Connectivity between terrestrial and marine systems along the Big Sur coast before and after the Basin Complex Fire

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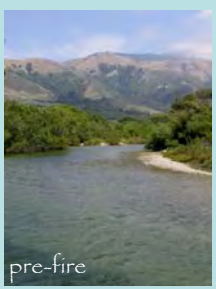
Introduction

Although nearshore marine ecosystems are a small fraction of the world's oceans, they support a disproportionately large fraction of the ocean's productivity and biodiversity. The productivity and biodiversity in the Eastern Pacific is supported by the influx of nutrients delivered via upwelling circulation, but the extent to which terrestrial subsidies contribute to this system is not well documented or understood.

Rivers are a point source vector for large concentrations of dissolved and particulate organic matter to the world's oceans. The influx of terrestrial material from rivers along the Big Sur coast can be quite substantial due to highly seasonal rainfall and steep, short watersheds. The goal of my dissertation research was to quantify the subsidies delivered to nearshore kelp bed communities from upwelling and river inputs and determine how they influence community composition and functioning.

The Basin Complex Fire burned over 180,000 acres during the summer of 2008 and seriously impacted numerous coastal watersheds along the Big Sur coast. This large, intense wildfire caused drastic ecosystem level changes that has significantly increased the downstream movement of sediments, nutrients, and particulates, which may fundamentally change the terrestrial, stream and nearshore communities and the connections that exist between them.



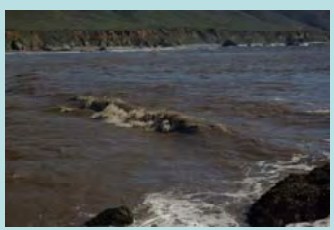
Pre-fire

My research was conducted in Big Sur from 2005 to 2008 and focused on the two predominant streams in Big Sur – the Big Sur River and Big Creek. Within each of these areas I monitored river inputs and kelp forest communities near to and 4-6 kilometers away from the river input to address the broad question:

How do nutrients and particulates from upwelling and river sources influence the nearshore kelp forest system in Big Sur?

This research was highly interdisciplinary and included the following components:

- Water sampling – bottle samples were collected year round to measure the amount of particulates and nutrients that were being delivered to the nearshore system via upwelling and river inputs.
- Community surveys – benthic algae, kelp, and invertebrate populations were surveyed to determine if there were differences in community composition at sites near-to and far-from river inputs.
- Stable isotope analyses – $\delta^{13}C$ and $\delta^{15}N$ values of kelp tissue, filter feeders, and detritivores were analyzed to determine the use of upwelling, terrestrial, and kelp forest subsidies by primary producers and consumers in the kelp forest community.



Big Sur River plume following heavy March rains

Post-fire beach wrack near Big Sur River mouth

Post-fire

Following the Basin Complex Fire, over 90% of the 74 km^2 Big Sur watershed was moderately to severely burned. In contrast, the entirety of the Big Creek watershed remained unburned. The ecosystem effects of large, intense wildfires can include loss of vegetation and seed banks, reduced permeability and water storage capacity of the soil, increased erosion, and increased nutrient run-off; these effects can last several years. Although rainfall was low this winter, it is clear that the run-off dynamics have been altered in the Big Sur watershed (photos at left).

We are in the unique position of having four years of pre-fire data that document the composition and quantity of terrestrial materials flowing through stream habitats into the nearshore ocean. In addition to collecting data that are consistent with pre-fire sampling, we are expanding our research to include terrestrial and stream communities to better our understanding of the effects of large-scale fire on downstream habitats and habitat connectivity. We will be working with multiple universities and agencies on the following questions:

1) How does post-fire run-off alter benthic and invertebrate stream communities?

2) How do storm events combine with post-fire run-off to alter the productivity of streams and the transport of that productivity to nearshore communities?

3) How do concentrations of dissolved and particulate organic matter and nutrients in streams change post fire?

4) Is there a shift in the source of nutrients used by stream and nearshore primary producers or in the particulate organic material used by nearshore consumers?

5) What are the social and economic impacts of the Basin Complex Fire on the community of Big Sur?