Evaluating Streaked Horned Lark Habitat Creation and Population Response at Herbert Farm

2016

Annual Report to US Fish and Wildlife Service; Grant Agreement # F14AP00668

Report prepared by Peter Moore

Institute for Applied Ecology

Institute for Applied Ecology

PREFACE

IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.

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Cover photographs: Streaked horned lark at Herbert Farm (Peter Moore, July 2015)

SUGGESTED CITATION

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TABLE OF CONTENTS

Evaluating Streaked Horned Lark Habitat Creation and Population Response at Herbert Farm

2016 ANNUAL REPORT TO US FISH AND WILDLIFE SERVICE; GRANT AGREEMENT # F14AP00668

1. INTRODUCTION

The streaked horned lark (*Eremophila alpestris strigata*) is endemic to the Pacific Northwest and is found in the Puget Lowlands, Washington Coast and Lower Columbia River and the Willamette Valley, with a range-wide population estimated as 1170-1610 individuals (Altman 2011). In 2013 the subspecies was listed as threatened under the federal Endangered Species Act due to its declining numbers and shrinking range. Streaked horned larks are ground-nesting birds that use short, sparsely-vegetated habitats dominated by grasses and forbs and situated within wide open areas with few trees or shrubs. They tend to use early successional habitats and readily use landscapes modified by humans, such as airfields, dredge deposits and agriculture fields (Anderson & Pearson 2015). In the Willamette Valley, high use areas have bare ground (17-31%) and short vegetation (0-15cm) with no trees or shrubs (Anderson & Pearson 2015).

Creating habitat for streaked horned lark on working agricultural lands and restored prairies is critical to any efforts to recover this imperiled bird species. Approximately 80% of the range-wide lark population occurs in the Willamette Valley (Altman 2011) and more than 70% of those birds occur on agricultural lands. Lark conservation on agricultural lands requires a two phase process. First, specific actions and associated costs to effectively create and maintain lark habitat must be identified. Second, to implement these actions, they must be promoted to private landowners with potential for lark habitat, likely through economic incentive programs, such as those coordinated by the Natural Resources Conservation Service. To date, the extensive efforts by numerous agencies and non-governmental organizations to restore both wet and upland prairie habitat from former agricultural lands have not integrated effective techniques for creating streaked horned lark habitat.

The Herbert Farm and Natural Area (Fig. 1) is a 221 acre property, located just south of Corvallis, Oregon, owned by the City of Corvallis (City), with a conservation easement held by Oregon Department of Fish and Wildlife (ODFW) and Bonneville Power Administration (BPA). The property offers a unique opportunity to evaluate the creation of lark habitat since there is active prairie restoration underway (IAE 2013), and there are working agricultural lands on, and surrounding, the property (Figs. 2, 3). Larks have been documented to occur at Herbert Farm, which is less than one mile from the largest lark population in the Willamette Valley, located at the Corvallis Municipal Airport (USFWS 2016). Known hot-spots at Herbert Farm include a large seasonally inundated swale on the eastern part of the property (R. Moore,

OSU, pers. comm. 2015) and along Herbert Avenue, where two nests have been recorded (City of Corvallis 2011: map 2.14).

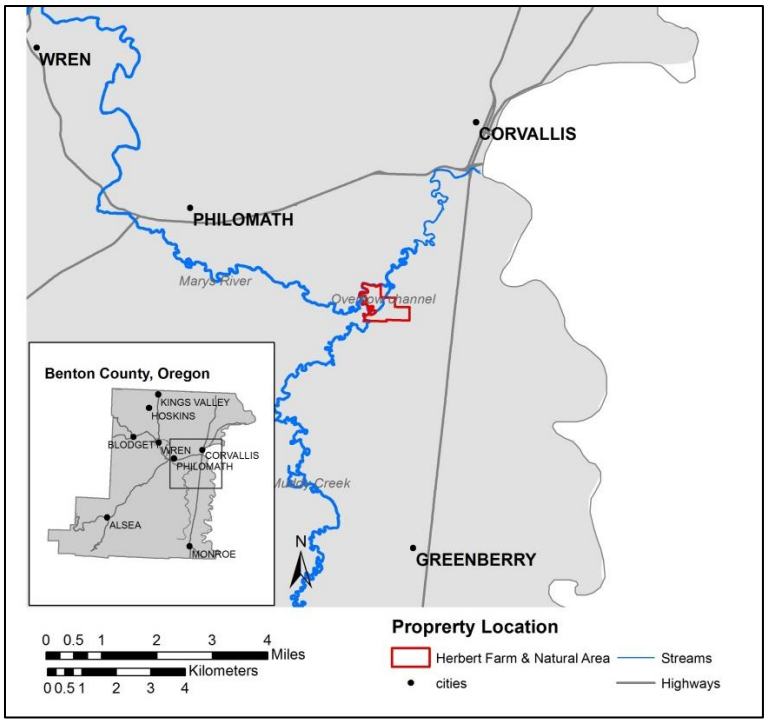

Figure 1. Location of Herbert Farm

Discussions among agency, non-governmental biologists, and private landowners indicated that expansion of the marginal strip of sparse vegetation between roads and agricultural fields, especially grass seed fields, has the greatest potential to increase lark habitat within working agricultural lands. This non-production area, approximately 3 meters in width, and including the roadside ditch, is regularly sprayed with herbicides to prevent contamination of fields by weeds. This also is an area where some larks previously have nested at Herbert Farm.

The Institute for Applied Ecology was awarded funds by US Fish and Wildlife Service (USFWS) in August 2014 to compare methods of creating streaked horned lark habitat at Herbert Farm. The grant agreement #F14AP00668 award is from USFWS Endangered Species Conservation – Recovery Implementation Funds.

The set-up of the project, initial treatments in fall 2015, and the lark monitoring in 2014-2015 were previously described in the 2015 annual report (IAE 2015). This report describes the results for 2016.

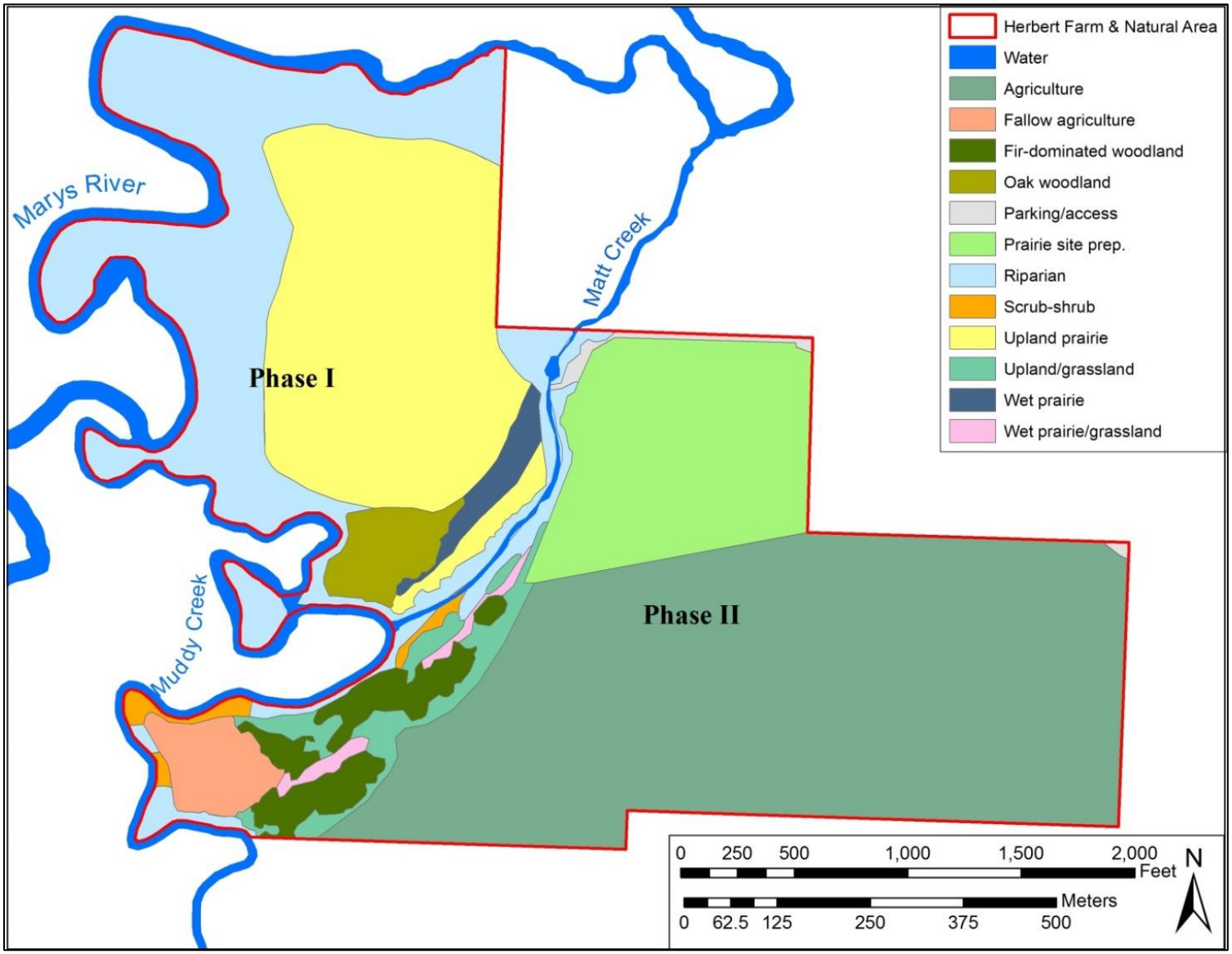

Figure 2. Current habitats at Herbert Farm

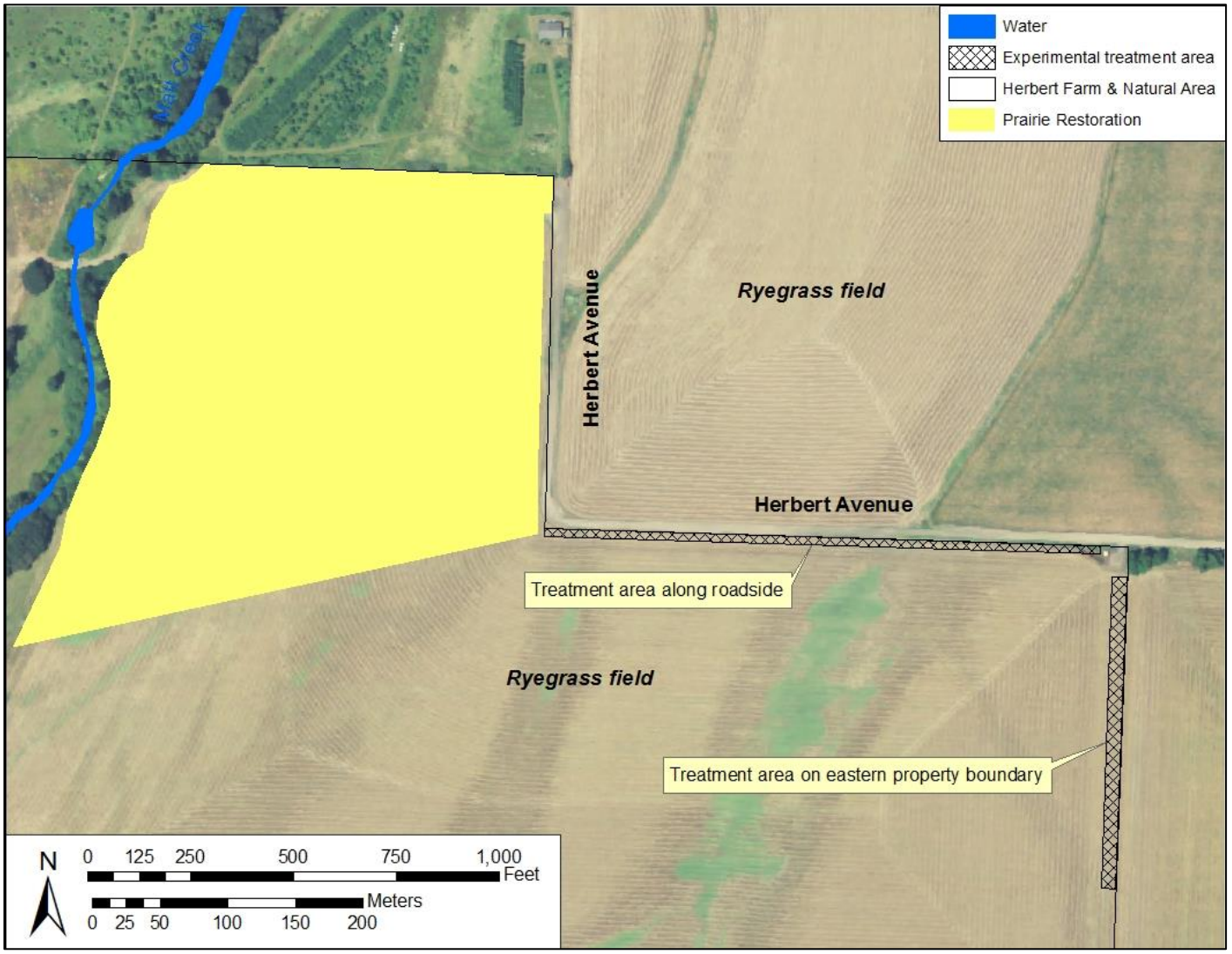

Figure 3. Streaked horned lark experimental treatment areas at Herbert Farm.

2. GOALS AND OBJECTIVES

The goal of this project is to compare three cost-effective techniques for creating streaked horned lark habitat along roadsides.

This project has two primary objectives:

1) Implement multiple management techniques that create lark habitat in association with working agricultural lands and prairie restoration of former agricultural lands; and

2) Monitor and evaluate the response of an existing nesting lark population.

3. METHODS

3.1. Experimental Treatments

Study area is an approximately 600 meter long x 6 meter wide strip at the field edge along Herbert Avenue and the eastern property boundary of Herbert Farm (Figs 3-4).

The treatments applied include:

1) Fall + Spring Herbicide: Apply broad-spectrum herbicide (e.g., glyphosate) in fall and spring.

2) Fall Disk + Spring Herbicide: Disk once in fall and apply broad-spectrum herbicide treatment in spring.

3) Fall Disk + Spring Mow: Disk twice in fall and mow in spring.

The three treatments were chosen for their applicability to common farming practices and their ability to suppress vegetation establishment and growth, and increase the amount of bare ground and sparse vegetation. Other treatments such as gravel and mulch were considered but rejected because of the high cost per unit area and the long-term effect on the treatment area.

Each treatment has two replicates, each approximately 6 meters wide and 100 m long. An additional 6 m wide strip on the eastern property boundary will be sprayed with herbicide to maintain an open "boundary road" between the two fields so that all treatment areas are bordered by a road on one side and fields on the other (Figs 3-5).

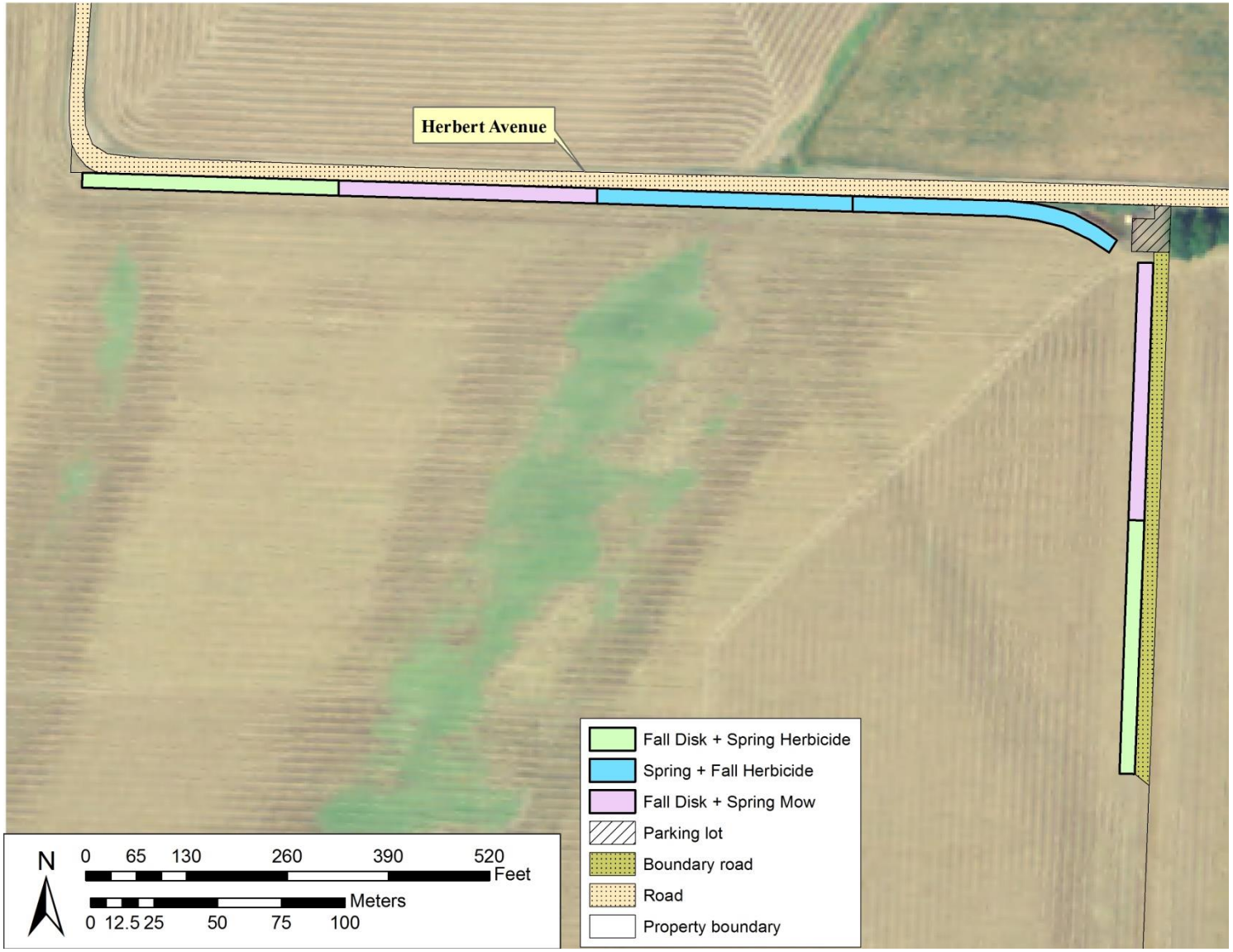

Figure 4. Experimental treatment layout.

Figure 5. View of the streaked horned lark habitat experiment treatment area along the eastern boundary of Herbert Farm, showing the "boundary road" between fields (left of photo), the 6 m wide treatment area (middle), and the recently cut ryegrass field (right). Photo: July 1, 2016.

The treatment schedule is provided in Table 1.

Table 1. Treatment schedule

	Fall + Spring Herbicide treatment	Fall Disk + Spring Herbicide treatment	Fall Disk + Spring Mow treatment
October 2015		Disk	Disk
November 2015	Herbicide		Disk
March-May 2016	Herbicide	Herbicide	Mow
October 2016		Disk	Disk
November 2016	Herbicide		Disk
March-May 2017	Herbicide	Herbicide	Mow

3.2. Monitoring

The project includes monitoring of streaked horned lark populations during the two years preceding habitat treatments (Spring-Summer 2014 and 2015) and two years during treatments (Spring-Summer 2016 and 2017). Streaked horned lark monitoring methods include:

1. Transects: Transect surveys through the prairie restoration and agricultural field will be conducted during three visits, equally spaced through May-June of each year The surveys, conducted by Bob Altman (American Bird Conservancy/Avifauna Northwest) and Randy Moore (OSU), will provide indices of abundance and density estimates for the site.

2. Lark searches: Lark-specific area searches will be conducted by an Oregon State University seasonal field technician to locate and count nesting pairs throughout the treatment area as well as the entire Herbert Farm. There will be a minimum of six visits per year to determine if nesting is occurring. If larks are nesting, each nest will be monitored every few days throughout the breeding season to determine the outcome of the breeding attempt.

Photopoints (at least 6) in the experimental treatment areas will be established and photographed at least twice per year (spring and fall) to document changes in vegetation. Landscape and close-up photos will be taken at each point in each of the four cardinal directions to visually monitor habitat conditions.

4. RESULTS

4.1. Experimental Treatment Implementation

4.1.1 Fall + Spring Herbicide

The previous herbicide treatment in fall 2015 (IAE 2015) had set back vegetation growth compared to the untreated adjacent farmland, but by April there was a ryegrass sward developing (Appendix A, Figs A1-A2).

The spring herbicide application on the two treatment areas (1A and 1B) was conducted on 04/20/16 by a contractor (Habitat Restoration, LLC) using Rodeo (glyphosate) herbicide at a rate of 0.5 gallons per acre along with MSO surfactant at 0.25 gallons per acre. Although broadleaf weeds became more prevalent as the year progressed, the herbicide treatment did a good job of keeping the area sparsely vegetated (Appendix A, Figs A1-A2), compared with the other treatments and adjacent farmland.

The fall herbicide treatment occurred on 10/11/16 using a combination of Rodeo (glyphosate) at 0.5 gallons per acre, Opensight (aminopyralid and metsulfuron-methyl) at 2 oz. per acre, and Competitor surfactant at 1 pint/acre. Opensight was used to improve control of broadleaf weeds but was not used in the lowest lying part of Plot 1A so as not to have a pre-emergent herbicide applied where standing water would later accumulate. The herbicide was applied before a period of heavy rain which started on the evening of 10/12/16. The initial control of vegetation was effective (Appendix A, Fig. A7).

4.1.2 Fall Disk + Spring Herbicide

Subsequent to the harrowing treatment in fall 2015, which had been used in place of disking (IAE 2015), a thick growth of ryegrass had developed by April 2016 (Appendix A, Figs A3-4).

The spring application of Rodeo (glyphosate) herbicide on the two treatment areas (2A and 2B) was conducted on 04/20/16. The height and density of the vegetation shielded some of the foliage from the herbicide, so a touch-up spray was conducted on 5/13/16. Standing dead thatch remained over the next two months and broadleaf and grass weeds began to establish (Figs A3-4, A8). The City Parks and Recreation Department mowed the treatment area on 7/22/16 to remove any remaining thatch prior to disking.

ODFW disked the two treatment areas (2A and 2B) on 10/10/16 (Fig. 5). The disking treatment broke up the soil surface but only partially set back the germinating ryegrass (Appendix A, Figs A3-A4, A8).

Figure 5. Colin Tierney (ODFW) unloading the disk (left) and operating the tractor and disk (right) at Herbert Farm, October 2016.

4.1.3 Fall Disk + Spring Mow

Subsequent to the harrowing treatment in fall 2015, which had been used in place of disking (IAE 2015), a thick growth of ryegrass had developed by April 2016 (Appendix A, Figs A5-6).

The spring mowing treatment of two areas (3A and 3B) was conducted by IAE staff on 04/19/16 using a walk-behind brush mower. The mowed ryegrass grew rapidly in the next few weeks, so a follow up mow was conducted on 05/10/16. The ryegrass still grew rapidly, and although less dense than the ryegrass on the adjacent cultivated field, it achieved a similar height and had set seed by July (Appendix A, Figs A5-6). It was evident that the ryegrass growth was more luxuriant than in the Fall Disk + Spring Herbicide treatment areas.

ODFW disked the two treatment areas (3A and 3B) on 10/10/16 (Fig. 5) two days before the start of a period of heavy rain. The disking treatment broke up the soil surface into clods and only partially set back the sprouting ryegrass (Appendix A, Figs A4-A5, A9).

ODFW attempted to complete the second disk treatment on 11/10/16, after a period of dry weather in November, however the soil was too wet in the low-lying areas, and the attempt had to be abandoned.

4.2. Streaked Horned Lark Monitoring

Randy Moore was contracted to conduct streaked horned lark monitoring in 2016 (Moore 2016, Appendix B). No larks were detected using the experimental areas, but 5-6 individual birds were detected in the nearby restoration area between late March and late April, with one bird occasionally seen in June. The majority of these sightings were of one territorial pair, which included a banded male. The pair did not breed at Herbert Farm, but was later found breeding at the Corvallis Municipal Airport. Apparently, as habitat conditions deteriorated at Herbert Farm due to regrowth of ryegrass, larks moved to occupy fallow fields near the airport (Moore 2016, Appendix B).

5. DISCUSSION

Most of the experimental treatments were completed as planned in 2016, with some variations due to the vigorous growth of ryegrass and weather conditions (Sections 4 and 7).

The Fall + Spring Herbicide treatment created sparse, low lying vegetation for most of the year, which approaches the desired habitat conditions for streaked horned larks. Former farmed fields in the Willamette Valley tend to be fertile and are quickly invaded by vigorously growing non-native weeds. Two applications of glyphosate per year may not create enough bare ground or long-lasting weed control, particularly as some species may be resistant to families of herbicides. Therefore, it is worth utilizing a variety of chemicals and pre-emergent herbicides for more complete control.

Neither of the two other experimental treatments provided suitable habitat for larks during 2016. This is likely to have resulted from a combination of factors, including: ryegrass being seeded in the experimental area prior to commencement in 2015, which supplemented the existing seed bank and created a large flush of germination throughout 2016; using a harrow in place of the disking treatment in fall 2015 may have been less effective at disturbing the ryegrass roots; and the intensity and frequency of treatments was not high enough to combat the ryegrass re-growth. The outcome may have been different if ryegrass had not been sown in 2015, however, the results indicate that one-two years of site preparation with herbicides may be necessary before introducing the use of mowing or disking.

Fall is an ideal time to disrupt the germinating grass and weeds with herbicide or disking, however disking in November may be impractical in most years. October 2016 was unusually wet, which meant that the second disking in November could not be completed without getting equipment stuck in the mud. One to two passes with the disk were made in the October treatment, but multiple passes of the disk may be needed to more thoroughly disrupt the germination of ryegrass.

Although no larks were recorded in the experimental areas in 2016, it was noteworthy that larks were attracted to the adjacent 24 acre restoration field which was sparsely vegetated as a result of previous herbicide treatments (broadcast of glyphosate in fall 2014 and 2015). Re-growth of ryegrass prior to herbicide application in spring (on 5/13/16) may have contributed to larks re-locating to more suitable habitat at the Corvallis Airport. At least 12 acres of the field is being restored as streaked horned lark habitat, and larks may be attracted back to Herbert Farm in 2017. Furthermore, there may be increased

lark activity at Herbert Farm, since the airport population is recovering from a recent crash, and it is anticipated that the habitat near the airport may be less suitable for the birds in 2017 (Moore 2016).

Although the size and type of habitat in the adjacent restoration field is likely to continue to be more attractive to streaked horned larks than the experimental areas, insight will be gained by comparing which combination of techniques creates conditions that are most similar to lark habitat.

6. CONCLUSIONS

Of the three treatment combinations, herbicide applications in spring and fall created the most sparsely vegetated habitat.

Monitoring of streaked horned larks determined that no birds used the experimental areas, but a few birds occupied an adjacent restoration field during early spring 2016.

7. DIFFERENCES FROM ORIGINAL PROPOSAL

Modifications to the experimental design in the original proposal include:

- Follow-up spraying and mowing was needed for the Fall Disk + Spring Herbicide and the Fall Disk + Spring Mow treatments in order to combat the vigorous growth and thick thatch of ryegrass.
- Both the above treatment areas also needed to be mowed in summer to remove thatch prior to disking in the fall.
- The second disking in the Fall Disk + Spring Mow treatment areas could not be completed in November because of wet ground conditions.

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U.S. Fish and Wildlife Service 2016. Recovery outline for the streaked horned lark (*Eremophila alpestris strigata*). 40pp.

APPENDIX A. PHOTOPOINTS

Fig. A1. Fall + Spring Herbicide area 1A in April (before treatment), July (after spring treatment) and October (after fall treatment) 2016.

Fig. A2. Fall + Spring Herbicide area 1B in April (before treatment), July (after spring treatment) and October (after fall treatment) 2016.

Fig. A3. Fall Disk + Spring Herbicide area 2A in April (pre-treatment), July (after spring herbicide treatment) and October (after summer mowing and fall disking treatment) 2016.

Fig. A4. Fall Disk + Spring Herbicide area 2B in April (pre-treatment), July (after spring herbicide treatment) and October (after summer mowing and fall disking treatment) 2016.

Fig. A5. Fall Disk + Spring Mow area 3A in April (pre-treatment), July (after two mowing treatments) and October (after third mowing and fall disking treatment) 2016.

Fig. A6. Fall Disk + Spring Mow area 3B in April (pre-treatment), July (after two mowing treatments) and October (after third mowing and fall disking treatment) 2016.

Fig. A7. Fall + Spring Herbicide treatment close-up view of weedy forbs (top photo, June 2016), and dead weeds, moss and bare ground (bottom photo, late October 2016).

Fig. A8. Fall Disk + Spring Herbicide treatment close-up view of weedy grasses and forbs (top photo, June 2016) and ryegrass regrowth (bottom photo, October 2016).

Fig. A9. Fall Disk + Spring Mow treatment after the fall disking (late October 2016).

APPENDIX B. STREAKED HORNED LARK MONITORING REPORT 2016

Streaked Horned Lark Monitoring at Herbert Farm and Natural Area: Breeding Season 2016

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Executive Summary

The following report details efforts to monitor streaked horned lark (*Eremophila alpestris strigata*, hereafter SHLA) populations at Herbert Farm and Natural Area (hereafter HFNA) during the 2016 breeding season. Monitoring goals were to record population size, habitat use, and nest success of breeding SHLA. Monitoring efforts began in late March, ended in late July, and took the form of walking transects (9 visits) and area searches (15 visits) through A) experimental linear roadside treatment areas adjacent to actively farmed grass fields, B) ~10 ha. (~25 acres) of active 1st year prairie restoration east of Muddy Creek, and C) the 2nd year wet prairie restoration west of the stream ford. SHLA did not breed at HFNA in 2016. SHLA were recorded 15 times over the course of monitoring, representing a total of at least 5 individuals. Territorial SHLA were never detected in the experimental treatment areas or west of the stream ford. A single territorial pair was present in the 10 ha. prairie restoration plot beginning in late March and continued through late April, but had abandoned that territory by early May when SHLA typically begin their first nesting attempts. This pair was relocated in June breeding in a fallow agricultural field at Corvallis Municipal Airport (CVO). A 2nd pair and a single individual were located on 8 April in the 10 ha. prairie restoration area but none were detected on subsequent visits. A single non- territorial male was recorded on two separate occasions at HFNA, both times in the area abandoned by the previously mentioned territorial pair. This male was recorded at various locations within CVO both before and after these sightings, and was labeled as an unmated and non-territorial "floater" male there. Although no breeding occurred at HFNA in 2016, the presence of so many non-breeders bodes well for a future breeding population.

Monitoring Streaked Horned Larks at Herbert Farm and Natural Area, Breeding Season 2016

Methods

Herbert Farm and Natural Area (HFNA) was surveyed for streaked horned larks (SHLA) during the entirety of their 2016 breeding season, March-July. Survey goals were to:

- catalog breeding larks recorded during 9 transect walks in May (n=3), June (n=3), and July (n=3, Table 1). The transect covered the:
    - experimental linear roadside treatment areas adjacent to actively farmed grass fields,
    - the active 1st year prairie restoration east of Muddy Creek,
    - 2nd year wet prairie restoration west of the slough ford.

- record specific information on lark numbers, presence of colored leg bands, breeding ecology (breeding status, nest locations, outcome of nesting attempts), territorial boundaries, and territorial persistence during more intensive area searches conducted on a minimum of 12 visits over the entirety of HFNA (March-July).

Walking Transects

The walking transect route is shown in Figure 1. This path was walked by an experienced observer at a slow, even pace before 10 a.m. on 9 visits spread evenly over the 3 months of the nesting period: May, June, and July. The observer altered the initiation point on successive visits, from A to B (Fig. 1). Age, sex, and behavior were to be recorded for all SHLA detected. Location was recorded using a sub-meter Geneq SX-Blue GPS unit, a Tru-Pulse laser rangefinder, and a handheld Windows computer, all of which

communicate via Bluetooth. This system allows an observer to record location of subjects remotely and very accurately (i.e., without observer leaving the transect line, and without disturbing sensitive subjects).

The portion of the transect that traversed the 2nd year prairie restoration west of the stream ford was not included in the last 5 transect runs, as the habitat that might have supported larks in that portion of HFNA had become unsuitable as a result of vegetative succession.

Area Searches

Much more intensive area searches were conducted after the walking transect had been completed (May-July), or with detection of a lark by any means (March- July). These searches were either focused on areas of suitable lark habitat not directly covered by the transect, or an area in which a lark had been detected. If SHLA were detected during area searches, the observer recorded age, sex, and band combination if viewing conditions and circumstances allowed. Once this basic data had been recorded, the observer stayed with the bird(s) to record behavioral observations to help determine whether they had established a territory and whether they were actively breeding. If subjects showed signs of wariness at being observed, they were left for a period exceeding 30 minutes so that they could resume normal behavior. Position information for individuals or pairs was recorded only on the

observer's first contact or upon resuming observation after the subjects had moved of their own accord; this increases the accuracy of territorial boundary designation, as SHLA are known to move well outside territorial boundaries when reacting to disturbance (Moore, unpub. data). When the portion of HFNA

that is still in agricultural production was harvested in late June/early July, the portions of those fields that are subject to winter inundation (and thus are more suitable as lark habitat in spring/summer) were added to the area searches.

Nest Checks

Had the presence of breeding SHLA required it, observers would have checked nests every 1-3 days to allow calculation of nest success rates. Because larks did not breed, this activity was not required in 2016.

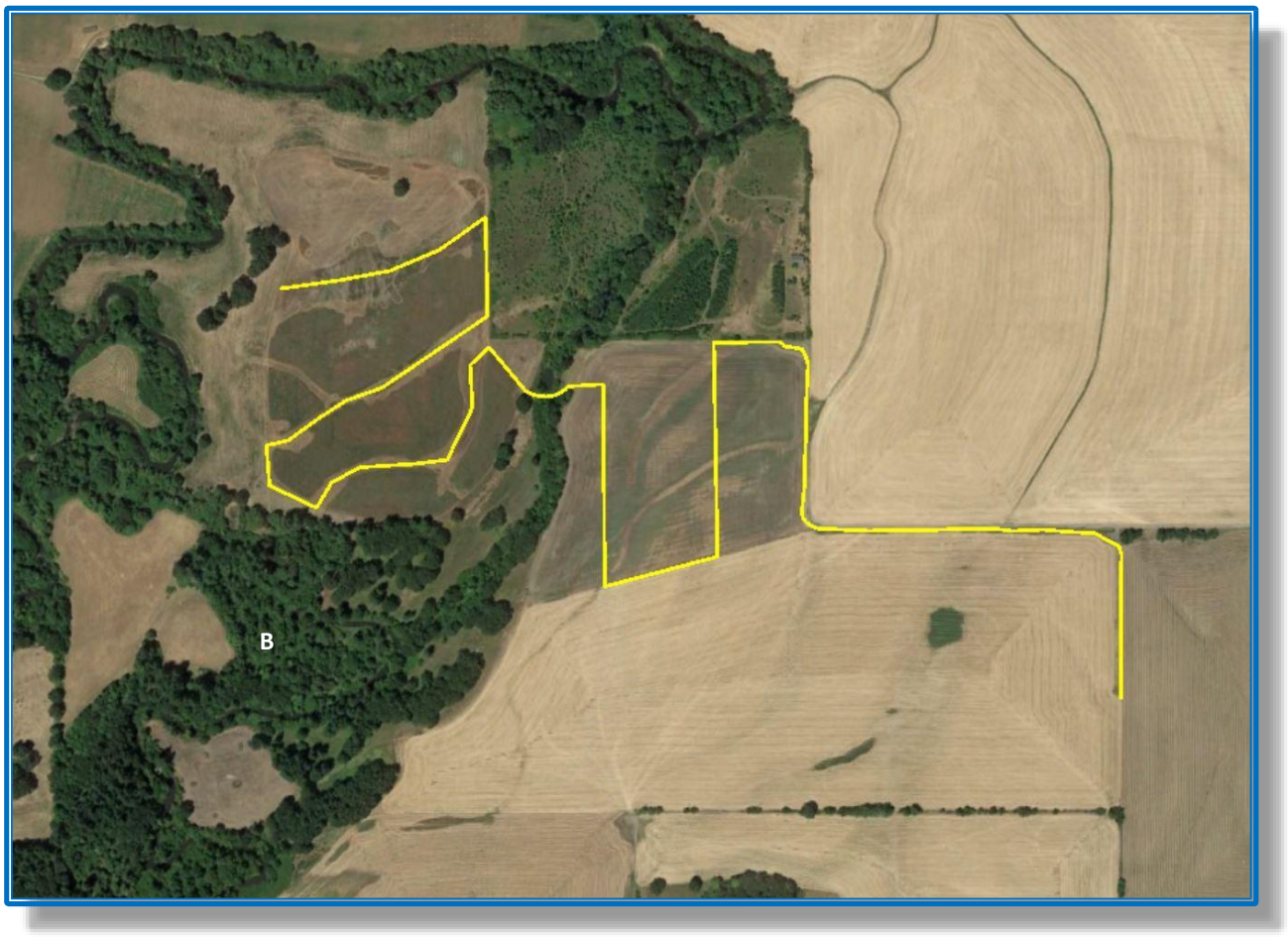

Figure 1- SHLA monitoring transect route at HFNA, breeding season 2016.

Results

	# SHLA Detected			
Date	Transect	Area Search	Effort (hrs.)	Notes
3/28/2016	NA	2	3	One territorial pair (male banded hm/YH).
4/1/2016	NA	2	3	One territorial pair (male banded hm/YH).
4/8/2016	NA	5	5.5	One territorial pair (male banded hm/YH), one additional pair, one individual
4/23/2016	NA	2	3	One territorial pair (male banded hm/YH).
4/26/2016	NA	2	4	One territorial pair (male banded hm/YH).
5/9/2016	0	0	3	-
5/18/2016	0	0	3	-
5/30/2016	0	0	3	-
6/6/2016	0	1	5	One adult male, banded Cm/OC.
6/7/2016	NA	0	2	-
6/18/2016	0	0	3	-
6/29/2016	0	1	5	One adult male, banded Cm/OC.
7/6/2016	0	0	4	-
7/15/2016	0	0	3	-
7/27/2016	0	0	3	-

Table 1- Results of SHLA monitoring visits to Herbert Farm and Natural Area, breeding season 2016. Number of SHLA detected is per visit; the 15 detections represented only 5-6 individuals (see text). Color-band combinations are read left-to-right, top-to-bottom, and letter case indicates band size. hm/YH, for example, refers to a lark with a small hot pink (h) band over an aluminum USFWS (m) band on the left leg, and a large yellow (Y) band over a large hot pink band on the right leg. C and O are chartreuse and orange, respectively.

SHLA Detections at HFNA

Monitoring data are summarized in Table 1. During 9 transect runs and 12 area search sessions (15 total visits), no fewer than 5 and no more than 6 individual SHLA were detected at HFNA in 2016. The reason for this uncertainty is the possibility that individual A (recorded on 8 April, Fig. 2, Table 1) was the same bird as individual B (recorded during multiple visits in June, Fig. 2, Table 1). Individual A flushed from the active prairie restoration with views that were insufficient to determine sex or the

presence of colored leg bands; it left HFNA as the observer watched and did not return. Individual B was recorded twice during area searches in June (and almost certainly once by an independent observer), and although this bird was definitively identified as a banded adult male (Table 1), he was not separable from individual A despite the 2 months that separated the sightings. All other detections represented 4 individuals separable in the field, 2 males (1 banded, 1 unbanded) and 2 females (both unbanded). These 4 individuals comprised 2 pairs, and were seen simultaneously on 8 April with individual A. One of these pairs was recorded on 5 visits in March and April (pair A), the other (pair B) was never recorded after its initial detection on 8 April.

Both banded males recorded at HFNA in 2016 were 2nd year males banded in the nest at CVO in 2015.

All SHLA detections occurred in the 1st year prairie restoration plot; there were no detections west of the slough ford, in the experimental treatment plots, or in the portion of HFNA still in agricultural production (Figure 2).

SHLA Territoriality and Breeding at HFNA

Pair A (Figure 2) was classified as territorial by virtue of consistent presence, and both vocal and agonistic territorial behavior. On 8 April, the Pair A male was observed aggressively chasing pair B from the patch in which he had been consistently present from late March through most of April (Fig. 2, Table 1). He also sang infrequently during every visit during which he was detected. Unlike many passerine birds, SHLA are often territorial weeks and sometimes months before the actual nesting period begins, at least in this part of the subspecies' range (Moore, unpub. data). This pair, however, disappeared from their HFNA territory sometime between 27 April and 9 May, not to be recorded there again. They were

relocated at CVO in July, breeding 2.5 km. from their HFNA territory.

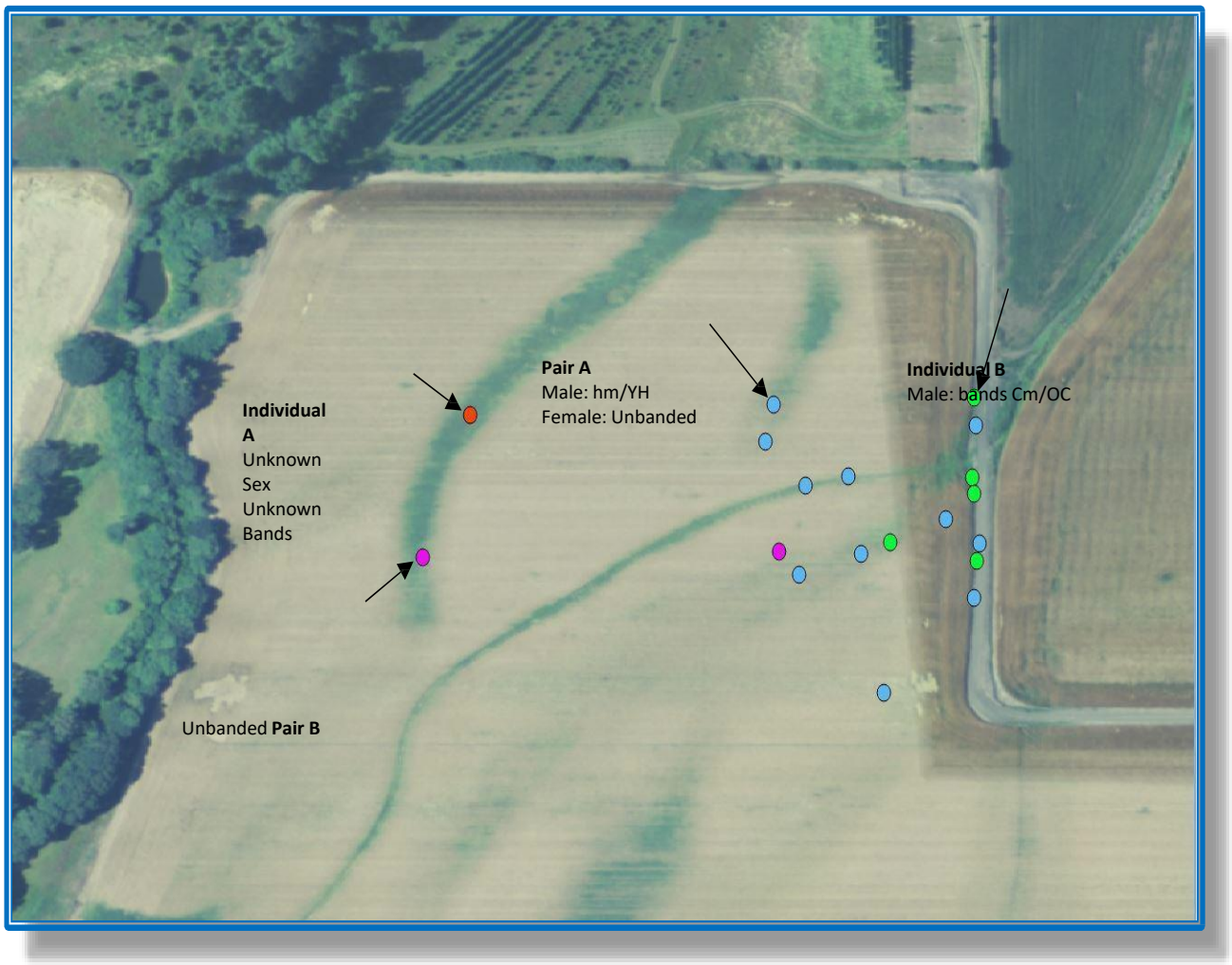

Figure 2- All independent SHLA detections at HFNA, breeding season 2016. Individual colors represent the same individual/pair; legend is on the map. Note that the unknown sex/bands individual at upper left (red icon) cannot be distinguished from the male banded Cm/OC at right even though the sightings were separated by some 2 months. See Table 1 for explanation of color-band combinations.

None of the other SHLA detected at HFNA in 2016 were territorial. Pair B and Individual A were present only on 8 April, and although Individual B was present on more than one occasion and displayed some territorial behavior (singing and flight display), he was never consistently present at HFNA or CVO (where he was also

recorded multiple times during the 2016 breeding season), nor was there ever a female associating with him at either site.

Discussion

Breeding season 2016 at HFNA can be summarized thusly: habitat availability and occupancy were better than the period prior to commencement of restoration activity, but the SHLA that showed up did not stay to breed. In other words, more SHLA showed up in 2016, but fewer stayed to breed.

Historically, SHLA have bred both along the gravel access road at HFNA and in the swales that traverse the adjacent agricultural fields. In the limited survey work that has been done prior to 2015, not more than one pair has been recorded breeding simultaneously in a given season. Because of the ground disturbance introduced with the onset of prairie restoration activities, one might have expected that 2016 would have seen more SHLA breeding at HFNA than in previous years. However, although there were more SHLA recorded at HFNA than in any previous year, none bred in 2016.

This counter-intuitive result- more birds, less breeding- very likely has two main causes. There were more birds because there was more high quality habitat available early in the breeding season at HFNA. These birds did not remain to breed for a combination of reasons. Quality of available habitat did not remain uniformly high throughout the breeding season. Quality began to decline (because of successional crowding of bare ground) at the end of April and into the beginning of May, which coincides with the critical juncture between territory establishment (March and April) and onset of nesting (beginning of May). However, in a normal year,

the decline of habitat quality at HFNA may not have been sufficient to cause SHLA (pair A, Figure 2) to abandon an established territory; there was still more suitable habitat available in early May at HFNA than has been typical in previous years. 2016 was not a normal year. At the Corvallis Municipal Airport (CVO), from which at least some, if not all, of the SHLA visitors to HFNA come, 2016 saw a very significant expansion of suitable habitat when some 243 Ha (~ 600 acres) of agricultural fields were fallowed for spring and summer. The result was that as suitable SHLA habitat was decreasing in area and in quality at HFNA, it was being maintained at CVO in such quantity that consistently good habitat was available for any breeding pair that wanted it; available habitat was not ever filled at CVO in 2016. It is a certainty that the one territorial pair (Pair A) that occupied HFNA in April relocated to breed at CVO, and one unmated male (Individual B, Fig. 2, Table 1) recorded at HFNA in June spent much more time at CVO than at HFNA. It is reasonable to assume that all other larks detected at HFNA were visitors there and resident breeders at CVO.

This set of circumstances bodes well for future SHLA breeding at HFNA. The SHLA population at CVO rebounded dramatically in 2016, and as the atypically abundant agricultural habitat present this year reverts to its normal unsuitable state in 2017 and 2018, the remaining suitable habitat at CVO will likely approach capacity fairly quickly. Since most larks at HFNA are likely emigrants from CVO, suitable habitat of sufficient area at HFNA is more likely to be occupied in ensuing breeding seasons.