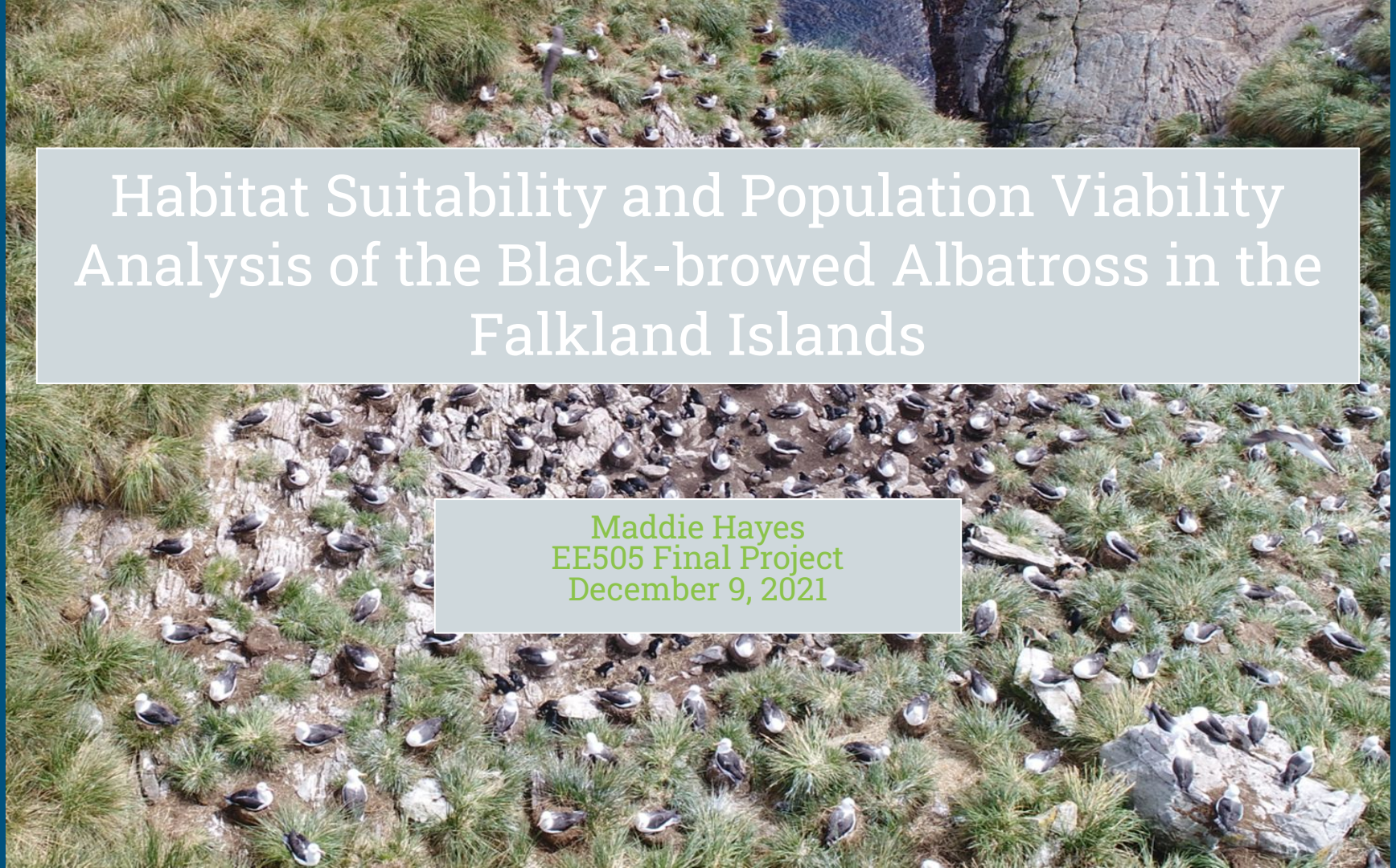

Habitat Suitability and Population Viability Analysis of the Black-browed Albatross in the Falkland Islands

Maddie Hayes
EE505 Final Project
December 9, 2021

Background

- Globally, albatrosses are one of the most threatened groups of seabirds
- The Falkland Islands are home to the only remaining increasing population of Black-browed Albatrosses.
- However, these birds are threatened by climate change, particularly increasing sea surface temperature and increasing Southern Annular Mode indices
- Shifts in Falkland Islands Black-browed Albatross population dynamics could upend the equilibrium of the Patagonian Shelf ecosystem

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Study Area

- Breeds at 12 distinct sites in the Falkland Islands
- Population estimated around half a million
  - World's largest breeding population
- Largest colony is Steeple Jason - population estimated around 200,000
- Third largest colony is Grand Jason - population estimated around 60,000

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Research Objectives

1. Estimate a Black-browed Albatross habitat suitability model based on historical climate conditions
2. Estimate a Black-browed Albatross habitat suitability model based on predicted climate conditions for RCPs 4.5 and 8.5
    a. Determine difference in habitat suitability between historical and predicted
3. Conduct Population Viability Analysis (PVA) to determine Black-browed Albatross population-level consequences of predicted changes in marine ecosystems, particularly sea surface temperature and the large-scale climate index Southern Annular Mode (SAM)

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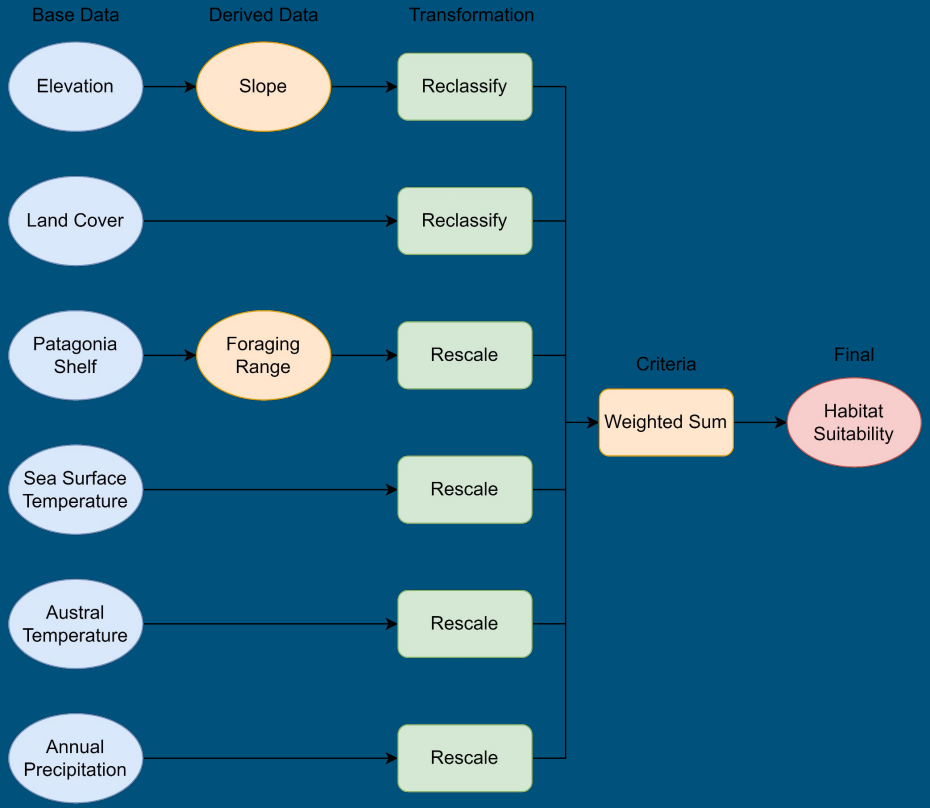
Workflow: Habitat Suitability



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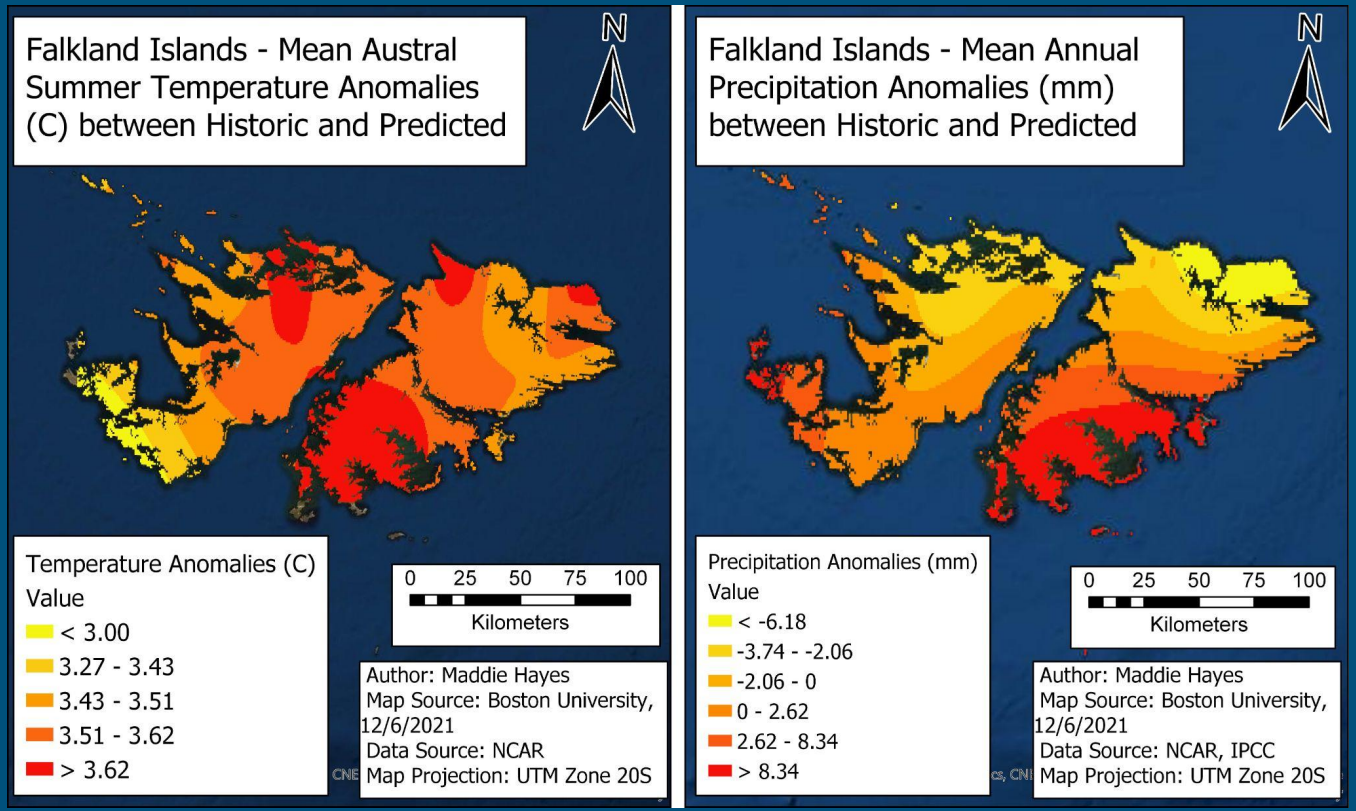
Data: Climate Predictions



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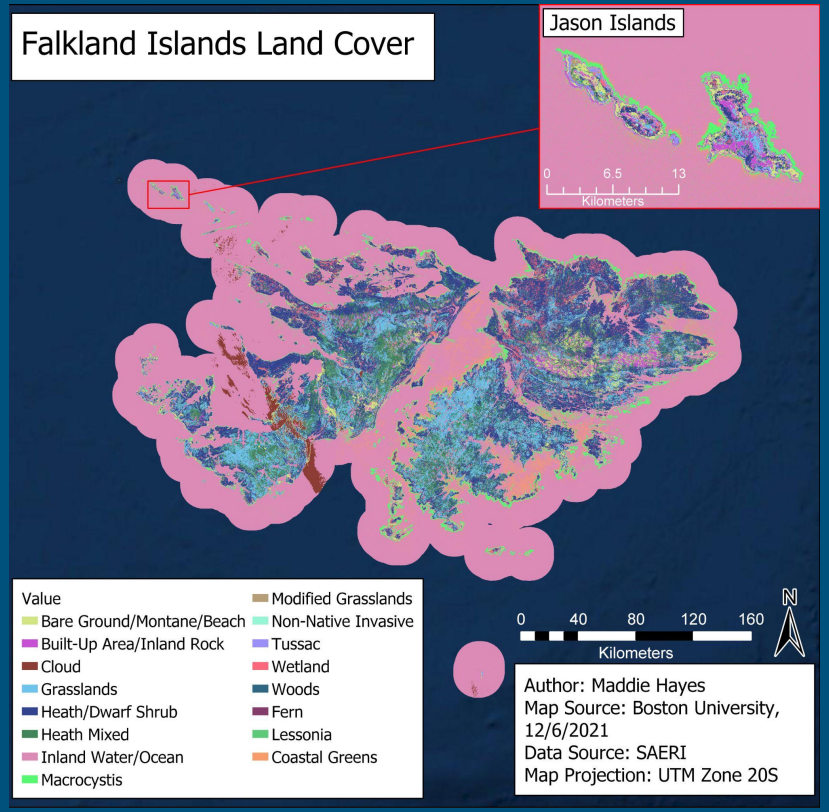
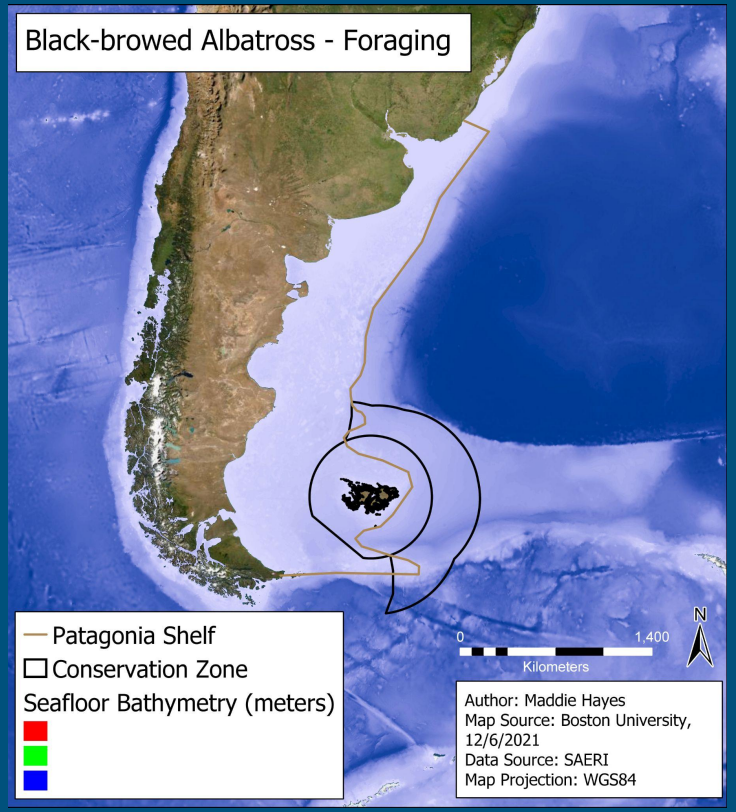
Data: Land Cover and Foraging Range





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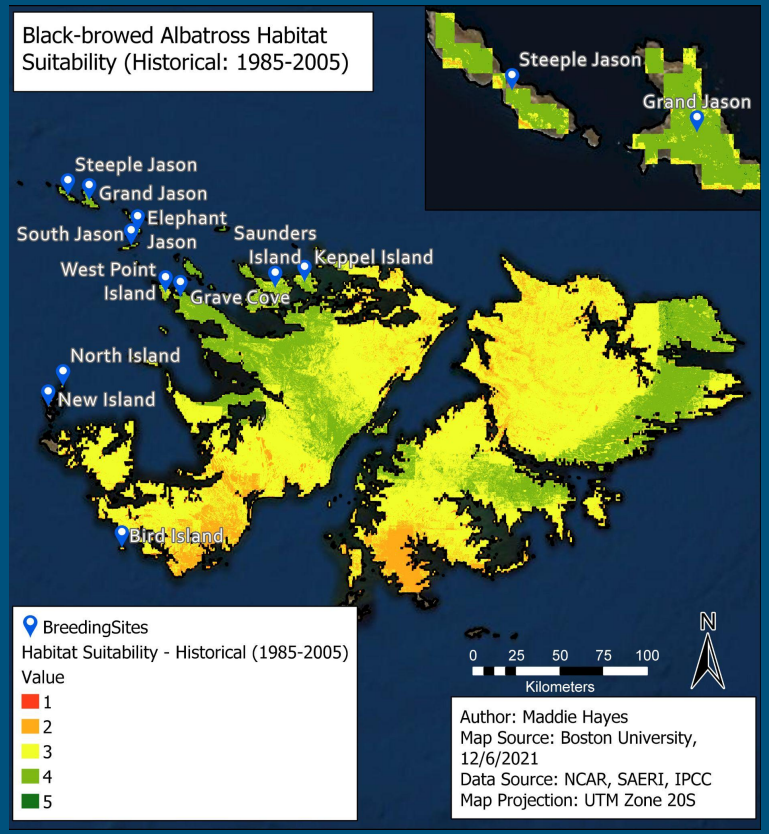
Results: Habitat Suitability for Historical Climate



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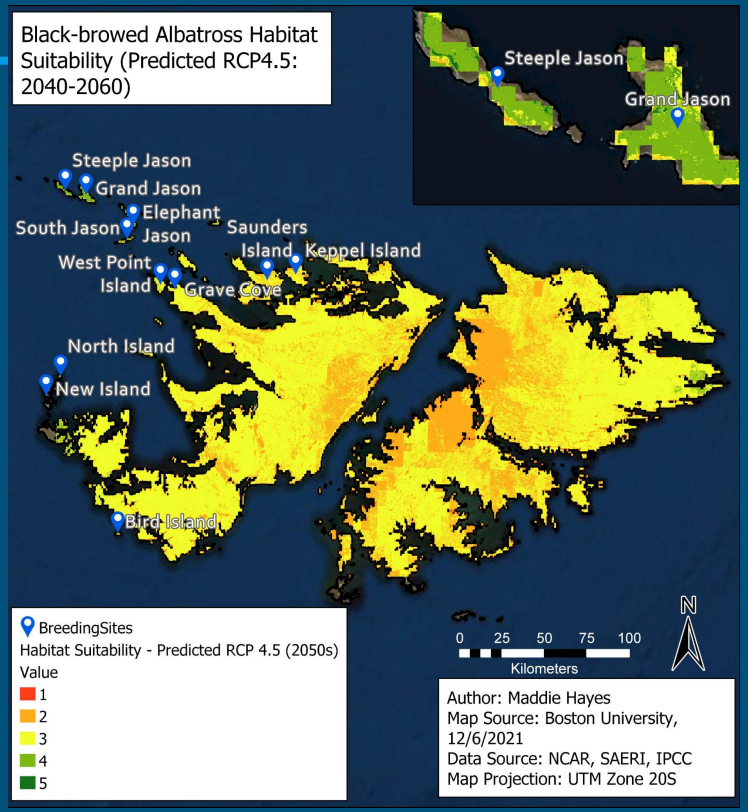
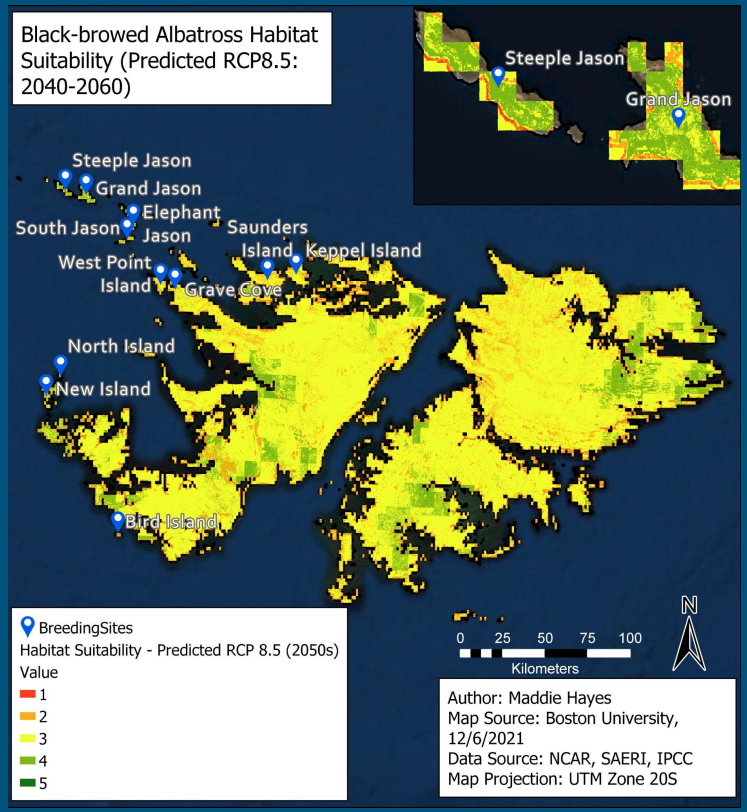
Results: Habitat Suitability for Historical Climate





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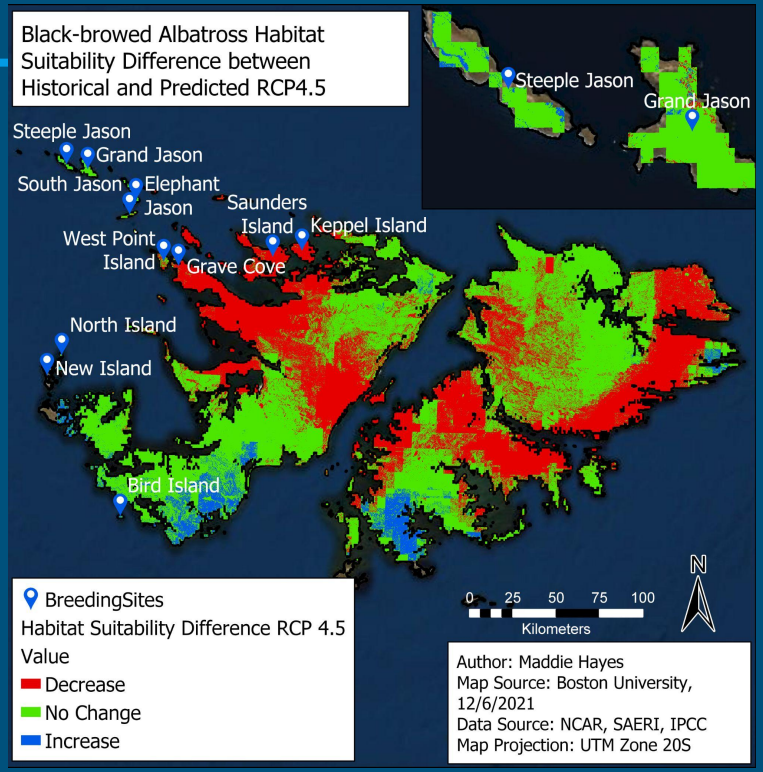
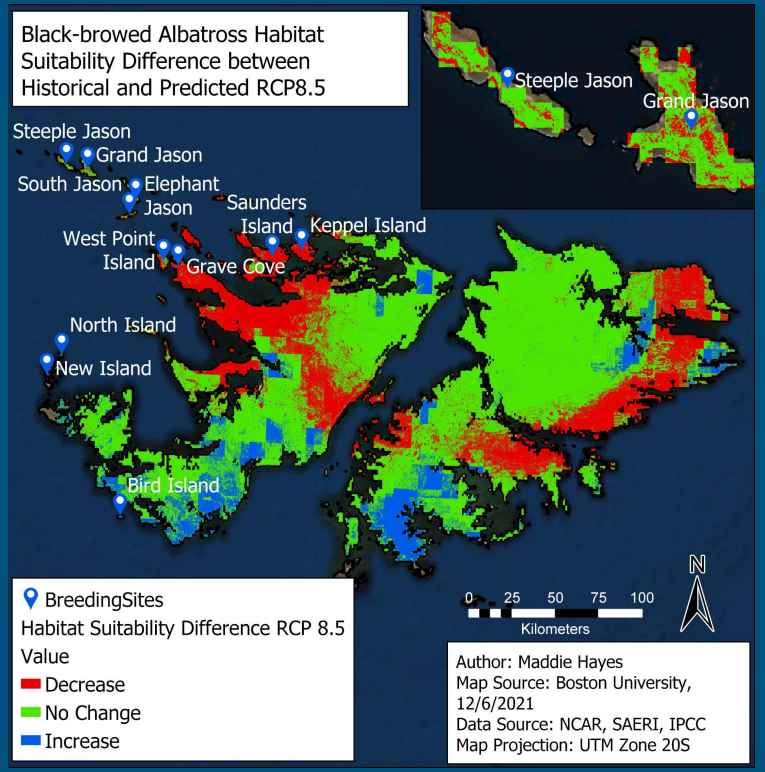
Results: Habitat Suitability





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Data: Population Viability Analysis

Demographic Parameter	Value	Source
Age at first breeding	6 years	Pardo et al. 2017
Adult Survival	0.94 (SD: 0.023)	Catry, Forcada, and Almeida 2011
Juvenile Survival	0.75 (SD: 0.03)	Catry, Forcada, and Almeida 2011
Productivity rate per pair	0.525 (SD: 0.144)	Catry, Forcada, and Almeida 2011
Impact Scenario 1: SSTA decrease by 1	Productivity: mean = -0.0048	Ventura et al. 2021b
Impact Scenario 2: SSTA decrease by 2	Productivity: mean = -0.0096	Ventura et al. 2021b
Impact Scenario 3: SSTA increase by 1	Productivity: mean = 0.0048	Pardo et al. 2017, Ventura et al. 2021b
Impact Scenario 4: SSTA increase by 2	Productivity: mean = 0.0096	Ventura et al. 2021b
Impact Scenario 5: SAM decrease by 1	Survival: mean = -0.0032	Ventura et al. 2021b
Impact Scenario 6: SAM increase by 1	Survival: mean = 0.0032	Ventura et al. 2021b
Impact Scenario 7: SAM increase by 2	Survival: mean = 0.0064	Ventura et al. 2021b

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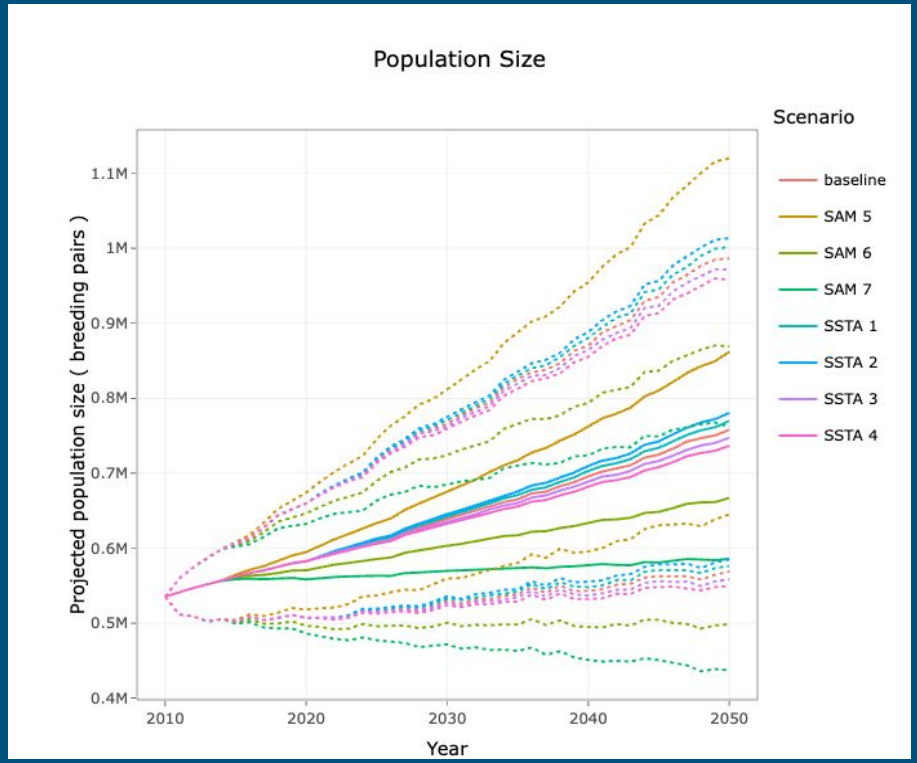
Results: Population Viability Analysis



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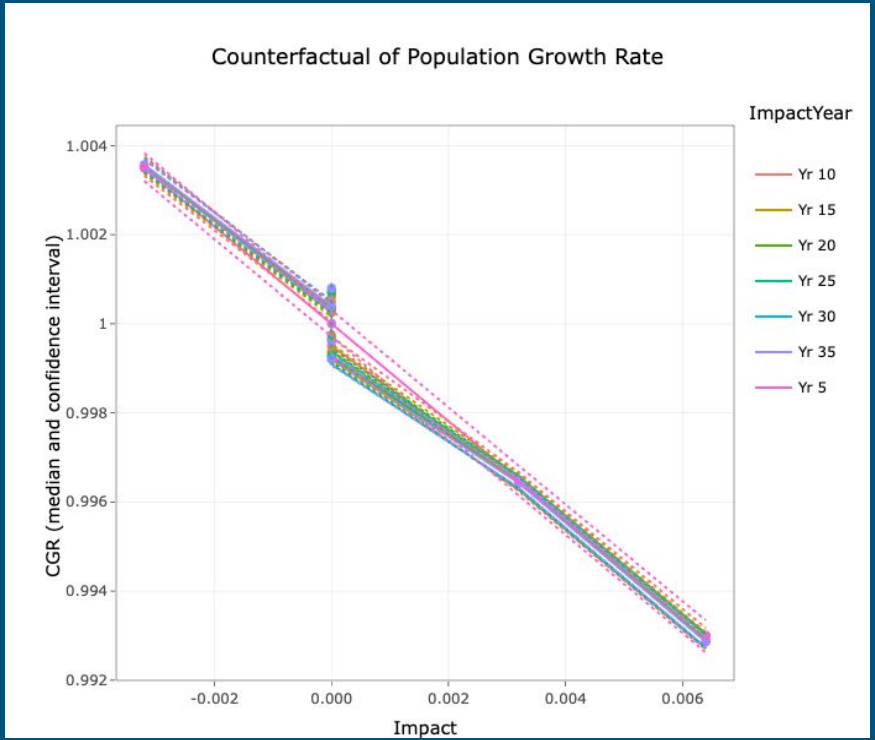
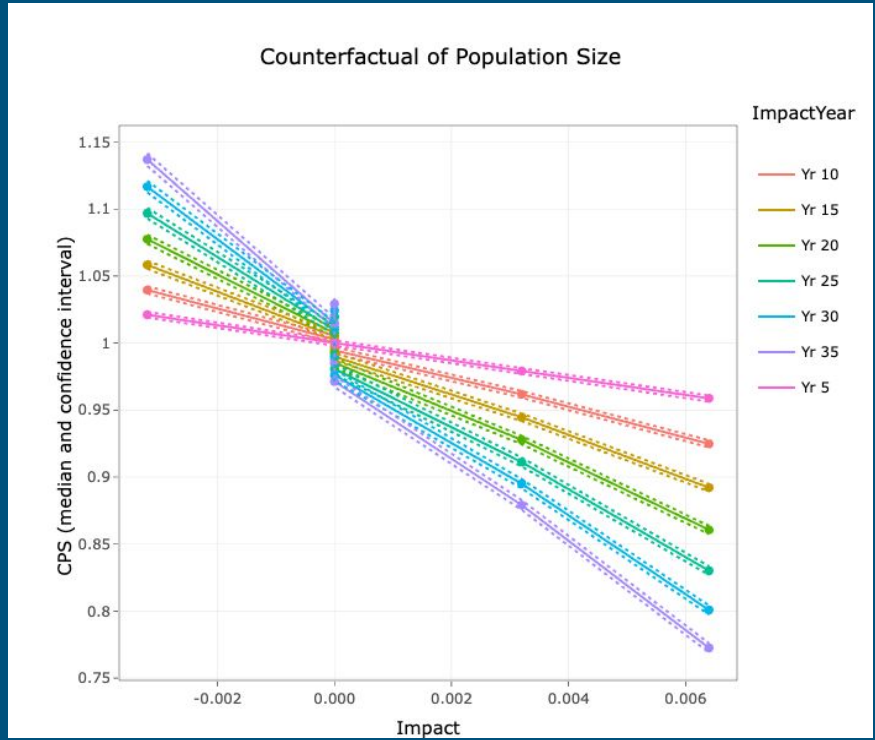
Results: Population Viability Analysis





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Discussion: Habitat Suitability

- RCP 4.5 scenario will not significantly impact habitat suitability
- RCP 8.5 scenario will decrease suitability for half the colonies
- Due to the uncertainties of climate modelling and coarse resolution, the results should be treated only as possibilities, serving as a guide for future analysis or as supporting information for decision-making
- Future iterations should investigate more habitat suitability variables beyond SST, temperature, and precipitation

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Discussion: Population Viability Analysis

- Black-browed Albatross population dynamics are mainly driven by adult survival
- PVA projected that increases in the Southern Annular Mode (SAM) index will decrease population size the most
  - SAM represents a deeper ecosystem change
- Increasing sea surface temperature will have a small impact on breeding productivity
  - SST represent local environmental variability
- Positive SAM phases and warmer SST are predicted to increase in frequency as climate change worsens

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Conclusion

The results of this study emphasize an urgency for change. The Falkland Islands are home to one of the only remaining stable populations of albatrosses and the Patagonian Shelf is one of the most productive ocean ecosystems. The findings presented here indicate that this population of Black-browed Albatrosses is threatened by environmental variability, with increases in the Southern Annular Mode index having the highest effect on adult survival. Increases in sea surface temperature and air temperature are also shown to negatively impact breeding productivity and habitat suitability. If this population starts to collapse, then the collapse of the Patagonian Shelf marine ecosystem could soon follow, creating a critical point of no return for biodiversity conservation.

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