AESO/SE
2-21-99-F-362 July 11, 2000

Mr. Terry Oda, Chief
Clean Water Act Standards and Permits Water Division
Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105-3901

Subject: Biological Opinion on the Effects of the Countryside Vista (Blocks 5 and 6) Development in Marana, Arizona

Dear Mr. Oda:

This responds to the Environmental Protection Agency (EPA) August 10, 1999, request for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) on the effects of the proposed Countryside Vista (Blocks 5 and 6) residential housing development on the endangered cactus ferruginous pygmy-owl (CFPO) (*Glaucidium brasilianum cactorum*) with critical habitat and the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*).

The proposed action involves issuance of a National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act (CWA) from the EPA. This permit will facilitate the development of a 9.4 ha (23.2 ac) residential and commercial development, located in Marana, Arizona. Hartman Hardy, L.L.C. (applicant) applied for a section 402 permit under the CWA and has been designated by the EPA as their non-Federal representative for this consultation.

The EPA and the applicant have requested Service concurrence that the proposed action is not likely to adversely affect the lesser long-nosed bat and will have no effect on the American peregrine falcon (*Falco peregrinus*). We concur with this determination for the lesser long-nosed bat. The American peregrine falcon was removed from the Federal list of Endangered and Threatened Wildlife on August 25, 1999 (USFWS 1999b) and Federal agencies are no longer required to consult with the Service under section 7 of the Act.

This biological opinion is based on information provided in the August 1999 biological assessment (BA) (WestLand Resources 1999a); November 1999 supplemental BA (WestLand Resources 1999b); July 3, 2000 second supplemental BA (WestLand Resources 2000); correspondence between the Service and the applicant; numerous telephone and personal conversations; field investigations; correspondence from, and meetings with the applicant and

Arizona Game and Fish Department (AGFD); and other sources of information. References cited in this opinion are not a complete bibliography of all literature available on the species of concern, residential developments and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at this office. We have assigned log number 2-21-99-F-362 to this consultation. Please refer to that number in future correspondence on this consultation.

Consultation History

The applicant and the Service met on several occasions beginning in informal section 7 consultation on July 9, 1999. Formal consultation was initiated with the Service on August 13, 1999 with the submittal of the BA and a supplemental BA was received on November 11, 1999, containing revisions to the original action proposal. We requested and were granted a 60-day extension which ended on February 23, 2000. A draft biological opinion was submitted to the EPA on March 9, 2000. Comments were received from the applicant on April 12, 2000 and EPA on May 28, 2000 and were considered in this final opinion.

I. DESCRIPTION OF THE PROPOSED ACTION

Description of the proposed project site and action area

The project site is within the Arizona Upland Subdivision of the Sonoran Desertscrub vegetation community (Brown 1994). This subdivision is limited in its distribution, forming a narrow, curved band along the northeast edge of the Sonoran Desert from the Buckskin Mountains, southeast to Phoenix, Arizona, and south to Altar, Sonora, Mexico. It is described as a low woodland of leguminous trees with an overstory of columnar cacti and with one or more layers of shrubs and perennial succulents. Within the United States, columnar cacti include either saguaros (*Carnegiea gigantea*), or organ pipe cactus (*Stenocereus thurberi*). Trees within this subdivision include blue paloverde (*Cercidium floridum*), foothills paloverde (*C. microphyllum*), ironwood (*Olneya tesota*), mesquites (*Prosopis* spp.), and cat-claw acacia (*Acacia* spp.). Cacti of many species are found within this subdivision, and include many varieties of cholla and prickly pear (*Opuntia* spp.), fish-hook barrel cactus (*Ferocactus wislizenii*), and compass barrel cactus (*F. acanthodes*) (Brown 1994).

The project site is within the paloverde-cacti-mixed scrub series of the Arizona Upland Subdivision of the Sonoran Desertscrub community. The paloverde-cacti-mixed scrub series is described as developed on the bajadas and mountain sides away from valley floors. A bajada is the area between level plains and the foot of a mountain, and is dissected by arroyos, exhibiting numerous variations in slope and pattern. While there is great variation between bajadas, they are generally characterized by good drainage, and slowed evaporation, resulting in enhanced growing conditions for xerophytic plants. Cacti are particularly prevalent on bajadas, and woody, spiny shrubs and small trees, and annuals are abundant. The increased diversity of plants

in turn supports a diversity of wildlife species (Benson and Darrow 1981, Olin 1994). A list of plant and wildlife species associated within this subdivision can be found in Appendix II of Brown (1994), and is incorporated herein by reference.

Proposed action

The proposed action is the EPAs issuance of a NPDES permit to facilitate development of 101, single-family, detached, residential units, associated roads, associated onsite utilities, and passive recreation parks and natural open space on the 9.4 ha (23.2 ac) (project site). The project site is located on the southeast corner of Linda Vista Boulevard and Hartman Lane in Marana, Arizona, in T 12S, R 12S, Section 24 (Figure 1). Within the project site, approximately 8.4 ha (20.8 ac) would be developed into a residential area/open recreation area and 1 ha (2.4 ac) as natural open space. Open space areas consist of about 0.5 ha (1.3 ac) of common open space managed by a homeowners association and 0.4 ha (1.1 ac) of private land located in 19 residential lots bordering the adjacent Canada Agua Wash. Open areas would contain restrictive covenants required by a Homeowners Association restricting their use for perpetuity as natural open space.

To further reduce on-site impacts from the above proposed residential development to the CFPO within the action area, the applicant will conserve 24.3 ha (60 ac) of off-site conservation land that will remain as natural open space to be managed in perpetuity for conservation purposes for the CFPO as defined in the BA and supplements (i.e., fencing, gating, signing, monitoring, etc.). Two off-site conservation parcels have been identified by the applicant. The Service has concurred they provide appropriate habitat values to off set effects of the proposed development. The first parcel is a 16.2 ha (40-ac) parcel, located at T 10S, R 11E, Sec. 11, S ½, SE ¼. This parcel has been obtained by the applicant. The second is a 16.2-ha (40-ac) parcel (of which 8.1 ha [20 ac] will be conserved to off-set the effects of this project), located at T 12S, R 12E, Sec. 11, NW ¼, NW ¼ This parcel has been identified by the applicant, but as of this final opinion, has not yet been obtained by the applicant. In the event this second parcel is not obtained by the applicant, the applicant will conserve another 8.1 ha (20 ac) parcel located south of Tangerine Road that the Service agrees is suitable to offset the effects of this project on the CFPO and its critical habitat. All off-site conservation lands will located within the Special Management Area (SMA) of Recovery Area 3 as identified by the CFPO Recovery Team (Recovery Team) (USFWS 1999c). A conservation easement or other protective measures will be established on these lands that prohibits development or other uses that are incompatible with the conservation of the CFPO as specified in the BA and supplemental reports. In addition, an endowment or other source of secured funding will be assured by the applicant to ensure the management measures outlined in the BA and its supplements take place on off-site conservation lands in perpetuity. The applicant may convey to a local, state, governmental authority or agency maintenance of these off-site conservation lands or, at its option, may record on the title of these lands covenants (see Second Supplement BA), which may be transferred to a conservation entity (i.e., not-for-profit organization).

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). In the BA, the applicant defines the action area as 457 m (1,500 ft) of the project site (WestLand Resources 1999a). We disagree with this definition. The Service has determined the action area to include the project site and areas within 19 mi of the project site 31 km (19 mi) of the project site. The Service based this determination on the dispersal distance of juvenile CFPOs in Texas and Arizona (average distances were 8 - 10 km [5-6 mi]) (range 1 - 31 km [1- 19 mi]) (Proudfoot unpubl. data, S. Richardson, AGFD unpubl. data). With so few individual CFPOs, the maximum dispersal distance may be periodically needed to maintain genetic fitness. We have also documented movement between owls in southern Pinal county and northwest Tucson (S. Richardson, AGFD unpubl. data).

II. STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The Service listed the Arizona population of the CFPO on March 10, 1997, effective on April 9, 1997 (USFWS 1997a [FR 62 10730]). The past and present destruction, modification, or curtailment of habitat is the primary reason for the decrease in population levels of the CFPO. On December 30, 1998, we proposed approximately 290,000 ha (725,500 ac) of critical habitat in southern and central Arizona (USFWS 1998 [63 FR 71820]). We published a final rule (USFWS 1999a [64 FR 37419]) on July 12, 1999 which designated approximately 296,240 ha (731,712 ac) of riverine, riparian, and upland habitat in Pima, Cochise, Pinal, and Maricopa counties in Arizona. Only lands containing, or likely to develop, those habitat components that are essential for the primary biological needs of the owl are considered critical habitat. By definition, all areas above 1,219 m (4,000 ft), areas not containing or capable of developing constituent elements (e.g., saguaro, large diameter trees, etc.), existing features and structures (e.g., roads, buildings, etc.) and areas not requiring special management or other areas (e.g., National Parks, Tribal lands, etc.) were excluded and are not critical habitat. The actual area meeting this definition as defined in the final rule is substantially less than the total area within the exterior boundaries of the area designated.

Areas designated as critical habitat included recent owl locations and important areas for genetic and demographic interchange within the geographical area occupied by the species that are essential to the conservation of the species and requiring special management considerations. These areas, containing the primary constituent elements, or the capacity to develop these habitat components are essential for the primary biological needs of this species and include foraging, nesting, rearing of young, roosting, sheltering, and dispersal. Actions that may destroy or adversely modify critical habitat are actions that destroy or alter the primary constituent elements to the extent that the value of critical habitat for both survival and recovery of the species is appreciably diminished. These activities include, but are not limited to: removing vegetation, water diversions or impoundments, ground water pumping, and recreational activities that appreciably degrade habitat.

CFPOs are small, averaging 17 cm (6.75 in) in length. The average weight of a male is 62 g (2.2 oz), while females average 73 g (2.6 oz). CFPOs are reddish-brown overall, with a cream-colored belly streaked with reddish-brown. Their crown is lightly streaked, and they have paired black-and-white "eye" spots on the back of their head and neck. They have no ear tufts and their eyes are yellow. Their tail is reddish-brown with darker bars, and is relatively long for an owl.

The CFPO is crepuscular/diurnal, with a peak activity period for foraging and other activities at dawn and dusk. During the breeding season, they can often be heard calling throughout the day, but most activity is reported between one hour before sunrise to two hours after sunrise, and late afternoon/early evening from two hours before sunset to one hour after sunset (Collins and Corman 1995).

Specific information on the amount of suitable habitats required to support CFPOs in Arizona is incomplete. Research in Texas has provided useful insights of the ecology of this subspecies; however, the habitat and conditions are somewhat different than in Arizona. For instance, owls found in developed areas appears to be unique to northwest Tucson, not found in other portions of this subspecies' range.

CFPOs are known to use a variety of habitat types such as riparian woodlands, mesquite bosques, and Sonoran desertscrub communities as well as in nonnative habitat within these communities. While plant species composition differs between these communities, there are certain unifying characteristics in each of these occupied habitat types. These unifying characteristics include the presence of vegetation in a fairly dense thicket or woodland, the presence of trees or cacti large enough to support cavity nesting, and elevations below 1,616 m (4,000 ft). Historically, CFPOs were associated with riparian woodlands in central and southern Arizona. Plants present in these riparian communities include cottonwood, willow (*Salix* spp.) and hackberry (*Celtis* spp.). Cottonwood trees are suitable for cavity nesting, while the density of mid- and lower-story vegetation provides necessary protection from predators and an abundance of prey items for the CFPO. Mesquite bosque communities are dominated by mesquite trees, and are described as mesquite forests due to the density and size of the trees.

Over the past several decades, CFPOs have been primarily found in Sonoran desertscrub communities in southern and southwestern Arizona consisting of palo verde, ironwood, mesquite, acacia, bursage (*Ambrosia* spp.), and columnar cacti (Phillips et al. 1964, Monson and Phillips 1981, Davis and Russell 1984, 1990, Johnson and Haight 1985a, Johnsgard 1988). Recently however, they have also been found in riparian and xeroriparian habitats and semidesert grasslands as classified by Brown (1994). Desertscrub communities are characterized by an abundance of saguaros or large trees, and a diversity of plant species and vegetation strata. Xeroriparian habitats contain a rich diversity of plants that support a wide array of prey species and provide cover. The density of annuals and grasses, as well as shrubs, are important to the CFPO's prey base. Shrubs and large trees provide protection against aerial predation for juvenile and adult CFPOs and cover from which they may capture prey. Saguaros and large trees provide

substrate for nesting cavities in Sonoran desertscrub, while trees with cavities provide nesting strata in deciduous forest riparian habitats. One common thread found in each of these vegetation communities is a high degree of both horizontal and vertical heterogeneity between tree, shrub, and ground cover layers (Wilcox et al. 1999).

The Arizona Upland Subdivision of the Sonoran Desert (Brown 1994) provides mature saguaros which are suitable for cavity nesting, as well as large mesquites and other trees which may additionally be used for nesting. Saguaro cavities are also used for roosting, perching, and caching food (Smith 1996). The mid- and lower-stories are comprised of a variety of mesquite, palo verde, ironwood, acacia, graythorn (*Zizyphus obtusifolia*), bursage, cholla (*Opuntia* spp.), prickly pear (*Opuntia* spp.), and annual and perennial grass species. As in riparian habitat, the larger trees provide perches for foraging and protection from predators. Adequate vegetation in mid- and lower-stories appears to be important, and likely provides protection from predators and a higher density of prey items including lizards, small birds and mammals, and insects (Abbate et al. 1996, Wilcox et al. 1999).

The density of trees and the amount of canopy cover preferred by CFPOs is unclear. Habitat descriptions of the highest concentrations of these owls are most commonly characterized by semi-open or open woodlands, often in proximity to forests or patches of forests. Where they are found in forested areas, they are typically observed along edges or in openings rather than deep in the forest itself (Binford 1989, Sick 1993), although this may also be a factor of the increased ability of observers to view them in more open areas as well. The physical settings and vegetation composition varies in various portions of *G. brasilianum's* range. However, it appears that vegetation structure is more important than composition (Wilcox et al. 1999, Cartron et al. 2000a).

The importance of desertscrub and grasslands in Arizona as habitats for the CFPO is not well understood. This species may not be specifically dependent on riverine ecosystems throughout its range. Where riparian vegetation forms a closed-canopy forest gallery, owl densities may be low. Cartron et al. (2000b) identified thickets and woodlands with a dense understory that often consists of spiny shrubs as important structure. In Sonora, Mexico, where riparian areas closely resemble that found in Arizona, associations between these communities and the CFPO may be weak. However, one explanation may be the presence of large expanses of wooded areas adjacent to these riparian systems, which are also available to these owls. In Arizona, however, riparian systems generally support a much higher degree of wooded vegetation compared to uplands and as a result, attract a disproportionate amount of wildlife (Carothers et al. 1977, Hubbard 1977, Pase and Layser 1977). For example, migrating passerines tend to prefer these riparian corridors over uplands (Stevens et al. 1977). Historically, riparian areas are where the owl was most often detected included thickets; however, these areas also included a high proportion of edge. These areas generally support a higher average number of reptiles (Brode and Bury 1984, Jones 1988) and mammalian prey species compared to adjacent uplands (Stamp and Ohmart 1979, Frey and Yates 1996). An abundant and high diversity of prey may be important for a perch and wait predator such as the CFPO (Cartron et al. 2000b).

In southern Texas, CFPO habitat includes coastal plain oak (*Quercus virginiana*.) associations as well as the Tamaulipan Thornscrub of the lower Rio Grande Valley region, which is comprised of mesquite, hackberry, oak, and Texas ebony *(Pithecellobium ebano)* (Griscom and Crosby 1926, Bent 1938, Oberholser 1974, Tewes 1993, Wauer et al. 1993). Proudfoot (1996) found that moderate to dense understory cover and large trees capable of containing cavities are most important. In northeastern Mexico, they occur in lowland thickets, thornscrub communities, riparian woodlands, and second-growth forest (van Rossem 1945, Enriquez-Rocha et al. 1993, Tewes 1993). In central and southern Arizona, their primary habitats are riparian cottonwood forests, mesquite bosques, and Sonoran desertscrub, although most recent observations have occurred primarily in Sonoran desertscrub associations of palo verde, bursage, ironwood, mesquite, acacia, and giant cacti such as saguaro and organ pipe (Gilman 1909, Bent 1938, van Rossem 1945, Phillips et al. 1964, Monson and Phillips 1981, Johnson-Duncan et al. 1988, Millsap and Johnson 1988). Farther south in northwestern Mexico, CFPOs occur in Sonoran desertscrub, Sinaloan thornscrub, and Sinaloan deciduous forest as well as riverbottom woodlands, cactus forests, and thornforest (Enriquez-Rocha et al. 1993).

While the majority of Arizona CFPO detections in the last six years have been from the northwest Tucson area, CFPOs have also been detected in southern Pinal County, at Organ Pipe Cactus National Monument (OPCNM), on the Buenos Aires National Wildlife Refuge (BANWR), and on the Coronado National Forest. CFPOs at OPCNM have been detected in Sonoran desertscrub habitat dominated by creosotebush (*Larrea tridentata*), saguaro, velvet mesquite (*P. velutina*), palo verde, cat-claw acacia, ironwood, triangle-leaf bursage (*A. deltoidea*), and white brittlebush (*Encelia farinosa*). Small washes in the area support canyon ragweed (*A. ambrosioides*) and salt cedar (*Tamarix pentandra*). In addition, relatively large mesquite bosques are present in some areas (Collins and Corman 1995). On the BANWR and adjacent areas in the Altar Valley, CFPOs have been located within riparian habitat in semi-desert grassland communities. Vegetation in these riparian areas included netleaf hackberry, velvet mesquite, Arizona ash (*Fraxinus velutina* var. *velutina*), acacia, and Mexican elderberry (*Sambucus caerulea*).

CFPOs are considered non-migratory throughout their range by most authors, and have been reported during the winter months in several locations, including OPCNM (R. Johnson unpubl. data, T. Tibbitts, OPCNM unpubl. data). Major Bendire (1888) collected CFPOs along Rillito Creek near Camp Lowell at present-day Tucson on January 24, 1872. The University of Arizona Bird Collection contains a female CFPO collected on January 8, 1953 (University of Arizona 1995). Similarly, records exist from Sabino Canyon documenting CFPOs as present on December 3, 1941, and December 25, 1950 (USDA Forest Service unpubl. data). These winter records demonstrate that CFPOs are found within Arizona throughout the year, and do not appear to migrate south to warmer climates during winter. However, Russell and Monson (1998) postulated that they may be migratory in the northern portion of their range.

CFPOs nest in natural cavities or those made by other species, particularly by Gila woodpeckers (*Melanerpes uropygialis*), and rely on suitable cavities to be present for roosting and nesting.

CFPOs nest in a cavity in a tree or large columnar cactus. Historically, nests were found in cavities of cottonwood, willows, or mesquites, and with the loss and alteration of riparian areas in Arizona, saguaros may now provide the most available source of cavities for nesting. Most recent nests have been located in saguaro cavities (Abbate et al. 1996, S. Richardson, AGFD unpubl. data). Although recent nest sites have primarily been located in saguaro cavities, in 1999, two nests were also located in cavities of other tree species (one each in an ash and eucalyptus [*Eucalyptus* spp.]) (S. Richardson, AGFD unpubl. data). These cavities may be naturally formed (e.g., knotholes) or excavated by woodpeckers, and nest lining material may or may not be present. Researchers in Texas noted that one pair of CFPOs removed material from a cavity prior to laying eggs one year, but laid eggs on material in the nest cavity the following year (Proudfoot et al. 1994a). Breninger (1898) noted that no nest lining was used at one observed nest. Whether or not a nest lining is actually constructed, it is likely that prey remains, including feathers and other materials, build up on the nest cavity floor during its use.

CFPOs begin nesting activities in late winter to early spring. With respect to current research, much of the specific timing of CFPO nesting chronology is unknown due to limited opportunities for study and the secretive nature of the CFPO. Data generated from nest box studies in Texas and research conducted in Arizona indicate that CFPOs lay eggs from mid- to late-April. Eggs were laid asynchronously, with one egg laid every 32 to 39 hours until the entire clutch of four to five eggs has been laid (Proudfoot 1996). Incubation continued for 21 to 23 days, with eggs hatching asynchronously at a rate of one egg every 20 to 26 hours. Fledging occurred 26 to 28 days after hatching was complete (Proudfoot 1996). In Arizona differences between nest sites may vary as much as two months (Abbate et al. 1996, S. Richardson, AGFD unpubl. data). As with other avian species, this may be the result of a second brood or a second nesting attempt following an initial failure (Abbate et al. 1996).

In both Texas and Arizona, observations indicate that the female incubates the eggs and attends hatchlings, while the male provides food to the female and young. In Texas, studies noted that males provided all of the food collected for the females and their young for approximately the first week following hatching (Proudfoot 1996). In Arizona, the majority of hunting activity and prey captures by male CFPOs were conducted away from the nest site and, consequently, out of sight of nest observers (Abbate et al. 1996).

Adult CFPOs, and particularly young may be susceptible to predation from avian species such as Cooper's hawks (*Accipiter cooperii*), Harris's hawk (*Parabuteo unicinctus*), great horned owls (*Bubo virginianus*) and others; therefore, cover, particularly near nest sites for young to fledge to are important (Wilcox et al. 1999, S. Richardson, AGFD pers. comm. 1999).

According to studies conducted in Texas, juveniles remained within approximately 50 m (165 ft) of adults until dispersal. Dispersal occurred approximately 63 days after the young first left the nest. In Texas, dispersal distances (straight line) of 20 juveniles monitored from their natal sites to nest sites the following year averaged 8.2 km (5 mi) (ranged from 1.2 km [0.75 mi] to 30.5 km [19 mi] (G. Proudfoot unpubl. data). One banded juvenile from Arizona was observed

approximately 3.9 km (2.4 mi) from its nest site following dispersal (S. Richardson, AGFD unpubl. data). Radio telemetry studies conducted by AGFD in 1998 showed dispersal distances of young fitted with transmitters from 3.5 km (2.17 mi) up to 10.4 km (6.5 mi) (straight line distance) (n=5, mean 5.9 km [3.6 mi]) (S. Richardson, AGFD unpubl. data). Telemetry studies in Arizona during 1999 resulted in generally greater dispersal distances, ranging from 2.3 km (1.4 mi) to 20.7 km (12.9 mi) (straight line distance) (n=6, mean 10 km [6.2 mi]) (S. Richardson, AGFD unpubl. data). Juveniles typically dispersed from natal areas in July did not appear to defend a territory until September. They may move up to 1.6 km (1 mi) in a night; however, they appear to fly from tree to tree instead of long single flights (S. Richardson, AGFD unpubl. data).

Subsequent surveys during the spring have found that their locations are in the same general location as last observed the preceding fall.

CFPOs typically hunt from perches in trees with dense foliage using a perch-and-wait strategy; therefore, sufficient cover must be present within their home range for them to successfully hunt and survive. Their diverse diet includes birds, lizards, insects, and small mammals (Bendire 1888, Sutton 1951, Sprunt 1955, Earhart and Johnson 1970, Oberholser 1974) and frogs (Proudfoot et al. 1994b). Recent studies in Texas confirmed that CFPOs take prey from a variety of animal classes, with the highest number of prey items from the Insecta and Reptilia classes (Proudfoot et al. 1994b). Prey items delivered by the female at a nest site in Arizona included house finches, black-tailed gnatcatchers, lizards, and cicadas. Observed prey bird size range from mourning doves (*Zenaida macroura*) to hummingbirds (*Trochilidae* fam.) indicating CFPOs are capable of taking prey considerably heavier than their own weight and a wide variety of bird species (G. Proudfoot 1994b, S. Richardson, AGFD unpubl. data). Studies in both Texas and Arizona indicate that lizards are the predominant prey item for CFPOs. Proudfoot (1994b) noted that while insects make up a higher number of individual prey items, lizards constitute the largest percentage of the biomass (S. Richardson, AGFD unpubl. data). Abbate et al. (1999) noted that, of 187 prey items either captured near or delivered to the nest in 1998 and 1998, 36 percent were reptiles (lizards), while birds accounted for 30 percent, mammals 7 percent, and insects were 2 percent. The remainder of the prey items (25 percent) could not be identified through observation. Seasonal variations in prey availability and abundance may affect prey taken by CFPOs; however, further research is needed to determine these fluctuations.

In Texas, Proudfoot (1996) using radio telemetry determined that the area used by adult male CFPOs (n=3) during the incubation period ranged in size from 1 to 9 ha (3 to 21 ac), with a mean size of 4 ha (10 ac). Proudfoot (1996) further determined that CFPOs of unknown sex used an area ranging from 19 to 115 ha (48 to 287 ac), with a mean of 68 ha (172 ac) in late fall. Additionally, Proudfoot (1996) notes that, while CFPOs used between 1 and 9 ha (3 and 21 ac) during the breeding season, they would defend areas up to 113 ha (279 ac), indicating that their total territory may encompass an area at least 110 ha (279 ac) in size. Proudfoot (unpubl. data) indicated that pairs utilize an area within 600 m (1,969 ft) of their nest site. Proudfoot (unpubl.

data) has stated that his data indicate that the area necessary to successfully raise young is approximately 39.5 ha (98.8 ac).

Based on visual and auditory detections of one adult pair and one fledgling at a 1996 nest site, Abbate et al. (1996) estimated a breeding season home range size for CFPOs in Arizona. By following the adult female and the fledgling, it was noted the size of the area used by the female and fledgling expanded as the fledging aged. In fact, the fledgling was observed at what may have been the northern and southemmost points of the nesting territory. In contrast, the adult male appeared to be using the same size area during incubation as he did during the nestling stages. The adult female was observed to use an area approximately 0.2 ha (0.5 ac) in size during the pre-fledgling and nesting stages. However, this area expanded to approximately 14 ha (35 ac) post-fledging, this area was also used by the fledgling (Abbate et al. 1996). Following dispersal of the fledgling, it was believed that the area used by the adult CFPOs expanded beyond the 14 ha (35 ac) area (Abbate et al. 1996). An additional pair of CFPOs was found in the late fall of 1997. Researchers in Arizona indicated that this pair used approximately 64 ha (160 ac) (S. Richardson, AGFD unpubl. data). In addition, an unpaired male was monitored by AGFD in the late fall of 1997 and used approximately 64 ha (160 ac) (S. Richardson, AGFD unpubl. data).

CFPOs must have available to them, sufficient prey items to survive and successfully raise their young. Proudfoot (1996) observed an increase in home range size during the winter months up to 113 ha (to 280 ac), possibly due to less abundant prey species. Because this species is considered a generalist, seasonal and annual shifts in diet likely occur due to availability of prey (Proudfoot 1996, Proudfoot 1994b, S. Richardson, AGFD unpubl. data). Prey species may be less abundant during winter months, possibly forcing owls to forage over a wider area. Initial results from ongoing studies in Texas indicate that the home range of CFPOs may also expand substantially during dry years (G. Proudfoot unpubl. data). Based on the above information, it appears that survival during winter months, and possibly exacerbated in dry years with less abundant prey species available, may be of particular concern for this species. Therefore, the use of the maximum home range territory size (113 ha (280 ac) is appropriate to adequately support a pair and to provide sufficient prey and cover throughout the year.

Species status and distribution range-wide

The CFPO, in the Order *Strigiformes*, Family *Strigidae*, is one of four subspecies of ferruginous pygmy-owl. CFPOs are known to occur from lowland central Arizona south through western Mexico to the States of Colima and Michoacan, and from southern Texas south through the Mexican States of Tamaulipas and Nuevo Leon. It is unclear at this time if the ranges of the eastern and western populations of the ferruginous pygmy-owl merge in southern Mexico. However, genetic information indicates that eastern and western populations of the CFPO may be genetically dissimilar, (refer to Final Rule [USFWS 1997a] for additional information). Genetic research is currently being conducted by Pima County to analyze whether there is any genetic variation within tissue samples collected in Arizona compared to samples from Mexico

and Texas. This study will help determine if current populations of CFPOs in Arizona lack genetic variation relative to healthy populations and to clarify the genetic variability among populations.

The Service is currently funding surveys in Sonora, Mexico to determine the distribution and relative abundance of the CFPO there. Little is currently known of the population and distribution of CFPOs in Mexico. Based on the lack of sightings, they may be absent, rare, or uncommon in northern Sonora, Mexico (Hunter 1988, USFWS 1997a).

According to early surveys referenced in the literature, the CFPO, prior to the mid-1900s, was "not uncommon," "of common occurrence," and a "fairly numerous" resident of lowland central and southern Arizona in cottonwood forests, mesquite-cottonwood woodlands, and mesquite bosques along the Gila, Salt, Verde, San Pedro, and Santa Cruz rivers and various tributaries (Breninger 1898 *in* Bent 1938, Gilman 1909, Swarth 1914). Bendire (1888) noted that he had taken "several" along Rillito Creek near Fort Lowell, in the vicinity of present-day Tucson, Arizona. Records indicate that the CFPOs were initially more common in xeroriparian habitats (very dense thickets bordering dry desert washes) than more open, desert uplands (Monson and Phillips 1981, Johnson and Haight 1985a, Johnson-Duncan et al. 1988, Millsap and Johnson 1988, Davis and Russell 1990). The CFPO was also noted to occur at isolated desert oases supporting small pockets of riparian and xeroriparian vegetation (Howell 1916, Phillips et al. 1964).

The historic use of Sonoran desertscrub habitats by CFPOs is not as clear. A disproportionately low number of historical records from desertscrub habitats may be due to the focus of early collection efforts along rivers where humans tended to concentrate, while the upland areas received less survey. An additional hypothesis is offered by Johnson and Haight (1985a), who suggest that CFPOs adapted to upland associations and xeroriparian habitats in response to the demise of Arizona's riparian bottomland woodlands. It is also possible that desertscrub habitats simply are of lesser quality for CFPOs and have always been occupied by CFPOs, but at lower frequency and density (Johnson and Haight 1985b, Taylor 1986). Historical records of CFPOs do exist for Sonoran desertscrub in areas such as the Santa Catalina foothills and in "groves of giant cactus" near New River, north of Phoenix. Kimball (1921) reported one CFPO in a mesquite tree in the foothills of the Santa Catalina Mountains. Fisher (1893) took two CFPO specimens near New River, and observed "several others" in mesquite and large cacti.

The range of CFPOs in Arizona extends from the International Border with Mexico north to central Arizona. The northernmost historic record for the CFPO is from New River, Arizona, about 56 km (35 mi) north of Phoenix, where Fisher (1893) reported the CFPO to be "quite common" in thickets of intermixed mesquite and saguaro cactus. The Museum of Vertebrate Zoology contains a clutch of four eggs collected by G.F. Breninger on May 18, 1898 in Phoenix, Maricopa County. One additional record exists for this northern portion of the CFPO's range, and is filed under R.D. Lusk with the United States National Museum Smithsonian Institution. This record indicates that five eggs and a skin were collected at Cave Creek on April 12, 1895

(USNM 1996). CFPOs were also detected in central Arizona at the Blue Point Cottonwoods area, at the confluence of the Salt and Verde rivers, in 1897, 1949, 1951, and 1964 (AGFD 1999, Phillips et al. 1964). Additionally, CFPOs were detected at Dudleyville on the San Pedro River as recently as 1985 and 1986 (AGFD 1999, Hunter 1988).

Records from the eastern portion of the CFPO's range include a 1876 record from Camp Goodwin (nearby current day Geronimo) on the Gila River, and a 1978 record from Gillard Hot Springs, also on the Gila River. CFPOs have been found as far west as the Cabeza Prieta Tanks in 1955 (Monson 1998).

Hunter (1988) found fewer than 20 verified records of CFPOs in Arizona for the period of 1971 to 1988. Although CFPOs are diurnal and frequently vocalize in the morning, the species was not recorded or reported in any breeding bird survey data in Arizona (Robbins et al. 1986). Formal surveys for the CFPO on OPCNM began in 1990, with one located that year. Beginning in 1992, survey efforts conducted in cooperation with the AGFD, located three single CFPOs on OPCNM (USFWS and OPCNM unpubl. data).

In 1993, surveys were conducted at locations where CFPOs had been sighted since 1970. These areas included the lower San Pedro River from Cascabel to Winkelman, northwest Tucson, east Tucson from Sabino Canyon to Tanque Verde Wash, the lower elevations of Saguaro National Park, Rincon Mountain District, Rincon Creek from the X-9 Ranch to Thunderhead Ranch, and the confluence of the Salt and Verde rivers. Only one CFPO was detected during these survey periods, and it was located in northwest Tucson (Felley and Corman 1993).

Surveys were again conducted in 1994 at Catalina State Park north of Tucson, Winkelman, the Aravaipa Creek confluence, near Mammoth, and Bingham Cienega along the lower San Pedro River, Cabeza Prieta National Wildlife Refuge, Picacho Reservoir, Sycamore Canyon in the Pajarito Mountains, and at the confluence of the Salt and Verde rivers. These surveys yielded no CFPO detections (Collins and Corman 1995). However, two owls were located in northwest Tucson during informal survey work by AGFD (Abbate et al. 1996).

In 1996, AGFD focused survey efforts in northwest Tucson and Marana and detected a total of 16 CFPOs, two of which were a pair, and two of which were fledglings. Three additional CFPOs were detected at OPCNM in 1996. There were also three additional but unconfirmed reports of CFPOs from OPCNM.

In 1997, survey efforts of AGFD located a total of ten CFPOs in their Tucson Basin study area, which is roughly bounded on the north by the Picacho Mountains on the east by the Santa Catalina and Rincon Mountains, on the south by the Santa Rita and Sierrita Mountains, and on the west by the Tucson Mountains. Eight of the ten CFPOs were found in the northwest Tucson area, and the remaining two were found on the western bajada of the Tortolita Mountains. Of the eight CFPOs documented from northwest Tucson in 1997, one pair successfully fledged four young. The remaining three CFPOs included a single adult in the northwest Tucson area and the

two CFPOs found on the western bajada of the Tortolita Mountains. Nine of the CFPOs were located during the nesting season, while three were located in the fall. Of the three CFPOs located in the fall, two were known to be from the nest site. It is unknown if the third CFPO located in the fall was from the known nest site for that year. This CFPO was located more than 3 km (2 mi) from the nest site, and was counted as the tenth CFPO for 1997 (S. Richardson, AGFD unpubl. data). Two adult males were also located at OPCNM 1997, with one reported from a previously unoccupied area (T. Tibbitts, OPCNM unpubl. data).

In 1998, a total of 35 CFPOs were observed, including 11 juveniles in the action area, and five juveniles at OPCNM (S. Richardson, AGFD unpubl. data, USFWS unpubl. data, T. Tibbitts, OPCNM unpubl. data, D. Bieber, Coronado National Forest unpubl. data). Three adults were found along xeroriparian drainages in semi-desert grassland in southern Arizona, and two adults were also located in Pinal County. One adult was located in eastern Tucson as well (USFWS unpubl. data). We believe that the larger number of owls observed in 1998 is largely due to increased survey effort from previous years, and location of successful nest sites.

The 1999 survey season resulted in a total of 41 adult CFPOs found in Arizona. Statewide, a total of 28 CFPO sites were documented, 10 of which had nesting confirmed which produced 33 young, although only 16 juveniles were known to successfully fledge (juveniles documented to have successfully dispersed from their natal area) (S. Richardson, AGFD unpubl. data). CFPOs were found in three distinct regions of the state: the Tucson Basin (northwest Tucson and southern Pinal County), Altar Valley, and OPCNM.

- **Tucson Basin** - A total of 17 adults were documented at 11 sites (11 adults at 7 sites in northwest Tucson and 6 adults at 4 sites in southern Pinal County) found in Sonoran desertscrub and xeroriparian vegetation. The four nests in northwest Tucson produced 16 young, of which 10 juveniles successfully fledged. The two nests in southern Pinal County produced 6 young, of which 3 juveniles successfully fledged.

- **Altar Valley** - Until 1999, this area of the state, located in southern Pima County, was largely surveyed. A total of 18 adult CFPOs were documented at 14 sites, located in riparian woodlands and xeroriparian habitats in semi-desert grasslands and upland Sonoran desertscrub habitat in this region. Four nests were documented in this region, producing 11 young, of which 3 juveniles successfully fledged. Monitoring of some of these sites was not possible through the nesting season.

- **OPCNM** - Three sites were documented in this region in Sonoran desertscrub and xeroriparian vegetation. At each of the three sites a pair was found; however, a nest was found at only one site which failed. Frequent monitoring was not possible at these sites, so nests may have been overlooked.

Overall, mortality was documented for a number of fledglings due to natural causes (e.g., predation). Of the 33 young documented in 1999, only 16 were documented as surviving until dispersal, and the fate of several others was unknown. It is unclear what the survival rate for CFPOs is; however, as with other owls and raptors, a high mortality (50 percent or more) of young is typical during the first year of life.

Surveys conducted during the recently completed 2000 survey season resulted in 24 CFPO sites (35 adults) being located. Ten sites were confirmed in the Tucson Basin (14 adults), 6 sites in the Altar Valley (9 adults), 6 sites (8 adults) at OPCNM, and 2 sites (4 adults) in south-central Arizona (S. Richardson, AGFD unpubl. data, T. Tibbitts, OPCNM unpubl. data, USFWS unpubl. data).

In summary, the action area (i.e., Tucson Basin) contains one of the highest known concentrations of CFPOs in Arizona. Surveys in 1996 found 16 CFPOs in this area, including one pair and two fledged young. Surveys in 1997 located nine CFPOs, including one pair and four fledged young. In 1998, researchers found three nests where 11 juveniles were successfully raised in this area alone, which is at least twice the number of young documented in any prior year. In 1999, four pairs of CFPOs were documented nesting and three territorial single males were found in the northwest Tucson (S. Richardson, AGFD unpubl. data). The recently completed 2000 surveys have resulted in ten sites confirmed within the action area. At these sites 14 adults have been documented and four nests have been confirmed (S. Richardson, AGFD unpubl. data).

Range wide trend

The most urgent threat to CFPOs in Arizona is the loss and fragmentation of habitat, especially from large scale and commercial developments (USFWS 1997a, Abbate et al. 1999). The complete removal of vegetation and natural features required for many large scale and high-density developments directly and indirectly impacts CFPO survival, and the stabilization and recovery of this known population (Abbate et al. 1999).

Habitat loss, degradation, and fragmentation are widely accepted causes contributing to raptor population declines worldwide (Snyder and Snyder 1975, Newton 1979, LeFranc and Millsap 1984). Availability of nests and food supplies are considered limiting factors for raptor populations (Whitcomb et al. 1981, Temple 1986, Wilcove et al. 1986, Cline 1988, Watson and Landslow 1989). Worldwide, habitat destruction is considered a major cause of wildlife extinctions (Wilson 1989). Habitat fragmentation is the process by which a large and continuous block of natural habitat is transformed into much smaller and isolated patches by human activity (Noss and Csuti 1994). Fragmentation has two components (1) reduction of the total amount of habitat type and (2) apportionment of remaining habitat into smaller, more isolated patches (Harris 1984, Wilcove et al. 1986, Saunders et al. 1991).

Nesting in small natural patches may have additional risks. For example, Haug (1985) found burrowing owl home range size increases with the percentage of habitat disturbance. In fragmented landscapes, burrowing owls may forage greater distances and spend more time away from the nest, making them more vulnerable to predators, and therefore, less efficient at reproduction (Warnock and James 1997). As fragmentation increases, particularly in the action area, competition for fewer productive CFPO territories may also occur (Abbate et al. 1999). Unlike other larger birds that can fly long distances over unsuitable or dangerous areas to establish new territories, CFPOs, because of their small size, and their short style of flight are exposed to greater risks from predation and other threats (Abbate et al. 1999).

Site tenacity in birds is one of many factors that may create time lags in response to fragmentation and other disturbances. Individuals may remain in sites where they bred successfully in the past, long after the habitat has been altered (Wiens 1985). Because of lack of data, it is unclear whether site tenacity for CFPOs, in increasingly fragmented landscapes, such as exists in the action area is a factor. Additional data is needed to determine if this is the circumstance. For example, researchers will be closely monitoring a long established owl site (documented each year since 1996) in which the male died in 1999, apparently from a collision with a wire fence (S. Richardson, AGFD unpubl. data.). Thus far (as of July 2000), this site does not appear to be occupied by CFPOs this breeding season. This site had the highest amount of development (about 33 percent) of any other known site within its estimated home range (S. Richardson, AGFD unpubl. data.). Further monitoring will be done at this site.

One factor affecting the known distribution of CFPOs in Arizona is where early naturalists spent most of their time and where recent surveys have taken place. For example, a majority of surveys in the recent past (since 1993) have taken place in OPCNM and in the Tucson Basin, and these areas are where most owl locations have been recorded. However, over the past two years, large, previously unsurveyed areas have been inventoried for owls, resulting in a much wider distribution than previously thought. For example, before 1998, very few surveys had been completed in the Altar Valley in southern Pima County. Prior to 1999, the highest known concentration of CFPOs in the state was in northwest Tucson; however, in 1999, after extensive surveys in Altar Valley, more owls were found there (18 adults) than in northwest Tucson (11 adults) (S. Richardson, AGFD unpubl. data). As a result, our knowledge is changing as to their distribution and habitat needs as new information is collected. For example, (based on 1999 surveys) we now know of more owls/sites in areas with no or little human activity or development (20 sites [33 owls]) than in suburban interface areas (8 sites [13 owls]).

All currently known CFPO locations in the northwest Tucson are in areas of low-density housing where abundant native vegetation separates human structures from one another. Additionally, these areas are adjacent to large tracts of undeveloped land. CFPOs appear to use non-native vegetation to a certain extent, and have been observed perching in non-native trees in close proximity to individual residences. However, the persistence of CFPOs in areas with an abundance of native vegetation indicates that a complete modification of natural conditions likely results in unsuitable habitat conditions for CFPOs. While development activities are occurring in

close proximity to several nesting owls, overall, noise levels are low. Housing density is low, and, as a result, human presence is also generally low. The majority of the roads in the area are dirt or two-lane paved roads with low speed limits which minimizes traffic noise. Low density housing areas generally have low levels of traffic noise because of the limited number of vehicles traveling through the area.

Other factors contributing to the decline of CFPO habitat include the destruction of riparian bottomland forests and bosques. It is estimated that between 85 to 90 percent of low-elevation riparian habitats in the southwestern U.S. have been modified or lost; these alterations and losses are attributed to woodcutting, urban and agricultural encroachment, water diversion and impoundment, channelization, groundwater pumping, livestock overgrazing, and hydrologic changes resulting from various land-use practices (e.g., Phillips et al. 1964, Carothers 1977, Kusler 1985, Jahrsdoerfer and Leslie 1988, USFWS 1988b, U.S. GAO 1988, Szaro 1989, Dahl 1990, State of Arizona 1990, Bahre 1991). Cutting of trees for domestic and industrial fuel wood was so extensive throughout southern Arizona that, by the late 19th century, riparian forests within tens of miles of towns and mines had been decimated (Bahre 1991). Mesquite was a favored species because of its excellent fuel qualities. In the project area, the famous vast forests of "giant mesquites" along the Santa Cruz River in the Tucson area described by Swarth (1905) and Willard (1912) fell to this threat, as did the "heavy mesquite thickets" where Bendire (1888) collected CFPO specimens along Rillito Creek, a Santa Cruz River tributary, in present-day Tucson. Only remnant fragments of these bosques remain.
Regardless of past distribution in riparian areas, it is clear that the CFPO has declined throughout Arizona to the degree that it is now extremely limited in distribution in the state (Johnson et al. 1979, Monson and Phillips 1981, Davis and Russell 1984, Johnson-Duncan et al. 1988, Millsap and Johnson 1988, Monson 1998). The continuous corridors of riparian and associated flood plain forests once covered hundreds of miles in the Southwest, and supported a sizable population of CFPOs in Arizona as described in early accounts from Bendire (1888) and Breninger (1898). A very low number of CFPOs in riparian areas in recent years may reflect the loss of habitat connectivity rather than the lack of suitability (Cartron et al. 2000b).
Cottonwoods also were harvested for fuel wood, fenceposts, and for bark for cattle feed (Bahre 1991).

In recent decades, the CFPO's riparian habitat has continued to be modified and destroyed by agricultural development, woodcutting, urban expansion, and general watershed degradation (Phillips et al. 1964, Brown et al. 1977, State of Arizona 1990, Bahre 1991, Stromberg et al. 1992, Stromberg 1993a and 1993b). Sonoran desertscrub has been affected to varying degrees by urban and agricultural development, woodcutting, and livestock grazing (Bahre 1991). In addition to clearing woodlands, the pumping of groundwater and the diversion and channelization of natural watercourses are also likely to have reduced CFPO habitat. Diversion and pumping result in diminished surface flows, and consequent reductions in riparian vegetation are likely (Brown et al. 1977, Stromberg et al. 1992, Stromberg 1993a and 1993b).
Channelization often alters stream banks and fluvial dynamics necessary to maintain native riparian vegetation. The series of dams along most major southwestern rivers (e.g., Colorado,

Gila, Salt, and Verde rivers) have altered riparian habitat downstream of dams through hydrological and vegetational changes, and have inundated former habitat upstream.

Livestock overgrazing in riparian habitats is one of the most common causes of riparian degradation (Ames 1977, Carothers 1977, Behnke and Raleigh 1978, USDA Forest Service 1979, USGAO 1988). Effects of overgrazing include changes in plant community structure, species composition, relative species abundance, and plant density. These changes are often linked to more widespread changes in watershed hydrology (Brown et al. 1977, Rea 1983, USGAO 1988), and are likely to affect the habitat characteristics essential to the CFPO. Direct results of livestock grazing include removal of vegetative cover and trampling of grass and brush. Indirect or delayed effects of grazing include altered forage composition, reduced vigor of plants, and accelerated soil erosion resulting in a reduction of land productivity.

Many avid wildlife viewers intentionally seek out rare or spectacular species (Knight and Cole 1995). Some have a reputation for striving for the most viewing opportunities in the least amount of time (e.g., bird listing). Because these activities may occur during sensitive times of the year (e.g., nesting), and because they often involve close approaches to wildlife for purposes of identification or photography, the potential for negative effects is large (Knight and Cole 1995). Visitation of nests may decrease nest survivorship, provoke nest abandonment, or discourage renesting (Gotmark 1992).

In the United States, CFPOs are rare and highly sought by bird watchers, who concentrate at a few of the remaining known locations. Limited, careful bird watching is probably not harmful; however, excessive attention by bird watchers may at times constitute harassment and affect the occurrence and behavior of the CFPO (Oberholser 1974, Tewes 1993). For example, in 1996, a resident in Tucson reported a CFPO sighting which subsequently was added to a local birding hotline and the location was added to their website on the internet. Several car loads of birders were later observed in the area of the reported location (S. Richardson, AGFD pers. comm. 1999).

One of the few areas in Texas known to support CFPOs continues to be widely publicized as having organized field trips and birding festivals (American Birding Association 1993, Tropical Birds of the Border 1999). Resident CFPOs are found at this highly visited area only early in the breeding season, while later in the season they could not be detected. O'Neil (1990) also indicated that five birds initially detected in southern Texas failed to respond after repeated visits by birding tours. It is unknown if the birds habituate to the playing of taped calls and stopped responding, or if they abandoned the area. Oberholser (1974) and Hunter (1988) additionally indicated that in southern Texas, recreational birdwatching may disturb owls at highly visited areas.

Recreational disturbance has been viewed as most detrimental to wildlife during the breeding season. It has also become apparent that disturbance outside of a species' breeding season may have equally severe effects (Skagen et al. 1991). Some outdoor recreation activities (e.g., off

road vehicle [ORV] and motor bike use/racing, firearm target practicing, jeep tours, etc.) may disturb CFPOs during their breeding season (particularly from March through the end of July (G. Proudfoot pers. comm. 1999 and S. Richardson pers. comm. 1999). Disturbance during the breeding season may affect an individual's productivity; disturbance outside of this period may affect the energy balance and, therefore survival (Knight and Cole 1995). Wildlife may respond to disturbance during the breeding season by abandoning their nests or young, leading to nest abandonment (Knight and Cole 1995).

Noise can affect animals by disturbing them to the point that a detectable change in behavior may occur, such changes can affect their activity and energy consumption (Bowles 1995). Dangerous or unfamiliar noises are more likely to arouse wildlife than harmless and familiar noises. Habituation is the crucial determinant of success in the presence of noisy disturbances. Exposures of some experienced birds may produce no or minimal losses (Black et al. 1984). The habituation process can occur slowly, so it may not be detected in the short-term. In the long-term, some nesting birds become more tenacious and less responsive in the presence of human disturbance if they are not deliberately harassed (Burger and Gochfeld 1981). The limited literature to date suggests that human harassment is a crucial determinant of effects on birds, and human occupation and activity are clearly and directly correlated with declines in breeding populations of birds (Andersen 1988, Weseman and Rowe 1987, Burger 1984).

Trichomoniasis is a disease which may affect CFPOs. Because CFPOs prey on finches, sparrows, and other seed-eating birds known to carry trichomoniasis, they have a higher risk of contracting the disease. According to Boal and Mannan (1996), raptors in urban areas experience greater exposure to trichomoniasis, resulting in high mortality of raptor nestlings. No studies have been completed to date on the CFPO in urban or other areas to determine if, in fact, they have been affected by this disease; however studies have recently been initiated (S. Richardson, AGFD pers. comm. 1999).

Little is known about the rate or causes of mortality in CFPOs; however, they are likely susceptible to predation from a wide variety of species. In Texas, Proudfoot and Johnson (in press, pers. comm.) have documented predation of adult CFPOs by great horned owls (*Bubo virginianus*), Harris's hawk (*Parabuteo unicinctus*), Cooper's hawk (*Accipiter cooperi*), and eastern screech owls (*Otus asio*). In Arizona, predation of both adults and juveniles are also suspected by these species (S. Richardson, AGFD unpubl. data). CFPOs are most vulnerable to predation and other threats during and shortly after fledging (Abbate et al. 1999). Proudfoot (unpubl. data) found that racoons (*Procyon lotor*), snake, and screech owl predation may be an additional factor adversely affecting the CFPO population on the Norias Division of the King Ranch in Texas. He documented CFPO eggs and nestlings in nest boxes being eaten by an indigo snake (*Drymarchon corais)*. Proudfoot notes that, from 1993 to 1996, 8 out of 112 available nest boxes (or 232 nest box opportunities) were used by CFPOs. Where metal flashing was placed around trees to prevent the possibility of predation by snakes, eggs were not disturbed. For the four nest boxes left unprotected, three had eggs eaten before they hatched, and in the fourth the hatchlings were eaten. Proudfoot further noted that fecundity (the number of

young successfully raised per year), for natural cavities was approximately one-third that of fecundity for nest boxes, and speculates that eggs and birds in natural cavities were likely to have been eaten by both snakes and long-tailed weasels (*Mustela frenata*), resulting in a lower fecundity rate (G. Proudfoot unpubl. data). He recently documented predation of two adult female CFPOs and their eggs from screech owls when they attempted to nest in nest boxes that were previously used by screech owls for roosting (unpubl. data).

Pesticides may pose an additional threat to the CFPO. The presence of CFPOs in close proximity to residents and nurseries may cause direct exposure to environmental contaminants such as pesticide and herbicides, and direct exposure or ingestion of affected prey items may cause death or reproductive failure (Abbate et al. 1999). Pesticide application in Arizona occurs year-round. Because crops, such as cotton, are grown repeatedly year after year, an accumulation of resistant pesticides may result. Illegal dumping of waste is also a threat to owls and their prey; in one case, an incident occurred where drums of toxic solvents were found within 1.6 km (1 mi) of an owl detection (Abbate et al. 1999). No quantitative data on the effects of this threat on the CFPO are known at this time; however, the effects of pesticides such as DDT on the reproductive success of other bird species are well known. Potentially harmful residues of pesticides and heavy metals have been reported in the eggs or in the potential prey of several raptorial species in southern Arizona including the Cooper's hawk (*Accipiter cooperii*), peregrine falcon, aplomado falcon *(Falco femoralis septentrionalis)*, and bald eagle (*Haliaeetus leucocephalus*) (DeWeese et al. 1986, Henry 1992, King et al. 1991, King et al. 1995, USFWS unpubl. data.). Many raptor species are susceptible to DDE-induced eggshell thinning and reproductive failure (Hickey and Anderson 1968, Lincer 1975, Ratcliff 1967). Dietary levels of 0.6 to 3.0 µg/g wet weight DDE can result in a significant degree of eggshell thinning in a variety of bird species including screech-owls (*Otus asio*) (McLane and Hall 1972), barn owls (*Tyto alba*) (Mendenhall et al. 1983), and American kestrels (*Falco sparverius*) (Lincer 1975, Wiemeyer and Porter 1970). Little is known about levels and potential effects of environmental contaminants in the food chain of the CFPO. An assessment is needed of contaminant concentrations in the food chain of the CFPO throughout its range in southeastern Arizona.

Other direct and indirect human caused mortalities (e.g., collisions with cars, glass windows, fences, power lines, domestic cats [*Felis* spp.], etc.), while likely uncommon, are often underestimated, and are likely to increase as the human interface with owls increases (Banks 1979, Klem 1979, Churcher and Lawton 1987). This may be particularly important in the Tucson area where many CFPOs are located. Incidents of owls flying into windows and fences resulting in death, have been documented in at least two incidences; a juvenile owl collided into a parked car (Abbate et al. 1999), and an adult apparently flew into a fence (S. Richardson, AGFD unpubl. data). Richardson also has documented incidents of children shooting BB guns near a nest site in Tucson, also indicating another potential of owl mortality within urban areas. In Texas, one adult owl and one fledging were killed by a domestic cat. Free roaming cats can also affect the number of lizards, birds, and other prey species available to CFPOs; however, very little research has been completed to date.

Roads and other habitat openings (e.g., golf courses) increase fragmentation and may act as a barrier or restrict CFPO movement. Radio-marked juvenile CFPOs have been observed on several occasions crossing two-lane roads with light to moderately heavy vehicular traffic, where trees and large shrubs were present on either side (Abbate et al. 1999). However, on another occasion, a juvenile dispersing a considerable distance in a single direction from its nest site, stopped within 1.1 km (0.7 mi) of Interstate 10 where there were larger openings and fewer tress or shrubs, and reversed its direction (Abbate et al. 1999). The typical flight pattern of CFPOs is about 0.5 - 1.5 m (2-4 ft) above the ground or just over the tops of shrubs or ground cover, and consists of short "hops" up to 50 m (165 ft), as they move from one tree or shrub to another (Abbate et al. 1999, Proudfoot pers. comm., S. Richardson, AGFD unpubl. data). The absence of adequate trees or other vegetation along roadways and large distances across highways or other areas may reduce the likelihood that they may cross (Abbate et al. 1999, Proudfoot pers. comm, S. Richardson, AGFD pers comm.). Pruning or removal of trees or saguaros to accommodate road expansions, maintenance of road shoulders, and some utilities may impact owls by removing cover, perch sites, and nest cavities (Abbate et al. 1999). In addition, CFPOs have been observed moving around the perimeter of golf courses, avoiding open, non-vegetated areas (Abbate et al. 1999, S. Richardson, AGFD unpubl. data).

Fires can impact CFPOs through direct destruction of nesting habitat, as well as loss of habitat structure and foraging habitats that would create long-term loss of these habitats (Abbate et al. 1999). In 1998 researchers in Arizona documented a car fire on a one-lane dirt road within a few feet of dense vegetation and less than 1 km (0.6 mi) of an active CFPO nest site. This fire was quickly extinguished by the local fire department; however, as human activity increases in previously undisturbed desert vegetation, so do risks of wildfires, and the realistic potential risk of danger to owls and their habitat (Abbate et al. 1999).

Post-fire mortality of saguaros has been clearly documented (Steenbergh and Lowe 1977 and 1983, McLaughlin and Bowers 1982). A recent fire altered an area where a nesting pair of CFPOs had been documented (Flesch 1999). Although four mature saguaros in the area survived (at least in the short-term), young saguaros may have been killed. He also observed approximately 20 to 30 percent of the mesquite woodland within 50 m (164 ft) of the nest was fire- or top-killed, and ground cover was also eliminated until the summer monsoons. Careful uses of prescribed fires in areas of suitable habitat are necessary to protect important elements of owl habitat so that it is not lost or degraded (Flesch 1999).

Low genetic variability can lead to a lowering in reproductive success and environmental adaptability. Caughley and Gunn (1996) further note that small populations can become extinct entirely by chance even when their members are healthy and the environment favorable. The pairing of siblings or parents with their young, particularly in raptors is rare, and has been documented in only 18 cases, representing 7 species (Carlson et al. 1998). Four of these species were owls: barn owls (*Tyto alba*), burrowing owls (*Athene cunicularia*), screech owls (*Otus asio*), and spotted owls (*Strix occidentalis*). In 1997, two sibling CFPOs, that were banded in their nest were later found paired and successfully fledged three young (Abbate et al. 1999).

This unusual pairing may have been the result of dispersal behavior or extremely low numbers of available mates within a small population; and habitat loss, fragmentation, and dispersal barriers may influence dispersal of young which may result in young in closer proximity than would normally occur (Abbate et al. 1999). Further, because the CFPO is nonmigratory, there may be an additional limitation on the flow of genetic material between populations which may reduce the chance of demographic and genetic rescue from immigration from adjacent populations.

Environmental, demographic, genetic stochasticity, and catastrophes have been identified as interacting factors that may contribute to a population's extinction (Hunter 1996). Environmental stochasticity refers to random variation in habitat quality parameters such as climate, nutrients, water, cover, pollutants, and relationships with other species such as prey, predators, competitors, or pathogens. Demographic stochasticity is uncertainty due to random variation in reproductive success and survivorship of individuals. Genetic stochasticity is the random variation in gene frequencies of a population due to genetic drift, bottlenecks, inbreeding, and similar factors. Catastrophes are events such as droughts or hurricanes that occur randomly. When these factors interact with one another, there are likely to be positive feedback loops, or snowballing of effects, such that a random environmental change like habitat fragmentation can result in population and genetic changes by preventing dispersal. These factors are much more likely to cause extinction when a species' numbers are already extremely low. The small, fragmented population of CFPOs in Arizona may not have the ability to resist change or dramatic fluctuations over time caused by one or more of the factors mentioned above.

Soule (1986) notes that very small populations are in extreme jeopardy. This is due to their susceptibility to a variety of factors, including demographic stochasticity, where chance variations in birth and death rates can result in extinction. A series of environmental changes such as habitat reduction reduce populations to a state in which demographic stochasticity takes hold. In small populations such as with the CFPO, each individual is important for its contributions to genetic variability of that population. As discussed above, low genetic variability can lead to a lowering in reproductive success and environmental adaptability, affecting recovery of this species.

III. ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation; and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Several thousand acres of State Trust land are located in a large continuous block, approximately 3 km (2 mi) to the northwest of the project site. At present, this land is not developed; however, State Trust lands may be sold or exchanged and could be used by future owners for development.

Presently, State Trust lands are being leased for grazing, and other activities (e.g., recreational ORV use, organized ORV racing events, shooting/target practicing, hunting, etc.) occur on these lands.

The project site is currently zoned by the Town of Marana as R-6 (six residential units per 0.4 ha [ac]). Much of the private lands to the east and south of the project site has been converted to high density housing developments as part of the Countryside developments. The area immediately adjacent to the north is primarily zoned for low density residential (one house per 1.3 ha [3.3 ac]). This area includes two, 16.2 ha (40 ac), unsubdivided parcels with suburban ranch (SR) zoning. One of the parcels has a single residence. Existing developments (Countryside Vistas) are located immediately south and east of the project site; densities vary between 5.13 and 6.39 Residential Units/Acre (RAC).

We are aware of many planned residential and commercial developments, schools, churches, etc. in the action area that may further reduce and fragment CFPO habitat in this area. As stated above (Species Distribution section), this area supports one of the highest known concentrations of CFPOs in the state (four active nest sites in 1999). Additionally, this area is currently experiencing a rapid growth in new home sales and development. Since the listing of this distinct population segment in Arizona, housing construction has continued to increase in the Tucson area. For example, in May 1999, new-home closings were a record 467 units, higher than any other May within the past decade (The Arizona Star 1999). In 1999, Tucson-area building permits were 10.9 percent more than in 1988, and topped 7,000 for the first time. Permits were highest in northwest Tucson and, for the first time, Marana issued more than 1,100 permits, with a strong building trend expected to continue steady or increasing (The Arizona Star 2000). We have received, and continue to receive notification of numerous new housing subdivisions and commercial developments in this region as well.

Over the past six month period, we have conducted over 50 informal section 7 consultations within the project area (e.g., planned residential, commercial, and other developments) and have provided technical assistance to hundreds of individuals seeking to develop single family residents on individual lots. Both federally permitted and private actions are expected to continue to grow in the action area in the near future. In addition, on December 1999, approximately 16 ha (40 ac) were graded for the Amphitheater High School site in northwest Tucson. We did not receive a request for consultation on this activity prior to grading.

We have completed several livestock grazing consultations with the USDA Forest Service and Bureau of Land Management (BLM) in southern and central Arizona that addressed adverse impacts to CFPOs. These consultations resulted in a non-jeopardy and no adverse modification determination by the Service. We have also reinitiated consultation with the BLM on the effects their grazing program has on the CFPO and its critical habitat.

In December 1998, a Habitat Conservation Plan (HCP) and 10(a)(1)(B) permit for the CFPO was approved for a guest ranch which may eventually be converted to low density residential housing in northwest Tucson.

No habitat restoration projects specific to the CFPO exist for lands managed by the U.S. Government, Indian Nations, State agencies, or private parties. The Forest Service and BLM have focused attention in some areas on modifying livestock grazing practices in recent years, particularly as they affect riparian ecosystems. Several of these actions are within the currently known range of CFPOs, including historical locations.

CFPOs were first documented in the action area around 1872 (see Status and Distribution section above) and historically were widespread in, and immediately adjacent to, the project site. Collections of CFPOs were fairly regular in this region compared to elsewhere in the state until 1918 (Johnson et al. in prep.). Only one CFPO observation was recorded between 1918 and the 1970's (Hunter 1988, Johnson et al. in prep.). Several sightings of CFPOs were documented during the 1970's in the Basin; however, systematic surveys did not take place until 1993 by AGFD (AGFD 1994, AGFD 1995, Abbate et al. 1996). Survey efforts in this area have dramatically increased since listing, particularly in the last couple of years (USFWS unpubl. data). In addition, AGFD initiated radio telemetry research in the action area in 1998, which has provided valuable information on habitat use and movement patterns of adult and juvenile CFPOs.

There have been no documented uses of the project site by CFPOs, either nesting or dispersal, and the site is not within a known CFPO territory. However, there have been eight different pairs or resident males documented within an approximate 3.2 km (2 mi) radius area of the project site since 1996 (S. Richardson, AGFD unpubl. data, USFWS unpubl. data). Most recently, in 1999, there were three active nest sites and one resident male CFPO documented within this same vicinity (S. Richardson AGFD unpubl. data, USFWS unpubl. data). The closest CFPO to the project site was in the fall of 1999, when AGFD tracked an owl fitted with a radio transmitter to a location within approximately 0.8 km (0.5 mi) to the north of the project site (S. Richardson AGFD unpubl. data). In addition, a dispersing male CFPO was also documented moving through this vicinity of the project site (within about 1.6 km [1 mi] to the north) in 1998 (S. Richardson, AGFD unpubl. data). These owls were tracked by radio telemetry as they dispersed from their nest site to the northeast of the project site, traveling east towards Interstate 10, then to the north, at which time their transmitter battery ran out and subsequent relocations were not possible.

We currently know of only a small population (17 adults in 1999) of CFPOs in the action area. However, the information regarding owl use of this area over time is limited. Specific use information collected in the action area, and particularly the vicinity of the project site, represents only limited data, collected primarily over the past four years. For example, use of radio telemetry equipment, which provides detailed information on use patterns and areas wasn't utilized until 1998, and its use has been limited by the small number of birds transmittered and available resources (i.e., limited personnel for intensive monitoring and equipment). In addition, battery life on radio transmitters is limited to only 90 days because of the small size that must be used on these small owls, which further limits the amount of telemetry data that can be collected.

Further, CFPOs can typically only be captured and fitted with radio transmitters during the spring and early summer, which further limits the amount and type of data that can be gathered.

IV. EFFECTS OF THE ACTION

Analysis of the species/critical habitat likely to be affected

The action area, within which the proposed project site occurs, contains the highest known breeding concentration of CFPOs (six of the ten nest sites in 1999) within Arizona. It is also within Critical Habitat Unit 4 designated for the owl. The proposed action will result in the removal of about 8.4 ha (20.8 ac) of suitable nesting, foraging, roosting, and dispersal habitat that are also primary constituent elements for the owl. The site has been surveyed during the past two breeding seasons and is not within a known owl territory. No CFPOs have been recorded within the project site, although owls were documented as close as within 0.8 km (0.5 mi) to the north in the fall of 1999.

Direct and Indirect Effects

This proposed action will result in the permanent loss of approximately 8.4 ha (20.8 ac) of Sonoran desertscrub vegetation which likely provides foraging, sheltering, and movement and dispersal habitat for CFPOs and has the potential to support nesting pairs as owls disperse from nearby nests. The entire project site contains suitable habitat and provides for each of these life history components. The project site is near existing urban development, and adjacent to a large expanse of undeveloped land that is also suitable habitat. The proposed action will also cause short-term noise disturbance associated with construction and long-term noise disturbance and increased human activity. Because of the lack of data specific to this subspecies in Arizona, we must also rely in part on our knowledge of effects this type of action may have on other species, particularly other raptors.

The project site is located in Critical Habitat Unit 4 (also Recovery Area 3). The Recovery Team and the Service believe this area (defined generally as south of Tangerine Road, east of Interstate 10, north of Cortaro Farms Road, and west of La Cholla Blvd.) to be of the highest concern because it contains the highest known concentration of nesting owls, and therefore serves as an important source of young that are essential to the conservation of this subspecies in Arizona. This area is also threatened by rapid urban development. Survival and recovery of the CFPO will be dependent on the availability of areas of suitable habitat for offspring to disperse and establish new territories.

Current information suggests that CFPOs can successfully live and breed in areas having at least some degree of human development, although more sites in Arizona are now known to occur in undeveloped areas (20 sites) than developed areas (8 sites) (S. Richardson, AGFD unpubl. data, USFWS unpubl. data). To determine the level of vegetation disturbance CFPOs may be able to tolerate, members of the Recovery Team completed an analysis of all known existing owl sites

(n=7) in northwest Tucson (USFWS 1999c). They calculated the amount of vegetation disturbance within the estimated home range or territory (113 ha [280 ac]) at each owl site. Disturbed areas include any areas where native vegetation had been removed or altered (e.g., roads, buildings, horse corals and pastures, parking lots, golf courses, etc.). Levels of vegetation disturbance were then grouped according to their percentage of disturbance (i.e., 0-5, 5-10, 10-15, etc.). The amount of vegetation disturbance in five of the seven CFPO home ranges was between 20-25 percent. One of the remaining two sites contained 17 percent disturbance and the other site had 33 percent disturbance.

It should be noted that the site with the highest amount of ground disturbance is that of a long established pair that has been documented in each of the past three years (since 1997). Development in the general vicinity of this site has continued. As noted in the Status and Baseline sections above, site tenacity is a factor that may create lags in responses to increased fragmentation, loss of habitat, and other disturbances, and individuals may remain at established sites, breeding successfully long after the habitat has been altered (Wiens 1985). This may be a factor for this pair, although further research is needed to better quantify these relationships. Owls may be able to persist in areas such as this as development continues, although the threshold at which development will cause owls to abandon a site is unknown. As noted above, the male of this pair was found dead late last summer. As of July 2000, another male has not moved into this site, and the location of the female is not known at this time (S. Richardson, AGFD pers comm.). It is likely that site tenacity in the short-term may have been a factor in this pair's ability to withstand this higher level of disturbance compared to other sites in Arizona; however, the long-term effect of this amount of disturbance is unknown. Owls have not been documented establishing new territories or utilizing areas other than for movement in areas with this high level of development other than at this site. In addition, 20 of the 28 known sites in 1999 were located in undeveloped areas, which places the level of ground disturbance at this site even further as an extreme, compared to all the other sites in Arizona. The amount of development at this site as an exception rather than the norm, therefore, the 20 percent disturbance level is likely the maximum level tolerated by CFPOs in their nesting territories. Based on this analysis, the Service has concluded that development within specific areas, such as those identified as Special Management Areas (SMAs) and in Recovery Areas, should be limited to 20 percent, particularly for large projects, to provide for the survival and recovery of the CFPO (USFWS 1999c).

Because of the high level of existing fragmentation and urban development in northwest Tucson, particularly between Cortaro Farms Road and Tangerine Road (including the project site), east of Interstate 10 and west of La Cholla Blvd., very few suitable areas that do not have nesting owls are available to fledgling owls upon leaving their natal area to establish a new territory. Reviewing dispersal data compiled by AGFD using radio telemetry over the past two breeding seasons, dispersing juveniles from sites in this area typically move several miles to the north, to areas with lower levels of development and less fragmentation, to establish their territory (S. Richardson, AGFD unpubl. data). This may indicate suitable nesting habitat that is not currently being used for nesting (such as the project site) south of Tangerine Road is limited, and

dispersing juveniles are forced to continue to move to less developed areas. Therefore, these areas are extremely limited and of highest concern.

Recovery of the CFPO will require not only protection of all known sites, but also the conservation of other areas not currently known to have nesting owls, which can be measured at two spacial scales. At a large scale, connectivity is necessary among large blocks of suitable habitat that are either currently known to have nesting owls or are important for recovery. An example is habitat connecting the Tucson Mountains east of Interstate 10 to the high concentration of owls in northwest Tucson. At a finer scale, the protection of habitat within the vicinity of known owl sites for establishment of new sites and movement between them is also essential. For example, the area located south of Tangerine Road in northwest Tucson, which contains the highest number and density of breeding CFPOs known in Arizona also contains areas not currently known to have nesting owls that is particularly important for the expansion of the population. The Recovery Team specifically identified this area, (including the project site) as a SMA within Recovery Area 3, and recommended that development not exceed 20 percent disturbance and adhere to connectivity guidelines (USFWS 1999c). However, the Recovery Team and the Service also believe that some small projects, occurring outside existing known territories, may be developed beyond the 20 percent ground disturbance guideline, if appropriate conservation measures are applied (USFWS 1999c). Because of the factors listed above, a combined 25 percent ground disturbance level for the expanded project site is considered appropriate for this action together with other conservation measures specified in the BA and this biological opinion. This level of disturbance is within the range of where most owls in northwest Tucson were found and best describes their tolerance for ground disturbance based on the best available science (USFWS 1999c).

Researchers in Arizona have found that CFPOs require areas or corridors, consisting of continuous cover or patches of trees and large shrubs spaced at regular intervals within a territory and for dispersal, to provide concealment and protection from predators and mobbing, as well as shade and cool temperatures (S. Richardson, AGFD unpubl data, Abbate et al. 1999). To permit the movement of owls through the project site and vicinity, and to partially offset adverse effects of the removal of approximately 8.4 ha (20.8 ac) of suitable habitat, 1 ha (2.4 ac) of open space within the project site will be established along the entire length of the Canada Agua Wash. This natural open space is located along the southern boundary of the project site (Figure 2). This, in combination with lands owned in the wash by Pima County (3.8 ha [9.3 ac]) will total approximately 4.7 ha (11.7 ac) of xeroriparian vegetation. The Canada Agua Wash corridor will average 85 m (280 ft) wide (ranging from 64 m [210 ft] at its narrowest point to 135 m [442 ft] at its widest point). The wash corridor will also be enhanced with the planting of native trees along the entire southern border of the planned residential area to provide additional screening from developed areas. Management of the wash corridor will be conducive to the movement of owls because the amount and type of human activities will be restricted. This corridor therefore, should allow for movement of owls through the project site.

The project site is immediately adjacent to a large (324 ha [800 ac]) high density (6 houses per 0.4 ha [1 ac]) residential area and a school. This action will increase the size of this block of development by 8.4 ha (20.8 ac) or 2.6 percent. Because of its juxtaposition to a large existing developed area, this action will not increase fragmentation within undeveloped or low density residential areas.

Casualties caused by pest control, pollution, collisions with cars, radio towers, glass windows, power lines, and cat predation are often underestimated, although likely increasing in occurrence due to human population growth (Banks 1979, Klem 1979, Churcher and Lawton 1987). Even where human-related deaths are uncommon, they may still substantially affect populations of rare birds (Cartron et al. 2000a). Because of the proximity of CFPO sites in residential areas in northwest Tucson, these interactions may be a significant cause of owl mortality there (Cartron et al. 2000a). Scott Richardson (AGFD unpubl. data) has documented two separate instances where a CFPO has been severely injured or died as a direct result of a collision with a window or fence. In Texas, a domestic cat killed an adult and fledgling owl (Cartron et al. 2000a).

Because human activity (e.g., noise from increased vehicle and foot traffic), and the building of walls, houses, etc. will increase, the likelihood of human interaction or possible adverse effects may occur. Conservation measures (e.g., screening, planting of trees, restricting use within the open space areas) in and adjacent to the xeroriparian wash corridor, will minimize potential of adverse effects.

In addition to on-site conservation measures identified above, the applicant will also protect an additional 24.3 ha (60 ac) of suitable CFPO habitat in the general vicinity of the proposed project site to reduce the total area of vegetation disturbance to 25 percent over the landscape. At least 8 ha (20 ac) will be acquired and conserved south of Tangerine Road and east of Interstate 10 within the SMA located in Recovery Area 3 (USFWS 1999c) and the remaining areas will be located within the SMA in Recovery Area 3. All off-site conservation lands will contain suitable habitat of similar vegetative structure and elements as that found on the proposed project site and will have prior approval of the Service as appropriate areas to off-set effects from this proposed action. Management of all on and off-site conservation lands will be provided by the applicant, homeowner association, or the lands may be conveyed with a management endowment to a governmental agency, or other conservation entity. These lands will be managed in a manner consistent with the conservation of the CFPO in perpetuity.

Currently, all known CFPOs within northwest Tucson are located in areas containing low-density housing developments that are adjacent to undeveloped tracts of land with varying amounts of noise disturbance. Individual CFPOs may react differently to noise disturbances, some individuals exhibiting less tolerance than others. It is unknown if noise habituation occurs in some CFPOs as it does with other bird species (Black et al. 1984). Robert and Ralph (1975), Schreiber (1979), Cooke (1980), Burger and Gochfeld (1983), Parsons and Burger (1982), Ainley et al. (1983), and McNicholl (1983) found that adults, and chicks to some extent, habituated to the presence of humans, and the responses of disturbed birds to people seemed to

be less than those of undisturbed birds. Burger and Gochfeld (1981) and Knight et al. (1987) found responses to noise disturbances and habituation in nesting birds become more tenacious and less responsive in the presence of human disturbance if they were not deliberately harassed.

Raptors in frequent contact with human activities tend to be less sensitive to additional disturbances than raptors nesting in remote areas. However, exposure to direct human harassment may make raptors more sensitive to disturbances (Newton 1979). Where prey is abundant, raptors may even occupy areas of high human activity, such as cities and airports (Newton 1979, Ratcliffe 1980, White et al. 1988). The timing, frequency, and predictability of the disturbance may also be factors. Raptors become less sensitive to human disturbance as their nesting cycle progresses (Newton 1979). Studies have suggested that human activities within breeding and nesting territories could affect raptors by changing home range movements (Anderson et al. 1990) and causing nest abandonment (Postovit and Postovit 1987, Porter et al. 1973).

With respect to CFPOs and noise disturbance at the project site, it is noted that human use in and around the site is on-going; however, activity levels will substantially increase with construction activities and the resulting 101 single-family residential development. It is expected that owls will avoid use of the 8.4 ha (20.8 ac) high density residential area and park, and it is expected that owl use will be restricted to the open space area located in the Canada Agua Wash. The applicant has agreed to construct walls and establish vegetative screening (i.e., plant native tree species) along the residential area bordering the open space area which will provide both visual and noise screening reducing potential noise impacts to owls. Activities will be restricted to passive recreation within the wash which will further reduce impacts from human activities.

Based on the best available scientific information, it appears this species may be tolerant, at least to some extent, of certain low level noise disturbances associated with human activity. These disturbances include daily activities in residential areas such as people walking, voices, children playing, horses and other livestock, dogs, low to moderate vehicle and large truck traffic, and some occasional construction equipment activity. However, the threshold between noise levels and types of activities that an owl can tolerate versus those that will cause an owl to leave an area are not clearly known at this time.

Interrelated and Interdependent Actions

Interrelated activities are part of the proposed action that depends on the action for its justification, and interdependent activities have no independent utility apart from the action. There are no interrelated and interdependent actions with this action since all effects to the CFPO and critical habitat will be on-site and are discussed in the Direct and Indirect Effects section above.

Critical Habitat

A total of 8.4 ha (20.8 ac) of critical habitat will be eliminated under this proposed action, which equals approximately 0.003 percent of the total area designated as critical habitat in Arizona and 0.03 percent of Critical Habitat Unit 4. However, the actual percentage of critical habitat removed is actually higher since not all areas within the boundaries of critical habitat contain primary constituent elements (see Status of the Species section above). Constituent elements containing components essential for nesting, rearing of young, roosting, sheltering, and dispersal will be removed in this area. These elements include Sonoran desertscrub and xeroriparian vegetation containing saguaro cactus, and large diameter trees, including ironwood, palo verde, mesquite, etc.

Primary constituent elements will be removed on a total of 25 percent of the expanded project site (the project site plus off-site conservation lands). This falls within the range where CFPOs are found in northwest Tucson (see Effects section). In addition, movement corridors will be maintained through the project site to allow for the movement of owls through the area. The conservation measures described above maintain the function and viability of designated critical habitat, particularly within Critical Habitat Unit 4.

Summary

Combining the project site with the off-site conservation lands, the net vegetation disturbance will be approximately 25 percent over the entire 33.7-ha (83.2-ac) expanded project site. Off-site conservation lands will be located in the same Recovery Area 3 as the proposed action, and within a SMA. These lands will be managed in perpetuity for the conservation of the CFPO in an area the Service and Recovery Team have identified as essential to the survival and recovery of the species. We believe this approach to be consistent with the best available science and the intent of recommendations made by the Recovery Team (USFWS 1999c) for conservation of the species.

Direct or indirect impacts resulting in mortality of a CFPO caused by increased human activity are not expected to occur due to the relatively small scale of this action and minimization measures (i.e., vegetation screening planted along the Canada Agua Wash, maintain open space in the wash corridor, and off-site conservation areas).

AGFD has documented CFPOs moving through existing wash corridors between high density developments in northwest Tucson that in some cases were narrower in width than what will exist in this action. In summary, because of the land use restrictions placed in the open space areas, it is expected that movement of owls through the project site will not be occluded or restricted as a result of this action.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area is subject to ongoing residential and commercial development pressures. State, local, and private actions include continued development immediately to the north, west, and southwest of the project site and elsewhere in the action area. Any activity clearing 2 ha (5 ac) or more requires a NPDES section 402 permit under the CWA from the EPA and activities occurring within jurisdictional waters of the U.S. require a section 404 permit under the CWA from the Corps. As a result, a substantial number of these actions will be subject to future section 7 consultations. However, many individual undeveloped parcels that will not require a Federal permit or have a federal nexus (e.g., zoned SR) will continue to be built out, and will not be subject to future consultations. This is particularly important in the action area due to the large number of undeveloped small parcels in Marana and Pima County that when developed, will further reduce the amount of suitable habitat, increase fragmentation, and degrade habitat conditions in this area in particular. Also, we are aware of at least two actions that have graded greater than 4 ha (10 ac) without filing for a section 402 or 404 permit and have thus not undergone section 7 consultation.

VI. CONCLUSION

After reviewing the current status of the CFPO, the environmental baseline for the action area, the effects of the proposed Countryside Vista Block 5 and 6 residential development, and the cumulative effects, it is the Service's biological opinion that this development is not likely to jeopardize the continued existence of the CFPO. Due to the location of the proposed action within critical habitat and its relative small size, and the conservation of off-site lands containing primary constituent elements, it is the Service's biological opinion that the proposed development is not likely to result in the destruction or adverse modification of critical habitat. We base these conclusions on the following:

1. The project site will be surveyed in the spring of 2000, using the current survey protocol (AGFD and USFWS 2000). These surveys will be completed prior to land clearing or salvaging activities. If grading activities have not commenced at the site prior to January 1st of any given year, CFPO surveys will be conducted according to the current protocol.

2. The site is not within a CFPO territory of a pair or resident owl. If a new owl is found within 600 m [0.4 mi]) of the project site in or adjacent to ongoing construction activities the following measures and those in the section 3.2.4 and Exhibit 1 of the Second Supplemental BA (WestLand Resources 2000) will apply:

If the Service, EPA, or applicant become aware of a new CFPO nest or activity center of a CFPO on or within 600 m (0.4 mi) of the subject property, they shall immediately notify each of the other agencies or parties. No additional clearing of vegetation will occur within this area until the Federal agency, applicant, and the Service conduct a site specific analysis regarding this new information, and the effects of ongoing and proposed activities to the CFPO. The Service has determined the following activities within the parameters outlined below **will not** affect the CFPO beyond that which we have analyzed in this biological opinion and construction activities may continue, provided each of these conditions are met.

a. Clearing of vegetation that is suitable CFPO habitat outside of the estimated home range (113 ha [280 ac]) or 600 m (0.4 mi) radius of a CFPO nest or activity center;

b. Construction noise disturbance outside of a 400 m (0.25 mi) radius of a CFPO nest or activity center;

c. New construction noise disturbance of any intensity between a 100 m (330 ft) and 400 m (0.25 mi) radius of a CFPO nest or activity center outside of the breeding season (March 1 through July 31); and

d. Ongoing construction noise disturbance of the same or less intensity of that occurring during the period of time that the territory was being established up to 400 m (0.25 mi) radius of a CFPO nest or activity center at any time during the year.

3. The loss of 8.4 ha (20.8 ac) will be offset with the protection of 1 ha (2.4 ac) on-site and 24.3 ha (60 ac) off-site suitable habitat for conservation purposes of the CFPO. Both on- and off-site conservation lands will be managed in a manner that will protect and suitable habitat for the CFPO and contribute to its conservation in perpetuity.

4. All off-site lands will have prior approval of the USFWS to ensure they adequately offset impacts of the action.

5. At least 8.1 ha (20 ac) of the off-site conservation lands will be located in the SMA south of Tangerine Road in Recovery Area 3, and the remaining 16.2 ha (40 ac) will be located within a SMA in Recovery Area 3 (as identified in the Draft Recovery Plan [USFWS 1999c]).

6. Clearing, and salvaging activities will not commence on the project site prior to the applicant obtaining and securing 24.3 ha(60 ac) of the off-site conservation lands. The lands must either be conveyed to a mutually acceptable agency or a conservation

easement will be recorded. The management endowment will be provided to the selected management entity or placed in a trust account prior to commencement of development.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount of Extent of Take Anticipated

We do not anticipate the proposed action will incidentally take any CFPO based on the lack of any documented use on or immediately adjacent (within 600 m [0.37 mi]) to the project site. In the event a new owl site is established on or immediately adjacent to the project site, we do not anticipate incidental take to occur for activity that falls within the parameters specified in the Conclusion section above. Activities outside these parameters will require additional analysis not covered in this opinion as specified on the Reinitiation Notice section below.

Disposition of Dead or Injured Listed Animals

Upon finding a dead or injured threatened or endangered animal, initial notification must be made to the Service's Division of Law Enforcement, Federal Building, Room 8, 26 North McDonald, Mesa, Arizona (602/261-6443) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph, and any other pertinent information. Care must be taken in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible condition. If feasible, the remains of intact specimens of listed animal species shall be submitted as soon as possible to the nearest Fish and Wildlife Service or AGFD office, educational, or research institutions (e.g., University of Arizona in Tucson) holding appropriate State and Federal permits.

Arrangements regarding proper disposition of potential museum specimens shall be made with the institution before implementation of the action. A qualified biologist should transport injured animals to a qualified veterinarian. Should any treated listed animal survive, the Service should be contacted regarding the final disposition of the animal.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information on listed species. The recommendations provided here do not necessarily represent complete fulfillment of the agency's section 2(c) or 7(a)(1) responsibilities for the CFPO. In furtherance of the purposes of the Act, we recommend implementing the following discretionary actions:

1. The EPA should conduct or fund studies using both monitoring and telemetry, to determine CFPO habitat use patterns and relationships between owls and the human interface in northwest Tucson. Surveys involving simulated or recorded calls of CFPOs require an appropriate permit from the Service. AGFD should also be contacted in regard to State permitting requirements.

2. Surveys and monitoring of the Canada Agua Wash should be continued through the construction phase and at periodic intervals after build-out, to provide information on usage of owls in the area.

3. The EPA should continue to actively participate in regional planning efforts, such as Pima County's SDCP, and other conservation efforts for the CFPO.

REINITIATION NOTICE

This concludes formal consultation on the Countryside Vista (Blocks 5 and 6) residential development in Marana, Arizona. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) any incidental take occurs, (2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a way that causes an effect to a listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by this action. In instances where any incidental take occurs, any operations causing such take must cease pending reinitiation.

Effects to the CFPO that are outside of the parameters specified in the Conclusion Section of this opinion will require a case-by-case analysis to determine if reinitiation of consultation is necessary. If reinitiation is necessary, the Service shall expeditiously consult with the EPA and applicant to resolve any concerns related to the CFPO and to determine what, if any, measures are needed to minimize potential adverse effects to the CFPO.

We have assigned log number 2-21-99-F-362 to this consultation. Please refer to that number in future correspondence on this consultation. Any questions or comments should be directed to Mike Wrigley or me at 602/640-2720 or Sherry Barrett at 520/670-4617.

Sincerely,

David L. Harlow
Field Supervisor

cc: Assistant Regional Director, Ecological Services, Albuquerque, NM
Scott Richardson and Sherry Ruther, AGFD, Region 5, Tucson, AZ
Robert Wilson, ADEQ, Phoenix, AZ
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LITERATURE CITED

Abbate, D., A. Ditty, S. Richardson, and Ron Olding. 1996. Cactus ferruginous pygmy-owl surveys and nest monitoring in the Tucson Basin area, Arizona. Final Report to the Arizona Game and Fish Dept. Internal Enhancement No. U95503, Phoenix. 25 pp.

Abbate, D., S. Richardson, R. Wilcox, M. Terrio, and S. Belhumeur. 1999. Cactus ferruginous pygmy-owl investigations in Pima and Pinal counties, Arizona 1997-1998. Arizona Game and Fish Department Region 5 Wildlife Program. Phoenix. 83 pp.

Abouhalder, F. 1992. Influence of livestock grazing on saguaro seedling establishment. Pp 57-61 *in* C.P. Stone and E.S. Bellantoni (eds.), Proceedings of the Symposium on Research in Saguaro National Monument, Tucson.

Ainley, D.G., R.E. LeResche, and W.J.L. Sladen. 1983. Breeding biology of the Adelie penguin. Univ. of Calif. Press. Berkeley.

American Birding Association. 1993. Good birds from the hotline. April 1993. Winging it 5(5):3.

Ames, C.R. 1977. Wildlife conflicts in riparian management: grazing. Pp. 49-51 *in* O.B. Cope (ed.), Forum -- grazing and riparian/stream ecosystems. Trout Unlimited, Denver, CO.

Anderson, D.W. 1988. In my experience. Dose-response relationship between human disturbance and brown pelican breeding success. Wildlife Society Bulletin. 16:339-345.

Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1990. Home range changes in post-breeding raptors exposed to increased human activity levels in southeastern Colorado. Wildlife Society Bulletin. 18:134-142.

Arizona Game and Fish Department (AGFD). 1994. Cactus ferruginous pygmy-owl surveys in Arizona: 1993-1994 season. Tech. Rept. No. 37. Nongame and Endangered species program. Arizona Game and Fish Department, Phoenix. 8 pp.

Arizona Game and Fish Department (AGFD). 1995. Cactus ferruginous pygmy-owl surveys in Arizona: 1993-1995. Tech. Rept. No. 76. Nongame and Endangered species program. Arizona Game and Fish Department, Phoenix. 15 pp.

Arizona Game and Fish Department (AGFD). 1999. Heritage management data system. Nongame Branch, Arizona Game and Fish Department, Phoenix.

Arizona Game and Fish Department (AGFD) and U.S. Fish and Wildlife Service (USFWS). 2000. Cactus ferruginous pygmy-owl survey protocol.

Bahre, C.J. 1991. A legacy of change. Historic human impact on vegetation in the Arizona borderlands. Univ. of Arizona Press, Tucson.

Banks, R.C. 1979. Human-related mortality of birds in the United States. USDI, Fish and Wildlife Service, Spec. Sci. Rep. Wildl. No. 215.

Behnke, R.J., and R.F. Raleigh. 1978. Grazing and the riparian zone: impact and management perspectives *in* R.R. Johnson and J.F. McCormick (tech. coords.), Strategies for protection and management of flood plain wetlands and other riparian ecosystems: a symposium. Gen. Tech. Rep. WO-12. USDA Forest Service, Washington, D.C.

Bendire, C.E. 1888. Notes on the habits, nests and eggs of the genus *Glaucidium boie*. Auk 5:366-372.

Benson, L. and R.A. Darrow. 1981. Trees and shrubs of the southwestern deserts. The University of Arizona Press. Tucson. 416 pp.

Bent, A.C. 1938. Life histories of North American birds of prey, part 2. U.S. Natl. Mus. Bull. 170. 482 pp.

Binford, L.C. 1989. A distributional survey of the birds of the Mexican state of Oaxaca. Ornithological Monographs No. 443. American Ornithologists' Union, Washington, D.C. 418 pp.

Black, B.B., M.W. Collopy, H.F. Percival, A.A. Tiller, and P.G. Bohall. 1984. Effects of low-level military training flights on wading bird colonies in Florida. Report by Florida Coop. Fisheries and Wildlife Resources Unit. Tech. Rpt. No. 7. Univ. of Florida, Gainesville. 190 pp.

Boal, C.W. and R.W. Mannan. 1996. Nest-site selection of Cooper's hawks in urban environments and the effects of trichomoniasis on reproductive success. Arizona Game and Fish Department Heritage Project No. U94010, Phoenix. 38 pp.

Bowels, A.E. 1995 Responses of wildlife to noise. 1995. Pp. 109-144 *in* R.L. Knight and K.J. Gutzwiller (eds.), Wildlife and recreationists coexistence through management and research. Island Press, Washington D.C.

Breninger, G.F. 1898. The ferruginous pygmy-owl. Osprey 2(10):128 (*in* Bent 1938).

Brode, J.M. and R.B. Bury. 1984. The importance of riparian systems to amphibians and reptiles. Pp. 30-36 *in* R.E., Warner and H. Hendrix (eds.), California riparian systems. Univ. of California Press, Berkeley.

Brown, D.E, C.H. Lowe, and J.F. Hausler. 1977. Southwestern riparian communities: their biotic importance and management in Arizona *in* R.R. Johnson and D.A. Jones (eds.), Importance, preservation, and management of riparian habitats: a symposium. Gen. Tech. Rep. Rm-43. USDA Forest Service, Denver, CO.

Brown, D.E. 1994. (ed) Biotic communities: Southern United States and Northwestern Mexico. Univ. of Utah Press, Salt Lake City.

Burger, J. 1984. Colony stability in least terns. Condor 86: 61-67.

Burger, J. and M. Gochfeld. 1981. Discrimination of the threat of direct versus tangential approach to the nest by incubating herring an great black-backed gulls. Journal of comparative and physiological psychology (Series A). 95: 676-684.

Carlson, P.C., W.S. Lahaye, and A.B. Franklin. 1998. Incestuous behavior in spotted owls. Wilson Bull., 110 (4): 562-564.

Carothers, S.W. 1977. Importance, preservation, and management of riparian habitats: an overview *in* R.R. Johnson and D.A. Jones (eds.), Importance, preservation, and management of riparian habitats: a symposium. Gen. Tech. Rep. RM-43. USDA Forest Service, Denver, CO.

Cartron, J.E., W.S. Richardson, and G.A. Proudfoot. 2000a. The cactus ferruginous pygmy-owl taxonomy, distribution, and Natural History. Pp. 5-15 *in* J.E. Cartron and D.M. Finch (eds.), Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. Gen. Tech. Rpt. RMRS-GTR-43. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

Cartron, J.E., S.H. Soleson, S. Russell, G.A. Proudfoot, and W.S. Richardson. 2000b. The ferruginous pygmy-owl in the tropics and at the northern end of its range: habitat relationships and requirements. Pp. 47-53 *in* J.E. Cartron and D.M. Finch (eds.), Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. Gen. Tech. Rpt. RMRS-GTR-43. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

Caughley, G. and A. Gunn. 1996. Conservation biology in theory and practice. Blackwell Science Inc. United States. 459 pp.

Churcher, P.B. and J.H. Lawton. 1987. Predation by domestic cats in an English village. Journal of Zoology, London 212: 439-455.

Cline, K.W. 1988. Raptor nest and roost management in the southeast. Pp. 175-188 *in* Proc. of the southeast raptor management symposium and workshop, Virginia Polytechnic Inst. and State Univ., Blacksburg, 14-16 September, 1988.

Cockrum, E.L. and Y. Petryszyn. 1991. The lesser long-nosed bat. *Leptonycteris*: An endangered species in the Southwest? Texas Tech Univ., Occas. Pap. Mus., No. 142.

Collins, M.D. and T.E. Corman. 1995. Cactus ferruginous pygmy-owl Surveys in Arizona: 1993-1994 season. Nongame and Endangered Wildlife Program Technical Report No. 37. Arizona Game and Fish Department, Phoenix.

Cooke, A.S. 1980. Observations on how close certain passerine species will tolerate an approaching human in rural and suburban areas. Biological Conservation 18:85-88.

Dahl, T.E. 1990. Wetland losses in the United States, 1780s to 1980s. USDI, Fish and Wildlife Service, Washington, D.C. 13 pp.

Dalton, V.M., D.C. Dalton, and S.L. Schmidt. 1994. Roosting and foraging use of a proposed military training site by the long-nosed bat, *Leptonycteris curasoae*. Report to the Luke Air Force Natural Resources Program, Contract Nos. DACA65-94-M-0831 and DACA65-94-M-0753. 34 pp.

Davis, W.A. and S.M. Russell. 1984. Birds in southeastern Arizona. Tucson Audubon Society, Tucson, AZ. 169 pp.

Davis, W.A. and S.M. Russell. 1990. Birds in southeastern Arizona. Tucson Audubon Society, Tucson, AZ. 154 pp.

DeWeese, L.R., L.C. McEwen, G.H. Hensler, and B.E. Peterson. 1986. Organochlorine contaminants in passeriformes and other avian prey of the peregrine falcon in the western United States. Environ. Toxicol. and Chem. 5:675-693.

Earhart, C.M. and N.K. Johnson. 1970. Size dimorphism and food habits of North American owls. Condor 72(3):251-264.

Enriquez-Rocha, P., J.L. Rangel-Salazar, and D.W. Holt. 1993. Presence and distribution of Mexican owls: a review. J. Raptor Res. 27:154-160.

Felley, D.L. and T.E. Corman. 1993. Spring 1993 cactus ferruginous pygmy-owl surveys in Arizona. Nongame and Endangered Wildlife Program Technical Report. Arizona Game and Fish Department, Phoenix. 16 pp.

Fisher, A.K. 1893. The hawks and owls of the United States in their relation to agriculture. U.S. Dept. Agr. Div. Ornithol. and Mammal. Bull. 3:1-210.

Fleming, T.H., R.A. Nunez, and L.S.L. Sternberg. 1993. Seasonal changes in the diets of migrant and non-migrant nectarivorous bats as revealed by carbon stable isotope analysis. Oecologia 94:72-74.

Flesch, A.D. 1999. Cactus ferruginous pygmy-owl surveys and nest monitoring on and around the Buenos Aires National Wildlife Refuge, Altar Valley, Arizona. A report to the USDI Fish and Wildlife Service, FWS Coop. Agreement No. 1448-00002-99-G943. 21 pp.

Frey, J.K. and T.L. Yates. 1996. Mammalian diversity in New Mexico. New Mexico Journal of Science 36:4-37.

Gentry, H.S. 1982. Agaves of Continental North America. Univ. of Arizona Press, Tucson.

Gilman, M.F. 1909. Some owls along the Gila River in Arizona. Condor 11:145-150.

Gotmark, F. 1992. The effects of investigator disturbance on nesting birds. Pp. 63-94 *in* D.M. Power (ed.). Current Ornithology, Vol. 9. Plenum Press, New York.

Griscom, L., and M.S. Crosby. 1926. Birds of the Brownsville region, southern Texas. Auk 43:18-36.

Harris, M.P. 1984. The puffin. T & A D Poyser, Calton, Staffordshire, England. (81).

Haug, E.A. 1985. Observations on breeding ecology of burrowing owls in Saskatchewan. M.S. thesis. Univ. of Saskatchewan.

Henry, A.L. 1992. Organochlorine levels in aplomado falcon habitat as indicated by residues in great-tailed grackles: A final report. Dept. of Fisheries and Wildl. Science. New Mexico State Univ. Las Cruces. 27 pp.

Hickey, J.J. and D.W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. Science 162:271-273.

Hoffmeister, D.F. 1957. Review of the long-nosed bats of the genus *Leptonycteris.* J. Mammal. 38:454-461.

Horner, M.A., T.H. Fleming, and M.D. Tuttle. 1990. Foraging and movement patterns of a nectar feeding bat: *Leptonycteris curasoae*. Bat Research News 31:81.

Hoyt, R.A., J.S. Altenbach, and D.J. Hafner. 1994. Observations on long-nosed bats (*Leptonycteris*) in New Mexico. Southwestern Naturalist 39:175-179.

Howell, A.B. 1916. Some results of a winter's observations in Arizona. Condor 18:209-214.

Hubbard, J.P. 1977. Importance of riparian ecosystems: biotic considerations. Pp. 14-18 *in* R.R. Johnson and D.A. Jones (tech. coords.), Importance, preservation, and management of riparian habitat: a symposium. Gen. Tech. Rep. RM-43. USDA Forest Service, Rocky Mountain Forest and Range Experimental Station, Fort Collins, CO.

Hunter, M.L., Jr. 1996. Fundamentals of conservation biology. Rand McNally, Taunton, MA. 482 pp.

Hunter, W.C. 1988. Status of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) in the United States and Northern Mexico. USDI, Fish and Wildlife Service, Phoenix, AZ. 13 pp.

Jahrsdoerfer, S.E. and D.M. Leslie, Jr. 1988. Tamaulipan brushland of the Lower Rio Grande Valley of South Texas: description, human impacts, and management options. USDI, Fish and Wildlife Service, Biol. Rep. 88(36). 63 pp.

Johnsgard, P.A. 1988. North American owls. Smithsonian Institution Press, Washington, D.C. 295 pp.

Johnson, R.R., L.T. Haight, and J.M. Simpson. 1979. Owl populations and species status in the southwestern United States. Pp. 40-59 *in* P. Schaffer and S.M. Ehler (eds.), Owls of the west: their ecology and conservation. Proc. Natl. Audubon Soc., George Whittel Education Center, Tiburon, CA.

Johnson, R.R. and L.T. Haight. 1985a. Status of the ferruginous pygmy-owl in the southwestern United States. Abstracts, 103rd Stated Meeting of the American Ornithologists' Union, Arizona State Univ., Tempe.

Johnson, R.R. and L.T. Haight. 1985b. Avian use of xeroriparian ecosystems in the North American warm deserts. Pp. 156-160 *in* R.R. Johnson et al. (tech. coords.), Riparian ecosystems and their management: reconciling conflicting uses.

Johnson-Duncan, E.E., D.K. Duncan, and R.R. Johnson. 1988. Small nesting raptors as indicators of change in the southwest desert. Pp. 232-236 *in* R.L. Glinski et al. (eds.), Proceedings of the Southwest Raptor Management Symposium and Workshop. Nat'l. Wildl. Fed., Washington, D.C. 395 pp.

Jones, K.B. 1988. Distribution and habitat associations of herpetofauna in Arizona: comparisons by habitat type. Pp. 109-128 *in* R.C., Szaro, K.E. Stevenson, and D.R. Patton (tech. coords.), Management of amphibians, reptiles, and small mammals in North America. Gen. Tech Rep. RM-166. USDA, Forest Serv., Rocky Mountain Range and Experimental Station, Fort Collins, CO.

Kimball, H.H. 1921. Notes from Southern Arizona. Condor 23:57-58.

King, K.A., D.L. Baker, W.G. Kepner, and J.D. Krausmann. 1991. Contaminants in prey of bald eagles nesting in Arizona. Arizona Ecological Services Field Office report. 16 pp.

King, K.A., D.L. Baker, C.T. Martinez, and B.J. Andrews. 1995. Contaminants in potential aplomado falcon prey from proposed reintroduction sites in Arizona. Arizona Ecological Services Field Office report. 22 pp.

Klem, D.A. 1979. Biology of collisions between birds and windows. Ph.D. thesis. Southern Illinois Univ.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pp. 51-62 *in* R.L. Knight and K.J. Gutzwiller (eds.), Wildlife and recreationists coexistence through management and research. Island Press, Washington D.C.

Knight, R.L., D.L. Grout, and S.A. Temple. 1987. Nest behavior of the American crow in urban and rural areas. Condor 89:175-177.

Kusler, J.A. 1985. A call for action: protection of riparian habitat in the arid and semi-arid West *in* R.R. Johnson et al. (eds.), Riparian ecosystems and their management: reconciling conflicting uses: First North American Riparian Conference. Gen. Tech. Rep. RM-120. USDA Forest Service, Fort Collins, CO.

LeFranc, M.M. Jr. and B.A. Millsap. 1984. A summary of state and federal agency raptor management programs. Wildl. Soc. Bull. 12:274-282.

Lincer, J. 1975. DDE-induced eggshell thinning in the American kestrel. A comparison of the field situation with laboratory results. J. Appl. Ecol. 12:781-793.

McLane, M.A.R. and L.C. Hall. 1972. DDE thins screech owl eggshells. Bull. Environ. Contam. Toxicol. 8:65-68.

McLaughlin, S.P. and J.E. Bowers. 1982. Effects of wildlife on the Sonoran desert plant community. Ecology 61:246-248.

McNicholl, M.K. 1983. Reactions of male blue grouse to intrusions by an observer. J. Field Ornithology. 54:77-83.

Mendenhall, V.M., E.E. Klass, and M.A.R. McLane. 1986. Breeding success of barn owls (*Tyto alba*) fed low levels of DDE and dieldrin. Arch. Environ. Contam. Toxicol. 12:235-240.

Millsap, B.A. and R.R. Johnson. 1988. Ferruginous pygmy-owl. Pp. 137-139 *in* R.L. Glinski et al. (eds.), Proceedings of the Southwest Raptor Management Symposium and Workshop. Nat'l. Wildl. Fed., Washington, D.C. 395 pp.

Monson, G. and A.R. Phillips. 1981. Annotated checklist of the birds of Arizona. The Univ. of Arizona Press, Tucson. 240 pp.

Monson, G. 1998. Ferruginous pygmy-owl. Pp. 159 - 161 *in* R.L. Glinski (ed.), The raptors of Arizona. Univ. of Arizona Press, Tucson.

Newton, I. 1979. Population ecology of raptors. Poyser Ltd., Hertfordshire, England. 399 pp.

Noss, R.F. and B. Csuti. 1994. Habitat fragmentation. Pp. 237-264 *in* G.K. Meffe and C.R. Caroll (eds.), Principles of conservation biology. Sinauer Assoc., Sunderland, MA.

Oberholser, H.C. 1974. The bird life of Texas. Univ. of Texas Press, Austin. 1,069 pp.

Olin, G. 1994. House in the sun. A natural history of the Sonoran Desert. Southwest Parks and Monuments Assoc. Tucson, AZ. 210 pp.

O'Neil, A.W. 1990. Letter, Appendix B *in* Tewes, M.E. 1993. Status of the ferruginous pygmy-owl in south Texas and northeast Mexico. Draft Project Report No. 2, Job 25, Texas Parks and Wildlife Department. Texas A & I Univ., Kingsville. 42 pp.

Parsons, K.C. and J. Burger. 1982. Human disturbance and nestling behavior in black-crowned night herons. Condor 84:184-187.

Pase, C.P. and E.F. Layser. 1977. Classification of riparian habitat in the southwest *in* R.R. Johnson and D.A. Jones (tech. coords.), Importance, preservation, and management of riparian habitat: a symposium. Gen. Tech. Rep. RM-43. USDA, Forest Serv. Rocky Mountain Forest and Range Experimental Station, Fort Collins, CO.

Phillips, A.R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. of Arizona Press, Tucson. 212 pp.

Porter, R.D., C.M. White, and R.J. Erwin. 1973. The peregrine falcon in Utah, emphasizing ecology and competition with the prairie falcon. Brigham Young Univ., Bulletin of Biological Science. 18:1-74.

Postovit, H.R. and B.C. Postovit. 1987. Impacts and mitigation techniques. Pp. 183-213 *in* G.B. Pendleton, B.A. Mildsap, K.W. Cline, and D.M. Bird (eds.), Raptor management techniques manual. National Wildlife Federation, Washington, D.C. Scientific Technical Series 10.

Proudfoot, G., S.L. Beasom, and M. Hernandez. 1994a. Use of nest boxes by pygmy owls in south Texas. Pp. 20 *in* the Annual Report to the Caesar Kleberg Foundation for Wildlife Conservation from the Caesar Kleberg Wildlife Research Institute, College of Agriculture and Human Sciences.

Proudfoot, G., S.L. Beasom, D. Graul, and T. Urban. 1994b. Food habits of the cactus ferruginous pygmy owl. Pp. 19 *in* the Annual Report to the Caesar Kleberg Foundation for Wildlife Conservation from the Caesar Kleberg Wildlife Research Institute, College of Agriculture and Human Sciences.

Proudfoot, G. 1996. Natural history of the cactus ferruginous pygmy-owl. Master's Thesis, Texas A & M Univ., Kingsville.

Ratcliff, D.A. 1967. Decrease in eggshell weight in certain birds of prey. Nature 215:208-210. Wiemeyer, S.N. and R.D. Porter. 1970. DDE thins eggshells of captive American kestrels. Nature 227:737-738.

Ratcliffe, D.A. 1980. The peregrine falcon. Poyser Ltd., Hertfordshire, England. 416 pp.

Rea, A.M. 1983. Once a river: bird life and habitat changes on the middle Gila. Univ. of Press, Tucson, AZ. 285 pp.

Robbins, C.S., D. Bystrak, and P.H. Geissler. 1986. The breeding bird survey: its first fifteen years, 1965-1979. USDI, Fish and Wildlife Service. Resource Publication 157, Washington, D.C. 196 pp.

Robert, H.C. and C.J. Ralph. 1975. Effects of human disturbance on the breeding success of gulls. Condor. 77:495-499.

Russell, S.M. and G. Monson. 1988. The birds of Sonora. The Univ. of Arizona Press. 360 pp.

Sahley, C.T., M.A. Horner, and T.H. Fleming. 1993. Flight speeds and mechanical power outputs in the nectar feeding bat, *Leptonycteris curasoae* (Phyllostomidae: Glossophaginae). J. Mammal. 74:594-600.

Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology. 5: 18-32.

Schreiber, E.A, R.W. Schreiber, and J.J. Dinsmore. 1979. Breeding biology of laughing gulls in Florida. Part 1: Nesting, egg, and incubation parameters. Bird Banding. 50:304-321.

Sick, H. 1993. Birds in Brazil: a natural history. Princeton, N.J.:Princeton Univ. Press.

Sidner, R. 1997. Eighth annual monitoring of the lesser long-nosed bat (*Leptonycteris curasoae*) and other species of bats with emphasis on roost sites on the Fort Huachuca Military Reservation, Cochise County, Arizona, May-October, 1997 (draft). Report to Fort Huachuca, Contract #DABT63-97-P-0623.

Tropical Birds of the Border. 1999. Sixth Annual Rio Grande Valley Birding Festival. Harlingen, TX.

Skagen, S.K., R.L. Knight, and G.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1(2):215-225.

Slauson, L. 1996. Pollination ecology of *Agave chrysantha* and *Agave palmeri.* Pp. 154-203 *in* Amorphametric and Pollination Ecology Study of *Agave chrysantha* Peebles and *Agave palmeri* Englem. (Agavaceae). Ph.D. Diss., Arizona State Univ., Tempe.

Slauson, L. 1999. Pollination biology of two chiropterophilous agaves in Arizona, Draft. Desert Botanical Garden, Phoenix.

Slauson, L., G. Dalton, and D. Dalton. 1998. Effects of prescribed burning on the Palmer agave and lesser long-nosed bat. Research Joint Venture Agreement No. 28-JV7-943.

Smith, H. 1996. Comments on the proposal to list the cactus ferruginous pygmy-owl as an endangered species and to designate critical habitat. Letter to the USDI Fish and Wildlife Service from USDI Park Service, Organ Pipe Cactus National Monument.

Synder, N.F. and H.A. Snyder. 1975. Raptors in range habitat. Pp. 190-209 *in* D.R. Smith. ed. Proc. symposium on management of food and range habitat for nongame birds. USDA Forest Service Gen. Tech. ref. W0-1.

Soule, M.E. 1986. Conservation biology. The science of scarcity and diversity. Sinauer Assoc., Inc. Sunderland, MA. 548 pp.

Sprunt, A. 1955. North American birds of prey. National Audubon Society. Harper and Brothers, New York, NY. 227 pp.

Stamp, N.E. and R.D. Ohmart. 1979. Rodents of desert shrub and riparian woodland habitats in the Sonoran desert. Southwestern Naturalist 24:279-289.

State of Arizona. 1990. Final report and recommendations of the Governor's riparian habitat task force. Executive Order 89-16. Streams and riparian resources. October 1990. Phoenix, AZ. 28 pp.

Steenberg, W.F. and C.H. Lowe. 1977. Ecology of the saguaro: II, reproduction, germination, establishment, growth, and survival of the young plant. National Park Service Scientific Monograph Series No. 8. U.S. Government Printing Office, Washington D.C.

Steenberg, W.F. and C.H. Lowe. 1983. Ecology of the saguaro: III, growth and demography. National Park Service Scientific Monograph Series No. 17. U.S. Government Printing Office, Washington D.C.

Stevens, L.B., B.T. Brown, J.M. Simpson, and R.R. Johnson. 1977. The importance of riparian habitat to migrating birds. Pp. 156-164 *in* R.R. Johnson and D.A. Jones (tech. coords.), Importance, preservation, and management of riparian habitat: a symposium. Gen. Tech. Rep. RM-43. USDA, Forest Serv. Rocky Mountain Forest and Range Experimental Station, Fort Collins, CO.

Stromberg, J.C., J.A. Tress, J.D. Wilkins, and S.D. Clark. 1992. Response of velvet mesquite to groundwater decline. J. Arid Environments 23:45-58.

Stromberg, J.C. 1993a. Fremont cottonwood-Goodding willow riparian forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 26(3):97-110.

Stromberg, J.C. 1993b. Riparian mesquite forests: A review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 27(1):111-124.

Sutton, G.M. 1951. Mexican birds: first impressions based upon an ornithological expedition to Tamaulipas, Nuevo Leon and Coahuila. Univ. of Oklahoma Press, Norman. 282 pp.

Swarth, H.S. 1905. Summer birds of the Papago Indian Reservation and of the Santa Rita Mountains, AZ. Condor 7:22-28.

Swarth, H.S. 1914. A distributional list of the birds of Arizona. Cooper Ornithological Club, Hollywood, CA.

Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants 9:70-138.

Taylor, R.C. 1986. Checklist to the birds of Sonora and the Sea of Cortez, including Barranca del Cobre. Borderland Productions, Portal, AZ. 23 pp.

Temple, S.A. 1986. Predicting impacts of habitat fragmentation on forest birds: a comparison of two models. Pp. 301-304 *in* J. Verner, M.L. Morrison, and C.J. Ralph (eds.), Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press, Madison. 470 pp.

Tewes, M.E. 1993. Status of the ferruginous pygmy-owl in south Texas and northeast Mexico. Draft Project Report #2, Job 25, Texas Parks and Wildlife Department. Texas A & I Univ. Kingsville. 42 pp.

The Arizona Star. 1999. Homes are hot. Newspaper article. June 23, 1999.

The Arizona Star. 2000. Area home permits passed 7,000 in '99. Newspaper article. January 7, 2000.

U.S. Fish and Wildlife Service (USFWS). 1988a. Endangered and threatened wildlife and plants; determination of endangered status for two long-nosed bats. Federal Register 53(190):38456-3860.

U.S. Fish and Wildlife Service (USFWS). 1988b. Riparian Habitat: An Unrecognized Resource. Pamphlet.

U.S. Fish and Wildlife Service (USFWS). 1997. Endangered and threatened wildlife and plants; determination of endangered status for the cactus ferruginous pygmy-owl in Arizona. Fed. Reg. 62:10730-10747.

U.S. Fish and Wildlife Service (USFWS). 1997b. Lesser long-nosed bat recovery plan. Albuquerque, New Mexico. 49pp.

U.S. Fish and Wildlife Service (USFWS). 1998. Endangered and threatened wildlife and plants; proposed determination of critical habitat for the cactus ferruginous pygmy-owl. Fed. Reg. 63:71820-71838.

U.S. Fish and Wildlife Service (USFWS). 1999a. Endangered and threatened wildlife and plants; designation of critical habitat for the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum)*. Fed. Reg. 64:37419-37440.

U.S. Fish and Wildlife Service (USFWS). 1999b. Endangered and threatened wildlife and plants; final rule to remove the American peregrine falcon from the Federal list of endangered and threatened wildlife, and to remove the similarity of appearance provision for free-flying peregrines in the conterminous United States. Fed. Reg. 64:46542-46558.

U.S. Fish and Wildlife Service (USFWS). 1999c. Cactus ferruginous pygmy-owl draft recovery plan. Arizona Ecological Services Office, Phoenix Field Office. 100 pp.

U.S. Forest Service (Forest Service). 1979. Action program for resolution of livestock-riparian conflicts on the Salt River and Verde River: Tonto, Prescott, and Coconino National Forests, Region 3. 129 pp.

U.S. General Accounting Office (USGAO). 1988. Public rangelands: Some riparian areas restored but widespread improvement will be slow. Report to Congressional Requesters, U.S. General Accounting Office, Washington D.C.

U.S. National Museum, Smithsonian Institution (USNM). 1996. Records from the United States National Museum of Natural History. Provided through Russell B. Duncan from Craig Ludwig, Scientific Data Manager.

University of Arizona. 1985. Records from the University of Arizona Bird Collection. Provided by T. Huels.

van Rossem, A.J. 1945. A distributional survey of the birds of Sonora, Mexico. Occasional Papers Mus. Zool., Louisiana State Univ., Baton Rouge. 379 pp.

Warnock, R.G. and P.C. James. 1997. Habitat fragmentation and burrowing owls (*Speotyto cunicularia*) in Saskatchewan. Pp.477-484 *in* J.R. Duncan, D.H. Johnson, and T.H. Nicholls (eds.), Biology and conservation of owls of the northern hemisphere. USDA Forest Service, North Central Forest Experimental Station, Gen. Tech. Rpt. NC-190. Winnipeg, Manitoba. February 5-9, 1997.

Watson J. and D.R. Landslow. 1989. Can food supply explain variation in nesting density and among breeding success amongst golden eagles (*Aquila chrysaetos*)? Pp. 181-186 *in* B.U. Meyburg and R.D. Chancellor (eds.), Raptors in the modern world. Proc. of the third world conference on the birds of prey and owls. 22-27 March 1987.

Wauer, R.H., P.C. Palmer, and A. Windham. 1993. The ferruginous pygmy-owl in south Texas. American Birds 47:1071-1076.

Wesemann T. and M. Rowe. 1987. Factors influencing the distribution and abundance of burrowing owls in Cape Coral, Florida. Pp. 129-137 *in* L.W. Adams and D.L. Leedy eds. Integrating man and nature in the metropolitan environment. Proceedings of a National Symposium on Urban Wildlife. November 4-7, 1986. Chevy Chase MD.

WestLand Resources. 1999a. Biological assessment for the Countryside Vista, Blocks 5 and 6. August 1999. 34 pp.

WestLand Resources. 1999b. Supplemental report to the biological assessment of Countryside Vista, Blocks 5 and 6. 5 pp.

WestLand Resources. 2000. Second supplemental report to the biological assessment of Countryside Vista, Blocks 5 and 6. 7 pp.

Whitcomb, R.F., C.S. Robbins, J.F. Lynch, B.L. Whitcomb, M.K. Kimkiewkz, and D. Bystrak. 1981. Effects of forest fragmentation in avifauna of eastern deciduous forest. Pp. 125-205 *in* R.L. Burgess and D.M. Sharpe (eds.), Forest island dynamics in man-dominated landscapes. Springer Verlag, NY. 310 pp.

White, C.M., W.B. Emison, and W.M. Bren. 1988. Atypical nesting habitat of the peregrine falcon (*Falco peregrinus*) in Victoria, Australia. J. Raptor Res. 22:37-43.

Wiemeyer, S.N. and R.D. Porter. 1970. DDE thins eggshells of captive American kestrels. Nature 227: 737-738.

Wiens, J.A. 1985 Vertebrate responses to environmental patchiness in arid and semiarid ecosystems. Pp 169-193 *in* S.T.A. Pickett, and P.A. White (eds.), The ecology of natural disturbance and patch dynamics. New York: Academic Press.

Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. 237-256 *in* M.E. Soule (ed.), Conservation biology: the science of scarcity and diversity. Sinauer Assoc., Sutherland, MA.

Wilcox, R.L., S. Richardson, and D. Abbate. 1999. Habitat characteristics of occupied cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) sites at the suburban/rural interface of north Tucson, Arizona. Report to Arizona Game and Fish Dept., Phoenix, AZ.

Willard, F.C. 1912. A week afield in southern Arizona. The Condor 14:53-63.

Wilson, D.E. 1985. Status report: *Leptonycteris sanborni* Hoffmeister, Sanborn's long-nosed bat. US Fish and Wildlife Serv., Denver Wildlife Res. Center, Nat'l. Mus. Nat. Hist., Washington D.C. 35pp.

Wilson, E.O. 1989. Threats to biodiversity. Scientific American. 261(3): 108-116.

Figure 1

Figure 2

APPENDIX - CONCURRENCE

We concur with the applicant's determination that the proposed action may affect, but is not likely to adversely affect the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*). The rationale for this concurrence is detailed in the following discussion.

STATUS OF THE SPECIES

The lesser long-nosed bat is one of four members of the tropical bat family *Phyllostomidae* which are found in the United States. It was formally separated from the Mexican long-nosed bat (*L. nivalis*) as a distinct species (*L. sanborni*) by Hoffmeister (1957). The lesser long-nosed bat is a medium size, leaf-nosed bat. It has a long muzzle, a long tongue, and is capable of hover flight. These features are adaptations that allow the bat to feed on nectar from the flowers of columnar cacti such as the saguaro and organ pipe cactus, and from paniculate agaves such as Palmer's agave (*Agave palmeri*) and Parry's agave (*A. parryi*).

The lesser long-nosed bat is a medium-sized bat with a forearm measuring 51 to 56 mm (2.0-2.2 in) and weighing 20 to 25 grams (0.7-0.9 oz) as an adult. Adult fur is grayish to reddish-brown; juveniles have gray fur. Its elongated rostrum bears a small, triangular noseleaf, its ears are relatively small and simple in structure, and it has a minute tail. It is generally smaller in external and cranial measurements than *L. nivalis*. *L. curasoae* can be distinguished from the Mexican long-tongued bat (*Choeronycteris mexicana*), with which it co-occurs in Arizona, by the larger size, less elongated snout, and tiny tail.

The lesser long-nosed bat is migratory and found throughout its historic range, from southern Arizona and extreme southwestern New Mexico, through western Mexico, and south to El Salvador. In southern Arizona lesser long-nosed bat roosts have been found from the Picacho Mountains (Pinal County) southwest to the Agua Dulce Mountains (Pima County), southeast to the Chiricahua Mountains (Cochise County) and south to the international boundary. Individuals have also been observed from the vicinity of the Pinaleno Mountains (Graham County) and as far north as the McDowell Mountains (Maricopa County) (AGFD 1999). This bat is also known from far southwestern New Mexico in the Animas and Peloncillo Mountains (Hidalgo County). It is a seasonal resident in Arizona, usually arriving in early April and leaving in mid-September to early October. It resides in New Mexico only from mid-July to early September (Hoyt et al. 1994).

Roosts in Arizona are occupied from late April to October (Cockrum and Petryszyn 1991, Sidner 1997). In spring, adult females, most of which are pregnant, arrive in Arizona and gather into maternity colonies in southwestern Arizona. These roosts are typically at low elevations near concentrations of flowering columnar cacti. Litter size is one. After the young are weaned these colonies disband in July and August; some females and young move to higher elevations, ranging up to more than 1,818 m (6,000 ft), primarily in the southeastern parts of Arizona near concentrations of blooming paniculate agaves. Actual dates of these seasonal movements by

lesser long-nosed bats are rather variable from one year to the next (Cockrum and Petryszyn 1991, Fleming et al. 1993). Adult males typically occupy separate roosts forming bachelor colonies. Males are known mostly from the Chiricahua Mountains but also occur with adult females and young of the year at maternity sites (USFWS 1997b). Throughout the night between foraging bouts both sexes will rest in temporary night roosts.

The lesser long-nosed bat consumes nectar and pollen of paniculate agave flowers and the nectar, pollen, and fruit produced by a variety of columnar cacti. In Arizona, four species of agave and two cacti are the main food plants (Wilson 1985). The agaves include Palmer's agave, Parry's agave, desert agave (*A. deserti*), and amole (*A. schotti*). Amole is considered to be an incidental food source. The cacti include saguaro and organ pipe cactus. Nectar of these cacti and agaves are high energy foods. Concentrations of food resources appear to be patchily distributed on the landscape and the nectar of each plant species utilized is only seasonally available. Cacti flowers and fruit are available during the spring and early summer; blooming agaves are available through the summer, primarily from July through early October, though Parry's agave blooms earlier. Columnar cacti occur in lower elevation areas of the Sonoran Desert region, and paniculate agaves are found primarily in higher elevation desertscrub areas, desert grasslands and shrublands, and into the mountains. Parry's agave is usually found at higher elevations than Palmer's agave (Gentry 1982). The bats are generally considered to time their movement and feeding to the progression of flowering associated with these cacti and agaves. Many species of columnar cacti and agaves appear to provide a "nectar corridor" for lesser long-nosed bats as they migrate in spring from Central America and Mexico to as far north as southern Arizona, through fall when they return south (Gentry 1982, Flemming et al. 1993, Slauson et al. 1998).

Lesser long-nosed bats appear to be opportunistic foragers and efficient fliers, capable of flight speeds up to 23 km per hour (14 mph) (Sahley et al. 1993), and often foraging in flocks. Seasonally available food resources may account for the seasonal movement patterns of the bat. The lesser long-nosed bat is known to fly long distances from roost sites to foraging sites. Night flights from maternity colonies to flowering columnar cacti have been documented in Arizona at 24 km (15 mi), and in Mexico at 40 km (25 mi) and 61 km (38 mi) (one way) (Dalton et al. 1994, V. Dalton, pers. comm., Y. Petryszyn, University of Arizona, pers. comm.). A substantial portion of the lesser long-nosed bats at the Pinacate Cave in Sonora (a maternity colony) fly 40 to 50 km (25-31 mi) each night to foraging areas in OPCNM (USFWS 1997b). Horner et al. (1990) found that lesser long-nosed bats commuted 48 to 58 km (30-36 mi) round trip between an island maternity roost and the mainland in Sonora; the authors suggested these bats regularly flew at least 80 to 100 km (50-62.5 mi) each night. Lesser long-nosed bats have been observed feeding at hummingbird feeders many miles from the closest potential roost site (Petryszyn, pers. comm.).

Suitable day roosts and suitable concentrations of food plants are the two resources that are crucial for the lesser long-nosed bat (USFWS 1997b). Caves and mines are used as day roosts. The factors that make roost sites useable have not yet been identified. Whatever the factors are that determine selection of roost locations, the species seems sensitive to human disturbance.

Instances are known where a single brief visit to an occupied roost is sufficient to cause a high proportion of lesser long-nosed bats to temporarily abandon their day roost and move to another. Perhaps most disturbed bats return to their preferred roost in a few days. However, this sensitivity suggests that the presence of alternate roost sites may be critical when disturbance occurs. Interspecific interactions with other bat species may also influence lesser long-nosed bat roost requirements.

Food requirements of the lesser long-nosed bat are very specific. Adequate numbers of flowers or fruits are required within foraging range of day roosts and along migration routes to support large numbers of this bat. Locations of good feeding sites play an important role in determining availability of potential roosting sites, and roost/food requirements must be considered jointly when discussing the habitat requirements of this bat. A suitable day roost is probably the most important habitat requirement, but potentially suitable roosts must be within reasonable foraging distances of sufficient amounts of required foods before this bat will use them. It seems evident that the lesser long-nosed bat forages over wide areas and that large roosts require extensive stands of cacti or agaves for food. Therefore, destruction of food plants many kilometers from a roost could have a negative impact on this bat (USFWS 1997b).

The lesser long-nosed bat recovery plan (USFWS 1997b) identifies the need to protect foraging areas and food plants. Columnar cacti and agaves provide critical food resources for this bat. Populations of these plants need continued protection to sustain nectar-feeding bat populations. A critical need in this area is information about the size of the foraging areas around roosts so that adequate areas can be protected. This information will show the minimum area needed to support a roost of nectar- and fruit-eating bats, provided the roost locations are known.

Known major roost sites include 16 large roosts in Arizona and Mexico (USFWS 1997b). According to surveys conducted in 1992 and 1993, the number of bats estimated to occupy these sites was greater than 200,000. Twelve major maternity roost sites are known from Arizona and Mexico. According to the same surveys, the maternity roosts are occupied by a total of more than 150,000 lesser long-nosed bats. The numbers above indicate that, although many of these bats are known to exist, the relative number of known large roosts is small. Disturbance of these roosts and the food plants associated with them could lead to the loss of the roosts. Limited numbers of maternity roosts may be the critical factor in the survival of this species.

ENVIRONMENTAL BASELINE

Current and past environmental conditions in the project area are summarized in the environmental baselines for the CFPO. They are included here by reference.

Leptonycteris bats require suitable forage plants (paniculate agaves and columnar cacti) and suitable roost sites. Mines and caves occurring in southern and central Arizona provide suitable sites for post-maternity roosts of the lesser long-nosed bat. Potential foraging habitat (saguaros) for the lesser long-nosed bat occurs in the project site and vicinity. Agaves are found in varying

densities and age classes within residential areas, but are absent in the project site. However, they are found within the broad vegetation community classification of desertscrub, desert grassland, interior chaparral, oak woodland, pinyon-juniper woodland, pine-oak woodland, and mixed conifer in areas of the Coronado National Forest (Forest) and other areas in the region. The primary agave used by the bat is Palmer's agave, which, as estimated by the Forest, is widely scattered over 390,000 ha (1,000,000 ac) at densities less than 3 to over 40 individuals per ha (10-200 per ac), generally between the elevations of 909 and 1,818 m (3,000-6,000 ft). Parry's agave is found between 1,545 and 2,485 m (5,000-8,200 ft), and begins blooming in mid-spring.

Considerable evidence exists suggesting a dependence of *Leptonycteris* on certain agaves and cacti, although some Palmer's agave has been shown not to be dependent on *Leptonycteris* for pollination (Slauson 1996 and 1999, Slauson and Dalton 1998). Activities that adversely affect the density and productivity of columnar cacti and paniculate agaves may adversely affect populations of lesser long-nosed bats (Abouhalder 1992, USFWS 1997b). Excess harvest of agaves in Mexico, collection of cacti in the United States, and conversion of habitat due to urban expansion, agricultural uses, livestock grazing, and other development may contribute to the decline of long-nosed bat populations (USFWS 1988a).

Status of the Species in the Project Area

No documented lesser long-nosed bat maternity colonies are known from the project site; however, there is a suspected maternity colony on Saguaro National Park in the Rincon Mountains, approximately 56 km (35 mi) to the southeast (USFWS 1997b). Numbers of bats at this site have fluctuated widely from year to year, from several hundred to zero. Several post-maternity roosts which house from many thousands to only a few individual bats are also known from various locations in the region, the nearest being about 44 km (27 mi) to the northeast of the project site (AGFD 1999). These roosts are generally occupied from July through September, though the bats have been recorded in southeast Arizona in April (Petryszyn, pers. comm.) and they may remain into October (Sidner 1997). Based on distances lesser long-nosed bats have been known to travel from roost sites to foraging areas, potential foraging habitat may extend in a 64 km (40 mi) radius from roosts. From the known roosts in southeastern Arizona, the project site lies within potential foraging range of the lesser long-nosed bat.

EFFECTS OF THE ACTION

The severity of adverse effects to *Leptonycteris* bats resulting from the potential reduction in forage resources is dependent on the importance of forage plants in a specific area to reproduction, survival, and growth of the bat.

Indirect effects from residential developments in the action area on *Leptonycteris* bats may occur through adverse effects to forage plants, primarily paniculate agaves and saguaros. Both direct

and indirect impacts, resulting from continued urban development, may occur to forage plants, particularly saguaros. Saguaros occurring on the project site will be salvaged.

The primary food source for the lesser long-nosed bat in southeastern Arizona from mid-summer through fall is Palmer's agave, which does not occur in the action area, therefore it will not be affected by this action. Documented bat use in the action area consists of few, mostly old records. However, on the neighboring Saguaro National Park in the Rincon Mountains, there is a suspected maternity roost.

CONCLUSION

Leptonycteris bats are opportunistic foragers and are capable of long distance flights and potentially could forage in the project site. However, because of the distance from known forage, roost, and maternity sites, the small size of the project site, and the low number of potential forage species on the project site, we concur with the effect determination that this action, as proposed, may affect, but is not likely to adversely affect the lesser long-nosed bat. Critical habitat has not been designated for the bat; therefore, none will be affected. We base this finding on the following:

1. Potential direct adverse effects to the species are expected to be discountable (i.e., extremely unlikely to occur).

2. Indirect adverse effects are considered insignificant (i.e., small size, extent of the impacts).

3. Saguaros will be salvaged according to Pima County's protective ordinances which will maintain them on-site.

4. The project site is immediately adjacent to highly developed areas which are unlikely to be used by this species.