Common Raven Predation on the Desert Tortoise
November 2010

Summary
Over the past few decades, common raven (*Corvus corax*; raven) populations have increased substantially and its distribution has expanded in the California desert, primarily in response to human-provided subsidies of food, water, and nest sites associated with a variety of land uses. Ravens are a known predator of the desert tortoise (*Gopherus agassizii*), a species listed as threatened under the federal Endangered Species Act (ESA) and the California ESA (CESA). A large number projects are currently proposed in the California deserts within the range of the desert tortoise. Due to the locations of these projects, associated infrastructure, and the increase in human activities that will occur if these projects are approved, a corresponding increase in raven presence and predation on desert tortoises is anticipated throughout the region. The direct, indirect, and cumulative impacts from these projects throughout the range of the desert tortoise have been and will continue to be substantial. As discussed below, conservation efforts at both the project and regional level will be required to address impacts to the desert tortoise from an increase in raven populations throughout the desert.

Offsetting Direct Impacts from Development Projects:

The Bureau of Land Management (BLM) addresses the increase of ravens and associated issues in each of the amendments to the California Desert Conservation Area Plan (CDCA). The CDCA plan amendments established that all new projects with the potential to increase raven populations would be required to implement mitigation measures to reduce or eliminate the opportunity for proliferation of ravens. The BLM's biological assessments and the U.S. Fish, and Wildlife Service's (USFWS) biological opinions for the CDCA plan amendments reiterate the need to address this species and its potential impacts on desert tortoise populations.

Pursuant to CESA, the California Department of Fish and Game (CDFG) issues incidental take permits for projects that may affect desert tortoises and their habitats. Permit conditions include mitigation measures designed to offset project impacts and typically require the development of a raven control plan and implementation of off-site measures to reduce the indirect and cumulative environmental effects of increased raven predation.

To address project-specific impacts on desert tortoises from ravens that may be attracted to project sites and associated features, (e.g. buildings, fences, and transmission lines), project proponents should design their projects to exclude ravens to the maximum extent practicable and implement measures to reduce raven predation on the desert tortoises at the local level. Each project proponent should develop an on-site raven management plan to eliminate and/or minimize the availability of subsidies and the potential for ravens to occupy the project site during all phases of development and use, including construction, operation, and maintenance, and decommissioning. The USFWS developed a project-specific raven management plan template, which is provided in Appendix A. However, because it is not possible to completely exclude ravens from using project infrastructure (e.g., buildings, fences, solar structures, transmission lines and towers, etc.) as nesting, perching, and roosting substrates (during breeding as well as non-breeding seasons), a regional raven management plan was developed. Contributions to and implementation of the regional plan are intended to address the indirect and cumulative impacts associated with development projects and other land uses in the desert that facilitate the expansion of raven populations into desert tortoise habitats.

Offsetting Indirect and Cumulative Impacts from Development Projects:

To address the impacts from ravens on desert tortoises and their habitats, the USFWS together with several cooperating agencies, including the BLM, National Park Service, Department of Defense, and the Department of Agriculture completed an environmental assessment for the implementation of a regional plan to reduce predation by the common raven on the federally threatened desert tortoise in the California desert (Raven EA; USFWS *et al*. 2008). This document was prepared because the raven is a known predator of the desert tortoise and the Desert Tortoise (Mojave population) Recovery Plan identifies reducing predation on the species as an important recovery task.

The Raven EA outlines a large scale, adaptively managed program that is expected to be implemented in a phased approach in collaboration with the cooperating agencies and local partners. The plan includes five primary actions:

1) Reduction of human provided subsidies (i.e., food, water, sheltering and nesting sites, etc.)
2) Education and outreach
3) Raven nest removal
4) Raven removal
5) Evaluation of effectiveness and adaptive management

The latter three activities are accomplished first through the identification of offending ravens by surveyors (whom also can remove nests) and then reporting those birds to the Department of Agriculture Animal and Plant Health Inspection Service Wildlife Services (WS) who are contracted to remove the offending individuals. Offending ravens are birds that are known to prey on desert tortoises as determined by survey results. Effectiveness monitoring is incorporated into subsequent years of the survey effort; therefore, the survey effort should remain consistent or increase but should not decrease. After the first 3 years of implementation, removal may increase to include additional (i.e., non-breeding) ravens depending on the results of monitoring.

The Raven EA identifies three levels of effort pertaining to lethal removal of ravens, which can be increased or decreased following the third and sixth year of implementation based on monitoring results. Thus, the level of effort for this component will/could change every 3 years and reach a maximum level at year 6 (these are represented by levels 1-3 below). In addition, there is an understanding among agencies (e.g., BLM, CDFG, and USFWS) that every component of the plan may not be implemented each year. For example, an education and outreach program from one year may not need to be repeated annually.

To assess the potential cost to implement the regional raven management plan, the USFWS evaluated three primary aspects of the plan identified in the Raven EA [removal (conducted by WS), outreach and education, and monitoring surveys]. The following outlines the assumptions and cost estimates used to develop the budget outline:

- Removal: In 2010, a single year-round WS employee costs approximately $92,000. For the first 3 years of the plan, if seasonal workers were utilized only during raven breeding season, this cost would be reduced. In 2009, $30,000 covered one WS staff for approximately 2.5 months, including training. We anticipate that survey and removal efforts would be divided amongst the three desert tortoise recovery units in the California Desert. Assuming that the optimum use of a WS employee would be one per recovery unit, a minimum of three people is needed at the lowest level of effort (approximately $40,000/WS personnel during the breeding season). After 3 years, removal efforts would no longer be limited to raven breeding season, necessitating year-round personnel. We estimated that maximum effort would require no more than two WS staff per recovery unit.

- Outreach and education position: Outreach and education is an important component of the plan. Currently, the assumption is that two people can effectively implement the education and outreach program for the Raven EA. A base annual salary for a GS-11 position within the region is approximately $64,000. Education and outreach would also benefit from media support including pamphlets and radio and television broadcasts, which would increase the costs to administer this component of the plan.
- Monitoring survey team: The effort, and therefore cost, of the monitoring survey team is dependent on the level of implementation of the plan. Effectiveness monitoring is essential in determining the success of the plan, and whether additional efforts will be needed. The three levels of survey effort considered below are compatible with the three increasing levels of raven removal effort.

The table below estimates the annual cost of these activities at each of the three levels of implementation described in the Raven EA, beginning with level 1.

Table 1. Annual budget estimates for implementation of the Raven EA.

Primary Activities in the Raven EA	**Level 1**	**Level 2**	**Level 3**
Removal staff	120,000	276,000	552,000
Outreach	128,000	128,000	128,000
Monitoring survey team	820,000	1,000,000	4,381,745
TOTAL	**$1,068,000**	**$1,404,000**	**$5,061,754**

In addition, there is a multitude of additional activities identified in the Raven EA that could be conducted in the desert to facilitate the reduction of raven subsidies. These include: identification and cleanup of illegal dump sites, surveys of communities to identify business that do not adequately control their waste, and surveys of landfills and transfer stations. Depending on the required level of implementation necessary for effectiveness, funds to conduct these other activities may be available.

Calculating Project-Specific Contributions to the Regional Raven Management Plan:

As stated above, implementation of the regional raven management plan is necessary to address the indirect and cumulative impacts of development projects. Given the potential for ravens to use a variety of human-provided structures and sites for foraging, nesting, and shelter and because it is not possible to completely exclude ravens from using project infrastructure, which can extend across thousands of acres for each project; it is appropriate to calculate the contribution of each project to the regional raven management plan based on the total area required for the development of the facility and associated components. These funds would be used to carry out the primary actions described above.

With the assistance of the National Fish and Wildlife Foundation (NFWF), who will be holding and managing the funds to implement the regional raven management plan, the USFWS and CDFG calculated the equitable contribution for development projects that are expected to increase raven presence and predation on the desert tortoise. This was accomplished by utilizing modeling tools to determine a per acre contribution for projects with permit terms of 20 or 30 years.

First, we estimated the developable (contributing) acreage within the implementation area of the Raven EA by reviewing state, federal, and county planning documents. Lands allocated for conservation or with otherwise “protected status”, such as Department of Defense installations, congressionally designated Wilderness Areas, National Park Service units, State Parks, and lands

managed by CDFG were excluded from developable acreage. For determining developable acreage on BLM lands, we included all of the current right-of-way applications for solar and wind projects, and assumed that no more than 1% of the Desert Wildlife Management Areas (DWMAs) would be developed pursuant to the CDCA plan and associated amendments (Table 2).

Table 2. Total estimated acres of potential development within the range of the desert tortoise in California.

Land Use Category	**Acreage**
Potentially developable acres in CDCA (desert tortoise habitat modeled .2-1, Nussear 2009)	2,453,600
1% of DWMAs	42,232
Solar project applications	450,000
Wind project applications	569,000
TOTAL	**3,514,832**

Since not all of these acres will actually be developed, we assumed that 35% of the total acreage in Table 2, or 1,230,191 acres, would be developed over the next 30 years. Then, based on the figures in Table 1, NFWF performed the following calculations:

- Calculated the year-by-year costs of raven removal, outreach, and survey activities;
- inflated those costs over the 20- or 30-year period for inflation, which was assumed at 3%;
- discounted the inflated cost stream to a "net present value" using an expected rate of return net of administrative/financial fees and expenses (analyzed discount rates of 2%, 3%, 4%, and 5%); and
- divided the net present value by the developable/contributing acreage of 1,230,191.

The resulting "per acre" charge is what a developer would pay up-front in a single lump sum for its contribution to the regional raven management plan, with this charge being multiplied by the number of acres used or impacted by a project to arrive at the total payment amount for that project.

The various discount rates (2%, 3%, 4%, and 5%) are intended to reflect what net investment return might be earned on the mitigation funds as they await disbursement. The term "net" here refers to investment return after assessing the NFWF's administrative fees and financial institution investment advisory fees (likely to be roughly 3% in the aggregate). The USFWS, in consultation with the CDFG, determined a 3% discount rate would be appropriate for this type of program, based on an estimated 20 to 30 year implementation period. Table 3 below provides the resulting cost per acre contribution for development projects with a permit terms of 20 and 30 years. If approvals are granted to extend the term of a project past the initial permit term (i.e., 20 or 30 years), the applicable state and/or federal agencies will re-evaluate the level of implementation of the regional raven management plan and assess whether the project is responsible for contributing additional funds to the account.

Table 3. Per acre contribution for the implementation of the regional raven management plan.

Permitted Duration of Project	**Per Acre Contribution**
20 years	$64.00
30 years	$105.00

For energy-related projects that require transmission lines (including associated towers and

substations) that are expected to remain in place in perpetuity to support the project, the contribution to the regional raven management plan will be $105 per acre impacted. The total contribution for a transmission line and its associated components will be determined according to the following acreages and formula:

Total contribution for transmission line and components = (1 + 2) x $105.00

1= # acres impacted by all associated substations

2= # acres impacted by the transmission line (determined by multiplying the width of the widest tower pad (acres) by the length of the transmission line)

Projects within and near currently occupied desert tortoise habitat or suitable desert tortoise habitat would contribute to the implementation of the regional raven management plan at the amounts specified above. Based on the methodology used for calculating the contribution, the total amount would be paid in full as part of the overall mitigation for the project. However, for projects that will be built in phases, the per-acre contribution may be paid as each phase is approved for construction pending agency agreement. For projects being mitigated through the NFWF program, the schedule of payments would be dictated by the terms of that program.

The total contributions for development projects within the California deserts will facilitate the ability for the resource and land management agencies to fully implement the actions identified in the regional raven management plan. Managing raven populations will play an important role in furthering the recovery of the desert tortoise.

Literature Cited

U.S. Fish and Wildlife Service, U.S. Department of Agriculture, U.S. Department of Defense, Bureau of Land Management. 2008. Environmental Assessment to Implement a Desert Tortoise Recovery Plan Task: Reduce Common Raven Predation on the Desert Tortoise. Ventura Fish and Wildlife Office. Ventura, California.

Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H.Webb. 2009. Modeling habitat of the desert tortoise (*Gopherus agassizii*) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

Appendix A
Common Raven (*Corvus corax*) Management Plan Template

(for all development projects within the range of the Mojave population of the desert tortoise)

Introduction

The purpose of the project-specific management plan is to address direct impacts to desert tortoises by eliminating and minimizing subsidies to the maximum extent practicable that are known to attract and be exploited by common ravens (ravens) during project construction, operation and maintenance, and decommissioning (i.e., removal of project facilities and infrastructure, reclamation of access roads, restoration of native vegetation). To address the indirect and cumulative effects of the project, the proponent would participate in the regional raven management plan either through monetary or in-kind contributions coordinated by the Raven Management Work Group, and working group formed by the Desert Managers Group.

The project-specific management plan should be implemented throughout the life of the project and include management strategies to control and limit raven abundance in and around the project area. In situations where subsides such as structures for perching cannot be eliminated (i.e., power lines and towers) the proponent will implement best management practices (BMPs) such as, reduction of available subsidies, raven monitoring, and raven nest removal. The project-specific plan is designed to avoid and minimize direct impacts resulting from the proposed project.
Potential subsidies to be considered for each project include but are not limited to:

- Availability of water from dust abatement activities, equipment cleaning and maintenance, evaporation and retention ponds, drainage areas or landscaping;
- Potential perching, roosting, or nesting sites;
- Food sources from soil disturbance and road kill (e.g., small mammals, insects, etc.); and
- Food sources and attractants from human and animal food and waste.

Plan Development

The project-specific raven management plan should address each of the following elements for each phase of project implementation:

- Identification of project design features and other measures to manage potential introduction of subsidies that may attract ravens to the area, including repellant devices to discourage nesting, perching, and roosting on project facilities such as transmission poles and towers; a refuse management system; a monitoring program; and a list of adaptive management options that would be applied if necessary, including the removal of all raven nests;
- Documentation of the effectiveness of project design features and BMPs;
- Identification of triggers that will prompt implementation of adaptive management procedures; and
- Regular reporting to document raven management measures that have been implemented and results of raven abundance and effectiveness monitoring throughout the life of the project.

The following are examples of elements that should be addressed at each stage of project implementation. This should not be considered a complete list, as there may be other elements that should be considered depending on the project.

Construction

Surface disturbance unearthing food sources
Ponding water
Human and animal food and waste management
Temporary nesting, perching, and roosting sites
Revegetation

Operation and Maintenance

Surface disturbance unearthing food sources
Ponding water
Human and animal food and waste management
Temporary and permanent nesting, perching, and roosting sites
Evaporation ponds
Landscaping

Decommissioning

Surface disturbance unearthing food sources
Ponding water
Human and animal food and waste management
Temporary and permanent nesting, perching, and roosting sites
Landscaping
Restoration, revegetation, and/or reclamation activities

Plan Implementation/Monitoring

Implementation and effectiveness monitoring of on-site efforts are critical to the understanding of the success and value of raven management activities. At a minimum, the plan should identify, address, and implement the following activities:

Construction

The project site should be monitored to ensure BMP compliance and document any raven use. The monitoring protocol should be rigorous enough to detect raven use. If a component of construction is identified as providing subsidies or attracting ravens, immediate steps should be taken to address the subsidies through an adaptive management program.

Operation

Raven nest removal should be conducted on all property structures for the life of the project. In the event that a nest is located with eggs, the nest will be removed following the completion of the nesting cycle unless, current implementation standards of the regional raven management plan allow for immediate removal. A raven abundance monitoring plan should be developed to verify the effectiveness of the BMPs and evaluate the need for adaptive management. The frequency and intensity of the monitoring plan will be related to the number of potential subsidies and the size of the proposed project. Monitoring stations will in most cases be associated with structures or elements where BMPs have been utilized or potential raven attractants are expected.

Decommissioning

The project site should be monitored to ensure BMP compliance and document any raven use. The monitoring protocol should be rigorous enough to detect raven use. If

a component of decommissioning is identified as providing subsidies or attracting ravens, immediate steps should be taken to address the subsidies through an adaptive management program.

Adaptive Management

The project proponent should identify and describe adaptive management practices as they will be used to ensure effectiveness of accomplishing the purpose of the raven management plan. Project specific triggers will be established through coordination with the agencies. Lethal removal of ravens will only be utilized under special circumstance and will be commensurate with the level of implementation of the regional raven management plan.

Education

This component should outline worker education, at all phases of development, as it pertains to avoiding and reducing subsidies for ravens and to promoting desert tortoise awareness. It should address continued education for long-term employees and users of the site (i.e., customers, etc.).