United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021
Telephone: (602) 242-0210 FAX: (602) 242-2513

AESO/SE
2-21-99-F-364 December 21, 2001

Mr. Terry Oda
Manager, CWA Standards and Permits Office
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105-3901

RE: Final Biological Opinion on the Effects of the Proposed Hartman Vistas Development in Marana, Arizona.

Dear Mr. Oda:

This responds to the Environmental Protection Agency (EPA) September 13, 1999, request for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) on the effects of the proposed Hartman Vistas Project on the endangered cactus ferruginous pygmy-owl (CFPO or owl) (*Glaucidium brasilianum cactorum*) without critical habitat, and the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) without critical habitat.

The federal action under consideration is the issuance of a National Pollutant Discharge Elimination System (NPDES) storm water permit under section 402 of the Clean Water Act (CWA) from the EPA and a section 404 permit under the CWA from the U.S. Army Corps of Engineers (COE). EPA is lead for this consultation. New World Homes (applicant) was designated by the EPA as their non-federal representative for this consultation.

The EPA has requested Service concurrence that the proposed action is not likely to adversely affect the lesser long-nosed bat. We concur with this determination for the lesser long-nosed bat.

This biological opinion is based on information provided in the August 30, 1999 Hartman Vistas Biological Assessment (BA) (WestLand Resources 1999); the June 21, 2001 Supplemental Report to the Biological Assessment of Hartman Vistas (Supplemental Report) (WestLand Resources 2001); correspondence and meetings with the applicant; numerous telephone and ersonal conversations; field investigations; correspondence and meetings with the Arizona

Game and Fish Department (AGFD); and other sources of information. A complete administrative record of this consultation is on file at this office. We have assigned log number 2-21-99-F-364 to this consultation. Please refer to that number in future correspondence on this consultation.

Consultation History

The applicant, their consultant, and their attorney have met with us on a number of occasions, and the details of those meetings are in the administrative record for this consultation. The most significant activities in the consultation process are summarized in Table 1.

Table 1: Summary of Consultation History.

DATE	ACTIVITY
February 16, 1999	Initiation of informal section 7 consultation
March 30, 1999	On-site visit conducted
September 13, 1999	Initiation of formal consultation
December 15, 1999	Service requested of the EPA a 60-day extension of the 135-day formal consultation period, scheduled to expire on January 26, 2000
December 21, 1999	EPA granted the requested 60-day extension; consultation period to expire on March 28, 2000
March 31, 2000	Service requested of the EPA an additional 30-day extension of the consultation period and notified the applicant of its request
April 13, 2000	EPA granted the requested 30-day extension; consultation period to expire April 27, 2000
May 10, 2000	Service provided a draft jeopardy/adverse modification biological opinion to EPA and COE
March 22, 2001	On-site visit completed
July 6, 2001	Service received from EPA a June 29, 2001 letter transmitting its Supplemental Report and requesting continuing formal consultation

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

The applicant revised their project from their original proposal, for which we issued a draft biological opinion on May 10, 2000. These changes were made to avoid jeopardizing the continued existence of the CFPO and adversely modifying its critical habitat. In the draft opinion, we identified two reasonable and prudent alternatives to avoid jeopardy and the destruction or adverse modification of critical habitat. The applicant has redesigned the project to implement one of the two reasonable and prudent alternatives as follows: In addition to the original 160-acre parcel located at the southwest corner of Hartman Lane and Linda Vista (referred to hereafter in this opinion as the Hartman Vistas Parcel), the applicant has expanded the project to include two additional parcels (Appendix A) (WestLand Resources 2001). These parcels include the 158-acre "north off-site mitigation parcel" (hereafter referred to in this opinion as the Potvin Parcel), and the 100-acre "south off-site mitigation parcel" (hereafter referred to in this opinion as the Oasis Parcel). Each of these three parcels are discussed individually below.

Hartman Vistas Parcel

This parcel is located on the southwest corner of Linda Vista and Hartman Lane, located at T12S, R12E, Section 23, NE 1/4 (Appendix A). It includes the approximately 158-acre parcel, plus approximately 14.4 acres of off-site utilities, totaling 171.7 acres. The applicant proposes to develop residential and commercial properties on approximately 82 acres, plus an additional 14.4 acres of off-site utilities. Approximately 340 single-family residences, an undetermined commercial development center at the corner of Hartman and Linda Vista roads, and a 1.49-acre water plant facility in the northern portion of the property adjacent to Linda Vista are proposed. Narrow strips of land on the margins of the areas proposed for residential and commercial development totaling 7.25 acres will be disturbed during grading activities. Portions may be suitable for revegetation with native plants, whereas other areas will need to be stabilized with rock rip-rap or other structural stabilization techniques to prevent erosion. Approximately 59 acres of lands within this parcel will be set aside and preserved in place as conservation areas. With the exception of a small area required for construction of dry utilities, these areas will be left naturally vegetated in their current condition in perpetuity.

The off-site sewer rights-of-way (ROW) will run for approximately 3,750 feet from the southwest corner of the Hartman Vistas Parcel south to an existing sewer service. The width of the construction disturbance for the off-site sewer utility will average 50 feet. A maximum of 6.9 acres of land will be disturbed by construction of the sewer line. Approximately one-third of this area occurs along an existing dirt road. A portion of the off-site sewer will traverse lands proposed as conservation lands for another project currently under section 7 consultation.

Water service for the subject property will be provided by development of a well near the intersection of Linda Vista and El Camino de Mañana. The off-site water line will be

constructed entirely within the existing Linda Vista ROW. The expected width of construction disturbance along this ROW is 40 feet. Native vegetation will be cleared from the entire ROW area, resulting in approximately 7.5 acres of vegetation clearing.

A dry utility easement will follow the southern boundary of this parcel to link the central and southeastern development areas. The exact configuration of this easement has not yet been determined. The easement is approximately 800 feet in length and will require a disturbance width of 25 feet during construction. Once construction has been completed, disturbed areas will be seeded with native plant species. Table 2 displays the applicant's summary of proposed surface disturbance in the Hartman Vistas Parcel.

Table 2. Hartman Vistas Parcel Development.

TOTAL GRADED ON-SITE		97.98 acres
Residential and Commercial Activities (includes water plant)	81.81 acres	
Slopes and Open Space Requiring Some Revegetation and/or permanent stabilization	7.25 acres	
Stabilized Drainage Easements	1.23 acres	
Common Area and Developed Open Space for Recreation	7.19 acres	
Dry Utility Development within conservation areas	0.50 acres	
ON-SITE CONSERVATION AREAS PROTECTED IN PERPETUITY		59.35 acres
TOTAL ON-SITE ACREAGE		157.33 acres
Off-site UTILITY DEVELOPMENT ACTIVITIES		
Utility	**Total Area of Construction Activities in Acres**	
Sewer	6.9	
Water	7.5	
TOTAL	**14.4 acres**	

Oasis Parcel

This parcel is located in T12S, R12E, Section 14, SW 1/4, totaling approximately 99.4 acres in size (Appendix A). Within this parcel, approximately 30.89 acres of land will be developed for residential uses, 3.45 acres of land will be set aside for public road ROW, and 2.73 acres of lands will be used for utility construction. Refer to the Supplemental Report (Figure 10 of the Supplemental Report) for additional information and development layout.

To avoid impacts to jurisdictional waters of the United States and xeroriparian habitats that traverse the parcel, residential development will be implemented in two distinct areas within the northern portion of this parcel. Approximately 42 single-family residential lots will be developed in one area, and approximately 96 single-family residential lots will be developed in the other. The total area of residential development, including the construction transition area, is approximately 30.89 acres.

Along the border of some of these development areas there will be additional construction and ground disturbance totaling 2.33 acres. The applicant will place detention/retention basins to minimize and mitigate for increased storm water runoff generated within these areas. Significant clusters of trees along the borders of these two development areas will be retained (Figure 10 of the Supplemental Report). The applicant will avoid impacts to significant clusters of vegetation within the delineated construction transition area. Sewer and water service for the development areas are provided through easements that run along the western and southern boundary of this parcel, totaling approximately 2.73 acres in size. The remaining approximately 62.3 acres will be managed as open space (i.e., conservation areas) in perpetuity and left in their natural vegetated condition.

Table 3. Oasis Parcel impact calculation summary.

Residential development	30.89 acres
ROW	3.45 acres
Utilities	2.73 acres
On-site conservation areas	62.33 acres
Totals	**99.4 acres**

Potvin Parcel

This parcel is located in T12S, R12E, Section 11, SW 1/4, totaling approximately 157.9 acres in size (Appendix A). The entire parcel will be set aside in perpetuity and access will be restricted through fencing to preserve its habitat values.

The entire project will disturb approximately 141 acres and conserve approximately 280 acres in in natural open space (hereafter referred to as conservation areas) in perpetuity for the CFPO. A summary of development impacts and mitigation is provided in Table 4 below. As outlined in this table, the proposed project plus preservation of conservation areas results in a net surface disturbance of project and project-related activities of 24 percent using conservation credits from high value areas.

Table 4. Summary of area disturbed, conservation credits, and percent disturbance for the revised project.

Parcel		Impacted Area Acres	Conservation Area Acres	Conservation Credits	Percent Surface Disturbance
Hartman Vistas	*On-site*	97.98	59.35	59.35	62%
	Off-site	9.6	0	0	100%
Oasis Parcel*		33.62	62.33	62.33	35%
Potvin Parcel**		0	157.9	315.8	0%
TOTAL		**141.2**	**279.58**	**437.48**	**24%**

* Excludes 3.45 acres of future public ROW

** Utilizes a 2:1 conservation credit (each acre preserved results in 2 conservation credits)

Prior to initiation of clearing and development, the applicant will establish a perpetual conservation easement or other equivalent legal protection on the conservation lands that prohibits development or other uses that are incompatible with the conservation of the CFPO. Prior to the initiation of clearing and development on the Oasis Parcel, the applicant and the Service will agree upon a long-term management plan for all conservation areas. This plan will include a description of specific management actions, identification of the management entity, and assurance of adequate funding for all management actions in perpetuity. In the interim, the applicant will ensure that measures identified below will be taken to minimize adverse effects to the CFPO that are consistent with the management of the CFPO.

Prohibited activities in all conservation areas are: use of any motorized vehicles (i.e., ORV, vehicles), use of pesticides (i.e., herbicides and insecticides), use of artificial lights, organized events that consist of more than 10 people, any type of vegetation salvage or activities that result in the removal or disturbance of natural vegetation other than that which is necessary for utilities, boarding or staging of equestrian events, and use of fires or other outdoor cooking equipment. Permitted uses include foot traffic (hiking), walking of leashed pets, and equestrian use of groups less than 10 per party. A long-term management entity for conservation lands has not been identified at the this time; however, this will occur prior to any clearing of vegetation or construction activity. In the interim, the applicant will forgo all development activities on the Oasis Parcel, until a management entity and a management plan have been approved by the Service. Within conservation areas, the applicant will utilize fencing, walls, and locked gates to ensure their conservation value to owls is maintained. They will also complete semi-annual inspections and clean-up, photo-documentation, and annual reporting to the Service. Native trees will be planted to the maximum extent possible where Canada Agua Wash crosses Hartman Lane to increase the amount of cover for CFPOs. Existing vegetation will be retained where possible where developed areas border conservation areas.

The Supplemental Report describes four zones that will be established upon the discovery of a breeding or resident CFPO on or within 1,500 feet of any of the construction sites. These measures are intended to minimize adverse effects if owls are present during the construction phase. Protocol CFPO surveys will be completed prior to initiation of construction activities.

II. STATUS OF THE SPECIES/CRITICAL HABITAT

A detailed description of the life history and ecology of the CFPO may be found in the *Birds of North America* (Proudfoot and Johnson 2000), *Ecology and Conservation of the Cactus Ferruginous Pygmy-owl in Arizona* (Cartron and Finch 2000), and other information available at the Arizona Ecological Services Field Office. Information specific to the CFPO in Arizona is limited. Research in Texas has provided useful insights into the ecology of the subspecies, and in some instances represents the best available information; however, habitat and environmental conditions are somewhat different in Arizona and conclusions based on Texas information are tentative.

Species description

The Service listed the Arizona population of the CFPO as a distinct population segment (DPS) on March 10, 1997, (U.S. Fish and Wildlife Service 1997 [62 FR 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 July 12, 1999, we designated approximately 731,712 acres of critical habitat supporting riverine, riparian, and upland vegetation in seven critical habitat units, located in Pima, Cochise, Pinal, and Maricopa counties in Arizona (U.S. Fish and Wildlife Service 1999 [64 FR 37419]). However, on September 21, 2001, the U.S. District Court for the District of Arizona vacated this final rule designating critical habitat for the CFPO, and remanded its designation back to the Service for further consideration.

Life history

CFPOs are small birds, averaging 6.75 inches in length. CFPOs are reddish-brown overall, with a cream-colored belly streaked with reddish-brown. 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).

A variety of vegetation communities are used by CFPOs, such as: riparian woodlands, mesquite (*Prosopis* spp.) "bosques" (Spanish for woodlands), Sonoran Desertscrub, and semidesert grassland communities, as well as nonnative vegetation within these communities. While plant species composition differs among these communities, there are certain unifying characteristics such as the presence of vegetation in a fairly dense thicket or woodland, the presence of trees or saguaros large enough to support cavity nesting, and elevations below 4,000 feet 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 the Arizona Upland Subdivision of the Sonoran Desert, particularly Sonoran Desertscrub (Brown 1994). This community in southern Arizona consists of paloverde, ironwood, mesquite, acacia, bursage (*Ambrosia* spp.), and columnar cacti (Phillips et al. 1964, Monson and Phillips 1981, Davis and Russell 1984, Johnson and Haight 1985, Johnsgard 1988). However, over the past several years, CFPOs 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. Semidesert grasslands have experienced the invasion of velvet mesquites (*Prosopis velutina*) in uplands and linear woodlands of various tree species along bottoms and washes.

The density of trees and the amount of canopy cover preferred by CFPOs in Arizona is unclear. However, preliminary results from a habitat selection study indicate that nest sites tend to have a higher degree of canopy cover than random sites (Wilcox et al. 2000). For areas outside Arizona, CFPOs 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 be a bias of increased visibility. Overall, vegetation density may not be as important as patches of dense vegetation with a developed canopy layer interspersed with open areas. The physical settings and vegetation composition varies across *G. brasilianum's* range and, while vegetation structure may be more important than composition (Wilcox et al. 1999, Cartron et al. 2000a), higher vegetation diversity is found more often at nest sites than at random sites (Wilcox et al. 2000).

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. 1994). The density of annuals and grasses, as well as shrubs, may be important to the CFPO's prey base. Shrubs and large trees also provide protection against aerial predation for juvenile and adult CFPOs and cover from which they may capture prey (Wilcox et al. 2000).

CFPOs are considered non-migratory throughout their range by most authors, and have been reported during the winter months in several locations, including Organ Pipe Cactus National Monument (OPCNM) (R. Johnson unpubl. data, T. Tibbitts, Organ Pipe Cactus National Monument unpubl. data). CFPOs begin nesting activities in late winter to early spring. In Arizona differences between nest sites may vary by as much as two months (Abbate et al. 1996, S. Richardson, Arizona Game and Fish Department 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 Texas, juveniles remained within approximately 165 feet of adults until dispersal. Dispersal distances (straight line) of 20 juveniles monitored from their natal sites to nest sites the following year averaged 5 miles (ranged from 0.75 to 19 miles (G. Proudfoot unpubl. data). Telemetry studies of dispersing juveniles in Arizona during 1999 and 2000 ranged

from 1.4 to 12.9 miles (straight line distance) (n=6, mean 6.2 miles) in 1999, and 1.6 to 11.7 miles (n=6, mean 5.8 miles) in 2000 (S. Richardson and M. Ingraldi, Arizona Game and Fish Department unpubl. data). CFPO telemetry studies have documented movement of owls between southern Pinal County and northwestern Tucson (S. Richardson and M. Ingraldi, Arizona Game and Fish Department unpubl. data). Typically, juveniles dispersed from natal areas in July, but did not appear to defend a territory until September. They may move up to one mile in a night; however, they typically fly short distances from tree to tree instead of long single flights (S. Richardson, Arizona Game and Fish Department unpubl. data). Subsequent surveys during the spring have found that locations of male CFPOs are in the same general location as last observed the preceding fall.

Apparently, unpaired females may also remain in the same territory for some period of time. In the spring of 2001, an unpaired female (the male died in 2000) remained in the same territory as was occupied in previous years well into the spring, exhibiting territorial behavior (calling) for approximately two months until ultimately switching territories and pairing with an unpaired male and successfully nesting (S. Richardson, Arizona Game and Fish Department unpubl. data). Researchers suspect that if this unpaired female could have attracted an unpaired male during that time, she would have likely remained in her original territory. Apparently at some point the urge to pair is too strong to remain and they seek out new mates.

In Texas, Proudfoot (1996) noted that, while CFPOs used between 3 and 57 acres during the incubation period, they defend areas up to 279 acres in the winter. Therefore, a 280 acre home range is considered necessary for CFPOs. Proudfoot and Johnson (2000) indicate males defend areas with radii from 1,100 - 2,000 feet. 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).

Species status and distribution range wide

The CFPO 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. Recent genetic studies suggest that ferruginous pygmy-owl populations in southern Arizona and southern Texas are distinct subspecies, and that there is no genetic isolation between populations in the United States and those immediately south of the border in northwestern or northeastern Mexico (Proudfoot and Slack 2001). Results also indicate a comparatively low haplotypic diversity in the northwestern Tucson population, suggesting that it may be recently separated from those in the Altar Valley, Arizona, and in Sonora and Sinaloa, Mexico.

The Service is currently funding habitat studies and surveys in Sonora, Mexico to determine the distribution and relative abundance of the CFPO there. Based on the lack of sightings, they may be absent, rare, or uncommon in northern Sonora, Mexico (Hunter 1988, U.S. Fish and Wildlife

Service 1997). Preliminary results indicate that CFPOs are present in northern and central Sonora (U.S. Fish and Wildlife Service unpubl. data). Further studies are needed to determine their distribution in Mexico.

The range of the Arizona DPS of the CFPO extends from the International Border with Mexico north to central Arizona. The northernmost historic record for the CFPO is from New River, Arizona, about 35 miles north of Phoenix, where Fisher (1893) reported the CFPO to be "quite common" in thickets of intermixed mesquite and saguaro cactus. 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, Gilman 1909, Swarth 1914). Additionally, CFPOs were detected at Dudleyville on the San Pedro River as recently as 1985 and 1986 (Arizona Game and Fish Department unpubl. data, 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, Yuma County in 1955 (Monson 1998).

Hunter (1988) found fewer than 20 verified records of CFPOs in Arizona for the period of 1971 to 1988. 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 (U.S. Fish and Wildlife Service unpubl. data and Organ Pipe Cactus National Monument unpubl. data). In 1993, surveys were conducted at locations where CFPOs had been sighted since 1970. Only one CFPO was detected during these survey periods, and it was located in northwestern Tucson (Felley and Corman 1993). In 1994, a pair and single owl of unknown breeding status were located in northwestern Tucson during informal survey work by AGFD (Abbate et al. 1996). In 1995, AGFD confirmed 5 adult CFPO and one juvenile, one of which was the first nest in many years. In 1996, AGFD focused their survey efforts in the Tucson Basin. A total of 12 CFPOs were detected, including one known nesting pair and their 2 fledglings which successfully fledged. Three additional CFPOs and three other unconfirmed reports were also recorded at OPCNM in 1996.

While the majority of Arizona CFPO detections in the last seven years have been from the northwestern Tucson area in Pima County, CFPOs have also been detected in southern Pinal County, at OPCNM, Cabeza Prieta National Wildlife Refuge (CPNWR), Buenos Aires National Wildlife Refuge (BANWR), and on the Coronado National Forest. The following is a brief summary of recent owl numbers and distribution[1]:

[1] To a large degree, survey effort plays an important factor in where owls have been documented. Survey effort has not been consistent over the past several years in all areas of the state, affecting the known distribution and numbers of owls in any particular area.

In 1997, survey efforts of AGFD located a total of five CFPOs in the Tucson Basin study area (the area bounded to the north by the Picacho Mountains, the east by the Santa Catalina and Rincon mountains, the south by the Santa Rita and Sierrita Mountains, and the Tucson Mountains to the west). Of these owls, one pair successfully fledged (young that left their nest cavity) two young which were banded. Two adult males were also located at OPCNM, with one reported from a previously unoccupied area (T. Tibbitts, Organ Pipe Cactus National Monument pers. comm. 1997).

In 1998, survey efforts in Arizona increased substantially and, as a result, more CFPOs were documented, which may at least in part account for a larger number of known owls. In 1998, a total of 35 CFPOs were confirmed (S. Richardson, Arizona Game and Fish Department unpubl. data, U.S. Fish and Wildlife Service unpubl. data, T. Tibbitts, Organ Pipe Cactus National Monument unpubl. data, D. Bieber, Coronado National Forest unpubl. data).

In 1999, a total of 41 adult CFPOs were found in Arizona at 28 sites. Of these sites, 11 had nesting confirmed by AGFD and the Service. CFPOs were found in three distinct regions of the state: Tucson Basin, Altar Valley, and OPCNM. Almost half of the known owl sites were in the Altar Valley. Overall, mortality was documented for a number of fledglings due to natural (e.g., predation) or unknown causes. Of the 33 young found, only 16 were documented as surviving until dispersal (juveniles known to have successfully dispersed from their natal area). It is unclear what the survival rate for CFPOs is; however, as with other owls and raptors, a high mortality (50% or more) of young is typical during the first year of life.

Surveys conducted in 2000 resulted in 24 confirmed CFPO sites (i.e. nests and resident CFPO sites) and several other unconfirmed sites (S. Richardson, Arizona Game and Fish Department unpubl. data, T. Tibbitts, Organ Pipe Cactus National Monument unpubl. data, U.S. Fish and Wildlife Service unpubl. data). A total of 34 adult CFPOs were confirmed. Nesting was documented at 7 sites and 23 fledglings were confirmed. A total of 9 juveniles were known to have successfully dispersed from their natal areas in 2000. Successful dispersal was not confirmed at two nests with four fledglings. The status of the remaining fledglings was unknown; however, they were presumed dead.

Surveys conducted during the 2001 season resulted in a total of 47 adult CFPOs confirmed at 29 sites[2] in Arizona (S. Richardson, Arizona Game and Fish Department unpubl. data, T. Tibbitts, Organ Pipe Cactus National Monument unpubl. data, U.S. Fish and Wildlife Service unpubl. data). There were also several other unconfirmed sites that are not included in these totals. Nesting was documented at 17 sites and 24 young were confirmed to have successfully fledged. In addition, there were 2 nests with young that potentially could have fledged young; however, this was not confirmed. Similar to the previous three years, there was over a 50% fledgling mortality documented in 2001 (S. Richardson, Arizona Game and Fish Department unpubl. data).

[2] CFPO sites are nests and resident male CFPO sites that have been confirmed by AGFD or the Service.

The following regions of the state are currently known to have CFPOs:

- **Tucson Basin** (northwestern Tucson and southern Pinal County) - A total of 8 adults (3 pairs and 2 single resident males) were confirmed at 5 sites, all of which were in Pima County. One single unpaired male CFPO was documented in southern Pinal County. Three nests in northwestern Tucson were confirmed, all with young.

- **Altar Valley** - A total of 18 adult CFPOs were documented at 12 sites[3]. As a result of increased access to portions of the valley, the number of known owls increased to 7 pairs and 4 resident single owls. A total of 7 nests were confirmed.

- **OPCNM and CPNWR** - Twelve adults, consisting of 2 pairs and 4 single CFPOs were confirmed at 8 sites. Three nests were active. Two new sites were documented on the CPNWR and 1 north of OPCNM near Ajo, Arizona.

- **Other Areas** - A total of 9 adults, consisting of 4 pairs and 1 single CFPO at 5 sites documented elsewhere in southern Arizona. Nesting was confirmed at 4 of these sites. It is unknown how many of these young successfully dispersed. There were several other possible CFPO detections reported elsewhere in the state, but they were not confirmed.

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 three years, large, previously unsurveyed areas have been inventoried for owls, resulting in a much wider distribution than previously thought. As a result, our knowledge is changing as to CFPO distribution and habitat needs as new information is collected. 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 northwestern Tucson. However, in 1999, after extensive surveys in Altar Valley, more owls were found there (18 adults) than in northwestern Tucson (11 adults), although until 2001, there have been fewer nest sites in Altar Valley than in the Tucson Basin (S. Richardson, Arizona Game and Fish Department unpubl. data). As a result, our knowledge is changing as to their distribution and habitat needs as new information is collected.

Range wide trend

One of most urgent threats to CFPOs in Arizona is thought to be the loss and fragmentation of habitat (U.S. Fish and Wildlife Service 1997, Abbate et al. 1999). The complete removal of vegetation and natural features required for many large-scale and high-density developments

[3] There was one additional female found in Altar Valley dead in a saguaro cavity, suspected to have been killed by a screech owl (S. Richardson, Arizona Game and Fish Department unpubl. data).

directly and indirectly impacts CFPO survival and recovery (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). 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). 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 to residential areas in northwestern Tucson, these interactions may be a significant cause of owl mortality there (Cartron et al. 2000a).

Nesting in small natural patches may have additional risks. For example, Haug (1985) found burrowing owl home range size increases with the percentage of vegetation 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, competition for fewer productive CFPO territories may 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. For example, researchers have been closely monitoring an established CFPO site (documented each year since 1996) in which the male died in 1999, apparently from a collision with a fence (S. Richardson, Arizona Game and Fish Department unpubl. data.). This site has not been known to be active since 1999. It has the highest amount of development (33%) within its estimated home range of any other known nest site (S. Richardson, Arizona Game and Fish Department unpubl. data.). The site will continued to be monitored to determine if new owls reestablish a nest site.

In northwestern Tucson, all currently known CFPO locations, particularly nest sites, are in low-density housing areas where abundant native vegetation separates structures. Additionally, they are adjacent to or near 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 owl sites, particularly nest sites, overall noise levels are low. Housing density is low, and as a result, human presence is also generally low. Roads in the areas are typically dirt or two-lane paved roads with low speed limits that minimizes traffic noise. Low density housing areas generally have lower 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 85 to 90% of low-elevation riparian habitats in the southwestern U.S. have been modified or lost; these alterations and losses are attributed to woodcutting, non-native plant invasions, 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, U.S. Fish and Wildlife Service 1988, U.S. General Accounting Office 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). 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).

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). 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.

In the United States, CFPOs are rare and highly sought by bird watchers, who concentrate at a few of the remaining known locations. Limited, conservative bird watching is probably not harmful; however, excessive attention and playing of tape-recorded calls 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, Arizona Game and Fish Department 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.

Human activities near nests at critical periods of the nesting cycle may cause CFPOs to abandon their nest sites. In Texas, 3 of 102 CFPO nests monitored from 1994-1999 were abandoned during the early stage of egg laying. Although unknown factors may have contributed to this abandonment, researchers in Texas associated nest abandonment with nest monitoring (G. Proudfoot pers. comm.). Some outdoor recreational 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 February through July (G. Proudfoot pers. comm. 1999 and S. Richardson, Arizona Game and Fish Department pers. comm. 1999). Noise disturbance during the breeding season may affect productivity; disturbance outside of this period may affect the energy balance and, therefore survival. Wildlife may respond to noise disturbances during the breeding season by abandoning their nests or young (Knight and Cole 1995). It has also become apparent that disturbance outside of a species' breeding season may have equally severe effects (Skagen et al. 1991).

Currently, all known nesting CFPOs within northwestern Tucson are located in areas containing no development or 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. Noise can affect animals by disturbing them to the point that detectable change in behavior may occur. Such behavioral 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. 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). It is unknown if

noise habituation occurs in some CFPOs as it does with other bird species. Robert and Ralph (1975), Schreiber et. al (1979), Cooke (1980), Parsons and Burger (1982), Ainley et al. (1983), and McNicholl (1983) found that adult birds, and chicks to some extent, habituated to the presence of humans, and their responses 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.

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 CFPOs elsewhere and other species, particularly raptors. Raptors in frequent contact with human activities tend to be less sensitive to additional noise disturbances than raptors nesting in remote areas. However, exposure to direct human harassment may make raptors more sensitive to noise 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 noise 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).

Application of pesticides and herbicides in Arizona occurs year-round, and these chemicals pose a potential threat to the CFPO. The presence of CFPOs in proximity to residences, golf courses, agricultural fields, and nurseries may cause direct exposure to pesticides and herbicides. Furthermore, ingestion of affected prey items may cause death or reproductive failure (Abbate et al. 1999). Illegal dumping of waste also occurs in areas occupied by CFPOs and may be a threat to CFPOs and their prey; in one case, drums of toxic solvents were found within one mile of a CFPO detection (Abbate et al. 1999).

Little is known about the rate or causes of mortality in CFPOs; however, they are susceptible to predation from a wide variety of species. In Texas, eggs and nestlings were depredated by racoons (*Procyon lotor*) and bullsnakes (*Pituophis melanoleucus*). Both adult and juvenile CFPO are likely killed by great horned owls (*Bubo virginianus*), Harris' hawks *(Parabuteo unicinctus*), Cooper's hawks, and eastern screech-owls (*Otus asio*) (Proudfoot and Johnson 2000, G. Proudfoot unpubl. data). CFPOs are particularly vulnerable to predation and other threats during and shortly after fledging (Abbate et al. 1999). Therefore, cover near nest sites may be important for young to fledge successfully (Wilcox et al. 1999, Wilcox et al. 2000). Although nest depredation has not been recorded in Arizona, only a few nests have been monitored (n = 21 from 1996-1999). Additional research is needed to determine the effects of predation, including nest depredation, on CFPOs in Arizona and elsewhere.

Another factor that may affect CFPOs is interspecific competition/predation. In Texas, depredation of two adult female CFPOs nesting close to screech-owls was recorded. These incidences were recorded as "depredation by screech-owl" after examination of the CFPO

corpses and assessment of circumstances (i.e., one CFPO attempted to nest in a box that was previously used as screech-owl roost site, the other established a nest in a box within 5 meters (16 feet) of screech-owl nest site). In 2001, an unpaired female CFPO was found dead in a tree cavity, apparently killed by a screech-owl (S. Richardson, Arizona Game and Fish Department unpubl. data). Conversely, CFPOs and screech-owls have also been recorded successfully nesting within 2 meters (7 feet) of each other in the same tree without interspecific conflict (G. Proudfoot unpubl. data). The relationship between CFPO and other similar small owl species needs further study.

Direct and indirect human-caused mortalities (e.g., collisions with cars, glass windows, fences, power lines, domestic cats [*Felis domesticus*], etc.), while likely uncommon, are often underestimated, and probably increase as human interactions with owls increase (Banks 1979, Klem 1979, Churcher and Lawton 1987). This may be particularly important in the Tucson area where many CFPOs are located. CFPOs flying into windows and fences, resulting in serious injuries or death to the birds, have been documented twice. A CFPO collided into a closed window of a parked vehicle; it eventually flew off, but had a dilated pupil in one eye indicating serious neurological injury as the result of this encounter (Abbate et al. 1999). In another incident, an adult owl was found dead on a fence wire; apparently it flew into a fence and died (S. Richardson, Arizona Game and Fish Department unpubl. data). AGFD also has documented an incident of individuals shooting BB guns at birds perched on a saguaro which contained an active CFPO nest. In Texas, two adult CFPOs and one fledging were killed by a domestic cat. These owls used a nest box about 75 meters (246 feet) from a human residence. In 2001, predation by a domestic cat is also suspected by researchers in at least one instance in northwestern Tucson (S. Richardson, Arizona Game and Fish Department unpubl. data). A female juvenile owl was found dead from apparent wounds sustained from a 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 done in the southwest on this potential problem.

CFPOs have been observed moving around the perimeter of golf courses, avoiding non-vegetated areas. Roads and other openings may act as barriers to their movements (Abbate et al. 1999, S. Richardson, Arizona Game and Fish Department unpubl. data). On one occasion, a radio-tagged dispersing juvenile stopped within 0.7 mile of Interstate 10 where there were large openings and few trees or shrubs, and reversed its direction (Abbate et al. 1999). However, radio-tagged, juvenile CFPOs have crossed two-lane roads with low to moderate vehicular traffic, where trees and large shrubs were present on either side (Abbate et al. 1999). Most recently, CFPOs monitored during the summer 2001 dispersal period were observed near two lane roads on several occasions (Arizona Game and Fish Department unpubl. data). Although owls were not directly observed crossing roads, radio telemetry data were collected on either side of roadways. Movement across roads appeared to occur during the night, although transmittered owls were not continuously monitored. Because of a lack of funds and personnel, AGFD researchers are at best only able to collect relocations during 2 random times during a 24-hour period, therefore, the time and location of this crossing is unknown.

CFPOs are capable of flying short distances up to 100 feet or more over undisturbed vegetation

(e.g., Sonoran Desertscrub, semidesert grasslands, or riparian areas) with little or no human activities or structures such as roads, fences, buildings, etc. (G. Proudfoot, unpubl. data, S. Richardson, Arizona Game and Fish Department unpubl. data). However, as opening size (i.e., gaps between trees or large shrubs) increases, coupled with increased threats (e.g., moderate to high traffic volumes and other human disturbances) relatively wide roads (greater than 40 feet), may act as barriers or significantly restrict owl movement. Wide roadways and associated clear zones cause large gaps between tree canopies on either side of roadways, resulting in lower flight patterns over roads. This low flight level can cause owls to fly directly in the pathway of oncoming cars and trucks, significantly increasing the threat of owls being struck. Measures can be implemented in roadway design to minimize these threats and allow successful movement across roadways. Among other measures, decreasing the canopy openings between trees on either side of roads and increasing the density of trees along roadways to provide greater shelter and cover from predators and human activities can be utilized to minimize adverse effects to owls attempting to cross roads. Specific research is needed to determine at what distance do road and clear zone widths significantly affect successful owl movement, types of vegetation needed, roadway and landscaping designs, speed limits, etc.

Telemetry data collected by AGFD in 2001 indicate that owl movement is affected by roads and traffic (S. Richardson, Arizona Game and Fish Department, unpubl. data). On two separate occasions within the action area, juvenile owls fitted with radio transmitters were tracked moving along washes and upland areas with native vegetation until they came upon busy roads with relatively wide clear zones on either side of the roadways. These owls stopped and were repeatedly observed reacting to passing vehicular traffic by retreating from the road edge vegetation to nearby trees as cars and trucks passed by. They appeared to be affected by road width, the density of vegetation on either side of the roadway, and traffic volume. In both cases, they eventually crossed these roads during lower traffic periods at areas with narrower gaps in vegetation where there where trees were present on either side of the road. More research is needed to fully understand how these and other factors affect owl movement.

Researchers in Arizona have found that CFPOs require habitat linkages, within and between territories for movement and dispersal of young. Continuous cover or patches of trees and large shrubs spaced at close, regular intervals, to provide concealment and protection from predators and mobbing, as well as shade and cool temperatures is necessary (S. Richardson, Arizona Game and Fish Department unpubl data, Abbate et al. 1999). CFPOs, particularly juveniles because of their inexperience, are susceptible to predation, weather extremes, human-related injury/mortality factors (e.g., cars, buildings, fences, domestic cats, etc.) and other mortality factors (mortality of juveniles is typically 50% or more for owls and other raptors). Therefore, it is essential to maintain habitat conditions that reduce their exposure to these threats and provide protection as they disperse from their natal areas. A high degree of cover throughout the landscape increases the likelihood of survivorship to the next breeding season. Limiting these mortality factors is critical, especially for small, depressed populations, such as CFPOs in Arizona.

Fires can affect CFPOs by altering their habitat (Abbate et al. 1999). A recent fire altered habitat near an active CFPO nest site (Flesch 1999) and although four mature saguaros in the area

survived (at least in the short-term), post-fire mortality of saguaros has been recorded (Steenbergh and Lowe 1977 and 1983, Mclaughlin and Bowers 1982). Flesch (1999) also noted that approximately 20 to 30% of the mesquite woodland within 50 meters (164 feet) of the nest was fire- or top-killed, and ground cover was also eliminated until the summer monsoons. Careful use of prescribed fires in areas potentially suitable for CFPOs is necessary so that habitat is not lost or degraded (Flesch 1999).

Low genetic variability can lead to a reduction 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 offspring, 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, burrowing owls (*Athene cunicularia*), screech-owls, and spotted owls (*Strix occidentalis*). In 1998 and 1999, two cases of sibling CFPOs pairing and breeding were documented (Abbate et al. 1999). In both cases, young were fledged from the nesting attempts. These unusual pairings may have resulted from extremely low numbers of available mates within their dispersal range, and/or from barriers (including fragmentation of habitat) that have influenced dispersal and limited the movement of young owls (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.

Recent genetic research suggests that CFPOs in the action area may be isolated from other populations in Arizona and Mexico (Proudfoot and Slack 2001). They have found that the low level of genetic variation and the absence of shared haplotypes between owls in northwestern Tucson and the remainder of the state and Mexico may be indicative of natural divergence of this population from the rest of the CFPO population in Arizona. Specifically, this study found that CFPOs in northwestern Tucson are in a distinct clade and suggests a current separation between populations in northwestern Tucson and elsewhere in the state and Mexico. In addition, these owls have extremely low levels of average haplotype diversity. Researchers acknowledge this may also be a product of sampling (i.e., sampling from one maternal lineage) and or an extremely high level of inbreeding as a result of low population numbers and geographic isolation. Given the low number of CFPOs in the action area, their potential isolation from source populations, the fact that inbreeding has occurred to the second generation in two documented cases, and potential pressure from urban development, there is a high level of concern for the Tucson Basin population of CFPOs.

Environmental, demographic, and 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 uncertain 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 a combination 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 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.

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). The EPA has determined the action area to be approximately 1,500 feet of the project parcels (WestLand Resources 1999). We disagree with this determination. The Service has determined the action area to include the project parcels and off-site utilities and areas within 19 miles. We based this determination on the dispersal distance of juvenile CFPOs in Texas and Arizona (G. Proudfoot unpubl. data, S. Richardson, Arizona Game and Fish Department unpubl. data). With so few individual CFPOs in Arizona, the maximum dispersal distance may be periodically needed to maintain genetic interchange between groups of owls. This is particularly important when there is a limited gene pool available. On two separate occasions in the action area, siblings of the same nest were documented breeding with each other the following year (Abbate et al. 1999) (see Range wide Trend section below). Instances of sibling breeding may be a reflection of small isolated populations of owls, and maintaining genetic diversity within depressed populations is important to maintain genetic stochasticity and fitness.

The project parcels are 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 parcels are 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.

Over the past 12-month period, we have conducted over approximately 100 informal section 7 consultations for projects within the action area (e.g., capitol improvements, residential, commercial, and other developments) that have either yet to undergo formal section 7 consultation, or were not likely to adversely affect the CFPO. In addition, we have provided technical assistance to approximately 500 individual projects without a federal nexus (i.e., projects not requiring a federal permit, authorization, or funding [e.g., develop single family residences, churches, fire stations, etc on individual lots]). These projects individually were not likely to adversely affect CFPOs, or their adverse effects were insignificant or discountable due to their location, size, and scope. Collectively however, these projects without a federal nexus have taken place since listing, and continue to occur in areas that are within known CFPO territories, dispersal corridors, and areas that are important for survival and recovery within the action area. The Service has provided technical assistance to many of these landowners and project proponents to reduce and minimize these adverse effects of their projects by retaining suitable habitat on their parcel (generally limiting vegetation disturbance to 20-25% of their parcel and maintaining the remainder portion in a natural condition) and providing connectivity for owl movement. However, this assistance is not always requested, nor has it always been followed. Overall, suitable CFPO habitat in this area continues to be lost, and movement corridors continue to be affected.

Within the action area, the Town of Marana has experienced 467% growth and Oro Valley 310% growth from 1990-1999; the Arizona State Department of Economic Security stated that Marana is one of the two fastest growing communities in Arizona (The Arizona Daily Star 2000b). Housing starts in the area have continued to increase with Marana issuing over 1,000 permits for

the first time in 1999 (The Arizona Daily Star 2000a). As increasingly more houses are built, commercial developments and capitol improvements all continue to affect the survival and recovery of the CFPO. Pima County's population has grown from 666,000 in 1990 to estimates of at least 850,000 in 2000 or a 30% increase. This annual growth rate has varied from 15,000 to 30,000 persons each year, consuming at the present urban density approximately 7-10 square miles of Sonoran Desert each year (Pima County 2001). Also see Status section above for additional threats to the CFPO that have occurred since listing.

In addition, there have been several projects that have occurred, or are on-going at this time that have not undergone formal section 7 consultation with a federal agency. In December 1999, approximately 40 acres were graded for the Amphitheater High School site in northwestern Tucson. We did not receive a request for consultation on this activity prior to grading. Since that time, there have been four other federally permitted projects[4] that we are aware of within the project area that have resulted in (or are currently causing) the destruction of approximately 550 acres of suitable habitat without undergoing section 7 consultation. This has further reduced the amount and availability of suitable habitat and movement corridors within the action area.

We have completed 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 projects have adversely affected suitable habitat from continued livestock grazing and associated gathering activities. Also, within the project area we have completed several other consultations with the EPA and COE: In July 2000, we completed a consultation with the EPA for a 20-acre residential development (Countryside Vistas Blocks 5 and 6) immediately adjacent to the Hartman Vistas Parcel to the east. In October 2000, we completed a consultation with the EPA for a 5,924-acre residential and commercial development (Dove Mountain) approximately 4 miles to the northwest of the project parcels. In December 2000, we completed a consultation with the EPA for a 29-acre residential development (Tecolote de Oro) approximately 4 miles to the northeast. In July 2001, we completed a consultation on the 7-acre Crescent Ridge Apartments, approximately one mile to the north. We have also completed consultations on several smaller projects including a utility substation, water recharge facility, recreation facility, and 5-year hiking trail work plan. For each of these projects, suitable CFPO habitat will be removed; however, they all incorporated conservation measures that are consistent with the best scientific and commercial information available and with draft recommendations of the CFPO Recovery Team. These measures maintain connectivity and movement corridors through the affected areas, and provide suitable habitat at levels consistent with those where successful breeding owls have occurred elsewhere within the action area (e.g., maintaining a 20-25% vegetation disturbance level [see discussion below for this analysis]). All of these consultations resulted in no jeopardy and no adverse modification of critical habitat (which was designated at that time) determinations by the Service.

In December 1998, an ESA section 10(a)(1)(B) permit for the CFPO was issued by the Service

[4] Section 402 and/or 404 permits under the CWA issued by the EPA and COE, respectively.

for a guest ranch (Lazy K Bar) which may eventually be converted to low density residential housing in northwestern Tucson. This project contained conservation measures to minimize adverse effects that were based on the best available information at that time. Although breeding, sheltering, and foraging were adversely affected, their functions and movement of CFPOs through this area were maintained. Pima County is currently working with the Service on developing a county-wide multi-species habitat conservation plan (i.e., Sonoran Desert Conservation Plan [SDCP]) which, if approved, will result in the issuance of a section 10(a)(1)(B) permit (i.e., Habitat Conservation Plan [HCP]) to Pima County and other participating jurisdictions for not only CFPOs but also potentially several other listed and sensitive species. We are currently working with other applicants on two additional HCPs in the action area consisting of residential and commercial developments ranging from 300 to 500 acres in size.

Several thousand acres of State Trust land are located in a large continuous block immediately to the north and west of the project parcels. This land contains suitable CFPO habitat. Surveys in this area have not been comprehensive, but there is documentation of dispersing juveniles moving through the area. Nests have not been documented in this area, but this may be due to the low level of survey efforts to date. At present, this land is not developed. Presently, State Trust lands are being leased for grazing. Other activities (e.g., recreational off-road vehicle [ORV] use, shooting/target practice, hunting, etc.) also occur on these lands.

CFPOs were first documented in the action area around 1872 (see Status and Distribution section above) and historically were widespread in the action area. 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 Tucson Basin; however, systematic surveys did not take place until 1993 by AGFD. Survey efforts in this area have dramatically increased since listing, particularly in the last 4 years (U.S. Fish and Wildlife Service 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.

The action area supports one of the highest known concentrations of breeding CFPOs in the state. We currently know of a small population (8 adults in 2001) of CFPOs in the action area (northwestern Tucson and southern Pinal County). However, the information regarding owl use in the action area, and particularly the vicinity of the project parcels, represents only limited data, collected primarily over the past few years. For example, telemetry equipment, which provides detailed information on use patterns and areas, was not 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 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.

Current information suggests that CFPOs can live and breed successfully in areas which have

undergone at least some degree of low density human development; however, they do not appear to be able to tolerate all types of development, particularly high density development. Since widespread surveys began in Arizona in 1999, more owl sites have been documented in areas with little or no human activity or development. For example, in 2001, of the 29 known CFPO sites in the state, 24 sites (83%) were in undeveloped areas with very little human activity, compared to only 5 sites (17%) that were in areas with some level of low density development (S. Richardson, Arizona Game and Fish Department unpubl. data, U.S. Fish and Wildlife Service unpubl. data). No CFPOs have been documented in high density commercial or residential developments. Of the known nest sites in 2001, 14 (82%) of the 17 nest sites were in undeveloped areas with little or no ground disturbance or human activity.

To determine the level of vegetation disturbance nesting CFPOs may be able to tolerate, a group of CFPO experts on the Recovery Team completed an analysis of all known 2001 and earlier nest site home ranges (n=9) occurring in developed areas in northwestern Tucson that successfully produced offspring. They calculated the amount of vegetation disturbance (e.g., roads, buildings, horse corals, pastures, parking lots, golf courses, etc.) within the estimated home range (280 acres) at each nest site. They calculated their average percent disturbance to be 23% (also the median). However, over one-half (5 of the 9 home ranges [55%]) had levels below that average, and two-thirds (6 of the 9 sites [66%]) were at or below the 25% disturbance range. This, when added to the total number of nesting CFPO breeding sites in the state as indicated above, indicates the selection preference of CFPOs to areas with very little or no human development. In addition, because the majority of surveys are conducted in areas already with some level of development as a result of a proposed project, these areas are sampled in higher proportion to areas with no current or planned development, potentially under sampling areas without development.

Differences in the tolerance of vegetation disturbance between breeding and non-breeding owls are important because nesting owls are necessary for recruitment of young owls and demographic support to achieve recovery of the CFPO in Arizona. Although also important to the population from a demographic standpoint, non-breeding males do not directly contribute to the increase of the population by producing young. Therefore, the Service and Recovery Team believe that because successful breeding sites are necessary to produce offspring for the survival and eventual recovery of the CFPO Arizona population, vegetation disturbance levels found at breeding sites should be used as guidelines rather than those in non-breeding territories. These guidelines are particularly important within specific areas of the state recommended by the Recovery Team as Special Management Areas (SMAs).

It should be noted that one of the nest sites with the highest amount of vegetation disturbance (33%) is that of a long established pair that was documented from 1997 through 1999. Development in the general vicinity of this site continued during this time. As noted above, the male of this pair was found dead in 1999. Surveys in 2000 and 2001 did not locate any CFPOs at this site, therefore it remains inactive. Site tenacity in the short-term may have been a factor in this pair's ability to withstand this higher level of vegetation disturbance compared to other sites in Arizona; however, the long-term effect of this amount of disturbance is unknown. There were

three new nest sites[5] in 2001 with disturbance levels of 21%, 30%, and 34% (S. Richardson, Arizona Game and Fish Department, unpubl. data). Each of these territories successfully produced fledglings that dispersed to other areas in 2001. This is the first year these sites were reproductively successful, and it is unknown whether they will be able to continue to remain in these territories in subsequent years. As indicated above, two of these new nest sites, together with the other nest site that has been inactive since 1999 are at the extreme range of the amount of development occurring within all other CFPO nesting territories in Arizona (greater than 30% disturbance).

There also appears to be a difference in the tolerance to the amount of vegetation disturbance (i.e., development) between nesting and non-breeding CFPOs. Single owls may be able to tolerate higher levels of development and more marginal habitats, while breeding owls may need less disturbed vegetation within their home ranges. An analysis of all known CFPO sites in northwestern Tucson resulted in a considerably lower amount of vegetation disturbance at nest sites compared to non-breeding sites (e.g., unpaired males) (S. Richardson, Arizona Game and Fish Department unpubl. data). As stated above, the average amount of vegetation disturbance within the home range of 1998-2001 nesting sites in developed areas was 23%. The amount of vegetation disturbance within the home range of non-breeding sites in developed areas was considerably higher, averaging 37% during the same period. Although these overall results are based on a small sample size, they represent the best available information and indicate that nesting CFPOs may require less disturbed areas than unpaired owls. For example, a juvenile male CFPO established a new territory in the fall of 2000, which is surrounded on three sides by densely developed residential and commercial properties. This male has remained there throughout the 2000 and 2001 breeding seasons and failed to pair with a female owl, even after vigorous calling throughout the spring and summer months both years. In September 2001, a juvenile female CFPO dispersed from its nest and paired with this resident male. They remained together for approximately 2 weeks until the female was found dead, apparently as a result of cat predation. At this time, the male remains unpaired. Within this territory the habitat is highly fragmented, containing the highest degree of development (approximately 50%) of any other known CFPO territory (S. Richardson, Arizona Game and Fish Department unpubl. data.). It is unclear whether the amount of development and vegetation disturbance is too high for successful breeding. The Service and AGFD will continue to monitor this owl, using radio telemetry and direct observations.

The Service recognizes that even though there have been some nesting territories in the upper range of disturbance, other factors also play an import role in developing a recovery strategy for this species. For example, these data represent a very limited sample size for breeding sites within developed areas (n=9); little is understood regarding the long-term effects of increasing levels of development occurring within nest sites in higher developed areas and how this will affect their suitability for breeding and movement in the future; and the potential cumulative

[5] Both were resident male CFPOs establishing territories in the fall of 1999, remaining at their respective sites until paired with females in the spring of 2001.

effects that increasing levels of development have on owls in this region are not fully understood. The long-term productivity and success of breeding sites in these higher disturbed areas is unknown. In 2001, all of the nest sites were in new areas, resulting in a relatively large proportion (67%) of sites where nesting had occurred in the past but that were inactive in 2001 (S. Richardson, Arizona Game and Fish Department unpubl. data). More research and monitoring is needed to better understand habitat needs and the long-term relationship between development and CFPO requirements.

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 spatial scales. At a large scale, connectivity is necessary among large blocks of suitable habitat that are either currently known to be occupied by owls or are important for recovery. An example is habitat connecting the Tucson Mountains east of Interstate10 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 and is particularly important for the expansion of the population. Based on the analysis by CFPO experts on the Recovery Team, the best available science indicates the maximum amount of ground disturbance CFPOs are able tolerate is 20 - 25% (average of 23%), combined with other conservation measures that provide connectivity for movement, etc. 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 current data.

The Service has identified, based on the preliminary recommendations of the Recovery Team, an area of high conservation value which is located in the southern portion of the Northwest Tucson SMA. This area has been identified because it supports one of the highest densities of CFPOs in the state, contains important dispersal and movement corridors, and other reasons. This area also is under intense development pressures from a variety of activities. In order to promote the protection of habitat within this area, The Recovery Team and the Service recommend additional conservation credits be given for lands that are put into conservation status for the benefit of the CFPO. As a result, for this consultation, each acre of conservation within this area will be given two conservation credits, provided the parcel does not also contain proposed development.

Surveys in 1996 found 16 CFPOs in this area, including one pair and two fledged young. In 1997, surveys located 9 CFPOs, including one pair and four fledged young. In 1998, researchers found 3 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, 11 sites and 6 nesting pairs of CFPOs were documented in the action area (S. Richardson, Arizona Game and Fish Department unpubl. data). As of late March 2000, on-going surveys have documented 12 adults (3 pairs) at 9 sites in the action area (S. Richardson, Arizona Game and Fish Department, unpubl. data).

Of the 3 parcels within this project, the Potvin Parcel is within a breeding territory (last active in

1999). In 2000, a territorial male CFPO was also documented at this owl site. There are 3 nesting territories within 1.5 miles, and within a 4-mile radius, there are 14 different CFPO sites that have been documented by AGFD since 1996 (S. Richardson, Arizona Game and Fish department, unpubl. data, U.S. Fish and Wildlife Service, unpubl. data).

Dispersing CFPOs were documented on each of the 3 parcels in 2001. Additionally, CFPOs were documented using the Hartman Vistas Parcel on September 6 - 7, 2000 (S. Richardson, Arizona Game and Fish Department, unpubl. data). A juvenile owl with a transmitter dispersed from its nest to the northeast of this parcel, and traveled onto this parcel using the Canada Agua Wash. It stayed on this parcel one day, before it departed to the northeast. In 2001, AGFD researches monitored another juvenile CFPO with a radio transmitter as it dispersed from its nest, east to the project parcels. This owl traveled through the Hartman Vistas Parcel, continuing north to the Oasis Parcel, spending approximately one day on each. It then continued north to the Potvin Parcel, where it remained for approximately two weeks before it was found dead of unknown causes (S. Richardson, Arizona Game and Fish department, unpubl. data).

The Hartman Vistas Parcel is near existing high density residential developments to the east, and it is adjacent to large expanses of undeveloped land and low density residential developments on the other three sides. It is currently zoned by the Town of Marana as R-6 (six residential units per acre for up to 500 residential units and commercial development. The area immediately to the north is primarily zoned for low density residential (one house per 3.3 acre) and includes two, 40-acre unsubdivided parcels (one parcel has a single residence) with suburban ranch (SR) zoning. Countryside Vistas, an existing development, is located immediately south and east of the parcel; densities vary between 5.13 and 6.39 residential units/acre (RAC). West of the project site is undeveloped land and Interstate 10. Both the Oasis and Potvin parcels are within the Acacia Hills Specific Plan which contains a variety of housing densities up to 3,827 houses over the 862 acre planning area. Currently, these parcels and adjacent areas are largely undeveloped or have low density residential housing.

IV. EFFECTS OF THE ACTION

The proposed action will result in the permanent loss of approximately 141 acres of Sonoran desertscrub and xeroriparian vegetation which provides habitat for CFPO sheltering, feeding, and movement/dispersal, and has the potential to support nesting pairs of. The proposed action will cause short-term noise disturbance and human activity associated with construction and long-term noise disturbance and human activity from use of the residential and commercial development.

This action will occur in the area that is of greatest concern to the Service (between Cortaro Farms Road and Tangerine Road, east of Interstate 10 and west of La Cholla Boulevard) because it contains not only a very high concentration of owls, but also nesting owls. This area of northwest Tucson currently contains a considerable amount of residential and commercial development. Survival and recovery of the CFPO will be dependent on the availability of suitable habitat in this area for offspring to be able to successfully disperse and establish new

territories.

For this consultation, the Service[6] has identified an area of high conservation value within the southern portion of Northwest Tucson. The Potvin and Oasis parcels are within this high value area. To encourage the conservation of habitat in this area, the Service has assigned a 2:1 credit[7] for the Potvin Parcel only, based on its location, habitat quality, and importance to the survival and recovery of the CFPO. For this consultation, the conservation of approximately 157.9 acres in the Potvin Parcel results in 315.8 conservation credits using this 2:1 ratio. This parcel also is within a known owl territory. The Oasis Parcel is also located in this high conservation area; however, because approximately one-third of this parcel (33.62 acres of the 99.4 acres) will be developed or otherwise disturbed, additional conservation credits will not be assigned to this parcel (1:1 credit ratio is used). Development on this parcel reduces its conservation value below that which would otherwise be attained if it were conserved in its entirety. The Hartman Vistas Parcel is outside of the high conservation area, not because it has reduced value, but because of its location and proximity to highly developed areas, and because development will occur on this parcel. Therefore, conservation on this parcel will receive a 1:1 credit. See Table 4 above for a summary of the area disturbed, conservation credits, and percent disturbance for each parcel for this project.

This project will conserve 280 acres within the approximately 421-acre project site, resulting in an overall 33.5% disturbance. However, as stated above, because important areas will be conserved (i.e., within a known CFPO territory and within a high value area), the use of conservation credits for the Potvin Parcel lowers the overall disturbance rate for the project to 24%, which is comparable to recommendations from the Recovery Team when the consultation was initiated in 1999, and is within the range of the best available information on the amount of disturbance that owls may be able to tolerate. Therefore, this projects contributes to the overall goal of conserving important areas for the survival and recovery of the CFPO where they are most at risk. The Service, using information from the Recovery Team, has since recommended that disturbance be no greater than 20% in Northwest Tucson.

CFPOs, particularly juveniles, are susceptible to predation, weather extremes, human-related injury/mortality factors (e.g., cars, buildings, fences, domestic cats, etc.) and other mortality factors (mortality of juveniles is typically 50 percent or more for raptors). Therefore, it is essential to maintain habitat conditions that reduce their exposure to these threats and provide protection as they disperse from their natal areas. A high degree of cover throughout the landscape increases the likelihood of survivorship to the next breeding season. Limiting these mortality factors is critical, especially for small, depressed populations, such as CFPOs in Arizona. Although conservation areas within these parcels will be established, based on current information, they will not be of sufficient size or configuration to support breeding activities by

[6] Based on the preliminary recommendations of the Recovery Team

[7] For every acre in conserved status, 2 credits are earned at a 2:1 ratio

themselves. It is unknown at this time as to what will occur on adjacent parcels, but if land uses are not compatible with CFPO conservation, dispersing juvenile owls will need to move greater distances from their natal areas to establish new territories, increasing their exposure to threats beyond what would otherwise occur if the parcel is not developed or if it is developed at a lower density that is compatible with CFPOs. Because of size, these 2 parcels in of themselves are not expected to support nesting, but combined with adjacent lands (if they are left in their current condition, or developed in a manner the is conducive to their conservation of the CFPO) could continue to contribute to breeding in the long-term.

CFPOs require habitat linkages, within and among territories for movement and dispersal, consisting of continuous cover or patches of trees and large shrubs spaced at regular intervals, to provide concealment and protection from predators and mobbing, as well as shade and cover to moderate temperature extremes (S. Richardson, Arizona Game and Fish Department unpubl data, Abbate et al. 1999). To partially offset some of the adverse effects of the removal of approximately 141 acres of suitable habitat on the Hartman Vistas Parcel, approximately 59.4 acres will be conserved along Canada Agua Wash and an un-named wash in the northern portion of the parcel. However Canada Agua Wash will be substantially constricted by several building pads located on the eastern boundary of this parcel, which will act as a bottleneck for movement of owls through this parcel. The applicant will plant an unspecified number of trees on the Hartman Vistas Parcel, where the Canada Agua Wash crosses Hartman Lane. However, because of the building of several lots at this location, this measure will not likely maintain an effective movement corridor through this wash, which has had previous documented use by CFPOs. Placement of these houses in this location will essentially restrict and eliminate the likelihood that owls will continue to utilize this known movement corridor. The conservation areas on the Hartman Vistas parcel will not match up with the conservation area wash corridor to the east of Hartman Lane[8]. For CFPOs to successfully move through this area, they will need to utilize other off-site properties to the north and west of this parcel. CFPO movement through the conservation areas on the Potvin and Oasis parcels is not expected to be restricted or limited due to the lack of development on the former and the configuration of development on the latter, and due to the management that will occur. AGFD has documented CFPOs moving through relatively wide (200 feet and greater) existing wash corridors between high density developments in northwestern Tucson. While it is true owls have in some instances utilized relatively narrow strips of trees and vegetation, these areas expose them to considerable risks from predation, and in this instance, being struck by on-coming vehicular traffic if they attempted to cross the road at this location.

The Hartman Vistas Parcel is immediately adjacent to a large, 800-acre, high-density (6 houses per acre) residential area and a school. The proposed development on the Hartman Vistas and northern portion of the Oasis parcels will increase fragmentation and increase the overall size of an existing block of high-density development (unsuitable as CFPO nesting, foraging, sheltering, and movement/dispersal habitat) by about 98 acres or 12%. Development of this parcel will

[8] Countryside Vistas Blocks 5 & 6

increase fragmentation within undeveloped and low density residential areas in section 23 which currently has very little ground disturbance or development, further reducing suitable habitat in this area and increasing potential for human-related mortality of CFPOs.

The development of about one-third of the Oasis Parcel will fragment a relatively undeveloped block of suitable habitat. Adjacent areas are currently open space and low density residential areas. Fragmentation is minimized because development will be clustered as opposed to dispersed throughout the parcel. No additional fragmentation will occur on the Potvin Parcel because it will not be developed or otherwise disturbed.

Construction of off-site utilities will remove about 14.4 acres of suitable habitat, which will further reduce the amount of habitat in the area and increase fragmentation of remaining habitat. Of particular concern is the construction of the sewer line south of the Hartman Vistas Parcel, which is located in a relatively undisturbed area. However, access will be controlled to restricted uses such as unauthorized motorized vehicles which might otherwise preclude owl use in and adjacent to this parcel.

A component of this project includes the construction of a 600 GPM well and off-site water line to supply the proposed development with water. The well and waterline are larger than required for this project, so future use by other projects is likely and within this facility's capacity to supply additional future projects with water. The applicant has stated in meetings with the Service, that because of the cost of construction of this line, this project alone will not be able to offset its cost, and that other future developments would be necessary to compensate these costs. Future non-federal projects may be facilitated by this well and water line, and may occur in nearby undeveloped lands further reducing the amount of owl nesting, foraging, and sheltering habitat in the area and adversely affecting CFPO travel corridors.

Casualties caused by pest control, pollution, collisions with cars, radio towers, glass windows, power lines, and domestic 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 to residential areas, these interactions may be a significant cause of owl mortality (Cartron et al. 2000a). Scott Richardson (Arizona Game and Fish Department 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. The facilities, structures, and increased human activities resulting from the proposed project will increase the likelihood of CFPO mortality. In addition, the use of pesticides will likely increase within the proposed residential and commercial areas, indirectly affecting owls by reducing the availability of their prey base and potentially injuring or killing them from exposure. Use of pesticides will not occur within conservation areas to preserve their value to owls.

Predation by domestic cats has been now documented in both Arizona and Texas (Cartron et al. 2000a, S. Richardson, Arizona Game and Fish Department, unpubl. data). It is expected that

with this residential development, the number of cats will substantially increase in both the Hartman Vistas and Oasis parcels, resulting in increased possibility of predation of CFPOs and a reduction in the abundance of CFPO prey species (e.g., lizards, birds) in this area, resulting in additional adverse impacts to CFPOs. The applicant will provide educational materials to homeowners with the allowed activities within the conservation areas, and those that are restricted. Information as to the importance of keeping dogs on leashes, and preventing free-roaming cats to reduce adverse effects to CFPOs and other wildlife species will be described in these materials. However, even with these measures, unattended cats and dogs may still enter these areas and may adversely affect owls and their prey base.

The management plan outlines acceptable uses within the conservation areas and measures that will be taken to minimize adverse effects to the CFPO that are consistent with the management of the CFPO. Activities that will be prohibited from all conservation areas are: use of any motorized vehicles (i.e., ORV, vehicles), use of herbicides, and insecticides, use of artificial lights, organized events that consist of more than 10 people, any type of vegetation salvage or activities that result in the removal or disturbance of natural vegetation, equestrian gathering, and use of fires or other outdoor cooking equipment. Permitted uses include foot traffic (hiking), walking of leashed dogs or pets, and equestrian use of groups less than 10 per party. In addition, because the use of fires will be prohibited in conservation areas, the risk of the loss of habitat from wildfire will be minimized. Due to their proximity to residential areas, the use of firearms is not expected to be permitted within conservation areas, thereby avoiding adverse effects to owls as well. These measure will minimize adverse effects to CFPOs, and will ensure these areas will continue to provide breeding, sheltering, foraging, and movement habitat (unless otherwise noted above) for CFPOs.

A management entity for conservation lands has not been identified at the this time, but the applicant has committed to forgo all development activities on the Oasis Parcel until such time that a management entity and a management plan have been approved by the Service. In this interim, the conservation measures will be administered by a third party with reporting requirements to the Service to ensure these protective measures are met.

With respect to CFPOs and noise disturbance at the project parcels, it is noted that human use in and around the parcels is on-going; however, activity levels will substantially increase with construction activities and the resulting residential and commercial developments. It is expected that owls will avoid use of the 141 acres of high-density residential and commercial developed areas, and it is expected that owl use will be restricted to the conservation areas where natural vegetation is retained and has not been disturbed. 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). The construction of the residential and commercial development will be a relatively short-term event, with a foreseeable end in noise disturbance activities. However, noise disturbance, increased vehicle traffic, and human activity within developed and conservation areas after development is complete is a permanent effect. Increased noise levels may significantly disrupt normal behavioral patterns including breeding, feeding, and sheltering.

CFPOs may be tolerant, to some extent, of certain low-level noise disturbances associated with a few scattered residences and light traffic. 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.

If a new CFPO site is established prior to or after a construction phase has been initiated on the project parcels, the applicant will take adequate conservation measures as defined in the development constraints above to ensure noise disturbances will not cause the CFPOs to abandon their nest or activity center. In addition, a sufficient amount and configuration of suitable habitat will be present within their territory for it to remain viable for CFPOs.

Summary

Survival and 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. The project site provides important corridors for habitat within 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. Connectivity between breeding and non-breeding owls and areas where juvenile owls can establish new nesting territories or replace owls as they die are essential for the conservation of the CFPO. With the exception of the Canada Agua Wash, this project will maintain existing movement corridors for CFPOs. Within the Hartman Vistas Parcel the known movement corridor for the CFPO will be essentially eliminated because of the development that will occur on the north side of the Canada Agua Wash. CFPOs will need to travel off-site and use adjacent areas to move through this parcel.

The project will remove approximately 141 acres of suitable habitat that provides sheltering, foraging, movement, and possibly breeding habitat for owls. To minimize these adverse effects, approximately 280 acres (437.48 conservation credits) will be managed in perpetuity for the conservation of the CFPO. Activities that are not conducive to the conservation of the CFPO (e.g., ORV use, application of herbicides, insecticides, disturbance of vegetation, large groups of people, etc.) will not take place in these conservation areas. A portion of these lands are within and/or directly benefit an owl territory by providing nesting, foraging, sheltering, and movement habitat for the CFPO. We believe this approach to be consistent with the best available science and the intent of preliminary recommendations made by the Recovery Team and Service for conservation of Arizona CFPO population.

Because a management entity for conservation lands has not been identified at the this time, the applicant will forgo all development activities on the Oasis Parcel, until a management entity and a management plan have been approved by the Service. In the interim, the conservation measures will be administered by a third party with reporting requirements to the Service to

ensure these protective measures are met.

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 ESA.

The action area is subject to ongoing residential and commercial development pressures, capitol improvements, and state, local, and private actions are expected to continue development in the immediate vicinity of the project site and elsewhere in the action area. Any activity clearing five acres or more requires a NPDES section 402 permit under the CWA from the EPA, and activities occurring within jurisdictional waters and wetlands of the U.S. require a section 404 permit under the CWA from the COE. As a result, a substantial number of these anticipated projects will be subject to future section 7 consultations and are not considered. However, we are aware of at least 5 other projects greater than 5 acres in size within the project area that have initiated or completed grading of suitable habitat either without filing for a section 402 or 404 permit, or they have submitted a notice of intent (NOI) for a 402 permit with the EPA but not undergone section 7 consultation with the Service. Many individual undeveloped parcels will not require a federal permit or other federal nexus and will continue to be built, and not subject to future consultation. For example, we have become aware of an estimated 500 private actions without a federal nexus[9] (e.g., single family residences, churches, fire stations, etc) that have taken place within northwestern Tucson over the past 12 months. This is particularly important in the action area due to the large number of undeveloped small parcels zoned as SR and low density residential areas that, when developed, will further reduce the amount of suitable habitat, increase fragmentation, and degrade habitat conditions.

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 (3 active nest sites in 2001). Additionally, this area is currently experiencing a rapid growth in new home sales. Since the listing of this distinct population segment in Arizona, housing construction has continued to increase in the Tucson area, and this trend is expected to continue into the foreseeable future. For example, in May 1999, new-home closings were a record 467 units, higher than in any other May within the past decade (The Arizona Daily Star 1999). In 1999, Tucson-area building permits were 10.9% more than in 1988, and topped 7,000 for the first time. Permits were highest in northwestern Tucson and, for the first time, Marana issued more than 1,000 permits, with a strong building trend expected to continue steady or increasing (The Arizona Daily Star 2000a). We have received, and continue

[9] Such as a section 402 or 404 permit under the CWA, or some other Federal authorization or funding.

to receive notification of numerous new housing subdivisions and commercial developments in this region as well. Many of these activities will require a Federal permit or authorization, and may enter into consultation with the Service in the future. However, as stated above, some projects are resulting in adverse effects to the CFPO and affecting the survival and recovery of the species but are not undergoing consultation. Therefore, these activities continue to reduce the amount of habitat and reduce possible movement corridors within the project area, further degrading the baseline condition. In addition, projects not having a Federal nexus (such as single family residences) are expected to continue in undeveloped areas within the project area until build-out, which will further affect the survival and recovery of the CFPO if not done in a manner that maintains a high proportion of conservation areas that is available for use by CFPOs.

VI. CONCLUSION

After reviewing the current status of the CFPO, the environmental baseline for the action area, the effects of the proposed capital improvement, and cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the CFPO. There currently is no critical habitat for the CFPO, therefore none will be affected. These conclusions are based on the record of this consultation including the BA, Supplemental Report, project description, and the following:

1. Conservation measures will be implemented to minimize noise and vegetation disturbance within the project parcels.

2. The loss of approximately 141 acres of suitable habitat will be offset with the protection of approximately 280 acres of conservation areas (437.5 conservation credits) managed for CFPO conservation purposes. These lands will be managed in a manner that will protect suitable habitat for the CFPO and contribute to its conservation.

3. Although movement corridors through the Hartman Vista Parcel will likely no longer be viable, CFPO habitat connectivity within the Potvin and Oasis parcels and to adjacent suitable habitat areas will be maintained.

4. The Potvin and the southern portion of the Oasis parcels will continue to provide habitat suitable for breeding, sheltering, feeding, and movement for CFPOs.

5. The known territory containing the Potvin Parcel will be placed in conservation status in perpetuity for the CFPO.

6. Management of the conservation areas within all three parcels will generally be conducive to the CFPO by limiting those activities that might adversely affect the owl in perpetuity.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA 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 ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Amount or Extent of Take Anticipated

We do not anticipate the proposed action will incidentally take any CFPOs.

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 ESA direct federal agencies to utilize their authorities to further the purposes of the ESA 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 ESA, we recommend implementing the following discretionary actions:

1. The applicant, EPA, and COE, should reconfigure the development on the north side of the Canada Agua Wash in the Hartman Vistas Parcel to widen the wash corridor to allow a functional CFPO movement corridor to exist. Planting of native trees should be utilized to improve the amount of cover.

2. The applicant, EPA, and COE should plant native trees where developed areas border conservation areas to provide visual screening and buffer to minimize adverse effects from human disturbances. Trees should be planted on 25-foot centers and irrigated to ensure survivability.

3. The EPA and COE 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 northwestern 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.

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

5. The EPA and COE should assist in the implementation of recovery tasks identified in the CFPO Recovery Plan when approved by the Service.

REINITIATION NOTICE

This concludes formal consultation for the Hartman Vistas project in Pima County, 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 not authorized herein 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 draft 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 draft 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 not authorized herein 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

COE 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-364 to this consultation. Please refer to that number in future correspondence on this consultation. Any questions or comments should be directed to David Harlow, Mike Wrigley (602/242-0210), or Sherry Barrett (520/670-4617) of the Arizona Ecological Services Office.

Sincerely,

/s/ David L. Harlow
Field Supervisor

cc: Assistant Regional Director, Ecological Services, Albuquerque, NM
(Attn: Cindy Schulz)
Terry Klinger, New World Development, 3550 North 1st Avenue, Suite 150, Tucson, AZ 85719

Director, Arizona Game and Fish Department, Phoenix, AZ
Arizona Game and Fish Department, Tucson AZ (Attn: Scott Richardson)
Town Manager, Town of Marana,13251 N. Lon Adams Road, Marana, AZ 85653

Enclosures

W:\WRIGLEY\Hartman Vistas fnl bo.wpd\ij

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 and Fish Department Region 5 Wildlife Program. Phoenix. 83 pp.

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.

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 and U.S. Fish and Wildlife Service. 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.

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.

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.

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

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. 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. and D.M. Finch (eds.). 2000. 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., 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.

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.

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

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

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.

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.

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

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.

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. 1985. 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-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. Wildl. Fed., Washington, D.C. 395 pp.

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

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.

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.

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.

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.

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.

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

Pima County. 2001. Draft Scientific Biological Reserve. Mr. Chuck Huckelberry. 6 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.A. 1996. Natural history of the cactus ferruginous pygmy-owl. Master's Thesis, Texas A & M Univ., Kingsville.

Proudfoot, G.A., S.L. Beasom, D. Graul, and T. Urban. 1994. 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. A. and R.R. Johnson. 2000. Ferruginous pygmy-owl (Glaucidium brasilianum). *in* A. Poole and F. Gill (eds), The Birds of North America, No. 498, 2000.

Proudfoot, G.A. and R.D. Slack. 2001. Comparisons of ferruginous pygmy-owl mtDNA at local and international scales. Department of Wildlife and Fisheries Sciences, Texas A&M Univ. A report for Pima County. 11 pp.

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

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

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.

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

Soule, M.E. 1986. Conservation biology. The science of scarcity and diversity. Sinauer Assoc., Inc. Sunderland, MA. 584 pp.

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

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.

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.

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 non-game birds. USDA Forest Service Gen. Tech. ref. W0-1.

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

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 Daily Star. 1999. Homes are hot. Newspaper article. June 23, 1999.

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

The Arizona Daily Star. 2000b. Suburb rush - newcomers piling into booming northwest. Newspaper article. April 2, 2000.

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

U.S. Fish and Wildlife Service. 1988. Riparian Habitat: An Unrecognized Resource. Pamphlet.

U.S. Fish and Wildlife Service. 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. 1999. 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. General Accounting Office. 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.

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.

WestLand Resources. 1999. Hartman Vistas Biological assessment. August 1999. 35 pp.

WestLand Resources. 2001. Supplemental Report to the biological assessment of Hartman Vistas. June 21, 2001. 14 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.

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.

Wilcox, R.L., S. Richardson, and D. Abbate. 2000. Habitat selection by cactus ferruginous pygmy-owls in southern Arizona - preliminary results. Arizona Game and Fish Dept., Tucson, AZ. 13 pp.

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