Lab 3: Efficiency

Name:

This lab introduces you to the importance of considering costs in creating a reserve network. In the previous activities we used an acquisition cost; the dollar value of purchasing the land contained in each planning unit for incorporation into a reserve system.

Yet, there are lots of ways that people assign cost to a planning unit in conservation planning. there is opportunity cost (the foregone revenue from a certain activity, like agriculture or fishing, that is lost when parts of the land and sea become reserves), socio-economic costs, measures of naturalness, and management costs to name a few. choosing a suitable cost layer for a conservation planning problem depends on the problem you are trying to solve.

Section 1: Exploring costs

* In the previous activities we used an acquisition cost. In the next activities we will explore three different cost layers: the cost of land acquisition (1), the cost of management (2) where we assume that the cost of each planning unit is greatest close to roads – which might be a consequence of visitors, weeds and/or fire management, and a cost based on the Area of planning units (3-not shown). The darker shades of blue indicate higher cost.

Throughout the lab, we will refer to these as Cost 1 and Cost 2.

|  |  |
| --- | --- |
| Macintosh HD:Users:uqjmcgow:Documents:PROJECTS:Marxan_training:Images:AquisitionCost.jpg  Acquisition Cost (1) | Macintosh HD:Users:uqjmcgow:Documents:PROJECTS:Marxan_training:Images:DistRoadsCost.jpg  Management Cost (2) |

* go to http://marxan.net/CONS7021.html and link to Activity4a/b
* as before we are targeting 10% of every feature. Let us first explore how different costs influence the best solution.
* Click through the Best solution maps (1,2,3). Insert small screen shots of the three best solutions.

Discuss the impact of different cost layers on the best reserve system.

Note: Using area as a cost (3), reduces the variability of cost between planning units and is sometimes used in the absence of better cost information.

Section 2: Measures of similarity

* Marxan uses a binary assignment scheme to place each planning unit either *in* (1) or *out* (0) of the reserve network for each solution it generates. Beyond visual inspection, there is a more quantitative method to describe the similarities and differences between our three scenarios.
* Now look at the best solutions difference map to compare between our cost scenarios (1 and 2). Planning units in green are those selected in our Acquisition cost scenario. Blue planning units are selected in our management cost scenario. Turquoise planning units are selected in both scenarios.
* Click on the link, download and open the K-stat Best Solutions Table.
* This table shows every individual planning unit (PUID) in our Tasmanian example. The next two columns give us the configuration of planning units in the best solution for our three cost scenarios. Here, we see the binary assignment values of either 0 (out) or 1(in) for each PUID.
* There are several metrics used for conducting pairwise comparisons of lists made up of zeros and ones. These can be used to determine the degree of overlap between our two scenarios. A simple measure of similarity is how often the two solutions are the same, as a proportion of all the planing units.
* This fractional similarity is described by:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  | | --- | --- | --- | --- | | solution II | solution 1 | | | |  | in | out | | in | a | b | | out | c | D | | Similarity value= |  | | | where Similarity Value |

* calculate the comparison between all cost scenarios in the K-stat best solutions excel file and fill in the tables below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  | Cost 3 in | Cost 3 out | | cost 1 in |  |  | | Cost 1 out |  |  | | value= |  | | | |  |  |  | | --- | --- | --- | |  | Cost 3 in | Cost 3 out | | cost 2 in |  |  | | Cost 2 out |  |  | | value= |  | | |
| |  |  |  | | --- | --- | --- | |  | Cost 1 in | Cost 1 out | | cost 2 in |  |  | | Cost 2 out |  |  | | value= |  | | |  |

Discuss your results and refer back to the original best solution figures. If this a useful statistic for assessing differences?

Extension exercise: can you think of other ways of calculating the similarity between strings of zeros and ones? For discussion.

Section 3: Selection Frequencies (SF)

If we look at the number of times an individual planning unit is included in a good solution for a specific scenario we can find the planning unit’s selection frequency (SF). For example, if we executed 10 runs, as we do in these activities, the highest selection frequency value for any planning unit would be 10, meaning it was chosen in all 10 solutions. If we executed 100 runs, the highest SF would be 100. We can use this value to find a measure of importance of any planning unit in finding an efficient solution. if a planning unit has a SF of 1 then it is always needed in efficient solutions, but if it is only selected 50% of the times then there may be an equally efficient alternative.

* First view each scenario’s selection frequency map. Then view the selection frequency difference map. In this Difference map the color gradient for each cost scenario remains the same (green= Cost 1, blue = cost 2). the color gradient shows the difference in each planning unit’s selection frequency between the two scenarios. The darker the shade, the greater the difference in selection frequency.

Insert small screen shots of the three selection frequency maps and describe what you see below.

describe whether or not you think using a selection frequency map to determine which planning units should be prioritized is a good or bad idea.

* Lets explore this question more rigorously. Download the k-stat selection frequencies table.
* Similar to the last section, this table shows every individual planning unit (PUID) in our Tasmanian example. The next two columns give us the selection frequency for the two cost scenarios.
* Choose a threshold you think makes sense for the level of irreplaceability you would like to have in your solution. i.e. you want to have a spatial plan comprised of planning units with selection frequencies of 7 or higher. You can choose any threshold you think is reasonable and that you can justify.
* Once you have your threshold determined, turn the selection frequencies of the cost scenario you chose into zeros or ones. Where 1 is for the cells that meet your threshold setting and should be included in the solution.
* Now compare the solutions that you just created to the best scenario (acquisition or management) from the last section. Cost “t” in the table refers to “threshold” cost scenario you chose.

|  |  |  |
| --- | --- | --- |
|  | Cost in | Cost out |
| cost T in |  |  |
| Cost T out |  |  |
| Value = |  | |

How well does this approach capture the spatial configuration of the best solution for your scenario? Describe your findings.

Does this support or refute your previous feelings about using the selection frequency to develop a spatial plan?

What key concept of systematic conservation planning does this approach, and other ranking or richness approaches ignore? Explain your thoughts.

Section 4: Trade-offs

In systematic conservation planning, the objective function tries to achieve targets while minimizing cost. One area of ongoing research is how best to combine multiple costs into this objective function. This challenge becomes particularly complex if we want to consider, for example, the cost of enforcing a protected area and the social cost of excluding a local community from accessing a valued historical fishing site.

Let’s play with our two cost layers to see if, how, and when it is feasible to combine multiple costs into a single value.

* go to http://marxan.net/CONS7021.html and link to Activity4c
* In the control panel on the left, there is a slider that ranges from 0 to 1.
* This slider operates by varying alpha in the following way.

* When the alpha is set to 0, we are using only the Acquisition cost, when alpha is set to 1, we are using only the Management cost.
* You will now use the slider to vary alpha and run marxan several times. Your task is to record the values in excel for the best solutions.
* Start by setting alpha to 0 and running marxan. View the Table tab and record the values for the costs.
* now move alpha to the right (wherever you like), run marxan and record the value for the alpha you selected as well as the costs.
* do this two more times and then move alpha all the way to the 1 for the last scenario.

|  |  |  |  |
| --- | --- | --- | --- |
| Alpha | Total Cost | Cost 1 (Acquisition) | Cost 2 (Management) |
| 0 |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| 1 |  |  |  |

Plot the trade-off curve for the two costs and insert below. Discuss your observations.

Does combining costs in this way make sense? Why or why not?