

AN INTRODUCTION TO PREY OF THE MEXICAN SPOTTED OWL IN WALNUT CANYON NATIONAL MONUMENT, ARIZONA

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The Mexican Spotted Owl (*Strix occidentalis lucida*), one of the three subspecies of the Spotted Owl recognized within the United States, is designated as threatened under the Endangered Species Act. Arizona's Walnut Canyon National Monument has been designated as critical habitat for it. This continuing study focuses on composition of the species' diet through the identification of prey items found in its regurgitated pellets. Similar research has taken place in surrounding areas (Ganey 1992, Block et al. 2005; J. Ganey pers. comm., 2020), but this is the first such study within the national monument. In my pilot study, in 2018, my collaborators and I gathered 48 pellets (comprising 1600+ individual bones), then in 2020 an additional 70 pellets (comprising 3100+ individual bones). In total they included the bones of rodents, small passerine birds, shrews, bats, and a single owl. Pellets gathered in 2020 were dissected and analyzed in early 2021. At that time five Spotted Owl territories were known in the canyon.

Walnut Canyon National Monument (Figure 1) is located ~13 km from Flagstaff. It encompasses 1433 hectares, including 16.8 km of Walnut Creek, a tributary of the Little Colorado River. The canyon is composed primarily of Kaibab limestone and Coconino sandstone and reaches depths of 122 m along its 32-km-long serpentine course. Its ecological communities are characterized by forest of ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) on the canyon rims and

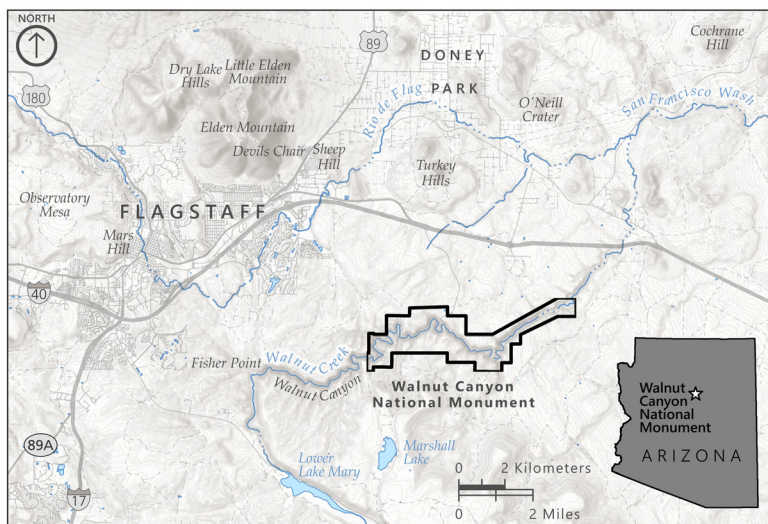


FIGURE 1. Location of Walnut Canyon National Monument, Arizona (map courtesy of K. Gaiz, National Park Service cartographer).

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slopes, which gives way to riparian woodland at the canyon bottom; elevations range from 2091 m along the south rim to 1896 m at the bottom (Drost 2009).

We opportunistically collected pellets from core roost areas in the canyon throughout the breeding seasons of 2018 and 2020 as National Park Service personnel monitored the birds' nesting. Collected pellets were individually wrapped in aluminum foil for protection during transport, then bagged and labeled with individuals' roost-site identifiers (site name, coordinates, collection date). Pellets were stored in climate-controlled facilities before being sterilized (to avoid potential transmission of any zoonotic disease) in a 350° F oven for 30–40 min prior to dissection. I dissected all pellets with the aid of a high-resolution digital dissecting scope. I isolated the contents of individual pellets from other pellets and sorted them roughly before focusing on those skeletal elements (almost exclusively cranial bones) readily identified to genus or species. Nearly all individual pellets contained skeletal elements belonging to multiple animals of various sizes, the majority consisting of postcranial elements of small mammals, but I identified remains to genus or species only when skulls and/or mandibles were present. Each pellet usually contained several dozen individual bones, but generally only one or two cranial elements, and there was no definitive way to pair skulls/mandibles with the much larger number of postcranial elements.

All specimen identifications were accomplished by direct comparison with specimens in the Natural Sciences Department at the Museum of Northern Arizona and with comparative materials I had curated. My identifications were also aided by reference to Hoffmeister (1986), Drost (2009), Holmes et al. (2010), and several vertebrate osteology manuals (Gilbert 1990, Cohen and Serjeantson 1996, Gilbert et al. 1996, Elbroch 2006). Upon completion of the project, all specimens will be permanently curated in the natural science collections at the Museum of Northern Arizona, Flagstaff.

Analysis of the 48 owl pellets collected in 2018 resulted in identifications of *Peromyscus* sp. (deer mouse), *Perognathus* sp. (pocket mouse), *Neotoma albigula* (western white-throated woodrat), *Neotoma mexicana* (Mexican woodrat), *Thomomys bottae* (Botta's pocket gopher), *Microtus mogollonensis* (Mogollon vole), *Sorex merriami* (Merriam's shrew), *Lasionycteris noctivagans* (silver-haired bat), and *Glaucidium gnoma* (Northern Pygmy-Owl).

The 70 pellets collected in 2020 yielded *Peromyscus* sp. (deer mouse), *Neotoma albigula*, *Neotoma mexicana*, *Thomomys bottae*, *Microtus mogollonensis*, unidentified small passerines (order Passeriformes), an unidentified bat (order Chiroptera), and an unidentified frog or toad (order Anura). In addition to the array of vertebrate remains, more than 100 limb, thorax, and abdomen elements from scarab beetles (family Scarabaeidae) were recovered from the pellets from two of the roosts. No arthropod remains were identified from the 2018 specimens.

These results align with those of other Spotted Owl studies from the region (Ganey 1992, Block et al. 2005, Willey 2013) and beyond (Cutler and Hays 1991, Young et al. 1997, Smith et al. 1999, Munton et al. 2002, Bond et al. 2013), with small mammals constituting nearly 96% of prey (specifically woodrats, mice, and voles), followed by arthropods and birds (primarily small passerines), each constituting 1–3% of the prey (Table 1). The assemblage included some noteworthy species for the area. First records for Walnut Canyon National Monument comprised six skeletal elements of *Sorex merriami* and a single specimen of *Perognathus* sp. (pocket mouse), and skeletal elements of *Neotoma albigula* (white-throated woodrat) from both years provided the first certain evidence of that species' occurrence in the monument. *Sorex merriami*, the only species of shrew known from the region, was identified by its diminutive size, unique cranial form, and eye-catching reddish-maroon dentition. *Perognathus* was identified by its pronounced bullae. *Neotoma albigula* was distinguished from the other local woodrat species by its specific dental forms and unique nasal suture patterns. Drost (2009) had listed *Sorex merriami* and

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TABLE 1 Numbers and Percentages of Items of Prey Identified in Spotted Owl Pellets from Walnut Canyon National Monument, Arizona

	2018	2020	Total
Rodent	1545 (95%)	2953 (94%)	4498 (94%)
Bat	31 (2%)	45 (1.4%)	76 (1.6%)
Shrew	6 (0.4%)	0	6 (0.1%)
Scarab beetle	0	114 (3.6%)	114 (2.4%)
Bird	49 (3%)	34 (1.1%)	83 (1.7%)
Frog/toad	0	4 (0.1%)	4 (0.1%)
Total	1631	3150	4781

Perognathus flavus as expected for Walnut Canyon National Monument but did not detect them in trapping from 2002 to 2004 or in a review of museum collections from the area. He reported capture of one possible example of *Neotoma albigula* but could not confirm the identification. Walnut Canyon National Monument is in the general range of all of these species (Hoffmeister 1986). Multiple specimens of *Lasionycteris noctivagans* (silver-haired bat) were also recorded from the pellet assemblages, providing interesting baseline data for the monument, although bats are well known from a number of studies of the Spotted Owl's diet elsewhere in the American West and in Mexico (see Ganey 1992, Young et al. 1997, Smith et al. 1999, Block et al. 2005, Willey 2013).

Finally, the remains of a Northern Pygmy-Owl were represented by the premaxilla, maxilla, nasal, and palatine (Figure 2), as well as multiple postcranial elements, including the humerus, scapula, and coracoid—representing the first reported occurrence of any owl in a Mexican Spotted Owl pellet. Forsman et al. (2004) reported the occurrence of that species, as well as other owl species, in pellets of the Northern Spotted Owl (*S. o. caurina*) in Oregon.

Following two years of study and the analysis of 4700+ bones from 115 pellets, it is evident that at Walnut Canyon National Monument Mexican Spotted Owls consumed a variety of prey but that small mammals dominated their diet, followed by the occasional arthropod, bird, bat, or frog or toad. Continued collecting and analysis of pellets in the coming years will provide resource managers with baseline



FIGURE 2. Premaxilla, maxilla, nasal, and palatine of a Northern Pygmy-Owl recovered from a Mexican Spotted Owl pellet. Scale is in centimeters.

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data critical to the development of more effective forest-management plans and fire-management projects that support the prey of this protected bird.

I thank the Western National Parks Association for providing grant funding for this study, and their unwavering support of science in our national parklands. I also acknowledge Mark Szydlo and Brent Hetzler for collecting the bulk of the pellets used in this study and for enthusiastically sharing their local ornithological knowledge. I thank Janet Gillette for making available the fantastic natural science collections over which she formerly presided at the Museum of Northern Arizona. Without these carefully curated comparative materials this study would not be possible. I thank Rodney B. Siegel, Mark Szydlo, and David W. Willey for their careful reviews of this note.

LITERATURE CITED

- Block, W. M., Ganey, J. L., Scott, P. E., and King, R. M. 2005. Prey ecology of Mexican Spotted Owls in pine-oak forests of northern Arizona. *J. Wildl. Mgmt.* 69(2):618–629; doi.org/10.2193/0022-541X (2005)069[0618: PEOMSO]2.0.CO;2
- Bond, M. L., Lee, D. E., Siegel, R. B., and Tingley, M. W. 2013. Diet and home-range size of California Spotted Owls in a burned forest. *W. Birds* 44:114–126.
- Cohen, A., and Serjeantson, D. 1996. *A Manual for the Identification of Bird Bones from Archaeological Sites* (rev. ed.). Archetype Publ., London.
- Cutler, T. L., and Hays, D. W. 1991. Food habits of Northern Spotted Owls in high elevation forests of Pelican Butte, southwestern Oregon. *Northwest. Nat.* 72:66–69; doi.org/10.2307/ 3536802.
- Drost, C. 2009. Inventory of mammals at Walnut Canyon, Wupatki, and Sunset Crater national monuments. *Nat. Res. Tech. Rep. NPS/SCPN/NRTR-2009/278*. Dept. Interior, Natl. Park Service, Natl. Resource Program Center, Fort Collins, CO; <https://in.nau.edu/wp-content/uploads/sites/128/2018/08/NAU-64-ek.pdf>.
- Elbroch, M. 2006. *Animal Skulls: A Guide to North American Species*. Stackpole, Mechanicsburg, PA.
- Forsman, E. D., Anthony, R. G., Meslow, E. C., and Zabel, C. J. 2004. Diets and foraging behavior of Northern Spotted Owls in Oregon. *Raptor Res.* 38:214–230.
- Ganey, J. L. 1992. Food habits of Mexican Spotted Owls in Arizona. *Wilson Bull.* 104:321–326.
- Gilbert, B. M. 1990. *Mammalian Osteology*. Missouri Archaeol. Soc., Columbia, MO.
- Gilbert B. M., Martin, L. D., and Savage, H. G. 1996. *Avian Osteology*. Missouri Archaeol. Soc., Columbia, MO.
- Hoffmeister, D. F. 1986. *Mammals of Arizona*. Univ. Ariz. Press and Ariz. Dept. Game and Fish, Tucson.
- Holmes, J., M. Johnson, J., Door, S., and Whitefield, P. 2010. Avian inventory for Walnut Canyon National Monument, 2009–2010 final report. On file at Walnut Canyon National Monument, AZ.
- Munton, T. E., Johnson, K. D., Steger, G. N., and Eberlein, G. P. 2002. Diets of California Spotted Owls in the Sierra National Forest. U.S. Forest Service Gen. Tech. Rep. PSW-GTR-183; https://www.fs.fed.us/psw/publications/documents/gtr-183/011gtr183_muntonsp.pdf.
- Smith, R. B., Peery, M. Z., Gutierrez, R. J., and LaHaye, W. S. 1999. The relationship between Spotted Owl diet and reproductive success in the San Bernardino Mountains, California. *Wilson Bull.* 111:22–29.
- Willey, D. W. 2013. Diet of Mexican Spotted Owls in Utah and Arizona. *Wilson J. Ornithol.* 125:775–781; doi.org/10.1676.13-026.1.
- Young, K. E., Zwank, P. J., Valdez, R., Dye, J. L., and Tarango, L. A. 1997. Diet of Mexican Spotted Owls in Chihuahua and Aguascalientes, Mexico. *Raptor Res.* 31:376–380.

Accepted 4 March 2022

Associate editor: Daniel D. Gibson