

Northern Flying Squirrel

Glaucomys sabrinus

REGULATORY STATUS

USFWS: No special status
USFS R2: No special status
USFS R4: No special status
Wyoming BLM: No special status
State of Wyoming: Nongame Wildlife

CONSERVATION RANKS

USFWS: No special status
WGFD: NSS4 (Cb), Tier II
WYNDD: G5, S3S4
Wyoming Contribution: LOW
IUCN: Least Concern

STATUS AND RANK COMMENTS

The Wyoming Natural Diversity Database (WYNDD) has assigned Northern Flying Squirrel (*Glaucomys sabrinus*) a state conservation rank ranging from S3 (Vulnerable) to S4 (Apparently Secure) because of uncertainties in the species' abundance, the amount of occupied habitat, and population trends in Wyoming. An isolated population of Northern Flying Squirrel is found in the Black Hills of Wyoming and South Dakota. WYNDD assigns this population a state conservation rank of S1 (Critically Imperiled) and a Wyoming contribution of VERY HIGH.

NATURAL HISTORY

Taxonomy:

Recent genetic analyses suggest Northern Flying Squirrel could be comprised of more than one species^{1, 2}; however, only one species is currently recognized³. There are approximately 25 subspecies of Northern Flying Squirrel. Currently, *G. s. bangsi* is the only one known to occur in Wyoming; however, *G. s. lucifugus* occurs in northeastern Utah and may occur in southwestern Wyoming^{4, 5}. Additional research suggests the disjunct population in the Black Hills of Wyoming and South Dakota is genetically isolated and should be considered a separate subspecies^{6, 7}, but this taxonomic revision is not yet widely accepted.

Description:

Identification of Northern Flying Squirrel is possible in the field. Northern Flying Squirrel is a small tree squirrel ranging from 29–32 cm in length, including the tail, and weighing 105–170 g. Dorsal pelage is typically soft gray to beige and the underside is white. Eyes are notably large and dark. The species is distinguished from other sympatric tree squirrels by a layer of loose skin attached to the fore- and hind-limbs, which assists with gliding⁸.

Distribution & Range:

Northern Flying Squirrel is broadly distributed across Canada and Alaska, and its range extends south along the east and west coasts of the United States and along the Rocky Mountains into

Utah. Disjunct populations also exist on the southern periphery of the species range. In Wyoming, the species is found in the northwestern mountains and the Black Hills in the northeast. The species is also known to occur in the Uinta Mountains in northeastern Utah but has not been confirmed from the portions of this mountain range in southwestern Wyoming^{5, 8}.

Habitat:

Northern Flying Squirrel is found in mature and old-growth coniferous, deciduous, mixed, and riparian forests throughout its range^{9, 10}. The species tends to be more abundant and occur at higher densities in old-growth and mature forest stands than in secondary growth type forests, though both types of forests are used^{9, 11, 12}. In conifer-dominated forests in Ontario, density of Northern Flying Squirrel was strongly related to the density of large spruce (*Picea* spp.) and hardwood trees and snags¹³. In Wyoming, the species is primarily found in coniferous forests, particularly those with tall, large diameter trees, moist conditions, and abundant standing and downed snags and decaying logs^{5, 8, 10, 14, 15}. Northern Flying Squirrel requires tall trees to provide launch points for gliding, cavities for nesting/denning, and moist decaying materials that support growth of fungi, its primary food. The species also prefers forests with open understories that allow for longer unobstructed glides but avoids clear-cuts^{5, 12}. Habitat use does not change seasonally¹⁰.

Phenology:

Northern Flying Squirrel is active throughout the year and does not hibernate. In Wyoming, the species breeds from late March to May. Gestation lasts 37–42 days and litter size ranges from 2–6 young. Young are weaned at about two months and are sexually mature in 6–12 months. The species has been known to breed more than once a year in some parts of its range, but it is unknown if this occurs in Wyoming^{8, 10, 16}.

Diet:

Fungi, particularly mycorrhizal fungi, and lichens comprise the majority of the diet of Northern Flying Squirrel, and these appear to be a critical component of the species' diet throughout its range. However, the species will also eat insects, nuts, buds, seeds, and fruit, and occasionally bird eggs and nestlings^{5, 8-12}.

CONSERVATION CONCERNS

Abundance:

Continental: WIDESPREAD

Wyoming: UNCOMMON

There are no robust estimates of Northern Flying Squirrel abundance in Wyoming; however, the probability of occupancy for survey grids in the Wyoming Range was high (0.80)¹⁴, as was the probability of occupancy in the Black Hills (0.87)¹⁵. Elsewhere in the species' range, densities in good habitat range from 0.1 to 4.0 individuals per ha^{9, 17}. The statewide abundance rank of UNCOMMON is based on state occupancy estimates and the quantity and quality of potential available habitat in Wyoming.

Population Trends:

Historic: UNKNOWN

Recent: UNKNOWN

Historic and recent population trends for Northern Flying Squirrel in Wyoming are unknown, although protocols are in place to evaluate trends in occupancy of Northern Flying Squirrel in

portions of its range in Wyoming¹⁵. Across northern North America, populations are thought to be stable^{10, 11}. In the southern portions of the species' range, including Wyoming, loss of preferred habitat may currently be causing a decline in populations¹¹.

Intrinsic Vulnerability:

MODERATE VULNERABILITY

Northern Flying Squirrel is moderately vulnerable to extrinsic stressors due to the species' reliance on mesic old-growth and mature forests, specialized diet, and relatively low fecundity for its body size. Northern Flying Squirrel's dependence on tall trees in forests with relatively open understory for gliding and its avoidance of open areas limit the species' dispersal ability. Because Northern Flying Squirrel is a secondary cavity nester, density of suitable nest cavities is known to limit population densities in some areas^{12, 18}.

Extrinsic Stressors:

SLIGHTLY to MODERATELY STRESSED

Factors that decrease old-growth and mature conifer forests and snag density will likely affect Northern Flying Squirrel populations in Wyoming. Forest management practices such as clearcutting and thinning reduce and fragment mature and old-growth forest habitat. Fragmentation of populations through these disturbances may lead to local extirpations. Although the species will use secondary forest types, abundance, density, and productivity are lower in these habitats^{9, 11, 12}. A meta-analysis of 14 studies confirmed the association of Northern Flying Squirrel with mature uncut forest¹⁹. Although some studies of the effects of thinning on Northern Flying Squirrel suggest that impacts can be minimized by maintaining a heterogeneous forest that allows the species to shift distribution to neighboring suitable patches²⁰, other studies suggest landscape configuration does little to offset habitat loss²¹. Wildfires and the recent Mountain Pine Beetle (*Dendroctonus ponderosae*) epidemic potentially have resulted in the loss of Northern Flying Squirrel habitat in Wyoming.

KEY ACTIVITIES IN WYOMING

In the fall of 2011, the Wyoming Game and Fish Department evaluated several survey techniques for Northern Flying Squirrel in the Wind River Range in the Shoshone National Forest²². The combination of bait stations and remote cameras proved most effective, and subsequent studies further improved the efficiency and utility of the technique²³. This survey method was used in 2012 and 2013 in the Wyoming Range and in 2014 in Teton County and the Black Hills to assess Northern Flying Squirrel occupancy and habitat use^{14, 15, 24}. Baseline occupancy estimates from this study will be used to assess population trends in the future.

ECOLOGICAL INFORMATION NEEDS

Northern Flying Squirrel would benefit from continued research to determine its abundance and population trends in Wyoming. The taxonomy of Northern Flying Squirrel needs to be resolved following genetic research suggesting it should be split into multiple species. In Wyoming, genetic research has been limited to the isolated Black Hills population, and additional research is needed to determine subspecies and/or species designations across the state^{1, 2}.

MANAGEMENT IN WYOMING

This section authored solely by WGFD; Nichole L. Bjornlie. Recent activities for Northern Flying Squirrel have included developing and evaluating monitoring protocols, assessing

baseline occupancy and distribution, and evaluating habitat use. Moving forward, management priorities include continuing and expanding occupancy surveys in order to monitor population trends throughout the range the species in Wyoming. Surveys will continue to include habitat assessment in order to better understand what influences presence and distribution at a finer scale, including the availability of food resources. Evaluating changes in presence and occupancy in the face of potential stressors, such as natural and anthropogenic habitat loss, is of particular importance. Results from these efforts will be ultimately be used to develop management and conservation recommendations.

CONTRIBUTORS

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REFERENCES

- [1] Arbogast, B. S. (1999) Mitochondrial DNA phylogeography of the new world flying squirrels (*Glaucomys*): implications for pleistocene biogeography, *Journal of Mammalogy* 80, 142-155.
- [2] Arbogast, B. S. (2007) A brief history of the new world flying squirrels: phylogeny, biogeography, and conservation genetics, *Journal of Mammalogy* 88, 840-849.
- [3] Bradley, R. D., Ammerman, L. K., Baker, R. J., Bradley, L. C., Cook, J. A., Dowler, R. C., Jones, C., Schmidly, D. J., Stangl, F. B., Jr., Van Den Bussche, R. A., and Wursig, B. (2014) Revised checklist of North American mammals north of Mexico, *Occasional Papers Museum of Texas Tech University*.
- [4] Hall, E. R. (1981) *The Mammals of North America, Volume I*, Vol. 1, John Wiley & Sons, New York.
- [5] Buskirk, S. W. (2016) *Wild Mammals of Wyoming and Yellowstone National Park*, University of California Press, Oakland, California.
- [6] Kiesow, A. M. (2008) Genetic structure of Northern Flying Squirrel (*Glaucomys sabrinus*) and Red Squirrel (*Tamiasciurus hudsonicus*) populations in the Black Hills, p 221, University of South Dakota, Vermillion, SD.
- [7] Kiesow, A. M., Wallace, L. E., and Britten, H. B. (2011) Characterization and isolation of five microsatellite loci in Northern Flying Squirrels, *Glaucomys sabrinus* (Sciuridae, rodentia), *Western North American Naturalist* 71, 553-556.
- [8] Clark, T. W., and Stromberg, M. R. (1987) *Mammals in Wyoming*, University of Kansas Press, Lawrence, Kansas.
- [9] Smith, W. P. (2007) Ecology of *Glaucomys sabrinus*: habitat, demography, and community relations, *Journal of Mammalogy* 88, 862-881.
- [10] NatureServe. (2015) NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1, <http://explorer.natureserve.org>, NatureServe, Arlington, Virginia.
- [11] Weigl, P. D. (2007) The Northern Flying Squirrel (*Glaucomys sabrinus*): a conservation challenge, *Journal of Mammalogy* 88, 897-907.
- [12] Smith, W. P. (2012) Sentinels of ecological processes: the case of the Northern Flying Squirrel, *Bioscience* 62, 950-961.
- [13] Holloway, G. L., and Malcolm, J. R. (2006) Sciurid habitat relationships in forests managed under selection and shelterwood silviculture in Ontario, *Journal of Wildlife Management* 70, 1735-1745.
- [14] Van Fleet, L., Cudworth, N., and Grenier, M. (2014) Trends and distribution of the Northern Flying Squirrel (*Glaucomys sabrinus*) in Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations* (Orabona, A. C., and Cudworth, N., Eds.), pp 307-324, Wyoming Game and Fish Department.
- [15] Van Fleet, L., and Boulerice, J. (2015) Distribution and habitat requirements of Northern Flying Squirrels (*Glaucomys sabrinus*) in the Black Hills National Forest, Wyoming., In *Threatened, Endangered, and*

- Nongame Bird and Mammal Investigations* (Orabona, A., C., and Rudd, C. K., Eds.), pp 207-219, Wyoming Game and Fish Department.
- [16] Smith, M. J., Forbes, G. J., and Betts, M. G. (2011) Evidence of multiple annual litters in *Glaucomys sabrinus* (Northern Flying Squirrel), *Northeastern Naturalist* 18, 386-389.
- [17] Smith, W. P., Anthony, R. G., Waters, J. R., Dodd, N. L., and Zabel, C. J. (2003) Ecology and conservation of arboreal rodents of western coniferous forests, In *Mammal Community Dynamics: Management and Conservation in the Coniferous Forests of Western North America* (Zabel, C. J., and Anthony, R. G., Eds.), pp 157-206, Cambridge University Press, Cambridge, United Kingdom.
- [18] Aitken, K. E. H., and Martin, K. (2012) Experimental test of nest-site limitation in mature mixed forests of central British Columbia, Canada, *Journal of Wildlife Management* 76, 557-565.
- [19] Holloway, G. L., and Smith, W. P. (2011) A meta-analysis of forest age and structure effects on Northern Flying Squirrel densities, *Journal of Wildlife Management* 75, 668-674.
- [20] Sollmann, R., White, A. M., Tarbill, G. L., N., M. P., and E., K. E. (2016) Landscape heterogeneity compensates for fuel reduction treatment effects on Northern Flying Squirrel populations, *Forest Ecology and Management* 373, 100-107.
- [21] Ritchie, L. E., Betts, M. G., Forbes, G., and Vernes, K. (2009) Effects of landscape composition and configuration on Northern Flying Squirrels in a forest mosaic, *Forest Ecology and Management* 257, 1920-1929.
- [22] Van Fleet, L., and Grenier, M. (2012) Evaluation of Survey Techniques for the Northern Flying Squirrel, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Abel, B., and Cudworth, N., Eds.), pp 182-193, Wyoming Game and Fish Department.
- [23] Boulerice, J. T., and Van Fleet, L. A. (2016) A novel technique for detecting Northern Flying Squirrels, *Wildlife Society Bulletin* doi:10.1002/wsb.701.
- [24] Van Fleet, L. (2015) Documenting distribution and habitat attributes of Northern Flying Squirrels (*Glaucomys sabrinus*) in Teton County, Wyoming., In *Threatened, Endangered, and Nongame Bird and Mammal Investigations* (Orabona, A. C., and Rudd, C. K., Eds.), pp 195-205, Wyoming Game and Fish Department.



Figure 1: A radio-collared adult Northern Flying Squirrel in the Black Hills, South Dakota. (Photo courtesy of Melissa Hough)

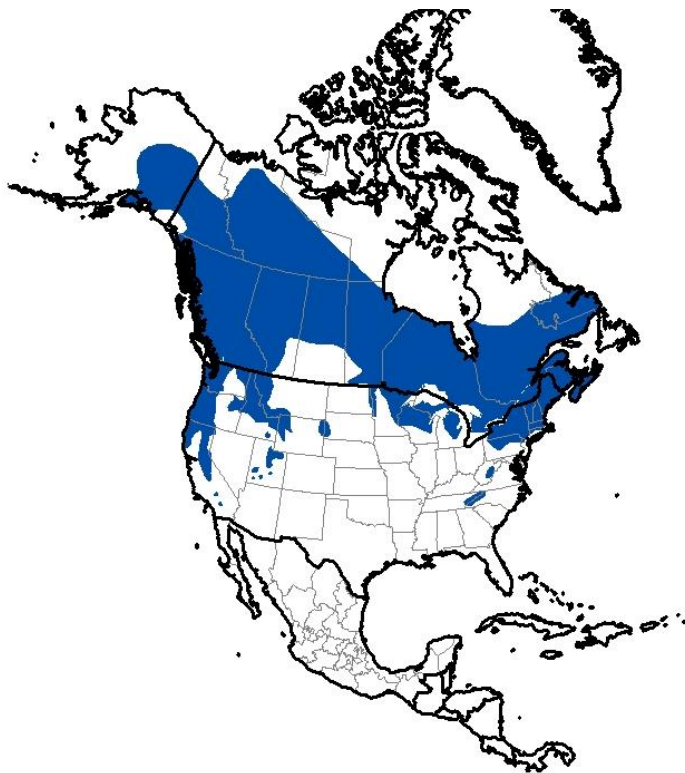
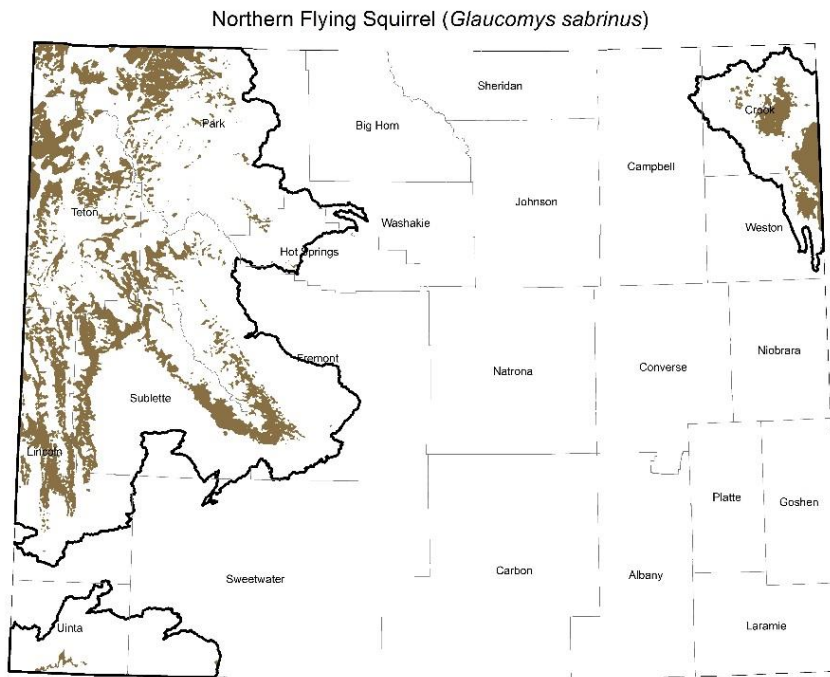


Figure 2: North American range of *Glaucomys sabrinus*. (Map from: Patterson, B. D., et al. (2007) Digital Distribution Maps of the Mammals of the Western Hemisphere, version 3.0, NatureServe, Arlington, Virginia.)



Figure 3: Northern Flying Squirrel habitat in the Black Hills, South Dakota. (Photo courtesy of Melissa Hough)



SOURCE: Digital maps of ranges for Wyoming Species of Greatest Conservation Need: Sept. 2016.
Wyoming Game and Fish Department and Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
Note that brown indicates the predicted distribution of the species;
heavy black lines indicate outermost boundaries of possible occurrence.

Figure 4: Range and predicted distribution of *Glaucomys sabrinus* in Wyoming.