**Impacts of the Gulf of Mexico Oil Spill on Ecosystem Services of the Mississippi Delta**

We propose to estimate the impacts of the Gulf of Mexico oil spill on ecosystem services of the Mississippi delta. This proposal grows out of a recently released report on the identification and valuation of ecosystem services provided by ecosystems in the Mississippi River Delta entitled “Gaining Ground – Wetlands, Hurricanes, and the economy: The Value of Restoring the Mississippi River Delta.” This analysis and report is the most comprehensive valuation of the “natural capital” of the Mississippi River Delta to date. The provision of 11 ecosystem goods and services in the Mississippi River Delta provide at least $15-58 billion in benefits to people in the Delta and across the United States every year with a natural asset value of $300 billion to $1.4 trillion. In comparison, the total estimated value of Northern Gulf of Mexico deepwater oil reserves is the order of $150-250 billion. The ecosystem services provided by the Mississippi Delta benefit much of the population of the US with seafood, navigation and shipping benefits, oil and gas and other goods and services.

Ecosystem services considered in the report include hurricane protection, flood protection (i.e., Shaffer, et al. 2009), drinking water, water quality enhancement, food, aesthetic, recreational, cultural, tourism, carbon sequestration, and endangered species habitat values. The report is available at the following website: (<http://www.eartheconomics.org/FileLibrary/file/Reports/Louisiana/Earth_Economics_Report_on_the_Mississippi_River_Delta_compressed.pdf>). The report considered the value of ecosystem services in the aggregate and did not estimate these services spatially or temporally. And the report did not consider the impact of the Gulf of Mexico oil spill.

The objectives of this proposal are to:

1. Compile information on the environmental impacts of the oil spill and from this information calculate the impact of the oil spill on ecosystem services of the Mississippi delta.
2. Compile spatially explicit information on the delta to input into the next phase of analysis of ecosystem services of the delta.

Approach

To achieve the objectives, we propose the following:

* **Mapping** of the impacts of the oil spill and restoration scenarios to inform decision makers and ensure wise investments. These data will provide input to modeling for examining the physical and economic aspects of changes on the Mississippi Delta under different investment, energy, climate and restoration scenarios.
* **Analysis** of the economic returns provided by restoration investments to the local, regional and the national economy.

The team that produced the first report on ecosystem services is planning to apply the Multi-scale Integrated Models of Ecosystem Services (MIMES) developed by Dr. Roel Boumans. The information developed in the proposal to NGI will provide detailed input to the modeling effort. The MIMES framework addresses the magnitude, dynamics, and spatial patterns of ecosystem services while also explicitly addressing the linked dynamics of natural, human, built, and social capital. This allows integration of site-specific information with regional and global surveys, Geospatial Information System (GIS) and remote-sensing data into a simulation model that is process based, spatially explicit, dynamic, and nonlinear. MIMES is capable of modeling carbon, water, nitrogen, phosphorus, plants, consumers, and a range of ecosystem services under various climate, economic, and policy scenarios. The model can exhibit catastrophic, irreversible changes of system structure, helping to explore model system sustainability across a range of scales.

Our NGI proposal will also develop improved analysis of and additional ecosystem service analysis. The data collection will provide data to input into model development for hurricane buffering and the development of restoration scenarios including major diversions. We will also include the importance of energy scarcity and rising fossil fuel prices.

Preliminary runs of the MIMES model will be run based on the data developed in the NGI proposed project. MIMES builds on several previous models from a range of disciplines and perspectives, and demonstrates that this experience can be synthesized into a workable integrated model. We propose to improve and apply the MIMES systems model and the ARIES ecosystem service mapping, model developed by our group with EPA and National Science Foundation funding. These model’s ancestry includes the Coastal Ecological Landscape Simulation (CELS) model first used for the Mississippi delta (Costanza et al. 1990), the Polygon-Based Systems model (PBS (Boumans and Sklar 1990), the Patuxent Landscape Model (PLM, Costanza et al 2002), and the Global Unified Metamodel of the BiOsphere (GUMBO, Boumans et al. 2002). MIMES includes spatial and temporal aspects of ecosystem services and the NGI proposal will provide spatially and temporally explicit data for model input.

The NGI proposed project will provide:

1. Analysis of the impacts of the oil spill and comprehensive restoration of the Mississippi River Delta on the ecosystem services provided by the delta.

2. Additions to the Batker, et al. 2010 Mississippi Delta report, emphasizing identification of valuable ecosystem services enhanced by restoration.

3. Maps showing spatial variations in ecosystem services and the beneficiaries of ecosystem services (economic sectors and communities who benefit from ecosystem services); and impediments to ecosystem service provisioning.

4. A spatially explicit analysis of the impact of the oil spill and the spatial impact of the spill on ecosystem service function, such as reduced hurricane protection due to degradation of wetlands due to oil impacts.

5. Calculation of the energy return on investment for oil drilling in the Gulf of Mexico and the economics of allocating resources, such as cheap oil to recover difficult, expensive oil as opposed to investing resources more productively.

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| GoM Research Initiative (BP) Project Spending Plan | | |  |  |  |  |
| Project Title: | **Impacts of the Gulf of Mexico Oil Spill on Ecosystem Services of the Mississippi Delta** | | | | |  |
| Project Lead: John Day | |  |  |  |  |  |
|  |  |  |  | Jan. 1-Dec. 31, 2011 | **Year 2** | **Total** |
| **I.** | **Salaries** |  |  | **$60,955** | **$0** | **$60,955** |
| 1a | Senior Personnel (John Day, Professor Emeritus) | | | 21% | 0% |  |
|  | $0 |  |  | $15,955 | $0 | $15,955 |
| 1b | Senior Personnel (Matt Moersbaecher, RA3) | |  | 100% | 0% |  |
|  | $0 |  |  | $45,000 | $0 | $45,000 |
| **II.** | **Fringe Benefits** |  |  | **$24,225** | **$0** | **$24,225** |
| 2a | 1a-1b Senior Personnel | @ | 34.00% | $20,725 | $0 | $20,725 |
| 2b | 1c Students | @ | 0.00% | $3,500 |  | $3,500 |
| 2c | Tuition, Fees, and Insurance | $0 |  | $0 |  | $0 |
| **III.** | **Travel** |  |  | **$3,500** | **$0** | **$3,500** |
| **IV.** | **Commodities/Supplies** |  |  | **$1,000** | **$0** | **$1,000** |
| **V.** | **Equipment** |  |  | **$0** | **$0** | **$0** |
| **VI.** | **Contractuals (analytical analysis)** | |  |  | **$0** |  |
| **VII.** | **Subcontracts** | 0 |  | **$0** | **$0** | **$0** |
|  | **Total Direct Costs** |  |  | **$89,680** | **$0** | **$89,680** |
|  | **Modified Total Direct Costs** |  |  | **$89,680** | **$0** | **$89,680** |
|  | **Indirect Costs** |  | **48%** | **$43,046** | **$0** | **$43,046** |
|  | **Total Costs** |  |  | **$132,726** | **$0** | **$132,726** |

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Boumans, R., R. Costanza, J. Farley, M. A. Wilson, J. Rotmans, F. Villa, R. Portela, and M. Grasso. 2002. Modeling the dynamics of the integrated earth system and the value of global ecosystem services using the GUMBO model. Ecological Economics. 41: 3(529 – 560).

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Costanza, R., A. Voinov, R. Boumans, T. Maxwell, F. Villa, L. Wainger, and H. Voinov. 2002. Integrated ecological economic modeling of the Patuxent River watershed, Maryland. *Ecological Monographs* 72:203-231.

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