Using Aerial Photography to Monitor Salmonid Redds on the Lower American River

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Introduction

- Redd surveys provide critical management information regarding habitat use, population estimates, and interannual variation in run size.
- During redd construction, female Chinook salmon disturb and “clean” gravel, making their redd (nest) visually distinguishable as a light patch against the darker background of the river bed.
- Currently, the most commonly used methods for collecting redd distribution data are on the ground and aerial surveys.
- Managers at the Sacramento Water Forum and the US Bureau of Reclamation have used aerial photography to monitor spawning on the Lower American River since 1991.

Informing adaptive management

Aerial redd surveys provide a snapshot of how salmon are using spawning habitat. These data can support restoration prioritization, allowing managers to direct their actions and funding to maximize benefits to salmon population recovery efforts. At the Sacramento Water Forum, data from aerial surveys are used to evaluate habitat quality throughout the lower American River and to adaptively manage habitat restoration projects.

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Aerial redd survey methodology

High-resolution aerial photos of the river are captured that reveal redd locations over the course of the fall salmon run. Beginning in October, weekly visits to the river are made to monitor spawning progression and plan photography.

Photos are geo-referenced in ArcMap using a base map for the first flight. Subsequent flights are geo-referenced to the last date’s imagery for maximum in river spatial accuracy and consistency.

Redds are counted and recorded as point features in a shapefile and entered in a table. Redundant redds are eliminated by performing a spatial join to calculate the distance of a redd in the earlier flight to the nearest redd in the later flight and then deleting from the earlier flight redds which are less than 2.08 m apart, the average redd diameter as derived from on the ground surveys.

In areas of high spawning use, redds become superimposed and difficult to enumerate. A polygon is drawn around these areas and the number of redds is calculated by dividing the superimposed area by average redd size. Points are also added based on best visual estimation.

Attribute information including restoration status and date restored is added.

Repeatability

To investigate the accuracy and repeatability of aerial survey data, redd counts were performed independently by two technicians for two different years. Although counts are positively correlated, there is high variability between readers.

Mean percent difference: 105%
Standard deviation: 650%

Limitations

The decision to count a feature in the river as a redd is subjective and often challenging, especially for a technician who lacks in-depth knowledge of the river. A patch of scour may look like a group of superimposed redds. A fish guarding her redd might really be a stick floating down the river. Variability in counts is higher for areas of high spawning use because it is difficult to distinguish individual redds due to superimposition.

Aerial versus on-the-ground surveys

In deciding how to monitor, river managers must consider:

- time and cost efficiency of the method
- accuracy and detail of the data collected

Aerial surveys cover more area in less time and at a lower cost than on-the-ground surveys. Redds which would be difficult to access due to water depth and velocity may be visible in an aerial photograph, but redd architecture measurements cannot be made from aerial photos, and aerial photos are more prone to inaccuracy due to reader error.

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Future directions

- Digitize past years’ aerial survey data.
- Capture geo-referenced high-resolution photos using a drone, which may improve image quality and enable identification of individual fish.
- Incorporate high-precision topography data.
- Monitor using aerial and on-the-ground surveys in tandem and compare data.

Take-aways

- Aerial surveys provide data on abundance and distribution of salmon spawning that is used to evaluate restoration projects.
- The repeatability of redd counts appears to be low due to the subjective nature of identifying redds in aerial photographs, especially in high spawning use areas. Ground-truthing data in these areas would improve the accuracy of counts.
- Gains in time and cost efficiency come at the expense of detail and interannual variation in run size.

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To improve accuracy, technicians performing counts should be familiar with the river. Combining aerial surveys with on-the-ground surveys may improve accuracy, particularly in problematic areas.

Visibility is reduced during times of high turbidity, making surveying impossible either on the ground or by aerial photo.

Aerial photograph quality is poor during rain or high cloud cover, increasing the potential for reader error.

Upper Sailor Bar, restored 2006
Source: California Department of Fish and Wildlife

2014-11 30 aerial survey
Source: Cramer Fish Sciences

2014-11 30 ground survey
Source: USBR