# VEGETATION HETEROGENEITY INDICATORS FOR SPRAGUE'S PIPIT (*Anthus spragueii*) HABITAT ON NATIVE PRAIRIE MANAGED BY LIVESTOCK GRAZING

**PRELIMINARY**

Photo Credit: Kevin Ellis, Wildlife Conservation Society

**RANCHERS STEWARDSHIP ALLIANCE, Inc.**

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## EXECUTIVE SUMMARY

The Sprague's Pipit (*Anthus spragueii*) is a small ground-nesting grassland bird whose range in Saskatchewan includes the mixed-grass, moist mixed-grass and Aspen Parkland ecoregions. Sprague's Pipit is listed as Threatened in Canada under Schedule 1 of the Species at Risk Act. The goals of the 2008 Recovery Plan are to increase and maintain population size and distribution at the 1980-89 levels. Sprague's Pipit require native prairie with certain habitat quality traits for their life cycle.

This project reviews the large volume of scientific literature and anecdotal information regarding Sprague's Pipit habitat requirements and indicators for their abundance in the Northern Great Plains. The project examines the information and breaks it down into characteristics that can be assessed or evaluated at the landscape, pasture, paddock and patch-sized scales. Range condition and vegetation volume have shown to provide strong correlation with Sprague's Pipit abundance. Other indicators of carry-over (standing dead and residual cover), litter and vegetation height are also important indicators. Patch size is also an important factor.

The vegetation heterogeneity index proposed for Sprague's Pipit is:

**Vegetation Heterogeneity Index for Sprague's Pipit = Patchiness* Patch Density**

Where patchiness is made up of:

**Patchiness = Vegetation Height + Litter + Carry Over**

In areas with potential Sprague's Pipit habitat, managing patches of native prairie for a range of suitable vegetation height (15-30 cm), litter (> 400 kg/ha), and carry-over (>40%) should result in increased attractiveness of the native prairie to Sprague's Pipit.

## ACKNOWLEDGEMENTS

The author would like to thank the following people for their recommendations, suggestions and insight into Sprague's Pipit habitat requirements and the development of vegetation heterogeneity indicators for Sprague's Pipit: Stephen Davis, Brenda Dale, Ryan Fisher, Darcy Henderson and Candace Neufeld (Canadian Wildlife Service, Environment Canada), Etienne Soulodre (Water Security Agency), Allison Henderson (University of Saskatchewan), Joseph Kotlar (Nature Conservancy of Canada), Sue Michalsky (Ranchers Stewardship Alliance, Inc) and Kim Good (Miistakis Institute for the Rockies). There is a plethora of scientific and anecdotal information regarding Sprague's Pipit required sorting through the information to determine the best factors to use for this project.

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**PRELIMINARY**

## 1. Sprague's Pipit and Its Habitat Requirements

The Sprague's Pipit (*Anthus spragueii*) is a small ground-nesting grassland obligate bird that breeds in native prairie. It's range in Canada is from the foothills of the Rocky Mountains in southern and central Alberta to southwestern Manitoba and south to southern Montana, northern South Dakota, and northwestern Minnesota (Environment Canada, 2008). The range in Saskatchewan includes the mixed-grass, moist mixed-grass and Aspen Parkland ecoregions. This grassland bird breeds in native prairie habitats (Robbins and Dale 1999) and may utilize non-native tame forage areas where the structure of the vegetation is similar to native vegetation (Dale et al., 1997; Sutter and Brigham, 1998; Davis and Duncan, 1999).

Sprague's Pipit is listed as Threatened in Canada under Schedule 1 of the Species at Risk Act (Government of Canada, 2014). The 2008 Recovery Plan set goals to increase and maintain population size and distribution at or above the 1980–1989 levels and to prevent further loss and degradation of native prairie within its historic range (Environment Canada, 2008).

Sprague's Pipits prefer dry, open grasslands with very low shrub cover for breeding habitat (Robbins and Dale 1999). Medium grass height and litter depth are preferential at nest sites (Davis et al. 1996). Their breeding habitat is also used as foraging habitat. Sprague's Pipits run or walk to forage and therefore avoid dense litter that can be difficult to move through (Robbins and Dale 1999, Madden et al. 2000). Their nests are built out of medium length dried grasses (litter) and often have a dome over top made of live grasses around the nest (Robbins and Dale 1999). The territorial range for Sprague's Pipit is approximately 2 ha (~5 acres) in size (Davis, pers. com.).

Sprague's Pipit habitat preferences are represented in Figure 1 and are summarized below (refer to Table 1 for detailed information).

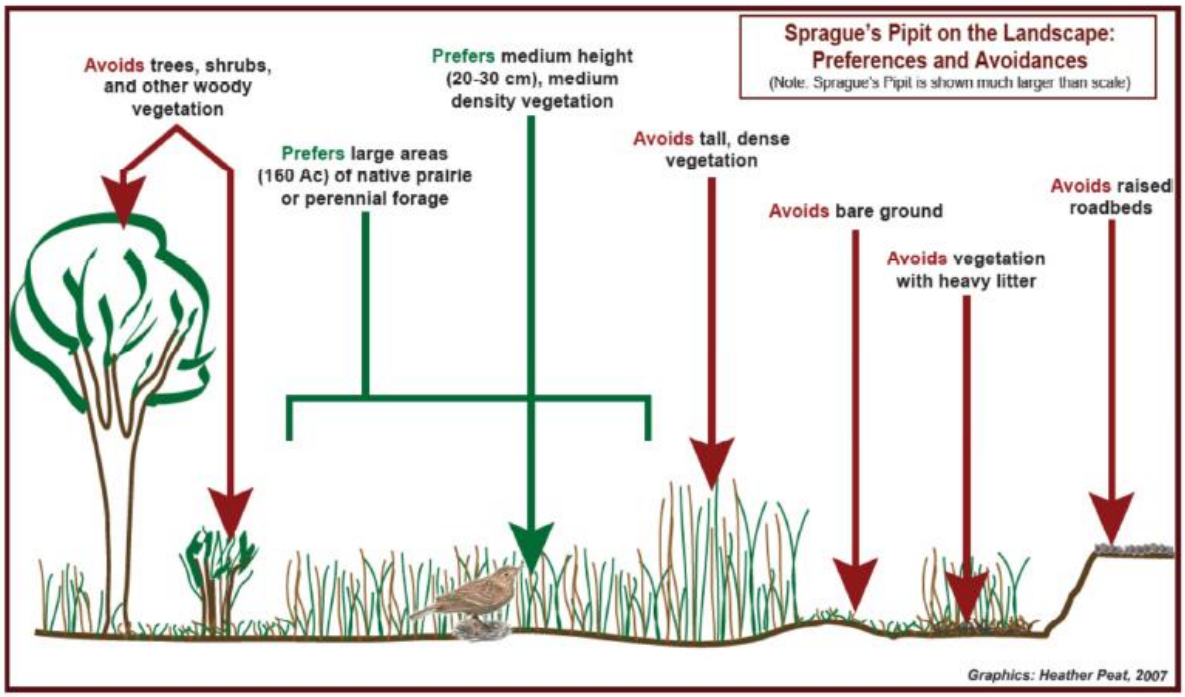


Figure 1. Habitat Requirements of Sprague's Pipit on the Landscape (CEC, 2013).

Sprague's Pipits prefer native prairie habitats that are:

- Large blocks of habitat (>145 ha),
- Flat to gently rolling terrain, and
- Fine to medium textured soils.

Sprague's Pipits prefer native prairie vegetation managed with a goal of:

- Medium vegetation height (10–30 cm),
- Good standing dead vegetation (carry-over) (>35%), and
- Good litter cover (>400 kg/ha volume; >0.8 cm depth).

Sprague's Pipits tend to avoid areas with:

- Native prairie less than 64 hectares in size
- Trees and shrubs (>20% shrub density),
- Tall dense vegetation (>45cm height; >10 cm visual obstruction),
- Bare ground (>30%),
- Heavy litter,
- Presence of invasive species,
- Fragmented with cropland (<500 m to cropped areas),
- High occurrence of wetland and livestock water development, and
- Linear disturbances associated with roads, trails and pipeline right-of-ways.

Sprague's Pipits tend to respond well to grazing management practices that:

- Result in Good to Excellent range condition,
- Large paddock sizes,
- Late to mid-season grazing
- Low to moderate grazing intensities,
- Low to moderate stock densities, and
- Reduced number of water developments.

Sprague's Pipits requires habitat characteristics at the landscape, pasture, paddock and patch-size scales (outlined in Table 1). Characteristics include geomorphology, vegetation community structure, and management type indicators. Thresholds were developed for each characteristic based upon literature review and discussion with various experts. Many of these thresholds are general estimates and need to be further refined with existing datasets and further monitoring of the species.

At the landscape scale, Sprague's Pipit select large blocks of native prairie habitat in landscapes dominated by native prairie (Henderson, 2014). Minimum habitat size is 64 hectares (Davis, 2004) with greatest preference for blocks >2,590 hectares (Henderson, 2014). Sprague's Pipits are more common on landscapes that are dominated by fine to medium textured soils than coarse, thin or solonetzic soil types (Dale, pers. com.), however the thresholds for soil type have not been determined. Flat to gently rolling topography is preferential over rolling and steep slopes (Dale and Davis, pers. comm.); the thresholds for topography have not been determined.

At the pasture scale, Sprague's Pipit select for habitat block sizes that are a minimum of 64 hectares and most suitable at greater than 314 hectares (Davis, 2004). Pastures located further from crop land (minimum 500 meters, greatest >1,250 meters) tend to be more attractive for the species (Koper et al., 2009). Topography, at the pasture scale, is also an influence with flat and gently rolling lands being more preferential (Davis and Dale, pers. com.). Shrub and tree densities have an impact; thresholds for density and distribution have not been determined. Anecdotally, the threshold for shrubs is a density of 20 to 25% (Davis, pers. com.).

The grazing unit / paddock scale is where Sprague's Pipit make the finer scale habitat selection for breeding and nesting. The geomorphological characteristics of range ecosite (clay and loam are preferential over gravel, sandy, solonetzic and thin range ecosites) (Dale pers. com.) and the amount and type of wetlands (Dale, pers. com.) affect the attractiveness of a paddock. The vegetation characteristics of bare soil (<30%), carry-over / standing dead grass (>35%) (Fisher and Davis, 2011) litter volume (>400 kg/ha) (Henderson, 2014), litter depth (>0.8 cm) (Fisher and Davis, 2011), and plant height (10-30 cm) (Fisher and Davis, 2011) provide the most suitable habitat. Grazing management that promotes large paddocks with mid to late season grazing (Dale, pers. com.), reduced number of watering sites (Dale, pers. com.), low to moderate grazing rates (Sliwinski, 2011) and an overall Good to Excellent range condition (Davis et al., I*n Press*) appear to increase habitat attractiveness.

Within a paddock / grazing unit, there can be patchiness of different habitat types for Sprague's Pipits from nesting sites, breeding sites, and foraging sites.

Table 1: Probably of Occurrence of Sprague's Pipit in Suitable Habitat at Landscape, Pasture and Paddock Scales Based upon Various Characteristics

| Characteristics | Probability of Occurrence | | | Outside Normal Range | Reference |
|---|---|---|---|---|---|
| | High | Moderate | Reduced | | |
| **Landscape Scale** | | | | | |
| **Geomorphology** | | | | | |
| **Dominant Soil Type** | Fine Textured Soil (e.g. Clay) | Medium Textured Soils (e.g. Loam) | Medium-Course Textured Soils (e.g. Sandy-Loam) | Coarse Textured (e.g. Sand and Gravelly), Solonetzic, Thin | Dale pers. com. |
| **Topography** | Flat to Slightly Rolling | Gently Rolling | Rolling | Steep Slopes | Davis pers. com.; Dale pers. com |
| **Vegetation Communities** | | | | | |
| **Native Habitat Block Size** | >2,590 ha | 314 – 2,590 ha | 64-314 ha | <64 ha | Davis 2004; Henderson 2014 |
| **Native Habitat Amount** | >75% | 50-75% | 35-50% | <35% | Various sources |
| **Pasture Scale** | | | | | |
| **Distance to Cropland** | >1,250 m | 750 – 1,250 m | 500 – 750 m | <500 m | Koper et al 2009 |
| **Pasture Size** | >314 ha | 146 - 314 ha | 64 – 145 ha | <64 ha | Davis 2004 |
| **Topography** | Flat to Slightly Rolling | Gently Rolling | Rolling | Steep Slopes | Davis pers. com.; Dale pers. com |
| **Paddock Scale** | | | | | |
| **Geomorphology** | | | | | |
| **Ecosite / Range Site** | Clay (Fine Textured Soil) | Loam (Medium Textured Soils) | Sandy Loam (Medium-Course Textured Soils) | Sand and Gravelly (Course Textured Soils), Solonetzic, Thin | Dale pers com. |
| **Vegetation Community** | | | | | |
| **Bare Soil** | 10-20% | 20-30% | 30-40%, 0-10% | >40% | Fisher and Davis 2011 |
| **Shrub Densities** | <10% | 10 - 20% | >20-25% | >25% | Davis pers. com |
| **Vegetation Characteristics** | | | | | |
| **Carry-Over / Standing Dead** | >60% | 40-60% | 20-40% | <20% | Fisher and Davis 2011 |
| **Litter (volume)** | >600 kg/ha | 400 – 600 kg/ha | 200 – 400 kg/ha | <200 kg/ha | Henderson 2014 |
| **Litter Depth** | >1.0 cm | 0.9 - 1.0 cm | 0.8 – 0.9 cm | <0.8 cm | Fisher and Davis 2011 |
| **Vegetation Height** | 20-25 cm | 15-20 cm, 25-30 cm | 10-15 cm; 30-35 cm | <10 cm; >35 cm | Fisher and Davis 2011 |
| **Vegetation Volume (Robel)** | >25 $cm^3$ | 20-25 $cm^3$ | 18-20 $cm^3$ | <18 $cm^3$ | Henderson 2014 |
| **Visual Obstruction** | 5 – 8 cm | 8 - 9 cm | 9 – 10 cm | >10 cm | Madden et al. 2000 |
| **Range Management Monitoring** | | | | | |
| **Range Condition** | Excellent (75-100%) | Good (High) (63%-74%) | Good (Low) (50-62%) | Fair (25-49%) Poor (0-24%) | Davis et al 2014 |
| **Rangeland Health** | Not An Indicator | Not An Indicator | Not An Indicator | Not An Indicator | Henderson 2014 |
| **Grazing Management** | | | | | |
| **Distance to Water Sources** | >450 m | 300 – 450 m | 150 - 300 m | <150 m | Koper et al. 2011 |
| **Season of Grazing** | Late Season | Mid-season | Early Season | | Dale pers. comm. |
| **Stocking Rate** | Lower (20%) than Recommended Stocking Rate for Ecosite based on Condition/Health | Recommended Stocking Rate for Ecosite based on Condition/Health | Higher (20%) than Recommended Stocking Rate for Ecosite based on Condition/Health | | Modified from Sliwinski 2011 |

## 2. Vegetation Heterogeneity of Native Prairie

Heterogeneity is defined as the uneven, non-random distribution of objects. This contrasts with homogeneity and the arrangement of objects that are spatially configured in a particular way (Forman, 1995). Heterogeneity of native prairie is created through variability in vegetation stature, composition, density, and biomass (Fudelforf and Engle, 2001). This heterogeneity influences species diversity, variations in wildlife habitat, and ecosystem function (Christensen 1997, Wiens 1997, Bailey et al. 1998, cited by Fudelforf and Engle 2001). Native prairie is heterogeneous at multiple scales with variability in composition, productivity, and diversity (Ludwig and Tongway 1995, Patten and Ellis 1995, Fuhlendorf and Smeins 1999, cited by Fudelforf and Engle 2001).

Disturbance is an event that significantly alters the variation pattern in the structure or function of an ecosystem. Both a high and a low disturbance frequency may decrease heterogeneity resulting in more homogeneity, whereas an intermediate disturbance frequency may create more heterogeneity (Forman, 1995). Historically, grazing and fire were natural disturbances that affected the physical environment and maintained the biodiversity on the Northern Great Plains. Disturbances are events that change landscapes, ecosystems, communities, populations, species, genetics, resources, and the physical environment. Disturbances initiate and alter succession in communities by changing composition, structure, and function at many scales (Romo, 2007).

Traditional range management practices were developed to create homogenous landscapes to maximize and sustain livestock production through decreasing the heterogeneity of native prairie by favoring the most productive and palatable forage species for livestock (Fudelforf and Engle, 2001). Grazing of native prairie has focused largely on distribution of grazing through time and space and grazing intensity (stocking rate). Range management tools of stock densities, paddock size, fence placement, rotational grazing, development and location of watering systems, and distribution of salt blocks have been implemented to aid in utilization of native prairie.

Range management practices that increase vegetation heterogeneity can provide positive outcomes for grassland birds by increasing the variability in vegetation structure and/or composition (Dernier et al., 2009) and increase habitat for both grazing-intolerant and grazing dependent bird species (Saab et al. 1995, cited by Dernier et al., 2009). Management techniques can increase plant community heterogeneity or patchiness in species composition as well as vegetation structure through increased spatial variation in abiotic and biotic factors (Pickett and White, 1985; cited by Gross and Romo, 2010). Heterogeneity in species composition in grassland communities is balanced by different types and frequencies of disturbance (Collins 1992; cited by Gross and Romo, 2010). Spatial heterogeneity in species composition is increased through the variation in timing of disturbance (Whittaker and Levin, 1977; cited by Gross and Romo, 2010).

Heterogeneity can be created at the pasture and grazing unit / paddock scale (Dernier et al., 2009). Pasture scale heterogeneity is applied to the entire pasture, with the goal of creating substantial differences in vegetation structure among paddocks within a larger management unit.

The pasture-scale approach may include varying techniques including grazing intensities (none, light, moderate, heavy, very heavy), seasons (winter, spring, summer, fall), and/or grazing animals (sheep, goats, cattle, or some combination) among paddocks to alter the structure of vegetation within a given pasture. The conservation and management objectives established will indicate the techniques used. A benefit of altering paddock scale heterogeneity is minimizing negative ecological consequences over the entire pasture by localizing impacts spatially to targeted locations and temporally because these patches can be moved within a pasture each year. Paddock scale heterogeneity can be used to manipulate heterogeneity characteristics for different species since many grassland birds require a mosaic of habitat patches.

In mixed-grass and moist mixed-grass ecoregions of Saskatchewan, Bai et al, (2001) found that grazing can be used to manipulate heterogeneity. Grazing regimes that maintain good range condition also maintain species and structural diversity of grasslands. Structural parameters, such as the cover, height, or thickness of standing plants (live or dead) and litter, increased with range condition especially from good to excellent. Grazing altered the structure of grassland vegetation with live vegetation height reduced both by moderate and heavy grazing, but not by light grazing. Litter cover and accumulation was reduced by grazing and bare soil surface also tended to increase with grazing. The total cover of live vegetation, the cover of litter, the height of live vegetation and standing dead materials, and the thickness of litter increased with range condition.

## 3. Vegetation Heterogeneity and Grassland Bird Species

Extensive research has been conducted on habitat heterogeneity requirements for waterfowl in the Northern Great Plains (Greenwood et al., 1995; Klett et al., 1988). Waterfowl habitat managers have developed a suite of programs and habitat management methodology to create suitable habitat requirements across landscapes of the Northern Great Plains to meet the heterogeneity requirements for various waterfowl species. A large scale heterogeneity project is underway at Grasslands National Park, studying grazing induced heterogeneity and its effects at various scales and on various species (Henderson, 2006; Henderson, D. pers. com).

Grazing can be used to improve wildlife habitat through altering vegetation composition, increase productivity of selected species, increase nutritive value of forage, and altering structure to increase diversity in habitat (Severson and Urness, 1994. Dernier et al. (2009) proposed that using livestock to alter vegetation structure for grassland bird habitat is feasible in terms of application by ranchers and land managers within the context of current livestock operations. Many grassland birds require a mosaic of habitat patches to complete their breeding requirements and that paddock scale management might often be appropriate. The lack of information on the optimal size, distribution, and juxtaposition of habitat patches for individual species across the landscape is a limiting factor in successfully utilizing livestock to reach heterogeneity-based management objectives.

Fritcher (2004) found that seral stage was an effective predictor of density for many grassland birds. Birds with habitat requirements for tall vegetation and residual cover were more abundant in later seral stages. The author recommended a mosaic that includes all seral stages is necessary to maximize grassland bird species diversity and abundance across the landscape.

Patchiness can be manipulated by increased selectiveness by livestock through low stock densities (Fuhlendorft and Smeins, 1999). Low to moderate grazing density, during the active growing season, would result in the greatest heterogeneity in vegetation patch structure within a landscape (Henderson, 2006).

Grassland bird species require a gradient of vegetation structure from relatively undisturbed, taller-structured vegetation to very short structure (Figure 2; Knopf, 1996). Widespread use of moderate grazing intensities has reduced availability of suitable habitat structure for many grassland birds at the extremes of the vegetation structure gradient. Grazing management can be implemented to create the level of disturbance and vegetation structure required for a target species or a suite of species. Sprague's Pipits require light to moderate grazing intensities that result in medium to tall vegetation structure (Figure 2; Knopf, 1996). This type of management also benefits other grassland bird species including Baird's Sparrow, Chestnut-collared Larkspur, and Lark Bunting.

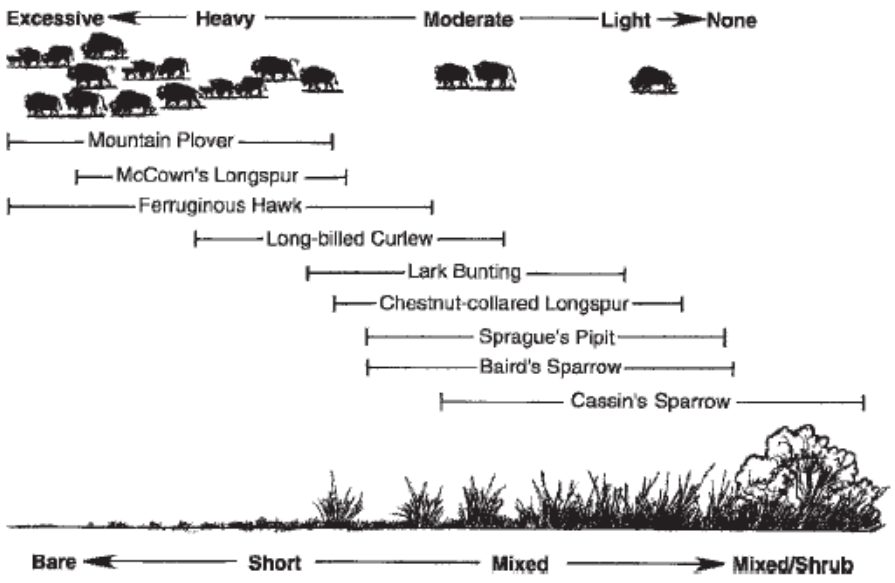


Figure 2. Responses of grassland birds in shortgrass steppe to a vegetation structure gradient (Knopf, 1996)

Relative abundance of Sprague's Pipit is least effected by low to moderate grazing intensities, but severely affected by high grazing intensity (Figure 3, Romo, 2007). Western Meadowlark and Savannah Sparrow respond similarly. Management objectives established for one bird species may provide benefits for other grassland birds.

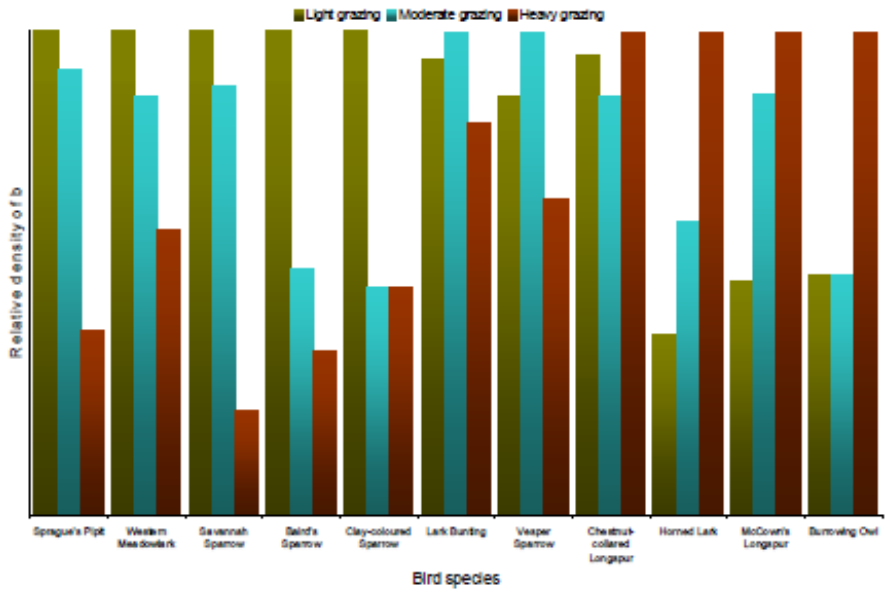


Figure 3. Birds on the Northern Great Plains and the effects of grazing intensity on their relative abundance (Romo, 2007 adapted from Kantrud and Kologiski, 1982).

## 4. Vegetation Heterogeneity Indictors for Sprague's Pipit

### a. Range Condition as an Indicator for Sprague's Pipit Habitat

Range Condition (Abougendia, 1990) has been used as an indicator for vegetation heterogeneity (Bai et al, 2001) and grassland bird suitability (Fritcher et al., 2004). Davis et. al., (*In Press*) found that range condition strongly influenced Sprague's Pipit at the pasture level, while vegetation structure had no influence. Sprague's Pipit increased in abundance as range condition increased. Abundance was the highest in high-Good (65-74% score) to low-Excellent (75%-85% score) condition (Figure 4).

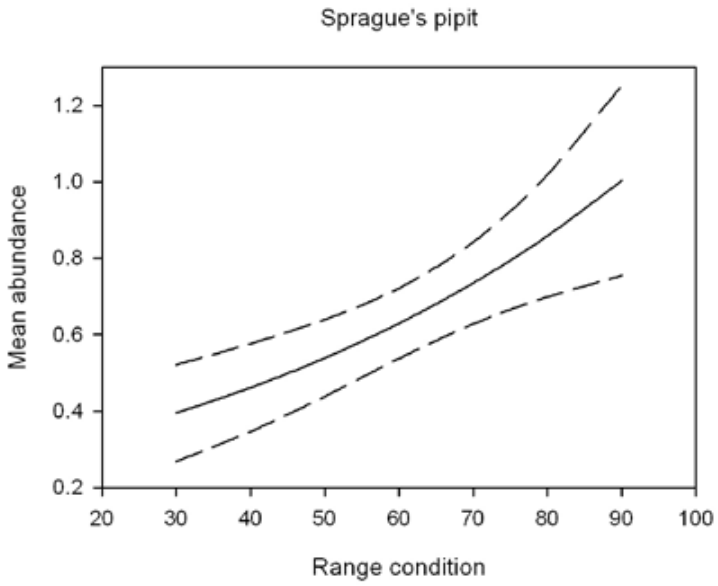


Figure 4. Influence of range condition on the abundance of four grassland passerines (including Sprague's Pipit) at count points (Davis et al., *In Press*).

For singing males (Davis et al, In Press), Excellent range condition (>75% score) provided the best overall conditions for their habitat requirements, with high Good condition (65-74%) capturing 75-90% of the number of singing males (Figure 5).

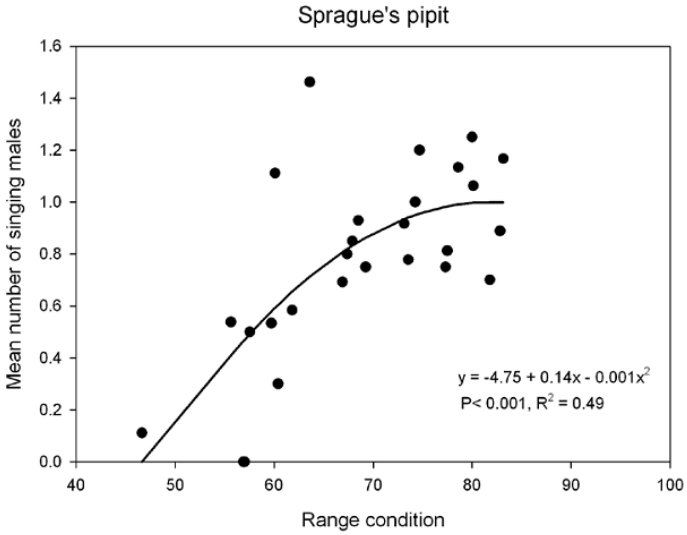


Figure 5. Relationship between Sprague's Pipit (singing males) abundance and range condition at the pasture level. (Davis et al., *In Press*)

Henderson and Davis (2014) found that range health (Saskatchewan PCAP, 2008) was not a good predictor of Sprague's Pipit habitat suitability. The authors felt that the weighting of the categories towards vegetation community and the broad ranges for litter component prevented the monitoring assessment criteria from providing the detail required to assess grassland bird habitat.

Davis (pers. com.) suggested that residual cover could be a driver for Sprague's Pipit habitat. As range condition increased, residual cover increased while bare soil decreased (Davis, unpublished data).

Davis (pers. com.) and Dale (pers. com.) both highly recommend range condition as an indicator for Sprague's Pipit habitat suitability. Excellent range condition (75-100%) provides greater than 80% of the mean abundance of Sprague's Pipit. Good range condition (50% - 74%) provides 50 to 80% of the mean abundance with the upwards standard deviation of 60 to 90% (Davis et al., In Press).

Table 2. Range Condition Thresholds at the Pasture and Paddock Scale for Sprague's Pipit

| Range Condition Thresholds for Sprague's Pipit Probability of Abundance at the Pasture Scale | |
|---|---|
| **Probability of Abundance** | **Range Condition** |
| Excellent | Excellent (75-100%) |
| Good | High Good (63-74%) |
| Fair | Low Good (50-62%) |
| Poor | Fair (25-49%); Poor (0-24%) |

For the purposes of vegetation heterogeneity indictors, range condition does not meet the requirements. Range condition does provide a measure and indicator of management objectives for land management / grazing management at both the paddock and pasture scale and should be considered for that.

### b. Anecdotal Vegetation Heterogeneity Indictor

The development of visual indicators to represent the habitat requirements for Sprague's Pipit will help ranchers and land managers visualize how the paddock and pasture should appear with grazing management. Anecdotally, the ability to hide a football in native prairie or a tame forage stand during the nesting season was an indicator of the habitat heterogeneity requirements for nesting Mallards (Grilz, pers. experience). This analogy was used by land managers at Ducks Unlimited Canada when assessing dense nesting cover and native prairie for Mallard habitat enhancements and management. It was an effective communication tool and a good visual representation of the vegetation heterogeneity requirements of the species.

A baseball could be used to represent a Sprague's Pipit when examining habitat suitability. A Sprague's Pipit develops its nest through ground scraping and places a grass cover dome over its nest (Davis, pers. com). Due to this "hunkered down" nesting style, an object the size of baseball may work to create a visual representation. This concept needs to be field tested in habitat that has Sprague's Pipit present and Sprague's Pipit absent to determine if it is a valid indictor (Davis, pers. com.).

To use this concept, you can walk through a paddock, looking for places where baseball can be placed. After placing the baseball in the grass (or throwing it randomly), back away four meters and determine if you can spot the baseball. The baseball should be partially to fully-obscured for the patch to be considered suitable for Sprague's Pipit.

From a heterogeneity perspective, the ability to hide the baseball is not required across the entire paddock. Suitable patches across 25-50% of the area could be considered fair, 50-75% could be considered good, and >75% would be considered excellent suitable habitat for Sprague's Pipit. See Figure 13 for a representation of what the various patch densities represent.

### c. Within Paddock Scale (Patch) Indicators for Vegetation Heterogeneity for Sprague's Pipit

#### i. Standing Dead / Carry Over

In native prairie, Sprague's Pipit nests are positively associated with standing dead vegetation (Figure 6) (Fisher and Davis, 2011). As the amount of dead vegetation increases, the probability of use increased. The amount of residual cover from the previous year is a strong indicator of Sprague's Pipit habitat suitability (Davis, pers. com.). In the spring, the birds appear to be attracted to those areas with the residual cover to set up their breeding and nesting territories.

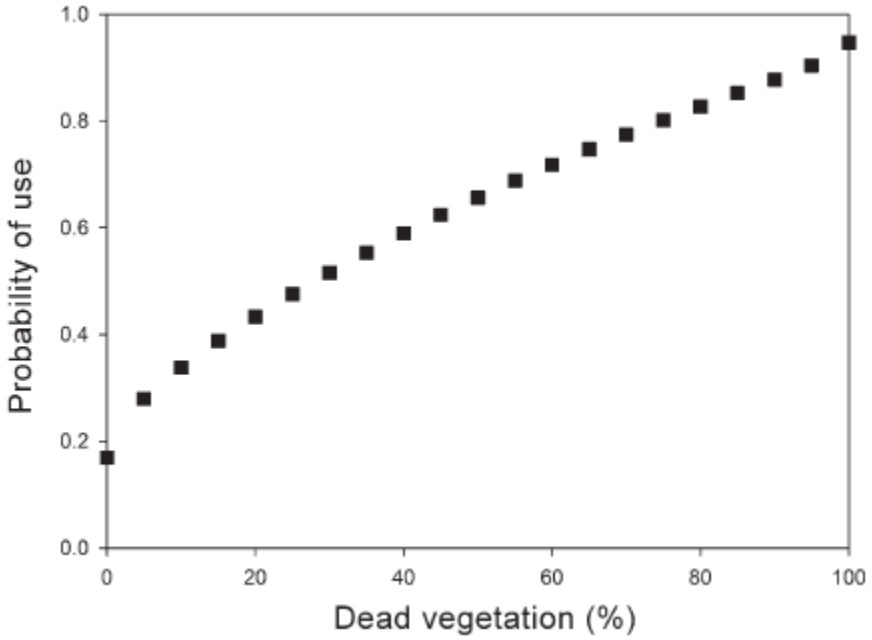


Figure 6. Probability of Sprague's Pipit nest use in native pastures based on estimates of dead vegetation (Fisher and Davis, 2011)

The range of use of dead vegetation in native prairie at the territory scale is 55 – 90% dead vegetation with random sites ranging from 50-90% (Figure 7). For nest sites, dead vegetation ranged from 45-75% with the random sites ranging from 25-65%.

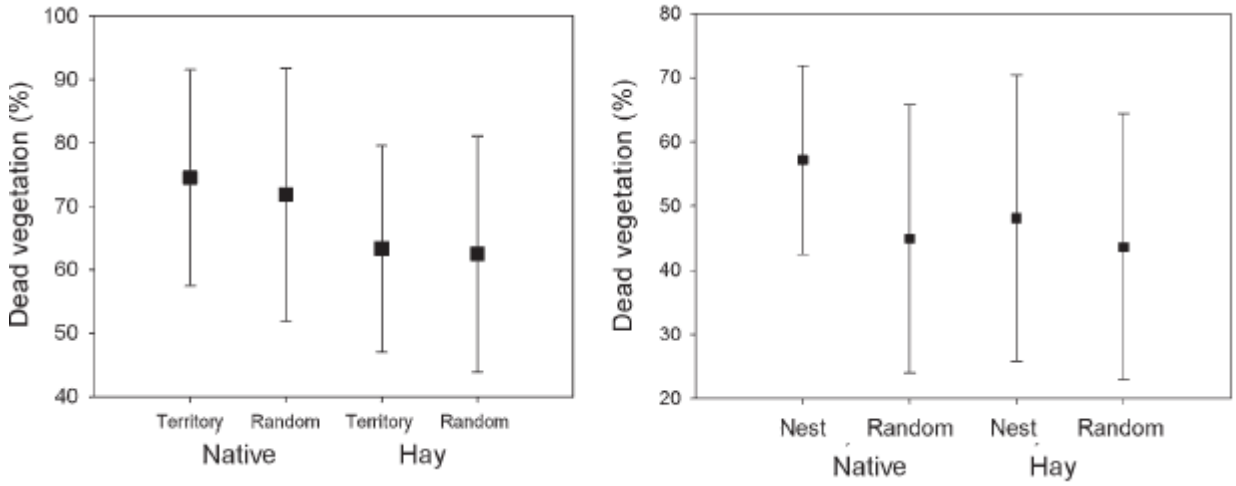


Figure 7. Mean dead vegetation measured at Sprague's Pipit nest with random sites and territories with random sites in native pastures and hay fields (Fisher and Davis, 2011).

In developing vegetation heterogeneity indicators, dead vegetation / carry over was determined to be a variable for indicating Sprague's Pipit abundance. Excellent probability of use with dead vegetation is greater than 60%, with good use at 40-60% (Table 3). Poor use is classified as <20% dead vegetation

Table 3. Dead Vegetation / Carry-Over Thresholds for Sprague's Pipit

| **Standing Dead / Carry Over Thresholds for Sprague's Pipit Probability of Occurrence at the Patch Scale** | |
|---|---|
| **Probability of Occurrence** | **% Standing Dead / % Carry Over** |
| Excellent | >60% |
| Good | 40 – 60% |
| Fair | 20 – 40% |
| Poor | <20% |

### ii. Vegetation Height

Sprague's Pipits prefer to build their nests in areas with 25-30 cm vegetation height in native prairie (Figure 8). Suitable vegetation height of 20-30 cm is important for attracting them to native prairie (Fisher and Davis, 2011). Range of vegetation heights for nesting sites is 15-30 cm and for foraging and breeding use from 12 cm to 35 cm.

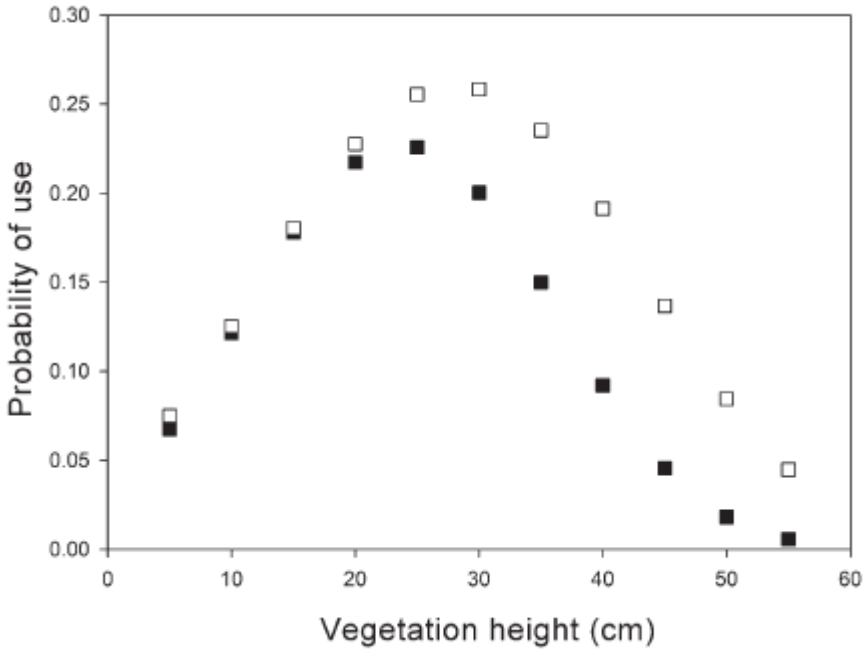


Figure 8. Probability of Sprague's Pipit nest use in native pastures (filled squares) and hay fields (open squares) based on estimates of vegetation height (Fisher and Davis, 2011)

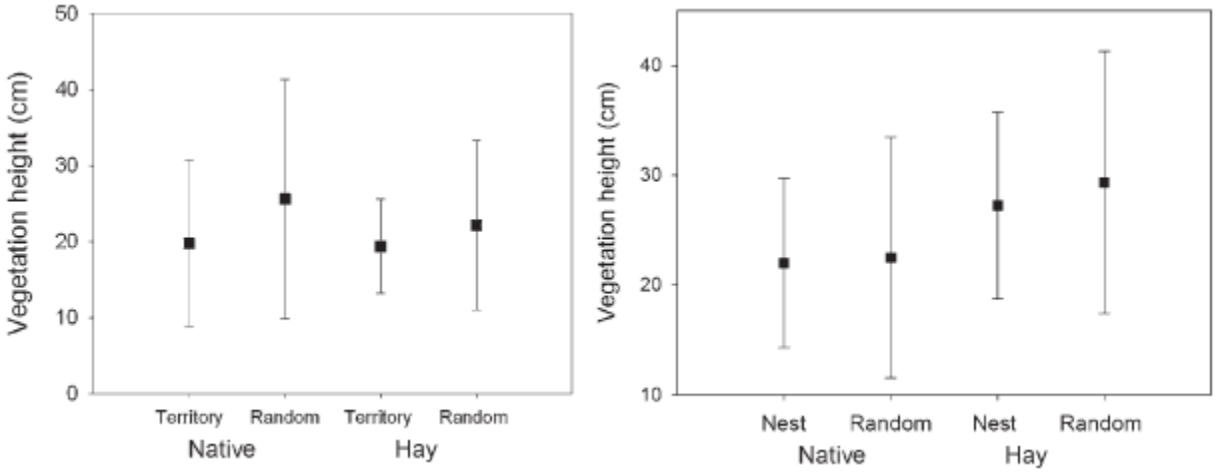


Figure 9. Mean vegetation height measured at Sprague's Pipit nest with random sites and territories with random sites in native pastures and hay fields (Fisher and Davis, 2011).

In developing vegetation heterogeneity indicators, vegetation height was determined to be a variable for indicating Sprague's Pipit abundance. Excellent probability of use is in a vegetation height range of 20-25 cm, with good use at 15-20 cm and 25-30 cm (Table 4). Poor use is classified as grass height less than 10 cm or greater than 35 cm. Figure 10 provides a visual representation of various grassland vegetation heights.

Table 4. Vegetation Height Thresholds for Sprague's Pipit

| **Vegetation Height Thresholds for Sprague's Pipit Probability of Use at the Patch Scale** | |
|---|---|
| **Probability of Use** | **Vegetation Height** |
| Excellent | 20-25 cm |
| Good | 15-20 cm; 25-30 cm |
| Fair | 10-15 cm; 30-35 cm |
| Poor | <10 cm; >35 cm |

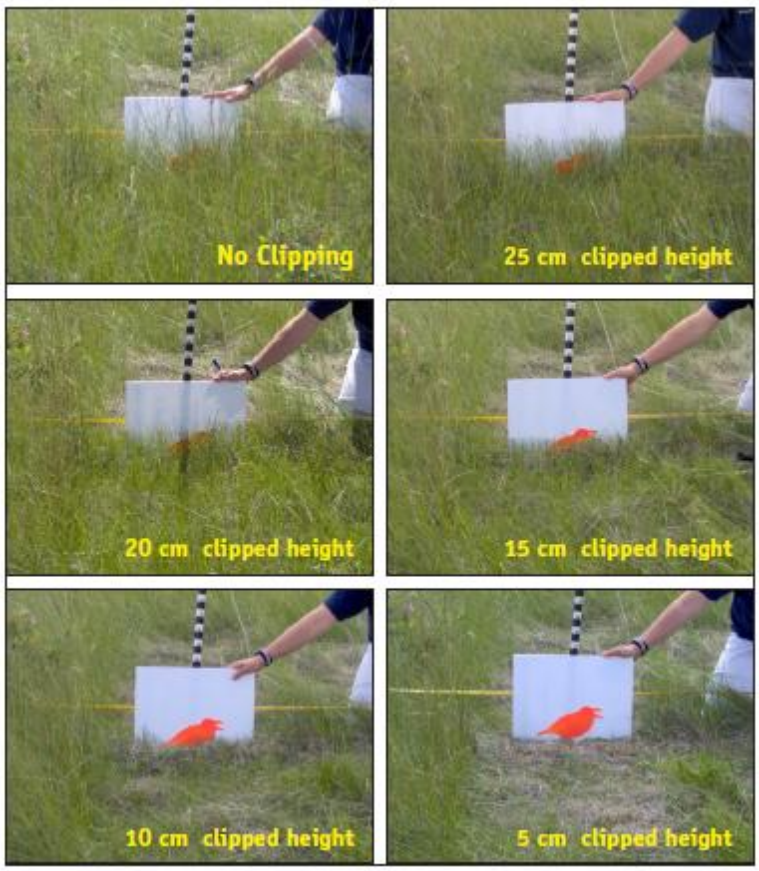


Figure 10. Visual representation for grassland vegetation height used for nesting bird cover (Haddow et al., 2013)

### iii. Litter

Litter depth (Fisher and Davis, 2011) and volume (Henderson and Davis, 2014) are strong indicators of Sprague's Pipit use (Figure 11). Henderson (2014) found a linear relationship with Sprague's Pipit abundance and the amount of litter volumes. The threshold for litter volume is unknown and needs to be examined (Davis, pers. com.).

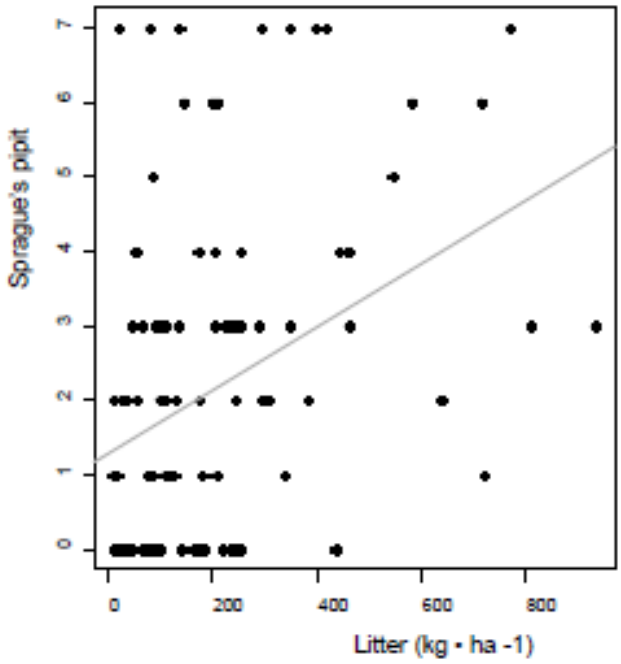


Figure 11. Litter volume and its relationship with Sprague's Pipit abundance (Henderson, 2014)

In developing vegetation heterogeneity indicators, litter volume was determined to be a variable for indicating Sprague's Pipit abundance. Excellent probability of use is in a litter volume of >600 kg/ha, with good use at 400-600 kg/ha (Table 5). Poor use is classified as litter volume less than 200 kg/ha. Figure 12 provides a visual representation of litter volume.

Table 5. Litter Volume Thresholds for Sprague's Pipit

| Litter Volume Thresholds for Sprague's Pipit Probability of Occurrence | | |
|---|---|---|
| **Probability of Occurrence** | **Litter Volume (kg/ha)** | **Litter Volume (lb/ac)** |
| Excellent | >600 kg/ha | >535 lb/ac |
| Good | 400-600 kg/ha | 355 – 535 lb/ac |
| Fair | 200-400 kg/ha | 180 – 355 lb/ac |
| Poor | <200 kg/ha | <180 lb/ac |

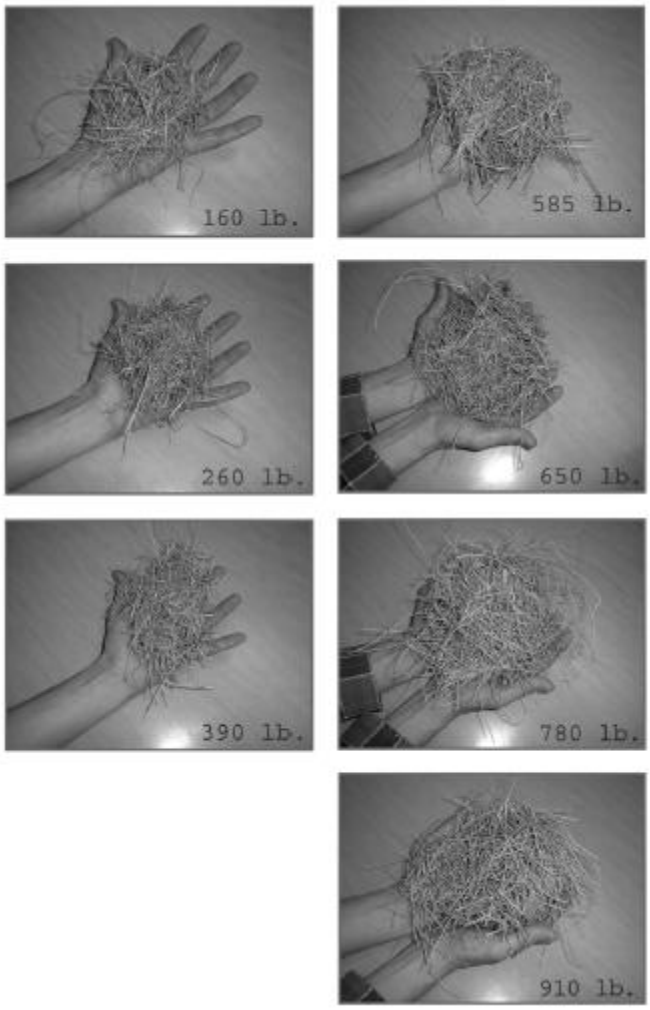


Figure 12. Visual representation of litter normals for native grasslands (from Saskatchewan PCAP, 2008).

### iv. Patch Size and Density

Sprague's Pipit territories occupy 2 ha (~5 acres) in size (Davis, pers.com). In developing these indices, it was determined that patch size and density of suitable Sprague's Pipit habitat (good to excellent ranked vegetation height, litter, and carry-over) is an important factor. Patches of a minimum size of 2 ha, containing good to excellent ranked cover (vegetation height, litter and carry-over) should be estimated across the paddock. Figure 13 provides a representation of what various patch density thresholds may look like. If the area contains >75% of good to excellent cover, it should be ranked excellent for patchiness (Table 6). Good patchiness is 50-75% of the area being good cover and poor is under 25%.

Table 6. Patch Density Thresholds at the Paddock Scale for Sprague's Pipit Habitat

| **Patch Density Thresholds for Sprague's Pipit Probability of Occurrence at the Paddock Scale** | |
|---|---|
| **Probability of Occurrence** | **Patch Density of the Paddock** |
| Excellent | >75% |
| Good | 50 - 74% |
| Fair | 25 - 49% |
| Poor | <25% |

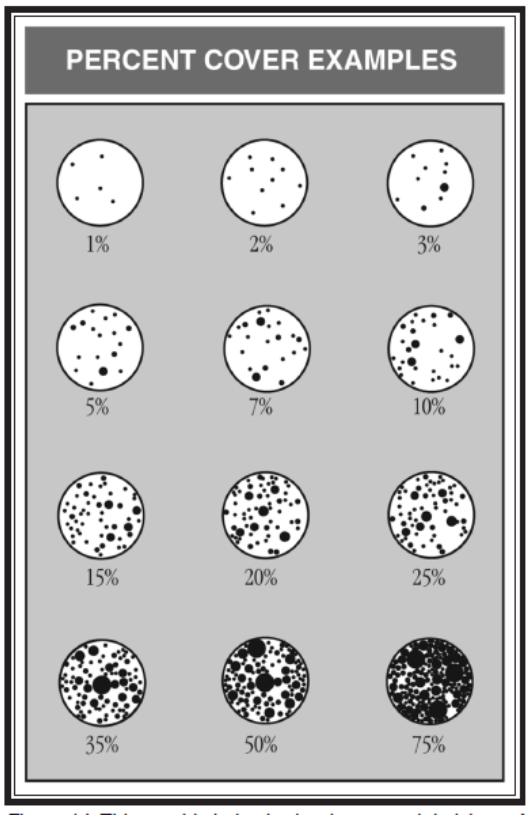


Figure 13. Graphic used to develop an image of what various densities of patches represent on a landscape (from Saskatchewan PCAP, 2009).

## 5. Vegetation Heterogeneity Indices for Sprague's Pipit

The vegetation heterogeneity indices for Sprague's Pipit were designed by the desire to create an index that could be used by ranchers and land managers. The index was designed that it could be visually assessed while conducting normal land management operations. The index can also be conducted empirically when required.

Vegetation volume was recommended to be considered as an indicator in the index (Soulodre, pers. com.; A. Henderson, pers. com.). Vegetation volume was rejected because volume is difficult to quantify visually and would require the use of measurement devices such as a Robel Pole (Robel et al., 1970). Range Condition (Abougendia, 1990) was strongly recommended to be used as an indicator (Dale, pers. com., Davis, pers. com.; Soulodre, pers. com). Range condition was rejected because it requires detailed assessments being conducted with knowledge of plant identification. Range condition is typically conducted on a 5 to 10 year cycle because it measures shifts in vegetation community composition. This assessment method is a strong indicator at the pasture and paddock scale, but difficult to assess at a patch scale.

The vegetation heterogeneity index proposed for Sprague's Pipit is:

**Vegetation Heterogeneity Index for Sprague's Pipit = Patchiness* Patch Density**

Where patchiness is made up of:

**Patchiness = Vegetation Height + Litter + Carry Over**

A calculation score sheet, for Vegetation Heterogeneity Index is located in Table 7.

Table 7. Vegetation Heterogeneity Index for Sprague's Pipit Score Sheet.

| Vegetation Heterogeneity Index for Sprague's Pipit | | | | |
|---|---|---|---|---|
| **Patchiness Score** | | | | |
| **Criteria** | **Ranking** | **Range** | **Ranks** | **Score** |
| **Vegetation Height** | Excellent | 20-25 cm | 6 | |
| | Good | 15-20 cm; 25-30 cm | 4 | |
| | Fair | 10-15 cm; 30-35 cm | 2 | |
| | Poor | <10 cm; >35 cm | 0 | |
| **Litter Volume** | Excellent | >535 lb/ac | 6 | |
| | Good | 355 – 535 lb/ac | 4 | |
| | Fair | 180 – 355 lb/ac | 2 | |
| | Poor | <180 lb/ac | 0 | |
| **Standing Dead / Carry Over** | Excellent | >60% | 6 | |
| | Good | 40 – 60% | 4 | |
| | Fair | 20 – 40% | 2 | |
| | Poor | <20% | 0 | |
| **Patchiness Score Total** | | | | |
| **Patch Density Score** | | | | |
| **Criteria** | **Ranking** | **Range** | **Scores** | **Score** |
| **Patch Density** | Excellent | >75% of Area has Suitable Patches | 12 | |
| | Good | 50-74% of Area has Suitable Patches | 8 | |
| | Fair | 25-49% of Area has Suitable Patches | 4 | |
| | Poor | <25% of Area has Suitable Patches | 0 | |
| **Patchiness Score Total** | | | | |
| **Vegetation Heterogeneity Index Score (Patchiness Score * Patch Density Score)** | | | | |
| **Vegetation Heterogeneity Index Rank** | | | | |

Table 8. Vegetation Heterogeneity Index Rankings

| Vegetation Heterogeneity Index for Sprague's Pipit | |
|---|---|
| **VHI Score**<br>**Patchiness (Veg Height + Litter + Carry Over) * Patch Density** | **Vegetation Heterogeneity Index Rank** |
| 162-216 | Excellent |
| 108-161 | Good |
| 54-107 | Fair |
| 0-53 | Poor |

## 6. Additional Research Requirements

For the last 30 years, grassland birds, including Sprague's Pipit have been extensively studied across the Northern Great Plains. Extensive datasets have been collected and various characteristics on habitat requirements have been analyzed and published. The potential exists to further refine the heterogeneity requirements of Sprague's Pipits by analyzing the various datasets that are available. Some of the recommended analysis includes:

1) Thresholds for litter depth and litter volume (Davis, pers. com.)
2) Thresholds for bare soil (Davis, pers. com.)
3) Thresholds for shrubs density and distribution patterns (Davis, pers. com)
4) Thresholds for wetland density and wetland type (Dale, pers. com.)
5) Thresholds for topography and slope characteristics (Davis, pers. com)
6) Relating range site / ecosite to habitat selection (Dale, pers. com.)
7) Relating range site / ecosite to specific parameters of litter and vegetation height requirements (Soulodre, pers. com.)
8) Test the use of a baseball as an indicator for potential Sprague's Pipit habitat quality
9) Determine litter volume measurement thresholds to modify range health assessment criteria to capture Sprague's pipit and other grassland bird requirements (A. Henderson, pers. com.)
10) Analyze Grasslands National Park, Biodiversity and Grazing Management Area study (BGMA) research data to determine variables for heterogeneity requirements (D. Henderson, pers. com.)

Brenda Dale (pers. com.) is currently analyzing datasets for Sprague's Pipit associations with range sites / ecosites. This analysis will begin in spring 2014 and should be complete by fall 2014.

Dr. A. Henderson (pers. comm.) recommends revising the range health assessment criteria (Thorpe, 2007) for Saskatchewan to incorporate finer scale categories for litter and Robel pole (vegetation volume) measures. The current criteria are to coarse scale to be of value for grassland bird indictors (Henderson, 2014). This additional category and modification to the litter category could be modified to provide indicators for Sprague's Pipit and other grassland bird habitat.

Dr. D. Henderson (pers. comm.) recommends that the data collected during the extensive Grasslands National Park Biodiversity and Grazing Management Area (BGMA) project (Henderson, 2006) could be analyzed to provide site specific heterogeneity requirements for Sprague's Pipit and other grassland birds. Dr. Koper from the University of Manitoba was the research lead on this project with Dr. D. Henderson being a co-researcher and project designer. Dr. D. Henderson suggests that a Master's research project could be developed utilizing this dataset and others to fine tune heterogeneity requirements at various scales.

## 7. Management Implications

Ideal landscapes for Sprague's Pipit habitat include flat to gently rolling topography, on fine textured range sites, within large blocks of native grassland. Steep slopes and hummocky topography have reduced attractiveness for Sprague's Pipit due to limitations including reduced litter accumulation, reduced vegetative growth on south facing slopes, and increased presence of shrubs on north facing slopes. Coarser soils tend to have increased shrubs and reduced vegetative growth.

Within the landscape, large pastures with low to moderate shrub densities and limited livestock water sources provide the most suitable habitat. Pastures managed through low to moderate stock densities with large paddocks that result in good to excellent range condition. Moderate grass height with good carry-over of standing dead grass and a good litter component provide habitat that could maximize Sprague's abundance. These vegetation characteristics can be managed for within a patch (2 hectares, ~5 acres). The more patches within a grazing unit / paddock with these desired vegetation characteristics will provide more suitable habitat for Sprague's Pipit in its range.

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