Guide to Managing for Optimal Habitat Attributes:

Chestnut-Collared Longspur
(Calcarius ornatus)

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Many sources of information were used in compiling this document including expert opinions and both published and unpublished literature. References used in compiling this review are provided.

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Front cover photo: Gerrit Vyn.

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ABOUT THIS GUIDE

A New Approach to Managing For Species At Risk

The intent of this guide is to determine site and landscape-scale habitat features that are optimal for species at risk at different life stages, as well as important non-habitat-related beneficial management practices. As habitat for species at risk declines and threats to populations increase in jurisdictions outside Canada, it becomes critical to provide optimal conditions on what habitat remains if we are to conserve or recover a species.

This First Approximation of the guide for Chestnut-collared Longspur should be considered a living or dynamic document that will continually evolve. As our knowledge of prairie species at risk improves with research and monitoring, this guide will need to be periodically revisited and updated.

Who Should Use This Guide?

Most grassland species at risk in Saskatchewan exist on working agricultural lands that most often support grazing livestock and sometimes support annual or perennial crops. This guide provides habitat targets and non-habitat-related beneficial management practices (BMPs) for land managers who may have the opportunity to aid in the conservation of species at risk on the land under their control. Additionally, the habitat targets and BMPs may be used by conservation organizations in designing results-based agreements with land managers.

The Environmental Benefit Index is designed to be used by any stakeholder to prioritize sites and/or projects for conservation and recovery programs, or by land managers to evaluate the value of their property for a single species.

How to Use This Guide

This guide is presented in two parts. The first part summarizes the important spatial and temporal needs of the species and presents habitat targets and non-habitat related BMPs. Habitat targets are presented at two major spatial scales: landscape and site. Landscape scale habitat targets are those attributes that an individual opts for when choosing a breeding location or home range. These targets are often land cover or topography-related, but may also include such factors as whether or not there are other individuals of the same species already in the area. Site scale targets are those attributes that the individual prefers at a certain time (e.g., breeding, brood rearing, hunting or foraging) or in a certain portion of their home range. Site habitat targets are most commonly physical vegetation, water, soil and/or topography parameters, but may also include such attributes as configuration of land cover, block size, or presence/absence of human infrastructure, among others. The rationale for each target or BMP is also provided so land managers can readily understand the relationship between the target and use of habitat by the species.

Guides have been prepared for individual species. Habitat targets for individual species give the land manager information about the species they could benefit. Managing for a single species may result in habitat that is undesirable for another species. Conflicts between species are addressed in the Environmental Benefit Index.

The second part of the guide presents an index (Environmental Benefit Index) that places values on the habitat targets and BMPs in combination with other considerations. An Environmental Benefit Index (EBI) is a compound index that considers multiple environmental factors when determining an ecological outcome. EBIs can be used to evaluate and prioritize opportunities for conservation programs. An EBI is of considerable importance in determining priority sites to invest in, particularly when funds are limited.

The overall goal of the EBIs for species-at-risk habitat is to ensure maximum environmental value for an investment in results-based conservation programming. The EBI has several potential uses including:

- To geographically target the most important locations;
- To evaluate and rank candidate properties or projects for their environmental benefit;
- To rank the environmental benefit of candidate properties or projects by cost (or bid);
- To evaluate projects over time to determine if environmental values are being improved or maintained, or to evaluate the efficiency of the investment over time.

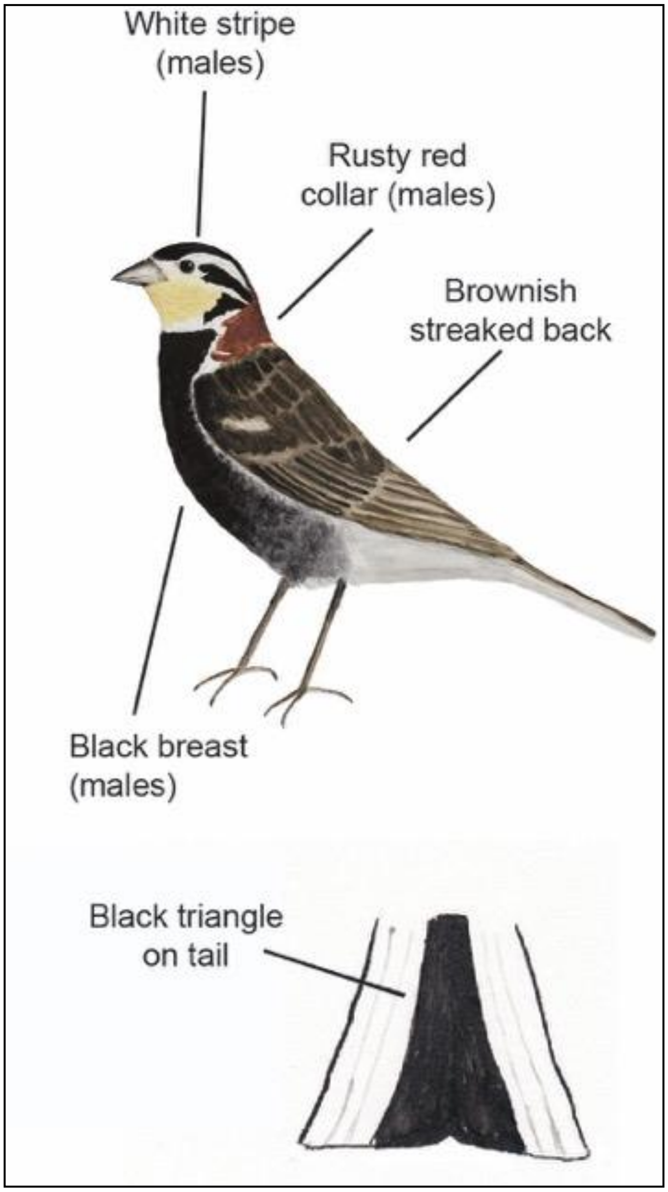
EBIs were identified as a method to target programming and prioritize participation in the design of the Prairie Beef & Biodiversity program (Commission for Environmental Cooperation, 2013). EBIs were subsequently developed for the Greater Sage-Grouse (Ranchers Stewardship Alliance Inc., 2014), Piping Plover (PCAP SK, 2017), Burrowing Owl (PCAP SK, unpublished), Northern Leopard Frog (PCAP SK, 2018a), and Loggerhead Shrike (PCAP SK, 2018b).

Chestnut-collared Longspur Identification

Size - Length: 6" (15 cm), Wingspan: 10.5" (27 cm)

Features - **Male:** Black cap and chest; white line above eye; chestnut collar on back of neck; streaked back; tail has dark triangle in an otherwise white tail.

Female: Streaked and unremarkable except for dark triangle in white tail.



Similar species – Breeding male is distinct from most other grassland birds except the McCown's Longspur male. A McCown's male, while lacking the chestnut collar and having black restricted to a chest patch, also has a black and white tail. Males of both species spread their tail feathers in an aerial song flight but the McCown's flies higher in his display and the white in the tail is so extensive that the black is reduced to an inverted "T" in contrast to the Chestnut-collared Longspur's black triangle. The female is similar to a number of grassland birds.

Song – Short, musical, and similar to the song of a Western Meadowlark; often given in a short flight with spread tail feathers.

To help identify birds by sound, you can visit the following websites to listen to audio clips of their songs:

Nature Instruct - *www.natureinstruct.org/*

Cornell Online Guide to Birds - *www.allaboutbirds.org*

Xeno-Canto worldwide birdsong database– *www.xeno-canto-org*

Where Do Chestnut-collared Longspurs Live?

Chestnut-collared Longspur is an endemic grassland specialist which has suffered severe population declines (as much as 90%) since the late 1960s. Results of several recent surveys suggest that the population declines continue. Once considered a relatively common grassland bird, the Chestnut-collared Longspur is now considered rare throughout its entire range. Canada represents about 35% of its breeding range and is thought to support about 22% of the continental population. Range contractions have occurred in both the US and Canada. In Canada, population declines are greater in the Aspen Parkland Ecoregion, due to declining habitat suitability, than in the grassland ecoregions, resulting in a shift in range to the south and west. Figure 1 shows habitat suitability for Chestnut-collared Longspur in Saskatchewan.

Behaviour and Habitat Use in Canada

Chestnut-collared Longspurs breed in the Mixed-grass, Moist Mixed-grass, Fescue Grassland and Aspen Parkland ecoregions of the northern Great Plains including Alberta, Saskatchewan, and Manitoba.

The breeding territory for nesting, foraging and hunting commonly ranges from approximately 0.4 to 1.0 ha. Territories up to 4 ha in size may occur in marginal habitat. Selection of territories may be influenced by soil moisture or soil temperature.

Chestnut-collared Longspurs forage by walking on the ground and picking up insects and seeds. During nesting, their diet is entirely insects (mainly grasshoppers). In summer, their diet is roughly 75% insects and 25% seeds. During migration and in their winter habitat, their diet is entirely or mainly seeds.

In general, the nests (a scrape in ground lined with fine grasses) are in areas of sparse vegetation, but the actual nest site has more cover and less bare ground than is generally available in the vicinity. Nests are often established near intact, dried out pats of cattle manure, or pasture sage plants either to help hide the nest or to reduce the variability of the nest microclimate. Nest orientation to the southeast is preferred.

A typical clutch is 3 - 5 eggs. The species is considered double-brooded and will attempt up to four clutches in a breeding season in the event of nest failures. Eggs are incubated for 10 - 13 days. Nestlings stay in the nest and are fed by both parents for about 10 days. Young leave the nest and continue to be fed by both parents for at least 2 weeks until they can fly and forage for themselves.

These summer residents use grasslands with low growing and sparse vegetation, with low litter levels and some bare ground (Figure 2). They avoid areas smaller than about 18 ha and are lower in abundance near grassland edges particularly where pastures border cropland. They also prefer areas with no trees and very low shrub cover. They are more abundant on native grassland than tame hayland or cropland. They may occur in similar or greater densities in tame pasture, but reproductive success is lower.

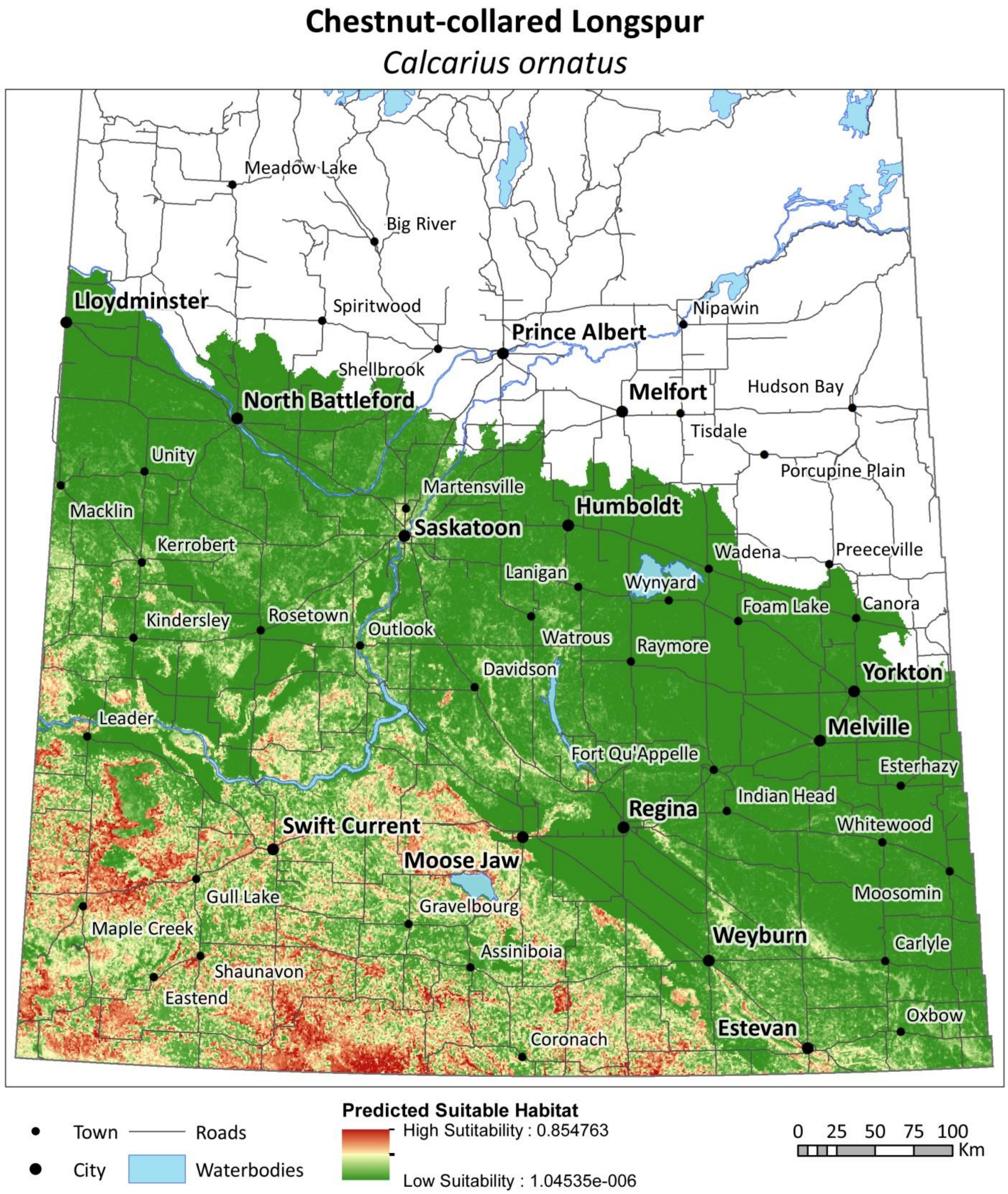


Figure 1. Distribution map of habitat suitability for Chestnut-collared Longspur (Saskatchewan Conservation Data Centre, 2019). This map is not intended to be a definitive statement on the presence, absence or status of a species within a given area, nor as a substitute for onsite surveys. Models predict if a species might occur in areas based on characteristics of the landscape and species observations.

They are often the most common bird species on large tracts of grazed native rangelands. As a result, maintaining native rangeland pastures, especially in Fair to Good range condition, is beneficial to the sustainability of Chestnut-collared Longspur populations.

Chestnut-collared Longspurs are quite sensitive to abrupt changes in vegetation structure. This edge habitat occurs in places such as interfaces between native grassland and other types of land cover, along roadsides, around gas wells and in riparian areas adjacent to wetlands and other water bodies.

Chestnut-collared Longspurs tend to avoid infrastructure associated with natural gas extraction, roads, above-ground utility lines and wind turbines. In some cases, such as in areas of higher shallow gas well density, productivity is negatively affected. Chestnut-collared Longspurs are considered acoustically sensitive and avoid unpredictable or loud noises as well as cyclic, rhythmic noises (e.g., noise from oil wells). In situations where they do not avoid infrastructure, they may experience an increase in physiological stress.

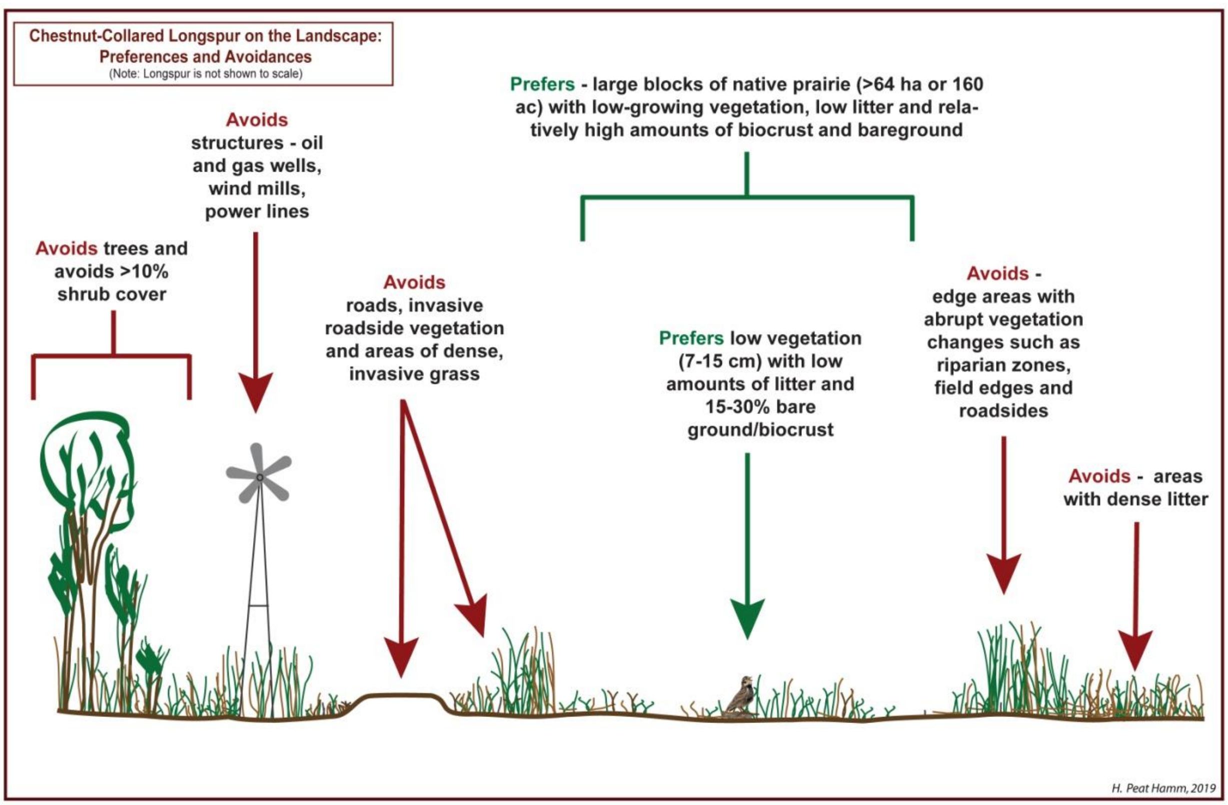


Figure 2. Habitat Diagram for Chestnut-collared Longspur (Peat Hamm, H. 2019).

Threats to Chestnut-collared Longspur in Canada

Chestnut-collared Longspur was historically common across the Great Plains of North America. It suffered declines stemming primarily from the loss and degradation of both breeding and overwintering habitat. Over 75% of native grassland in the Chestnut-collared Longspur's breeding range has been eliminated since the 1800s, mainly through conversion to cropland or urban development.

HABITAT LOSS AND DEGRADATION

Activities that remove or fragment native grassland cover, or alter the desired structural characteristics, are deleterious to the abundance and/ or productivity of Chestnut-collared Longspur.

Loss of native grassland is detrimental because Chestnut-collared Longspurs are rare or absent in crops and do not normally nest on cultivated land. In general, Chestnut-collared Longspur numbers decline as the amount of grassland on the landscape declines. Occurrences in crop or stubble fields are thought to be related mainly to resting or foraging during migration. Reproductive success is also known to be low in haylands and tame grassland.

Habitat loss and fragmentation may eliminate or degrade suitable habitat and reduce productivity by reducing block size and increasing the amount of edge. Chestnut-collared Longspurs tend to avoid habitat edges (e.g., cropland boundaries or roadsides) where vegetation structure changes abruptly. Replacement or invasion of native grassland by tame grasses can reduce abundance and productivity of Chestnut-collared Longspurs.

INFRASTRUCTURE

Transportation, utility and energy infrastructure and activities may reduce either abundance or productivity of Chestnut-collared Longspur in their vicinity.

Studies have not shown a clear pattern on the response of Chestnut-collared Longspur abundance to road disturbances. Some studies have shown that Chestnut-collared Longspur avoid using or nesting near roads or decline with road or disturbance footprint while others found no effect, or even a positive effect. Given their preference for short, sparse vegetation, they may be avoiding the dense vegetation found in ditches. Nest productivity has been shown to be lower near roads, with fewer offspring fledged and those surviving offspring fledged at an older age.

Abundance, clutch size, and nesting success of Chestnut-collared Longspurs have been shown to be negatively affected by proximity to infrastructure and density of gas wells. However, there is some spatial and/or temporal variability in their response that is not yet well understood. Chestnut-collared Longspur abundance is lower near gas wells and declines as gas well densities increase. Research shows mixed results for productivity of Chestnut-collared Longspur in the vicinity of gas wells, although this may be related to well density as one study found productivity declined as gas well density increased.

While Chestnut-collared Longspurs do not appear to avoid oil infrastructure itself, they are an acoustically sensitive species, avoiding unpredictable loud noises as well as rhythmic, chronic noise (such as the noise coming from oil wells). They also tend to avoid tree-like infrastructure sometimes associated with energy development such as above-ground power lines and wind turbines. Research shows mixed results for productivity of Chestnut-collared Longspurs in the vicinity of oil infrastructure. One study found reduced parental care and productivity near oil wells and access roads. Recent research indicates that Chestnut-collared Longspurs experience physiological stress in the vicinity of oil wells.

One study, however, found that nest survival of Chestnut-collared Longspurs was higher near fences and pipelines possibly because populations of predators, such as Richardson's Ground Squirrel, were lower near these developments.

One recent study found that Chestnut-collared Longspurs had reduced abundance within 300 m of wind turbines. However, more research is required on the impacts of renewable energy infrastructure on Chestnut-collared Longspurs.

PREDATORS AND BROOD PARASITES

Vegetation and infrastructure that support predators and brood parasites reduce the productivity of Chestnut-collared Longspur.

Predation is the greatest cause of nest failure for Chestnut-collared Longspurs. Therefore, increases in predator abundance may be a threat. Known nest predators include Richardson's Ground Squirrel, Northern Grasshopper Mouse, American Badger, garter snakes, Northern Harrier and Swainson's Hawk. Suspected predators include Meadow Vole, Deer Mouse, Meadow Jumping Mouse, Harvest Mouse, Thirteen-lined Ground Squirrel, Coyote, Black-tailed Prairie Dog, Western Rattlesnake, Bull Snake, Short-eared Owl, Long-billed Curlew, Loggerhead Shrike, American Crow, Black-billed Magpie, Western Meadowlark, gulls, hawks, Red Fox, Striped Skunk, and Raccoon. Many of these predators benefit from human development such as buildings, shelterbelts and edge habitat, thus increasing the potential for predation of Chestnut-collared Longspurs.

The Brown-headed Cowbird is a brood parasite, laying its eggs in the nests of other bird species. Reported parasitism rates for Chestnut-collared Longspur nests range from 0 to 50%. However rates are commonly less than 20%. Cowbirds often use perches to watch the activities of host birds so that they can find their nests. The presence of perches such as fences, oil and gas infrastructure, shrubs and shelterbelts may consequently increase the probability of nest parasitism.

PESTICIDES

Chestnut-collared Longspurs may be susceptible to both direct and indirect effects of certain pesticides.

Chestnut-collared Longspurs eat seeds as a portion of their diet. Studies have identified direct toxic effects to Chestnut-collared Longspurs from various strengths of Chlorophacinone /strychnine used for rodent control on rangelands. The total number of unintended mortalities in songbirds may be considerable.

Chestnut-collared Longspur fatalities have been documented in insecticide field trials. Grassland songbirds are particularly vulnerable to grasshopper insecticides, as these birds eat primarily grasshoppers (often consuming some species considered to be pests) and beetles. It should be noted, however, that native and tame grasslands rarely receive insecticide applications.

OTHER

Woody Species Encroachment – Expansion of woody vegetation into grasslands is likely to reduce available habitat for Chestnut-collared Longspurs. This is most likely to occur in the Aspen Parkland, Moist Mixedgrass and Fescue Grassland ecoregions.

Invasive grasses- Invasion of exotic grasses or forbs with a shrub-like form, such as alfalfa into grasslands may reduce habitat quality or availability for Chestnut-collared Longspur. Even invasion of crested wheatgrass into native grassland has been shown to reduce Chestnut-collared Longspur abundance.

Renewable Energy – The large footprint of solar farms situated in grassland renders habitat unusable by endemic grassland birds. Wind turbines also have negative impacts on Chestnut-collared Longspurs by removing native grassland (estimated 1.23 ha per turbine) and causing a delayed avoidance reaction.

HABITAT REQUIREMENTS OF CHESTNUT-COLLARED LONGSPUR IN CANADA

Chestnut-collared Longspurs migrate north from their wintering range and arrive at their breeding range in Canada in mid-April through early May. The males arrive roughly two weeks before the females and select a breeding territory. Peak breeding season occurs from early May to mid-June. Egg-laying for the first clutch is commonly initiated in late May and peaks in early to mid-June. Chestnut-collared Longspurs are double-brooded and the second clutch is commonly initiated between early June to mid-July. They may re-nest up to four times in the event of nest failures. They leave their breeding range in Canada in mid- to late September and migrate south to overwinter in the southern United States (Arizona, New Mexico and Texas) and northern Mexico.

The critical dates related to the various habitats required by Chestnut-collared Longspur are listed in Table 1.

Table 1. Critical dates of habitat use by Chestnut-collared Longspur in Saskatchewan.

Life Stage	Critical dates for Chestnut-collared Longspurs in Saskatchewan
Breeding	Arrive in breeding grounds mid- to late April Peak breeding occurs early May to mid-June
Nesting	Late May to late July (includes more than one clutch)
Brood-rearing	Mid-June to mid-August(includes more than one clutch)

Landscape Scale Features Important to Chestnut-collared Longspurs

Recent studies suggest that large-scale factors (e.g. weather or land cover) which are generally not under the control of a single land manager are good predictors of habitat selection by Chestnut-collared Longspurs. Chestnut-collared Longspurs are thought to have relatively high site fidelity, returning to the same general area to breed each year. Land cover is the most important predictor of suitable habitat on a landscape scale, with increasing amounts of native or tame grassland being increasingly attractive to Chestnut-collared Longspur.

Preferred habitat features on the landscape scale include the following:

- Land cover of predominantly grassland within a 400 m radius of habitat block: >50% (>70% optimal).
- Topography - flat to gently rolling: <27% slope (<14% is optimal).
- Soil type – Solonetzic or loamy Chernozemic soils.
- Loam and Solonetzic ecosites in Saskatchewan.

- Little or no shrub (<20% cover), or tree cover (0%), 2m high or taller. Somewhat more than 20% shrub cover on the landscape may be tolerated if the shrub cover is clumped into dense and sparse patches rather than having uniform or diffuse distribution.

Site Characteristics of Chestnut-collared Longspur Habitat

Birds may select breeding sites based on a variety of signs such as resource availability, conspecific attraction and cues that suggest minimized predation.

Chestnut-collared Longspurs occur primarily in native grasslands but will use tame forages if the vegetation structure is suitable. They avoid native pastures modified by substantial amounts of tame grasses such as Kentucky bluegrass. Crested wheatgrass may be used but productivity is lower and it may act as a sink habitat. Hayland and cropland are rarely used by Chestnut-collared Longspurs.

They avoid areas of suitable habitat smaller than about 18 ha in extent and average abundance increases with block size.

Chestnut-collared Longspurs will tolerate a low density of scattered shrub, but anything more than sparse shrub is not attractive. They prefer low growing, sparse vegetation likely for ease of foraging, but also require some patches or clumps of moderately dense vegetation or cattle / bison manure to shelter nests. Tall, dense vegetation is generally not occupied by Chestnut-collared Longspurs.

Visual obstruction which influences shelter, foraging and hunting is an important site feature for Chestnut-collared Longspurs. They prefer relatively low visual obstruction. Visual obstruction, which is a measure of vegetation height and density, is comprised of both live and dead grasses. They also appear to prefer structural variability in the vegetation within their territory. Chestnut-collared Longspurs prefer relatively low residual cover and moderate cover of bare ground and biocrust (mosses, lichens and little club moss).

While Chestnut-collared Longspurs often prefer the vegetation structure provided by grazing, they select for grass species that decrease in response to grazing pressure. Chestnut-collared Longspurs prefer Fair to Good range condition at the site level. Rainfall has an overriding influence on vegetation structure, which in turn affects Chestnut-collared Longspur populations. For example, a moderately grazed pasture may attract longspurs in a normal rainfall year, but in a wet year, the birds may not be present because the vegetation height and density are too great. Conversely, in lightly grazed pastures, Chestnut-collared Longspurs may only be present in dry years. Adjusting grazing intensity to match vegetation density as influenced by rainfall can be beneficial to Chestnut-collared Longspurs.

Chestnut-collared Longspurs tend to avoid edge habitat, especially when the vegetation structure changes substantially. Studies have shown that they may avoid edge habitats such as roadsides, cropland borders, and wetland and water body boundaries.

They also may avoid or experience stress near natural gas and oil wells (particularly in developments with high densities of wells), roads, above-ground power lines and wind turbines. Recent research suggests that noise is one of the factors triggering physiological stress in Chestnut-collared Longspur in the vicinity of oil infrastructure.

Preferred habitat features on the site scale include the following:

- Blocks of suitable grassland a quarter section (64 ha or 160 acres) or larger in size are optimal; blocks of suitable grassland 18 ha (45 acres) to 64 ha (160 acres) are suboptimal.
- Native grassland with less than 15% cover of invasive tame forages is optimal; tame grassland or native grassland with more than 15% cover of invasive tame forages with vegetative structure similar to native grassland in the same ecoregion is suboptimal.
- No tree cover; and shrub cover <20% (<10% is optimal).
- Residual vegetation cover (represented by dead grass) 5 – 40% (15 – 30% optimal).
- Vegetation height 3 – 20 cm (7 – 15 cm is optimal).
- Visual obstruction 0 – 10 cm (2 - 7 cm optimal).
- Combined biocrust and bare soil cover <50% (15 - 30% optimal).
- Range condition Fair to Good is optimal.
- Habitat edges such as roadsides, cropland edges, gas wells and sometimes edges of riparian areas, wetlands and other water bodies > 200 m from suitable habitat block optimal (100 – 200 m suboptimal).
- Infrastructure such as oil wells, compressor stations and wind turbines >400 m from suitable habitat block.

Optimal habitat targets are listed in Table 2. Many of these habitat targets, particularly site scale targets, may be created through management of vegetation (e.g., timing of grazing, stocking rates, etc.). Management using controlled fire is only recommended in situations where the amount of woody vegetation or invasive grasses needs to be reduced. Chestnut-collared Longspurs are reliant on manure as nesting cover, and other management tools can be used to create more consistently suitable habitat. Chestnut-collared Longspur's consistent response to habitat structure created by grazing suggests that their distribution can be managed using livestock.

Table 2. Optimal habitat targets for Chestnut-collared Longspur at landscape and site scales.

HABITAT	HABITAT FEATURE	HABITAT TARGET
Landscape Scale Habitat	Land Cover	70 - 100% grassland within minimum 400 m radius of habitat block optimal; 50 - 70% grassland within minimum 400 m radius suboptimal
	Topography	Optimal slope <14% (8 degrees); suboptimal slope 15 – 27% (9 – 15 degrees)
	Soil Type	Solonetzic and loamy Chernozemic soils
	Woody Vegetation (2 m high and taller)	<20% shrub cover AND 0% tree cover
Site Scale Habitat	Ecosites	Loam; Solonetzic
	Block Size	>64 ha (160 ac) optimal; suboptimal 18 – 64 ha (45-160 ac)
	Plant Community	Native grassland with less than 15% cover of invasive tame forages is optimal; tame grassland with vegetation structure similar to native grassland in the same ecoregion or native grassland with more than 15% cover of invasive tame forages is suboptimal
	Shrub Cover	<10% optimal; 10 - 20% suboptimal
	Vegetation Height	7 – 15 cm optimal; 3 – 7 cm OR 15 – 20 cm suboptimal
	Visual Obstruction Reading[1]	2 – 7 cm optimal; 0 – 2 cm OR 7 – 10 cm suboptimal
	Residual (Dead) Grass Cover	15 – 30% optimal; 5 – 15% OR 30 – 40% suboptimal
	Combined Biocrust[2] and Bare Soil Cover	15 - 30% optimal; 5 – 15% OR 30 – 50% suboptimal
	Range Condition	Fair to Good optimal; Poor or Excellent suboptimal
	Habitat Edge	>200 m from edge is optimal; 100 – 200 m from edge is suboptimal
	Infrastructure	>400 m from infrastructure

[1] Visual Obstruction Reading is an index of vegetation height and density.
[2] Biocrust includes mosses, lichens and little club moss.

OTHER MANAGEMENT PRACTICES FOR CHESTNUT-COLLARED LONGSPUR

There are some management issues unrelated to the natural characteristics of the landscape or site that should be taken into consideration when managing to optimize habitat for Chestnut-collared Longspur. These beneficial management practices are as follows:

- Avoid the creation of roads. They may influence the density or productivity of birds.
- Avoid placing wind turbines, oil or gas wells, or large infrastructure such as compressor stations or solar farms within large blocks of native grassland. Encourage directional drilling from a single site rather than spaced wells.

ENVIRONMENTAL BENEFIT INDEX FOR CHESTNUT-COLLARED LONGSPUR HABITAT

Criteria and Scoring

The Environmental Benefit Index (EBI) was developed by compiling comprehensive categories of criteria based on available knowledge, such as Chestnut-collared Longspur population and habitat research, expert opinion and species recovery documents.

The EBI begins with five screening criteria. These criteria are either met, in which case the user continues to the next criterion, or not met, in which case the property or potential project is eliminated from further consideration. The remaining criteria are grouped into landscape and site scale habitat features.

A scoring system was devised for the EBI. Each criterion is weighted out of 600, 300, 200, or 100 based on relative importance to the species.

The total scores are calculated based on the following formula:

EBI= {(1)(2)(3)(4)(5)[(6.1+6.2)+(7.1+7.2+7.3+7.4+7.5+7.6+7.7+7.8+7.9+7.10+7.11)+(8)]}

The EBI result may then be divided by the costs of the proposed project or the bid for the project to determine cost effectiveness. The cost to achieve the habitat requirements could include added management, added infrastructure or inputs or lost opportunities.

The range of possible scores for candidates that pass the screening criteria is quite wide. The lowest possible total score is 500 and the highest possible score is 2700. When evaluating candidate properties for a project or program, it may be possible to divide the scores into more general High, Moderate and Low priorities. There are many uses for a general ranking. For example, a more general ranking could be used to determine the total cost of implementing results-based programming on all high priority sites.

SCREENING CRITERIA

1. The landscape is topographically flat or gently rolling with slopes <27% (15 degrees).
   Yes=1, No=0.

2. The landscape supports no tree cover, and <20% shrub cover, 2 m high or taller. If shrub cover is clumped rather than widespread, up to 25% can be tolerated.
   Yes=1, No=0.

3. The landscape is composed of at least 50% native and/or tame grassland within at least 400 m of, and including, the area of consideration. Native and tame grasslands are combined at the landscape scale because current remote sensing technology does not allow us to accurately distinguish between these two cover types. However, because of lower reproductive success in tame grasslands, a higher weighting is given to native grassland.
   Yes=1, No=0.

4. The area of consideration is greater than 18 ha (45 acres) in size.
   Yes=1, No=0.

5. The area of consideration is free of, and distant (>400m) from oil wells, major roads, wind turbines and large infrastructure such as compressor stations or solar farms.
   Yes=1, No=0.

LANDSCAPE SCALE HABITAT CRITERIA

6. Chestnut-collared Longspurs are thought to have relatively high site fidelity, often returning to the same general area to breed each year. This makes both landscape and site scale habitat suitability more critical to conservation of the species than if it had low site fidelity. Various risks and threats associated with Chestnut-collared Longspur recovery may be outside the decision-making capability of a single land manager, but because of location and proximity to certain landscape features, environmental benefits can be impacted.

   6.1. Land cover is the most critical landscape feature predicting potential habitat for Chestnut-collared Longspur. Generally, the more grassland a landscape supports, the more attractive it will be to Chestnut-collared Longspur. Grassland may be comprised of native vegetation or tame forages. These thresholds were derived from models using a 400 m radius, but this relationship has been measured up to 1492 km^2. Chestnut-collared Longspurs are sensitive to landscape scale grassland habitat amount even though suitable habitat might be locally available. **(Max 600 points)**

Land Cover

600	70 - 100% grassland within 400 m of, and within, the area of consideration
300	50 - 70% grassland within 400 m of, and within, the area of consideration

   6.2. Chestnut-collared Longspur prefer flat to gently rolling grassland. **(Max 300 points)**

Topography - Slope

300	Slopes mainly <14% (8 degrees)
200	Slopes mainly 15 – 27% (9 – 15 degrees)

SITE LEVEL CRITERIA

7. Site scale targets for Chestnut-collared Longspurs are those attributes that the individual prefers when selecting their home range or territory. They also include habitat attributes that maximize productivity of the species.

7.1. Chestnut-collared Longspurs select for a minimum patch of suitable habitat of about 18 ha (45 acres) in size, but are most abundant when that block size is a quarter section (64 ha/ 160 acres) or larger. Productivity of Chestnut-collared Longspurs has also been shown to increase with greater block size. **(Max points 200)**

Block Size

200	Area of consideration supports a minimum of 64 ha (160 acres) of continuous, suitable grassland habitat.
50	Area of consideration supports 18 - 64 ha (45 -160 acres) of continuous, suitable grassland habitat.

7.2. Reduced parental care of young has been measured up to at least 800m from oil wells in Chestnut-collared Longspurs.
(Max points 100)

Proximity to Oil Wells

100	Area of consideration is at least 800 m from any oil wells
0	Area of consideration is within 400 – 800 m from oil wells

7.3. Negative impacts to Chestnut-collared Longspurs have been measured up to 250m from natural gas wells.
(Max points 100)

Proximity to Natural Gas Wells

100	Area of consideration is > 250 m from any gas wells
0	Area of consideration <250 m from any gas wells

7.4. Chestnut-collared Longspurs will use native grassland and tame grassland pasture, but tend to avoid or have low productivity in hayland and cropland. The tame forages must have a comparable vegetative structure to native grassland to be used. For example, seeded crested wheatgrass pastures may be suitable, but grasslands dominated by smooth bromegrass would not. The preference of Chestnut-collared Longspurs is for native grassland and studies indicate that reproductive success of Chestnut-collared Longspur is higher in native pasture than tame pasture.

Chestnut-collared Longspurs perceive crested wheatgrass invasion of native grasslands as edge habitat to be avoided. Studies have found that the tolerance threshold is approximately 15% cover of crested wheatgrass in otherwise native grassland.
(Max points 100)

Habitat Quality – Type of Vegetation

100	Native grassland with <15% cover of tame forage invasion
50	Tame grasslands with similar structure to native grassland in the same ecoregion OR native grassland invaded by > 15% cover of tame forages
0	Tame pastures or hayland supporting tall grasses or dense shrub-like vegetation.

7.3. Chestnut-collared Longspurs can tolerate a few shrubs within their territories and may even use a low growing shrub for a singing perch. However, they tend to avoid areas where trees grow and where shrub cover is relatively high. This criterion includes woody vegetation of all heights.
(Max points 200)

Habitat Quality – Woody Vegetation

200	Tree cover = 0% AND shrub cover <10%
50	Tree cover = 0% AND shrub cover between 10 - 20%
0	Tree cover >0% OR shrub cover >20%

7.6. Residual vegetation would include litter, but is represented in this module by the measurement of dead grass (carry over). Percent foliar cover was measured using quadrats.
(Max points 100)

Habitat Quality – Residual Vegetation

100	Residual vegetation cover between 15 - 30%
50	Residual vegetation cover between 5 - 15% OR between 30 - 40%
0	Residual vegetation cover <5% OR >40%

7.7. Visual obstruction is one of the most important habitat features that attract Chestnut-collared Longspurs. Visual obstruction readings are a combined measurement of vegetation height and density. The values used here are measured using a Robel pole. Visual obstruction is a measurement that can be related to foraging efficiency for Chestnut-collared Longspurs. Lower visual obstruction is thought to enhance foraging efficiency, although dense vegetation often produces more insects. Chestnut-collared Longspurs avoid tall and dense vegetation and areas where vegetation is too short and sparse. This could be related to the needs for shelter and foraging, or the need to be able to detect and escape predators.
(Max points 200)

Habitat Quality – Visual Obstruction

200	Visual obstruction reading between 2 - 7 cm
100	Visual obstruction reading < 2 cm OR between 7 - 10 cm
0	Visual obstruction reading >10 cm

7.8. Bare ground and biocrust (mosses, lichens and little club moss) is one of the most important habitat features that attract Chestnut-collared Longspurs. Chestnut-collared Longspurs have a high tolerance for biocrust and bare soil cover. This tolerance is likely related to their preference for relatively short and sparse vegetation.
(Max points 200)

Habitat Quality – Biocrust and Bare Soil

200	Biocrust and bare soil cover between 15 - 30%
100	Biocrust and bare soil cover between 5 - 15% OR between 30 - 50%
0	Biocrust and bare soil cover <5% OR >50%

7.9. Vegetation height is one of the most important habitat features that attract Chestnut-collared Longspurs. Chestnut-collared Longspurs have a preference for low growing vegetation. Heights should be variable within the range of optimal or suboptimal as opposed to uniform.
(Max points 200)

Habitat Quality – Vegetation Height

200	Vegetation height between 7 - 15 cm
100	Vegetation height between 3 - 7 cm OR between 15 - 20 cm
0	Vegetation height <3 cm OR > 20 cm

7.10. Range condition indicates the status or composition of the present plant community in relation to the potential, or climax, and expresses changes in vegetation composition, productivity, and land stability. The relative contribution of decreasers, increasers and invaders to the composition of the range ecosite determines its condition rating. Range condition ratings are not interchangeable with range health ratings.
(Max points 100)

Habitat Quality – Range Condition

100	Range condition Fair to Good
50	Range condition Poor OR Excellent

7.11. Chestnut-collared Longspurs tend to avoid habitat edges where vegetation structure changes abruptly. Research has shown reduced abundance of Chestnut-collared Longspurs close to roadside ditches, cropland and associated with areas where tame grasses are invading native grasslands. In some cases, the increasing abundance has been measured up to two kilometres away from these edges. Some studies have demonstrated lower abundance of Chestnut-collared Longspurs near wetlands and water bodies. This avoidance may be related to the presence of habitat edge.
(Max points 200)

Habitat Quality - Distance to Habitat Edge

200	Habitat edge > 200 m from area of consideration.
100	Habitat edge 100 – 200 m from area of consideration.
0	Habitat edge within OR <100 m from area of consideration.

8. Interaction with other Species at Risk (SAR): Other SAR may exist in the area. The presence of optimal Chestnut-collared Longspur habitat may have a positive, negative or neutral effect on the other SAR found in the area of consideration. For example, optimal habitat for Chestnut-collared Longspur may reduce the suitability of habitat for other endemic grassland birds such as Baird's Sparrow or McCown's Longspur. In the event of multiple species and both positive and negative impacts, this criteria should be applied for each Species at Risk. (**Max points 100**)

Interaction with other Species at Risk

100	Chestnut-collared Longspur habitat contributes positively to other area SAR.
0	Chestnut-collared Longspur habitat has no impact on other area SAR.
-100	Chestnut-collared Longspur habitat has a negative impact on other area SAR

$$\mathbf{EBI = \{(1)(2)(3)(4)(5)[(6.1+6.2)+(7.1+7.2+7.3+7.4+7.5+7.6+7.7+7.8+7.9+7.10+7.11)+(8)]\}}$$

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