Enhancing Stakeholder Bargaining Power – The Effectiveness of Collaborative GIS in Marine Zoning

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Abstract

This study evaluates the effectiveness of collaborative GIS in supporting marine zoning among stakeholders. Undertaken over a 12-month period and continuing, the case study focuses on a group of stakeholders developing their conservation-based zoning vision for the proposed Southern Strait of Georgia National Marine Conservation Area. Over a series of workshops, using GIS and Marxan, a reserve design software based on a simulated annealing heuristic algorithm, participants generated and explored several zoning scenarios. The study demonstrates that the collaborative GIS process has enhanced participants' understanding of an unstructured zoning problem and prepared them to understand a complex spatial analysis tool to be used by government agencies, thereby increasing their ability to effectively contribute in a public consultation process.

Background and Relevance

Increasingly marine protected areas (MPAs) are being designed as large multiple use MPAs instead of smaller reserves. Potentially opposing goals of conservation and human use within a multiple use MPA inherently demand spatial zoning. Core, buffer, special use and multiple use zones are configured and regulated to protect key species and habitats, separate incompatible uses and minimize conflict [1-3]. The complexity of zoning requires an iterative and exploratory problem-solving approach. There is no single best zoning plan, but instead, a range of options which represent different tradeoffs exist. Zoning has generally been *ad hoc*, and sometimes resulted in enhanced conflict when based on inadequate information, when tradeoffs and restrictions are deemed unacceptable to a group, or when stakeholders have not been adequately involved in the process [4,5]. In response, studies highlight the necessity of incorporating the diversity of local stakeholders' perspectives in designing a MPA and developing a management plan through a participatory planning process in which stakeholders set and prioritise goals [1, 6, 7]. In addition, GIS and specifically-designed spatial algorithms such as Marxan, based on a simulated annealing heuristic algorithm, are now standard in the MPA toolbox [8,9]. Current research is extending the application of Marxan to marine zoning. The parallel needs of stakeholder participation and more rigorous, systematic analytical approaches to zoning make MPA zoning a rich ground for research in collaborative GIS [10,11].

Using a case study approach, the goals of this ongoing study are:

1. To evaluate the effectiveness of incorporating Marxan into a collaborative spatial zoning exercise with community participants; and
2. To prepare local residents to participate in a government-led MPA zoning process by helping them to understand how MARXAN works.

The case study focuses on the Southern Strait of Georgia, British Columbia, a proposed National Marine Conservation Area (NMCA) by the Parks Canada Agency, which is leading a Feasibility Study for the area.

This paper particularly addresses:

- How can stakeholder preferences and values be translated into Marxan?
- How can Marxan be adapted to designing multiple use zones as opposed to a network of marine reserves?
- What are the contributions and limitations of collaborative GIS to understanding and problem-solving complex zoning?
- What are the benefits and limitations on engaging stakeholders in a protracted collaborative process?

Methods and Data

Participants were recruited from the NMCA Network, a group of conservation organisations and individuals coordinated by the BC Chapter of the Canadian Parks and Wilderness Society. A total of 18 members of the network participated in a series of orientation sessions and workshops (six to date) since April 2006. Six members participated in most workshops. Initially, the workshops focused on defining the group's goals and objectives for the NMCA and the kinds of zones to be considered. The reserve design program Marxan has been the fundamental analytical tool, along with ArcMap GIS to generate zoning scenarios. Data on a range of biophysical and human use features in the study area were provided by Parks Canada. Mid-way through the project, participants completed a questionnaire survey to evaluate the effectiveness of using Marxan and GIS in collaboratively developing a zoning vision.

Results

Marxan has a range of input parameters, both technical and those which define the specific decision problem. Technical specifications which controlled the algorithm were determined by researchers. Using small group discussions and worksheets, participants generated a list of relevant biophysical and human use features, conservation targets and spatial relationships between a particular zone and other features which represented their priorities. In successive iterations generating scenarios, participants modified the parameters of the decision problem by varying the relevant biophysical and human use features included in the analysis and their conservation targets.

To adapt Marxan from designing a network of marine reserves to zoning, a step-wise approach was developed. Each of four zones was modeled successively starting with the zone with the highest conservation priorities which was then excluded as potential sites for other zones. The last, most general, zone to be modeled was the multiple-use zone which occupied that portion of the study area not already assigned to one of three zones.

Participant responses to the questionnaire and feedback throughout the process reveal that the collaborative GIS process helped to increase their understanding of both the marine environment and of the zoning process. Participants perceived GIS and Marxan to be a necessary ingredient in developing zoning scenarios and, nevertheless, did not feel that the process was driven by the technology, nor that the technology constrained the scope of zoning scenarios.

Most studies on collaborative GIS are set within a short term process typically lasting one day. This study so far has involved six half-day workshops over one year. Due to a variety of factors, particularly competing demands on time, not all participants were able to come to all workshops, although there was a core of six participants who attended most of the workshops. A lengthy, iterative process with changing participants at each workshop posed some challenges in ensuring that everyone at the table had a current understanding of the progression of the decision process. However, participants did feel that their zoning vision was progressing at each workshop and they generally did not have to re-visit issues when new participants joined the table. Some participants did express frustration at the span of time in between successive workshops.

Conclusions

This study has shown that a collaborative GIS process can translate stakeholder priorities and values for zoning into a complex optimization algorithm such as Marxan. Furthermore, using a step-wise approach Marxan, developed to design a network of marine reserves, can be adapted for zoning. While testing participants' commitment and availability, a long term collaborative GIS process spanning over 12 months to date provides participants with the opportunity to thoroughly explore the scope of an unstructured zoning problem, understand tradeoffs and negotiating positions and become literate in an optimization algorithm to be able to more effectively participate in a government consultation process.

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