

Rocky Mountain Research Station Science You Can Use *(in 5 minutes)*



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Northern Goshawks: A 20 year study of ecology and habitat on the Kaibab Plateau

A recently published Wildlife Monograph, *Long-Term Demography of the Northern Goshawk in a Variable Environment*, by Richard Reynolds, a Research Wildlife Biologist with the Rocky Mountain Research Station (RMRS) and other RMRS scientists and university collaborators reports on a 20-year mark-recapture study of northern goshawks (*Accipiter gentilis*). Northern goshawks are forest-dwelling raptors and sensitive species in all of the Forest Service's Regions except the Southeastern region. The 425,000-acre study area encompasses spatially isolated coniferous forests of Arizona's high elevation Kaibab Plateau and includes the Kaibab National Forest and the Grand Canyon National Park North-Rim. Monitoring goshawk populations is difficult because of their relatively low density and elusive behavior and, as a result, most goshawk studies have been restricted in scope.



Northern goshawk (*Accipiter gentilis*) on the Kaibab Plateau
(photo C. Van Cleave)

MANAGEMENT IMPLICATIONS

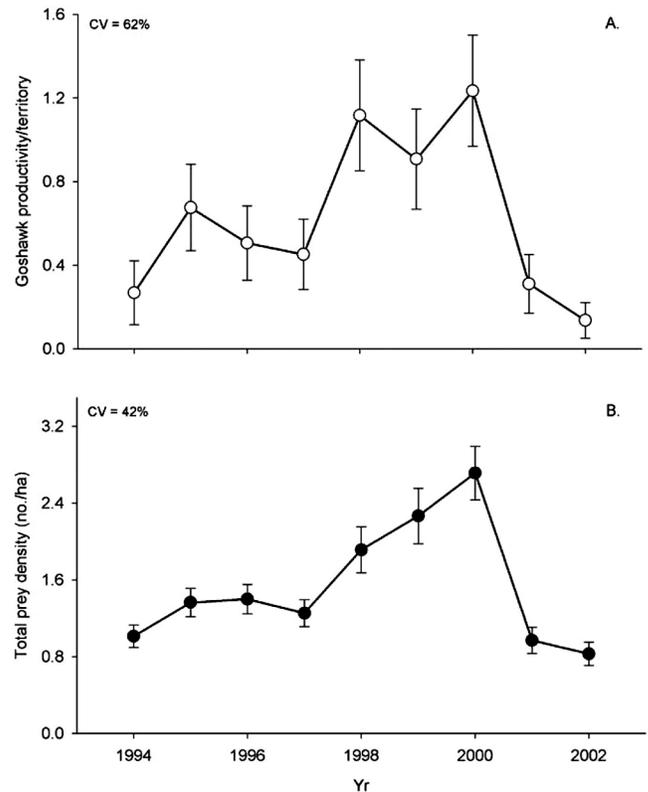
- Forest management that creates a diversity of prey habitats in ponderosa pine and mixed-conifer forests is beneficial to goshawks. The desired habitat diversity includes all tree age classes with a focus on older trees in fine-scale mosaics composed of groups of trees, scattered individual trees, large snags and logs and small openings with species-diverse and productive herbaceous-shrub communities.
- Re-establishment of natural vegetation composition, forest structure and spatial pattern would improve prey habitat and, in turn, goshawk reproduction and population growth. Risk of high-severity fire and susceptibility to insect and disease outbreaks would also decrease in restored forests.
- High severity fires had highly detrimental effects on breeding success whereas low severity surface fire and fires where at least one third of the forest canopy remained had minimal to no impact on breeding success.
- Increasing vegetation diversity, forest productivity and lowering the risk of stand-replacing fires (loss of habitat) are the best management objectives for conserving biodiversity, food webs and goshawk viability in ponderosa and mixed-conifer forests.

Research on the Kaibab has shown that goshawks, predators of birds and small mammals, are strongly food-limited; whether the hawks lay eggs or not depended on prey abundance, which fluctuated over 3–4 year periods of El Niño Southern Oscillation (ENSO) wet and dry years. The amount of ENSO precipitation affected the primary productivity of forest under- and overstory vegetation, and primary productivity controlled the availability of food resources to ground- and canopy-dwelling prey and ultimately their abundance. Extensive annual variation in breeding was observed; in drought periods, only 8% of breeders laid eggs, whereas in exceptional wet periods, up to 87% of pairs laid eggs. The extent to which the goshawk population was shown

KAIBAB GOSHAWK DEMOGRAPHICS

- Goshawk territories were shown to be spatially stable over years. Total prey abundance accounts for more variation in reproduction than abundance of any individual prey species
- Goshawk reproduction is strongly associated with precipitation patterns and consequent understory and overstory plant productivity and growth.
- There is extensive variation in the number of territories fledging young, both in time and space.
- Annual variation in breeding was expressed as variation in proportion of pairs laying eggs, brood sizes, nest failure rates, and fledging production.
- Minimum age at both recruitment and first breeding was 2 years.
- Maximum observed age of both male and female goshawks was 15-years.

to be food-limited indicated that the combined abundance of individuals within the suite of prey species (from ground and tree squirrels, to rabbits, jays, woodpeckers, and grouse) was important for sustaining the goshawk population through time. The presence of all species in the local suite of prey depends on the amount, quality, and inter-mixture of the particular habitats needed by each prey. The habitat mixture included a fine-scale (at 10 acres or less) mix of small groups of mature trees with interlocking crowns for tree squirrels, woodpeckers, grouse, and other birds, and scattered small grass-forb openings for rabbits, ground squirrels, grouse, and other prey. Interestingly, this habitat mix characterized the natural conditions of the ponderosa pine and mixed conifer forests on the Kaibab Plateau before initiation of fire suppression and organized tree harvests. The mix of habitats had been maintained historically with frequent surface fire with small patches of stand-replacing or high-severity fire, which left much of the forest canopy intact but regularly reduced the constant build-up of fuels and kept trees from invading into small grass-forb openings. The increased density of today's forests, the consequence of fire suppression perhaps enhanced by climate warming, has contributed to increased numbers and sizes of stand-replacing wildfires, which has resulted in long-term displacement of goshawks from affected Kaibab territories. During the study period, the goshawk population was slightly declining to stable. However, further habitat loss to crown fire, prolonged drought periods, and other stressors could prompt a decline in Kaibab Plateau population.



Goshawk reproduction is strongly correlated with density of available prey. These graphs show the relationship between goshawk productivity (A) and prey density (B) during the period 1994–2002 (figure by R. Reynolds).

FURTHER READING

- Reynolds, Richard T.; Lambert, Jeffrey S.; Flather, Curtis H.; White, Gary C.; Bird, Benjamin J.; Baggett, L. Scott; Lambert, Carrie; Bayard De Bolo, Shelley. 2017. Long-term demography of the Northern Goshawk in a variable environment. *Wildlife Monographs*. 197: 1–40. <https://www.treesearch.fs.fed.us/pubs/54157>.

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