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RECONNAISSANCE SURVEY OF CRITICAL MIGRATION RIFFLES IN THE BIG SUR RIVER, WITHIN LOWER ANDREW MOLERA STATE PARK, MONTEREY COUNTY, CA

WITH SPECIAL REFERENCE TO A COMPLEX RIFFLE UPSTREAM OF THE BIG SUR LAGOON

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A visual and photographic reconnaissance survey of habitat conditions in the lower reach of Andrew Molera State Park channel yielded several riffle sites where migration of adults could be impeded at low flows. The most critical site was a complex riffle located just upstream or at the boundary of the tidal zone of the Big Sur River Lagoon. Water depths were measured along two transects placed across the shallowest portion of the riffle. Streamflow at the time was estimated at 146 cfs. Total riffle crest length was approximately 133 feet, or about 2X to 3X the base channel width at two critical riffles further upstream. As indexed by depth measurements and criteria often used for recommending passage flows, the passage conditions were judged marginal for adult migration at a discharge of 146 cfs. Passage at lower flows would be problematic, but the site will probably change as discharge declines after each storm event. In any case, flow recommendations that are being developed for adult passage in the lower Big Sur River as part of the CDFG's should take into account conditions at this location. Notably, the underlying cause of bank erosion and channel change at this location is probably related to the major channel shift following 1995/98 storms. Until vegetation growth returns and sediment delivery to the channel declines, this location will continue to impede the upstream migration of adult steelhead.

Background and Introduction – A visual and photographic reconnaissance survey of habitat conditions in the Big Sur River within the lower reach of the Big Sur River in Andrew Molera State Park was conducted on April 29, 2011. This survey yielded several locations where the upstream migration of adult steelhead and possibly downstream emigration of juvenile fish could be impaired under low-flow conditions. (**Figure 1**) The most difficult site was at a complex riffle located just upstream of or at the upper boundary of the tidal zone of the Big Sur River Lagoon, where previous lateral (southern) migration of the stream channel appeared to be associated with localized bank erosion and bedload deposition.

Purpose and Methods – The purpose of this reconnaissance survey was to locate critical migration riffles; compare conditions at the locations to sites identified by the CDFG for further work in their STUDY PLAN: HABITAT AND INSTREAM FLOW RELATIONSHIPS FOR STEELHEAD IN THE BIG SUR RIVER, MONTEREY COUNTY (CDFG 2009); and conduct a series of water depth measurements on the most critical riffle.

Photographs were taken of critical riffles in the lower reach of Andrew Molera State Park, downstream of a bench reference site at a large bedrock/boulder on the left bank.[1] (**Photo 1 Photo 4**) Based on visual observations, I developed a qualitative description of channel conditions and ranking of potential migration delays at each of the sites.

At the most critical riffle, i.e. the site with the shallowest depths across the riffle crest, I measured water depth along two transects placed across the shallowest portion of the riffle. Streamflow during the survey was estimated at 146 cubic feet per second (cfs) based on interpolation between discharge measurements at USGS gage Nos. 11143000 and 11143010 taken on April 15 and May 4, 2011.[2]

Conditions at Critical Migration Sites – Three riffle locations were noted where shallow water depths could impair migration at lower flows. All were identified by CDFG as shallow gradient riffles and two were selected for further study (Sites 18-19 and 36). (**Table 1**)

At the most critical riffle the total crest length was approximately 133 feet at 146 cfs, or about 2X to 3X the base channel width at two critical riffles further upstream. As indexed by depth measurements and criteria often used for recommending passage flows, the passage conditions were judged marginal for adult migration at a discharge of 146 cfs. Only 15-16 percent of the overall riffle crest width is covered with depths greater than 0.7 feet; and with a depth criterion of 0.6 feet the percentage ranges from 18 to 28 percent of the crest width. With existing channel conditions adult steelhead would need to negotiate narrow, 5- to 7-foot and 6- to 16-foot wide strings of flow. Fish may be able to physically negotiate the narrow strings of suitable depths, but are probably at risk from higher terrestrial or avian predators. In any case, the flow recommendations that are being developed for adult passage in the lower Big Sur River, as part

[1] GPS Location of bench reference feature is 36°17'15.07"N/121°50'46.75"W
[2] CPSA/CBD-104 provides details on how the discharge was calculated.

of the CDFG's Study Plan, should account for the conditions at this location. Notably, the underlying cause of bank erosion and channel change at this location is probably related to the major channel shift following 1995/98 storms. Until dense vegetation growth returns and the sediment delivery to the channel declines, this location will continue to impede the upstream migration of adult steelhead.

Figure 1: Location of critical riffles for adult migration in the Big Sur River between the ocean and Andrew Molera State Park parking lot. Includes a complex riffle at CDFG Station 9 (waypoint 230), a possible transverse riffle at CDFG Site 18-19 (waypoint 239), and a wide, shallow riffle section at CDFG Site 36 (waypoint 256). Date of survey: April 29, 2011.

Photo 1: Complex critical riffle located at Waypoints 229-232, CDFG Site No. 9; view looking downstream from the top of the left streambank. Streamflow was estimated at 146 cfs.

Photo 2: Same location as previous photo, but looking upstream from gravel bar in the middle of channel. One transect used for measuring water depths along the riffle crest is shown.

Photo 3: Riffle below Waypoint 239, CDFG Site 19; view looking downstream from right bank to the upper edge of Site 18, located at the gravel bar on the left side of stream and middle back of photo. Overbank flow in an accessory channel from the left side appears to have deposited gravel and cobble bedload at this location. This may set up formation of a transverse, longitudinal riffle crest, with flow breaking to the right as the flow declines.

Photo 4: Waypoint 256,CDFG Site 36/T3; view looking downstream, note wide, shallow riffle in this section, summer stream crossing just downstream, streamside trails appear well used in this section.

Table 1: Characterization of critical riffles identified during reconnaissance survey in the Big Sur River, April 29, 2011. Streamflow at time of survey was estimated to be 146 cfs.

Date	Time	Survey Waypoint Number	CDFG Site Number	GPS location (Lat/Long)	Channel width (ft)	Dominant Depth (ft), Qualitative Depth Rank	Site selected by CDFG for further evaluation (Y/N)
4/29	11:41	229-232	9	36.282255°/121.855952°	75 – 120	0.5, shallowest	No
4/29	14:10	239	18-19	36.285180°/121.853564°	54	0.8, deepest	Yes
4/29	15:48	256	36/T3	36.287470°/121.846488°	65	0.7, mid-range	Yes

Table 2: Ratings of passage criteria for adult steelhead were measured at CDFGF Site 9, located in the Big Sur River just upstream of the tidal zone, April 29, 2011. Criteria included percentage of riffle cross section width with depths greater than or equal to 0.6 and 0.7 feet; and the width of riffle cross section with continuous depths greater than or equal to 0.6 and 0.7 feet. Streamflow at time of survey was estimated to be 146 cfs.

Transect Name	Percentage (%) of riffle cross section width with depths >= 0.6 feet depth	Width (ft) of riffle cross section with continuous depth >=0.6 feet	Percentage (%) of riffle cross section width with depths >= 0.7 feet depth	Width (ft) of riffle cross section with continuous depth >=0.7 feet
229 – 230	18	7	13	5
231 – 232	28	16	15	6