Evaluating the ecological and economic value of the 100th Meridian Initiative
Project Update

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In our proposal to "Evaluating the ecological and economic value of the 100th Meridian Initiative" we had three central questions that outlined the goals our this project: 1) In what parts of the Columbia and Colorado, river and reservoir systems are zebra mussels likely to thrive if they are introduced from infested eastern waters? 2) For those parts of the target river systems that meet the ecological requirements of zebra mussel, what a) environmental goods and services, and b) financial and commercial goods and services are at risk? 3) What are the costs and how effective are different prevention strategies? For the 100th Meridian Initiative, what is the most cost-effective level of investment in prevention and control?

The introduction of zebra mussels into western waters requires an understanding of the probabilities of introduction and the habitat requirements of zebra mussels. Our modeling of the spread of zebra mussels to western rivers is based on gravity models, which are frequently used by geographers. Our gravity models estimate recreational boater movement patterns based on the distance to and attractiveness of different bodies of water. The mechanistic basis underlying gravity models was explored using a social survey to look at boater behavior for 6000 boaters. These surveys confirmed the basis underlying gravity models, and illustrated their usefulness (Leung, Bossenbroek, and Lodge, Biological Invasions, submitted). Based on our understanding of the mechanisms of spread, we have constructed a gravity model to explore the movement patterns of recreational boaters on a national scale. This model has been constructed and we are currently identifying and assessing different data sets by which to parameterize this model in order to predict the probability of zebra mussel spread from eastern waters. On a more local level we have also been exploring the ability of zebra mussels to spread through stream systems, such that we can predict the likelihood that lakes are likely to become infested if they are downstream of an infested lakes (Bobeldyk, Bossenbroek, Evans-White, Lodge, Lamberti, Ecoscience submitted).

The ability of zebra mussels to become established in western rivers once transported there has also been explored at two different scales. On a national scale, we have predicted the suitable habitat for zebra mussels based on eleven environmental and geologic variables using a genetic algorithm for rule-set prediction (GARP; Drake and Bossenbroek, Bioscience, in press). GARP analysis, often called ecological niche modeling, estimates the potential suitable habitat of a species based on the available environmental variables and the current distribution of a species. Our results suggest that much of the western United States may not be as susceptible to zebra mussel invasion as previously thought. Our results, however, do predict that the river basins that we are studying in this proposal are still at significant risk. On a more localized scale, we have been collecting water quality parameters from state and federal sources for the western rivers in order to predict the potential densities of zebra mussels if they were to become introduced into these systems.

If zebra mussels become established in the Columbia and Colorado Rivers they could cause significant impacts upon the ecology and economy of these regions. Our current focus on the impacts of zebra mussels has been focused on the economic impacts. The industries that would be most affected in these two regions would be hydropower, agriculture (due to the reliance on irrigation) and water supply. The potential impact of zebra mussels on the salmon fishery is an additional industry that we are considering along the Columbia River. This summer two trips were taken to meet with individuals and organizations that were identified as stakeholders along the Colorado and

Columbia Rivers. These trips laid the groundwork for identifying the scope and specific impacts that zebra mussels could have on these river systems. Compared to the Midwest, the west is more dependent of surface water supplies of water for power, drinking water and irrigation. This dependence highlights the importance of understanding the probability and impacts of a zebra mussel invasion.

To assess the economic impacts on the Colorado and Columbia River basins, we are assessing the potential costs at two scales: local and regional. At the local scale, we are building a Real Options model to account for various types of uncertainty, including the variability in the zebra mussels population. We focus on a single reservoir and will account for regional conditions through the probability of arrival of zebra mussels, an input from the gravity model described above. We analyze trade-offs for 4 possibilities: prevention, detection, control, and adaptation. We are about to collect micro level data to get a handle on the costs of these activities. At the regional scale, we are in the process of estimating the impacts of a zebra mussels invasion on different economic sectors using computable general equilibrium modeling so that we may capture both primary and secondary (indirect) effects. The data for the Columbia River basin (Washington, Oregon, and Idaho) has been purchased from IMPLAN, and the model is under construction. We are working with an existing model of the Colorado River basin to update it and extend it for our purpose. The method is based on developing ranges in the expected increases in costs due to full infestation of zebra mussels in the river basins for agriculture, electricity generation, water-intensive industries, and municipalities. This “increased cost” approach is the most pragmatic and straightforward way to get at a rough estimate of economic impacts, and combined with the regional computable general equilibrium model allow an estimate of both direct and indirect impacts of an infestation. For the range of expected cost increases we will evaluate both sector specific and regional welfare measures. To develop the range of cost estimates, we are finishing the design of an email and phone survey to gather regional cost estimates from various experts to mesh with the IMPLAN data in the general equilibrium model. Micro-level data used in the local scale model will be aggregated to get a rough check on our regional analyses.