Prioritizing Sacramento River and San Joaquin River salmonid habitat restoration with open data and structured decision making

Prioriser la restauration de l'habitat des salmonidés de la rivière Sacramento et de la rivière San Joaquin grâce à des données ouvertes et à une prise de décision structurée

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RÉSUMÉ

En Californie, les populations de saumons ont connu un déclin important au cours des dernières décennies (Moyle et al 2008). L'un des principaux facteurs de ce déclin est le manque d'habitats d'alevinage convenable pour le saumon juvénile, en particulier dans les plaines inondables (Opperman et al 2009). Malgré son importance pour l'espèce et pour l'économie agricole de la Californie, en raison des limites imposées dans les cours d'eau par les populations de saumons menacées, il n'existait pas de quantification complète et bien organisée de l'habitat d'alevinage des plaines inondables dans la vallée centrale. Dans le cadre de son programme de décision structurée (SDM) pour prioriser le budget de rétablissement des populations de saumons de la rivière Sacramento et de la rivière San Joaquin, le programme d'amélioration des projets de Central Valley a élaboré un modèle de cycle de vie du saumon et des estimations de l'habitat d'alevinage des plaines inondables pour tous les bassins hydrographiques de la vallée centrale de la Californie. Les données de la plaine d'inondation du DSM, ainsi que d'autres données sur l'habitat, le débit et la température, ont été mises en œuvre dans un cadre de données ouvertes conforme à la nouvelle loi californienne sur les eaux ouvertes et transparentes (California State Legislature 2017). Ces nouvelles données ouvertes ont amélioré la compréhension de l'habitat d'élevage du saumon de la vallée centrale et rendu plus transparente la prise de décision concernant la restauration de cet habitat.

ABSTRACT

Salmon populations in California have been in severe decline in recent decades (Moyle et al 2008). One of the main drivers of this decline is lack of suitable rearing habitat for juvenile salmon, especially floodplain rearing habitat (Opperman et al 2009). Despite its importance to the species, and to the agricultural economy of California because of the limits placed on water deliveries by threatened salmon populations, a comprehensive, well-organized quantification of existing suitable floodplain rearing habitat did not exist for the Central Valley. As part of its structured decision making (SDM) program to prioritize expenditures to restore Sacramento River and San Joaquin River salmon populations, the Central Valley Project Improvement Act (CVPIA) program has developed a salmon life cycle model (decision support model, DSM) and estimates of floodplain rearing habitat for all of the watersheds in the Central Valley of California. The floodplain habitat inputs to the DSM, as well as other habitat, flow, and temperature inputs, have been implemented in an open data framework consistent with California's new Open and Transparent Water Data Act (California State Legislature 2017). This new open data product has advanced the state of understanding of Central Valley salmon rearing habitat and made decision-making around restoration of this habitat more transparent.

KEYWORDS

Floodplains, salmon, restoration, open, data

1   SALMONID DECLINE IN CENTRAL VALLEY OF CALIFORNIA

The southernmost populations of salmon, steelhead, and trout, uniquely adapted to California's climate, have been in steep decline over the last decade (Moyle et al 2008), and remain so today. California's salmon populations are extremely important because of the commercial and recreational fisheries they have supported, and because of the limitations they have placed on water management in the state as populations have dwindled. A variety of factors have contributed to the widespread decline of California's salmonid populations, including human competition for use of high quality water, alteration of the landscapes that provide salmon habitat, overfishing, and introductions of alien species as predators or competitors.

One of the most important landscape changes affecting California's salmonid populations is the large-scale loss of floodplain ecosystems in the Central Valley, where approximately 3360 km of state and federal levees, along with local flood protection projects, have cut off approximately 95% of floodplains from river channels. Recent studies (Katz et al 2017) have demonstrated that floodplains allow juvenile salmon to grow faster and have higher survival rates in the ocean than juveniles without access to floodplains. As California's natural resource managers have begun a major overhaul of the Central Valley Flood Protection Plan (California DWR 2017), floodplain restoration has emerged as one of the most important and potentially effective approaches to multi-objective flood and ecosystem restoration.

2   THE CENTRAL VALLEY PROJECT IMPROVEMENT ACT (CVPIA) STRUCTURED DECISION MAKING (SDM) APPROACH

The CVPIA mandates changes in management of the Central Valley Project (the Federal water management system in California), particularly for the protection, restoration, and enhancement of fish and wildlife. The CVPIA Fisheries Program is using an SDM approach to develop a framework to allow decision-makers to identify program objectives and guide planning of broad scale fisheries activities. Using a rapid prototyping process, CVPIA stakeholders developed a coarse resolution Chinook Salmon (Oncorhynchus tshawytscha) model and parameterized it using a combination of expert judgment and empirical data. The coarse resolution decision support model (DSM) was built to evaluate the relative effectiveness of restoration and conservation activities across broad geographical areas. The intent is to use the DSM to identify activities and watersheds where management actions have the greatest likelihood of achieving salmon population objectives. The effectiveness of the SDM approach is strongly influenced by the transparency around and trust in the input parameters to the model, especially the parameters quantifying current areas of available habitat for different salmonid life stages.

3   FLOODPLAIN REARING HABITAT IN AN OPEN DATA FRAMEWORK

After two years of development and application, participants in the SDM approach identified a need to more accurately quantify existing floodplain rearing habitat for use as an input to the DSM. The Conservation Strategy developed by the California Department of Water Resources to support the CVFPP quantified historical and existing floodplain habitat area in all twenty six of the Central Valley Improvement Act (CVPIA) watersheds. Floodplain areas from this study provided initial floodplain rearing habitat inputs for the DSM. We expanded these inputs using best avaliable hydraulic models to generate relationships between flow and suitable floodplain rearing habitat area throughout the Central Valley, and further augmented the flow : area relationship inputs with weighting based on durations of inundation. We then organized the analytical methods and floodplain rearing habitat flow : area curves for all twenty six CVPIA watersheds in an Open Data compliant database and developed web applications (see Figure 1) to facilitate transparent communication of the new and improved input data. The availability of this new Open Data resource has already facilitated related discussions and evaluations of floodplain habitat restoration, including an ongoing voluntary settlement agreement process aimed at implementing increased flows from the Sacramento and San Joaquin Rivers into and through the Delta.
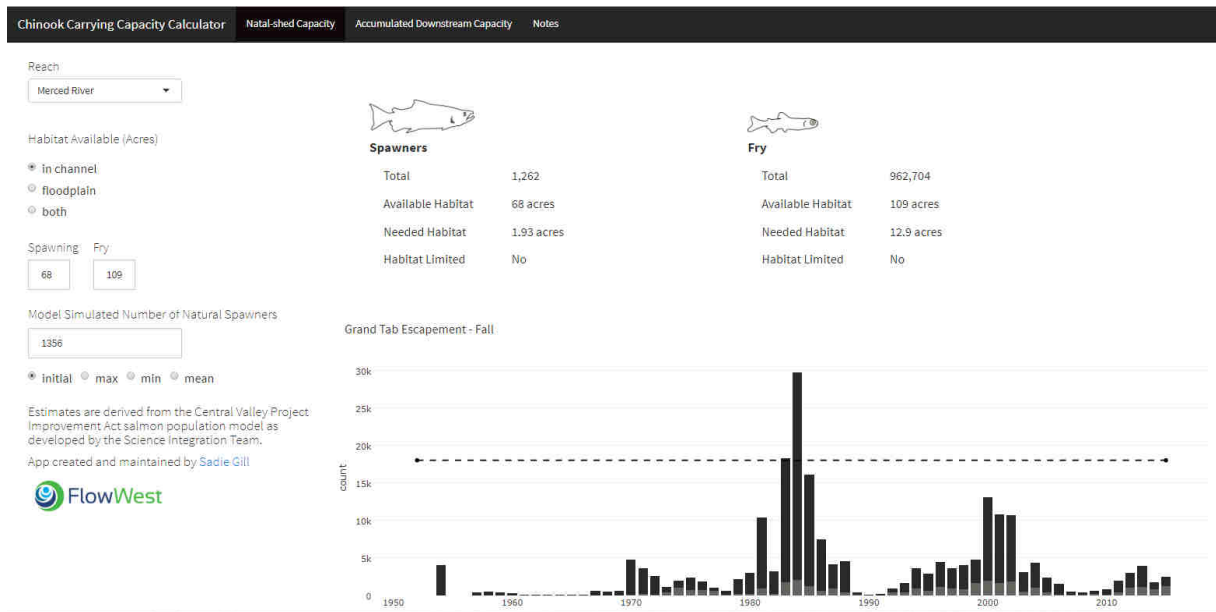
Figure 1: Example web application using Open Data compliant floodplain rearing habitat for Central Valley salmon

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