ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Animal Abstract **Element Code:** ABNSB12012
Data Sensitivity: Yes

CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Strix occidentalis lucida* (Nelson) Ridgway
COMMON NAME: Mexican Spotted Owl
SYNONYMS: *Syrnium occidentale lucidum* Nelson, *Strix occidentalis huachucae* Monson and Phillips
FAMILY: Strigidae

AUTHOR, PLACE OF PUBLICATION: Nelson. 1903. Descriptions of new birds from southern Mexico. Proc. Biol. Soc. Wash. 16: 151-160.

TYPE LOCALITY: Mount Tancitaro, Michoacan, Mexico.

TYPE SPECIMEN: *Syrnium occidentale lucidum*: USNM 185269 (complete female adult skin). E.W. Nelson 9179 and E.A. Goldman, 27 Feb 1903.

TAXONOMIC UNIQUENESS: The Mexican Spotted Owl (MSO), *Strix occidentalis lucida*, is 1 of 3 subspecies in the species *S. occidentalis*. The other 2 subspecies include the Northern Spotted Owl (*S. o. caurina*) and the California Spotted Owl (*S. o. occidentalis*). Based on genetic work, the MSO may represent a distinct species because of geographical isolation from the Northern and California spotted owls (Barrowclough and Gutierrez 1990).

DESCRIPTION: The subspecies *lucida* is a medium sized owl (although the spotted owl ranks among the largest owls in North America (NA) where only 4 species among the 19 in NA are larger), where males average 23-41 cm (9-16 in) in length and females average 30-34 cm (12-13.4 in) (Ganey, *in* Glinski 1998 reports average length as 16-19 in); wingspan 107-114 cm (42-45 in, per Ganey *in* Glinski 1998); males weigh 449-625 g (16-22 oz), females 480-680 g (17-24 oz). The MSO is a brown colored owl with large, irregular and numerous white spots on the head, neck, back, and underparts, giving it a lighter appearance than the other two subspecies. The sexes are nearly identical, but females have darker head and face color, and breeding females have brood patches. The remiges and rectrices of both sexes are dark brown and barred with light brown and white; tail has about ten light bands. MSO has a round face that lacks ear tufts. The large, round, brownish facial disks are concentrically barred with dark brown, with a dark brown border. Their dark brown eyes appear almost black. The bill is a pale yellowish green color, and their legs and feet are fully feathered. Juvenile spotted owls (hatchling to approximately 5 months) have a white downy appearance. Subadults (5 to 26 months) possess adult plumage but have pointed rectrices with white tips. The rectrices of adults (>27 months) have rounded and mottled tips.

AIDS TO IDENTIFICATION: MSO is similar to the Barred Owl (*Strix varia*), but is slightly smaller, and has white spotting on head, back, and underparts rather than streaking. The Barred Owl is the only other large owl with dark eyes and concentric rings on facial disk. Both owls show strong orange-red eye shine when illuminated by direct light. MSO has a distinctive main call, a series of three or four hesitant, dog like barks and cries. The background coloration of MSO is generally darker brown than other subspecies with plumage spots larger, more numerous and whiter, which gives a lighter appearance.

ILLUSTRATIONS: Color drawing (Scott 1987: 240)
Color drawing (Peteron 1990: 205)
Color photo (Terres 1980: 658-659)
Color drawing (Sloan, in Glinski 1998: plate 39)
Color photo (Fink, *in* Johnsgard 2002: plate 24)
Color photo (Pat Ward, *in* http://ifw2es.fws.gov/mso/)
Color photo (*In* http://www.gf.state.az.us/w_c/research_mexican_spotted_owl.shtml)
Color photo (NPS, 2002 http://www2.nature.nps.gov/YearinReview/yir2002/04_f.html)
Color photo (Steve Howe, *in* http://biology.usgs.gov/s+t/noframe/r027.htm)
Color photo of species (Jeffrey Rich, *in* ENature at http://www.enature.com/fieldguide/showSpeciesIMG.asp?imageID=17545)
Color photos of species (http://www.owlpages.com/species/strix/occidentalis/Default.htm)

TOTAL RANGE: The MSO currently occupies a broad geographic area, but does not occur uniformly throughout its range. It can be found from southern Utah and central Colorado south through Arizona, New Mexico, and western Texas (mountains in the Trans Pecos) to the Mexican Plateau (Michoacan and Guanajuato).

RANGE WITHIN ARIZONA: Patchily distributed in forested mountains statewide, along with steep canyons on the Colorado Plateau including the Grand Canyon. They have been found in the following counties: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, and Yavapai.

SPECIES BIOLOGY AND POPULATION TRENDS

BIOLOGY: Mexican Spotted owls are mostly solitary outside the breeding season. They roost during the day, and hunt at dusk and at night. They are intolerant of moderately high temperatures, thus, often selecting daytime summer roosts on north facing slopes with dense overhead canopy. Lifetime nest site tenacity has been observed by pairs. "Some owls remain year-round in the same general areas but exhibit seasonal shifts in habitat use pattern (USFWS 1995). Some migrate 20-50 km between summer and winter ranges (USFWS 1995)." (NatureServe 2005). Seasonal migration of some individuals occurs in many or most

MSO populations, and in both sexes, but not always year to year. Reasons why only some owls migrate are unknown. When migration occurs too wintering areas, it generally is from higher to lower elevations, and to more open habitats. Recent examples of known wintering areas in Arizona include the Verde Valley, Tonto Creek, and Sabino Canyon (Ganey, in Glinski 1998). Further, owls use these areas at a time when they are unlikely to vocalize (Ganey 1990), making it difficult to locate such areas through calling surveys. It is presently unknown how and why migrating owls select particular wintering areas. (Ganey and Block, 2005).

Adults are generally long-lived, however, there is a low survival of young to breeding age. Based on banding studies, the species often live for 16-17 years. Exploitive competition (where individuals compete for similar resources such as prey and nest sites) may occur with Great Horned owl (*Bubo virginianus*). They are not a fast flier, but are very agile and maneuverable. Their flight consists of quick wingbeats interspersed with gliding flight. Observed actively defending nest sites and fledged young against Common Raven (*Corvus corax*), Northern Goshawk (*Accipiter gentiles*), Cooper's Hawk (*A. cooperi*), and Golden Eagle (*Aquila chrysaetos*). Starvation is likely another common source of mortality. Juveniles are more vulnerable to starvation because of their poor hunting skills. Both adults and juveniles may be affected by starvation in those years when there is a low abundance or availability of prey.

MSO calls infrequently during the winter (although, Ganey (*in* Glinski 1998) has heard them in all months of the year in Arizona); increases in late Feb-Mar between pair members and adjacent pairs at onset of breeding. There is a general decline in calling activity among MSOs from Jun to Nov (Ganey 1990, *in* Gutiérrez et al. 1995). On a daily basis, calling activity is greatest during the 2-hour period following sunset, with smaller peaks 4-8 hours after sunset and just before sunrise (USFWS 1995). They communicate using a variety of hoots, barks, and whistles. Sexes can be distinguished based on pitch of the call; females are consistently have higher-pitched calls. Besides having lower pitched calls, males generally call more frequently than females. The most common call is the Four-note Location Call, described phonetically as *hoo—hoo-hoo—hoo*. This call is used by males and females to announce territory occupancy and in territorial disputes. It is also used by the male when nearing the nest with food, and after copulation. The Contact Call is a hollow whistle ending in an upward inflection phoneticized as *cooo-weep!* It usually serves to establish and maintain contact between a pair. The Bark Series is used primarily by females during territorial disputes, and sometimes between pairs to maintain contact. It consists of a rapid series of 3-7 loud barking notes phoneticized as *ow!-ow!-ow!-ow!-ow!* Or *yenk!-yenk!-yenk!-yenk!* Both fledged young and adults use bill clicking, which occurs when birds are agitated, excited, or threatened. (Gutiérrez et al. 1995).

Northern spotted owls are known to hybridize with barred owls, however, hybridization has not been reported in the Mexican subspecies. The possibility of hybridization exists in Mexico where barred owls, fulvous owls, and spotted owls overlap in distribution. No evidence exists documenting actual sympatry among these species, however. (USFWS 1995).

REPRODUCTION: MSO's do not build their nests. In Arizona, they use cavity or abandoned platform nests about 80 feet up in coniferous tree, however, they also use ledges on cliffs or pothole sites, and mistletoe clusters. They are monogamous, breeding sporadically, and generally not nesting every year (Ganey 1988, in USFWS 1995). In good years most of the population will nest, whereas in other years only a small proportion of pairs will nest (Fletcher and Hollis 1994, in USFWS 1995). They have one brood, with egg laying peaking sometimes as early as early March in Arizona and New Mexico. They lay 1-3 (usually 2) faintly buff, unmarked eggs that are 5.0 cm (2.0 in.) long. Incubation by female lasts 28-32 days. Hatching usually occurs in early to mid-May. Young have eyes closed at hatching, are immobile and downy. Male feeds female and young until young are two weeks old. Young leave the nest at about 5 weeks (June), and fly at about 6-7 weeks of age. They stay near the nest for several weeks, and are fed by the adults until late summer, and are independent by early fall (dispersal of young occurs in September-October). Adults breed at 2-3 years of age, but may not breed every year. Reproductive success is generally low (USFWS 1993), with average number of young fledged per pair at about 1.0 (USFWS 1995). (NatureServe 2005).

FOOD HABITS: MSO regularly caches excess food, usually on tree branches. Prey is snatched from the ground in talons after gliding descent from a perch. In Arizona: most common prey includes cottontails, deer mice, woodrats, and voles (Ganey et al. 1988); but also may prey upon various birds, bats, lizards, and snakes (Duncan 1992, Herpetol. Rev. 23:81). (NatureServe 2005). Over most of the MSO range, *Neotoma* species dominate diets in terms of biomass (Kertell 1977, Wagner et al. 1982, Ganey 1992, *in* Gutiérrez et al. 1995). Woodrats were generally more abundant in pellet samples collected in northern latitudes, and peromyscid mice and birds were generally more abundant in southern regions of the owl's range (http://ifw2es.fws.gov/mso/Biology.cfm accessed 2005). Regional differences in the owl's diet likely reflect geographic variation in population densities and habitats of both the prey and the owl.

HABITAT: In the 1993 Federal Register, the USFWS estimated the total suitable MSO habitat in the U.S. at 5,589,734 to 5,714,734 acres. They primarily breed in dense old growth mixed-conifer forests located on steep slopes, especially deep, shady ravines. These sites have high canopy closure, high basal area, many snags, and many downed logs. For foraging, multistoried forest with many potential patches is desirable. In Arizona, they occur primarily in mixed-conifer, pine-oak, and evergreen oak forests; also occurs in ponderosa pine forest and rocky canyonlands (Ganey and Balda 1989). In Arizona, they generally foraged more than or as frequently as expected (based on availability) in virgin mixed-conifer forests (Ganey and Balda 1994). (NatureServe 2005). Range size for single owls in Arizona averages 1,600 acres and combined home ranges occupied by pairs averages 2,000 acres.

MSO nest and roost primarily in closed-canopy forests or rocky canyons. In the northern portion of the range (southern Utah and Colorado), most nests are in caves or on cliff ledges in steep-walled canyons. Elsewhere, nests appear to be in trees (Fletcher and Hollis 1994, USFWS 1995). Nest trees are usually large in size, whereas roosting occurs in both large and small trees. Nest tree species vary somewhat among areas and habitat types, but available evidence suggests that Douglas-fir is the most common species of nest tree (SWCA 1992, Fletcher and Hollis 1994, Seamans and Gutiérrez, in press; *in* USFWS 1995).

Based on the Recovery Plan's established Recovery Units (RU's) for Arizona (USFWS 1995), the major landforms of the Colorado Plateau RU includes interior basins and high plateaus dissected by deep canyons, including the canyons of the Colorado River and its tributaries. Grasslands and shrub-steppes dominate at lower elevations, but woodlands and forests dominate the higher elevations. The Upper Gila Mountains RU consists of steep mountains and deep entrenched river drainages dissecting high plateaus. The Mogollon Rim, a prominent fault scarp, bisects the unit. The vegetation is a zonal pattern of grasslands at lower elevations upward through pinyon-juniper woodlands, ponderosa pine, mixed-conifer, and spruce-fir forests at higher elevations. Many canyons contain stringers of deciduous riparian forests. The Basin and Range – West exhibits horst and graben faulting with numerous fault-block mountains separated by valleys. Complex faulting and canyon carving define the physical landscape within these mountains. Vegetation ranges from desert scrubland and semi-desert grassland in the valleys upwards to montane forests. The montane vegetation includes interior chaparral, encinal woodlands, and Madrean pine-oak woodlands at lower and middle elevations, with ponderosa pine, mixed-conifer, and spruce-fir forests at higher elevations. Riparian forests may also function as important components of ecosystems supporting spotted owls. They may serve as direct avenues of movement between mountain ranges or as stopover sites where drainages bisect large expanses of landscape that otherwise would be inhospitable to dispersing owls. Many of the riparian ecosystems have deteriorated in the Southwest, and the loss of riparian habitat was another reason for listing the MSO (USFWS 1995).

ELEVATION: 4,500 - 10,000 ft. (1373-3050 m); Ganey (*in* Glinski 1998) reports elevations in Arizona as 3,700 – 9,600 feet (1128-2926 m); while the HDMS reports the elevation range between 2,720 – 9,600 ft. (829-2926 m) based on unpublished records (AGFD, accessed 2005).

PLANT COMMUNITY: Mixed-conifer forests are commonly used throughout most of the range. These forests are generally dominated by Douglas-fir (*Pseudotsuga menziesii*) and/or white fir (*Abies concolor*), with codominant species including southwestern white pine (*Pinus strobiformis*), limber pine (*Pinus flexilis*), and ponderosa pine (*Pinus ponderosa*) (Brown et al. 1980, *in* USFWS 1995). The understory often contains the above coniferous species as well as broadleaved species such as Gambel oak (*Quercus gambelii*), maples (*Acer* sp.), boxelder (*Acer negundo*), and/or New Mexico locust (*Robinia neomexicana*). In southern Arizona and Mexico, Madrean pine-oak forests are also commonly used, and are typically dominated by an overstory of Chihuahuan pine (*Pinus leiophylla*) and Apache pine (=Engelmann pine, *Pinus engelmannii*), in conjunction with Douglas-fir, ponderosa pine, and Arizona cypress (*Cupressus arizonica*). Evergreen oaks are typically prominent in the understory. (Brown et al. 1980, *in* USFWS 1995). (http://ifw2es.fws.gov/mso/Biology.cfm accessed 2005).

POPULATION TRENDS: Unknown. According to USFWS (1995), there is inadequate data to estimate population trends in MSO. There is little confidence in the estimates of population trend that include estimates of juvenile survival because the estimates of juvenile survival are probably biased low. In addition, the population studies from which parameter

estimates were derived have not been conducted for a sufficiently long period to capture temporal variation. The greatest concentration of the known MSO population occurs within the Upper Gila Mountains RU, with many spotted owls found within the wilderness areas in this RU (USFWS 1995). Based on crude population estimates, there may be 600-1,200 MSO's in Arizona (Fletcher 1990; McDonald et al. 1991, *In* Ganey *in* Glinski 1998).

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS:	Critical Habitat Listed (USDI, FWS 2001) LT (USDI, FWS 1993), without Critical Habitat [PT (USDI, FWS 1991)] [C2 (USDI, FWS 1989)] [C2 (USDI, FWS 1985)]
STATE STATUS:	WSC (AGFD, WSCA in prep) [State Threatened (AGFD, TNW 1988)]
OTHER STATUS:	Forest Service Sensitive (USDA, FS Region 3 1999) [Forest Service Sensitive (USDA, FS Region 3 1988)] Group 3 (NNDFW, NESL 1994)

MANAGEMENT FACTORS: Two primary reasons for listing include: the historical alteration of its habitat in Arizona and New Mexico as the result of timber management practices, specifically the use of even-aged silviculture, plus the threat of these practices continuing, as provided in National Forest Plans. Also cited is the potential threat for additional habitat loss due to catastrophic wildfire. The risk of catastrophic fires is widespread in Southwestern forests and woodlands. Fuel accumulations and forests overstocked with trees place spotted owl habitat at risk with respect to stand-replacing fires. After a large crown fire, habitat components for nesting, roosting, and foraging are reduced or eliminated. Small-scale natural fires and prescribed burns, however, can reduce fuel loadings and create small openings and thinned stands that increase horizontal diversity and reduce the spread of catastrophic fire. (USFWS 1995). Natural disturbances such as the western spruce budworm, or the bark beetle, are also a concern especially during long outbreaks (usually following droughts). Bark beetles are important wood-boring insects in pinyon, ponderosa pine, Douglas-fir, and Engelmann spruce. During long outbreaks, they can kill large groups of mature trees over widespread areas, which can alter MSO habitats. These disturbance agents should be considered in developing management strategies for owl recovery. Several vegetation management tools, including various kinds of silviculture, risk-abatement for fire or insect/disease damage, prescribed burning, and direct population control are appropriate in various combinations. (USFWS 1995).

MSO habitats continue to be lost or degraded by logging and/or forest fragmentation. Also, according to USFWS (1995), "The potential for grazing to influence various components of

spotted owl habitat cannot be ignored. However, current predictions of grazing effects on plant communities as they relate to the owl are inexact. Thus, the integration of spotted owl needs and grazing management will require coordination, and an interactive and adaptive approach between protection, restoration, and management." In addition, there is the "potential for competition with and/or predation by other raptors, including great horned owl and red-tailed hawk (USFWS 1993)." (NatureServe 2005). AGFD (in prep) also reports possible competition problems from great horned owls, in forests that have been thinned.

General recommendations from the Recovery Plan, are proposed for three levels of management: 1) Protected Areas – include a 243 ha (600 ac) "Protected Activity Center" (PAC) placed at known or historical nest and/or roost sites, with slopes >40% in mixed-conifer and pine-oak forests that have not been harvested within the past 20 years. Harvest of trees >22.4 cm dbh (diameter at breast height) is not allowed, but light underburning is permitted on a case-specific basis as needed to reduce fuels. 2) Restricted Areas – include ponderosa pine-Gambel oak and mixed-conifer forests and riparian environments. 3) Other Forest and Woodland Types – include ponderosa pine and spruce-fir forests, pinyon-juniper woodlands, and aspen groves that are not included within PACs. (USFWS 1995).

The MSO inhabits diverse forest types scattered across a physically diverse landscape. In order to approach a status assessment on a rangewide basis, the Recovery Plan divided their range into 11 geographic areas called "Recovery Units" (RU's), six of which occur in the U.S. Three RU's occur in Arizona: Colorado Plateau (includes portions of northern Arizona), Upper Gila Mountains (along the Mogollon Rim/Plateau in Arizona, SE into New Mexico), and Basin and Range – West (southern Arizona where it geographically exhibits horst and graben faulting with numerous fault-block mountains separated by valleys). The RU's were identified based on (in order of importance): 1) Physiographic provinces, 2) biotic regimes, 3) perceived threats to owls or their habitats, 4) administrative boundaries, and 5) known patterns of owl distribution. (USFWS 1995).

PROTECTIVE MEASURES TAKEN: A high profile species to which apply a large number of policies and regulations. Critical Habitat was designated in 2001 (Federal Register 66(22): 8530-8553). "About 90% of the U.S. population occurs on lands administered by the U.S. Forest Service (USFWS 1995). Logging is restricted in a number of areas in national forests, national parks, wilderness areas, and BLM lands." (NatureServe 2005). Owl surveys at Grand Canyon National Park in 2001 and 2002, uncovered 53 MSO in rugged, rocky canyon habitat. Roosts and nests were generally located on rock shelves. These findings resulted in the establishment of 39 Protected Activity Centers surrounding the owl locations, ranging from 700 to 1,000 acres and subject to the management recommendations contained in the Mexican Spotted Owl Recovery Plan. (NPS, 2002).

The Recovery Plan Duration is for ten years, which was determined by the team to 1) allow adequate time to monitor the trends in population and habitat; 2) to fill some of the major gaps in existing knowledge, and accommodate possible changes in future conditions; 3) To try to plan beyond the next decade or so would require an unjustified confidence in our ability to predict the state of our society and the environment; and 4) The Act requires that the status of listed species be reviewed every five years. The Team recommends that once the population

and habitat are shown to be stable or increasing, delisting should be considered at the RU level. (USFWS 1995).

SUGGESTED PROJECTS: More rigorous and directed studies will be needed to address questions on dispersal, genetics, habitat, populations, and effect of management on spotted owls and other ecosystem attributes. Habitat monitoring should address two aspects: persistence of forest types that owls prefer (macrohabitat) and specific habitat attributes within those types (microhabitat). (USFWS 1995). Global inventory needs should be to obtain up-to-date information on occurrences throughout their range. (NatureServe 2005). Since the early 1990s, U.S. surveys have found owls at more locations but this was the last comprehensive attempt to estimate the total number of occurrences (USFWS 2000). Marking individual birds with FWS leg bands and color bands for visual identification provides greater validity in the estimation of the owl population size on the i.e. quadrat, because assumptions of the mark-recapture methods can be tested. Individually marking birds will: 1) eliminate bias, 2) is necessary to estimate annual survival on quadrats that are sampled for two consecutive years, 3) capturing birds allows for careful aging of individuals; hence the resulting age structure data are more useful in assessing the impact of floaters in the population, 4) minimum estimates of dispersal and emigration from the quadrat can be assessed with banded birds that are located off the quadrat. (USFWS 1995).

Suggested research needs include: Determine population attributes and trends in relation to existing management activities. Determine silvicultural techniques that could produce wood products and owls. Determine ways to make younger forests capable of supporting owls. Determine extent of competition with other owls. (NatureServe 2005).

LAND MANAGEMENT/OWNERSHIP: Primarily national forests in Arizona including: Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests. Other ownerships/managements include: BIA – Havasupai and Fort Apache Reservations, Navajo Nation, and Navajo Hopi Joint Use Area; BLM – Kingman and Safford Field Offices; DOD - Fort Huachuca Military Reservation and Navajo Army Depot; NPS – Chiricahua, Coronado and Walnut Canyon National Monuments, and Grand Canyon and Saguaro National Parks; AGFD Lamar Haines Wildlife Area; State Land Department; TNC – Muleshoe Ranch and Ramsey Canyon Preserves; Private.

SOURCES OF FURTHER INFORMATION

REFERENCES:

Arizona Game and Fish Department. 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department Publication. Phoenix, Arizona. P. 17.

Arizona Game and Fish Department. In prep. Wildlife of special concern in Arizona. Arizona Game and Fish Department Publication. Phoenix, Arizona. 32 pp.

Barrowclough, G.F. and R.J. Gutierrez. 1990. Genetic variation and differentiation in the spotted owl (*Strix occidentalis*). The Auk. 107: 737-744.

Bison Information System of New Mexico, BISON. 2004. Mexican Spotted Owl, *Strix occidentalis lucida*, species account 041375. New Mexico Game and Fish. Accessed 3/28/2005 at http://fwie.fw.vt.edu/states/nmex_main/species/041375.htm.

Duncan, R.B., S.M. Speich and J.D. Taiz. 1992. Banding and blood sampling study of Mexican spotted owl in southeastern Arizona. Unpublished report for Arizona Game and Fish Department, Phoenix Arizona and Coronado National Forest, Tucson, Arizona.

Fletcher, K. 1990. Habitats used, abundance and distribution of the Mexican spotted owl *Strix occidentalis lucida* on national forest system lands. Unpublished report for the U.S. Forest Service, Southwestern Region. Albuquerque, New Mexico.

Forman, E.D. 1983. Methods and materials for locating and studying spotted owl. Forest Service general technical report PNW-162. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Ganey, J. 1989. Home-range characteristics of spotted owls in northern Arizona. Journal of Wildlife Management. 53(4): 1159-1165.

Ganey, J. 1992. Calling behavior of spotted owls in northern Arizona. The Condor 92: 485-490.

Ganey, J.L. Spotted Owl, *Strix occidentalis*. *In* R.L. Glinski, Ed. 1998. The Raptors of Arizona. The University of Arizona Press, Tucson and The Arizona Game and Fish Department, Phoenix. Pp. 170-174.

Ganey, J.L. 2004. Thermal regimes of Mexican spotted owl nest stands. The Southwestern Naturalist. 49(4): 478-486.

Ganey, J.L. and R.P. Balda. 1989. Development of a large-scale predictive model for potential spotted owl habitat in northern Arizona using geographic information system technology and existing data. Unpublished final report. Extension to contract #0140 for Arizona Game and Fish Department, Nongame Branch. Phoenix, Arizona.

Ganey, J.L., and M.A. Benoit. 2002. Using terrestrial ecosystem survey data to identify potential habitat for the Mexican spotted owl on National Forest System Lands: A Pilot Study. Gen. Tech. Rep. RMRS-GTR-86. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 25p.

Ganey, J.L., and W.M. Block. 2005. Winter movements and range use of radio-marked Mexican spotted owls: an evaluation of current management recommendations. Gen. Tech. Rep. RMRS-GTR-148-WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 9p.

Ganey, J.L., W.M. Block, and S.H. Ackers. 2003. Structural characteristics of forest stands within home ranges of Mexican spotted owls in Arizona and New Mexico. West. Jour. Applied Forestry. 18(3): 189-198.

Ganey, J.L., W.M. Block, and R.M. King. 2000. Roost sites of radio-marked Mexican spotted owls in Arizona and New Mexico: sources of variability and descriptive characteristics. Jour. Raptor Res. 34(4): 270-278.

Ganey, J.L., W.M. Block, J.S. Jenness, and R.A. Wilson. 1997. Comparative habitat use of sympatric Mexican spotted and great horned owls. J. Wildl. Res. 2(2): 115-123.

Ganey, J.L., W.M. Block, J.S. Jenness, and R.A. Wilson. 1999. Mexican spotted owl home range and habitat use in Pine-Oak Forest: implications for forest management. Forest Science 45(1): 127-135.

Ganey, J.L., J.A. Johnson, R.P. Balda and R.W. Skaggs. 1988. Status report. Mexican spotted owl. Pp. 145-150. *In* R.L. Glinski, B.G. Pendleton, M.B. Moss, M.N. LeFranc, Jr., B.A.

Millsap and S.W. Hoffman eds. Proceedings of the southwest raptor management symposium and workshop. National Wildlife Federation, Washington, D.C.

Gutiérrez, R.J., A.B. Franklin, and W.S. Lahaye. 1995. Spotted Owl (*Strix occidentalis*). In The Birds of North America, No. 179 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Http://ifw2es.fws.gov/mso/

Integrated Taxonomic Information System (ITIS). Retrieved 3/25/2005 from ITIS, http://www.itis.usda.gov.

Jenness, J.S., P. Beier, and J.L. Ganey. 2004. Associations between Forest Fire and Mexican Spotted Owls. Forest Science 50(6): 765-772.

Johnsgard, P.A. 2002. North American Owls, Biology and Natural History. Second Edition. Smithsonian Institution Press. Washington and London. Pp. 176-185.

Johnson, C.L., and R.T. Reynolds. 2002. Responses of Mexican spotted owls to low-flying military jet aircraft. Research Note RMRS-RN-12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 4p.

May, C.A., and R.J. Gutiérrez. 2002. Habitat associations of Mexican spotted owl nest and roost sites in Central Arizona. Wilson Bull., 114(4): 457-466.

National Park Service, Natural Resource Year in Review. 2002. Mexican spotted owl survey at Grand Canyon by R.V. Ward. Accessed 3/25/2005 from http://www2.nature.nps.gov/YearinReview/yir2002/04_F.html.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.3. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: March 25, 2005).

Navajo Fish and Wildlife Department. 1994. Navajo Endangered Species List. P. 3.

Nelson. 1903. Descriptions of new birds from southern Mexico. Proc. Biol. Soc. 16: 151-160.

Johnsgard, P.A. 1988. North American owls. Biology and natural history. Smithsonian Institution, Washington, D.C.

Peterson R.T. 1990. Peterson field guides: western birds. Houghton Mifflin Company. Boston, Massachusetts. Pp. 204-205.

Reichenbacher, F.W. and R.B. Duncan. 1992. Diet of Mexican spotted owl on national forest system lands in Arizona and New Mexico. Final Report. Unpublished report for US Forest Service. Albuquerque, New Mexico.

Scott, S.L. editor. 1987. Field guide to the birds of North America. Second Edition. National Geographic Society. Washington, D.C. Pp. 240-241.

Terres J.K. 1980. The Audubon Society: encyclopedia of North American birds. Alfred A. Knopf. New York, New York. Pp. 658-659.

USDA, Forest Service Region 3. 1988. Regional Forester's Sensitive Species List.

USDA, Forest Service Region 3. 1999. Regional Forester's Sensitive Species List.

USDI, Fish and Wildlife Service. 1985. Endangered and Threatened Wildlife and Plants; Review of Vertebrate Wildlife; Notice of Review. Federal Register 50(181): 37964.

USDI, Fish and Wildlife Service. 1989. Endangered and Threatened Wildlife and Plants; Animal Notice of Review. Federal Register 54(4): 560.

USDI, Fish and Wildlife Service. 1989. Management guidelines and inventory protocols for the Mexican spotted owl in the southwestern region. Federal Register. 54(24): 27416-17418.

USDI, Fish and Wildlife Service. 1990. Finding on a petition to list the Mexican spotted owl as threatened or endangered. Federal Register. 55(60): 11413-11414.
USDI, Fish and Wildlife Service. 1991. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule. Federal Register 56(225): 58807.
USDI, Fish and Wildlife Service. 1993. Final rule to list the Mexican spotted owl as a threatened species. Federal Register. 58(49): 14248-14271.
USDI, Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule. Federal Register 59(219): 58985.
USDI, Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl: Vol. I. Albuquerque, New Mexico. 172pp.
USDI, Fish and Wildlife Service. 2001. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Mexican Spotted Owl. Federal Register 66(22): 8530-8553.
USNM Birds Type Catalog. http://nmnhgoph.si.edu/cgi-bin/wdb/bird/specimen/query.

MAJOR KNOWLEDGEABLE INDIVIDUALS:

Russ Balda - Northern Arizona University, Flagstaff, Arizona.
Keith Fletcher - USDA, Forest Service
Joe Ganey - USDA, Forest Service

ADDITIONAL INFORMATION:

Strix occidentalis translates as “owl of the west”; *lucida* means “light” or “bright.”

Habitat connectivity, buffers a population from stochastic variability through time by providing the opportunity for local population failures to be “rescued” by immigration from other populations (USFWS 1995).

Revised: 1992-01-24 (JGH)
1995-07-13 (DBI)
1998-01-28 (SMS)
2001-12-07 (SSS)
2005-04-26 (SMS)

To the user of this abstract: you may use the entire abstract or any part of it. We do request, however, that if you make use of this abstract in plans, reports, publications, etc. that you credit the Arizona Game and Fish Department. Please use the following citation:

Arizona Game and Fish Department. 20XX **(= year of last revision as indicated at end of abstract)**. X…X **(=taxon of animal or plant)**. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. X pp.