SC CASC SCIENCE NEEDS 2012

Priority Science needs

In Fiscal Year 2012, the SCCSC is interested in inviting Statements of Interest (SOI) that address the following priority science needs:

1. Synthesis of the state of the science regarding six topics important to the LCC efforts to manage sustainable landscapes: regional downscaling of global climate models; ecohydrology; sea-level rise; modeling of urban growth; unique climate-vulnerable and climate-sensitive ecosystems; and the communication of scientific uncertainty to decision makers.

The goal for each of the individual topics listed below is to generate a synthesis of the current state of the science for the topic in relation to the information needs of the LCCs in the South Central US (SC). In general, these information needs are associated with the LCC objective of developing conservation adaptation strategies that support regional scale sustainable landscapes. The emphasis in these syntheses is the development of "actionable scientific information"' that can support LCC management activities and future investment of CSC and/or LCC dollars. Investigators will be expected to collaborate with the LCCs in the identification of priority information needs. The syntheses of the state of the science of scientific approaches should broadly reflect awareness of these needs and result in a deliverable that is suitable for distribution to a broad range of stakeholders within the conservation community (scientists, managers, and administrators).

a. Regional downscaling of global climate models: The need for projections of future climate change at the scale of management and decision-making has resulted in the advancement of numerous downscaling methodologies and datasets. This proliferation of model results, broadly categorized within statistical and dynamical downscaling frameworks, can provide important insights in regards to future regional impacts of climate change. However, the large number of methods involved, different downscaling approaches, resolutions, time periods, and focal variables limits the ability to quickly form robust conclusions that reflect the breadth of modeling

efforts. The goal of this task is to synthesize the state of the science for different downscaling methodologies and to compare the results of downscaling efforts whose modeling extent covers the SC CSC region. The comparison should address the advantages and disadvantages of downscaling approaches in terms of the characterization of model-related uncertainties, the appropriateness of downscaled data for use in hydrologic and other models, and the ability of the models to simulate (or enable the derivation of) important derived variables such as potential evapotranspiration, relative humidity, wind speed and direction, and snow fall. The synthesis should provide an assessment of model accuracy but also should consider approaches that allow for pooling of model results to provide LCCs with a combined ensemble of downscaled climate projections. (Project limit: $50,000, with completion in one year)

b. Ecohydrology: The body of scientific knowledge concerning ecological-hydrology relations has expanded greatly over the last decade, and many studies have identified hydro logic alteration as one of the most serious threats to the ecological sustainability of the world's streams and rivers and their associated biotic communities. A large number of hydrologic models have been developed - each with a very specific extent, temporal and spatial resolution, accuracy and precision, and appropriate application. The goal of this effort is to synthesize the state of the science regarding the use of the various existing rainfall-runoff and statistical hydro logic models to support investigations of the effects of climate and land cover change on stream ecology and hydrology. Because LCC management questions encompass multiple scales, ranging from stream reach {what is the effect of land use change on hydrology and the fish assemblage in a particular tributary') to region (what is the relation between water use, stream characteristics and the sustainability of the human and natural landscape at the scale of a USEPA Level Ill ecoregion?) the synthesis should consider the advantages and disadvantages of each modeling approach at multiple scales and the potential for integration with models of lentic (lake or reservoir), coastal wetland, and marine aquatic systems. The synthesis should also provide information about the capabilities of each model to portray uncertainty in model

parameters and model predictions. Consideration should be given to coordination of this synthesis with a regional model comparison project currently being conducted by the Office of Surface Water at USGS {Project limit: $50,000, with completion in one year)

c. Sea-level rise: Coastal areas are highly complex systems, vulnerable to abrupt change, and stressed by human development activities. Future sea-level rise, coupled with changes in storm intensity and freshwater runoff, may result in dramatic changes in coastal systems, effecting natural and built habitats. The goal of this task is to synthesize the state of the science in two areas, including: {a) approaches for predicting sea-level rise, and {b) tools and other methods to assist coastal communities and natural resource managers in anticipating, understanding, and applying information on the effects of sea-level rise and associated climate related hydrologic effects (and their uncertainty) on natural and human communities. An important outcome of this work will be a base of knowledge that managers and scientists in the area served by the SCCSC can use to plan future management and scientific activities. {Project limit: $50,000, with completion in one year)

d. Modeling urban growth: Rapid urbanization in the SC complicates the ability of managers and decision-makers to plan for and adapt to a changing climate. Urban growth models can aid the decision process by identifying areas that are likely to continue to experience urban growth. They also can aid managers through the development of scenarios that show the consequences of future land use planning strategies. However, the existing suite of urban models spans a wide range of scales, data requirements, assumptions, and approaches. The goal of this task is to synthesize the state of the science of urban growth models and to compare results from projects previously undertaken across the region. Parcel-based approaches versus dynamic modeling and empirical approaches should be evaluated with respect to their ability to capture future local, sub-regional, and regional urban growth {and decay) scenarios that conflict with strategies to adapt to climate change. Model capabilities to represent uncertainty in model predictions should be assessed. (Project limit: $50,000, with completion in one year)

e. Identify unique climate-vulnerable and climate-sensitive ecosystems, their key stressors, and adaptation/mitigation options: The regional landscape encompassed by the SCCSC contains diverse and biologically rich ecosystems with numerous endemic species of flora and fauna. The goal of this task is to synthesize the state of the science regarding what is known about several unique and important ecosystems in this region that are especially sensitive to climate-related impacts include vernal pools; forests; karst-related systems; swamps; sinks; deserts, high elevation deserts, prairies, plains and others. The emphasis should be on systems-level understanding of these ecosystems, rather than a focus on a particular species or assemblage. The synthesis should catalog the general locations of these systems across the area of the 5 LCCs, describe what is known about the factors that control their distribution, including geologic and climatic settings and hydrology, describe the likely effect of climate and land use change on the condition of these systems, and the current suite of conservation strategies used to protect these systems or otherwise mitigate the effects of processes that degrade these systems. (Project limit: $50,000, with completion in one year)
f. Communicating and using uncertain scientific information: Uncertainty is a fundamental characteristic of the science used to describe and understand the world we live in. This is particularly the case for climate change science, where predictions regarding climate factors and the associated ecological responses range from the whole planet to local habitats. Moreover, climate change predictions carry differing degrees of uncertainty; for example, we have a high degree of certainty that carbon dioxide concentrations in the atmosphere will continue to rise, but a lower degree of certainty in predicting how plant community dynamics will change with this increased CO2• For many policy makers and resource managers, a misunderstanding about the meaning of scientific uncertainty may inhibit or even distort decision-making critical for mitigating or adapting to climate-associated risks. The goal of this task is to bring climate scientists together with social scientists (particularly specialists in the areas of risk communication and public policy) to (a) synthesize the state of the science about uncertainty in predicted climate factors and

ecological responses, particularly with emphasis on conservation adaptive strategies in the south central US; and (b) develop and implement a strategy to improve decision-makers' understanding of the uncertainty in climate prediction (particularly as it pertains to risks, vulnerabilities, and proposed mitigation/adaptation activities in the SC) as well as climate scientists' capabilities to effectively communicate about climate risk and uncertainty. (Project limit: $50,000, with completion in one year)

2. Terrestrial connectivity analysis across the entire SC region: The goal of this task is to improve the capacity to predict patterns of terrestrial habitat connectivity necessary to sustain natural resources. Models and other approaches developed as part of this task should cover the entire SC region and be capable of producing measurable predictions of the impacts of changes in connectivity based on future landscape conditions and potential conservation actions. Models should be capable of identifying where to conserve and restore habitat connectivity for priority or idealized species of interest across the six LCCs and natural landscapes across the SC to ensure the long-term viability of the region's wildlife populations.

3. Conceptual model for regional-scale sustainable landscapes: A sustainable regional landscape can be thought of as an ensemble of stable and productive human and natural ecosystems that maintain important physical, chemical, and biological processes characteristic of that landscape. This broad concept of "sustainable landscapes" is focused on sustainable levels of fish, wildlife and other resources desired by the public, and represents a reasonable general endpoint for adaptive management of these ecosystems in the face of global changes in climate and land use. The concept of a sustainable regional landscape is, however, not well understood and agreed upon by the scientific and management communities. Common agreement is also lacking about the identity and measurement of the attributes of a sustainable regional landscape, as well as the identity and role of factors that influence the condition of regional landscapes.
   There are three goals related to this task:
   (a) Frame a conceptual model that links the concept of a sustainable landscape, at the scale of individual level Ill ecoregionsl in the SC

United States that coincide with the boundary of the 6 SC LCCs, to the drivers and stressors that affect the sustainability of that landscape. This effort should involve a synthesis of the state of the current scientific and management thinking about the concepts that are part of this framework and how these concepts can be operationalized and measured.

(b) The conceptual model from (a) will be used, in consultation with the LCCs, to identify potential adaptive management strategies that may not now be commonly used in the SC; these adaptive strategies will be incorporated into the overall conceptual model as factors that can shape a sustainable landscape.

(c) Because this conceptual model represents a hypothesis about the functioning of key natural and human ecosystems in these ecological regions, the conceptual model derived from (a) and (bl will serve as the basis for identifying important knowledge gaps and research priorities. This proposal should be staged as necessary.

4. Flow-ecology relationships and surface and groundwater interactions in the face of climate change: Understanding the intricate connections between flow-ecology relationships and the interactions between surface and groundwaters is critical for the South Central US. How these will be impacted by climate further complicates the decisions that land and resource managers must make. Together these impact the availability and quality of habitat for aquatic biota. Development of flow-ecology relationships to inform flow management strategies and state flow policies is key.

5. Coastal impacts of climate change: Conduct a quantitative assessment of changing conditions of the SC coastal area including temperature, sea level rise, precipitation and the impacts of these changes on species and habitats including vegetative communities.

6. Regional Continuity: Because LCCs cross state, regional, and CSC boundaries and each CSC is at a different starling place depending on when

it stood up, there is some benefit to giving consideration to projects that were begun in other CSCs but could benefit the SCCSC by transferring strategies, data, or expertise. If a USGS office or consortium member identifies such an effort it would be considered as an eligible submission so long as all of the other guidelines are followed for submission.