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PASSIVE RELOCATION: A METHOD TO PRESERVE BURROWING OWLS ON DISTURBED SITES

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Abstract.—The Western Burrowing Owl (*Speotyto cunicularia hypugaea*) is declining throughout its range, in part as a result of urban development and other physical disturbances to owl burrows. One way to protect owls from disturbance is to allow birds to relocate to artificial burrows created in a safe location. This method, passive relocation of birds using artificial burrows, is described in detail and the results of passive relocations at six sites in northern California are presented. These results suggest that placing artificial burrows as close as possible but within approximately 100 m of burrows to be destroyed is expected to attract the evicted owls. Passive relocation appears to be a reliable way to move owls short distances and it presents fewer risks to birds than capturing and relocating them long distances.

RELOCALIZACIÓN PASIVA: UN MÉTODO PARA PRESERVAR INDIVIDUOS DE *SPEOTYTO CUNICULARIA* EN LUGARES DISTURBADOS

Sinopsis.—Las poblaciones de *Speotyto cunicularia hypugaea* están reduciéndose a través de su distribución, en parte como resultado del desarrollo urbano y de otros disturbios modernos a los huecos usados por estas lechuzas. Una forma de proteger las lechuzas de disturbios es permitir que estas se relocalicen en huecos artificiales establecidos en lugares protegidos. Se discuten la forma de relocalizar pasivamente las aves usando huecos artificiales y los resultados del uso de este método en seis lugares en el norte de California. Los resultados sugieren que colocar los huecos artificiales tan cerca como sea posible pero a un limite de 100 m de los nidos a destruirse deben atraer las lechuzas desalojadas. La relocalización pasiva parece ser un método razonable de mover lechuzas a cortas distancias que presenta menos riesgos a las aves que la captura y relocalización a distancias largas.

The Western Burrowing Owl (*Speotyto cunicularia hypugaea*) lives and nests underground in open grassland habitats west of Minnesota and Iowa, north into Canada and south into Mexico. This bird is most often found living in close proximity with colonial rodents (Family: Sciuridae), such as prairie dogs and ground squirrels. The Western Burrowing Owl generally does not dig its own burrow, but appropriates abandoned burrows dug by other animals, such as sciurids. Owls are known for their intense site-tenacity, especially during the nesting season (Zarn 1974).

Burrowing Owl numbers have declined significantly in the western U.S. and Canada during the last 150 yr as a result of agricultural conversion, destruction of colonial rodents, and urbanization (Evans 1982, Haug and Didiuk 1993, Zarn 1974). The species is listed as endangered in Minnesota and Iowa, threatened or endangered in several Canadian provinces and a Species of Special Concern in six western states. In many areas, remaining owl populations are threatened by urban development or other disturbances on the flat, open grassland they occupy. The owl's legal status and its protection under the federal Migratory Bird Treaty Act (1918) forbid the destruction of owls or their nest burrows and require mitigation for human-caused destruction of burrows. One approach to mitigating such damage is to relocate birds that lose burrows.

Here I describe passive relocation of owls using artificial burrows, a method that has proven a reliable way to coax owls into taking up residence in new burrows. Artificial burrows were first described in the literature by Collins and Landry (1977) who used the burrows to increase owl populations in areas disturbed by people. Owls readily colonized the human-made burrows.

PASSIVE RELOCATION METHODOLOGY

The passive relocation protocol described here was used at two sites in the San Francisco Bay Area (Trulio 1992) and at one site in Sacramento, California (T. A. Schulz, pers. comm.) to relocate birds living in burrows directly in the path of commercial development. Variations of these procedures have been used at several other locations in northern California (J. Barclay, pers. comm.; P. Delevoryas, pers. comm.). The relocation process is composed of four phases: impact assessment, artificial burrow creation, owl eviction and monitoring.

The extent of the impact to owls on disturbance sites must be assessed. Recently, the Burrowing Owl Consortium, an *ad hoc* group of over 25 consultants, agency personnel, academic biologists and private citizens studying Burrowing Owls in northern California, developed survey protocol and mitigation guidelines for use in California (Burrowing Owl Consortium Mitigation Committee 1993). The protocol and guidelines recommend that surveys on sites which will be disturbed be conducted during the breeding season (March–August), during the winter, and then again within 30 d of disruption. Disturbances to owls should be avoided if at all possible (Office of Planning and Research 1992).

If impacts cannot be avoided, passive relocation may be the best alternative. Owls must be observed for 2–3 wk to determine which burrows they are using and which of these burrows will be destroyed. Artificial burrows should be placed as close as possible to the burrows to be destroyed and as far as possible from trees, roads, sidewalks, structures and human disturbances. The Migratory Bird Treaty Act prohibits destruction of birds, eggs or burrows, so eviction of owls and destruction of burrows must occur outside the breeding season.

The artificial burrow design described here is based on that described by Collins and Landry (1977). Tunnels and nest boxes are placed in dirt mounds 7–13 m in diameter and approximately 1.5 m high (Fig. 1). Dirt should be shaped into a mound and compacted slightly. The tunnels may be terra cotta pipe or flexible plastic tubes with an interior diameter of 10 cm. Tunnels should be approximately 2.5 m long with a 45° or 90° angle in the middle to prevent light from reaching the nest box. A nest box, approximately 0.3 m in all dimensions, is placed at the end of the tunnel (Fig. 2). Irrigation boxes, valve boxes or plastic buckets all make fine nest boxes. Boxes should not have a bottom and should sit on the soil. If they do have a bottom, holes should be drilled for drainage and to allow moisture vapor from the soil into the nest box to keep an acceptable humidity level for egg development (L. Thomsen, pers. comm.).

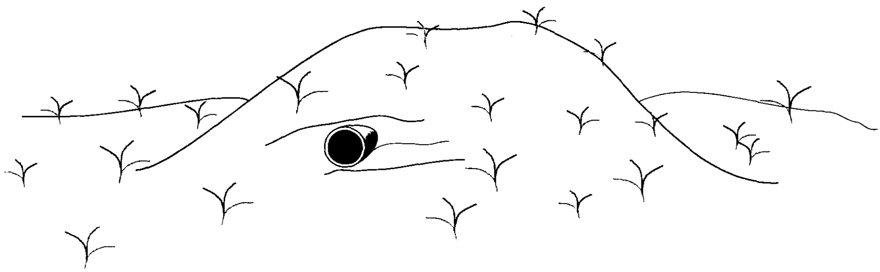

FIGURE 1. Artificial burrow mound with tunnel opening at least 0.3 m from ground level. The mound should be 7–13 m in diameter and approximately 1.5 m high. Dimensions can be altered to suit the site.

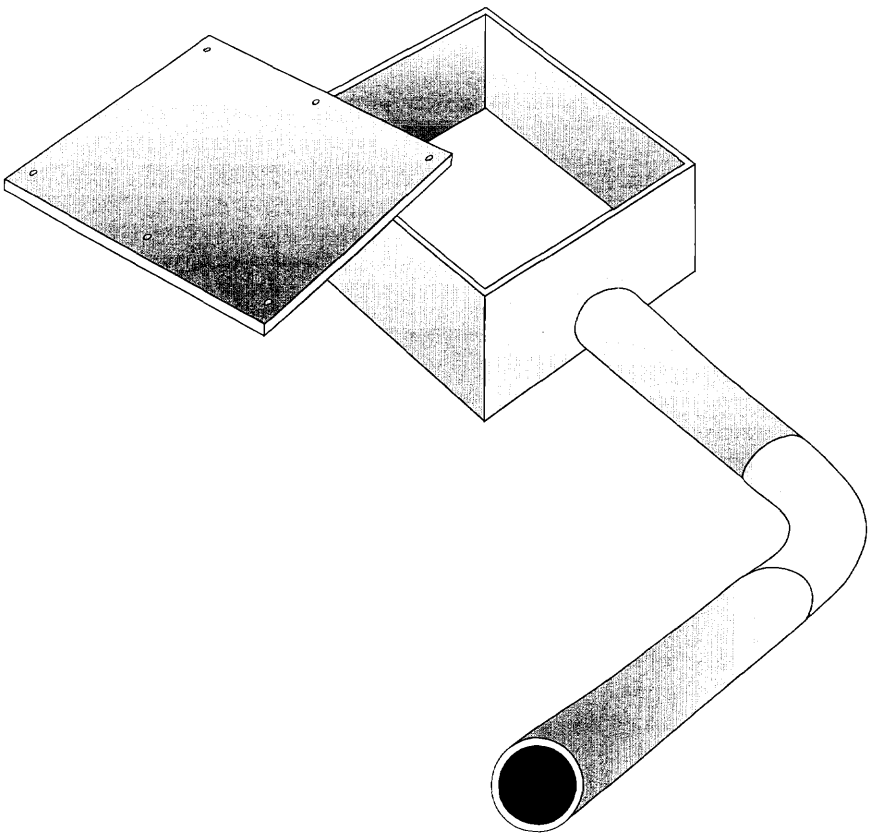

FIGURE. 2. Tunnel and next box assembly. Tunnels must have an interior diameter of 10 cm, be approximately 2.5 m long and have a 45° or 90° angle. The nest box should be at least 0.3 m on all sides. Removable lids should be firmly secured.

Removable lids must be firmly secured. The tunnel entrance should extend just slightly from the soil, approximately half way up the dirt mound. The tunnel should be level or tip slightly down toward the entrance. The nest box should be at least 0.3 m below the top of the mound. Two such burrow-and-nest-box assemblies can fit into each mound. At least one perching post (1 m tall) should be placed near each burrow entrance. Ideally, two mounds should be constructed for each owl pair displaced.

After artificial burrows are constructed, the birds must be given at least 3 wk to familiarize themselves with the new burrows. Then, owls should be evicted from the burrows slated for destruction and allowed to occupy the new burrows. Owls should be banded before eviction, if possible, and banding must be done by a bird bander licensed to handle Burrowing Owls. Several days before the site disturbance, one-way doors should be placed over all burrows so that the birds can leave but not re-enter their doomed burrows. These doors, which typically consist of an aluminum tube with a plastic door on the front, should be left in place for 3–4 d (T. Schulz, pers. comm.; P. Delevoryas, pers. comm.). All previously occupied burrows should then be carefully excavated to be sure no owls are still below ground. Alternatively, on the day of or before the site disturbance, owls should be observed to be sure all are out of their burrows; then the burrows should be excavated.

After evicting the birds, the site should be graded immediately so that owls cannot return to the original burrows or any other in the construction area. Construction crews must be made aware of the owls and their new burrows. Ideally, a safe zone with a radius of 50 m should be cordoned off around the new burrows to prevent disturbance. The owls should be monitored monthly for use of the new burrows until the next breeding season to determine if the birds stayed and had offspring.

As much of the site around the new burrows as possible should be managed as open grassland to provide foraging habitat for owls. The Burrowing Owl Consortium recommends that each mated owl pair be provided at least 2.6 ha of foraging area contiguous with or near their burrow (Burrowing Owl Consortium Mitigation Committee 1993). Mowed grass may be used by owls as a foraging habitat, but the use of pesticides on turf usually seriously lowers its value to owls. The typical practice of poisoning ground squirrels, other rodents or insects in these managed areas must be avoided as poisons can kill or injure owls (Dyer 1987, James and Fox 1987).

RESULTS OF PASSIVE RELOCATION

Between 1988 and 1993 passive relocations using artificial burrows were conducted on six sites in northern California by members of the Burrowing Owl Consortium (Table 1).

Burrowing Owls moved into the artificial burrows in less than 1 mo in all but one of these relocations. In most cases, it is not known whether the evicted owls were the new occupants because birds were banded only at Shoreline in Mountain View. In the Shoreline case, the banded bird

TABLE 1. Results of passive Burrowing Owl relocations in northern California.

Relocation site[1]	# birds evicted	Distance to new burrow[2]	Results
Shoreline, Mountain View	1 pair	7 m	2 burrows made (1 mound); 1 owl banded; evicted pair moved to new mound
Auto Mall Parkway, Fremont	1 pair	15 m	2 burrows made (1 mound); owls unbanded; pair moved in (probably evicted pair)
Cosumnes River College, Sacramento[3]	6 single owls	45–70 m	6 burrows made; owls unbanded; 5 of 6 burrows occupied same month that owls were evicted
Santa Clara Valley site[4]	1 pair; 2 single owls	8–75 m	3 burrows made; owls unbanded; 1 evicted pair probably moved in; unknown if single birds moved in; all burrows occupied the day after their completion.
Northern California[4]	2 pairs	30–65 m	17 burrows made; owls unbanded; 15 of 17 artificial burrows were used by owls
Kato Boulevard, Fremont[5]	1 pair	165 m	3 burrows made; owls unbanded; no owls used burrows

[1] Site and city given when allowed by consultant; otherwise only a general location is provided.
[2] Distance artificial burrow was located from original burrow.
[3] T. A. Schulz (pers. comm.).
[4] J. Barclay (pers. comm.).
[5] P. Delevoryas (pers. comm.).

and its mate moved into the artificial burrow within one week after eviction from their original burrow. They stayed the entire year and raised chicks in the artificial burrow. In the other cases, the biologists (see Table 1) conducting the work believed the evicted owls were the occupants.

DISCUSSION

Passive relocation has been defined as "encouraging owls to move from occupied burrows to alternate natural or artificial burrows" (Burrowing Owl Consortium Mitigation Committee 1993). Birds are encouraged to relocate voluntarily to new burrows and are captured only for banding. Passive relocation using artificial burrows is designed to take advantage of the well known site-tenacity of burrowing owls (Zarn 1974). These birds resist abandoning nest burrows even in disturbed areas (P. Delevoryas, pers. comm.; Schulz 1993) and will return year after year to the same burrow (Haug and Oliphant 1990, Millsap and Bear 1993, Thomsen

1971). Owls spend most of their time within 50–100 m of their nest or satellite burrows during daylight hours (Haug and Oliphant 1990). Inter-nest distances, which indicate the limit of an owl pair's territory, have been found to average from 61 (Thomsen 1971) to 214 m (Haug and Oliphant 1990). Given these facts, placing artificial burrows as close as possible but within approximately 100 m of the burrows to be destroyed is expected to attract the evicted owls.

The results in Table 1 show that owls were quickly attracted to artificial burrows at five of the six relocation sites. The successful sites were all within 75 m of the destroyed burrow, a distance generally within a pair's territory. The only unoccupied habitat, one created 165 m from the destroyed burrows, may have remained undiscovered by the evicted birds. Owls were not banded at four of the five successful sites, so it cannot be known in those cases whether the evicted owls moved into the new burrows. The contention that the target birds were the occupants of the artificial burrows is reasonable, however. In the future, banding must be used to verify the identity of owls inhabiting new burrows.

The Burrowing Owl Consortium (1993) recommends passive relocation instead of the primary alternative, active or long distance relocation. Active relocation requires capturing owls, taking them to a new area some distance from their original site and releasing them or putting them in temporary aviaries placed over newly created owl burrows. Unfortunately, after the aviaries are removed, birds generally disappear from the site within the season. Some birds return to their original burrow site but many are never observed again (Schulz 1993). Owls moved long distances may suffer increased predation over owls living in a familiar neighborhood (Dyer 1987). Other raptors, such as Golden Eagles (*Aquila chrysaetos*), have shown similar site-tenacity and mortality when relocated long distances (Phillips et al. 1991).

Results from several active relocation projects indicate that this procedure may have the best chance of success if owls are moved just prior to egg-laying (P. Delevoryas, pers. comm.) or while they have fledglings in the burrow (Dyer 1987, 1991). Anytime owls or nests are disturbed during the nesting season, authorization must be secured from the U.S. Fish and Wildlife Service and, potentially, local wildlife agencies. Given the regulatory problems and the considerable risk this procedure presents to breeding birds and their young, active relocation is recommended only when no other alternative is possible.

Although passive relocation appears to be a successful way to relocate birds, this method should be not used to compensate for lost burrows if the impact to nest burrows can otherwise be avoided. Nor is passive relocation an adequate mitigation if enough adjoining foraging habitat is not preserved.

The use of artificial burrows in passive relocation has advantages over letting owls attempt relocation to natural burrows. Artificial burrows provide new homes immediately and evicted owls need not compete with squirrels and other owls for burrows. By using artificial burrows, owls can be enticed to a site that has been deemed safe from disturbance.

The mound design is easily altered to suit specific site conditions. A large mound with each burrow at least 0.3 m above the ground level is well suited to sites that might flood. It is also recommended on landfills to give owls an extra buffer between their nest and the solid waste underneath. Owls prefer short-grass habitats and tall vegetation must be removed from burrows to attract and retain the birds. Vegetation removal must be done by hand because mowers cannot climb the mound. In areas safe from flooding where mowing is available, a low mound, which allows the mower to pass over the burrow, may be used. In areas with terrestrial predators such as red foxes (*Vulpes vulpes*) and coyotes (*Canis latrans*), the burrow tunnel and nest box should be constructed of terra cotta or other material impenetrable to the predators. Mound design should maximize owl protection and attractiveness to the birds, while minimizing cost and maintenance.

Artificial nest creation is a well-recognized technique for improving the nesting success of rare species such as Osprey (*Pandion aliaetus*), and is being applied successfully to Red-Cockaded Woodpeckers (*Picoides borealis*), a federally-listed endangered species (Copeyon et al. 1991). Artificial burrows have been successfully used to increase Burrowing Owl populations in southern California (Collins and Landry 1977), reintroduce owls into British Columbia (Dyer 1991), create owl habitat in areas safe from disturbance and relocate rehabilitated birds who need a new home (Trulio 1992). Artificial burrows provide an effective method by which to improve the survival chances of Burrowing Owls disturbed by human activity and they should be used whenever feasible.

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LITERATURE CITED

Burrowing Owl Consortium Mitigation Committee. 1993. Burrowing owl survey protocol and mitigation guidelines. Tech. Rep. Burrowing Owl Consortium, Alviso, California.

Collins, C. T., and R. E. Landry. 1977. Artificial nest burrows for Burrowing Owls. N. Am. Bird Bander 2:151–154.

Copeyon, C. K., J. R. Walters, and J. H. Carter. 1991. Induction of red-cockaded woodpecker group formation by artificial cavity construction. J. Wildl. Manage. 55:549–556.

Dyer, O. 1987. Burrowing owl workshop—western raptor management symposium: a summary of discussions. Boise, Idaho. 32 pp.

———. 1991. Reintroductions of Burrowing Owls (*Athene cunicularia*) to the south Okanagan Valley, British Columbia (1983 to 1988). Pp. 231–235, *in* G. L. Holroyd, G. Burns, and H. C. Smith, eds. Proc. Second Endang. Species Prairie Cons. Workshop, Prov. Mus. Alberta Nat. Hist.

Evans, D. L. 1982. Status report on twelve raptors. Rept. No. 238. U.S. Department of the Interior. Washington, D.C. 68 pp.

Haug E. A., and A. B. Didiuk. 1993. Use of recorded call to detect Burrowing Owls. J. Field Ornithol. 64: 188–194.

———, AND L. W. OLIPHANT. 1990. Movements, activity patterns and habitat use of burrowing owls in Saskatchewan. J. Wildl. Manage. 54:27–35.

JAMES, P. C., AND G. A. FOX. 1987. Effects of some insecticides on productivity of Burrowing Owls. Blue Jay 45:65–71.

MILLSAP, B., AND C. BEAR. 1993. Mate and territory fidelity and natal dispersal in an urban population of Florida Burrowing Owls (*Athene cunicularia floridana*). J. Raptor Res. 27:62.

OFFICE OF PLANNING AND RESEARCH. 1992. CEQA: California environmental quality act statutes and guidelines. Off. Plan. and Res.

PHILLIPS, R. L., J. L. CUMMINGS, AND J. D. BERRY. 1991. Responses of breeding golden eagles to relocation. Wildl. Soc. Bull. 19:430–434.

SCHULZ, T. A. 1993. Observations, resightings, and encounters of rehabilitated, orphaned and relocated Burrowing Owls. J. Raptor Res. 27:63.

TRULIO, L. A. 1992. Burrow borrowers. Pacif. Discov. 44:19–21.

THOMSEN, L. 1971. Behavior and ecology of Burrowing Owls on the Oakland Municipal Airport. Condor 73:177–192.

ZARN, M. 1974. Burrowing owl (*Speotyto cunicularia hypugaea*). Habitat management series for unique or endangered species. U.S. Bur. Land Manage. Rept. No. 11.

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