CACTUS FERRUGINOUS PYGMY-OWL SURVEYS AND NEST MONITORING IN THE TUCSON BASIN AREA, ARIZONA - 1996

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RECOMMENDED CITATION

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CACTUS FERRUGINOUS PYGMY-OWL SURVEYS AND NEST MONITORING IN THE TUCSON BASIN, ARIZONA 1996

INTRODUCTION

The ferruginous pygmy-owl (*Glaucidium brasilianum*) is a small, 6.5 to 7.0 in (16.5 to 17.8 cm) long owl with a long rufous colored tail accented by dark barring. The front view of the head is characterized as smooth and lacking ear tufts while the back of the head has a pair of conspicuous black "eye spots" outlined in white. The cactus ferruginous pygmy-owl (*G.b. cactorum*) is the northernmost subspecies of *G.brasilianum* ranging from southern Arizona and southern Texas south to Michoacan, Nuevo Leon, and Tamaulipas, Mexico (Johnsgard 1988). This species occurs in lower more arid areas than the northern pygmy-owl (*Glaucidium gnoma*) known from forested mountain locations. In Mexico, *G.brasilianum* is known from elevations below 4000 ft (1200 m).

In Arizona, historical records have shown *G.b.cactorum* to inhabit riparian woodlands, nesting in cottonwoods (*Populus fremontii*) and willows (*Salix gooddingii*) (Rea 1983) and also occurring in mesquite thickets (Bent 1938). Much of Arizona's riparian broadleaf habitat has been destroyed or severely altered due to groundwater depletion, woodcutting, grazing, other agricultural practices, dam construction and other development. While some stands of mesquite (*Prosopis spp.*) bosque habitat type have survived, associated broadleaf trees and adjacent saguaro cacti, which could potentially be used for nesting by cactus ferruginous pygmy-owls, are increasingly rare. Recent confirmed reports of cactus ferruginous pygmy-owls (hereafter "pygmy-owl") in Arizona are exclusively from Sonoran desertscrub below 3000 ft (914 m) in elevation and south of Picacho Peak (AGFD survey records 1993-96).

The decline in range and abundance of this species since the 1950's (Phillips et al. 1964, Monson and Phillips 1981, Rea 1983, Johnson and Haight 1985, Hunter 1988, Millsap and Johnson 1988) led to the classification of the pygmy-owl as a Category 2 species by the U.S. Fish and Wildlife Service (USFWS) in 1989. The status of the pygmy-owl was changed to Category 1 candidate species in 1991 (USFWS 1991). The Arizona Game and Fish Department (AGFD) began formal surveys in 1993 to determine the current distribution and population size in the state, identify current specific habitat requirements, and formulate management recommendations (Felly and Corman 1993). In response to a petition, the USFWS proposed listing the ferruginous pygmy-owl as endangered in Arizona in 1994 (USFWS 1994), but work on the listing ceased during a federally imposed moratorium on the listing of new species. The listing proposal is again going forward after the moratorium was lifted in 1996..

1996 SURVEY AREAS

The Tucson Basin was selected as the focus of pygmy-owl surveys in 1996 (Figure 1). This area is bounded by five mountain ranges. The Tucson Mountains on the west boundary, the Rincon Mountains to the east, the Santa Catalina and Tortolita Mountains to the north and the Santa Rita Mountains to the south define the perimeter. The 1996 survey effort concentrated on an area in the northwest portion of Tucson (east of Interstate 10) where a limited number of pygmy-owl detections were recorded between 1993 and 1995. Surveys in 3 additional areas outside this primary survey location were also conducted. These included the Cienega Creek Preserve, Northeast Tucson, and the Red Rock - Marana areas.

Northwest Tucson

The northwest Tucson survey area is semi-rural but changing rapidly due to residential and commercial development. Surveys were focused along land parcels, mostly in private ownership, containing residences and zoned as Suburban Ranch (SR in Pima County). Horse stables, arenas and corrals are common. Parcels range in size from 3.3 to 40 acres (1.3 to 16 ha) with the majority under 10 acres (4 ha) in size. Despite home construction and some clearing for livestock use, much of the vegetation and wash areas within the parcels remain natural and relatively undisturbed, however, corridors have been cleared to provide a network of access roads. Many of the roads remain dirt and are periodically maintained by grading. Larger tracts (one or more topographic map sections) in the surrounding area are owned by development corporations and are currently being developed.

The survey area falls within the biotic community described by Brown (1994) as Sonoran desertscrub and is considered an upland subdivision. The topography is gently sloping, influenced by numerous large dry washes and smaller tributaries. Survey routes ranged in elevation from 2235 to 2740 ft (681 to 835 m) and fell mostly within the Paloverde-Cacti-Mixed Scrub Series (Brown 1994). Dominant vegetation includes saguaro (*Carnegiea gigantia*) , ironwood (*Olneya tesota*), foothill paloverde (*Cercidium microphyllum*), velvet mesquite (*Prosopis velutina*) and blue paloverde (*Cercidium floridum*). Catclaw acacia (*Acacia greggii*) and whitethorn acacia (*Acacia constricta)* can also be found in locally large numbers. A number of species of cholla and prickly pear (*Opuntia spp.*) as well as fishhook barrel cactus (*Ferocactus wislizenii*) and Fendler hedgehog (*Echinocereus fendleri*) are common. Larger shrub species include creosote bush (*Larrea tridentata*), desert hackberry (*Celtis pallida*) and graythorn (*Zizyphus obtusifoia*). Triangle-leaf bursage (*Ambrosia deltoidea*) is the most abundant small shrub over most of the terrain.

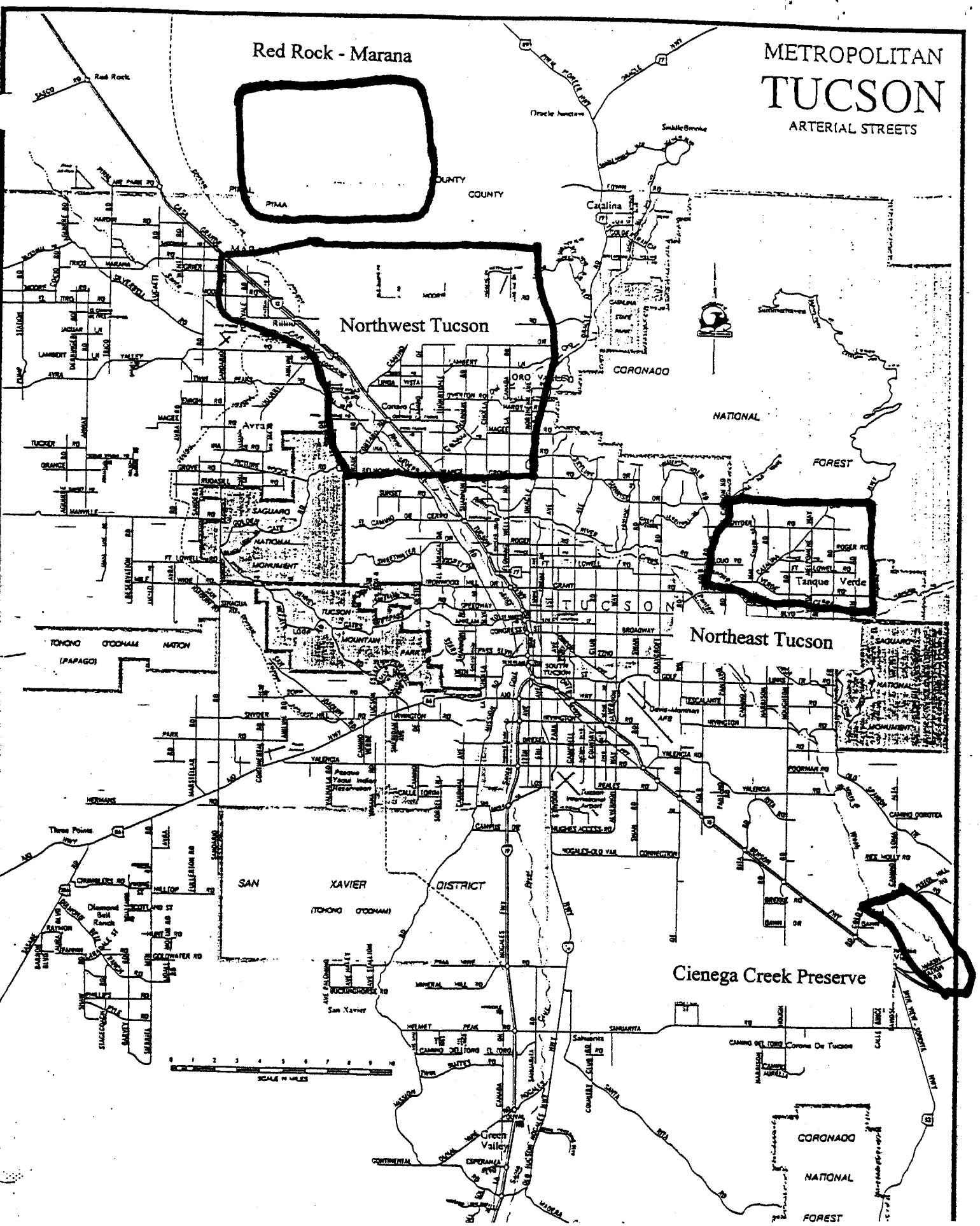


Figure 1. Survey Area Map - General areas surveyed for Cactus Ferruginous Pygmy-Owls during 1996.

Northeast Tucson

The northeast Tucson surveys included three distinct locations. The Lower Bear Canyon route begins at the mouth of the canyon in the Sabino Canyon Recreation Area near the north end of the access road to Bear Canyon. Land outside the recreation area and on three sides of the lower portion of the survey route is private residential on 1 to 3.3 acre (0.4-1.3 ha) parcels. A few parcels with larger acreage are also in the area. The survey route follows the trail south that parallels Bear Creek to the access road outside the recreation area. This habitat is also described as Sonoran desertscrub, but the steeper rocky slopes above the creek bottom are relatively open and support foothill paloverde and saguaro as dominant species. Ocotillo (*Fouquieria splendens*) brittlebush (*Encelia farinosa*), fishhook barrel cactus, and a number of cholla and prickly pear are also common. Velvet mesquite and acacia are superior in numbers along the banks of the creek.

The Agua Caliente Park survey location is surrounded by Sonoran desertscrub. The land outside the park is private residential with most parcels at 1 to 3.3 acres (0.4-1.3 ha) in size. This unique 100 acre (40.5 ha) park contains natural springs and has been heavily modified by present and past owners including some clearing for agriculture, management, recreation, parking areas and the development or modification of water ponds. Large palm trees and other non-native species produce substantial cover and small cavities. A riparian woodland with velvet mesquite and burro-weed as co-dominants is also within the park boundaries and covers approximately 60 acres (24 ha). Many large saguaros can be found outside the park while the number of large cacti within the park is limited. Fifty percent of the saguaros in the park are under 10 ft (3 m) in height. Agua Caliente Wash runs close to the north and west boundaries. This dry wash contains patches of large Arizona sycamore (*Platanus wrightii*), desert willow (*Chilopsis linearis*), Fremont cottonwood and more areas of mesquite bosque. The park's elevation ranges from 2720 to 2800 ft (829 to 853 m).

The third northeast Tucson survey route is along the Agua Caliente Wash from Houghton Road west to the confluence of Tanque Verde Creek and Agua Caliente Wash. This area contains patches of eucalyptus (*Eucalyptus spp.*), Arizona sycamore, Fremont cottonwood, and desert willow with large areas of mesquite bosque as you move away from the wash banks. The surrounding area is considered suburban with land devoted mostly to residential use. Small ranches and horse property are also common. Elevations range from 2550 to 2590 ft (777 to 789 m).

Cienega Creek Preserve

The Cienega Creek Preserve survey route was limited to a 1.1 mile (1.8 km) stretch of Sonoran riparian habitat (Brown 1994) with call points upstream from the Cienega Bridge past Davidson Canyon and downstream to the first major bend northwest, where a break

in the mesquite bosque occurs. Desert willow, Fremont cottonwood, and other broadleaf riparian species were dominant in some locations but intermixed with extremely dense mesquite bosque along other sections of the creek bank. Perennial water flows through a major portion of this stretch of the Preserve supporting grasses, sedges, and other strictly water dependent species. Railroad lines located on the upper slopes roughly follow the creek's course. The still higher, rolling hill terrain in the surrounding area is relatively open and is a Sonoran desertscrub transition area with grasses and shrubs increasing while large cacti decrease in abundance. This area is used for occasional livestock grazing with sparse development of private residences outside the Preserve. Elevations covered by this survey route range from 3280 to 3400 ft (1000 to 1036 m).

Red Rock - Marana

The Red Rock - Marana survey area south of the Coronado Wash and west of the Tortolita Mountains is characterized as Sonoran desertscrub habitat with locally dense stands of saguaro and foothill paloverde becoming dominant. Ironwood is commonly found along with these dominant species though not in all localities. A variety of cholla, prickly pear, hedgehog, and fish hook barrel cacti are representative of the understory with creosote bush increasing at lower elevations. Similar to the northwest Tucson survey area, the most abundant small shrub is triangle-leaf bursage. Velvet mesquite and acacia increase in numbers along the many smaller dry washes, with desert willow appearing in the larger washes that drain the foothills to the east. This general area contains a number of small and large ranches with vast areas used for open range livestock grazing. Rural private residences on 3 to 40 acre (1-16 ha) parcels are spread throughout this area and are increasing, along with some potentially higher-density developments. Elevations of the survey locations ranged from 2180 to 2500 ft (664 to 762 m).

METHODS

Surveys for cactus ferruginous pygmy-owls during the 1996 field season were conducted between 22 January and 14 June. Survey efforts were concentrated in northwest Tucson. Initial survey locations were selected based on detections from previous field seasons (1993 to 1995), earlier observations and reports. Survey routes were expanded from these locations once all known detection areas were investigated and additional areas of similar habitat were identified. Our approach during the 1996 season was to narrow the focus of survey efforts providing a more intensive search over a smaller area. With the exception of a few surveys by AGFD Region V personnel in outlying areas, the contract personnel conducted all surveys.

Survey Protocol and Equipment

Based on the limited success of surveys in previous years, recommendations from earlier survey workers, and the objective to provide increased coverage of a smaller survey area, the Cactus Ferruginous Pygmy-Owl Survey Protocol was revised for the 1996 season (Appendix 1). The protocol developed by the AGFD (Felly and Corman 1993) was modified in several ways. First, while the primary focus of survey activity continued during the times considered peak activity periods (one hour before sunrise until two hours after sunrise and one to two hours before sunset until two hours after sunset), surveys were not strictly limited to this schedule and experimentation with extended calling periods was encouraged. Secondly, the distance between call points was increased from 150 to 300 yds (137 to 274 m) with the option of adding intermediate call points to a section of the route if the terrain, habitat, disturbances or other local conditions prevent adequate coverage with 300 yd (274m) intervals. Perhaps the most important revision was to increase the broadcast and listening times for each call point location. The broadcast time was increased to a minimum of 10 minutes with the option of calling longer if disturbances limited coverage or superior habitat quality warranted increased survey time. The 10 minute broadcast period began with a 30 second broadcast followed by a 60 to 90 second listening sequence. This broadcast and listening sequence was repeated for the entire 10 minutes. The listening period at the end of the 10 minute broadcast period was also increased from 2 or 3 minutes to a minimum of five minutes. The combined broadcast and listening periods for each call point was a minimum of 15 minutes unless a pygmy-owl was detected.

Most surveys for pygmy-owls were conducted by broadcasting a taped call using a Johnny Stewart Game Caller - MS 240. Volume was set between 1/3 and ½ capacity. No numerical designations for volume are indicated on this caller but slash marks represent units of volume. The speaker was separated from the player and held waist to shoulder high - approximately 39 to 60 inches (99 to 152 cm) above the ground during broadcasts. Taped calls were broadcast with the speaker aimed in a different direction during each 30 second broadcast during the 10 minute period. Estimates of the four cardinal directions were called unless a structure such as a building or wall presented a barrier. Broadcasts were aimed between the primary directions when the surveyor wanted to increase the calling coverage. Broadcasts were aimed in the same or nearly the same direction for several 30 second intervals when a sound or an initial response could not be identified. Once the sound or response was identified, the next broadcast was aimed in a different direction. The total calling coverage area was estimated by multiplying the distance traveled by 0.4 mi (0.65 km) (Felly and Corman 1993).

Detection Defined

Detection of a pygmy-owl is defined as the aural detection or visual observation of one or more pygmy-owls during a formal survey, monitoring visit or an unplanned observation. Multiple detections of the same individual or pair of birds are included in the total number of general detections for the 1996 survey season. The actual number of individual birds will be less than the total number of detections since it is likely that the same individuals were observed during more than one visit and occasionally in different locations. Primary detections are distinguished from general detections and are defined as observations of pygmy-owls in new locations that are at least .25 mi (.4 km) from another detection location, or are known to represent new individuals in the current survey year. A pygmy-owl was considered a new individual if it had not been detected during previous surveys in the same year and the nearest neighbor pygmy-owl was still detected near its original location. Primary detections do not include repeated detections of the same individual or pair. Once a pygmy-owl was detected for the first time, location information, weather conditions and other observations were recorded on survey forms which have been revised for the 1996 season (Appendix 2A to 2E). Detection locations were plotted on USGS 7.5 minute topographical maps. Both the legal description and UTM location were recorded on the survey form (Appendix 2A). Locations were considered the same unless birds were detected a minimum of 300 ft (91 m) from the previous location. Locations do not equal detections and there may be more than one location per detection site. Recording separate pygmy-owl locations using the 300 ft criterion allowed differences in vegetation and man-made structures to be reflected in the vegetation sampling measurements of high use areas. It also enabled mapping records to indicate only pygmy-owl locations that were substantially different from initial detection locations.

Detection Site Monitoring

Detection sites were monitored by AGFD personnel, property owners and survey workers. All sites were visited by survey workers every 5 to 10 days to determine occupancy and nesting status. Post detection visit forms were completed for each visit to document the status of each site (Appendix 2B). We also began using a post-detection monitoring protocol. On arrival, the surveyor listens and scans the general area for 5 minutes. If no detection is made, a 15 minute calling and listening sequence described in the general survey protocol is completed. Once a detection is confirmed and the birds general location is determined, survey broadcasts are ended and monitoring begins to assess nesting status, vegetative structure use and behavior. If no detection results, a more complete survey effort in the general area is conducted in an attempt do document the presence of any pygmy-owls.

Pygmy-Owl Monitoring by Residents

Residents living near pygmy-owl detection locations were interviewed to determine their awareness of the owl's activity and to gain permission for access to their property to complete survey and monitoring work. They were informed about pygmy-owl population status, life history and AGFD survey and monitoring activities in their neighborhood. Some residents expressed great interest in the birds and were willing to assist in monitoring the owl's activities. A list of property owners and local contacts where pygmy-owls were detected in 1996 was compiled for future recruitment of site monitors and are on file in the AGFD Region V office. A monitoring form was developed and distributed to interested residents providing a record of observations to AGFD during the blocks of time when survey workers could not visit the site (Appendix 2C). Photographs of pygmy-owls and a recording of the territorial call were reviewed with interested parties to confirm accurate identification.

Nest Searches

Nest searches were conducted in areas around detection locations particularly when pygmy-owls heard calling regularly during the first half of the survey season were no longer detected. Property owners were contacted to gain permission for access to private parcels. Survey workers visited the properties, interviewed the owners and conducted intensive searches. The searches consisted of examining all trees and large shrubs that appeared to offer adequate cover for shade, perches or roosts. We attempted to identify high use structures by searching for castings, white wash accumulation or prey remains. In addition, all large saguaros with potential nesting cavities were surveyed by positioning one or two workers at good vantage locations, imitating pygmy-owl calls by whistling, and watching suitable cavities for the appearance of curious owls.

Nest Monitoring

Nest monitoring was conducted primarily by two field workers and resident property owners. During incubation and nestling stages, observations were conducted from a distance of 70 ft (21.3 m) using binoculars and 15 to 60 power spotting scopes. No blind was used and observers were located to provide a direct frontal view of the nest cavity opening. Once fledging occurred, observation locations changed and the distance between birds and observers was variable. Observations were recorded in field notes and later summarized on nest monitoring and prey delivery log forms (Appendix 2D & 2E).

SURVEY RESULTS

Survey Effort

Pygmy-owl surveys were conducted from 22 January to 14 June 1996 over a total distance of 55.2 mi (88.8 km) using 356 call point locations. Some of these call points were visited more than once, but all replicated points and survey routes are included in the total number of points called and total distance surveyed. We estimated the area of calling coverage at 22.1 mi² (57.8 km²) (Table 1). There were 268 call points surveyed over a distance of 42.4 mi (68 km) when replicated points and repeated survey routes are excluded from calculations. The estimated area of calling coverage for this initial effort was 17.0 mi² (44.2 km²).

Table 1. Cactus ferruginous pygmy-owl 1996 total survey effort and detections in the Tucson Basin area, Arizona.[1]

Month	Survey Hours	Survey Days	Total Distance mi	Total Distance km	Coverage Estimate mi²	Coverage Estimate km²	Total Call Points	Detections[2]
January	11.5	6	6.1	9.8	2.4	6.4	36	1
February	35.0	20	13.9	22.4	5.6	14.6	99	8
March	30.5	19	16.6	26.7	6.6	17.4	77	18
April	23.0	12	7.3	11.7	2.9	7.6	60	9
May	20.5	22	8.9	14.3	3.6	9.3	64	4
June	7.0	3	2.4	3.9	1.0	2.5	20	1
Totals	127.5	82	55.2	88.8	22.1	57.8	356	41

[1] The summary of survey effort and detections includes replicated call points and repeated survey routes.

[2] The total number of detections include formal survey results from repeated visits to previous detection locations and detections recorded during casual observations by AGFD personnel. Nest site detections after nesting was confirmed are excluded (see Detection Defined, Page 6).

The surveys were concentrated in northwest Tucson since detection success increased in this area during the first half of the field season. This approach was continued when no detections were made during initial surveys in other locations, until another detection was made in the Red Rock - Marana area. We increased survey efforts in this second area in late May. The first pygmy-owl detection was 29 January and the last detection by survey workers during formal surveys was 6 June 1996. Residents in known detection areas have documented owls calling through 19 June. Table 2 summarizes survey efforts from 1993 to 1996.

Table 2. Comparison of cactus ferruginous pygmy-owl survey efforts in southern Arizona 1993 - 96.

Survey Dates	Estimate Area of Calling Coverage mi^2	km^2	Total Survey Hours	Total Survey Days
8 April - 21 May 1993	62.4	161.6	136.2	54
21 Sep 1993 - 11 May 1994	70.1	179.3	184.6	62
5 Jan - 7 Apr 1995	39.7	103.9	155.7	68
22 Jan - 14 June 1996	22.1	57.8	127.5	82
Totals	194.3	502.6	604.0	266

Detections

Seventeen primary detections (see Detections Defined, p.6) of cactus ferruginous pygmy-owls were recorded from northwest Tucson and Red Rock - Marana survey areas during the survey period. An additional primary detection was recorded after the formal survey period, but within the survey area. We feel that these detections represent a minimum of 14 individuals including one known nesting pair and their 2 successfully fledged young (see Nest Monitoring Section, p.14). A total of 48 general detections were recorded through 12 August 1996. Formal surveys and monitoring resulted in 37 detections. Unplanned observations by AGFD personnel living in detection areas accounted for 11 additional detections with nine of these recorded in March. An additional 60 detections were recorded during nest site monitoring.

During formal surveys and monitoring, 18 detections (49 percent) were documented by eliciting responses using taped-call broadcasts. Nineteen detections (51 percent) were recorded when pygmy-owls were heard calling spontaneously along formal survey routes without elicitation from taped-call broadcasts. However, only three primary pygmy-owl

detections were made in this manner. The remaining primary detections were documented during taped-call broadcast surveys. We recorded a total of 12 hours and 7 minutes of formal survey time both before and after protocol survey hours. These extended experimental survey hours resulted in no pygmy-owl detections.

An informal comparison of morning with evening formal survey and monitoring success indicates 25 pygmy-owl detections during morning surveys and 12 during the evening. Spontaneous calling by pygmy-owls during morning and evening hours accounted for 14 and 5 detections respectively.

Habitat Description of Detection Areas

Formal measurements of site specific habitat characteristics within detection areas is underway but analysis has not been completed. This work will be continued by AGFD personnel during field work during the later part of 1996 and during 1997. In general, cactus ferruginous pygmy-owls during the 1996 season were detected within approximately 300 ft (91 m) of private residences. In an area outside the 1996 survey, at least one pygmy-owl was also detected close to buildings and human activity at Organ Pipe Cactus National Monument (OPNM) (T. Tibbitts, pers. comm.). Three other detections at OPNM were in backcountry locations away from buildings. Many of the Tucson detection locations are within small ranches or horse properties from 3.3 to 10 acres in size with most of the parcels retaining some natural vegetation. Most of these areas are considered semi-rural to suburban. Two locations in the Red Rock - Marana survey area can be described as rural.

All detection sites are within the Arizona upland subdivision of the Sonoran desertscrub biotic community and in the paloverde-cacti mixed scrub series (Brown 1994). The dominant species in most detection locations are saguaro, foothill paloverde, ironwood, and velvet mesquite. Almost all initial visual detections of pygmy-owls were in one of the above three tree species. Whitethorn acacia and catclaw acacia are common especially near washes. Desert hackberry and graythorn increase near washes as well. A number of cholla and prickly pear species are common along with fishhook barrel and hedghog cactus. Creosote bush and desert broom are found sporadically, but sometimes are locally abundant. Desert broom was especially common in disturbed sites. The most abundant low shrub is triangle-leaf bursage.

Dry, braided wash systems and associated vegetation were common in most of these locations. These xeroriparian areas included small arroyos less than 5 ft (1.5 m) in width and larger washes over 20 ft (6 m) in width. In a review of the 17 primary detection locations, 4 were within washes, 6 were within 100 ft (30 m) and 7 detections were more than 100 ft from a dry wash. We were not able to determine if these drainages were used with greater frequency than other areas, but it is something that will be analyzed during future habitat characterization work. Owls were often observed very close to residences

perching in both native and non-native trees and shrubs with dense branches and foliage. Some non-native species used were Aleppo pine (*Pinus halepensis*), eucalyptus (*Eucalyptus spp.*) and California pepper tree (*Schinus molle*). At the nest site, the pepper tree was heavily used during incubation and nestling periods for cover, feeding, and prey deliveries. During this time and especially after fledging, the owls frequently used foothill paloverde, velvet mesquite and ironwood.

Measurements were taken on 33 trees or structures which were used by owls for perching. The mean height of perch limbs was calculated to see if there was any indication that perch structures of a certain height were being used (Table 3).

Table 3. Average perch heights used by pygmy-owls at the nest site location, 1996.

	# of Trees	# of Perch Sites	Mean Perch Height (feet)	Mean Perch Height (meters)	Perch Height Range (feet)	Perch Height Range (meters)
Palo Verde	9	11	8.4	2.6	1.2-9.5	0.4-2.9
Ironwood	8	17	7.5	2.3	5.8-10.0	1.8-3.0
Mesquite	9	21	6.6	2.0	2.0-10.0	0.6-3.0
Creosote	2	3	3.3	1.0	3.0-4.5	0.9-1.4
Eucalyptus	1	3	16.0	4.9	13.0-20.0	3.9-6.1
Cottonwood	1	1	8.0	2.4	8.0	2.4
Pepper Tree	1	2	9.5	2.9	6.0-13.0	1.8-3.9
Tree Stakes	2	2	5.7	1.7	5.0-6.4	1.5-1.9
TOTAL	33	60	7.6	2.3	1.2-20.0	0.4-6.1

The mean perch height of 60 perching sites was 7.6 feet (2.3 m) with a range of 1.2 ft. (0.4 m) to 20 ft.(6.1 m). These data do not necessarily indicate a preferred perch height. They may merely represent the height of available limbs of suitable diameter for perching and, therefore, may be a factor of tree size or growth pattern. Measurements of perching heights in Texas habitats, or riparian habitats in Arizona, with different tree species would shed light on the preferred vs. available perching height question.

Nest Search Results

In addition to formal surveys, nest searches were conducted in areas where regular calling by at least one pygmy-owl over several weeks suddenly stopped, possibly indicating pairing, or where detections were sporadic. Eleven nest searches were conducted on private property after approval was gained from the owners. One nest was located at a site where pygmy-owl activity had been previously detected by both residents and survey

workers. This nest was found using the nesting cavity survey method described in the methods section. No aural response occurred, but the incubating female briefly appeared in the saguaro cavity opening, looked around and then disappeared back inside the cavity. This silent response could be easily missed by one worker if observing from a different position.

Preliminary Results of Pygmy-owl Monitoring by Area Residents

Preliminary analysis of resident observations has provided an additional 85 detections at 6 different locations. These areas were also monitored by survey workers but at different times. One resident has documented sustained pygmy-owl activity through direct observation and aural detection for over one year (1995- 96) with the exception of approximately 1 week. Residents have provided valuable information about the pygmy-owl's daily behavior that might have otherwise gone unrecorded. For example, residents documented frequent water use, which was only detected twice by formal surveys and monitoring. Other information gained from residents includes favorite perches and other high-use areas, owl movements, vocalizations, nesting chronology, diet, prey observations and other general behavioral information. The contributions of these interested and cooperative residents have increased our knowledge of pygmy-owl ecology and assisted workers in finding owls more easily. The importance of private property owner assistance should not be underestimated and every effort should be made to foster and maintain these valuable relationships.

Territorial Vocalizations

The primary pygmy-owl vocalization detected by survey workers during formal surveys was the single pitch "whistle-like" repeated note uttered by suspected territorial males. Calling sequences were composed of one or two notes and up to 98 without a pause. One resident reported a pygmy-owl calling 298 times without a pause. One individual flew in and perched within 10 ft (3 m) of the surveyor calling for the six minute observation period. During this event the one-pitch repeated- note call changed briefly to a chirping or "hiccup" at a slower cadence, then reverted quickly back to the previous one-pitch call. At another location, a resident recorded one pygmy-owl vocalization changing from the typical one-pitch repeated-note call to a much higher metallic or "horn-like" squeak. This vocal change continued for approximately 45 minutes and then returned to the more common call.

Responses of Songbirds and Raptors to Taped-Call Broadcasts

The responses of other birds to pygmy-owl taped-call broadcasts were variable (Table 4). It was often unclear whether changes in bird behavior or vocalizations were in response to the broadcast or the presence of the survey worker. It was common to see birds reacting to the actual presence of an owl once it was detected in the area, but responses to the

broadcast shortly before the detection were not always recognized. During nest monitoring sessions, mobbing behavior by songbirds often alerted observers to owl locations. In fact, it was the primary means of locating the owls once prey deliveries to the fledgling stopped. Responses to broadcasts and owl presence did not always occur and sometimes when birds did respond, it only lasted for a few minutes. The most common species to respond to taped broadcasts during daylight were black-tailed gnatcatchers, verdins, ash-throated flycatchers, and cactus wrens. These birds would usually fly to perches within 10 to 25 ft (3 to 7.6 m) and hop erratically from perch to perch, scolding and looking for the source of the sound or call softly from one or two perches. Harris hawks were the only diurnal raptor to respond to the broadcast by screaming a few times, but this was rare.

Only two other owl species responded to broadcasts. Great horned-owls were common along most survey routes and vocalized in response. However, none were observed moving closer to the surveyor. Western screech-owls were heard responding in a number of locations. One called in response to the broadcast before sunset. A second flew in and perched within 50 ft (15 m) making a variety of sounds. An elf owl was heard before dawn in the area of the pygmy-owl nest, but this calling was not elicited.

Table 4. Comparison of songbird and raptor frequency of response to pygmy-owl broadcasts and actual pygmy-owl presence.

rare = 1 response, uncommon = 2 to 3 responses, common = 4 to 6 responses, very common = 7 or more responses

Species	Response to Broadcast	Response to Pygmy-Owl Presence
Ash-throated flycatcher	very common	uncommon
Black-tailed gnatcatcher	very common	very common
Bushtit	none	rare
Cactus wren	common	common
Curve-billed thrasher	uncommon	common
Gila woodpecker	common	very common
Harris' hawk	rare	none
House finch	uncommon	common
Phainopepla	rare	rare
Pyrrhuloxia	rare	rare
Northern cardinal	rare	uncommon
Northern mockingbird	none	rare
Lesser nighthawk	rare	none
Great horned owl	very common	rare
Verdin	very common	very common
Western screech-owl	common	none

Pygmy-Owl Response to Human Presence

Detection locations close to residences and human activities is one indication that cactus ferruginous pygmy-owls are not intimidated by the presence of people or can acclimate to low density urbanization and associated activities. Pygmy-owls were regularly observed by survey workers and residents from a distance of less than 50 ft (15 m). During formal surveys, one pygmy-owl flew in and perched within 10 ft of the surveyor, remaining in this location and calling even after broadcasts were discontinued. Several residents in detection areas reported owls flying in and perching nearby when doing outside work, as though they were curious about the activity. One resident reported watching the female owl at the nest site close to eye level and less than 10 ft (3 m) away when the male flew in and delivered prey in full view of the observer. One surveyor determined the exact location of a calling owl by walking slowly, but directly to the location of the sound. Using this technique, the surveyor was able to approach several owls within 25 ft (7.6 m) or less. However, another worker sometimes found the direct approach only possible to about 20 yards (18 m), then used a zig-zag approach to get closer.

NEST SITE MONITORING RESULTS

Monitoring Effort

A nesting pair of cactus ferruginous pygmy-owls were first discovered by a resident who owns the property where the nest was located. Survey workers had detected pygmy-owl activity in the area but were not able to document more than one bird in the same location. The resident reported observation of 2 pygmy-owls engaged in copulation on 31 March. A suspected nest site cavity was discovered on 8 April. During a nest search of the property, the surveyor stood approximately 20 ft (6 m) from the base of a large multi-armed saguaro and imitated a pygmy-owl call by whistling. A pygmy-owl stuck its head out of the cavity almost immediately and looked around. This suspected female did not respond vocally and quickly disappeared back inside the cavity. The nest site and surrounding area was monitored by two field workers for 237.8 hours over 65 days from 8 April to 20 August (Table 5).

This nesting pair of pygmy-owls successfully fledged 2 young on 4 June. One fledgling disappeared within the first 24 hours. The missing juvenile could not be found and the cause of disappearance was not determined.

Table 5. Cactus ferruginous pygmy-owl nest monitoring effort in southern Arizona 1996.

	April	May	June	July	Aug	Total
Days	3	14*	23	19	6	65
Hours	3	63.5	105.8	53	12.5	237.8
Detections	3	11	24	17	6	61

* Two visits by different observers on the same day are included.

Nest Description

The 1996 nest site was located in a cavity of a large multi-armed saguaro 21.7 ft (6.6 m) from a private residence. A number of medium to large foothill paloverde, velvet mesquite, ironwood and acacia trees occur 20 to 200 ft (6 to 61 m) from the base of the saguaro. Additional large saguaros are numerous in the area, but only one lies within 200 ft (61 m) of the nest location. This second saguaro is where one fledgling found cover and protection in an easily accessed cavity on Day 8 after fledging. The understory in the immediate area is patchy, interrupted by gravel drives, bare ground and groomed landscaping. In the areas where it does occur, triangle-leaf bursage is an abundant low shrub with occasional medium-sized shrubs such as creosote bush and desert broom. A variety of cholla and prickly pear are also common. The height of the nest cavity opening is 17.9 ft (5.5 m) and is in the upper one-third of the main trunk of the saguaro. We counted 25 total cavities in the saguaro, but did not inspect all of these for nesting or roosting suitability. Two out of five inspected cavities appeared suitable (i.e. the cavity was large enough to accommodate an owl). The saguaro had six primary arms and one secondary arm. Cavities in the main trunk numbered 14 while the arms contained 11. Outside and immediately below the bottom edge of the nest cavity opening is a sloping scar that was used as an entry ramp and a temporary perch for the adult male during prey deliveries to the cavity. The cavity opening aspect is 24 degrees.

Nesting Chronology

The secretive nature of the cactus ferruginous pygmy-owl during nesting and the apparent decline of this species in Arizona have prohibited biologists from documenting observations on the breeding biology of this species for many years. Millsap and Johnson (1988) suggested that virtually nothing is known about the breeding biology of this species. Researchers from Texas A&M University have studied breeding populations in

several counties of southern Texas in recent years (Waur et al. 1993, Beasom and Trant 1993). Their work appears on track to document the breeding biology of pygmy-owls in Texas. In southern Arizona, the discovery of a recent fledgling at one location in 1995 and the intensive monitoring of a nest in another location during 1996, have allowed a glimpse into the breeding biology of this species in Arizona and permitted reasonable estimates of the nesting chronology. Using 28 to 30 days for incubation and 27 to 30 days for fledging (Scherzinger 1977, Terres 1991), we estimated times for nesting events based on observations of copulation, fledging and adult behavior at the nest (Appendix 3).

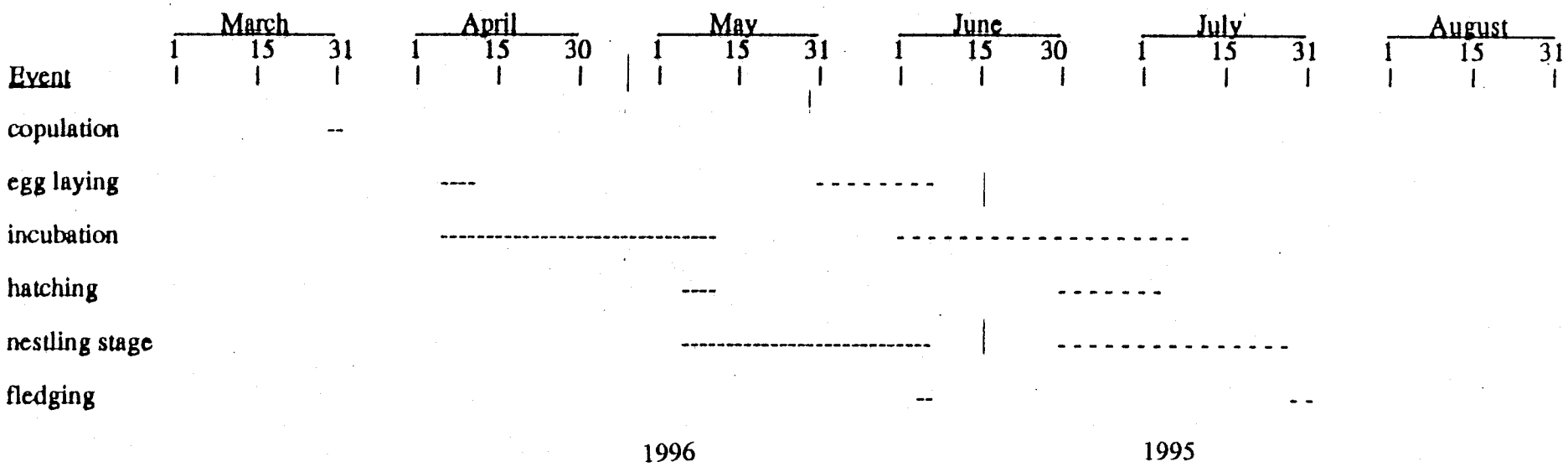
During 1996, copulation was observed on 31 March and fledging was confirmed on 4 June. We estimated egg laying from 6 to 11 April and the onset of incubation from 7 to 12 April. Hatching was estimated at 9 May. In 1995, fledging at a different nest was documented on 29 July. We estimated egg laying at 31 May to 5 June and the onset of incubation at 1 to 6 June. Hatching was calculated from 30 June to 3 July. The differences between the 1995 and 1996 nesting chronologies are pronounced and it is unknown whether, or why, the 1995 nesting activity was unusually late (Figure 2). There are no other recent Arizona records for comparison. The 55 days between times of fledging for these two sites may represent a second brood or a second nesting attempt after an initial failure. In any case, both nest sites successfully fledged young and it is not possible to more narrowly define the nesting period at this time. In Texas, Proudfoot (1996) reports the commencement of egg-laying between 12 April and 26 April, but he does not provide dates for hatching or fledging.

Nest Site Vocalizations

Bird vocalizations are extremely difficult to "translate" into words. Therefore, descriptions are subjective and determined not by the observer's ability to aurally discriminate sounds, but in his or her interpretation and translation into language. Because of these differences, it was sometimes difficult to tell whether two workers hearing vocalizations at different times were describing to each other the same or different vocalizations. The following descriptions are based on the observations of two workers.

Female vocalizations were documented from the monitored nest site during two dawn to dusk observation periods and many monitoring sessions of shorter duration. The primary female vocalization was a rapid "chitter" uttered in short bursts or sequences. These were heard periodically throughout the day increasing in frequency once incubation had ended and primarily during the morning and evening high activity periods. This call often appeared to be directed at the male and certainly used for food-begging, but was also frequently heard after recent prey deliveries, after her own successful prey captures, while she was feeding the fledgling and during other events. It appeared to be used to announce her location to the fledgling. On at least one occasion, the male delivered prey to the female while the fledgling remained at another location more than 25 ft (7.6 m) away. The female remained at the delivery location and chittered repeatedly, apparently

Figure 2. Comparison of 1995 - 96 nesting chronology estimates for 2 cactus ferrunginous pygmy-owl nests in southern Arizona.



calling the fledgling to her to feed. The fledgling flew to the female after a short time and the female began to feed it. On one occasion, the chitter was also heard shortly before and after a nest defense pursuit of a bird and was the first female vocalization during dawn observation periods. In all, we recognized at least 4 female vocalizations or sound combinations: 1) the chitter described above, 2) a single pitch call similar to the male one pitch, but higher, at a slower cadence and possibly with a different tonal quality, 3) the combined chitter and one note at the end of the chitter sequence and 4) chirping - single notes repeated only a few times with a slight pause between notes or, sometimes, called only once. This call seemed to indicate concern or alarm about something and was only documented infrequently.

In addition to the single-note territorial call, males were observed using 3 other vocalizations. One, named flying chirps by a worker, occurred as the male flew off after a prey delivery to the female. It was a series of chirp-like notes, not exactly the same as the female's. It was difficult to detect. Another call, the "alarm" call, was heard only once when a resident approached the owl too closely and it flew off. It was a series of high-pitched "squeaks" that did not change pitch during the note. The third has only been heard at the 1995 nest site, several times by the residents and once by a worker. It is extremely difficult to describe; the best way is as a rough-quality trilling chirp performed rather intensely. It is unlike any other call and the intent of the vocalization is unknown.

A typical prey delivery event during late incubation, nestling and early fledging periods provided the opportunity to observe male and female interaction and the most dramatic vocalizations. An event would begin by the female chittering or the male giving the territorial call, sometimes from a distance. The male would fly to the female's location or nearby and may be silent or may announce his arrival with several one-pitch notes. The female would increase the volume and the chittering sequence frequency once she detected the male's presence. The female vocal intensity reached its peak during the actual prey delivery and diminished once she had possession. The male vocalizations were hard to detect over the female's excited calling, but it was common to hear several "flying chirps" just after prey delivery or as he flew off. During the second week after fledging, intensive vocalizations by the female associated with prey deliveries seemed to decrease. This may have been due in part to fewer deliveries by the male and increased hunting by the female.

Fledgling vocalizations were often difficult to detect due to the pitch and low volume. They were similar to the female's chitter, but much higher in pitch and with a thinner, more metallic tone quality. It was first heard coming from the nestlings in the cavity. Because the sex of the fledglings was undetermined, it is not know if the call was similar to the adult female's because they were female birds or if this is typical nestling/fledgling vocalization, regardless of sex.

A tape of all the different vocalizations that have been recorded is in the process of being compiled for analysis and possible use in future survey work. These tapes are available at the AGFD's Region V office.

Foraging Behavior

Most hunting activity and associated prey captures by the male were away from the nest area and out of sight of the nest observers. Our documentation of this activity was through observation of prey deliveries from the male to the female. However, we did observe eight prey pursuits by the adult female and one by the adult male resulting in 6 successful captures. Observed pursuits were within 150 ft (46 m) of the nest cavity and therefore easily observed. The prey pursued during the three unsuccessful capture attempts were small passerines (2 house finches and 1 black-tailed gnatcatcher). The prey items captured were two lizards, three cicadas, and one undetermined. Prey caching by both the female and the fledgling was observed.

Another successful prey capture by the adult female was observed post-fledging and may shed some insight into the regular mobbing of pygmy-owls by other birds. The adult female entered and removed a nestling cactus wren from the its nest after an extended period of observing the nest. She ate a portion of the nestling at the wren's nest, the whole time being mobbed by the adult wrens. She then flew off and delivered the remaining prey to the fledgling approximately 30 ft. (10 m) away.

Our observations indicate that foraging and prey delivery occurs primarily from just before dawn through as late as 11:00 am. Afternoon foraging usually began sometime after 3:00 pm and ceased shortly after sundown. There was little or no activity during the heat of the day nor after dark. Our observations are only for the nesting and fledging periods. Foraging may occur throughout the day later in the year when it is cooler and prey becomes less available.

Two hunting and prey pursuit strategies were observed. These included pouncing from low (3 ft) to medium (7 - 10 ft) (.9 to 2 - 3 m) perches almost directly above the prey and involved little or no flight. The second was a rapid flight pursuit over a distance of 30 to 100 ft (9 to 30 m) attempting to snatch prey from its tree branch perch. These prey perches appeared to be on the outer edge of the tree and toward the end of the branch. The origin of the attack was from below or at the same level as the prey location during the rapid flight pursuit. If the first capture attempt was not successful, the chase was broken off and the owl returned to its perch.

Prey Descriptions

We observed 84 prey items captured near or delivered to the nest area (Table 6). Fifty-two of these were captured by the male and only 6 by the female from the onset of incubation to the second week after the young had fledged. In the next month, 10 prey items were captured by the male, 10 by the female and 4 were unknown. The fledgling was seen caching prey on 2 occasions that it had apparently captured itself. We distinguished the adult male and female by differences in vocalizations (see Nest Site Vocalizations, p.16) and behavior during prey exchanges. The female remained in or near the nest cavity often within view of the nest monitors while the male frequently disappeared shortly after prey delivery. The female did most of the feeding, but the male was observed feeding the fledgling on at least 2 occasions. Lizards made up 60.0 percent of observed prey items, while birds and mammals accounted for only 8.3 and 4.8 percent respectively. Cicadas were the only captured insect we could document during nest monitoring and represented 4.8 percent of total items. While the identification of 26.2 percent of observed prey items could not be confirmed, there were indications that several of these unknowns were lizards and cicadas.

Table 6. Cactus ferruginous pygmy-owl prey summary - 1996 nest site Tucson Basin, Arizona.

	April	May	June	July	Total
Observation Days	3	14	24	20	28
% of Diet					
Reptiles (60.0%)	1	24	15	7	47
Birds (8.3%)	0	5	2	0	7
Mammals (4.8%)	0	4	0	0	4
Insects (4.8%)	0	0	4	0	4
Undetermined (26.2%)	0	5	10	7	22
Total	1	38	31	14	84

Defense of Young and Nest Area

All observed defensive reactions toward avian intruders were by the female. We documented 9 incidents of nest and/or young defense. All occurred after hatching and continued through the second week after fledging. Most pursuits took place after a bird perched on or flew near the saguaro containing the nest cavity, but their distances from the cavity were variable. One pursuit occurred when a bird was perched in the same tree as the fledgling. A defensive pursuit was from below or at the same height as the intruder. The female would jump off her perch and fly directly at the target and extend her legs towards the target just before the strike attempt. We could determine contact in just 4 of the defensive pursuits, but suspected contact was made during most attempts. Recent conversations with Texas researchers (Proudfoot, pers. comm.) indicate that these interactions may have actually been prey pursuits rather than nest defense. This might explain some inconsistency in attacks. Doves sitting on the same saguaro arm near the nest cavity would be pursued sometimes and ignored at others. Although nest defense seems a reasonable explanation for this behavior, further observations are needed to clarify the intentions of these types of pursuits.

Fledgling and Adult Field Identification Characteristics

Some observers have documented the appearance of adult pygmy-owls seen in the field, but we have not found descriptions of young or recently fledged birds. Their small size, short rapid flights, and concealment within dense vegetation makes recognition of field characteristics even more difficult. Many hours of nest monitoring gave field workers the opportunity to observe adult and fledgling pygmy-owls close together and under different light conditions. Fledglings first observed at 28 to 31 days were fully feathered with no indication of down remaining. Facial appearance was initially smaller and lighter in color than adults probably due to incomplete growth of feathers forming the facial disks. The general coloration on head, back, and wings was light brown with the chest and abdomen being white with less streaking than adults. The crown of the head lacked the white flecks which are found on the adults. Colors appeared richer and darker than adults. The outer primaries and tail were distinctly rufus in color, but this was difficult to detect without direct light. Binoculars (8 and 10 power) alone were often inadequate to detect the more subtle differences, but could be used for identification of recent fledglings based on several characters. The most reliable characters we observed for a fledgling 28 to 40 days old were shorter tail feathers and lighter, less distinct eye patches on the back of the head. Tail feathers were a rich rufous color with darker barring, but much shorter than adults. Eye patches were grayish and lacked a clear white outline compared to the black and distinctly white outlined patches of adults. As the fledgling's tail grew longer, it became harder to distinguish the juvenile from the adults by using this feature, unless they were observed together. The tail was fully grown in about three weeks following fledging.

After this time, identification was based on behavior, the presence of more white on the breast of the juvenile, and the lack of white on the crown if the fledgling was close enough for that characteristic to be observed.

Flight skills and behavior were also good indicators of the young owl. The fledgling flew very little during the first week after fledging and appeared weaker and slower than adults on short trips of generally only 20 ft (6 m) or less. During the first 24 hours after fledging, landing and perching also seemed challenging, as the two young birds slipped and struggled to maintain their balance on perches, getting their wings caught in branches during hops from one level to another. The skills of the surviving fledgling rapidly improved during the second week - increasing the longest flight distance to 100 ft (30 m). Head bobbing and moving the head in circles while perched, a behavior which we observed primarily in the fledgling, also seemed to increase during the second week.

Full tail molt occurs in pygmy-owls and on 25 July, the male was first observed with no tail. The female was not observed for about 3 weeks during this time frame and when she was finally observed on 6 August, her tail was short, showing only 2 black bars of the normal 6-7. Young of the year do not molt their tail until much later (Proudfoot 1996), so if a bird with no tail is observed in late summer, it is probably an adult. A researcher doing work on pygmy-owls in Texas (Proudfoot, pers. comm.) theorizes that tail molt in the parents decreases their foraging success which encourages the dispersal of the young. The last detection of the 1996 fledgling was on 26 July which seems to support this theory.

Differentiation between the adult male and adult female was possible, especially when observed together. The female was a little larger, more rufous on the wings and browner on the back and chest. The "eye spots" on the back of the head seemed blacker and brighter, appearing to stand out more than the male's eye spots. The male appeared more charcoal gray than brown on the back and chest. Early in the season, when the birds were seen very frequently, it was possible to tell the sexes apart, even when observed separately. However, as the season progressed and the birds were seen less often, usually only briefly and at a distance, it became difficult to distinguish them using only visual clues. Changes in light conditions also added to the difficulty of distinguishing the subtle differences in color between the male and female. These differences between the sexes are based on only the pair of birds we were able to monitor, but it appears to be consistent with what is being observed in Texas (Proudfoot 1996).

Water Use

The presence of water may be one characteristic that has attracted pygmy-owls within close proximity of private residences and livestock operations. However, only two observations of direct use of water by owls for drinking or bathing were documented during 1996. On one occasion at the monitored nest, the female jumped in a shallow water dish 2 in (5 cm) deep and 10 in (25.4 cm) in diameter. Her activity in the dish was

obscured so we could not determine if she actually drank. This occurred shortly after four failed attempts to enter the nest cavity with a large lizard when she was obviously hot and exhausted - raising her wings away from her body and remaining on the ground for several minutes. In addition, three residents near the nest site reported seeing a single owl, a pair, or both adults and the fledgling using bird baths and water pans for bathing and drinking. At another location, we observed a pygmy-owl wade into a below grade concrete basin to several inches in depth. The resident at this site reported regular water use for drinking and bathing by a pair of nesting pygmy-owls during 1995 and an unmated male in 1996. Bathing behavior consisted of a bird squatting down, wetting its legs and under parts. Using its wings, the bird would then splash water onto its head and back.

Home Range

A general estimate of home range size for the nesting pair was made based on visual and aural detections. The male was detected more aurally than visually. His locations based on aural detections suggested that he used a larger area than visual observations alone would have indicated. The female spent all of her time in or very near the nest until the young fledged. After fledging occurred, it was not clear if she followed the fledgling as it changed locations or if the fledgling followed her. The size of the area used by the female and fledgling expanded as the fledgling grew older. It was actually the fledgling which was observed at the northern and southern most points in the home range area. Post-fledging, the male appeared to use about the same area as during the incubation and nestling stages. The female used an area approximately 0.5 acres in size during the pre-fledging period. This expanded to about 35 acres post-fledging and was also used by the fledgling. Once the fledgling dispersed, we never saw it again and it was extremely difficult to track the male and female, but we feel confident that the area used by both the male and the female expanded beyond 35 acres.

DISCUSSION

Detection Success

The 1996 cactus ferruginous pygmy-owl surveys produced more detections than previous survey efforts completed from 1993 to 1995. This detection success occurred despite the reduction in number of survey routes and area of calling coverage. The 17 primary and 48 general detections during formal survey efforts, including the discovery of one nest, represent more pygmy-owl activity than all previous survey years combined. The factors contributing to the increased detection rates are not clear and several questions emerge: 1) did pygmy-owl activity in 1996 detection locations go undetected in previous survey years, or have pygmy-owls recently moved into these areas and, if so, why? One resident reported hearing pygmy-owl calls for close to 10 years, but did not know what they were - describing the sound as a "squeaky cooler belt". Other long time residents indicated they had never heard the call before. 2) Do drought conditions such as those during 1995 and

early 1996 influence pygmy-owls to move closer to water and more stable prey populations it may support? 3) Does the concentration of potential prey created by bird feeders in suburban settings play a role in recent pygmy-owl detection locations? Initial observations of prey taken by pygmy-owls do not support water and feeders as important factors, though they cannot be ruled out at this time (see Diet, p.28). The above questions can really only be answered by conducting additional survey and monitoring activities.

On several occasions during formal surveys, pygmy-owls known to be present near surveyors did not respond vocally to taped-call broadcasts. Workers in Texas have also indicated lack of response did not necessarily mean absence of pygmy-owls (Wauer et al. 1993, Beasom et al. 1994). These observations suggest that actual numbers of individual pygmy-owls within survey areas may be higher than we were able to detect. In addition, changes in calling patterns or the abrupt end of detections at monitored locations may indicate that there were also more nesting pygmy-owls.

We tested the response of known birds to broadcast calls at three locations. At one, there was no response to taped calls even though the owl had called spontaneously a few minutes before. This occurred in late August during a morning calling period. At the second, there was only a very brief response from a bird that calls very regularly. This was during late summer, the post-fledging period, during a morning calling period. At the last location, we ran six trials between 18 July and 5 August and got responses of varying degree by the male during 5 of the trials. The most intense responses were during the early trials, with the non-response during the later trials. All trials were conducted during the morning. We observed the female only once during a calling trial. She flew about 10 yards toward the tape player and chittered once. The fledgling also responded during two of the trials by moving closer and vocalizing.

Our survey results suggest possible increased calling activity and detection success during the morning hours described in the survey protocol (Appendix 1) from late January to early June. However, these results are inconclusive and require continued testing. Future surveyors should be cautious in interpreting the results of these early observations. In addition, surveys before or after the January to June breeding season may have very different outcomes. At the nest site, the male pygmy-owl called habitually and spontaneously 30-45 minutes before sunrise from mid-May through mid-August, usually for only a few minutes. This was the only time of the day that calling was predictable and lends further support to increased detection success during morning surveys. Again, however, this is based on the observation of only one bird. Unpaired birds, or other paired birds, may behave differently.

Pygmy-Owl Tolerance of Human Activities

Some birds were more tolerant of human intrusion than others. None of the closely monitored birds showed any hesitation in flying directly over a worker's head or within arm's reach. They seemed to show no real fear of approaching humans, but did seem to exhibit a "comfort zone" when being approached. Mexican spotted owls (*Strix occidentalis*) are known for their tameness and are often captured by field workers using noose-poles. They are also fed live mice (mousing) to determine the location of nests or young. Development of effective capture and banding techniques may be able to use the apparent curiosity of pygmy-owls and their tolerance of human activity.

Protocol and Equipment

A review of differences between 1996 survey methods, equipment, and field conditions and those of previous years may provide insight into differences in detection rates and help increase success rates of future surveys. The almost exclusive use of the Johnny Stewart Game Caller MS240 during 1996 provided consistent sound quality and volume during taped-call broadcasts for all survey routes. The wide range of volume control permitted adjustments when disturbances, wind, terrain, or other field conditions interrupted calling coverage. The ability to separate the speaker from the player allowed increased flexibility to adjust direction and height when needed and the directional speaker concentrated the broadcast without the diffusion effect of other speaker types. The on-off toggle switch eliminated excessive static and noise between calling sequences.

The AGFD survey protocol (Felly and Corman 1993) was revised to increase the calling time from 6-8 minutes to a 10 minute minimum. Listening time after the completion of the broadcasts was increased to five minutes. The increased broadcast and listening time at each calling station during formal surveys and monitoring visits resulted in at least 3 new detections. Lesh and Corman (1995) recommended increased calling and listening times after recognizing four occasions when pygmy-owls did not respond to taped-call broadcasts until 15 or more minutes after the calling sequences were initiated.

Consultation with researchers in Texas conducting pygmy-owl research suggests that the changes we implemented in the protocol should increase the effectiveness of our survey efforts (Proudfoot, pers. comm.). They suggested that distance between call points could be increased even more, however, we feel this needs to be evaluated on a site specific basis as urban factors may necessitate a shorter distance between call points than can be used in areas with less disturbance.

Habitat

Development of methodology and work on habitat measurement by AGFD personnel is in progress. The success of the survey season and the requirements of nest site monitoring limited the available time for habitat work. However, general habitat descriptions of the detection sites were completed. Most of the locations and the nest site were photo documented. These photographs are available for viewing at the Arizona Game and Fish Region V office in Tucson.

The general habitat in detection areas contains foothill paloverde and saguaro cacti in large numbers, but it is the presence of medium and large ironwood trees in varying densities that makes these areas stand out, and gives them the characterization commonly known as "ironwood forest". Ironwoods were present in almost every detection location and no detections were recorded in areas that did not have this species nearby. If ironwood is important in Arizona pygmy-owl ecology, its specific role is not understood, but surveys in areas with ironwood may provide increased success in the number of detections. Ironwoods may provide increased thermal cover in the summer and could also be an indicator of frost-free zones, somehow related to the owl's energy budget or thermoregulation abilities during winter. All pygmy-owl detections from 1993 through 1996 have been in Sonoran desertscrub and it appears pygmy-owls occupy this habitat type more often in Arizona than earlier reports had indicated (Hunter 1988).

One of the reasons for the high number of pygmy-owl detections near private residences may be the attraction of both humans and owls to dense stands of trees and greenery. It is common for residents in the detection areas to add to the natural density and complexity of paloverde-cacti mixed-scrub habitat creating a kind of oasis with the addition of water sources and irrigated native and non-native trees. Planting non-native, dense, shade-producing trees such as California pepper trees, aleppo pine, mulberry and magnolia close to homes provides increased cover, shade and potential foraging areas for owls. The frequent use of these densely foliated trees by nesting and individual pygmy-owls for cover, feeding, roosting and prey deliveries, suggests both native and non-native tree species may be suitable for meeting pygmy-owl nesting and lifestyle requirements.

Dense foliage seems to be especially important for use as cover by young owls. The fledgling was observed in the dense, protected areas of trees, usually ironwoods, for the first 10 days after fledging. It was often impossible to see the owl due to its cryptic coloration and the dense vegetation; it was located by its vocalizations. For the next two and a half weeks, workers observed that use of protected perches by the fledgling decreased; however, the time spent on exposed perches remained less than that of the adults for at least a month after fledging.

Cavity Use

Pygmy-owls were directly observed using cavities at four detection locations. Observations at a fifth site were indirect, but cavity use was strongly suspected. A total of 8 cavities (9 including the site of suspected use) were used by pygmy-owls on at least one occasion. All cavities were located in large, living, multi-armed saguaros except for one. This exception was in a dead rotting saguaro which fell down two weeks after its use was discovered. One cavity was used for nesting in 1995 and a second was used for nesting at a different site in 1996. Another was used by a fledgling apparently for cover and protection. This saguaro cavity was adjacent to an ironwood tree and was easily accessible to the young owl and adults attempting to feed it. The remaining five were used by individual birds. Two of these birds were observed entering cavities repeatedly over an extended time period and appeared to be territorial males that selected cavities for nesting, but were not successful in attracting a mate. One of these sites was used for nesting in 1995. Measurements of specific cavity characteristics are in progress.

The transport of nesting material into the nest cavity was not observed, however numerous whole prey items were brought into the cavity from incubation through the nestling period and we did not observe the removal of prey remains or other material. Since at least some of these items were birds and feeding locations outside the cavity were littered with feathers, it is reasonable to assume that prey remains, particularly feathers, accumulated on the floor and walls of the cavity bottom and may provide additional insulation and protection to eggs and young birds. In short, nesting material could potentially be added to the cavity in the form of feathers and other prey remains.

At another location earlier in the survey season we discovered possible evidence to support these observations. We were able to collect a nest-like accumulation of material, consisting of feathers, grasses, etc., from a saguaro cavity after the cactus fell down. This cavity was frequented by one pygmy-owl for several weeks before the rotting cactus fell to the ground during strong winds. It is also possible some of this material was deposited by previous woodpecker activity. Researchers in Texas (Proudfoot et al. 1994) observed that a pair of pygmy-owls removed material from a cavity prior to egg laying during one year and layed eggs on nest material in the following year. They could not determine if this material was brought-in by the owls and did not comment on the addition of materials from prey remains.

One consequence of prey material accumulation is the possibility of parasite infestation and the attraction of various insects. An undetermined species of red ant was observed in large numbers outside and around the cavity late in the nestling period and could present an additional threat to the survival of young pygmy-owls, especially during the early nestling stage.

Diet

The discovery of nesting pygmy-owls early in the breeding season provided the opportunity for direct observation of prey items delivered to the nest and young. Future analysis of collected pellets and prey remains will provide a more complete picture of the diet of this species in Arizona. At present, the large majority of confirmed prey taken during incubation, nestling, and early fledging periods were lizards (60.0%). Other observers also documented individual pygmy-owls eating lizards in 1995 and 1996.

The high percentage of lizards observed may or may not be an accurate reflection of the importance of this prey group. We could only observe prey deliveries and captures during daylight hours when lizards are most active and likely to be captured. Nocturnal mammals may account for a larger percentage of prey items, but at those times of day there was not enough light for observation nor identification. Likewise, birds may be of greater importance during the winter when lizards and small mammals are less active.

In addition, the composition of prey items observed by residents at the 1995 nest site was much different. Of 12 observed prey items, 4 (33%) were lizards, 4 (33%) were mammals, 3 (25%) were birds and 1 (8%) was unknown. These same residents also observed a pygmy-owl catching and eating numerous sphinx moths during a late summer evening. As the temperatures rose in June, we observed the capture and use of cicadas with increasing frequency. At least 3 attempts to capture birds in view of observers were unsuccessful and mammals represented only 4.8 % of the total prey items. These observations may suggest pygmy-owls prefer prey items that are both abundant and easier to catch. Further study will be needed to determine if the differences in prey items at the two nest sites are due to differences in habitat and prey availability, prey preference or season of observation.

Numerous castings (pellets) and several prey remains were collected primarily from the monitored 1996 nest site and one site in the Red Rock - Marana area. After analysis, these items combined with pellets collected during the 1995 survey season and the direct observation of prey items at the 1996 nest site, will help provide insight into the diet of cactus ferruginous pygmy-owls in southern Arizona.

Pygmy-Owl Predation and Mortality

Monitored, adult pygmy-owls during 1996 appeared successful at predator avoidance. Except for calling periods, their use of trees with dense branches, foliage and desert mistletoe (*Phoradendron californicum*) combined with cryptic coloration often made them difficult to detect. The armament of desert trees and shrubs may also act as partial deterrent to predators. Their rapid and low style of flight presents even greater challenges to potential avian predators as they often seem to be within just a few feet or inches of the tops of cacti and desert shrubs. Despite the presence of many other diurnal and nocturnal

raptors in survey and nesting areas, no physical, interspecific interactions were observed. Great horned-owls (*Bubo virginianus*) and Harris' hawks (*Parabuteo unicinctus*) were common in all areas surveyed. During one evening survey in February after sunset, 3 great horned-owls, a screech-owl and a cactus ferruginous pygmy-owl were calling at the same time within approximately 300 feet (100 m) of each other. The pygmy-owl, apparently unintimidated, called vigorously for at least 15 minutes. American kestrels (*Falco sparverius*) were frequently heard calling by field workers monitoring the pygmy-owl nest. One was observed picking up prey remains within 60 ft (18 m) of the nest saguaro and on another occasion a kestrel flew less than 100 ft (30.5 m) over the nest. On both occasions, no reaction by the nesting owls was observed.

During one instance, however, the female pygmy-owl was on an exposed perch at the nest site with a lizard when two Harris' hawks flew into a tree about 90 ft. (30 m) away. The female froze until both hawks left the area. She then immediately delivered the prey to the fledgling in a nearby tree.

As in most raptor species, it appeared the time when pygmy-owls were most vulnerable was for a short period post-fledging, until young were capable of sustained flight and were more adept at movement to vegetative structures offering greater protection and concealment. Recently-fledged young were observed on the ground beneath a velvet mesquite tree and on very low perches. The young were probably well hidden from predators above, but were extremely vulnerable to ground dwelling predators such as greater roadrunners (*Geococcyx californicus*) or snakes which were seen foraging in the area. One resident actually observed a roadrunner chase an owl away from a water dish.

Mobbing by birds could also negatively affect young owls. In 1995, a fledgling was brought to a wildlife rehabilitator after being repeatedly pecked on the head by a curve-billed thrasher (*Toxiostoma curvirostre*). Once, the 1996 fledgling was observed being severely harassed by Gila woodpeckers. When the owl began to eat a lizard, a woodpecker tried to pull the lizard out of the owl's grasp. After a couple of minutes of this, the owl flew off, losing the lizard along the way. In addition to natural predators, the location of nests near homes and ranches presents the additional threat to fledglings from domestic dogs and cats.

Heat exposure presents another hazard to young pygmy-owls. Once out of the nesting cavity, the presence of vegetative structures offering adequate cover close to the nest location appears very important. The high temperatures at the nest monitoring area during the first few days after fledging were between 105 and 108 degrees Fahrenheit. While the cause of death for one fledgling was undetermined, it appeared the limited cover offered by the tree used by these young owls may have been a factor in both reducing concealment from predators and increasing heat stress. Observation of saguaro cavity use by the surviving fledgling several days later appeared to be in response to workers presence, but

it is reasonable to assume that availability of easily accessed cavities for young owls would provide additional protection against heat stress, as well as predators, and increase the chance of survival.

Potential Threats to Pygmy-owls

Several direct and indirect threats to pygmy-owls were recognized during the 1996 season. The monotonous calling by territorial birds sometimes occurred throughout the night and often very early in the morning. The frequent location of these birds close to residences created such an annoyance that some residents in frustration; expressed that they "felt like blasting the thing." Once these residents understood the source of the sound, they were very tolerant. The apparent tolerance of the owls to human activity and the curiosity of at least some birds may also increase the chance encounter with young or less responsible individuals testing their skills with various projectiles. As was mentioned earlier, the presence of domestic cats may present danger to new fledglings spending time near the ground.

Harassment by birders and photographers is another concern. We were able to document this impact on one occasion in 1996 when a pair of pygmy-owls was reported on the Tucson Audubon Bird Hotline. The information apparently also appeared nationally on an Internet site. Within hours, numerous birders were documented in the area looking for the pair. We observed van loads of people and also several people from out of state. Although instructed to refrain from putting these sightings on the hotline, birding networks are well established and it is expected that future sightings will result in at least some birding pressure which could result in disturbance of the birds and annoyance of property owners..

Blading of undisturbed desert areas for urban development and the resulting loss of potential foraging areas, nest sites, and general habitat is the most serious threat, as large land tracts near detection areas are zoned for high density housing. Projects varying in size from a few acres to several thousand acres are already in progress. The potential impacts to this local population of pygmy-owls resulting from habitat loss and fragmentation is significant.

RECOMMENDATIONS

General

1) Continue to use the 1996 revised protocol which extends taped-broadcast calling time to ten minutes and post broadcast listening to five. Consider experimenting with longer broadcasts of 30 to 60 minutes at select call points where pygmy-owls were detected earlier in the breeding season, but were not detected after 3 additional monitoring visits.

2) Surveys should be conducted from January 1 through June 30 based on activity observed in 1996. Experimentation should continue during other months, however, lack of response during such surveys should not be considered conclusive. Surveys to determine the presence of pygmy-owls in relation to proposed land use projects should be conducted during the recommended time period.

3) Standardize sunrise and sunset times to establish the start and end of survey periods using Sunrise and Sunset Tables For Key Cities and Weather Stations of the U.S. ,1977 (Appendix 4).

4) Continue to monitor detection locations throughout the year to determine occupancy, calling periods, and to track movements.

5) Maintain a 300 yd (274 m) distance between calling points especially early in the breeding season (January through March) when males are more readily detected and they appear to respond more vigorously from greater distances. This will permit calling coverage of larger areas in less time. Additional or intermediate call points can always be added if local conditions require more thorough coverage. On long calling routes (more than 1.5 miles), consider increasing the distance between calling points to 400 yards (366 m) - especially routes along roads where buildings or natural terrain barriers to broadcasts are minimal and background noise levels permit adequate detectibility.

6) Conduct intensive nest searches in locations where vocalization patterns have changed or stopped during monitoring visits. Begin in the location of the most recent detection and work outward in all directions within a .25 mi radius. Adjust this distance accordingly based on the cooperation of property owners and the existence of saguaros with suitable cavities. The privacy and concerns of property owners usually require "late morning" or day visits, but searches should be conducted during the high activity times when possible. Focus on large multi-armed saguaros with nearby dense perching or cover trees using a whistle call or taped-call broadcast from locations that permit observation of multiple cavities at one time. This is best accomplished with at least two searchers.

7) Develop several versions of taped-call broadcasts using recently recorded male, female, and fledgling vocalizations from local pygmy-owls. Conduct a literature search and consult with biologists that have used calling survey methods for other owl or raptor species to assess detection success using less common calls. Develop a strategy for experimentation with alternative calls to determine their relative success at detection.

8) Recruit area residents to help monitor pygmy-owl activity using the list of property owners where detections were recorded in 1996. Develop an orientation packet complete with a brief tape of common pygmy-owl calls and distribute these packets no later than the first week of January. Conduct interviews and orientation meetings with residents as needed.

9) Consider presenting information on pygmy-owl biology and AGFD survey activities to neighborhood associations or other local groups where pygmy-owl detections have occurred. The objectives of this educational effort would be to enlist the aid of residents in locating new birds, protecting nest sites, guarding against harassment, and to encourage landscaping and land use practices that would support continued pygmy-owl activity in their area.

10) Begin cooperation and regular discussions with Texas A&M University researchers and Texas Parks and Wildlife to share information on research and survey methods. Enlist the aid of these workers in developing capture, handling, banding, and radio tracking techniques and implement these as appropriate and/or funding becomes available.

11) Train surveyors to recognize both male and female calls and to recognize mobbing responses by other birds to the broadcast calls. Areas where owls were not detected, but where mobbing behavior occurs warrant repeated survey efforts.

Management

1) It appears that upland areas characterized by braided wash systems and a structurally diverse vegetation component are important to pygmy-owl populations in the Tucson area. These areas are also currently undergoing rapid residential and some commercial development. The AGFD, local governments and other agencies should carefully evaluate proposed development projects in potential pygmy-owl habitat areas and pursue design and density options which would allow the area to retain habitat components important to pygmy-owls such as densely-vegetated wash areas, water sources and areas with high vegetative structural diversity. If feasible, open space areas of > than 3 acres which have the above characteristics should be incorporated into development designs and preserved. Such open space areas should retain some type of connectivity to adjacent, large areas of undisturbed or protected natural habitat.

2) We are still unsure of the long-term importance of Sonoran upland vegetation types with regard to the needs of pygmy-owls and we do not know what role the few remaining areas of riparian habitat, which historically was the habitat type occupied by pygmy-owls, currently play in protecting the Arizona population of pygmy-owls. More work should be conducted on the habitat requirements of this species looking at currently utilized habitats, as well as historic habitats. In the interim, vegetation types which we believe to be important to the owls, i.e. riparian, mesquite bosque and ironwood forest, should be carefully managed with regard to commercial and residential development, recreation, and livestock grazing so that structural diversity and the contiguous nature of the area is maintained.

3) The maintenance of habitat used by pygmy-owls, as well as potential habitat, should be pursued. Because much of the habitat is in private ownership, a variety of methods may be needed. There are also some areas of public land and state trust lands which are potential habitat. Potential methods include conservation agreements, conservation easements, deed restrictions, fee acquisition and intergovernmental agreements.

Future Survey Areas

1) Surveys of historical habitat along riparian areas and mesquite bosque should continue, however emphasis should be placed on Sonoran desertscrub areas where pygmy-owls have been detected in recent years, and adjacent locations with similar habitat. This is especially important if funding and manpower are limited. Historical areas should be evaluated based on present condition and the presence of suitable numbers of saguaros or other vegetation with potential nesting cavities. Preliminary visits to these locations prior to calling surveys will be necessary to make this determination and can be done during the off season or when surveys for other wildlife are conducted.

2) Identify small public and private water catchment locations with suitable vegetative characteristics in adjacent areas. Examine especially water containments with at least one sloping edge or shallow area that would allow a pygmy-owl to walk or hop in at 2 to 4 inch depths. Survey these locations using one calling station for 30 to 60 minutes during one morning and one evening high activity period.

3) The Red Rock-Marana Area produced one successful nest in 1995 and two territorial males in 1996. This survey area is large and surveys will require a large time commitment. Consider using mountain bikes or horses instead of motor vehicles to decrease time investment, but maintain quiet approaches. Surveys within suitable habitat and near clusters of homes and ranches in this area should be increased. Coordinate with the Bureau of Land Management for lands in this area under their jurisdiction.

SITE SPECIFIC LOCATION INFORMATION

Due to the sensitive nature of pygmy-owl locations and nest sites, site specific information on locations of birds, nests, survey routes and contact people has been omitted from this report. Land management agencies requiring more specific site descriptions or other information should contact the AGFD's Heritage Data Management System.

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APPENDICES

1: 1996 Cactus Ferruginous Pygmy-Owl Revised Survey Protocol

2A: Cactus Ferruginous Pygmy-Owl Survey Form (Revised 1996)

2B: Post-Detection Site/Territory Visit Form 1996

2C: Cactus Ferruginous Pygmy-Owl Observation Sheet

2D: Cactus Ferruginous Pygmy-Owl Nest Site Monitoring Form 1996

2E: Cactus Ferruginous Pygmy-Owl Prey Delivery Log

3: Cactus Ferruginous Pygmy-Owl 1996 Nesting and General Activity Chronology

4: Sunrise and Sunset Table for Tucson, Arizona

APPENDIX 1: 1996 CACTUS FERRUGINOUS PYGMY-OWL SURVEY PROTOCOL

1) Survey during the peak period of activity - primarily 1 hour before sunrise to 2 hours post sunrise and 2 hours before sunset to 1 hour after sunset. NOTE: Due to the limited success of previous surveys and the observed activity of birds during all hours, experimentation with survey times is encouraged if time and schedule permit.

2) Survey stations or point locations for broadcasting calls should be established at 300 yard intervals to insure complete coverage. However, intermediate points may be added if terrain, habitat, disturbances, or other conditions prevent adequate coverage.

3) Broadcast calls for 30 seconds and follow with 60 to 90 second listening and visual observation periods. We recommend using a Johnny Stewart Caller with a medium volume setting, however, other tape recorders may be used as well. If other players are used, use your best judgement about the appropriate volume setting. One method is to place the player in a tree at chest level and walk a distance away to judge the volume effectiveness.

4) Repeat the 30 second play and 60 to 90 second observation sequence for at least 10 minutes. Extend this period if disturbances such as dogs or vehicle traffic noise has limited your calling coverage.

5) Observe and listen for a minimum of 5 minutes after the initial 10 minute calling period. Then proceed to the next station.

6) Record date, time, and weather conditions at start and end of each survey route.

7) If an owl is heard or visually observed:

a) end broadcasts unless additional responses are needed to pinpoint the location.
b) Record the compass bearing from your location and estimate distance to the bird.
c) Record the date and time of response.
d) Record the type of response (vocal or behavioral - e.g. perched nearby)
e) Flag your location with surveyors tape so it can be easily revisited and record directions to the site. Mark the location on a map if possible.
f) Record the habitat type.
g) Observe the owl as long as possible with minimal disturbance (i.e. do not chase the bird).
h) Record your observations.

APPENDIX 2A: ARIZONA GAME AND FISH DEPARTMENT
CACTUS FERRUGINOUS PYGMY-OWL
1996 SURVEY FORM

Today's survey date (D/M/Y): _____

Survey route name or description: _____
Route surveyed previously: Y N Date of last survey _____
Length of survey route (from topo or atlas map): _____ Number of call points _____
Direction of travel _____

7.5 min. quad: _____ County: _____
Legal description: T_____, R _____, Section(s): _____ Elevation: min _____ max _____
Land ownership: _____

Surveyor(s) name(s): _____ Affiliation: _____

Start time: _____ Starting weather conditions: Temp: _____ Wind: _____ Cloud Cover (%) _____
End time : _____ Ending weather conditions : Temp: _____ Wind: _____ Cloud Cover (%) _____
Total hours: _____ Moon visible during survey: Y N Moon Phase (1/4, 1/2): _____

Survey method used: Tape playback surveyor whistle
Type of player used: (brand and model) _____ Volume setting:_____

Detection? Y N (If CFPO is detected, fill out separate detection form)

Number of woodpeckers heard or seen: _____
Number of saguaros with possible nesting cavities observed along route: _____
Number of starlings (possible competitors) heard or seen: _____

Disturbances during survey (barking dogs, vehicle traffic, construction, ATV's, etc):_____
_____

Are water sources available along this survey route? Yes No Undetermined
Number: ___ Size(s): _____ source type(s):_____(if known)

List other bird species responding to survey calls and describe their behavior:
_____
_____
_____
_____
_____
_____

*Habitat Type:_____
Dominant Vegetation:_____
Other species present: _____
_____
_____
Vegetation comments: _____

*Refer to Brown, David E. (ed.) 1994. Biotic Communities: Southwestern United States and Northwestern Mexico, Univ. of Utah Press

APPENDIX 2B: ARIZONA GAME AND FISH DEPARTMENT
CACTUS FERRUGINOUS PYGMY-OWL
1996 POST-DETECTION SITE / TERRITORY VISIT FORM

Site Name:_____ 7.5 min. quad:_____

Date: (D/M/Y)_____ Arrival time:_____

Observer(s):_____Affiliation:_____

Date of last visit or initial detection:_____CFPO detected? Y N

Reason for today's visit: occupancy check_____, behavioral observations _____, vegetation work _____
nesting status _____, photographs _____, other_____.

Legal Description: T_____, R_____, _____1/4 of the_____1/4 of Section_____

Weather Conditions: temp:_____cloud clover (%)_____wind speed_____
Weather Comments:_____

On Arrival - Initial 5 minute listening and scanning: time:_____to _____

15 minute survey or observation period (if 5 minute results are negative)
Survey Time: start_____ end_____

Aural detection time:_____ Visual detection time:_____ Check here if no detection:_____
Distance from observer:_____

Vegetation used for perching or calling:_____
Approximate perch height above ground:_____

Did you attempt to elicit a response? Y N
Calling method used? tape playback observer whistle

Type of player used (brand and model):_____ volume setting:_____

New UTM description (if location is 300 feet or more from the original detection location) - include map or sketch showing old & new locations if possible:

Easting_____ Northing_____

General Comments/Observations (behavior, evidence of breeding, use of cavity, etc.):

APPENDIX 2C: ARIZONA GAME AND FISH DEPARTMENT
CACTUS FERRUGINOUS PYGMY-OWL PROJECT
OBSERVATION FORM FOR RESIDENTS

Observer's Name:_____ Address:_____

Date	Time	Type of Detection	Location	Distance from Observer	Comments

Key: Date = today's month-day-year; Time = time when owl first heard or seen; Type of detection = visual, aural or both; Location = type of vegetation or structure where bird observed or suspected; Distance from observer = estimate distance in feet; Comments = any comments about behavior, other birds in the area, prey, two owls in area, suspicions about nesting, weather, etc.

APPENDIX 2D: ARIZONA GAME AND FISH DEPARTMENT
CACTUS FERRUGINOUS PYGMY OWL NEST SITE MONITORING
1996 OBSERVATION SUMMARY FORM

Nest Site Name / General Location:_____
Date (D/M/Y):_____ Estimated Nesting Stage:_____
Observer (s):_____ Affiliation:_____
Arrival Time:_____ Official Sunrise:_____ Official Sunset:_____
Observation Start Time:_____ End Time:_____ Total Hours:_____
Starting weather conditions: wind_____ clouds_____ temp_____
Ending weather conditions: wind _____ clouds_____ temp_____

Time of Initial Detections (A= aural, V=visual): male: (A)_____ (V):_____ female: (A)_____(V):_____

Prey Data Summary

	a.m.	p.m.	total
Number of prey items delivered directly to female:			
Number of prey items delivered to nest cavity by male:			
Number of prey items delivered to nest cavity by female:			
Number of prey items cached by female:			
Number of prey items captured by female:			
Total number of prey items captured by male and female:			

Prey Description

Prey Item	a.m.	p.m.	total	Comments - prey identification, suspicions, etc.
birds				
reptiles (lizards)				
mammals				
undetermined				

Vegetation/Structure Use

Description	Observed activity/behavior	# times used

Water use description: _____

Female Time Budget	a.m.	p.m.	total
total visual observation time:			
total aural observation time:			
amount of time in cavity:			
amount of time outside cavity:			

APPENDIX 2E: CFPO PREY DELIVERY LOG
1996 NEST SITE

Observer(s):_____

Date	Time of Delivery	Male to Female*	Item Description	Disposition

Appendix 3: CACTUS FERRUGINOUS PYGMY-OWL NESTING AND GENERAL ACTIVITY CHRONOLOGY 1996 NEST SITE

Date	Description
10 Feb 96	First detection of CFPO in general area for 1996 - aural and visual.
4 Mar 96	First detection in vicinity of nest site - aural and visual - CFPO calling non-stop.
31 Mar 96	Resident reports sighting two CFPOs and copulation observed.
8 Apr 96	CFPO observed in saguaro cavity - stuck head out in response to surveyor's whistle.
19 Apr 96	Two CFPOs confirmed at nest site by AGFD - 1 in cavity and 1 perched nearby.
30 Apr 96	First prey delivery to suspected nest cavity in saguaro observed - lower half of lizard.
2 May 96	2 hour monitoring of nest (1619 - 1830) - 2 CFPOs observed - female off nest on 2 occasions for 10 and 8 minutes respectively, male delivered small bird to female - she flew to another perch to feed on the first break. When the female left the nest the second time, the male flew into the cavity and out of site. Male remained in cavity for 3 minutes while female remained in perch nearby stretching and preening, Female returned to cavity at 1829. Cavity not occupied by male or female for a total of five minute during this observation period.
4 May 96 to 13 May 96	Estimated hatch date depending on onset of incubation.
13 May 96	Observation of prey delivery from male to female outside cavity - female returned to cavity with prey bird - first possible indication of hatching.
16 May 96	Dawn to dusk nest monitoring - 0400 to 2017 - 6 prey deliveries to cavity observed. First defensive behavior by female - pursuit of woodpecker. First prey caching by female observed. First use of water by female - jumping in shallow water dish - actual drinking not observed due to obstruction.
21 May 96	Nest monitoring for 2 hours - 2 prey deliveries.
22 May 96	Dawn to noon nest monitoring - possibly heard young food begging for the first time - defensive behavior around nest for the second time - female pursued and struck white-winged dove. Seven prey deliveries observed - brood patch on female observed through scope appearing half dollar size.
27 May 96	Nest monitoring for 6 hours - 7 prey deliveries - 6 into nest cavity and 1 cached.
29 May 96	Dawn until dusk nest monitoring - 2 observers split shifts - first sighting of nestling - peering out of cavity - fully feathered on head, breast and visible parts of wings - estimated age 24 to 28 days.
30 May 96 to 9 June 96	Estimated fledge date depending on hatch date.

Appendix 3 - continued
CACTUS FERRUGINOUS PYGMY-OWL
NESTING AND GENERAL ACTIVITY CHRONOLOGY
1996 NEST SITE

Date	Description
4 June 96	Actual fledge date.
5 June 96	Two fledglings confirmed - estimated age 28 to 31 days. Both adults also observed. Adult male continues doing most of hunting delivering prey to female and female goes to young and feeds them. First observation of cicada capture and eating by male. On one occasion male flew to a fledgling location and began feeding the fledgling - part of what appeared to be a cicada. Female observed picking up dead passerine nestling that was obviously old and dried out - began feeding on it for a short time.
6 June 96	Both adults observed, but only one fledgling located. One may have perished due to heat or predation. Both adults observed in locations further south for the first time. It is becoming more difficult to keep track of the female.
9 June 96	Day five after fledging - adult male and female observed. One fledgling observed - estimated age 32 - 36 days. We are now confident the second fledging has perished. Male continues to bring prey to female and female feeds fledgling. However, female now chitters from location of prey delivery and fledgling flies to her location to be fed. Both fledgling and adults are using structures over a larger area, but periodically return to structures within 150 feet of the nest cavity.
17 June 96	Fledgling moved to a different group of trees farther from the nest, centered activity around an ironwood.
24 June 96	Fledgling has full tail.
4 July 96	Fledgling began expanding its range.
12 July 96	Fledgling observed with prey it probably caught itself.
13 July 96	Last observed prey delivery to fledgling, last observation of female until 6 August.
17 July 96	Birds beginning to get very difficult to locate.
22 July 96	Fledgling retrieved prey from cache.
25 July 96	Male observed with no tail.
26 July 96	Last detection of fledgling.
6 Aug 96	Last detection of female - tail was 2 bars long.
20 Aug 96	Last day of nest monitoring - only the male was detected an only aurally.

Appendix 4: SUNRISE AND SUNSET TABLE FOR THE TUCSON BASIN
(From: Sunrise and Sunset Tables For Key Cities and Weather Stations of the U.S. 1977.)

SUNRISE AND SUNSET AT TUCSON, ARIZONA

NO. 1023

MOUNTAIN STANDARD TIME

DAY	JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.		DEC.	
	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.
1	7 25	5 30	7 18	5 57	6 52	6 21	6 13	6 43	5 38	7 04	5 18	7 25	5 21	7 34	5 38	7 21	5 59	6 48	6 17	6 09	6 40	5 34	7 06	5 19
2	7 25	5 31	7 17	5 58	6 51	6 22	6 11	6 44	5 37	7 05	5 18	7 26	5 21	7 34	5 39	7 20	5 59	6 47	6 18	6 08	6 41	5 33	7 07	5 19
3	7 25	5 32	7 17	5 59	6 49	6 23	6 10	6 45	5 36	7 06	5 18	7 26	5 22	7 34	5 40	7 20	6 00	6 46	6 19	6 07	6 42	5 32	7 08	5 19
4	7 25	5 32	7 16	6 00	6 48	6 24	6 09	6 45	5 35	7 06	5 17	7 27	5 22	7 34	5 40	7 19	6 01	6 45	6 19	6 05	6 43	5 32	7 09	5 19
5	7 25	5 33	7 15	6 01	6 47	6 24	6 08	6 46	5 34	7 07	5 17	7 27	5 22	7 34	5 41	7 18	6 01	6 43	6 20	6 04	6 44	5 31	7 10	5 19
6	7 26	5 34	7 14	6 02	6 46	6 25	6 06	6 47	5 33	7 08	5 17	7 28	5 23	7 34	5 42	7 17	6 02	6 42	6 21	6 03	6 45	5 30	7 11	5 19
7	7 26	5 35	7 14	6 03	6 45	6 26	6 05	6 47	5 33	7 08	5 17	7 28	5 23	7 34	5 42	7 16	6 02	6 41	6 21	6 01	6 45	5 29	7 11	5 19
8	7 26	5 36	7 13	6 04	6 43	6 27	6 04	6 48	5 32	7 09	5 17	7 29	5 24	7 33	5 43	7 15	6 03	6 39	6 22	6 00	6 46	5 28	7 12	5 19
9	7 26	5 36	7 12	6 05	6 42	6 27	6 03	6 49	5 31	7 10	5 17	7 29	5 24	7 33	5 44	7 14	6 04	6 38	6 23	5 59	6 47	5 28	7 13	5 19
10	7 26	5 37	7 11	6 05	6 41	6 28	6 01	6 49	5 30	7 11	5 17	7 30	5 25	7 33	5 44	7 13	6 04	6 37	6 24	5 58	6 48	5 27	7 14	5 19
11	7 26	5 38	7 10	6 06	6 40	6 29	6 00	6 50	5 29	7 11	5 17	7 30	5 25	7 33	5 45	7 12	6 05	6 36	6 24	5 57	6 49	5 26	7 14	5 20
12	7 26	5 39	7 09	6 07	6 38	6 29	5 59	6 51	5 29	7 12	5 17	7 30	5 26	7 32	5 46	7 11	6 05	6 34	6 25	5 55	6 50	5 26	7 15	5 20
13	7 25	5 40	7 08	6 08	6 37	6 30	5 58	6 52	5 28	7 13	5 17	7 31	5 27	7 32	5 46	7 10	6 06	6 33	6 26	5 54	6 51	5 25	7 16	5 20
14	7 25	5 41	7 08	6 09	6 36	6 31	5 57	6 52	5 27	7 13	5 17	7 31	5 27	7 32	5 47	7 09	6 07	6 32	6 26	5 53	6 52	5 25	7 16	5 20
15	7 25	5 42	7 07	6 10	6 35	6 32	5 55	6 53	5 26	7 14	5 17	7 32	5 28	7 31	5 48	7 08	6 07	6 30	6 27	5 52	6 52	5 24	7 17	5 21
16	7 25	5 43	7 06	6 11	6 33	6 32	5 54	6 54	5 26	7 15	5 17	7 32	5 28	7 31	5 48	7 07	6 08	6 29	6 28	5 51	6 53	5 23	7 18	5 21
17	7 25	5 43	7 05	6 12	6 32	6 33	5 53	6 54	5 25	7 16	5 17	7 32	5 29	7 30	5 49	7 06	6 09	6 28	6 29	5 49	6 54	5 23	7 18	5 21
18	7 24	5 44	7 04	6 12	6 31	6 34	5 52	6 55	5 24	7 16	5 17	7 32	5 29	7 30	5 50	7 05	6 09	6 26	6 29	5 48	6 55	5 23	7 19	5 22
19	7 24	5 45	7 03	6 13	6 29	6 34	5 51	6 56	5 24	7 17	5 17	7 33	5 30	7 30	5 50	7 04	6 10	6 25	6 30	5 47	6 56	5 22	7 19	5 22
20	7 24	5 46	7 02	6 14	6 28	6 35	5 50	6 56	5 23	7 18	5 17	7 33	5 31	7 29	5 51	7 03	6 10	6 24	6 31	5 46	6 57	5 22	7 20	5 23
21	7 23	5 47	7 01	6 15	6 27	6 36	5 48	6 57	5 23	7 18	5 18	7 33	5 31	7 29	5 52	7 02	6 11	6 22	6 32	5 45	6 58	5 21	7 21	5 23
22	7 23	5 48	7 00	6 16	6 26	6 37	5 47	6 58	5 22	7 19	5 18	7 33	5 32	7 28	5 52	7 01	6 12	6 21	6 32	5 44	6 59	5 21	7 21	5 24
23	7 23	5 49	6 58	6 17	6 24	6 37	5 46	6 59	5 22	7 20	5 18	7 34	5 33	7 27	5 53	6 59	6 12	6 20	6 33	5 43	7 00	5 21	7 22	5 24
24	7 22	5 50	6 57	6 17	6 23	6 38	5 45	6 59	5 21	7 20	5 18	7 34	5 33	7 27	5 54	6 58	6 13	6 18	6 34	5 42	7 00	5 20	7 22	5 25
25	7 22	5 51	6 56	6 18	6 22	6 39	5 44	7 00	5 21	7 21	5 19	7 34	5 34	7 26	5 54	6 57	6 14	6 17	6 35	5 41	7 01	5 20	7 22	5 25
26	7 21	5 52	6 55	6 19	6 20	6 39	5 43	7 01	5 20	7 21	5 19	7 34	5 35	7 26	5 55	6 56	6 14	6 16	6 35	5 40	7 02	5 20	7 23	5 26
27	7 21	5 53	6 54	6 20	6 19	6 40	5 42	7 01	5 20	7 22	5 19	7 34	5 35	7 25	5 56	6 55	6 15	6 14	6 36	5 39	7 03	5 20	7 23	5 27
28	7 20	5 54	6 53	6 20	6 18	6 41	5 41	7 02	5 19	7 23	5 20	7 34	5 36	7 24	5 56	6 53	6 15	6 13	6 37	5 38	7 04	5 19	7 24	5 27
29	7 20	5 55	6 53	6 21	6 17	6 41	5 40	7 03	5 19	7 23	5 20	7 34	5 36	7 23	5 57	6 52	6 16	6 12	6 38	5 37	7 05	5 19	7 24	5 28
30	7 19	5 55			6 15	6 42	5 39	7 03	5 19	7 24	5 20	7 34	5 37	7 23	5 57	6 51	6 17	6 10	6 39	5 36	7 06	5 19	7 24	5 29
31	7 19	5 56			6 14	6 43			5 18	7 24			5 38	7 22	5 58	6 50			6 40	5 35			7 24	5 29

Add one hour for Daylight Saving Time if and when in use.

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