



Prey Analysis of Mexican Spotted Owls (*Strix occidentalis lucida*) in Walnut Canyon National Monument, Arizona

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FINAL REPORT

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Cover photo: A complete *Sorex merriami* (Merriam's shrew) mandible recovered from a Mexican Spotted Owl pellet (photo by J. Hardes)

Introduction

The Mexican Spotted Owl (MSO) is designated as a Threatened species under the Endangered Species Act (ESA) and Walnut Canyon National Monument is designated Critical Habitat for the species. This study focuses on diet composition of MSO through the identification of prey items found within regurgitated owl pellets from the canyon's resident birds.

A pilot study started in 2018 analyzed some 45 individual MSO pellets from the canyon. Over 1,600 individual bones and bone fragments were recovered from these pellets, including the identified remains of an array of rodent species, small passerine birds, voles, shrews, bats, and a single Northern Pygmy Owl. Following this successful pilot study and upon receiving grant funding from the Western National Parks Association (WNPA) in the Fall of 2019, a second season of pellet collecting took place in 2020, with dissections and analysis occurring in early 2021.

Methods

Pellets were opportunistically collected from MSO core roost areas in the canyon throughout the breeding season as nesting surveys were conducted by National Park Service (NPS) Resources personnel. Collected pellets were individually wrapped in aluminum foil to provide structural protection during transport, and then bagged and labelled with individual owl roosting site identifiers (site name, coordinates, collection date, etc.). Pellets were stored in climate-controlled facilities before being sterilized (from potential parasites) in a 350-degree oven for 30-40 minutes, prior to dissection. All pellet dissection was completed by the author, and included the use of fine-tipped tweezers, dental picks, soft brushes, sorting trays, and a high-resolution digital dissecting scope (purchased with funds from this WNPA grant [*Grant #20-11*]). The contents of individual pellets were isolated from other pellets and subjected to a "rough sort" before focusing on those skeletal elements (primarily cranial bones and post-cranial elements exhibiting unique hallmarks), that could be used for identification to taxonomic genus or species.

All specimens identified to the level of genus or above were done so with the use of skeletal comparative collections housed in the Natural Sciences Department at the Museum of Northern Arizona in Flagstaff, as well as those curated by the author. Identifications of specimens to genus or species level were accomplished exclusively through direct one-to-one comparison with multiple voucher specimens of known species (Figure 1). Prey item identifications were also aided using the 2009 *Inventory of Mammals at Walnut Canyon, Wupatki and Sunset Crater Volcano National Monuments* technical report, the 2010 *Avian Inventory for Walnut Canyon National Monument* report, Hoffmeister's *Mammals of Arizona*, as well as an array of published vertebrate osteology manuals.



Figure 1: Northern Pygmy Owl humerus - museum voucher specimen (left) and pellet-recovered specimen (right) – photo by J. Hardes

Background/Results

As this is the first study of its kind to be undertaken within Walnut Canyon National Monument, very little is known about the diet of the local subspecies of Mexican Spotted Owl (*Strix occidentalis lucida*) inhabiting this unique canyon environment. Though a similar study was conducted in the far western reaches of Walnut Canyon, the research area was well outside the Monument boundaries (Ganey pers. comm. February 24, 2020). The 45 owl pellets collected in 2018, were fully dissected in 2019, resulting in the identification of more than 1,600 individual bones and bone fragments (Figure 2). Genera and specific identifications include *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 mogolonensis* (Mogollon vole), *Sorex merriami* (Merriam's shrew), *Lasionycteris noctivagans* (silver-haired bat) and *Glaucidium*

gnoma (Pygmy Owl). These identifications represent the first confirmed occurrences of the western white-throated woodrat and Merriam's shrew from Walnut Canyon National Monument.

Number of Prey Items by Location (2018 pilot study)						
	Roost A	Roost B	Roost C	Roost D	Roost E	Roost F
Mammal	217 (95%)	598 (97%)	147 (94%)	351 (100%)	84 (100%)	185 (95%)
Avian	11 (5%)	18 (3%)	10 (6%)	0	0	10 (5%)
Herp	0	0	0	0	0	0
Arthropod	0	0	0	0	0	0
Total:	228 (100%)	616 (100%)	157 (100%)	351 (100%)	84 (100%)	195 (100%)
<div> <div>Total Mammal: 1,582 (97%)</div> <div>Total Avian: 49 (3%)</div> <div>Grand Total: 1,631</div> </div>						

Figure 2: 2018 pilot study results by roost/collection location. (Note: Individual roost names were replaced with generic letter designations in order to protect their sensitive locations)

The 70 pellets collected in 2020 (a 40% increase from the previous year's collecting sessions), and dissected and analyzed in early 2021, resulted in the identification of more than 3,100 individual bones (Figure 3). This increase in numbers over the previous year's collecting sessions is partially due to three additional collecting locations being added to the 2020 season, but it is also likely a result of all five Walnut Canyon MSO pairs successfully breeding and rearing their young that season, something that did not happen in 2018. Identified specimens include *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 mogolonensis* (Mogollon vole), unidentified small passerine or songbird (order Passeriformes), unidentified bat (order Chiroptera), and unidentified frog or toad (order Anura). In addition to the array of vertebrate remains, more than 100 limb, thorax and abdomen elements from scarabs or scarab beetles (family Scarabaeidae) were recovered from two of the roost locations (Figure 3). Interestingly, the previous collecting season did not result in the identification of

any arthropod remains. Other non-osteological materials observed in the pellets, included passerine feathers, rodent whiskers, and fur. For reasons currently unknown, pellets containing bat skeletal remains tended to preserve intact portions of the animal's pelt as well, while other animal's fur was preserved only as separated, individual hairs. The majority of pellets contained the partial or complete remains of more than one individual.

Number of Prey Items by Location (2020)									
	Roost A	Roost B	Roost C	Roost D	Roost E	Roost F	Roost G	Roost H	Roost I
Mammal	396 (83%)	115 (100%)	94 (100%)	419 (89%)	462 (99%)	734 (100%)	115 (100%)	203 (94%)	450 (99%)
Avian	0	0	0	16 (3%)	0	0	0	12 (6%)	6 (1%)
Herp	0	0	0	0	4 (1%)	0	0	0	0
Arthropod	79 (17%)	0	0	35 (8%)	0	0	0	0	0
Total:	475 (100%)	115 (100%)	94 (100%)	470 (100%)	466 (100%)	734 (100%)	115 (100%)	215 (100%)	456 (100%)
Totals:			Mammal: 2,988 (95%)	Avian: 34 (1%)	Herp: 4 (<1%)	Arthropod: 114 (4%)	Grand Total: 3,140		

Figure 3: 2020 study results by roost/collection location. (Note: As in the previous study year, individual roost names were replaced with generic letter designations in order to protect their sensitive locations)

Discussion

In all, this study resulted in the analysis of some 4,771 individual bones and exoskeletal elements from 115 Mexican Spotted Owl pellets. Though further work is needed in order to create broader, more meaningful datasets, this initial study represents the beginnings of a more complete understanding of the prey base that Walnut Canyon MSO rely upon within their designated Critical Habitat, which in turn, will allow NPS resource managers to more effectively shape forest management plans and fire management projects to support prey abundance.

Climate change models predict dramatic forest composition change in the Flagstaff area over the next 70 years, with a significant decline in old-growth ponderosa pine, Douglas fire, and Gambel oak tree stands.

A relatively rapid forest stand replacement with heavily concentrated Pinyon-Juniper understories will impact current prey species compositions and availabilities for all predatory birds, including the Mexican Spotted Owl. This new baseline inventory of species composition and biomass will allow natural resource managers to protect this critical MSO habitat and associated prey environments.

Interpretive Products

Educational products started with the creation of a 40-slide PowerPoint presentation and a large-scale (3'x4') project poster (Figure 4). Funds from this WNPA grant allowed for the acquisition of pellet



Figure 4: MSO 3'x4' educational poster (photo by J. Hardes)

dissection kits (handheld magnifiers, forceps, bone sorting charts and sanitized barn owl pellets), a stereo dissecting scope with attached digital camera, and a large flat screen monitor on which microscopic specimens can be projected. These items have been vital to successful

interpretation and educational events. Presentations and hands-on events were held at the annual Flagstaff Science in the Park event on Saturday, September 18, 2021. This 4-hour event was a massive success, with approximately 100 children and other members of the public visiting the station, which showcased real, pre-prepared Barn Owl pellet contents (under high resolution magnification projected onto a large flatscreen monitor), hands-on dissecting methods, as well as question and answer sessions with the principal investigator focused on predator prey relationships in canyon habitats and the science of vertebrate osteology (Figure 5).

The station was shared with the Walnut Canyon National Monument Biologist, who concurrently showcased the passive audio recording equipment used at more than 10 participating park units and the bird call detection software, used for recording/monitoring local MSO. The shared presentation format allowed for a wholistic look at Walnut Canyon's Mexican Spotted Owl population. Similar 3-hour events were held at Bushmaster Park in



Figure 5: Public education and outreach event setup at Walnut Canyon Visitor Center (photo by J. Hardes)

Flagstaff on Wednesday, September 22, 2021 and again at the Walnut Canyon Visitor Center on Saturday, September 25, 2021. Just as with the Science in the Park event, these subsequent events were also very well attended. Plans are in the works to present at the annual Flagstaff S.T.E.M night in March 2022 as well as at local elementary schools, and the Flagstaff Area National Monuments Headquarters, as pandemic-related health restrictions permit.

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