Cachuma Project Hearing, Phase 2
United States Bureau of Reclamation Applications 11331 and 11332
Statement of Jonathon Mann, P.E.

Qualifications

1992, Bachelor of Aerospace Engineering, Auburn University, Alabama.

1997, U.S. Fish and Wildlife Service National Education and Training Center Fish Passageways and Diversion Structures course, Redding, California.

2002, California registered professional engineer in the field of civil engineering.

I have been employed by NOAA since 1993. In 1996 I began practicing hydraulic engineering for fish passage and stream channel restoration for the National Marine Fisheries Service. I have been directly involved with assisting biologists on fish passage for steelhead in the Santa Ynez River watershed and surrounding areas since that time. My primary duty and area of responsibility is to provide engineering support in coastal California watersheds for the range of salmonids.

Introduction

Fish passage around large reservoirs in California is currently being investigated as a means of recovery and restoration of anadromous fish runs, primarily for the large dams and reservoirs in the Central Valley. Restoration of access to historic spawning and rearing areas blocked by dams is intended as a supplement to, or in lieu of, traditional mitigation techniques such as hatcheries. In addition, for federally listed species such as the southern California steelhead, provision of fish passage is viewed as more closely meeting the goals of the Federal Endangered Species Acts which calls for the restoration of the ecosystems upon which the federal species depends. For steelhead, this includes timely and efficient passage of upstream migrating adults and passage of emigrating juveniles past an area that is limiting for their swimming abilities and life cycle needs.

Bradbury Dam is an earth fill structure constructed across the mainstem of the Santa Ynez River approximately 48 miles above its mouth a the Pacific Ocean, below most of the major steelhead spawning and rearing tributaries of the Santa Ynez River system. The Dam has a crest width of 3,350 feet and an effective height above the streambed of approximately 160 feet. Because Bradbury Dam and Cachuma Reservoir were constructed without any fish passage facilities, it prevents the timely and safe passage of

adult steelhead to upstream habitat, and adults and juveniles from going downstream. Because of the complexity of providing fish passage at the dam and reservoir project, effective fish passage can only be fully and adequately considered through a series of systematic investigations, performed by a technical advisory group facilitated by a lead agency such as the State Water Resources Control Board.

Adult Fish Passage

Typical options to provide adult fish the opportunity to pass upstream of a dam include ladders and bypass channels, lifts (water elevators), or a trap with a transportable tank (or a combination of two or more of these methods).

A fish ladder is analogous to a water stairway that allows the fish to make small leaps and swimming bursts from the base of the dam in steps to the reservoir's water surface. The adult fish then have to make their way through to upstream habitat. For large reservoirs this can cause a physical delay due to the time it takes for fish to swim the length of the reservoir from the dam to upstream habitat. A behavioral delay can also occur due to fish rapidly changing from a stream type of environment to a reservoir type of environment. In this case some fish may go back downstream.

A bypass channel is analogous to a flume, canal, or simulated stream channel that fish can swim through to reach upstream areas. This channel must exhibit hydraulic characteristics (e.g., velocity, depth, etc.) which enable fish to pass effectively through the channel in a timely manner to the natural stream environment.

Water elevators or lifts operate in much the same way as an elevator, elevating fish in a water column through mechanical means, and are usually employed in situations where the rise to run ratio is large, or where there is limited space to accommodate a more traditional step pool fish ladder.

Trap and transport methods involve trapping upstream migrating fish at the base of a dam (and juveniles at the inlets to a reservoir) and physically transporting the fish to an upstream location, usually a natural channel. Fish trapping and transportation facilities at dams usually include some form of a small fish ladder before fish are actually trapped in a pool or tank for transport.

The difference between the efficiencies of mechanized transport or voluntary swimming of adult fish around or through the reservoir is the subject of on-going investigations, and must be evaluated on a case by case basis

Selection of adult fish passage options to further consider depends upon run size (number of fish expected during the migration season and should account for expected increases through restoration and recovery efforts), run timing (duration and frequency of the migration season), and facility needs for juvenile fish passage.

Juvenile Fish Passage

Juvenile anadromous fish are frequently concentrated in the upper reaches of river and stream systems (excluding estuaries), and when they have reached smolt stage must emigrate downstream to the ocean to complete the ocean phase of their development.

Typical options to provide juvenile fish the opportunity to pass downstream of a reservoir and dam include head-of-reservoir and tributary collection facilities, collection areas at the upstream face of dams and hydraulic structures, and pass-through routes at hydraulic structures of the dam (spillways, fish bypasses, release valves, turbines, etc.).

For large reservoirs without head-of-reservoir and tributary collection facilities juvenile fish can be subject to physical delays from the time it takes for fish to migrate downstream through the entire length of the reservoir. Mortality can occur due to predation in the reservoir. Pass-through systems at a dam can also subject juvenile fish to delay and mortality. A head-of-reservoir collection and tributary collection facilities can consist of a downstream migration barrier such a screen to guide fish to a collection or bypass point.

Selection of juvenile fish passage options to further consider also depends upon run size, run timing and facility needs for adult fish passage. Since steelhead can migrate back to the ocean after a spawning run, head-of-reservoir and tributary collection facilities can also serve adults going back downstream. Since a majority of the steelhead spawning and rearing habitat exists above the Bradbury Dam and Cachuma Reservoir, effective means of providing fish passage for juveniles ready to emigrate to the ocean (smolts), is an essential component of fish passage in the Santa Ynez River.

Recommended Fish Passage Investigations

An outline of general data collection necessary for a full and adequate investigation of different fish passage options at the Bradbury Dam and Cachuma Reservoir facilities includes but is not limited to:

A. Biological

1. Fish species description – physical size range of fish
    a. Swimming ability and leaping ability
    b. Preference for passage (e.g., wall/floor oriented)
    c. Range of run size (including restored runs)
2. Migration period
    a. Start, peak, end
    b. Upstream, adult
    c. Downstream, juvenile
3. Fish activity and condition at barrier
    a. How do they approach barrier
    b. Fatigued or injured
    c. Energy expended
4. Location of barrier in fish migration route

a. Pass through
b. Spawning in vicinity
c. Rearing in area

B. Physical Site Conditions

1. Road alignments
   a. Nearest road to site
   b. Condition of road
   c. Access for construction equipment
   d. Permanent access
2. Topography and existing features
   a. Environmental issues
      i. Sensitive plants or animals
      ii. Riparian disruption or removal
      iii. Archeological site
      iv. Residential area nearby

   b. Geological
      i. Bedrock, type and location
      ii. River bed material
      iii. Bank material
   c. River Characteristics
      i. Cross sections
      ii. Profile
      iii. Bank details
      iv. Water surface at varying flow conditions
3. Additional information
   a. As-built drawings and surveys for structure
   b. Core samples, structure or soil
   c. Construction requirements
      i. Access
      ii. Dewatering
      iii. Staging areas
      iv. Spoils area
      v. Power sources
   d. Utilities in area

C. Hydrology/Hydraulics
1. River flow
   a. Stream gage nearby
   b. Basin hydrology
      i. Flow duration
      ii. Flood flows-annual, 10, 50 year, etc.
      iii. Bankfull discharge
      iv. migration flows

2. Operating flows
    a. Fish screen, existing or future
    b. Bypass, existing or future
    c. Fish ladder and auxiliary flows, existing or future
3. Headwater/Tailwater stage relationships
    a. Entrance pool area hydraulics
    b. Holding pool hydraulics
    c. Exit area hydraulics

Conclusion

The successful design and operation of anadromous fish passage facilities requires experience and knowledge in the areas of fish behavior, hydraulic engineering, water resources engineering and/or hydrology, geology, fluvial geomorphology, structural engineering, general civil engineering, electrical engineering and construction engineering economics.

The importance of involving the resource agencies in the process of designing fish passage structures is critical to obtain efficient and meaningful project plans and response to permitting issues. A long-standing working relationship has been established between the Bureau of Reclamation, the U.S. Fish & Wildlife Service, the National Marine Fisheries Service, and many regional, state, and local organizations and agencies for working on fish passage facilities. That relationship can be further facilitated for the Bradbury Dam/Cachuma Reservoir project by identifying a multi-agency technical team under the direction of the State Water Resources Control Board to begin a more careful consideration of fish passage options.

References

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