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Chapter 6:

Research Needs for the Conservation of the Cactus Ferruginous Pygmy-Owl in Arizona

In this chapter, we describe research needs for the conservation of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) in Arizona. Estimates of population size, structure, and dynamics, as well as demographic data, are needed for the recovery team to formulate sound population objectives. Habitat loss due to residential development may represent the primary threat to the pygmy-owl, yet the impacts of other human activities and of disease or predation have not been evaluated. Studies of the cactus ferruginous pygmy-owl's habitat requirements are essential to determine the importance of various vegetation types to the owl, protect critical habitat on federal lands, and develop guidelines for residential development. Using annual population surveys in conjunction with continued nest monitoring, habitat sampling, and telemetry will best address Arizona's owl research needs. Habitat studies and population surveys in Sonora, Mexico may be necessary as well. The use of nest boxes in riparian areas, while presenting potential benefits for the management of the owl, may also address habitat research needs.

1. Current state of knowledge and management situation _____

Historical accounts and specimen records suggest that the cactus ferruginous pygmy-owl was common or fairly common in some riparian areas in the late 19th

and early 20th centuries (Chapter 2). A substantial population decline may have occurred during the first few decades of the 20th century which eventually led to the extirpation of the owl along the lower and middle Gila River, the Santa Cruz River and Rillito Creek, and the Salt River in the Phoenix area (Chapter 2). The population decline along those rivers coincided with the loss and alteration of riparian areas due to human activities (Chapter 2). Although some riparian areas appear to remain suitable for pygmy-owl occupancy, very few owls have been detected in this habitat in the last decade (Chapter 3).

The recent survey effort suggests that population size of the pygmy-owl is now small (Chapter 3) and that the owl is chiefly associated with xeroriparian vegetation and dense, well-structured desertscrub (Chapters 3 and 4). In at least some areas, the remaining owl population is threatened by urban development (Chapter 3). Added to the threat of habitat loss is the risk of extinction inherent to small population size due to stochastic variation in demographic parameters, sex ratio, genetic diversity, environmental conditions, and disease (Shaffer 1981, Petterson 1985, Simberloff 1988, Clark et al. 1990).

2. Research needs _____

In the last two years, the need to rapidly accumulate more information on the population status and

habitat needs of the cactus ferruginous pygmy-owl has led to an increased survey effort and to the use of telemetry (Chapter 3). Habitat sampling and nest monitoring have also been continued.

Additional research is needed to develop a recovery plan for the owl, to guide habitat protection and enhancement efforts on federal lands, and formulate guidelines for future residential development compatible with the persistence of the cactus ferruginous pygmy-owl. Delisting criteria typically include population objectives for ensuring the long-term viability of a species. Examples of population objectives used for other federally listed species are:

- 1) Minimum average number of individuals over a specified number of years (U.S. Fish and Wildlife Service 1986).
- 2) Maximum rate of annual population decline over a specified number of years (U.S. Fish and Wildlife Service 1986).
- 3) Minimum productivity per active nest (U.S. Fish and Wildlife Service 1990).
- 4) Minimum number of self-sustaining populations (U.S. Fish and Wildlife Service 1996).

The choice of a particular population parameter and objective requires knowledge about current population size and structure, demographics, and the cause(s) of the population decline responsible for the listing of the species. Recovery plans also list recommendations for reaching the population objective(s). Such recommendations require a good understanding of past, current, and future threats to the listed species and its habitat.

Under Section 7 of the Endangered Species Act, federal agencies are required to protect and enhance critical habitat located on federal lands. However, efforts by federal agencies regarding critical habitat may be less effective if the owl's habitat needs and preferences are not fully understood. Further, due to the lack of biological information, land managers are having difficulty developing management guidelines to reduce impacts of various activities on cactus ferruginous pygmy-owls. Developers also need development guidelines which outline appropriate development locations, densities, and patterns. The livestock industry is searching for suitable grazing systems while the recreationists ponder whether some areas may be restricted due to pygmy-owls. To answer the need for sound management guidelines, defensible, biological information has to be gathered through research.

Estimates of population size, distribution, structure, and movement

In the spring and summer of 1999, 78 owls were reported from Organ Pipe Cactus National Monument, northwest Tucson, southern Pinal County, and

the Altar Valley (Chapter 3). Despite the increased number of owls located, many questions remain concerning the exact size and attributes of the Arizona population. It is only through annual population surveys that an accurate estimate of population size and population trend will become possible. In particular, the Tohono O'odham Reservation represents a key area not yet formally surveyed. In addition to its large size and the fact that pygmy-owls have been documented within its boundaries, its geographic position between the Tucson area, the Altar Valley, and Organ Pipe Cactus National Monument suggests that it could be occupied by a substantial number of pygmy-owls. Other inadequately surveyed locations where cactus ferruginous pygmy-owls may persist include the lower San Pedro River and the middle Gila River. Although some sections of the lower San Pedro River have been surveyed since 1993 (Chapter 3), the absence of detections is not reliable because most of the habitat occurs on private lands, and these have not yet been surveyed. The lower San Pedro still supports a cottonwood-willow gallery forest and mesquite bosques. A pair of cactus ferruginous pygmy-owls was detected at the Dudleyville crossing in the late 1980s (Hunter 1988). Access to private properties along the lower San Pedro was recently granted to conduct Southwestern willow flycatcher (*Empidonax traillii eximius*) surveys.

For 15 miles, the banks of the Gila River from Ashhurst-Haydn Dam upstream to near Kearny (elevation 390 m to 540 m) support thickets of exotic tamarisk (*Tamarix* spp.), but also regenerating cottonwood and willow intermixed with extensive mesquite bosques (Chapter 3).

In the last five years, cactus ferruginous pygmy-owl nest sites have been found (Chapters 1 and 4). Yet, whether the Arizona owl population is self propagating or receives a flow of recruits from Mexico is uncertain. Long-distance dispersal capabilities of individuals are unknown. In particular, northward movements of at least some cactus ferruginous pygmy-owls from across the Mexican border remain a possibility (Chapter 1). Because the recruitment of dispersing individuals can lead to the recolonization of historical habitat and thus population recovery, determining the presence or absence of long-distance dispersal is crucial. As noted in Chapter 4, the cactus ferruginous pygmy-owl seems common locally in southern Sonora, Mexico. Yet, its population status over the entire state of Sonora has not been evaluated using population surveys.

Demographic study

To maximize the chances of success of a recovery or management plan, conservation biologists have learned to rely heavily on demographic studies (Dobson and

Lyles 1989, Noon and Biles 1990, Wyllie and Newton 1991, Sjögren 1991, Noon et al. 1992, Powell and Zielinski 1994, Koehler and Aubry 1994, Donovan et al. 1995, Olmsted and Alvarez-Buylla 1995). Life history tables and demographic modeling form the basis on which population growth rates and characteristics are projected (Ricklefs 1973, 1983). Population growth rates reflect the influence of age at first breeding, the proportion of the adult population that breeds, productivity, and juvenile and adult mortality. Based on the normal ranges of these demographic parameters, it is also possible to infer optimal rates of population recovery and run sensitivity analyses, the results of which can point to the factors most responsible for limitations on population growth.

At present, it is unknown whether population size of the cactus ferruginous pygmy-owl in Arizona is chiefly limited by high adult mortality, low recruitment (i.e., low productivity or high juvenile mortality), a low proportion of breeding adults, or a combination of the three. High adult mortality and low recruitment may be caused by predation, disease, lack of food, or human-related factors. A high proportion of adults that do not breed is perhaps due to habitat fragmentation, lack of nest sites, or low owl densities. The use of banding and radiotelemetry is needed to complement nest monitoring and provide estimates of survivorship, and breeding and productivity rates. Initially, these data could be compared with the demographic data on the Texas population of ferruginous pygmy-owls.

Besides residential development, potential threats to the cactus ferruginous pygmy-owl and its current and historical habitat exist in Arizona. Among them is the possible incidence of trichomoniasis in cactus ferruginous pygmy-owls. While it has not yet been reported, owls found in the Tucson area may be at risk for contracting the disease (Chapter 1). Other potential causes of mortality, such as window strikes, fence strikes, cats, and shooting need to be evaluated. In the last five decades, wildfire frequency has increased in upland Sonoran Desert communities (Schmid and Rogers 1988, Narog et al. 1995). With their mortality reaching 80%, saguaros (*Carnegiea gigantea*) are especially vulnerable to wildfires (Wilson et al. 1996). Their numbers have been shown to decrease drastically in burned areas (Cave and Patten 1984).

Habitat study

As shown in Chapter 4, while the ferruginous pygmy-owl occurs in various low-elevation plant communities, it may exhibit a preference for semi-open habitats with large trees (or cacti) and a moderate to dense understory. Other structural attributes of preferred habitat, such as amount of edge, stand insularity, and spatial connectivity, are not well known and require additional research. Together with vegetation gap

analyses and a knowledge of the population's distribution and movements, data on habitat characteristics can be used to create a map of occupied, suitable (i.e., suitable for occupancy but currently unoccupied), and potential (i.e., currently unsuitable for occupancy but with the potential to develop to a suitable condition) habitat and to assess habitat connectivity. Ultimately, such a map can provide critical insight for conservation planning (Murphy and Noon 1992).

A critical, unresolved issue, is whether the ferruginous pygmy-owl in Arizona should be managed as an upland species, a riparian species, or both. In desert-scrub, pygmy-owls have been found in dense upland desert-scrub or along washes lined with xeroriparian vegetation. They have also been found in low-density residential areas, often in association with artificially enhanced native or exotic vegetation (Chapter 4). Why some pairs would choose to nest near houses in this type of vegetation may be an indication of habitat preferences. Alternatively, the association may suggest human encroachment into an area historically occupied by pygmy-owls.

An essential finding of recent surveys is the observed near-absence of pygmy-owls in presumably suitable riparian areas. Possible reasons for this finding include loss of connectivity particularly in the Phoenix area where the owl was once reportedly common or fairly common. Another possible contributing factor is the lack of large trees or saguaros. In areas with dense understory, but few trees or saguaros, the use of nest boxes may help with the recovery of the owl. It may also identify nest site availability as a key habitat component currently missing, preventing recolonization of riparian areas. If nest boxes are used, they should be closely monitored for occupancy.

Human-related impacts (e.g., development, grazing, recreation) on cactus ferruginous pygmy-owl habitat represent another research priority. In semi-urban and semi-rural areas, factors such as densities of development and size of road may affect cactus ferruginous pygmy-owl movements and demographics and may best be evaluated by demographic and habitat use studies. While low-density residential areas are sometimes compatible with cactus ferruginous pygmy-owl occupancy (Chapter 4), further habitat evaluation is needed. Local extirpation can result from a reduction in total habitat area and habitat fragmentation which leads to the insularization of populations (Wilcove et al. 1986). Habitat fragmentation is often responsible for the disruption of ecological relations such as prey-predator interactions (Gilbert 1980). In populations with little or no dispersal ability, the loss of connectivity between patches of suitable habitat becomes an additional problem: as already mentioned in this chapter, small isolated populations may become extinct due to stochastic processes.

List of priorities

- Increase survey effort. Extend surveys to the Tohono O'odham Indian Reservation and the middle Gila River. Through the continued use of public education and outreach programs, enlist the cooperation of the public for reporting pygmy-owls. Where appropriate, obtain authorization of private land owners to conduct surveys on their properties.
- Conduct habitat suitability studies. Compare survivorship and productivity between nest sites in undisturbed desertscrub and low-density residential areas.
- Evaluate the impact of human-related activities (e.g., development, livestock grazing, and recreation) through demographic and habitat use studies.
- Continue to monitor all nesting pairs located.
- Continue to capture and band individual owls located. Continue using telemetry to study movements and mortality.
- In riparian areas and other habitat types, evaluate the benefits and costs of nest box use where the understory is dense but nest site availability appears limited. Give priority to areas near occupied sites.
- Conduct research in western Mexico to study population status and habitat associations and evaluate pygmy-owl population exchanges between Sonora and Arizona.
- Conduct and annually update vegetation gap analyses to assess habitat connectivity.

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