Lab 10: Site Prioritization for Marine Spatial Planning

Yutian Fang

Scenario 1

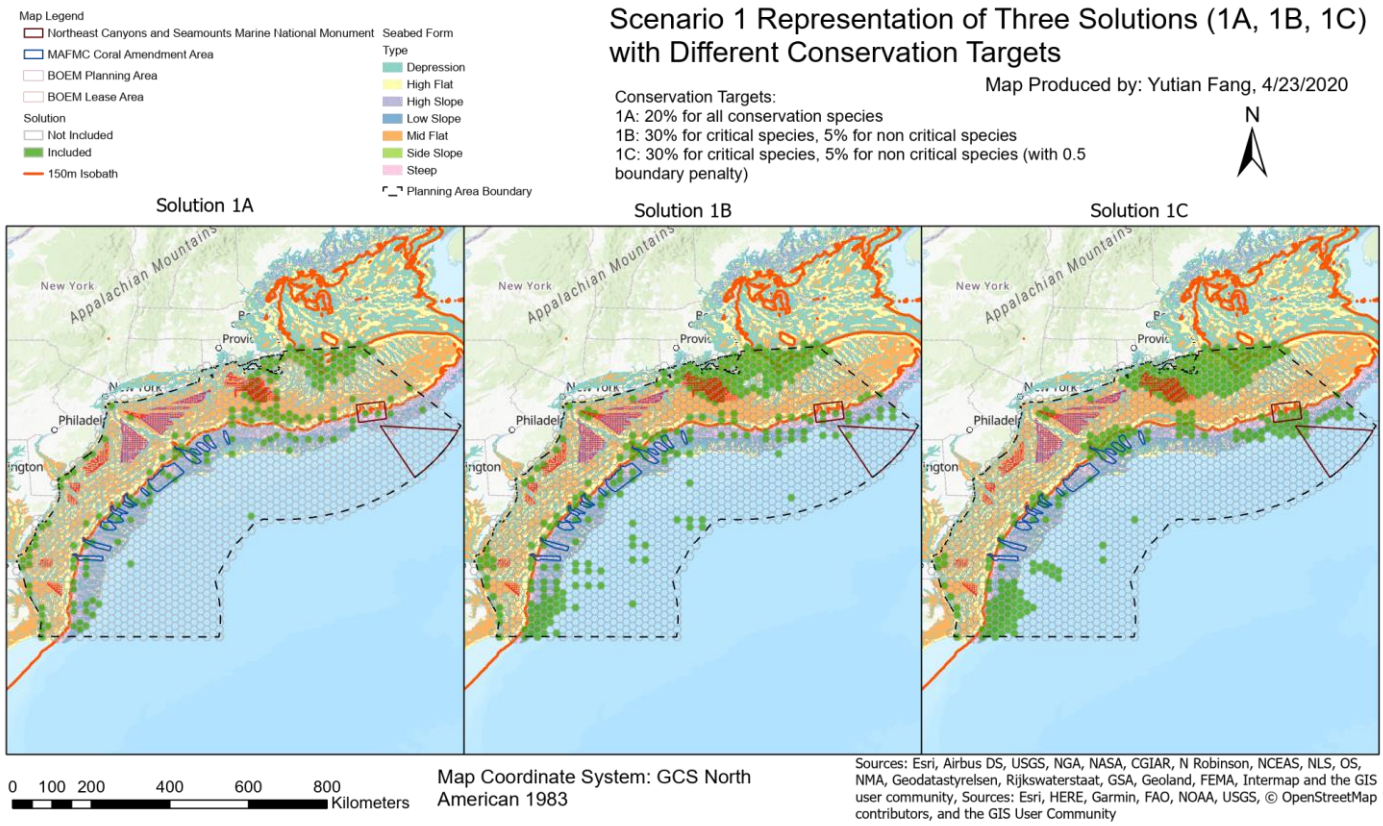
Introduction

In this project, we conduct the site prioritization analysis for marine spatial planning. The objective is to use prioritizR to optimize the cost and meet the conservation target for each divided planning unit within the North Atlantic planning region. The input conservation target is based on the relative abundance of all avian, fish and marine mammal species in the region, and also the relative abundance of critical avian, fish and marine mammal species. Furthermore, different proportion of sea bed forms (depression, low slope, steep, mid flat, side slope, high flat, and high slope) are also included in the conservation target, as they could be the habitat of endangered species like deep sea corals. The relative abundance of all conservation features listed above are summarized for each marine planning unit for further processing in prioritizR.

For scenario 1, the cost is generally overlooked by setting each marine planning unit has a symbolized cost "1". Also, all planning units within the planning region are take into consideration for prioritizR to find the optimum solution. This scenario has three different situations for conservation target to meet in prioritizR. Situation 1A sets the target to protect 20% of all conservation features, regardless the critical status. Situation 1B sets the target to protect 5% for all non-endangered features, and 30% for endangered features. Situation 1C has the same conservation target as 1B, but with 0.5 boundary penalty when prioritizR make the decision. This means that the planning units selected for 1C will be more clumped together than 1B as the final decision.

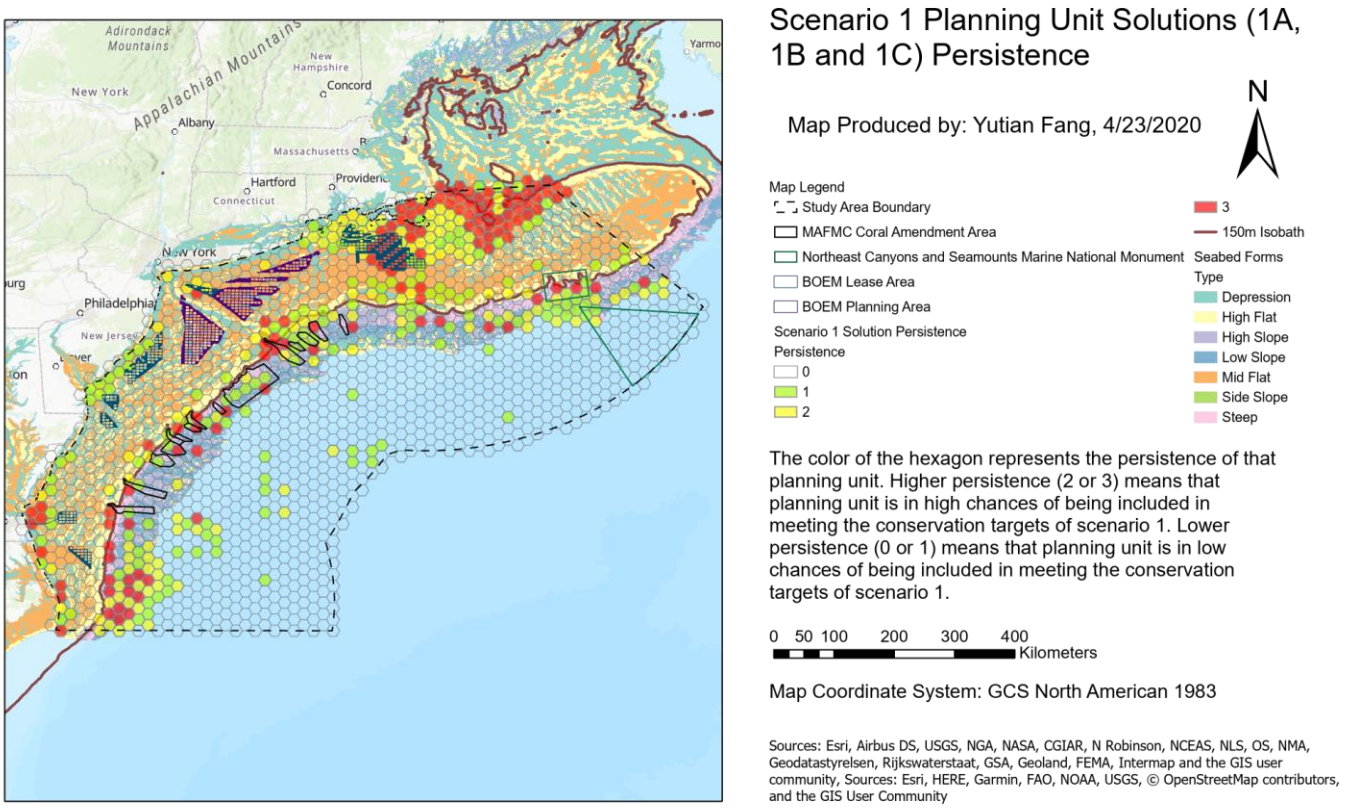
Result & Discussion

Map 1: Scenario 1 three solutions (1A, 1B, 1C) representation



Map 1 shows the representation of the three solutions (1A, 1B and 1C) with different conservation targets from scenario 1. The hexagon that labeled in dark green are the planning units that selected for the solution, whereas the hexagon not labeled are those that not selected. Although the three solutions have different conservation targets, we can see some common patterns from them. All of them tend to select planning units along the coast, along the 150m isobath and the planning units in northwest/southwest within the planning region (Map 1). We can also see currently, there are some planning units that already been set as protected region (coral amendment area and national monument, Map 1). However, there are also some planning units overlap with the BOEM wind planning and lease area (Map 1). Those are the planning units that should deserved high attention.

Map 2: Scenario 1 Planning unit persistence



Map 2 shows the persistence of each planning unit among all three solutions in scenario 1. High persistence (2 or 3) represents that planning unit is very likely to be selected by all three solutions, where as low persistence (0 or 1) represents that planning unit is unlikely to be selected by all three solutions. According to map 2, those planning units that have high persistence tend to distributes along the 150m isobath, and also clustered in northwest and southwest corners of the planning region. Furthermore, some high persistence planning units (most have 2) are distributed far away from the shore and close to the border of the planning region (Map 2). Those regions should be considered as potential conservation “hot spots”, whereas other places can be considered as “cold spots”. It is also worthwhile to mention that some conservation “hotspots” overlap with the existed protected area, and also the BOEM wind energy lease area (Map 2). Those planning units should deserve more attention when making the spatial planning decision. For example, if they are already been included in protected area, then they should not be worried. However, if they have potential conflicts with the wind energy use, then negotiation should be conducted between the two sides to

determine the best way that can meet the conservation target.

Table 1: Conservation target met and cost for each conservation feature

		Solution 1A		Solution 1B		Solution 1C	
Feature ID	**Feature Name**	**Target Met**	**Target Difference**	**Target Met**	**Target Difference**	**Target Met**	**Target Difference**
1	all avian species	20.13%	0.13%	26.32%	21.32%	25.92%	20.92%
2	avian on "high priority" List	20.16%	0.16%	30.00%	0.00%	30.01%	0.01%
3	all fish species	22.45%	2.45%	29.30%	24.30%	29.91%	24.91%
4	vulnerable fish species	20.72%	0.72%	30.09%	0.09%	30.07%	0.07%
5	all cetacean species	20.03%	0.03%	19.94%	14.94%	21.33%	16.33%
6	ESA listed cetacean species	20.02%	0.02%	30.00%	0.00%	30.01%	0.01%
7	Depression	20.18%	0.18%	28.44%	23.44%	27.93%	22.93%
8	Low Slope	22.18%	2.18%	31.43%	26.43%	35.24%	30.24%
9	Steep	26.53%	6.53%	33.33%	3.33%	40.99%	10.99%
10	Mid Flat	20.02%	0.02%	20.13%	15.13%	18.84%	13.84%
11	Side Slope	20.87%	0.87%	32.21%	2.21%	32.22%	2.22%
12	High Flat	20.02%	0.02%	28.88%	23.88%	29.21%	24.21%
13	High Slope	20.22%	0.22%	31.70%	1.70%	38.78%	8.78%
	Cost	194		286		321.38	

Table 1 shows the target met and cost for each optimum solution under scenario 1. The target difference is calculated based on the target set for that solution and the final target met for that solution. The critical conservation habitat/species are labeled in red (they have 30% target for 1B and 1C). According to table 1, the cost increased from solution 1A to 1C. This is understandable, as higher conservation requirements will correspond to higher costs.

The target difference is also interesting to explore. For solution 1A, which has 20% target for each conservation feature, all fish species and steep has the largest target differences. For solution 1B, which has 30% target for critical and 5% target for non-critical species, all fish species and low slope has the largest target differences. For solution 1C, which has same conservation target as 1B, all fish species and low slope has the largest target differences. This high difference may due to the spatial location of all fish species biomass raster layer, steep and low slope on the seabed form layer. The all fish species layer is located closer to the coast, which has high overlap with the layer that contained high relative abundance of endangered species. The locations of steep and low slope are located closer to the 150m isobath, which also has high overlap with the layer that contained high relative abundance of endangered species. Such high overlap may lead the conservation target of those features to be overly met, even they are not viewed as critical features, as the prioritizR is trying to meet higher conservation target of the endangered species.

Scenario 2

Introduction & Method

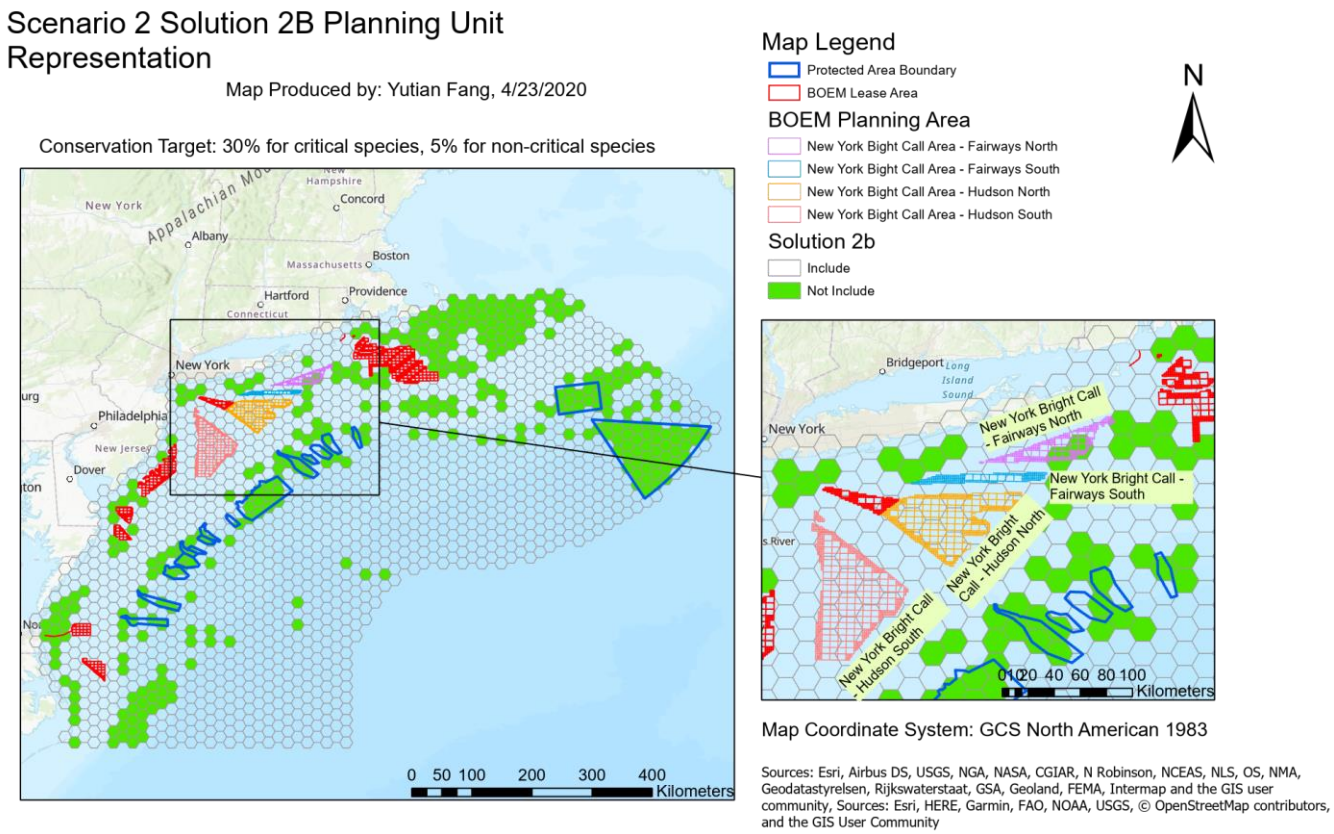
Different than scenario 1, scenario 2 has different cost sets and locked in/locked out status sets for each planning unit. The cost is determined by the Atlantic fishing revenue intensity raster, with higher revenue generated in the planning unit corresponds to higher protection cost. The cost set for those planning units have revenue generated greater than 1000000 is set to be 200, whereas for other planning unit the cost is set to be 100.

Locked in and locked out status means whether the planning unit will be take into consideration when prioritizR make the optimum decision. The planning units that overlap with the existed protected area (coral amendment and national monument) will be set as locked in status, which means they will always be included in the optimum solution. The planning units that overlap with the BOEM wind energy lease area will be set as locked out status, which means they will always not be included in the optimum solution. This locked in/locked out status makes the optimum solutions get closer to the real situation.

Other than that, each planning unit still contain the summarized data of each conservation feature like scenario 1. The conservation goal for 2A, 2B and 2C are the same as 1A, 1B and 1C except the cost and locked in/out status for each planning unit. 2A intends to protect 20% of all species, 2B intends to protect 5% for non-critical species and 30% for critical species, and the goal of 2C is the same as 2B except for the 0.5 boundary penalty.

Result & Discussion

Map 3: Solution 2B representation



Map 3 shows the solution 2B from the scenario 2, with the conservation target 30% for critical species, and 5% for non-critical species. The smaller frame of map 3 has zoomed to the BOEM wind planning area, and we can see clearly which wind planning area has overlapped with the planning units that included in the optimum solution. From map 3, it is clear that New York Bright Call-Fairways North has large overlap with the planning units, and Fairway South has small overlap with the planning units (Map 3). Hudson North and Hudson South on the other hand does not have any overlap with the selected planning units in solution 2B (Map 3). Furthermore, as the planning units that overlapped with BOEM lease area have been locked out, there is no planning units overlap with the lease area in the optimum solution (Map 3). Besides, as the existed protected area has been set to locked in status, the planning units within the boundary are all be selected (Map 3).

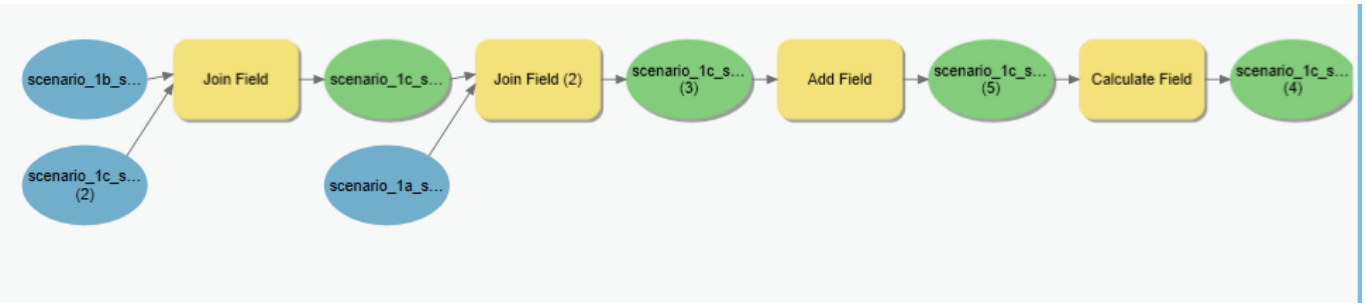
Table 2: the proportion of each wind planning area overlap with the selected planning units

BOEM Wind Planning Area Name	Percentage
New York Bright Call Area-Fairway North	38.29%
New York Bright Call Area-Fairway South	1.20%
New York Bright Call Area-Hudson North	0.00%
New York Bright Call Area-Hudson South	0.00%

Table 2 shows the detailed percentage that each wind planning area has overlapped with the selected planning units from solution 2B. Combine the observation from map 3, it is clear that there are future BOEM wind planning area that overlap with the potential high priority conservation places. Fairway North has the largest overlap percentage, which is 38.29%, and Fairway South also has 1.2% overlap (table 2). The Hudson north and Hudson south does not show any overlap with the potential conservation sites (table 2). This result demonstrates that there should be a negotiation going on between the BOEM and the agency who are interested in setting the potential conservation sites to determine what's the best way to fulfill the needs of wind energy development and conservation.

Appendix

Scenario 1: Persistence



Scenario 2: Wind Planning Area Proportion