

The Bees' Needs

Identifying Suitable Habitat for *Colletes validus* on Cape Cod and the Islands

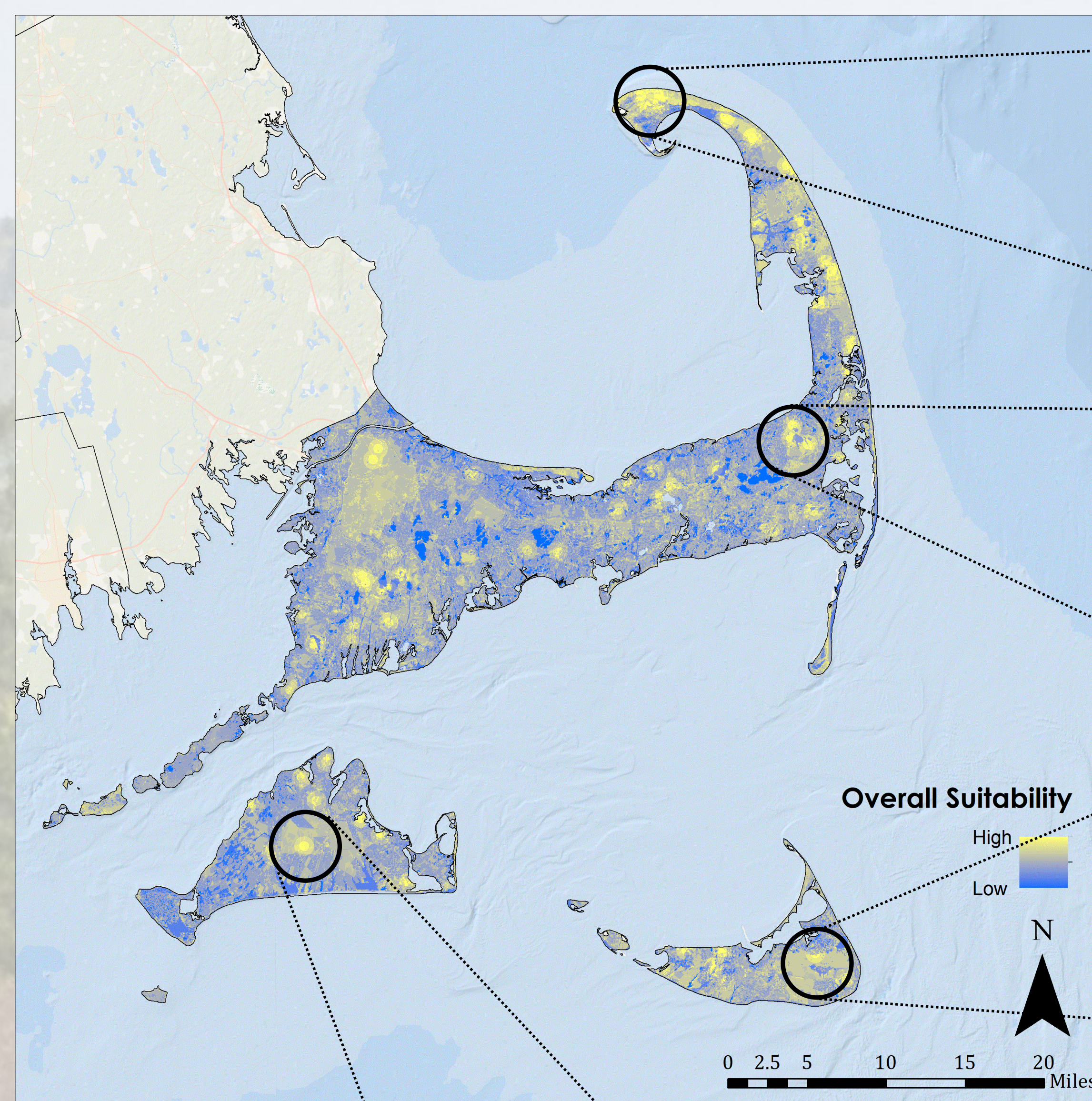


Introduction

Wild bees are ecologically and economically important insects that contribute substantially to pollination of both crops and wild plants. Even so, the ecology of most wild bee species is largely unknown. Building comprehensive knowledge of wild bee ecology is essential for development of conservation strategies that effectively support maximum diversity of wild bees in the face of habitat loss, climate change, and other anthropogenic threats.

Field-work-based research is key to improving our understanding of bee ecology. Studying species at multiple sites is useful for capturing variation that may exist among populations. Detailed research of bee ecology requires location of bee nesting areas. Unfortunately, nests of wild bees are often difficult to detect. Most species are solitary, with single females constructing nests in locations that can be difficult to identify.

In New England, cellophane bees of the genus *Colletes* present an ideal study system. These ground-nesting bees form conspicuous aggregations in patches of bare soil, with large numbers of females nesting in close proximity. The goal of this project is to identify areas that are suitable both as field research sites and as habitat for *Colletes validus*, a widespread and easily-identifiable northeastern *Colletes* species¹. Documentation of *C. validus* in Massachusetts is somewhat sparse, but the species is known from Cape Cod and Martha's Vineyard and could possibly occur on Nantucket.



Cape Cod National Seashore
This is a large protected area with substantial potential *Colletes* habitat. However, research may not be feasible if aggregations are in off-limits areas in dunes.



Nickerson State Park
This location is largely forested, but occurrence of *Vaccinium* suggests existence of open patches that could host *Colletes*, perhaps around campgrounds.



Middle Moors
C. validus has yet to be found on Nantucket, but the open, sandy habitat and low, scrubby vegetation in this conservation area could be a likely location to search.



Manuel Correllus State Forest
Sandy soil, patches of blueberry, and open areas maintained for rare plants and insects make this a good site to look for *C. validus* on Martha's Vineyard.

Methods

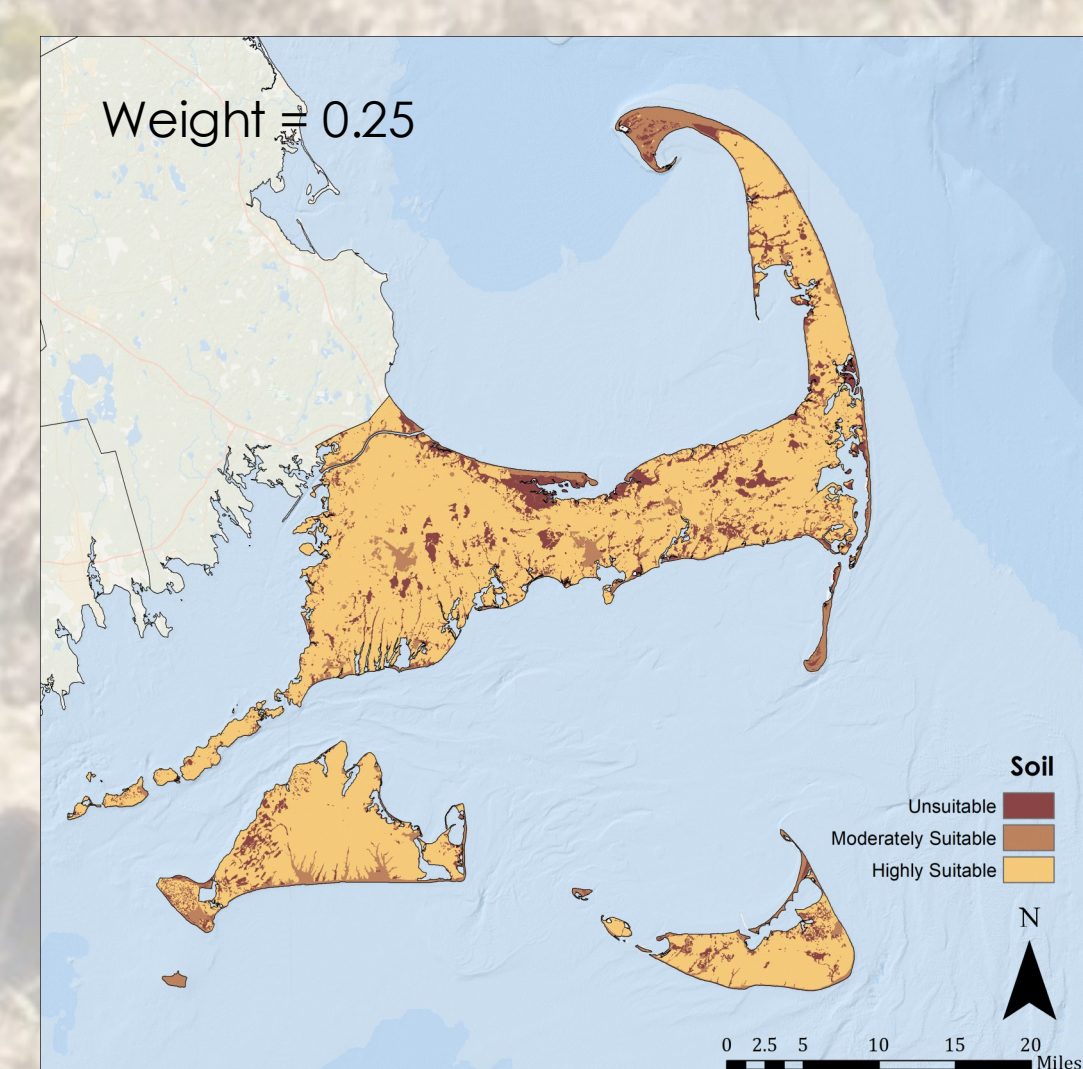
This analysis assessed habitat and field site suitability based on five factors: soil, land use, land protection, land cover (NDVI), and proximity to observations of blueberry (*Vaccinium*), the host plant of *Colletes validus*. Soil, land use, and land protection data were obtained from MassGIS, NDVI was calculated from the USGS Landsat 8 dataset, and blueberry occurrence data was obtained from the iNaturalist citizen science database. Observations of *Vaccinium macrocarpon* and *V. oxycoccos* were removed from iNaturalist data, as these species are not known to be used by *C. validus*. Each factor was classified in three categories and mapped in a 30m x 30m raster. These were weighted and summed to produce a final suitability raster.

Results and Conclusion

This analysis identifies several areas on Cape Cod, Martha's Vineyard, and Nantucket that could provide usable field sites for studying *Colletes validus*. Although suitable soil for *Colletes* nesting exists in most parts of Cape Cod and the Islands, NDVI indicates that only a small portion of this area is bare ground or open space that is actually conducive to *Colletes* aggregations. Consideration of land use further limits the number of plausible locations, as much of the Cape and Islands is residential property where research cannot be conducted. Fortunately, numerous well-protected conservation areas also exist, including state parks and forests and the extensive Cape Cod National Seashore. Inclusion of blueberry occurrence

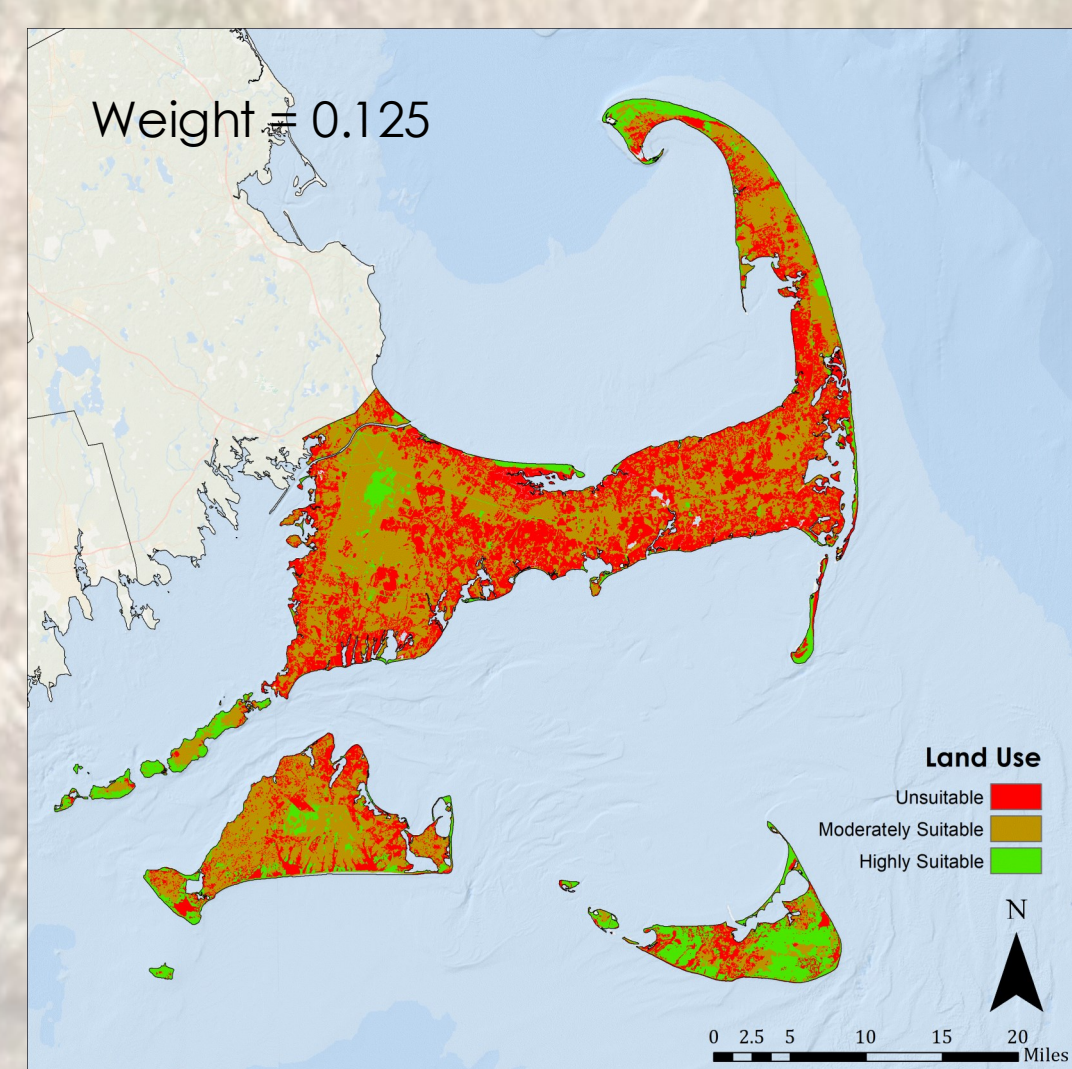
data provides additional confirmation of the quality of habitat at some sites.

Further analyses could build on this study to target suitable *Colletes* habitat by refining some of the criteria used here. Finer-scale soils classification would eliminate unsuitably rocky sites while ground-truthing of NDVI would allow for improved differentiation between vegetation communities and densities and between bare ground and impervious surfaces. Finally, digitized herbarium records could provide additional extensive and reliable information about blueberry occurrence.



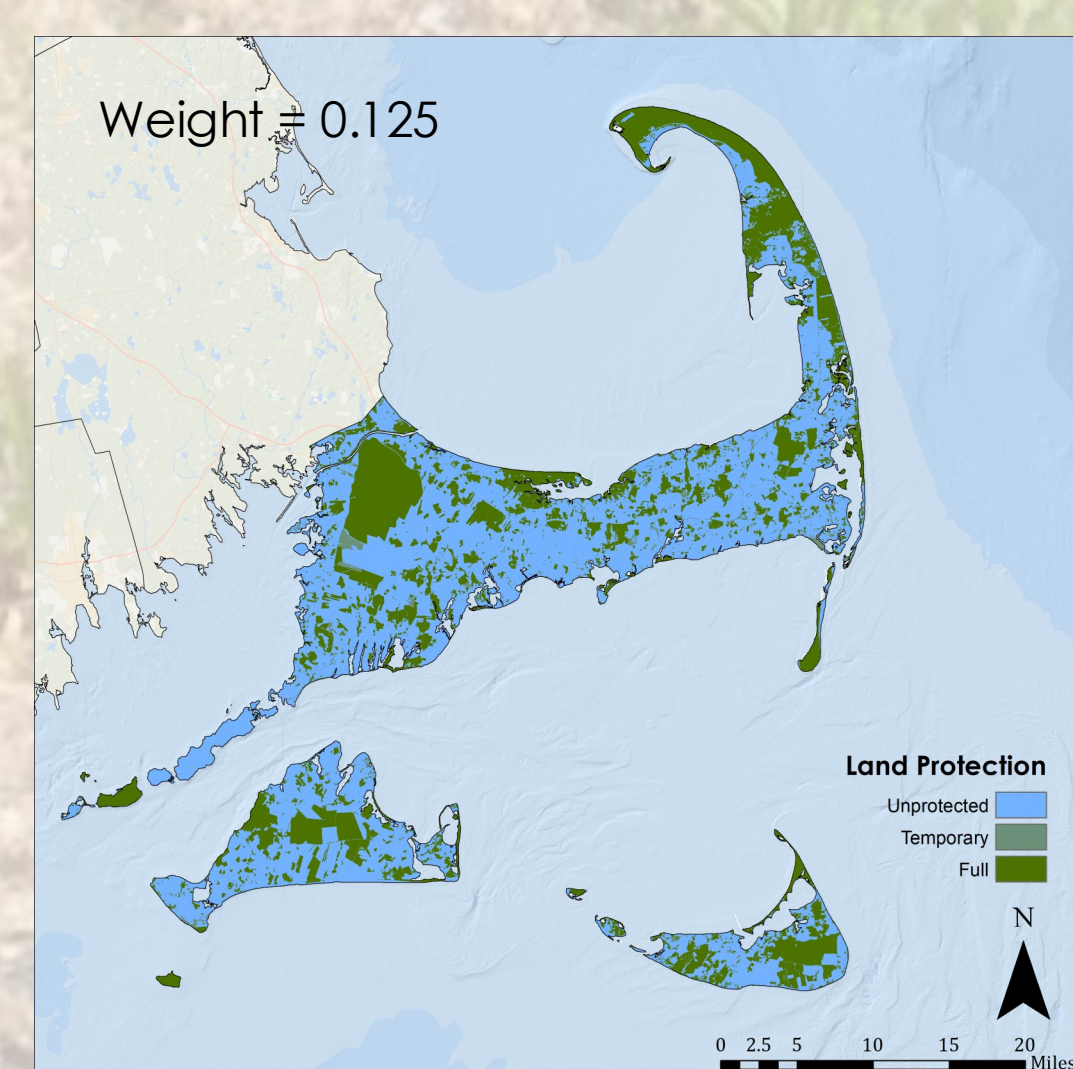
Soil

Colletes are ground-nesting bees that primarily utilize loose, sandy soils¹. In New England, these soils tend to be glacial in origin. Although *Colletes* occasionally nest in non-sandy soils, wet soils and bedrock are entirely unsuitable.



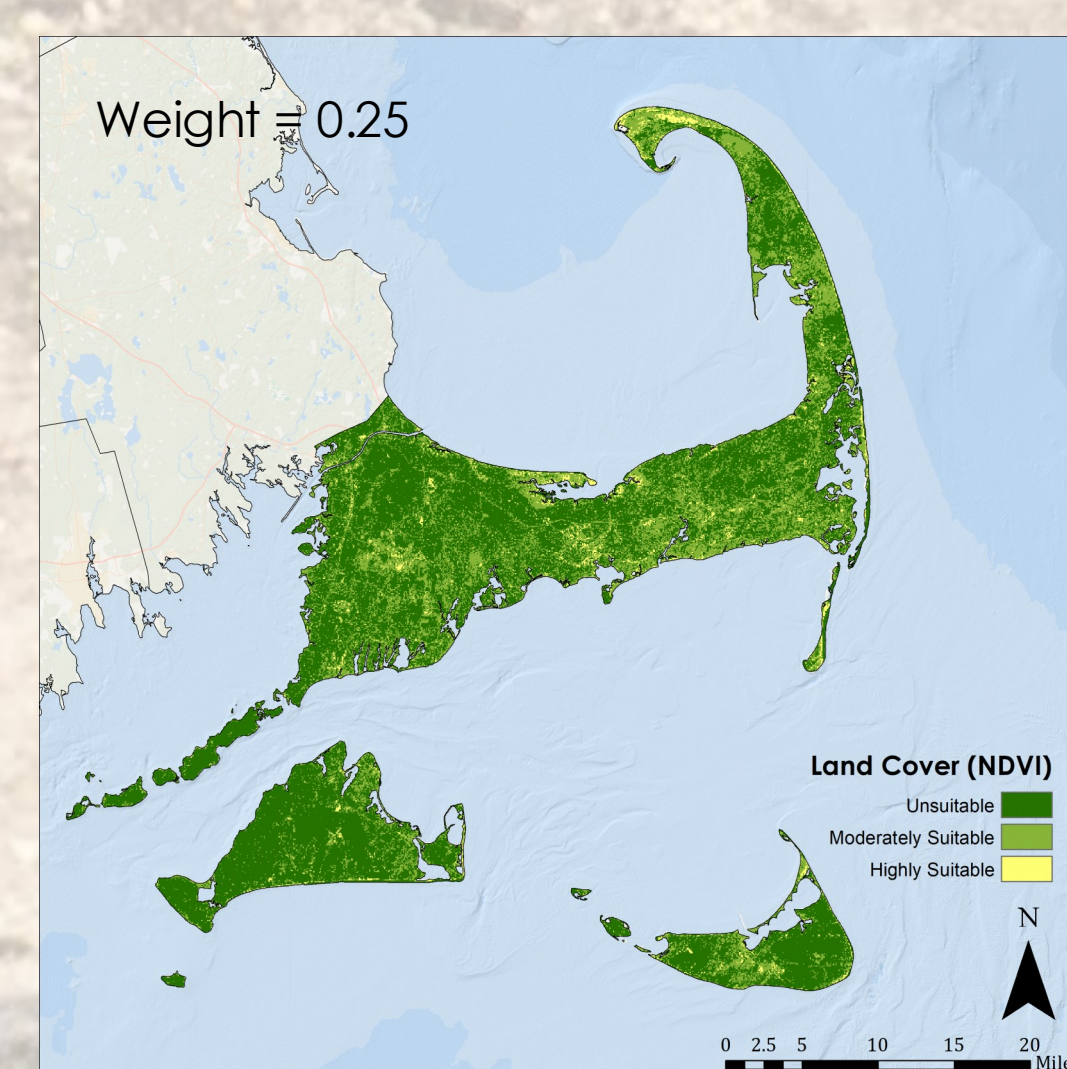
Land Use

Land use can suggest the suitability of a site for *Colletes* as well as accessibility for field research. Open sites provide ideal nesting locations for *Colletes*, but private uses may prevent researchers from accessing some areas.



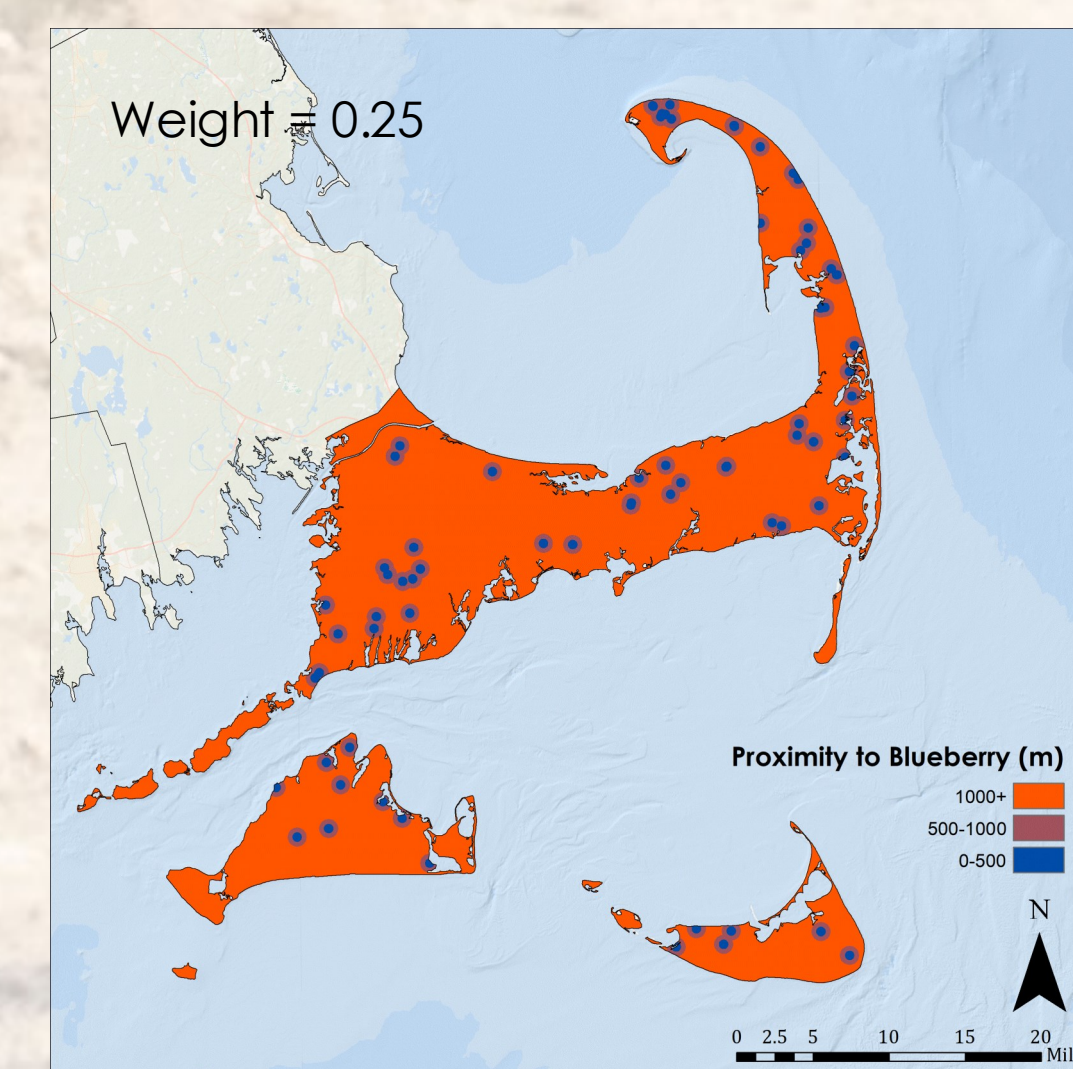
Land Protection

Land may be under permanent protection, temporary protection, or lack official legal protection altogether. Long-term ecological research depends on data collection in multiple years, so increased protection improves field site viability.



Land Cover (NDVI)

Normalized difference vegetation index (NDVI) is an indicator of land cover that is calculated from satellite data based on reflective properties of water, ground, and vegetation. *Colletes* prefer bare ground to vegetated areas and avoid wet soils.



Proximity to Blueberry

Colletes validus is a dietary specialist, collecting pollen only from blueberry (*Vaccinium*) flowers¹. Presence of blueberry within foraging distance (1000 meters maximum)² of nesting sites is an essential component of suitable habitat.

References: 1. Batra, S. W. T. J. *Kansas Entomol. Soc.* **53**, 509-538 (1980). 2. Zurbuchen, A., Landert, L., Klaiber, J., Muller, A., Hein, S., and Dorn, S. *Biol. Conserv.* **143**, 669-676 (2010).

Data Sources: MassGIS, USGS, iNaturalist

Projection: Lambert Conformal Conic

Coordinate System: NAD 1983 State Plane Massachusetts Mainland FIPS 2001 (m)

Photos: National Park Service, K. A. Omand (Nantucket Conservation Foundation), Ray Ewing (The Vineyard Gazette), Max McCarthy

Cartographer: Max McCarthy **Class:** GIS 101

Date: December 16, 2019