

## **AQUATIC RESOURCE PROGRAM REPORT**

### **6. Recommendations for a long-term monitoring plan for aquatic species in the Cosumnes and Mokelumne river basins**

This section consists of recommendations for the timing and locations of sampling for regular monitoring, especially for the Cosumnes Basin which is still undergoing dramatic changes in its fauna. Methods recommended are described in detail in other sections of the report. The report is divided into two sections: 6A: invertebrates, 6B: fish.

## **6A. Long-Term monitoring recommendations for aquatic invertebrates in the Cosumnes and Mokelumne river basins**

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### **Introduction**

One of the primary goals of natural resource management is to identify the causes of changes in the biological resources of a focal ecosystem. Measuring ecosystem change and ascribing those changes to the impacts of particular human or naturally occurring disturbances or stressors requires adequate measures of the inherent variation in that ecosystem. Long-term monitoring data collected on the appropriate temporal and spatial scales are best assessment of the variation inherent in the system as well as the best means of determining if a given impact or stressor is responsible for sudden changes in ecosystem properties. The development of a “recommended” long-term monitoring plan is a process that involves many decisions about the use of resources and sampling effort.

One primary decision point is how to distribute sampling effort to with regard to spatial vs. temporal variation. Given a fixed amount of resources, adding spatial resolution such as additional study sites will necessarily mean sacrificing temporal resolution such as additional sampling dates.

### **Recommended Methods**

#### **Floodplains**

***Temporal sampling.*** Because of the dynamic nature of floodplains, they are among the most difficult habitats to sample effectively. Significant changes in the abundance of primary and secondary producers can happen on the scale of days, so sampling on at least a weekly basis is required to capture at least the major component of temporal change (Table 1).

At spillover events, biological features change very quickly and sampling on different parts of the flooding hydrograph are key to capturing this variation. Sampling to identify materials transported on the floodplain, for instance with the use of driftnets, require that the first floodwaters coming onto the floodplain be sampled, at least within the first 24 hours.

***Spatial sampling.*** Spatial variation can take place on nearly as small a scale as can be sampled. The most important considerations are coverage of major habitat types and coverage of different flow levels and inferred residence times within habitats. The most important feature distinguishing the major habitats are whether they remain inundated throughout the year. Permanent water bodies usually include the main river channel as well as side channels, adjacent sloughs used as conduits for irrigation water and low points on floodplain that retain water throughout the year although disconnected from the river. Seasonal habitats will include relatively open agricultural fields that have primarily non-woody forbs and grasses (within 15 years) known as agriplains, naturally occurring floodplains (exceedingly rare) and flooded forest areas, which have been open floodplain colonized by woody perennials.

One of the most difficult aspects of floodplain monitoring is the changing depth of the water and the rapid drying of many sites on the floodplain. Establishing permanent sampling sites on the floodplain means a tradeoff between sites of the same water depth and sites at the same geographic location (lat/long). Sites at the geographic location are likely to fluctuate substantially in both water depth and inundation time, whereas attempting to sample at the same depth across sampling dates may mean moving over significant distances and across different soil and vegetation types, all of which may influence invertebrate abundances. Because the relative flow at a given site (relative to other sites) and the vegetation remain somewhat constant, we recommend choosing sampling sites and measuring water depth as a covariate with other parameters. Our data have shown that sites separated by a

hundred meters or less can shown dramatically different flow velocities, so careful choice of sites to cover a range of flow speeds is important.

To look for long term changes in the invertebrates, a thorough sampling program should be undertaken at least once every 5 years (see 6B), but more frequently if funds permit.

**Table 1** Monitoring methods for the Cosumnes River floodplain.

Monitoring Category	Method of Sampling	Frequency of Sampling	Duration of Sampling
Allocthonous materials into floodplain	Drift nets	On rising limb of flood	Daily for duration of spillover
Phytoplankton abundance	Collection bottle	At least weekly	Entire flooding season
Periphyton	Artificial substrate	Weekly	Two weeks after flooding through season
Zooplankton abundance	Plankton net	At least weekly	Entire flooding season
Aquatic insects	Sweep net	At least weekly	Entire flooding season
Emergent insects	Emergence traps	Weekly	Two weeks after flooding through season
Physical parameters	YSI, various	Weekly	Entire flooding season

## Rivers and Upper Watersheds

**Temporal sampling.** River channel are also dynamic entities with heterogeneity in substrate, flow, light and other measures. Our sampling recommendations applying largely to post-flood season, since our activities are not possible during the higher flow periods.

Primary producers including periphyton grow very rapidly and change their distribution over periods of days. Sampling periphyton should occur at least a weekly basis. The relative absence of zooplankton in the water column compared with the lower river and floodplain is replaced by the

increased diversity of aquatic insects. Aquatic insect distributions change as insects develop and emerge, but on a less dramatic timescale, so biweekly is recommended.

***Spatial sampling.*** Spatial sampling must take into consideration the ephemeral nature of naturally flowing rivers. Some reaches and occasionally entire branches may become seasonally dry. Our recommendation is to begin sampling as soon as the water levels permit sampling and to continue into the early-mid fall when temperatures begin to drop off.

Spatial sampling on the scale of the entire watershed should take into consideration representation of different forks of the river such as the north, middle and south forks of the Cosumnes. Also, within the watershed, landuse patterns are important factors influencing stream biota. Sites should be stratified to get appropriate representative sampling in major land use types including residential/developed, evergreen and deciduous forests, range lands, grasslands, etc. Also, proximity and number of small dams and diversions upstream of the site are particularly important.

### **Recommended Sites**

Because of the power in long-term data, the first recommendation would be to continue monitoring at many of the sites initiated in this project. Figure 1 in section 2A indicates where the sampling sites for this project are located within the watershed. Sites are distributed along all three forks, although more spatial coverage would be desirable. Access to private lands is very restrictive in the upper watershed, but additional site availability may be possible.