

PROPOSED

*Species at Risk Act*  
Management Plan Series

# Management Plan for the Greenish-white Grasshopper (*Hypochlora alba*) in Canada

## Greenish-white Grasshopper



2022



Government  
of Canada

Gouvernement  
du Canada

Canada

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11 The official version of the recovery documents is the one published in PDF. All  
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16 hyperlinks were valid as of date of publication.

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19  
20 For copies of the management plan, or for additional information on species at risk,  
21 including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)  
22 Status Reports, residence descriptions, action plans, and other related recovery  
23 documents, please visit the [Species at Risk \(SAR\) Public Registry](#)<sup>1</sup>.

24  
25  
26 **Cover illustration:** Greenish-white Grasshopper resting on White Sagebrush ©  
27 Chris Helzer, The Nature Conservancy

28  
29  
30 Également disponible en français sous le titre  
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<sup>1</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html](http://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html)

## 42 Preface

43

44 The federal, provincial, and territorial government signatories under the [Accord for the](#)  
45 [Protection of Species at Risk \(1996\)](#)<sup>2</sup> agreed to establish complementary legislation and  
46 programs that provide for effective protection of species at risk throughout Canada.  
47 Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent  
48 ministers are responsible for the preparation of management plans for listed species of  
49 special concern and are required to report on progress within five years after the  
50 publication of the final document on the SAR Public Registry.

51

52 The Minister of Environment and Climate Change and Minister responsible for the Parks  
53 Canada Agency is the competent minister under SARA for the Greenish-white  
54 Grasshopper and has prepared this management plan as per section 65 of SARA. To  
55 the extent possible, it has been prepared in cooperation with the provinces of Alberta,  
56 Saskatchewan, and Manitoba as per section 66(1) of SARA.

57

58 Success in the conservation of this species depends on the commitment and  
59 cooperation of many different constituencies that will be involved in implementing the  
60 directions set out in this plan and will not be achieved by Environment and Climate  
61 Change Canada and the Parks Canada Agency or any other jurisdiction alone. All  
62 Canadians are invited to join in supporting and implementing this plan for the benefit of  
63 the Greenish-white Grasshopper and Canadian society as a whole.

64

65 Implementation of this management plan is subject to appropriations, priorities, and  
66 budgetary constraints of the participating jurisdictions and organizations.

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<sup>2</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2](http://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2)

69

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71

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91 maps.

92

93

## 94 **Executive Summary**

95

96 Greenish-white Grasshopper (*Hypochlora alba*) is a small, distinctive, pale milky-green  
97 coloured Orthopteran insect. The colouration closely matches that of the host plant,  
98 White Sagebrush (*Artemisia ludoviciana*), that the species relies on for multiple life  
99 stages. Greenish-white Grasshopper is a late-hatching species (mid-July) and females  
100 are typically larger than males.

101

102 The species' distribution in Canada is small being known only from southern Alberta,  
103 Saskatchewan, and Manitoba. The distribution is at the northern periphery of the  
104 species global range. Existing records encompass 47 sites where Greenish-white  
105 Grasshoppers have been observed in Canada, including 33 from 2010 until 2021,  
106 eight from 1985-2009 and six historical sites prior to 1985. Greenish-white Grasshopper  
107 is listed as a species of Special Concern under the *Species at Risk Act* (SARA).

108

109 The most significant limiting factors for Greenish-white Grasshopper are its reliance on  
110 a single host plant that occurs in patches of low densities, and a low dispersal ability to  
111 move among habitat patches. With a reliance on one main host plant, any threats to this  
112 host plant constitute a threat to this rare grasshopper. Several poorly understood threats  
113 have been identified for Greenish-white Grasshopper including habitat loss, degradation  
114 or fragmentation from grassland conversion to cultivated crops; herbicide and pesticide  
115 use; road construction or maintenance; and oil and gas drilling. Other threats that result  
116 in changes to the natural disturbance regime include enhancing forage production in  
117 pastures, or changes to grazing or fire regimes, landscape hydrology and climate.

118

119 The management objective for Greenish-white Grasshopper is to maintain the  
120 distribution of the species, based on records from 1985 until 2021, in Alberta,  
121 Saskatchewan and Manitoba, as well as any additional populations that are discovered  
122 or rediscovered in the future.

123

124 Broad strategies to address the threats and attain the management objective include  
125 inventory and monitoring, research to address knowledge gaps of the species and its  
126 habitat, habitat management and conservation, and lastly communication, collaboration  
127 and engagement. Conservation measures are described to address these broad  
128 strategies.

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## 1. COSEWIC\* Species Assessment Information

**Date of Assessment:** November 2012

**Common Name (population):** Greenish-white Grasshopper

**Scientific Name:** *Hypochlora alba*

**COSEWIC Status:** Special Concern

**Reason for Designation:** This distinctive grasshopper is restricted to dry mixed grass prairie in southernmost Saskatchewan and southwestern Manitoba. Most of the Canadian population is found in only a few sites with many sites having very small populations. There is evidence that there has been a decline in the western part of the range. A number of threats have been documented including conversion to tame pasture, pesticide use and overgrazing. Re-establishment of lost populations and rescue effect are limited by the fact that this species is mostly flightless, although some Canadian habitat is continuous across the border.

**Canadian Occurrence:** Alberta, Saskatchewan, Manitoba

**COSEWIC Status History:** Designated Special Concern in November 2012.

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\* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

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## 2. Species Status Information

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In Canada, Greenish-white Grasshopper (*Hypochlora alba*) was listed as Special Concern under Schedule 1 of the *Species at Risk Act* (SARA) on February 2, 2018. It is estimated that approximately 5.7 % of the range of the Greenish-white Grasshopper occurs in Canada (based on global range boundaries in Pfadt 1996 and Capinera et al. 2004). However, this is difficult to estimate since the species distribution and abundance is not known in many states in the United States.

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NatureServe (2021) designates a ranking of the global population of Greenish-white Grasshopper as Secure (G5; status last reviewed 2017). Nationally the species is ranked as Apparently Secure or Secure (N4N5) in Canada and Secure (N5) in the United States (Nature Serve 2021). Table 1 describes the NatureServe status rankings of the species at the sub-national level for provinces and states where the status is defined.

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Greenish-white Grasshopper is not listed in any of the provinces where it is found. In Alberta, the *Pest and Nuisance Control 184/2001 Regulations* under the *Agricultural Pests Act* list Grasshopper (Locustidae) under Schedule 1, Part 1 as insects declared to be pests throughout Alberta. In Saskatchewan, *The Pests Declaration Regulations*

183 Chapter P-7 REG 2 list grasshoppers (Section 2 (c)) as declared pests for the purposes  
 184 of *The Pest Control Act*. Despite a broad listing of grasshoppers as pests in these  
 185 provinces, Greenish-white Grasshopper has not had any significant pest status  
 186 attributed to it in North America (COSEWIC 2012). This is because it does not feed on  
 187 economically important plant species in any appreciable amount to cause high levels of  
 188 damage requiring population suppression measures or interventions.

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**Table 1.** Global, national, and sub-national conservation status of Greenish-white Grasshopper based on NatureServe status ranks (NatureServe 2021).

| Global (G)Rank <sup>a</sup> | National (N) Rank <sup>a</sup>        | Sub-national (S) Rank <sup>a</sup>   |
|-----------------------------|---------------------------------------|--|
| G5                          | Canada: N4N5<br><br>United States: N5 | Canada: Alberta (S2S3, Saskatchewan (S3), Manitoba (S2S3)<br><br>United States: Wyoming (SNR), Montana (SNR) |

193 <sup>a</sup> Status rank is designated as a letter reflecting the geographic scale of assessment (G= Global, N= National, and  
 194 S= Sub-national) followed by a number: 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction;  
 195 4- apparently secure; 5– secure; NR – status not ranked. If two letter/number combinations are shown, this denotes  
 196 a range rank indicating the taxon straddles criteria for more than one rank.

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 198

### 199 3. Species Information

200  
 201

#### 202 3.1. Species Description

203 The Greenish-white Grasshopper is an insect that is a member of Order Orthoptera  
 204 (grasshoppers, locusts, crickets and katydids), and is placed in the Family Acrididae  
 205 (short-horned grasshoppers). Within the Acrididae, it is further placed in the Subfamily  
 206 Melanoplinae, the spur-throated grasshoppers (COSEWIC 2012). Members of this  
 207 subfamily have a characteristic ventral spine or spur between their front legs, in a  
 208 position approximating the location of the throat (Johnson 2002). It is the only member  
 209 of the genus *Hypochlora* that is found in North America.

210  
 211 While generally known as the Greenish-white Grasshopper in Canada, it is also known  
 212 by several other common names. This includes the Sage Grasshopper in Alberta and  
 213 Manitoba (ACIMS 2017, MB CDC 2017), Cudweed Grasshopper in Saskatchewan  
 214 (SK CDC 2017), and Cudweed Sagewort Grasshopper or Sagebrush Grasshopper in  
 215 the U.S. These names reflect the close association with its host plant, White Sagebrush  
 216 (*Artemisia ludoviciana*) which is also known as Cudweed Sagewort and Prairie Sage  
 217 (Knutson 1982, Pfadt 1996).

218  
 219 Greenish-white Grasshopper displays a typical grasshopper life cycle as it is univoltine,  
 220 having one generation per year, composed of 3 stages: egg, nymph (consisting of  
 221 several immature stages) and adult (Criddle 1935, Pfadt 1994). The nymph stage  
 222 represents a gradual metamorphosis from hatchling to adult. Each immature stage  
 223 resembles a smaller version of the adult where every sequential nymphal stage shows a  
 224 successive increase in size. In Canada the first nymphs hatch from eggs (the

225 overwintering stage) in mid-July with adults being observed on the landscape by August  
 226 (COSEWIC 2012). This timing makes them a late-developing grasshopper species.

227

228 **Adults** -The colouring of the adult Greenish-white Grasshopper is cryptic as it closely  
 229 matches the milky-green colouring of its primary host plant, White Sagebrush,  
 230 making it difficult to distinguish when on the plant (Smith and Grodowitz 1987). Adult  
 231 Greenish-white Grasshoppers are small, generally flightless grasshoppers with greatly  
 232 reduced forewings. Females occasionally are encountered with long wings but this is  
 233 infrequent (Pfadt 1996). Males are typically smaller compared to females in overall  
 234 length (males 1.1 to 1.5 cm, females up to 2.0 cm; D. Johnson pers. comm) and weight  
 235 (males 122 mg, females 326 mg; Pfadt 1996).

236

237 The body is an overall pale milky-green  
 238 colour with a broad green band running  
 239 from behind the eyes on each side of  
 240 the body to the pronotum (a saddle  
 241 shaped structure of the thoracic region<sup>3</sup>)  
 242 (Figure 1; Pfadt 1996). A white stripe on  
 243 either side of the body gives the  
 244 appearance of four light green stripes  
 245 when viewed from above. The eye is  
 246 grey to tan and the legs are light green  
 247 in colour, but may be slightly darker  
 248 green than the body (COSEWIC 2012).  
 249 In Canadian populations, the antennae  
 250 are reddish-brown/tan through to grey in  
 251 adults but these may be more green in  
 252 southerly U.S. populations (COSEWIC  
 253 2012).

254

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**Figure 1.** Photo of Greenish-white Grasshopper.

<sup>3</sup> The thorax is the part of the insect's body between the head and the abdomen.

261  
262 **Nymphs** – There are 5 nymphal stages, known as instars, which can be individually  
263 identified based on size, structures present, and colour (see Pfadt 1996 for details).  
264 Instar 1 hatch from eggs at an approximate body length of 5.5 mm proceeding through  
265 subsequent stages until reaching Instar 5 with a range in size of 1.1 -1.82 cm (Pfadt  
266 1996). All instars are green in colour with varying patterns of brown speckles. The  
267 nymphs live in the same habitats and consume the same food sources making it have  
268 the same host plant as adults (Pfadt 1996). In more southerly US populations the  
269 nymphal period from first hatching to adult lasts approximately 44-46 days (Alexander  
270 and Hilliard 1969, Pfadt 1996) but this time period is currently not known for Canadian  
271 populations.

272  
273 **Eggs** – Eggs are laid in late summer just under the surface of the soil close to host  
274 White Sagebrush plants. With soil temperature building through the summer this timing  
275 allows laid eggs to reach a sufficient development stage before they will overwinter in the  
276 ground in a state of diapause<sup>4</sup> (Fisher et al. 1996). The eggs are approximately 4 mm in  
277 length, tan in colour, and are laid in groups of 8 to 12 in egg pods that are oriented  
278 vertically in the soil (Pfadt 1996).

279

## 280 **3.2. Species Population and Distribution**

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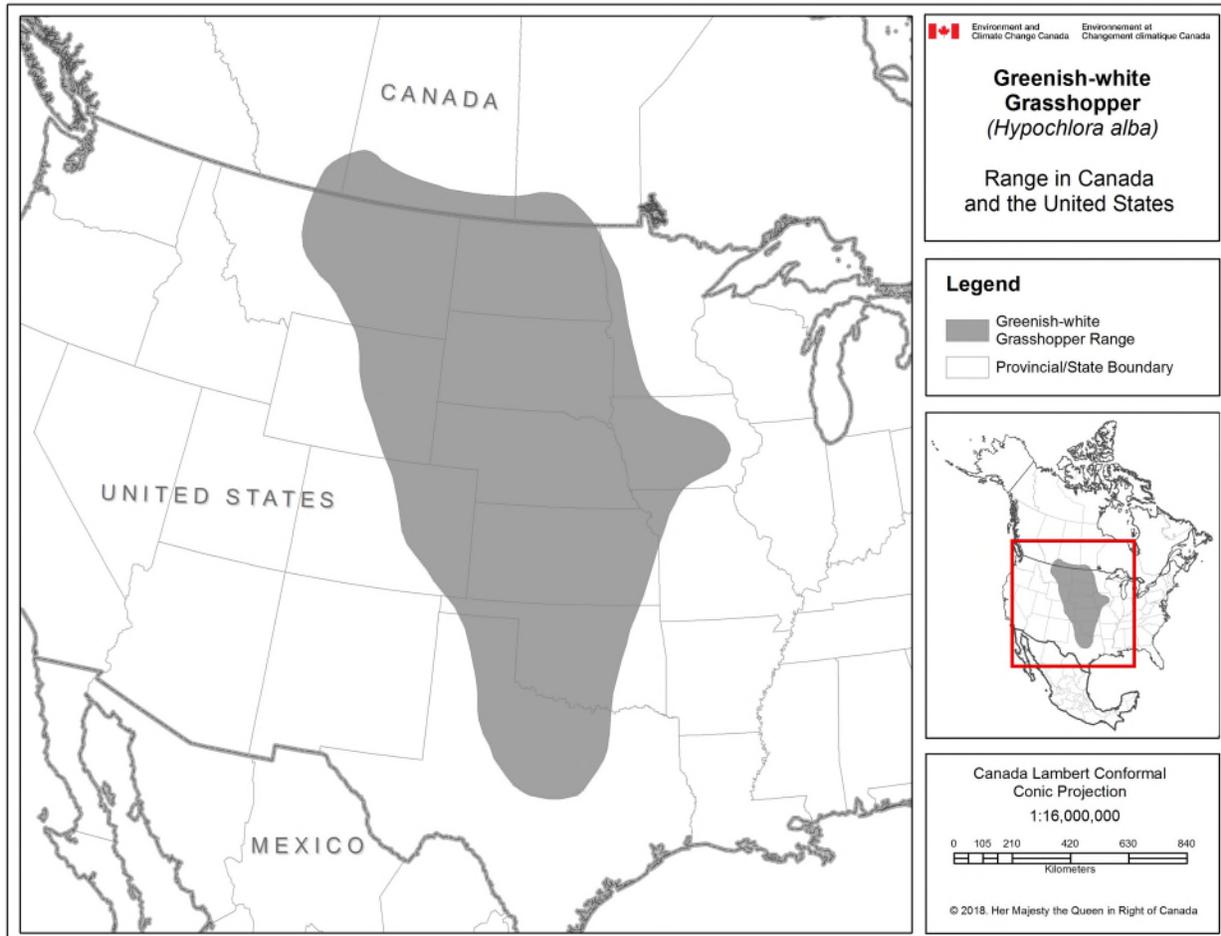
### 282 **Global Distribution**

283

284 The Greenish-white Grasshopper is endemic to North America, being widely distributed  
285 within the Great Plains Region. It extends from southern Alberta, Saskatchewan and  
286 Manitoba, south into Montana, Wyoming, Colorado and into northern Texas, and east  
287 into North and South Dakota, Western Minnesota, Iowa, Nebraska, Kansas and  
288 Oklahoma (Figure 2; Brooks 1958, Pfadt 1996, Capinera et al. 2004, COSEWIC 2012).  
289 The species range is irregular and restricted within the broader distribution of the host  
290 food plant, White Sagebrush. The host plant has a range that extends further north and  
291 south (Northwest Territories through to Mexico), and east and west to both the Atlantic  
292 and Pacific coasts (Anderson 2005). Within its range, the Greenish-white Grasshopper  
293 is restricted in its distribution being found at lower elevations (e.g., generally <1800 m:  
294 Alexander and Hilliard 1969), and may be patchy as it is absent from areas where  
295 grasslands have been converted to annual crop agriculture (COSEWIC 2012).

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<sup>4</sup> Diapause is a period of suspended development in an insect during unfavourable environmental conditions.



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**Figure 2.** Greenish-white Grasshopper global range (adapted from COSEWIC 2012, Pfadt 1996 and Vickery and Kevan 1985).

**Canadian Distribution and Population**

Like many prairie grassland species in Canada, populations of the Greenish-white Grasshopper are at the northern edge of their North American range. It is restricted to a small geographic area in the prairie provinces stretching across southern Alberta, southern Saskatchewan and southwestern Manitoba. Ecoregions represented in the distribution include the Mixed Grassland of Alberta and southwestern and south-central Saskatchewan, Moist Mixed Grassland of southeastern Saskatchewan and lastly into the Aspen Parkland of southwestern Manitoba. The estimated extent of occurrence<sup>5</sup> in Canada ranges from >43 000 to 46 000 km<sup>2</sup> and index of area of occupancy<sup>6</sup> ranges from 100 – 400 km<sup>2</sup> (COSEWIC 2012).

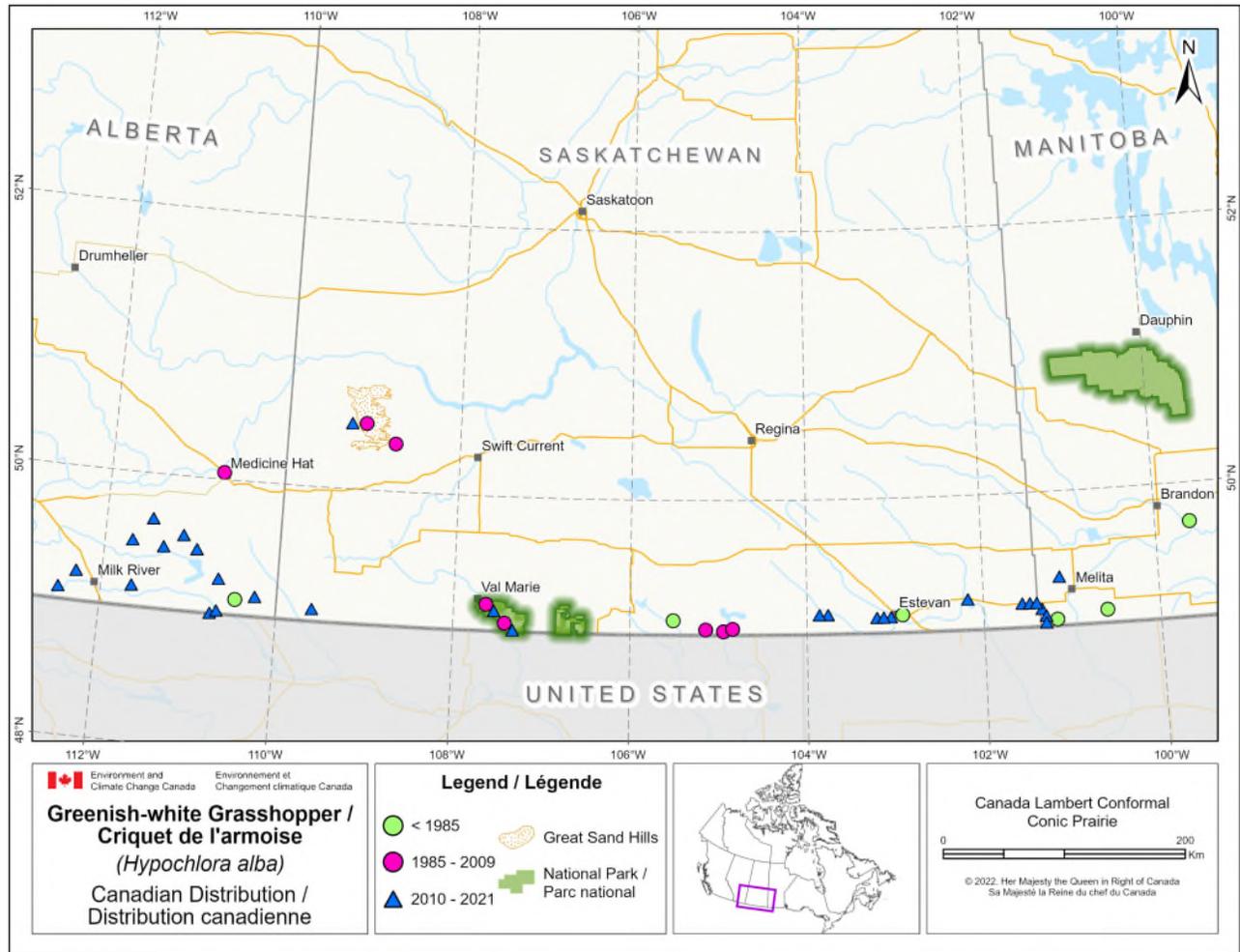
<sup>5</sup> Extent of occurrence is the area included in a polygon without concave angles that encompasses the geographic distribution of all known wildlife species (COSEWIC 2016).

<sup>6</sup> Index of area of occupancy refers to the area within ‘extent of occurrence’ that is occupied by a taxon, excluding cases of vagrancy, as measured using a 2x2 km grid. The measure reflects the fact that the extent of occurrence may contain unsuitable or unoccupied habitats (COSEWIC 2016).

312  
313 Historical records (prior to 1985) include 6 locations stretching from Onefour, AB; south  
314 of Coronach and near Big Muddy, SK, to Carberry, MB, primarily below 50°N clustering  
315 close to the border with the United States (Brooks 1958). Survey work from 1985 to  
316 2009 found additional sites for the species around Medicine Hat, AB; in and around the  
317 Great Sand Hills, and in the west block of Grasslands National Park, SK (summarized in  
318 COSEWIC 2012). This work extended the range northward by nearly 100 km. The  
319 species was noted as being generally rare with low population sizes at some sites  
320 suggesting a decline in the number of sites and overall distribution from 2000 to 2007  
321 (COSEWIC 2012). Directed searches for the species in southern Alberta and  
322 Saskatchewan from 2008 - 2010 by D. Johnson (University of Lethbridge) documented  
323 the species at 12 locations in southeastern Saskatchewan and southwestern Manitoba  
324 (Figure 3). In these surveys, the number of individuals identified ranged from  
325 1 to >40 individuals per 10 m<sup>2</sup> at the sites. More recent surveys, since 2015, have  
326 reconfirmed occurrences of the species in the southern prairie provinces with many new  
327 occurrences at locations where the species had not been observed during earlier  
328 surveys and with highest abundance and frequency of occurrence noted in 2020  
329 (D. Johnson pers. comm. 2020, R. Turnquist and K. Hecker, pers. comm. 2021,  
330 J. Tuckwell and S. Liccioli, pers. comm., 2021)

331  
332 Collectively, existing records encompass 47 sites where Greenish-white Grasshoppers  
333 have been observed in Canada, including 33 from 2010-2021, eight from 1985-2009  
334 and six historical sites prior to 1985 (Figure 3 and in Appendix A). In addition, recent  
335 information has emerged about several undocumented observations of the species  
336 since 2015 and especially in 2020 in southern Alberta (D. Johnson pers. comm. 2020).  
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**Figure 3.** Distribution of Greenish-white Grasshopper records in Alberta, Saskatchewan, and Manitoba based on records from 1920 until 2021. Note: at the scale shown some records overlap making them indistinguishable as distinct locations.

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It is difficult to estimate the population size for a species that is naturally rare and poorly studied given the currently available data. The relative rarity of the species can be inferred from Johnson (1989) who failed to find Greenish-white Grasshopper among more than 11,000 grasshoppers collected near Taber, Alberta in habitat typically used by Greenish-white Grasshopper (Johnson 1989). Based on an extrapolation of numbers within designated areas, COSEWIC (2012) coarsely estimated that there are up to 1000 individuals on a typical 1000 ha site and that there would be over 100,000 grasshoppers within the currently known sites in Canada. However, there is a great deal of uncertainty associated with this estimate since relatively few sites have been surveyed and the field surveys that were conducted were not designed to estimate the species population size in Canada. Further complicating the estimation of population size is that temporal variability in numbers appears to be high, as individuals were encountered frequently in 2020 at locations in southern Alberta where they had not been observed in earlier years (D. Johnson pers. comm. 2020).

360 Surveys from 2008-2010 reconfirmed a northward decline in population densities where  
361 higher densities were observed at Canadian sites in close proximity to the United States  
362 border with the highest densities recorded at sites south of the border in North Dakota  
363 (COSEWIC 2012). At Canadian sites near the border, populations were confirmed at  
364 12 of 15 sites that contained White Sagebrush although a zone along the Souris River  
365 in Saskatchewan had low grasshopper densities that had previously been high  
366 (COSEWIC 2012). Nevertheless, trends from these surveys show increases at some  
367 sites, such as south and west of Estevan, Saskatchewan where numbers observed  
368 exceed those recorded in the previous 20 years (COSEWIC 2012). Fluctuations in  
369 population size and density are natural in grasshopper populations owing to variation in  
370 weather conditions, availability and productivity of host plants, and pressures from  
371 disease and natural enemies such as predators and parasitoids (Branson 2005,  
372 Joern 2000, Laws and Joern 2012). Recent population increases in Greenish-white  
373 Grasshopper are believed to be closely tied to the growth of White Sagebrush, with  
374 large population increases observed in years when the food plant was abundant and  
375 experienced excellent growth (D. Johnson pers. comm. 2020, COSEWIC 2012).

376

### 377 **3.3. Needs of the Greenish-white Grasshopper**

378

#### 379 **General Habitat Requirements**

380

381 The Greenish-white Grasshopper is a species of the Great Plains of North America  
382 where it is typically found in relatively undisturbed, dry mixed-grass prairie habitats such  
383 as managed pastures and grasslands (grazed but not improved rangelands and natural  
384 grasslands; COSEWIC 2012). In more southern areas of its range in the U.S., it can  
385 also be found in tallgrass and sandhills prairie habitats (Evans 1988, Joern 1983a).  
386 Within these general areas, the species is associated with habitats where primary host  
387 White Sagebrush plants occur. This can include sites such as native prairie, grazed  
388 rangelands and livestock pastures, uncultivated areas along roadsides, fencelines,  
389 streams, shelterbelts, and some disturbed sites (COSEWIC 2012, Whipple et al. 2012).  
390 Greenish-white Grasshopper is not found at every site where the primary host plant  
391 occurs however; it can occur at a small proportion of the sites with host plants or also be  
392 absent from areas where abundance of host plants is quite high (COSEWIC 2012).  
393 Since the species overwinters as eggs laid just under the surface of the soil, suitable  
394 soils with the appropriate composition, texture and generally favourable soil conditions  
395 (e.g., moisture, topographic position) may also be important (Criddle 1935).

396

#### 397 **Host Plant Specificity**

398

399 In contrast to the large majority of grasshoppers that typically feed on a wide variety of  
400 plant species, the Greenish-white Grasshopper is a specialist species feeding primarily  
401 on White Sagebrush (Knutson 1982, Joern 1985). This plant is not eaten to any great  
402 extent by other grasshopper species since it has physical and/or chemical defenses that  
403 make it less palatable. These include a dense covering of largely indigestible small hairs  
404 on the leaves (trichomes) that the Greenish-white Grasshopper is capable of ingesting  
405 and others are not (Smith and Kreitner 1983, Blust and Hopkins 1987a). The plant also

406 produces volatile compounds such as terpenoids that deter other grasshopper species  
407 and/or attract the Greenish-white Grasshopper to it (Blust and Hopkins 1987b). An  
408 ability to use a food plant that other grasshoppers do not may mean competition for food  
409 resources is lowered for Greenish-white Grasshopper. Other secondary plant foods  
410 occasionally used by the species in other parts of its range include other sage plants like  
411 Pasture Sage (*A. frigida*) and Silver Sagebrush (*A. cana*), forbs such as Purple  
412 Locoweed (*Oxytropis lambertii*) and Western Wallflower (*Erysimum asperum*), and  
413 grasses such as Blue grama (*Bouteloua gracilis*), Buffalograss (*Bouteloua dactyloides*)  
414 and needle-and-thread grass (*Hesperostipa comata*) (Joern 1985, Chapman 1990,  
415 Pfadt 1996). It is important to note that these other plants are consumed in much  
416 smaller amounts compared to White Sagebrush.

417  
418 White Sagebrush is used as food for all life stages of the Greenish-white Grasshopper  
419 from hatched nymphs through to adults making it a key food plant for the species.  
420 Plants are a silvery-green colour that appear as greenish-white from a distance owing to  
421 the covering of fine trichomes on stems and leaves (USDA 2017). It typically reaches a  
422 size of 20 to 50 cm in height and it flowers from August to September with yellow-ish  
423 flowers (USDA 2017). The species is native to the prairies and it responds fairly well to  
424 disturbances such as fire, grazing and occasional flooding depending on the intensity  
425 and timing of these activities (Archibold et al. 2003, Anderson 2005). Although widely  
426 distributed, White Sagebrush is often a minor component of plant communities owing to  
427 climatic factors and specific site disturbance histories that make its distribution on the  
428 landscape quite patchy (Smith and Grodowitz 1987, Anderson 2005, Adams et al. 2013,  
429 COSEWIC 2012).

430  
431 In addition to feeding on White Sagebrush, Greenish-white Grasshopper also lays eggs  
432 in the top layer of the soil near host food plants (Criddle 1935, Pfadt 1996). This  
433 facilitates newly hatched nymphs being in proximity to the food plant upon hatching for  
434 rapid development which is beneficial for a late-hatching species. The species shows a  
435 general low mobility compared to other grasshoppers and shows strong host-plant  
436 fidelity (Joern 1983b, Pfadt 1996). In a study in Kansas, daily movements were found to  
437 be quite low (averaging around 106 cm and at maximum 3 m) with individuals remaining  
438 in close proximity to host plants, if not the same plant for multiple days (Smith and  
439 Grodowitz 1987). In that same study, dispersal among host plant patches was also  
440 exceptionally low with marked individuals never being recorded moving among study  
441 plant patches separated by a distance of only 8 m. Movements in general may be low if  
442 a sufficient number of high quality host food plants are available in a local patch area to  
443 meet the needs of grasshoppers. These movements may be larger in areas or years  
444 when food plant resources are less abundant and available. The finding of some  
445 females with long wings may suggest the species can make larger movements from  
446 time to time although this is not known (COSEWIC 2012). The species is not currently  
447 known to migrate (COSEWIC 2012).

448  
449 With the colour of Greenish-white Grasshopper closely matching that of the host plant,  
450 White Sagebrush also likely provides camouflage to the species to minimize predation  
451 (Knutson 1982, Smith and Grodowitz 1987). When disturbed and flushed, they will jump

452 off a plant but almost immediately jump back to another nearby host plant, rather than  
453 remain on the ground (Pfadt 1996). This supports the idea of the grasshoppers using  
454 the plants for shelter from predators. Thus, Greenish-white Grasshoppers carry out  
455 multiple daily activities on the plants including taking advantage of various opportunities  
456 for optimizing their thermal conditions. Activities include stretching out their legs to  
457 better expose their abdomen to the sun's rays for warming (basking), retreating to  
458 shaded areas of plants during hot periods, or in taking shelter overnight (Pfadt 1996,  
459 Blust and Hopkins 1990).

460

### 461 **3.4 Limiting factors<sup>7</sup>**

462

#### 463 **Reliance on a Single Host Plant**

464

465 Greenish-white Grasshopper relies heavily on one species of plant for multiple aspects  
466 of its life history including feeding by immature nymphs during development, feeding by  
467 adults, and to some extent, for breeding and overwintering. Thus, the species almost  
468 continually occupies or is in close contact with host White Sagebrush plants where the  
469 distribution and abundance of plants at a site will impact these same parameters of  
470 Greenish-white Grasshopper populations (Pfadt 1996). Any reductions in the growth,  
471 density or distribution of the host plant could result in periodic reductions in the  
472 abundance of the species (COSEWIC 2012).

473

#### 474 **Limited Dispersal Capability**

475

476 As it is currently understood, the species has a low dispersal ability as it is small in size,  
477 generally flightless, and has low mobility since individuals make limited movements  
478 (Smith and Grodowitz 1987). The re-establishment of historical and now lost  
479 populations, and rescue effects from the movement of individuals from more abundant  
480 populations (e.g., from those in the United States) may be limited due to this low  
481 dispersal ability. Furthermore, dispersal from fragmented or destroyed habitat to  
482 colonize new habitat is also likely limited. Combined with other other traits such as  
483 being a late-hatching species, and having a high reliance on one host plant means that  
484 recovery from low population abundances or a reduced distribution could take longer  
485 (COSEWIC 2012).

486

#### 487 **Natural Predators and Parasites**

488

489 In addition to factors such as weather and host plant availability and quality,  
490 grasshopper populations are also influenced by pressures from competition with other  
491 species, disease, predators and parasitoids (Joern 2000, Branson 2005, Laws and  
492 Joern 2012). Predation by birds has been shown to contribute to regulation of  
493 grasshopper populations (Bock et al. 1992, Branson 2005). However, the effects can be

---

<sup>7</sup> It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to management/conservation efforts.

494 complex and variable across locations as they may depend on the local site  
495 grasshopper community and availability of food resources (Belovsky and Joern 1995).  
496 It is suspected that Greenish-white Grasshopper is subject to bird predation although  
497 this has not yet been documented for the species (COSEWIC 2012).  
498

499 Other known predators of grasshoppers include spiders but similar to bird predation, the  
500 effects can be context-dependent (Oedekoven and Joern 2000, Laws and Joern 2015).  
501 Still other known grasshopper predators include beetles, crickets and bee flies that feed  
502 on grasshopper eggs (Joern and Gaines 1990). Parasitoid<sup>8</sup> flies have been shown to  
503 prey on Greenish-white Grasshopper which, in turn, impacts the reproductive output of  
504 individuals (Laws and Joern 2012). Other parasites like mites and nematodes may also  
505 infect and impact the species such as those found in other grasshopper species  
506 (Branson 2003, Laws 2009). Since the impacts of these biotic interactions are variable,  
507 dependant on habitat and resource availability, and have not generally been looked at  
508 collectively for the species, these interactions and effects are not known in how they  
509 impact Greenish-white Grasshopper population dynamics.  
510

### 511 **Thermal and Moisture Sensitivity**

512

513 It is thought that Greenish-white Grasshopper is likely not resistant to conditions of  
514 prolonged extreme heat and drought because it has a delicate integument<sup>9</sup>, and the  
515 abdomen is not protected by heavy forewings as is found in other prairie grasshoppers  
516 (COSEWIC 2012). These physical characteristics may mean that the species has a high  
517 susceptibility to drying out, heat stress and overheating, which in turn may limit the  
518 species' survival rate; however, this has not been directly investigated.  
519

---

<sup>8</sup> A parasitoid is a parasite whose immature stage develops in or on a host while the adult is free-living.

<sup>9</sup> The integument is the outer protective covering of an insect that forms the exoskeleton.

520 **4. Threats**

521  
522 **4.1. Threat Assessment**

523  
524 The Greenish-white Grasshopper threat assessment is based on the IUCN-CMP (World Conservation Union–  
525 Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities  
526 or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of  
527 the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or  
528 subnational). Limiting factors are not considered during this assessment process. For purposes of threat assessment, only  
529 present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other  
530 relevant information that would help understand the nature of the threats are presented in the Description of Threats  
531 section.

532  
533 **Table 2.** Threat calculator assessment.

| Threat # | Threat description                  | Impact <sup>a</sup> | Scope <sup>b</sup> | Severity <sup>c</sup> | Timing <sup>d</sup> |
|----------|-------------------------------------|---------------------|--------------------|-----------------------|---------------------|
| 2        | Agriculture & aquaculture           | Low                 | Restricted         | Moderate              | High                |
| 2.1      | Annual & perennial non-timber crops | Low                 | Restricted         | Moderate              | High                |
| 2.3      | Livestock farming & ranching        | Low                 | Small              | Slight                | High                |
| 3        | Energy production & mining          | Low                 | Restricted         | Slight                | High                |
| 3.1      | Oil & gas drilling                  | Low                 | Restricted         | Slight                | High                |
| 4        | Transportation & service corridors  | Low                 | Restricted         | Slight                | High                |
| 4.1      | Roads & railroads                   | Low                 | Restricted         | Slight                | High                |
| 7        | Natural system modifications        | Unknown             | Unknown            | Unknown               | Unknown             |
| 7.1      | Fire & fire suppression             | Unknown             | Unknown            | Unknown               | Unknown             |
| 7.2      | Dams & water management/use         | Unknown             | Unknown            | Unknown               | Unknown             |

| Threat # | Threat description                | Impact <sup>a</sup> | Scope <sup>b</sup> | Severity <sup>c</sup> | Timing <sup>d</sup> |
|----------|-----------------------------------|---------------------|--------------------|-----------------------|---------------------|
| 9        | Pollution                         | Low                 | Small              | Slight                | Moderate            |
| 9.3      | Agricultural & forestry effluents | Low                 | Small              | Slight                | Moderate            |
| 11       | Climate change & severe weather   | Unknown             | Unknown            | Unknown               | Unknown             |
| 11.2     | Droughts                          | Unknown             | Unknown            | Unknown               | Unknown             |

534  
 535 <sup>a</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The  
 536 impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a  
 537 species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each  
 538 combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%),  
 539 and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated:  
 540 impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be  
 541 in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

542 <sup>b</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a  
 543 proportion of the species’ population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%;  
 544 Negligible < 1%).

545 <sup>c</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat  
 546 within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species’ population. (Extreme = 71–100%;  
 547 Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

548 <sup>d</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended  
 549 (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long  
 550 term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 551 **4.2. Description of Threats**

552

553 The threats that impact Greenish-white Grasshopper are poorly understood as the  
554 specific information of these threats to the species is generally incomplete (COSEWIC  
555 2012). With the species relying on primarily one main host plant, ultimately any threats  
556 to the host White Sagebrush plants are threats to Greenish-white Grasshopper (Hall et  
557 al. 2011). The loss of host plants or a reduction in the quality of host plants as habitat  
558 could occur as a result of threats acting together or on their own. This could occur from  
559 changes to the natural disturbance regime such as changes to grazing or fire regimes,  
560 landscape hydrology and climate. Direct habitat loss, degradation or fragmentation can  
561 also occur from multiple threats such as enhancing forage production in pastures,  
562 conversion to cultivated crops, herbicide and pesticide use, road construction or  
563 maintenance, and oil and gas drilling. The identified threats to Greenish-white  
564 Grasshopper are discussed in depth below.

565

### 566 **IUCN-CMP Threat 2. Agriculture & Aquaculture (Low)**

567

#### 568 ***Threat 2.1 Annual & perennial non-timber crops***

569

570 The historical conversion of native prairie habitat to cultivated crops likely contributed to  
571 an overall loss and fragmentation of Greenish-white Grasshopper habitat. Conversion  
572 of current native grasslands and rangeland habitats (where host plants occur) to planted  
573 areas for cereal and forage crops remains an ongoing threat to the species. This is due  
574 to factors such as increased prices for specific crops and advancements in new  
575 agricultural technologies and practices (Wright and Wimberly 2013, Lark et al. 2015).  
576 When these factors reduce production costs and drive demand for these crops and land  
577 for their cultivation, this may make areas previously less suitable for cultivation  
578 (e.g., rangelands and native grasslands) attractive as new targets for planted crops.  
579 Those grassland habitats that contain host plants for Greenish-White Grasshopper that  
580 are converted to cultivated crops would represent loss and potentially fragmentation of  
581 key habitat for the species.

582

#### 583 ***Threat 2.3 Livestock farming & ranching***

584

585 The host plant of Greenish-white Grasshopper has a generally low forage value for  
586 livestock and is thus not a highly desired plant for grazing livestock (Tannas 2004,  
587 Anderson 2005) although is often a minor component of the plant community of grazed  
588 pastures (COSEWIC 2012). Pastures and ranges are sometimes improved by seeding  
589 or overseeding with desired pasture plants to improve yields or extend the seasonal  
590 timing of productivity. These improved pastures are sometimes known as tame  
591 pastures. If these planted species are strong plant competitors, they can outcompete  
592 the host plant. Any reductions in host plant population or distribution would then  
593 negatively impact Greenish-white Grasshopper.

594

595 Before the introduction of cattle, the grasslands of Canada were primarily grazed by  
596 herbivores such as Bison (*Bison bison*), Pronghorn (*Antilocapra americana*) and Elk

597 (*Cervus Canadensis*) such that Greenish-white Grasshopper evolved in a landscape  
 598 subject to grazing that occurred at variable intensities, locations and frequencies  
 599 (Anderson 2006, Shorthouse and Larson 2010a). Cattle grazing has a long history on  
 600 pastures and rangelands that occur within the range of Greenish-white Grasshopper  
 601 dating back to European settlement. Areas were subjected to varying grazing intensities  
 602 managed at a localized level depending on land tenure, local site environmental  
 603 conditions (e.g., weather, topography), and practices of range management at the time  
 604 (Wang et al. 2014). Grazing has been shown to have mixed effects on White Sagebrush  
 605 where in one study it reduced plant density (Brand and Goetz 1978) but in others there  
 606 was increased plant growth (Anderson 2005). This suggests that some level of grazing  
 607 is tolerated by the plant but heavy and intensive grazing (overgrazing) may limit the  
 608 plants ability to grow and recover such that other plants takeover resulting in the  
 609 elimination of host plants (COSEWIC 2012). Specific grazing conditions (e.g., cattle  
 610 stocking rates<sup>10</sup>, rest periods etc.) that are tolerated or are beneficial to White  
 611 Sagebrush plants are not currently known.

612

### 613 **IUCN-CMP Threat 3. Energy Production & Mining (Low)**

614

#### 615 ***Threat 3.1 Oil & gas drilling***

616

617 The construction of oil and gas wells could destroy or fragment White Sagebrush habitat  
 618 for Greenish-white Grasshopper. These impacts would depend on the size, number and  
 619 extent (e.g., density) of disturbed areas in relation to distribution and abundance of the  
 620 host plants on the landscape. Impacts from from oil and gas drilling are expected to  
 621 continue in the future and may increase depending on the economic conditions that  
 622 drive energy demand and exploration. There are other impacts from oil and gas  
 623 activities and these are covered under their respective threat categories (pipelines,  
 624 roads and invasive non-native species).

625

### 626 **IUCN-CMP Threat 4. Transportation & Service Corridors (Low)**

627

#### 628 ***Threat 4.1 Road & railroads***

629

630 The construction of roads can destroy, degrade or fragment habitat containing White  
 631 Sagebrush host plants that are essential for Greenish-White Grasshopper survival.  
 632 Roads can result in direct loss of habitat and create large linear disturbances of  
 633 degraded habitat from introduced plant species that out-complete White Sagebrush  
 634 (see threat 8.1; Nasen et al. 2011, Manier et al. 2014). These impacts would act to to  
 635 isolate local Greenish-white Grasshopper populations since it is a largely flightless  
 636 species that has limited dispersal ability.

637

638 Roads and associated road allowance maintenance can result in mortality to individuals  
 639 and some occurrence records for the species are from known from road allowances.  
 640 Mechanized mowing for weed control and harvest (e.g., haying) is known to impact

---

<sup>10</sup> Stocking rate refers to the number of cow-calf pairs or yearlings per unit area of pasture for a given period of time

641 grasshoppers by causing direct mortality of individuals or result in their displacement  
642 from habitats as they move to escape the disturbance (Gardiner and Hill 2006, Humbert  
643 et al. 2012). Displacement could result in mortality for Greenish-white Grasshopper if  
644 they are unable to find new host plants. This would be of concern in situations where  
645 road allowances containing host plants are surrounded by cultivated areas and thus  
646 represent isolated and fragmented habitat islands for Greenish-white Grasshoppers.  
647 Chemical control of weeds on road allowances are discussed in threat 9.3. The threat of  
648 road construction and maintenance is expected to continue in future years.

649

## 650 **IUCN-CMP Threat 7. Natural System Modifications (Unknown)**

651

### 652 ***Threat 7.1 Fire & fire suppression***

653

654 Insects living on the prairie such as Greenish-white Grasshopper, evolved with  
655 disturbances such as grazing, and periodic drought and fire that impacted the  
656 distribution and abundance of plant resources these insects require (Hall et al. 2011).  
657 Land management practices since European settlement have resulted in the reduction  
658 in frequency and extent of fires on the prairie from reductions in grass biomass fuels  
659 (from introduced livestock grazing) and fire suppression (Brockway et al. 2002). Host  
660 plants of Greenish-white Grasshopper have shown a mixed response to prescribed  
661 fires. In studies in Alberta and Saskatchewan, density and canopy coverage of White  
662 Sagebrush was shown to increase post-burn (Bailey and Anderson 1978, Archibold et  
663 al. 2003). However, in other studies little or negative-effects of fire have been shown  
664 depending on the burn season and interaction of other disturbance histories at the sites  
665 (e.g., grazing; reviewed in Anderson 2005). The specific effects of prescribed burns and  
666 long-term fire suppression on Greenish-white Grasshopper subpopulations are not  
667 currently known.

668

### 669 ***Threat 7.2 Dams & water management/use***

670

671 The host plant of Greenish-white Grasshopper is frequently associated with moist and  
672 mesic sites such as streambanks, floodplains, roadsides and valley bottoms (Coupland  
673 1950, Coxson and Looney 1986). The natural water flow at a site can be altered by the  
674 construction and operation of man-made dams, dugouts, ditches and resevoirs for  
675 livestock watering, irrigation of cropland, and wetland drainage. These structures divert  
676 water and can reduce the magnitude and/or frequency of flood events and instream flow  
677 such that important natural disturbances like overflow and sedimentation are interrupted  
678 (McNeil et al. 2004). This is particularly problematic during periods of drought. Since  
679 White Sagebrush is associated with mesic sites that may be subject to periodic flooding,  
680 changes to the natural hydrology of these sites from these man-made structures may  
681 alter plant productivity or result in elimination of plant subpopulations and may  
682 negatively impact Greenish-white Grasshopper populations.

683

684 **IUCN-CMP Threat 9. Pollution (Low)**

685

686 ***Threat 9.3 Agricultural & forestry effluents***

687

688 A small proportion (approximately 12%) of the more than 85 species of grasshoppers  
689 found in the Canadian prairies are considered to be pests (at certain times) because  
690 they damage crop or forage plants of economic importance when their populations are  
691 large (Calpas and Johnson 2003). Greenish-white Grasshopper is not considered a pest  
692 species since it does not feed on plants of high economic value and occurs in low  
693 numbers (COSEWIC 2012). Nevertheless, the use of broad spectrum insecticides to  
694 control grasshoppers in pastureland and other types of land where Greenish-white  
695 Grasshopper habitat exists would likely kill individual Greenish-white Grasshoppers and  
696 could result in the loss of small local populations (COSEWIC 2012). Although several  
697 insecticides are approved for use to control grasshoppers in pastures (e.g., Government  
698 of Saskatchewan 2021), the extent of their use in such habitat where Greenish-white  
699 Grasshopper is most often found, is unknown, but is believed by several experts to be  
700 low (J. Kotlar and R. Turnquist, ECCC, 2021; S. Hartley and J. Tansey, Government of  
701 Saskatchewan, *pers. comm.*, 2021). The contention that use of insecticides for  
702 grasshopper control in pastures is low is supported by an economic analysis indicating  
703 that the cost of applying insecticides to pastures to control grasshoppers likely exceeds  
704 the benefit derived from that application unless the cost is subsidized by the  
705 government (Shewchuk and Kerr 1993), as was the case during the 1980's but is no  
706 longer the case today. Furthermore, it is unknown whether Greenish-white  
707 Grasshopper would be affected by the use of bran-bait insecticides which are labelled  
708 for control of grasshoppers in pastures and rangelands, but which may not attract  
709 Greenish-white Grasshopper given the species' fidelity to White Sagebrush. Negative  
710 effects could also occur due to drift from pesticide application in cropland areas that lie  
711 adjacent to Greenish-white Grasshopper habitat, although the amount of drift would  
712 likely decline steeply within a short distance from the edge of the crop (Bird et al. 1996).

713

714 In controlling weedy or invasive plant species on linear disturbances (road allowances,  
715 pipelines, transmission lines) or managed tame pastures, the use of broad-spectrum  
716 herbicides, such as glyphosate, to control undesirable plants could reduce host plant  
717 productivity or eliminate host plant populations such that Greenish-white Grasshopper  
718 populations are in turn negatively impacted (COSEWIC 2012).

719

720 **IUCN-CMP Threat 11. Climate Change & Severe Weather (Unknown)**

721

722 ***Threat 11.2 Drought***

723

724 An increased frequency of dry periods could decrease populations of Greenish-white  
725 Grasshopper because the species does not seem to have physical characteristics that  
726 would enable them to deal well with such conditions (COSEWIC 2012). Climate change  
727 scenarios for the prairie provinces project greater precipitation, and possibly warmer  
728 weather, but this precipitation may fall outside of the dry summer season (Sauchyn and  
729 Kulshreshtha 2008). Further, warmer conditions may impact winter hydrological inputs

730 (e.g., negative effects on snowpack and glaciers) and evaporation rates in spring and  
731 summer such that drought conditions would increase in frequency or severity (Sauchyn  
732 and Kulshreshtha 2008, Schindler and Donahue 2006). While the potential of this threat  
733 specifically to Greenish-white Grasshopper is currently not known, it is possible that low  
734 winter snowpack and sudden cold snaps could have a deleterious impact on overwinter  
735 egg survival (J. Tansey pers. comm. 2021).

736  
737

## 738 **5. Management Objective**

739

740 The management objective for Greenish-white Grasshopper is to maintain the  
741 distribution of the species, based on records from 1985 until 2021, in Alberta,  
742 Saskatchewan and Manitoba, as well as any additional populations that are discovered  
743 or rediscovered in the future.

744

745 With information generally lacking on the overall distribution, local population  
746 abundances and trends for the species in Canada, it is currently not feasible to develop  
747 a quantitative management objective. Moreover, as its Canadian distribution represents  
748 the northern edge of its global range and as it appears to occur patchily across its  
749 Canadian distribution and to experience wide and unpredictable population fluctuations  
750 over time, a distribution-based management objective may be the most reasonable  
751 approach for the Greenish-white Grasshopper. This objective will be achieved by  
752 reducing or eliminating threats to the species and its habitat.

753

754

## 755 **6. Broad Strategies and Conservation Measures**

756

### 757 **6.1. Actions Already Completed or Currently Underway**

758

759 Relatively little work has been done in advancing our understanding of the biology and  
760 ecology of Greenish-white Grasshopper in Canada. Actions specific to monitoring  
761 and/or conserving the species, that have been completed or are currently underway  
762 include:

763

#### 764 **Actions Completed**

765

766 The BIObus project of the Centre for Biodiversity Genomics at the University of Guelph  
767 samples arthropod diversity across National Parks in Canada. Surveys for grassland  
768 arthropods were carried out in Grasslands National Park in Saskatchewan. Specimens  
769 were collected and submitted for genetic analysis (i.e., DNA sequencing to obtain  
770 DNA barcodes ) that included the collection, sequencing and identification of a  
771 Greenish-white Grasshopper in the summer of 2008.

772

773 In preparation for the COSEWIC status report, targeted surveys for the species were  
774 carried out by Dr. Dan Johnson (University of Lethbridge) along road-side transects in  
775 Alberta, Saskatchewan, and Manitoba (2008 -2010).

776

### 777 **Actions Current/Ongoing**

778

779 Monitoring for Greenish-white Grasshopper continues to be carried out by  
780 Dr. Dan Johnson (University of Lethbridge) in Alberta and Saskatchewan  
781 (2011-current).

782

783 A photo identification guide of prairie grasshoppers for non-specialists is being  
784 developed by Dr. Dan Johnson (University of Lethbridge). It will update an earlier one  
785 that he published in 2008 by Dr. Johnson.

786

787 Under the umbrella of NatureServe, the Manitoba Conservation Data Centre and  
788 Saskatchewan Conservation Data Centre track and store information of Greenish-white  
789 Grasshopper occurrences in their respective provinces.

790

791 Data collection by the general public on occurrences and distribution of the species in  
792 North America through iNaturalist<sup>11</sup> and the Global Biodiversity Information Facility  
793 (GBIF)<sup>12</sup> databases.

794

## 795 **6.2. Broad Strategies**

796

797 To achieve the management objective, conservation measures to be carried out are  
798 organized under four broad strategies:

799

- 800 • Inventory and monitoring
- 801 • Research to address knowledge gaps of the species and its habitat
- 802 • Communication, collaboration and engagement
- 803 • Habitat management and conservation

---

<sup>11</sup> iNaturalist is an online, user-submitted, biodiversity observation tracking program that documents organism occurrences using a crowdsourced species identification system.

<sup>12</sup> GBIF is an international network and research infrastructure that collects and stores biodiversity data. These data are from various sources such as museum specimens, research data and amateur naturalist observations using common standards and open-source tools to provide open access to data.

804 **6.3. Conservation Measures**

805

806

**Table 3.** Conservation Measures and Implementation Schedule.

| Conservation Measure   | Priority <sup>a</sup> | Threats or Concerns Addressed                                       | Timeline   |
|--|-----------------------|---|--|
| <b>Broad Strategy – Inventory and monitoring</b>   |                       |   |  |
| Use standardized methods to survey suitable habitat throughout the known range to locate new populations or relocate unconfirmed or historic populations.      | High                  | Measure progress towards attaining the management goal              | 2022-2027  |
| Support citizen science projects and tools (e.g., iNaturalist), which could return valuable data, be economically feasible, and help increase public awareness | High                  | Measure progress towards attaining the management goal              | Ongoing  |
| Develop models (e.g., habitat suitability/distribution models) to assess habitat and predict priority search areas for new populations for the species.        | Medium                | Knowledge gaps  | 2022-2027  |
| Use consistent monitoring guidelines to implement a monitoring plan across the known range examining population dynamics and habitat trends/conditions.        | Medium                | All threats; measure progress towards attaining the management goal | By 2027 then as determined by the plan (e.g., bi/tri-ennially) |
| <b>Broad Strategy – Research to address knowledge gaps of the species and its habitat</b>  |                       |   |  |
| Conduct research on life cycle characteristics of all stages (e.g., seasonal timing of stage, duration, conditions for nymphs, adults and overwintering eggs). | Medium                | Knowledge gaps  | 2022 – ongoing   |
| Conduct research to develop a better understanding of the species ecology and needs (e.g., dispersal, recruitment and survival, genetic exchange).             | Medium                | Knowledge gaps, Threat 2.1  | 2022 – ongoing   |
| Conduct research on threat impacts to the species (e.g., grazing, fire or fire suppression, roads/road maintenance, water management, pesticides).             | High                  | Threats 2.3, 4.1, 7.1, 7.2, 9.3                                     | 2022 – ongoing   |

|  |        |   |                |
|--|--------|---|----------------|
| Conduct research on anticipated climate change effects on grasslands (native and rangelands) and the impacts to the species.   | Low    | Threat 11.2                               | 2022 – ongoing |
| <b>Broad Strategy – Communication, collaboration and engagement</b>  |        |   |                |
| Develop and implement beneficial management practices (e.g., for mowing, grazing, integrated pest management) to maintain populations of high quality host plants by engaging with conservation groups, landowners and land managers.  | High   | Threats 2.1, 2.3, 3.1, 4.1, 7.1, 7.2, 9.3 | 2022 – ongoing |
| Develop or adapt communication materials on non-pest grasshopper species, such as Greenish-white grasshopper. Collaborate with governments, conservation agencies and agricultural and ranching associations and programs to distribute materials to landowners and land managers. | High   | Threats 2.1, 2.3, 9.3                     | 2022 – ongoing |
| <b>Broad Strategy –Habitat management and conservation</b>   |        |   |                |
| Engage land managers and owners, through conservation or stewardship agreements and programs, to preserve native and range grasslands that contain host plants, and limit conversion to cropland.  | High   | Threats 2.1, 2.3, 3.1, 4.1, 7.1, 7.2, 9.3 | 2022 – ongoing |
| Target stewardship and conservation measures at areas identified as being at highest risk for degradation or future loss, promote/encourage continued stewardship at areas where habitat is already being managed or conserved   | Medium | Threats 2.1, 2.3, 3.1, 4.1, 7.1, 7.2, 9.3 | Ongoing        |

807 <sup>a</sup> “Priority” reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a  
 808 measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or  
 809 direct influence on attaining the management objective for the species. Medium priority measures may have a less immediate or less direct  
 810 influence on reaching the management objective, but are still important for the management of the population. Low priority conservation measures  
 811 will likely have an indirect or gradual influence on reaching the management objective, but are considered important contributions to the  
 812 knowledge base and/or public involvement and acceptance of the species.

## 813 **6.4. Narrative to Support Conservation Measures and** 814 **Implementation Schedule**

### 815 816 **Broad Strategy – Inventory and monitoring**

817  
818 Few targeted surveys have been carried out for Greenish-white Grasshopper in Prairie  
819 Canada where these surveys assessed presence/no evidence of presence and were  
820 not able to estimate population size. Further, owing to the large area to be surveyed  
821 across the species range in three provinces, these previous surveys have been largely  
822 opportunistic or highly targeted in nature where only small areas at a time could be  
823 surveyed and they have not been revisited. The use of existing recent survey data in  
824 conjunction with new surveys could be explored for developing a habitat suitability  
825 model to help identify priority search areas to target survey efforts. The implementation  
826 of a standardized methodology for surveys throughout the species range is needed to  
827 locate new populations, re-confirm historical populations and tease out important habitat  
828 characteristics for the species. Given the large area to be surveyed, the use of  
829 standardized methods will facilitate multiple groups or organizations to collaborate in  
830 survey efforts where data can be combined across surveys in a comprehensive manner.  
831 Standardized methods will enable a monitoring program to be developed and  
832 implemented to estimate population sizes, track population dynamics and explore these  
833 interactions with habitat conditions over time. Citizen science initiatives such as  
834 iNaturalist ([www.inaturalist.org](http://www.inaturalist.org)) have significant potential to yield new data about  
835 occurrences of the species and should be supported.

### 836 837 **Broad Strategy – Research to address knowledge gaps of the species and its** 838 **habitat**

839  
840 There are many knowledge gaps on several aspects of the species' life cycle  
841 characteristics, ecology, and threat impacts that require research. Basic aspects of the  
842 timing and duration of the various life stages (i.e., overwintering eggs, nymphs and  
843 adults) are poorly characterized in Canada. Since populations in Canada are at the  
844 northern periphery of the species range these may be different from more southern  
845 populations in the US. Critical aspects of the species ecology such as dispersal,  
846 recruitment, survival, and genetic connectivity of populations are lacking. These  
847 parameters and characteristics are important for understanding basic population  
848 dynamics (e.g., size, status and trends) of the species. They are also important for  
849 understanding the adaptability of the species to help determine if there are periods of  
850 sensitivity. Collectively, these are important components of understanding how and  
851 when the identified threats specifically impact the species. In general, the impacts of the  
852 identified threats are poorly understood and research on these is needed. For example,  
853 specific grazing conditions (e.g., cattle stocking rates, rest periods etc.) or natural  
854 disturbance regimes (e.g., fire, floods) that are tolerated, beneficial or harmful to White  
855 Sagebrush plants and thus Greenish-white Grasshopper are not currently known.  
856 Lastly, research that links aspects of the species biology and ecology to the effects of a  
857 changing climate are also needed.

**858 Broad Strategy – Communication, collaboration and engagement**

859

860 The role of grasshoppers as important components of biodiversity in grassland  
861 ecosystems is not often considered or is underappreciated. Their roles include being  
862 being a key food source for organisms such as grassland songbirds (Martin et al., 2000)  
863 and in contributing to nutrient cycling in grasslands via grazing as insect herbivores  
864 (Belovsky 2000). Often all prairie grasshoppers are grouped together and viewed  
865 uniformly as pest species that exhibit periodically damaging outbreaks to economically  
866 important crops. As a result, prescriptive broad level grasshopper controls (e.g.,  
867 spraying with pesticides) may be applied regardless of what species they are and what  
868 plants they consume. Increasing education and awareness of non-pest grasshopper  
869 species and their ecological value and roles, including Greenish-white Grasshopper, is  
870 recommended through various communications (e.g., grasshopper identification  
871 materials, species at risk guides). Beneficial management practices (e.g., for mowing  
872 and grazing regimes to retain and maintain high quality host plants; and integrated pest  
873 management) should be developed and implemented. This can be accomplished  
874 through collaborations with species groups experts such as academic researchers, and  
875 research scientists with Agriculture and Agri-Food Canada or provincial agriculture  
876 departments. Further, many existing conservation organizations have programs that  
877 actively engage land owners and managers already and would be valuable  
878 collaborators for these efforts. Examples include MULTISAR and Operation Grassland  
879 Community in Alberta, SODCAP Inc. in Saskatchewan, and the Manitoba Habitat  
880 Heritage Corporation in Manitoba.

881

**882 Broad Strategy – Habitat management and conservation**

883

884 Key management and conservation of habitat for Greenish-white Grasshopper will  
885 occur from voluntary measures such as beneficial management practices for managing  
886 pastures and grasslands, and from stewardship agreements for land management and  
887 protection. Land use planning at multiple levels (municipal, provincial, federal) that  
888 incorporates the retention and protection of important habitat features (e.g., native  
889 grasslands and managed pastures) will assist in the long term conservation and  
890 persistence of Greenish-white Grasshopper habitat for current and future populations.

891

892

**893 7. Measuring Progress**

894

895 The performance indicator presented below provides a way to measure progress  
896 towards achieving the management objectives and monitoring the implementation of the  
897 management plan.

898

- 899 - The populations of Greenish-white Grasshopper found from 1985 until 2021 in  
900 Alberta, Saskatchewan, and Manitoba, as well as any additional populations  
901 newly located or rediscovered in the future, are maintained or increased by 2031.

902

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1161  
1162 **PERSONAL COMMUNICATION**  
1163  
1164 James Tansey – Government of Saskatchewan  
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1167

## Appendix A: Summary of Greenish-white Grasshopper Records in Canada.

| Time Period | Locality                               | Province | First Year | Last Year | No. Individuals | Data Source  |
|-------------|--|----------|------------|-----------|-----------------|--|
| Before 1985 | Aweme                                  | MB       | 1936       | 1939      | 6               | JBWM   |
| Before 1985 | Goodlands                              | MB       | 1920       | 1923      | 3               | CNC, AAFC, JBWM, LEM   |
| Before 1985 | Lyleton                                | MB       | 1937       | 1951      | 18              | JBWM   |
| 2010 – 2021 | Pierson                                | MB       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Lyleton West                           | MB       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Lyleton NWest                          | MB       | 2010       |           | 0 to 1          | D. Johnson   |
| Before 1985 | Onefour                                | AB       |            |           |                 | Vickery and Kevan  |
| Before 1985 | Coronach                               | SK       | 1941       | 1941      | 1               | CNC, AAFC  |
| Before 1985 | Estevan                                | SK       | 1953       | 1955      | 44              | CNC, AAFC  |
| 1985 - 2009 | Big Beaver                             | SK       | 1988       |           | 3               | LEM  |
| 1985 - 2009 | Big Muddy                              | SK       | 1988       |           | 1               | LEM  |
| 1985 - 2009 | Grasslands National Park               | SK       | 2008       |           | 1               | UGCBG  |
| 2010 – 2021 | Oungre East                            | SK       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Gainsborough 1                         | SK       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Gainsborough 2                         | SK       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Gainsborough 3                         | SK       | 2010       |           | 2 to 20         | D. Johnson   |
| 2010 – 2021 | Oxbow                                  | SK       | 2010       |           | 0 to 1          | D. Johnson   |
| 2010 2021   | Rafferty 1                             | SK       | 2010       |           | 21 to 40        | D. Johnson   |
| 2010 – 2021 | Rafferty 2                             | SK       | 2010       |           | > 40            | D. Johnson   |
| 2010 – 2021 | Rafferty 3                             | SK       | 2010       |           | 21 to 40        | D. Johnson   |
| 2010 – 2021 | Oungre West                            | SK       | 2010       |           | 0 to 1          | D. Johnson   |
| 2010 – 2021 | Broomhill                              | MB       | 2020       |           |                 | <a href="http://www.inaturalist.org">www.inaturalist.org</a> |
| 2010 – 2021 | Div No. 4                              | SK       | 2015       |           |                 | <a href="http://www.inaturalist.org">www.inaturalist.org</a> |
| 2010 – 2021 | East of Etzikom, North of Pakowki Lake | AB       | 2020       |           |                 | <a href="http://www.inaturalist.org">www.inaturalist.org</a> |
| 1985 - 2009 | Grasslands National Park               | SK       |            |           |                 | D. Johnson   |
| 2010 – 2021 | Great Sand Hills                       | SK       |            |           |                 | D. Johnson   |
| 1985 - 2009 | Great Sand Hills                       | SK       |            |           |                 | COSEWIC  |
| 1985 - 2009 | Medicine Hat                           | AB       |            |           |                 | COSEWIC  |
| 1985 - 2009 | East of Great Sand Hills               | SK       |            |           |                 | COSEWIC  |
| 1985 - 2009 | Big Muddy                              | SK       |            |           | 2               | COSEWIC  |
| 2010 – 2021 | Between Nemiskam and Foremost          | AB       | 2019       |           |                 | D. Johnson   |
| 2010 – 2021 | East of Prairie Home Colony            | AB       | 2019       |           |                 | D. Johnson   |

|             |   |    |      |      |       |                          |
|-------------|---|----|------|------|-------|--------------------------|
| 2010 – 2021 | North of Etzikom  | AB | 2018 | 2019 |       | D. Johnson               |
| 2010 – 2021 | South of Manyberries  | AB | 2019 |      |       | D. Johnson               |
| 2010 – 2021 | Highway 41 just north of USA  | AB |      |      |       | D. Johnson               |
| 2010 – 2021 | Twin River Heritage Rangeland Natural Area                                | AB | 2014 |      |       | D. Johnson               |
| 2010 – 2021 | Kennedy Coulee and Milk River Natural Area                                | AB | 2018 |      |       | D. Johnson               |
| 2010 – 2021 | southeastern Alberta  | AB | 2016 |      |       | D. Johnson               |
| 2010 – 2021 | southeastern Alberta  | AB | 2016 |      |       | D. Johnson               |
| 2010 – 2021 | southeastern Alberta  | AB | 2016 |      |       | D. Johnson               |
| 2010 – 2021 | North of Twin River Heritage Rangeland Natural Area, and SW of Warner, AB | AB | 2018 |      |       | D. Johnson               |
| 2010 – 2021 | Halfway between Bow Island and Foremost                                   | AB | 2019 |      |       | D. Johnson               |
| 2010 – 2021 | Milk River Natural Area   | AB |      |      |       | D. Johnson               |
| 2010 – 2021 | Near Pakowki Lk   | AB | 2013 |      |       | D. Johnson               |
| 2010 – 2021 | East of Milk River  | AB | 2020 |      |       | D. Johnson               |
| 2010 - 2021 | Prairie Pastures Conservation Area (Nashlyn)                              | SK | 2021 |      | 15-20 | K. Hecker & R. Turnquist |
| 2010 - 2021 | Grasslands National Park (West Block)                                     | SK | 2021 |      |       | S. Liccioli              |

1168 <sup>a</sup> Data source abbreviations as follows: AAFC – Agriculture and Agri-Foods Canada; CNC - Canadian National  
 1169 Collection of Insects, Arachnids, and Nematodes; COSEWIC – Committee on the Status of Endangered Wildlife in  
 1170 Canada (2012); UGCBG – University of Guelph, Centre for Biodiversity Genomics; D. Johnson – D. Johnson,  
 1171 University of Lethbridge, AB; inaturalist.org – [www.inaturalist.org](http://www.inaturalist.org); JBWM – JB Wallis/RE Roughley Museum at  
 1172 University of Manitoba; LEM – Lyman Entomological Museum, McGill University; Vickery and Kevan - Vickery, V.R.,  
 1173 and D.K. McE. Kevan. 1985. The Grasshoppers, crickets and related insects of Canada and adjacent regions.  
 1174 Agriculture Canada, Research Branch, Publication 1777, Ottawa.

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## Appendix B: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>13</sup>. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s<sup>14</sup> (FSDS) goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the management plan itself, but are also summarized below in this statement.

This management plan will benefit the environment by promoting the conservation of the Greenish-white Grasshopper. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will benefit the environment and will not entail any significant adverse effects. The most significant effect that conservation and habitat management for Greenish-white Grasshopper will have on other species will be the protection of grassland habitats.

Many other species use native grassland habitats during all or portions of their life cycles in locations that overlap to varying degrees with the range of Greenish-white Grasshopper. This includes several federal species at risk: Dakota Skipper (*Hesperia dacotae*), Monarch (*Danaus plexippus*), Mormon Metalmark (*Apodemia mormo*), McCown's Longspur (*Rhynchophanes mccownii*), Baird's Sparrow (*Ammodramus bairdii*), Chestnut-collared Longspur (*Calcarius ornatus*), Long-billed Curlew (*Numenius americanus*), Sprague's Pipit (*Anthus spragueii*), Sage Thrasher (*Oreoscoptes montanus*), Ferruginous Hawk (*Buteo regalis*), Greater Sage-grouse (*Centrocercus urophasianus*), American Badger *taxus* subspecies (*Taxidea taxus taxus*), Swift Fox (*Vulpes velox*) and Buffalograss (*Bouteloua dactyloides*). Conservation and management efforts that are designed to conserve and restore native prairie or create grassland habitats could benefit these species. To avoid potential negative effects on other species at risk, the ecological risks to other species should be evaluated prior to the implementation of habitat management actions for Greenish-white Grasshopper. For more information on how Greenish-white Grasshopper interact with other species and the ecosystem, refer to the following sections of this document: Species Description, Needs of the Greenish-white Grasshopper, Threats and Conservation Measures.

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<sup>13</sup> [www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html](http://www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html)

<sup>14</sup> [www.fsds-sfdd.ca/index.html#/en/goals/](http://www.fsds-sfdd.ca/index.html#/en/goals/)