Idaho Point-headed Grasshopper Survey and Inventory

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ABSTRACT

The Idaho point-headed grasshopper (*Acrolophitus pulchellus*) (IPG) is a rare Idaho endemic known to occur in xeric shrublands of Idaho's Birch Creek and Big Lost River drainages. The species is known from only 17 records dating from 1883 to 1993. Surveys conducted in 2002-2003 failed to detect IPGs, leading to speculation that the species was extinct. Due to the lack of essential information on distribution and status, the IPG is designated as an Idaho Species of Greatest Conservation Need and a Bureau of Land Management Type 2 Sensitive Species. The purpose of our project was to survey public lands within the known range of this species to demonstrate, if possible, its extant status, evaluate habitat composition and condition at historical sites of collection, and assess its general conservation status.

We surveyed 7 historic collection sites and 22 additional sites from 21 July to 20 August 2010. We detected 55 IPGs in 11 of 29 survey sites. We recorded a majority of detections in the Birch Creek Valley of Clark County (n = 41) on public lands managed by the Upper Snake BLM Field Office and the Dubois Ranger District of Caribou-Targhee National Forest. We recorded IPG in Custer County (n = 14) in the Big Lost River drainage on public lands managed by the Challis BLM Field Office. We did not detect IPG in Lemhi or Butte counties, in the Little Lost River Valley, or on public lands managed by the Salmon BLM Field Office. Five of 7 historic collection sites were found occupied by IPG. Of 22 additional sites surveyed, we located IPG at 6 new localities in Clark County. Occupied sites were located on outwash fans, alluvial fan and stream terraces, and foothills at elevation range 1572 m to 2082 m. Soils were well drained and gravelly to gravelly-loamy with unconsolidated surface gravels and cobbles. Sites were barren to sparsely vegetated with low-growing xeric shrubs, grasses, forbs, vagrant lichens, and moss/ lichen biological soil crusts.

We discovered previously unreported aspects of IPG appearance, life history, and behaviors. We documented sexual dimorphism in IPG size and color and observed IPG foraging on stemless mock goldenweed (*Stenotis acaulis*). Reproductive behaviors were documented at communal "lek" sites where both sexes exhibited stridulation (calling songs produced by rubbing of the femur against the forewing) and crepitation (visual/ acoustical communication involving rapid flexing or snapping of the hindwings in flight).

Our survey indicated widespread but low magnitude impacts to occupied IPG habitat from noxious weeds and invasive plants, off-highway vehicle (OHV) use, conversion of native habitat to agricultural use, and livestock grazing. Management actions that: refrain from pesticide use in areas the IPG is known or predicted to occur; prevent the spread of noxious weeds and exotic invasive plants; restrict OHV travel to designated routes; utilize native species for rangeland restoration projects; and closely monitor livestock grazing impacts in known breeding sites should benefit this rare endemic grasshopper.

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INTRODUCTION

The Idaho point-headed grasshopper (*Acrolophitus pulchellus*) (IPG) is a rare Idaho endemic known to occur in xeric shrublands of Idaho's Birch Creek and Big Lost River drainages. The species is designated as an Idaho Species of Greatest Conservation Need (SGCN) due to lack of essential information on distribution and population status (Idaho Department of Fish and Game [IDFG] 2005). The Idaho State Office of Bureau of Land Management (BLM) lists the IPG as a Type 2 Sensitive Species, indicating that populations are imperiled rangewide, extinction risk is high, and likelihood of being listed under the Endangered Species Act in the foreseeable future is also high. Prior to this survey, no IPG had been observed for 17 years, raising the prospect that the species was extinct (Baker 2003).

Fewer than 20 records exist for the IPG (Table 1). The most recent collections were in 1972, when 5 specimens were collected in 3 excursions to Birch Creek Valley (Scoggan and Bresven 1972), and in 1993, when 2 specimens were collected in 7 days of survey in the Birch Creek Valley (Kell et al. 1993). During 2002-2003, Baker (2003) surveyed historical sites of collection and other potentially suitable sites, but found no IPG. He speculated that extreme drought had suppressed populations, resulting in low density or possibly extinction.

Considering the lack of information regarding ecology and current status, recommended actions in the Idaho Comprehensive Wildlife Conservation Strategy (CWCS) call for additional attempts to locate the IPG (IDFG 2005). The objectives of this project were to:

1. Survey public lands within the known range of IPG to demonstrate, if possible, its extant status.

2. Evaluate habitat composition and condition at all historical sites of collection.

3. Report all IPG occurrences, including locations, habitat composition and condition, current land uses, and potential threats.

4. Assess the conservation status of the IPG and make any necessary recommendations regarding conservation management.

STUDY AREA

The study area encompassed portions of the Challis, Salmon, and Upper Snake Field Offices of the Idaho Falls District of BLM; Dubois Ranger District of Caribou-Targhee National Forest; and Upper Snake and Salmon IDFG administrative regions. The core study area was located in the Big Lost River, Little Lost River, and Birch Creek fault-block valleys of east-central Idaho within the Beaverhead Mountains Ecological Section (Figs. 1, 2). These 3 drainages form part of the Sinks Drainages that originate in the mountains of southeastern Idaho and flow southward where they percolate into the Snake River Plain aquifer (IDFG 2007).

The Big Lost River is the largest of the Sink Drainages, originating in the Pioneer, Boulder, Lost River, and White Knob mountain ranges of east-central Idaho. Topography is varied and dramatic, with elevations ranging from 1460 m at the Big Lost River Sinks to 3859 m at Borah

Peak summit. Valleys are dominated by huge alluvial fans comprised of gravelly loam radiating from the steep, rugged mountains. Valley climate is seasonally influenced by moist Pacific Ocean air masses and dry, cold continental fronts from Canada. Resulting precipitation is relatively uniform throughout the year. Mean annual precipitation at Mackay (period of record 1954-2005) was 25 cm and temperatures ranged from -36 to 40° C (IDEQ 2004). Valley and foothill land cover is predominantly Inter-mountain Basins Big Sagebrush Steppe and Inter-mountain Basins Montane Sagebrush Steppe (Appendix B).

The Little Lost River drainage is a high elevation valley rimmed by the Big Lost River Range to the west and the Lemhi Range to the east. Elevations range from 1463 m at the Little Lost River Sinks to 3000-3600 m peaks in the Big Lost River and Lemhi ranges. Mountain tributaries are short and flow steeply from the flanking mountains producing a series of coalescing alluvial fans extending more than halfway across the valley in places. Numerous springs contribute to valley hydrology, making this valley more resistant to drought than the Big Lost River Valley to the west (IDEQ 2000). Mean annual precipitation was ≤25 cm and temperatures ranged from -36 to 40° C (period of record 1954-2005). Inter-mountain Basins Big Sagebrush Steppe, Inter-mountain Basins Montane Sagebrush Steppe, and Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland are the primary land cover types in the valley and foothills.

Birch Creek is a large intermontane valley between the Lemhi Range to the west, and the Beaverhead Mountains to the east. Elevations range from 1458 m at the Birch Creek Sinks to 3500 m at Diamond Peak in the Lemhi Range. Birch Creek Valley is dominated by alluvial fan systems comprised of carbonate bedrock sediments (Moseley 1992). Most drainages in the bordering mountains have no permanent streams. Those that do, sink into the alluvium as groundwater. Mean annual temperatures as measured at the Idaho National Laboratory (period of record from 1954-2005) ranged from -44 to 41° C (Moseley 1992). Land cover in Birch Creek Valley is represented by Inter-mountain Basins Big Sagebrush Steppe and Inter-mountain Basins Montane Sagebrush Steppe, which predominate on the broad alluvial fans.

METHODS

We surveyed all historical collection sites using mapped collection records managed by the Idaho Natural Heritage Program. Each record in this dataset is characterized by how accurately the reported collection site could be mapped. For records with fair to poor location accuracies (i.e., mapped location expected to be within 1 to 5 km of the actual collection site), we searched a 1 km^2 area centered on the mapped point using Global Positioning Systems (GPS) units to locate and navigate the sites. For those records with general location accuracies (vague or problematic data; 9 of 17 records), we surveyed the nearest probable or suitable locations and recorded perimeter coordinates with GPS units. Nearest probable or suitable locations were chosen on the basis of plant community, elevation, landform, soils, and proximity to historically occupied habitat (Scoggan and Brusven 1972, Kell et al. 1993, Baker 2003). A record which mapped high in the Lemhi Range was determined inaccurate and omitted as a survey site. In addition, we surveyed areas of potentially suitable habitat unaffiliated with historic records. These areas were selected to sample spatial gaps between historic collection sites.

We conducted surveys from 21 July to 20 August, expecting that IPG would be in the adult stage and presumably more detectable (Kell et al. 1993). All sites were surveyed at least once. We conducted second surveys at minimum 10-day intervals at historic collection sites where IPG was not detected during the first survey. For all survey sites, a team of 2 observers conducted searches walking in belt transects approximately 20 m apart. We visually inspected the ground surface and vegetation (grasses, forbs, shrubs) while making intermittent sweeps with insect nets to capture and/or flush grasshoppers. Beating sheets were initially used, but abandoned due to greater capture efficiency with sweep nets. We surveyed at temperatures ≥15˚ C, and surveys typically lasted 60 to 90 minutes. Date, time, field identification number, coordinates, and collector were recorded in field notebooks for each grasshopper collected. In addition, observers recorded the substrate on which grasshoppers were collected (i.e., vegetation, ground), surface soil characteristics, topography, general plant associations, and grasshopper behaviors and physical descriptions. We collected a representative sample of grasshoppers from each survey site. At sites occupied by IPG, we collected up to 2 individuals per site and photographed all IPG not collected. All collected grasshoppers were euthanized in kill jars primed with ethyl acetate 99%, then pinned, labeled, and stored in Schmidt boxes equipped with Vaportape II™ insecticidal strips to deter dermestid beetle damage. The W. F. Barr Entomology Museum at the University of Idaho, Moscow, was the principle repository for the grasshopper collection.

We mapped all IPG locations with ArcMap Version 9.3 overlaid with digital land cover and soils layers to examine habitat characteristics. We used 2 land cover layers consistent with respective habitat classification systems used by BLM and IDFG. The standard BLM system is Potential Vegetation Type (PVT), modeled from Natural Resource Conservation Service (NRCS) ecological site descriptions (ESD) (NRCS 2010b). The model used by IDFG is the Northwest Gap Analysis Program (NWGAP) land cover layer. NWGAP is based on ecological systems as defined by NatureServe's "International Ecological Standard: Terrestrial Ecological Classifications (United States Geologic Survey 2008, NatureServe 2010)." We used the NRCS Soil Survey Geographic (SSURGO) data base for soils coverage. Soil survey information was available for the entire study area (Hipple et al. 2006, NRCS 2010b).

RESULTS

Surveys

We surveyed 7 historic collection sites and 22 additional sites from 21 July to 20 August 2010. We detected 55 IPGs in 11 of 29 survey sites (40%) (Table 2, Fig. 2, Appendix C). We recorded a majority of detections in the Birch Creek Valley of Clark County (n = 41) on public lands managed by the Upper Snake BLM Field Office and Dubois Ranger District of Caribou-Targhee National Forest. We recorded IPG in Custer County (n = 14) in the Big Lost River drainage on public lands managed by the Challis BLM Field Office. We did not detect IPG in Lemhi or Butte counties, in the Little Lost River Valley, or on public lands managed by the Salmon BLM Field Office. All IPG detections were located within latitudinal parallels 43° 58' N to 44° 16' N, and longitudinal meridians 112° 32' W and 113° 44' W, an area approximately 98 km wide (E-W) and 33 km long (N-S) (Fig. 2).

Five of 7 (71%) historic collection sites were found occupied by IPG. We detected IPG on first surveys of the Blue Dome, Pete Creek, and Upper Cedar Creek sites, and on second surveys of the Birch Creek and Myers/Grouse sites. The 2 historic sites where IPGs were not detected were the Howe and Skull Canyon sites. The Howe site, which was based on an undated IPG record of fair location accuracy, corresponded to a parcel of fallow private land. Because this portion of the lower Little Lost River Valley has been under cultivation for more than a century, we assumed this was an inaccurate location for this record. The Skull Canyon site, where IPG was collected in 1993, was densely covered by exotic weedy species, including cheatgrass (*Bromus tectorum*) and kochia (*Kochia scoparia*), indicating poor ecological condition.

Of 22 additional sites surveyed, we located IPG at 6 new localities in Clark County. Non-detection of IPG at the other 15 survey sites may have been due to variable detectability, plant phenology, or other biotic and/or abiotic factors. Elevation may have accounted for non-detection at 8 of the additional survey sites in upper Birch Creek Valley near Gilmore Summit (Salmon FO). Elevations in upper Birch Creek ranged from 2073 m to 2246 m. Soils and landform features were similar to other IPG occupied sites, but plant associations and stunted structure indicated harsher climatic conditions. Elevations at positive detection sites across the study area ranged from 1572 m to 2082 m ($\bar{x}$ = 1859 m, SD = 130).

Habitat Associations

Survey sites occupied by IPG shared several coarse-scale environmental features. Survey sites were located in 2 of 5 basins (Birch, Big Lost) of the Sinks Drainages in southeast Idaho. Both basins contain high elevation valleys rimmed by mountain "island" land masses. Soil map unit characteristics for foothills and valleys show average annual precipitation in the range of 23 to 25 cm (NRCS 2010b). Topography at survey sites included windswept, flat to gently rolling outwash fans, alluvial fan terraces, stream terraces, fan remnants, and foothills between 1572 m to 2082 m. Soil properties were typically well drained, and gravelly to gravelly-loamy with unconsolidated surface gravels and cobbles. Survey sites were often sparsely vegetated with matrices of low-growing xeric shrubs, grasses, forbs, and vagrant lichens, and evidence of a moss/lichen biological soil crust.

PVT Analysis —Detections were associated with 8 ESDs in various combinations (Table 3, Appendix A). The most common ESDs at sites occupied by IPG were Gravelly Loam 8-12" ARTRW8/PSSPS and Shallow Gravelly Loam 8-12" ARAR8/PSSPS-ACHY. These data did not statistically compare habitat use and availability, thus, results are preliminary and should not be interpreted as IPG habitat preferences

NWGAP Analysis.—NWGAP predicted land cover types associated with IPG detections (n = 55) comprised 5 ecological systems (Table 4, Appendix B): Intermountain Basins Montane Sagebrush Steppe (n = 26), Intermountain Basins Big Sagebrush Steppe (n = 16), Northern Rocky Mountains Lower Montane, Foothill, and Valley Grassland (n = 7), Open Space (n = 4), and Intermountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (n = 1). Mapped ecological systems at most occupied sites correctly classified vegetation cover type with the exception of 4 locations at the Blue Dome site, which were erroneously designated as Open Space (Appendix B). These sites were within 30 m of Idaho State Highway 28, and spectral

characteristics of the site were evidently influenced by the road surface. As with PVT, these are preliminary land cover data and should not be interpreted as IPG habitat preferences.

Floristic Associations—Sites occupied by IPG shared several floristic characteristics. Shrub layers were open-canopied (estimated ≤5 percent cover) with low stature. Shrub composition was typically a mix of Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), black sagebrush (*A. nova*), and/or low sage (*A. arbuscula* ssp. *arbuscula*), with minor components of green rabbitbrush (*Chrysothamnes viscidiflorus*) and/or shadscale saltbush (*Atriplex confertifolia*). Sites had a sparse to abundant herbaceous layer of cool-season perennial bunch grasses and forbs (estimated ≥10 to 25 percent cover). Important graminoids included bluebunch wheatgrass (*Pseudoroegneria spicata*), Sandberg's bluegrass (*Poa secunda*), Idaho fescue (*Festuca idahoensis*), and Indian rice grass *Achnatherum hymenoides*). Common forbs were stemless mock goldenweed (*Stenotis acaulis*), Hood's phlox (*Phlox hoodii*), aster (*Symphyotrichum* spp.), prickly pear *(Opuntia* spp.), and buckwheat (*Erigonium* spp.). Sites typically had an extensive layer of vagrant lichen (*Rhizoplaca* spp., *Xanthoparmelia* spp.) and evidence of moss/lichen biological soil crusts. Shrubs, forbs, grasses, and vagrant lichens exhibited robust growth and vigor across the study area due to higher than average precipitation during the 2010 water year (NRCS 2010a).

Soil Associations—Sites occupied by IPG were associated with 8 SSURGO soil types (Table 4). Shared characteristics among soil types were geologic landform (e.g., outwash fan, fan terrace); gravelly to gravelly loam surface profiles; loamy-skeletal[1] taxonomic class; and formation in alluvium or colluvium derived from limestone parent material (i.e., calcareous properties).

Identification and Behavior

We identified and aged IPGs in the field from Scoggan and Brusven's (1972) technical descriptions of first through fifth instars and a single photograph of an adult specimen collected in 1972 by Brusven (Baker 2003). Distinguishing characteristics were its conspicuous apple-green and white mottled color pattern, acutely slanted face, filiform (thread-like) antennae, and long, dense pubescence over its body (Fig. 3). Field identification was subsequently verified on the basis of specimens (Frank Merickel, W. B. Barr Museum of Entomology, University of Idaho). We found 53 of 55 IPGs in the adult stage with fully developed reproductive organs and wings. Among 50 individuals in which sex was determined, 44% were male and 56% female. Among 40 individuals in which sex and length (front of head to tip of wings) were recorded, we observed considerable sexual dimorphism in size and coloration. Adult males (n = 17) measured 20 mm to 26 mm in length ($\bar{x}$ = 22 mm, SD = 1.6) and adult females (n = 23) measured 27 mm to 37 mm in length ($\bar{x}$ = 31.65 mm, SD = 2.1). Adult female length averaged 44% greater than male length. Sexual dimorphism was also expressed in adult coloration. Whereas females were predominantly green with white mottling, males exhibited some tan coloration tinged with rufous on the antennae, distal edge of the pronotum, femora, and forewings (Fig. 4).

[1] Skeletal soils are soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments.

Our ability to detect and capture IPGs was aided by its unique response to visual stimuli compared to most other grasshoppers we encountered. Upon our approach, it remained quiescent, shifted slightly, or made a few short hops. Individuals were easily captured by hand, whereas, most other grasshoppers responded to our approach with rapid jumping and flight, requiring our use of sweep nets. We found IPGs on the ground in 89% (n = 49) of detections. In the few instances we detected IPG on vegetation (n = 6), individuals were resting or feeding on stemless mock goldenweed. In contrast to most herbaceous plants at survey sites, stemless mock goldenweed had not yet transitioned to senescence. Adult IPG were remarkably camouflaged against the green and dried leaves and peduncles of stemless mock goldenweed, exhibiting an effective combination of disruptive coloration and crypsis that made visual detection especially challenging (Fig. 5).

We documented reproductive behaviors of IPG unreported in the literature. At the Pass Creek survey site on 28 July, we encountered a "lek" of several males producing calling songs. Songs consisted of a series of 2 to 9 brief "chirps" produced by rubbing of the femur against the forewing (stridulation), which were audible from 8 m. We followed male calling songs to locate, photograph, and film stridulating males and a copulating pair (Fig. 6). We documented a stridulating female at the Eightmile Canyon Flats survey site, establishing that both sexes communicate in this manner. Notably, we documented crepitation behavior (visual/acoustical communication involving rapid flexing or snapping of the hindwings in flight) by 1 male and 2 females at lek sites. This finding is apparently uncommon among other species of the Gomphocerinae subfamily, of which only a few are known to crepitate (Richmond et al. 1993). We did not document egg deposition by gravid females, but suspect egg-laying occurred at or near sites where males were attending females. These sites appeared to have loamier soils than other detection sites, suggesting an important soils characteristic for oviposition.

DISCUSSION

We demonstrated that the IPG is an extant species in Clark and Custer counties, occupying 5 of 7 historical sites of collection and 6 newly discovered sites. Our surveys contributed 55 new occurrence records, increasing the number of known records by >3-fold. Our survey was conducted after 2 consecutive years of above normal precipitation as recommended by Baker (2003). He suggested that such conditions would allow potentially drought-stressed IPG populations to recover, thereby increasing its detectability. We attribute our success in finding IPG in part to favorable climatic and range conditions, but also to survey timing which coincided with gregarious mating behaviors, which enabled visual and auditory detection of this species.

The lack of IPG detections in the Little Lost drainage may have been "false absences" (i.e., it was present but undetected) possibly due to sampling conditions (e.g., dense grass growth). As the intervening drainage between the Big Lost and Birch Creek drainages, the Little Lost is situated as a probable linkage zone between extant populations. Environmental features (e.g., vegetation, soils, and landform) were consistent with occupied sites in the Big Lost and Birch Creek drainages. Given both physiographic and habitat suitability, we believe extant populations likely occupy the Little Lost drainage and recommend that future surveys for this species be attempted.

The highest elevation sites occupied by IPG were Myers/Grouse at 2082 m and Upper Cedar Creek at 2003 m. Searches in the upper Birch Creek Valley near Gilmore Summit at higher elevations yielded no IPG detections despite similar soils and landforms to occupied sites. We surmise that the maximum elevation threshold for this species is at or near 2100 m, in which case potentially suitable habitats in the Salmon FO north of Gilmore Summit (e.g., ≤2100 m) should be considered for future surveys.

Our survey found widespread but generally low magnitude impacts at historic collection sites from off-highway vehicles (OHV), livestock grazing, and noxious/invasive weeds, with the exceptions of the Blue Dome and Skull Canyon survey sites. Blue Dome had widespread disturbance impacts from a gravel pit, water diversions, road construction, livestock grazing, and range seeding. Spotted knapweed (*Centaurea maculosa*) was patchy along roads and irrigation ditches. Most of the SW survey quadrant had been converted from native habitat to crested wheatgrass (*Agropyron cristatum*) and other exotic livestock forage species. Grasshopper numbers and diversity were considerably lower in this quadrant. OHV tracks were evident on slopes and terraces where seasonally compact ground and lack of shrubs facilitates travel. OHV compressional impacts can negatively impact many aspects of the structure and function of biological soil crusts, which in turn can affect a cascade of ecological functions from soil hydrology to vascular plant health (Belnap et al. 2001). In general, the sparsely vegetated slopes and terraces where IPG were detected received light cattle use, but locally heavy impacts were found at salt block sites and along the Pass Creek bottoms where IPG mating was documented. Anthropogenic impacts at the Skull Canyon site were primarily from OHV use and associated invasion of noxious and invasive weedy species along the canyon floor. Cheatgrass, kochia, and other weedy species have outcompeted native herbaceous species, perhaps to the degree the site is no longer suitable for IPG.

Our study identified a consistent association between IPGs and stemless mock goldenweed. Through several ad hoc field observations, we documented IPG feeding, resting, stridulating, and copulating on this plant (Figs. 5-7). In the adult stage, IPG is remarkably foliage-cryptic to stemless mock goldenweed (Fig. 5). Plant-associated crypsis in grasshopper species provides protection from predators, particularly if the species is relatively sedentary (Joern et al. 1986, Chambers et al. 1995). This correspondence between foliage crypsis and sedentary behavior (exhibited by IPG) suggests the importance of such crypsis in the foraging and reproductive behaviors of IPG.

We suspect stemless mock goldenweed is an important host plant for adult IPG, but emphasize that our observations may have shown temporal, opportunistic use based on plant abundance or favorable growth stage. Past collectors have widely speculated about IPG host plant preferences. Brunner (1890) reported collecting IPG from spiny hopsage (*Grayia spinosa*) in the Blue Dome vicinity. Baker (2003) noted that spiny hopsage was absent from the Blue Dome and Birch Creek collection sites, and suggested Brunner meant shadscale saltbush (*Atriplex confertifolia*), which is present. Other collectors suspected rabbitbrush (*Chrysothamnus* spp.) was a primary host plant (Kell et al.1993). One of the most prolific collectors, Dr. Merlyn Brusven, stated they were "possibly on the low forbs in the open areas between the shrubs (Baker 2003)." Baker (2003) also speculated that IPG may be a ground dweller that only incidentally was collected on shrubs. Future investigations should attempt to identify preferred host plants of IPG and

determine if the species is a mixed or specialist feeder. If the species is truly a forb specialist, adequate precipitation, which greatly influences annual vegetative growth, may be a critical aspect of its demography.

Investigations of rare, elusive, or spatially clustered populations can be particularly challenging for researchers and managers in wildlife-related disciplines. Apparent rarity may be related to survey methods that fail to detect a species (MacKenzie 2005). In our study, we were challenged to find a purportedly rare or extinct species in which we had no discernable search image and little information on abiotic or biotic predictor variables. One of our original project objectives was to develop estimations of detection probability for IPG. But given our rudimentary knowledge of its physical characteristics, life history patterns, and habitat associations, this objective overreached our capabilities for this initial survey. Instead, we focused on acquiring these basic data, which would help inform an appropriate study design incorporating occupancy estimation and detection probability in future investigations of the species. Our survey approach at historical sites of collection was effective in focusing searches where populations were more likely persistent. Once we acquired a specific search image of IPG, survey efficiencies improved. We suspect that lack of a search image may have accounted for our non-detections at the Birch Creek and Myers/Grouse sites during the first round of surveys. Our primary search image cues were visual, focusing on the species' unique locomotion (i.e., short-range lethargic hops when flushed). Secondary visual cues were its distinctive color pattern and association with barren areas with moderate forb cover. At lek sites, we used acoustic cues to detect stridulating and crepitating IPGs to good effect. Our survey was valuable in identifying several baseline covariates that appeared to influence the detectability of this species (Table 5). These covariates should be considered when developing protocols for estimation of detection probability for IPG, an important first step in developing effective population monitoring techniques for this species.

Our survey collection included 147 grasshopper specimens occurring sympatrically with IPG or occupying similar ecological systems. The collection was contributed to the W. F. Barr Entomology Museum, Department of Plant, Soil, and Entomological Sciences, University of Idaho, for curation. Taxonomic experts affiliated with the museum will determine specimen taxa and report results to IDFG. The collection may yield new records for several taxa of SGCN grasshoppers for which essential information pertaining to their status is lacking (Appendix D).

MANAGEMENT RECOMMENDATIONS

While certain aspects of the status, habitat, and life history of IPG were illuminated by this survey, we are still limited in the inferences we can draw about this rare Idaho endemic. Our survey indicated that short-term impacts to its habitat were of low magnitude. In this context and within its limited known range, we suggest the following management considerations to benefit this species:

1. Develop a sustainable monitoring program to periodically evaluate habitat conditions and population status.

2. Determine location of occupied sites through surveys targeting potentially suitable habitat. Consider development of species distribution model as a basis for prospective surveys and monitoring.

3. Working with IDFG and other partners, conduct vegetation assessments (e.g., physiognomy, structure, composition) to determine preferred habitat associations of IPG.

4. Refrain from use of pesticides in areas where IPG is known or predicted to occur.

5. In areas supporting IPG populations, restrict all OHV travel to existing roads and designated trails. Monitor OHV use to ensure compliance with travel management programs.

6. To protect and enhance IPG breeding habitat, closely monitor livestock impacts to soils and vegetation in the Pass Creek (Clark County) riparian corridor and floodplain to minimize soil compaction and overutilization of herbaceous cover.

7. Utilize native species for rangeland revegetation or restoration projects to maintain and restore native vegetation diversity and ecosystem functions.

8. Where feasible, place salt and mineral blocks away from fan and stream terraces to minimize cattle- and motor vehicle-associated compression of fragile, erosive soils.

9. Continue involvement in the Continental Divide and Custer County Cooperative Weed Management Areas to prevent the introduction, reproduction, and spread of spotted knapweed and other designated noxious weeds and invasive plants.

10. Maintain BLM Sensitive Species status ranking of the IPG.

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LITERATURE CITED

Baker, C. 2003. Idaho point-headed grasshopper surveys: 2002 and 2003. Report prepared for USDI Bureau of Land Management, Boise District Office, Boise, ID, USA.

Belnap, J., J. H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological soil crusts: Ecology and management. Technical Reference 1730-2. USDI Bureau of Land Management, Denver, CO, USA.

Bruner, L. 1890. New North American Acrididae, found north of the Mexican boundary. Proceedings of the United States National Museum 12(764): 47-82.

Chambers, P., G. Sword, J. E. Angel, S. Behmer, and E. A. Bernays. 1996. Foraging by generalist grasshoppers: two different strategies. Animal Behavior 52:155-165.

Hipple, K., K. Langersmith, R. Windward, D. Ames, and B. Duncan. 2006. Soil survey of Custer-Lemhi area, Idaho, parts of Blaine, Custer, and Lemhi counties. USDA Natural Resources Conservation Service. <http://soildatamart.nrcs.usda.gov/Manuscripts/ID752/0/ Custer_Lemhi.pdf >. Accessed 24 Nov 2010.

Idaho Department of Environmental Quality. 2004. Big Lost River Subbasin TMDL. Boise, ID, USA. < http://www.deq.idaho.gov/water/data_reports/surface_water/tmdls/big_lost_river/ big_lost_chap1_pages1to18.pdf>. Accessed 29 Nov 2010.

Idaho Department of Environmental Quality. 2000. Little Lost River Subbasin TMDL. Boise, ID, USA. <http://www.scc.idaho.gov/TMDL%20Plans/LittleLostRiverTMDL_DEQAug2000.pdf>. Accessed 29 Nov 2010.

Idaho Department of Fish and Game. 2005. Idaho Comprehensive Wildlife Conservation Strategy. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. <http://fishandgame.idaho.gov/cms/tech/CDC/cwcs.cfm>. Accessed 10 Nov 2010.

Idaho Department of Fish and Game. 2007. Mountain whitefish conservation and management plan for the Big Lost River drainage, Idaho. Boise, ID, USA.

Joern, A., R. Mitschler, and H. O'Leary. 1986. Activity and time budgets of three grasshopper species (Orthoptera, Acrididae) from a sandhills grassland. Journal of the Kansas Entomological Society 59**,** 1–6.

Kell, W., T. Zeik, and A. Benolkin. 1993. A survey of *Acrolophitus pulchellus* in Birch Creek, Idaho. USDA, Animal Plant Health Inspection Service, Plant Protection and Quarantine, Boise, ID, USA.

MacKenzie, D. I. 2005. What are the issues with presence-absence data for wildlife managers? Journal of Wildlife Management. Volume 69 (3):849-860.

Morse, C. A. 1994. *Stenotis acaulis*. *In*: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 12+ vols. New York and Oxford. Vol. 20, p. 175.

Moseley, R. K. 1992. Ecological and floristic inventory of Birch Creek fen, Lemhi and Clark counties, Idaho. Idaho Department of Fish and Game, Boise, ID, USA.

NatureServe. 2010. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, USA. <http://www.natureserve.org/publications/usEcologicalsystems.jsp>. Accessed 10 Nov 2010.

Natural Resources Conservation Service. 2010a. National Water and Climate Center. SNOWTEL historical precipitation data for eastern Idaho. <http://www.wcc.nrcs.usda.gov/snow/snotel-precip-data.html>. Accessed 15 Nov 2010.

Natural Resources Conservation Service. 2010b. Web Soil Survey. Clark County, Idaho soil map. <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>. Accessed 29 Nov 2010.

Richmond, D. B., D. C. Lightfoot, C. A. Sutherland, and D. J. Ferguson. 2003. A manual of the grasshoppers of New Mexico: Orthoptera: Acrididae and Romaleidae. New Mexico State University Cooperative Extension Service, Las Cruces, USA.

Scoggan, A. C. and M. A. Brusven. 1972. Differentiation and ecology of common immature Gomphocerinae and Oedipodinae (Orthoptera: Acrididae) of Idaho and adjacent areas. Melanderia. Washington State Entomological Society, Vol. 8.

United States Geologic Survey. 2008. Gap Analysis Program Northwest. < http://gap.uidaho.edu/index.php/gap-home/Northwest-GAP/landcover>. Accessed 15 Nov 2010.

Table 1. Records of Idaho point-headed grasshopper (*Acropholitus pulchellus*).

Date	Location	Collector	Source/citation	No. collected
1883	Birch Creek, Clark Co.	L. Bruner	Bruner 1890	2
1950	Blue Dome, Clark Co.	K. Evans	W.F. Barr Entomological Museum University of Idaho, Moscow	3
1952	Blue Dome area, Clark Co.	F. V. Nonini	Animal Plant, Health & Inspection Service collection Boise, Idaho	1
1952	Birch Creek, Clark Co.	F. V. Nonini	W.F. Barr Entomological Museum University of Idaho, Moscow	2
1952	West Blue Dome, Clark Co.	F. V. Nonini	Animal Plant, Health & Inspection Service collection Boise, Idaho	1
1961	¼ mi. N. Myers-Grouse Creek drift fence, Clark Co.	F. V. Nonini	W.F. Barr Entomological Museum University of Idaho, Moscow	2
1962	6 mi. NW of Mackay, Idaho, Custer Co.	W. F. Barr	W.F. Barr Entomological Museum University of Idaho, Moscow	1
1962	1 mi. NW Blue Dome, Clark Co.	G. B. Hewitt	W.F. Barr Entomological Museum University of Idaho, Moscow	3
1962	17 mi. W of Dubois, Idaho, Clark Co.	F. V. Nonini	W.F. Barr Entomological Museum University of Idaho, Moscow	2
1965	Clark Co.	F. V. Nonini	Animal Plant, Health & Inspection Service collection Boise, Idaho	1
1965	Clark Co.	G. Forsyth	Animal Plant, Health & Inspection Service collection Boise, Idaho	5
1966	8 mi. NW of Mackay, Idaho, Custer Co.	D. Horning	W.F. Barr Entomological Museum University of Idaho, Moscow	2
1972	½ to 1 mi. W of Blue Dome, Clark Co.	M. Brusven	Baker 2003	5
1993	Birch Creek Valley, T9N R30E S34, Clark Co.	A. Benolkin	Kell et al. 1993	1
1993	Skull Canyon, T10N R30E S29, Clark Co.	A. Benolkin	Kell et al. 1993	1
Unknown	2 mi. E of Howe, Idaho, Butte Co.	Unknown	Animal Plant, Health & Inspection Service collection Boise, Idaho	1
Unknown	Clark Co.	Unknown	Animal Plant, Health & Inspection Service collection Boise, Idaho	1

Table 2. Locations of Idaho point-headed grasshopper (*Acrolophitus puchellus*) detections in the Idaho Falls BLM District and Caribou-Targhee National Forest, 2010. Locations are Decimal Degrees, WGS 84.

Collection no.	Date	Location	County	BLM Field Office	Latitude	Longitude
2010-034	7/21/2010	Blue Dome-Pass Creek Rd	Clark	Upper Snake	44.1694	-112.9229
2010-035	7/21/2010	Blue Dome-Pass Creek Rd	Clark	Upper Snake	44.1673	-112.9212
2010-036	7/21/2010	Blue Dome-Pass Creek Rd	Clark	Upper Snake	44.1694	-112.9225
2010-043	7/21/2010	Blue Dome-Pass Creek Rd	Clark	Upper Snake	44.1701	-112.9236
2010-044	7/21/2010	Blue Dome-Pass Creek Rd	Clark	Upper Snake	44.1693	-112.9228
2010-074	7/24/2010	Myers/Grouse	Clark	CTNF Dubois RD	44.2679	-112.7031
2010-075	7/24/2010	Myers/Grouse	Clark	CTNF Dubois RD	44.2679	-112.7031
2010-082	7/25/2010	Pete Creek	Custer	Challis	43.9769	-113.7162
2010-083	7/25/2010	Pete Creek	Custer	Challis	43.9770	-113.7161
2010-085	7/25/2010	Pete Creek	Custer	Challis	43.9800	-113.7085
2010-086	7/25/2010	Pete Creek	Custer	Challis	43.9789	-113.7104
2010-119	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1606	-112.9464
2010-120	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1605	-112.9470
2010-121	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1587	-112.9507
2010-122	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1578	-112.9471
2010-123	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1584	-112.9463
2010-124	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1583	-112.9463
2010-125	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1583	-112.9462
2010-126	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1582	-112.9460
2010-127	7/28/2010	Pass Creek W of Blue Dome	Clark	Upper Snake	44.1585	-112.9461
2010-128	8/1/2010	Birch Creek	Clark	Upper Snake	44.0739	-112.8667
2010-129	8/1/2010	Birch Creek	Clark	Upper Snake	44.0738	-112.8665
2010-130	8/1/2010	Birch Creek	Clark	Upper Snake	44.0748	-112.8648
2010-131	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-132	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-133	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-134	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-135	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-136	8/1/2010	Birch Creek	Clark	Upper Snake	44.0746	-112.8650
2010-137	8/2/2010	Myers/Grouse	Clark	CTNF Dubois RD	44.2691	-112.7063
2010-139	8/3/2010	Upper Cedar Creek	Custer	Challis	43.9839	-113.7110
2010-140	8/3/2010	Upper Cedar Creek	Custer	Challis	43.9839	-113.7110
2010-141	8/3/2010	Upper Cedar Creek	Custer	Challis	43.9839	-113.7110
2010-142	8/3/2010	Upper Cedar Creek	Custer	Challis	43.9839	-113.7110
2010-143	8/3/2010	Upper Cedar Creek	Custer	Challis	43.9854	-113.7085
2010-151	8/4/2010	Cedar Creek Bar	Custer	Challis	43.9824	-113.7344
2010-152	8/4/2010	Cedar Creek Bar	Custer	Challis	43.9810	-113.7334
2010-153	8/4/2010	Cedar Creek Bar	Custer	Challis	43.9810	-113.7334
2010-154	8/4/2010	Cedar Creek Bar	Custer	Challis	43.9817	-113.7311
2010-155	8/4/2010	Cedar Creek Bar	Custer	Challis	43.9817	-113.7311
2010-156	8/4/2010	Kaufman Gulch	Clark	Upper Snake	44.1781	-112.9479
2010-160	8/4/2010	Kaufman Gulch	Clark	Upper Snake	44.1791	-112.9459
2010-180	8/5/2010	N of Lidy Hot Springs	Clark	Upper Snake	44.1418	-112.5422
2010-181	8/5/2010	N of Lidy Hot Springs	Clark	Upper Snake	44.1418	-112.5422
2010-182	8/5/2010	N of Lidy Hot Springs	Clark	Upper Snake	44.1418	-112.5422

Collection no.	Date	Location	County	BLM Field Office	Latitude	Longitude
2010-183	8/5/2010	N of Lidy Hot Springs	Clark	Upper Snake	44.1417	-112.5422
2010-184	8/5/2010	N of Lidy Hot Springs	Clark	Upper Snake	44.1417	-112.5417
2010-185	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0966	-112.8759
2010-186	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0966	-112.8759
2010-187	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0966	-112.8759
2010-188	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0979	-112.8763
2010-189	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0979	-112.8763
2010-190	8/10/2010	Eightmile Canyon Flats	Clark	Upper Snake	44.0979	-112.8763
2010-192	8/11/2010	Eightmile Bench	Clark	Upper Snake	44.0765	-112.8835
2010-194	8/11/2010	Bald Mountain Gulch	Clark	Upper Snake	44.1184	-112.9352

Table 3. PVT at sites occupied by Idaho point-headed grasshopper (*Acrolophitus pulchellus*), 2010.

NRCS Ecological Site	No. of detections	Percent of occurrences
Gravelly loam 8-12” ARTRW8/PSSPS	14	25
Shallow gravelly loam 8-12” ARAR8/PSSPS-ACHY	14	25
Gravelly loam 8-12” ARTRW8/PSSPS / Shallow gravelly loam 8-12” ARAR8/PSSPS-ACHY	7	13
Gravelly loam 12-16” ARAR8/PSSPS-FEID / Loamy 16 –22” ARTRV/FEID	6	11
Shallow gravelly loam 8-12” ARAR8/PSSPS-ACHY / Windswept 8-11” ARFR4/POSE	5	9
Limey gravelly 8-13”ARNO4/PSSPS / Gravelly Loam 12-16” ARAR8/PSSPS-FEID	5	9
Limey gravelly 8-13”ARNO4/PSSPS / Loamy 16-22” ARTRV/FEID-PSSPS	3	5
Loamy 8-12” ARTRW8/PSSPS / Gravelly loam 8-12” ARTRW8/PSSPS	1	2

Table 4. Summary of the environmental features at sites occupied by Idaho point-headed grasshopper (*Acrolophitus pulchellus*), 2010.

Occupied site	County	No. of grasshopper detections	Elevation Range (m)	Landform	Soils		Landcover	
					SSURGO Soil type	Character	PVT	NWGAP Ecological Section
Blue Dome	Clark	5	1,881 to 1,883	Outwash fans, fan terraces, fan remnants, hills	Simeroi gravelly loam	Calcareous; gravelly loam	Gravelly loam 8-12" ARTRW8/PSSPS	Inter-mountain basins montane sagebrush steppe
Myers/Grouse	Clark	3	2,025 to 2,082	Fan remnants	Simeroi-Zeale complex	Calcareous; very gravelly silt loam	Limey gravelly 8-13" ARNO4/PSSPS Loamy 16-22 ARTRV/FEID-PSSPS	Inter-mountain basins montane sagebrush steppe / Northern Rocky Mts lower montane, foothill and valley grassland
Pete Creek	Custer	4	1,918 to 1,975	Outwash fans, fan terraces	Windcoat-Fandow complex	Calcareous; shallow to hardpan; gravelly silt and gravelly loam	Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins montane sagebrush steppe / Northern Rocky Mts lower montane, foothill and valley grassland
Pass Creek W. of Blue Dome	Clark	9	1,933 to 1,951	Foothills, fan terraces, fan remnants, outwash fans	Zeale-Meegero complex Nicholia-Goosebury	Calcareous; gravelly loam; shallow to duripan	Loamy 16 –22" ARTRV/FEID	Inter-mountain basins montane sagebrush steppe / Northern Rocky Mts lower montane, foothill and valley grassland
Birch Creek	Clark	9	1,746 to 1,747	Outwash fans, fan terraces, stream terraces, foothills	Simeroi gravelly loam Zer complex	Calcareous; gravelly loam	Gravelly loam 8-12" ARTRW8/PSSPS / Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins big sagebrush steppe
Upper Cedar Creek	Custer	5	2,003 to 2,015	Outwash fans, fan terraces	Windcoat-Fandow complex	Calcareous; shallow to hardpan; gravelly silt and gravelly loam	Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins montane sagebrush steppe
Cedar Creek Bar	Custer	5	1,913 to 1,930	Outwash fans, fan terraces	Windcoat-Fandow complex	Calcareous; shallow to hardpan; gravelly silt and gravelly loam	Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins montane sagebrush steppe
Kaufman Gulch	Clark	2	1,907 to 1,914	Outwash fans, fan terraces, stream terraces	Nicholia-Goosebury Sparmo-Zer complex	Calcareous; gravelly loam; shallow to duripan	Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY / Windswept 8-11" ARFR4/ POSE	Inter-mountain basins montane sagebrush steppe
North of Lidy Hot Springs	Clark	5	1,578 to 1,579	North- and east-facing slopes of mountains and foothills	Mogg-Mogg variant	Ashy; very gravelly loam; shallow to bedrock	Limey gravelly 8-13" ARNO4/PSSPS	Northern Rocky Mts lower montane, foothill and valley grassland / Inter-mountain basins curl-leaf mountain mahogany woodland and shrubland
Eightmile Canyon Flats	Clark	6	1,779 to 1,781	Mountains, foothills, outwash fans, terraces	Zer complex	Loess and slope alluvium derived gravelly loam	Gravelly loam 8-12" ARTRW8/PSSPS / Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins big sagebrush steppe
Eightmile Bench	Clark	1	1,759 to 1,765	Outwash fans, fan terraces, fan remnants, hills	Simeroi gravelly loam	Calcareous; gravelly loam	Gravelly loam 8-12" ARTRW8/PSSPS	Inter-mountain basins big sagebrush steppe
Bald Mountain Gulch	Clark	1	1,900 to 1,912	Mountains, hills, outwash fans, terraces	Zer complex	Loess and slope alluvium derived gravelly loam	Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY	Inter-mountain basins montane sagebrush steppe

Table 5. Covariates influencing the detectability of Idaho point-headed grasshoppers (*Acrolophitus pulchellus*) during surveys, 2010.

Variable	Criteria	Effect on detectability
Survey window	Mid July to mid August window coincides with adult phase; species is full size, gregarious, engages in stridulation/crepitation	Increase
Temperature	Cool temperatures inhibit activity	Decrease
	Warm temperatures facilitate activity	Increase
Cloud cover	Heavy cloud cover reduces/minimizes color contrast	Decrease
	Clear to party sunny conditions improve/maximize color contrast	Increase
Wind speed	Winds ≥Beaufort Scale 4 (13-17 km/hr) may cause grasshoppers to retreat into rocky substrates/plant canopies	Decrease
Grass cover	Dense grass growth, particularly in steppe-dominated communities, obscures the ground	Decrease
Soil surface	Surface cobble/stones provide escape cover and disruptive coloration	Decrease
Search interval	Search interval should be scaled to sampling unit size for adequate coverage	Increase
Observer visual acuity	20:20 vision within field of view (from standing position to distal end of sweep net or ≤2 m)	Increase
Observer aural acuity	Excellent hearing to a distance of 10 m	Increase

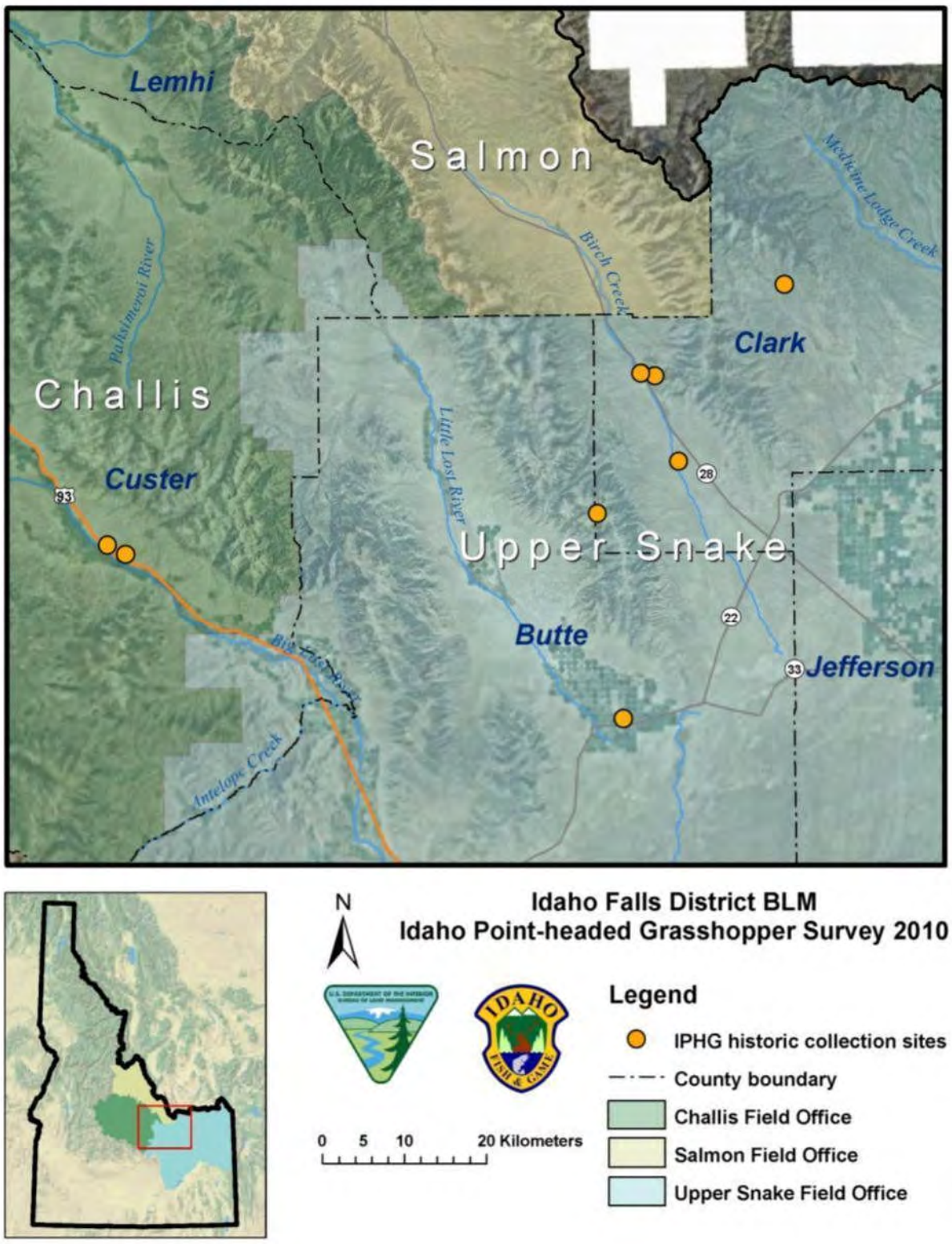


Figure 1. Location of the Idaho Falls BLM District study area and historic collection sites of Idaho point-headed grasshoppers (*Acropholitus pulchellus*).

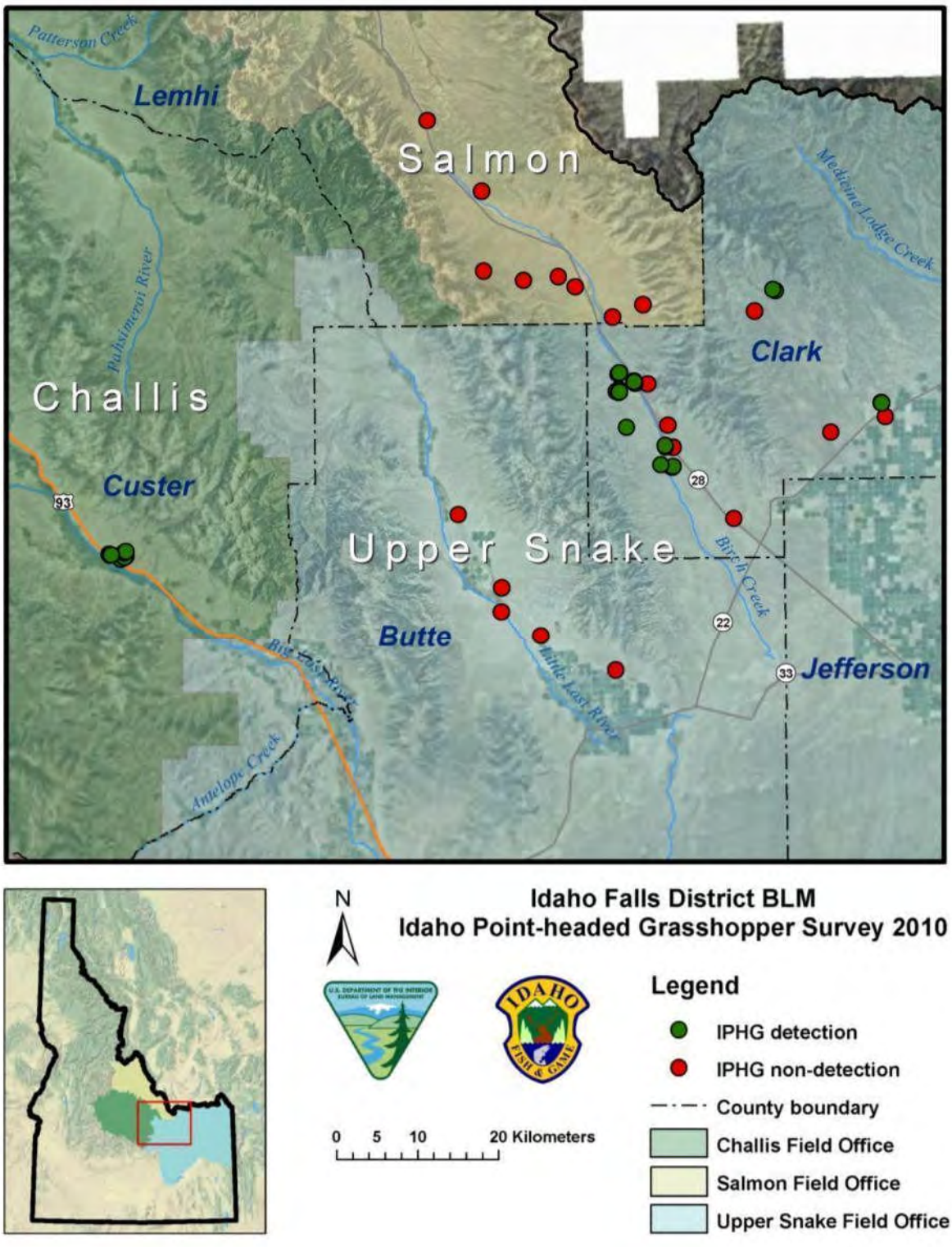


Figure 2. Map of study area showing Idaho point-headed grasshopper (*Acropholitus pulchellus*) survey sites and results.

Figure 3. An adult female Idaho point-headed grasshopper (*Acrolophitus pulchellus*) exhibiting its distinctive color pattern, acutely slanted head profile, and dense pubescence.

Figure 4. An adult male Idaho point-headed grasshopper (*Acrolophitus pulchellus*) showing tan and rufous coloration.

Figure 5. Examples of cryptic and disruptive coloration of the Idaho point-headed grasshopper (*Acrolophitus pulchellus*) against stemless mock goldenweed (*Stenotis acaulis*).

Figure 6. Mating Idaho point-headed grasshopper (*Acrolophitus pulchellus*) female (below) and male (above) showing sexual dimorphism in size and coloration. The forb supporting the pair is stemless mock goldenweed (*Stenotis acaulis*).

Figure 7. An Idaho point-headed grasshopper (*Acrolophitus pulchellus*) feeding on stemless mock goldenweed (*Stenotis acaulis*). The forb was past peak flowering but retained green foliage well into mid-August 2010.

Appendix A

PVTs at Sites Occupied by
Idaho Point-headed Grasshoppers

USDA Natural Resources Conservation Service
Ecological Site Descriptions

Site Name: LIMEY GRAVELLY 8-13” – ARNO4/PSSPS
Site ID: R012XY001ID

Physiography—This site occurs on mountain slopes on all aspects. Slopes generally range from 0 to 60 percent. Elevations range from 4,800 to 8,000 ft (1463-2438 m).

Climate— Average annual precipitation on this site ranges from 8 to 13 in (20-33 cm). Approximately 40 to 50 percent comes during the plant dormant period October to March. The months of May and June usually receive approximately 25 to 30 percent of the annual precipitation. The average frost-free period is 75 to 90 days.

Representative Soil Features—The soils of this site are loams to extremely gravelly loams. They can be stony, bouldery, and mildly alkaline or carbonic. An indurated hardpan can occur at varying depths from 7 to 20 in. Gravels often exceed 60 percent by volume below 12 in (30.5 cm) depth. The parent material is alluvium and colluvium from metamorphic and sedimentary rocks, heavily influenced by limestone. These soils are cold (47˚ F [8.3° C] mean annual soil temperature). The soils are well drained. Available water capacity is very low to low. The moisture supplying capacity of the soils is limited by the depth to the duripan or bedrock. Water erosion can be high when the plant cover is reduced and slope increases. These soils are characterized by an aridic soil moisture regime or an aridic bordering on xeric. The soil temperature regime is either frigid or cryic.

Plant Communities—The dominant visual aspect of this site is black sagebrush, bluebunch wheatgrass, and Salmon wildrye. Composition by weight is approximately 55 to 65 percent grass, 5 to 15 percent forbs, and 25 to 35 percent shrubs. In the last few thousand years, this site has evolved in an arid climate characterized by warm, dry summers and cold winters. Herbivory has historically occurred on the site at low levels of utilization. Herbivores include pronghorn, mule deer, Rocky Mountain elk, lagomorphs, and small rodents. Fire has historically occurred on this site every 80 to 100 years. Fire occurs only in years with above normal precipitation. The Reference Plant Community Phase is Phase A. This plant community is dominated by bluebunch wheatgrass, salmon wildrye, and black sagebrush. Subdominant species include Sandberg bluegrass, Hood’s phlox, needleleaf phlox and stemless goldenweed. There are a variety of other grasses, forbs and shrubs that occur in the plant community in minor amounts. Structurally, cool season deep rooted perennial bunchgrasses are dominant, followed by medium height shrubs being more dominant than perennial forbs while shallow rooted bunchgrasses are subdominant.

Site Name: Gravelly Loam 12-16” – ARAR8/PSSPS-FEID
Site ID: R012XY002ID

Physiography—This site occurs on alluvial and colluvial fans, terraces, gentle foothills, ridges, and mountain slopes. Slopes range from 5 to 30 percent on all aspects. Elevations range from 6,200 to 8,500 ft (1900 to 2600 m).

Climate—Average annual precipitation of this site ranges from 12 to 16 in (30-40 cm). Approximately 50 percent occurs during the growing season April to September. May and June usually receive 25 to 30 percent of the annual precipitation. Plant growth begins about 15 April and grasses and forbs are usually mature by 15 July to 1 August. Shrubs continue to grow throughout the summer but at a reduced rate. Grasses may green up again when fall rains are sufficient.

Representative Soil Features—The soils of this site are predominately gravelly loams. Gravel exceeds 40 percent by volume in the B horizon. They can be shallow to very deep to bedrock. Mountainboy is shallow to a duripan. If very deep, gravels exceed 60 percent by volume in the soil profile below 12 in depth, thus inserting a shallow depth soil influence on the plant community. Parent material consists of colluvium and alluvium from sedimentary and metamorphic rocks, heavily influenced by limestone. Occasionally they are moderately alkaline. The soils are well drained and have slow to moderately rapid permeability. Available water capacity is very low to moderate. The moisture supplying capacity of the soils is limited by the depth to the gravel layer or bedrock. Water erosion can be high when the plant cover is reduced and slope increases. These soils are characterized by an aridic soil moisture regime or an aridic bordering on xeric. The soil temperature regime is either frigid or cryic.

Plant Communities—The dominant visual aspect of this site is low sagebrush with bluebunch wheatgrass and Idaho fescue in the understory. Composition by weight is approximately 50 to 60 percent grasses, 10 to 15 percent forbs, and 25 to 35 percent shrubs. In the last few thousand years, this site has evolved in an arid climate characterized by dry summers and cold, wet winters. Herbivory has historically occurred on this site at low levels of utilization. Herbivores include mule deer**,** bighorn sheep, Rocky Mountain elk, pronghorn, lagomorphs, and small rodents. Fire has historically occurred on the site at intervals of 60-80 years. The Reference Plant Community Phase is Phase A. This plant community is dominated by bluebunch wheatgrass and Idaho fescue in the understory and low sagebrush in the overstory. Subdominant species include Sandberg bluegrass, prairie junegrass and Hood's phlox. There is a variety of other grasses, forbs, and shrubs that can occur in minor amounts. Structurally, cool season deep rooted perennial bunchgrasses are dominant followed by low to medium shrubs being more dominant than perennial forbs, while shallow rooted bunchgrasses are subdominant.

Site Name: GRAVELLY LOAM 8-12" – ARTRW8/PSSPS
Site ID: R012XY004ID

Physiography—This site occurs on alluvial fans and terraces with slopes <30 percent on all aspects or on mountain slopes >30 percent on south and west exposures. Elevation ranges from 4,700 to 7,500 ft (1400 to 2300 m).

Climate—Average annual precipitation of this site ranges from 8 to 12 in (20-30 cm). Approximately 50 percent comes during the plant growth period April to September; 25 to 30 percent of the annual precipitation is received in May and June. The climate is characterized by cool summers and cold winters. Plant growth begins between 1-15 April with the optimum plant growth period being from 1 May through 1 July.

Representative Soil Features—The soils of this site are well to somewhat excessively drained and are typically very deep to bedrock. The surface textures range from gravelly to extremely gravelly loams, silt loams, and sandy loams. The parent material is alluvium, colluvium, and lacustine sediments from sedimentary rock, limestone, and quartzite. Coarse fragments can exceed 60 percent by volume in the soil profile. Runoff is very low to very high and organic matter is low. The soils permeability is slow to very rapid and the available water capacity is very low to moderate. These soils are characterized by an aridic soil moisture regime or aridic that borders on xeric. Soil temperature regime is frigid.

Plant Communities—The dominant visual aspect of this site is Wyoming big sagebrush with bluebunch wheatgrass in the understory. Composition by weight is approximately 55 to 70 percent grasses, 5 to 15 percent forbs, and 20 to 30 percent shrubs. During the last few thousand years, this site has evolved in an arid climate characterized by dry summers and cold, wet winters. Herbivory has historically occurred on this site at low levels of utilization. Herbivores include mule deer**,** Rocky Mountain elk, bighorn sheep, pronghorn, lagomorphs, and small rodents. Fire has historically occurred on the site at intervals of 60-80 years. The Reference Plant Community Phase is Phase A. This plant community is dominated by bluebunch wheatgrass in the understory and Wyoming big sagebrush in the overstory. Subdominant species include Sandberg bluegrass and Hood's phlox. Salmon wildrye, thickspike wheatgrass, arrowleaf balsamroot, and Indian ricegrass can be important species in some areas. There is a large variety of other grasses, forbs, and shrubs that can occur in minor amounts. Structurally, cool season deep rooted perennial bunchgrasses are very dominant, followed by tall shrubs being more dominant than perennial forbs while shallow rooted bunchgrasses are subdominant.

Site Name: Windswept 8-11" – ARFR4/POSE
Site ID: R012XY006ID

Physiography—This site occurs on alluvial and colluvial fans, terraces, ridgetops, and mountain slopes. It usually occupies the windswept portion of the ridgetop or mountain slope. Elevation ranges from 5,400 to 8,500 ft (1650-2600 m) and it occurs on all aspects.

Climate—Average annual precipitation of this site ranges from 8-11 in (20-28 cm). Actual precipitation on surrounding sites may be significantly higher. The limiting climatic factor of this site is the high evapo-transpiration and the high winds that blow the snow and rain over or past the site. Very little snow accumulates on the site. Due to the extreme weather on this site all plants are diminutive in size. Plant growth begins about 1 April to 1 May. Grasses and forbs are usually mature by 15 July. The average frost-free period is approximately 80 days.

Representative Soil Features—The soils of this site are predominately gravelly and very gravelly loams. Gravel exceeds 40 percent by volume in the B horizon. These soils are very deep with the exception of Paint which is shallow to a duripan. Gravels can exceed 60 percent by volume. The limiting factors for this site are the extremely low moisture availability and the high wind stress. The soils are well to somewhat excessively drained and have slow to moderately rapid permeability. Available water capacity is very low to low. Water erosion can be high when the plant cover is reduced and slope increases. These soils are characterized by an aridic soil moisture regime or an aridic bordering on xeric. The soil temperature regime is either frigid or cryic.

Plant Communities—The dominant visual aspect of this site is low growing vegetation and it can be sparse and barren at times. Composition by weight is approximately 30-40 percent grasses, 25-35 percent forbs, and 30-40 percent shrubs. The plant community is dominated by fringed sagewort in the overstory and Sandberg bluegrass in the understory. Subdominant species include Hood's phlox and stemless goldenweed. Herbivory has historically occurred on the site at low levels of utilization. Herbivores include pronghorn, mule deer, bighorn sheep, Rocky Mountain elk, sage grouse, lagomorphs, and small rodents. Fire has historically occurred on this site every 80 to 100 years. Fire occurs only in years with above normal precipitation. Structurally, low growing shrubs and perennial grasses are co-dominant followed by perennial forbs.

Site Name: SHALLOW GRAVELLY LOAM 8-12" – ARAR8/PSSPS-ACHY
Site ID: R012XY007ID

Physiography—This site occurs on fans, terraces, and mountain foot slopes. Slopes range from 0 to 30 percent. It can occur on all aspects but generally has a southerly exposure. Elevations range from 5,400 to 7,200 ft (1650 to 2200 m).

Climate—The average precipitation for this site ranges from 8 to 12 in (20-30 cm). Approximately 40 to 50 percent comes during winter months October to March and 50 to 60 percent during plant growth period April through September. Twenty-five to 30 percent of the annual precipitation usually comes during May and June. Average annual temperature is 38 to 45° F (7.2° C). Average frost-free period is approximately 80 days; however, frost may occur during any month. Plant growth begins about 1 April. Grasses and forbs are usually matured by 15 July. Grasses may green up again when fall rains are sufficient to start plant growth. Shrubs continue to grow at a much reduced rate during the summer dormant period. Optimum plant growth period is from 15 April to 15 June.

Representative Soil Features—The soils for this site are generally shallow to a duripan or hardpan. Surface textures usually are gravelly to very gravelly loams and silt loams. The subsoil is also gravelly to very gravelly. These soils are well to somewhat excessively drained shallow to very deep soils. The soils have a moderate to moderately rapid permeability and a very low to low available water capacity. Parent material can be mixed sedimentary and metamorphic alluvium influenced heavily by limestone. Water erosion can be high when the plant cover is reduced and slope increases. These soils are characterized by an aridic soil moisture regime or an aridic bordering on xeric. The soil temperature regime is either frigid or cryic.

Plant Communities—The dominant visual aspect of this site is low sagebrush with bluebunch wheatgrass and Indian ricegrass. Composition by weight is approximately 40 to 55 percent grasses, 5 to 10 percent forbs, and 40 to 50 percent shrubs. During the last few thousand years, this site has evolved in an arid climate characterized by dry summers and cold, wet winters. Herbivory has historically occurred on this site at low levels of utilization. Herbivores include mule deer**,** bighorn sheep, lagomorphs, and small rodents. Fire has historically occurred on the site at intervals of 80 to 100 years. The Historic Climax Plant Community is Phase A. This plant community is dominated by bluebunch wheatgrass and Indian ricegrass in the understory and low sagebrush in the overstory. Subdominant species include Sandberg bluegrass, bottlebrush squirreltail, and Hood's phlox. There is a variety of other grasses, forbs, and shrubs that can occur in minor amounts. Structurally, cool season deep rooted perennial bunchgrasses and shrubs are about equal followed by perennial forbs, while shallow rooted bunchgrasses are subdominant.

Site Name: LOAMY 16 –22" – ARTRV/FEID
Site ID: R012XY021ID

Physiography—This site occurs on mountain slopes and in concave depressions. Slopes vary from 5 to 30 percent. Elevations range from 6,500 to 9,000 ft (1980-2745 m).

Climate—Average annual precipitation on this site ranges from 16 to 22 in (40-56 cm). Approximately 50 to 60 percent comes during the winter plant dormant period October to April, and 40 to 50 percent during the plant growing season of May to September. Snow depths range from 3 to 5 ft (0.9 to 1.5 m), with a snow pack water content of approximately 20 to 25 percent

in April. Plant growth begins about 1 May to 30 May. Grasses and forbs are usually mature by 15 August to 30 August. The optimum plant growth period is from 15 May to 15 July. In years of above-normal precipitation, this site may stay green until fall dormancy. Shrubs grow throughout the growing season, slowing down in the late summer as soil moisture is depleted. The average frost free period is approximately 50 days.

Representative Soil Features—The soils of this site are deep dark loams to gravelly loams and silt loams. The subsoil varies from loam to clay loam. Gravels often exceed 35 percent by volume in the soils profile and in some instances can exceed 60 percent. The soils are moderately deep to very deep to bedrock. The soils are moderately well to well drained and have slow to moderately rapid permeability. Available water capacity is very low to moderate. These soils are characterized by a xeric soil moisture regime and have a soil temperature regime of either frigid or cryic.

Plant Communities—The dominant visual aspect of this site is mountain big sagebrush in the overstory with Idaho fescue in the understory. Composition by weight is approximately 50 to 70 percent grasses, 10 to 20 percent forbs, and 20 to 30 percent shrubs. During the last few thousand years, this site has evolved in an arid climate characterized by dry summers and cold, wet winters. Herbivory has historically occurred on this site at low levels of utilization. Herbivores include mule deer, bighorn sheep, Rocky Mountain elk, and lagomorphs. Fire has historically occurred on the site at intervals of 20-50 years. The Reference Plant Community Phase is Phase A. This plant community is dominated by Idaho fescue and mountain big sagebrush. Subdominant species can include bluebunch wheatgrass, big bluegrass, Sandberg bluegrass, Columbia needlegrass, mountain brome, prairie junegrass, arrowleaf balsamroot, rose pussytoes, and mountain snowberry. There can be a large variety of other grasses, forbs, and shrubs that occur in minor amounts. Structurally, cool season deep rooted perennial bunchgrasses are very dominant, followed by tall shrubs being more dominant than perennial forbs, while shallow rooted perennial bunchgrasses are subdominant.

Site Name: LOAMY 8-12" – ARTRW8/ PSSPS
Site ID: R012XY032ID

Physiography—This site occurs on nearly level flats and benchlands to rolling and somewhat broken foothills. Small rock outcrops may be scattered throughout the site. Slopes predominately range from 0-30 percent. Elevation ranges from 5,000-7,500 ft (1524-2286 m).

Climate—Average annual precipitation of this site ranges from 8-12 in (20-30 cm). Approximately 50 percent comes during the plant growing season (April- September). Shrubs may continue to grow throughout the season, however, moisture is generally limiting for grasses and forb growth by mid-July. The average frost-free season is 60-100 days.

Representative Soil Features—The soils on this site are very deep loams, silt loams, gravelly silt loams and clay loams. Subsoils are strongly contrasting textural stratification starting at a depth between 25 to 40 in (64 to 102 cm), there is also an accumulation of lime at depths from 8 to 12 in (20-30 cm). Runoff is low to very high and organic matter is low. The soils permeability is slow to moderate and the available water capacity is very low to moderate. These soils are characterized by an aridic or aridic soil moisture regime that borders on xeric. Soil temperature regime is frigid.

Plant Communities—The dominant visual aspect of this site is Wyoming big sagebrush in the overstory and bluebunch wheatgrass in the understory. Composition by weight is approximately 55-65 percent grasses, 5-15 percent forbs, and 25-35 percent shrubs. During the last few thousand years, this site has evolved in an arid climate characterized by warm, dry summers and cold, wet winters. Herbivory has historically occurred on the site at low levels of utilization. Herbivores include pronghorn, mule deer, sage grouse, lagomorphs, and small rodents. Fire has historically occurred on this site every 50-70 years. The Reference Plant Community Phase is Phase A. This plant community is dominated by bluebunch wheatgrass and Wyoming big sagebrush. Subdominant species include Sandberg bluegrass, Indian ricegrass, needle and thread, and tapertip hawksbeard. Structurally, cool season deep-rooted perennial bunchgrasses are very dominant, followed by medium height shrubs with perennial forbs and shallow rooted perennial bunchgrasses being sub-dominant.

Appendix B

Northwest Gap Analysis Program

Ecological Systems at Sites Occupied by
Idaho Point-headed Grasshoppers

Idaho Department of Fish and Game uses a three-level hierarchy to classify landcover types, with lower, finer levels nested into progressively coarser levels. The finest level, the ecological system (ES), is used for analyzing existing vegetation patterns, habitat usage by animals and plants, and systems-level comparisons across multiple jurisdictions. As described in the CWCS, "Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. Terrestrial ecological system units represent practical, systematically defined groupings of plant associations that provide the basis for mapping terrestrial communities and ecosystems at multiple scales of spatial and thematic resolution. The systems approach complements the U.S. National Vegetation Classification, whose finer-scale units provide a basis for interpreting larger-scale ecological system patterns and concepts (IDFG 2005)."

Ecological System: Developed, Open Space

Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

Ecological System: Inter-Mountain Basins Big Sagebrush Steppe

This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin, east into the Wyoming Basins, central Montana, and north and east onto the western fringe of the Great Plains in Montana and South Dakota. It is found at slightly higher elevations farther south. In central Montana, this system differs slightly, with more summer rain than winter precipitation, more precipitation annually, and it occurs on glaciated landscapes. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata ssp. tridentata* (this is not at all important in Wyoming occurrences), *Artemisia tridentata ssp. xericensis, Artemisia tridentata ssp. wyomingensis, Artemisia tripartita ssp. tripartita* (Snake River valley in Wyoming), *Artemisia cana ssp. cana*, and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Sarcobatus vermiculatus, Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. In Montana and Wyoming, stands are more mesic, with more biomass of grass, have less shrub diversity than stands farther west, and 50 to 90% of the occurrences are dominated by *Artemisia tridentata ssp. wyomingensis* with *Pascopyrum smithii*. In addition, *Bromus japonicus* and *Bromus tectorum* are indicators of disturbance, and *Bromus tectorum* is typically not as abundant as in the Intermountain West, possibly due to a colder climate. Associated graminoids can include *Achnatherum hymenoides, Calamagrostis montanensis, Elymus lanceolatus ssp. lanceolatus, Koeleria macrantha, Poa secunda, Pascopyrum smithii, Hesperostipa comata, Nassella viridula, Bouteloua gracilis,* and *Pseudoroegneria spicata*. Important rhizomatous species include *Carex filifolia* and *Carex duriuscula,* which are very common and important in the eastern distribution of this system in both Wyoming and Montana. *Festuca idahoensis* is uncommon in this system, although it does occur in areas of higher elevations/precipitation; *Festuca campestris* is also uncommon. In Wyoming, both *Nassella viridula* and *Pseudoroegneria spicata* rarely occur, with the latter typically found in eastern Wyoming on ridgetops and rocky slopes outside of this system. In

Montana, there is an absence of *Festuca* spp., except *Vulpia octoflora*. Common forbs are *Phlox hoodii, Arenaria* spp., *Opuntia* spp., *Sphaeralcea coccinea, Dalea purpurea, Liatris punctata,* and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata ssp. tridentata* but have largely been converted for other land uses. The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50- to 70-year interval, the area would be considered Columbia Basin Foothill and Canyon Dry Grassland (CES304.993).

Ecological System: **Inter-Mountain Basins Montane Sagebrush Steppe**

This ecological system includes sagebrush communities occurring at foothills (in Wyoming) to montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. In Montana, it occurs on mountain "islands" in the north-central portion of the state and possibly along the Boulder River south of Absarokee and at higher elevations. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general, this system shows an affinity for mild topography, fine soils, some source of subsurface moisture or more mesic sites, zones of higher precipitation and areas of snow accumulation. Across its range of distribution, this is a compositionally diverse system. It is composed primarily of *Artemisia tridentata ssp. vaseyana, Artemisia cana ssp. viscidula,* and related taxa such as *Artemisia tridentata ssp. spiciformis (= Artemisia spiciformis). Purshia tridentata* may codominate or even dominate some stands. *Artemisia arbuscula ssp. arbuscula*-dominated shrublands commonly occur within this system on rocky or windblown sites. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum, Ribes cereum,* and *Chrysothamnus viscidiflorus*. *Artemisia tridentata ssp. wyomingensis* may be present to codominant if the stand is clearly montane as indicated by montane indicator species such as *Festuca idahoensis, Leucopoa kingii,* or *Danthonia intermedia*. Most stands have an abundant perennial herbaceous layer (over 25% cover, in many cases over 50% cover), but this system also includes *Artemisia tridentata ssp. vaseyana* shrublands. Common graminoids include *Danthonia intermedia, Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa, Calamagrostis rubescens,* and *Pseudoroegneria spicata*. Species of *Achnatherum* are common, including *Achnatherum nelsonii ssp. dorei, Achnatherum nelsonii ssp. nelsonii, Achnatherum hymenoides,* and others. In many areas, wildfires can maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.

Ecological System: **Northern Rocky Mountain Lower Montane, Foothill, and Valley Grassland**

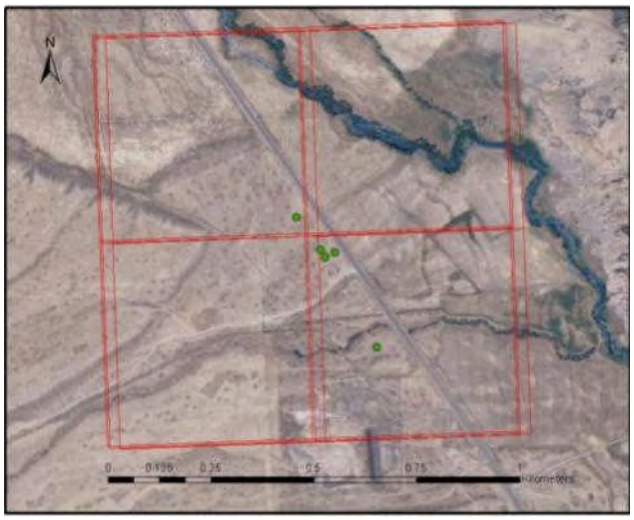
This ecological system of the northern Rocky Mountains is found at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana,

west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. They also occur to the east in the central Montana mountain "islands," foothills, as well as the Rocky Mountain Front and Big and Little Belt ranges. These grasslands are floristically similar to Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), and Columbia Basin Palouse Prairie (CES304.792), but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. These northern lower montane and valley grasslands represent a shift in the precipitation regime from summer monsoons and cold snowy winters found in the southern Rockies to predominantly dry summers and winter precipitation. In the eastern portion of its range in Montana, winter precipitation is replaced by a huge spring peak in precipitation. They are found at elevations from 300 to 1650 m, ranging from small meadows to large open parks surrounded by conifers in the lower montane, to extensive foothill and valley grasslands below the lower treeline. Many of these valleys may have been primarily sage-steppe with patches of grassland in the past, but because of land-use history post-settlement (herbicide, grazing, fire suppression, pasturing, etc.), they have been converted to grassland-dominated areas. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline, often with a microphytic crust. The most important species are cool-season perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer. *Pseudoroegneria spicata, Festuca campestris, Festuca idahoensis*, or *Hesperostipa comata* commonly dominate sites on all aspects of level to moderate slopes and on certain steep slopes with a variety of other grasses, such as *Achnatherum hymenoides, Achnatherum richardsonii, Hesperostipa curtiseta, Koeleria macrantha, Leymus cinereus, Elymus trachycaulus, Bromus inermis* ssp. *pumpellianus* (= *Bromus pumpellianus*), *Achnatherum occidentale* (= *Stipa occidentalis*), *Pascopyrum smithii*, and other graminoids such as *Carex filifolia* and *Danthonia intermedia*. Other grassland species include *Opuntia fragilis, Artemisia frigida, Carex petasata, Antennaria* spp., and *Selaginella densa*. Important exotic grasses include *Phleum pratense, Bromus inermis*, and *Poa pratensis*. Shrub species may be scattered, including *Amelanchier alnifolia, Rosa* spp., *Symphoricarpos* spp., *Juniperus communis, Artemisia tridentata*, and in Wyoming, *Artemisia tripartita* ssp. *rupicola*. Common associated forbs include *Geum triflorum, Galium boreale, Campanula rotundifolia, Antennaria microphylla, Geranium viscosissimum*, and *Potentilla gracilis*. A soil crust of lichen covers almost all open soil between clumps of grasses; *Cladonia* and *Peltigera* are the most common lichens. Unvegetated mineral soil is commonly found between clumps of grass and the lichen cover. The fire regime of this ecological system maintains a grassland due to rapid fire return that retards shrub invasion or landscape isolation and fragmentation that limits seed dispersal of native shrub species. Fire frequency is presumed to be less than 20 years. These are extensive grasslands, not grass-dominated patches within the sagebrush shrub steppe ecological system. *Festuca campestris* is easily eliminated by grazing and does not occur in all areas of this system.

Appendix C

Descriptions of Survey Sites Occupied by
Idaho Point-headed Grasshoppers

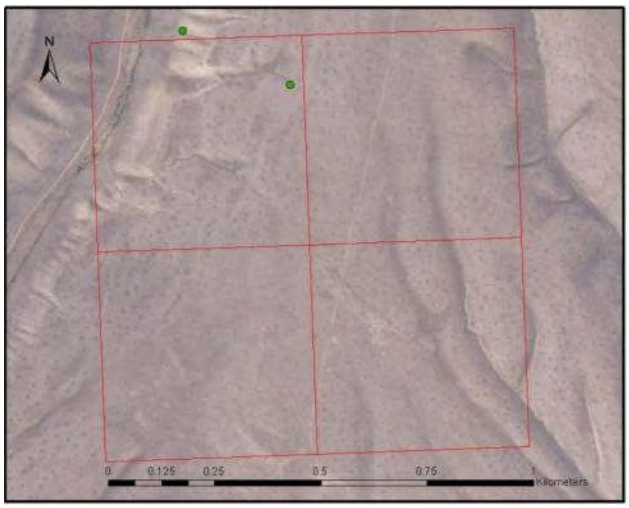
Blue Dome, Clark County



Date surveyed: 21 July 2010
Elevation range: 1881 to 1883 m
PVT: Gravelly loam 8-12" ARTRW8/PSSPS

Blue Dome is a community landmark at the junction of Skull Canyon Road and State Highway 28. Historic collection localities for Idaho point-headed grasshopper (IPG) were to the west of this site, on the flats and stream terraces above Birch Creek and Pass Creek. Approximately half of the 1 km^2 grid encompassed private lands in dryland hay production. These areas weren't accessed, but didn't appear to be suitable habitat for IPG. The south quadrants were impacted by anthropogenic disturbance, including a gravel pit, irrigation ditches, road grading, livestock grazing, OHV traffic, and a range seeding in the SW quadrant. On the day we surveyed, Clark County employees were spraying for spotted knapweed along the primary irrigation ditch. We found IPG in the SE and NW quadrants on gravelly, duripan sites supporting perennial grass, forbs, and vagrant lichen with sparse patches of *Chrysothamnus viscidiflorus* and *Artemisia tridentata* spp. *wyomingensis* (see photo at right looking west toward the Lemhi Range). We observed the species in close proximity to the State Highway 28 right-of-way. Vegetation in this corridor is highly disturbed and an apparent pathway for exotic species invasion.

Myers/Grouse, Clark County

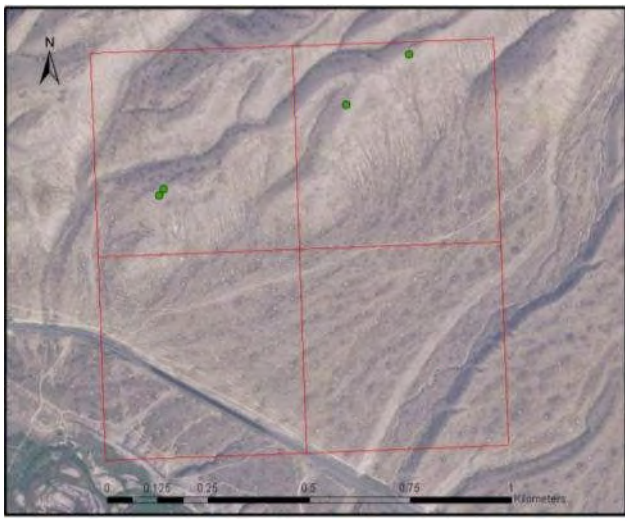


Date surveyed: 24 July 2010
Elevation range: 2025 to 2082 m
PVT: Limey gravelly 8-13" ARNO4/PSSPS
Loamy 16-22" ARTRV/FEID-PSSPS

The Myers/Grouse site is located in the Dubois Ranger District of Caribou-Targhee National Forest. Myers Creek and Grouse Canyon are drainages within the larger Crooked Creek watershed. The site contained rolling topography of alluvial fan remnants with a dense growth of low growing grass and forbs with some *Artemisia nova*. Soil surface characteristics were very gravelly/silty/loamy.

Vegetation was very low growing throughout the survey site. IPGs were found on fan slopes in bare gravelly soils with *Stenotis acaulis*. This was the only site where a nymphal stage of the species was collected (perhaps due to high elevation phenology). An unusual pink slant-headed grasshopper nymph was collected at this site. The specimen (pictured above left) measured 18 mm from front of head to tip of abdomen.

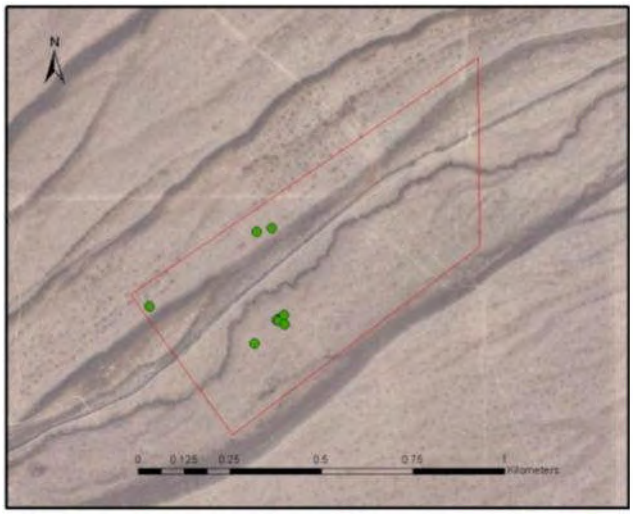
Pete Creek, Custer County



Date surveyed: 25 July 2010
Elevation range: 1918 to 1975 m
PVT: Shallow gravelly loam 8-12" ARAR8/PSSSPS-ACHY

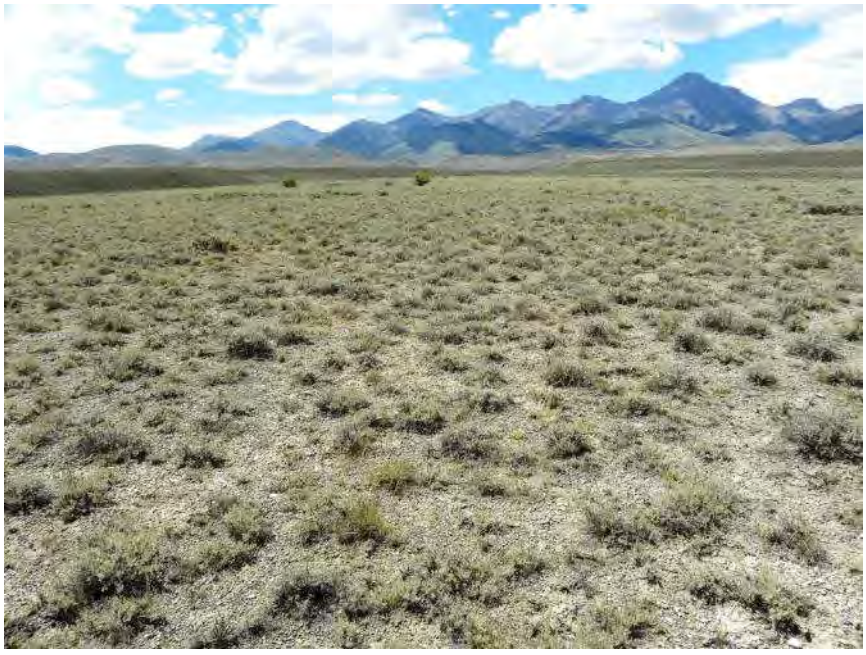
The Pete Creek site is located just north of Mackay Reservoir on the north side of US 93. The site encompassed broad outwash fans and fan terraces. Soils were extremely rocky/gravelly and sparsely vegetated with low growing shrubs, grasses, and forbs. Predominant shrubs were *Artemisia arbuscula*, *Grayia spinosa*, and *Chrysothamnes* spp. Herbaceous species included *Stenotis acaulis*, *Opuntia* spp., and *Eriogonum* spp. Vagrant lichen was sparse at this site. Adult specimens of IPG were found on exposed, very rocky/gravelly ground on east and southeast-facing slopes of ridges. The photo below illustrates the habitat at a microsite occupied by IPG.

Pass Creek – West of Blue Dome, Clark County

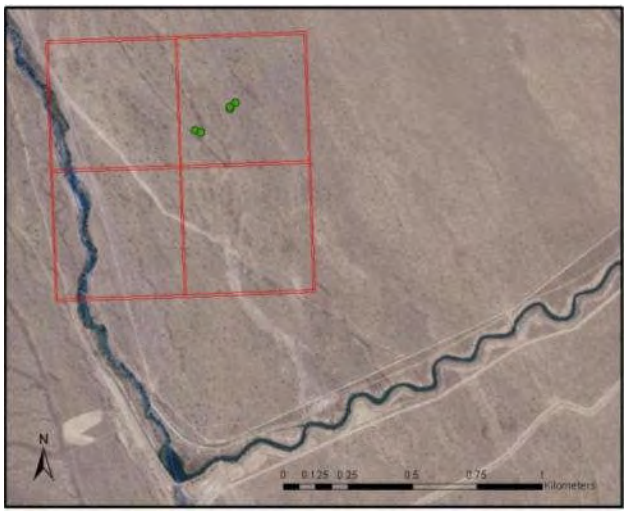


Date surveyed: 28 July 2010
Elevation range: 1933 to 1951
PVT: Loamy 16-22" ARTRV/FEID

This site was not associated with a historic collection locality, but was 2 km west-southwest and updrainage from the Blue Dome site. We searched the stream and alluvial fan terraces north and south of Pass Creek and searched along the Pass Creek floodplain. Soils on the fans and terraces were gravelly/loamy with scattered cobbles and areas of shallow gravelly duripan. Vegetation was sparse and low-growing with *Artemisia nova* being the primary shrub species. Soils in the floodplain area appeared to have a greater component of silty loam mixed with gravel and supported denser growth of *A. nova*, *Chrysothamnes viscidiflorus*, *Stenotis acaulis*, bunchgrasses, and vagrant lichen than the terrace sites. The floodplain/flat pictured at left (looking west) was the site of an IPG "lekking" area in which we observed several specimens engaged in reproductive behaviors. We speculated that the silty/loamy, softer soil texture may be preferable to females for egg laying. Cattle trailing was noticeable in this area. Soil compression impacts may potentially affect the suitability of this site as breeding habitat for IPG.



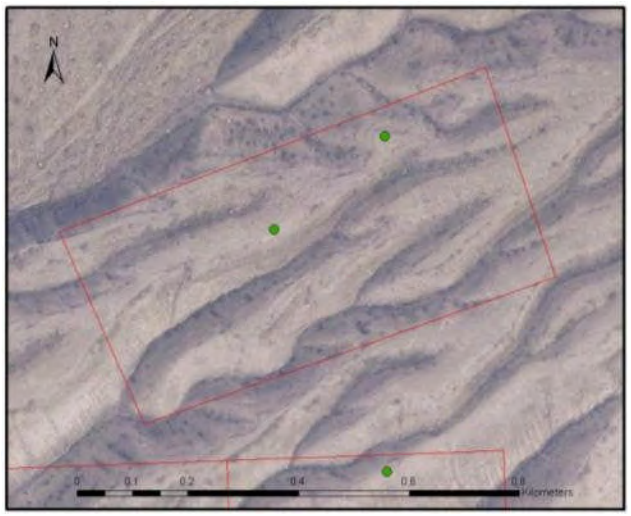
Birch Creek, Clark County



Date surveyed: 21 July and 1 August 2010
Elevation range: 1746 to 1747 m
PVT: Gravelly loam 8-12" ARTRW8/PSSPS
Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY

This site was successfully collected in 1993 (Kell et al. 1993) and extensively searched by Baker (2003). The south quadrants were predominantly flat with gravelly loamy soils and areas of shallow gravelly duripan. North quadrants had more rolling topography with similar soils. Vegetation across the grid was sparse with widely scattered patches of *Artemisia tridentata* ssp. *wyomingensis* and more uniform coverage of low growing *Artemisia nova* and *Chrysothamnes viscidiflorus*. Portions of the south quadrants were planted to (or colonized by) *Agropyron cristatum*. Sites occupied by IPG had components of the aforementioned shrubs with sparse groundcover of *Stenotis acaulis*, *Opuntia* spp., and grasses, primarily *Pseudoroegneria spicata*. No IPG were detected on survey 1, but 9 individuals were found on survey 2, including a mating pair. The photo at left is a collection site, showing the high proportion of bare soil to vegetation cover and gravelly/duripan nature of the soil. The photo is looking south to the Birch Creek diversion canal, visible in the distance.

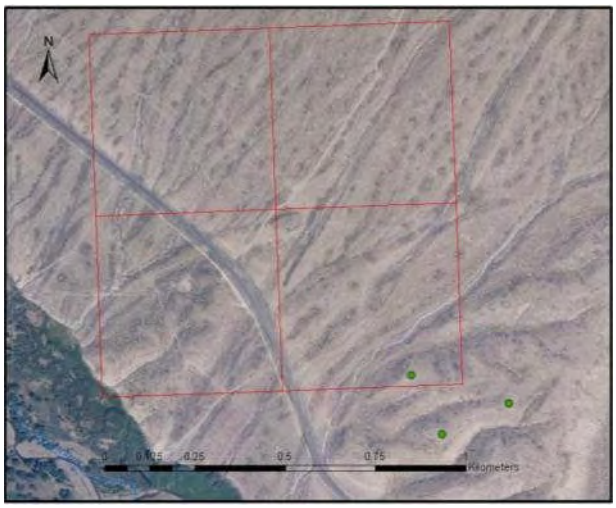
Upper Cedar Creek, Custer County

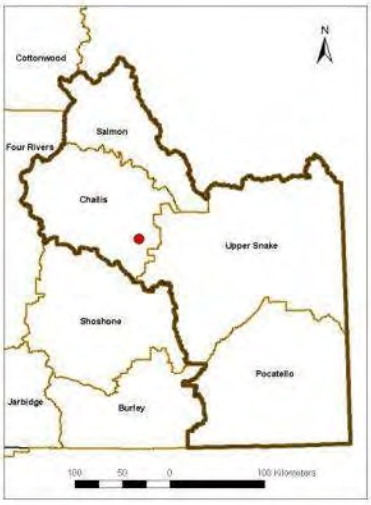


Date surveyed: 3 August 2010
Elevation range: 2003 to 2015 m
PVT: Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY

This survey site was about 500 m north-northeast of the Pete Creek km^2. The site is part of a huge alluvial outwash fan radiating from the Big Lost River Range. Soils were extremely rocky/gravelly and sparsely vegetated with low growing shrubs, grasses, and forbs. Predominant shrubs were *Artemisia arbuscula*, *Atriplex confertifolia*, and *Chrysothamnes* spp. Herbaceous species included *Stenotis acaulis*, *Opuntia* spp., and *Eriogonum* spp. Vagrant lichen was sparse at this site. Adult specimens of IPG were found on exposed, rocky/gravelly ground on ridge top flats. Sites had a high proportion of bare soil. The photo below (looking northwest along the spine of the Big Lost River Range) illustrates habitat at an IPG collection site.

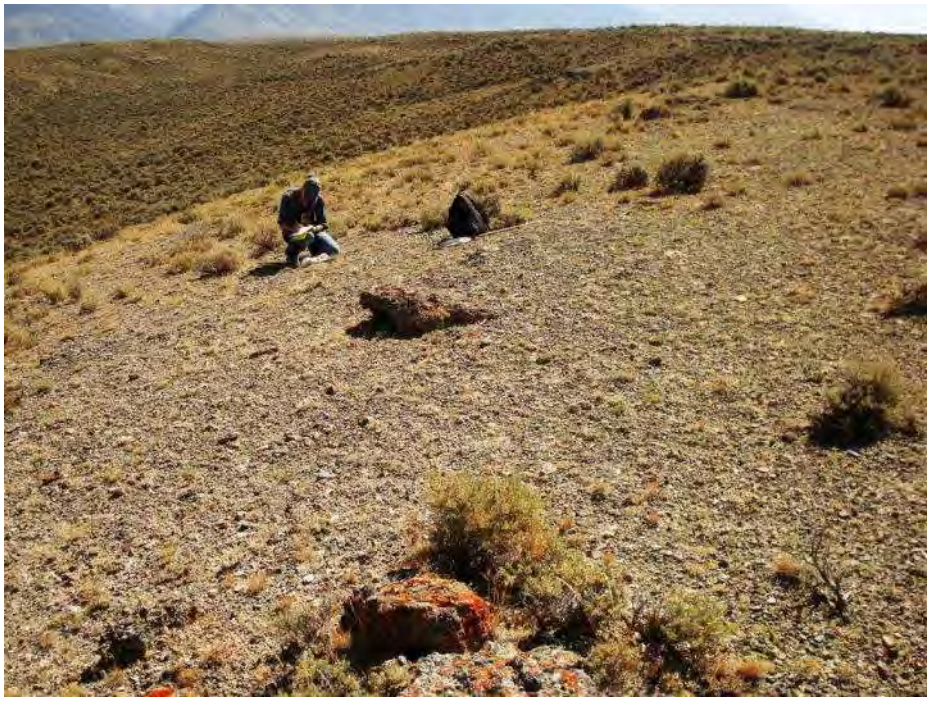
Cedar Creek Bar, Custer County



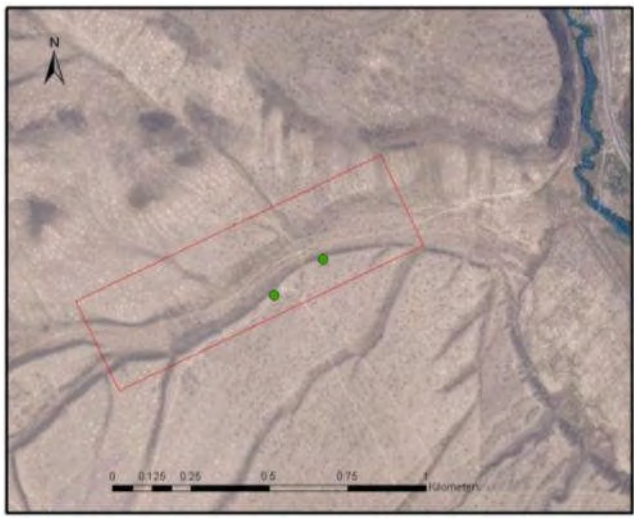


Date surveyed: 4 August 2010
Elevation range: 1913 to 1930 m
PVT: Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY

This survey site was located about 2.5 km northwest of the Pete Creek km^2 on the east side of US 93. Terrain within the grid was primarily outwash fan and fan terraces with gentle to moderate slopes. Soils were very gravelly and cobbly with areas of near bare soils on the crests of hills and terraces. Predominant shrubs were *Artemisia arbuscula, Atriplex confertifolia,* and *Chrysothamnes* spp. Herbaceous species included *Eriogonum* spp., *Opuntia* spp., and mixed perennial grasses, primarily *Pseudoroegnaria spicata*. *Stenotis acaulis* and vagrant lichen were sparse at this site. The photo below (looking west toward the Big Lost River Valley) is an IPG detection site showing the characteristic bare, gravelly/cobbly soils they were associated with.

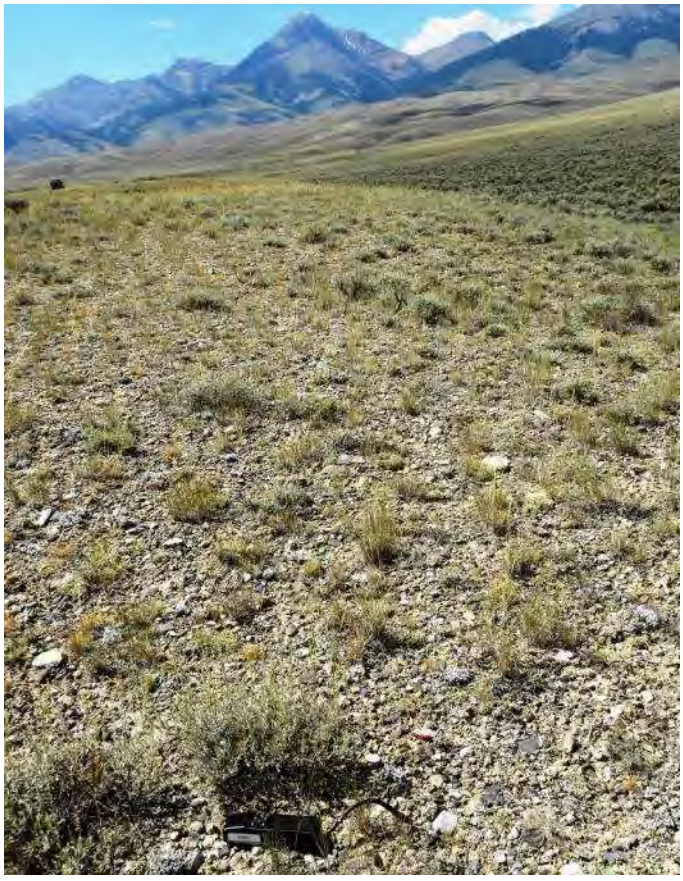


Kaufman Gulch, Clark County



Date surveyed: 4 August 2010
Elevation range: 1907 to 1914 m
PVT: Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY
Windswept 8-11" ARFR4/POSE

This site was located 2 km northwest of the Blue Dome site and was the northernmost positive detection survey site in the Birch Creek drainage. The site encompassed the stream terraces on the north and south sides of Kaufman Gulch and the gulch draw. Soils were very gravelly with prevalent surface cobbles. Loamier soils prevailed in the draws. Vegetation on south-facing slopes was substantially more desiccated than vegetation on north-facing slopes. Predominant shrub species were *Artemisia nova* and *Chrysothamnus viscidiflorus*. The sparse understory included *Stenotis acaulis, Phlox hoodii,* and *Pseudoroegnaria spicata*. Vagrant lichen was fairly abundant at this site. IPGs were found on north-facing ridge crests where forbs were still green. We documented an adult female feeding on *Stenotis acaulis* and a creptitating adult male. The photo to left is looking southwest toward the Lemhi Range. The GPS unit in the foreground is where the female grasshopper was detected.



North of Lidy Hotsprings, Clark County

Date surveyed: 5 August 2010
Elevation range: 1578 to 1579 m
PVT: Limey gravelly 8-13" ARNO4/PSSPS

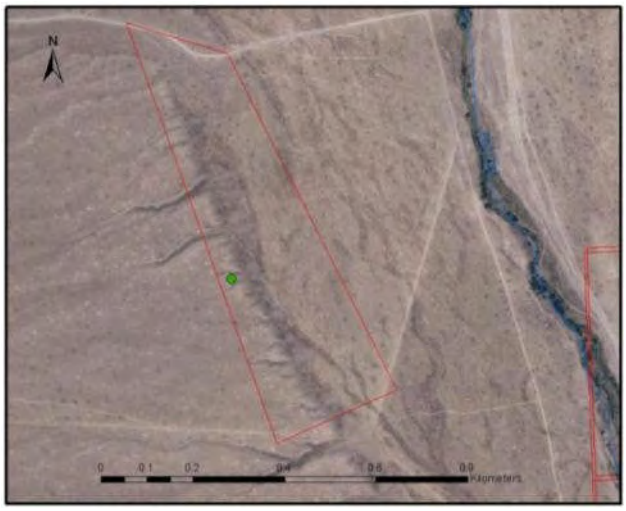
The area within the 1 km^2 is a private mine site and could not be accessed. The area surveyed lies 300 m east-northeast from the grid within rolling foothill topography. Soils were unique compared to other survey sites, with ashy characteristics and "slatey" cobbles incorporated in the surface gravels. Vegetation had a high proportion of mixed perennial grass (mostly *Pseudoroegnaria spicata*) with scattered low shrubs (*Artemisia nova*, *Atriplex confertifolia*) and sparse forbs (*Stenotis acaulis*). Five IPGs were found on barren, rocky flats on ridge tops. The photo at left is the site of an IPG detection showing coarse soil surface and sparse vegetation. The image is looking due south to the Snake River Plain.

Eightmile Canyon Flats, Clark County

Date surveyed: 10 August 2010
Elevation range: 1779 to 1781 m
PVT: Gravelly loam 8-12" ARTRW8/PSSPS
Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY

This site was an intermediate survey site located between Blue Dome, about 8.5 km to the north, and the Birch Creek site, about 2.5 km to the south. The site was located about 600 m west of State Highway 28 and 75 m east of Birch Creek. Topography was relatively flat, grading from a broad outwash fan to the Birch Creek floodplain. Soil type was gravelly loam with extensive surface cobbles. Associated vegetation included scattered shrub cover of *Artemisia tridentata* spp. *wyomingensis*, *Artemisia nova*, and *Atriplex confertifolia*, mixed bunchgrasses, and sparse forbs, including *Stenotis acaulis* and *Opuntia* spp. IPGs were found closely associated with *S. acaulis* at this site. The photo at left of an adult female shows the cobbly substrate they inhabited. We documented another active "lek" at this survey site. Observed mating behaviors included a copulating pair, a stridulating male, and crepitating male and female.

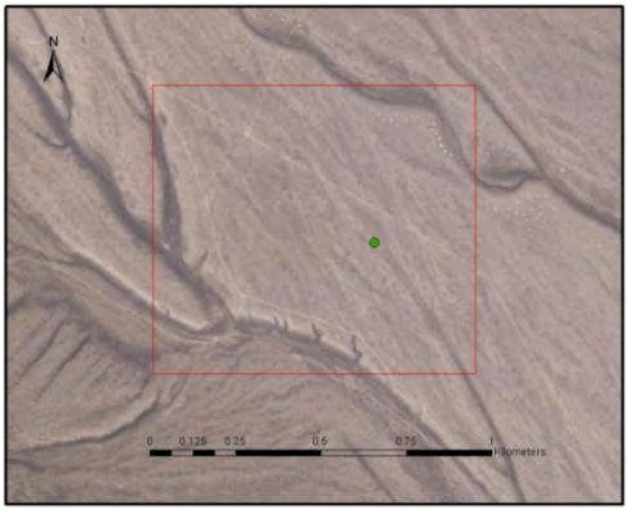
Eightmile Bench, Clark County



Date surveyed: 11 August 2010
Elevation range: 1759 to 1765 m
PVT: Gravelly loam 8-12" ARTRW8/PSSPS

This survey site was located about 800 m west of the Birch Creek survey site. It encompassed an alluvial/stream terrace running northwest to southeast parallel to and west of Birch Creek. Soil type was gravelly loam with some surface cobble and scattered duripan sites. Associated shrub species were *Artemisia nova* and widely scattered patches of *Artemisia tridentata* spp. *wyomingensis*. Coverage by herbaceous species (*Pseudoroegnaria spicata*, *Stenotis acaulis*, *Phlox hoodii*) was low. Total vegetative cover was estimated at <30%, with bare ground predominating. The single IPG detected at this site was found on a gravelly barren at the crest of a terrace. The photo below, looking to the south, shows representative habitat of this site. Green vegetation along the Birch Creek diversion ditch can be seen in the distance.

Bald Mountain Gulch, Clark County



Date surveyed: 10 August 2010
Elevation range: 1900 to 1912 m
PVT: Shallow gravelly loam 8-12" ARAR8/PSSPS-ACHY

This site was located about halfway between the Blue Dome and Birch Creek historic collection localities. It lies in an outwash fan emanating from Pass Creek and Bald Mountain in the Lemhi Range. The terrain contained rolling hills and soils were gravelly-loamy with few surface cobbles. The plant community was somewhat barren and open with patchy shrubs of low stature, primarily *Artemisia nova*, *Artemisia arbuscula*, and some *Chrysothamnus viscidiflorus*. The herbaceous component was very sparse. Total vegetative coverage was typically <30%. An adult female IPG was detected on a *Stenotis acaulis* plant in a relatively flat portion of the outwash fan that had a loamier soil texture than other parts of the survey site. The photo at left shows characteristics of the site where the IPG was collected. The view is looking northwest toward the Pass Creek drainage.

Appendix D

Idaho SGCN Grasshoppers
Potentially Occurring in the Study Area

Table D-1. Grasshopper species lacking essential information pertaining to their status in Idaho which may occur in the 2010 Idaho point-headed grasshopper (*Acrolophitus pulchellus*) study area.

Scientific name	Common name	Rangewide conservation status	Statewide conservation status	Idaho endemic	Date of most recent record	County of occurrence(s)
Melanoplus artemisiae	Sagebrush spur-throat grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1928	Lemhi County
Melanoplus digitifer	A spur-throated grasshopper	Imperiled/ vulnerable	Imperiled	No	1961	Adams, Butte, Caribou, Clearwater, Custer, Idaho, Valley counties
Melanoplus idaho	A spur-throated grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1928	Lemhi County
Melanoplus lemhiensis	A spur-throated grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1928	Lemhi County
Melanoplus salmonis	A spur-throated grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1928	Lemhi County
Melanoplus trigeminus	A spur-throated grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1928	Clark, Lemhi counties
Argiacris amissuli	A grasshopper	Critically imperiled/ vulnerable	Critically imperiled	Yes	1965	Butte County
Argiacris militaris	A grasshopper	Vulnerable/ apparently secure	Imperiled	Yes	1971	Camas, Blaine, Lemhi, Custer counties
Barracris petraea	A grasshopper	Vulnerable	Imperiled	No	1970	Lemhi, Clark, Idaho counties in Idaho; also Montana