Best management practices for mitigating impacts to streaked horned larks on occupied airfields

Management recommendations for airfield managers

Washington Department of FISH & WILDLIFE

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Best management practices for mitigating impacts to streaked horned larks on occupied airfields: Management recommendations for airfield managers

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Table of Contents

List of Tables

Introduction

The streaked horned lark (*Eremophila alpestris strigata*; "larks") best management practices (BMPs) have been developed to guide airport and federal lands site management that enables the ongoing use and maintenance of site functionality for the site's intended purpose while minimizing impacts to streaked horned larks. The streaked horned lark is listed as threatened under the Federal Endangered Species Act (ESA; 16 USC 1531 et seq., 78 FR 61451, listing effective November 4, 2013) and was listed as endangered by the State of Washington Fish and Wildlife Commission under the authority of the Washington Administrative Code (WAC) 220-610-110. The intent of the BMPs is to contribute to the recovery and conservation of the streaked horned lark while conducting regular airport operations and required safety and maintenance activities at airport sites occupied by larks. Incorporating the BMPs into site planning and management meets objectives of the ESA, particularly Section 7, where federal agencies must aid in listed species conservation and ensure their activities are not likely to jeopardize the species' existence.

It is agreed upon by the Washington Streaked Horned Lark, Airports and Federal Lands Working Group (hereafter "working group") that not all options in the BMPs will be feasible to implement by all users, and the BMPs are not a finite or inflexible list. There are likely other project management options not considered within these BMPs that may be appropriate. This document is intended to be dynamic and to incorporate new, innovative practices that achieve the dual goal of site management and lark conservation while encouraging site managers to implement these actions voluntarily or through formal consultation. Federal lands and military installations can use these guidelines in establishing conservation measures with the USFWS. Site managers who employ new, yet successful site management strategies are encouraged to document in detail (e.g., description, phasing, photos) those strategies to be incorporated into future updates to this document so others are aware of their potential use.

Avoiding, Minimizing, and Mitigating Adverse Impacts

Activities that occur within habitat used by breeding larks may result in incidental take (i.e., take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity) either through physical harm to individuals or reduced capacity of the habitat to serve essential life functions, such as reproduction, foraging, and survival. The application of these BMPs reduces the risk of incidental take of larks due to site management and use. Both the ESA and WAC requires that such impacts be avoided or, if unavoidable, minimized to the maximum extent practicable to protect listed species. Where impacts cannot be avoided or minimized, mitigation to compensate for unavoidable take may be appropriate.

The USFWS Section 7 consultation process outlines the requirements for projects conducted at federally obligated airports for which the FAA is the lead federal agency (i.e., providing funding for improvements or approving an action or airport management plan). Biological Opinions (BO) issued by the USFWS include Terms and Conditions for minimizing impacts to larks. USFWS consults with airport managers

and FAA to incorporate conservation measures directly into project descriptions and contracts, thereby removing the need to require those conservation measures within the Terms and Conditions. Airports are required to comply with their FAA federal grant assurances. Nothing within this document replaces or supercedes this federal process; rather, these BMPs are intended to support and streamline that process for the applicant. The consulting agency (e.g., FAA) and the applicant (e.g., airport being represented by the agency) can include BMPs as Conservation Measures in their project description to minimize take, thus reducing or eliminating the necessity for additional Terms and Conditions within the required BO. Application of these BMPs is intended to make the consultation process smoother and more efficient. Airports must ensure that implementation of any BMP will not result in non-compliance with any FAA regulation, policy, or grant assurance, and must not impact the safety or efficiency of airport operations. From the state (i.e., WDFW) perspective regarding non-federal jurisdictional permit review (e.g., city or county), adherence to BMPs will also make that process smoother and help satisfy the state's requirements for avoiding, minimizing, and mitigating impacts to larks. Most BMPs within this document can be used in conjunction with other applicable BMPs.

Non-federal entities must obtain an incidental take permit for taking of a listed species incidentally to, but not the purpose of, carrying out an otherwise lawful activity (16 U.S.C. 1539(a)(2)(A)(i)-(iv)). These incidental take permits are possible through section 10(a)(1)(B) of the ESA. This section 10 process involves three phases: development of a Habitat Conservation Plan (HCP), formal permit processing, and post-issuance. Nothing within this document replaces or supercedes the requirements of an adopted HCP where one exists. Rather, these BMPs are intended to support and streamline the inclusion of streaked horned lark conservation principles into the HCP process.

For the purposes of this document, the lark breeding and nesting season (which includes pair bonding and nest building) is mid-March through late August but can vary depending on climatic conditions and region (Pearson and Hopey 2004; Moore 2011; Wolf 2011). It is generally agreed upon by the working group that site activities planned outside of the nesting season that result in no adverse impacts to individuals and no permanent impact to or loss of suitable lark habitat will receive a "not likely to adversely affect" (informal consultation) or a "no effect" determination by federal and state agencies.

Caveats to the Implementation of Best Management Practices

Per the Memorandum of Understanding (MOU) between the USFWS and FAA (2019), airports cannot engage in "any process, procedure, or agreement that would lead to an increase in lark populations or the enhancement or creation of lark habitat within the boundaries of the airport property or adjacent to the airport property where the species could interfere with current and future departure and arrival airspace." The MOU further states, "The recovery approach for lark populations on airports will be to maintain the current populations until alternate off-airport sites can be established. Only after new sites have been established and colonized by larks will it be appropriate to implement practices to make airports less attractive to larks, which will ultimately benefit both the larks (by discouraging them from using the inherently unsafe habitats on airports) and aviation (by reducing the risk of bird-aircraft strikes)." These BMPs are intended to help meet both objectives of the MOU. The working group

recognizes the need to continue collaborating on establishing larks off-airports and will continue to spend time on this pursuit.

Compliance Monitoring, Adaptive Management, and Scientific Research

In addition to being state and federally listed, streaked horned larks are a Species of Greatest Conservation Need under WDFW's State Wildlife Action Plan (SWAP). The SWAP is part of a nationwide effort by all 50 states and five U.S. territories to develop conservation action plans for fish, wildlife, and their natural habitats and identify opportunities for species' recovery before they are imperiled and more limited. Streaked horned larks are also a Priority Species under WDFW's Priority Habitat and Species Program. Priority species require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. The various BMPs contained within this document directly relate to lark survival and productivity on the airports and federal lands they inhabit as well as range wide lark recovery. The information gained through tracking compliance along with input from site managers should be used to adapt these BMPs. While these BMPs are recommendations and are not enforceable by law, monitoring the use of these BMPs is a critical component to improving the use of activities in occupied lark habitat.

Variables and values referenced herein are based on cited applicable research. Where research was lacking, guidance was developed based on the expertise of the working group. In all cases, best available science provided by WDFW and USFWS should be used and incorporated into the implementation of BMP activities.

All BMPs listed in this document are potentially applicable for use in occupied lark habitat and may have a benefit to the maintenance of lark populations. Specific BMPs are known to positively maintain lark populations most, particularly Avoidance, Sequencing, Mowing plan development, Least-impact mowing Equipment, and Disturbance buffers.

Table 1. Potential airport activities and their recommended best management practices.

Activity	Best Management Practices (BMPs)														
	Avoidance and/or Minimization Measures	Sequencing	Mowing Equipment	Mowing Plan Development	Disturbance Buffers for non-construction	Dissuasion	Avoid/Minimize Permanent Habitat Reduction	Post-Project Revegetation	Rodent Control	Insect Control	Weed Control	Nuisance/Dangerous Wildlife Control	Vehicle Use	Helicopter Activity	Surveying and Monitoring	Compliance Monitoring
Capital improvement projects	X	X				X	x	X					X		X	X
Mowing	X	X	X	X	X								X		X	X
Pavement maintenance or construction	X	X			X	X	x	X					X	X	X	X
Signage and lighting	X	X			X	X	X	X					X		X	X
Fencing	X	X			X	X	X	X					X		X	X
Weed control	X	X			X	X		X			X		X		X	X
Pest control	X	X		X	X	X			X	X		X	X		X	X
Disturbance activities (non-construction)	X	X		X	X	X			X	X	X	X	X	X	X	X
Vehicle and helicopter use	X	X			X								X	X	X	X
Lark population surveying and monitoring															X	X
Compliance monitoring and adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Avoidance and/or Minimization Measures

Description

Describes the avoidance of activities that disturb breeding larks during breeding and nesting season and activities that negatively impact lark habitat.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks.

Guidelines

1. When practicable and feasible, plan activities to occur from approximately September 1 - March 14 to avoid or minimize disturbance during the breeding and nesting season.
    a. Avoid activities that disturb breeding larks during the courtship/pairing/territory establishment phase, March 15 - 31.
    b. Avoid activities that disturb breeding larks during the nesting phase, approximately April 1 - August 31.
2. In advance of work commencement in occupied lark habitat, contractors will be briefed on environmental constraints, avoidance areas, site access, and operations specific to identified conservation and minimization measures.
3. If construction activities must occur on airports with known populations of larks during the breeding and nesting season, these facilities will be surveyed by a qualified biologist following the “Surveys and Management” BMP five days before each phase commences. The biologist will determine the presence and location of active lark nests and report this information to the contractors performing the work. If active nests are located within the project action area, conservation measures such as buffers and/or timing adjustments should be applied to reduce disturbance (see “Sequencing” BMP). Any mutually agreed upon conservation measures should be incorporated into contracts well before construction begins.

Sequencing

Description

Describes sequencing activities to avoid or minimize impacts to larks during the breeding and nesting season:

- Lark courtship, pairing, and territory establishment phase is March 15 - 31
- Lark nesting phase is April 1 - August 31

Purpose

The purpose of this BMP is to avoid or minimize impacts to breeding larks by sequencing activities to avoid disturbing areas used by larks during the breeding and nesting season.

Guidelines

1. Avoid project activities that may impact larks during the breeding and nesting season (see "Avoidance" BMP). Projects that cannot avoid the lark breeding and nesting season will be required to consider the possibility of sequencing activities.
2. Sequenced projects should avoid the courtship, pairing, and territory establishment phase but could be scheduled during the nesting phase, when nests can be identified and avoided. Projects occurring during the nesting phase should be planned outside a 50-meter (m; 164-foot (ft)) distance from any lark use area (Pearson and Hopey 2004). Where current nest locations are available through authorized nest surveys, the results of those surveys can be used to create 110 m (361 ft) buffers around each nest (Wolf and others 2015; USFWS 2017). Where nest surveys are not available, encircle the entire lark use area as determined by the most recent authorized lark surveys and buffer this by a 50 m (164 ft) activity avoidance buffer for the duration of the project that occurs during the breeding and nesting season.
3. Highly weather-dependent portions of a project may take place within nest buffers provided they occur on paved area and are temporary in nature (e.g., a walk-through buffer) to minimize disturbance to larks. All stationary construction activities, including foot traffic, should be prohibited within nest/avoidance buffers. Avoid loitering, parking, or leaving equipment and minimize vehicle and equipment speed when working on paved areas within nest buffers (see "Vehicle Use" BMP).
4. Sequenced project work areas should be confined to the minimum area needed to complete the work. Prior to any site construction, the surveyed boundaries of the work limits should be clearly marked, and the markings should be maintained during construction of the project. There should be no heavy equipment outside of marked areas, and all equipment and human movement should be constrained to within the work areas or as described in 3 above.

5. Stage all equipment and supplies associated with a project on pavement rather than habitat to the greatest extent possible and provide justification when not feasible. Actions that impact lark habitat may require mitigation.
6. Haul routes should be limited to existing roads and paved areas where feasible and provide justification in permit where not feasible.
7. Do not clear or grade until just prior to the construction project to prevent creating suitable habitat for larks in areas that will later be impacted by the project. If the project site is considered suitable lark habitat (see Anderson and Pearson 2015), dissuasion practices might be employed (see "Dissuasion" BMP).
8. To reduce the risk to larks and lark nests from being struck by debris during projects, contractors should aim routing and other equipment in a way that sends any projectile debris toward existing pavements, rather than toward airport shoulders and infields constituting potential habitat. Use of a plywood shield at the edge of pavement could be implemented to aid contractors where directional aiming is not feasible. Router shrouds should be inspected in advance of work to ensure debris is contained to within the approved operation footprint. Shrouds and router operation should be adjusted if debris is exceeding this footprint during operation. To account for aircraft and personnel safety, all debris should be removed from the site to eliminate Foreign Object and Debris (FOD) hazards.
9. In advance of work commencement, brief contractors on environmental constraints, avoidance areas, site access, and operations specific to identified conservation and minimization measures.

Mowing Equipment

Description

Provides mowing activity and equipment guidelines for avoiding or minimizing impacts to breeding larks associated with mowing by using appropriate equipment.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks associated with mowing by using appropriate equipment.

Guidelines

1. Use the best available mower that minimizes number of passes and impact to habitat.
2. When replacing mowers used in occupied lark habitat, justify buying tractors with mower heads greater than 15 ft wide. Minimize tire width when possible.
3. Ensure mowing equipment is well-maintained and working properly, to include wheel movement and maintenance to mower deck hydraulics.
4. Seek USFWS or other partner funding to purchase larger mowers as part of species conservation efforts.

Note: Mowing equipment is not an FAA-funded expense.

Mowing Plan Development

Description

Provides mowing plan development guidelines for avoiding or minimizing impacts to breeding larks.

Purpose

The purpose of this BMP is to avoid or minimize impacts to breeding larks caused by mowing. Mowing during the breeding season is one of the greatest threats to larks, contributing to nest failure and direct mortality of eggs, young, and incubating females (Slater and others 2021). Additional considerations may apply to areas occupied by other state and federally listed species, such as the Mazama pocket gopher (*Thomomys mazama*). There is no FAA regulation for mowing height or mowing schedule on airfields, but maintaining grass height such that personnel and aircraft safety are maintained is an FAA mandated airport maintenance requirement.

Guidelines

1. Whenever possible, avoid or minimize the frequency of mowing in areas used by larks during the breeding and nesting season. Timing may vary from season to season depending on climate conditions. Develop mowing plans using the following suggested schedule, developed by the working group with dual consideration of airport management needs and lark habitat needs:
    a. Early mowing window: Prior to May 1
    b. Late mowing window: After August 15
2. Allow vegetation growth to the maximum height allowed by safety and hazard regulations. FAA guidelines suggest a vegetation height not to exceed 12 inches (in), but there are no formal regulations addressing vegetation height. Based on research evaluating key habitat characteristics for larks, vegetation height habitat objectives should not exceed 25 cm (10 in) for the Puget Lowlands (Anderson and Pearson 2015) or 33 cm (13 in) overall (Rockwell and others 2022), as larks tend to use sites with vegetation height between approximately 11-20 cm (4-8 in; Pearson and Hopey 2005). Develop mowing plans to meet the following mowing heights:
    a. Prior to May 1:
        i. Mow vegetation as short as possible to increase time between mow events.
    b. May 1 to August 15:
        i. Mow vegetation to 20-25 cm (8-10 in) in height in areas used by larks during the nesting season as determined by authorized lark surveys (Anderson and Pearson 2015).
        ii. Mow vegetation to 23-30 cm (9-12 in) in height in areas surrounding but outside lark nesting use areas to provide a vegetative buffer.
3. Where nests are known and avoidance of nests is possible or planned, and to either voluntarily maintain lark populations per the FAA and USFWS MOU (2019) or as part of USFWS

consultation, maintain a 110 m (360 ft) buffer around each nest to avoid loss of young and nests from mowing (Wolf and others 2015; USFWS 2017).

4. When possible, while navigating to and between mow areas, mowers should use pavement to avoid known and unknown nest locations.

Disturbance buffers for airport non-construction activities

Description

Provides disturbance buffer guidelines to minimize disturbance to breeding larks from non-construction activities.

Purpose

The purpose of this BMP is to minimize disturbance to breeding larks and their nests from non-construction activities through the establishment of buffers. These disturbance activities may include the following: human presence, noise, fire, machinery, aircraft, parachuting, on-the-ground training, vehicle maneuvers or operations, and others not specifically identified here.

Guidelines

The following disturbance buffers are based on the combination of proximity of an activity to larks before they flush (i.e., flushing distances) and how far young fledglings can disperse in response to a disturbance (i.e., flush response distance). These buffers were largely advised by Pearson and Hopey (2004) and Wolf and others (2015). Federal lands and military airfields should consult with USFWS to establish conservation measures appropriate to the site. See the Joint Base Lewis-McChord Biological Opinion (USFWS 2017) as an example of how disturbance buffers are used on an active military airfield.

1. Commercial airfields should implement the following disturbance buffers, derived from Pearson and Hopey (2004):
    a. Short duration (less than an hour and/or non-stationary) on-the-ground activities should not occur within 30 m (100 ft) of any known nest or likely occupied nesting habitat. Where practical, this buffer should be extended to 50 m (164 ft).
    b. Long duration (lasting over an hour, or several days) and/or stationary on-the-ground activities should not occur within 50 m (164 ft) of any known nest or likely occupied nesting habitat.
    c. Restrict vegetation management activities, including mowing, grading, and boom-spraying, for example, outside of 110 m (330 ft) from known nest locations to avoid impacts to recently fledged lark young (Wolf and others 2015).
    d. Commercial airfields that cannot meet these disturbance buffers should rely on sequencing activities and/or applying dissuasion techniques in areas that may impact larks during the nesting season (see “Sequencing” and “Dissuasion” BMPs).
    e. Airfield coordination with lark biologists monitoring nests can guide routine maintenance activities (e.g., replacing or fixing lighting) within these buffered areas.
2. Where possible, use existing paved surfaces to access activity area.

a. Avoid placing equipment or machinery off paved surfaces and onto lark habitat. Only where staging of equipment onto habitat is completely unavoidable, minimize the area needed to stage equipment within habitat used by larks during the breeding and nesting season.
b. Restrict personnel to the minimum area needed to complete work within habitat used by larks during the breeding and nesting season and avoid pedestrians repeatedly walking through lark habitat during the breeding and nesting season.

Dissuasion

Description

Provides dissuasion guidelines to minimize direct impacts to larks. If areas known to be used by larks during the breeding and nesting season cannot be avoided, temporary dissuasion measures may be used to discourage larks from occupying those areas.

Purpose

The purpose of this BMP is to prevent larks from occupying an area prior to the nesting phase to minimize direct impacts to breeding larks.

Applications

This BMP may be used in areas where the avoidance and sequencing BMPs cannot be practicably employed.

No standard dissuasion techniques have been approved by USFWS and WDFW for use in lark habitat, although some have been tested (see Borland and others 2024). The option to dissuade larks must be vetted with USFWS and WDFW during consultation and prior to implementation. There is potential for FAA to fund studies of dissuasion techniques through the Airport Improvement Program (AIP). Interested airports may sponsor such projects if able to provide the required 10% match and tie the project to the FAA mission (e.g., airport safety and reducing risk). Airfields are strongly encouraged to work with USFWS and WDFW partners to design such studies including post-project reporting.

There are currently no Part 139 certificated airports in the state of Washington occupied by the streaked horned lark. The following techniques could potentially be used at occupied non-certificated airports if safety can be guaranteed. For Part 139 certificated airports, coordination with FAA Part 139 inspectors would be required prior to use.

Guidelines

1. In consultation with the USFWS and WDFW, ensure suitable habitat remains available for larks to successfully nest and ensure existing populations are maintained outside of the dissuasion footprint.
2. The dissuasion area should equal the concern area plus a 50 m (164 ft) buffer (Pearson and Hopey 2004).
3. Implement dissuasion measures by March 1 of any given year to avoid territory establishment.
4. If dissuasion techniques must be implemented after April 1, occupancy surveys following the “Survey and Monitoring” BMP may be required and may involve additional survey design as indicated by the USFWS and WDFW.

5. Dissuasion measures may be used in conjunction with each other to enhance their effectiveness. Potential dissuasion measures may include:
    a. Orange snow fencing or erosion control fencing secured with metal stakes (20-25 ft apart) and triple zip ties for non-Part 139 airports. Airports are responsible for ensuring the safety and hazard risk of any materials used per FAA regulations. In addition, materials used should be durable and UV resistant (e.g., Everbilt brand) to prevent deterioration requiring replacement and FOD removal.
    b. Frangible stakes or plastic water-filled airport barriers for Part 139 airports. Tops of such devices should be designed to avoid use by perching birds/raptors that would cause an airport hazard (e.g., short, brightly painted, contain flashing lights, etc.).
    c. Habitat manipulation, if allowed by Section 10 permit or Section 7 consultation. Manipulate project area prior to birds arriving or before the nesting season to create unsuitable nesting habitat for larks thereby dissuading larks from being attracted into areas that will ultimately be impacted by project activity.
    d. May include scraping the ground to keep it completely devoid of vegetation and/or covering the ground with material that precludes nesting and avoids bycatch (e.g., large plastic tarping; Augustine and others 2024). A scraped site must be consistently monitored to remove any new vegetation growth to deter larks.
6. A stormwater or other permit(s) may be required depending on technique and size.
7. See also Borland and others (2024) *Nesting dissuasion techniques at airports: A literature review on strategies, considerations, and recommendations for the conservation of streaked horned larks* [unpublished manuscript].

Dissuasion Maintenance

Periodically inspect employed dissuasion methods to ensure they remain secure. Assess whether methods are working to inform future management decisions, to include approved surveys by trained personnel (see “Surveys and Monitoring” BMP).

Dissuasion Removal

1. Remove all dissuasion methods immediately following project completion unless permanent conversion is part of the construction or project design.
2. Follow “Post-project Revegetation” BMP guidelines.

Avoid and/or Minimize Permanent Habitat Reduction

Description

Provides guidelines for avoiding permanent reduction of suitable habitat at sites occupied by larks.

Purpose

The purpose of this BMP is to avoid or minimize the permanent reduction and fragmentation of available lark habitat.

Guidelines

1. In otherwise open breeding habitat, avoid permanently placing hard edges within 100 m (328 ft) of breeding habitat such that the habitat is not visually fragmented to the greatest extent practicable (Anderson and Pearson 2015). Hard edges may include buildings, walls, tree lines, permanent large machinery, or other tall structures that block direct line of sight for larks.
2. When modifying occupied interior habitat, avoid increasing the edge-to-interior ratio and maintain the interior habitat away from the edge to the greatest extent practicable (Anderson and Pearson 2015).
3. If possible, replace suitable vegetation and habitat outside of high use maintenance and operations areas (see “Post-Project Revegetation” BMP).
4. For projects that will result in a permanent loss of habitat, consider the following:
    a. Placing new structures adjacent to existing facilities.
    b. Reducing the size or footprint of the new structure.
    c. Consider placing structures outside of high lark use areas and/or suitable habitat.
    d. Reduce the height of the project to that of nearest existing structure(s).

Post-Project Revegetation

Description

Provides post-project revegetation guidelines for revegetating areas after the completion of a project to retain habitat quantity and quality for breeding larks.

Purpose

The purpose of this BMP is to provide guidelines for revegetating areas after the completion of a project to minimize impacts to breeding larks while meeting airport safety and hazard requirements as guided by the consultation process.

Guidelines

1. Where practicable and feasible, areas to be revegetated post-project should be reseeded with regional native prairie seed mixtures dominated by cespitose grasses (i.e., bunchgrasses) and perennial forbs (e.g., perennial lupines) if consistent with wildlife hazard mitigation efforts. Perennial forbs are important for nest success, though should only be replanted in patches (Pearson and Knapp 2016). Soil amendment should be avoided (e.g., adding topsoil or fertilizer).
2. Plan revegetation and management such that bare pervious surfaces make up 16-70% of the site (Pearson and Hopey 2005). Bare pervious surfaces may consist of dirt, gravel, cobble, sand, shell, and moss/lichen as opposed to thatch-dominated ground cover. Areas of moss and lichen should not exceed 50% of the groundcover (Pearson and Knapp 2016). Airports should consider safety issues created from added vegetative material blowing onto runways and how to prevent or secure loose material.
3. Avoid planting trees and shrubs in and adjacent to suitable and occupied habitat. In addition, avoid using rhizomatous or turf-forming grasses, which make habitat unsuitable for larks (Pearson and Hopey 2005; Pearson and Knapp 2016).
4. Consider incorporating grass conversion into airport planning documents, whereby native bunchgrasses and forbs replace rhizomatous or turf-forming grasses and are widely spaced, short in structure, and require minimal or no mowing (Slater and others 2021). Airports may want to avoid including state or federally listed plant species that may require additional oversight.
5. Restoration may include re-grading disturbed areas to re-establish original ground cover.
6. For guidance on lark habitat preferences and revegetation guidelines, refer to *Minimizing conflict between airfield operations and lark conservation: a grass conversion demonstration project at Joint Base Lewis-McChord military base* (Slater and others 2021) and *Streaked horned lark habitat characteristics* (Anderson and Pearson 2015). Key points are provided in Appendix 1 and Appendix 2, respectively.

Rodent Control

Description

Provides rodent control guidelines for avoiding or minimizing the application of rodenticides during the lark breeding and nesting season and reducing the risk of exposure of larks to toxic rodenticides.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks associated with rodent control and rodenticide application.

Guidelines

1. Avoid any application of rodenticides on airfields occupied by state and federally listed Mazama pocket gophers.
2. Since not explicitly required by FAA, only conduct rodent control in lark breeding habitat where necessary based on documented hazards/BASH reports at the site. Application of rodenticides should be done outside of the lark breeding and nesting season whenever possible.
3. Where necessary, consider alternatives to zinc phosphide treated grain; although it has a low non-target hazard, testing confirmed presence of the chemical in a sample of tested lark carcasses at Corvallis Airport, indicating that they will consume treated grain (Corvallis Airport, pers. comm.). If using zinc phosphide bait, consider using the largest available pellet or bait sizes to reduce the potential for birds to ingest bait. *Note: toxic baits are less effective during wet periods and so use of baits outside of lark breeding period may not be successful.*
    a. If possible, drill rodenticide into known pest species burrows instead of broadcast spraying to reduce impacts to larks and other non-target species.
4. Consider changing grass management/replacing grass to a cover that is less inviting to rodents but that does not reduce use by larks. Consult state and federal biologists to advise.
5. Prescribed burning where permitted may be an acceptable alternative to rodent chemical control but should be conducted outside of lark breeding and nesting season.

Insect Control

Description

Provides insect control guidelines for avoiding or minimizing the application of insecticides during the lark breeding and nesting season and reducing the risk of exposure of larks to toxic insecticides.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks associated with insect control and insecticide application. While adult larks are largely granivorous and periodically eat insects, nestlings are fed insects exclusively (Stinson 2016). Reducing insect populations and treating insects present increases the potential for negative impacts to larks.

Guidelines

1. Where possible, avoid use of insecticides during the lark breeding and nesting season.
2. Follow the manufacturer's recommended concentrations and methods of application when using insecticides.
3. Spot-apply insecticides where needed and where feasible. Insecticides with liquid formulations should incorporate spray-drift mitigation requirements.
4. Avoid use of neonicotinoids, which are sufficiently toxic to small birds such that ingestion of a few treated seeds can cause death or inhibit normal reproduction (Goulson 2013; McCallum 2022). Neonicotinoids include Acetamiprid, Clothianidin, Dinotefuran, Imidacloprid, Nitenpyram, Thiocloprid, and Thiamethoxam.
5. Diflubenzuron (Dimilin 2L), carbaryl (Sevin XLR), and malathion (Fyfanon) are documented being used for control of insects (e.g., grasshoppers) on airfields. See Appendix 3 for further details regarding these three insecticides.

Weed Control

Description

Provides weed control guidelines for avoiding or minimizing the application of herbicides during the lark breeding and nesting season and reducing the risk of exposure of larks to toxic herbicides.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks associated with weed control and herbicide application.

Guidelines

1. Where possible, conduct weed control outside of the lark breeding and nesting season.
2. Conduct noxious weed surveys to determine core treatment areas and species present. Control on foot and restrict vehicles to paved/unpaved roads to avoid impacts to lark habitat.
3. If weed control must occur during lark breeding and nesting season, apply herbicides by spot spray rather than broadcast spray wherever feasible. In addition, avoid application in active lark use areas, including adjacent to nest locations (see "Disturbance buffers for airport non-construction activities" BMP).
4. Seeds treated with herbicide should be incorporated into the soil and seed spills should be removed to avoid ingestion by seed-eating species.
5. If possible, use the least toxic herbicides available to achieve weed control. See McCallum (2022), which details further information about recommended herbicides in lark-occupied habitats (e.g., Atrazine, Dicamba, Diuron, Dimethenamid-p, Glyphosate, and Metolachlor-s, which are slightly toxic to practically non-toxic to wildlife).
6. Regularly survey and treat newly established weeds to prevent infestation. Larks may use certain species (e.g., *Centaurea spp.*) as a nest host, which can negatively impact larks if treatment is required after larks have established territories and nests.
7. Maintain gravel and two-track roads to keep them free of vegetation during the lark breeding season. Sparsely vegetated roads can be desirable nesting locations for larks, and preventing vegetation growth in roads can prevent conflicts between vehicles and larks.
8. Follow EPA-registered guidelines and herbicide labels for herbicide application.

Nuisance/Dangerous Wildlife Control

Description

Provides guidelines for avoiding or minimizing impacts to larks resulting from activities associated with controlling nuisance and dangerous wildlife on and around airfields.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to larks associated with nuisance and dangerous wildlife control.

Guidelines

1. Anthraquinone, a compound that causes temporary digestive irritation, is used on some airfields to dissuade birds, specifically geese. Test results found the compound to have low toxicity to small birds (EPA 1998); however, because it has some level of toxicity combined with its need for weekly application to be most effective, Anthraquinone should not be used on airfields during the lark breeding and nesting season. Outside of the lark breeding and nesting season when larks are absent, Anthraquinone may pose little threat to larks.
2. Avoid the use of lead ammunition in wildlife control operations.
3. Check placed traps regularly to track and avoid non-target captures.
4. Bird Airstrike Hazard (BASH) or other animal control personnel assigned to lark-occupied airfields should familiarize themselves with lark species identification or have visual aids on hand to help identify larks.

Vehicle Use

Description

Provides vehicle use guidelines to avoid or minimize impacts to larks during the breeding and nesting season.

Purpose

The purpose of this BMP is to avoid or minimize impacts to breeding larks from vehicles.

Guidelines

1. Minimize off-pavement vehicle driving on lark breeding habitat during the breeding and nesting season except when associated with an approved project, route, and staging location.
2. Where driving off-pavement is crucial to site operations on a consistent basis, establish and mark allowed driving routes (e.g., using Seibert stakes or other approved markings). Haul routes should be limited to existing roads and paved areas where feasible.
3. Limit vehicle speed on pavement to 15 miles per hour (mph).
4. Within occupied lark habitat, contractors should store equipment, vehicles, and construction materials on currently paved areas or on nearby areas outside of the project action area.

Helicopter Activity

Description

Provides helicopter use guidelines to avoid or minimize impacts to larks during the breeding and nesting season.

Purpose

The purpose of this BMP is to reduce or eliminate impacts to breeding larks from helicopter use.

Guidelines

1. Helipads in lark breeding habitat should have surface material not conducive to lark nesting (e.g., concrete); see the "Post-project Revegetation" BMP for characteristics of suitable lark habitat components to avoid using on helipads.
2. Where feasible, helicopters should use paved surfaces for landing.
3. Avoid hovering over occupied lark habitat during the breeding and nesting season where downdraft may adversely affect larks and their nests.
4. Avoid repeated flight maneuvers over occupied lark habitat during the breeding and nesting season.

Surveys and Monitoring

Description

Provides guidance to conduct streaked horned lark surveys following accepted scientific protocols and maintain data resulting from such surveys for use in management.

Purpose

The purpose of this BMP is to assess population trends, identify breeding habitat, locate nest sites, and maintain a state database of findings to aid lark population and site management planning. This BMP is not designed to conclude streaked horned larks are absent from a site location (e.g., absence surveys) but rather to conclude that larks are using a site and monitor trends in that use. Further, determining location of and avoiding nests is an effective method of maintaining lark populations (Augustine and others 2024).

Guidelines

1. Follow the guidance of Anderson and Pearson (2015) to determine if a site has potential streaked horned lark breeding habitat (Appendix 2).
2. Only biologists trained and experienced with conducting lark or other grassland bird surveys should conduct streaked horned lark survey and monitoring. Such biologists may be public agency personnel, academia personnel, or hired consultants.
3. If a site has potential to be used by larks for breeding and needs presence confirmation, a trained biologist should conduct an Occupancy Survey using the approved protocol. Confirm with WDFW or USFWS the most updated protocol version.
4. For sites known to be used by larks for breeding and for which lark abundance and trend information is needed, a trained biologist should conduct an Abundance and Trend Survey using the approved protocol.
5. A trained biologist should conduct comprehensive nest surveys where needed for intensive ongoing activity or for planned construction projects that cannot occur outside the breeding and nesting season (see “Avoidance” and “Sequencing” BMPs). [Seek USFWS and/or FAA funds to pay for such nest surveys. FAA in general will not fund surveys at sites already known to be used by larks but may fund if surveys are part of a capital improvement project].
6. For projects requiring formal consultation with USFWS due to a project having adverse effects on streaked horned larks, a monitoring and reporting component for monitoring the effects of the action on larks must be provided to USFWS. A report summarizing the monitoring efforts and effects on the species must be submitted following completion of the project.

Compliance Monitoring

Description

Monitors the compliance of application of the various BMPs within this guidance document by the various land managers.

Purpose

The purpose of this BMP is to evaluate whether the BMPs are being applied to site management, whether they are effective in accomplishing their purpose, and to allow the opportunity to modify the BMPs as new information arises.

Guidelines

1. Recommend the application of BMPs within this guidance document in project planning on all projects occurring on sites used by larks during the breeding and nesting season. In addition, recommend completion of the *Project Planning and Implementation and BMP Selection Checklist* (Appendix 4).
2. Recommend that project applicants complete a *Post-project Compliance Form* at the completion of each construction project and one form at the end of each maintenance season for maintenance activities (e.g., one mowing season or one lark survey season; Appendix 5)
3. Use the Streaked Horned Lark Airports and Federal Lands Working Group meetings as an opportunity to discuss the application and effectiveness of the BMPs.
4. Update the BMPs and this guidance document periodically to reflect new information.

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Appendices

Appendix 1: Minimizing conflict between airfield operations and lark conservation: a grass conversion demonstration project at Joint Base Lewis-McChord military base

The following information is derived from Slater and others (2021) to inform successful vegetation conversion on airfields.

1. Incorporate airport and aircraft safety measures into revegetation projects as needed.
2. In virtually all attempts to re-establish prairie vegetation, year-effects outweighed all other variables. For example, variables such as site selection and microhabitat played a lesser role in success than the climatic yearly conditions. To overcome this, be prepared to repeat applications and maintenance over multiple years.
3. Native fescue grass was primarily planted with a few perennials scattered into the plots during year two. This approach is consistent with Pearson and Knapp 2016.
4. Seed was planted at a rate of 10 lbs per acre.
5. Planting was conducted in the fall following herbicide application. On one airfield, the seed germinated but died during the summer and required a second seeding. Therefore, have a seed source available and be prepared to repeat seeding in the same year if the initial seed does not survive.
6. Although fescue was successfully established on each of the various airfield study areas, results were better on one site, likely due to site conditions (i.e., soil, microclimate). Successfully revegetated areas should be assessed each year for 3-5 years to determine if additional seeding or maintenance is necessary and particular attention should be paid to those that initially failed. Success is also affected by the amount of native fescue and/or other native prairie vegetation already on the site. All sites require post-project maintenance to treat invasive plants and reseeding in areas not initially successful, consistent with the native prairie restoration process.

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Appendix 2: Streaked horned lark habitat characteristics and selection criteria

The following are streaked horned lark suitable habitat characteristics, derived from Anderson and Pearson (2015).

- Located within the appropriate geographic range for streaked horned larks.
- Proximal to known current breeding locations, and habitat characteristics or land use is similar to other sites where larks breed.
- Situated in an open landscape with low edge (perimeter) to interior area (open habitat) ratios and dominated by short, sparsely arranged herbaceous vegetation and considerable bare ground. Appropriate breeding habitat patches should be located greater than 100 m from hard edges.
- A minimum of 150 acres, though larger sites of ideal openness and vegetation are more likely to be occupied. Larks will occupy sites of smaller acreage in the river and coastal region as sites may have a higher perceived openness because of their proximity to open water bodies.
- Larks select habitat
- Habitat variables and composition may vary based on geographic region. The site does or can meet the guidelines of vegetation composition and structure found in Table 2 of Anderson and Pearson (2015) and Rockwell and others (2022), and site selection criteria found in Pearson and Knapp (2016).

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Pearson, S. F., and S. M. Knapp. 2016. Considering spatial scale and reproductive consequences of habitat selection when managing grasslands for a threatened species. PLoS ONE 11(6): e0156330.

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Appendix 3: EPA toxicity overview of select insecticides used on airfields

The following information is derived from USDA (2002).

Carbaryl is of moderate acute oral toxicity to mammals and slightly toxic to birds (USDA 2002). Based upon the quantitative calculations of doses of carbaryl to vertebrate species, most animals have negligible risk of adverse toxicological effects from full coverage treatments. The toxic effects of carbaryl full coverage treatments will be most evident as decreases in susceptible invertebrate populations. The immediate effect of a treatment results in more limited predator avoidance by susceptible insects within the treatment area and easier foraging for insectivorous species there. This is followed by rapid decreases in population density of the susceptible species and the need for more widespread foraging by the insectivorous species. The decrease in populations of susceptible insects following carbaryl treatments is expected to be temporary with rapid recolonization of the treated areas from surrounding range and croplands. As part of the grasshopper IPM monitoring studies, a test was conducted in North Dakota of the effect of carbaryl bait on the nestling growth and survival of vesper sparrow (Adams and others 1994). This study was designed to simulate the treatment of a small grasshopper infestation with carbaryl bait. There was no difference reported in any of the productivity parameters between nests on treated and untreated sites (Adams and others 1994). Adult sparrows on treated sites had to forage farther from the nests to obtain food but did so successfully (McEwen and others 1996). Any effects on nontarget species due to bait treatments can be considered indirect; that is, the prey populations are affected, while no direct toxicity to the nontarget species is likely to occur.

Diflubenzuron is slightly to very slightly toxic to mammals and slightly to very slightly toxic to birds (USDA 2002). Based upon the quantitative calculations of doses of diflubenzuron to vertebrate species, all vertebrates have negligible risk of adverse toxicological effects from full coverage treatments. The primary concern for bird species has related to the effects of decreases in insect populations from insecticide applications on insectivorous species rather than to the direct toxicity to birds from diflubenzuron exposure. Because of its mode of action, diflubenzuron is more target-specific and can be expected to pose a reduced threat to nontarget species relative to the other grasshopper suppression insecticides. Because of its mode of action (a growth regulator rather than a neurotoxin), diflubenzuron is more target-specific and can be expected to pose a reduced threat to nontarget species relative to the other grasshopper suppression insecticides. IPM monitoring studies have shown the effects of suppression insecticides on small mammals such as mice and squirrels to be slight. Since many of these species are nocturnal, they are not as readily exposed to spray treatments as other larger mammals or birds (McEwen and others 1996).

Malathion is very slight to moderately toxic to mammals and slightly to moderately toxic to birds (USDA 2002). The toxic effects of malathion full coverage treatments will be most evident as decreases in susceptible invertebrate populations. In a 3-year study conducted to determine the indirect effects of malathion on nesting birds in Idaho (Howe 1993), findings showed adults had to forage longer on treated plots, and nestlings demonstrated an increased propensity for parasitic blowfly infestations.

Either of these indirect effects might impact survival in some situations. However, this field study did not show these effects to be significant.

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Appendix 4: Project planning and implementation and BMP selection checklist

ACTIVITY INFORMATION	
Location:	State/Federal Contacts with Project:
Project Lead:	Month/Year:
Describe Activity:	

CHECKLIST		
Steps	**Completed (✓)**	**Comments**
1. Site visit before starting work		
2. Define activity, scope, and limits		
3. Identify sensitive areas and determine avoidance buffers		
4. Review Activity category and BMP options related to this project		
5. Select applicable BMPs and incorporate into permit application		
6. Submit permit and response		
7. Understand all permit conditions and resolve outstanding issues before proceeding		
8. Prepare construction & maintenance schedule and/or sequence per permit (including installing, monitoring, maintaining, and removing BMPs techniques)		
9. Schedule a pre-maintenance or pre-construction meeting with state/federal project contacts (could also be scheduled after step 11)		
10. Arrange for delivery of BMP products		
11. Identify/mark work area, sensitive areas and location of BMP(s) as needed. Confirm BMPs are applied per the *Streaked Horned Lark BMPs Guidance Document* and/or the permit conditions		

Steps	Completed (✓)	Comments
12. Conduct activity. Monitor/check BMPs routinely to confirm BMP outcomes are achieved. Make repairs, adjustments and/or additions as necessary and as permit allows. Schedule additional state/federal meetings as needed.		
13. Remove BMPs and re-vegetate in accordance with the post-project revegetation BMP or as permitted.		
14. Complete *Post-Project Compliance Form* and submit to state/federal project contacts		

Appendix 5: Post-project compliance form

Attach additional pages as needed. If possible, provide maps, pictures, and specific BMP use details. Provide this post-project compliance form to state/federal project contacts. If appropriate, schedule a post-project meeting with state/federal project contacts to debrief on BMP use and effectiveness.

ACTIVITY INFORMATION	
Location:	State/Federal Contacts with Project:
Project Lead:	Month/Year:
Describe Activity:	

Steps	Was this BMP applied to this project?	Describe result of BMP application and problems encountered	How could this BMP be improved and/or strengthened?
Avoidance and/or minimization measures			
Sequencing			
Dissuasion			
Avoid and/or minimize permanent habitat reduction			
Post-project revegetation			
Mowing equipment			
Mowing plan development			
Rodent control			
Insect control			
Weed control			
Nuisance/dangerous wildlife control			
Disturbance buffers for airport non-construction activities			
Vehicle use			
Helicopter activity			
Surveys and monitoring			