


Guidance for
the Review & Mitigation of Impacts
to Grassland Bird Habitat
in Connection with
Regulated Projects in Vermont

October 2021

Signed: 

Commissioner, Vermont Fish & Wildlife Department

Date: Oct 26 '21

Vermont Agency of Natural Resources
Fish and Wildlife Department



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Introduction

This guidance document provides Vermont Fish and Wildlife Department (VFWD) wildlife biologists guidelines to ensure consistent, objective application of mitigation measures where grassland habitat is threatened from some forms of development. These guidelines are specifically intended for the development of biological opinions in the Section 248 and Act 250 processes and other local, state, and federal regulatory processes that apply to the protection of grassland habitat in Vermont. Furthermore, these guidelines set forth a decision-making framework by which VFWD determines the level of impact and necessary avoidance, minimization and mitigation/compensation measures that apply to a proposed development's impact on grassland habitat. Therefore, these guidelines are used to make recommendations to the Public Utility Commission (PUC), Act 250 District Environmental Commissions, and other local, state and federal regulatory decision makers for permit conditions, mitigation agreements, land conservation instruments (e.g., easements), and, if necessary, permit denials.

These guidelines are designed for application on a case-by-case basis to allow for the use of professional judgement and discretion by the VFWD. For example, some impacts may be relatively minor and thus, may not require habitat compensation in perpetuity. In some cases, restrictions on haying practice, or habitat protection for a specified period (e.g., for the life of the permit) may be sufficient to mitigate relatively minor impacts to grassland habitat. These determinations will be made by VFWD and will be based on past precedent and individual circumstances, as well as current species status.

Grassland habitat contributes to the ecological health and diversity of wildlife in Vermont by providing breeding and foraging habitat for certain species of grassland-obligate birds, as well as habitat for plants and numerous other species of wildlife. Four species of birds that rely on grasslands for nesting are listed as Threatened or Endangered under Vermont's Endangered Species Act and another seven are listed as Species of Greatest Conservation Need (SGCN) due to population declines. Proactive protection of functional grassland bird habitat now will reduce the need to upgrade listed species (e.g. SGCN to Endangered) and list additional grassland bird species as Threatened, Endangered, or SGCN over time.

The VFWD considers grassland habitat as “necessary wildlife habitat” for all species of grassland birds in Vermont. This guidance identifies Bobolink as a species whose habitat requirements best overlap those of other grassland bird species in Vermont and whose presence at a particular site is used as an indicator of suitable grassland bird habitat.

Section 248 and Act 250 Review Process

In accordance with 30 V.S.A § 248(b)(5), petitioners for a Certificate of Public Good (CPG) are required to demonstrate that the construction and operation of an electric generation, transmission facilities, or natural gas facility will not have “an undue adverse effect on aesthetics, historic sites, air and water purity, the natural environment, the use of natural resources... with due consideration having been given to the criteria specified in 10 V.S.A. §§ 1424a(d) and 6086(a)(1) through (8).” To meet the criteria, a project cannot have an undue adverse effect on rare, threatened, or endangered species, necessary wildlife habitat, or the natural environment. "Necessary wildlife habitat" is defined as “concentrated habitat which is identifiable and is demonstrated as being decisive to the survival of a species of wildlife at any period in its life including breeding and migratory periods.” 10 V.S.A. § 6001 (12). Under Section 248, the Agency is statutorily required to provide evidence and make recommendations to the Vermont Public Utility Commission (PUC) concerning a project's effect on the natural environment, including its effect on wildlife habitat. In Act 250, a permit will not be granted if any party demonstrates that the project will destroy or significantly imperil

necessary wildlife habitat.¹ Under Act 250, the Agency is a party by statute in any proceeding affecting the Agency and may also be called upon by a District Environmental Commission to make recommendations regarding a project's impacts to necessary wildlife habitat.

Background

Grassland Habitat in Vermont – Limited and Shrinking

Currently, grasslands in Vermont are almost exclusively anthropogenic areas dominated (>50%) by noninvasive (but often non-native) grasses with a lesser abundance of forbs. They are typically cultivated for livestock forage (e.g., hayfields and pasture). Grasslands do not include fields of cereal grains or row crops. Habitat for species of birds that require grassland for breeding and foraging is the primary ecological function addressed in this document and for which conservation of grasslands is viewed as essential. At the same time, it is worth noting that grasslands also provide habitat for native plants and numerous other species of wildlife that use grasslands for their life requirements. Vermont's landscape is currently 75% forested. Grassland habitat is limited to 4% of Vermont's land area, one-quarter of the grassland habitat that existed 70 years ago (USDA 1946). Although natural forces such as fire and flooding can create and maintain grassland habitat, most of the habitat that exists today is the result of agricultural practices.

The northeastern U.S. was estimated to be more than 9% grassland before European settlement (Helinski 2001). Grasslands are by nature uncommon in the Northeast.² Most grasslands at that time were situated along coastal plains, seasonally flooded areas adjacent to large rivers, beaver meadows, and naturally occurring sandplain ecosystems. Other grasslands were associated with natural and Native American-induced fire events that maintained grassland habitat.

Today, as in the past, grassland habitat is not uniformly distributed within Vermont. Much of the grassland habitat is found in the Lake Champlain valley, Lake Memphremagog basin, Connecticut River valley and the valley bottom lands along major rivers such as the White, Lamoille, and Missisquoi. The Champlain Valley and the Connecticut River valley have particularly high concentrations of grasslands due to their agricultural nature. These regions represent the areas of Vermont with the highest concentrations of both grassland bird habitat and grassland bird populations. However, wherever grassland habitat exists in adequate quality, size, and arrangement, grassland birds can and do utilize it. Therefore, all grasslands in Vermont present an opportunity for improving grassland bird survival and productivity and all suitable grassland habitats warrant consideration for protection.

Vermont's Grassland Bird Management and Recovery Plan (LaBarr et al. 2014) identifies habitat loss as the most significant factor responsible for grassland bird population declines in their breeding range:

¹ 10 V.S.A. § 6086(a)(8)(a) also requires the party opposing the development to demonstrate one of three subcriteria:

- (i) the economic, social, cultural, recreational, or other benefit to the public from the development or subdivision will not outweigh the economic, environmental, or recreational loss to the public from the destruction or imperilment of the habitat or species; or
- (ii) all feasible and reasonable means of preventing or lessening the destruction, diminution, or imperilment of the habitat or species have not been or will not continue to be applied, or
- (iii) a reasonable acceptable alternative site is owned or controlled by the applicant which would allow the development or subdivision to fulfill its intended purpose.

² As a point of reference, deer winter habitat (which is also necessary wildlife habitat) comprises 13.25% of the forested landscape, or 10.13% of Vermont's overall landscape (2019).

“Grassland birds migrate each spring from their wintering grounds in the southern U.S. and Central and South America to their breeding grounds in Vermont. These breeding grounds are almost exclusively agricultural fields or other human-altered grassland habitats. However, each year there are fewer of these habitats available to them. Grasslands to which they once returned have become overgrown with woody vegetation, converted to row crops such as corn and legumes or developed into housing.”

Ongoing habitat conservation and management measures will help achieve the goal of stabilizing and enhancing populations.

Recently, an increasing number of large-scale solar energy projects have been proposed for development on Vermont’s agricultural lands, including land with grassland bird nesting habitat characteristics. This trend may accelerate the loss of this necessary wildlife habitat, making it imperative that grassland habitat loss be appropriately considered in Act 250 and Section 248 proceedings. Review and consideration of impacts to grassland bird nesting habitat in the context of Vermont’s land use regulations complements existing non-regulatory conservation initiatives such as the federal Farm Bill Grassland Reserve Program.

Grassland Birds – Populations in Decline

Grassland birds specialize in the use of grassland habitat for nesting and rearing their young. Species such as Bobolink (*Dolichonyx oryzivorus*), Eastern Meadowlark (*Sturnella magna*), Grasshopper Sparrow (*Ammodramus savannarum*), and Vesper Sparrow (*Pooecetes gramineus*), among others, rely on suitable grassland habitat to reproduce. A complete list of Vermont’s grassland bird species is attached as [Appendix A](#). Of the 16 grassland bird species known to occur in Vermont, 2 are listed as state endangered, 2 are listed as state threatened, 7 are species of greatest conservation need (SGCN), 1 is uncommon, and 4 are considered common.

Breeding bird data collected for the North American Breeding Bird Survey from 1968 to 2017 indicates a majority of North American bird populations have experienced population declines. These data indicate a staggering loss of bird life, with many grassland species that breed in Vermont estimated to have lost more than 50% of their populations since 1968. Annual population declines of four obligate grassland species in Vermont reported by the North American Breeding Bird Survey (1968-2017) have been substantial, ranging from 2% to 10% per year. The number of 5 X 5 km blocks occupied that were surveyed in the 2013 Vermont Breeding Bird Atlas decreased for each grassland bird species by 26% to 85% compared to the 1982 atlas.³

As grassland bird populations decline, maintaining suitable grassland habitat in Vermont becomes increasingly important. Nationally, this need is reflected in the ranking of grassland bird species as high priorities in bird conservation plans, including those produced by Partners in Flight (PIF) and the North American Bird Conservation Initiative (NABCI). In Vermont the Nature Conservancy has designated conservation efforts in several of their project areas in the Champlain Valley for grassland birds. A collaboration between academic institutions and state Audubon groups in New England has created the Bobolink Project, which uses donated funds to provide financial assistance to landowners who manage grasslands in ways that maintain quality grassland bird breeding habitat. Much of this work is implemented in Vermont.

Habitat loss, primarily attributed to the conversion of grasslands to other uses and the intensification of agricultural practices, contributes to population declines of grassland bird species. Maintaining and

³ See Appendix B, Figures 1-3.

enhancing grasslands of adequate quality, size, and arrangement will enable populations of grassland birds, plants, and other animals to persist in Vermont into the future as land use and climate patterns change. This approach is consistent with recent efforts of the Agency and its conservation partners, reflected in Vermont Conservation Design (2016, 2018), to conserve landscape elements which provide habitat for the life requirements of plants and wildlife.⁴

Definition of Grassland Bird Habitat

Grassland bird habitat supports successful reproduction, nesting, rearing of young, foraging, shelter, and cover (protection) for these birds. Research demonstrates that many grassland birds exhibit fidelity to an individual field, returning to the same field to breed year after year (Fajardo et al. 2009, Bollinger and Gavin 1989). In fact, this same research indicates that individuals exhibiting strong site fidelity tend to be more productive and successful breeders.

Grassland bird habitat meets the definition of necessary wildlife habitat in that it is a landscape condition that is concentrated and easily identifiable, meaning it can be mapped as a discrete geographic area, and is essential for the reproductive success and survival of a suite of birds.

The Agency defines grassland bird habitat for the purposes of this document as a field that:

- consists of greater than 20 acres⁵,
- is sufficiently open to attract and retain nesting grassland birds (see Appendix C)⁶
- is vegetated primarily with grasses (where forbs may also be present),
- contains little to no woody vegetation, and
- has any of the following species present during their breeding season (approximately May 1 through July 31: Bobolink, Savannah Sparrow, Eastern Meadowlark, Grasshopper Sparrow, Upland Sandpiper, or Vesper Sparrow.

Bobolink as an Indicator Species for Grassland Bird Habitat

Bobolink are one of the more common grassland bird species in Vermont, and their habitat preferences overlap to a large extent with most other grassland bird species that breed in the state, making them well suited to serve as an indicator of the habitat needs for this suite of species. The VFWD therefore recognizes grassland bird habitat largely, but not exclusively, on the presence of Bobolink. Bobolinks are a high priority Species of Greatest Conservation Need in Vermont's 2015-2025 Wildlife Action Plan, due to their dependence on grassland, accelerated loss of this habitat, and continental population declines.

Bobolinks return to Vermont each year following their 6000-mile journey from grasslands, both natural and agricultural, in South America. They nest throughout Vermont where suitable grassland habitat exists. Males

⁴ Vermont Conservation Design is an analysis and mapping of the Vermont landscape to identify what features are most important in order to maintain and enhance an ecologically functional landscape into the future. An ecologically functional landscape is one that includes a connected network of large and intact forested habitat, healthy aquatic and riparian systems, and the full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend. Maintenance and enhancement of this functional landscape will conserve much of Vermont's biological diversity and the ability of most species to shift location in response to climate and land-use changes over time.

<https://vtfishandwildlife.com/conservation/vermont-conservation-design>

⁵ While fields smaller in size can function as grassland habitat, the 20-acre threshold was chosen to focus protection on those fields capable of supporting larger populations of nesting birds.

⁶ Helzer and Jelinski 1999, Shustack 2010, Keyel 2013

arrive first in early- to mid-May to establish territories, followed by the females about a week later. Non-forested and non-developed landscapes are most desirable (Shustack et. al. 2010). Site selection criteria include topographic openness, distance from edge (forest edges, hedgerow vegetation, man-made structures such as buildings, fences, roads, and other infrastructure), and vegetative structure of the grassland (Fletcher and Koford 2003, Keyel et al. 2012, Keyel et al. 2013). Bobolinks prefer to nest in grasslands with vegetation that reaches a medium to tall height (e.g., uncut hay and alfalfa) and few to no tall trees or other vertical structure within roughly 164 feet (50 meters) depending on topography.

Grassland Breeding Bird Survey

When is a Breeding Bird Survey Necessary?

A Section 248 petition or net metering application should include a breeding bird survey when a proposed project is sited in potential grassland bird habitat. Failure to perform a survey and produce it with a petition could result in delayed review or an incomplete petitioner determination from the Agency because the petitioner bears the burden of demonstrating that the project will not have an undue adverse impact on necessary wildlife habitat. Other unique circumstances, as described below, may also warrant the need for a survey. In other words, the burden is on the applicant to demonstrate that the site clearly provides no suitable grassland bird habitat. Otherwise, the presumption is that grassland bird habitat is potentially present when suitable site characteristics are present.

The Agency encourages Act 250 permit applicants to consult with the VFWD prior to filing an application with a District Environmental Commission if a project is proposed in potential grassland bird habitat. The results of a bird breeding survey should be provided with the Act 250 application if the VFWD determines a survey is necessary during pre-application consultation. The Agency may request a survey be completed and results appended to an Act 250 application prior to the issuance of a permit if a survey has not been filed with the application and the project is sited in potential grassland bird habitat. Though the burden of proof under Criterion 8(A) in Act 250 is with parties opposing an application, an applicant must still provide District Environmental Commissions adequate information to make positive findings under Criterion 8(A).

Projects proposed in areas that have either of the following site characteristics will require a breeding bird survey be included as part of a project application:

- The project is proposed in a field of at least 20 acres consisting predominantly of grasses and forbs and has a perimeter to area ratio of 0.015 or less – (see Appendix C, Figure 1, Helzer and Jelinski 1999)⁷; or
- The project is proposed in a field that has a history of grassland bird use as evidenced by the VFWD Natural Heritage Database (available publicly on the ANR Natural Resources Atlas), e-Bird database, or other reliable sources of bird-related scientific information.

Contact the VFWD if there is any question as to whether a breeding bird survey is necessary.

The VFWD should be consulted in instances where fields are rotated from pastures and hayfields to row crops, and where there are presently fields with grassland characteristics in close proximity to a project site in row crops.

Conducting a Breeding Bird Survey

Breeding bird surveys must be conducted by a qualified biologist and in accordance with either the current VFWD Grassland Breeding Bird Survey Protocol (Survey Protocol) or direct department biologist

⁷ Fifteen acres is the threshold for successful nesting habitat based on research by Dr. Strong, Dr. Renfrew and others (Perlut et al 2006). Perimeter area ratio is correlated to species likelihood of field occupancy (Helzer and Jelinski 1999).

consultation. The Survey Protocol (pending release) identifies acceptable dates for conducting a survey. Project developers are expected to adhere to these dates which are limited and seasonal in nature but are subject to change in future versions of this document. Therefore, developers are strongly encouraged to consult with the VFWD early in the project planning process to determine whether a breeding bird survey is necessary and which version of this document is the most current. Surveys not conducted following these guidelines may result in postponing the review of the project.

Survey Report and Determination of Grassland Bird Habitat

Applicants must include completed forms from the Survey Protocol along with a narrative report with their Section 248 or Act 250 project application. The Agency will use the survey results to make its determination as to whether the project has the potential to impact grassland bird habitat. In certain instances, the Agency may need to conduct its own survey before making a final determination. The Agency's determination of grassland bird habitat will primarily be based upon the habitat conditions and presence of grassland bird species, including Bobolink, Eastern Meadowlark, Grasshopper Sparrow, or Vesper Sparrow during the breeding season.

Assessment of Impacts to Grassland Bird Habitat

The VFWD will consider the following factors in assessing the extent of a project's impact on grassland bird habitat.

Direct Impact: Direct impact is measured as the area of grassland habitat occupied by the project, or project components, which converts grassland to another use (e.g., structure, roads, lawns, tall visual landscaping). Solar panels and perimeter fencing that occupy air space above grassland fields are considered to constitute direct impact as well as tall plantings used for visual screening if planted in otherwise open habitat. Grassland birds are highly sensitive to vertical structure in their breeding habitat and will not utilize fields where obstructions, such as trees or solar panels, exist over the grasses.

Indirect Impact: Indirect impact is measured as the area of grassland bird habitat surrounding the footprint of project vertical components extending outwards up to 50 meters (164 feet) into the grassland habitat.⁸ This distance is based on current science but is subject to change as new data emerges.

Total Impact: Total impact is the sum of both the direct and indirect impacts calculated in units of acres.

Impact Avoidance Analysis and Mitigation Requirements

Designation of Resource Categorization

The VFWD's "Policy and Programs on Development Impacts of Habitats"⁹ places habitat types into one of three resource categories (RC's). All grassland bird habitat will at a minimum be classified as RC3 (high to medium value, relatively scarce or becoming so regionally). Grassland bird habitat is considered unique and will be classified RC2 (high value, unique, and irreplaceable on a regional basis). The VFWD has yet to formally identify any RC2 or RC1 grassland bird habitat.

Direct and indirect impacts are not allowed in RC 1 or RC2 grassland bird habitat. Direct and indirect impacts may be allowed in RC3 grassland bird habitat only after conducting a comprehensive assessment of

⁸ Indirect effects from the physical presence of trees or other vertical features and habitat edges can extend up to 100 meters into grasslands (Renfrew and Ribic 2002, Fletcher and Koford 2003, Bollinger et al. 2004, Renfrew 2005, Keyel et al. 2012, Keyel et al. 2013).

⁹ Vermont Department of Fish & Wildlife Policy and Programs on Development Impacts on Habitat 6/24/1991

project alternatives for avoiding or minimizing impacts, and only after providing for appropriate mitigation when avoidance is not feasible.

The stepwise mitigation process utilized by the VFWD for other resources is appropriate for managing impacts to grassland habitat. Steps 1 and 2 must be demonstrated before moving to step 3.

1. Avoid all direct and indirect impacts to grassland bird habitat, if possible, through site selection and design of the project. Is an alternate site, either within or outside of the host parcel, available and suitable for the project? If an alternate site is available, then neither direct nor indirect impacts should be allowed. If a suitable alternate site is not available, proceed to Step Two.
2. Minimize unavoidable project impacts to grassland bird habitat by adjusting the scope, scale, and design of the project. Will the project result in direct or indirect impacts to grassland bird habitat which has high value, is unique, or is irreplaceable on a regional basis? If yes, the habitat should be designated RC2 and neither direct nor indirect impacts should be allowed. If no, the habitat should be designated RC3 and the project will be further evaluated under Step Three.
3. Compensate for unavoidable impacts (Mitigation). Is the project developer willing to provide for mitigation to offset the project's impacts to grassland bird habitat? If yes, then apply the below mitigation requirements to establish the appropriate type and amount of mitigation. If no, then impacts, whether direct or indirect, should not be permitted and the Department's recommendation will reflect that position.

Mitigation Requirements

A habitat compensation ratio of 2:1 (protected to impacted) to conserve habitat of similar or better quality is required to ensure no net loss of habitat statewide through long-term conservation and enhancement of suitable grassland habitat.¹⁰ When the impact avoidance analysis indicates that impacts to grassland bird habitat may be allowed if adequate mitigation is provided, the VFWD will seek mitigation which results in the protection and management of grassland bird habitat of equal or greater quality in accordance with the following standards.

Compensation for the unavoidable loss of habitat shall be evaluated based on the following options for implementation:

1. Conserve adequate grassland bird habitat at a 2:1 ratio of the combined direct and indirect acreage of impact on or near¹¹ the project site by securing a conservation easement with terms and conditions reviewed and approved by VFWD, that specifically protects the grassland habitat functions for the duration of the project impacts.¹² Compensatory grassland bird habitat proposed as mitigation for a project's impacts must be evaluated by, and subject to the prior approval of, the VFWD. A habitat management plan that has been reviewed and approved by the VFWD is required and must include delayed mowing or grazing and control of invasive plants, as well as a mechanism for monitoring implementation and adjustment over time as necessary to maintain or improve habitat quality. Delayed mowing shall either occur: (a) only after August 1 (preferable), or (b) prior to June 1 with the next cut only after August 5th. Other management activities such as invasive plant

¹⁰ The same policy of no net loss of habitat functions and values applies to grassland habitat as has been applied by the Department to other forms of necessary wildlife habitat (e.g., bear habitat, wetlands, deer winter habitat, Bicknell's' Thrush montane habitat). This no net loss policy should govern all aspects of the mitigation process.

¹¹ Within the same Biophysical region unless otherwise specified by the VFWD.

¹² See "Duration of Compensation" below

control should be clearly described in the plan in terms of methods used, locations, and frequencies of herbicide application within the protected habitat.

2. Provide a financial contribution to the Bobolink Project for a time period equivalent to the duration of impacts attributed to the project, with the annual funding amount assessed based on the average of the most recent 3 years of participant disbursements from the Bobolink Project (this should be coordinated with VFWD and the Bobolink Project but is \$52/acre in 2021). The Bobolink Project manages funding to compensate landowners who commit to grassland bird habitat management practices which support successful grassland bird reproduction. Vermont mitigation funds are held separate from all other donations to the project for use exclusively in Vermont by formal agreement between VFWD and the Bobolink project.
3. Provide a financial contribution to a conservation organization, approved by VFWD, other than the Bobolink Project for a period equivalent to the duration of impacts attributed to the project, at a per acre rate consistent with the most recent USDA NRCS standards for grassland conservation programs established in the most current federal Farm Bill. Conservation organizations must have the expertise and capacity to enroll grassland habitat into a delayed mowing program for this option to be available to applicants. Payments may be made in lump sum, annually, or in accordance with another schedule approved by the Agency and VFWD. Net present value payments will not be accepted.

Duration of Compensation

Projects without a finite duration, such as residential or commercial development, will be considered to have a permanent impact to grassland bird habitat and will be required to provide for compensation in perpetuity to mitigate the project's impacts. Projects with a predetermined and finite duration and are subject to an approved and financially secured decommissioning plan, such as certain energy generation facilities approved by the PUC, will be required to remit compensation for a time period equivalent to the duration of the project's impact on the habitat. Typically, this will be for the life of the project plus the time necessary to restore the impacted habitat to pre-project conditions after the project has been decommissioned.

A Note Concerning Threatened or Endangered Species

State law prohibits *taking a threatened or endangered species* or *destroying or adversely impacting critical habitat* without prior authorization from the Secretary of the Agency, which may be obtained only through a formal permitting process and issuance of a takings permit pursuant to 10 V.S.A. § 5408.

Henslow's sparrow, Upland Sandpiper, and Sedge Wren are state-endangered. Grasshopper sparrow is state threatened.

Taking is broadly defined and with respect to wildlife includes an act that creates a risk of injury to wildlife, whether or not the injury occurs, including harassing, wounding, or placing, setting, drawing, or using any net or other device used to take animals.

Destroying or adversely impacting critical habitat is defined as a direct or indirect activity that negatively affects the value of critical habitat for the survival, conservation, or recovery of a threatened or endangered species 10 V.S.A. § 5401.

Where adverse impacts to a listed threatened or endangered species or a critical habitat may occur, applicants must demonstrate that reasonable steps have been taken to avoid and minimize takings in their project siting and design.

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Appendix A: Vermont's Grassland Bird Species

Species	Scientific Name	Status
Henslow's Sparrow	<i>Ammodramus henslowii</i>	State Endangered
Upland Sandpiper	<i>Bartramia longicauda</i>	State Endangered
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	State Threatened
Sedge Wren	<i>Cistothorus platensis</i>	State Threatened
Field Sparrow	<i>Spizella pusilla</i>	Species of Greatest Conservation Need
Vesper Sparrow	<i>Poocetes gramineus</i>	Species of Greatest Conservation Need
Bobolink	<i>Dolichonyx oryzivorus</i>	Species of Greatest Conservation Need
Eastern Meadowlark	<i>Sturnella magna</i>	Species of Greatest Conservation Need
American Kestrel	<i>Falco sparverius</i>	Species of Greatest Conservation Need
Short-eared Owl	<i>Asio flammeus</i>	Species of Greatest Conservation Need
Northern Harrier	<i>Circus cyaneus</i>	Species of Greatest Conservation Need
Horned Lark	<i>Eremophila alpestris</i>	Declining, Uncommon
Clay-colored Sparrow	<i>Spizella pallida</i>	Common, Population Expanding Eastward
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Common Grassland Inhabitant
Song Sparrow	<i>Melospiza melodia</i>	Common Grassland Inhabitant
Swamp Sparrow	<i>Melospiza georgiana</i>	Common Grassland Inhabitant

Appendix B: Population Trends of Selected Grassland Bird Species

Figure 1. Estimated population declines for two Vermont grassland bird populations reported from the North American Breeding Bird Survey, 1966-2019.

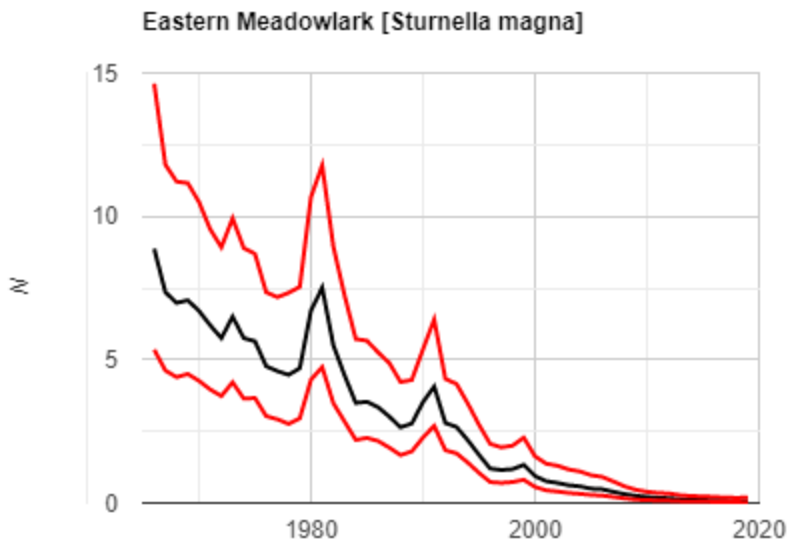
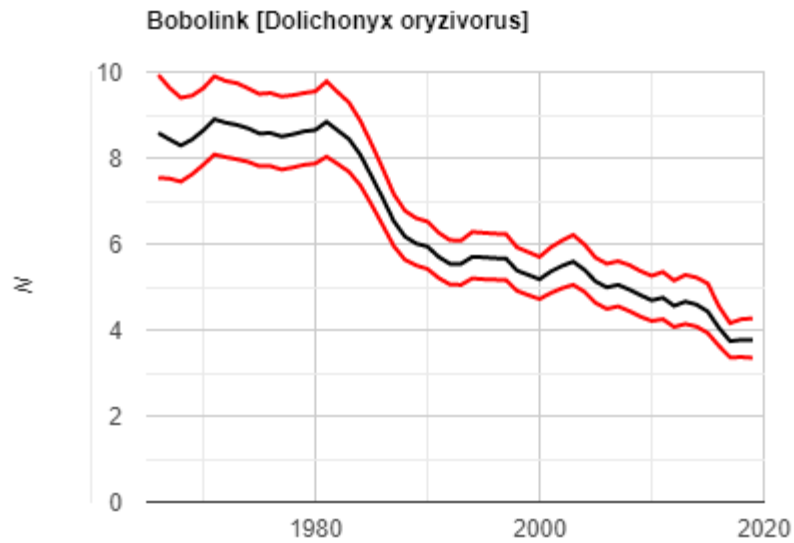
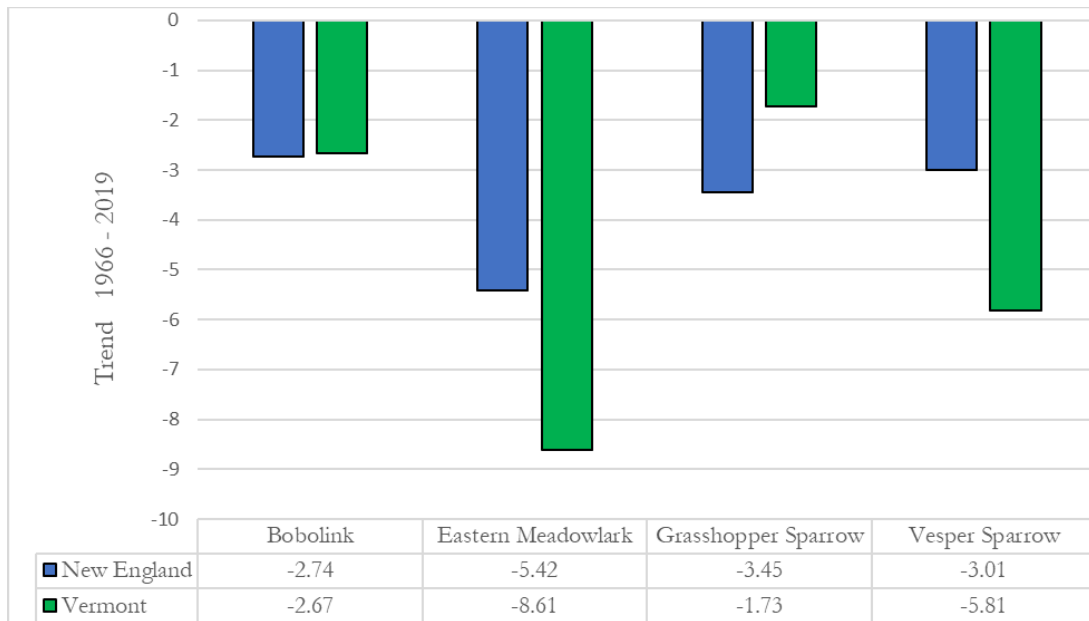
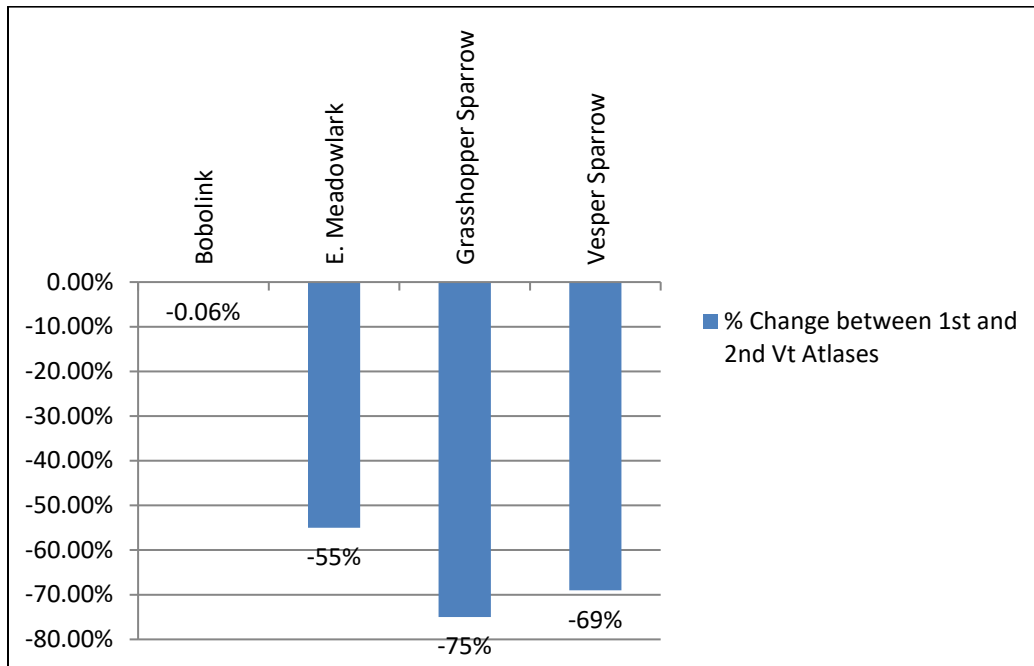


Figure 2. Annual population decline of four of Vermont’s grassland bird species as reported by the North American Breeding Bird Survey (1966-2019).



*VT. Grasshopper Sparrow sample too small for statistical significance

Figure 3. Percent change in occupied blocks between first Vermont Breeding Bird Atlas (1982) and the second Vermont Breeding Bird Atlas (2013).



Appendix C: Identifying and quantifying Grassland Bird Habitat

Step One:

- Identify and determine the extent of the field(s) potentially impacted by the project.
 - Entire fields must be considered, not just the portion(s) occupied by a project's area.
 - Roads can be considered fragmenting features, particularly if they are high use, and have associated transmission lines.
 - If unsure or extent unclear, contact VFWD.

Step Two:

- Measure the perimeter of the field.
 - Units must match those used for area calculation e.g., meters → square meters, feet → square feet.

Step Three:

- Measure the area of the field using a system compatible with the linear distance used to measure perimeter (square feet, square meters). This system should be consistent between fields.
 - Fields <20 acres in size do not warrant surveys.

Step Four:

- Divide the perimeter by the area to get Perimeter /Area ratio. ("PA_Ratio" in figure 2)

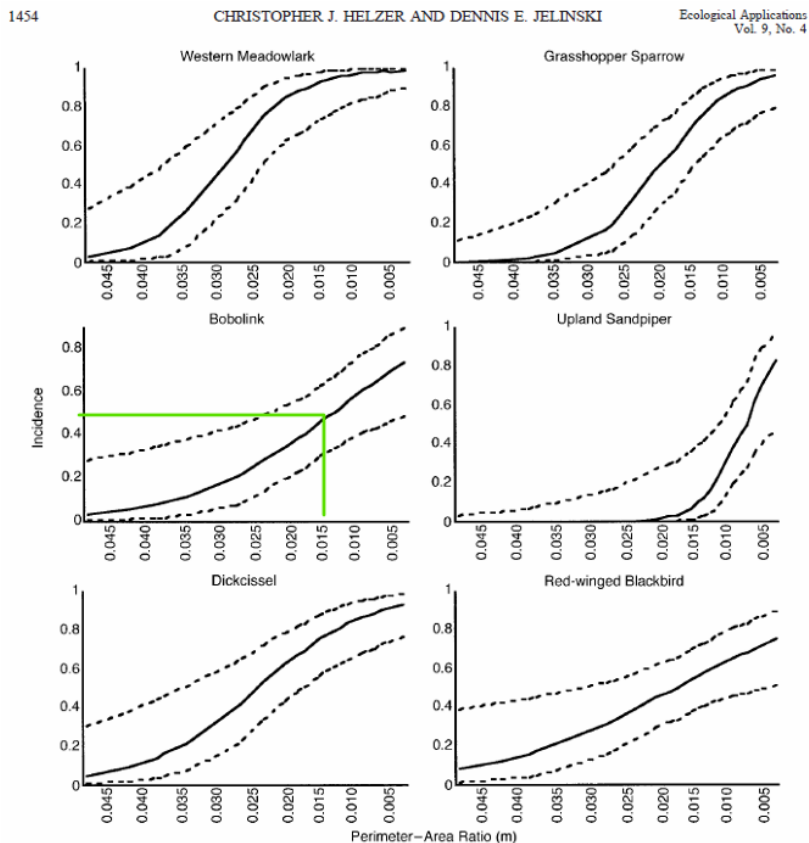


FIG. 3. Incidence curves for common grassland birds in the Platte River wet meadows. Solid lines represent probability of occurrence at a particular perimeter-area ratio value. Dashed lines represent 95% confidence intervals. Patterns were not significantly different ($P > 0.05$) in 1995, but see Table 4 for threshold estimates for both years.

Figure 1. Incidence curves for common grassland birds from Helzler and Jelinski. 1999
Green lines added to indicate threshold for this guidance.



Figure 2. Example Grassland Habitat size and configuration and how the various metrics could play out.

The VFWD also utilize calculations of topographic openness derived from available Digital Surface Model LiDAR data as an additional metric for evaluating suitability of grassland habitat for nesting birds. This analysis is based upon a similar metric used in the Keyel papers and is applied using geospatial analysis via The R Project for Statistical Computing¹³, and SAGA (System for Automated Geoscientific Analyses)¹⁴. While this evaluation would not be the sole trigger for the need for grassland bird survey and further habitat assessment, it shows promise for predicting habitat use by grassland birds.

¹³ <https://www.r-project.org/>

¹⁴ <http://www.saga-gis.org/en/index.html>