Grasshopper Sparrow, photo by ©Robert Shantz

Conservation Profile

Species Concerns
Declining Populations
Habitat Loss (Rural Development)
Unsustainable Livestock Grazing

Conservation Status Lists	
USFWS[1]	BCC List (BCR 33, 34)
AZGFD[2]	Tier 1B
DoD[3]	Yes
BLM[4]	Sensitive Species
PIF Watch List[5b]	Common Bird in Steep Decline
PIF Regional Concern[5a]	No

Migratory Bird Treaty Act
Covered

PIF Breeding Population Size Estimates[6]	
Arizona	61,000 ◑
Global	34,000,000 ●
Percent in Arizona	.18%

PIF Population Goal[5b]
Stabilize

Trends in Arizona	
Historical (pre-BBS)	Unknown
BBS[7] (1968 – 2013)	Not given

PIF Urgency/Half-life (years)[5b]
> 50

Monitoring Coverage in Arizona	
BBS[7]	Not adequate
AZ CBM	Covered

Associated Breeding Birds
Horned Lark, Botteri's Sparrow, Cassin's Sparrow, Chihuahuan Meadowlark

Breeding Habitat Use Profile

Habitats Used in Arizona
Primary: Semi-desert Grasslands
Secondary: None

Key Habitat Parameters	
Plant Composition	Mid-height bunchgrasses (gramas, three-awns, lovegrasses, bluestem) with scattered young mesquite or mimosa[8]
Plant Density and Size	75% grass cover about 12 inches tall, 5% low woody cover, 20% bare ground[8]
Microhabitat Features	Nest under overhanging bunchgrasses; scattered shrubs nearby; seldom occupy grasslands with > 35% bare ground[8,9]
Landscape	Large expanses of grassland, preferably > 100 – 350 acres[16]; other landscape requirements unknown

Elevation Range in Arizona
3,400 – 5,200 feet[10]

Density Estimate
Territory Size: 1 – 3 acres[8]
Density: 10 – 20 pairs / 100 acres[8]

Natural History Profile

Seasonal Distribution in Arizona	
Breeding	July – September[10]
Migration	Arizona (*ammolegus*) race: mostly year-round resident; Western (*perpallidus*) race: April – early May; mid-Sept – October
Winter	Western race: October – April; breeding populations mostly resident

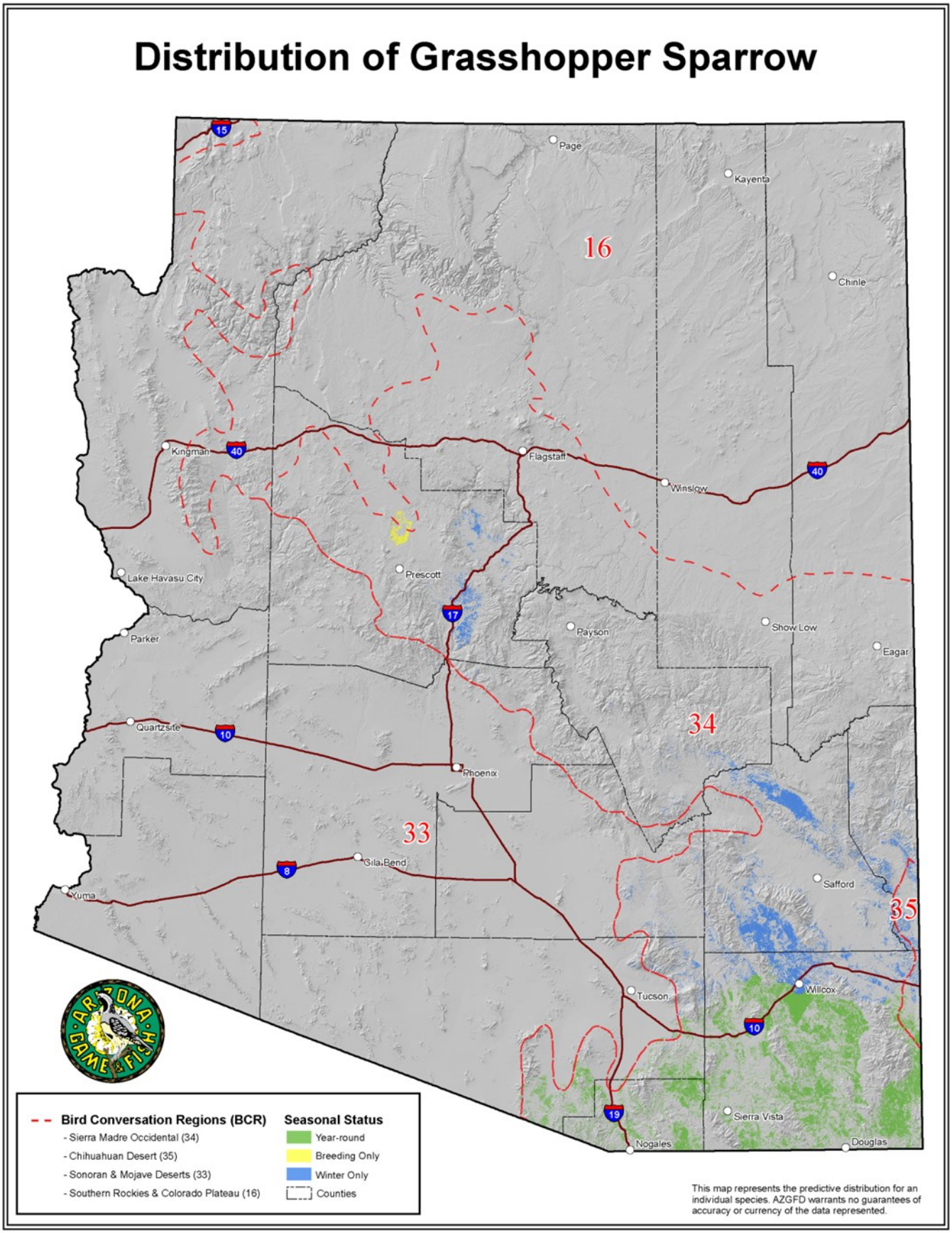
Nest and Nesting Habits	
Type of Nest	Cup, with a grassy dome above[8]
Nest Substrate	Ground, typically at base of grass clump[8]
Nest Height	Ground[7]

Food Habits	
Diet/Food	Insects; seeds in winter[8]
Foraging Substrate	Ground or grass stalks

SPECIES ACCOUNT ● *GRASSHOPPER SPARROW Ammodramus savannarum*

Confidence in Available Data: ● High ◑ Moderate ○ Low ^ Not provided

Last Update: April 2023


Distribution of Grasshopper Sparrow
Page
Kayenta
Chinle
16
Kingman
Flagstaff
Winslow
Lake Havasu City
Prescott
Parker
Payson
Show Low
Eagar
Quartzsite
34
Phoenix
33
Gila Bend
Yuma
Safford
35
Tucson
Willcox
Sierra Vista
Nogales
Douglas
Bird Conversation Regions (BCR)
- Sierra Madre Occidental (34)
- Chihuahuan Desert (35)
- Sonoran & Mojave Deserts (33)
- Southern Rockies & Colorado Plateau (16)
Seasonal Status
Year-round
Breeding Only
Winter Only
Counties
This map represents the predictive distribution for an individual species. AZGFD warrants no guarantees of accuracy or currency of the data represented.

General Information

Distribution in Arizona

The isolated southwestern (Arizona) subspecies of the Grasshopper Sparrow (*A. s. ammolegus*) nests in the southeastern part of the state (Corman 2005). These Grasshopper Sparrows occur from the Altar Valley to the San Bernardino Valley, and reach their highest densities in the San Rafael, Sonoita, and upper Cienega valleys (Corman 2005, Ruth 2008). There is (or was) also a small population of what has been identified as the Western subspecies (*A.s. perpallidus*) in the Chino Valley area in Yavapai County (Corman 2005). Wintering populations in southeastern Arizona primarily consist of a mix of the resident Arizona and migrant Western subspecies (Ruth 2015), while wintering populations elsewhere in the state are of the Western subspecies.

Habitat Description

Grasshopper Sparrows prefer moderately open grasslands with patchy bare ground and relatively few trees or tall shrubs (Vickery 1996). In southeastern Arizona, they occupy relatively lush grassland areas with low shrubs (Bock and Bock 1992), but no more than 16% shrub cover; habitat suitability increases with increasing grass cover (Block and Morrison 2010). In another study, researchers found that Grasshopper Sparrows occupy areas of more and taller grass cover and less bare ground than Horned Larks and Lark Sparrow in a comparative study, and rarely occupied plots with > 35% bare ground (Bock and Webb 1984). Wintering populations of Grasshopper Sparrows use similar habitat types as breeding populations, but areas with higher shrub cover are also used in winter (Block and Morrison 2010). Grasshopper Sparrow abundance in the winter is negatively associated with the amount of bare ground (Ruth et al. 2014).

Microhabitat Requirements

Grasshopper Sparrows build domed, cup nests on the ground under tufts of dense, overhanging bunch grass during the monsoon season (Vickery 1996). They forage almost exclusively on the ground (Vickery 1996) and typically skirt the edges of vegetation patches and skulk around and among bunch grasses (J. Ruth pers. comm.) Along with the negative association with bare ground, the best model for wintering Grasshopper Sparrow abundance also includes a weak positive association with more openness at ground level with overlying protective vegetation, which is consistent with cryptic ground foragers (Ruth et al. 2014). Little is known about the ratio of grass to bare ground in suitable breeding habitat.

Landscape Requirements

Various studies conducted on Grasshopper Sparrows in other regions of North America suggest they are more likely to occupy large tracts of grasslands than small fragments, with minimum area requirements estimated at 75 – 350 acres (Herkert 1994, Vickery et al. 1994, Rao et al. 2008). However, estimates have not been determined for the resident Arizona subspecies. Alternate habitat types, such as agricultural fields, are not used for breeding by southwestern populations.

Conservation Issues and Management Actions

Population Decline

Although data are insufficient for calculating trends in Arizona, Grasshopper Sparrows are declining almost everywhere else (Sauer et al. 2012). Grasshopper Sparrow has been designated as a Common Bird in Steep Decline (NABCI 2014). Although it does not represent an analysis of long-term continuous data, Ruth (2008) compared repeated roadside survey data from 2004 – 2005 with historical survey data conducted in 1982 (Mills 1982) and 1987 (Strong 1988). She found substantial between-year variation in numbers, but the limited data do not provide any clear statistical evidence for a decline during this time period. However, long-term data (1992 – 2006) for the Arizona subspecies population in southwestern New Mexico does indicate statistically significant declines for both the Animas Valley and McKinney Flats (Williams 2007) and Grasshopper Sparrow is listed as Endangered by the state of New Mexico. Without additional population data for Arizona, it is assumed that Grasshopper Sparrows are similarly vulnerable to declines in Arizona.

Threats Assessment

This table is organized by Salafsky et al.'s (2008) standard lexicon for threats classifications. Threat level is based on expert opinion of Arizona avian biologists and reviewers. We considered the full lexicon but include only medium and high threats in this account.

Threat	Details	Threat Level
Residential and Commercial Development • Housing and urban areas	Housing and urban areas: exurban development leads to permanent habitat loss	High
Agriculture • Annual and perennial non-timber crops • Livestock farming and ranching	Conversion to vineyards and orchards is permanent habitat loss High intensity unsustainable grazing	High
Natural System Modifications • Fire and fire suppression		Medium
Invasive and Problematic Species • Invasive non-native/alien plants • Problematic native plants	Primarily Lehmann and weeping lovegrass Mesquite and other woody shrub encroachment	Medium
Climate Change • Changes in temperature regimes • Changes in precipitation and hydrological regimes		Medium

In the following section we provide more detail about threats, including recommended management actions. Threats with similar recommended actions are grouped.

Residential and Commercial Development:

- Housing and urban areas
- Commercial and industrial areas

Urban sprawl and dispersed rural development are among the biggest threats to Grasshopper Sparrow habitat in Arizona, particularly in the Sonoita Valley and the upper San Pedro Valley, which are largely privately owned (Latta et al. 1999, Ruth 2008). Conversion of grasslands for urban/suburban or commercial development is the most drastic threat, as it represents a permanent loss of habitat. Remaining fragmented grasslands are not ideal Grasshopper Sparrow habitat. In the Sonoita Valley, Grasshopper Sparrows occurred less frequently in grasslands in exurban areas than in grasslands in undeveloped areas, and abundance was negatively correlated with the number of homes within 250 m (Bock et al. 2008).

Recommended Actions:

1. Create conservation easements, open space, and greenbelts that are large enough to preserve significant tracts of grasslands (> 75 acres).
2. Educate the public about the beauty and value of grasslands to people, as well as native wildlife.
3. Provide opportunities for interpretive outreach, such as hiking trails, in easement areas.
4. Promote the retention or restoration of native grasslands on private property, including management recommendations for landowners.

Agriculture:

- Livestock farming and ranching
- Annual and perennial non-timber crops

Grazing is not incompatible with Grasshopper Sparrow conservation when it is well-managed. Impacts from livestock grazing are likely highest in consecutive drought years, during which Grasshopper Sparrow populations may already be struggling. Many early studies of Grasshopper Sparrow response to grazing in southeastern Arizona were conducted on a single ungrazed site (the National Audubon Society's Appleton-Whittell Research Ranch) and one private range managed with high-density, short-duration, rotational grazing. These studies found breeding and wintering Grasshopper Sparrows only on the ungrazed site (Bock and Webb 1984, Bock and Bock 1999) or they were more abundant on the ungrazed site (Bock et al. 1984, Bock and Bock 1988). This presents a somewhat limited perspective on Grasshopper Sparrow response to grazing. Recent studies had more complex results. On multiple sites in the Sonoita Valley, researchers found that breeding and wintering Grasshopper Sparrows were more abundant on ungrazed sites in an exurban environment, but were more abundant on grazed sites in an undeveloped environment (Bock et al. 2008). Gordon (2000) also found variation between years in how wintering Grasshopper Sparrows responded to grazing. A comparison of current and historical roadside surveys for Grasshopper Sparrows found the highest densities of singing males in the grasslands of San Rafael Valley (all grazed), followed by sequentially lower densities in the Sonoita Valley (mostly grazed, but one ungrazed site) (Ruth 2008).

In addition to grazing effects, another agricultural issue is conversion of grasslands to annual or perennial crops. In the Sonoita Valley this has been largely in the form of an expanding local wine industry, where grasslands are plowed under and planted to grapes (Ruth 2008).

Recommended Actions:

1. Rotate pasture use to allow for regular grass structure recovery between seasons to minimize impacts to Grasshopper Sparrow habitat.
2. Implement grazing practices in grasslands to allow for natural fire regimes and if needed, introduce periodic prescribed fires to reduce undesirable woody and other vegetation.
3. Shift livestock use toward fall, winter, and late spring where possible to minimize grazing during the breeding season; where grazing does occur during the breeding season, encourage annual variation so that sites are not grazed during sequential breeding seasons.
4. Prevent Grasshopper Sparrow breeding areas from being converted to vineyards.

Natural System Modifications:

- Other ecosystem modifications
- Fire and fire suppression

Semiarid grasslands evolved with fire, which maintains relatively shrub-free grasslands. However, fire frequency has decreased in the region due to intentional suppression, widespread grazing, and other factors that reduce fine fuels. Fire reduces grass cover for one to three post-fire growing seasons, stimulates forb growth, and increases seed production (Bock and Block 2005). Researchers in southeastern Arizona suggest that breeding Grasshopper Sparrow presence and abundance were reduced for at least two years post-fire (Bock et al. 1976, Bock and Bock 1988, Bock and Bock 1992). However, there was no significant evidence for response of wintering Grasshopper Sparrows following spring and summer burns (Bock and Bock 1992, Gordon 2000, Kirkpatrick et al. 2002). We are not aware of any literature suggesting that there are long-term, habitat-related negative effects of fire on Grasshopper Sparrows. In addition to altered fire regimes, other disturbances or ecosystem modifications, like shrub encroachment, contribute to habitat degradation through changes in plant species composition, patchiness, and vegetation structure (Merola-Zwartjes 2005). For example, encroachment of woody plants and loss of native ground cover (Van Auken 2000) reduces habitat suitability for Grasshopper Sparrows.

Recommended Actions:

1. Use prescribed fires where feasible (outside the Grasshopper Sparrow breeding season) to reduce shrub cover and maintain native bunch grasses.
2. Delineate important Grasshopper Sparrow areas and prioritize these for habitat conservation and enhancement (> 75 acres).
3. Create conservation easements and undertake grassland protection in highly suitable areas > 75 acres, with a recommended management patch size of > 350 acres.
4. Prevent or minimize recreational impacts in grasslands occupied by Grasshopper Sparrows.

Invasive and Problematic Species:

- Invasive non-native/alien plants
- Problematic native plants

For Grasshopper Sparrows, the invasive and problematic species that pose a threat are woody vegetation encroachment of native mesquite into grasslands, and exotic, invasive species, primarily Lehmann's and

weeping lovegrasses. The semiarid grasslands of Arizona and New Mexico have a seasonal variation in how Grasshopper Sparrows respond to shrub cover. In the breeding season, Grasshopper Sparrow abundance was negatively correlated with woody cover (Bock and Webb 1984, Pidgeon et al. 2001, Block and Morrison 2010). In winter, abundance showed no significant correlation with shrub cover (Block and Morrison 2010, Ruth et al. 2014). Grasshopper Sparrows were less abundant on sites dominated by exotic lovegrasses than they were on native grass-dominated sites (Bock et al. 1986, Bock and Bock 1988). In winter, abundance showed no significant correlation with percent non-native grass (Ruth et al. 2014).

Recommended Actions:

1. Work to control exotic lovegrasses and encroaching mesquite and other woody vegetation.

Climate Change:

- Changes in temperature regimes
- Changes in precipitation and hydrological regimes

Grasshopper Sparrows occupy native grasslands that are susceptible to effects of climate change, particularly prolonged drought and higher temperatures that might lead to increased fire frequency and loss of plant vigor. Much of the research on small-bodied birds vulnerable to stress from increased temperatures and water loss and on catastrophic mortality events have focused on desert birds because they already survive near the limits of their physiological tolerances (Wolf and Walsberg 1996, McKechnie and Wolf 2009). However, there is evidence that Grasshopper Sparrows may exhibit behaviors that stressed birds employ, such as use of thermal refugia (Wolf et al. 1996). They have been observed suspending territoriality and perching together in shrubs during the hottest days (J. Ruth, unpub. data). Projections of vegetation changes in western grasslands suggest that semiarid grasslands habitat will expand northward from the southwest into the Great Basin, Colorado Plateau, and southern Great Plains and will occupy nearly four times its present distribution (Friggens et al. 2012), which could lead to a shift in Grasshopper Sparrow distribution.

Recommended Actions:

1. Develop a monitoring or regular population inventory plan for Grasshopper Sparrows that allows for trend estimation and documentation of changes in occupancy due to the effects of climate change.
2. Encourage additional research on the physiological vulnerability of Arizona Grasshopper Sparrows to higher temperatures and greater water loss.

Research and Monitoring Priorities

1. Clarify habitat selection criteria for Grasshopper Sparrow territories, such as relative ground cover types, territory sizes, and area requirements. While area requirements have been studied in other regions, southwestern populations may have different needs.
2. Continue or expand monitoring efforts to better estimate trends of the Arizona Grasshopper Sparrow subspecies, or alternately, conduct full population inventories at regular intervals.
3. Study winter ecology of Grasshopper Sparrows in Arizona, including specific habitat requirements.

4. Determine stewardship responsibility of Arizona for maintaining the *A. s. ammolegus* subspecies and winter populations of *A. s. perpallidus*.
5. Promote specific research on the effects of various grazing regimes on the presence, abundance, survival, and productivity of Grasshopper Sparrows and other grassland birds.

Literature Cited

[4]Arizona Bureau of Land Management Sensitive Species List – March 2017.

[2]Arizona Game and Fish Department. 2012. Arizona's State Wildlife Action Plan: 2012 – 2022. Arizona Game and Fish Department, Phoenix, AZ.

Block, G., and M.L. Morrison. 2010. Large-scale effects on bird assemblages in desert grasslands. Western North American Naturalist 70(1):19 – 25.

Bock, C.E. and J.H. Bock. 1988. Grassland birds in southeastern Arizona: impacts of fire, grazing, and alien vegetation. Pp. 43-58 *in* P.E. Goriup (editor) Ecology and conservation of grassland birds. Girton,Cambridge, United Kingdom.

Bock, C.E., and J.H. Bock. 1992. Response of birds to wildfire in native versus exotic Arizona grassland. Southwestern Naturalists 37(1):73 – 81.

Bock, C.E. and J.H. Bock. 1999. Response of winter birds to drought and short-duration grazing in southeastern Arizona. Conservation Biology 13(5):1117 – 1123.

Bock, C.E., J.H. Bock, K.L. Jepson, and J.C. Ortega. 1986. Ecological effects of planting African lovegrasses in Arizona. National Geographic Research 2:456 – 463.

Bock, C.E., J.H. Bock, W.R. Kenney, and V.M. Hawthorne. 1984. Responses of birds, rodents, and vegetation to livestock exclosure in a semidesert grassland site. Journal of Range Management 37(3):239 – 242.

Bock, J.H., C.E. Bock, and J.R. McKnight. 1976. A study of the effects of grassland fires at the Research Ranch in southeastern Arizona. Journal of the Arizona Academy of Science 11(2):49 – 57.

Bock, C.E and W.M. Block. 2005. Fire and birds in the southwestern United States. In: Saab, V. and H. Powell, eds. Fire and avian ecology in North America. Studies in Avian Biology No. 30. Cooper Ornithological Society14 – 32. Camarillo, CA.

[9]Bock, C.E., and B. Webb. 1984. Birds as grazing indicator species in southeastern Arizona. J. Wildl. Manage. 48(3):1045 – 1049.

Bock, C.E., Z.F. Jones, and J.H. Bock. 2008. The oasis effect: response of birds to exurban development in a southwestern savanna. Ecological Applications 18(5):1093 – 1106.

[10]Corman, T.E. 2005. Grasshopper Sparrow. *In*: Arizona Breeding Bird Atlas. Corman, T.E., and C. Wise-Gervais (eds.) University of New Mexico Press. Albuquerque, NM.

[3]Department of Defense. 2012. DoD PIF Mission-Sensitive Priority Bird Species. Fact Sheet #11. Department of Defense Partners in Flight Program.

Friggens, Megan M., M.V. Warwell, J.C. Chambers, and S.G. Kitchen. 2012. Modeling and predicting vegetation response of western USA grasslands, shrublands, and deserts to climate change (Chapter 1). *In*: Finch, D.M., ed. Climate change in grasslands, shrublands, and deserts of the interior American West: a review and needs assessment. Gen. Tech. Rep. RMRS-GTR-285. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Pp. 1 – 20.

Gordon, C.E. 2000. Fire and cattle grazing on wintering sparrows in Arizona grasslands. Journal of Range Management 53(4):384 – 389.

Herkert, J.R. 1994. The effects of habitat fragmentation on Midwestern grassland bird communities. Ecological Applications 4(3):461 – 471.

Kirkpatrick, C., S. DeStephano, R.W. Mannan and J. Lloyd. 2002. Trends in abundance of grassland birds following a spring prescribed burn in southern Arizona. Southwestern Naturalist 47(2):282 – 292.

Latta, M.J., C.J. Beardmore, and T.E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan, Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, AZ.

McKechnie, A.E. and B.O. Wolf. 2009. Climate change increases the likelihood of catastrophic avian mortality events during extreme heat waves. Biology Letters 6(2):254 – 256.

Merola-Zwartjes, M. 2005. Birds of Southwestern grasslands: Status, conservation, and management. In: Finch, D.M., editor. Assessment of grassland ecosystem conditions in the Southwestern United States: wildlife and fish—volume 2. Gen. Tech. Rep. RMRS-GTR-135-vol. 2. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. pp. 71 – 140.

Mills, G.S. 1982. Status report: *Ammodramus savannarum ammolegus* (H.C. Oberholser). Arizona Natural Heritage Program, Tucson, Report to Office of Endangered Species, USDI Fish and Wildlife Service, Albuquerque, NM.

North American Bird Conservation Initiative, U.S. Committee. 2014. The State of the Birds 2014 Report. U.S. Department of Interior, Washington, D.C. 16 pp.

[5a]Partners in Flight. 2019. Avian Conservation Assessment Database, version 2019. Accessed on March 31, 2019.

[6]Partners in Flight Science Committee. 2020. Population Estimates Database, version 3.0. Accessed on March 31, 2019.

Pidgeon, A.N., N.E. Mathews, R. Benoit, and E.V. Nordheim. 2001. Response of avian communities to historic habitat change in the northern Chihuahuan Desert. Conservation Biology 15(6):1772-1788.

Rao, D., S. Gennet, M. Hammond, P. Hopkinson, and J. Bartolome. 2008. A landscape analysis of grassland birds in a valley grassland-oak woodland mosaic. Pp. 385 – 397 *in* Merenlender, A., D. McCreary, and K. Purcell (eds.) Proceedings of the sixth California oak symposium: today's challenges, tomorrow's opportunities. Gen. Tech. Rep. PSWGTR-217. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

[5b]Rosenberg, K.V., J.A. Kennedy, R. Dettmers, R.P. Ford, D. Reynolds, J.D. Alexander, C.J. Beardmore, P. J. Blancher, R.E. Bogart, G.S. Butcher, A.F. Camfield, A. Couturier, D.W. Demarest, W.E. Easton, J.J. Giocomo, R.H. Keller, A.E. Mini, A.O. Panjabi, D.N. Pashley, T.D. Rich, J.M. Ruth, H. Stabins, J. Stanton, T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee.

Ruth, J.M. 2008. Distribution of breeding Arizona Grasshopper Sparrow (*Ammodramus savannarum ammolegus*) in the southwestern United States: Past, present, and future. Studies in Avian Biology 37:113 – 124.

Ruth, J.M., T.R. Stanley, and C.E. Gordon. 2014. Associations of wintering birds with habitat in semidesert and plains grasslands in Arizona. The Southwestern Naturalist. 59(2):199 – 211.

Ruth, J.M. 2015. Status assessment and conservation plan for the Grasshopper Sparrow (*Ammodramus savannarum*), Version 1.0. U.S. Fish and Wildlife Service, Lakewood, CO.

Salafsky, N., Salzer, D., Stattersfield, A.J., Hilton-Taylor, C., Neugarten, R., Butchart, S.H.M., Collen, B., Cox, N., Master, L.L., O'Connor, S. and Wilkie, D. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22(4): 897 – 911.

[7]Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr., and W.A. Link. 2016. The North American Breeding Bird Survey, Results and Analysis 1966 – 2013, Version 2016. USGS Patuxent Wildlife Research Center, Laurel, MD. Accessed on July 1, 2016.

Strong, T.R. 1988. Status of the Arizona Grasshopper Sparrow (*Ammodramus savannarum ammolegus* Oberholser). Arizona Game and Fish Department, report to Office of Endangered Species, USDI Fish and Wildlife Service, Albuquerque, NM.

[1]U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pp.

Van Auken, O.W. 2000. Shrub invasions of North American semiarid grasslands. Annual Review of Ecology and Systematics. 31:197 – 215.

[8]Vickery, P.D. 1996. Grasshopper Sparrow (*Ammodramus savannarum*), The Birds of North America Online (A. Poole, ed.) Ithaca: Cornell Lab of Ornithology.

Vickery, P.D., M.L. Hunter, Jr., and S.M. Melvin. 1994. Effect of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4):1087-1097.

Williams III, S.O. 2007. Status of the Arizona Grasshopper Sparrow on the Diamond A (Gray) Ranch, Hidalgo County, New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM.

Wolf, B.O. and G.E. Walsberg. 1996. Respiratory and cutaneous evaporative water loss at high environmental temperatures in a small bird. Journal of Experimental Biology 1999:451-457.

Wolf, B.O., K.M. Wooden, G.E. Walsberg. 1996. The use of thermal refugia by two small desert birds. Condor 98(2):424-428.

Recommended Citation

Arizona Bird Conservation Initiative and Sonoran Joint Venture. 2023. Grasshopper Sparrow (*Ammodramus savannarum)* Species Account. Available at https://sonoranjv.org/accounts/grasshopper-sparrow.pdf.