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DEVELOPING A STRATEGY OF PREDATOR CONTROL FOR THE PROTECTION OF THE CALIFORNIA LEAST TERN: A CASE HISTORY

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ABSTRACT: In recent years, predation has been determined to be a seriously limiting factor in the reproduction of the endangered California least tern (*Sterna antillarum browni*) at many of its nesting colonies. Among them is a major colony at Camp Pendleton Marine Corps Base near Oceanside, CA. Early efforts to control predation were limited in effectiveness. In 1988, the U.S. Department of Agriculture, Animal Damage Control Program was contracted to provide control of mammalian and avian predators. The development of the successful strategy that has evolved over four years is discussed, with emphasis on the development and application of techniques, and the timing and areas of control.

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INTRODUCTION

Predation has been seen by some in recent years as a significant limiting factor in the recovery of endangered species and as a result predator control has been undertaken to benefit several endangered species (Butchko 1990). One of these is the California least tern which is a seasonal resident of California where it traditionally nests in colonies on the coastal estuaries and beaches. While much of its preferred nesting habitat has been lost to development, approximately 35 colonies remain, most of which are controlled by public agencies. One of the largest and most important is in northern San Diego County at Camp Pendleton Marine Corps Base. The Base Environmental and Natural Resources Management Office (ENRMO) has conducted a comprehensive least tern protection program including habitat restoration, habitat protection and monitoring, which revealed that both avian and mammalian predators frequently limited reproduction. Such was the case in 1987, when predators - primarily coyotes - destroyed approximately 106 of 234 nests, resulting in the production of only 65 fledglings (Keane 1989). Early control efforts, including fencing and occasional shooting, were limited in effectiveness (C. Winchell, pers. comm.). Consequently, the U.S. Department of Agriculture, Animal Damage Control Program (ADC) was contracted by the U. S. Navy to provide predator control for the 1988 nesting season. The program was coordinated with the ENRMO and conducted with Section 7 approval by the U. S. Fish and Wildlife Service (Kaufman 1988).

This paper documents the development and results of the predator control strategy in 1988 through 1991. It is offered as a case history which may be useful to resource managers as they plan a predator control program for a wildlife resource of their concern.

LOCATION

There are actually two tern colonies on Camp Pendleton but for the purposes of this paper, discussion will focus on the colony within the Santa Margarita River estuary. The estuary is an area of approximately 400 acres consisting of sandy dunes, tidal flats and salt marsh habitat. The dominant vegetation of the estuary is pickleweed (*Salicornia virginica*) while the beach was dominated by sea-rocket (*Cakile maritima*).

The Santa Margarita colony consists of three sites: North Beach, Salt Flats and Salt Hats Island. The North Beach site

is the largest—approximately 30 acres—with approximately 80% of the 200+ nests occurring there in recent years (D. Boyer, pers. comm.). It is bounded by an extensive, solar-powered electric fence. The Salt Flats and Salt Flats Island are unfenced and are used by approximately 20% of the terns. Areas adjacent to the estuary include a recreational beach, military facilities, agricultural fields, riparian vegetation, upland vegetation and a freeway/railroad corridor. The estuary itself is off limits to people but the surrounding areas have considerable military and civilian activity. The only people, other than ENRMO personnel, authorized to enter the colony itself were those individuals under contract to monitor the tern nesting. ADC investigated predation signs within the colony when notified by the contract monitors.

1988 PROGRAM

Analysis

An analysis of the site and the terns revealed the following factors as significant in developing a strategy:

- 1) Due to the endangered status of the terns, the ENRMO considered the protection of the terns from predators the highest priority.
- 2) Many potential predators were known to be in or near the estuary, including coyotes (*Canis latrans*), raccoon (*Procyon lotor*), opossum (*Didelphis virginianus*), striped skunk (*Mephitis mephitis*), ground squirrel (*Spermophilus beecheyi*), raven (*Corvus corax*), crow (*Corvus brachyrhynchos*), kestrel (*Falco sparverius*), and loggerhead shrike (*Lanius ludovicianus*). Based on previous observations of predation at the Santa Margarita colony, it was expected that the most serious threat to the terns were coyotes, kestrels, shrikes and ravens.
- 3) The electric fence around the North Beach site, while necessary, was not 100% reliable in excluding mammalian predators.
- 4) The regular presence of predators in or near the nesting sites can deter site selection or result in nest abandonment through harassment.
- 5) Even one predatory episode can result in extensive losses. This was illustrated in 1987 when coyotes caused severe nest destruction, most of which occurred in three nights (C. Winchell, pers. comm.).

Goal

As a result of this analysis, it was mutually agreed that the goal of the program was to make the colony free of all known and potential predators during the tern nesting season.

Strategy

The following elements were selected to effect the strategy necessary to accomplish the goal:

1) The timing of control efforts would be phased in to coincide with tern breeding stages. Because mammals can disrupt adult terns during site selection and nest construction, mammalian control began prior to the anticipated tern arrival. Because ravens can disrupt nesting activities, ravens were controlled when nest selection began. Because kestrels and shrikes are most threatening to tern chicks, control of these species was initiated just prior to tern hatching.

2) Control methods would include steel leghold traps, cage traps, shooting, gas cartridges (for ground squirrels), raptor trap (Channing and Bal-chatri) and DRC-1339. DRC-1339 was used to control ravens and crows, under a state research authorization, by injecting 1 milliliter of a 10% solution into hard-boiled chicken eggs. The baited eggs were delivered to ravens and crows on the ground near the estuary after acceptance of untreated eggs. A minor modification was made in the use of steel traps near the colony. Tension devices, routinely used elsewhere to eliminate smaller, non-target animals, were not used in order to catch all predators in close proximity to the nesting colony. Control efforts were conducted seven days a week.

3) Control efforts would be conducted not only in the colony but also in a buffer zone surrounding the colony. This was accomplished by beginning control efforts within 50 yards of the tern colony. As these control efforts were successful in removing predators, control efforts were expanded outward in an effort to prevent predators from entering the colony. In an effort to remove the coyotes, the most mobile and threatening mammalian predator, this perimeter was extended to a distance of approximately 1 mile. There were many (at least seven) mated pairs of coyotes coming into the estuary from surrounding areas to forage in the estuary. To make avian control more selective, ADC extensively monitored their presence and movements in areas adjacent to the estuary. Once avian predators entered the estuary they were the object of control efforts.

4) A system of communication between tern monitors and ADC personnel was critical. Because only monitors routinely entered the tern colony itself, they were most likely to observe or suspect predation which would be information vital to ADC personnel. However, since both monitors and ADC personnel had irregular schedules, face-to-face communication was very unpredictable. To facilitate this communication, a log book was kept at the estuary for both parties to record and receive pertinent information regarding predators or nesting activities.

Results

The 1988 tern nesting results were outstanding. An estimated 246 pairs fledged an estimated 365-409 birds. This was by far the most productive colony in the state in 1988 (Massey 1988) and the most productive the Santa Margarita colony had been in many years (Keane 1989). Virtually no

nests or birds were lost to predators. The ENRMO attributes the successful season primarily to the effective predator control program (C. Winchell, pers. comm.).

1989 PROGRAM

Strategy

In 1989, the predator control program for the protection of the least terns was resumed with the same elements as the 1988 program with the following exceptions:

1) DRC-1339 treated hard-boiled chicken eggs were again used to control corvids. However, instead of presenting the eggs on the ground, the eggs were placed on elevated platforms and secured to the platform with a wire. This was done to eliminate the caching of eggs by ravens, which was observed in 1988, and to reduce the hazard to non-target animals.

2) Raptor control efforts were expanded. Shooting, Channing traps and Bal-chatri traps were often effective but there were many cases, such as with owls, when they were neither effective and/or feasible. Therefore, an adaptation of a pole trap was developed and found to be quite effective. It involved affixing a small (1 inch) elevated perch to the pan of a small (#0 or 1/2) padded jaw steel trap. The trap was mounted on a post or sections of aluminum conduit with a wire for the trap to slide to the ground when it was sprung. The pole trap assembly was built so as to be easily portable and was used almost continually once terns began hatching.

The threat of raptor depredation increased with the recognition that Northern harriers (*Circus cyaneus*) were preying on terns. A harrier, shot while inside the North Beach site, revealed upon examination that it had consumed five embryos - three tern and two snowy plover embryos - in ten minutes.

3) Control efforts, in one instance, were begun after predation was occurring. As a result of a misunderstanding, control of ground squirrels was delayed until significant egg predation was occurring at North Beach. Upon discovery of this, control of ground squirrels was attempted with shooting, gas cartridges, conibear traps and steel traps. It took approximately 14 days of control until egg losses were halted. By this time approximately 50 nests were destroyed. The ground squirrel predation, in combination with severe harrier predation, seemed to reduce the vigor of the terns defensive mobbing and perhaps increased nest abandonment.

Results

The 1989 tern nesting results were significantly reduced from 1988. An estimated 163 nests producing only 67 fledglings (Massey 1989). The primary reason for this was considered to be that ground squirrel and harrier control was done reactively rather than proactively.

1990 AND 1991 PROGRAM

Strategy

The predator control program for the protection of the least terns was resumed with the elements as in previous years with the following modifications:

1) Reduction in pole trap use. In 1990, in an instance that was considered virtually impossible, a tern landed on and was caught in a pole trap. The incident was immediately reported to the Fish and Wildlife Service and the consensus was that the bird should be released on site. To further mini-

mize the unlikely event of this reoccurring, no pole traps are set when monitors enter the colony, which causes significant numbers of terns to become airborne. Gradually, pole traps were generally limited to nighttime use after owls were observed predated on terns or other shorebirds within the estuary. This was feasible only because ADC personnel and contract monitors were able to provide extensive surveillance of the estuary.

2) Increased use of nonlethal methods on harriers. Northern harriers, while common elsewhere in California, are uncommon breeders in coastal Southern California and are becoming a species of special concern. Efforts are now made to disrupt harrier nesting efforts, which seems to divert their attention from the tern colony, before lethal control of the adults is attempted.

3) Increased use of relocation of target animals. Because of the large size of Camp Pendleton, it affords unusual opportunities to relocate animals within the property boundaries. At the request of ENRMO, this option was occasionally used, particularly for barn owls and bobcats. The fate of the relocated animals is unknown but their return to the tern colony has not been documented.

4) Reduce lethal control of ravens. The Navy has contracted with the Denver Wildlife Research Center to study raven behavior and taste aversives as it pertains to deterring predation upon terns. To accommodate the research, ravens were only controlled when they foraged in a colony.

Results - Tern nesting was very successful. In 1990, 293 pairs fledged and an estimated 275 - 335 birds (Belluomini 1991a). In 1991, 328 pairs fledged an estimated 377 birds, which was the highest ever recorded at Camp Pendleton (Belluomini 1991b). While many factors contributed to this success, the reduction of predation is considered to be a major factor (D. Boyer pers. comm.).

DISCUSSION

California ADC personnel had not been involved in any operational program protecting endangered birds, such as the least tern, until 1988. After four years, we believe we have developed a strategy that is effective if thoroughly applied. Two principles for effective predator control can be summarized from this case history:

1) Effective predator control must be of sufficient scale and intensity. Buffer zones and the removal of all known and potential predators ought to be considered.

2) Effective predator control must be implemented prior to the onset of predation. This was clearly proven in the inadvertent delay in the control of ground squirrels in 1989.

Obviously, there are other factors that pertain to the for-

mation of a successful predator control program. However, wildlife managers unfamiliar with predator control would be inclined to violate these principles by underestimating predator control requirements. Wildlife managers may tend to unwisely restrict the scale and intensity of control or delay control efforts in order to minimize the number of predators removed. Such restrictions or delays reduce the margin of safety and increase the risk of predation to the resource, which is ill-advised, if the resource is truly deserving of protection.

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