METHODS FOR MINIMIZING IMPACTS TO SENSITIVE SMALL MAMMALS

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Abstract: The number of small mammal species categorized as sensitive is increasing at a rapid rate as development continues to reduce populations and fragment habitats. The development of reserves is necessary, but the commitment to monitor and manage these lands in perpetuity is tenuous. Further, acquisition of compensation lands usually results in a net loss of occupied habitat and contributes to the fragmentation of populations. In certain cases, habitat enhancement may reclaim disturbed lands in order to create habitat to compensate for proposed losses. In cases of temporary habitat disturbance, a wider range of options exists. Fencing can exclude sensitive target species from areas during active disturbance. Resident individuals within the disturbed area may be displaced to an area outside the disturbed area or may be temporarily housed during the activity. Subsequent to project activities, the disturbed area can be rehabilitated and the target species reintroduced or encouraged to recolonize the affected area. This may be done prior to removal of the fencing, in the case of temporarily housed animals. Reduction of impacts to individuals by exclusion, rehabilitation of temporarily disturbed habitats, and re-establishment of occupation are key to minimizing net habitat loss and fragmentation of existing populations.

An increasing number of terrestrial small mammal species (< 500 g) are being categorized as threatened, endangered, or are under consideration for such listing by various state and federal agencies. In California alone, there are 7 federal- and state-listed threatened or endangered taxa (U.S. Fish and Wildlife Service 1991a, California Code of Regulations 1991). Three taxa are federal Category 1 candidates for listing and California threatened (U.S. Fish and Wildlife Service 1991b, California Code of Regulations 1991). A total of 34 additional taxa have been accorded federal Category 2 candidate for listing and California species of special concern status (U.S. Fish & Wildlife Service 1991b, California Dept. Fish and Game 1992). The National Environmental Protection Act and/or the California Environmental Quality Act require that potential impacts to sensitive species be evaluated for proposed projects as defined in the acts.

Impacts must be avoided where possible and minimized when avoidance is not possible. Mitigation of unavoidable impacts can take many forms, depending on the degree of sensitivity of the species impacted and conscientiousness of the lead regulatory agency's implementation of the acts. The most common, and concrete, mitigation measure involves the purchase of compensation lands. Other strategies include funding of research that answers important questions concerning recovery, management, and protection of the target species, moving individuals from the sphere of proposed activities, and implementing methods to exclude sensitive species from projected harm.

The purchase of lands does not always provide appropriate benefit to the target species. For example, acquisition of 100 acres of occupied habitat to compensate for the destruction of 100 acres of similarly occupied habitat will result in the net loss of that quantity of an organism's range. This is generally the best compromise for the species' long-term survival, due to habitat preservation, provided that the habitat secured is equal to or better than the habitat to be lost. Personal experience indicates that the lands offered by developers for compensation are those that are unsuitable for development. It is almost axiomatic that such lands are also unsuitable for the target species. If an organism is threatened or endangered, habitat loss is a major factor in the designation. Habitat loss is generally due to development, thus the species and developers compete for the same resource.

Once land is acquired as compensation, it must be managed. Encroachment of destructive practices (e.g., off-road vehicle use) must be controlled. The target species and its habitat must be regularly monitored to identify negative trends early and allow appropriate action to return conditions to optimal levels. Natural vegetation must be maintained within prescribed limits, while invasive, non-native vegetation may require control. These management activities must be planned in perpetuity, necessitating a long-term funding mechanism to which the regulatory agencies cannot commit, and the project proponent may be unwilling or unable to fund.

Since 1989, the senior author has worked intensively with the federal-endangered and state-threatened Stephens' kangaroo rat (*Dipodomys stephensi*) throughout its range in southern California. In addition to presence/absence surveys for proposed projects, I (MO'F) studied habitat use (O'Farrell and Clark 1987; O'Farrell and Andersen in litt.), methods for population and habitat monitoring (O'Farrell 1992), and the efficacy of habitat enhancement and translocation procedures (O'Farrell 1993; O'Farrell unpubl. data). These works

form the base for the following conceptual discussion of possible ways to minimize impacts to small mammals in general.

Many studies in applied biology are performed under contract with entities that maintain a propriety control over dissemination of the results. Many of these contain enough constraints that the ultimate publication in scientific journals is precluded, thus precipitating a massive body of information that is difficult to access. The lag time in achieving publication in scientific journals presents another barrier to the dissemination of such results. A secondary goal of the present paper is to highlight the need for timely presentation and discussion of concepts important to decision makers.

HABITAT LOSS

The paramount consideration in minimizing impacts to a sensitive species should be the reduction or elimination of a net loss in occupied habitat. The severity and permanency of the habitat loss dictate the range of mitigation measures available.

If a project results in a permanent loss of habitat, the only possibility to achieve no net loss of habitat would be to create occupied habitat elsewhere. This is possible if the habitat requirements of the target species are known, an appropriate quantity of potentially suitable land is available within protected ownership, and the ability exists to manipulate such currently unoccupied habitat to within suitable limits. Ideally, such lands would be adjacent to existing, occupied habitat so that when the manipulated habitat becomes suitable, it will be colonized from surrounding areas. When suitable, but unoccupied, acquired lands are remote from existing occupied habitat, suitably prepared habitat can be stocked with individuals from select sites elsewhere in the species' range.

Creation of isolated patches of habitat stocked with translocated individuals may create island populations with initial limited genetic diversity. Such a condition perpetuated may result in ultimate extirpation of that population. Either periodic translocations or establishment/preservation of movement corridors will be necessary to allow sufficient gene flow to provide a high likelihood for the population to persist.

Projects that cause a temporary disturbance (e.g., utility corridors) need not result in a permanent loss of all habitat affected by the activity. A power line necessitates permanent disturbance at the placement point of poles or towers and the access roads required for construction and maintenance. A pipeline requires development of a prepared right-of-way to allow access for equipment and supplies and manufacture and installation of the pipeline. This type of activity represents a continuous, serious disturbance for the entire width and length of the working right-of-way. A more extreme form of this type of disturbance would be construction of a permanent road.

Habitat loss can be minimized for transmission line projects by selective placement of structures to avoid sensitive habitat. Secondarily, preparation of the working area should be minimized. Unless topography is rugged, there is no need to grade a flat pad devoid of vegetation. Vegetation recovery is greatly enhanced if grading is avoided. Driving equipment over existing vegetation will crush or destroy above ground biomass, but root systems will continue to stabilize soil and many shrubs will recover quickly through crown sprouting.

A pipeline corridor presents a more difficult situation than a transmission line. Although grading should be avoided when practical, this will rarely occur. If top soil is initially stockpiled, it can be replaced after the area is recontoured to provide a ready seed bank for rapid revegetation by local species. Likewise, roadsides may be managed and maintained to enable movement among larger occupied habitat patches.

SPECIES PROTECTION

Regardless of the temporary or permanent nature of a proposed activity, the disturbance to a sensitive species must be minimized. One method is to exclude access by the species to the area of disturbance. For terrestrial small mammals, this may be accomplished by appropriate placement of an effective fence. In southern California, hardware cloth fencing has been used to attempt exclusion of *D. stephensi*. Agency specifications dictated that the fence be both 61 cm (2 ft) above and below the surface of the ground. In all cases we field checked, the specifications were rarely met for even small lengths of the entire fence. Hardware cloth was too fragile to withstand physical contact, and staking with reinforcing steel bars placed at approximately 2-m intervals was insufficient to keep the fence vertical. Fence depths rarely met specifications due to undulating ground surface contours. The fence, once installed, was irregular in height, failed to fully seal at points of intersection, and rapidly collapsed at points receiving drainage flow or simply mechanical damage by equipment or pedestrian workers. These structural weaknesses were compounded by the fact that kangaroo rats can climb the fencing.

Consequently, we developed a sturdy fence that accommodated to irregular terrain, withstood rugged treatment, incorporated connecting seams to eliminate any gap for entry, and when properly placed away from vertical objects completely excluded climbing entry by small mammals. This fence design is currently being used to exclude *D. stephensi* from an approximate 8-ha (20-acre) site undergoing a subsurface toxic waste clean-up (Figure 1; O'Farrell unpubl. data). This site is

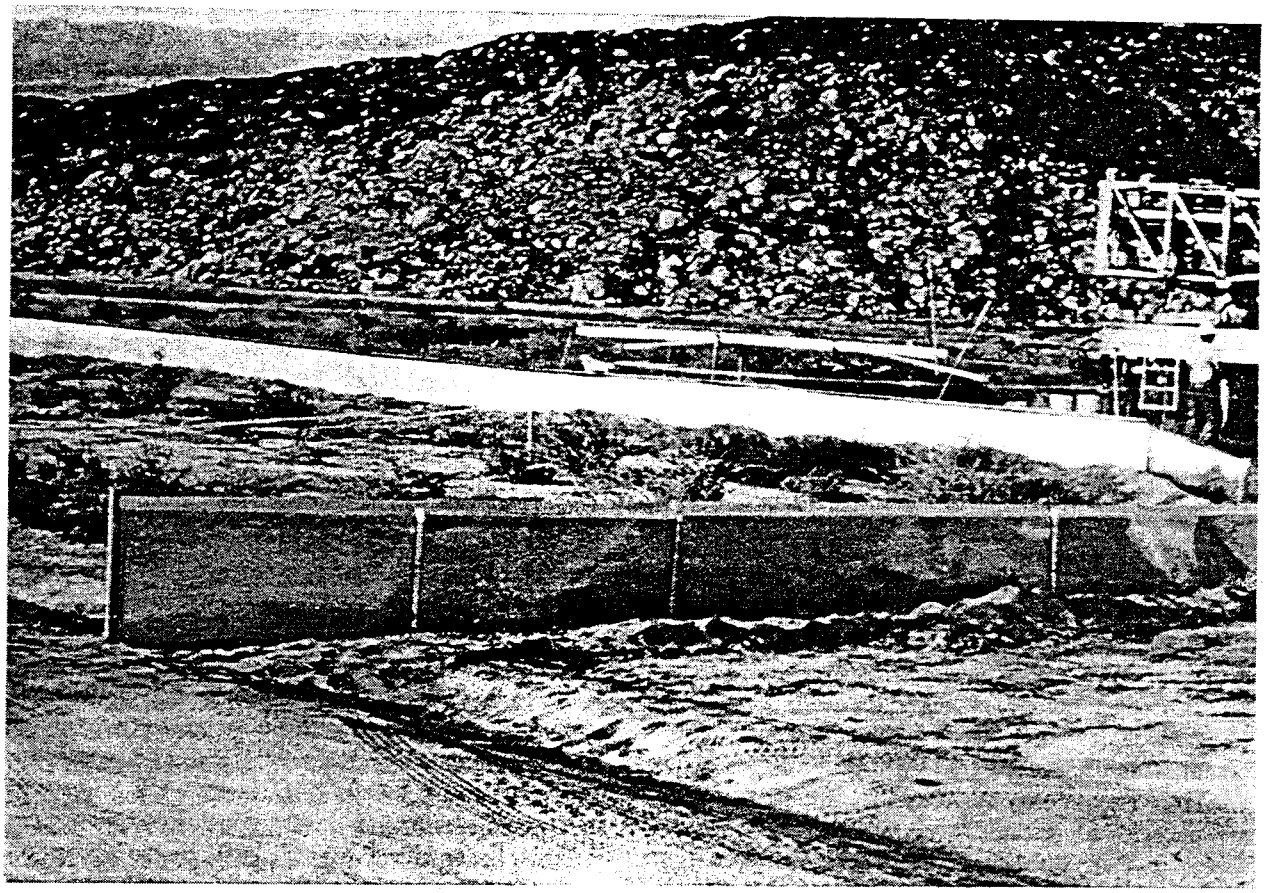

Fig. 1. Kangaroo rat exclusion fence installed for the toxic waste clean-up effort at Potrero Creek, Riverside Co., California.

irregular in shape. Two gates allow through traffic of heavy equipment but seal when closed to prevent kangaroo rat entry.

The fence is constructed of galvanized sheet metal panels, 122 cm in height, vertically installed 61 cm above and below the ground surface. The upper 15 cm is bent at 45° to the outside to further discourage an animal's attempt to climb the smooth surface of the fence. The panel widths vary to accommodate uneven terrain. Steep terrain requires specialized panels that step up or down to maintain the required height and depth. Panels are connected by recessed seams fixed to metal t-posts. Fence corners contain engineered, recessed seams. Thus, no external hardware or other irregularities exist for an animal to gain purchase for climbing. The fence may be removed and reused after rehabilitation of the disturbance.

DISCUSSION

Habitat loss throughout California, concomitant with expanding urban and industrial development, continues to jeopardize species as indicated by the number of listed and sensitive species (U.S. Fish and Wildlife Service 1991a and b, California Code of Regulations 1991, California Department of Fish and Game 1992). Establishment of preserves may be the only option to curtail extirpation, if not total extinction of particular species. The current trend towards organization of networks of multi-species reserves is an important step in species and community preservation. Ideally, such a network will contain reserves of sufficient size connected by movement corridors to minimize the need for management intervention.

Regional habitat loss eventually reaches the point where the realities of political and economic pressures prevent attainment of ideal preserve conditions. Thus, early acquisition of reserves is critical in establishing a viable network. Rehabilitation or reclamation of previously disturbed areas should be attempted whenever possible. However, this necessitates a thorough understanding of the composition of the community and

the ability to recreate these conditions. Some habitats are simpler to manipulate and provide more rapid results (e.g., grasslands as opposed to shrublands).

Minimizing permanent habitat loss aids in preserving natural interchange among population centers. Maintenance of habitat integrity along utility rights-of-way may be important in preserving connecting corridors. Most utility pathways represent a general, temporary disturbance, with minor areas of more substantial loss of habitat. However, any project that entails a mostly temporary disturbance should be targeted for rehabilitation and maintenance of viable habitat.

A project that disturbs occupied habitat should exclude free-ranging individuals from adjacent, undisturbed areas from entering the footprint of activity. At present, we are unaware of any study that addresses the magnitude of impacts to individuals in adjacent habitat. However, mobile species are likely to move into the sphere of disturbance if no effective barrier is present. Until studies have quantified these impacts, placing effective barriers to immigration during construction is prudent.

A barrier fence, such as described above, effectively excludes not only small mammals but other terrestrial taxa. Of particular relevance are sensitive species.

A fence provides several distinct strategies. The structure may exclude movement of target species from the area to be disturbed. If the species' distribution surrounds the area of disturbance, it may be excluded by completely fencing the area to be affected. Residents within the disturbed area will be subjected to project impacts and will require some level of mitigation. Compensation can be minimized if the animal can be successfully moved from the site or, if the disturbance is temporary, reestablished after completion of the project.

If the area to be disturbed is small, the target species may be displaced by capturing and simply placing individuals on the outside of the exclusionary fence. This could be accomplished regardless of the permanency of the disturbance. However, the possible effects on the existing social structure of residents outside the fence are not known. Impacts of such displacement on outside residents should be thoroughly investigated. Displacement may not only be lethal to the individuals being displaced, significant negative effects may be experienced by outside residents through social disruption and/or attraction of predators to the presence of confused newcomers.

For areas of permanent disturbance, translocation of resident animals to suitable, unoccupied habitat is a potential option. This would eliminate the loss of a local gene pool and may minimize the net loss of occupied habitat. However, habitat suitability and isolation from existing occupied habitat are concerns. Creation of an island population with no possibility of migratory interaction may not contribute to the long-term survival of the species.

A unique method for avoiding a net loss of occupied habitat or local gene pool and the possible fragmentation of existing populations is to employ a combination of fencing and *ex situ* measures (see Emmerson and O'Farrell, these proceedings) during a temporary disturbance. The area to be disturbed is completely fenced and the target species trapped and removed from the site. These individuals are housed temporarily during the project activity and subsequent rehabilitation of habitat on the site. The animals are then returned to the fenced area and allowed time to re-establish. The fence is then removed and the residents can freely interact with the local population. This activity minimizes permanent loss of occupied habitat and the disruption to the surrounding population.

Methods for minimizing impacts to sensitive small mammals can and should be creative. The greater the knowledge of the biology of the target species, the greater the opportunity to be creative. The methods outlined in the present paper are not meant to be exhaustive. Rather, they are provided as a starting point for further investigation, refinement, and communication of these results to the scientific community. Most of the methods described cost less to implement than outright purchase of compensation lands. Efforts to eliminate net loss and fragmentation of the habitat of a sensitive species will benefit the species as well as surrounding biotic communities. Minimizing mitigation costs ensures fewer acrimonious and litigious responses by project proponents, translating into more effective implementation of protective measures.

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LITERATURE CITED

California Code of Regulations. 1991. Animals of California declared to be endangered or threatened. Title 14, Section 670.5.

California Department of Fish and Game. 1992. List of mammal species of special concern.

O'Farrell, M.J. 1992. Establishment of a habitat and population monitoring program for the endangered Stephens' kangaroo rat. Transactions of the Western Section of the Wildlife Society 28:112-119.

_____. 1993. Stephens' kangaroo rat translocation studies at the Lake Mathews Ecological Reserve. Final Report to The Metropolitan Water District of Southern California, Los Angeles.

_____, and W.A. Clark. 1987. Habitat utilization by Stephens' kangaroo rat (*Dipodomys stephensi*). WESTEC Services, Inc. report to Southern California Edison Company, Rosemead, California.

U.S. Fish and Wildlife Service. 1991a. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12. 37 pp.

_____. 1991b. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species, proposed rule. Fed. Reg. 56(225):58804-58836.