ENVIRONMENTAL IMPACT STATEMENT

for the

MANAGEMENT OF THE COMMON RAVEN

in the

California Desert Conservation Area

DRAFT

APRIL, 1990

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DRAFT (X) **FINAL ( )** **ENVIRONMENTAL IMPACT STATEMENT**

1. Type of Action: Administrative (X) Legislative ( )

2. Abstract:

This Environmental Impact Statement (EIS) is for a plan for management of the common raven (Corvus corax) in the California Desert Conservation Area (CDCA). Raven predation on juvenile desert tortoises, a federally listed endangered and state listed threatened species, has significantly affected desert tortoise populations, resulting in lowered numbers and reduced survival rates of juvenile desert tortoises. The raven management plan was developed to provide the framework for initiating a multi-agency program with the goal of restoring a balanced predator/prey relationship between the desert tortoise and raven in the California Desert Conservation Area.

3. Lead Agency: U.S. Department of the Interior,
Bureau of Land Management

Cooperating Agencies: U.S. Fish and Wildlife Service
U.S. Department of Agriculture
California Department of Fish and Game
U.S. Marine Corps
U.S. Air Force

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5. Date by which comments must be received: 24 JUL 1990

SUMMARY

This Environmental Impact Statement (EIS) reviews the plan for management of the common raven (Corvus corax, hereafter referred to as "raven") in the California Desert Conservation Area (CDCA). Management of the raven is addressed in the draft "Raven Management Plan for the California Desert Conservation Area". The measures proposed in this plan constitute the EIS "Proposed Action" (i.e., "Preferred Alternative"). The management plan was developed to restore a balanced predator-prey relationship between the raven and desert tortoise (Xerobates agassizii). Raven predation on juvenile desert tortoises, a federally listed endangered and state listed threatened species, has significantly affected desert tortoise populations, resulting in lowered numbers and reduced survival rates of juvenile desert tortoises. The raven management plan was developed to provide the framework for initiating a multi-agency program with the goal of restoring a balanced predator/prey relationship between the desert tortoise and raven in the California Desert Conservation Area.

During public scoping, a number of issues were raised. Concerns included the need to collect additional data on raven ecology and behavior, explore and adopt effective nonlethal means of raven control, and emphasize monitoring of both ravens and desert tortoise populations. The decision to prepare an Environmental Impact Statement for this program was based on the regional scope of the project, the long-term duration of program actions, and the controversial aspect of using lethal forms of raven control voiced during the 1989 pilot control program.

Under the no action alternative, raven predation rates on juvenile desert tortoises would continue without attempts to reduce predation levels and boost tortoise recruitment rates.

Under the Proposed Action, using a combination of lethal and nonlethal means of raven control, regional inventories would be conducted to locate sites of raven predation on desert tortoises. Containment practices at landfills and sewage treatment ponds near or within areas of excessive tortoise predation would be modified. Raven nesting and perching would be reduced by use of anti-perch wire, selective destruction of nests, and modification of some structures. Selective lethal raven control would also be initiated, using both poisoned baits and shooting. Additional information on the ecology of the raven and the effectiveness of different management techniques would be obtained through several studies.

Undertaking raven management by nonlethal methods only, landfill and sewage treatment practices would be modified in an effort to discourage year-round bird use and concentrations of birds. Anti-perch devices would be placed at perch sites and selective

destruction of raven nests would be undertaken. No attempts would be made to lessen predation rates by ravens on CDCA desert tortoise populations. Additional information on the distribution and ecology of the raven in the CDCA would be obtained through research. No attempts would be made to lessen predation rates by lethal raven control measures.

Confining raven control to pre-selected areas, the Bureau would confine raven management to relatively small portions of the CDCA in the western Mojave Desert and northern Colorado Desert. Research would be confined to these areas and would focus on pre-selected areas where excessive raven predation on juvenile desert tortoises has been documented (e.g., portions of the western Mojave Desert, central Mojave Desert, and northern Colorado Desert). Surveys would be undertaken to document and map locations of raven perching, roosting, and nesting sites. Nonlethal forms of control, including installation of anti-perch wire devices, would be employed. Changes in landfill and sewage treatment plant containment practices would be encouraged to deny ravens steady food supplies and to discourage concentrations of birds. Selected lethal control would be undertaken using a combination of poisoning and shooting.

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1.1 PURPOSE AND NEED FOR ACTION

1.1.1 Purpose and Need

Populations of the desert tortoise (Xerobates agassizii) in California have declined drastically in recent years. Contributing factors include habitat loss and fragmentation, vandalism, outbreaks of disease, and predation by ravens (Corvus corax). The Bureau of Land Management (Bureau, or BLM), as the major Federal agency administering Public Lands in desert tortoise habitat, is one of several agencies with the responsibility to protect this species.

Common raven (Corvus corax) populations in the California deserts have rapidly increased over the last 20 years. These increases are a result of human-induced alterations of desert regions, providing numerous perching and nesting sites and stable food sources.

Raven predation on juvenile desert tortoises has increased substantially in those areas with the highest increase in raven population. By lowering numbers of juvenile tortoises and altering tortoise age-class composition, raven predation has significantly affected the desert tortoise in these areas. Implementation of a comprehensive management program for the raven in the California Desert Conservation Area (CDCA) (Figure 1) to restore a balanced predator/prey relationship between the desert tortoise and raven in the CDCA is needed.

Without immediate action to counter the losses of young individuals in the tortoise populations, declines will continue. Tortoise populations must recruit juveniles and immatures on a regular basis to maintain themselves. While many other human uses have severe impacts on tortoises (e.g., Berry and Nicholson 1984, Berry 1986), management efforts to reduce these impacts will be fruitless unless tortoise populations have the opportunity to recruit young. Therefore, excessive raven predation should be reduced.

1.1.2 Program Objectives

A draft management plan for the common raven in the California Desert conservation Area has been developed and is available for public review and comment (BLM 1990a). Actions described in the draft management plan constitute the proposed action (e.g., control using combined lethal and nonlethal techniques) in this draft EIS and are hereby incorporated by reference. The management plan addresses two aspects of raven control: (1) reducing ravens from areas where excessive predation on desert

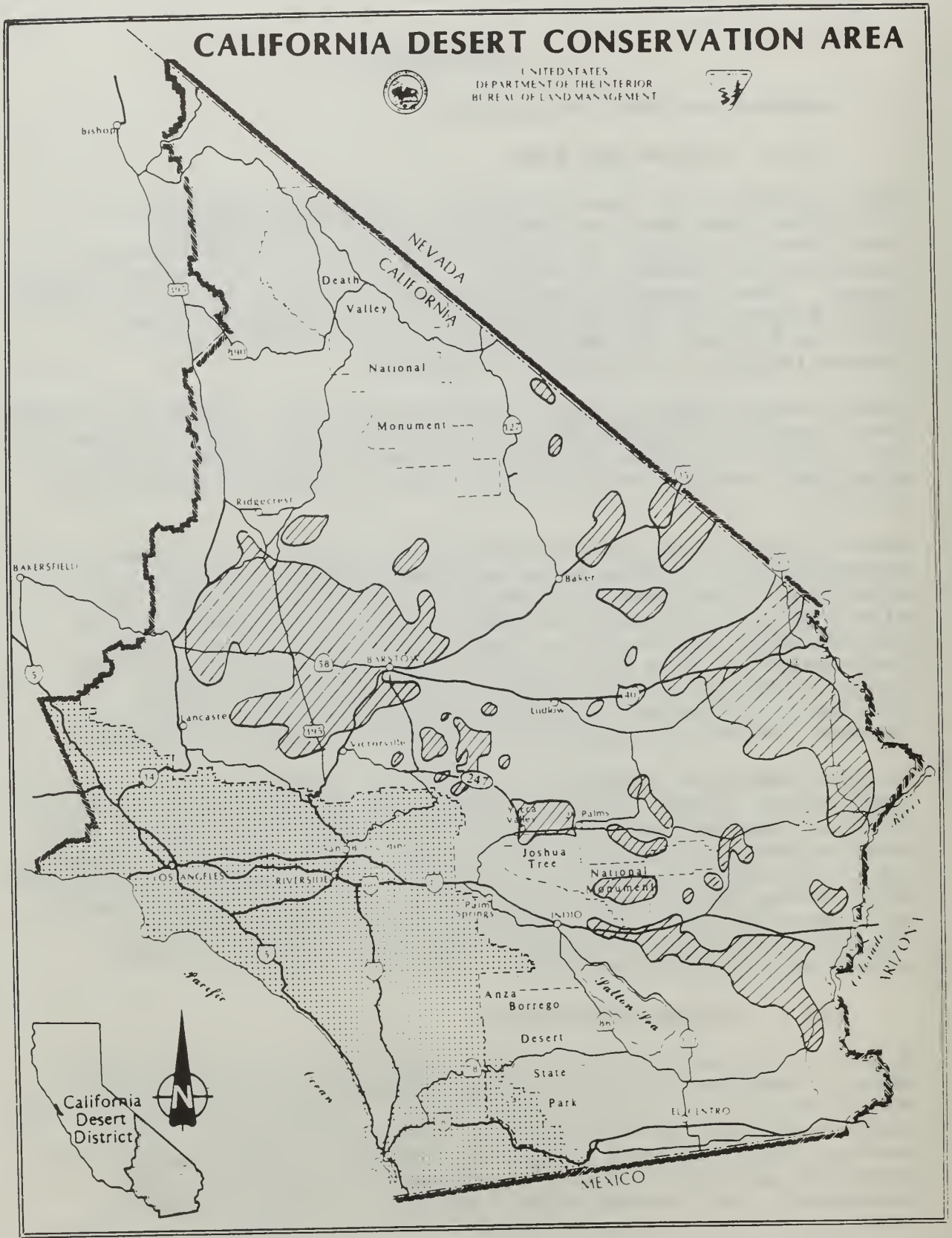

Figure 1. Boundary of California Desert Conservation Area, showing locations of comparatively high density desert tortoise habitats where raven management will occur (Adapted from Berry, 1984).

tortoises has been identified; and (2) experimentally attempting other forms of control and applying these on a regional long-term basis where proven successful. Actions to accomplish this focus on: (1) selectively poisoning and shooting ravens to reduce predation levels on a short-term basis; (2) concurrently undertaking research on the ecology of the raven in the CDCA; (3) concurrently testing nonlethal techniques for raven control; and (4) implementing effective raven control techniques desert-wide on a long-term basis.

There is also a need to provide supplemental data that may be used to speed recovery and delisting of the desert tortoise. Information from the raven management program in the CDCA also will have application in other locations where excessive predation of tortoises occurs.

An important assumption of this program is that the raven is a resident of the desert and an integral component of the desert ecosystem. As such, the management plan proposes to manage the raven in a manner that allows for the perpetuation of desert populations which are compatible with enhancement of desert tortoise populations.

1.1.3 Summary of Scoping Process

A public scoping meeting was held in Riverside, California, on September 15, 1989. The meeting was conducted to provide an opportunity for public and governmental agencies to submit verbal comments on the issues to be addressed in the EIS. Those not able to attend this meeting were invited to submit written comments in a Federal Register notice published on September 1, 1989 (54 FR 36394-36395). Issues of concern raised as a result of this scoping process fall into four broad categories: (1) the need to emphasize increased collection of information on raven ecology in the California deserts and to gather existing information; (2) the need to explore several lethal and nonlethal means to control ravens; (3) the need to protect other wildlife species during raven control; and (4) the need to implement monitoring programs to reliably determine results of program actions.

A central issue relating to program implementation is the effects of raven control on other species of wildlife. Will other "non-target" wildlife species be inadvertently harmed or killed as a result of use of poison? Will such species' behavior patterns become inadvertently impaired as a consequence of reduction of available food at landfills, reducing availability of carrion along highways, placement of anti-perch wire along fence or structures, or other planned management actions?

Another issue is the effectiveness of raven control measures at actually increasing desert tortoise populations. Will survival of juvenile tortoises increase, or will animals simply fall "prey" to something else? Will predation rates remain unchanged because of increased predation by other ravens not initially "targeted" for control? Will other ravens simply move into "control" areas and immediately begin preying on tortoises?

Program implementation includes specific measures to reduce the potential for inadvertent harm to other species of wildlife during both nonlethal and lethal raven control. Monitoring to determine effectiveness of these actions is also an essential component of this process.

Several specific measures to control raven populations were considered but dropped from detailed analysis. These alternatives were: (1) applying raven management efforts on only Public Lands in the CDCA; (2) using shooting as an exclusive means of controlling ravens; (3) establishing an "open season" on ravens; (4) using alternate poisons, such as Strychnine, instead of Starlicide; and (5) undertaking raven control using raven predators. These measures are discussed in greater detail in Chapter V of this EIS.

1.1.4 Predatory Behavior by Ravens on Tortoises

Ravens are opportunistic feeders that use tortoises for food when available. Ted Rado (BLM), Tom Campbell (Naval Weapons Center, China Lake), and Jim Farrell (BLM) have observed ravens in the process of killing tortoises. Laura Stockton (pers. comm.) and Bev Steveson (pers. comm.), tour guides for the Desert Tortoise Preserve Committee, rescued a juvenile tortoise that had been attacked by a raven at the Desert Tortoise Natural Area.

Woodman and Juarez (1988) described a raven nest and perch site with exceptionally high levels of predation on juvenile tortoises at the BLM's Kramer permanent study plot for tortoises. They collected remains of 190 juveniles killed between 1984 and 1987 and concluded that ravens accounted for probably 185 (97%) of the deaths. In the spring of 1988, they collected additional fresh remains of juvenile desert tortoises from the nest and perch area, bringing the total number of juveniles killed between spring 1984 and spring 1988 to 250 (Woodman, pers. comm.). Woodman and Juarez (1988) noted that ravens began killing larger juvenile desert tortoises, and after these were removed from the population, focused on progressively smaller juveniles.

John Wear, a biological consultant, collected shells of 24 freshly killed juvenile desert tortoises under a raven nest in the Chemehuevi Valley in 1985 (Berry 1985). In the fall of 1988, Jim Farrell (BLM, pers. comm.) found 46 shells here. Additional tortoise shells were also found at this location in 1989 (Jim

Raley, pers. comm.). In the spring of 1988, Bureau biologist Jim Farrell surveyed a few hundred miles of transmission line towers and wooden poles for raven nest sites in the eastern deserts of California. He found nine nests and one perch site used by nesting ravens and their families. Two of the nine nests were occupied by families of ravens that use tortoises extensively for food. One nest, on a transmission line tower in Ward Valley, had a total of 87 tortoise shells under the tower with the nest and under the adjacent five towers. The second nest, on a transmission line that crosses the Fenner and Piute Valleys in an east-west direction, had 61 tortoise shells. North of Kelso, a third raven family used a perch site consisting of eight wooden power poles for feeding. Nineteen shells were associated with this perch. Farrell was unable to locate the nest used by this raven family. Farrell concluded that three out of the ten nesting pairs of ravens under observation were consuming large amounts of desert tortoises in the eastern California desert. Farrell also found several other sites under towers with a few juvenile shells (Farrell 1989).

Followup inventories of transmission towers in portions of the eastern California deserts were undertaken during the spring of 1989 by BLM biologists Phillip Hughes and Bill Montgomery. Remains of juvenile desert tortoises were discovered beneath or near 11 different transmission towers (Bill Montgomery, BLM, field notes; Phillip Hughes, BLM, field notes). Monitoring conducted during a 1989 pilot raven control program documented additional juvenile tortoise remains underneath raven nesting and roosting sites (Jim Raley, Quail Unlimited, pers. comm.).

Campbell (1983) described the collection of 136 carcasses of juvenile desert tortoises ranging in size from 36 mm to 103 mm carapace length (estimated age 0 to 7 years) at fence posts on the Desert Tortoise Research Natural Area (DTNA) in 1980 and 1981. Berry (1985) reported additional heavy predation rates in the Natural Area at a raven nest site along the fence, and on a study plot in the late 1970's and early 1980's. Seventy-three juvenile tortoises killed by ravens were found on one DTNA study plot between 1978 and 1982. Additional remains of juvenile tortoises have been subsequently recovered along the DTNA boundary fence (Rado 1989).

Remains of juvenile desert tortoises can be found at the base of transmission towers, at isolated fence posts, at mining claim stakes, next to road barricades, under Joshua trees, at the bottom of wash embankments, on hilltops, and elsewhere in the deserts of California (Berry 1985; Jim St. Amant, CDFG, pers. comm.; John Wear, consultant, pers. comm.; Jim Raley, Quail Unlimited, pers. comm., Ted Rado, BLM, pers. observ.). Examples of sites with tortoise remains include the DTNA perimeter fence, isolated Joshua trees in the DTNA and immediately west of the Kramer study plot, road barricades west of California City, the

perimeter fence at the Barstow Wooly Sunflower Area of Critical Environmental Concern, several locations at the southern end of the U.S. Marine Corps Air Ground Combat Center at Twentynine Palms, the base of a rocky hill west of Needles, and below several different transmission towers in the northern Colorado Desert (Jim Raley, pers. comm.; Roger Twitchell, USMC, pers. comm.; Ted Rado, pers. observ.).

Ravens may also be consuming adult tortoises, although information on this type of predation is circumstantial. Farrell (pers. comm.) documented an instance where tracks and a freshly killed adult tortoise indicated that an apparently healthy animal was attacked and killed by a group of ravens in the northern Colorado Desert. Similar attacks on adult tortoises by groups of ravens in the central Mojave Desert near Kramer Junction have also been reported (Dr. David Morafka, California State University Dominguez Hills, pers. comm.). Additionally, remains of adult tortoises under an unidentified raptor nest west of the DTNA have been photographed (Richard Buckberg, California Energy Commission, pers. comm.).

Evidence indicates that ravens are preying on healthy tortoises rather than scavenging on dead juvenile desert tortoises killed by disease or other causes. Until 1988, very few sick or disabled tortoises were observed on the 27 BLM study plots in the California deserts. In 1988, two tortoise populations were discovered with diseases, one at the DTNA and the other at the Chuckwalla Bench. However, large numbers of dead juvenile desert tortoises have been found under raven perching and nesting sites in areas where incidence of diseased tortoises has not been documented.

1.1.5 Relationship to Pilot Program

A pilot program to selectively reduce common raven populations in the California Desert Conservation Area in response to excessive predation by ravens on juvenile desert tortoises was initiated in 1988. Briefly, the pilot program involved selectively reducing raven populations at three general areas: the DTNA (Kern County); the landfill at the U.S. Marine Corps Air Ground Combat Center at Twentynine Palms (San Bernardino County); and several isolated raven nesting and perching sites in the Chemehuevi Valley, Piute Valley, and Ward Valley near Needles (San Bernardino County).

Raven reduction involved using a combination of poisoning with the avicide "Starlicide" (DRC-1339) and shooting. Raven control was initiated at two of the three proposed areas: the USMC landfill at Twentynine Palms, and the DTNA.

An estimated 100-110 individual ravens were killed over a four-day period at the USMC 29 Palms landfill (May 19-25, 1989). Eighteen of these birds were shot; the remainder were poisoned.

Between 6-10 ravens were killed over a one-day period (May 24, 1989) at the DTNA.

Lethal means of raven control discussed in this current EIS under the proposed action and two alternatives would utilize the same combination of shooting and poison to kill ravens employed during the 1989 pilot program.

1.2 Location

Proposed raven control actions reviewed under this EIS will encompass the California Desert Conservation Area (CDCA) (Figure 1). The CDCA covers approximately 30% of California, extending south and east from the southern edge of the Tehachapi Mountains. Portions of the Mojave Desert, Colorado Desert, and Sonoran Desert are included within this area.

Raven control will take place only within those portions of the CDCA that contain desert tortoise populations. The distribution of the desert tortoise in the California deserts is not continuous, and has been influenced by such factors as elevation, topography, substrate, and level of prior disturbance.

1.3 Relationship to BLM Policies, Plans, and Programs: Consistency Determination

Control of ravens to protect the desert tortoise is in conformance with objectives in the California Desert Conservation Area Plan, that directs the Bureau to undertake management actions "which enhances wherever possible-and which does not diminish, on balance-the environmental, cultural, and aesthetic values of the Desert and its future productivity" (BLM 1980a).

The BLM has designated the desert tortoise as a "sensitive" species. Bureau Manual Section 6840 directs BLM to manage such species by "providing for the conservation of Special Status Species in the preparation and implementation of BLM plans". Manual Section 6840 also directs the Bureau to manage listed species such as the desert tortoise to "ensure the conservation of T/E species and their habitats."

Bureau Manual Section 6521.11 directs the BLM to work cooperatively with the California Department of Fish and Game on plans detailing use of avicides and other poisons and "involving the taking of fish and wildlife, including the disposition of any carcasses".

Instruction Memorandum Number 86-290 states that the U.S. Fish and Wildlife Service maintains principal statutory responsibility and authority for migratory birds and threatened and endangered species. The FWS will assist BLM in managing wildlife, including "participation in certain field projects, providing specialized

expertise, developing data collection and interpretation methods, assessing major impacts on wildlife, recommending measures for preventing or mitigating damage to important habitats, and conducting research and sharing research findings to support identified BLM needs".

More specifically, raven management/control has been incorporated as a management action in the plan for the Desert Tortoise Research Natural Area (BLM 1988), which specifies that the BLM "[r]educe incidence of raven predation on juvenile tortoises to natural levels."

Preparation of an environmental review document detailing planned measures is required pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (P.L. 91-190).

The Federal Land Policy and Management Act of 1976 (P.L. 94-579) states that it is the policy of the Federal government to manage public lands "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife..."

The Federal Endangered Species Act of 1973, as amended (P.L. 97-304) directs that Federal agencies "further the purposes of the Act by carrying out conservation programs for listed species." (50 CFR 402.01).

Raven control actions with the intent to restore a balanced predator/prey relationship with the desert tortoise would be in conformance with these BLM policies, Federal laws, and documents.

1.4 Relationship to Policies, Plans, and Programs of State and Local Agencies

The California Endangered Species Act of 1984 (Fish and Game Code Sec. 2050-2098) requires that any State "lead" agencies for projects consult with CDFG on projects that may affect state listed species such as the desert tortoise. State agencies involved with actions affecting the tortoise, such as construction of protective fences along highways, would be required to initiate consultation under this Act regarding predator control impacts to nontarget threatened and endangered species.

Implementation of actions may also require preparation of review documents under the California Environmental Quality Act (CEQA) by non-Federal agencies. Implementation of specific measures, such as landfill containment practices could require modification or development of specific County of local zoning ordinances. It

will be the responsibility of "lead" agencies to undertake these actions.

1.5 Authorizing Actions

The common raven is protected under the Migratory Bird Treaty Act (16 USC 701-718h). Implementation of management actions that involve manipulating or harming ravens requires a permit from the U.S. Fish and Wildlife Service. Additionally, actions that involve the application of Starlicide or other compounds to kill, sterilize, or otherwise impede raven predation on desert tortoises may require authorization by the BLM Washington Office. A Pesticide Use Proposal (PUP) for such actions will be developed in accordance with Bureau policy.

Subsequent monitoring actions that may include analysis or collection of dead tortoises will require a permit from the U.S. Fish and Wildlife Service because of the Federal "endangered" status of this species. A Memorandum of Understanding with the California Department of Fish and Game is required, since the tortoise is listed as "threatened" by the State of California. Appropriate permitting requirements will be followed during the course of program actions involving any collection of deceased tortoises for analysis.

II. PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action - Combined Control Methods

Actions for implementation are summarized in Appendix A, Table 1. Management actions are designed to achieve a specific stated objective. The individual tasks are detailed in the Draft Raven Management Plan for the California Desert Conservation Area, which is hereby incorporated by reference.

Raven management and control will be undertaken using a combination of lethal and nonlethal means to:

(1) reduce mortality of juvenile desert tortoises caused by raven predation;

(2) permit increased recruitment (e.g., survival) of juvenile desert tortoises into sub-adult and adult age-classes;

(3) improve understanding of the biology of the raven through research and monitoring;

(4) acquire additional data on means of limiting raven predation of juvenile desert tortoises;

(5) implement those measures that are found to be effective for raven management and control; and

(6) implement a monitoring program to determine effectiveness of program actions at reducing raven predation rates on desert tortoises.

Raven management consists of two basic components: (1) short-term application of lethal forms of raven control at sites where excessive predation threatens tortoise populations; and (2) longer-term regional management based on results of initial testing of nonlethal forms of control, research on the ecology of the raven in the California deserts, and results of regional inventories to locate sites where raven predation on tortoises is occurring. Ravens will be selectively killed at sites where recruitment rates of juvenile tortoises into adult age-classes have been severely depressed as a result of predation. These sites include portions of the western Mojave Desert and northern Colorado Desert. Killing of birds is necessary on a short-term basis due to the severe losses of juvenile tortoises and immediate need to boost recruitment rates to increase chances of longer-term population survival. Sites of known raven predation on desert tortoises will be clearly identified prior to initiation of control efforts through regional inventories and review of prior site-specific data.

Concurrently with initial site-specific poisoning and/or shooting of ravens, research will be conducted on the ecology of the raven in the California deserts. The focus of this research effort will be on obtaining information that may be used to more effectively manage and maintain raven populations in the desert while reducing predation rates on the desert tortoise. Baseline information on total numbers of ravens in the California deserts will also be obtained. Current estimates of raven increases are based on comparisons of relative abundance (e.g., numbers of birds observed per unit time), and not on actual population numbers. Emphasis of research programs will be outside of those site-specific areas where lethal control measures are applied.

Implementation of raven control activities involving use of poison will be preceded by a field study to determine exposure risk to other wildlife species. This field study will include an analysis of risk to owls by leaving poisoned eggs at stations overnight. Measures to reduce the potential for inadvertent poisoning of other wildlife species may be implemented after review of this study. Such measures may include, but are not limited to: (1) placing increasing emphasis on nonlethal control techniques to modify raven feeding behavior or to limit raven use of specific areas; (2) placing increasing emphasis on selective shooting of ravens; (3) removal of poisoned eggs during evening hours to reduce risk to owls; (4) monitoring bait stations 100 percent of the time during poisoning; (5) shortening timeframes

that poisoned eggs are placed at individual stations; (6) increasing monitoring time prior to application of poisoned baits; (7) decreasing the number and/or density of bait stations used during poisoning; (8) decreasing the total number of poisoned eggs available for raven consumption at any one time; (9) limiting seasons during which poison may be applied; and (10) increasing personnel effort during the control program.

Several nonlethal forms of raven control will be experimentally applied to test effectiveness. These techniques are explained in more detail in Section 2.1.2 of this EIS. Nonlethal techniques that will be experimentally applied include: conditioned taste aversion; timed destruction of raven nests; egg addling; placement of anti-perch devices; live-trapping and offsite release of birds; modification of human waste containment practices; and sterilization. Initial "focus" of this program will be in specific areas that will be limited to that form of experimental control only in order to determine effectiveness. Where nonlethal forms of raven control are proven effective, these techniques can be used to substitute initial control using lethal methods. Over time, raven control using lethal techniques may be "phased out" or substantially reduced in favor of one or more nonlethal control measures.

Implementation of program actions are contingent upon interagency cooperation, availability of funding, and availability of agency staff time. The "lead" agency is responsible for coordinating project actions with other agencies, completing necessary paperwork to undertake the task, developing appropriate experimental design, implementing and monitoring results of the action, and preparing a written report of results.

Establishment of an interagency Workgroup provides the basic framework necessary to undertake management tasks. An interagency Workgroup consisting of representatives of Federal, State, and local agencies involved with raven management efforts will be established. The establishment of this Workgroup is essential to effective regional raven control since several independent agencies maintain jurisdictional authority over lands or permitting authority over actions requiring management. The function of this Workgroup will be to oversee raven management program direction, coordinate control and research measures with other agencies/groups, solicit funding for implementation of management measures, and distribute information/data.

The Workgroup will meet regularly to discuss raven management actions, funding, and scheduling. In order to ensure long-term commitments from participating agencies and to clarify individual agency roles and responsibilities, an Implementing Agreement will also be developed for signature by agencies that participate in the Workgroup.

Tasks have been subdivided into measures addressing research, nonlethal control, lethal control, and administrative actions. Many of the management actions require the participation and cooperation of other Federal, State, and local agencies. The BLM will lead in developing an Implementing Agreement specifying individual roles and responsibilities with these agencies.

2.1.1 Monitoring and Research

Monitoring actions shall serve three basic functions: (1) to evaluate ongoing measures to reduce raven predation effects on the desert tortoise; (2) to evaluate measures to mitigate program actions on other species and resources; and (3) to "track" the status of the raven in the CDCA.

Research actions will be undertaken for the following reasons: to increase understanding of the ecology of the raven in the CDCA; to explore methods of raven control; and to refine existing control methods. Information on foraging and feeding behaviors of ravens would be obtained through tracking studies of radio-transmittered birds captured at landfills and at nesting and perching sites. Seasonal movements of birds and site fidelity of individual pairs of nesting birds will be determined through use of radio-transmitters and patagial tags (Hester 1963; Kochert et al. 1983).

2.1.2 Nonlethal Control Techniques

Nonlethal control will be undertaken using a combination of measures to disrupt feeding behavior, lower predation rates on tortoises, and reduce raven populations where high predation rates have been documented. However, many measures require the cooperation of agencies that exercise site jurisdictional authority. Emphasis will be placed on: (1) modifying refuse containment practices to reduce food availability to ravens; (2) experimentally testing several techniques to lower raven numbers or modify feeding behavior, and (3) employing such measures where proven successful on a regional basis.

Several methods to reduce raven predation rates on desert tortoises require experimental application. "Hazing" (i.e., disrupting raven perching and feeding by intermittent loud noise) may be appropriate at "concentration" sites such as landfills where birds regularly come to feed. Conditioned taste aversion [i.e., modifying acceptance of tortoises as food by feeding ravens look-alike baits laced with bad-tasting or emetic compounds such as carbachol or Trimethacarb (Nicholaus and Nellis 1987; Nicholaus et al. 1989)] may prove practical at specific nesting and roost sites. Conditioned birds may continue to defend nesting territories from other ravens that may be tortoise predators. Temporary sterilization using baits treated with compounds such as mestranol (Sturtevant 1970) or SC-12937 (Lofts

et al. 1968) may prevent successful reproduction by nesting birds that may otherwise "teach" offspring to selectively hunt for tortoises, although initial studies under controlled conditions would have to be conducted prior to field use. Selective nest destruction, if properly timed, may also inhibit successful raven reproduction (Stiehl 1978). Livetrapping using a variety of techniques applied to other studies (Engel and Young 1989) and release into offsite areas may disrupt individual bird behavior patterns without requiring killing of birds. Placement of anti-perch wire at sites where ravens habitually perch and feed on tortoises may disrupt bird feeding patterns and lower tortoise predation rates. This technique has been experimentally applied to the DTNA boundary fence during 1989.

The above-mentioned techniques require site-specific experimental application to determine effectiveness prior to any decision for regional application. The raven management program will initially emphasize experimental design and testing by several "lead" agencies. More widespread use will be appropriate if initial testing clearly demonstrates the control measure is effective at reducing raven predation rates on desert tortoises.

2.1.3 Lethal Control Techniques

Ravens will be selectively killed using a combination of poisoning and shooting. Poisoning and shooting efforts will focus on raven nest-sites, roosts, and perches where remains of juvenile desert tortoises showing signs of predation are found. Poisoning and shooting will be preceded by inventories to locate and map sites of raven predation on tortoises.

The avicide "Starlicide" (DRC-1339) will be injected into hard-boiled eggs at the rate of 1 milliliter of a 10% solution of 98% concentrate. This is roughly equivalent to eight raven lethal doses per treated egg. Untreated eggs will be introduced to ravens "targeted" for poisoning for a period of pre-baiting to increase acceptance of eggs. Once ravens readily accept the untreated eggs, poisoned eggs will be substituted. A maximum of two poisoned eggs will be placed at each bait station at any one time. Poisoned eggs will be wired to each station to minimize the potential for offsite caching of poisoned eggs by ravens. Dead birds collected after poisoning will either be buried at the site or removed for analysis. An overview of toxicity to wildlife species is provided in Appendix A, Table 2.

Shooting will be selectively employed in two situations: in concert with poisoning of ravens, and to remove single birds or pairs of birds known to be preying on tortoises. Ravens become wary after initial shooting attempts. Survivors are difficult to approach. Shooting alone is therefore not considered a viable means of effectively reducing raven predation rates using lethal means.

2.2 No Action

Under the "No Action" alternative, no specific actions for management of the raven in the California deserts will occur. The BLM will continue to monitor desert tortoise populations using a combination of study plots, transects, and research studies. Observations of ravens are recorded when study plot data are gathered. Raven sightings may be recorded during transects or studies. However, such observations will not be recorded for the purpose of actively managing the raven.

No attempt will be made to increase understanding of the status and habits of the raven in the CDCA. No attempts will be made to reduce predation rates by ravens on desert tortoise populations. Establishment of an interagency Workgroup to "pool" information and funding and to oversee management direction for the raven will not take place.

Other Federal, State, and local agencies could implement specific actions to control ravens. However, such actions would be independent and outside of the scope of this EIS. Preparation of separate environmental documents pursuant to NEPA and/or the California Environmental Quality Act (CEQA) would be required. Opportunity for separate public and agency review and comment would occur at that time.

2.3 Nonlethal Control Only

Under this alternative, only nonlethal forms of control will be implemented. Additional information on the distribution, behavior, and means of management for the raven in the CDCA would be obtained.

Landfill and sewage pond containment practices will be modified in an effort to discourage year-round use by ravens and to prevent concentrating birds. Roadkilled animals will be regularly collected and buried to reduce food for ravens. Fence barriers will also be constructed along roads to reduce incidence of wildlife mortality by vehicles.

Measures to modify raven predation behavior and to limit reproductive success will include selective nest destruction, taste aversion conditioning, live-trapping, egg addling, sterilization, and placement of anti-perch/roost devices as described under Section 2.1.2 of the "Proposed Action". These techniques would initially be attempted on an experimental basis. Where proven successful, they will be implemented regionally.

No attempts to kill ravens will take place. Individual ravens could be inadvertently harmed or killed during livetrapping or

other actions implemented for raven management or control. A listing of any such birds would be required under the conditions of a permit obtained for this program from the FWS. A summary report describing the circumstances associated with any injury or death of individual birds will also be prepared and submitted to the Service at that time.

An interagency Workgroup will be established as discussed under Section 2.2.1.4. Workgroup agencies and the function of this group will remain unchanged from that previously described.

2.4 Specific Area Focus Only

Under this alternative, the BLM will confine raven management and control to specific areas delineated in Figure 2. The BLM and other agencies will implement the following studies to obtain supplemental information on the ecology of the raven in portions of the CDCA on: (1) foraging and feeding behavior; (2) seasonal movement patterns; and (3) population size and trends. The BLM will concurrently conduct inventories in these areas to: (1) locate raven nesting, perching, and roosting sites; (2) determine current use of these sites by ravens; (3) determine predation rates on desert tortoises; (4) determine tortoise population trends where raven predation has been documented; and (5) develop an effective management response to curb excessive tortoise predation by ravens using nonlethal and/or lethal forms of raven control.

The management strategy under the Specific Area Focus alternative will be identical to that described for the Proposed Action except that raven management actions will be restricted to specific pre-selected areas where excessive raven predation on juvenile desert tortoises has been previously documented. These areas are shown in Figure 2. Briefly, they include two regions: (1) the western Mojave Desert, extending roughly from Victorville, east to Barstow, north to Randsburg, and west to Mojave; and (2) that portion of the northern Colorado Desert consisting of the Piute, Ward, and Chemehuevi Valleys and bordering mountain ranges.

2.5 Alternatives Considered but Eliminated From Detailed Analysis

Several specific measures to control raven populations were considered but dropped from detailed analysis. Alternatives consisted of measures reviewed by agency staff during preparation of the draft EIS, and actions proposed during the public scoping process. Alternatives focused in two areas: location and scope of control efforts, and specific type of action(s) to undertake raven control.

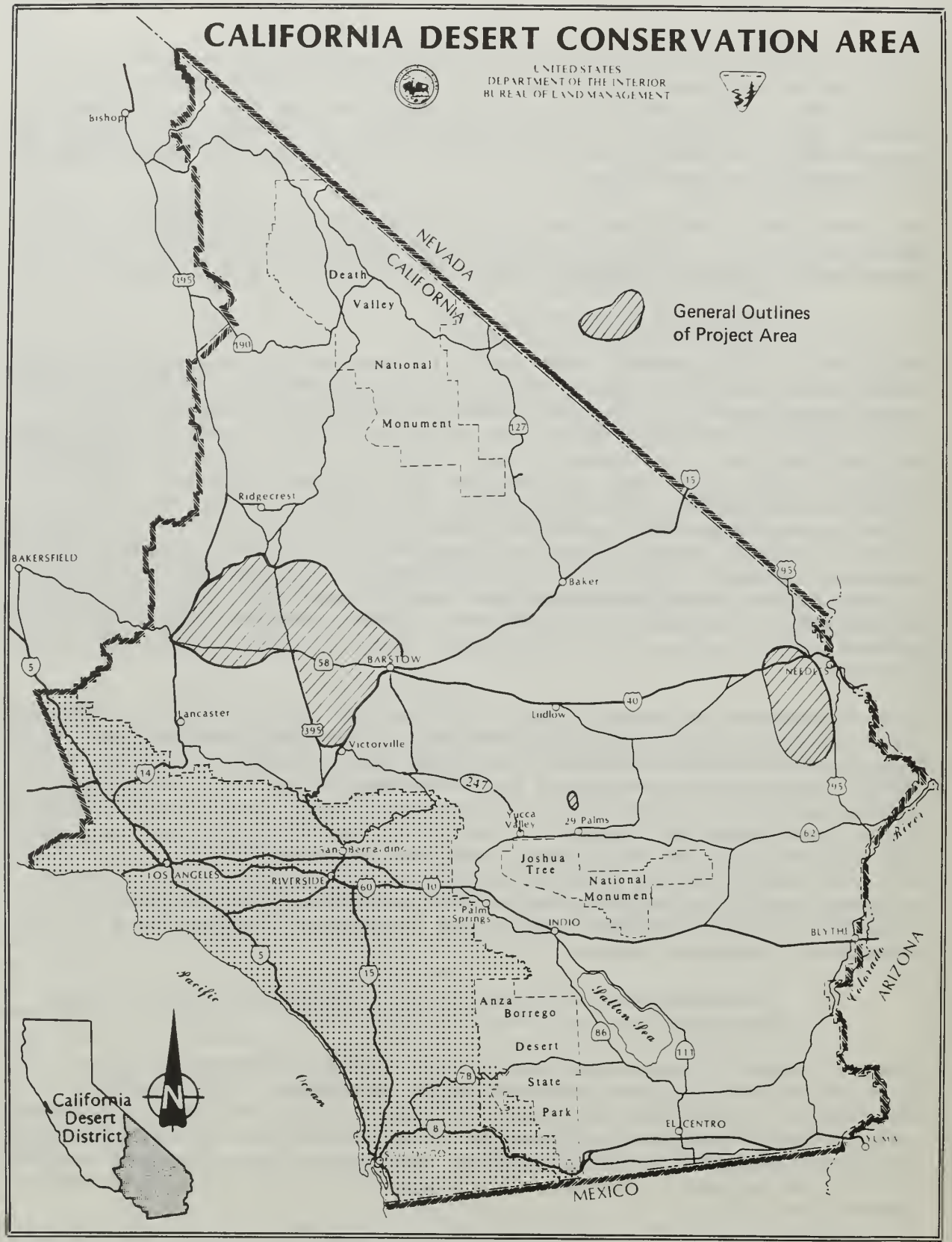

Figure 2. Locations of Raven Management under the "Specific Area Focus" Alternative.

Applying raven management efforts on only Public Lands in the CDCA was considered but rejected as impractical. Ravens are highly mobile. Nesting birds that may prey on desert tortoises as a seasonal food source may forage over large distances that include both private and public lands. Landfills and other sites that concentrate birds and provide stable food supplies may also be on private lands. Desert tortoise populations on private lands, lands administered by other agencies, and on Public Lands administered by BLM proximate to landfills and other raven "concentration" areas could remain highly vulnerable to continued excessive raven predation in spite of intensive control efforts if study shows that ravens frequenting landfills are contributing to excessive predation on juvenile desert tortoises.

Shooting, as an exclusive means of controlling ravens, by lethal was judged impractical. Ravens quickly learn to avoid humans when shooting attempts are employed, significantly lowering opportunities to kill birds (Paullin 1987; Jimmie Eichman, CDFG, pers. comm.; Bart O'Gara, FWS, pers. comm.). Shooting also increases risk of damage to structures where ravens nest and roost, such as transmission towers.

An "open season" on ravens was proposed during public scoping. This alternative was considered but rejected as impractical for several reasons. Indiscriminate shooting or poisoning could inadvertently impact other wildlife species due to reduced control and monitoring. Several alternate poisons, such as Strychnine, are not as selective as Starlicide and have a high likelihood of killing scavengers and other wildlife predators that could feed on raven carcasses. Raven control efforts would not be "focused" in areas experiencing the heaviest predation rates and might not contribute to increased survival of juvenile desert tortoises. Additionally, indiscriminate shooting would greatly increase the wariness of individual ravens over large areas, making effective long-term control even more difficult.

Undertaking raven control using raven predators was suggested during the scoping process. This management technique was judged inappropriate for several reasons. There are no known specific predators of ravens. Increasing population densities of a non-selective predator could serve to increase predation on species other than ravens. Increasing potential predator populations would also be largely experimental and extremely costly, with highly problematical results.

Individual actions for raven control discussed in the No Action, Nonlethal Control Only, and Specific Area Focus Only alternatives may also prove impractical. These include nonlethal techniques to control raven predation rates on desert tortoises through behavioral modification or reductions of bird numbers. As discussed in the text, the effectiveness of each technique will be subject to initial experimental application. If proven

effective, the technique will be employed on a regional basis. A "screening" process to determine most effective management measures is therefore a necessary component of this program irrespective of Alternative selected.

A comparison of effects to resources from the Proposed Action and alternatives is provided in Table 1.

Table 1. Overview of Impacts to Resources

Species	Alternative/Anticipated Effects
	Proposed Action
Desert Tortoise	Predation rates by ravens lowered by 50-70% below current levels. Increased recruitment rates of juveniles into adult age-classes. Increased prospects for long-term perpetuation of tortoise populations.
Raven	Anuual killing of between 200-750 ravens by poisoning and shooting. Displacement of several thousand ravens from landfills and other concentration areas by hazing, reduction of food sources, and live-trapping. Disrupted breeding and feeding by sterilization and aversion conditioning, affecting 100-300 ravens annually. Inadvertent killing or harming of 50 ravens during implementation of nonlethal and research projects each year.
Other Wildlife	Reduced predation rates by killing ravens and lowering overall populations. Increased populations of other wildlife species preyed upon by ravens where raven populations have been reduced. Potentially increased predation rates on other wildlife as displaced ravens seek alternate food sources. Accidental injury or death of 100 animals each year during implementation of lethal control methods.
Cultural	Minor effect as a result of overall slight reduction in numbers of ravens desert-wide.
Other	Enhanced opportunities to view tortoises. Lowered opportunities to view ravens. Localized increases in noise levels from shooting/hazing programs. Enhanced aircraft

Table 1. Continued

Species	Alternative/Anticipated Effects
	safety from lowered collision potential. Reduced potential for power outages from buildup of guano on transmission lines. Public concerns as a result of killing ravens.
	<u>No Action</u>
Desert Tortoise	Raven predation rates will remain high in the Mojave and Colorado deserts, and increase in time in other desert areas. Predation would contribute significantly to reductions and possible extirpation of tortoises in crucial population areas. The potential to recover the desert tortoise would be lowered significantly.
Ravens	No effect
Other Wildlife	Declines in species number as a result of excessive raven predation. In addition to areas of the Mojave and Colorado deserts, wildlife populations near urban areas, agricultural areas, and wetland habitats where ravens concentrate would receive high impacts.
Cultural	No effect
Other Resources	Increased potential for aircraft damage from bird strikes as raven populations increase. Increased potential for power outages from buildup of guano on transmission lines and insulators. Potential for spread of disease, transmitted by birds.
	<u>Nonlethal Control Methods Only</u>
Desert Tortoise	If techniques are proven effective: same as Proposed action If techniques are not proven effective: Same as No Action
Raven	Displacement/harassment of several thousand ravens each year from hazing, refuse containment, placement of anti-perch wire, nest destruction, taste aversion, and

Table 1. Continued

Species	Alternative/Anticipated Effects
	sterilization. Accidental loss of about 50 ravens each year during implementation of these actions and ongoing research projects. Slightly lowered recruitment rates desert-wide as a result of sterilization, nestdestruction, addling, and live-trapping programs.
Other Wildlife	Increased predation rates on other wildlife species as displaced ravens seek alternate food sources. accidental injury or mortality to 100 animals each year during implementation of nonlethal control measures and research projects.
Cultural	Minor effect as a result of overall slight reduction in numbers of ravens desert-wide.
Other Resources	If effective: increased opportunity to view tortoises. Continued opportunity to view ravens. If ineffective, same as No Action.
	<u>Specific Area Focus</u>
Desert Tortoise	In control areas: Same as Proposed Action Outside control areas: Same as No Action
Ravens	In control areas: Up to 500 ravens killed annually by poisoning and shooting. Several thousand ravens displaced by disruption techniques. Between 50-200 ravens affected annually be sterilization and taste aversion conditioning. accidental killing of 50 ravens annually be implementation of nonlethal control methods and research programs. Outside control areas: Same as no Action
Other Wildlife	In control areas: Same as Proposed Action Outside control areas: Same as No Action
Cultural	In control areas: Same as Proposed Action Outside control areas: Same as No Action
Other Resources	In control areas: Same as Proposed Action Outside control areas: Same as No Action

III. AFFECTED ENVIRONMENT

3.1 Wildlife

3.1.1 Overview of Wildlife Resources

The emphasis of this management program is "focused" on the predator/prey relationship between the desert tortoise and raven. However, the program is regional in scope, encompassing a diverse group of wildlife species that occur within the geographic range of the desert tortoise in the CDCA. A brief summary of these wildlife resources follows.

The large geographic extent, proximity to coastal and mountain influences, and variation in terrain, rainfall patterns, soil composition, elevation, and availability of water have created a heterogeneous "mosaic" of wildlife habitats utilized by a diverse group of species in the CDCA. Over 100 different types of wildlife habitats have been documented (BLM 1980b). More "widespread" wildlife habitats include creosote bush (Larrea tridentata) scrub, Joshua tree (Yucca brevifolia) and Mojave yucca (Yucca schidigera) communities, and saltbush (Atriplex spp.) shrubland. Disjunct higher montane habitats and areas of scarce surface or subsurface perennial water flows create "island" habitats surrounded by a "sea" of desert.

Many wildlife species inhabit this area using one or a combination of adaptive strategies. Certain animals are able to survive due to special adaptations that allow them to tolerate excessive dryness and heat or to remain active only during seasonal "windows" when critical resources such as food and water are available. This group includes the Merriam kangaroo rat (Dipodomys merriami) and desert tortoise. Other species, including many species of birds, migrate to the desert to take advantage of seasonally available resources. Wetland "pockets", mountain tops, or other "island" mesic habitats are inhabited by wildlife species normally unable to coexist in a harsh desert environment. Species such as the Amargosa vole (Microtus californicus scirpensis) and Gilberts skink (Eumeces gilberti) are examples.

At least 635 species of vertebrates have been recorded from the CDCA. This includes 36 fishes, 16 amphibians, 64 reptiles, 419 birds, and 94 mammals (BLM 1980b). An unknown but far larger number of invertebrate species are also present. Species of special management concern include the desert tortoise, desert pupfish (Cyprinodon macularius), Mohave ground squirrel (Spermophilus mohavensis), desert bighorn sheep (Ovis canadensis nelsoni), Andrews dune scarab beetle (Pseudocotalpa andrewsi), least Bell's vireo (Vireo belli pusillus), and flat-tailed horned lizard (Phrynosoma mcallii). Specific management actions for these species are listed in the CDCA plan (BLM 1980a).

3.1.2 Raven Populations

Ravens were uncommon in the deserts of California in the first half of the 20th century. When Eugene Cardiff, Curator of Natural History at the San Bernardino County Museum, began searching for ravens in the western Mojave Desert in the early 1940's, it took two years to locate a specimen for the museum (Eugene Cardiff, pers. comm.). Ravens were also very scarce in the deserts of eastern California between the 1920's and 1940's. Johnson et al. (1948), in a survey of the eastern Mojave Desert encompassing the Providence, New York, and Clark mountains and adjacent areas, reported few ravens. In fact, they saw so few ravens over a several year period that they noted that the raven was only a summer resident.

During 1975-1976, James Van Remsen conducted bird surveys in the eastern Mojave Desert and suggested that ravens were much more common during his field work than in earlier decades (Berry 1985; BLM files for the East Mojave Unit Resource Analysis: Wildlife, Needles, and Riverside, California). In other words, from the 1920's to the mid-1970's the raven changed from a "summer resident" to a "permanent resident."

Data from both formal surveys and experienced observers indicate that growth in the desert raven population continues. One of the more important sources of data is the U.S. Fish and Wildlife Service (FWS), which developed a comprehensive bird breeding survey for the United States and Canada (Robbins et al. 1986). Using experts in bird songs and calls, the Service established a network of routes for breeding bird surveys. In the deserts, surveys were usually conducted in May along established routes 25 miles long. The observer-listener made 50 stops at 0.5-mile intervals to record observations. Routes were established in 1968 and have been run consistently for 22 years.

In the Mojave Desert of California, southern Nevada, and extreme southwestern Utah, raven populations have increased approximately 14.9% annually in the 20-year period between 1968 and 1988 (Unpubl. data, FWS); this amounts to a 15-fold or 1528% increase. In the same period, raven populations increased 9.1% annually for a population increase of 474% in the Colorado and Sonoran desert regions of California and Arizona, respectively. Data on the Great Basin Desert in California and west-central Nevada indicate raven populations increased 5.05% annually and populations almost doubled (168% total increase) in the last 20 years. In the southern California basin extending from the Los Angeles-San Bernardino area south to San Diego, raven populations also have experienced significant increases of 7.5% annually with a 3-fold population increase (328% total increase) during the last 20 years. Increases are statistically significant at $P < 0.01$ for the Mojave and Colorado/Sonoran deserts and the southern

California basin. Fish and Wildlife Service data are summarized in Table 2.

Other data support the findings of the FWS. In the western Mojave Desert, there are many examples of high raven numbers.

Table 2. Increase in raven population in the western United States deserts (FWS data - 1968 to 1988).*

Region	Annual Trend (% annual change)	Change (%) in 20 years	P
Mojave Desert	+14.97	+1528	<0.01
Colorado-Sonoran Desert	+ 9.13	+ 474	<0.01
Great Basin Desert	+ 5.05	+ 168	<0.1
So. California Basin	+ 7.54	+ 328	<0.01

*Unpublished data courtesy of U.S. Fish and Wildlife Service, North American Breeding Survey Program, Laurel, Maryland.

Eugene Cardiff reports substantial increases in the species in the general region and has observed flocks of 100 to 400 birds in the Harper Dry Lake and marsh areas near Barstow (Cardiff, San Bernardino County Museum and San Bernardino Audubon Society files). Mike Phillips and Mark Hagen, biologists at Edwards Air Force Base, reported flocks of 100 to 200 ravens at the base landfill in 1988. Groups of over 100 ravens have been regularly observed at the U.S. Marine Corps Air Ground Combat Center at Twentynine Palms (Roger Twitchell, USMC, pers. comm.). Flocks of more than 100 ravens are common at sewage ponds on the China Lake Naval Weapons Center (Knowles et al. 1989). Large numbers of ravens, ranging to over 100 birds, have also been observed at landfills for the desert communities of Boron, Apple Valley, Victorville, and Baker (Knowles et al. 1989) (Appendix A, Table 3). Lesser numbers of birds are regularly observed at sewage treatment sites at Ridgecrest, Baker, and Boron (Knowles et al. 1989; Appendix A, Table 4). Knowles et al. (1989) have observed ravens feeding on filtered rags at sewage ponds and on the sewage in the ponds. Significantly, only five of 17 ponds under study showed consistent use by ravens.

Austin (1971) conducted a study of the roadside distribution of the raven in the Mojave Desert of California and southern Nevada

during 5,500 miles of travel between 1967 and 1969. The results of his studies are compared with information obtained in 1988-1989 through inventories conducted under Bureau contract (Knowles et al. 1989), and by BLM wildlife staff biologists (Appendix A, Table 5).

More recently, this road survey information has been supplemented with a contract survey of four major regions of the California deserts (Knowles et al. 1989) and with data obtained by the BLM staff in the Needles area.

Knowles et al. (1989) conducted ten separate vehicle transects in the west Mojave, Ivanpah Valley, Fenner-Chemehuevi Valleys, and southern Colorado Desert of California during the winter of 1988-89 (Appendix A, Table 6). They recorded sightings of 4,328 ravens during 26,239 miles of driving on paved and unpaved roads. Ravens were most abundant in the western Mojave Desert and Ivanpah Valley. Raven observations were significantly lower in the Fenner-Chemehuevi Valleys and southern Colorado Desert. Observations along paved roads accounted for the majority of all raven sightings during this survey. These results are also consistent with those of a concurrent study conducted during 1989 for the Southern California Edison Company in the California deserts, showing a higher incidence of raven observations close to paved roads (Dr. Richard Knight, Colorado State University, pers. comm.).

Between November 1988 and May 1989, Bill Montgomery and Phillip Hughes of the BLM Needles Resource Area Office staff conducted surveys of paved and unpaved roads in the eastern Mojave Desert and northern Colorado Desert. Numbers of ravens observed and mileages driven were recorded during routes on freeways, County paved and unpaved, and dirt roads. A total of 840 observations of ravens were made during 12,036 miles of driving. Observations of ravens during this survey were significantly higher on dirt roads than for all classes of paved roads (Appendix A, Table 7).

Data are being gathered on numbers of ravens observed flying over, perching, or otherwise present on desert tortoise permanent study plots. So far, data have been gathered on 11 of the 15 study plots (Appendix A, Table 8). The raven data from the tortoise plots provide a means of comparing the numbers of ravens seen per unit time during the spring months of March through June when tortoises are active. The data (presented in numbers of ravens observed per 100 hours of tortoise survey) can be compared from different desert regions and can offer an index of abundance of ravens in the open desert.

Numbers of ravens observed per 100 survey hours on tortoise study plots ranged from 0.41 to 45.32. A total of 14 ravens were observed per 100 hours of monitoring effort during the pilot raven control effort conducted at the Desert Tortoise Natural

Area during 1989. Sites with significant losses of juvenile tortoises include areas where frequencies of raven observations range from 3 to 45 ravens per 100 survey hours.

3.1.3 Tortoise Populations

The desert tortoise was state-listed as "threatened" in California on June 22, 1989 [California Code of Regulations, Section 6705(b)(4) of Title 14] and federally listed as "endangered" under the emergency provisions of the Federal Endangered Species Act on August 4, 1989 (54 Federal Register 32326-32331). Reasons for both Federal and State listing include loss or deterioration of habitat, disease, predation, and collection for pets. Contributing factors include urbanization, vandalism and poaching, release of sick animals into wild populations, excessive predation on juvenile tortoises by ravens, motorized vehicle use, and route proliferation. The desert tortoise receives legal protection afforded under both the California Endangered Species Act of 1984 and the Federal Endangered Species Act of 1973, as amended.

In California, data on distribution and densities of tortoises have been derived from a database of over 2000 strip-transects and 30 study plots. Desert tortoises are distributed within an area of approximately 40,156 square miles, 84% of which has low densities estimated at 0 to 20 per square mile (Berry and Nicholson 1984). Approximately 73% of habitat is on public lands administered by the BLM (Table 3).

Desert tortoise populations and habitats are subjected to a number of man-induced actions, including mineral exploration and development, urbanization, road construction, motorized vehicle recreation, grazing by domestic livestock, and energy development. The cumulative effects of such activities are direct loss of individual tortoises, habitat fragmentation and degradation, and habitat loss (Berry and Nicholson 1984).

Data gathered over periods ranging from 9 to 17 years on permanent study plots indicate that tortoise populations have declined precipitously in several areas since 1979-80. Areas experiencing severe declines include the "core" populations in the western Mojave Desert and southern Colorado Desert in California (Berry et al. 1987, 1988). Outbreaks of two different diseases, raven predation, vandalism, and vehicle kills have contributed to population declines exceeding 50% in the last four to seven years.

Table 3. Land ownership of desert tortoise habitats containing 20 or more tortoises per square mile in California in the 1970's.*

Est. Tortoise Densities (no./sq. mile)	Land Ownership (sq. miles)** BLM	Private	Totals (sq. mi.)
20 to 50	2,687	729	3,416
50 to 100	1,334	478	1,812
100 to 250	559	314	873
250	47	225	272
Totals	4,627	1,746	6,373

*Source: Berry and Nicholson (1984)
**Gross estimates that do not deduct habitat lost as a result of developments such as roads, small towns, off-road vehicle staging areas, etc. Actual habitat is less than shown.

3.2 Vegetation

The CDCA supports over 2,000 species of plants. Although plant diversity is high, a comparatively few species of individual plants dominate the desert landscape. Desert scrub and shrubland dominates approximately 80 percent of the CDCA (BLM 1980b). Vegetation within desert scrub habitats often consists of creosote bush, burrobush (Ambrosia dumosa), scattered Joshua trees (Yucca brevifolia), and several species of saltbush, including allscale (Atriplex polycarpa), desert holly (A. hymenelytra), and Mojave saltbush (A. spinifera). Other conspicuous but less abundant perennials may include Mojave aster (Machaeranthera tortifolia), Mojave yucca, beavertail cactus (Opuntia basilaris), desert trumpet (Eriogonum inflatum), cholla cactus (Opuntia echinocarpa), big galleta grass (Hilaria rigida), cheesebush (Hymenoclea salsola), rubber rabbitbrush (Chrysothamnus nauseosus), and Anderson thornbush (Lycium andersonii) (BLM et al. 1989).

Plant diversity can be heavily influenced by soil type and/or availability of water. Riparian corridors and scattered marshlands contain plants less adapted to a xeric environment, such as cottonwood trees (Populus fremontii), willows (Salix spp.), cattails (Typha spp.), and bulrush (Scirpus olneyi). More mountainous areas can contain pinyon pine (Pinus monophylla) and juniper (Juniperus californica).

Six vascular plant species have been federally listed as threatened or endangered in the california Desert District. an additional 108 plant species are considered candidates for possible future Federal listing as threatened or endangered by the FWS. Twenty-nine plant species are listed by the State as endangered or rare (most of these are included in the Federal totals above).

3.3 Cultural Resources

Over 14,000 cultural resource sites have been officially recorded from the CDCA. Based on sampling undertaken, the actual number of historic-prehistoric sites that may be present could exceed 100,000. Sites are diverse, and represent a cross-section of human uses and cultures. Cultural sites include stone tool manufacture areas, intaglios, petroglyphs, fish weirs, and hunting camps. Historic sites include old towns, mining camps and mine sites, roads and railroad lines, and forts (BLM 1989b). Due to widespread human use of the desert in recent times, many of these sites have been subjected to degradation and vandalism. Over 35 percent of known sites in the CDCA have been seriously degraded.

Native American tribal groups have inhabited the CDCA for many centuries. Although recent data are unavailable, ethnographic notes collected for the preparation of the CDCA plan (BLM 1980a) suggest that the raven may be a species with traditional or spiritual values to the Desert Cahuilla, the Chemehuevi, and the Mojave Indians. The Native American community considers many native species, including the desert tortoise, to be important aspects of the natural and spiritual environment.

3.4 Other Resources

The CDCA is utilized for a variety of reasons. Activities include mining, livestock grazing, and recreation (including both "intensive" and "passive"). Environmental analyses often review prospective actions to determine effects on air quality, visual quality, and surface and ground waters. Proposed project actions under review in this EIS should not affect any of these resources.

IV. ENVIRONMENTAL CONSEQUENCES

4.1 Proposed Action - Combined Control Actions

4.1.1 Impacts to Ravens

Selective killing of ravens initially employing a combination of poisoning and shooting, and possibly incorporating livetrapping

and killing, shall result in the cumulative and intentional destruction of hundreds of ravens over a minimum 10-year period. The numbers of birds killed will depend upon several variables: effectiveness of nonlethal forms of management and control, that are largely experimental at this time; effectiveness of actions at reducing predation on tortoises over a prolonged time period; numbers of ravens identified for lethal control efforts, as determined by regional surveys and documented tortoise predation rates; priority assigned to lethal control; availability of staff; and funding. During initial phases of this program, program "focus" will be on experimental application of nonlethal raven control techniques, acquiring additional life history information on the raven, and conducting regional surveys to locate raven nesting and perching sites.

Poisoning and shooting will be limited in scope, emphasizing areas where raven predation rates on tortoises are especially high. During this time, the numbers of ravens that will be killed annually shall not exceed 200 birds. Should nonlethal control techniques prove successful, this number could decrease over time. However, if nonlethal control techniques prove unsuccessful, the number of ravens that will be killed shall increase. Approximately 500-700 birds may be killed annually in this case.

Larger numbers of ravens may be subject to harassment and/or displacement as a result of implementation of nonlethal control techniques. Hazing could reduce opportunity for ravens to feed and congregate at landfills and sewage ponds. Displaced birds may leave the area, or could seek other sites of reliable food supply. Collectively, several thousand ravens could be displaced from landfills and sewage ponds. Placement of anti-perch wire along fences and other perching and roosting sites could modify bird behavior patterns, possibly resulting in changed foraging strategies by birds. Conditioned taste aversion could result in modified feeding behavior. Sterilization could disrupt breeding, resulting in lowered recruitment rates of ravens known to prey excessively on tortoises.

Although the emphasis of raven control activities is on ravens that prey on tortoises, other ravens that might not feed on tortoises may also be inadvertently killed or displaced. These ravens may be transient animals or juveniles that wander through a control area or birds that roost or "loaf" in close association with ravens known to prey on tortoises. Approximately 25 percent of the ravens subject to annual control efforts may fall into this category.

Individual birds may be accidentally killed or injured during implementation of research projects involving capturing, handling, and marking. Additional ravens may be accidentally killed or injured during implementation of nonlethal forms of

control, such as sterilization or conditioned taste aversion training. The total number of individual ravens that may be injured or killed during such activities is expected to be low. The actual number of accidental injuries or fatalities will probably not exceed 50 birds over a minimum 10-year period. Low numbers of ravens may be unintentionally killed during handling; the overall impact of such deaths, however, will be insignificant.

The anticipated net effect of program actions to California desert raven populations is expected to be minor. Program emphasis is on birds that are known to prey on tortoises and/or within areas experiencing documented excessive predation rates by ravens. The goal of the program is to manage ravens in a manner that also perpetuates the raven population in the deserts.

4.1.2 Impacts to the Desert Tortoise

Program implementation under this Alternative is expected to have a beneficial impact to the desert tortoise. Effective raven control, using methods designed to reduce raven predation rates on desert tortoise populations should, on the long-term, result in increased recruitment of juvenile desert tortoises into adult age-classes. This recruitment is necessary to maintain desert tortoise populations. Current raven predation rates, ranging regionally between 15% and 50%, could be reduced by an estimated 50-75% by effective raven control over a minimum 10-year timeframe.

4.1.3 Impacts to Other Wildlife Species

Raven control measures will likely result in a beneficial impact to other species of wildlife. Ravens are opportunistic predators that are known to eat a variety of small animals. Actions undertaken to boost tortoise survival may also result in the increased survival of other wildlife species in the same areas.

However, displacement of ravens and/or modifications of raven feeding behavior could result in increased mortality of other wildlife species, as ravens "shift" foraging strategies to compensate for decreased availability of food at landfills, or modify hunting practices to "focus" on species other than tortoises. Displaced birds may leave the CDCA altogether.

Other wildlife species could be indirectly killed as a result of livetrapping and offsite release of ravens from areas experiencing excessive tortoise predation. These include species that may be accidentally livetrapped, such as gulls or turkey vultures. Live-trapped ravens may contribute to increased predation rates on species of animals present at release sites. Such species are expected to be active by day, and include many nesting species of birds, lizards, snakes, and ground squirrels.

The degree of impact to such wildlife populations is unknown. Experimental release of ravens will emphasize the collection of such data. If experimental release demonstrates that released ravens significantly affect resident wildlife populations, this program will be discontinued and released birds killed or captured. Alternate raven control techniques would be implemented.

Non-target wildlife may be accidentally killed or injured during both nonlethal and lethal raven control efforts. The actual number of animals that could be killed or injured by nonlethal forms of raven control is expected to be less than 50. Starlicide poisoning could result in the death to blackbirds, starlings, crows, and ravens, that are especially susceptible. Other species of birds such as doves, thrashers, gulls, and owls, also could be killed from eating this poison. Mammals and reptiles are much more tolerant of the poison and are not expected to be affected. No evidence of injury or mortality to species other than ravens was collected during the pilot program (BLM 1990). The actual number of animals that could be inadvertently killed or injured by lethal forms of raven control is expected to be less than 100. Implementation of measures proposed to reduce the likelihood of adversely affecting nontarget wildlife species discussed under Section 4.6 should reduce these potential affects to an insignificant level.

4.1.4 Cultural Resources

Raven control activities will reduce the total number of ravens by only a small factor in the entire CDCA. Population numbers will remain at levels much higher than extrapolated for prehistoric to recent historic times. The impact of this program on any Native American traditional values should be minimal.

4.1.5 Other Resources

Raven management actions will not have any negative impacts on wilderness study areas or Areas of Critical Environmental Concern. Passive recreational activities may benefit from the program since raven control should enhance opportunities for the public to view and photograph desert tortoises. Opportunities to view ravens will be diminished. However, because the goal of this program is to control but not eliminate ravens, this visual impact is not expected to be significant and may be unnoticeable to many observers.

Some areas may be subject to intermittent increases in noise levels due to hazing or shooting of ravens. This increased noise level would be concentrated primarily at sites where ravens concentrate, such as landfills and sewage ponds.

Local communities may benefit from the proposed action through: (1) reduction in noise from the vocalizations of ravens, that roost and perch in trees; (2) reduction in the potential for spread of disease, since ravens are potential vectors for disease; (3) reduction in potential for power outages, as a result of perching by birds or build up of guano on transmission tower insulators; and (4) enhanced safety of aircraft from lowered potential for bird/aircraft collisions.

Some local communities may receive negative impacts from the proposed action if: (1) ravens die or are found dead in yards in the community; and (2) gunshots from the shooting program can be heard in adjacent communities. Additionally, raven control measures undertaken by communities may generate some public concern and opposition. These community concerns can be reduced through the following measures: (1) placing emphasis on nonlethal raven control measures that are shown to be effective; (2) effectively containing trash and other food items that attract ravens; (3) implementing a public education program prior to onset of local raven control activities; and (4) undertaking selective killing of birds only where raven predation rates on juvenile tortoises are shown to be excessive.

The Proposed Action is not expected to have any impact on air quality, water resources (surface or subsurface), mineral resources, grazing lands, or paleontological resources.

4.2 No Action

4.2.1 Impacts to Ravens

Under the No Action alternative, there would be no impacts to raven populations. Numbers would be expected to increase in corresponding fashion to an increasing human population. Current annual raven population increases, ranging from 5% in the Great Basin Desert to 15% in the mojave Desert, would continue. Regional areas of greatest raven population increase would be in the western Mojave Desert, south-central Mojave Desert, and northern Colorado Desert. Natural controls on raven populations are unknown, and food availability is not currently a limiting factor due to the large number of landfills and availability of roadkills.

4.2.2 Impacts to the Desert Tortoise

Under the No action Alternative, impacts of raven predation on desert tortoise populations will remain high in portions of the Mojave and Colorado Deserts and increase through time in other portions of the geographic range of the desert tortoise as raven distribution becomes more widespread and raven numbers increase. Continued raven predation on young desert tortoises could significantly contribute to the extirpation of tortoise

populations in such critical management areas as the DTNA and Fenner-Chemehuevi Valleys.

Data from permanent desert tortoise study plots provide a sample of the levels of raven predation occurring on juvenile desert tortoises in the California deserts (Berry 1985; Berry et al. 1986a, 1986b, 1987; BLM 1988 data). Data collected between 1976 and 1987 are provided in Appendix A, Table 8.

Since the mid- to late 1970's and early 1980's, raven predation has had significant adverse effects on desert tortoise populations. Specifically, ravens have: (1) reduced numbers of juvenile tortoises in the hatchling to eight-year classes, (2) reduced recruitment of tortoises into the larger and older size-age classes (e.g., tortoises from 9 to 20 years of age), (3) altered the size-age class composition of the population to favor adults, and (4) contributed to overall population declines from multiple sources. Examples of the degree and nature of the impacts are evident at five permanent study plots in the western Mojave Desert and at two study plots in the northeastern Colorado Desert, as well as in other regions.

Briefly, for the purposes of analyzing tortoise population data, tortoises are divided into six size-age classes based on carapace length: juvenile 1 (<60 mm); juvenile 2 (60-99 mm); immature 1 (100-139 mm); immature 2 (140-179 mm); subadults (180-207 mm); and adults (>208 mm) (Turner and Berry 1984). The classes reflect age, degree of shell ossification, vulnerability to predators, and sexual maturity. In general, tortoises in the juvenile 1 class are less than three to four years old, those in the juvenile 2 class are four to seven years old, those in the immature 1 class are seven to 13 years old, and those in the immature 2 class range from 13 to 20 years of age. Ages for tortoises in the smaller size classes vary considerably and depend on food supply, precipitation, and other factors. However, most tortoises require 15 to 20 years to reach sexual maturity, which occurs when individuals reach 180 to 200 mm in length.

Because ravens prey heavily and selectively on small size-age classes and are very efficient predators, they have contributed to significant changes in size-age classes of tortoise populations throughout the California deserts. In the western Mojave Desert, where data are available from several study plots, the pattern is consistent and significant (Berry et al. 1986a, 1986b, 1987, 1988). This data is summarized for five study plots in Appendix A, Table 9.

The data on population densities from the study plots underscore the severity of raven predation on young desert tortoises. Tortoise population densities have dropped substantially on the western Mojave Desert plots, with declines ranging from

approximately 30% to 60% between 1979-82 and 1985-88 (Berry et al. 1986a, 1986b, 1987, 1988). Substantial losses to population densities are occurring in juvenile and immature 1 size classes. Another indicator of the impact is the dead tortoises found on the plots (Appendix A, Table 10). High proportions of young tortoises <100 mm in length are being killed by ravens. Taken as a unit, this information reveals that raven predation is having a substantial adverse effect on the desert tortoise population in the western Mojave Desert.

Of considerable concern is the lack of recruitment of young tortoises into the adult breeding population. When tortoises are preyed upon heavily in the hatchling to eight-year cohorts (each year-class of tortoises is a "cohort"), then few tortoises are incorporated into the cohorts for nine to 20 years and older. Figure 3 shows a histogram of live tortoises registered at the DTNA Interior Plot in 1979 and 1988. The 1979 histogram depicts a tortoise population experiencing intensive raven predation pressure; tortoise numbers were very low in the size-age classes representing 60 to 100 mm in length (i.e., 3 to 7 years of age). By 1988, the effects of raven predation pressure were evident in all tortoise juvenile and immature size-age classes, as well as in young subadults (i.e., 3 to 20 years of age). The presence of very small tortoises at the bottom of the histogram indicates that females still lay eggs that are hatching. However, hatchling tortoises are not surviving to reach the larger size and older age categories. These histograms illustrate what is happening to desert tortoise populations in the western Mojave Desert.

Effects of raven predation on desert tortoise populations are similar in the northeastern Colorado Desert of California to that in the western Mojave Desert, although not as severe. Two study sites in the Ward Valley show low numbers of juvenile 1 and 2 tortoises (Berry et al. 1988, Karl 1988). One study plot established in 1980 showed a decline in juvenile tortoise size-age class frequencies from about 23% to 8% between 1980 and 1987. Excessive raven predation has been documented for this general area.

4.2.3 Impacts to Other Wildlife Species

Other wildlife species are expected to similar declines as raven numbers increase. Biologists with long-term experience conducting wildlife surveys in specific desert areas have noted overall declines in wildlife species diversity and relative abundance while raven numbers have increased dramatically (Eugene cardiff, pers. comm.). There are, however, no quantifiable data dealing with species other than the desert tortoise.

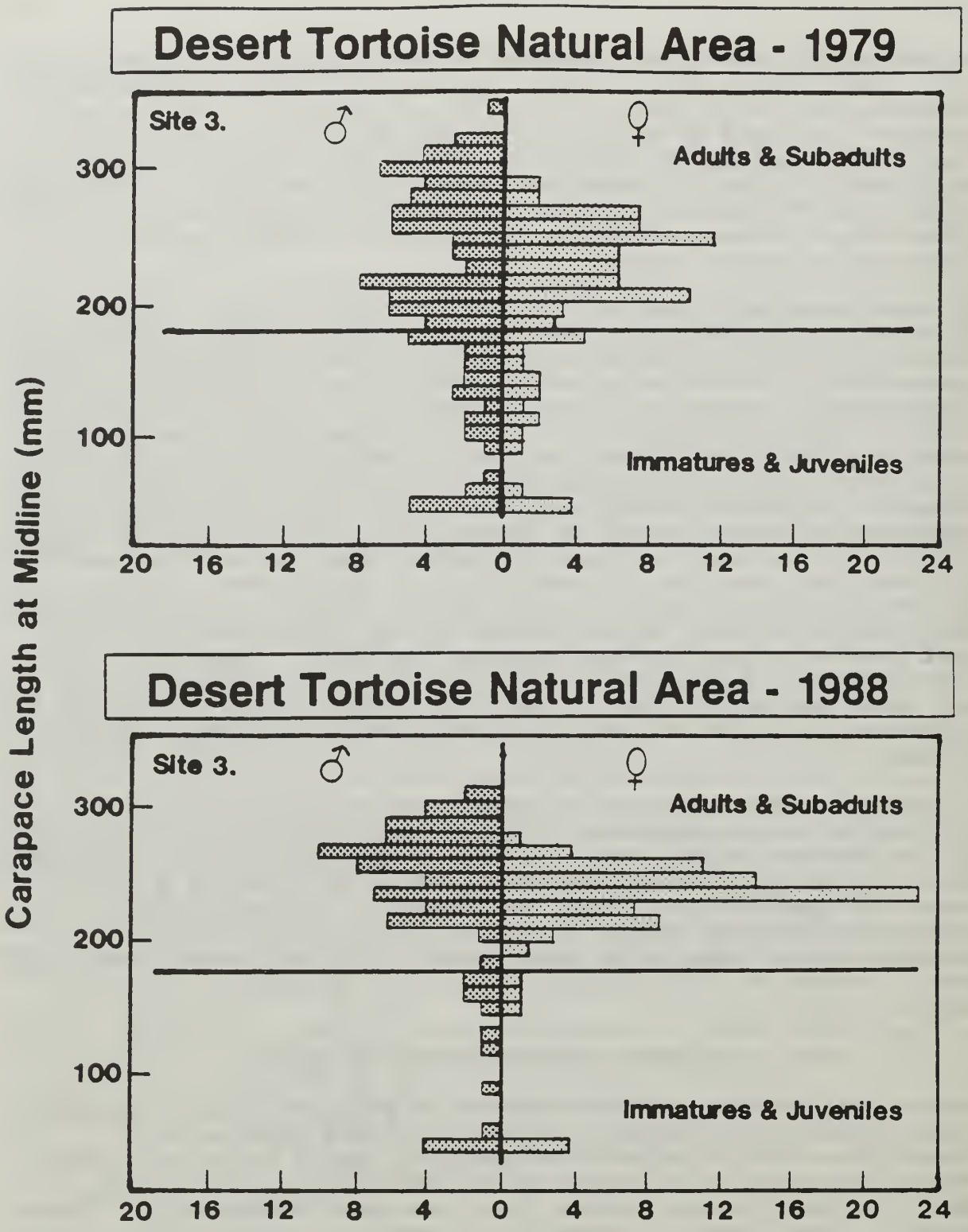

Figure 3. Histograms of live tortoises captured at the Desert Tortoise Natural Area interior study site during 60-day spring surveys in 1979 and 1988. In the 1979 histogram, note the low numbers of juvenile tortoises 60-100 mm in length. In the 1988 histogram, note the lack of recruitment of juvenile tortoises 60-100 mm in length into the larger size classes.

4.2.4 Cultural Resources

Cultural resources will not be affected under this Alternative.

4.2.5 Other Resources

Failure to implement a raven management program could possibly result in costly aircraft damage or the complete loss of an aircraft and possibly its crew in a bird/aircraft collision.

As raven populations continue to increase, greater numbers of birds may congregate in local communities and at landfills. Potential for transmittal of disease could increase with the bird population increase in urbanized areas. Potential for temporary power outages as a result of raven perching or guano buildout may also increase with this desert-wide population increase.

There would be no effect to other resources under this Alternative.

4.3 Nonlethal Control Only

4.3.1 Impacts to Ravens

Under this Alternative, limited numbers of ravens will be killed as a result of capture, marking, and handling during research projects. Low numbers of ravens will be killed as a consequence of nonlethal forms of control designed to disrupt feeding and breeding behavior. Larger numbers of ravens will be subject to harassment as a result of live-trapping and removal to offsite locations, hazing at landfills and other concentration sites, nest destruction, and placement of anti-perch wire at specific locations. such effects may be short-term in nature, resulting in the movement of birds to offsite areas. However, displaced birds may leave the region as a consequence of nonlethal control. Effects are largely unknown due to the experimental nature of many planned nonlethal control actions.

The numbers of ravens that will be killed as a consequence of management efforts will be restricted to those birds accidentally killed during measures described above. The total numbers of ravens accidentally killed will not exceed 50. The number of ravens that will be subject to harassment through modification of landfill containment practices, hazing, or other behavioral disruption techniques will collectively total several thousand birds.

4.3.2 Impacts to the Desert Tortoise

The effects of this alternative on the desert tortoise are largely unknown, and depend solely upon the success of largely experimental techniques employed to reduce raven predation.

Program actions entail applying nonlethal techniques proven successful at reducing raven predation on desert tortoises on a regional basis. Nonlethal techniques have been used with varying success for ravens and other species (Lounsbury 1972; Nicolaus 1987; young and Engel 1988; ed Knittle, pers. comm.; Kristinn Skarphedinsson, pers. comm.). Should these techniques prove effective, raven predation rates, ranging regionally between 15% and 50%, could be reduced by an estimated 50-75% over a minimum 10-year timeframe.

However, if nonlethal forms of control are not effectve, declines in desert tortoise populations as a result of excessive raven predation will continue. Over time, tortoise populations may become extirpated as a consequence of severely depressed recruitment rates of juvenile tortoises into adult age-classes. This loss, including portions of "core" tortoise populations in the western Mojave Desert and northern Colorado Desert, would substantially lessen the ability of the agencies to recover the tortoise (e.g., ensure the long-term protection of the tortoise and remove the species from its current Federal endangered status).

4.3.3 Impacts to Other Wildlife Species

The effects of controlling raven predation on tortoises by exclusively nonlethal methods are expected to be "mixed" for other wildlife species. Animals could be adversely affected by raven control activities, including inadvertent injury or mortality from trapping or displacement as a consequence of planned hazing and modified landfill containment practices. These include species that may be accidentally livetrapped, such as gulls or turkey vultures. Live-trapped ravens may also contribute to increased predation rates on species of animals present at release sites. Such species include birds, lizards, snakes, and ground squirrels. Displacement of ravens and/or modification of raven feeding behavior could result in increased mortality to other wildlife species, as ravens "shift" foraging strategies to compensate for decreased availability of food at landfills, or modify hunting practices to "focus" on species other than tortoises.

However, raven control techniques employed will displace groups of birds at "concentration" points such as landfills, where surrounding lands may be subject to especially high predation rates by foraging birds. Displaced birds may leave the CDCA altogether.

4.3.4 Cultural Resources

There should be no effect on cultural resources under this Alternative.

4.3.5 Other Resources

Anticipated impacts under this Alternative would be similar to those described for the Proposed Action.

4.4 Specific Area Focus Only

4.4.1 Impacts to Ravens

The effects of this Alternative will be the same as the Proposed Action where raven control efforts are undertaken. However, long-term success is uncertain since it is likely that other ravens will replace those killed and the raven population CDCA-wide will not be managed. Program actions will be limited to portions of the western Mojave Desert and northern Colorado Desert, shown in Figure 2. Remaining areas of the CDCA will be subject to no raven control.

Poisoning and shooting will be limited in scope, emphasizing areas where raven predation rates on tortoises are especially high. the numbers of ravens that will be killed annually will not exceed 500 birds. Larger numbers of ravens may be subject to harassment and/or displacement as a result of implementation of nonlethal control techniques. Hazing could reduce opportunity for ravens to feed and congregate at landfills and sewage ponds. Displaced birds may leave the area, or could seek other sites of reliable food supply. Collectively, several thousand ravens could be displaced from landfills and sewage ponds. Placement of anti-perch wire along fences or other perching and roosting sites could modify bird behavior patterns, possibly resulting in changed foraging strategies by birds. Conditioned taste aversion could result in modified feeding behavior. Sterilization could disrupt breeding, resulting in lowered recruitment rates of ravens known to prey excessively on tortoises. The numbers of individual ravens affected by taste aversion and sterilization is expected to range between 50 and 200 annually.

Although the emphasis of raven control activities is on ravens that prey on tortoises, other ravens that might not feed on tortoises may also be inadvertently killed or displaced. These ravens may be transient animals or juveniles that wander through a control areas or birds that roost or "loaf" in close association with ravens known to prey on tortoises. Approximately 25% of the ravens subject to annual control efforts may fall into this category.

Individual birds may be accidentally killed or injured during implementation of research projects involving capturing, handling, and marking. Additional ravens may be accidentally killed or injured during implementation of nonlethal forms of control, such as sterilization or conditioned taste aversion training. The total number of individual ravens that may be

injured or killed during such activities is expected to be low. The actual number of accidental injuries or fatalities will probably not exceed 50 birds over a minimum 10-year period. Low numbers of ravens may be unintentionally killed during handling; the overall impact of such deaths, however, will be insignificant.

The anticipated net effect of program actions to California desert raven populations is expected to be minor. Program emphasis is on birds that are known to prey on tortoises and/or within areas experiencing documented excessive predation rates by ravens. The goal of the program is to manage ravens in a manner that also perpetuates the raven populations in the deserts.

4.4.2 Impacts to the Desert Tortoise

Program implementation under this Alternative is expected to have a beneficial impact to the desert tortoise within those areas selected for raven control. Effective raven control using methods designed to reduce raven predation rates on desert tortoise populations should result in increased recruitment of juvenile desert tortoises into adult age-classes. Current raven predation rates could be reduced by an estimated 50-75% over a minimum 10-year timeframe within control areas.

Tortoises populations in remaining portions of the CDCA not subject to raven control would experience impacts previously described under the "No Action" alternative.

Impacts to desert tortoise populations in these areas will be identical to that described for the No Action alternative, although outside these areas tortoises will experience a continued negative impact.

4.4.3 Impacts to Other Wildlife Species

The effects of controlling raven predation on other wildlife species within control areas are expected to be identical to those described for the Proposed Action. The effects of this alternative on wildlife species outside of control areas are expected to be identical to those previously described for the No Action alternative.

4.4.4 Cultural Resources

Effects of project actions will be identical to those described for the Proposed Action where raven management actions are undertaken. Cultural resources will be unaffected in remaining areas.

4.4.5 Other Resources

Effects of project actions will be identical to those described for the Proposed Action where raven actions are undertaken. Actions shall be restricted to portions of the western Mojave Desert and northern Colorado Desert shown in Figure 2. Project effects in remaining areas will be identical to those described under the No Action alternative.

4.5 Mitigation Measures

The following measures have been developed to mitigate the impacts identified in "Environmental Consequences":

(1) Nest destruction will involve only nests actively used by ravens. Prior to destruction, the nest(s) will be observed to clearly identify nesting bird species. Timing of destruction will be attempted late in the incubation season in order to reduce opportunities for successful nesting by "parent" birds. No nests used by other bird species will be destroyed.

(2) During livetrapping, the following measures will be employed:

   (a) traps will be inspected regularly for birds (minimally once per day);

   (b) other birds that inadvertently are live-trapped, if any, will be released immediately at the capture site;

   (c) traps will be placed in a manner that reduces thermal exposure in order to limit stress to captured ravens;

   (d) if specific livetrap designs are found to contribute to unintentional injury or mortality of captured birds, such designs will be discontinued in favor of alternate livetrapping methods; and

   (e) injured wildlife species, excluding ravens, will be provided to the California Department of Fish and Game for treatment. Animals that recover from injuries incurred as a result of livetrapping will be released at the point of capture.

(3) During implementation of sterilization or taste aversion conditioning programs, the following measures will be undertaken:

(a) compounds utilized for sterilization or taste aversion conditioning will be administered orally via treated baits;

(b) appropriate compound dosages will be determined prior to application through literature review and discussions with individuals familiar with these techniques;

(c) use of compounds will be preceded with a period using untreated baits to increase acceptance by ravens;

(d) both untreated and treated baits will be regularly monitored to determine acceptance level by ravens and exposure potential to other wildlife species;

(e) proposed program actions will be discontinued or modified if, during prebaiting, non-target wildlife species are observed consuming baits; and

(f) each experimental program will be stopped and reviewed in the event that ravens die or are irreparably injured as a consequence of bait ingestion or if other species of wildlife that inadvertently consume baits die or are irreparably injured.

(4) Research and monitoring programs involving the capture, handling, and marking of ravens will be undertaken by specialists with prior demonstrated experience using identical or similar techniques with this species or other bird species in order to minimize any potential for inadvertent harm to study birds.

(5) Use of chemical compounds for sterilization, taste aversion conditioning, or poisoning of ravens will be accomplished within label restrictions.

(6) Starlicide-treated eggs will be placed in elevated platforms minimally 4.5 feet in height. Such eggs shall be secured to these platforms by insertion of heavy gauge wire fastened to bait boxes in order to minimize any potential for eggs to be removed and cached by ravens. Bait boxes will also be constructed in a manner that reduces any likelihood that eggs will fall to the ground while being consumed by ravens.

(7) Prior to application of poisoned eggs, untreated eggs will be placed at each bait station to determine acceptance by other wildlife species. Such bait will be regularly inspected by ADC staff or other agency

biologists to determine exposure risk to other nontarget species. Inspection will consist of monitoring of each bait station for at least a three hour period prior to application of poisoned baits. If inspection documents feeding behavior or interest in bait by other wildlife species, poisoning at that site will not take place.

(8) A maximum of two poison-treated eggs will be placed at a bait station at any given time.

(9) Poisoned baits will be used for a period not to exceed seven consecutive days at any given site. Poisoning may be continued at such sites only after subsequent monitoring documents continued raven predation on tortoises. Each site where poisoned eggs are secured will be regularly monitored by ADC staff or other agency personnel.

(10) Each day after poisoning is initiated, beginning 24-48 hours after onset of poisoning, attempts will be made by program staff to locate poisoned birds. Such attempts will include: (a) inspection of the treatment site(s); (b) checks of known raven perching, nesting, or roosting sites proximate to the treatment site(s); (c) checks for additional raven perching, nesting, or roosting sites proximate to the treatment site(s) as determined by observed flight patterns of ravens, vegetational features, structures, or terrain; and (d) checks at area springs and water holes. Poisoned ravens will be removed from the site. Such ravens will be disposed of by either: (a) donation to a museum or university collection for research or educational purposes; (b) use for research purposes; or (c) disposal via burial in a landfill. In the event that sick or recently killed species of wildlife other than ravens are discovered, and the causes of such illness or mortality are not readily attributed to actions other than poisoning, poisoning will be discontinued immediately. The circumstances surrounding such discovery, number(s) and types of animals discovered, and recommendations for modifying program actions to reduce future poisoning, will be conveyed to the Workgroup members within 72 hours of date of discovery. The poisoned animals discovered will be collected and frozen for pathological analysis. Each specimen will also be labelled with location, date of discovery, and the name and telephone number of the person who recovered the specimen to facilitate Workgroup review. Poisoning will not resume until program measures are modified in a manner acceptable to the BLM, ADC, FWS, and CDFG.

(11) Poisoned baits will be removed from the treatment site(s) immediately following completion of control activities.

(12) Shooting will be implemented in the following circumstances: (a) where individual birds or small groups of birds (such as a nesting pair of ravens) habitually perch and feed on tortoises; (b) as a followup to poisoning to kill one or a few remaining birds, and; (c) at sites where a potential risk to other wildlife species from poisoning has been determined from monitoring of untreated egg baits. Ravens killed via shooting will be collected and disposed of in a manner described under (10) above.

(13) Shooting and poisoning will be accomplished by designated individuals only. Designated individuals will be employees of ADC or other authorized agency personnel with prior experience controlling predators and/or contract employees with prior predator control experience. Such individuals will obtain appropriate permits to administer Starlicide-treated eggs and to kill ravens.

(14) Individuals implementing raven control measures using either lethal or nonlethal means will also follow any supplemental protection measures outlined in State or Federal permits for the program.

(15) Selection of specific sites to place live-traps, bait stations, or other devices associated with raven management will minimize disturbance to wildlife habitats.

(16) Modification of landfill containment practices, placement of protective fencing along roadways, or other actions that may result in localized disturbance to wildlife habitats will incorporate site-specific measures to reduce loss of wildlife habitats or disturbance to wildlife species. Such measures will include, but are not limited to:

(a) pre-activity surveys of the site for sensitive wildlife species;

(b) use of previously disturbed areas for stockpiling of equipment and parking of vehicles;

(c) review of prior observations of sensitive species obtained from the CDFG data base files, literature

review, or discussions with other wildlife biologists; and

(d) retention of native habitats to the extent practical during landfill modification.

(17) Existing routes of travel will be utilized by vehicles in order to minimize potential for inadvertent disturbance to native vegetation.

(18) Vehicle travel off existing routes or disturbed areas will not occur. Actions requiring cross-country travel will be accomplished on foot or by aircraft.

(19) Placement of devices such as bait boxes or traps will minimize disturbance to native vegetation.

(20) Locations of sensitive plant species or Unique Plant Assemblages will be provided to project staff by a BLM botanist prior to field work, in order to minimize any potential for inadvertent disturbance to such species or areas.

(21) Modification of landfill containment practices, placement of protective fencing along highways, or other actions that may result in localized disturbance to vegetated areas will incorporate site-specific measures to reduce loss of native vegetation or disturbance to sensitive plant taxa. Such measures may include, but are not limited to:

(a) pre-activity surveys of the site for sensitive plant species;

(b) use of previously disturbed or approved areas for stockpiling of equipment and parking of vehicles;

(c) review of documented localities of sensitive plant populations obtained from the California Native Plant Society or CDFG data bases; and

(d) retention of native habitats to the maximum extent practical.

(22) Prior to onset of any activities that may result in disturbance of surface soils, a qualified archaeologist will review existing site records to determine if significant cultural sites may be adversely affected by the proposed action, the action will either be dropped or another location selected.

(23) Areas that will be subject to localized disturbance will be inventoried by a qualified archaeologist prior to onset of activities that will disturb surface soils. If significant sites are discovered during such inventories, the project will either be modified to avoid affecting these resources, or an alternate site selected.

(24) Native Americans that may have ties to an area that will be subjected to raven control efforts may be contacted for input prior to onset of activities.

(25) Bait stations where eggs treated with Starlicide are used will be prominently posted to notify the general public.

(26) Shooting will be avoided near transmission towers or other structures in order to minimize any potential for inadvertent damage during raven control.

4.6 Residual Impacts

The Proposed Action, "Nonlethal control Only", and "Specific Area Focus" alternatives to control raven predation on juvenile desert tortoises will employ measures described under Section 4.5 "Mitigation". The desert tortoise populations in the CDCA should benefit substantially by increased raven control. Risk to other species of wildlife is low. Although ravens may be killed or displaced, the species will be managed in a manner that perpetuates desert populations.

Under the No Action alternative, desert tortoise populations will continue to decline as a consequence of excessive raven predation. Tortoise populations in areas where raven predation is excessive enough to prevent recruitment into adult age-classes may become extirpated over time as adult populations are reduced through other factors. Predation levels on desert tortoise populations from raven will remain significant.

4.7 Short-term Uses of the Environment Versus Maintenance and Enhancement of Long-term Productivity

Implementation of the Proposed Action will result in the short-term loss of ravens as a result of: (1) selected poisoning and shooting of birds in areas where tortoise predation rates are excessive; (2) livetrapping and removal of ravens from the same areas; and (3) accidental loss of a few ravens as a result of both research studies and nonlethal control methods. The long-term effects of the program, however, will be beneficial for the tortoise, and reflected in increased recruitment rates of juveniles into adult age-classes as a result of lowered raven predation rates. Populations of other species of wildlife that

are subject to excessive raven predation rates will also experience similar benefits. Program actions will also provide for increased understanding of the ecology of the raven in the CDCA, and maintenance of viable populations of this species.

If nonlethal forms of control prove successful, short-term effects under this alternative will include the inadvertent loss of relatively low numbers of individuals ravens and other bird species as a result of research studies and application of nonlethal control techniques. Because experimental application of several nonlethal control techniques will be required initially, desert tortoise populations will continue to experience restricted recruitment rates. If nonlethal control proves successful, long-term benefits to the desert tortoise would be similar to the Proposed action. However, should nonlethal control prove unsuccessful, desert tortoise populations will continue to experience excessive raven predation. Individual tortoise populations may be extirpated over a period of years as a consequence of this raven predation.

Under the No Action alternative, ravens will continue to prey on desert tortoises. Predation rates may increase as a consequence of increasing raven numbers in desert areas. Over time, predation may result in the extirpation of desert tortoise populations due to lack of recruitment. Excessive predation will likely significantly reduce the opportunity to recover the desert tortoise and remove it from both State and Federal lists. Excessive raven predation may also result in overall reductions of other wildlife species as well.

Under the Specific Area Focus alternative, short-term effects within "control" areas will be similar to that described for the Proposed Action. Short-term effects in remaining areas of the CDCA containing tortoises will be similar to the No Action alternative. Longer-term consequences of this alternative may include either: (1) increased tortoise recruitment rates in "control" areas, with increased predation rates on tortoises in remaining areas; or (2) continued decreased tortoise recruitment rates desert-wide, from continued immigration of "surplus" ravens into "control" areas.

Raven management and control would not prevent other uses of the environment, nor implementation of a wide range of other management actions for the protection of the desert tortoise and its habitat. Management measures prescribed for the desert tortoise (Kennedy et al. 1986; Sievers et al. 1988) would not be foreclosed by implementing measures proposed under the Proposed Action.

4.8 Irreversible and Irretrievable Commitment of Resources

"Irreversible resource uses" imply a commitment of land or renewable resources to a use for a certain period of time, during which the resources are unavailable to other uses. This period of time would coincide with the duration of time a raven control program is underway. For the Proposed Action and various alternatives, these include the following:

Alternative	Irreversible Resource Uses
Proposed Action	Selective killing and removal of ravens, resulting in lowered numbers of birds.
	Lowered opportunities to observe ravens in the desert as a consequence of reduced numbers of birds.
Alternative 1 (Nonlethal Control)	Possible lowered numbers of ravens as a result of displacement of individuals, improved trash containment practices, or other proposed measures.
	Possible irretrievable loss of tortoise populations as a result of raven predation.
Alternative 2 (No Action)	Continued reductions of tortoises as a consequence of raven predation.
	Long-term possible extirpation of populations where excessive predation prevents recruitment.
	Lowered opportunities by the public to view and photograph tortoises.
	Reduced chances of recovering the tortoise and removing species from both State and Federal lists.
Alternative 3 (Site-Specific)	Reduced numbers of ravens in control areas.
	Lowered opportunities to observed ravens in control areas.
	Continued reductions of tortoises as a result of raven predation in areas outside of control sites.

	Long-term possible extirpation of tortoise populations where excessive raven predation prevents recruitment.
	Reduced chances of recovering the tortoise, and removing species from both State and Federal lists.

4.9 Cumulative Impacts

Desert tortoise populations are subjected to a variety of impacts. The contributing causes of these impacts, in many cases, are a result of man-induced activities. The continued human population increases in the desert, and in peripheral areas to the desert, places an ever-increasing demand for desert space and resources. Activities that directly or indirectly impact desert tortoise populations and habitats include: urbanization; pipeline and utility line construction; agricultural development; livestock grazing; mineral exploration and development; road construction and route use; recreation; and military maneuvers. Tortoises may be adversely affected as a result of these activities by: habitat loss; habitat fragmentation; habitat degradation; isolation of populations; collection for pets; vandalism; disease; competition for available forage; road mortality; and increased predation.

Control of excessive tortoise predation by ravens is one of several actions either planned or currently underway for the protection of the desert tortoise. Implementation of several actions is needed for the long-term perpetuation of viable desert tortoise populations and the maintenance of this "key" species in the ecosystems of the California deserts. Important programs that are underway include: (1) research to increase understanding of the ecology of the species; (2) studies to determine locations and effects of respiratory disease outbreaks and to identify the disease; (3) monitoring of tortoise populations using a series of one-square mile or larger study plots desert-wide; (4) establishing turn-out limits for livestock to reduce competition for available forage during critical spring months; (5) establishing the Desert Tortoise Research Natural Area; (6) increasing ranger staffing to enforce applicable laws and area use restrictions; (7) implementing a public awareness program for the species; (8) developing appropriate mitigation and compensation measures for specific land use actions affecting both tortoises and tortoise habitats; (9) consolidating lands through purchase or exchange to protect tortoise habitats; and (10) establishing agency and interagency workgroups to improve regional management.

The cumulative effect of these actions in combination with control of raven predation of juvenile tortoises as described for

the Proposed Action will be highly beneficial for the desert tortoise. Long-term consequences of all measures combined may include: (1) initial stabilization of tortoise populations as conflicting land uses and activities are controlled, the current disease epidemics contained, and raven predation rates lowered; (2) initial maintenance of large contiguous tracts of lands in "core" tortoise population areas through land consolidation and management efforts focused at protection of tortoises and habitats in such areas; (3) longer-term increases in tortoise populations as habitat quality improves as a result of conflicting land uses in previously impacted areas, and juvenile tortoises reach maturity as a result of lowered mortality rates associated with raven predation and other factors and as a consequence of increased area carrying capacity.

V. CONSULTATION AND COORDINATION

5.1 Chronology of Meetings

A Public Scoping Meeting to obtain suggestions regarding draft management plan and associated DEIS preparation was held in Riverside, California on September 15, 1989.

5.2 The Scoping Process and Results

A public scoping process was initiated, as required by National Environmental Policy Act (NEPA) regulations and encouraged by the Council on Environmental Quality. Public scoping was undertaken to identify the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in the EIS, and to eliminate from detailed study issues found not to be important. The process was designed to solicit comments from the general public and from local, State, and Federal government agencies. Notifications included publication of the Notice of Intent in the Federal Register by BLM on September 1, 1989, indicating the nature of the project, and the date, time, and location of a planned scoping meeting (54 Federal Register 36394-36395); and a single scoping meeting held in Riverside, California.

A scoping meeting was held at the Howard Johnson Lodge, 1139 University Avenue, Riverside, California on September 15, 1989. The meeting was conducted to provide an opportunity for public and governmental agencies to submit verbal comments on the issues to be addressed in response to a presentation on the proposed (e.g., preferred) action. Those not able to attend a public meeting were invited through the Federal Register notice to submit written comments.

Several issues of public concern were identified during public scoping. These are summarized in Table 4.

Table 4. Raven Management Project Public Scoping Process Summary of Issues.

Comment	Response
Monitoring needs to be emphasized.	Monitoring is incorporated in all alternatives except "No Action"
Need to emphasize collection of information on raven ecology	Life history information on the raven in the CDCA is limited. Collection of such information is a part of all alternatives except "No Action"
Raven trapping techniques must be effective.	A variety of techniques to livetrap birds will be employed. Each will be tested and then used regionally if proven to be effective. Trapping will be used in all alternatives except "No Action."
Should consider an "open" season on ravens.	Establishing an "open" season on ravens was not considered viable. The intent of the program is to restore a balanced predator-prey relationship between ravens and tortoises. The ability to effectively control ravens could actually be impaired by an "open" season by increasing their wariness with little reduction of "killer" birds.
Should avoid use of lethal forms of raven control.	The Proposed Action uses a combination of lethal and nonlethal forms of raven control. Nonlethal forms are largely experimental. If proven successful, they will be used on a widespread basis. Lethal control will

Table 4. Continued.

Comment	Response
	be selectively "focused" for ravens that prey on tortoises. Risk potential for other wildlife species using lethal control is minimal.
Raven control by nest destruction may not work.	Selective nest destruction, if properly timed, may impede successful nesting. This technique will be experimentally tested. If successful, it will then be attempted on a regional basis.
Should examine biological control using raven predators.	Biological control using raven predators was considered, but dropped from more detailed analysis. No predators that would prey specifically on ravens are known. Attempts to increase populations of other predator species would be costly and could result in increased predation rates on many other wildlife species besides ravens.
Should examine impacts to tortoises as a result of other factors besides ravens.	The EIS examines the effects of raven management and control. It was not intended as a programmatic document reviewing other activities on the desert tortoise. Other actions are briefly reviewed in the "Cumulative Impacts" section of the EIS. Effects of other individual projects and programs on the desert tortoise would be reviewed during preparation of environmental documents pursuant to NEPA.

Table 4. Continued.

Comment	Response
Should examine use of nonlethal chemicals to disturb or sterilize ravens.	Attempts will be made to try this under all alternatives except "No Action". Where successful, it will be applied on a regional basis using mestranol or other sterilants.
Slow-acting poison should be used in order to allow "parent" birds time to feed offspring poisoned food.	The avicide "Starlicide" provides sufficient time between ingestion and death (48-72 hours) for ravens to feed their young. However, the likelihood of adult birds providing poisoned eggs to young is remote, due to mitigation measures proposed.
Contact other sources for information on raven behavior.	Attempts were made during preparation of this document to collect information on raven ecology, effects to other resources, and control, from all over the world. Information sources were obtained from the United States, Africa, Europe, and Canada. Additional information obtained during review of the draft EIS will be incorporated into the final document.
Include raven control at Edwards Air Force Base under "Specific Area Focus" alternative.	To the extent that funding is allocated for such efforts, Edwards AFB will cooperate in interagency efforts to manage raven populations under whatever alternative is implemented.

5.3 Agencies/Groups Contacted for Input

The following individuals, groups, and agencies were notified of the BLM intent to prepare a management plan addressing the common raven in the CDCA. Comments were invited at this time.

Mr. Bob Anderson, Tacoma, Washington
Mr. Keith Axelson, Los Angeles, California
Mr. Richard Bauer, U.S. Fish and Wildlife Service, Portland, Oregon
Mr. Chuck Bell, Lucerne Valley, California
Dr. Jerry Boggs, U.S. Department of the Navy, China Lake, California
Dr. Peter Brussard, University of Nevada, Reno, Nevada
Mr. Peter Butchko, U.S. Department of Agriculture, Animal Damage Control, Visalia, California
Dr. Faith Campbell, Natural Resources Defense Council, Washington, D.C.
Mr. Eugene Cardiff, San Bernardino County Museum, Redlands, California
Mr. Mike Coffeen, Utah State Division of Wildlife Resources, Cedar City, Utah
Ms. Jayne Chavez-Scales, Desert Tortoise Preserve Committee, Redlands, California
Commanding General, U.S. Marine Corps Air Ground Combat Center, Twentynine Palms, California
Desert Tortoise Council, Long Beach, California
Desert Tortoise Preserve Committee, Ridgecrest, California
Field Supervisor, U.S. Fish and Wildlife Service, Laguna Niguel Field Office, California
Dr. Bruce Fishman, Alameda, California
Dr. Kimball Garrett, Los Angeles County Museum, Los Angeles, California
Dr. Whitcomb Gibbons, Savannah River Ecology Lab, Aiken, South Carolina
Dr. John Grandy, The Humane Society of the United States, Washington, D.C.
Mr. Mark Hagen, Environmental Planning and Compliance Branch, Edwards Air Force Base, California
Mr. Bob Haussler, California Energy Commission, Sacramento, California
Dr. Bernd Heinrich, Burlington, Vermont
Colonel John Hofman, Center Vice Commander, Edwards Air Force Base, California
Dr. Elliott Jacobson, University of Florida, Gainesville, Florida
Mr. Steve Johnson, Tucson, Arizona
Dr. Richard Knight, Colorado State University, Ft. Collins, Colorado
Mr. Ed Knittle, Denver Research Center, Denver, Colorado
Dr. C. & Mrs. P. Knowles, Boulder, Montana
Mr. Ed Littrell, California Department of Fish and Game, Rancho Cordova, California

Dr. Wilbur Mayhew, University of California, Riverside, California
Mr. Steve McCormick, The Nature Conservancy, San Francisco, California
Mr. Sean McKeown, Fresno Zoo, Fresno, California
Mr. Robert McKernan, University of California, Riverside
Mr. George Moncsko, Desert Tortoise Preserve Committee, Ridgecrest, California
Dr. J.P. Myers, National Audubon Society, New York, New York.
Dr. Ken Nagy, University of California, Los Angeles, California
Mr. William Neil, Desert Protective Council, Anaheim, California
Dr. Richard Olendorff, BLM, Boise
Mr. Glenn Olsen, National Audubon Society, Sacramento, California
Mr. Dan Pearson, Southern California Edison Company, Rosemead, California
Mr. Don Pendleton, California Department of Food and Agriculture, Riverside, California
Mr. Charles Peterson, University of California, Los Angeles, California
Mr. Michael Phillips, Environmental Planning and Compliance Branch, Edwards Air Force Base, California
Mr. Jim Raley, Needles Desert Wildlife Association, Needles, California
Dr. Amadeo Rea, Natural History Museum, San Diego, California
Mr. Christopher Rush, Environmental Planning and Compliance Branch, Edwards Air Force Base, California
Mr. Marc Sazaki, California Energy Commission, Sacramento, California
Mr. Ron Schlorff, California Department of Fish and Game, Sacramento, California
Dr. Cecil Schwalbe, U.S. Fish and Wildlife Service, Phoenix, Arizona
Mr. Tim Shields, Haines, Alaska
Mr. Richard Spotts, Defenders of Wildlife, Sacramento, California
Ms. Bev Steveson, Desert Tortoise Preserve Committee, Bakersfield, California
Mr. Glenn Sudmeier, Hesperia, California
Mr. Ronald Thompson, U.S. Department of Agriculture, Animal Damage Control, Sacramento, California
Mr. Bob Turner, Nevada Department of Wildlife, Las Vegas, Nevada
Western Foundation of Vertebrate Zoology, Los Angeles, California
Dr. Clayton White, Brigham Young University, Provo, Utah
Mr. Fred Worthley, California Department of Fish and Game, Long Beach, California
Mr. Leonard Young, Washington Department of Natural Resources, Olympia, Washington

Additionally, the following individuals were contacted by telephone during preparation of the draft EIS and draft raven management plan, and asked for specific information relating to raven management and control:

Dr. Kate Engel, University of Wisconsin
Cr. Chuck Henry, U.S. Fish and Wildlife Service Coop. Unit, Corvallis, Oregon
Dr. Elwood Hill, U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland
Mr. Gary Ivey, U.S. Fish and Wildlife Service, Malheur Nat. Wildlife Refuge, Oregon
Dr. Lowell Nicolaus, Northern Illinois University
Dr. Richard Olendorff, BLM, Boise, Idaho
Mr. Bart O'Gara, Missoula Coop Unit, University of Montana
Mr. Kristinn Skarphedinsson, University of Wisconsin
Ms. Karen Steenhof, BLM, Boise, Idaho
Dr. Dick Steel, Southeast Missouri State University
Mr. Leonard Young, Wash. Dept. Nat. Resources, Olympia, Wash.

5.4 List of Persons/Groups/Agencies to Whom DEIS was Mailed

Randall Abbott
Alvino Alarcon
Ed and Cam Alden
Walter Allen
Julian and Phyllis Almaraz
Richard Alvarez
AMA Sports Committee, District 37
American Borate Company
Anaheim Public Library
Bob Anderson
Eugene Anderson
Judy Anderson
Rick Anderson
Dr. Ron Anderson
Julian L. Anderson
Angelo M. Iacoboni Public Library
Freda M. Annual
Sharon Apfelbaum
Area Manager, Providence Mtn State Recreation Area
Army Corps of Engineers, Los Angeles District
Arizona State University Library
James Arnold
Associated Blazers of California
Sam Atwood
Audubon Society, Coachella Valley
Audubon Society, El Dorado
Keith Axelxon
Hon. Ruben S. Ayala
Randy Babb
Hon. Charles W. Bader
Baker Unified School District Library
James R. Bagley
Baker Community Service District
Robert Ball
Tom Ballow

Julia Banks
Tilly Barling
Alice Barnes
J.C. Barnett
Sheryl Vaughan Barrett
Christine Bates
Richard Bauer
Michael Bean
Chuck Bell
Dana Bell
Dorothy & Hal Bennett
Bob Benton
Claudia Blair
Howard Blair
Vance Blair
Vern Bleich
Pete Bloom
Mike Blymer
Dr. Jerry Boggs
Steve Boland
Pete Bontadelli
Border Patrol
Ken Boyd
Barbara Bradfield
Barbara Bradford
J.P. Brady
Christopher Brand
Anita Brandenburg
Ray Bransfield
H. Marie Brashear
Martha Breed
Briggemeyer Memorial Library
John Brode
Clark Brott
Hon. George E. Brown
Lynn Brown
Phillip Brown
Lloyd Brubaker
Frst. Lt. Beth Buckrucker
Dr. Peter Brussard
Margaret Budd
Randy Buford
Laura Buker
Bureau of Indian Affairs
Bureau of Land Management, Denver Federal Center Library
Bureau of Mines
Bureau of Reclamation
Peter Burk
Betty L. Burge
Scott Burns
Dr. R. Bruce Bury
Pete Butchko

Bernice Butler
Cabazon Reservation
Cahuilla Reservation
Calif. Assn. 4-WD Clubs
Calif. Cattlemen's Association
California Department of Fish and Game
California Dept of Forestry
California Dept of Health Services
California Dept of Parks and Recreation
California Dept of Transportation
California Energy Commission
California Federation of Mineralogical Societies
California Highway Patrol
California Native Plant Society, El Cajon Chapter
California Native Plant Society, San Luis Obispo Chapter
California Off-road Vehicle Association
California Solid Waste Management Board
California State Lands Commission
California State Library, Sacramento
California State Polytechnic University Public Library
California State University Library, Chico
California State University Library, Fullerton
California State University Library, Northridge
California Turtle and Tortoise Club
California Wilderness Coalition
California Wool Grower's Association
Dr. Faith Campbell
Tom Campbell
Eugene Cardiff
Phil Carmell
Dr. Tim Carpenter
Dennis Casebier
Paul Chaffee
Chamber of Commerce, City of Twentynine Palms
Alice Chan
Vic Chatten
Jayne Chavez-Scales
Norden Cheatham
Chemehuevi Indian Reservation
Art Cheng
Robert Chesney
China Lake NWC Library
City of Palm Desert, City Manager
City of Palm Springs, City Manager
City of Ridgecrest, Office of the Mayor
City of Victorville, Mayor
Clara Claneaud
Claremont Colleges Libraries
Hon. Steve Clute
Coachella Public Library
Coachella Valley Association of Governments
Coachella Valley Regional Library

Coachella Valley Water District
CoCa Mines, Inc.
Mike Coffeen
Ben Collins
Colorado River Board, Executive Director
Colorado River Indian Tribes
Colorado State University Library
Contra Costa County Library
Bernie Cordero
Ted Cordery
Terri Correll
Marion Coslowsky
Mike Costello
Walter Courtenay, Jr.
County of Imperial, Board of Supervisors
County of Inyo, Board of Supervisors
County of Los Angeles, Dept. of Public Works
County of Riverside, Board of Supervisors
County of San Bernardino
Sen. Alan Cranston
Marie Crawford
Harold Cribbs
George Cropper
Billie & John Crowley
Lt. Col. Martin Crumrine
Culver City Library
Mike Cunningham
Eugene Dahlem
Eb Davis
Pat Davison
Death Valley National Monument
J. Decker
Mary DeDecker
James DeForge
Clifford W. DeGraw
Roger Dehart
Harold DeLisle
David Demars
Desert Bighorn Council
Desert Fishes Council
Desert Hot springs Public Library
Desert Protective Council
Desert Tortoise Council
Desert Tortoise Preserve Committee
Harley Dickensheets
George Divine
Dr. C. K. Dodd. Jr.
Tom Dodson
Linda Dondanville
Ann Dosher
Kent Downey
Anthony Drennan

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Cathy Dull
Fred Dunkley
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Alice Eben
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Norm Edmondson
Gary Edwards
CG, Edwards AFB
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Matthew Etcheverry
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Federation of Western Outdoors Clubs
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Dave Fisher
Mary Ann Fisher
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Forest Supervisor, Angeles National Forest
Forest Supervisor, Cleveland National Forest
Forest Supervisor, Inyo National Forest
Forest Supervisor, San Bernardino National Forest
Forest Supervisor, Sequoia National Forest
Betty & Warren Forgey
Ron Franceschi
Fresno County Free Library
Dr. H. Paul Friesema
Paul Fromer
Richard Fruto
Bob Furlow
Dr. Margaret Fusari
Elton Gallagly
Nora Garcia
Pam Garcia
Dr. Kimball Garrett

Dale Gaskill
Dr. Jack Gaskin
Don and Pat Gay
W.D. Gay
Jean Gaudreau
Jon Gellerstedt
General Telephone Company
Gear Grinder 4WD Club
Duane Georgeson
Susan Geraud
Giannini Foundation of Ag. Econ.
Dr. Whitcomb Gibbons
Derham Giuliani
Victor Gladstone
Rick Gochnaur
Bryan Goebel
George Goemans
Gold Rock Ranch
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Jovad Hada
Tim Hafen
Mark Hagan
William Haigh
Ross Haley
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Rich Hammond
Virginia Handley
Brad Hardenbrook
Cheryl Harrell
Lou Hass
Bill Havert
Nancy Hays
Scott Hazelton
Dr. Bernd Heinrich
Brian Henan
Mary Ann Henry
Brian Henen

John Hermann
David M. Hess
Jurg Heuberger
John Heumann
Rick Hewett
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W. Leon Hunter
Emmet D. Lemon
Huntington Park Library
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Imperial County Library
Installations Division, NREA
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James E. Kennedy
Kern Audubon Society
Kern County Library
Kern County Woolgrowers
Keystone Mining

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Dr. Richard Knight
Dr. Craig & Pam Knowles
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Kathy Kunysz
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Eldon Lee
Emmet Lemon
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Col. George Lewis
Rep. Jerry Lewis
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Living Desert Reserve
Long Beach Public Library
Long Beach State University Library
Los Aventureros
Los Angeles County Library
Los Angeles Public Library
Los Angeles Audubon Society
L.A. Daily News
West Valley Regional Branch, LA Public Library
Dr. Bruce Love
Bevery Lowe
Lucerne Valley Library
Lunar Landyacht Club
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Rick McIntyre
Don McKay
Sean McKeown
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Louis and Mary McKey
Grace McLaughlin
David McMullen
Mechanics Institute Library
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Dan Mello
Joe Mendiburo
Dr. Gary M. Meunier
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Thom Moisi
Mojave River Valley Museum
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Mono County Library
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George Moore
Erin Moran
Marilyn Moran
Morongo Basin Conservation Association
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Mt. San Antonio College Library
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Frank Munoz
Joyce Muraoka
Dr. Allan Muth
Joshua Tree National Monument
Dr. J.P. Myers
Nancy Myers
Steve Nagle
Dr. Ken Nagy
National Audubon Society, Western Region
National Outdoor Coalition
National Parks and Conservation Association
National Park Service, Regional Director

Native American Heritage Commission
Natural Resources Defense Council
Naval Air Facility, El Centro
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William Neil
Nevada Outdoor Recreation Association
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Nancy Nicolai
Dr. Lowell K. Nicolaus
Madeline Nichols
Lori Nicolson
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Office of the Mayor, Brawley
Office of the Mayor, Cathedral City
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Office of the Mayor, El Centro
Office of the Mayor, Needles
Office of the Mayor, Rancho Mirage
Office of the Mayor, Ridgecrest
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Dr. Richard Olendorff
Mayor Richard Oliphant
Sally Olsen-Edge
Glenn Olson
Ontario City Library
Janet Osborn
Gary Overson
Pacific Bell
Pacific Gas and Electric Company
W. Douglas Padley
Palmdale Public Library
Palm Desert Public Library
Palm Springs Library Center
Palm Springs Public Library
Palo Verde Valley District Library
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Harry Pappas
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Charles Peterson
Ina Petokas
Shirley Pettis
Pfizer, Inc.
Phillips Petroleum
Ralph L. Phillips
Al Pfister
Picacho State Recreation Area
Virginia Pockowski
Gail Pollard
Doug Pomeroy
R.G. Pote
Prairie Dogs Motorcycle Club
Michael Prather
Kathleen Pratt
Charles Pregler
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Quail Unlimited, Pine Valley
Quail Unlimited, Riverside
Jim Raley
Robert W. Rasor
Dr. Kurt Rautenstrauch
Dr. Amadeo Rea
Deborah Reames
Clayton Record
Knobby Reedy
George Reffner
Red Rock Canyon State Park
Colin Regall
Linda Reifschneider
Susan L. Reilly
D.A. Rein
Ron Rempel
Dr. J. V. Remsen
Republic Geothermal
Richard L. Reynolds
Riverside Central Library
Riverside Press-Enterprise
Riverside Public Library
Grover Roberts
Merna Roberts
Hon. Don Rogers
Edwin L. Rothfuss
John Ross

Dr. Walter Rosskopff
Dorothy Roton
Glenn Rouse
Richard Rudnick
Robert Ruesnick
Richard H. Russell
Mark Russell
Dr. Colin Ryall
Gary Ryan
Sacramento County Law Library
Sacramento State University Library
San Bernardino Audubon Society
San Bernardino County Farm Bureau
San Bernardino County Library
San Bernardino County Museum
San Bernardino Public Library
San Diego Public Library
San Diego Gem and Mineral Society
San Diego State University Library
Mary B. Saethre
San Francisco Public Library
San Jose State University Library
Andy Sanders
Santa Ana Public Library
Santa Rosa Public Library
Jim St. Amant
Audrey Sayre
James Sayre
Marc Sazaki
Dr. Ed Schafer
Dr. Mel Schamberger
Patricia Schifferle
Dr. R. Schiffman
Ron Schiller
Ron Schlorff
Joyce Schneider
Dr. Cecil Schwalbe
Marlyn Power Scott
Ron Schlorff
John Schmidt
Joyce Schneider
Charles R. Schockey
Eric Scholz
Jack & Annalee Schriber
Susan Icenogle Schultz
John Scull
Debbie Sease
Mildred Seelbach
Paul Selzer
76th Assembly District Office
Brian Sharp
Dr. Bill Shaw

Caryn Shetterly
Shields Library
Tim Shields
Sierra Club, Kern-Kaweah Chapter
Sierra Club, ORV Task Force
Cliff Sime
Fred Simon
James E. Simmons
Scott Simons
Ruth DeEtte Simpson
Kristinn Skarphedinsson
Dr. Virginia Skinner
Ronald Sloan
Sid Slone
Dr. Kurt Snipes
Terry Sopher
Southern California Association of Governments
Southern California Edison Company
Southern California Gas Company
South Coast AQMD
Southwestern Herpetologist's Society
E.O. Spencer
Richard Spotts
Jim St. Amant
Chris St. Clair
Dr. Robert C. Stebbins
Dr. Ver Steed
Dr. Dick Steele
Karen Steenhof
Peter Stine
Dr. Glenn Stewart
Bev Steveson
Peter Stine
Laura Stockton
James Strain
Roger Streeter
Dr. Richard Stroud
Glenn Sudmeier
Jim Sullins
Sun Telegram
John Swanson
Mary Swedelius
Dr. Ian Swingland
Dr. Charles Sylber
Tina Tapia
Dr. Stan Temple
Texaco Petroleum, Inc.
Kathryn Thomas
Donald W. Thompson
Robert Thompson
Ronald Thompson
Mel Thornton

Timbisha Shoshone Tribe
Maj. Michael topper
Torres Martinez Reservation
Tribal Chair, Big Pine Reservation
Tribal Chair, Bishop Reservation
Tribal Chair, Borona Reservation
Tribal Chair, Campo Reservation
Tribal Chair, Cuyapaipe Reservation
Tribal Chair, La Jolla Reservation
Tribal Chair, Lone Pine Reservation
Tribal Chair, Los Coyotes Reservation
Tribal Chair, Manzanita Reservation
Tribal Chair, Mesa Grande Reservation
Tribal Chair, Morongo Reservation
Tribal Chair, Santa Ysabel Reservation
Tribal Chair, Viejas Reservation
Dr. Ron Tronstad
Mary Trotter
Tulare County Free Library
Supervisor Marsha Turaci
Bob Turner
Carolyn Turner
Dr. Fred Turner
Kent Turner
Roger Twitchell
United 4WD Association
United Mining Council
University of Arizona Library
University of California, Davis, Law Library
University of California General Library
University of California, Los Angeles, Research Library
University of California, Riverside, Library
University of California, San Diego, Library
University of California, Santa Barbara, Library
University of California, Santa Cruz, McHenry Library
University of Nevada Library
University of Redlands, Armacost Library
University of San Diego Law Library
University of San Francisco, Richard A. Gleeson Library
University of Santa Clara, Orradre Library
U.S. Borax Corporation
U.S. Geological Survey Library
Mary Van Der Veen
Sara Van Dyck
Charles P. Van Epps
Gordon A. Van Vleck
Tamara Vegas
Ventura County Library
Bob Vernoy
Richard Vogl
Frannie Waid
Johanna Wald

Gilbert Walter
Brian Walton
Richard Ward
Curtis Warrick
Water Quality Control Board, Colorado River Basin
Water Quality Control Board, Lahontan Region
Water Resources Center Archives
Eric Watkins
Jim Watkins
Dr. J.F. Watson
Joe Watson
William Watson
John Wear
Richard Weaver
Dr. Gary Weddle
Robert Wegis
Karl F. Weikel
Dr. Mike Weinstein
Jim Wells
Todd Welch
Michael Weiner
Jay Von Werlhof
West Covina Library
Dan West
West. Found. Vertebrate Zoology
West Hills Community College Library
Burton J. Westman
West Valley Regional Branch Library
Connie Wheeler
Gretchen Whiserand
Dr. Clayton White
Nancy Whitaker
Whittier College, Wardman Library
Wildlife Management Institute
Wildlife Society
Dr. Phillip Wilke
Cathy Williams
Williams Raines Library
H.G. Wilshire
Jay Wilson
Sen. Pete Wilson
Lucille Winnett
Brian Woodbridge
Peter Woodman
Nowell Worthen
Fred Worthley
W. Walton Wright
Leonard S. Young
Martha Young-Wheeler
Hon. Phil Wyman
Carolyn Yale
Vicent Yoder

Yuma Audubon Society
Bruse Zeller
Paul Zucker

VI. REFERENCES

Austin, G.T. 1971. Roadside distribution of the common raven in the Mohave Desert. Calif. Birds 2:98.

Berry, K.H. 1984. The status of the desert tortoise (Gopherus agassizii) in the United States. Rept. to the U.S. Fish and Wildlife Service from the Desert Tortoise Council on Order No. 11310-0083-81. 838 pp.

Berry, K.H. 1985. Avian predation on the desert tortoise (Gopherus agassizii) in California. U.S. Bureau of Land Management, Riverside, California. Rept. to Southern Edison Company, Rosemead, California.

Berry, K.H., and L.L. Nicholson. 1984. A summary of human activities and their impacts on desert tortoise populations and habitat in California. In: K.H. Berry (ed.) The status of the desert tortoise (Gopherus agassizii) in the United States. Rept. to the U.S. Fish and Wildlife Service from the Desert Tortoise Council on Order No. 11310-0083-81. Pp. 61-117.

Berry, K.H., T. Shields, A.P. Woodman, T. Campbell, J. Roberson, K. Bohuski, and A. Karl. 1986a. Changes in desert tortoise populations at four study sites in California. 1986. U.S. Bureau of Land Management, Riverside, California. 39 pp.

Berry, K.H., T. Shields, A.P. Woodman, T. Campbell, J. Roberson, K. Bohuski, and A. Karl. 1986b. Changes in desert tortoise populations at the Desert Tortoise Research Natural Area between 1979 and 1985. U.S. Bureau of Land Management, Riverside, California. 46 pp.

Berry, K.H., A.P. Woodman, K. Bohuski, and T. Shields. 1987. Changes in tortoise populations in the Lucerne, Johnson, and Ivanpah Valleys of California between 1979-80 and 1986. Paper presented at the 1987 Desert Tortoise Council Symposium, Las Vegas, Nevada, for the U.S. Bureau of Land Management, Riverside, California.

Campbell, T. 1983. Some natural history observations of desert tortoises and other species on and near the Desert Tortoise Natural Area, Kern County, California. In: M. Trotter (ed.), Proc. Desert Tortoise Council Symp. 1983:80-88.

Engel, K.A. and L.S. Young. 1989. Evaluation of techniques for capturing common ravens in southwestern Idaho. N. Amer. Bird Bander Jan-Mar 1989:5-8.

Farrell, J.P. 1989. Natural history observations of raven behavior and predation on desert tortoises. Draft of paper presented at the 1989 Desert Tortoise Council Symposium, Las Vegas, NV. 16 pp.

Hester, A.E. 1963. A plastic wing tag for individual identification of passerine birds. Bird Banding 34:213-217.

Johnson, D.H., M.D. Bryant, and A.H. Miller. 1948. Vertebrate animals of the Providence Mountains of California. Univ. Calif. Publ. Zool. 48:221-376.

Karl, A.E. 1988. Results of investigations of the desert tortoise at the California Department of Health Services proposed low-level radioactive waste facility site in Ward Valley, California. Rept. to U.S. Ecology, Newport Beach, California, and Ecological Research Services, Claremont, California.

Knowles, C., R. Gumtow, P. Knowles, and P. Houghton. 1989. Relative abundance and distribution of the common raven in the deserts of southern California during fall and winter 1988. Draft final report. Prepared for the Bureau of Land Management, California Desert District Office, Riverside, California, under Contract No. CA-950-CT8-56. 44 pp.

Lofts, B., R.K. Murton, and J.P. Thearle. 1968. The effects of 22,25-diazacholesterol dihydrochloride on the pigeon testis and on reproductive behavior. Jour. Reprod. Fert. 1968(5):145-148.

Miller, L. 1932. Notes on the desert tortoise (Testudo agassizii). San Diego Soc. Nat. Hist. 7:187-207.

Nicolaus, L.K. and D. Nellis. 1987. The first evaluation of the use of conditioned taste aversion to control predation by mongooses upon eggs. App. Beh. Animal Sci. 1987(17):329-346.

Nicolaus, L.K., J. Herrera, J.C. Nicolaus, C.R. Dimmick. 1989. Carbachol as a conditioned taste aversion agent to control avian depredation. Agri. Eco. and Envir. 1989(26):13-21.

Rado, T. 1989. Results of the pilot raven control program conducted at pre-selected sites in the California Desert Conservation Area, 1989. Preliminary Draft. Prepared by the U.S. Dept. of Interior, Bureau of Land Management, California Desert District Office, Riverside, California. 42 pp.

Robbins, C.S., D. Bystrak, and P.H. Geissler. 1986. The breeding bird survey: its first fifteen years, 1965-1979. U.S. Fish and Wildlife Service, Washington, D.C. Resource Publ. 157.

Sturtevant, J. 1970. Pigeon control by chemosterilization: population model from laboratory results. Science 170:322-324.

U.S. Dept. of Interior, Bureau of Land Management. 1980a. The California Desert Conservation Area Plan. Bureau of Land Management, California Desert District Office, Riverside, California. 173 pp.

U.S. Dept. of Interior, Bureau of Land Management. 1980b. Final environmental impact statement and proposed plan, California Desert Conservation Area. Bureau of Land Management, California Desert District Office, Riverside, California.

U.S. Dept. of Interior, Bureau of Land Management. 1988. A Sikes Act management plan for the Desert Tortoise Research Natural Area and Area of Critical Environmental Concern. Prepared jointly by the Bureau of Land Management and California Department of Fish and Game. 43 pp. + append.

U.S. Dept. of Interior, Bureau of Land Management. 1989a. Supplemental environmental assessment for selected control of the common raven to reduce desert tortoise predation in the Mojave Desert, California. May 1989. Bureau of Land Management, California Desert District, Riverside, California. 6 pp.

U.S. Dept. of Interior, Bureau of Land Management. 1989b. Environmental assessment for selected control of the common raven to reduce desert tortoise predation in the Mojave Desert, California. Jointly prepared by the Bureau of Land Management, U.S. Fish and Wildlife Service, and California Department of Fish and Game. 33 pp.

U.S. Dept. of Interior, Fish and Wildlife Service. 1986. Final environmental assessment: alternatives to enhance the production of greater sandhill cranes on Malheur National Wildlife Refuge, Oregon. 78 pp. + Append.

Woodman, A.P. and S.M. Juarez. 1988. Juvenile desert tortoises utilized as primary prey of nesting common ravens near Kramer, California. Paper presented at the 13th Annual Meeting and Symposium of the Desert Tortoise Council held March 26-27, 1988, Laughlin, Nevada.

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VIII. APPENDICES

Appendix A -Tables

Table 1. Management actions, cooperating agencies, and time frames for initiation under the Proposed Action Alternative (Source: BLM 1990).

Action	Agencies	Date(s)
	Research	
Inventory California deserts for raven nesting and roosting sites	BLM, FWS, CDFG*	1991-92
Determine methodologies for censusing and monitoring raven populations	FWS, CDFG, BLM	1990-91
Determine foraging and feeding behaviors of ravens	CDFG, FWS, BLM	1991-92
Determine seasonal movements and site fidelity of ravens	CDFG, FWS, BLM	1991-92
Conduct regional inventories to locate sites of raven predation on tortoises	BLM, FWS, CDFG, DOD, NPS	1990-91
Collect information on tortoise recruitment rates in raven habitats	BLM, CDFG, FWS,	Continuous
	Nonlethal Control	
Limit raven food sources from roadkills	Caltrans, FWHA, CDFG, BLM, FWS	Begin 1990
Modify landfill practices	Counties, Cities, SWMB, BLM	Begin 1990
Modify sewage containment practices	Counties, Cities, RWCB, BLM	Begin 1990
Modify raven use of landfills and sewage ponds by behavioral disruption techniques	Counties, Cities, SWMB, RWCB, CDFG, BLM	Begin 1991

Table 1. Continued

Action	Agencies	Date(s)
Modify raven perches and roosts	BLM, CDFG, DOD, FWS, ADC	Begin 1990
Selectively destroy raven nests	ADC, BLM, FWS, CDFG, DOD	Begin 1991
Reduce raven nesting success by egg addling	ADC, BLM, FWS, CDFG, DOD	Begin 1991
Sterilize nesting ravens in areas of high tortoise predation	ADC, FWS, CDFG,	Begin 1991
Reduce raven predation rates on tortoises by conditioned taste aversion	ADC, FWS, BLM, CDFG, DOD	Begin 1991
Live-trap and remove ravens for release outside of tortoise areas	ADC, CDFG, FWS, BLM, DOD	Begin 1991
<u>Lethal Control</u>		
Selectively shoot ravens in areas of high tortoise predation	ADC, BLM, CDFG, FWS, DOD	Begin 1991
Selectively kill ravens by poisoning	ADC, BLM, CDFG, FWS, DOD	Begin 1991
Live-trap and kill ravens in areas of excessive tortoise predation	ADC, FWS, CDFG, BLM, DOD	Begin 1993
<u>Administrative Actions</u>		
Establish interagency workgroup to oversee management direction	BLM, FWS, CDFG, DOD, ADC, Counties	1990
Develop implementing agreement to ensure agency commitments	BLM, FWS, CDFG	1991
Modify management measures as determined by additional data/ monitoring	All of above (BLM lead)	Begin 1990

*First agency listed has "lead" for particular project
BLM = U.S. Bureau of Land Management
FWS = U.S. Fish and Wildlife Service
DOD = U.S. Department of Defense (includes the Marine Corps Air Ground Combat training Center and Air Force Test Flight Center)
ADC = U.S. Dept. of Agriculture, Animal Damage Control
NPS = U.S. National Park Service
FHWA = Federal Highways Administration
CDFG = California Department of Fish and Game
SWMB = Solid Waste Management Board
RWCB = Regional Water Quality Control Board
Caltrans = California Dept. of Transportation
Counties = Includes San Bernardino, Los Angeles, Kern, Inyo, and Riverside
Cities = Includes Boron, Apple Valley, Ridgecrest, Landers, Victorville, Twentynine Palms, Baker, Mojave, California City, and Desert Center

Table 2. Toxicity of Starlicide to various species of wildlife*

Species	Approximate lethal oral dose (50% of treated animals, mg/kg)
Amphibians	
Frog	225**
Reptiles	
Turtle	1,040**
Birds	
Blue-winged Teal	31.6
Starling	3.8
Redwinged Blackbird	1.8-3.2
Mourning Dove	5.6-10.0
Rock Dove	17.7
Ground Dove	4.2
White-winged Dove	4.2
Golden Eagle	100
American Kestrel	320
Cooper's Hawk	320-1,000
Northern Harrier	100
Red-tailed Hawk	320
California Quail	10
Common Raven	13.5
American Crow	1.33
White-crowned Sparrow	320
House Sparrow	320-448
Curve-billed Thrasher	3.2
Barn Owl	4.2
Mammals	
Cow	10 (no kill)
Coyote	100
Dog	100 (no kill)
Dog	71
Laboratory Mice	2,000
Deer Mouse	1,800
Grey Squirrel	280
Sheep	1 animal harmed at 200; 1 animal killed at 400

* (Sources: Shafer, 1984; Environmental Protection Agency data; Denver Wildlife Research Center data).
** Dose not administered orally

Table 3. Raven observations at active landfills in the California deserts during 1989*

Site	Total Number Ravens Observed	Maximum Count Birds/Visit	Frequency of Refuse Burial
Ridgecrest	444	82	Daily
Randsburg	31	15	Transfer Stat.
Boron	427	150	Daily
Hinkley	15	7	Daily
Yermo	115	74	Weekly
Newberry Springs	203	67	Weekly
Barstow	113	27	Daily
Apple Valley	950	200	Daily
Victorville	816	250	Daily
Camp Rock	278	66	Weekly
Landers	208	45	Daily
29 Palms	220	76	Daily
USMC 29 Palms Base	752-827	150	Daily
Baker	444	130	Weekly
Nipton	71	24	Periodic
Kelso	17	9	Periodic
Searchlight	71	28	Periodic
Needles	99	26	Daily
Goffs	54	30	Periodic
Essex	71	28	Never
Amboy	1	1	Periodic
Vidal Junction	11	4	Periodic
Desert Center	225	35	Weekly
Blythe	3	2	Daily
Palo Verde	0	0	Never
Indio	123	41	Daily

*(Source: Knowles et al. 1989; BLM data 1989)
**Raven numbers for the USMC 29 Palms Base landfill were derived over 14 days of monitoring between April 18, 1989 and August 16, 1989.

Table 4. Raven Counts during 1989 at sewage treatment sites in the California deserts*

Site	Total Number Ravens Observed	Maximum Count Birds/Visit
California City	5	2
Inyokern	76	20
Ridgecrest	249	43
Federal Prison	4	2
East Boron	153	36
West Boron	4	2
Barstow	8	2
Yermo USMC Base	2	2
Yermo Union Pacific RR	3	3
Silver Lakes	0	0
Victorville	6	3
Baker	181	47
Needles	3	3
Park Moabi	0	0
Blythe	0	0
Cactus City	3	2
Indio	0	0

*(Source: Knowles et al. 1989).

Table 5. Roadside distribution of ravens in the eastern Mojave Desert in the late 1960's compared to the late 1980's*

Type of Road Season	No. Ravens	No. Miles	No. Ravens/ 100 Miles
	1967-1969		
Highways			
Nov-Feb	38	1125	3.38
Mar-Apr	13	862	1.51
May-Aug	11	1463	0.75
Sep-Oct	17	870	1.95
Totals	79	4320	1.83
Secondary Roads			
Totals	9	1132	0.79
	1988-1989		
Highways			
Nov-Feb	674	5603	12.0
Secondary Roads			
Nov-Feb	85	1517	5.6
May-Aug	154	2215	6.95

* Sources: Austin (1971); Farrell (1989)

Table 6. Results of road surveys conducted for ravens along ten route transects in the California deserts during the winter of 1988-1989*

Region/ Route	% Raven Observations		% Route		Ravens/100 miles	
	Paved	Dirt	Paved	Dirt	Paved	Dirt
			West Mojave			
1	96	4	77	23	34	5
2	84	16	71	29	34	16
3	96	4	92	8	43	20
4	32	68	68	32	15	71
			Ivanpah Valley			
5	90	10	44	66	43	4
6	87	13	68	32	8	3
			Fenner-Chemehuevi			
7	78	22	65	35	3	2
8	77	23	54	46	5	2
			Southern Colorado			
9	100	0	56	44	2	0
10	91	9	60	40	7	1

*(Source: Knowles et al. 1989).

Table 7. Summary of east Mojave and northern Colorado Desert surveys conducted by BLM staff (Source: Montgomery and Hughes data).

Route Type	Ravens Observed	Miles Driven	Ravens/ 100 Miles
Freeway	194	3758	5.2
County Paved	180	1868	9.6
County Unpaved	44	1244	3.5
State Highway	197	3659	5.3
Dirt	188	912	20.6
Powerlines	37	597	6.1

Table 8. Numbers of ravens observed per 100 survey hours on permanent desert tortoise study plots between 1983 and 1988, and during pilot raven control program monitoring during 1989*

Region	Year	Total No. Ravens Seen/Mo. March	April	May	June	Number Ravens/ 100 hours
Western Mojave Desert						
Fremont Valley	1987	16	33	6	n.d.	14.76
Desert Tortoise Natural Area	1988	n.d.	99	90	n.d.	45.32
	1989	n.d.	3	22	0	14
Kramer Hills	1988	35	96	66	n.d.	41.04
Stoddard Valley	1988	n.d.	26	91	n.d.	28.92
Eastern Mojave Desert						
Shadow Valley	1988	n.d.	45	15	3	20.81
Goffs	1983	n.d.	3	19	4	3.32
	1984	n.d.	7	0	2	1.5
	1985	n.d.	0	3	0	0.76
	1986	n.d.	11	9	2	3.9
Colorado Desert						
Ward Valley	1987	n.d.	14	22	0	8.73
Chemehuevi Valley	1988	9	12	n.d.	n.d.	3.32
Chuckwalla Valley	1987	n.d.	0	2	0	0.41
Chuckwalla Bench	1988	9	21	5	0	6.01

n.d. = no data collected for that month
*(Sources: Berry, BLM data).

Table 9. Numbers of small tortoises (<110 mm carapace length) deaths attributed to common ravens on 15 desert tortoise study plots in California*

Desert Region Site Name	Years	Numbers of Deaths Raven Kills	Other	% due to Raven Kills
Western Mojave Desert				
Fremont Valley	1976-81	11	26	29.7
	1987	2	11	15.4
Desert Tortoise Natural Area	1978-82	73	19	79.4
Desert Tortoise Nat. Area Int. Ctr.	1985	16	24	40.0
Fremont Peak	1977-79	2	5	
	1980-85	1	0	
Kramer	1980-82	9	11	45.0
	1987	44	50	46.8
Calico	1978	1	0	
Stoddard Valley	1978-81	14	15	48.3
Lucerne Valley	1980	4	2	
	1986	9	16	36.0
Johnson Valley	1980	8	9	47.1
	TOTAL	**198**	**202**	**49.5**
Eastern Mojave Desert				
Ivanpah Valley	1977-79	3	10	14.3
	1986	1	14	
Goffs	1977-80	2	5	
	TOTAL	**6**	**29**	**17.1**

Table 9. Continued

Desert Region Site Name	Years	Numbers of Deaths Raven Kills	Other	% due to Raven Kills
Colorado Desert				
Ward Valley	1980	1	2	
	1987	5	27	17.1
Chemehuevi Valley	1977-82	1	35	2.8
Chuckwalla Bench	1977-82	13	34	27.6
Chuckwalla Valley	1980	0	4	
	1987	0	13	
	TOTAL	**20**	**115**	**14.8**

(Sources: Berry 1985; Berry et al. 1986a, 1986b, 1987)

Table 10. Changes in size-age class composition of desert tortoises at five permanent study sites in the western Mojave Desert between the 1970's and the present*

Study Site	Year	Frequency of Size-Age Class (%) Juvenile/Immature 1	Subadult/Adult
Fremont Valley	1981	30.0	52.2
	1987	22.3	64.5
Desert Tortoise Natural Area	1979	15.3	73.1
	1988	6.2	87.7
Desert Tortoise Nat. Area Interp. Ctr.	1979	18.6	67.6
	1985	13.5	80.6
Fremont Peak	1977	21.9	53.1
	1985	8.1	89.2
Kramer Hills	1982	38.9	51.4
	1987	17.5	65.1

*Sources: Berry et al. 1986a, 1986b, 1987, 1988)

Appendix B - Glossary

ABUNDANCE:	The relative numbers of an organism compared to all organisms within a specified area or sample, usually expressed as a percent.
ADAPTIVE STRATEGY:	Means by which organisms survive in an often harsh environment. Adaptive strategies can include behavioral patterns to avoid especially harsh conditions, or adaptations in form or physiology to cope with the environment.
ADDLING:	Shaking of eggs in an attempt to destroy embryos, and returning eggs to the nest in an attempt to confuse parent birds.
ANTI-PERCH WIRE:	Wires of differing designs specifically developed to deter perching by birds. Usually affixed to an object frequently used as a perch site.
BASELINE STUDIES:	Studies designed to document conditions at a certain time against which monitoring studies will later be compared.
CACHE:	To collect and store for future use.
CANDIDATE SPECIES:	A plant or animals species currently under review by the U.S. Fish and Wildlife Service for possible future listing as threatened or endangered.
CARAPACE:	The dorsal, or upper, portion of the shell of a tortoise.
CDCA:	The 25-million acre area of southeastern California that includes portions of the Mojave, Colorado, and Sonoran Deserts.
CLASS:	A grouping system devised for analyzing desert tortoise trend data. Desert tortoises are subdivided into six classes denoting age based on differences in carapace length.
COHORT:	A grouping system devised for analyzing desert tortoise trend data. Each year-class of desert tortoises is a "cohort".

CONDITIONED TASTE AVERSION:	Modifying feeding behavior by feeding look-alike baits laced with bad-tasting compounds.
CUMULATIVE IMPACT:	The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or persons undertake such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
DTNA:	The Desert Tortoise Research Natural Area, encompassing approximately 35 square miles of lands in the western Mojave Desert. Specifically designated and managed for the protection of the desert tortoise by BLM.
ECOLOGY:	The study of the relationship of organisms to their environment.
FREQUENCY:	The number of times an organism is encountered during sampling, often expressed as a percent.
ENDANGERED:	Any animal or plant species in danger of extinction throughout all or a significant portion of its range. Such species are protected under either one or both California and Federal endangered species acts.
HAZING:	Techniques used to disrupt the behavior patterns of pest species. Often employs noise-producing devices such as cannons, explosives, or gun discharges.
HISTOGRAM:	A graph of a frequency distribution, used to clearly show statistical variation.
INTAGLIO:	Artistic design rendered on the earth's surface, usually by removal of dark-colored desert pavement gravels to expose underlying lighter soils. Also known as a "geoglyph".

MESIC:	An environment containing a "balanced" supply of moisture.
PESTICIDE USE PROPOSAL:	Written proposal for use of a pesticide on Public Lands administered by BLM. Must receive the approval from the BLM Washington Office prior to application.
PETROGLYPH:	Prehistoric rock art, usually consisting of a figure or geometric design scratched or pecked into the surface of a rock face or boulder.
PILOT PROGRAM:	Limited raven control program implemented during 1989 in pre-selected portions of the CDCA.
PREDATION:	The capture, killing, and feeding on one animal by another.
RAVEN:	The common raven (Corvus corax).
RARE:	A generic term for species of limited distribution and/or abundance.
RECRUITMENT:	A term used in biology to denote the ability of juvenile animals in a given population to survive to maturity.
SCAVENGE:	To locate and feed on a dead animal.
SENSITIVE:	A BLM designation for species that require special management attention in order to prevent them from being federally listed as threatened or endangered. It includes State-listed species and Federal candidate species.
SITE FIDELITY:	The tenacity with which an animal remains at or continually returns to a particular site. Ex. Repeated nesting at the same site over a several year period by the same birds.
SITE-SPECIFIC:	An action planned for a particular location or locations; not used to denote general implementation over a widespread area.

STARLICIDE:	DRC-1339, or 3-chloro-p-toluidine hydrochloride. Developed by the U.S. Fish and Wildlife Service to control "pest" bird species. A poison, which kills in 2-3 days after ingestion by kidney failure or Central Nervous System depression. Extremely toxic to a narrow range of species.
STERILIZATION:	To destroy the ability of an organism to reproduce. In the instance of raven control, compounds utilized result in a temporary impairment of this ability.
STUDY PLOT:	A carefully selected and regularly monitored plot in the CDCA. Typically one square mile in size, there are 15 study plots in the CDCA specifically established to monitor desert tortoise population trends. Information is collected using standarized procedures that allow for comparisons with prior data.
THREATENED:	A plant or animal species threatened with becoming endangered. Such species are protected under either one or both California and Federal endangered species acts.
TRANSECT:	A sample of predetermined size and quality (usually linear) of a habitat or system.
URBANIZATION:	The expansion of cities, villages, or towns, including associated road, utility line, and pipeline networks, into previously undeveloped areas.
WEIR:	Fish traps constructed along the shoreline of standing bodies of water; often "V"-shaped or "U"-shaped with the "wings" ending above the high water mark. Constructed of rock or wood.
XERIC:	A dry environment, such as a desert.

Appendix C
List of Acronyms

ACEC	Area of Critical Environmental Concern
ADC	Department of Agriculture, Animal Damage Control
BLM	Bureau of Land Management
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
DEIS	Draft Environmental Impact Statement
DOD	Department of Defense (Includes both Marine Corps Air Ground Combat Training Center and the Air Force Flight Test Center)
DTNA	Desert Tortoise Research Natural Area
EA	Environmental Assessment
EIS	Environmental Impact Statement
FWS	Fish and Wildlife Service
FWHA	Federal Highways Administration
HSUS	Humane Society of the United States
KG	Kilograms (metric measurement)
MG	Milligrams (metric measurement)
NEPA	National Environmental Policy Act
NPS	National Park Service
PL	Public Law
PUP	Pesticide Use Proposal
RWCB	Regional Water Quality Control Board
SWMB	Solid Waste Management Board
US	United States
USMC	United States Marine Corps

Appendix D
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