Proposed Agreement between California Energy Commission
and
The Regents of the University of California, Santa Barbara

Title: The Projected Effects of Climate Change Induced Changes in Vegetation on Future Hydrologic Energy Generation in California
Amount: $600,000.00
Term: 36 months
Contact: Sarah Pittiglio
Committee Meeting: 1/18/2011

Funding

FY	Program	Area	Initiative	Budget	This Project	Remaining Balance	
09	Electric	EA	Global Climate Change	$4,323,000	$300,000	$0	0%
10	Electric	EA	Aquatic Resources	$850,000	$300,000	$550,000	65%

Recommendation

Approve this agreement with The Regents of the University of California, Santa Barbara for $600,000. Staff recommends placing this item on the discussion agenda of the Commission Business Meeting.

Issue

Hydropower supplies about 15% of California's energy. Most of the water that drives these facilities flows from forests. However, we know relatively little about the extent to which feedbacks between fire and invasive species may alter natural fire regimes and long term trends in vegetative cover and hydrologic cycling in California. These issues will become more critical as urbanization and suburbanization continue, and climate change affects both water supplies and occurrence of wildfire. In addition, demand for hydroelectric generation is expected to increase in the future due to its lower carbon emissions. A greater understanding of these complex issues will provide important information for water managers and improve their ability to predict the effects of land cover and climate change on the availability of water for hydropower operations.

Background

Past PIER-funded work has shown that climate change is likely to cause more frequent and larger fires in many parts of California, by creating greater climate variability and more extreme fire weather conditions. Such work has also identified that adapting to future fire regimes is one of the key challenges that California faces. This will be made even more difficult by interactions between fire and invasive species. Invasive annual grasses lengthen the fire season in many parts of California, because they dry much earlier in the year than native woody species (April-May) and then they persist as highly ignitable fuels throughout the entire summer drought. Invasive grasses are thus considered one of the most serious threats to maintenance of natural fire regimes and restoration of fire-prone landscapes. Invasive shrub species (e.g., European broom infestations) can also alter natural fire cycles and may invade as a result of fire hazard reduction activities; these tend to be more of a concern in northern parts of the state. Although fire and invasive plant species are a recognized problem, relatively little is known about the hydrological impacts of vegetation type conversion (e.g., on streamflow quality and quantity). Fine-scale field studies are one avenue for filling this knowledge gap at localized sites. However, watershed-scale modeling is one of the few ways to link fire, vegetation, and ecohydrology across larger areas.

Proposed Work

The researchers will examine on-going vegetation changes in areas of high fire activity and subsequent changes to hydrologic cycles (e.g., timing and amounts of stream flow, nutrients in run-off) caused by fire in specific watersheds of southern California, where invasive species have come to dominate over portions of the watersheds. Site selection will build on existing research in recently burned watersheds in Santa Barbara County or disturbed and burned plots in the Santa Clara River watershed in Ventura County (SCE hydropower site). In northern California, a parallel set of sites with non-native infestations will also be examined. Preliminary investigation indicates that several basins in the American River drainage network are excellent candidates for this type of analysis (PG&E and SMUD hydropower sites), although other watersheds will be evaluated (e.g., Feather, Mokelumne, and Kings). The American River watershed includes 19 hydropower facilities with a total online capacity of 1,221 MW. The addition of the Feather, Mokelumne and Kings watersheds would represent an additional 36 hydropower facilities with a total online capacity of 3,724 MW.

Relatively fine-scale study areas will be compared, stratified according to those that are dominated by native species and those that have largely been "type converted" into non-native invasive species. Local scale measurements of water infiltration, vegetation evapotranspiration, and soil surface conditions will be used to parameterize watershed scale models to predict changes in water yield and nitrate run-off relative to vegetation condition. The researchers will also examine the broad-scale extent of landscapes that have been transformed to invasives, to identify factors that contribute to ongoing ecosystem degradation. The results will be provided to water managers in a format that will improve their ability to predict runoff under future climate and land cover change scenarios.

Justification and Goals

This project "[will] advance energy science or technologies of value to California citizens..." (Public Resources Code 25620.(c)), and is part of a "full range of research, development, and demonstration activities that . . . are not adequately provided for by competitive and regulated markets (Public Resources Code 25620.1.(a)); and supports California's goal to study the impacts of climate change on its forests, CO2 emissions caused by forest land conversion, and climate mitigation opportunities per the Integrated Energy Policy Report 2005.

This will be accomplished by:

- Mapping broader extents of invaded landscapes through analysis of remote sensing imagery and use GIS to examine the relationship of vegetative cover to fire history and other variables.
- Quantifying vegetation composition and effects of wildfire on stream flows and chemistry, primarily through field measurements.
- Scaling effects up from field sites to watershed scales, by parameterizing a state-of-the-art integrated hydrological model (Regional Hydro-Ecologic Simulation System).
- Synthesizing results for use in guiding long-term management of water supplies for hydroelectricity.