Black crowberry patch bursting with ripe berries.

Determining climate change refugia on Schoodic Peninsula: investigating the relationship between location, abundance, and condition of black crowberry (*Empetrum nigrum*)

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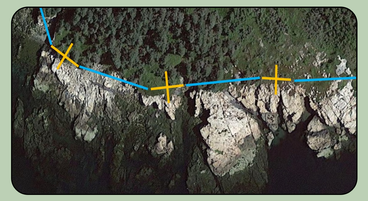
Introduction

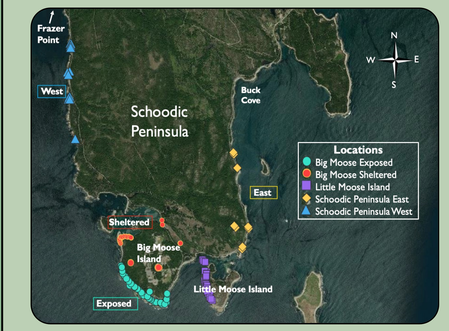
Refugia, areas that remain relatively buffered from changes in climate over time, shelter ecosystems and native species as temperature and participation patterns change.[1] Identifying refugia locations for representative species can provide valuable information for adapting to climate change.[2] Schoodic Peninsula has been identified as a potential climate change refugia due to a regular inland diffusion of coastal fog, variations in topography and habitats, and its proximity to the ocean.[2] Black crowberry, a low, mat-forming woody shrub, shelters smaller plants growing within its stems.[2] Our study aims to determine which locations within the Schoodic District of Acadia National Park are potential refugia for black crowberry by investigating the relationship between its abundance and condition at each location.

Methods

We collected data via ArcGIS Survey123 in five geographically distinct locations where black crowberry is present along the coastline of the Schoodic District of Acadia National Park from Frazer Point to Buck Cove. In areas where black crowberry was observed, two intersecting 5 meter (m) transect lines were laid over the patch - one parallel to the coast, and one perpendicular. The presence or absence of black crowberry was recorded at each 10 cm mark along the transect line (abundance). Coordinates, phenology traits (flowers or fruit), and percentage of the black crowberry patch that was alive (condition) were noted as well. For each transect line, an observation of black crowberry was uploaded to iNaturalist. This protocol was repeated every 20 m once black crowberry was observed. Data were collected between June and Oct. 2021.



Aerial image of coastline with 5m transect lines in orange and 20m distance in blue



Surveyed Locations

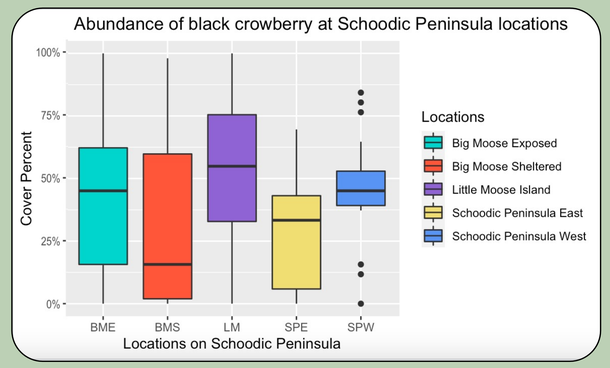
Each point on this map of the Schoodic District of Acadia National Park represents a 5m transect line. The five locations we surveyed include Little Moose Island, Big Moose Island (Sheltered and Exposed), and the East and West side of Schoodic Peninsula. We are defining Sheltered as protected from the open sea and prevailing winds, while Exposed is facing towards it.

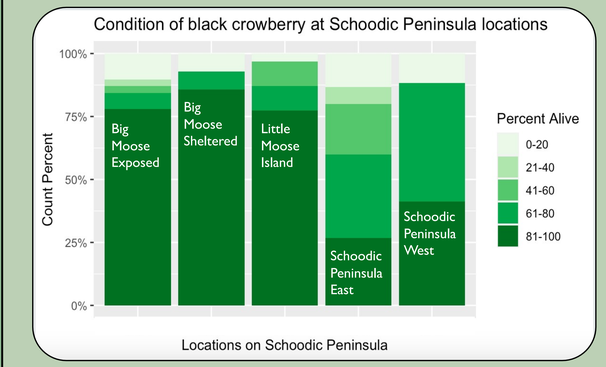
Results

- A total of 166 transect lines were laid over patches of black crowberry between all five locations.
- The preliminary results of abundance and condition of black crowberry are presented here; phenology data are not yet reported.

Box and whisker plot comparing the range of average cover percent of black crowberry at each location surveyed. The horizontal black bars indicate the median cover percent.

All locations had varying ranges of percent cover. However, LM had the highest median cover percent at 55%. BME, SPE and SPW all had medians below 50%, and BMS had the lowest at 16.6%.





Stacked bar plot comparing the condition of black crowberry at each location surveyed.

The larger the bar, the higher the count of transect lines in each "Percent Alive" bin.

More than 75% of the black crowberry surveyed on LM and both BM locations were 81-100% alive. Only 25% of the black crowberry at SPE and 41% at SPW were 81-100% alive.

Conclusions

- Our research shows that Little Moose Island and the coastline of Big Moose Island are currently excellent habitats for black crowberry and have a strong potential to operate as refugia in the future, making them high-priority sites for continued monitoring and management.
- Taken together, abundance and percent alive (condition) can tell us where refugia for black crowberry exists on Schoodic Peninsula. It is crucial to monitor these metrics over time to see how black crowberry reacts to climate change and determine if these areas continue to be refugia for black crowberry.

Further Research Recommendations

- Going forward, we recommend revisiting these five locations each year and expanding upon the surveyed areas by collecting data along the entirety of the Schoodic District of Acadia National Park coastline and inland.
- We also recommend recording the absence of black crowberry if it is not observed at a specific site to get a complete picture of where it is found.

Acknowledgments

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Literature cited

[1] USGS. (2020, June 1). *Climate-Change Refugia Special Issue: Buying Time for Biodiversity to Adapt in a Changing World.* Climate-change refugia special issue: Buying time for biodiversity to adapt in a Changing World.

[2] Smetzer, Jennifer and Morelli, Toni Lyn, (2019). "Incorporating Climate Change Refugia Into Climate Adaptation in the Acadia National Park Region" Article, Smith College, Northampton, MA.