simulated streamflow output from PRMS for the Sprague River indicate increased flooding earlier in the spring and decreased summer baseflow as a consequence of increased and decreased proportions of rainfall and snowfall, respectively. Supplying approximately 25 percent of inflow to the Upper Klamath Lake, the Sprague River basin is vital to environmental and human water needs within the Klamath River basin. As water demands increase, the reliability and timing of flow from the Sprague River becomes increasingly critical in water-management decisions. Potential alterations in flows to the Upper Klamath Lake as a result of climate change could necessitate (1) modifications to the operation of the lake as a storage reservoir and (2) creation of additional storage capacity to meet water demand during the summer.

Bathymetric Mapping with Airborne LiDAR in the Klamath-Trinity Basin

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The Trinity River Restoration Program (TRRP) collected airborne bathymetric LiDAR over 40 miles of the Trinity River in April of 2009. The airborne survey was performed by U.S. Geological Survey (USGS) personnel based in Florida using the EAARL (Experimental Advanced Airborne Research LiDAR) system, whereas supporting ground surveys based on both wading and sonar measurements were performed by TRRP and a separate USGS group from Colorado. Immediately after completion of the Trinity mission, both the airborne and ground USGS groups collected similar data from a short reach of the Klamath River. The EAARL system utilizes a green laser to penetrate water, and records full waveform returns that can be used to identify the stream bed with a nominal vertical precision of about ± 20 cm. Waveform data from the Trinity mission were initially processed to xzy coordinates by USGS personnel and delivered to TRRP in September 2009. This initial attempt to process the raw waveform data was largely unsuccessful. Although errors in shallow areas were only slightly larger than expected (RMS ~ 26 cm compared with wading ground-truth measurement), errors in deep water were typically on the order of m. Closer inspection revealed that initial processing had identified false bottoms, commonly at a depth of about 1 m, such that the magnitude of errors in deep water were often approximately H-1 m, where H is the actual water depth. Fortunately, subsequent inspection of the raw waveforms suggests that the raw data do contain sufficient information to correctly identify the stream bed to depths of approximately 3 m. At the time of abstract submission, TRRP is attempting to reprocess the waveform data to extract correct bottom elevations in areas where depths are between about 1 and 3 m, and is acquiring additional sonar surveys to patch in areas with greater depths. Techniques employed by TRRP in this re-processing effort and results will be presented.

Ecohydrology

Klamath River Stream Temperature Modeling and Use of Thermal Refugia by Salmonids

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Late summer and early fall water temperature regimes are critical to the persistence of endangered and threatened salmon on the Klamath River. Water temperatures critically influence fish physiology in numerous ways and understanding water temperature dynamics is a prerequisite to assessing acute and chronic thermal impacts on salmonids. Currently, the temperature dynamics of the Klamath River mainstem are not well understood at the appropriate scales necessary for fisheries management decisions. The presence and duration of cold water refugia may be a key factor for salmonid survival, yet little is known about the spatiotemporal dynamics of these refugia – particularly in relative to the mainstem temperature dynamics. We are addressing these issues through a combination of high-resolution stream temperature and fish mortality models of the Klamath River mainstem, and fish tracking studies to evaluate the associated spatial response of salmonid fishes in and around selected thermal refugia. This model is driven by recently developed NASA satellite derived climate data and will provide hindcasts and forecasts (including various climate change scenarios) of the mainstem at sub-hourly intervals for every 1 km of stream reach. These data will be used as inputs to spatially explicit fish mortality models to evaluate the temperature impacts on salmonids at sub-adult life stages. Finally, we will measure fine-scale spatiotemporal use of the thermal refugia and mainstem by salmonids through radio tracking of individual fish.

Potential Impacts of Climate Change on Aquatic Fauna: Finding a New Paradigm for Wetland and Riparian Systems in the Upper Klamath Basin, OR

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Resiliencies of the Klamath Basin's physical and ecological systems to precipitation and temperatures have provided the framework of our understanding of biotic response to abiotic patterns and processes. Climate change is poised to greatly alter the timing and magnitude of abiotic processes. Understanding which species and which ecological systems will be most vulnerable to climate change and how they will be vulnerable will be critical for setting conservation and management priorities and for developing successful adaptation strategies. One approach is to model climate change projections that have been downscaled from Global Circulation Models for a given watershed, link relevant climate parameters (e.g., temperature and precipitation) to a hydrologic model, and develop future projections for the hydrologic parameters of interest (e.g., streamflow, groundwater recharge, water table elevation). This information was used to design and implement management strategies which took into account how climate change may affect aspects of the freshwater ecosystem and species' responses and the complex socio-political landscapes in which they were implemented. We found the complicated systems of agrarian economics, water use and related infrastructure a constraint in prioritizing freshwater conservation strategies within any particular river basin.

Application of Hydrological and Ecological Models to Access Effects of Changing Climate and Adaptation Strategies on Pastures and Water Resources in the Wood River Basin

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It is important to design climate change adaptation strategies after accounting for the effects on water resource availability of various ecosystems in the Klamath Basin. Flood irrigated pasture is the dominant agricultural land uses in the major tributary subbasins (e.g., the Wood River, Williamson River, and Sprague River Subbasins) of the Klamath River. Therefore, understanding potential effects of changing climate and adaptation strategies on productivity and water use efficiency is a key factor for decision makers to predict water resource availability in the Klamath Basin. Our study used the MIKE-SHE hydrologic and the DAISY ecological models to model pasture systems in the Wood River Basin. These models were calibrated with observed vegetation and hydrologic data obtained from fully- and

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