3. Graduate student Emily Cooper navigates a stream during a field survey.

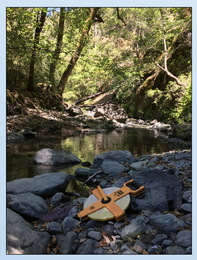

Figure 4. A survey reach on Bear Creek in the Eel River watershed.

Results

Potential spawning and rearing stream habitat was estimated between 89-127 km (55-79 mi) for Chinook, and potential steelhead habitat was estimated between 318-463 km (198-288 mi) for spawning and between 179-291 km (111-181 mi) for rearing. Maximum potential production of juveniles upstream of Scott Dam resulted in 57,374 steelhead parr and 201,426 Chinook parr. Using mid-range life-stage specific survival rates, these parr estimates converted to ~4,600 returning adult Chinook and ~1,500 returning adult steelhead. Estimates for spawner abundance above Scott Dam were calculated from South Fork Eel River fish count data; Chinook results were at ~4,620 adults and steelhead results were at ~7,400 adults.

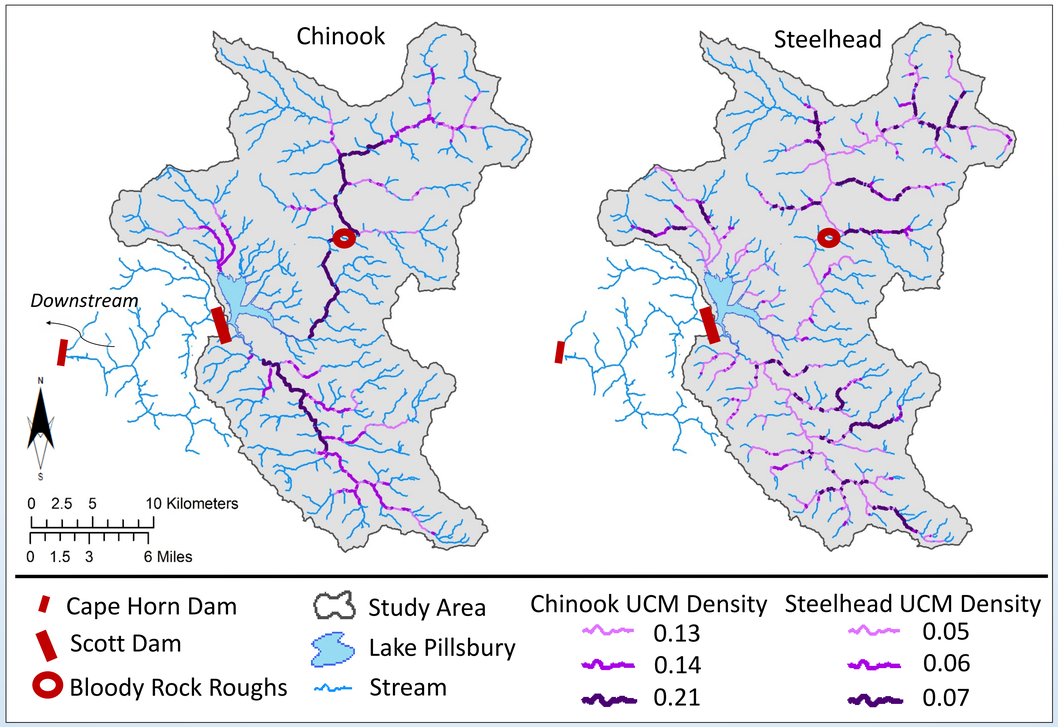

Figure 5. Potential distribution and juvenile densities among stratified reaches in the waterways upstream of Scott Dam for Chinook salmon (left) and steelhead trout (right).

Conclusions

The UCM modeling approach identified both high quality rearing conditions as well as those limiting to potential population production in the streams above Scott Dam, and these results were quantified and mapped. Spawner capacity estimates resulted in a larger number of potential juvenile recruits than what was estimated from parr habitat capacity mostly due to temperature-limiting rearing conditions; however, surplus juveniles may seek habitat downstream of the study area as needed or available. These results suggest an opportunity for a higher increase in salmonid production than what is estimated by simply modeling parr capacity in the streams above Scott Dam. Potential downstream effects from dam removal and how that may contribute to spawning and rearing productivity and overall salmonid survival and recovery in the upper Eel River must be considered for fisheries management.

Table 1. Potential steelhead stream habitat and abundance estimates from past reports compared to those from this research in the upper mainstem Eel River watershed, CA.

Steelhead Habitat in stream-km	Steelhead Spawner Abundance	*Source*
-	2,500	CDFG, 1979, unpublished
94	1,499	VTN, 1982
160	-	BLM, 1995
411	-	Becker and Reining, 2009
463	6,120	NMFS, 2016
-	408	PVID, 2017*
318 - 463	1,044-2,088	This research via UCM**
-	7,400	This research via conversion of spawner count data from Benbow Dam

*Includes estimates of spawners using stream habitat between Van Arsdale and Scott Dam only. PVID (2017) is an average of upstream migrant counts from 2000-2016 at Van Arsdale Fisheries Station.
**Includes estimates of spawners recruited from capacity estimate of 57,374 parr converted with a 28% parr to smolt survival rate and 13% ocean survival rate.

Table 2. Potential Chinook stream habitat and abundance estimates from past reports compared to those from this research in the upper mainstem Eel River watershed, CA.

Chinook Habitat in stream-km	Chinook Spawner Abundance	*Source*
-	2,300	CDFG, 1979, unpublished
94	1,250	VTN, 1982
160	-	BLM, 1995
-	3,092	Higgins, 2010*
127	2,060	NMFS, 2016
-	917	PVID, 2017*
89 - 127	4,593	This research via UCM**
-	4,620	This research via conversion of spawner count data from Benbow Dam

*Includes estimates of spawners using stream habitat between Van Arsdale and Scott Dam only. PVID (2017) is an average of upstream migrant counts from 2000-2016 at Van Arsdale Fisheries Station. Higgins (2010) reflects abundance estimate for habitat between dams from year 2010.
**Includes estimates of spawners recruited from capacity estimate of 201,426 parr converted with a 76% parr to smolt survival rate and 3% ocean survival rate.

References

1. Becker, G. S. and I. J. Reining. 2009. Steelhead/rainbow trout (*Oncorhynchus mykiss*) resources of the Eel River watershed, California. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA. **2.** CDFG (California Department of Fish and Game). 1979, unpublished. Potter Valley Project, FERC 77. Relicensing recommendations of the California Department of Fish and Game. Presented at Potter Valley Project Settlement Conference convened by FERC on May 24, 1979, in San Francisco. **3.** Cramer, S. P., and N. K. Ackerman. 2009a. Linking stream carrying capacity for salmonids to habitat features. *American Fisheries Society Symposium*, 71: 225-254. **4.** Higgins, P. 2010. Eel River fall Chinook monitoring project final 2010 report. Prepared for Friends of Eel River. **5.** PVID (Potter Valley Irrigation District) website. 2017. **6.** NMFS (National Marine Fisheries Service). 2016. Coastal Multispecies Recovery Plan. West Coast Region. Santa Rosa, California. VTN (Venture Tech Network). 1982. Potter Valley Project (FERC Project Number 77-110) Fisheries Study. Final report volumes I & II. Prepared for Pacific Gas & Electric Company, San Ramon, California. **7.** Yoshiyama, R. M. and P. B. Moyle. 2010. Historical review of Eel River anadromous salmonids, with emphasis on Chinook salmon and Steelhead. University of California, Davis, Center for Watershed Sciences. **8.** USFS & BLM (United States Forest Service & Bureau of Land Management). 1995. Watershed analysis report for the middle fork Eel River watershed.