

Comments and Recommendations for Socio-Economic Data Inclusion in MaPP's Marxan Analyses

29 May 2013

Purpose

MaPP has requested expert advice and feedback from PacMARA on draft methodologies and criteria to develop socio-economic "cost" layer(s) to identify possible management options (including high priority conservation areas), using the spatial planning decision-support tool Marxan. The ecological features in this analysis have been taken from the BC Marine Conservation Analysis (<http://bcmca.ca>).

The comments and recommendations below are based on information provided in MaPP's cost layer criteria draft, dated 16 May 2013, "*Developing a cost layer to identify high priority conservation areas*". This document is meant solely as an overview of advice, and builds upon our presentation and discussion during the telephone conference of 1 May 2013. PacMARA would be pleased to further discuss and elaborate upon any points of interest to MaPP, from this document or from earlier discussions.

Introduction

The exercise of selecting, setting and combining costs is probably the single most challenging technical task involved in a Marxan analysis. Although there is no single 'right' answer, there are a number of good practices that can be followed to better ensure results are properly balancing the various factors. To get balanced results, it is necessary to incorporate values and costs from key human uses in the planning region, but other values and costs left out of an analysis lead to the latter stakeholders' views only being addressed *post hoc*, which is far from ideal. On the other hand, when more costs are added to an analysis, it becomes increasingly difficult to combine them into a single *meaningful* measure. (Marxan with Zones considers many layers, which were previously 'costs' in Marxan, by allowing them to become 'features'. This is a huge step forward and one of the most compelling reasons for considering its use.) Striking a balance between inclusiveness and combining factors is a problem that will require several trial runs before a satisfactory compromise is met.

Below, PacMARA has identified some of the potential challenges facing MaPP, and some of our initial suggestions on ways in which the challenges can be addressed. We would be pleased to continue this dialogue as the process develops.

Comments and recommendations

A. Tenures

Not all tenures are alike, in that some tenured activities produce greater ecological impacts than others, and some may be more adversely affected by conservation zoning than others. Therefore, we support a differentiation of tenures, such as indicated in cost layer #2 of Table 1 (current tenures that are inconsistent with conservation objectives). Although perhaps not necessary for a preliminary analysis, we note that grouping different tenures together does not take the intensity of environmental impact into account. A more realistic analysis could be achieved if different types of tenures were assigned different *relative* costs, based on the magnitude of impact that activities are anticipated to have on the environment.

Other considerations for using tenures as costs include:

- Some tenures are map reserves (which withdraw the land from disposition) and presumably have positive effects on the environment that would impose no additional 'cost' on the analysis. Instead of treating these as costs, they could be 'locked in';
- Some tenures are notations of interest (which record the interest of another ministry), and will therefore require consultation with those ministries to evaluate possible costs and zoning implications;
- Some are issued but never acted upon, and therefore it is relevant when considering costs to know whether a tenure is active or likely to become active;
- Some have temporal (seasonal) uses, which may not interfere with other objectives;
- Some relate to only one dimension (surface or seabed, but not the water column), and again might not interfere with objectives in another realm;
- Some tenures are active for only a short duration but may have long-term, lasting impacts (e.g., log booming grounds); and
- We assume that only provincial tenures are being considered, but federal tenures (e.g., oil and gas leases) could also be relevant to MaPP's objectives.

To summarize, because tenures cover a wide range of possible activities, we do not recommend treating all tenures equally as a single cost layer (as in layer #1 of Table 1). Instead, tenures should be sorted based on criteria that reflect the objectives of the analysis, taking into consideration potential conservation costs (or benefits) to the environment, and also potential costs (or benefits) of conservation zoning to tenure holders.

B. Industrial use

Instead of treating established industrial use areas as costs, ports and major infrastructure could simply be locked out of the analysis. This technique would more realistically reflect industrial status as places that are unlikely to be re-zoned or moved. Additionally, locking such areas out is analytically easier and can reduce problems with reconciliation of radically different types of costs (i.e., how can one sum apples, oranges, and giraffes?). Areas of heavy industrial use could, however, include a cost buffer around them, reflecting the enhanced risk of ecological damage that might occur from routine or accidental events associated with those industrial activities.

C. Shipping

Shipping traffic is challenging to include as a cost for a variety of reasons. Similar to the tenure discussion, not all vessel traffic is alike. We note that altering formal shipping lanes would require federal cooperation. On the other hand, smaller vessels tend to wander, and those less than 20 metres generally do not carry AIS transponders, and therefore can be harder to manage from a pragmatic enforcement perspective. Hence, in both cases, zoning schemes with the intention to alter vessel traffic (e.g., “areas to be avoided”, no anchoring areas, etc.) come with high transaction costs, though for different reasons.

If vessel traffic is chosen as a cost component, rather than using it as a single uniform layer, we recommend taking into consideration the *density* of vessel traffic, which could be achieved by including vessel traffic count per unit area. To better reflect its planning objectives, MaPP could also stratify the data by vessel type (e.g., pleasure craft and yachts, government vessels, research vessels, passenger and cruise vessels, fishing vessels, tug and service vessels, tanker vessels, and merchant vessels, according to 2010 BCMCA guidelines) and how these different types of vessels are associated with different risks to the environment and costs to stakeholders, if zoned for conservation.

D. Absent costs

Cost analyses are strengthened by taking as inclusive an approach as possible. Therefore, in consideration of their importance to the planning region’s social heritage and economy, as well as their ecological effects, we strongly recommend that commercial, traditional, and recreational fishing be included if at all possible (it should be possible to access data on different types of commercial fisheries through BCMCA). Other important considerations that would strengthen the cost analysis include marine and coastal tourism activities, and First Nations traditional uses. As mentioned previously, it is good practice to differentiate activities as much as can be supported by the data available. For example, tourism activities in an area may involve individual users alongside economically vibrant fishing lodges,

kayaking, and whale watching operators, each with very different local impacts that may or may not be compatible with the objectives of a conservation zoning scheme.

In some instances, perhaps due to stakeholder reluctance to share data, some activities cannot be included in the analysis as costs, and the only option is to visually consider maps of Marxan results and potential spatial conflicts as overlays. On the positive side of this approach, stakeholders feel engaged while their personal knowledge is kept confidential. On the negative side, however, not allowing Marxan to consider these activities (creating *post hoc* analysis considerations) will increase the likelihood that solutions will not be as efficient, balanced, or equitable as they would if these costs were included.

E. Coastal focus

The cost layers considered so far are largely focused on coastal areas. Without comparable costs offshore, Marxan will tend to prefer those areas while avoiding the ‘higher cost’ coastal areas. Again, this points towards the practicality of considering of a wide a range of costs, including those that span geographical ranges. Note that one way to lessen coastal bias is to ensure that every planning unit has a minimum assigned cost value (i.e., none are set to zero).

F. Separating versus adding costs

Because the costs considered here are rather different in nature, and will have non-uniform ecological effects (e.g., shipping will disturb moulting birds but probably not fish, whereas many tenures will also affect the water column and seabed), it can be difficult to find a method by which to *meaningfully* add them together. Ultimately, using the most appropriate cost surface possible for the Marxan analysis (given the guidance above) can be augmented by overlaying human uses that were not already included. The overlay method was stated as a preference in MaPP’s cost layer criteria draft, but overlays should be combined with an actual cost surface that is as representative as possible. Furthermore, we recommend that sensitivity analyses are conducted for cost layers by running Marxan with and without cost values to assess the extent to which they drive results. Selection frequency results from the two scenarios (with and without costs) can be subtracted so that each planning unit has a difference value. Planning units with large selection frequency values (e.g., >50 on a 100 run scale) will indicate areas where an incomplete cost layer has had the most impact.

Further comments

A. Marxan versus Marxan with Zones

Often, zoning flows out of the planning objectives, with different zones (or special management areas, in this case) having their own costs. If the anticipated zoning system is to be multi-faceted, then Marxan with Zones may be the better option because it can accommodate multiple zones, rather than the simpler 'in' or 'out' designation scheme of Marxan. In this method, some costs, particularly those associated with designated human uses (e.g., traditional uses, commercial or recreational fisheries) are no longer 'costs' but instead become 'features' to be captured by a given zone, thus simplifying the problem of multiple costs. Marxan with Zones balances human uses through zoning rather than through cost equations. However, Marxan with Zones is somewhat more complicated to use, and requires GIS data associated with human uses. For analyses of only one type of zone (e.g., conservation) with only a few costs, Marxan is probably the better choice.

B. Future use

Predicting future use is always challenging, but some future uses are perhaps easier to anticipate than others. For example, LNG transport in Prince Rupert and Kitimat is a soon-to-be-existing use that is likely to increase rapidly, and hence will increase environmental risks that can be anticipated to some extent. Oil tanker traffic, while less certain, also has the possibility of increasing and could be included in some planning scenarios to test existing protected area networks for their robustness to possible associated future risks. Likewise, offshore wind farms can to some extent be anticipated, looking at a combination of windy areas with landfalls close to the electrical grid (though it is still unclear how soon they will become economically viable in the planning region). Other uses, (e.g., certain bottom fisheries), are likely to remain largely unchanged, as they rely on fixed physical characteristics. Finally, some future uses will be very challenging to predict, and hence setting costs for them will be difficult, if not impossible. For example, offshore aquaculture is so speculative that not enough is known to predict where it might be located, if anywhere.

Therefore, we suggest cautiously applying costs to future activities, unless it is already fairly well known that they will occur. It could be enlightening to do a second analysis that includes 'best guesses' for a variety of still uncertain future activities, with their associated (perhaps discounted) costs, but this should not play a substantial role in management of current siting and zoning decisions.

C. Weighting

Many initial analyses prefer not to weight costs, as it can be misinterpreted to mean that some activities are favoured over others. However, when done correctly, weighting is a legitimate and valuable way to account for the differing impacts of different zonings, human activities, and their costs. Once the shortcomings of unweighted costs are seen (e.g., recreational kayaking is treated in the same manner as tanker traffic), planners often want to better differentiate costs in subsequent analyses. As discussed above, Marxan with Zones can contribute to simplifying this problem by assigning different zones to different classes of human activities (e.g., industrial use, traditional use, and conservation zones).

D. Combining cost layers

As outlined in our 1 May 2013 presentation and conference call discussion, one of the greatest challenges with costs is combining the different components. When costs can be meaningfully combined, the advantage is a single set of results considering them all at once. However, sometimes it is best not to combine dissimilar data types, but to run separate analyses instead. Page 4 of *Developing a cost layer to identify high priority conservation areas* states that “cost layers may be combined such as: degraded areas, industrial uses/ports and shipping lanes”. We are unclear on exactly what this means – will the three categories be added together? Or will MaPP create three general cost groupings under those headings for separate analyses? Or is combining certain types of costs an option still to be explored? Whatever the intention, combining costs is difficult and will require exploration through various test runs. In short, uses that are similar to one another can usually be standardised to the same scale and combined (i.e., added or subtracted), but uses that are very different from one another should be treated as orthogonal (i.e., like sides of a right-angled triangle, in which the total is the square-root of the sum of squares).

E. Degraded areas

Some degraded areas will have higher recovery potential than others. Formerly important places could be justified in recovery planning, but past experience has shown that recovery is often challenging to predict. Some places may be so degraded that expecting their conservation would lead to recovery is not realistic. Being able to differentiate among the various types of degraded areas will allow for a more focussed use of the cost function.

F. Communication of outputs

Clear communication of Marxan analysis outputs is essential. The term ‘costs’ can be misleading and in some cases insulting to stakeholders who view their activities as ‘values’.

Hence, careful wording and preparation of the results will be necessary to avoid such misunderstandings. PacMARA suggests the use of selection frequency maps combined with multiple example solutions, both carefully explained. Our *Marxan for Managers* workshop covers communication issues and advice in much greater detail (<http://pacmara.org/events-workshops/marxan-for-managers>).

G. Next steps

PacMARA is interested in MaPP's planning problem and approach, and is committed to assisting as desired. Our pool of trainers is available for one-on-one help, as they are well versed in a variety of technical issues, common stumbling blocks, and problems, as well as tips and tricks to improve analyses. Also, PacMARA frequently provides third party organization and facilitation services around the managerial (e.g., setting targets, working with stakeholders, data inclusion, presenting results) aspects of Marxan analyses, and would be happy to do so in this case, if requested. We wish MaPP every success in this very important undertaking.