PROJECT SUMMARY

Overview:

This macrosystem project focuses on roles of hierarchical scales, system drivers, cross-scale interactions, and changing climates in controlling system metabolism, food webs, and biodiversity traits in rivers of temperate steppe biomes. The 3 primary hypotheses are: (i) hierarchical scaling relationships and effects of system drivers and cross-scale interactions should be the same in riverine macrosystems of temperate steppes on both continents as long as sampling is focused on similar ecoregions, includes similar hydrogeomorphic zones, and is undertaken in the same season under minimal anthropogenic impacts; (ii) macrosystem processes, drivers, and interactions, and both ecosystem function and biodiversity characteristics are more similar among ecoregions of the same type in different continents than they are among ecoregions of different types in the same continent; and (iii) differences in effects of climate change on functioning of temperate steppe rivers are more extreme among continents than are effects of zoogeographic differences. The study encompasses investigations at four hierarchical scales: (a) 2 continents with temperate steppe biomes (North American Great Plains and Euro-Asian Steppes of Mongolia); (b) 3 temperate steppe ecoregions/continent (mountain steppe shrublands, short-to-tall grasslands, and semi-arid shrublands); (c) 3 rivers/ecoregion; and (d) 2 structural types of hydrogeomorphic zones/river at the valley-to-microshed scale (3 single channels + 3 sites with main and side channels/river). A total of 162 sites will be sampled in 3 years. All scientists have worked in temperate steppes, with most having studied both U.S. and Mongolian rivers.

Intellectual Merit :

This project contributes to fundamental and applied macrosystem ecology in 4 areas: (1) field tests of macrosystem principles; (2) evaluating intercontinental, climate change effects; (3) testing general river theory on factors controlling large scale ecological variation in space; and (4) assessing impacts on river macrosystems from altered terrestrial landscapes and river channels. By examining scaling effects at 4 hierarchical spatial levels, this project directly tests scaling relationships and effects of drivers and cross-scale interactions for different river structures, ecoregions, and continents. This project both contrasts and complements an alternative NSF project (Macrosystems SCALER) examining the utility of cm- and reach-scale measurements and consumer manipulation experiments. That ongoing (2011-2015) study seeks to comprehend ecosystem characteristics of stream networks in 5 North American biomes. Climate impacts will be evaluated in the proposed study by comparing rivers in similar ecoregions but different continents, one of which (Central Asian subcontinental area of Mongolia) has one of the strongest warming signals on earth with air temperatures rising 3x faster than the overall northern hemisphere average.

Broader Impacts :

This project will provide research experiences for under-represented participants, particularly rural and Native American students, stimulate STEM program recruitment in largely under-represented states in science (EPSCoR states: KS, NE, NV, SD), and support faculty and students at primarily undergraduate institutions (PUI). In addition to training 2 postdocs and 5 grad students, the project strongly focuses on training the next generation of environmental scientists (17+ students) from colleges and high schools, with emphasis on Native American undergraduates (6) from Oglala Lakota College and high school students (5) from the Pyramid Lake Paiute Tribe. The research-focused universities have used existing partnerships to further interactions with the STEM Program Director (now a Collaborator) at Oglala Lakota College. Also, 2 students and a Co-PI from a Nebraska PUI will conduct research and interact with other project students and researchers to gain insights to future careers. This project features close research cooperation with a Mongolian Co-PI, Collaborators, and students (some with previous NSF training). One Collaborator trains high school teachers at a Mongolian university of education and will transfer her experiences to future high school teachers. Finally, public outreach will be promoted via development of an exhibit at the Nevada Discovery Museum (attracting 155,000 visitors/yr), a project website (with real-time expedition reports), and focused symposia at science conferences, journal articles, and a workshop in Mongolia (standard means there to report research and influence governments).

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