Cachuma Project Hearing, Phase 2
United States Bureau of Reclamation Applications 11331 and 11332
Statement of Dr. Brian Cluer

Qualifications

Ph.D. 1997 in Earth Resources from Colorado State University, emphasis on sediment transport, stream hydrodynamics, hillslope and fluvial geomorphology. Over 15 years professional experience in surface water and shallow groundwater investigations. Ten years field experience investigating the effects of dams on river systems, including the Colorado River in Grand Canyon National Park, the Green River in Dinosaur and Canyonlands National parks. Over 5 years experience investigating the effects of flow regulation on rare fishes and recommending management actions to protect associated geomorphic resources. Employed by NOAA Fisheries since August 2000.

Introduction

The total mainstem channel length of the Santa Ynez River is approximately 90 miles. The Santa Ynez River has three dam structures on its mainstem channel. The downstream most dam, Bradbury, is located at river mile 49 (RM49), next is Gibraltar Dam at RM73, and the upstream dam is Juncal at RM85.

The mainstem of the Santa Ynez River generally consists of two different channel types: cobble bedded and sand bedded dominated channels. Additionally, the various tributaries to the mainstem of the Santa Ynez River include cobble and boulder, and step pool dominated channels. Upstream from Bradbury Dam/Lake Cachuma the river is confined by valley walls, the channel is cobble bedded and bed features are influenced by bedrock exposures. Downstream from Bradbury Dam, beginning near Solvang, the river channel is predominantly sand bedded and the river valley includes floodplains of various heights and widths. Over a zone that probably varies annually there is a transition between these two different channel types from a confined course bedded stream to an unconfined fine-bedded stream. The distinct geomorphology of these three reaches provides for distinct steelhead habitats and distinct management opportunities. The tributaries downstream of Bradbury Dam tend to have lower gradients in their lower reaches than do tributaries above Bradbury Dam, and have less well developed step and cobble and boulder dominated channels.

Mainstem Reach Downstream from Bradbury Dam Cachuma Reservoir

Bradbury Dam and Cachuma Reservoir regulates annual flood flows and large flood releases are less frequent since completion of Bradbury Dam in 1953. Alluvial stream channel dimensions are the result of flood flows in the 1-5 year range of recurrence, known as the channel forming flows. Reduced frequency and/or magnitude of channel forming flows results in changes to channel size and shape. Interactions between natural hydrologic cycles, flood flow regulation, sediment regulation, riparian vegetation and shallow groundwater processes, and channel manipulation all complicate the response of channels downstream from large dams.

Channel changes, due to flow regulation and/or sediment trapping, precede changes in fish habitat, and must be understood to effectively management flows for fish passage and other life history phases. In order to maximize migratory conditions the following information should be developed:

1) Investigate changes in channel geometry since completion of Bradbury Dam. Relate to fish habitat changes. Determine how channel and fish habitat might be improved through incrementally reinstating historic channel forming flow regime, as baseline for assessing management alternatives.

Storage in Cachuma Reservoir has diminished over the past 50 years because the reservoir is an effective trap for all bed material and portions of the finer grained sediment load. The channel downstream is starved for bed material for some distance until tributary inputs make up the sediment deficit.

2) Determine the distance downstream from Bradbury Dam where tributary inputs of bed material achieve approximate equilibrium with regulated sediment transport capacity. Assess the potential to improve fish habitat by managing releases to shift the equilibrium point upstream or downstream. Prepare a sediment augmentation plan to approximately satisfy the downstream sediment deficit.

Flood flow regulation can cause tributary confluences to aggrade downstream from large dams. The reduced frequency and/or magnitude of effective sediment transporting flows can result in localized sediment accumulations in streams that are generally degrading.

3) Investigate the tributary mouths downstream from Bradbury Dam for evidence of aggradation, and relate to fish passage effectiveness.

Effective fish passage flows in the Santa Ynez River are related to groundwater conditions downstream from Cachuma Reservoir.

4) Determine the status of groundwater withdrawal zones including recharge volumes and rates from early winter flows. Relate recharge effects to fish migration delays.

Mainstem Reach Upstream from Bradbury Dam and Cachuma Reservoir

Flow regulation and the trapping of bed material in reservoirs modifies stream hydrology and sediment transport characteristics, in turn modifying downstream habitat quality and quantity. The primary effect of Juncal and Gibraltar dams is the trapping of bed material, combined with negligible regulation of flood flows.

1) Investigate the trap efficiency of Juncal and Gibraltar dams over the range of sediment sizes stored in their respective reservoirs. Determine the reduction in downstream supply relative to unimpaired sediment routing.

Based on geomorphic principals, the interception of bed material combined with negligible flow regulation causes changes in the channel pattern, substrate, and bed elevation downstream from dams. Reducing bed material supply to downstream reaches also diminishes the size and number of bars, pools, and riffles. This is primarily the result of reducing sediment supply to downstream reaches where sediment transport capacity remains high. Sediment starved streambeds degrade, lowering bed elevation, and/or armor the surface with large and relatively immobile cobbles. Trapping the bed material behind dams also reduces the size and extent of gravel patches used for salmonid spawning. All of these downstream effects reduce salmonid habitat either directly or by reducing production of the aquatic food base.

2) Investigate the pre-dam geomorphic and channel substrate conditions of the Santa Ynez River upstream from Cachuma Reservoir. Determine the changes from pre-dam to present time, and associate changes with salmonid habitat quality and quantity.

Secondary effects in the upper reach are the withdrawal and export of water from Gibraltar Dam and Juncal Dam. This action is likely to reduce summer steelhead habitat and will be addressed in detail by Stacy Li.

3) Investigate replacing the summer water withdrawals from Juncal and Gibraltar dams with other water sources or water conservation. Determine the modern need for Juncal and Gibraltar dams, and investigate their removal from the Santa Ynez River.

Tributaries above Gibraltar Dam

Tributaries to the reach influenced by Juncal and Gibraltar dams continue to supply sediment to the Santa Ynez River channel. The effects of bed material trapping by Juncal and Gibraltar dams may be partly overcome by tributary sediment inputs. Closer to the dams the effects of bed material starvation would be greatest, progressively diminishing downstream as tributaries contribute bed material to the river channel.

1) Investigate the delivery of bed material from tributaries downstream from Juncal and Gibraltar dams, at spatial and temporal scales relevant to steelhead habitat and life

history. Combine tributary sediment delivery investigation with reservoir trapping efficiency study.

Changes in the elevation of the main channel bed at tributary confluences can cause tributary channels to degrade through a process known as headcutting. Tributaries entering the Santa Ynez River channel in sediment starved areas, where bed degradation may have occurred, may be effected by headcutting. Streams subject to headcutting provide reduced quality salmonid habitat.

2) Assess tributary confluences for evidence of headcutting or channel degradation. Relate to fish passage and habitat degradation assessments.

The Santa Ynez River system provides a complex of physical habitats which are used by steelhead during the freshwater phases of their life-cycle; recognizing these distinct physical habitats and managing them is essential for the effective restoration and maintenance of the Santa Ynez River steelhead runs.

References

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