STATUS AND CONSERVATION

OF STATE SENSITIVE GRASSLAND BIRD SPECIES

IN THE WILLAMETTE VALLEY

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EXECUTIVE SUMMARY

This report presents results from a two-year project initiated by the Oregon Department of Fish and Wildlife to develop management and conservation strategies for several State Sensitive grassland-associated bird species in the Willamette Valley. Five species, Oregon vesper sparrow, streaked horned lark, western meadowlark, grasshopper sparrow, and common nighthawk, were designated as target species based on concerns about declining populations and habitat loss, and limited information on their status and breeding ecology.

Broad-scale censusing was conducted at 544 roadside point count stations throughout the Willamette Valley in May and June 1996 to characterize the grassland breeding bird community, and quantify target species abundance and habitat associations. Area searches, walking transects, and automobile transects (for common nighthawks) also were conducted to provide supplemental census data relative to specific conditions (off-road habitat), purposes (density estimates), or species requirements (i.e., common nighthawks). Territory-mapping and nest monitoring were conducted primarily in 1997 at selected sites to quantify species habitat area requirements and reproductive success, the two principal parameters being used for developing landbird conservation strategies. Habitat characterization was conducted at each point count station, nest site, and within each territory.

Ninety-nine species were recorded during censusing. An additional 7 species were only recorded as incidentals outside of censusing. Savannah sparrow was the most abundant species (n=1,784; relative abundance=1.64 birds/point count), and the only species among the 12 most abundant species considered characteristic of native grasslands. The next two most abundant species were European starling (n=1,205) and Brewer's blackbird (n=865). These three species accounted for 37% of all detections.

Among the three target species censused by point counts, vesper sparrow, horned lark, and western meadowlark, vesper sparrow was lowest and western meadowlark highest in all measures of abundance and distribution. Vesper sparrow had the lowest relative abundance (0.06 birds/point count), occurred at the fewest number of point count stations (7.3% of 544 stations), and occurred in the fewest number of regions (20 of the 40 regions). Horned lark and western meadowlark were similar in relative abundance (0.14 and 0.15 birds/point count, respectively), occurrence at point count stations (12.5 and 14.5% of 544 stations, respectively), and occurrence by region (23 and 25 of the 40 regions, respectively).

Different patterns of distribution for target species were evident. Horned larks occurred primarily within the central Willamette Valley, with the highest abundance in areas around Baskett Slough National Wildlife Refuge. Western meadowlarks were nearly absent in the northern Willamette Valley, occurred in relatively low abundance in the central Willamette Valley, but were most abundant in the southern Willamette Valley. Vesper sparrows occurred in relatively low abundance in the central Willamette Valley, were slightly more abundant in the eastern part of the northern Willamette Valley, but were most abundant in the southern Willamette Valley.

Twelve habitat types were delineated at point count stations. The dominant habitat type was cultivated grass fields (52.7%). Each of the other 11 habitat types comprised <10% of the habitat

sampled. Principal habitat types used by target species were pasture, Christmas tree farms, cultivated grass fields, and to a lesser extent fallow fields. The near absence of target species in wet prairies (only one detection, a western meadowlark) indicates the primary habitat association of these species is xeric grasslands. Other grassland habitat types which provided little or no habitat for target species were maintained fields and harvested grass fields.

Patterns of target species occurrence by habitat type indicate a relatively high degree of specialization for vesper sparrow and western meadowlark (each predominantly in two or three habitat types, respectively), and a relatively broad range of habitat types used by horned lark. Pasture was a primary habitat type for western meadowlark and vesper sparrow. Pasture habitat accounted for nearly 50% of detections of both species, despite less than 10% of sampling effort in pasture. Christmas tree farms were the other high use habitat type for vesper sparrow (approximately 45% of the detections), and cultivated grass fields were the other high use habitat type for western meadowlark (approximately 35% of detections). Percent detections of western meadowlarks in fallow fields (10.6) also were greater than percent of the habitat type sampled (6.3). The four principal habitat types used by horned larks included gravel and dirt roads, roadside right-of-ways, plowed fields, and cultivated grass fields. Horned larks detections in bare ground, Christmas tree farms, and herbaceous row crops also were a greater percent than percent sampling effort in those habitat types.

Vesper sparrow and western meadowlark occurred primarily in herbaceous pastures or pastures with less than 10% shrub cover; although western meadowlarks were most often associated with predominantly herbaceous pastures, and vesper sparrows with a higher percent of shrub/tree cover. Vesper sparrows rarely occurred in "manicured" Christmas tree farms where herbaceous vegetation was regularly controlled. They were regularly detected in "weedy" farms where herbaceous vegetation was mixed with bare ground.

Mean territory size for western meadowlark (n=21) was 14.3 acres (range 4.8-35.0), and 67% (n=14) of the territories were 10-19 acres. Mean territory size for vesper sparrow (n=38) was 3.1 acres (range 1.1-13.0), and all but one of the territories were less than 6 acres. Mean territory size for grasshopper sparrow (n=18) was 3.5 acres (range 0.5-9.0), and 72% (n=13) of the territories were less than 5 acres. Mean territory size for horned lark was 1.9 acres (range 1.5-2.5), although this included only three territories.

Territories were dominated by herbaceous vegetation (primarily grasses). Bare ground was a substantial component of horned lark territories (17%), but a relatively minor component in territories of vesper sparrow (6%), western meadowlark (3%), and grasshopper sparrow (2%). Shrubs were a minor component in western meadowlark, vesper sparrow, and grasshopper sparrow territories (2, 6, and 2%, respectively). Trees were incidental in western meadowlark and vesper sparrow territories (0.6 and 0.7%, respectively), and non-existent in grasshopper sparrow and horned lark territories.

Forty-seven nests of the five target species were located and monitored. This included 19 vesper sparrow nests, 13 horned lark nests, 12 western meadowlark nests, 2 grasshopper sparrow nests, and 1 common nighthawk nest. Proportional nest success was 49%, and ranged from 39% for horned

lark to 58% for vesper sparrow. Mayfield estimates of nest success ranged from 45% for horned lark to 58% for vesper sparrow. Overall Mayfield estimate of nest success was 53%. Proportional nest success was greatest in pasture (86%, n=7), and least in roadbank shoulders (25%, n=4) (all horned lark nests) and fallow fields (33%, n=12). Most western meadowlark nests in fallow fields failed (71%, n=7), and this included all meadowlark nest failures. Proportional nest success in Christmas tree farms, the habitat type where most nests (n=16) were found, was 50%.

Predation was implicated as cause of failure at 50% (n=12) of the nests. There also was a relatively high rate of nest abandonment (29%, n=7). Two horned lark and one western meadowlark nest were destroyed due to farming activities. There were no instances of brood parasitism by the brown-headed cowbird.

Meadowlark and grasshopper sparrow nest sites were characterized by high grass cover (84 and 89%, respectively) and low bare ground cover (6 and 1%, respectively). Conversely, vesper sparrow and horned lark nest sites were characterized by reduced grass cover (49 and 62%, respectively), and substantially more bare ground (24 and 31%, respectively).

Over 100 people assisted in common nighthawk censusing in 1996 and 1997. They traveled over 6,000 miles during over 300 party-hours of census effort. There were more detections in 1997 (125) than in 1996 (100) despite approximately half the effort. Seven survey areas accounted for 65% of the detections in both years. These can be generally lumped into two types of areas. The Sublimity/Waldo Hills area east of Salem is open uplands dominated by large grass fields and Christmas tree farms on the eastern edge of the central Willamette Valley and adjacent foothills. The remaining areas are lowlands in the historic floodplain on the west side of the Willamette River, extending from south of Corvallis to south of Dayton. Other areas where nighthawks were detected to a lesser degree include around Fern Ridge Reservoir, near the Molalla River, and around buttes and foothills in Linn County east of I-5.

Conservation of grassland birds in the Willamette Valley will require a combination of management and restoration activities on both private and public lands. Managing existing and future agricultural lands to provide suitable habitat for grassland birds is essential because of the near extinction of native grasslands. Since over 90% of the Willamette Valley is privately owned, actions to protect or enhance habitat for grassland birds must be in partnership with private landowners, many of whom make their living on these same lands. Efforts also must be directed toward including grassland birds in habitat management plans on public lands. Land-use on private agricultural lands often changes from year-to-year, and this instability likely adversely impacts grassland bird populations. Thus, the establishment of designated Grassland Bird Conservation Areas on public lands is important to maintain stable populations at multiple locations.

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INTRODUCTION

Grasslands are recognized by many as the most imperiled ecosystem worldwide (Department of the Interior 1996). Grassland birds in North America have been reported as declining more than any other avian group since the mid-1960s (Peterjohn and Sauer 1993, Knopf 1994). Factors implicated in the declines include habitat loss or degradation such as conversion of perennial grassland to annually cultivated cropland (Johnson and Schwartz 1993, Rodenhouse et al. 1993), reproductive failures due to increased rates of nest predation or parasitism (Johnson and Temple 1990), and intensification of agricultural practices such as earlier and more frequent mowing and tilling (Warner and Etter 1989), and increased use of agricultural chemicals (Swanson 1996).

Prior to European settlement, much of the Willamette Valley of western Oregon (Figure 1) was native grassland and oak savannah maintained by periodic fires (Wilson et al. 1995). Settlement, fire suppression, and cultivation resulted in the loss of most of these native grasslands. Populations of bird species associated with native grasslands were likely reduced, but some species were able to persist in newly created "secondary" grassland habitats such as hayfields and pasture. In more recent times, Willamette Valley grassland bird species have been further impacted by loss of this secondary grassland habitat to extensive suburban and residential development, and conversion to row crop agriculture and large, intensively cultivated grass-seed fields.

Grasslands in the Willamette Valley historically supported a diversity of breeding birds. Highly associated species included: savannah sparrow, Oregon vesper sparrow, streaked horned lark, grasshopper sparrow, western meadowlark, western bluebird, lazuli bunting, northern harrier, western kingbird, killdeer, common nighthawk, and short-eared owl. Burrowing owls formerly nested in Willamette Valley grasslands, but have been extirpated as a breeding species.

The Oregon Department of Fish and Wildlife (ODFW) has designated Willamette Valley populations of the Oregon vesper sparrow, streaked horned lark, western meadowlark, common nighthawk, and burrowing owl as State Sensitive Species (Critical Status) because of concerns about declining populations and habitat (OAR 635-100-040, Oregon Sensitive Species List, December, 1997). Other State Sensitive grassland-associated bird species in the Willamette Valley are western bluebird (Vulnerable Status) and grasshopper sparrow (Peripheral or Naturally Rare Status).

This report presents results from a two-year project initiated by the Oregon Department of Fish and Wildlife to develop management and conservation strategies for several State Sensitive grassland-associated bird species in the Willamette Valley. Five species, Oregon vesper sparrow, streaked horned lark, western meadowlark, grasshopper sparrow, and common nighthawk, were designated as target species based on concerns about declining populations and habitat loss, and limited information on their status and breeding ecology. The term "grassland" as used in this report refers to agricultural fields such as pasture, hayfields, and cultivated cropland (e.g., grass, grain, vegetable, and berry fields and Christmas tree farms); and non-agricultural fields such as remnant prairies and fallow fields. Bird species associated with these types of fields often were formerly native grassland species.

OBJECTIVES

Project objectives were:

- Characterize the breeding bird community in Willamette Valley grasslands,
- Locate populations of target species and quantify their abundance,
- Characterize habitat features associated with target species occurrence and breeding sites,
- Determine reproductive success and area requirements of target species within different grassland habitat types, and
- Provide management and conservation recommendations to protect, enhance, and restore grassland birds and their habitats.

This study is the first examination of grassland bird-habitat relationships in the Willamette Valley. The results will be used to guide management of habitat to support grassland bird species, particularly sensitive and declining species, and for predicting effects on the avian community in grassland restoration or enhancement projects. Project results also will help identify important habitat types and sites to focus conservation efforts. Application of the knowledge gained from this study will form the basis for developing conservation strategies and agreements to avert threatened and endangered listing status for several species.

METHODS

Data collection integrated multiple methods at extensive and intensive scales. Broad-scale (extensive) censusing was conducted throughout the Willamette Valley in 1996 to characterize the grassland breeding bird community, and quantify target species abundance and habitat associations. Extensive censusing also established baseline conditions at permanent monitoring stations for long-term monitoring of population trends. Intensive research was conducted primarily in 1997 at selected sites to quantify species habitat area-requirements and reproductive success, the two principal parameters being used for developing landbird conservation strategies (Mueller 1993, Bonney and Pashley 1994).

Extensive Scale

Censusing: The primary censusing method was roadside point counts. Area searches, walking transects, and automobile transects (for common nighthawks) also were conducted to provide supplemental census data relative to specific conditions (off-road habitat), purposes (density estimates), or species requirements (i.e., common nighthawks).

Point count censusing was conducted during a five-minute period (Ralph et al. 1995). Detections were recorded within fixed radii of 50 meters, 100 meters, beyond 100 meters, and flyovers. Based on recent research, 100 meters may be the most effective point count radius to use in grasslands (Cyr et al. 1995, Savard and Hooper 1995), and this was the data set used for all analyses. The 50-meter data set may be used for comparisons with most other point count censusing, and the unlimited distance data set may be used for comparisons with Breeding Bird Survey (BBS) data.

Point count censusing was conducted during an eight week period between May 5 and July 1 by four trained individuals. Censusing occurred between official sunrise and 10:00 AM under favorable weather conditions. Recommendations for extensive point count censusing suggest one visit per point during the breeding season (Ralph et al. 1995); however, the variability in breeding phenology among our target species necessitated two visits. One census was conducted at each point count station in May due to resident early breeders western meadowlark and streaked horned lark; and one in June for later breeding migrants, vesper sparrow and grasshopper sparrow.

Area searches were conducted where access to off-road habitats was available. A single observer walked through a defined grassland area (approximately 10-15 acres) recording species abundance during a 20-minute census (Ralph et al. 1993). Detections outside the area search plot (often in non-grassland habitat) were also recorded. Area searches occurred during the same daily and seasonal time frames as described for point count censusing.

Several roadside walking transects were conducted on June 11, 1996 to estimate densities of western meadowlark and horned lark. These occurred in areas known to have relatively high populations of these species. Automobile transects were used to census common nighthawks during late evening foraging bouts (see Appendix A). Volunteer participants censused designated survey areas during the last 1 1/2 hours before dark on June 26 and July 10, 1996, and June 25 and July 14, 1997.

Site Selection: Selection of point count stations was based primarily on known locations of target species and locations of potentially suitable habitat. Additional considerations included:

- spatial sampling throughout the valley,
- sampling of a broad range of potentially suitable habitat,
- sampling of physiographic regions (valley floor and foothills),
- sampling within "historic grasslands" (e.g., French Prairie, Elliott Prairie, Howell Prairie) and known remnant grasslands (Alverson 1990),
- maintaining a straight-line distance of at least 1/4 mile between point count stations to ensure statistical independence of the points,
- avoiding highways and heavily traveled roads for personnel safety and species detectability concerns, and
- avoiding BBS routes to ensure statistical independence for comparisons with BBS data.

Known locations of target species included recently documented sites (e.g., Marshall et al. 1996, Altman 1994, field notes in Audubon Society newsletters), 1995 Breeding Bird Atlas records, and reconnaissance inventories conducted prior to censusing. Suitable habitat was based on project staff knowledge of target species habitat requirements, examples of suitable habitat from reported locations of target species, and reconnaissance surveys prior to and during censusing. Suitable habitat for target species was described by 12 habitat types (Appendix B) including agricultural fields such as cultivated grass fields, row crops, and pasture; and non-agricultural fields such as fallow fields, roadside right-of-ways, and remnant prairies. Two habitat types considered grasslands because of target species use were Christmas tree farms and gravel/dirt roads.

Habitat Characterization: Habitat characterization was conducted at each point count station during May and June to evaluate target species habitat associations. Habitat characterization within the 100 meter fixed-radius point count circle included ocular estimates of percent cover of each field type (Appendix B), percent cover of each vegetation height class (Appendix C), and presence of abiotic features (e.g., fences, powerlines, roads). Additionally, habitat type and vegetation height class were recorded for each detection of a target species during censusing or when encountered incidentally. Incidental detections of several non-target grassland associated species such as western kingbird, northern harrier, western bluebird, short-eared owl, and lazuli bunting were also classified by habitat type and vegetation height class and plotted on topographic maps.

Intensive Scale

Territory-Mapping: Territory-mapping was conducted to provide data on target species area requirements. Territory-mapping was conducted using the "repeat-flush" technique (Wiens 1969). A single observer walked through study plots and mapped the location and flight paths of target species males as they were flushed. The objective was to record a minimum of approximately 20 locations for each male (Wiens 1969). Unlike Wiens (1969), multiple visits (2-5) were made to increase accuracy of territory boundaries. The repeat-flush method has been shown to be more accurate than spot-mapping (International Bird Census Committee 1970) for vesper sparrows (Reed 1985).

Territories were generated from point data collected with a Global Positioning System (GPS), and input into a Geographic Information System (GIS). A Garman GPS 12XL equipped with a DCI RDS 1000 differential receiver was used to determine latitude and longitude of 4-8 perimeter points of each territory. Individual point accuracy was in the range of ten meters provided by the differential receiver. GPS point data was downloaded into ESRI's Arc View GIS 3.0a. ArcView was used to convert the point locations into polygons and calculate individual territory sizes.

Nest Success: Nest monitoring was conducted to provide data on target species reproductive success and the incidence of predation/parasitism. Nests were located by observation of behavioral cues (Martin and Conway 1994), systematic walking through an area with several individuals spaced 1-2 meters apart (Basore et al. 1986), and rope-dragging (Wiens 1969). Nests were marked and revisited in a manner to reduce predator attraction and investigator-induced predation (Martin and Conway 1994). Follow-up monitoring to determine outcome at each nest occurred every third or fourth day until either the young fledged or the nest failed. A nest fledging at least one young was considered successful. Causes of nest failure were surmised based on examinations of the nests and the surrounding area (Best 1978, Patterson and Best 1996). If nest contents (eggs or nestlings) were removed, the nest was considered depredated.

Nest success was described in two ways; proportion of nests monitored that fledged at least one young, and Mayfield (1975) estimates. Mayfield (1975) estimates of nest success are considered better estimates since they account for the number of days a nest was under observation, thus eliminating potential underepresentation of nest losses by nests found late in the reproductive cycle.

Site Selection: Intensive sites were selected based on the presence of target species, and permission to access and conduct work on the property.

Habitat Characterization: Habitat variables and measurement techniques used at nest sites and within territories were selected based on a review of the literature, knowledge of likely important structural features for birds in Willamette Valley grasslands, and the time and relative cost to collect the data. To eliminate interference with reproductive success, data were collected after nests were no longer active, but as soon as possible to minimize changes in physical structure of the vegetation from growth or senescence.

Vegetation data were collected at each nest site and a "non-use" site 25 meters from the nest in a random direction. Data were collected within a 1-meter square plot centered on the nest in the 4 cardinal directions, and in 5 and 11.3 meter radius circular plots centered on the nest. Data collected within the 1-meter plot included ocular estimates of vegetation cover by growth form (i.e., grass/forb, litter/residue, bare ground, rock, moss, shrub, or woody), herbaceous and woody vegetation height at the nest (within 3 inches of the north wall of the nest) and within the plot, levels of litter/residue, and nest concealment as described in Appendix C. Vegetation cover was estimated to the nearest 5% on an overlapping basis so that the sum could exceed 100%.

Vegetation density within the 1-meter square plot was estimated with a density board 75 cm wide and graduated in 10 cm intervals (Gysel and Lyon 1980). The board was positioned immediately in front of the nest and viewed from the four cardinal directions at a distance of 3-meter and a height of 1-meter. The percent of each interval obscured by vegetation was recorded as 0-20, 21-40, 41-60, 61-80, or 81-100%, and scored as 1-5, respectively (Bryan and Best 1991). A density index was determined by averaging the scores from each direction for each interval, and then summing over all intervals (Basore et al. 1986).

Within the 5-meter plot, data collected included maximum shrub height and stem densities, and percent herbaceous cover and herbaceous height by 6 inch height classes. Within the 11.3-meter plot, data were collected on percent tree cover, stem density, dbh, and height. Landscape features such as distances to roads, shrubs or trees, and fencelines also were measured. Techniques for measurement of habitat variables were based on several sources including Wiens (1969), Rotenberry and Wiens (1980), Basore et al. (1986), Bryan and Best (1991), Herkert (1994), and Camp and Best (1994). Habitat characterization was supplemented with photo-documentation of each nest site.

Vegetation data were collected within each territory along 50-meter transects randomly located from the center of the territory. Three parallel transects were established 50 meters apart in western meadowlark and vesper sparrow territories, but only two transects in grasshopper sparrow and horned lark territories because of their smaller size. Data were collected within five 10-meter square plots centered along each transect, and summarized for the 10 or 15 plots per territory. Variables measured included ocular estimates of vegetation cover by growth form (see above), percent cover of grasses by 6-inch height classes, maximum shrub height and stem densities, and abiotic features such as length of fenceline, road, and telephone line within the territory.

DATA ANALYSIS AND INTERPRETATION

Limitations in study design affected analysis and interpretation of the data. Point count stations were not located in a random or systematic manner due to the relative rarity of the target species, and the principal objective of locating individuals and populations of target species. The lack of random sampling results in statistical constraints in analysis and potential biases in interpretation of the data due to the absence of randomness in the design, and the presumed lack of representative sampling of habitat types. Thus, data are presented descriptively rather than as inferential statistics, but reasonable inferences were made where the data clearly indicated patterns of abundance, distribution, or habitat associations of target species.

Analyses of point count data is presented as relative abundance, the mean number of individuals per count within a 100-meter fixed-radius circle. Analyses of target species occurrence by habitat type included all detections during point count censusing. Transect density estimates were based on detections of singing males and converted to pairs/mile.

Most population data is based on point count censusing for western meadowlark, vesper sparrow, and horned lark. Grasshopper sparrow was only recorded as an incidental detection at two locations in 1996. Data presented for the common nighthawk is based on a specialized census (automobile transects).

Point count data were pooled into regional data sets for analysis and interpretation. Forty regions were established on the basis of clusters of point count stations in similar habitats, physiographic areas (e.g., valley floor, foothills, river bottom lowlands), or established geographic areas such as historic prairies (e.g., French Prairie, Elliott Prairie) (Figure 2). The number of point count stations in a region varied from 5 to 29 (Appendix D). Comparisons of indices of target species abundance were made between regions to discern patterns throughout the valley.

Since over 95% of the land in the Willamette Valley is privately owned, location of intensive sites could not be randomly or systematically distributed. Thus, data on target species area requirements and nest success are not necessarily representative samples of habitat types. However, in lieu of the absence of data on these parameters for target species, data are presented descriptively and patterns are discussed where appropriate.

The timing of vegetation data collection in grassland habitats can affect results and interpretation of bird-habitat relationships (Whitmore 1979). Vegetation growth or senescence can account for statistically significant changes in species habitat requirements. This problem is inherent with habitat sampling in grasslands after nest completion. The use of range classes for variables (e.g., vegetation height classes) can minimize some of the biases, but recognition of the problem when interpreting the data is essential.

RESULTS AND DISCUSSION

Point Counts

Habitat Characterization: Habitat type (see Appendix B for descriptions) at the 544 point count stations was dominated by cultivated grass fields (52.7%) (Table 1). Each of the other 11 habitat types comprised less than 10% of the habitat sampled. These included pasture (9.5%), fallow fields (6.3%), Christmas tree farms (5.1%), roadside right-of-ways (4.2%), herbaceous row crops (3.9%), recently plowed fields (3.5%), gravel/dirt roads (3.0%), and recently mowed grass fields (2.5%). Habitat types only incidentally sampled included maintained fields (0.5%), bare ground (0.3%), and wet prairie (0.2%). Additionally, 8.4% of the habitat at point count stations was non-grassland types (e.g., forest, residential areas, paved roads).

Bird Community Abundance: Ninety-nine species were recorded during censusing at the 544 point count stations (Appendix E). Eighty-four of the species were recorded within 100 meters of point count stations, and 15 species were only recorded beyond 100 meters. An additional 7 species were only recorded as incidentals outside of censusing. Most species were associated with grassland habitat, but some habitat sampled was non-grassland, and some birds detected beyond 100 meters of a point count station occurred in forest or other non-grassland habitat.

Savannah sparrow was the most abundant species (n=1,784; relative abundance=1.64 birds/point count), followed by European starling (n=1,205) and Brewer's blackbird (n=865) (Table 2). These three species accounted for 37% of all detections.

Among the 12 most abundant species (Table 2), only savannah sparrow could be considered characteristic of native grasslands (Knopf 1988). The next three species, European starling, Brewer's blackbird, and red-winged blackbird, and the 12th most abundant species, killdeer, are species characteristic of agricultural lands. Of the remaining species, three swallows, barn swallow, cliff swallow, and violet-green swallow, are open country aerial foragers; and four other species, American robin, American goldfinch, song sparrow, and common yellowthroat are relatively common generalist or edge species.

Target Species Abundance and Distribution: Target species detections within 100 meters of point count stations were: vesper sparrow, 62; horned lark, 154; and western meadowlark, 165. Beyond 100 meters, there were an additional 38 detections of vesper sparrow, 68 of horned lark, and 196 of western meadowlark. The relatively high abundance of western meadowlark beyond 100 meters may be due to its loud vocalizations and higher detectability at longer distances. Total detections exceed actual populations because the numbers include both May and June censuses.

Vesper sparrow was lowest and western meadowlark highest in all measures of abundance and distribution (Table 3). Vesper sparrow had the lowest relative abundance (0.06 birds/point count), occurred at the fewest number of point count stations (7.3% of 544 stations), and occurred in the fewest number of regions (20 of the 40 regions). Horned lark and western meadowlark were similar

in relative abundance (0.14 and 0.15 birds/point count, respectively), occurrence at point count stations (12.5 and 14.5% of 544 stations, respectively), and occurrence by region (23 and 25 of the 40 regions, respectively).

Although target species occurrence in total number of regions was similar (20, 23, and 25 regions for vesper sparrow, horned lark, and western meadowlark, respectively), different patterns of distribution for each species were evident. Horned larks occurred primarily within the central Willamette Valley, with the highest abundance in areas around Baskett Slough National Wildlife Refuge (Figure 3). Other areas of high abundance occurred west of Interstate 5 in the northern portions of the southern Willamette Valley such as south of Tangent, east of Peoria, and north of Harrisburg.

Western meadowlarks were nearly absent in the northern Willamette Valley, occurred in relatively low abundance in the central Willamette Valley, but were most abundant in the southern Willamette Valley (Figure 4). Western meadowlark abundance was highest around Indian Head Hills (1.43 birds/point count) between Brownsville and Coburg along the east side of the valley. Other areas of high abundance in the southern Willamette Valley included areas north of Cheshire and Coburg.

Vesper sparrows occurred in relatively low abundance in the central Willamette Valley, were slightly more abundant in the eastern part of the northern Willamette Valley, but were most abundant in the southern Willamette Valley (Figure 5). Two areas where vesper sparrow was most abundant were north of Cheshire, and around Ward Butte, which is east of Interstate 5 in the southern valley. Vesper sparrows were also relatively abundant (0.31 birds/point count) southeast of Portland between Redland and Estacada which was censused, but not included in our regional analysis due to an absence of habitat characterization for this region.

Target Species Habitat Associations: Principal habitat types used by target species were pasture, Christmas tree farms, cultivated grass fields, and to a lesser extent fallow fields (Figure 6). The near absence of target species in wet prairies (only one detection, a western meadowlark) indicates the primary habitat association of these species is xeric grasslands. Other grassland habitat types which provided little or no habitat for target species were maintained fields and harvested grass fields.

Patterns of target species occurrence by habitat type indicate a relatively high degree of specialization for vesper sparrow and western meadowlark (each predominantly in two habitat types), and a relatively broad range of habitat types used by horned lark (Figure 6). Pasture was a predominant habitat type for western meadowlark and vesper sparrow; accounting for nearly 50% of detections of both species, despite less than 10% of sampling effort in pasture. Christmas tree farms were the other high use habitat type for vesper sparrow (approximately 45% of the detections), and cultivated grass fields were the other high use habitat type for western meadowlark (approximately 35% of detections). Percent detections of western meadowlarks in fallow fields (10.6) were also greater than the percent of this habitat type that was sampled (6.3). The four principal habitat types used by horned larks included gravel and dirt roads, roadside right-of-ways, plowed fields, and cultivated grass fields. Horned larks detections in bare ground, Christmas tree farms, and herbaceous row crops were also a greater percent than the percent sampling effort in those habitat types.

Western meadowlark and horned lark occurrence in cultivated grass fields was further described by the type of field (i.e., annual or perennial). Western meadowlarks (n=80) were detected nearly equally in annual and perennial grass fields, but horned larks (n=29) were substantially more abundant in annual grass fields (Figure 7). This difference may be due to the presence of more bare ground in annual grass fields in the spring due to planting; whereas, perennial grass fields are vegetated to a greater extent during this time period.

Target Species Associations with Vegetation Structure: The occurrence of western meadowlarks and vesper sparrows in pastures was further described by amount of vertical structure provided by shrubs and trees (Figure 8). Both species occurred primarily in herbaceous pastures or pastures with less than 10% shrub cover; although western meadowlarks were most often associated with predominantly herbaceous pastures, and vesper sparrows with a higher percent of shrub/tree cover (Figure 8). Pastures with greater than 10% shrub/tree cover were moderately used by vesper sparrows, but rarely used by western meadowlarks. The presence of shrubs and trees is important to both species for singing perches (Wiens 1973). Where shrubs and trees were absent, fence and telephone posts and telephone lines served the same purpose, particularly for western meadowlark.

Another opportunity for an examination of target species patterns of occurrence relative to vegetation structure was for vesper sparrow in Christmas tree farms. Although not quantified as part of data collection, subjective observations indicate that vesper sparrow presence in Christmas tree farms was dependent upon the degree of maintenance of competing herbaceous vegetation (i.e., grasses, forbs). Vesper sparrows rarely occurred in "manicured" farms where herbaceous vegetation was highly controlled, and the understory and ground were bare ground and needle debris. They were regularly detected in "weedy" farms where herbaceous vegetation was mixed with bare ground. The amount and height of herbaceous vegetation where vesper sparrows occurred was not quantified, but seemed variable, often being clumped and dense at some sites, and sparse with more bare ground in others. Christmas tree farms where vesper sparrows occurred were also often characterized by structural diversity in the soil with relatively deep furrows between the rows of trees, and many large clods of dirt and tree stumps.

Target Species Associations with Grass Height: Subjective observations indicated that most horned lark detections were in short grass (0-6 inches), vesper sparrows occurred in relatively short grass (1-12 inches), and western meadowlarks were most tolerant of different grass heights (up to 36 inches) depending on the type of field. These observations are generally supportive of other studies (Smith 1963, Patterson and Best 1996). The absence of grasshopper sparrow detections during censusing precludes even a subjective judgement about grass height. However, in 1997, most grasshopper sparrow territories were dominated by grass height in the 12-18 inch class.

Patterns of occurrence for western meadowlark and vesper sparrow in pastures was also described by grass height (Figure 9). Both species were substantially more abundant in fields characterized by shorter height classes (less than one foot tall), although western meadowlark was more tolerant of taller grasses.

Patterns of occurrence of western meadowlark relative to grass height were different among the three habitat types in which it most frequently occurred - pasture, cultivated grass, and fallow fields (Figure 10). In pastures, it occurred where grass height was up to two feet tall, although it was most frequently detected if the grass was less than 12 inches tall. In fallow fields, it occurred almost exclusively in fields less than 18 inches tall. In cultivated grass fields, it occurred infrequently in shorter grasses, but predominantly in fields 1-3 feet tall.

Area Searches

Nineteen area searches were conducted at 10 sites in 1996, and three at two sites in 1997 (Appendix F). These included several sites on Finley National Wildlife Refuge, four sites on Bureau of Land Management (BLM) land, a State Wildlife Management Area, two State Parks, and two sites on Conservation Reserve Program (CRP) private lands.

Seventeen sites were fallow fields, three were wet prairies, one was a tree farm, and one was a pasture. Forty-two species were recorded within grassland habitat of area search plots (Appendix F). Bird abundance and species richness was highly variable, although abundance was greatest on BLM land in the West Eugene Wetlands and on a BLM tree farm. Savannah sparrow, the most abundant species in point count censusing, was only recorded at five of the 17 area search censuses in the fallow fields, but relatively abundant in the two censuses in wet prairie on Finley National Wildlife Refuge.

Three individuals of target species were detected at three different sites (Appendix F). One western meadowlark was recorded at a BLM site in the West Eugene Wetlands complex along the Amazon Diversion Canal. Two vesper sparrows were detected, one on private CRP land west of Salem, and another at a BLM tree farm north of Cheshire. Outside of area search plots, a pair of vesper sparrows were detected at a BLM site along the Long Tom River, and a pair of western meadowlarks on BLM land along the Amazon Canal Diversion.

Transects

Fifteen walking transects were conducted along selected roads on June 11, 1996 to estimate densities of western meadowlark (7 transects) and horned lark (8 transects) (Table 4). Densities were similar for both species. Western meadowlark densities ranged from 2-5 pairs/mile except for Belts Road (12.8 pairs/mile). Horned lark densities ranged from 1.5-5.7 pairs/mile except for Harmony Road (11.6 pairs/mile). These estimates likely reflect maximum densities within the Willamette Valley since only locations known to have high densities of these species were selected.

Habitats along meadowlark transects were primarily pasture and cultivated grass fields (Table 4), although most sightings were in pasture. Habitats along horned lark transects were nearly all cultivated grass fields, although most birds were recorded on gravel roads adjacent to the fields or in bare or sparsely vegetated areas within or adjacent to the fields.

Territory-Mapping

Territory-mapping and habitat data were collected for 83 territories (Table 5). Analysis of territory size was conducted on 80 territories (Table 6). Mean number of flush-perches per male (used to calculate territory size) was 23.9 for western meadowlark, 22.9 for vesper sparrow, and 21.4 for grasshopper sparrow. Most territory-mapping occurred in pasture and Christmas tree farms (n=31 in each), or fallow fields (n=16) (Table 5). Although there was a substantial range in territory size for each species, the size of most territories fell within a relatively narrow range, and each species had a one or two outliers.

Mean territory size for western meadowlark (n=21) was 14.3 acres (range 4.8-35.0) (Table 6). Sixty-seven percent (n=14) of the territories were 10-19 acres. Only 19% (n=4) were less than 10 acres, and 14% (n=3) greater than 20 acres. Mean territory size in fallow fields (n=8) was greater than that of pastures (n=10) (Table 7).

Mean territory size for vesper sparrow (n=38) was 3.1 acres (range 1.1-13.0) (Table 6). However, all but one of the territories were less than 6 acres. Mean territory size by habitat type was similar except for one territory in a vineyard that was 6 acres (Table 8).

Mean territory size for grasshopper sparrow (n=18) was 3.5 acres (range 0.5-9.0) (Table 6). However, 72% (n=13) of the territories were less than 5 acres. Although sample size was small (n=4), mean territory size in fallow fields was greater than that in pastures (n=14) (Table 9).

Mean territory size for horned lark was 1.9 acres (range 1.5-2.5), although this included only three territories (Table 6).

Habitat Characterization: Territories were dominated by herbaceous vegetation (primarily grasses) with means of 94% for western meadowlark, 88% for vesper sparrow, 96% for grasshopper sparrow, and 83% for horned lark (Figure 11). Bare ground was a substantial component of horned lark territories (17%), but a relatively minor component in the territories of vesper sparrow (6%), western meadowlark (3%), and grasshopper sparrow (2%). Shrubs were a minor component in western meadowlark, vesper sparrow, and grasshopper sparrow territories (2, 6, and 2%, respectively), and trees were incidental in western meadowlark and vesper sparrow territories (0.6 and 0.7%, respectively) and non-existent in grasshopper sparrow territories. Shrubs and trees were absent in the two horned lark territories.

Patterns of habitat use relative to grass height were distinctive for each species. Mean percent occurrence of each height class in western meadowlark territories was relatively similar (Figure 12). However, individual territories were highly variable, such that each height class was dominant or codominant in at least one territory. This indicates habitat selection by western meadowlark may not have been dependent upon grass height.

Vesper sparrow and grasshopper sparrow territories were distinctive for particular grass height

classes, which may indicate some degree of habitat selection by grass height. Over 80% of mean percent occurrence of each height class was in the three classes less than 18 inches for both species (Figure 12). Vesper sparrow territories were dominated by grass heights of 6-12 inches (46%), and grasshopper sparrow territories by grass heights of 12-18 inches (49%).

Woody vegetation (shrubs and trees) was present in all vesper sparrow territories and most western meadowlark (70%) and grasshopper sparrow (61%) territories (Table 10). The most common woody vegetation was rose, present in all vesper sparrow territories, and approximately half the western meadowlark and grasshopper sparrow territories. Blackberry and hawthorn were also common shrubs and trees. Grasshopper sparrow territories were characterized by tall herbaceous plants such as thistle, tansy, and dock which functioned as shrubs by providing elevated singing perches above the height of the grass.

Abiotic features within territories, such as fencelines, roads, and telephone poles, were minimal to non-existent for vesper sparrow and grasshopper sparrow, but regularly occurring in western meadowlark territories (Table 11). Percent occurrence of fencelines in territories was similar for all three species, but amount of fenceline was substantially greater in western meadowlark territories. Percent occurrence of telephone lines and poles was substantially greater in western meadowlark territories. Telephone lines and poles function as singing perches for western meadowlarks, but are only occasionally used by vesper sparrows, and never used by grasshopper sparrows.

Nests

Nest Outcomes: Forty-seven nests were located and monitored (Table 12). Eleven nests were monitored in 1996, and 36 in 1997. Proportional nest success was 39% for horned lark (n=13), 50% for western meadowlark (n=12), and 58% for vesper sparrow (n=19) (Table 13). Mayfield estimates of nest success were 10% for western meadowlark, 14% for horned lark, and 30% for vesper sparrow. These proportional nest success estimates compare favorably with mean proportional estimate of nest success for open-cup nesting passerines that winter in the neotropics (42%), but our Mayfield estimates are considerably lower than the mean Mayfield of 44% for the same group (Martin 1992). Proportional and Mayfield nest success estimates for horned lark were similar to those reported in eastern Oregon (39 and 17%, respectively, n=28) (Holmes and Geupel 1998). Mayfield nest success estimates for western meadowlark were similar to that reported in eastern Oregon (11%, n=80), but proportional nest success was substantially less in eastern Oregon (28%) (Holmes and Geupel 1998).

An examination of nest success by habitat type is limited by small sample sizes, but a few comments are noteworthy. Proportional nest success was greatest in pasture (86%, n=7), and least in roadbank shoulders (25%, n=4) (all horned lark nests) and fallow fields (33%, n=12) (Table 14). Most western meadowlark nests in fallow fields failed (71%, n=7), and this included all meadowlark nest failures. Proportional nest success in Christmas tree farms, the habitat type where most nests (n=16) were found, was approximately 50%.

Apparent reasons for nest failure were varied. Most nest failures of ground-nesting passerines in grassland ecosystems are due to predation (Best 1978). Predation was implicated as the cause of failure at 50% (n=12) of the nests (Table 15). In most instances, the predator appeared to be a bird or snake based on removal of eggs or young with no disturbance to the nest. Most of these may have been snakes, since snakes have been associated with high predation rates of grassland birds (Best 1978, Miller and Knight 1993). Suspected mammalian predators were domestic cat and dog, raccoon, opossum, skunk, fox, and weasel. There also was a relatively high rate of nest abandonment (29%, n=7). There were two instances of apparent nest desertion in which fully intact dead nestlings within or near the nest may have indicated adult mortality, since nest desertion in the latter nestling stages is uncommon (Best 1978). Two horned lark nests and one western meadowlark nest were destroyed due to farming activities; two when fields were plowed, and a horned lark nest was run over by a vehicle. Destruction of horned lark nests from ATVs is believed to be common, since these are frequently used as transportation along paths, roads, and uncultivated edges of fields, places where horned larks nest.

There were no instances of brood parasitism by the brown-headed cowbird. It is unlikely that brown-headed cowbird plays a significant role in productivity of our target species. It is moderately abundant in the Willamette Valley, but is generally more of a factor with open-cup nesting birds in the shrub layer than with ground-nesting grassland birds which effectively conceal nests.

Nest Location: Nests for all target species except horned lark occurred primarily in three habitat types; pasture, fallow fields, and Christmas tree farms (Table 12). No horned lark nest was found in pasture, but nests were found in fallow fields, Christmas tree farms, roadside shoulders, and wetland mudflats.

It is noteworthy that all target species except grasshopper sparrow nested in Christmas tree farms, and more nests were found in Christmas tree farms than any other habitat. However, this likely reflects disproportionate effort since a substantial amount of nest searching occurred in Christmas tree farms due to permission to access large areas.

It also is noteworthy that only two nests (both western meadowlark) were found in cultivated grass fields, the dominant grassland habitat type in the Willamette Valley. However, access was not permitted to many cultivated grass fields, thus limited effort was spent searching for nests in this habitat type. Horned lark nesting was suspected in cultivated grass fields where bare or sparsely vegetated areas were available within the fields. Vesper sparrow and grasshopper sparrow were not observed to occur in cultivated grass fields, and are not suspected as nesting in them.

Nest Site Characterization: Relationships between species and several habitat variables were different among target species.

Bare Ground:

The ratio of grass to bare ground clearly separated the species. Meadowlark and grasshopper sparrow nest sites were characterized by high grass cover (84 and 89%, respectively) and low

bare ground cover (6 and 1%, respectively) (Figure 13). Conversely, vesper sparrow and horned lark nest sites were characterized by reduced grass cover (49 and 62%, respectively), and substantially more bare ground (24 and 31%, respectively). Whitmore (1979) similarly reported a high percent of bare ground (24%) in vesper sparrow territories, but also noted the same bare ground value for grasshopper sparrow territories on reclaimed surface mines in West Virginia. He also reported that eastern meadowlarks responded negatively to bare ground and increased in density as vegetation density increased.

Rock Cover:

Vesper sparrow nest sites were characterized by a relatively high percent (5) of rock or moss cover (Figure 13). This type of cover was incidental or non-existent at other target species nest sites. Most vesper sparrow habitat outside of Christmas tree farms was slopes of pastures and fallow fields at the edge of the valley floor or in the low foothills. These sites were often south-facing and characterized by shallow and rocky soils. Where large boulders were present, these were often used as singing perches.

Nest Concealment:

Western meadowlark nest sites were characterized by the highest means for maximum grass height (72 cm), litter/residue height (3 cm), vertical cover (density), and nest concealment (Figure 14). It has been reported that nest concealment is important to increase nesting success of ground nesting passerines that are relatively easily accessible to predators (Martin 1988). Meadowlark and grasshopper sparrow nests were often semi-domed and nearly completely concealed (3.7 and 3.5 out of a 4.0 maximum cover), while vesper sparrow and horned lark nests were open-cup and only moderately concealed (2.5 each).

Woody Vegetation:

Woody vegetation (shrubs and trees) was most characteristic of vesper sparrow nest plots. Woody vegetation was present in most (79%) of the 5-meter plots associated with vesper sparrow nests (n=16), and generally within close proximity (mean 6 meters) (Table 16). Stem densities and percent cover of woody vegetation were substantially higher for vesper sparrow (15 stems and 11%, respectively) than western meadowlark (8 and 3%, respectively) and grasshopper sparrow (5 and 1%, respectively) (Figure 15). Shrub height also was substantially higher within plots associated with vesper sparrow nests (mean 92 cm) than western meadowlark nests (mean 27 cm).

Common Nighthawk Census

In 1996, 118 people censused common nighthawks in 63 survey areas (Appendix G). Fifty-five survey areas (87%) were censused on both nights. Nighthawks were detected in 24 of the 63 survey areas (38%), and 10 survey areas had nighthawk detections on both nights.

Survey effort and nighthawk detections were similar on both surveys. On June 26, there were 49 detections during 92 hours of censusing and 2,006 census miles (0.03 detections/mile and 0.53

detections/hour). On July 10, there were 51 detections during 91 hours of censusing and 1,846 census miles (0.03 detections/mile and 0.58 detections/hour).

There were more detections in 1997 despite approximately half the effort from 1996. In 1997, 79 people censused common nighthawks in 41 survey areas (Appendix F). Thirty-six survey areas (88%) were censused on both nights. Nighthawks were detected in 19 of the 41 survey areas (46%), and 12 survey areas had nighthawk detections on both nights.

In 1997, survey effort was similar, but nighthawk detections were substantially higher during the first survey than the second. On June 25, there were 74 detections during 61.9 hours of censusing and 1,267 miles (0.06 detections/mile and 1.20 detections/hour). On July 14, there were 51 detections during 61.2 hours of censusing and 1,120 miles (0.05 detections/mile and 0.83 detections/hour).

Seven survey areas accounted for 65% of the detections in both years (Table 17). These can be generally lumped into two types of areas. The Sublimity/Waldo Hills area is open uplands dominated by large grass fields and Christmas tree farms on the eastern edge of the central Willamette Valley and adjacent foothills. The remaining areas are lowlands in the historic floodplain on the west side of the Willamette River, extending from south of Corvallis to south of Dayton. Other areas where nighthawks were detected to a lesser degree include around Fern Ridge Reservoir, near the Molalla River, and around buttes and foothills in Linn County east of I-5.

Species Summaries

The following accounts summarize the status and ecology of target species on the basis of data collected and subjective observations where data was limited. They are presented to provide a quick checklist of important factors to consider when managing for these species.

Western Meadowlark

Distribution:

- Only small, scattered populations (1-4 pairs) in the northern Willamette Valley, a few areas with moderate populations (4-10 pairs) in the central valley, but locally common in the southern valley, particularly at the interface of the valley and low foothills.
- Highest concentration occurs east of Interstate 5 between Coburg and Brownsville where large pastures are interspersed with fallow fields and cultivated grass fields.

Habitat Characteristics:

- Primarily associated with lightly grazed pastures and fallow fields, and to a lesser extent cultivated grass fields, that have elevated singing perches (e.g., trees, shrubs, fence line, telephone line), and structural diversity within singular field types (e.g., pastures and fallow fields) or adjacent multiple field types (e.g., pasture next to cultivated grass field).
- Habitat use not as strongly associated with grass height as for other target species; most frequently detected in pastures and fallow fields with grass height < 18 inches, and cultivated grass fields with grass height 1-3 feet tall.

- Highest densities in lightly grazed pastures or fallow fields with grass height < 2 feet tall, and shrub coverage less than 10%.
- Detected nearly equally in annual and perennial grass fields.
- Woody vegetation present in most (70%) territories.
- Territories dominated by grasses (mean of 94% cover) with minimal amounts of bare ground (3%) and shrub/tree cover (3%).
- Mean territory size was 14.3 acres (range 4.8-35.0, n=21), with nearly 70% of the territories 10-19 acres.
- Only 24% (n=5) of territories included cultivated grass field, and none were more than 50% cultivated grass field.
- Proportional nest success 50% (n=12); Mayfield estimates 10%.
- Most nests (n=7) in fallow fields, but 71% (n=6) of these failed.
- Nest sites characterized by relatively high grass cover (mean 84%) and litter/residue (13%), with some bare ground (6%).
- Among our target species, nest sites characterized by highest maximum grass height, most vertical cover, and greatest nest concealment.

Conservation Issues:

- Large territory size for a songbird, thus will require relatively large areas of suitable contiguous habitat to maintain populations. Considered moderately sensitive to habitat fragmentation (Herkert et al. 1993), and significantly more likely to nest in large (>130 ha) than small (<32 ha) grassland fragments (Johnson and Temple 1986, 1990).
- Appears to use cultivated grass fields as escape cover and to a lesser extent nesting cover, but only limited use as foraging habitat. Thus, quality foraging habitat (e.g., lightly grazed pastures, fallow fields) needs to be within territories dominated by cultivated grass fields. Additionally, singing perches must be available.

Vesper Sparrow:

Distribution:

- Most abundant in the southern Willamette Valley at the interface of the valley and low foothills (particularly where there are pastures and Christmas tree farms), and on buttes east of I-5. Relatively low abundance in the central and northern Willamette Valley, except in areas with Christmas tree farms such as west of Salem in the Eola Hills, near the foothill interface with the Coast Range, and southeast of Portland near Redland and Estacada.

Habitat Characteristics:

- Primarily associated with two habitat types:
  1) Christmas tree farms, particularly young farms 2-5 years post-planting, if extensive grasses and weeds are present.
  2) lightly grazed pastures with scattered shrubs where grass height is < 2 feet high and preferably < 1 foot high.
- Approximately 95% of detections during point count censusing occurred in these habitats, despite <15% of the sampling effort in these habitat types.
- Only one detection in cultivated grass fields, which comprise a large percentage of the

Willamette Valley, and included 53% of our sampling effort.

- Presence in Christmas tree farms dependent upon degree of maintenance of competing herbaceous vegetation; rarely occurred in "manicured" farms where herbaceous vegetation was controlled; regularly detected in "weedy" farms with moderate amounts of herbaceous vegetation mixed with bare ground.
- Territories (excluding Christmas tree farms) characterized by grass < 2 feet tall, and most abundant where the grass was < 1 foot tall. For example, 46% of territories dominated by grass heights of 6-12 inches. This association with shorter grass is exemplified by their absence from fallow fields, which often have scattered shrub component, but grass height is usually >2 feet tall due to lack of grazing or mowing.
- Mean territory size was 3.1 acres (range 1.1-13.0, n=38), but only one of the territories was greater than 6 acres.
- Territories mostly grass dominated (88%) with equal amounts of bare ground and shrubs/trees (6%).
- Proportional nest success 58% (n=19); Mayfield estimates 30%; most nests in Christmas tree farms.
- Nest sites characterized by relatively reduced grass cover (49%), and substantial bare ground (24%) and litter/residue (21%).
- Woody vegetation a prominent feature near most nests.

Conservation Issues:

- Does not appear to be area-sensitive, since nesting pairs occurred in small areas of habitat (< 20 acres). Thus, small blocks of suitable habitat (e.g., 10-20 acres) may provide for a few pairs irregardless of landscape effects. Elsewhere, its occurrence has been reported as similar in tracts of all sizes (Herkert et al. 1993).
- Nest success in Christmas tree farms dependent upon low degree of activity (e.g., management and recreation) during the breeding season, and low degree of tree maintenance (e.g., herbaceous vegetation control, pruning).

Grasshopper Sparrow:

Distribution:

- Occurred almost exclusively in the southeastern part of the valley (from Lebanon south) except for one pair north of Baskett Slough Wildlife Refuge. In 1997 occurred at 7 locations with approximately 25 singing males.

Habitat Characteristics:

- Primarily associated with two habitat types, lightly grazed pastures and fallow fields, that are dominated by grass < 18 inches high with little bare ground and little to no shrub cover.
- Occurred in areas characterized by less dense grasses (e.g., south-facing slopes).
- Territories characterized by scattered tall herbaceous plants (e.g., tansy, thistle) that functioned as shrubs, and grass height between 1-2 feet tall.
- Territories grass dominated (96%) with incidental bare ground (2%) and shrubs (2%).
- Mean territory size 3.5 acres (range 0.5-9.0, n=18)), and over 70% of the territories were less than 5 acres.
- Nest sites characterized by high percent grass cover (89%) and litter/residue (10%)

with only incidental (<1%) cover of bare ground and shrubs.

- Not detected in cultivated grass fields.

Conservation Issues:

- May not require large blocks of suitable habitat because territory size is relatively small and pairs were located in areas with limited suitable habitat. However, most pairs occurred semi-colonially where suitable habitat was extensive indicating that densities may be higher in larger tracts. Elsewhere, considered a moderately area-sensitive species (Herkert 1994), but also noted for between-year fluctuations in abundance, even when suitable habitat is available (Smith 1963). Occurred in <30% of grasslands <10 ha (25 ac) (Samson 1996).
- It is uncertain if the 1997 population was an influx year or if these populations were always present but unknown because they are mostly on private land.

Horned Lark:

Distribution:

- Most abundant in the central Willamette Valley, particularly on and near Baskett Slough National Wildlife Refuge. Other noteworthy populations occur along gravel roads in highly agricultural, lightly populated areas between Tangent, Peoria, and Harrisburg, and a few small, scattered roadside populations between Brownsville and Coburg east of Interstate 5.

Habitat Characteristics:

- Occurred in a relatively broad range of habitats including:
  1) gravel roads or gravel shoulders of lightly traveled paved roads,
  2) recently planted (0-3 years) Christmas tree farms with extensive bare ground,
  3) wetland mudflats, and
  4) bare or sparsely vegetated areas within or adjacent to grass seed fields, pasture, or fallow fields.
- Areas characterized as primarily foraging only habitats include:
  1) recently plowed or burned fields, and
  2) row crop vegetable fields with dirt rows between vegetation
- Substantially more abundant in annual than perennial grass fields.
- Occurred primarily in relatively short grass (0-6 in.) fields.
- Mean territory size less than two acres (1.9 acre, n=3).
- Territories (n=3) and nests (n=11) characterized by relatively high percent of bare ground (17 and 31%, respectively), relatively low percent grass/forb cover (83 and 62%, respectively), and no woody vegetation.
- Nests also characterized by relatively low vertical cover and nest concealment.
- Proportional nests success 39% (n=13); Mayfield estimates 14%.
- Nest failures due to abandonment (n=3), predation (n=3), and farming practices (n=2); one plowed over and other run over by a vehicle.
- Most nests located in wetland mudflats (n=6 at Baskett Slough National Wildlife Refuge) and road shoulders/roadbanks (n=4); 2 nests in fallow fields and one in a Christmas tree farm.

Conservation Issues:

- Horned larks benefit from natural events or agricultural activities that create barren or sparsely vegetated conditions (Owens and Myers 1973). Despite their versatility in habitat

use in the Willamette Valley, horned lark populations are vulnerable because habitats used are often ephemeral (e.g., plowed fields, bare or sparsely vegetated ground within fields), subject to human disturbances (e.g., roads and roadside shoulders, row crop field maintenance), subject to inundation with changing water levels due to flooding or heavy rainfall (wetland mudflats), and subject to changing field types and potential non-suitability of habitat from year-to-year. An example of the latter is road transects along Harmony Road in 1996 recorded 11.6 pairs/mile. Subjective observations in 1997 indicated only a few birds were present in the same area, which had changed from grass seed fields to other grains (e.g., wheat, oats) and had less bare ground associated with edges of fields. Thus, horned lark nests are subject to several direct (nest destruction) and indirect (nest abandonment) consequences that likely adversely affect populations in the Willamette Valley.

- Habitat management for nest sites can be accomplished at small scales by creating bare ground/sparsely vegetated areas within or adjacent to areas of suitable foraging habitat. Creation of suitable nesting habitat in areas secure from disturbance will reduce the species vulnerability and potentially increase nest success and population size. It also appears suitable habitat can support relatively dense populations because of their small territory size and their propensity to forage communally during the breeding season at good foraging sites.

Common Nighthawk: The occurrence of common nighthawk in association with the Willamette River and its tributaries was not unexpected since the survey was conducted for foraging birds and insect hatches often occur in riparian/aquatic habitats. Nighthawks are opportunistic foragers and may travel relatively long distances to exploit foraging resources, thus sightings do not necessarily indicate nesting nearby. However, it is possible that nighthawks are nesting on gravel bars or sparsely vegetated/bare ground areas on islands within the river.

It is also noteworthy that a substantial number of nighthawk sightings were near areas with Christmas tree farms, which occur primarily near and within the interface of the foothills and valley floor. Additionally, a nighthawk nest (unsuccessful) was found in a Christmas tree farm in 1996 (Table 6). Another area for potential nighthawk nesting, as suggested by survey data and behavior of some birds, is the gravel area around power substations (e.g., north of E.E. Wilson Wildlife Management Area). These have been reported as nesting sites in eastern Oregon (Craig Corder, pers. comm.).

MANAGEMENT AND CONSERVATION

Conservation of grassland birds in the Willamette Valley will require a combination of management and restoration activities on both private and public lands. Managing existing and future agricultural lands to provide suitable habitat for grassland birds is essential because of the near extinction of native grasslands. Since over 90% of the Willamette Valley is privately owned, actions to protect or enhance habitat for grassland birds must be in partnership with private landowners, many of whom make their living on these same lands. Efforts also must be directed toward including grassland birds in habitat management plans on public lands. Land-use on private agricultural lands often changes from year-to-year, and this instability likely adversely impacts grassland bird populations. Thus, the

establishment of designated Grassland Bird Conservation Areas on public lands is important to maintain stable populations at multiple locations. Because grassland bird species evolved under a landscape that was the product of variable levels of fire and grazing by native ungulates, it seems appropriate that these natural factors, or artificial factors which create similar conditions, should be considered for creation of suitable habitat.

Grassland birds in the Willamette Valley use a variety of habitat types, often seemingly dissimilar in their vegetative structure and composition (e.g., pastures, Christmas tree farms, row-crop agriculture). It has been speculated that grassland birds have been forced to evolve adaptiveness and a "searching response" for suitable habitat because of natural environmental changes due to climatic cycles, fires, and variable grazing patterns by native ungulates (Owens and Myres 1972). This may account for their presence in a variety of habitat types in the Willamette Valley. However, the success of their adaptations, and their ability to maintain viable populations in these diverse habitat types is questionable, especially considering the small and disjunct populations. Additionally, there is concern that the use of varied habitats in conjunction with declining populations might indicate that these habitats are not suitable. It may be that species are being forced to resort to these habitats as suitable habitat diminishes.

Although not addressed in this study, landscape-level factors may affect target species abundance and distribution, particularly for western meadowlark. Subjective observations indicate that meadowlarks only occurred in cultivated grass fields when these fields were part of a landscape that included their principal habitats, pastures and fallow fields. Grass seed fields appear to provide escape and nesting cover for meadowlarks, but poor quality foraging habitat, so grass fields can only maintain meadowlark populations if they are associated with suitable foraging habitat such as pasture and some fallow fields. However, caution should be exercised with the inclusion of cultivated grass fields in landscape planning because these fields can also function as ecological traps when harvesting aborts nesting attempts and reduces reproductive success.

Prioritization

All actions to acquire, maintain, enhance, or subsidize lands for grassland bird conservation in the Willamette Valley should be evaluated based on several factors. These include:

- proximity of the land to known populations of target species,
- benefit to multiple grassland species,
- risk of habitat loss to development or conversion to unsuitable habitat,
- existing quality of the habitat and compatibility of current and projected surrounding land uses as habitat,
- uniqueness of the site in a local and regional context, and
- the likelihood of securing the land for conservation.

Thus, biological, economic, and practical considerations must be balanced in prioritizing land for grassland bird conservation. For example, areas that are only marginally developable or

undevelopable for agriculture (e.g., hills, buttes, rocky soils, shallow soils), and near existing populations of target species would be a high priority.

Public lands such as State Parks and Federal Wildlife Refuges should be a conservation priority, since these lands potentially represent stable, long-term commitments. Private lands could be evaluated quantitatively based on a "scorecard" approach that assigns values to all the factors to be considered. This could be similar to the approach used by the Natural Resources Conservation Service (NRCS) for evaluating proposals in their conservation programs (e.g., CRP, WHIP).

Prioritizing conservation actions for multiple grassland bird species requires a balanced, integrative perspective to designate locations and types of actions to occur. Clearly, actions to create habitat for meadowlarks are not necessarily suitable for horned lark. Thus, a conservation strategy must emphasize landscapes with a mosaic of habitat types and diversity at the regional scale, with local decisions being made on management actions within the context of the regional scale.

Habitat Attributes

***Size and Contiguity*:** Because of the patchy distribution of suitable habitat for grassland birds in the intensively farmed Willamette Valley, conservation will require 1) maintaining existing habitat within core population areas, and 2) radiating out from these areas to connect fragmented habitat tracts to form large relatively contiguous tracts of suitable habitat. There is evidence that some grassland bird species require a minimum area of contiguous habitat (Swanson 1996). Conservation to increase the amount of contiguous suitable habitat into large tracts will benefit area-sensitive species such as grasshopper sparrow and western meadowlark (Herkert et al. 1993), and will also help maintain large populations of species that are not area-sensitive such as vesper sparrow and horned lark.

In the Willamette Valley, it is desirable to provide areas of suitable habitat >100 acres for grassland birds because of the 1) large territory size of meadowlarks, 2) area-sensitive and loosely colonial nature of grasshopper sparrow, 3) reduced edge that likely limits foraging by potential mammalian predators using non-suitable habitat as corridors for movement, and 4) reduced likelihood of loss of a population due to catastrophic events.

Actions:

- Where possible, provide suitable habitat in tracts >100 acres.
- Where not possible, maintain several small tracts >50 acres within 1/2 mile of each other.

Management of small and large tracts of habitat should be different. Small tracts (<50 acres) are likely to be dominated by bird species that are habitat generalists, and should be managed as a single unit (Swanson 1996). Management of larger grasslands (>100 acres) is more complex because they support the most management-sensitive species (Herkert 1991), and these species often require different management strategies. In larger grasslands, a rotational system of management on portions of the grassland will accommodate multiple species by providing a mosaic of successional stages and diversity of habitats and microhabitats. For example, mowing, grazing, or burning some percent of

the tract for species needing shorter, less dense grass (e.g., grasshopper sparrow, vesper sparrow), and leaving other areas idle from management for tall grasses used by western meadowlark.

Singing Perches: Availability of singing perches elevated above the height of the grass layer is an important habitat component for most grassland birds (Wiens 1973). In pre-settlement Willamette Valley, large oak trees scattered within native grassland and oak savannah likely provided these requirements. Post-settlement singing perches within the highly agricultural landscape include fences and fence posts, and more recently telephone/powerlines and poles.

Singing perches may not be as limiting for western meadowlark as for vesper and grasshopper sparrows because the large territory of meadowlarks generally ensures the presence of this attribute through fences and utility lines. Meadowlarks are probably excluded by the lack of singing perches only from the center of large grass fields or fields where no perches occur. However, vesper and grasshopper sparrows would only find adequate singing perches on the perimeter of cultivated grass fields where perches might exist.

Agricultural Practices

The following activities or agricultural practices are known to impact grassland birds. Management actions are recommended as ways land managers and private landowners can support grassland bird conservation.

Timing of Activities: Agricultural and recreational activities may cause disturbance to nesting birds and result in reproductive failure.

Actions:

- Agricultural field operations should avoid target species nesting habitat during the breeding season; April 15 - July 15.
- Recreational activities should be restricted during the same time period. These include activities such as ATV riding within and adjacent to fields and roads (may be particularly adverse to horned larks), and horseback riding on Christmas tree farms.

Mowing/Haying: Mowing/haying affects grassland birds directly and indirectly. It may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger et al. 1990). Studies on grasshopper sparrow have indicated higher densities and nest success in areas not mowed until after July 15 (Shugaart and James 1973, Warner 1992).

Actions:

- Delay mowing or haying as long as possible, preferably until after July 15.
- Space mowing or haying frequency as widely as possible to increase the probability of successful nesting.

Tilling: Tilling (disking, planting, cultivation) of crop fields may destroy active nests and cause mortality to nestlings or fledglings, particularly if the initial tilling is late (i.e., May) and birds have already initiated nesting in the residue of the field from the previous year. Minimum or no-tilling will also increase foraging opportunities by providing habitat for insect prey.

Actions:

- Where possible, use no-till practices or conduct tilling prior to April 15 or after July 15.

Grazing: On lands dedicated as pasture, grazing is most beneficial to grasshopper sparrow, vesper sparrow, and horned lark by decreasing grass height, creating patchy areas of varying heights and densities of vegetation, and thinning dense vegetation. When grazing pressure is limited or spread out over large areas, it creates more heterogeneity in pastures with heavier grazing in some areas and limited grazing in others. The same effect can be gotten in small pastures with a rotation grazing system.

Light or moderate grazing practices where grazing is non-uniform and grass height is variable and maintained in the range between 6-18 inches high are most likely to support the widest range of target species. Moderate grazing has been shown to reduce vegetative height, increase vegetative heterogeneity, and provide more suitable habitat than CRP fields in the midwest (Klute and Robel 1997). Additionally, grasshopper sparrow densities were significantly greater in lightly grazed than heavily-grazed plots. Light to moderate grazing resulting in 20-40% vegetative cover >25 cm tall (Skinner 1975, Baskett et al. 1980), and >40% vegetative cover >25 cm tall (Herkert et al. 1993) have been suggested as most beneficial to grasshopper sparrow and vesper sparrow.

Actions:

- Eliminate continuous year-long grazing in pastures.
- Subdivide large pastures into small pastures and develop a rotation grazing system.
- Move livestock before grass height gets below 6 inches for better growth and to discourage cowbird use in these higher grass heights; do not regraze until at least 1 foot tall.
- Conduct light to moderate grazing on pastures and grass fields that are intermittently grazed such that grass height is below 24 inches with some areas less than 12 inches.
- Manage livestock numbers or time in fields, or remove fences and hedgerows to spread out grazing pressure across larger fields.

Field Burning: Prescribed burning of fields every 2-3 years during the non-breeding season will reduce litter coverage and vegetative density, and stimulate plant growth. Numerous studies have reported positive response of grasshopper sparrows to fields 1-2 years post-burn. Fire may also be used in conjunction with other techniques that achieve similar objectives (e.g., grazing), but don't reduce litter residue for thsoe species that use residue for nesting cover and also forage on arthropds produced in residue (e.g., vesper sparrow).

Actions:

- Use low-intensity, prescribed burns to control encroachment of woody vegetation, stimulate plant growth, and reduce vegetative density.

Pesticides/Herbicides: Use of pesticides can reduce the insect food base for many grassland bird species. Use of herbicides can reduce cover and indirectly affect the insect food base.

Actions:

- Practice procedures in Integrated Pest Management (described in ORS 634.122) for reduced destruction of target and non-target insects.
- Encourage biological controls rather than chemical controls wherever possible.

Uncultivated Areas: Uncultivated areas provide habitat diversity within large expanses of cultivation. Some species may use uncultivated areas as refugia or as nesting habitat if large enough.

Actions:

- Provide uncultivated herbaceous areas within or adjacent to cultivated fields to provide habitat diversity and potential nesting habitat for grassland birds.
- Avoid spraying or mowing uncultivated herbaceous vegetation within or adjacent to cultivated fields (e.g., fence rows, roadsides, and untillable land such as rocky soils).
- Increase bare ground/sparsely vegetated habitat within cultivated grass fields and other agricultural lands by creating or expanding low spots within fields that will retain surface water longer in spring and inhibit vegetative growth (particularly for horned lark).

Prairie Restoration

Effort should be directed toward support of the Willamette Valley Natural Areas Network to restore native prairies. The success of prairie restoration efforts will directly benefit grassland bird species. An example of an existing project that is maintaining a small population of western meadowlarks is The Nature Conservancy property at Kingston Prairie near Stayton.

Landowner Participation

Education and Outreach: Specific recommendations that land managers and private landowners can incorporate into their management should be presented in a variety of forms. This may include workshops, brochures, and site visits.

Land Securements: Efforts to retire agricultural land (e.g., CRP) should be increased. CRP fields provide better habitat for grassland birds than cultivated fields (Patterson and Best 1996). Vegetation structure and composition of fallow (retired) fields and CRP land in the Willamette Valley are diverse, resulting in different bird community composition and abundance. These fields are likely more suitable for our target species than cultivated lands because of a more diverse vegetation structure and composition, and reduced activity on the land. Some active management may be appropriate on retired fields such as replanting with a diverse composition of native grasses, or periodic burning to reduce residue levels of dead vegetation and encroachment of woody vegetation. The necessity of these actions should be evaluated periodically.

Economic Incentives: Economic incentive-based programs should be initiated with private landowners to increase the land base of suitable grassland bird habitat. A prerequisite for any agreement should include an evaluation of existing densities of target species, suitability of the habitat, and proximity to existing suitable habitat. An example of an economic incentive might be financial considerations for delayed haying in areas where high densities of target grassland birds occur.

MONITORING RECOMMENDATIONS

1. Every 3-5 years, censusing and habitat characterization should be conducted in June at the 544 point count stations to determine changes in species abundance and habitat availability. This provides a unique opportunity to monitor not only landbird population trends, but how Willamette Valley agriculture is changing and how that may be impacting the avian community.

2. Common nighthawk censusing should be continued annually or every other year to monitor population trends. Additionally, effort should be expended to determine if nighthawks are nesting in several habitats/locations suggested by census data. These include; gravel bar/sandy areas on islands or peninsulas in the Willamette River and its tributaries, gravel areas associated with large power substations, and Christmas tree farms at the valley/foothill edge, particularly between Corvallis and Eugene, and southeast of Salem.

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Table 1. Habitat types at 544 point count stations in Willamette Valley grasslands, 1996.

HABITAT TYPE[a]	PERCENT OCCURRENCE[b]	REGION WITH HIGHEST PERCENT OCCURRENCE[c]
Recently harvested grass field	2.5	Morilo (9.8)
Cultivated grass field	52.7	Harno (82.0)
Low-growing herbaceous row crop	3.9	Aumsso (23.4)
Tall non-herbaceous row crop	5.1	Monrea (37.3)
Bare ground	0.3	Aumsso (2.1)
Recently plowed field	3.5	Aumsso (24.5)
Pasture	9.5	Dickpr (45.2)
Wet prairie	0.2	Staysw (2.6)
Fallow field	6.3	Richga (20.8)
Maintained field	0.5	Redpr (4.0)
Gravel or dirt road	3.0	Ballso (5.9)
Roadside right-of-way	4.2	Morilo (8.8)

[a] Descriptions in Appendix A.
[b] Non-grassland habitat (e.g., forest, residential areas, paved roads) accounted for 8.4% of the sampling.
[c] Region codes in Appendix C.

Table 2. The 12 most abundant species during point count censusing in Willamette Valley grasslands, May-June, 1996.[a]

SPECIES	MAY DETECTIONS	JUNE DETECTIONS	TOTAL DETECTIONS	BIRDS/POINT COUNT
Savannah sparrow	832	932	1,764	1.62
European starling	409	796	1,205	1.11
Brewers blackbird	280	585	865	0.80
Red-winged blackbird	270	316	586	0.54
Barn swallow	254	320	574	0.53
American goldfinch	320	231	551	0.51
Song sparrow	214	295	509	0.47
American robin	231	268	499	0.46
Common yellowthroat	187	242	429	0.39
Cliff swallow	118	279	397	0.37
Violet-green swallow	112	102	214	0.20
Killdeer	92	100	192	0.18

[a] Based on detections within 100 meters of 544 point count stations.

Table 3. Target species measures of abundance and distribution based on point count censusing in Willamette Valley grasslands, 1996.[a]

SPECIES	RELATIVE ABUNDANCE[b]	PERCENT OCCURRENCE[c]	REGION OCCURRENCE[d]
Vesper sparrow	0.06	7.3	20
Horned lark	0.14	12.5	23
Western meadowlark	0.15	14.5	25

[a] Based on detections within 100 meters of 544 point count stations; each station censused once in May and once in June.
[b] Mean number of individuals/point count.
[c] Percent of point count stations where species was detected.
[d] Number of regions (out of 40) in which species was detected.

Table 4. Western meadowlark and horned lark density estimates along selected road transects in Willamette Valley grasslands, June 11, 1996.

SPECIES	SITE	HABITAT	TRANSECT DISTANCE	MALES	DENSITY (Pairs/Mile)	COMMENTS
Western meadowlark	Belts Road	pasture 65%; cult grass 35%	0.7 mile	9	12.8	20-26 birds; 2 juv's; 8 males in pasture
Western meadowlark	Duckflat Road	corn grass	1.2 mile	3	2.5	
Western meadowlark	Riches Road	cult grass 80%; pasture 20%	1.7 mile	4	2.4	3 birds in pasture
Western meadowlark	Rodgers Mt Loop Road	pasture 60%; cult grass 40 %	0.8 mile	4	5	7 birds; all in pasture
Western meadowlark	Sandner Road	cult grass 85%; herb row crop 15%	1.0 mile	2	2	
Western meadowlark	Buyserie Road	cult grass 30%; herb row crop 45%; orchard 25%	0.9 mile	2	2.2	2 males in distance
Western meadowlark	Morris Road	fallow field 50%; cult grass 30%; pasture 20%	1.0 mile	4	4	
Horned lark	Glasser Road	corn grass 70%; herb row crop 30%	1.4 mile	3	2.1	4 birds; all on road
Horned lark	117th/ Kuenzi Road	plowed field 20%; corn grass 60%; burn field 20 %	0.7 mile	4	5.7	2 in plowed field; 2 in burned field
Horned lark	Bond Butte Road	corn grass 75%; herb row crop 25%	1.3 mile	2	1.5	1 in gravel road; other in herb row crop
Horned lark	Center School Road	corn grass 95%; herb row crop 5%	1.2 mile	3	2.5	7 birds; all on gravel road
Horned lark	Harmony Road	cultivated grass	0.6 mile	7	11.6	15 birds; all in bare patches in field
Horned lark	Kirk Road	cultivated grass	1.1 mile	3	2.7	5 birds; all on gravel road
Horned lark	Beck Road	cultivated grass	0.8 mile	2	2.5	4 birds; all on gravel road
Horned lark	Livermore Road	cultivated grass 90%; plowed field 10%	3.9 mile	6	1.5	5 pairs; 1 single male; all on gravel road

Table 5. Target species territories by habitat type in Willamette Valley grasslands, 1997.

SPECIES	# TERR[a]	FALLOW FIELD	XMAS TREE	PASTURE	CULT GRASS FIELD	VINE YARD	WETLAND MUDFLAT
Western meadowlark	23	9	2	10	1	1	
Vesper sparrow	40	3	29	7		1	
Grasshopper sparrow	18	4		14			
Horned lark[b]	2						2
Totals	83	16	31	31	1	2	2

[a] Includes all territories where habitat data collection occurred.
[b] Habitat data was not collected at one territory in roadbank/shoulder habitat.

Table 6. Territory size of target species in Willamette Valley grasslands, 1997.

SPECIES	TERRITORIES[a]	FLUSH PERCHES[b]	ACRES	
			MEAN	RANGE
Western meadowlark	21	23.9	14.3	4.8 - 35.0
Vesper sparrow	38	22.9	3.1	1.1 - 13.0
Grasshopper sparrow	18	21.4	3.5	0.5 - 9.0
Horned lark	3		1.9	1.5 - 2.5

a Includes only territories where size was calculated.
[b] Mean number of flush perches used to calculate territory size.

Table 7. Western meadowlark territory size by habitat type in Willamette Valley grasslands, 1997.

HABITAT TYPE	TERRITORIES	ACRES	
		MEAN	RANGE
Pasture	10	12.3	7.1 - 21.6
Fallow field	8	15.4	4.8 - 35.0
Cultivated grass field	1	11.1	
Christmas tree farm	1	19.5	
Vineyard	1	23.9	

Table 8. Vesper sparrow territory size by habitat type in Willamette Valley grasslands, 1997.

HABITAT TYPE	TERRITORIES	ACRES	
		MEAN	RANGE
Pasture	7	3.1	1.8 - 6.0
Fallow field	3	2.2	1.7 - 3.0
Christmas tree farm	27	3.1	1.1 - 13.0
Vineyard	1	6	

Table 9. Grasshopper sparrow territory size by habitat type in Willamette Valley grasslands, 1997.

HABITAT TYPE	TERRITORIES	ACRES	
		MEAN	RANGE
Pasture	14	2.8	0.5 - 9.0
Fallow field	4	5.8	2.5 - 8.4

Table 10. Shrub/Tree component of target species territories (excluding Christmas tree farms) in Willamette Valley grasslands, 1997.

SPECIES	% WITH WOODY	% WITH ROSE	% WITH BLACKBERRY	% WITH HAWTHORNE
Western meadowlark (n=20)	70	45	35	40
Vesper sparrow (n=10)	100	100	50	20
Grasshopper sparrow (n=18)	61	50	33	22

Table 11. Abiotic features within target species territories (excluding Christmas tree farms and vineyards) in Willamette Valley grasslands, 1997.[a]

SPECIES	TERRITORIES	FENCE LINE	TELEPHONE LINE	TELEPHONE POLES	ROAD
Western meadowlark	20	250 (65)	118 (50)	1.2 (45)	66 (25)
Vesper sparrow	10	15 (40)	11 (10)	0.2 (10)	5 (10)
Grasshopper sparrow	18	42 (44)	7 (11)	0 (0)	4 (6)
Horned lark	2	0 (0)	0 (0)	0 (0)	80 (50)

[a] Mean length of each feature in meters; () is percent of territories with this feature.

Table 12. Target species nests by habitat type in Willamette Valley grasslands, 1996-1997.

SPECIES	FALLOW FIELD	XMAS TREE	PASTURE	COMM GRASS FIELD	ROADBANK /SHOULDER	WETLAND MUDFLAT
Western meadowlark	7	2	1	2		
Vesper sparrow	3	12	4			
Grasshopper sparrow			2			
Horned lark	2	1			4	6
Common nighthawk		1				
Totals	12	16	7	2	4	6

Table 13. Target species nest success in Willamette Valley grasslands, 1996-1997.

SPECIES	NESTS	PROPORTIONAL SUCCESS (%)	MAYFIELD ESTIMATES (%)
Western meadowlark	12	50	10
Vesper sparrow	19	58	30
Grasshopper sparrow	2	50	[a]
Horned lark	13	39	14
Common nighthawk	1	0	[a]
Totals	47	49	na

[a] Small sample size precludes Mayfield estimate.

Table 14. Target species nest success by habitat type in Willamette Valley grasslands, 1996-1997.

OUTCOME	FALLOW FIELD	XMAS TREE	PASTURE	CULT GRASS FIELD	ROADBANK /SHOULDER	WETLAND MUDFLAT
Successful	4	8	6	1	1	2
Failed	8	7	1		3	3
Unknown	1	1		1		1
Totals	12	16	7	2	4	6

Table 15. Apparent reasons for nest failure of target species nests in Willamette Valley grasslands, 1996-1997.

SPECIES	FAILED	ABANDONED	PREDATION	FARMING	UNKNOWN
Western meadowlark	6	1	3	1	1
Vesper sparrow	8	3	5		
Grasshopper sparrow	1				1
Horned lark	8	3	3	2	
Common nighthawk	1		1		
Totals	24	7	12	3	2

Table 16. Shrub/Tree component associated with target species nest sites in Willamette Valley grasslands, 1996-1997.[a]

SPECIES	% PLOTS WITH SHRUBS/TREES	MEAN DISTANCE TO NEAREST SHRUB/TREE (meters)
Western meadowlark (n=11)	27	19
Vesper sparrow (n=16)	79	6
Grasshopper sparrow (n=2)	50	38
Horned lark (n=11)	0	63

[a] Includes only nests where habitat data was collected.

Table 17. Areas with most detections of common nighthawk during censusing in the Willamette Valley, 1996-1997.

AREA	DETECTIONS 1996		DETECTIONS 1997		TOTAL
	JUNE	JULY	JUNE	JULY	
Sublimity	6	7	8	9	30
Dayton South	7	5	6	5	23
Greenberry	5	5	5	3	18
Waldo Hills	3	9	3	2	17
Monmouth East	2	3	6	6	17
American Bottom	0	4	4	8	16
E.E. Wilson	4	4	4	3	15

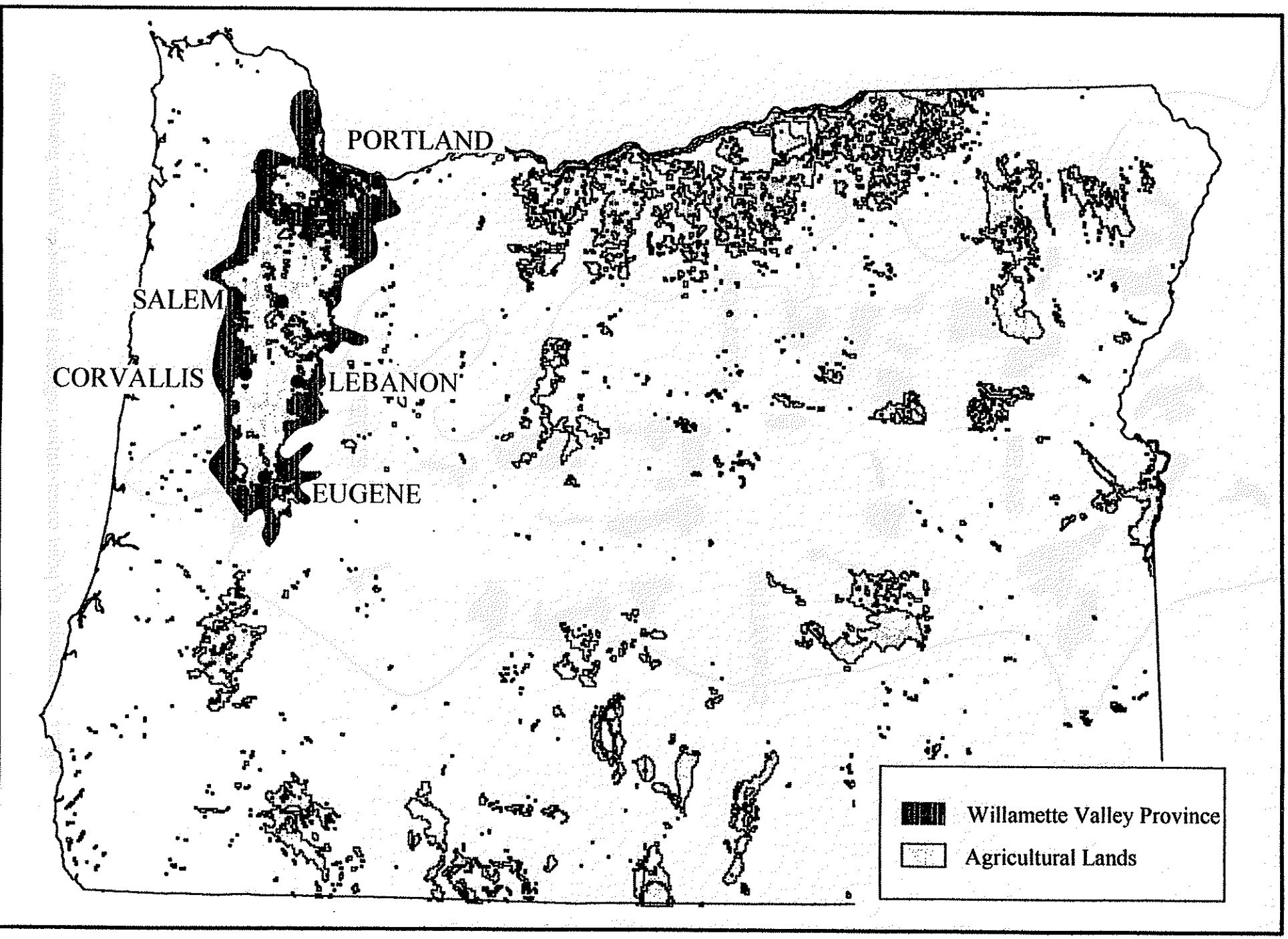


Figure 1. Location of Willamette Valley Within Western Oregon

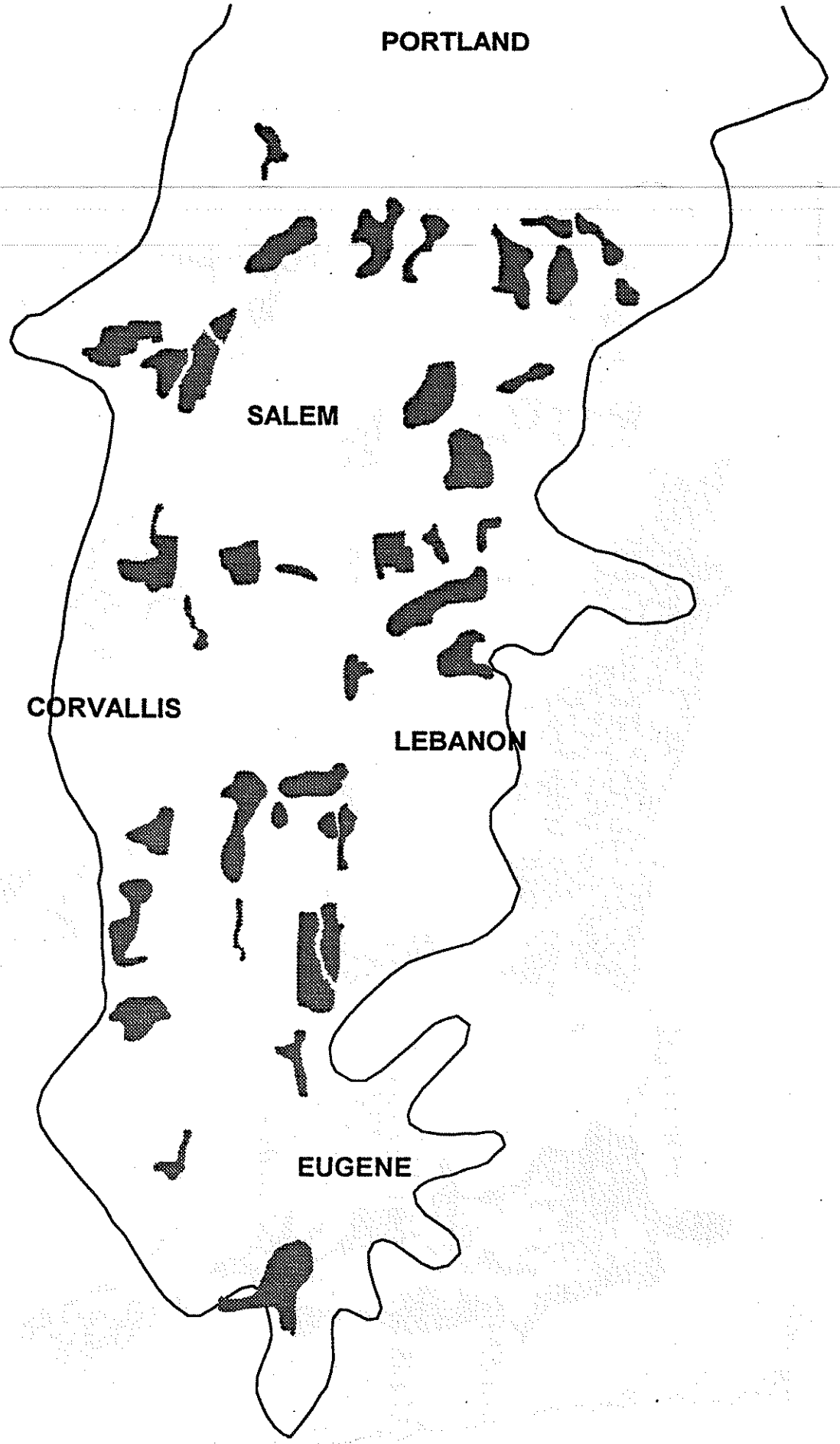


Figure 2. Location of point count station regions in Willamette Vailey grasslands.

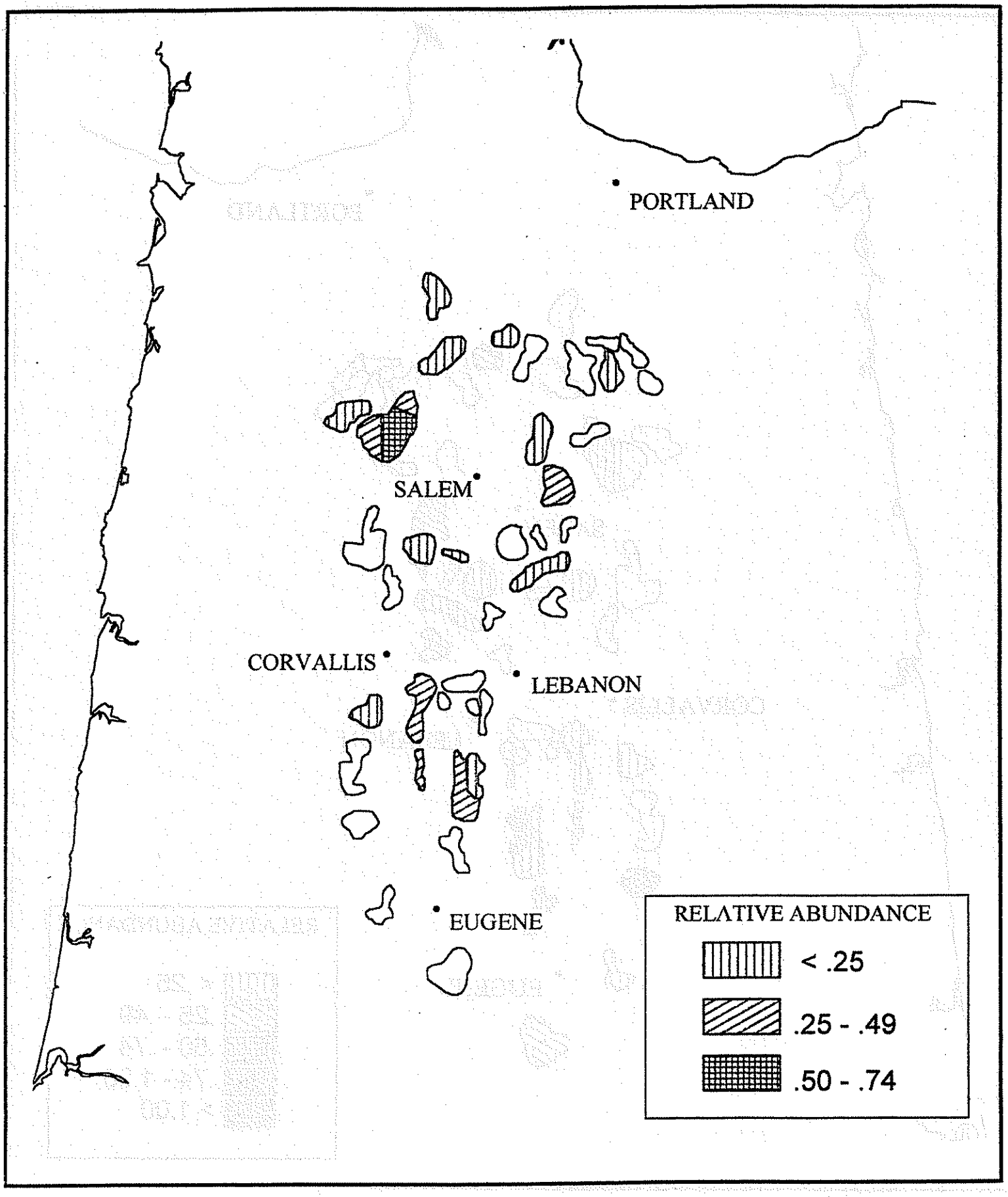


Figure 3. Horned Lark Relative Abundance by Region Based On Point Count Censusing in Willamette Valley Grasslands, May - June 1996.

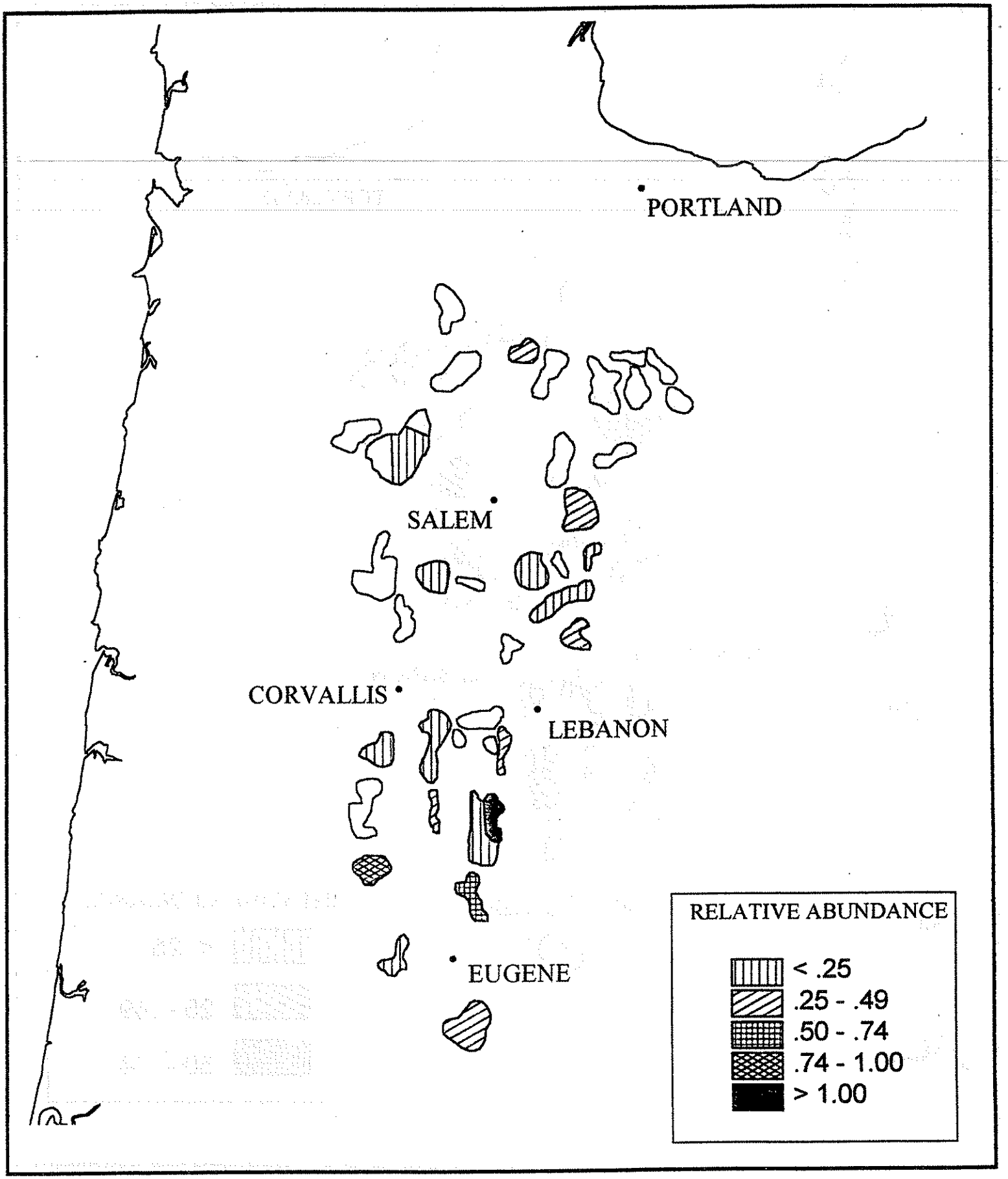


Figure 4. Western Meadowlark Relative Abundance by Region Based on Point Count Censusing in Willamette Valley Grasslands, May - June 1996

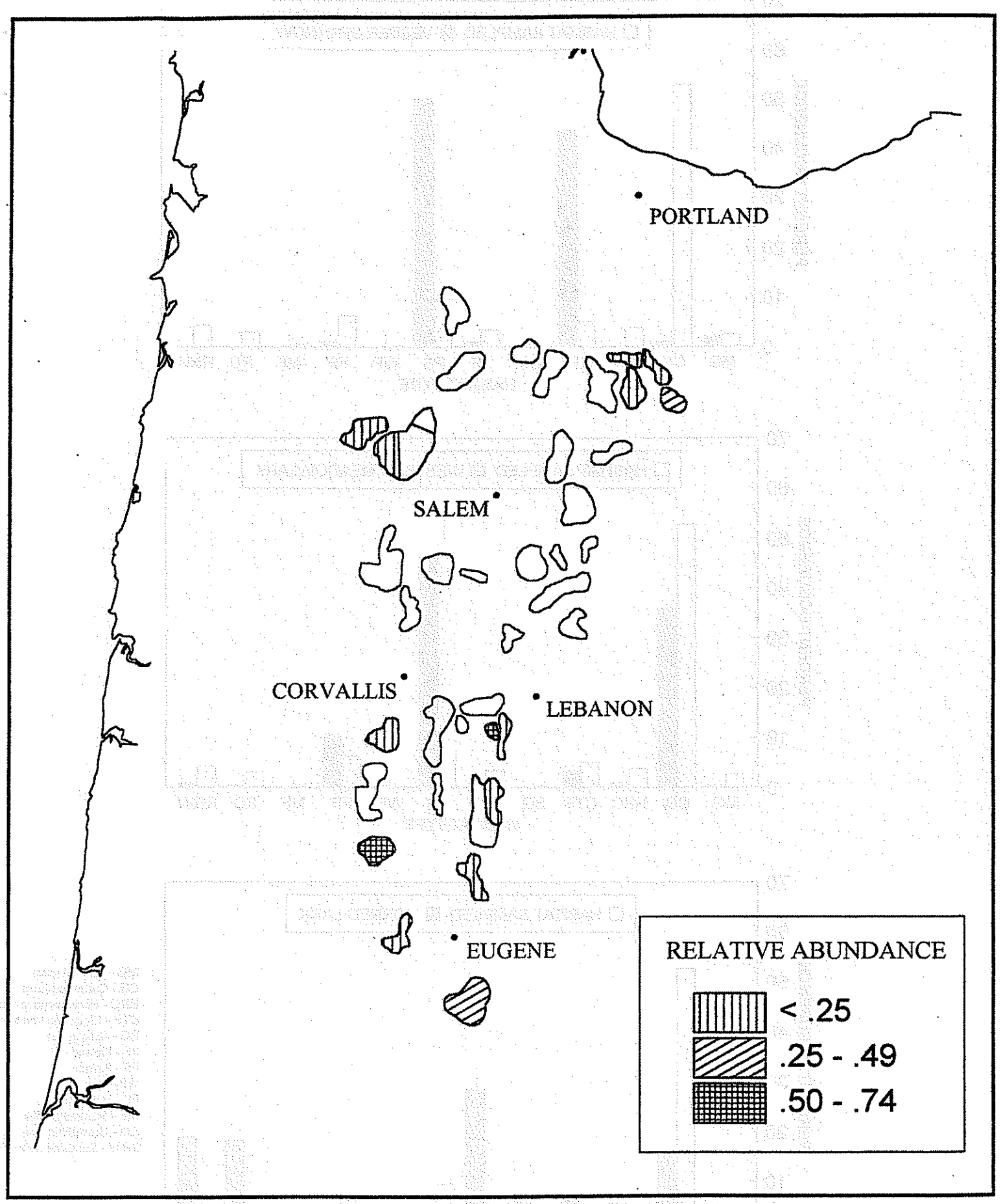
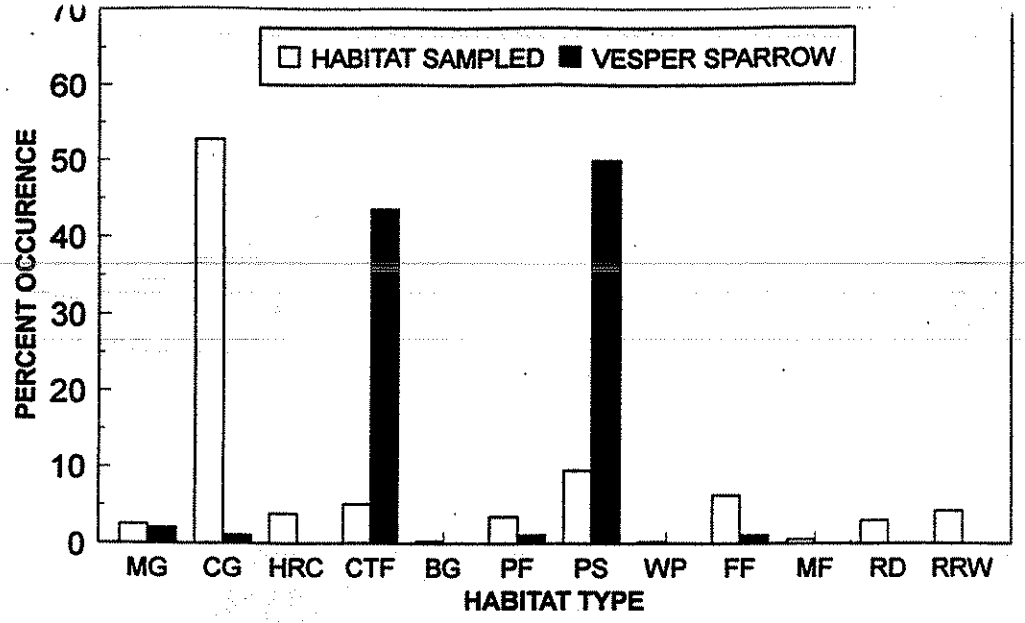
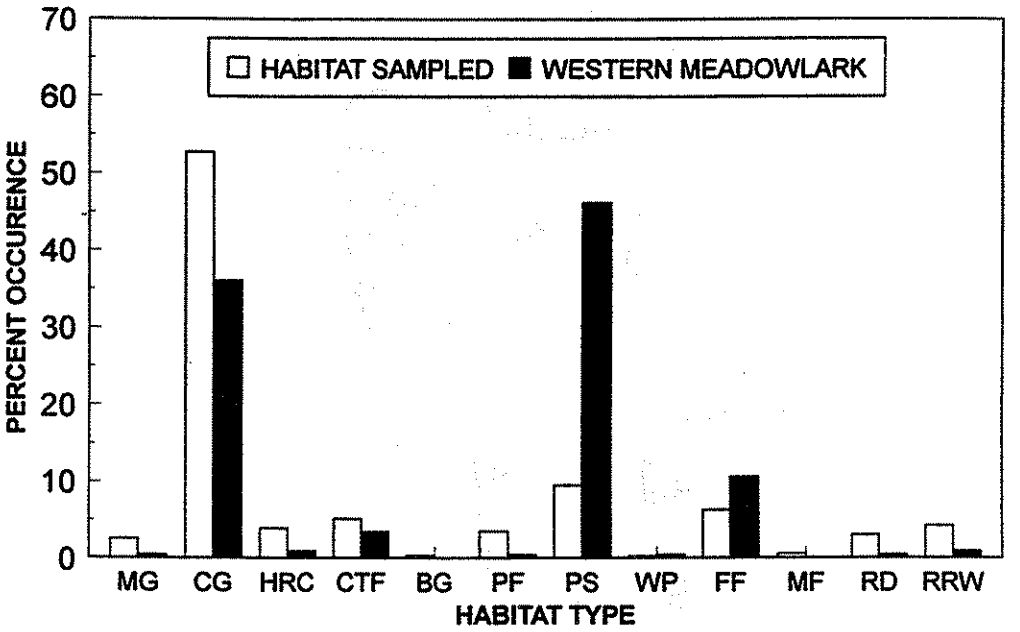
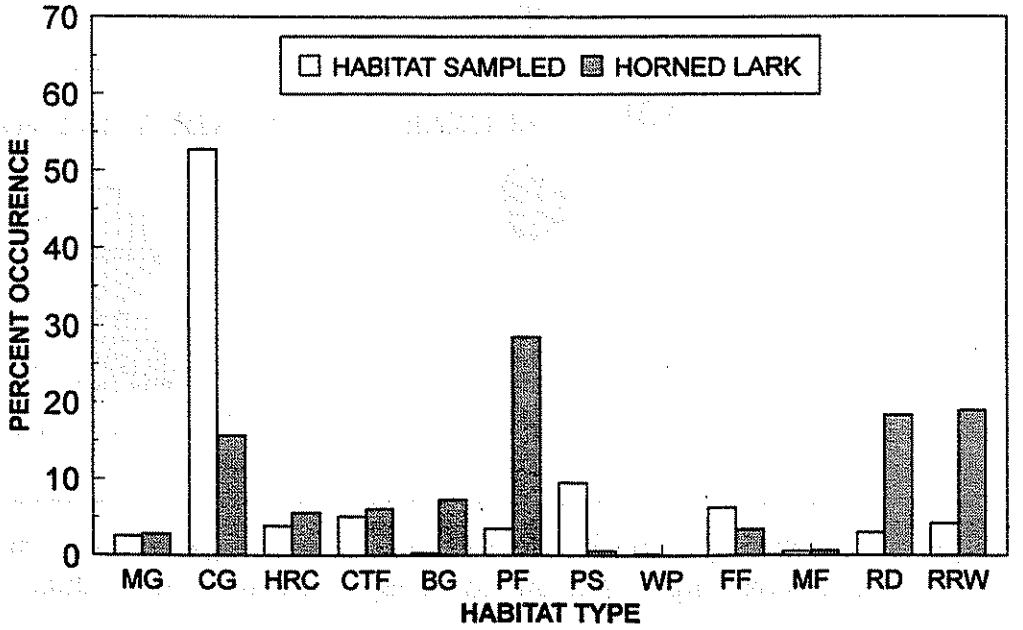


Figure 5. Vesper Sparrow Relative Abundance by Region Based On Point Count Censusing in Willamette Valley Grasslands, May - June 1996







MG - Mowed grass
CG - Cultivated grass
HRC - Herbaceous row crop
CTF - Christmas tree farm
BG - Bare ground
PF - Plowed field
PS - Pasture
WP - Wet prairie
FF - Fallow field
MF - Maintained field
RD - Gravel/Dirt road
RRW - Roadside right-of-way

Figure 6. Target species occurrence by habitat type based on point count censusing in Willamette Valley grasslands, May-June, 1996.

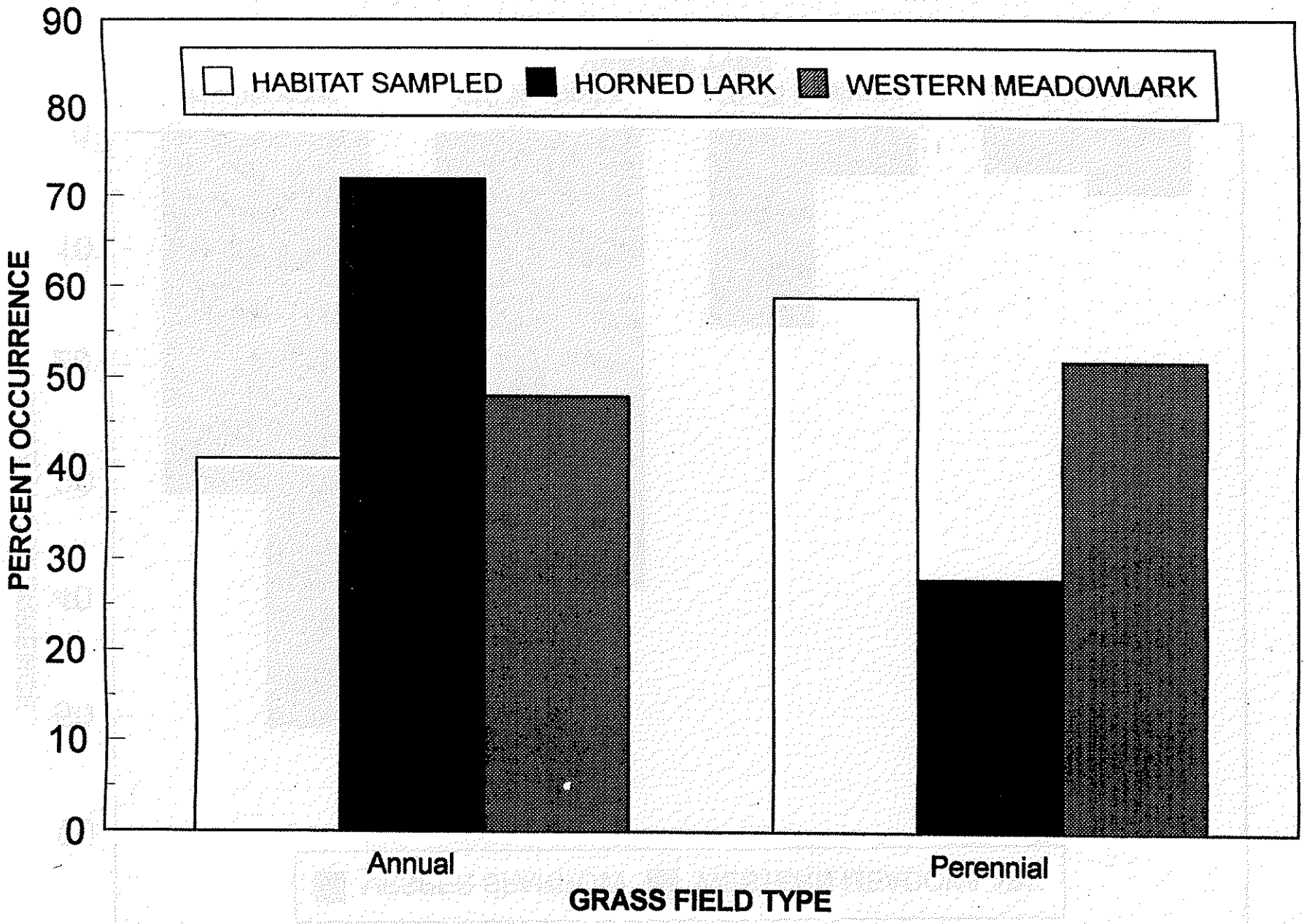


Figure 7. Western meadowlark and horned lark occurrence in annual and perennial grass fields based on point count censusing in Willamette Valley grasslands, May-June, 1996.

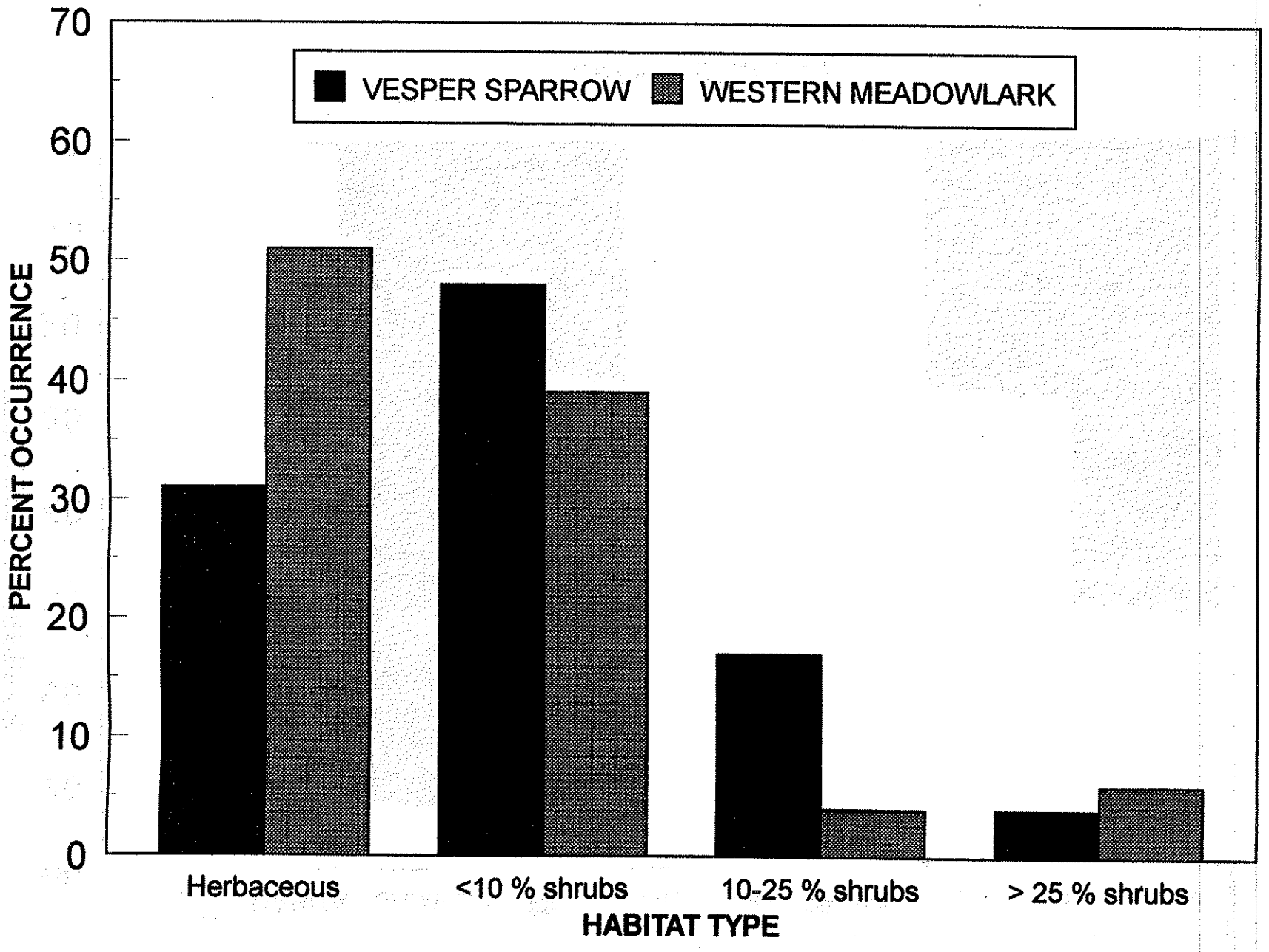


Figure 8. Vesper sparrow and western meadowlark occurrence in pasture types based on point count censusing in Willamette Valley grasslands, May-June, 1996.

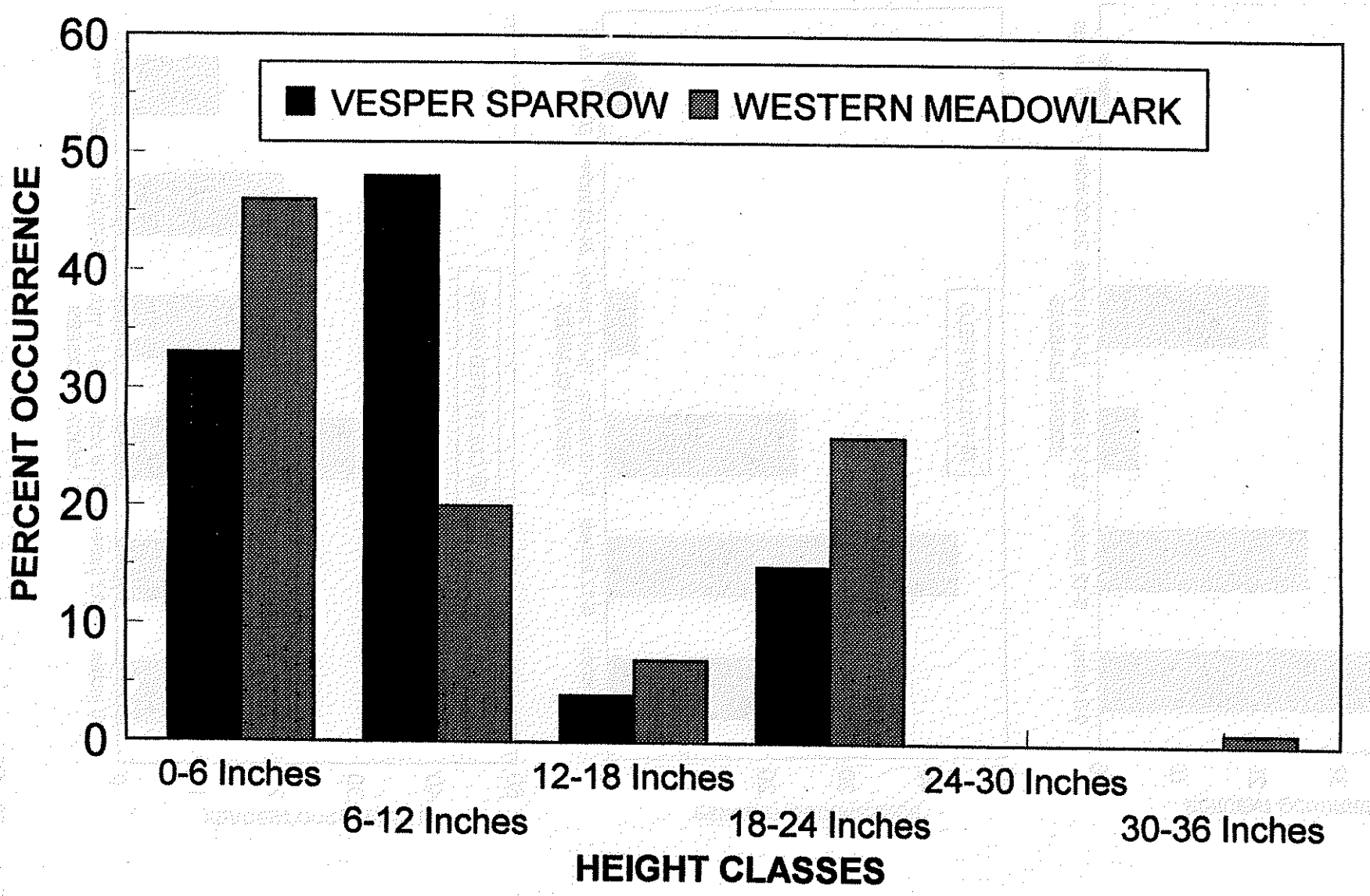
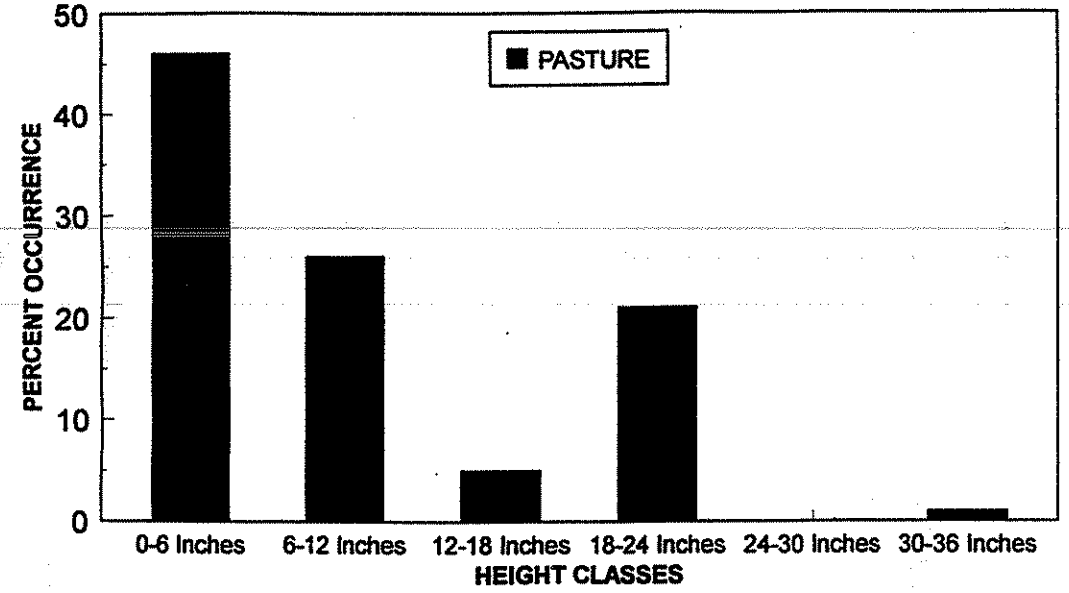
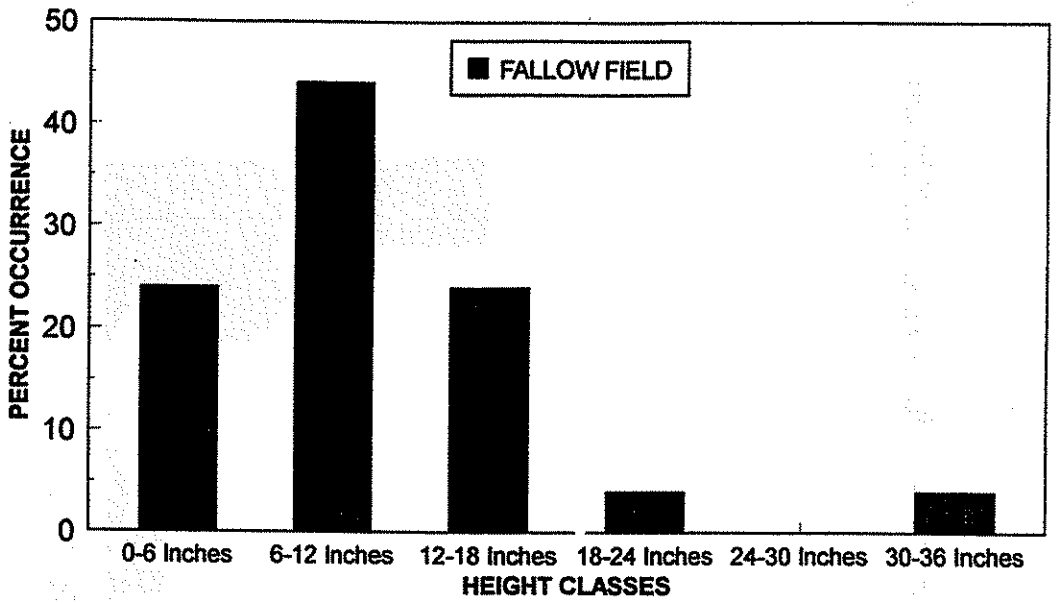


Figure 9. Vesper sparrow and western meadowlark occurrence by grass height in pastures based on point count censusing in Willamette Valley grasslands, May-June, 1996.





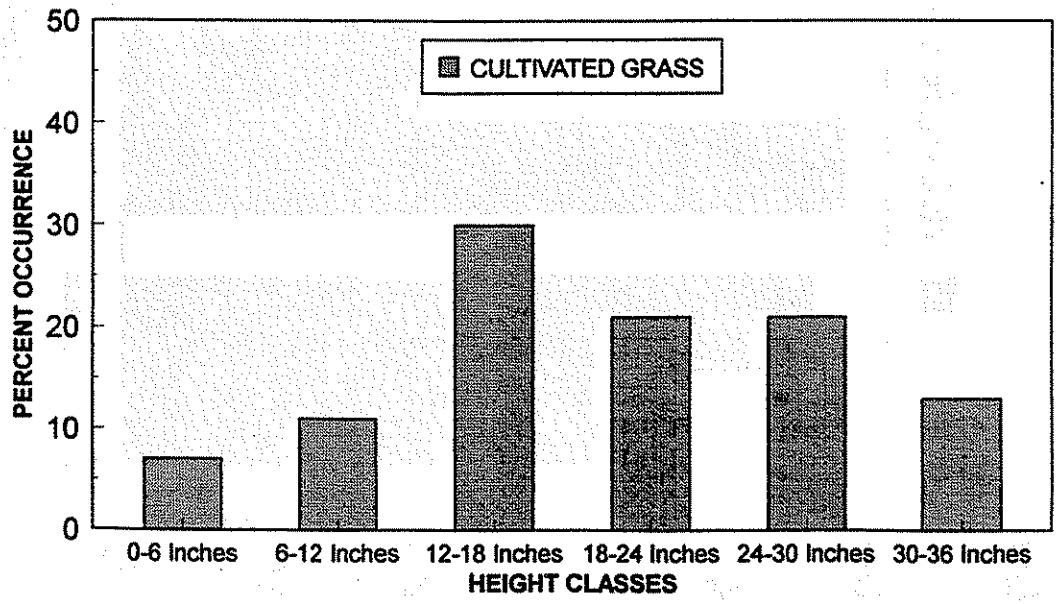


Figure 10. Western meadowlark occurrence by grass height in three habitat types based on point count censusing in Willamette Valley grasslands, May-June, 1996.

Figure 11. Mean percent cover in territories (excluding Christmas tree farms) of western meadowlark (n=20), vesper sparrow (n=10), grasshopper sparrow (n=18), and horned lark (n=2).

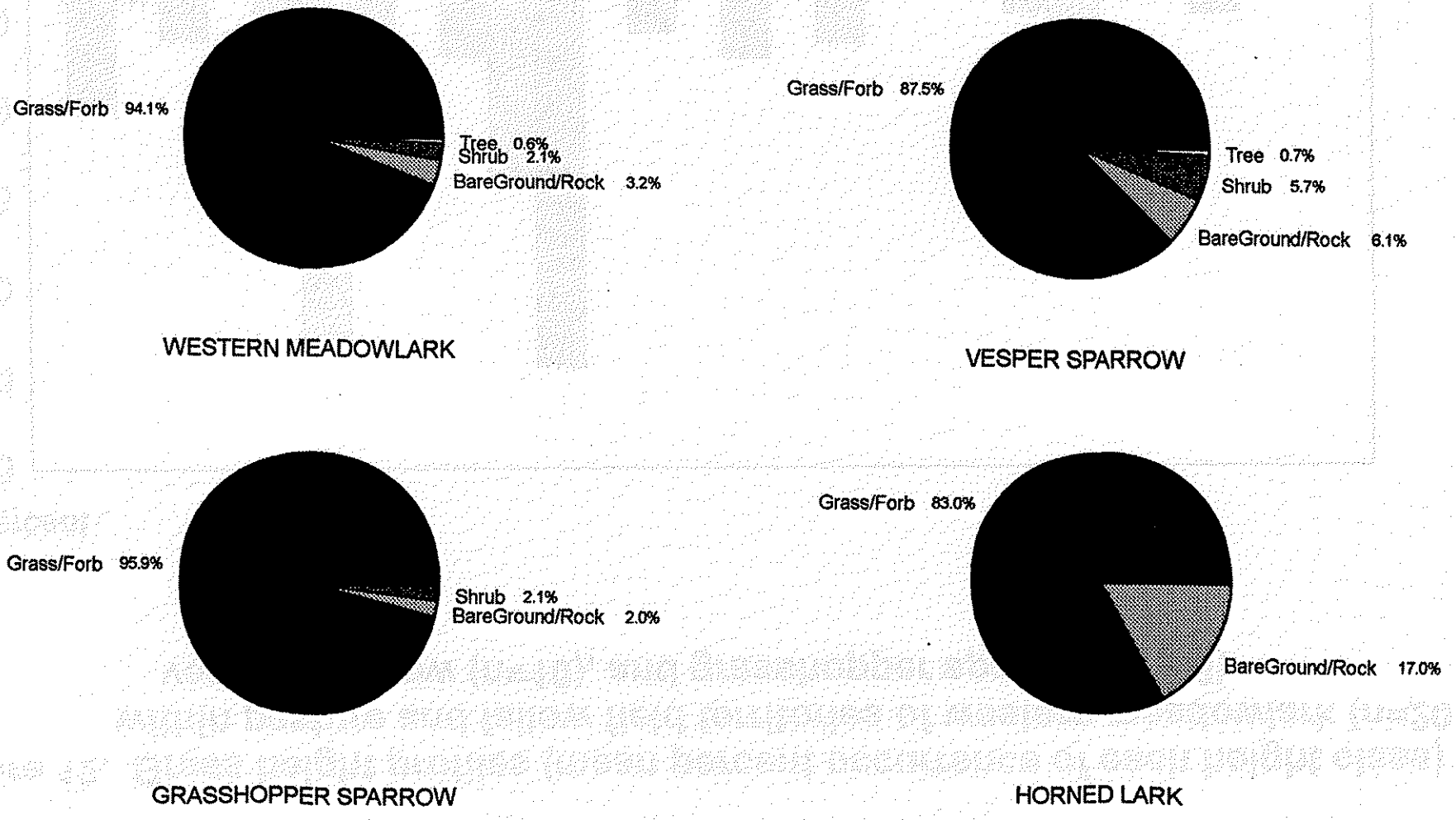


Figure 12. Grass height profiles (mean percent occurrence of each height class) within pasture and fallow field territories of western meadowlark (n=20), vesper sparrow (n=10), and grasshopper sparrow (n=18).

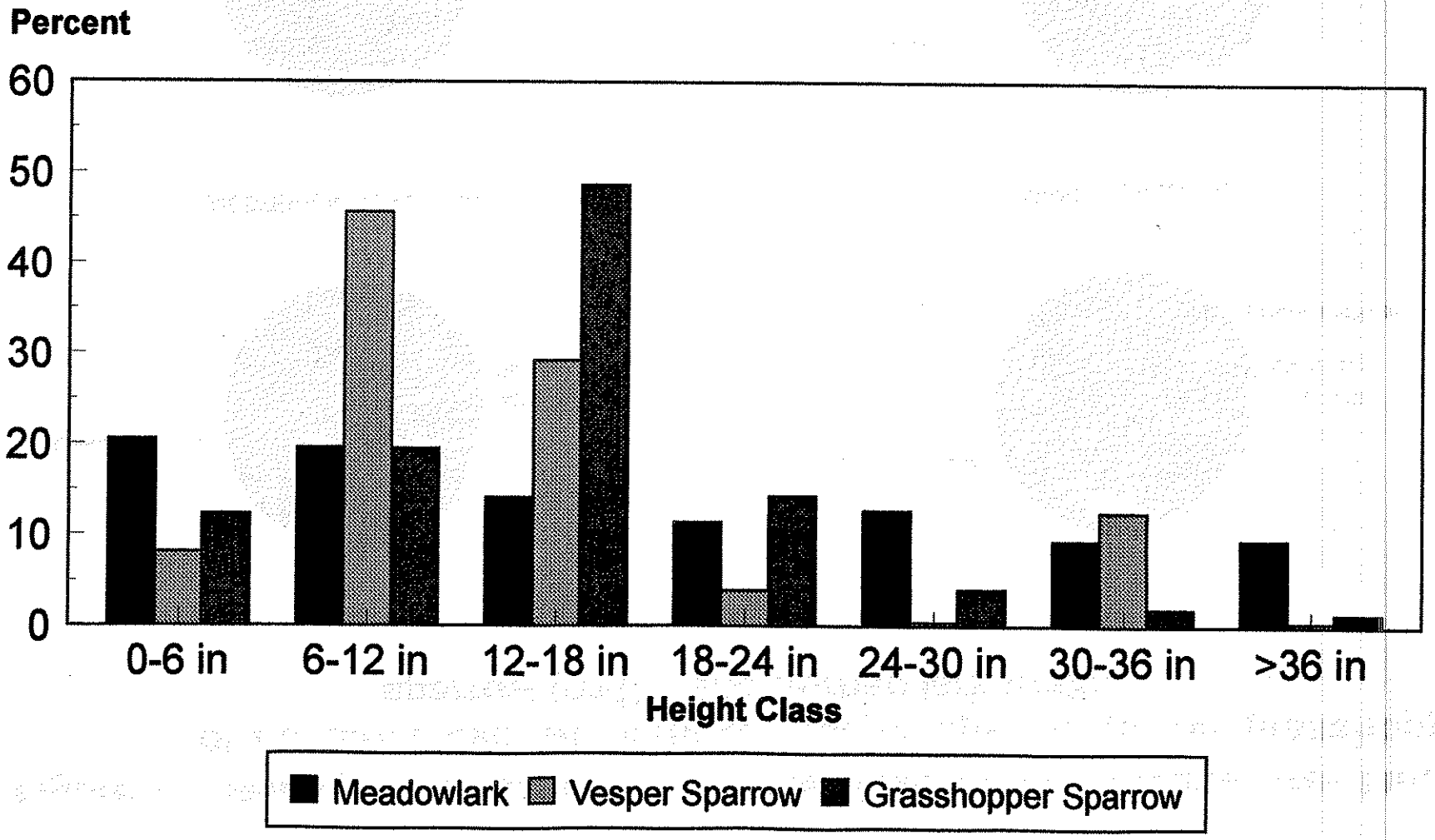
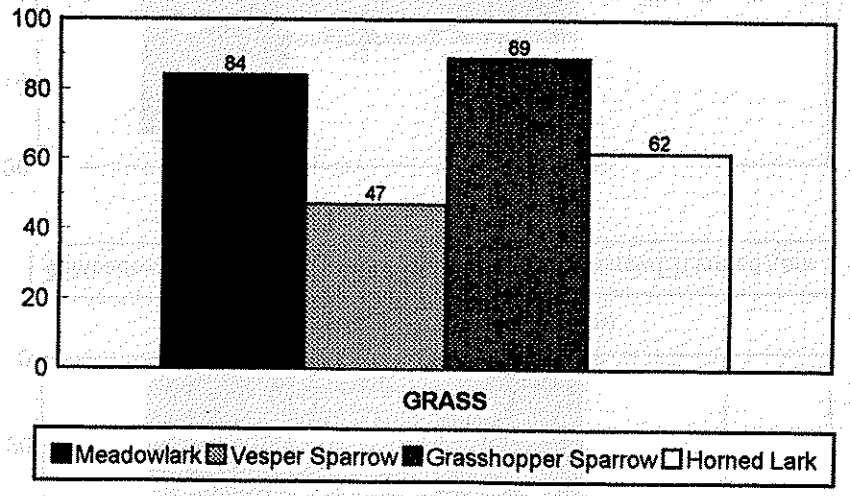
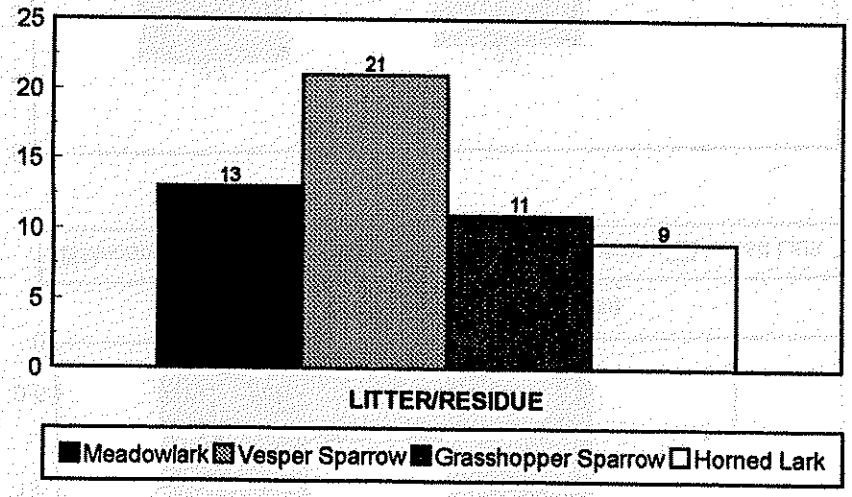
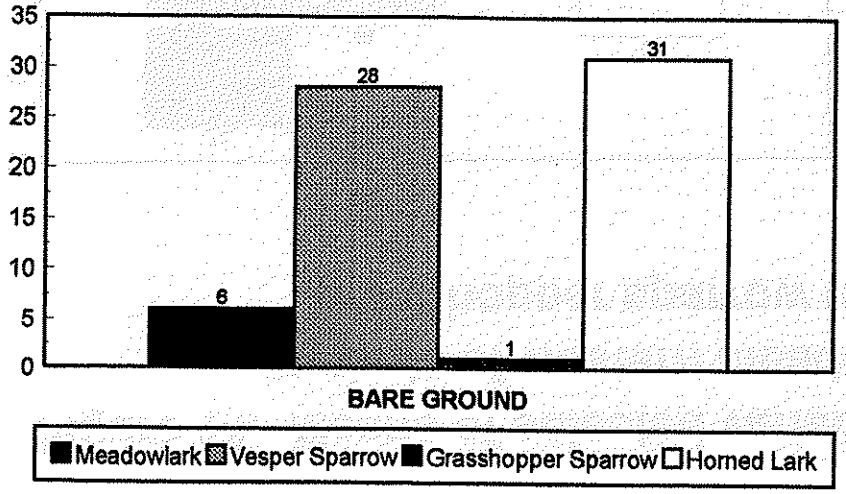


Figure 13. Mean percent cover in one-meter square plots centered on nests of western meadowlark (n=11), vesper sparrow (n=16), grasshopper sparrow (n=2), and horned lark (n=11).







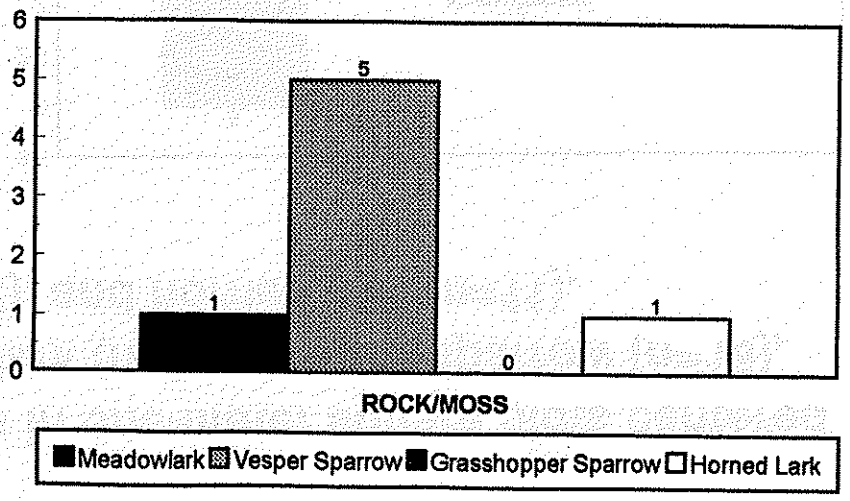
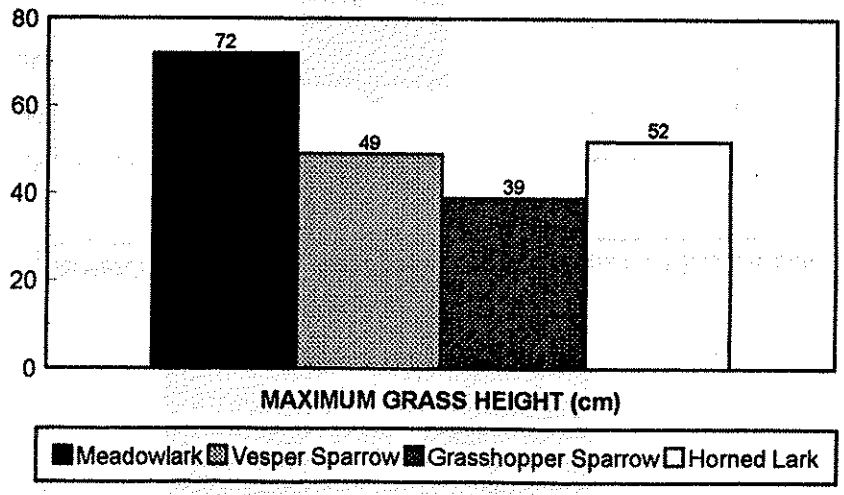
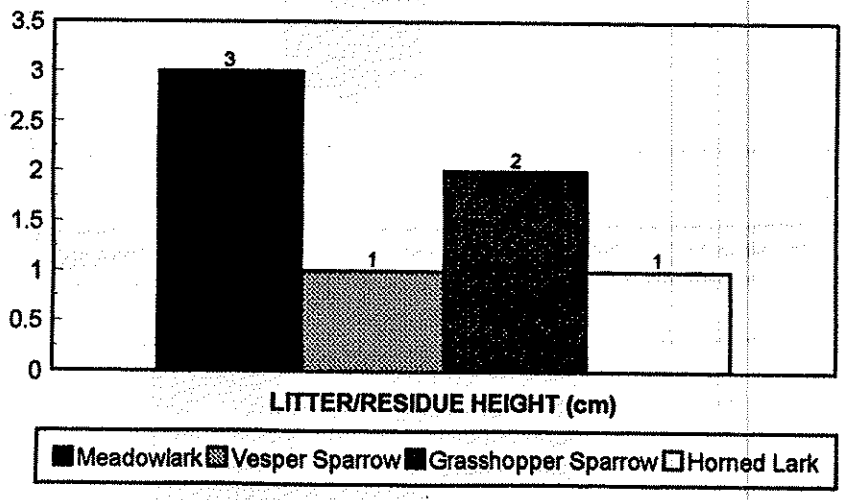
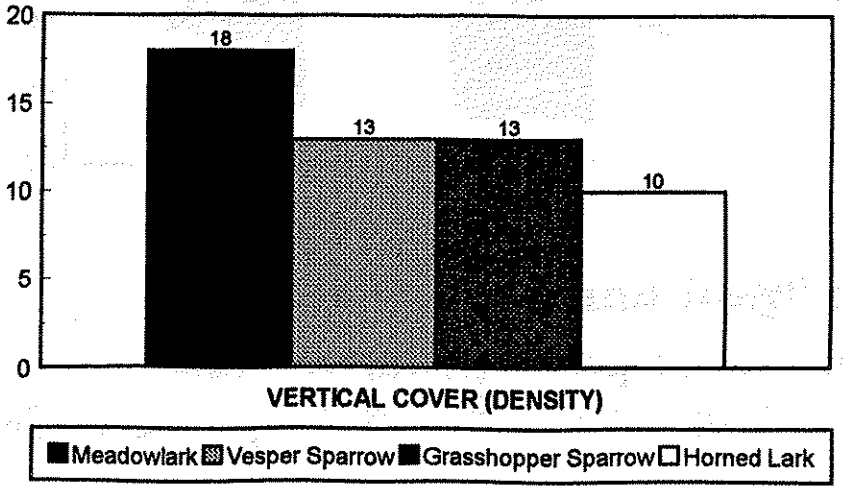


Figure 14. Means of selected variables in one-meter square plots centered on nests of western meadowlark (n=11), vesper sparrow (n=16), grasshopper sparrow (n=2), and horned lark (n=11).







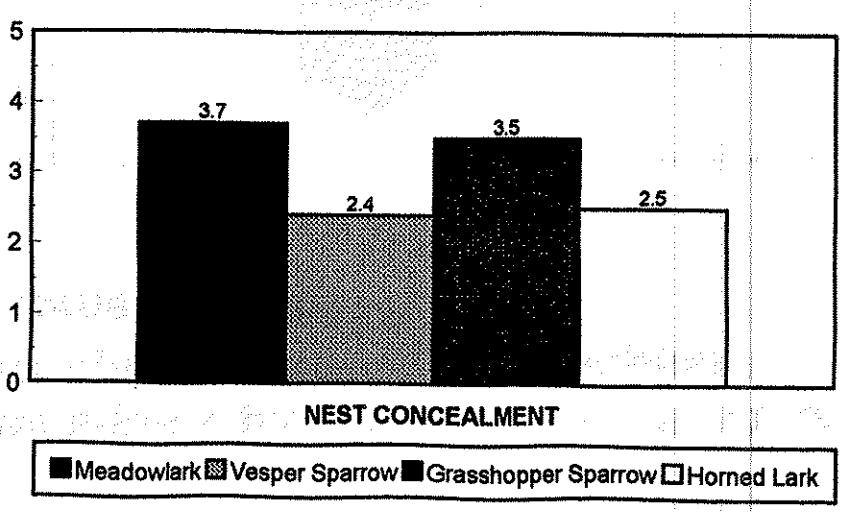
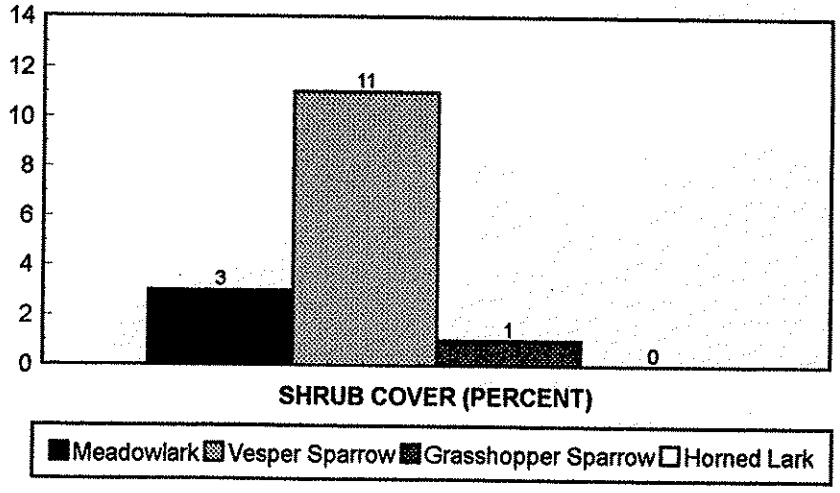
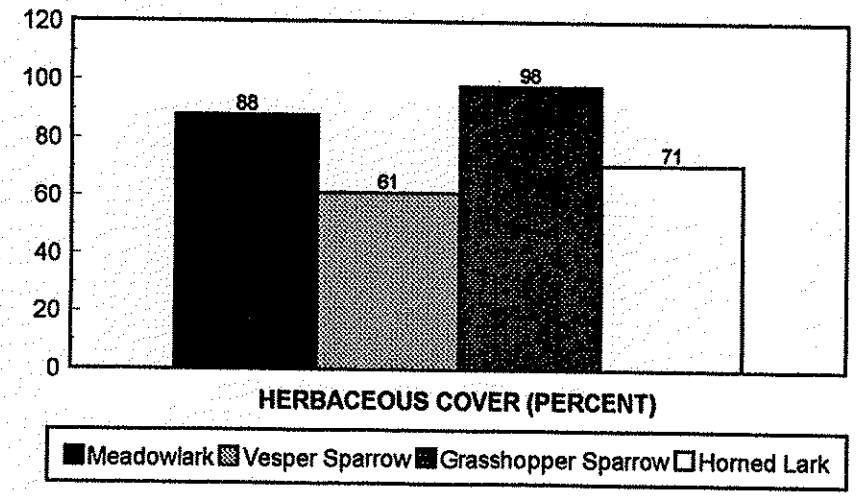
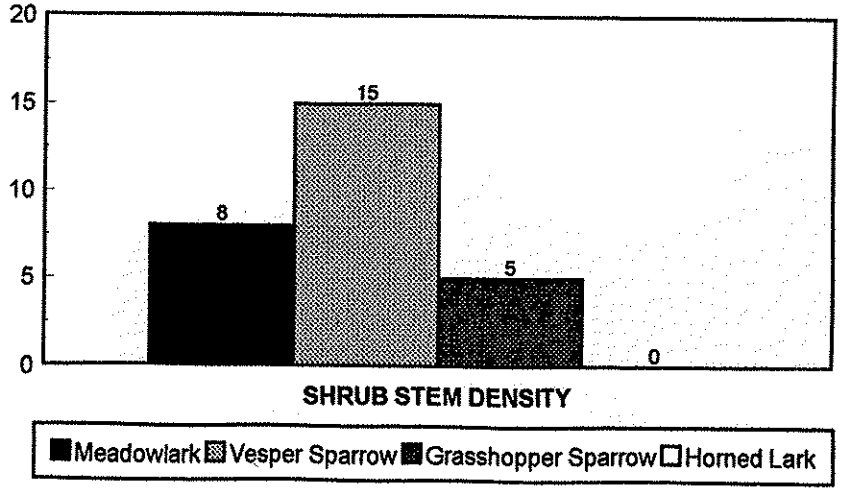
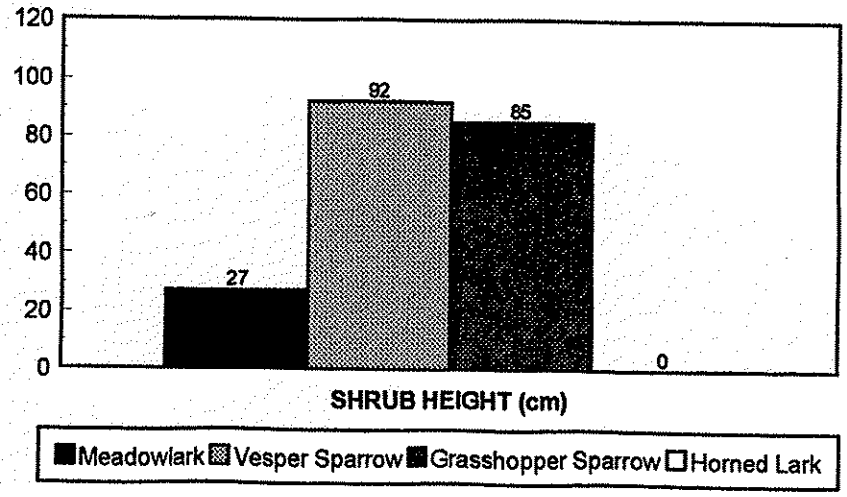


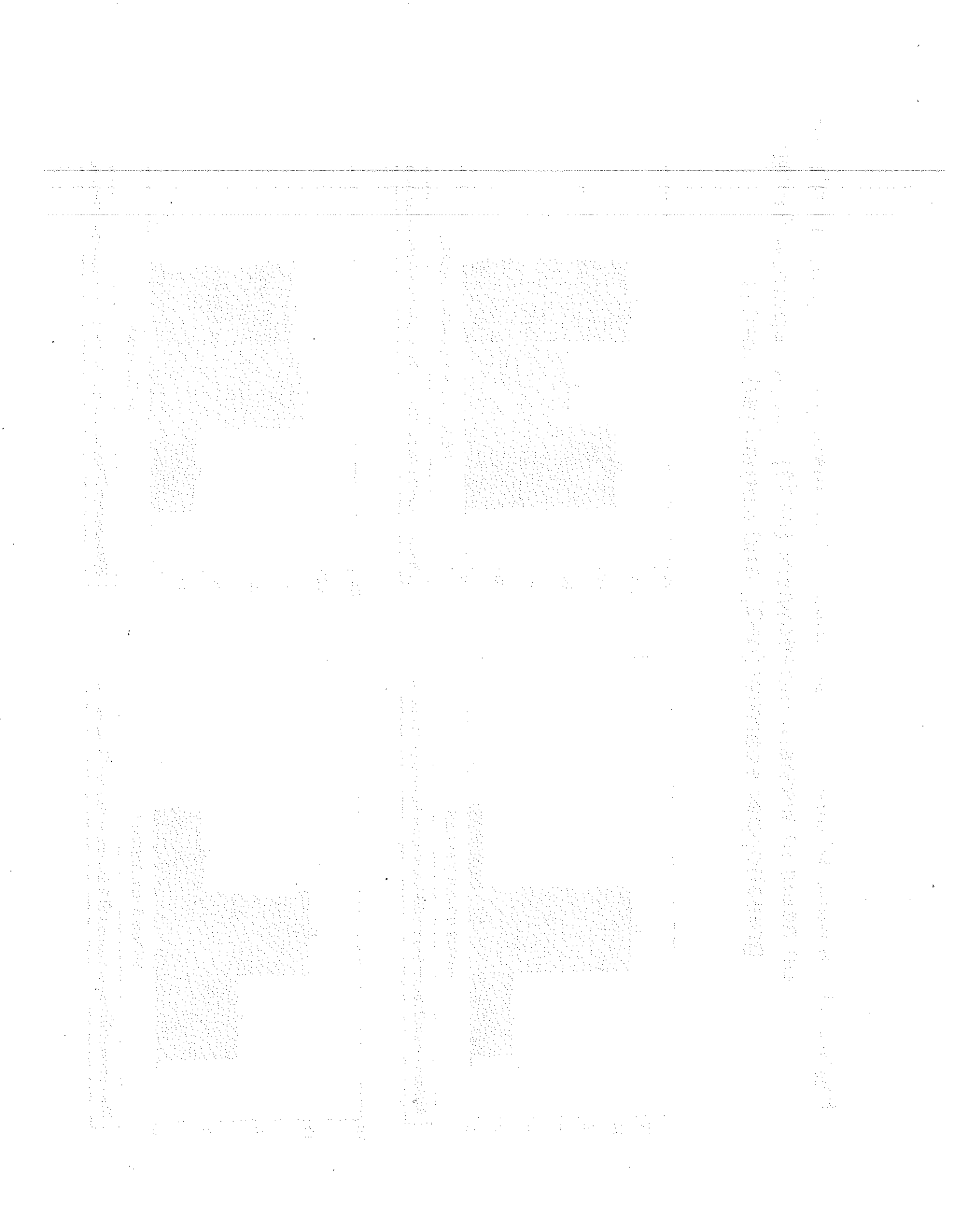
Figure 15. Means of selected variables in five-meter square plots centered on nests of western meadowlark (n=11), vesper sparrow (n=16), grasshopper sparrow (n=2), and horned lark (n=11).











APPENDIX A. Common nighthawk census forms, instructions, and summaries.

Protocol for Surveying Common Nighthawks in the Willamette Valley

This survey is being conducted to provide information on the abundance and distribution of common nighthawks foraging in the Willamette Valley. It is part of a larger project assessing the status of Willamette Valley grassland bird species. The common nighthawk historically nested in grassland habitat in the Willamette Valley, but is now uncommon to rare and may no longer be nesting in the Valley.

Instructions

*Conduct surveys covering the same area on two evenings - June 26 and July 10.

*Begin at 8:15pm and continue until dark.

*To survey, drive roads in your assigned area (map attached) as slowly as traffic will allow, looking and listening for nighthawks. Bring along a friend, a spouse, a date - two people per car is more effective than one. You can listen outside of the car at places with adequate room to pull over. Keep windows down and avoid roads with heavy traffic or limited visibility. Use vehicle emergency lights if needed. BE SAFE!

*Cover your area as completely as possible - particularly places where nighthawks are likely to be foraging (e.g. near rivers and reservoirs, over fields) or where you have seen them before. Stay within the Willamette Valley and lowest foothills.

*Complete and return map/data forms even if you had no nighthawk detections. Mark nighthawk detections on the attached map. Return forms to ODFW by July 15.

*Have fun, enjoy the evening, and DRIVE SAFELY!

Data Form

Name(s)_____Phone_____

Address_____

Date_____Miles driven_____Start time_____Stop time_____

Time	# Birds	Location (include road name and approx. distance from another road or landmark)	Comments/Behavior (flying, perching)

Time	# Birds	Location (include road name and approx. distance from another road or landmark)	Comments/Behavior (flying, perching)

APPENDIX B. Habitat codes and descriptions used for point count station habitat typing and target species habitat use in Willamette Valley grasslands, 1996.

Agricultural

1100 **recently harvested (mowed) grass field**
- 1110 cut grass removed, stubble, short-grass remains
- 1120 cut grass laying in field (e.g., hayed field)

1200 **cultivated grasses** - in general, there is a uniformity in terms of vegetation height, structure, and species composition (e.g, rye, fescue, wheat, oats)
- 1210 annual - has the appearance of a row crop
- 1220 perennial - a clumped, bunch grass appearance, often less uniform in appearance than annual grass field (e.g., hayfield)

1300 **low-growing herbaceous row crops**
- 1310 vegetable (e.g., cabbage, cauliflower, onion)
- 1320 mint/strawberry
- 1330 clover
- 1340 bulbs/flowers

1400 **tall, non-herbaceous row crops**
- 1410 nursery/Xmas trees
  - 1411 > 3 feet tall
  - 1412 < 3 feet tall
- 1420 orchards - fruit and nut
- 1430 vineyards (includes berries on vines and supports)
- 1440 corn
- 1450 hops

1500 **bare ground** - areas within fields where vegetation hasn't taken, at edge of fields, or between fields (note difference from plowed fields and difference from bare ground in roadside right of way)

1600 **recently plowed field** - most or all of field is exposed dirt; if planted, vegetation is not dominant

1700 **pasture** - fields that are fenced and are being grazed or have recently been grazed by livestock; generally there is some irregularity in terms of vegetation height, structure, and species composition (i.e., some areas may be heavily grazed and others lightly grazed); some cultivated grass fields will have livestock, usually sheep, grazing them; but these are not regular pastures; they should be called grass fields - 1200
- 1710 herbaceous
- 1720 shrubs/trees < 10 %
- 1730 shrubs/trees 10-25 %
- 1740 shrubs/trees > 25 %

Non-Agricultural

2100 **wet prairie** - herbaceous dominated wetlands should include some wetland herb vegetation such as rushes and sedges (e.g., marshes, floodplain of creeks/rivers)

2200 **fallow (unmanaged) fields** - includes fields fallow for several years such as CRP land or fields only not in use at this time(e.g., a field that has yet to be planted this year and is a mixture of weeds, grasses, bare ground etc.); also includes "native" grassland remnants; like pasture there may be a great deal of irregularity in terms of vegetation, height, structure, and species composition, but these fields have no sign of recent grazing and may or may not be fenced (an unfenced field like this is definetly a fallow field and not a pasture)

- 2210 herbaceous
- 2220 shrubs/trees <10 %
- 2230 shrubs/trees 10-25 %
- 2240 old field - early successional abandoned fields with mixture of forbs, grasses, scattered shrubs and/or small saplings; woody component > 25 of area

2400 **maintained fields** - includes recreational parks, cemeteries

2600 **gravel and dirt roads** - does not include field roads, must be a regularly travel road leading to other roads, homes, barns, etc. (for percentage purposes do not include shoulder)

2700 **roadside/railroad right of way** - area adjacent to road or railroad, including ditch, that is distinct from adjacent field or non-field habitat and dominated by:

- 2710 herbaceous vegetation (if shrub or tree dominated then non-field riparian or hedgerow)
- 2720 gravel
- 2730 dirt
- 2740 mixed (any relatively equal combination of above)

3000 **Non-Field Habitats** - lump all together for percent coverage at point counts

paved roads

fence row - a fence does not need to be present (e.g., hedgerow); codes:

1) unvegetated - "clean" fence (< 10 % of fenceline is vegetated)
2) herbaceous - grasses and forbs within fence (< 10 % of vegetation is woody)
3) mixed - herbaceous vegetation with scattered individual or clumps of woody (tree or shrub) vegetation
4) woody - relatively continuous trees and shrubs

upland forest/woodland (conifer or deciduous)

riparian forest - includes shrub and tree within riparian zone of pond, creek, stream, ditch

residential - includes buildings, yard, and maintained area associated with residence

open water - ponds, creeks, ditches, etc.

APPENDIX C. Habitat variables and methodology used at point count stations and target species nest sites in Willamette Valley grasslands, 1996.

Percent Habitat Type

* ocular estimate of the percent of each habitat type within a 100 meter fixed radius of all point count stations. Road types 1) paved, 2) gravel, 3) dirt.

Vegetation Cover

* herbaceous layer - ocular estimate of percent cover of grasses/forbs, litter/residue, bare ground, and rock within 1 m square frame placed at nest and at non-use plot - meter square plot centered on nest with corners in each of 4 cardinal directions
* tree layer - percent cover, stem densities, height, and size class (dbh) by species in 11.3 meter square
* shrub layer - percent cover, stem densities, and height by species in 5 meter square
* litter/residue depth measured at a point adjacent to 3 inches to the N side of the wall of the nest cup and at each of 4 corners of 1 m plot

Vegetation Density

* measured at each nest and non-use plot with density board (Basore et al. 1986) - 15 cm wide, 180 cm tall graduated at 10 cm intervals - ocular estimate of the percentage of the board obscured by vegetation (herbaceous and non-herbaceous) in each 10 cm interval using percentage categories of 0-20, 21-40, 41-60, 61-80, 81-100 - estimated from distances of 1.5 and 3 m and at a height of 1 m - also record type of vegetation making hit

Vegetation Height

* effective height - measured height of tallest herbaceous vegetation (alive or dead) in 1 m plot, shrub vegetation in 5 m plot , and tree vegetation in 11.3 m plot
* nest - measured height of tallest herbaceous vegetation within 6 inches of nest
* diversity of vegetation heights - intensive and extensive sites
  - uniform - height of more than 50 percent of non-woody vegetation within 5 cm of average height (ocular)
  - non-uniform - height of less than 50 percent of non-woody vegetation within 5 cm of average height (ocular estimate)
* height classes - ocular estimate of the median height of herbaceous vegetation only
  1. 0-6 inches
  2. 6-12 inches
  3. 12-18 inches
  4. 18-24 inches
  5. 24-30 inches
  6. 30-36 inches
  7. >36 inches

Other Nest Site Variables

* distance to nearest woody vegetation (tree or shrub)
* distance to road (field road and public Road)
* distance to edge (habitat type change or intra-habitat type change)
* distance to fenceline
* nest concealment - subjective estimate (excellent, good, fair, poor) from above and at 1 m away (1 m height) in each of the 4 cardinal directions

  excellent (4) - nest completely obscured by vegetation (herb or woody) or less than 10 percent visible

  good (3) - most (60-90 %) of the nest is obscured by vegetation

  fair (2) - some (20-60 %) of the nest is obscured by vegetation

  poor (1) - little (< 20%) of the nest is obscured by vegetation

APPENDIX D. Region names and codes used for point count censusing in Willamette Valley grasslands, May-June, 1996.

REGION (CODE)	TOTAL POINTS	QUAD (CODE)	POINT COUNTS
		NORTHERN VALLEY	
Carlton East (CARLEA)	13	Carlton (CARL)	1-13
Dayton Prairie (DAYTPR)	12	McMinnville (MINN)	1-8
		Dayton (DAYT)	2,4-6
French Prairie West (FRPRWE)	16	Dayton (DAYT)	1
		St Paul (STPL)	9,11-22,24,26
French Prairie East (FRPREA)	13	St Paul (STPL)	1-8,10,23,25
		Woodburn (WOOD)	1,2
Elliot Prairie (ELLIPR)	19	Woodburn (WOOD)	3-11
		Yoder (YODE)	2,5,8,15,17
		Scotts Mills (SCOT)	1-5
Marks/Gribble Prairie (MAGRPR)	9	Yoder (YODE)	3,10-12,19-23
Yoder East (YODEEA)	12	Yoder (YODE)	1,4,6,7,9,13,14,16,18,24
		Scotts Mills (SCOT)	13,14
Molalla River Lowlands (MORILO)	9	Molalla (MOLA)	1-9
Dickey Prairie (DICKPR)	8	Molalla (MOLA)	10-14
		Wilhoit (WILH)	1-3
TOTAL POINTS	111		
		CENTRAL VALLEY	
Silverton East (SILVEA)	10	Scotts Mills (SCOT)	6-12,15-17
Richardson Gap (RICHGA)	12	Scio (SCIO)	1-12
Stayton Southwest (STAYSW)	22	Stayton (STAY)	8-13,19,22-26
		Scio (SCIO)	13-15
		Crabtree (CRAB)	6-12
Crabtree West (CRABWE)	8	Crabtree (CRAB)	1-5,13-15
Aumsville South (AUMSSO)	7	Stayton (STAY)	14-18,20,21
Turner South (TURNSO)	17	Turner (TURN)	1-17
Sublimity East (SUBLEA)	7	Stayton (STAY)	1-7
Waldo Hills (WALDHI)	28	Stayton Northeast (STYN)	7-34
Howell Prairie (HOWEPR)	11	Stayton Northeast (STYN)	1-6
		Silverton (SILV)	1-5
Red Prairie (REDPRA)	15	Sheridan (SHER)	1-10
		Ballston (BALL)	17,19-22
Baskett Slough North (BASLNO)	18	Dallas (DALL)	1-10
		Ballston (BALL)	3,6,18
		Amity (AMIT)	2,3,7,12,13

Adair East (ADAIEA)	10	Lewisburg (LEWS)	1-3
		Airlie South (ARSO)	2-8
Luckiamute River Hills (LURIHI)	24	Airlie North (ARNO)	1-23
		Airlie South (ARSO)	1
Ankney Bottom (ANKNBO)	5	Sydney (SYND)	1-5
Monmouth South (MONMSO)	13	Monmouth (MONM)	1-13
Amity South (AMITSO)	8	Amity (AMIT)	1,4-6,8-11
Ballston South (BALLSO)	21	Ballston (BALL)	1-2,4-5,7-16,23-27
		Dallas (DALL)	11,12
TOTAL POINTS	236		

SOUTHERN VALLEY

Coburg Northeast (COBUNE)	12	Coburg (COBU)	1-10,17,18
Chesire North (CHESNO)	17	Chesire (CHES)	1-17
Harrisburg North (HARRNO)	12	Harrisburg (HARR)	1-12
Monroe East (MONREA)	15	Monroe (MONR)	2-10
		Greenberry (GREN)	6-11
Ward Butte (WARDBU)	8	Halsey (HALS)	1-8
Peoria East (PEOREA)	27	Peoria (PEOR)	1-18
		Riverside (RIVE)	1-9
Corvallis South (CORVSO)	6	Greenberry (GREN)	1-5,12
Shedd Northeast (SHEDNE)	5	Halsey (HALS)	10-14
Fern Ridge (FERNRI)	11	Veneta (VENE)	1-6
		Eugene West (EUWE)	1-5
Tangent Southeast (TANGSE)	15	Tangent (TANG)	1-14
		Lebanon (LEBN)	1
Camas Swale (CAMASW)	10	Creswell (CRES)	1-10
Brownsville North (BROWNO)	10	Brownsville (BROW)	1-10
Indian Head Hills (INHEHI)	20	Indian Head (INDH)	1-5,9-12,15-17,34-39
		Union Point (UNPT)	1,2
Bond Butte Lowlands (BOBULO)	29	Coburg (COBU)	11-16
		Indian Head (INDH)	6-8,13-14,18-33,40-41
TOTAL POINTS	197		

APPENDIX E. Species recorded during Willamette Valley grassland breeding bird project, 1996.

Species
Acorn woodpecker
American bittern
American crow
American goldfinch
American kestrel
American pipit**
American robin
Band-tailed pigeon*
Barn swallow
Black-capped chickadee
Belted kingfisher
Bewick's wren
Black-throated gray warbler
Blue-gray gnatcatcher**
Brown-headed cowbird
Black-headed grosbeak
Brewer's blackbird
California quail
Canada goose
Chestnut-backed chickadee
Cedar waxwing
Chipping sparrow
Cliff swallow
Common bushtit
Common nighthawk**
Common raven
Common snipe*
Common yellowthroat
Coopers hawk*
Dark-eyed junco
Downy woodpecker
European starling
Evening grosbeak
Golden-crowned kinglet
Golden-crowned sparrow
Grasshopper sparrow**
Gray jay*
Great-blue heron
Green heron
Short-eared owl**
Song sparrow

Species
Horned lark
House finch
House sparrow
House wren
Hutton's vireo
Killdeer
Lesser goldfinch**
Lazuli bunting
Mallard
MacGillivray's warbler
Marsh wren*
Mountain quail*
Mourning dove
Northern bobwhite
Northern flicker
Northern harrier
Northern mockingbird
Northern oriole
Northern shrike
Northern rough-winged swallow
Olive-sided flycatcher*
Orange-crowned warbler
Osprey
Pacific-slope flycatcher
Pileated woodpecker
Pine siskin*
Prairie falcon*
Purple finch
Red-breasted nuthatch
Red-breasted sapsucker*
Red-tailed hawk
Red-winged blackbird
Ring-necked pheasant
Rock dove
Rock wren**
Rufous hummingbird
Savannah sparrow
Scrub jay
Sharp-shinned hawk
Western kingbird
Western meadowlark

Solitary vireo
Spotted towhee
Swainson's thrush
Tree swallow
Turkey vulture
Varied thrush*
Vaux's swift*
Vesper sparrow
Violet-green swallow
Virginia rail
Warbling vireo
Western bluebird
Western sandpiper*
Western tanager
Western wood-pewee
White-breasted nuthatch
White-crowned sparrow
Willow flycatcher
Wild turkey
Wilson's warbler
Wood duck*
Yellow-breasted chat*
Yellow warbler
Yellow-rumped warbler

* recorded during point count censusing, but only beyond 100 meters
** recorded only as an incidental; not during censusing

APPENDIX F. Summary of area search censusing in Willamette Valley grasslands, May-June, 1996.

Location	Champoeg State Park		Rowland CRP	Howard CRP	Elijah Bristow	BLM Royal	BLM Coast	E.E Wilson		Finley NWR									
										Pigeon Butte					Bald Top			Wet Prairie	
Field Type	FF	FF	FF	FF	FF	FF	TF	FF	FF	FF	FF	FF	FF	FF	FF	FF	PT	WP	WP
Date	6/20	6/20	6/4	6/4	5/30	6/13	5/16	6/28	6/28	5/29	5/29	5/29	5/29	5/29	6/3	6/3	6/3	6/21	6/21
Site Number	1	2	1	1	1	1	1	1	2	1	2	3	4	5	1	2	3	1	2
Turkey vulture	9													2					
Great-blue heron	1					3		1											
Mallard						1													
Wood duck						1													
Red-tailed hawk						1													
Northern harrier	1																		
American crow	2				18														
Ring-necked pheasant						1													1
Northern flicker	1						1												
Killdeer	1																		
Scrub jay			1		1												1		
Rufous hummingbird																		2	
Western kingbird															1				
Willow flycatcher																			1
Western wood pewee	1												3						
Lazuli bunting	1		1												5	4			
American robin					3	1	4		1										
Western bluebird	3																		
Cedar waxwing			4			4					3				13	2	2	2	
Tree swallow	2								5										
Violet-green swallow	1																		
Barn swallow			2	1		5													
Cliff swallow									1				1						
Unidentified swallow								1				3							
Bewick's wren				1														1	
Black-capped chickadee			1																
Common yellowthroat		2	2	1		6		1	2		2	1				2	1	4	6
Orange-crowned warbler			1										1						1
Savannah sparrow	3	1																5	11
Song sparrow		1				6		3										2	3
White-crowned sparrow				2			8												
Vesper sparrow				1			1												
Dark-eyed junco							2												
Rufous-sided towhee							2		1										
Brown-headed cowbird			2			4				3						2		1	
Red-winged blackbird						12													
European starling	1														3	1	8		
Western meadowlark						1													
Evening grosbeak										2	2					2			
House finch																1			
American goldfinch	1		1	5		8	27	3		2	2		1	1	2	1	4	2	7
Totals	28	4	15	11	22	54	45	9	10	7	9	4	6	3	24	15	16	19	30

FF = Fallow field
TF = Tree farm
WP = Wet prairie

NIGHTHAWK NITE-OUT DATA SUMMARY - FIRST NIGHT					
Surveyor name(s)	**Survey area**	**Survey date**	**Survey miles**	**Survey minutes**	**Bird detections**
W & T Logan	Waldo Hills	6/26/96	61	195	3
K Weil	Dayton south	6/26/96	40	102	7
S & K Viste-Sparkman	Sublimity	6/26/96	59	115	6
M Platt & B Schreiber	Greenberry	6/26/96	19	90	5
B Bales & D Budeau	EE Wilson	6/26/96	35	65	4
S Sahnow	Riverside Dr	6/26/96	35*	75	4
M & T Sekora	Fern Ridge west	6/26/96	39	75	2
R Gerig	Monmouth east	6/26/96	50	120	2
D Cottam	Ingram Island	6/26/96	22	61	1
Eric & Jessyca Burke	Philomath east	6/26/96	25	115	1
W & C Hlebechuk	Pleasant Hill	6/26/96	32	69	1
J Reams & L Newton	Tangent	6/26/96	28	75	1
N & R Wogen, M Southard	Brownsville	6/26/96	35	120	5
H Nehls	French Prairie	6/26/96	51	105	1
R & D Titus	Peoria east	6/26/96	34	78	1
B Shoffner & J Becker	Molalla	6/26/96	25	70	1
C Klock	Rickreall	6/26/96	38	100	3
T & A Mickel	Fisher Butte	6/26/96	15	85	1
M A Sohlstrom& S Wagner	Carlton west	6/26/96	29	96	0
Richard Green	Freeway Lks east	6/26/96	30	101	0
D Felber	Monroe west	6/26/96	19	85	0
B Bellin & D Pederson	Stayton west	6/26/96	26	70	0
H & C Heinkel	Turner	6/26/96	32	90	0
K Merrifield	Finley NWR	6/26/96	21	80	0
D Philpott, J Fukuda,C Rim & K Higgins	Molalla west	6/26/96	30	75	0
K & S Freemark	Scio	6/26/96	35	87	0
K Larsen	Creswell	6/26/96	14	90	0
F Schrock	Amity south	6/26/96	33	75	0
S Dowlan	Labish	6/26/96	72	105	0
B Leaf & K Finley	Halsey east	6/26/96	26	98	0
C & E McCloskey	Irish Bend	6/26/96	35*	105	0
W High	Salem east	6/26/96	34	80	0
A Cornwell & D Gutcher	Stayton south	6/26/96	40	105	0
T Murtagh	Marquam	6/26/96	20	100	0
A Smith, R & K Raymond	Lebanon east	6/26/96	40	81	0
A Contreras	Wheatland	6/26/96	23	65	0
K Islam	Millersburg	6/26/96	24	75	0
S Page	Priceboro Rd	6/26/96	25	70	0
R Wise	Cox Butte	6/26/96	30	93	0
B Castillo & M Bishop	Alvadore	6/26/96	29	75	0
B Campbell	Coburg	6/26/96	24	80	0
D Irish & J Sylvestre	Harrisburg west	6/26/96	31	79	0
J Dillon & J Fulkerson	Amity Hills	6/26/96	26	90	0
R Keister	Ward Butte	6/26/96	70	90	0
G & A Ansell	Smith Loop	6/26/96	33	120	0
M Nebeker & B Lee	Airlie	6/26/96	30	104	0
D Wheeler & K Korn	Peterson Butte	6/26/96	26	95	0
D Lay & S Sears	Fern Ridge south	6/26/96	42	80	0
S Kohlman	American Bottom	6/26/96	32	135	0
J & Y Faulkner	Lebanon north	6/26/96	69	90	0
Aaron Bengtson	Lebanon northwest	6/26/96	17	105	0
S Bielke & L Allen	Silverton west	6/26/96	27	132	0
M Naughton & R Goggans	Baskett Slough NWR	6/26/96	25	120	0
G & N Hostick	Oakville	6/26/96	20	90	0
Paul Adamus	Albany east	6/26/96	32	90	0
Bob Altman	I-5 Pdx-Salem	6/26/96	82	60	0
B & D Gleason	Junction City south	6/27/96	58	105	0
N Ten Eyck & C Files	Dallas east	6/27/96	29	60	0
M McLaughlin	Harrisburg east	6/27/69	31	82	0
B & D Gleason	Cloverdale	6/25/96	62	95	0
Total			2006	5518	49
Average			34.6	92.0	
			* mileage not available so average used		

NIGHTHAWK NITE-OUT DATA SUMMARY - SECOND NIGHT					
Surveyor name(s)	Survey area	Survey date	Survey miles	Survey minutes	Bird detections
W & T Logan	Waldo Hills	7/10/96	30	120	9
T Buerger	Dayton south	7/10/96	27	110	5
K Viste-Sparkman	Sublimity	7/10/96	50	120	7
B Schreiber	Greenberry	7/10/96	20	85	5
B Bales & D Budeau	EE Wilson	7/10/96	13	59	4
C & G Woosley	Riverside Dr	7/10/96	21	79	1
W & C Morrow	Fern Ridge west	7/9/96	34	85	1
R Gerig	Monmouth east	7/10/96	46	105	3
D Cottam	Ingram Island	7/10/96	30	82	3
Eric & Jessyca Burke	Philomath east	7/10/96	39	100	1
S Kohlman	American Bottom	7/10/96	26	120	4
R Keister	Ward Butte	7/10/96	70	95	3
A Smith & K Farris, R & K Raymond	Lebanon east	7/10/96	45	138	2
M Nebeker	Airlie	7/10/96	31	120	1
Joan Hagar	Albany north	7/10/96	33*	65	1
K Maurice	Carlton east	7/10/96	32	90	1
M A Sohlstrom& S Wagner	Carlton west	7/10/96	37	90	0
Richard Green	Freeway Lks east	7/10/96	16	86	0
J Reams & L Newton	Tangent	7/10/96	42	65	0
D Felber	Monroe west	7/10/96	19	65	0
B Bellin & D Pederson	Stayton west	7/10/96	27	70	0
H & C Heinkel	Turner	7/10/96	46	95	0
K Merrifield	Finley NWR	7/10/96	27	90	0
D Philpott, J Fukuda,C Rim & K Higgins	Molalla west	7/10/96	35	105	0
K & S Freemark	Scio	7/10/96	30	85	0
K Larsen	Creswell	7/10/96	15	120	0
F Schrock	Amity south	7/10/96	28	70	0
B & D Gleason	Junction City south	7/10/96	58	120	0
B Shoffner & J Becker	Molalla	7/10/96	27	65	0
S Dowlan	Labish	7/10/96	69	105	0
K Finley & T Seager	Halsey east	7/10/96	28	80	0
N & G Sieglitz	Irish Bend	7/10/96	33*	105	0
W High	Salem east	7/10/96	24	75	0
N Ten Eyck & J & C Files	Dallas east	7/10/96	32	65	0
R & D Titus	Peoria east	7/10/96	22	60	0
A Cornwell	Stayton south	7/10/96	40	90	0
T Murtagh	Marquam	7/10/96	20	90	0
S Page	Priceboro Rd	7/10/96	30	70	0
R Wise	Cox Butte	7/10/96	29	83	0
B Castillo & M Bishop	Alvadore	7/10/96	29	80	0
B Campbell	Coburg	7/10/96	32	65	0
D Irish & J Sylvestre	Harrisburg west	7/10/96	31	75	0
J Dillon & J Fulkerson	Amity Hills	7/10/96	26	100	0
T & A Mickel	Fisher Butte	7/10/96	26	105	0
G & A Ansell	Smith Loop	7/10/96	33	120	0
H Nehls	French Prairie	7/10/96	54	95	0
C Klock & J Yeager	Rickreall	7/10/96	38	105	0
D & D Wheeler	Peterson Butte	7/10/96	26	90	0
W Morrow	Fern Ridge south	7/10/96	36	90	0
J & Y Faulkner	Lebanon north	7/10/96	63	80	0
Aaron Bengtson	Lebanon northwest	7/10/96	14	120	0
S Bielke & L Allen	Silverton west	7/10/96	25	125	0
M Naughton & R Goggans	Baskett Slough NWR	7/10/96	20	80	0
Paul Adamus	Albany east	7/10/96	36	95	0
Bob Altman & Carol Schuler	Willamte R. Falls-Canby	7/10/96	47	60	0
M McLaughlin	Harrisburg east	7/11/96	32	74	0
R & N Miller	Woodburn east	7/3/96	35	90	0
O Thomsen & S Sears	Cloverdale	7/8/96	28	82	0
Total			1846	5081	51
Average			33.0	90.7	
			* mileage not available so average used		

NIGHTHAWK NITE-OUT DATA SUMMARY -FIRST NIGHT 1997

Surveyor names	Survey area	Survey date	Survey miles	Survey minutes	Bird detections
K. Finely, J. Vail, T.Noel	Halsey East	1997/06/25	26*	90	0
W & T Logan	Waldo Hills	1997/06/25	34	120	3
T Burger	Dayton South	1997/06/25	20	90	6
S & K Viste-Sparkman	Sublimity	1997/06/25	48	90	8
M Platt	Greenberry	1997/06/25	21	75	5
D Budeau, H Wix, P&V Matthews	EE Wilson	1997/06/25	8	76	4
J Journey, A West	Fern Ridge West	1997/06/25	35	90	0
R Gerig	Monmouth East	1997/06/25	90	90	6
R. Goggans	Ingram Island	1997/06/24	17	105	0
J Reams & L Newton	Tanget	1997/06/25	35	75	0
R & D Titus	Peoria East	1997/06/25	41	115	0
M A Sohlstrom & N Dietrich	Carlton West	1997/06/25	20	85	0
R Green & L Hammond	Monroe West	1997/06/25	23	95	3
D Pederson	Stayton West	1997/06/25	33	80	0
H & C Heinkel	Turner	1997/06/25	30	110	0
K Merrifield	Finley NWR	1997/06/25	21	80	0
J Lundsten	Labish	1997/06/25	69	125	0
W High	Salem East	1997/06/25	31	90	4
A Cornwell & D Gutcher	Stayton South	1997/06/25	40	120	2
T Murtagh	Marquam	1997/06/25	20	100	0
A Smith & C Loomis	Lebanon East_	1997/06/25	34	90	0
R Wise	Cox Butte	1997/06/25	23	97	2
B &B Campbell	Coburg	1997/06/25	22	120	0
R Keister	Ward Butte	1997/06/25	81	90	4
G & A Ansell	Smith Loop	1997/06/25	34	90	0
D Wilson & H Brunkel	Airlie	1997/06/25	38	108	0
D Lay & L Graves	Fern Ridge South	1997/06/25	24	100	2
J Actuater	American Bottom	1997/06/25	14	90	4
A Drew, J Scheitzer	Basket Slough NWR	1997/06/25	24*	105	0
G& N Hostick	Oakville	1997/06/24	30	120	0
J Feischer	Albany East	1997/06/25	26	95	0
B & D Gleason	Pleasant Hill	1997/06/25	38	80	1
N Halcomb	Peterson Butte	1997/06/25	21	90	4
S Baker &L Mosley	Cloverdale	1997/06/25	50	95	1
Carole Hallett	Carlton East	1997/06/25	45	110	0
B Shoffner	Molalla	1997/06/25	30	90	9
T & A Mickel	Fisher Butte	1997/06/27	26*	75	2
P Graff	Priceboro Rd	1997/06/25	20	95	4
M Ratzlaff	Harrisburg East	1997/06/25	25	71	0
Total			1267	3712	74
Average			32.4	95.2	
	* mileage N/A so average used				

NIGHTHAWK NITE-OUT DATA SUMMARY-SECOND NIGHT 1997

Surveyor names	Survey area	Survey Date	Survey miles	Survey minutes	Bird detections
K Finley, J Vail, T Noel	Halsey East	1997/07/14	26*	90	0
W & T Logan	Waldo Hills	1997/07/14	35	120	2
T Buerger	Dayton South	1997/07/14	19	90	5
K Viste- Sparkman	Sublimity	1997/07/14	51	90	9
M Platt	Greenberry	1997/07/14	15	85	3
D Budeau, B&J Morrow, J&N Collete, D&R Myers	EE Wilson	1997/07/14	9	95	3
W & C Logan	Fern Ridge West	1997/07/14	35	90	0
R Gerig	Monmouth East	1997/07/14	42	90	6
N Wagen, M Southard	Ingram Island	1997/07/14	20	80	0
S Kohlman	American Bottom	1997/07/14	13	225	8
R Keister	Ward Butte	1997/07/15	84	95	3
A Smith, C Loomis	Lebanon East	1997/07/14	35	77	0
D Wilson, H Brunkel	Airlie	1997/07/14	38	120	0
M A Sohlstrom, N Dietric	Carlton West	1997/07/14	20	85	0
R Green, L Hammond	Monroe West	1997/07/14	19	90	4
D Pederson	Stayton West	1997/07/14	28	85	0
H &C Heinkel	Turner	1997/07/10	34	90	0
K Merrifield	Finley NWR	1997/07/14	27	65	0
B & D Gleason	Pleasant Hill	1997/07/14	38	90	0
W High	Salem East	1997/07/14	36	86	0
R & D Titus	Peoria East	1997/07/14	40	110	0
A Cornwell, D Gutcher	Stayton South	1997/07/14	42	130	2
T Murtagh	Marquam	1997/07/14	20	100	0
R Wise	Cox Butte	1997/07/14	23	85	0
N Holcomb	Peterson Butte	1997/07/14	13	90	0
B Castillo, M Bishop	Alvadore	1997/07/14	21	95	0
D Irish	Harrisburg West	1997/07/14	23	90	0
G & A Ansell	Smith Loop	1997/07/14	34	75	0
D Lay, L Graves	Fern Ridge South	1997/07/14	35	90	0
A Drew, J Scheitzer	Basket Slough NWR	1997/07/14	28	94	0
J Fleischer	Albany East	1997/07/14	30	87	0
S Baker, L Mosley	Cloverdale	1997/07/14	50	85	0
G Hostick	Oakville	1997/07/14	29	135	0
B Shoffner	Molalla	1997/07/14	20	100	1
T &A Mickel	Fisher Butte	1997/07/15	23	100	5
P Graff	Priceboro Rd	1997/07/14	21	90	0
B Campbell & L Glines	Coburg	1997/07/14	21*	110	0
M Ratzlaff	Harrisburg East	1997/07/14	23	66	0
Total			1120	3670	51
Average			28.7	94.1	
	*mileage N/A so average used				

1st Nite

0
3
6
8
5
4
6
4
3
1
4
2
2
4
2
1
9
2
4

all nites

Riverside Dr