Participatory Modeling for Adaptive Management: Reports from the Field II

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Abstract:

As the natural world has become dominated by human influences public involvement in natural resource management decisions has become vital. In addition, scientists are now viewing nature as a dynamic rather than "in balance". To accommodate these paradigms, natural resource managers have been encouraged to look holistically at the problems they manage through the lens of adaptive management. Current adaptive management theory incorporates variability, uncertainty, the relationship of impacts with respect to potential temporal and spatial disconnects, and social concerns. Add the obvious need for modeling and the stage is set for participatory system dynamics modeling.

Participatory SD modeling is a process that can integrate science and local knowledge with policy, and open the lines of communication between potentially different world views. We will use case studies to highlight three characteristics of participatory environmental modeling to illustrate the flexibility of process and the effectiveness of a broad range of interventions. The three characteristics are: 1) Interventions may take place anywhere on the "problem identification to solution producing" continuum. 2) Stakeholder involvement in the actual building of the model varies; the "hands on" continuum. 3) The type of data required varies on the "qualitative to quantitative" continuum.

Key words: participatory modeling, adaptive management, collaboration, system dynamics, watershed, estuary, wildlife management.

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Adaptive management focuses on the understanding that knowledge is provisional and that we should learn by doing and by monitoring the results of scientifically designed management plans and then adjust accordingly (Grumbine 1994). The paradigm builds on key premises which include: 1) significant connections need to be determined; 2) structural features are more important to measure than numbers; 3) changes in one variable can have unexpected impacts; 4) monitoring of one variable can seem to indicate no change when drastic change is imminent (Nagle and Ruhl 2002:337, Holling 1978). The understanding of resilience is also required. This perspective takes into account uncertainty, surprise and more importantly understands that variability is an important quality of ecosystems (Folke 2006). In addition, social and economic goals must be considered along with environmental goals; thus requiring the inclusion of non-scientific data and potentially polar world views. The process of including such diverse parameters lends itself ideally to system dynamics.

Participatory environmental modeling has been used as an adaptive management tool by natural resource managers, and those dependent upon natural resources, to help them better understand the complexities of ecosystem management. Those with a stake in such management must be able to assess the ecosystem of concern with respect to its boundary, time frames, endogenous and exogenous impacts, and the feedbacks and lags inherent in natural systems. Additionally, they must juggle a myriad of different personal, social and economic values in a system that is continually changing.

The concept of using dynamic simulation modeling for environmental issues is not new. In the 1978 work *Adaptive Environmental Assessment and Management,* Hollings et al. encouraged its use with the caveats that we are always careful of process. "Abstraction and simplification are necessary, and in this process it is quite important, but often inconspicuous, components may be overlooked" (Holling et al. eds 1978, p. ix). They further emphasize the importance of understanding dynamics, and whether elements are sensitive or robust (Holling et al eds 1978 p. xi). Costanza and Ruth, supporting the use of dynamic models for environmental problem solving, note that models "help us close spatial and temporal gaps between decision, actions and results" (Costanza and Ruth 1998 p 185). A large body of literature points out that computer modeling is useful with facilitation, decision support and consensus building (see Vennix 1996, Costanza and Ruth 1998, van den Belt 2004, Beall, Ford and Zeoli 2006, and others); all of which are important elements of adaptive management.

In *Participatory Modeling for Adaptive Management: Reports for the Field [I]* we began a comparison of processes to better understand both their homogeny and diversity (Beall et al. 2006). We compared models of wildlife including those used for sage-grouse management in central Washington (Beall, Ford and Zeoli. 2006), bear management in

New York (Siemer and Otto 2005) and Yellowstone (Faust 2004) and fishery management in Gloucester, Massachusetts (Otto and Struben 2004:287). Water resource models of watershed management in the Okanagan basin in British Columbia (Langsdale in preparation) and the Rio Grande basin in New Mexico (Tidwell 2004) were evaluated, as well as models for river basin management in the Baixo Guiadiana in Portugal (Videira et al. 2006) and protected areas planning in the Ria Formosa Natural Park, also in Portugal (Videira et al. 2003).

Reports from the Field I looked at the process participants with respect to number of stakeholders and number of modelers. Length of project was considered with respect to total length, time spent modeling and time spent with stakeholders. The number of model parameters was considered in an attempt to capture complexity. We asked about the overall purpose of the process. Was the primary goal learning or was the model to be used as a management tool?

In *Reports from the Field II* we are continuing our investigation and adding three more characteristics of participatory environmental modeling to illustrate the flexibility of process and the effectiveness of a broad range of interventions. 1) Interventions may take place anywhere on the "problem identification to solution producing" continuum. 2) Stakeholder involvement in the actual building of the model varies; the "hands on" continuum. 3) The type of data required varies on the "qualitative to quantitative" continuum.

The case studies illustrate that the processes are effective at different points of the problem identification to solution producing continuum. Modelers have typically become aware of a problem and offered their services but the point at which they joined the group process varies widely. The Okanagan study helped a group of concerned stakeholders wrap their minds around the problem itself (Langsdale et al. 2006). The sage grouse model is helping stakeholders identify solutions that will be implemented on the ground (Beall, Ford and Zeoli 2006). There is a whole continuum of timing for model intervention; each customized, if you will, to the needs of stakeholders.

The number of stakeholders and the manner in which they are involved may affect not only the problem definition but also the process timeframe and the degree of model complexity. The Ria Formosa study illustrates the effect of actually teaching the participants to build models. The sage-grouse and Rio Grande studies were modeled primarily "in the office" by the modelers with feedback at group meetings.

Type of data used varies. The sage grouse model was entirely dependent on the best available scientific data, while other models used combinations of scientific and qualitative data. For example the Ria Formosa model included an "attractiveness" parameter.

The complexities of ecosystem management have led to the adaptive management paradigm which has exceptional parallels systems thinking and participatory modeling. The purpose of *Reports from the Field II* is to further the discussion of participatory environmental modeling and to encourage more modelers to become involved in environmental problem solving.

Citations:

Beall, A., Zeoli. L., Ford, A. 2006. Participatory Modeling of Endangered Wildlife Systems: Simulating the Sage-grouse and Land Use in Central Washington. Paper submitted to the 24rd International Conference of the System Dynamics Society. July 23-27, 2006 Nijmegen, The Netherlands.

Beall, A., Ford, A, Jackson, R., Langsdale, S., Otto, P., Siemer, W., Struben, J., Tidwell,V. Videira, N., and Zeoli, L.. 2006 Participatory Modeling for Adaptive Management: Reports from the Field. Poster submitted to the 24rd International Conference of the System Dynamics Society. July 23-27, 2006 Nijmegen, The Netherlands.

Costanza, R. and Ruth, M. 1998. Using dynamic Modeling to Scope Environmental Problems and Build Consensus. Environmental Management Vol. 22, No.2, pp.183-195

Faust, L. Jackson R., Ford, A., Earnhardt, J., and Thompson, S.D. 2004. *System Dynamics Review* 20(2):163-178.

Folke, C. 2006 Resilience: The emergence of a perspective for social-ecological systems analysis. Global Environmental Change 16 (2006) 253-267

Grumbine, R. E. 1994. What is ecosystem management? *Conservation Biology* 8(1):27-38.

Holling, C.S. ed. 1978. *Adaptive Environmental Assessment and Management,* John Wiley & Sons. Chichester.

Langsdale, S., Beall A., Carmichael, J., Cohen, S., and Forster, C. 2006. Exploring Water Resources Futures with a System Dynamics Model. *In* Participatory Integrated Assessment of Water Management and Climate Change in the Okanagan Basin, British Columbia, edited by S. Cohen and T. Neale. Vancouver: Environment Canada and University of British Columbia.

Nagle, J.C. and Ruhl, J.B. 2002 *The Law of Biodiversity and Ecosystem Management*. Foundation Press. New York.

Otto, P. and Struben, J.. 2004. Gloucester Fishery: insights from a group modeling intervention. *System Dynamics Review* 20(4):287-312.

Siemer, W.F. and Otto P. 2005. A group model-building intervention to support wildlife management. Paper submitted to the 23rd International Conference of the System Dynamics Society, July 17-21, 2005, Boston, USA.

Tidwell, V.D., Passell H.D., Conrad, S.H., and Thomas, R.P. 2004. System dynamics modeling for community-based water planning: Application to the Middle Rio Grande. *Aquatic Science* 66(4):357-372.

van den Belt, M. 2004. *Mediated Modeling*. Island Press. Washington, D.C.; Covelo,California; London.

Vennix, Jac A. M. 1996. *Group Model Building. Facilitating Team Learning Using*

System Dynamics. John Wiley and Sons. New York.
Videira N. (1), Antunes, P., Santos, R., Borrego, D., Lobo, G. 2006. How and why does participatory modelling support water policy processes? The Baixo Guadiana experience. Paper submitted to *Ecological Economics.*
Videira, N. (2)., Antunes, P., Santos, R., Gamito, S. 2003. Participatory Modelling in Environmental Decision-Making: The Ria Formosa Natural Park Case Study. *Journal of Environmental Assessment Policy and Management* 5(3):421-447.