An Assessment of the Frenchmen Bay Community Forest for Migratory Birds

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AN ASSESSMENT OF THE FRENCHMEN BAY COMMUNITY FOREST FOR MIGRATORY BIRDS

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Biodiversity Research Institute (BRI) is a 501(c)(3) non-profit organization located in Portland, Maine. Founded in 1998, BRI's mission is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers.

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FRONT PHOTO*: Canada Warble. Photo credit: Ed Jenkins/BRI*

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1. Executive Summary

The Silver Maple Wind Project is a 20-megawatt wind energy facility proposed for Clifton, Maine. The Project will be developed, owned, and operated by SWEB Development USA, LLC. SWEB plans to make a financial contribution to the Frenchman Bay Conservancy (FBC) to mitigate the potential impact to migratory songbirds from the Project. FBC will use this contribution toward purchasing roughly 566 hectares (1,400 acres) of land in Hancock, Maine (known as the Frenchman Bay Community Forest), adjacent to existing conserved land. This contribution is a critical component toward the viability of the FBC project, being the final contribution that will allow the project to proceed. The property will have a "forever wild" conservation easement, and after initial thinning, FBC will use a passive land management approach to maintain the property.

In early July, Biodiversity Research Institute (BRI) conducted a breeding bird survey on the Frenchman Bay Community Forest to develop a baseline of habitat use during the breeding season. In response to a request from SWEB, BRI, with support from Deborah Perkins of First Light Wildlife Habitats, then conducted this desktop study to assess how migrating birds could use this property. The objectives were to describe the habitat; determine how migrating birds use the habitat; identify the migratory songbirds that may use the habitat; and provide a qualitative assessment on how the habitat may change over a 30-year time horizon.

The Frenchman Bay Community Forest comprises multiple habitat types, predominantly mixed forest, with smaller pockets of deciduous forest and evergreen forest, including patches of dense black spruce (*Picea mariana*). Examination of time series aerial imagery indicates that much of the property has been harvested for timber over the last 20 years. This harvest has resulted in areas of early successional forest and multiple patches of low herbaceous habitat.

The parcel likely provides value to migrants passing through the area through both extrinsic and intrinsic qualities. Proximity to the coast offers value to birds at the beginning or end of an overwater migration across the Gulf of Maine, and the various forested and wetland habitats provide the opportunity to rest and refuel for at least a short period for some species. BRI conducted a literature review that suggests habitats at the site could have moderate to high relative use by migrating birds in the region. Based on eBird data collected from the surrounding area, the property could provide habitat for up to 100 species during migration. Common migrants that may use the property include species like the Black-throated Green Warbler (*Setophaga virens*) and Yellow-rumped Warbler (*Setophaga coronata*).

Over the next 30 years, changes in the parcel are expected to vary by habitat. Based on current soil type and inundation, wetlands on the property will likely persist, although the effects of American beaver (*Castor canadensis*) activity and climate change for such habitats make forecasting challenging. With a passive management approach, the young and intermediate forest habitats (that currently comprise 97% of the property) should mature to older age classes, characterized by increased canopy height, greater canopy closure, and an increase in the stratification and complexity of the forest structure (especially in areas that experience natural disturbances). The existing early successional habitats associated with old skid trails and even-aged harvesting methods will become less available, while natural disturbances will reset forest succession in other patches. These changes will alter how migrating birds are expected to use the site. The succession of regrowing intermediate forest habitat will likely create more structure and increase usage, while regrowth of cut forest into intermediate stages is likely to reduce usage. The reduction in early successional habitat could change the community of birds using this site during migration, lowering the number of species that prefer open habitats like sparrows. While mature forest would likely support more migrants, the suite of species would probably be similar to those that currently use the intermediate forest. It is unclear whether these anticipated changes will change bird use overall; the rate of increase in structural complexity in intermediate compared over time relative to the decrease in early successional habitat and forest edge will likely be a large determinant of overall use. Irrespective of the changes to habitat qualities intrinsic to the site, the property's extrinsic value based on proximity to the Gulf of Maine coast is persistent; this likely stabilizes bird-use as the need for usable habitat before or after barrier crossing will not diminish over time.

2. Introduction

The Silver Maple Wind Project (hereafter "Project") will be a twenty (20) megawatt wind energy project, located in Clifton, Maine, directly adjacent to the existing Pisgah Mountain Wind Project. The Project will be developed, owned, and operated by SWEB Development USA, LLC. The Project will consist of five V136 turbines, which will stand on steel towers either 105 meters (344.5 ft) in height, or 117 meters (383.8 ft) in height (see Project application materials for further details[1]).

SWEB plans to make a financial contribution to the Frenchman Bay Conservancy (FBC) to mitigate potential impact to migratory songbirds from the Project. FBC will use this contribution toward the purchase of roughly 566 hectares (1,400 acres) of land in Hancock, Maine (named the Frenchman Bay Community Forest), which is adjacent to existing conserved land. The contribution from SWEB will be used to finalize the purchase and protection of the property. This parcel was selected because of the region's high value to migratory birds and the synergies with existing conservation efforts in the area. The Frenchman Bay Community Forest will have a "forever wild" conservation easement, which will not allow timber harvesting or any "mechanized" vehicles on the property. FBC does intend to request funding to conduct thinning to accelerate the succession to a more mature forest. After the initial thinning, however, FBC will use a passive land management approach.

Michael Carey, Development Manager at SWEB Development, initially contacted the Biodiversity Research Institute (BRI) on June 16, 2020, to discuss the property's value to songbirds. SWEB and BRI agreed that a simple breeding bird survey would provide important baseline information on the songbirds currently using the property. BRI field biologists were provided access to the property on July 1, by Aaron Dority, Frenchman Bay Conservancy Executive Director, and conducted 120-point counts over the mornings of July 2nd and 3rd, which detected 54 avian species.

The Maine Department of Environmental Protection (DEP) then requested that SWEB assess the property for migrating bird use. BRI was initially contacted by SWEB on November 16, 2020, and subsequently, SWEB and BRI had a call with the DEP on November 18, 2020. On the call, the group determined that a desktop study was needed to assess how migratory birds are using the existing habitat. In reviewing a scope of work for the assessment on November 30, 2020, the DEP emphasized the need to identify how the property may change through time and how this will potentially change the property's use by migratory birds.

The following assessment objectives were to describe the existing habitat, determine how the birds may use the habitat, identify the migratory songbirds that may use the habitat, and provide qualitative predictions on how the habitat will change over a 30-year time horizon. BRI conducted the desktop assessment with support from Deborah Perkins of First Light Wildlife Habitats.

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[1] https://www.maine.gov/dep/land/projects/silver-maple/index.html

3. Methods

We assessed the use of the Frenchman Bay Community Forest by (1) describing the existing habitat, (2) determining how birds may use the habitat, (3) identifying which migratory songbirds may use the habitat, and (4) provide qualitative predictions on how the habitat will change over a 30 years.

To describe existing habitat, we used spatial GIS and remote sensing data, including data from the Maine Office of GIS, and information from site visits. The spatial data encompassed a suite of publicly available and requested datasets; including Beginning with Habitat (BwH), LANDFIRE's Canopy Forest Height, Maine Natural Areas Program (MNAP) data, the National Land Cover Database (NLCD), Nature's Network data, the National Wetlands Inventory (NWI), and the gridded Soil Survey Geographic (gSSURGO) database (Table 1). The field observations included a summary of a site visit by the Maine Natural Areas Program in 2019; and habitat descriptions, photographs, and results of a breeding bird survey conducted by BRI in July of 2020. These datasets were first used to describe and map the current distribution and characteristics of the primary habitat types on the Frenchman Bay Community Forest parcel. Secondly, the spatial data allowed the parcel to be better understood within the broader landscape by using the regional datasets, such as Beginning with Habitat (BwH) and Nature's Network.

Table 1: Sources of spatial data using in habitat assessment of Frenchman Bay Community Forest

Data Sources	Description	More information
Beginning with Habitat (BwH)	A collaboration of federal, state, local agencies, and governments providing landowners and municipalities with landscape scale habitat data to assist in long-term conservation planning	https://www.maine.gov/ifw/fish-wildlife/wildlife/beginning-with-habitat/index.html
LANDFIRE Canopy Forest Height	Average height of the top of the canopy in forested areas.	https://www.landfire.gov/ch.php#:~:text=LANDFIRE%27s%20%28LF%29%20Forest%20Canopy%20Height%20%28CH%29%20describes%20the,These%20products%20are%20provided%20for%20forested%20areas%20only.
Maine Natural Areas Program (MNAP)	A comprehensive source of Maine's important natural features, including rare and endangered plants, rare natural communities and ecosystems, and outstanding examples of more common natural communities and ecosystems	https://www.maine.gov/dacf/mnap/
National Land Cover Database	A nationwide database of land cover at a 30 meter resolution	https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover&f%5B1%5D=region%3Aconus
USFWS Nature's Network	A collaboration of states, federal agencies, NGOs, and Universities to identify opportunities for ecosystem conservation and connectivity	http://www.naturesnetwork.org/
National Wetland Inventory (NWI)	A nationwide database from the USFWS detailing location and characteristics of wetlands	https://fws.gov/wetlands/
USDA-NRCS gridded Soil Survey Geographic (gSSURGO) database	A nationwide database of the most detailed geographic soil data developed by the National Cooperative Soil Survey (NCSS)	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628

Based on the habitat identified on the property, we gathered estimates of habitat use by migratory birds from relevant geographic areas in the literature. We then translated the study results into an assessment of habitat use in each of the NALCD land cover categories using succession stages. Many studies did not assess all habitat types; each represents an assessment of the relative importance of the habitat within the study's set. Studies in the northeastern United States that described habitat use during migration were selected. We determined what habitats (categorized by NALCD land cover category and successional stage) were sampled in the data then summarized each study's results. When the study

provided an analytical method for comparing the use of the habitat, we compiled the results. For simplicity, habitats were ranked in three categories: high, low, and uncertain. 'High' and 'low' were applied when habitats were used at higher or lower rates from the others tested in the study, and 'uncertain' was applied when the study had unclear results. No category was assessed when the habitat was not available to be compared in the study.

To describe the species of migratory birds expected to use the property, we used eBird[2] data for Hancock County, Maine. Administered by the Cornell Lab of Ornithology to aid citizen scientists in their record-keeping and gather information on avian ecology, eBird is the largest source of bird data in the world. eBird data from geographically proximate locations and similar habitats offer a reasonable proxy for bird presence and behavior at this property. Observers reported hundreds of thousands of observations in Hancock County in eBird, and this database provides an excellent resource for establishing what species of birds are present in the area, and when, as well as providing estimates of relative abundance. Data are validated using algorithmic QA/QC practices and a panel of reviewers when observations are flagged as unlikely. While eBird represents many observations, they are semi-structured data that have biased collection processes that lead to potential issues with: (1) observer error, (2) location accuracy, (3) preferential sampling of species, (4) preferential sampling of locations, and (5) precise estimation of survey biases like detectability (Johnston *et al.* 2019).

We downloaded the eBird Basic Dataset and selected all checklists from Hancock County using R and the 'auk' library (R Core Team 2019, Strimas-Mackey *et al.* 2018). We then removed any checklists prior to 2010, and any incomplete checklists. We also filtered out any checklists that used a protocol other than stationary or traveling counts, to avoid incomplete records. Of the resulting species detected in the county, we assigned each to one of two groups, based on knowledge of their life history using Billerman *et al.* (2020). The two groups were 'short-distance migrant or resident' (species whose population remains primarily within the U.S. throughout their annual cycle) or 'Neotropical migrant' (species whose population leaves the U.S. in the boreal winter). Within each group, we ranked all species by the number of checklists on which they were detected. For the 30 Neotropical migrant species most frequently detected in Hancock County, we calculated the mean number of individuals detected. We reviewed the eBird species list and then, using professional judgment, identified other species that we expect to use the property during migration that we felt were not detected by citizen scientists contributing to eBird.

There is significant uncertainty on how the property will change over a 30-year time horizon, due to a lack of site data to inform how the inherently variable process of forest succession will advance. Forecasting change over time is further complicated by the unknown and significant long-term influences of climate change on forest dynamics. Deborah Perkins of First Light Wildlife Habitats reviewed the information on the existing habitat, considered that the property would be managed through passive management, and provided an assessment, using professional judgment, on how the forest communities in this part of Maine are likely to change over time. The evaluation included suggestions of how migratory bird use of the property may to change as the forest structure changes.

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4. Results and Discussion

4.1. Property Information

4.1.1.Property Landscape Context

The Frenchman Bay Community Forest will provide stopover habitat for migratory birds within the Downeast Coastal Plain landscape. The property is a block of relatively unbroken forest with a few notable parcels of conserved land in the surrounding area. Notably, FBC and the New England Forestry Foundation coordinate the conservation of an adjoining 1,254-hectare (3,100 acre) block. The two organizations intend to work together to ensure the long-term conservation objectives for the two properties. Bordering that adjoining parcel is an additional 109-hectare (270 acre) Fletcher's Landing Vernal Pools parcel. A block of parcels forming the Kilkenny Cover Preserve is 2.4 km (1.5 mi) to the south. In addition, the Frenchman Bay Community Forest is located approximately 2.1 km (1.3 mi) from Franklin Memorial Park, a 152-hectare (375 acre) community park. Finally, the parcel is within 8 km (5 mi) of the Lyle Frost (Scammon Marsh) State Wildlife Management Area.

The habitats in the area surrounding the Frenchman Bay Community Forest include several areas designated as Exemplary Natural Communities by Beginning with Habitat (BwH; Beginning with Habitat 2019; Figure 1). A black spruce woodland and a salt-hay saltmarsh are to the south in conjunction with the Kilkenny Cove Preserve. In addition, a pipewort-water lobelia aquatic bed is in Great Pond to the northeast of the Frenchman Bay Community Forest. The southern end of the parcel abuts the Taunton Bay Focus area as defined by BwH. These focus areas are notable due to the concentration of at-risk species and natural communities and high-quality common natural communities, significant wildlife habitats, and their intersection with large blocks of undeveloped habitat at a landscape scale.

The landscape in which the parcel sits supports multiple areas classified as Inland Wading Bird and Waterfowl Habitat, a habitat that will also provide stopover habitat for Neotropical migrants. Notably, these areas include the habitat adjacent to the southwest of the property along the drainage flowing along the western boundary of the parcel and into Kilkenny Cove. In addition to these natural communities, the surrounding area includes multiple state-listed wildlife habitats and known locations of rare, threatened, endangered, or declining species. Taunton Bay and Kilkenny Cove are each less than one mile from the parcel, and both are entirely classified as Tidal Wading and Waterfowl Habitat and contain multiple areas of Shorebird Habitat. Both of these habitats also support multiple areas that are known locations for Bald Eagle (*Haliaeetus leucocephalus*). There are two nearby areas, to the southwest and north of the parcel, respectively, that support Great Blue Heron (*Ardea herodias*), a species of special concern. Last, to the south of the parcel is an area that supports the odonate, Arrowhead Spiketail (*Cordulegaster obliqua).*

While not directly related to migratory birds, it is worth noting that scattered small Deer Wintering Areas (DWAs) mapped by the Maine Department of Inland Fisheries and Wildlife (MDIFW) are present in the area, including a block that overlaps with the Frenchman Bay Community Forest parcel. These "candidate significant wildlife habitats" are used as shelter by deer in cold conditions and deep snow (Beginning with Habitat 2019). The Maine Natural Areas Program (MNAP) also notes that the adjoining parcels contain Atlantic Salmon (*Salmo salar*) critical habitat and that Egypt Stream, West Branch Egypt Stream, Kilkenny Stream, Hapworth Brook, and their tributaries support populations of wild brook trout (*Salvelinus fontinalis*; MNAP 2020).
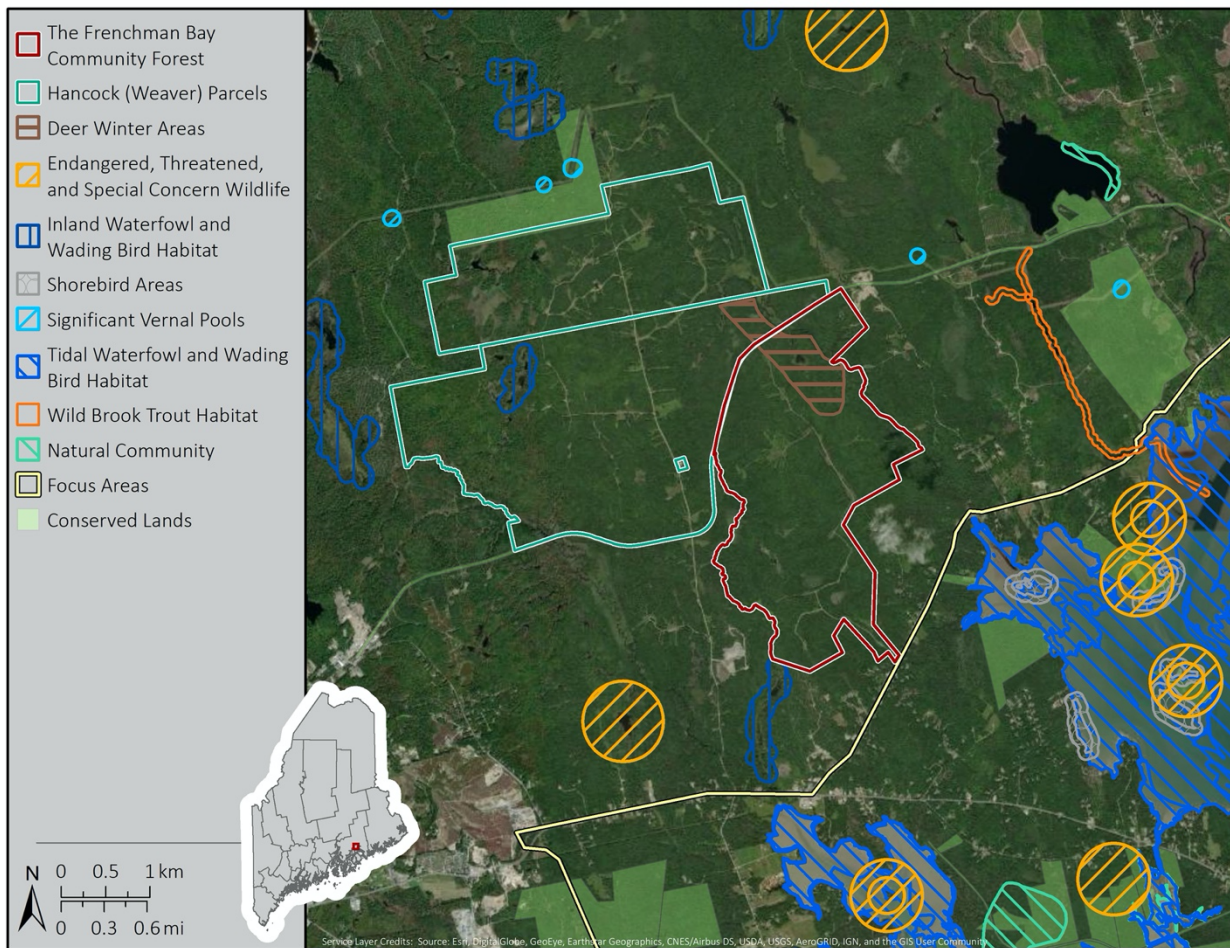
Figure 1: Important Natural Communities and Habitats in the landscape surrounding the Frenchman Bay Community Forest.

4.1.2. General Property Description

The Frenchmen Bay Community Forest is located in Hancock County, Maine (Figure 2). The property is approximately 588 hectares (1,455 acres) and is almost entirely within the Town of Hancock, a small corner in the northeast falls within the Town of Franklin. The confluence of the Main and West Branches of the Egypt Stream meet in the northeastern part of the property and form part of the eastern boundary before draining into nearby Egypt Bay. The western section of the Down East Sunrise Trail forms the property's northern and northeastern boundary, while the remaining boundaries are private property. Vehicular access to the property is from SR 182 on the southern side. The main branch of the existing road cut generally runs north from SR 182 through the parcel's heart and is approximately 4.7 km (2.9 mi). This road anchors a network of shorter road cuts branching from this main cut.

Much of the property, centered in the west and north of the parcel, is classified as terrestrial core area by USFWS analysis (U.S. Fish and Wildlife Service 2018; Appendix A). The USFWS defines core areas as including intact, resilient examples of major ecosystems, rare natural communities, and important habitat (U.S. Fish and Wildlife Service 2018). They are important habitats for species that are sensitive to disturbance and fragmentation (e.g., Wood Thrush, *Hylocichla mustelina*). The southern part of the parcel transitions from core to terrestrial core to core connector habitat linking the parcel to conserved core habitat to the south and a large block of core habitat in the northeast quadrant of Fletchers Landing Township to the north of the parcel.
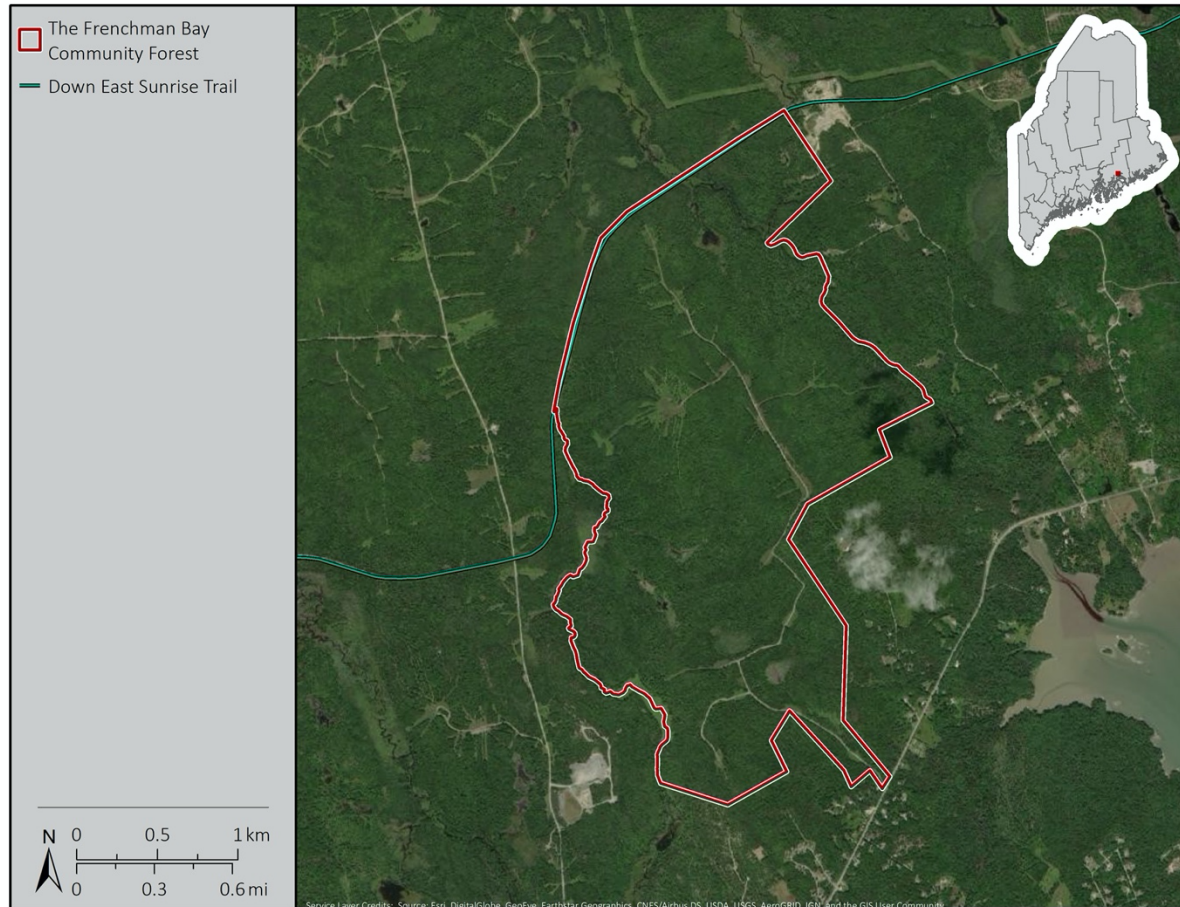
Figure 2: Frenchman Bay Parcel Location.

4.1.3. Description of Existing Habitat

The Frenchman Bay Community Forest is in a region influenced by a wet, cool climate that supports forests containing a large percentage of spruce and fir (Griffith *et al.* 2009). The property supports multiple habitat types, predominantly mixed forest, with areas of deciduous forest (primarily in the northern half) and evergreen forest, including patches of dense black spruce (*Picea mariana*). Such diversity provides habitat and resources for many bird species while on migration.

Soil Types

There is a total of 14 different soil types in the Frenchman Bay Community Forest parcel (Appendix A; Figure A1). The Scantic-Biddeford complex (0 to 3 percent slopes) is found on 200.5 hectares (459.5 acres; 34.0% of the parcel). Generally, these soils are deep and level with a high-water table (USDA & NRCS 1998). In this parcel, they are found along the drainage on the western boundary and along sections of Egypt Stream and its tributaries. There are also Marlow-Peru association (3 to 15 percent slopes, very stony) and Scantic-Lamoine-Peru complex (0 to 8 percent slopes, very stony) soils that comprise 114.3 hectares (282.5 acres; 19.4%) and 109.2 hectares (269.9 acres; 18.5%), respectively. Both of these soils are associated with glacial till ridges. These three types total 72% of the parcel, with no other soil type having more than 10% coverage. Generally, the diversity of soils on the parcel supports a heterogeneous mix of plants, from those associated with emergent wetlands to upland forests, that provide a range of habitat types for migratory birds and other wildlife.

Land-use history

Examination of aerial imagery time series data indicates that much of the property has been harvested for timber over the last 25 years. The former land manager of the property (Ralph Hosford) suggests that the most recent logging was likely in the early to mid 1990's (Aaron Dority *personal communication*, December 9, 2020). Throughout the property, timber harvesting has resulted in extensive areas of early successional and intermediate-aged forest, and multiple patches of low herbaceous habitat and forest openings in former log landings and skid trails concentrated along the main woods road that runs North to South, through the center of the property. A site visit by the Maine Natural Areas Program (MNAP) in 2019 confirmed the network for logging roads, skid trails, and log landings associated with this activity are still present today (MNAP 2019; Figure 2 and Figure 3). These findings were confirmed by BRI staff during the breeding bird survey.

Figure 3: An example of one of the many skid trails left by heavy forestry equipment. These corridors of early successional forest provide habitat for migrating songbirds including warblers and sparrows. Photo by Ed Jenkins.

Forests

The parcel is mostly upland forest in young to intermediate age classes, dominated by red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), yellow birch (*Betula alleghaniensis*), gray birch (*Betula populifolia*), and quaking aspen (*Populus tremuloides*), reflecting the previous logging activity (MNAP 2019). The National Land Cover database (NLCD) classifies the majority of the parcel as mixed forest (305.6 hectares [755.2 acres], 53.3% of the parcel; Table 2, Figure 4). An additional 20.6% of the parcel is composed of deciduous forest (92.4 hectares [228.4 acres]), predominantly located in the northern half of the parcel. The remaining area is classified as evergreen forest and is found in small scattered stands, totaling 28.7 hectares (70.91 acres).

Table 2: Area of cover types for the Frenchman Bay Community Forest derived from the National Land Cover Database (NLCD). Please note: the land cover type that is classified as Shrub/Scrub by NLCD below is considered as young forest habitat in the seedling /sapling stage for the purposes of this assessment.

Habitat Type	Area (hectares)	Percent Cover
Open Water	1.8	0.3%
Barren Land	0.5	0.1%
Deciduous Forest	92.4	15.7%
Evergreen Forest	28.7	4.9%
Mixed Forest	313.7	53.3%
Shrub/Scrub	81.3	13.8%
Herbaceous	3.1	0.5%
Woody Wetlands	65.2	11.1%
Emergent Herbaceous Wetlands	1.9	0.3%
Total	**588.6**	**100.0%**
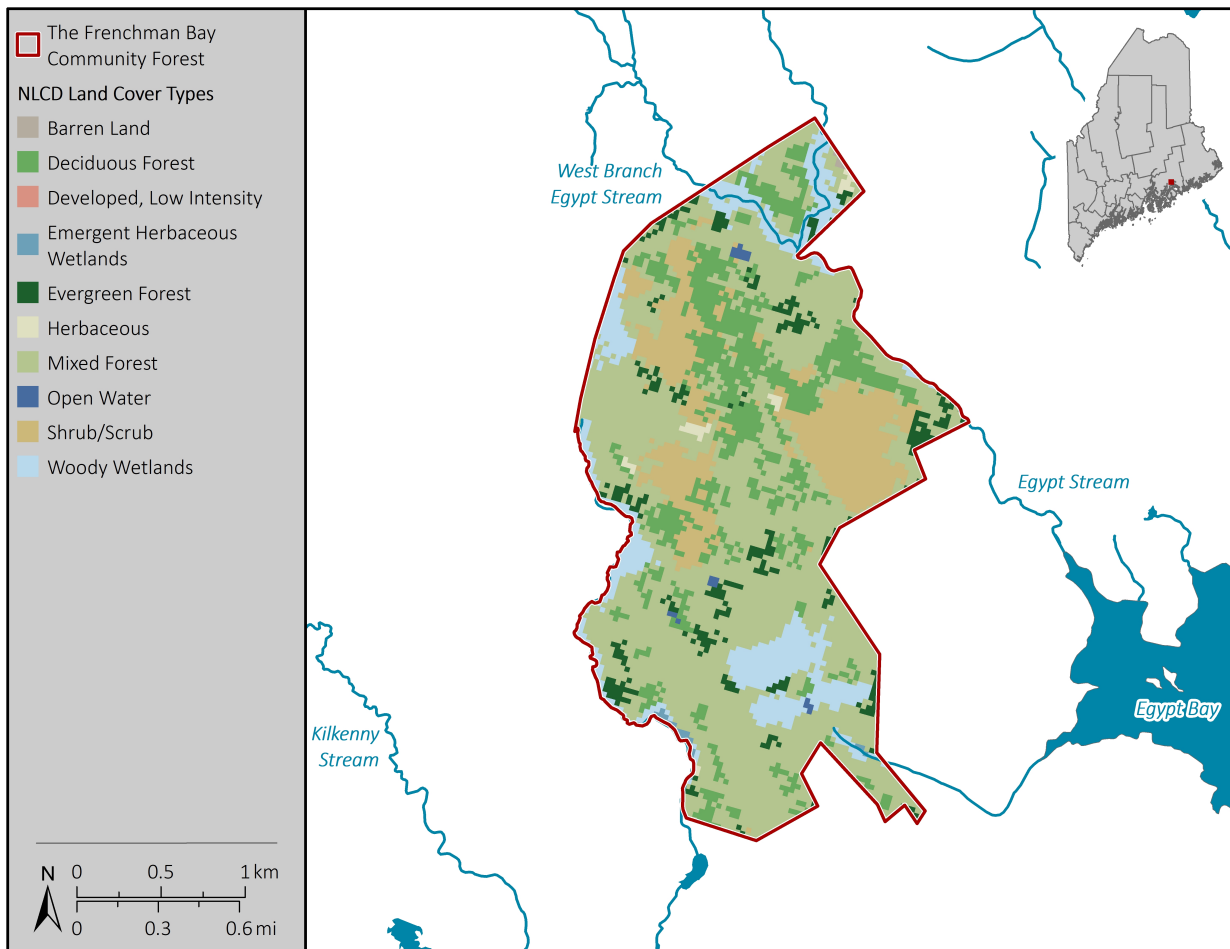
Figure 4: Existing cover types, as classified by the National Land Cover Database (NLCD) in the Frenchman Bay Community Forest.

The forest structure of the Frenchman Bay Community Forest likely reflects the parcel's history of even-aged harvests (Figure 5). Based on canopy height data, the forested habitats of the property are best described as young (early-successional) and intermediate (mid-successional; Figure 6). No forests with canopy heights over 21 m (69 ft) exist on the property. The majority of the parcel (377.2 hectares [932.1 acres], 64.1%) is classified as forest with a canopy height of between 9 m (30 ft) and 13 m (43 ft), with canopy height serving as the best proxy for forest age in the remotely acquired data. A further 114.6 hectares (283.2 acres; 19.5%) and 72.6 hectares (179.5 acres; 12.3%) are forest with canopies 5–9 m (16–30 ft) and 13–17 m (43–56 ft), respectively. Only 1.4 hectars (3.5 acres) of the entire parcel are classified as having a canopy height in the 17–21 m (56–69 ft) height class, the tallest height class found on the parcel. The evergreen stands have the highest percentage of canopy heights classified as above 13 m (43 ft; 32.7%) in comparison to the 55.1% in the 9–13 m (30–43 ft) class. By comparison, more than 75% of the deciduous forest is in the 9–13 m (30–43 ft) class. The mixed forest, which is the dominant land cover type on the parcel, is 65.4% in this 9–13 m (30–43 ft) class with an additional 23.3% in the 13–17 m (43–56 ft) class and 8.9% in the 5–9 m class (16–30 ft).
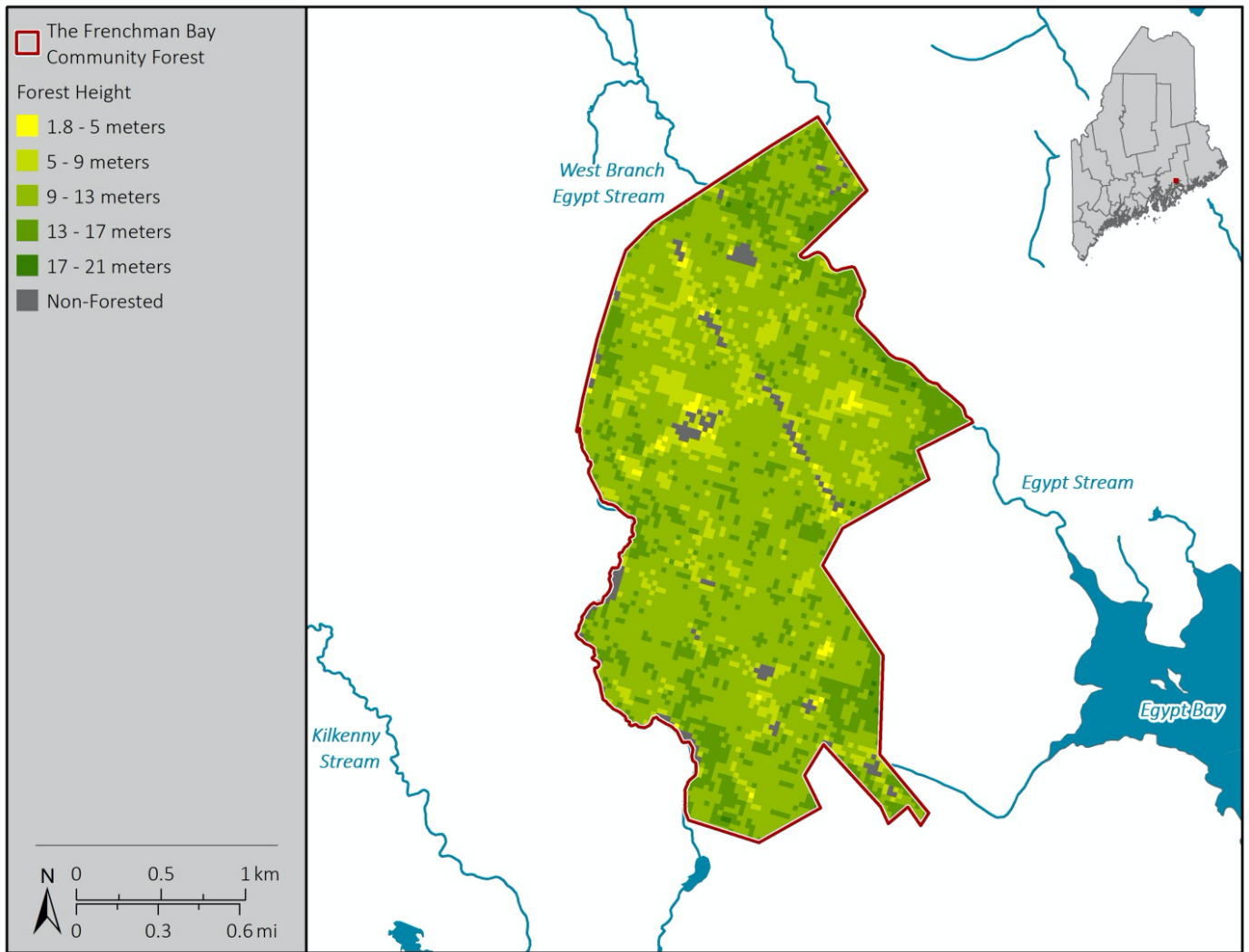
Figure 5: Forest canopy height (m) in the Frenchman Bay Community Forest.

Table 3: Summary of canopy height across habitats

Land Cover Type	Forest Height (meters)			
	Early (<9 m)	**Intermediate (9-21 m)**	**Non-Forested**	***Total***
Barren Land	0.23 (0.0%)	0.02 (0.0%)	0.91 (0.1%)	1.16 (0.1%)
Deciduous Forest	23.38 (1.6%)	201.38 (13.9%)	3.57 (0.2%)	228.34 (15.7%)
Developed, Low Intensity			0.19 (0.0%)	0.19 (0.0%)
Emergent Herbaceuous Wetlands	1.24 (0.1%)	0.19 (0.0%)	3.06 (0.2%)	4.49 (0.3%)
Evergreen Forest	8.45 (0.6%)	62.26 (4.3%)	0.02 (0.0%)	70.73 (4.9%)
Herbaceous	3.50 (0.2%)	1.37 (0.1%)	2.80 (0.2%)	7.67 (0.5%)
Mixed Forest	72.74 (5.0%)	688.09 (47.3%)	13.88 (1.0%)	774.72 (53.3%)
Open Water	0.02 (0.0%)	1.55 (0.1%)	2.87 (0.2%)	4.44 (0.3%)
Shrub/Scrub	63.01 (4.3%)	133.85 (9.2%)	4.04 (0.3%)	200.90 (13.8%)
Woody Wetlands	19.55 (1.3%)	129.98 (8.9%)	11.33 (0.8%)	160.87 (11.1%)
Total	**192.13 (13.2%)**	**1,218.71 (83.8%)**	**42.68 (2.9%)**	**1,453.51 (100.0%)**

Figure 6: Example of intermediate forest found on the property. Photo by Kevin Regan.

Wetlands

The NLCD classifies 65.2 hectares (161.1 acres) as woody wetlands. The woody wetlands land cover type had the following canopy height: >13 m (43 ft): 30.0%, 9–13 m (30–43 ft): 50.7%. This habitat type can be found primarily in three areas: along and at the junction of the main and west branches of Egypt Stream, along the drainage on the western boundary of the parcel, and in the southwestern quadrant of the parcel. The MNAP site visit noted that some of these forested wetlands had been harvested, and wetland crossings were used for access (MNAP 2019). These include a large block of woody wetlands (24.9 hectares [61.6 acres]) bisected by the main access road running through the parcel.

The parcel's remaining wetland area include small sections of emergent marsh, open water, and wet meadow in the northeastern and southern portions of the property. A system of beaver dams has created a matrix of small pools on the western boundary (Figure 4 and Figure 7). The USFWS provides the National Wetlands Inventory (NWI) data that classifies wetland areas into various more specific wetland habitats (U.S. Fish and Wildlife Service 2019). These data were updated and supplemented by MNAP during a site visit in August 2019 (MNAP 2019; Table 4). The updated wetlands include 29.9 hectares (73.9 acres) of forested (PFO), 7.9 hectares (19.5 acres) of scrub-shrub (PSS), 20.5 hectares (50.7 acres) of emergent (PEM), and 0.9 hectares (2.2 acres) of unconsolidated bottom (PUB; MNAP 2019). These wetland areas total 59.2 hectares (146.3 acres) or 10.1% of the parcel. The reduction in forested wetland from the NCLD and NWI classifications is partially driven by the transformation of scrub habitats to emergent or open water wetlands due to increased beaver activity.

Figure 7: Wetland habitat created by beaver activity in the foreground and dam in the background. The open areas and dense riparian vegetation provide habitat for migrants, including sparrows, warblers, blackbirds and shorebirds. Photo by Ed Jenkins.

Table 4: Area of habitat types for the Frenchman Bay Community Forest derived from the National Wetland Inventory (NWI) and adjusted by MNAP site visit (adapted from MNAP 2019).

Wetland Type	Area (hectares)	Percent Cover
Forested (PFO)	29.9	5.1%
Shrub/Scrub (PSS)	7.9	1.3%
Emergent (PEM)	20.5	3.5%
Unconsolidated Bottom (PUB)	0.9	0.2%
Total	**59.2**	**10.1%**

4.2. Use of Property by Breeding Birds

Two BRI biologists visited the property on July 2–3 to evaluate breeding bird diversity and abundance on the property using point counts. Overall, 63 species were detected, 54 of which were detected on point counts (Figure 8). The majority of species detected were migrants that spend the boreal winter in the southern states of the U.S. (e.g., Hermit Thrush, *Catharus guttatus*, and White-throated Sparrow, *Zonotrichia albicollis*), Central America (e.g., Black-throated Blue Warbler, *Setophaga caerulescens*, and Ovenbird, *Seiurus aurocapilla*), or South America (e.g., Red-eyed Vireo, *Vireo olivaceus*, and Canada Warbler, *Cardellina canadensis*). The five most detected species among the 120 total point counts were Ovenbird (145), Hermit Thrush (94), Black-throated Green Warbler (*Setophaga virens*, 59), Black-and-white Warbler (*Mniotilta varia*, 58), and Common Yellowthroat (*Geothlypis trichas*, 48), all typical species breeding in the region. Species richness (number of species detected per point) was 8.7 ± 3.5 (mean ± SD), while bird density (the number of individual birds detected per point) was 7.1 ± 2.6. Point counts with a higher number of detections were consistently those with higher species richness, typically located in, or near to, wetland-associated habitat.

The diversity of plant communities on the property, supported by wetland features and variable topography, provide breeding habitats for many species of birds. The data from our survey demonstrate that the open areas and forest edges created by historic anthropogenic activity provide habitat for American Kestrel (*Falco sparverius*), Chipping Sparrow (*Spizella passerina*), and Indigo Bunting (*Passerina cyanea*), and provide adjacent habitat for forest-adapted species, such as Black-throated Green Warbler and Winter Wren (*Troglodytes hiemalis*). The wetter areas support Swamp Sparrow (*Melospiza georgiana*), Palm Warbler (Yellow; *Setophaga palmarum*), and Alder Flycatcher (*Empidonax alnorum*), while flooded forest on the northeastern side of the property provides suitable habitat for Scarlet Tanager (*Piranga olivacea*) and Veery (*Catharus fuscesens*) to breed.
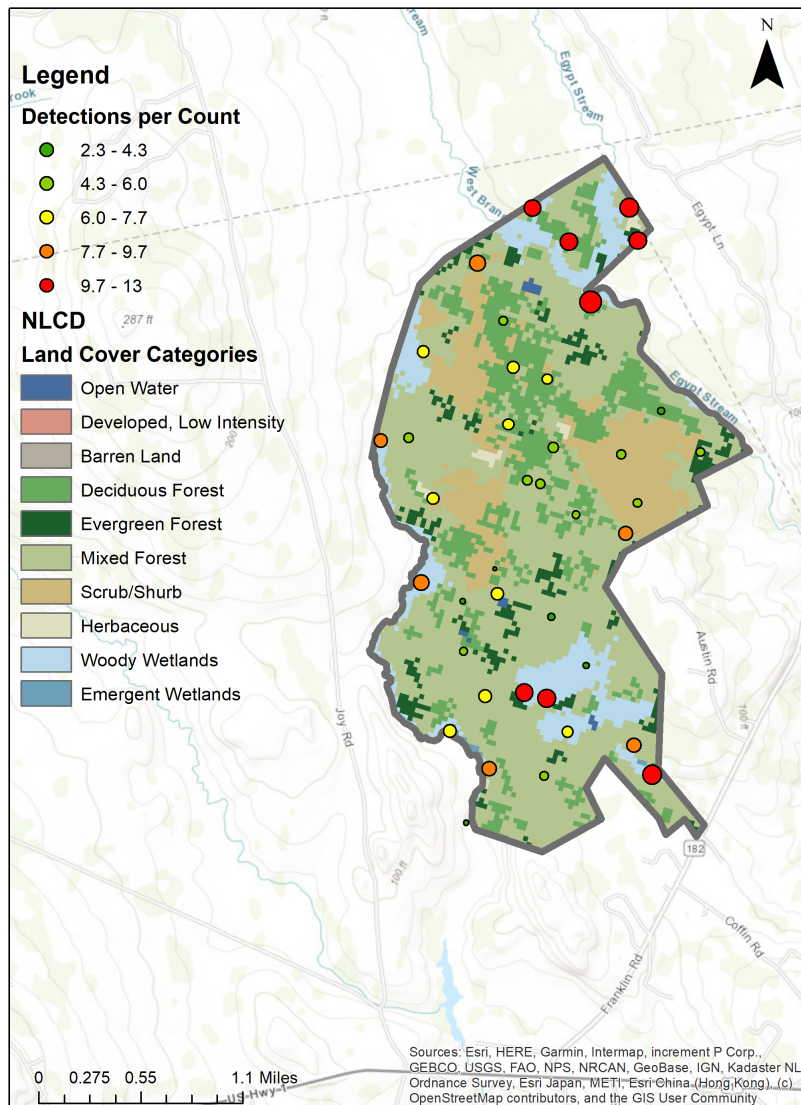

Figure 8: The Silver Maple Wind Farm mitigation parcel in Hancock, Maine, showing point count locations conducted on July 2-3 (dots), size- and color-coded by number of individual birds detected, and land cover categories.

4.3. Potential Use of Existing Habitat by Migratory Birds

Current best practices for wildlife conservation and management demand the consideration of the full-annual-life-cycle of a species (Marra *et al.* 2015, Moore *et al.* 2005), including migration. Migration is the riskiest component of the avian annual cycle—the majority of mortality occurs during this period where individuals take risks to cross continents and pass over ecological barriers (Sillett & Holmes 2002, Lok *et al.* 2015, Rushing *et al.* 2017). Individuals must balance the need to arrive at their destination at an appropriate time with the need to store enough energy to complete each flight (Alerstam & Lindstrom 1990). Habitat, such as that present at Frenchman Bay Community Forest, can be critical for adult survival and after nocturnal migration events, provides a place to rest and refuel, ideally with protection from predators.

The importance of stopover habitat depends on the condition of the individual, the location of the habitat, and the quality of the habitat itself. Stopover habitat is generally placed into three categories: (1) a 'fire escape', lower intrinsic quality habitat with high extrinsic quality that is primarily used for a short time when resources are depleted or weather prevents migratory flight; (2) a 'convenience store', habitat of higher intrinsic where a bird may linger and refuel for a short time, and (3) a 'full-service hotel', higher intrinsic quality habitat where a bird may remain for days while it prepares for another significant flight (Mehlman *et al.* 2005). The Frenchman Bay Community Forest parcel likely plays the role of a convenience store or a full-service hotel to birds. While its proximity to the Gulf of Maine could mean the site has some extrinsic value to barrier-crossing migrants (see Figure 9 and Appendix A), the patches of mostly forested habitat at the site provide intrinsic value that suggests migrants will stay at least a day at the site, depending on seasonal food availability.

Extrinsic habitat quality is mostly related to geography and the energetic condition of migrating birds. The Gulf of Maine area is a region of medium to high migratory activity (see Figure 9 and Appendix A), as birds are more likely to use the surrounding areas before or after long overwater flights. Moore & Aborn (2000) found that 'lean' migrating Summer Tanagers (*Piranga rubra*) at an island stopover in coastal Mississippi demonstrated stopover movements that resembled searching and explorations—presumably for food resources—compared to 'fat' individuals that did not travel as far. Furthermore, the lean birds spent more time in scrub habitats than fat individuals, who spent a higher proportion of time in mature pine forest. Thus, habitats can provide different value to birds depending on their location and the arrival condition of the birds. Intrinsic habitat quality is generated from the resources within the habitat. The features of primary concern are food resources, areas to rest, and protection from predators (Moore *et al.* 2005). Food resources and cover vary seasonally and by habitat type, and their value depends on the species exploiting them (Moore & Aborn 2000). Predation pressure also causes birds to use the landscape differently, with preferences toward high cover habitats (Moore *et al.* 2005). We expect similar habitat-mediated factors to affect the use of the Frenchman Bay Community Forest.

Table A1 in Appendix A summarizes scientific studies that have evaluated habitat preferences of migratory landbirds in the northeastern U.S. Studies were included that consider landbird migration occurring across scales ranging from continental to landscape to biological community levels that focus on assessing bird habitat preferences related to habitat quality. Quantifying the value of habitats to migrating birds is challenging, given that food availability can vary across years and within seasons, and individual species have differing food needs (Buler *et al.* 2017, Moore & Aborn 2000). This table is not a comprehensive view of the literature on bird migration, instead, it focuses on research that explores the use of habitats at the patch scale to elucidate the habitat types that are more likely to have bird activity

within them than surrounding habitat. It is essential to consider that these habitat types are not static but subject to successional processes and change due to disturbance regimes.

We have described both the habitat type and successional stages of the habitat in each study to attempt to disentangle these interacting effects. Tables 5 and 6 summarize the number of studies that found differences in bird activity relative to habitat type and successional stage, respectively. The ratio of studies finding higher and lower activity levels is used to describe the habitat's likely contribution to bird activity. Wetland habitats and forested habitats either in early or late stages appear to be preferred by migrants. Early successional habitat, in particular, had strong evidence for high use (10/1, higher-to-lower ratio). Older forests were more mixed (6/3) among studies, but tended to have positive effects. Intermediate habitats often had lower migratory activity (3/8). In terms of habitat composition, bird-use was higher for deciduous habitat (10/2), than for mixed (8/4) or evergreen (1/5). This review suggests that deciduous forest in early and late successional stages has the highest use-rates for migrants. Wetlands had some evidence for higher use (2/0), but more information is needed to confirm this trend.

Table 5: Summary of relative habitat use of migrating birds based on a literature review of studies in the northeastern United States. The numbers indicate the number of studies that found (1) 'Higher' use of this habitat when compared to others, (2) 'Lower' habitat use when compared to others, and (3) 'Uncertain' use when the study could not determine a difference. NALCD canopy height estimates categories were used to classify the successional stage. If a successional stage was not included in a study, then no information was included in this summary.

Successional Stage	Migratory Activity Relative to Other Habitats		
	Higher	Lower	Uncertain
Early	10	1	2
Intermediate	3	8	4
Mature	6	3	3

Table 6: Summary of relative habitat use of migrating birds based on a literature review of studies in the northeastern United States. The numbers indicate the number of studies that found (1) 'Higher' use of this habitat when compared to others, (2) 'Lower' habitat use when compared to others, and (3) 'Uncertain' use when the study could not determine a difference. NALCD land cover categories were used to classify the habitat type. If a habitat type was not included in a study, then no information was included in this summary.

Land Cover Type	Migratory Activity Relative to Other Habitats		
	Higher	Lower	Uncertain
Deciduous Forest	10	2	2
Mixed Forest	8	4	2
Evergreen Forest	1	5	5
Wetland	2	0	0

At the Frenchman Bay Community Forest, mixed forest is the most common habitat type with smaller amounts of deciduous forest, wetland, and coniferous forest. The literature review suggests this composition would lead to more frequent use during migration when compared to other habitats, but each habitat type merits more in-depth discussion:

- Wooded Wetlands / Emergent Wetlands: Wetlands can be considered high-quality habitat for migrating landbirds. Historically, persistent wetlands on the landscape contain fruits and insects, provide some cover depending on the amount of woody vegetation present, and abundant forest edge habitats when adjacent to forests. During the spring, wetland complexes often provide the earliest insects available, and during the summer and fall fruiting plants such as mountain holly (*Ilex mucronata*), withe-rod (*Viburnum nudum*), and chokeberry (*Aronia melanocarpa*; the first

two of which are found in the scrub-shrub wetland in the southern end of the parcel per MNAP [2019])

- Evergreen Forest: While evergreen forests are a key habitat type for a suite of breeding landbirds (including the Black-throated green Warbler, Blackpoll Warbler [*Setophaga striata*], Cape May Warbler [*Setophaga tigrina*], Bay-breasted Warbler [*Setophaga castanea*], and White-throated Sparrow, among others) they are not generally recognized as high-quality habitats for migrating landbirds due to a lack of soft mast (berries). Young evergreen forest patches may be more beneficial to migrating birds than intermediate or older forest patches, due to the succession process that results in fruiting shrubs establishing early in the successional process. As evergreen forests age, they can develop vertical complexity and forest gaps that improve their quality for migrating birds. Irregular insect outbreaks (e.g., spruce budworm) could greatly benefit birds during both nesting and migration.

- Deciduous Forests: Deciduous forests are of high utility to migrating birds, specifically those with abundant understories with fruiting shrubs. Certainly, young deciduous forests contain many fruiting shrubs, trees, and vines (Poison Ivy [*Toxicodendron radicans*], *Rubus* species, Virginia creeper [*Parthenocissus quinquefolia*], dogwoods [*Swida* species], cherries [*Prunus* species], serviceberries [*Amelanchier*]*,* etc.). Buler & Dawson (2014) documented that, at the landscape scale, deciduous forest along agricultural edges and riparian woodlands are habitats of high migratory activity.

- Mixed Forests: Mixed forests provide a diversity of plant and insect forage available to migrants during the spring and fall. Just over 53% of the Frenchman Bay Community Forest parcel is classified as mixed forest, with 5% described as young mixed forest. This habitat should provide high-quality beneficial forage and cover for migratory birds. A forest that maintains high vertical complexity with a diverse and abundant set of fruiting plants provides the greatest benefit to migrating landbirds.

A recent study by Buler et al. (2017), corroborates this analysis and generally describes the site as either in a medium to high importance category (Figure 9). Moreover, their analysis, conducted using NEXRAD estimation of migratory exodus, suggests that the site is a high density/high variance site (Appendix A, Figure A2). The site's importance does change over time (Appendix A, Figure A3), but it generally ranges from medium to high on the chosen metric. These results indicate that weather or other extrinsic factors have high importance of migratory bird use at the site (hence the high variance), but that site has enough cumulative value to have a high density of users. Variation in habitat on the site could play into the high use and the high variance in use. Each habitat type in the parcel can support migrants on their passage during spring and fall. During spring migration, many species of landbirds rely on emerging insects associated with bud emergence, while during fall, many species rely on fruit-bearing plants. Observations of migrants at the same site in Pennsylvania during multiple years in the spring and fall suggest that in the spring, birds may select mature forest edges and 'suburban' forest, but rely more on early successional and scrub habitats during the fall (Rodewald & Brittingham 2004, Rodewald & Brittingham 2007).
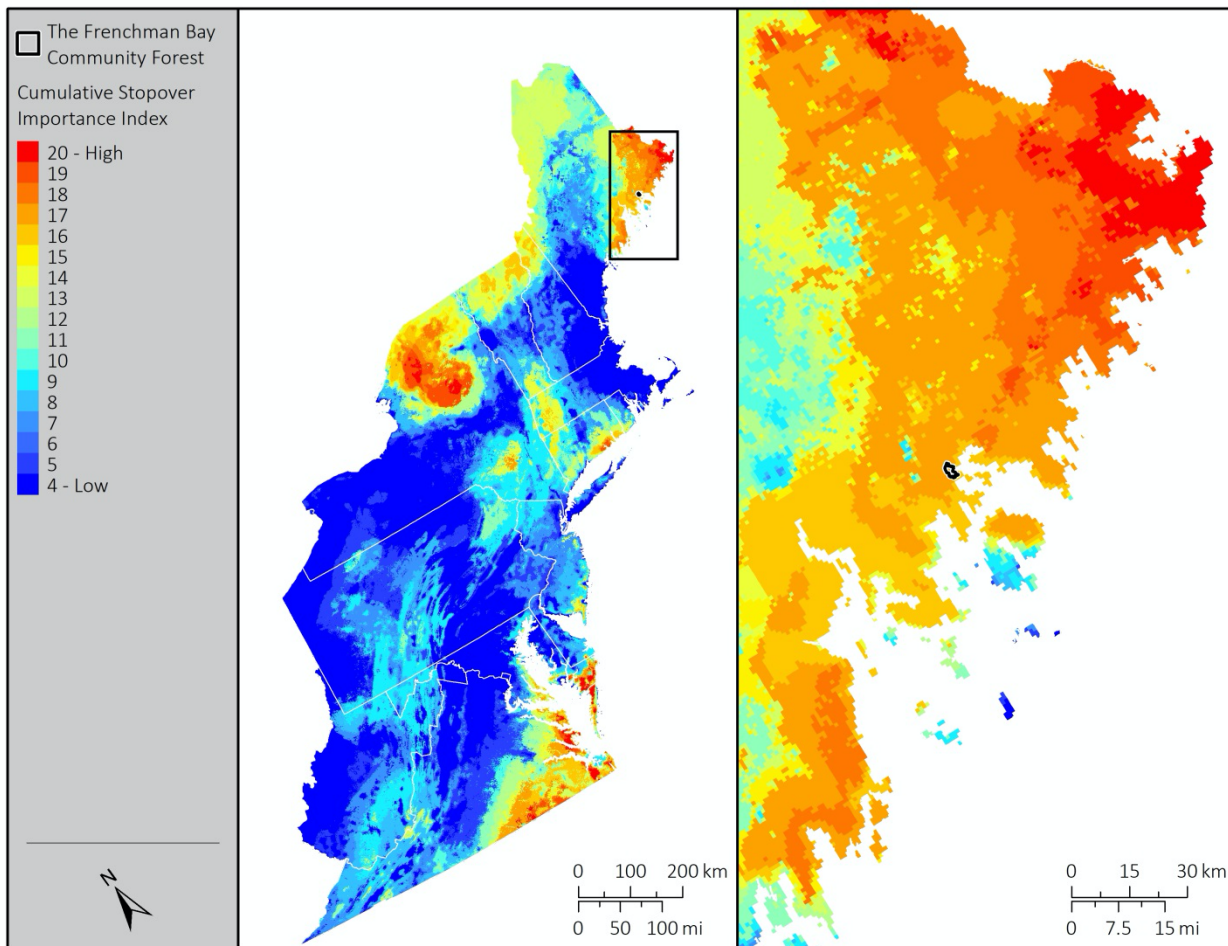
Figure 9: Cumulative Stopover Index (CSI) for the Northeast United States (Buler et al. 2017).

Diversity in habitat structure around intermediate succession forest in a vital coastal area likely combines to make this parcel valuable to migrating birds. The vast majority of the habitat at Frenchman Bay Community Forest is intermediate mixed forest, which has variable utility to migrants relative to other habitats in our review of the available science. Moderate amounts of early successional habitat likely provide significant benefit to migrants, with small amounts of mature forest not significantly factoring into the assessment. The greatest strength of the current habitat configuration is its diversity and the prevalence of wetland and scrub habitats around the intermediate forest. Habitat diversity—not only within the Frenchman Bay Community Forest but also in the broader regional context—is critical to migratory bird-use and includes consideration of forest types and age classes, forest edges, openings, and emergent wetlands, to support migratory birds' needs during their ephemeral use of habitats at locations along their migratory routes (Moore *et al.* 1995). Moreover, Moore *et al.* (1995) suggest 'structurally complex habitats, comprised of forest with a mixed shrub layer contained the greatest diversity and abundance of migrants.' Native plant species harbor a higher abundance and increased diversity of insects that are essential forage for birds compared to non-native plants (Narango *et al.* 2017). Observations of higher relative use of early successional and forest edge habitats (see discussion in section 4.5 about habitat will change through time), currently present on ~14% of the Frenchman Bay Community Forest, indicate that these habitats are of high value to migrants, likely due to (1) increased relative abundance of insects, (2) increased abundance of fruiting plants, and (3) available cover from predators (Suthers *et al.* 2000, Rodewald & Brittingham 2004, Rodewald & Brittingham 2007).

4.4. Species Expected to Use the Area

The Gulf of Maine coast is considered an area of high migratory use by birds. There is limited, if any, data regarding the use of Frenchman's Bay Community Forest parcel, which is private property, by migrating birds. Thus, we quantified expected species on the property using known habitat relationships during migration and eBird observation data from the surrounding region. To understand the seasonal activity of Neotropical migrants at the Frenchman Bay Community Forest, we have summarized eBird data to show monthly counts of species observed in Hancock County (Appendix A, Figure A4). These data suggest variation in the numbers of birds observed in the county by month with notable increases in the high count of many species in late summer or fall. This is consistent with the annual cycle of birds, due to the survival of adults plus the young of the year, but likely also reflects the movement of birds into the area due to migratory flights.

Across all bird guilds and seasons from 2010 to 2020, the eBird database documents 343 species of birds in Hancock County. This set of species includes observations of rare and vagrant species, as well as many species of coastal and marine birds that are unlikely to be observed at the property. We reviewed this list and modified it to include only species likely to use the habitat present on the property, which resulted in a list of 154 species, including 111 species of landbirds (full list available in Table A2, Appendix A). The 30 most commonly observed Neotropical migrant species, classified according to DeGraaf & Rappole (1995), are detailed in Table 7. Nine of these species are listed as Species of Special Concern to the State of Maine, including the Veery, American Redstart (*Setophaga ruticilla*), Black-and-white Warbler, Chestnut-sided Warbler (*Setophaga pensylvanica*), Canada Warbler, Least Flycatcher (*Empidonax minimus*), Eastern Kingbird (*Tyrannus tyrannus*), Eastern Wood-Pewee (*Contopus virens*), and Tree Swallow (*Tachycineta bicolor*).

Table 8 provides a summary of the 30 most commonly detected species of resident/short-distance migrant species observed in Hancock County, based on observations submitted to eBird from 2010–2020. Together, these 60 species of landbird species represent 15 bird families, including warblers, vireos, flycatchers, swallows, thrushes, cardinals and allies, blackbirds, corvids, parids, sparrows, nuthatches, kinglets, finches, tree creepers, and sturnids. This species diversity results from the geography of the region and the habitat diversity found in the county-coastal and inland habitats with wetlands, coastal scrub/shrub, and diverse forest types and age classes.

Table 7: Thirty most commonly detected Neotropical migrants) in Hancock County, ME, from 2010-2020

Common Name	Scientific Name	Detections
Black-throated Green Warbler	*Setophaga virens*	11528
Yellow-rumped Warbler	*Setophaga coronata*	9463
Northern Parula	*Setophaga americana*	9370
Common Yellowthroat	*Geothlypis trichas*	9151
Red-eyed Vireo	*Vireo olivaceus*	8104
Black-and-white Warbler	*Mniotilta varia*	6763
Ovenbird	*Seiurus aurocapilla*	5504
Blue-headed Vireo	*Vireo solitarius*	4922
American Redstart	*Setophaga ruticilla*	4461
Magnolia Warbler	*Setophaga magnolia*	3435
Yellow Warbler	*Setophaga petechia*	3158
Blackburnian Warbler	*Setophaga fusca*	2639
Alder Flycatcher	*Empidonax alnorum*	2453
Tree Swallow	*Tachycineta bicolor*	2350
Chestnut-sided Warbler	*Setophaga pensylvanica*	1951

Common Name	Scientific Name	Detections
Black-throated Blue Warbler	*Setophaga caerulescens*	1769
Nashville Warbler	*Leiothlypis ruficapilla*	1574
Eastern Wood-Pewee	*Contopus virens*	1540
Swainson's Thrush	*Catharus ustulatus*	1418
Palm Warbler	*Setophaga palmarum*	1222
Barn Swallow	*Hirundo rustica*	1157
Great Crested Flycatcher	*Myiarchus crinitus*	670
Least Flycatcher	*Empidonax minimus*	670
Eastern Kingbird	*Tyrannus tyrannus*	649
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	610
Blackpoll Warbler	*Setophaga striata*	607
Bobolink	*Dolichonyx oryzivorus*	561
Veery	*Catharus fuscescens*	517
Canada Warbler	*Cardellina canadensis*	505
Northern Waterthrush	*Parkesia noveboracensis*	475

Table 8: Thirty most commonly detected of resident/short-distance migrants (table 2) in Hancock County, ME, from 2010-2020

Common Name	Scientific Name	Detections
American Crow	*Corvus brachyrhynchos*	29291
Black-capped Chickadee	*Poecile atricapillus*	23697
American Goldfinch	*Spinus tristis*	17679
Blue Jay	*Cyanocitta cristata*	15995
Song Sparrow	*Melospiza melodia*	15834
Red-breasted Nuthatch	*Sitta canadensis*	14745
American Robin	*Turdus migratorius*	14033
Dark-eyed Junco	*Junco hyemalis*	11149
Hermit Thrush	*Catharus guttatus*	9014
Golden-crowned Kinglet	*Regulus satrapa*	8719
White-throated Sparrow	*Zonotrichia albicollis*	7235
Purple Finch	*Haemorhous purpureus*	6625
Common Raven	*Corvus corax*	6279
Eastern Phoebe	*Sayornis phoebe*	6032
Cedar Waxwing	*Bombycilla cedrorum*	5995
Chipping Sparrow	*Spizella passerina*	4988
Gray Catbird	*Dumetella carolinensis*	4875
White-breasted Nuthatch	*Sitta carolinensis*	4857
Winter Wren	*Troglodytes hiemalis*	4441
Red-winged Blackbird	*Agelaius phoeniceus*	3860
Northern Cardinal	*Cardinalis cardinalis*	3575
Brown Creeper	*Certhia americana*	3283
Common Grackle	*Quiscalus quiscula*	3046
European Starling	*Sturnus vulgaris*	2669
Tufted Titmouse	*Baeolophus bicolor*	2334
Pine Warbler	*Setophaga pinus*	2285
Swamp Sparrow	*Melospiza georgiana*	2141
Savannah Sparrow	*Passerculus sandwichensis*	1847
Pine Siskin	*Spinus pinus*	1659
Ruby-crowned Kinglet	*Regulus calendula*	1510

4.5. Potential Future Use of Property by Migratory Birds

Many factors will influence how the habitats of Frenchman Bay Community Forest will change over the next 30–40 years under a passive management regime, including climate change, beaver activity, and natural disturbances. The wetlands are expected to be maintained, due to the soil types and hydrology, and will possibly increase with increasing beaver impoundments; the early successional forest will begin to shift to intermediate forest; and the intermediate forest will age into older forest. It is challenging to predict how these changes will influence migratory abundance at the site. Early successional habitat will transition to intermediate habitat and likely lower habitat quality at the site, but intermediate forest will transition to more mature forest and likely increase habitat quality for migrants, thereby continuing to provide habitat for migrating birds over the life of the Silver Maple Wind Project. The expected reduction in early successional habitat will likely lead to open habitat species becoming less common; however some species preferring late succession forest might become more common, but few species have such strict habitat requirements during migration.

4.5.1. Significant factors influencing migratory bird habitat

While there are many factors that will affect the habitat on the parcel, the most significant factors for the Frenchman Bay Community Forest may include, but are not limited to:

- Climate change: By 2100, average Maine temperatures may increase 3 to 13 °F, and migratory bird habitats, including those within the parcel, are particularly vulnerable to changes in climate. Changes in hydrology and temperatures are expected to produce more frequent droughts which will negatively impact all habitats, particularly the wetlands on the parcel (Whitman *et al.* 2013).

- Beaver activity: Beavers have the potential to be active managers on the property by dramatically expanding wetland areas, and creating early successional habitats and extensive edge habitats, which are important for migratory birds. As a keystone species, beaver play a critical role in creating and maintaining diverse freshwater wetland ecosystems. Beavers and their dams positively influence stream complexity, riparian vegetation structure, species diversity, vegetative ground cover, floodplain connectivity, species migration patterns, sediment transport, nutrient cycling, water quality, water quantity, water storage, climate change, and drought (Brown & Fouty 2011).

- Natural Disturbances: Through time, both the frequency and intensity of natural disturbances are likely to increase due to the magnifying effects of climate change. The impacts of windthrow, ice storms, invasive insect outbreaks, non-native plants, and pathogens, reduced snow cover, and other amplified disturbances will influence the availability and quality of migratory bird habitat.

- Landscape Scale Changes: Forest fragmentation from increased development and land use conversion in the surrounding landscape, will change the extrinsic value of the parcel. If areas around the property become less available to migratory birds, due to development, the property could become a migratory bird refuge. While habitat connectivity could become so compromised that the FBC property is less utilized over time, this scenario is less likely due to the presence of other conserved lands in the vicinity.

Collectively, these processes are likely to impact the composition, structure, and availability of plant communities and habitat types that migratory birds prefer. Shifts in bird ranges, distribution, and adaptive behavior will also likely occur.

4.5.2. Potential Changes to Migratory Bird Habitat

As described above, climatic conditions and natural disturbances on the landscape will influence the dynamics and overall rates of forest succession (the change in community structure through time). The forests of Downeast Maine are typically slow-growing and characterized by highly acidic soils, and low soil temperatures. Tree growth rates are relatively slow due to high humidity levels (fog), low sunlight angles, winter severity, and cold air temperatures. The Tree Site Indices[3] for the property shows an overall range of growth of 12–25 m (39–82 ft) over a 50-year period (9), which over 30-year time horizon could be as little as 7 meters (23 ft) for species such as red spruce (*Picea rubens*).

Table 9: Tree canopy estimated over 50-years from the Tree Site Index Rating

Species	Scientific Name	Mean (m)	Min (m)	Max (m)
American beech	*Fagus grandifolia*	18.9	18.3	19.5
Balsam fir	*Abies balsamea*	17.1	14.6	20.1
Black spruce	*Picea mariana*	15.2	13.7	16.2
Eastern white pine	*Pinus strobus*	19.2	17.1	22.9
Northern red oak	*Quercus rubra*	20.7	16.2	25.3
Red maple	*Acer rubrum*	16.8	16.8	16.8
Red Pine	*Pinus resinosa*	18.3	15.8	20.7
Red spruce	*Picea rubens*	13.7	11.9	14.3
Sugar maple	*Acer saccharum*	15.2	15.2	15.2
Tamarack	*Larix laricina*	18.3	18.3	18.3
White ash	*Fraxinus americana*	21.0	17.1	22.3
White spruce	*Picea glauca*	17.1	15.8	18.3
Yellow birch	*Betula alleghaniensis*	19.2	15.2	21.3

While we can't predict how these processes will play out over time, specifically within the property boundaries, we can reasonably expect the following to occur over the next three to four decades:

- Young forest (early successional forested habitat, 0–25 years old): These habitats will advance into mid-successional stages over time. Densely growing, shade-intolerant, and short-lived tree species in the seedling and sapling stages (in large patches of regenerating forest, along skid trails, and log landings) will be replaced by longer-lived, more shade-tolerant species and developing overstory and midstory layers more characteristic of mid-successional and late-successional forests. See Table 3 with a breakdown that has the breakdown of age class.

- Intermediate forest (mid-successional forested habitat, 20–70 years old): This habitat will advance into late-successional forest with longer-lived tree species in larger size classes, complex habitat structure arising from canopy gaps, and layering of vegetation (developed understory and midstory layers). These later successional stages produce higher densities of high-quality snags, live cavity trees, and coarse woody debris over time. While the literature is sparse on the use of this habitat by migratory birds, we see evidence that bird activity can be both higher or lower than the surrounding habitat here.

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[3] https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

- Older forest (late-successional forest, >70 years old): This habitat will continue to mature and develop increasing complexity and characteristics associated with old-growth forest (see Hancock plan for further information and discussion of this habitat type). Bird activity tends to be high in these locations and, when aggregated with other forest habitat in the area, could provide places for multi-day stopover for migrants.

- Wetlands: These habitats may change over time, depending on soil type and the effects of beaver activity and climate change-related changes in precipitation patterns, in particular. Overall, we would expect these high-quality habitats to continue providing the attributes that migratory birds prefer for stopover use (high availability and density of food and cover). Restoration of wetland areas would improve the availability of these high-value habitats (as recommended by MNAP [2019]).

5. Conclusions

The Frenchman Bay Community Forest contains a diversity of habitats that likely provide valuable stopover habitat for migrating birds, some of which may be impacted by the Silver Maple Wind Project. The intermediate mixed forest that composes the largest proportion of the habitat is of moderate utility, but the surrounding diversity of other higher-quality habitats in the parcel, the quality habitat in adjacent properties, and the high importance of coastal habitat on the Gulf of Maine coast likely push this site into higher overall utility for migrants. A regional assessment of migratory stopover habitat suggested that the site had high density of migrants but with high variation in daily use, perhaps due to extrinsic factors like overwater migratory flights, weather, and intrinsic variation in habitat quality over the season. Future changes to the habitat will likely modify the site's intrinsic value to migratory birds: early successional habitat becoming intermediate is a downgrade in quality, but intermediate habitat becoming mature forest is an improvement. The community of migrants using the site is likely to change as the habitat changes, and the use of that habitat relative to the current configuration will depend on the relative rate of succession across habitat types. However, the extrinsic value of the habitat will not change. The site provides resources to birds preparing to cross the Gulf of Maine and respite for birds just completing a long overwater flight. Moreover, the site is part of landscape of protected properties in the region that likely provide synergistic value to migrants in the region. While passive management offers limited opportunities to dramatically change forest types or maintain early successional habitat, protected forests with persistent wetlands will likely be of high value in the region for the foreseeable future.

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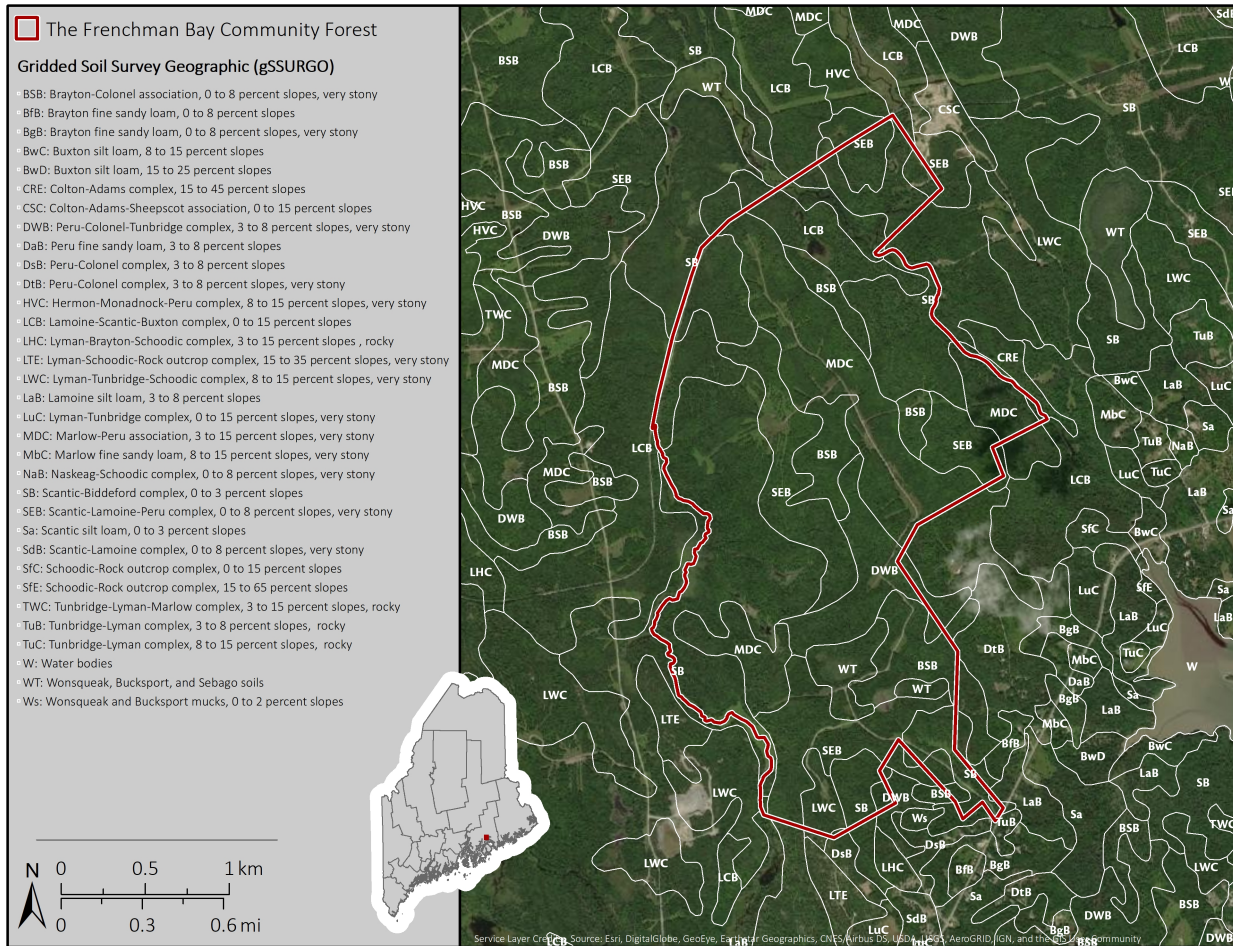
7. Appendix A.

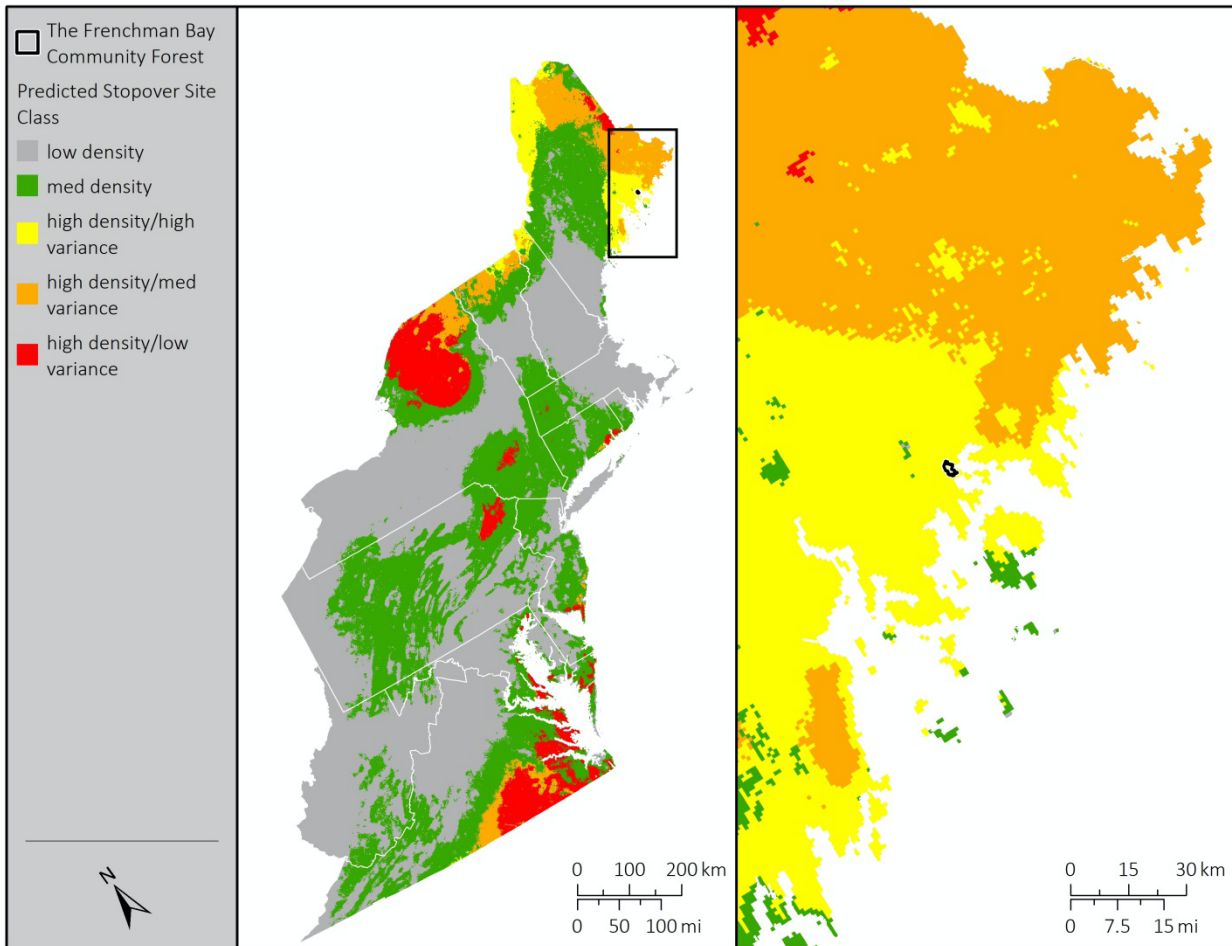Figure A1. Soils map of the Frenchman Bay Community Forest Parcel.

Figure A2. Predicted migratory land bird stopover site use classes during 2008 - 2014 autumn migration (Buler et al. 2017).
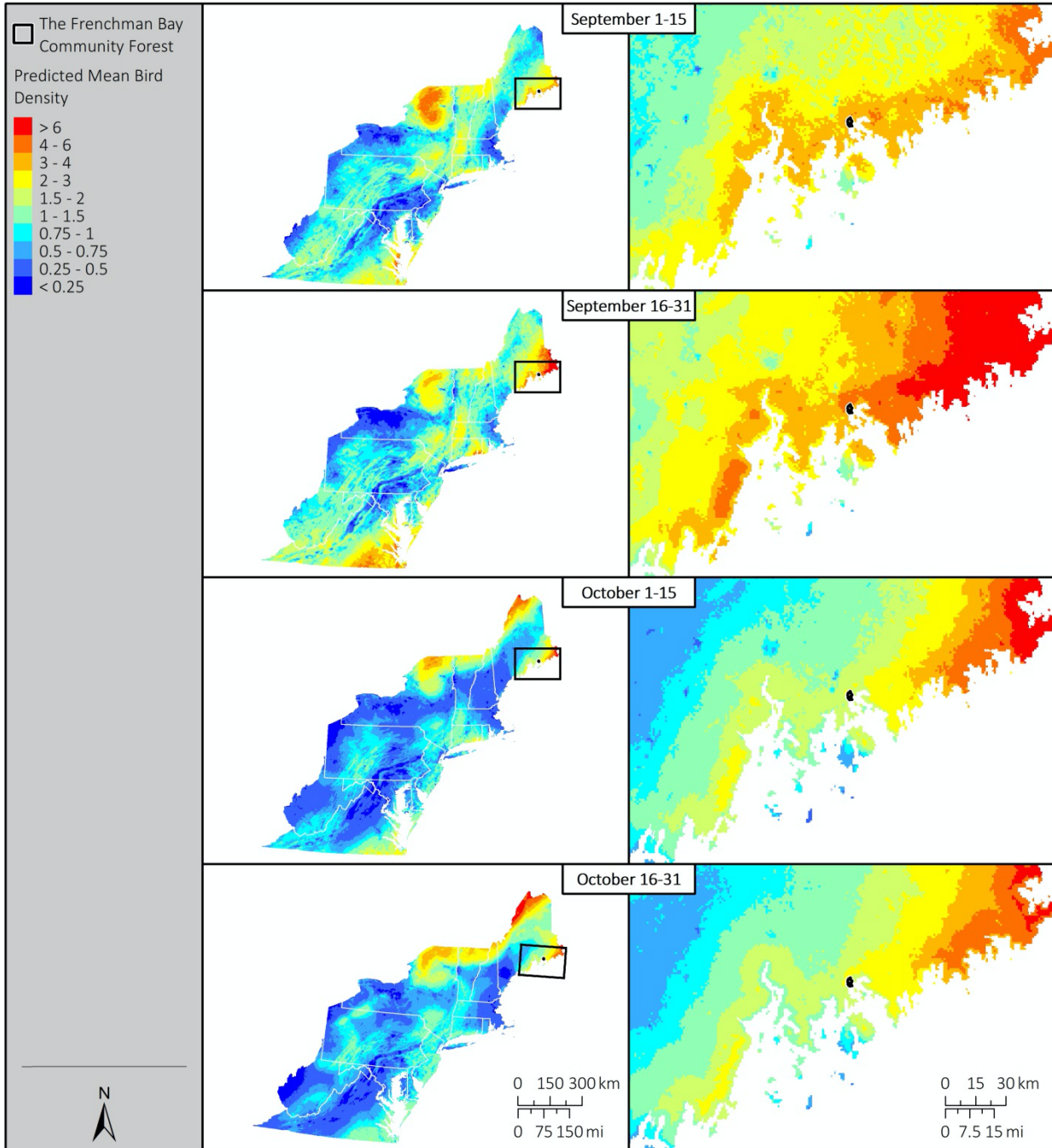
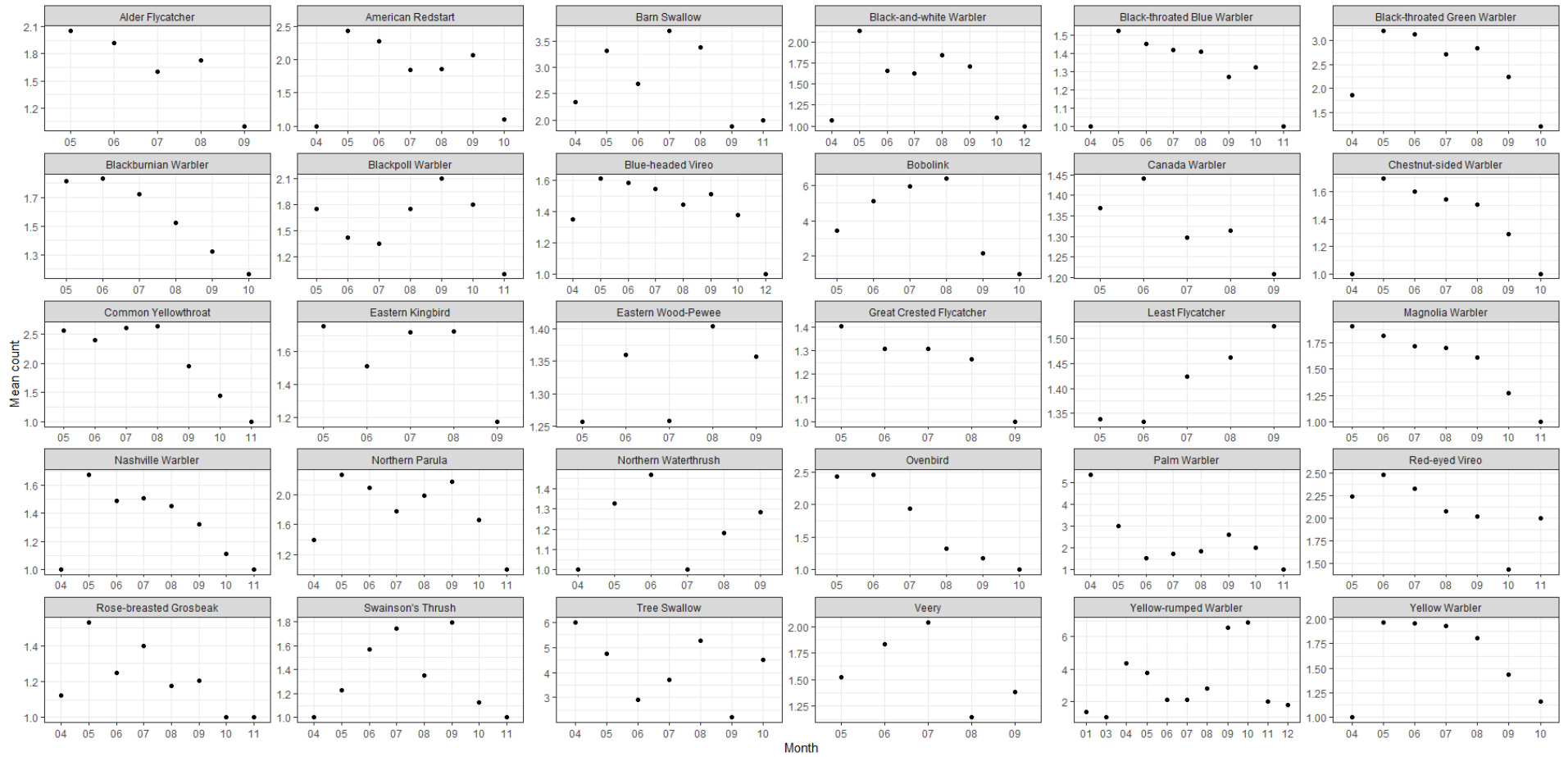Figure A3. Predicted bird density during four time periods during 2008 - 2014 autumn migration (Buler et al. 2017).

Figure A4: Mean eBird count of migrants in Hancock Country, Maine.

Table A1: Summary of literature review. The primary habitat types present at Frenchman Bay Community Forest are in the columns to the right designated with blue heading. Relative use by migratory birds is provided under each habitat type and successional phase: H= high; L = low; and U = uncertain.

Study	Methodology	Location	Habitats Included	Description of Results	Species	Seasons	Wet-lands	Deciduous			Evergreen			Mixed		
								Young	Intermediate	Old	Young	Intermediate	Old	Young	Intermediate	Old
Rodewald and Brittingham 2007	Observational transect surveys, foraging behavior	Central Penn-sylvania	Mixed forest habitats: (1) early successional shrub-sapling stage forest, (2) mid successional pole-stage forest, (3) mature forest interior, (4) mature forest agricultural edge, and (5) mature suburban forest	Relative abundance of migrant landbirds and foraging observations support that vertically dynamic forests, especially mature forest-agricultural edge and shrub-sapling forest habitats provide high quality stopover sites for migrating landbirds. Foraging rates of YRWA were higher in Forest-agricultural edge compared to other forest types but this was only significant for gleaning behaviors.	Migrant landbirds focus on Yellow-rumped Warbler	Spring (late April- late May)		H	L	H				H	L	H
Rodewald and Brittinham 2004 also Rodewald and Brittingham 2002 (similar results but 2002 is focused on mixed foraging flock behavior)	Transect surveys, relative abundance, habitat associations	Central Penn-sylvania	Mixed hardwood forest habitats: (1) early successional shrub-sapling stage forest, (2) mid successional pole-stage forest, (3) mature forest interior, (4) mature forest agricultural edge, and (5) mature suburban forest	Similar patterns of habitat use of many species and several migrant guilds. Species richness observed in the present study suggest that stop-over habitat quality varied among habitat types and varied from year to year. Mature edge-dominated (i.e. forest–agricultural edge and suburban forest) and especially shrub–sapling-stage forests were used most frequently by fall migrants. Similar patterns of habitat use by individuals and foraging guild. Mature forest edge and early-successional (shrub/sapling) forests were use used most frequently.	Neotropical Migrant landbirds: Mature-Forest-Breeders, Early-Successional-Breeders	Fall (late Aug.- Early Oct.)		H	L	H				H	L	H

Study	Methodology	Location	Habitats Included	Description of Results	Species	Seasons	Wet-lands	Deciduous			Evergreen			Mixed		
Suthers et al 2000	Capture & banding, habitat associations	Central New Jersey	Shrubland, early successional forest (aka, wooded shrubland) Panicled Dogwood dominated shrubland was preferred.	Migratory birds where more abundant in shrublands, but less abundant in shrublands that were 'shaded out by trees'. Birds were more abundant in habitat patches with abundant fruits compared to those with a paucity of fruit despite being of the same successional stage.	Migrant landbirds	Fall		H	U		L	L	L	H	L	
Buler and Dawson 2014	Radar, habitat associations	Northeastern US	All – interplay of scales broad geographic context vs habitat level scale.	Birds are observed in all areas but presence is greatest near the edge of large water bodies, hardwood forests embedded along waterways in agricultural areas, and hardwood forests in southwestern Ohio.	Migrating birds	Fall (Aug. 15-Nov. 7)	H	H	H	H	U	U	U		H	
McCabe and Olsen 2015	Modeling of monitoring data from 11 sites in Maine to test hypotheses about mig. bird behavior	Maine – coastal region	Vegetative cover predicts bird presence, does not really delineate beyond vegetated habitats	Landscape composition at fine spatial scales (4 km, i.e., close to landing) in combination with a species' relative remaining migratory distance explained stopover site use across space and among years.	Migrant landbirds	Fall							H	H	H	H
Moore and Aborn 2000	Radio Telemetry, Habitat associations	Gulf Coast Mississippi	Pine forest, scrub, dunes, marsh	Lean Summer Tanagers spent more time in scrub habitat while 'fat' birds spent more time in pine forest. Lean birds traveled more, indicating a search for preferred habitat.	Summer Tanager	Spring						U				

Study	Methodology	Location	Habitats Included	Description of Results	Species	Seasons	Wet-lands	Deciduous			Evergreen			Mixed		
Hoh et al 2018	Capture/ banding, body condition, metabolites, geography-habitat interplay	South Shore Lake Ontario		Compared body condition of White throated sparrows at an inland site and at a site along Lake Ontario. Birds at the inland site had Her body condition keep moving while leaner birds 'pile up' at geographic barriers and compete for resources. Suggest need for managing H quality habitat at geographic barrier congregations of migrants.	White Throated Sparrow	Spring										
McCabe et al 2019	Capture/banding	Maine Coast: 2 island sites, 2 mainland sites	Island coastal scrub	Birds on islands had Ler body condition than those on the mainland suggesting that birds use mainland sites for longer stopover.	Migratory Landbirds	Fall										
Buler 2017	Radar and ground truthing at patch, landscape, regional and temporal scales	Mid-Atlantic Delaware		Bird abundance is correlated with food availability (Arthropod abundance and fruit abundance) as well as habitat with H stem density (i.e. shrub scrub, or forest patches with vertical complexity).	Migratory Landbirds	Fall	H	H	H	U	U	L	L	H	U	U

Table A2: Full eBird list

Landbird (1=Yes)	Prospective Bird Species list during migration periods for the Frenchman Bay Community Forest Property (2020)
1	Mourning Dove
1	Black-billed Cuckoo
1	Common Nighthawk
1	Eastern Whip-poor-will
1	Chimney Swift
1	Ruby-throated Hummingbird
1	American Woodcock
1	Wilson's Snipe
1	Yellow-bellied Sapsucker
1	Downy Woodpecker
1	Hairy Woodpecker
1	Pileated Woodpecker
1	Northern Flicker
1	American Kestrel
1	Merlin
1	Peregrine Falcon
1	Olive-sided Flycatcher
1	Eastern Wood-Pewee
1	Yellow-bellied Flycatcher
1	Alder Flycatcher
1	Willow Flycatcher
1	Alder/Willow Flycatcher (Traill's Flycatcher)
1	Least Flycatcher
1	Eastern Phoebe
1	Great Crested Flycatcher
1	Eastern Kingbird
1	Blue-headed Vireo
1	Philadelphia Vireo
1	Warbling Vireo
1	Red-eyed Vireo
1	Northern Shrike
1	Blue Jay
1	American Crow
1	Common Raven
1	Black-capped Chickadee
1	Tree Swallow
1	Golden-crowned Kinglet

Landbird (1=Yes)	Prospective Bird Species list during migration periods for the Frenchman Bay Community Forest Property (2020)
1	Ruby-crowned Kinglet
1	Red-breasted Nuthatch
1	White-breasted Nuthatch
1	Brown Creeper
1	Blue-gray Gnatcatcher
1	House Wren
1	Winter Wren
1	Gray Catbird
1	Brown Thrasher
1	Northern Mockingbird
1	Eastern Bluebird
1	Veery
1	Gray-cheeked Thrush
1	Swainson's Thrush
1	Hermit Thrush
1	Wood Thrush
1	American Robin
1	Bohemian Waxwing
1	Cedar Waxwing
1	Evening Grosbeak
1	Pine Grosbeak
1	House Finch
1	Purple Finch
1	Common Redpoll
1	Red Crossbill
1	White-winged Crossbill
1	Pine Siskin
1	American Goldfinch
1	Chipping Sparrow
1	American Tree Sparrow
1	Fox Sparrow
1	Dark-eyed Junco
1	White-crowned Sparrow
1	White-throated Sparrow
1	Vesper Sparrow
1	Song Sparrow
1	Lincoln's Sparrow
1	Swamp Sparrow
1	Eastern Towhee
1	Baltimore Oriole

Landbird (1=Yes)	Prospective Bird Species list during migration periods for the Frenchman Bay Community Forest Property (2020)
1	Red-winged Blackbird
1	Brown-headed Cowbird
1	Rusty Blackbird
1	Common Grackle
1	Ovenbird
1	Northern Waterthrush
1	Black-and-white Warbler
1	Tennessee Warbler
1	Nashville Warbler
1	Mourning Warbler
1	Common Yellowthroat
1	American Redstart
1	Cape May Warbler
1	Northern Parula
1	Magnolia Warbler
1	Bay-breasted Warbler
1	Blackburnian Warbler
1	Yellow Warbler
1	Chestnut-sided Warbler
1	Blackpoll Warbler
1	Black-throated Blue Warbler
1	Palm Warbler
1	Pine Warbler
1	Yellow-rumped Warbler
1	Prairie Warbler
1	Black-throated Green Warbler
1	Canada Warbler
1	Wilson's Warbler
1	Scarlet Tanager
1	Northern Cardinal
1	Rose-breasted Grosbeak
1	Indigo Bunting
1	Killdeer
1	Upland Sandpiper
	Canada Goose
	Wood Duck
	Blue-winged Teal
	Gadwall
	Mallard
	American Black Duck

Landbird (1=Yes)	Prospective Bird Species list during migration periods for the Frenchman Bay Community Forest Property (2020)
	Northern Pintail
	Green-winged Teal
	Hooded Merganser
	Common Merganser
	Ruffed Grouse
	Wild Turkey
	Pied-billed Grebe
	Virginia Rail
	American Coot
	Least Sandpiper
	Semipalmated Sandpiper
	Spotted Sandpiper
	Solitary Sandpiper
	Greater Yellowlegs
	Lesser Yellowlegs
	American Bittern
	Great Blue Heron
	Great Egret
	Snowy Egret
	Green Heron
	Black-crowned Night-Heron
	Glossy Ibis
	Turkey Vulture
	Northern Harrier
	Sharp-shinned Hawk
	Cooper's Hawk
	Northern Goshawk
	Bald Eagle
	Red-shouldered Hawk
	Broad-winged Hawk
	Red-tailed Hawk
	Rough-legged Hawk
	Great Horned Owl
	Barred Owl
	Long-eared Owl
	Northern Saw-whet Owl
	Belted Kingfisher