

## Spawning Habitat Rehabilitation

### **Abstract**

Altered sediment and flow regimes in dammed and regulated rivers limit available spawning habitat to fishes. River managers have attempted rehabilitation of spawning habitat with river restoration, spawning habitat rehabilitation and dam removal, but often neglect well-established conceptual or predictive models of hydrogeomorphic and ecological processes. Project failure is not unusual and success can be difficult to accurately assess due to inadequate monitoring and unclear objectives. The scientific community has suggested a plethora of improved approaches to river restoration but little attention has been given to spawning habitat rehabilitation or providing detailed design methodologies. In many regulated rivers, complete restoration of geomorphic, hydrologic and ecological processes necessary for maintaining spawning habitat may not be possible. However, it is hypothesized that quality and availability of spawning habitat may be realistically improved upon with spawning habitat rehabilitation if a science-based approach is used. SHIRA (acronym for Spawning Habitat Integrated Rehabilitation Approach) was developed as a science-based framework for reach-scale rehabilitation of salmonid spawning habitat in regulated rivers. SHIRA relies on a mix of conceptual and numerical models to provide predictive and explanatory insight into the design and planning process. It is argued that application of such models can not only improve the outcome of rehabilitation projects, but also serve to further test and evaluate underlying scientific theories against the rigors of real-world

uncertainties. Although optimal spawning habitat is generally found in riffles and runs, proximity of spawning habitat to pools, large woody debris, boulder clusters, flow separations and overhanging cover underscores the importance of habitat heterogeneity in spawning habitat designs.

Once the SHIRA framework is conceptually defined, partial results are reported from SHIRA's application to a case study below Camanche Dam on the lower Mokelumne River (LMR) in Central California. The primary management goal of the project was to improve habitat for a single life stage of fall run chinook salmon (*Oncorhynchus tshawytscha*). Despite this characteristically narrow focus, a holistic restoration approach was used to account for broader ecological interactions and hydrogeomorphic processes. In June of 2001, we began a pre project appraisal, development and testing of 12 design scenarios for the placement of an original design volume of 1150 m<sup>3</sup> of gravel. In September of 2001, only 650 m<sup>3</sup> of spawning gravels and ten 450 to 680 kg boulders were available for placement in a 152 m-long reach of the LMR. Results from SHIRA suggest that:

- a) There is no inherent conflict between high quality spawning habitat and erosion of that habitat during spawning flows for LMR chinook salmon.
- b) A scientific understanding of ecologic functions and geomorphic processes can be used to conceptually develop multiple design scenarios and develop testable design hypotheses;
- c) A suite of existing models can be used to test design hypotheses before choosing a final design.
- d) Even with a 43% deficit from the design volume of gravel, the major conceptual design features of the final design model compared reasonably with measured and modeled post project conditions.

The utility of SHIRA at implementing spawning habitat rehabilitation projects is emphasized as opposed to declaring success or failure of the case study presented.