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Predator Management Techniques Used for the Recovery of Listed Shorebird Species

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ABSTRACT: Nest predation is pervasive and debatably the most vital factor limiting avian productivity. Studies have shown that avian and mammalian predator control programs for the protection of shorebirds have been successful in increasing overall nesting success. Our work focused on the management of both native and non-native predator populations at Naval Base Coronado (NBC) in an effort to minimize predation pressure upon the California least tern and western snowy plover populations during the breeding season. We had a total of 580 tern and plover egg and non-egg predation events on NBC between 2012 and 2015. Predation by corvids was responsible for 63% of total predations, raptors 24%, mammals 7%, and other animals 6%. We captured 60% ($n = 93$) of the corvids with modified goshawk traps and 90% ($n = 17$) of the raptors with Bal-chatri traps. Our predator management program focused on the control of corvids, rather than mammals and raptors, as corvids were historically responsible for the greatest loss of tern nests compared to other taxa. We used a variety of trapping and hunting techniques over the years and, through trial and error, have enhanced our removal success and overall predator management program on Naval Base Coronado.

KEY WORDS: American crow, California least tern, *Charadrius nivosus nivosus*, common raven, *Corvus brachyrhynchos*, *Corvus corax*, nest predation, predator management, relocation, shooting, *Sternula antillarum browni*, taste aversion, trapping, western snowy plover

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INTRODUCTION

Predator abundance in shorebird nesting sites can lead to a significant decline in annual reproductive success of listed species and is believed to be the primary cause of nest failure for most birds (Page et al. 1983, Martin 1992, Rangen et al. 2000, Powell 2001, Smith et al. 2007, Pauliny et al. 2008, National Audubon Society 2011, Manley and Garcelon 2015). Mammalian predators such as feral cats (*Felis catus*) and black rats (*Rattus rattus*) have been linked to the decline and extinction of a variety of native birds, reptiles, small mammals, and invertebrates around the world (Merton 1977, Atkinson 1985, King 1985, Burbridge and Manly 2002, Garcia et al. 2002, Mitchell et al. 2002, American Bird Conservancy 2004). Avian predators such as raptors and corvids can be detrimental to bird populations during the breeding season. Corvids are efficient nest predators and the frequency of corvids preying upon the eggs of other birds can significantly impact the reproductive success of avian species, especially ground nesting species (Shields and Parnell 1986, Massey and Fancher 1989, Avery and Decker 1993, Luginbuhl et al. 2001, Pauliny et al. 2008).

Past studies have shown that predator management programs have been successful in increasing the hatching success and fledging success of federally listed species of shorebirds (Neuman et al. 2004, Smith et al. 2010). The California least tern (*Sternula antillarum browni*; CLTE) is a federally endangered colonial beach-nesting species with a distribution ranging from Baja California up to the San Francisco Bay along the Pacific Coast (Garcia and Ceballos 1995). Western snowy plovers (*Charadrius nivosus nivosus*; WSPL) are federally threatened and occupy sparsely vegetated to unvegetated shorelines of the Pacific Coast. Their range extends from Baja, Mexico north to southwestern Washington, USA (Page et al. 2009, Copper and Squires 2011, Thomas et al. 2012).

Naval Base Coronado, San Diego, CA (NBC) provides important shorebird habitat and has had a management program for CLTEs since the late 1970s, and for WSPLs since the early 1990s (Copper and Squires 2011). Despite the conservation programs at NBC and throughout the range of CLTEs and WSPLs, predation of nests and nestlings by native and non-native predators remains a major issue for the recovery of tern and plover populations (National Audubon Society 2011).

Predator management for the recovery of the CLTE and WSPL was conducted by the Institute for Wildlife Studies (IWS) and was performed on NBC and at Marine Corps Base Camp Pendleton between March 2012 and 15 September 2015. Work involved monitoring and removal of confirmed and potential avian and mammalian predators of CLTEs and WSPLs in nesting sites on these two bases; however, in this paper we will focus on the work conducted on NBC. Our management goals were to 1) focus on the biggest threats, and 2) implement non-lethal control techniques for native predators when feasible.

METHODS

A variety of techniques were employed to minimize predation of CLTEs and WSPLs between the 2012 and 2015 breeding seasons, including trapping, relocating, hunting, and conditioned taste aversion. We attempted to identify species of predators responsible for predation at WSPL/CLTE nests in order to determine the impacts of predatory species on tern and plover nesting success and survival. We also explored non-lethal predator management techniques that could potentially be implemented at WSPL/CLTE nesting sites.

We classified predators into three groups: mammals, corvids, and raptors. Mammalian predators consisted of feral cats, black rats, Norway rats (*Rattus norvegicus*),

striped skunks (*Mephitis mephitis*), and Virginia opossums (*Didelphis virginiana*). Corvids consisted of American crows (*Corvus brachyrhynchos*) and common ravens (*Corvus corax*), hereafter “crows” and “ravens.” Raptors consisted of red-tailed hawks (*Buteo jamaicensis*), Cooper’s hawks (*Accipiter cooperii*), northern harriers (*Circus cyaneus*), American kestrels (*Falco sparverius*), peregrine falcons (*Falco peregrinus*), barn owls (*Tyto alba*), and great horned owls (*Bubo virginianus*).

Mammalian predator management activities included live-trapping, limited daytime hunting, nighttime spotlight/FLIR (forward-looking infrared imaging) hunting, and the placement of miniature exclosures over WSPL nests. We used large and small box traps, covered skunk traps, and padded leg-hold traps (size 1; Oneida Victor, Euclid, OH) for capturing mammals in CLTE/WSPL nesting sites on NBC. We replaced the original leg-hold trap chain springs with lighter springs to help minimize injuries. Although most of our hunting was done at night from our vehicle via spotlighting, we occasionally scanned for mammals on foot with FLIR scopes and used electronic game calls. The techniques employed for trapping and hunting varied and were dictated by sign indicating the species of mammal present. Miniature exclosures were placed over WSPL nests after the final egg was laid. These allowed the adult WSPLs to move with ease to and from the exclosure and helped protect eggs from predators by excluding some of the larger mesocarnivores and corvids.

Problem raptors were managed primarily through trapping and translocation, using a variety of capture methods including Bal-chatri traps, harness traps, bownets, goshawk traps, and pole traps with trap transmitters. Before translocation we banded most raptors with a service band and green alphanumeric band (ACRAFT Sign and Nameplate Co., Edmonton, AB, Canada), which helped us determine if a translocated raptor returned to the base. Chick shelters consisted of simple plywood tents (placed on the ground with the point up) and were deployed to provide extra protection for the tern and plover chicks from raptors.

We used trapping, hunting, and conditioned tasted aversion for managing corvids on NBC. We deployed an assortment of traps including modified goshawk traps, modified padded leg-holds (size 1; Oneida Victor), pole traps with trap transmitters, funnel traps, Australian crow traps, and net guns. Traps were baited with Cheetos (Frito-Lay Products, Dallas, TX), raw peanuts (non-shelled), and brightly colored food wrappers placed in and around traps. We used lure birds (live crows) in our goshawk, funnel, and Australian crow traps. While hunting corvids, we used multiple tools including lure birds, a camouflage (Ghillie) suit, an electronic game call, and a FLIR scope. When using live lure birds, we fitted our birds with custom made anklets (made from leather and grommets) that were connected to a weight (by a bungee cord) and buried in the sand. We placed brightly-colored food wrappers around the bait bird(s), occasionally adding an audio lure, and retreated to an area where we could set up with a firearm and safely remove corvids that landed near our bait bird. Although we often

used our vehicles to conceal us while hunting, we also occasionally used a Ghillie suit and sat in the dunes or heavy vegetation. We would also use our FLIR scope to locate crows on a nest or in a roost.

We used Japanese quail (*Coturnix coturnix japonica*) eggs for corvid conditioned taste aversion based on their morphological similarities with CLTE/WSPL eggs. We removed 1.5 ml of egg contents from each egg and added a water mixture containing 60 mg of carbamylcholine chloride (carbachol; Acros Organics, Pittsburgh, PA). We painted most of our eggs to better mimic the appearance of WSPL eggs. We based the 60-mg dose on a study by Bogliani and Bellinato (1998), where that concentration was successfully used to deter hooded crows (*Corvus corone cornix*) from predating night heron (*Nycticorax nycticorax*) and little egret (*Egretta garzetta*) nests. We placed our treated eggs in artificial tern and plover nests that we created on nesting sites throughout NBC and marked each nest with a green tongue suppressor (the same method used to mark active CLTE/WSPL nests).

RESULTS AND DISCUSSION

We were unable to assign a specific mammalian species to 45% (17) of the predations from mammalian predators due to a lack of tracks/signs remaining at the nests; however, striped skunks were responsible for nearly half (43%; $n = 9$) of the total number of CLTE/WSPL mammalian predations that we were able to identify. Of the tern and plover predations by raptors, peregrine falcons (35%), northern harriers (13%), and great horned owls (29%) were responsible for the highest numbers of predations. However, corvids were responsible for 363 of the predations (63%) on NBC between 2012 and 2015 (Figure 1).

Large box traps were our primary means of capturing mammals. Bal-chatri traps were used to capture 90% of

Figure 1. Number of predators responsible for 580 Western snowy plover and California least tern predations during the 2012 through 2015 seasons on Naval Base Coronado.

our raptors, including peregrine falcons, and were usually the first trap we deployed when attempting to remove a problem raptor. Of the 19 raptors we trapped and relocated, only one red-tailed hawk, identified by the green ACRAFT band, was confirmed to have returned to NBC. Although trapping and translocating were our primary means for managing raptors, we lethally removed two northern harriers after multiple failed trapping attempts.

Since crows and ravens committed nearly two-thirds of CLTE/WSPL predations, control efforts focused on the control of corvids rather than mammals and raptors (Figure 1). We used various trapping and hunting methods for the control of corvids; however, research and observation convinced us to modify our methods and traps in ways that enhanced our corvid management success on NBC. One of these methods was the addition of the goshawk trap in 2013. This trap type was credited with the capture of 60% of the corvids on NBC, and padded leg-holds (which are sometimes used in conjunction with goshawk traps) captured 26%.

Our trapping success for crows appeared to be substantially higher using Goshawk traps, although we have no catch per unit effort data to support this. We modified our original design to improve our trapping success by replacing the broomstick handle triggers with hinged 2×2-ft wood triggers which were more stable and easier to set up. We also reduced the overall height of our trap from 4.5 ft to 3 ft, as we believed the shallower trap chamber would make the entry into the trap less intimidating for corvids and make the trap more portable. Finally, we added a divider in the trap chamber which allowed us to capture multiple birds during a set instead of just one (which is ideal for capturing pairs).

Our Australian crow trap design had little success, and we redesigned the trap, making it larger and collapsible for easy transport. We raised the entrance ladder from 3 ft to 5 ft, as corvids can jump fairly high before opening their wings. We also constructed the entrance ladder from 1×2-ft boards and wire which had 4×8-inch gaps for crows to drop through instead of a continuous 4-inch gap stretching across the trap. Finally, we ran two wires parallel and 12 inches below the ladder to discourage crows from fully extending their wings to fly back out.

We modified our pole traps by adding “toppers” mounted on the top of our poles that better concealed the traps and made them less intimidating to perch on. We inset our padded leg-hold traps in 4×6×9-inch blocks of wood until the top of the trap was flush with the top of the block. We also placed a piece of burlap (held on by tiny strips of Velcro) over the trap and flush with the edges of the block. These pieces were then mounted on top of our poles with a straight bracket.

We found raw peanuts were a better bait than Cheetos, the usual favorite, as the effort to consume peanuts required corvids to spend more time around our trap sets, increasing their chances of getting captured. Peanuts were also more weather resistant. Finally, using peanuts instead of Cheetos decreased the probability of luring in non-target species such as gulls.

Corvids are social animals, so using them as lure birds in traps can increase trapping success rates. Corvids take

advantage of anthropogenic food sources, so using brightly-colored food wrappers in traps and around trap sets attracts them. It is important to check corvid traps regularly, as minimizing time an individual spends in a trap will minimize the chances of injury that individual will sustain and also minimize the chances of other corvids observing that individual in a trap and becoming leery of the area and trap.

Hunting was also an important control method for corvids, accounting for 31% of removals. Our initial approach was to stalk-hunt and opportunistically shoot them from a vehicle; however, the use of lure birds got the corvids to come into closer range so we were able to get a better shot. The use of an electronic game call also helped lure them in; however, it would only work a time or two before the corvids would figure it out and not respond anymore. Crows and ravens recognized our personnel and vehicles as a threat once they observed us capturing or shooting another corvid. They would then avoid getting within shotgun range. We adjusted to this by only taking shots when the chance for removing all individuals present was high.

We deployed conditioned taste aversion as a non-lethal control method for corvids. We had several cases where crows and ravens consumed treated eggs within the CLTE/WSPL nesting grounds and became sick (based on observations and finding evidence of vomiting). On a few of these occasions, we had crows get sick from our eggs before reaching CLTE nests and then leave the area before depredating any nests. However, conditioned taste aversion seemed to be more of a temporary solution, as some corvids seemed to eventually be able to differentiate between the artificial and real tern nests. We had several cases where corvids would visit nesting grounds where treated eggs had been deployed, approach an artificial nest and remove the treated eggs (without consuming them), pull up the nest markers, and then proceed to a CLTE nest and depredate the nest. On multiple occasions, we also had crows attempt to bury our treated eggs upon visiting the artificial nest. We concluded that at NBC conditioned taste aversion could be effective as a temporary management tool in areas where lethal control may be difficult to implement.

Although current evidence suggests that predator removal is an effective strategy for the conservation of vulnerable bird populations, the ethical and practical problems associated with predator removal are leading more managers to pursue alternative, non-lethal solutions (Neuman et al. 2004, Smith et al. 2010). Conditioned taste aversion may help provide temporary predatory relief in areas where lethal control may be difficult. More research is required to produce and synthesize data to determine the effectiveness of these management practices for bird conservation at NBC. Preemptive corvid management along with non-lethal techniques such as chemical taste aversion, if applied early enough to train egg predators prior to the nesting season, may provide a significant reduction in egg loss. A combination of lethal and non-lethal methods are often needed for an effective predator management program.

LITERATURE CITED

- American Bird Conservancy. 2004. Domestic cat predation on birds and other wildlife fact sheet. <http://abcbirds.org/cats/NFWF.pdf>
- Atkinson, I.A.E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on avifaunas. Pp. 35-81 in: P. J. Moors (Ed.), Conservation of Island Birds. ICBP Tech. Publ. No. 3, International Council for Bird Preservation, Cambridge, UK.
- Avery, M. L., and D. G. Decker. 1993. Responses of captive fish crows to eggs treated with chemical repellent. *J. Wildl. Manage.* 58:261-266.
- Bogliani, G., and F. Bellinato. 1998. Conditioned aversion as a tool to protect eggs from avian predators in heron colonies. *Colonial Waterbirds* 21:69-72.
- Burbridge, A. A., and B. J. F. Manly. 2002. Mammal extinctions on Australian islands: causes and conservation implications. *J. Biogeogr.* 29:465-473.
- Copper, E., and L. Squires. 2011. The status of the California least tern and western snowy plover at Naval Base Coronado in 2009. Unpubl. report prepared for the Natural Resources Management Branch, Naval Facilities Engineering Command Southwest, San Diego, CA.
- Garcia, A., and G. Ceballos. 1995. Reproduction and breeding success of California least terns in Jalisco, Mexico. *Condor* 97:1084-1087.
- Garcia, M. A., C. E. Diez, and A. O. Alvarez. 2002. The eradication of *Rattus* from Monito Island, West Indies. Pp. 116-119 in: C. R. Veitch and M. N. Clout (Eds.), Turning the Tide: The Eradication of Invasive Species. Occ. Paper of the IUCN Species Survival Commission, No. 27. IUCN, Gland, Switzerland, and Cambridge, UK.
- King, W. B. 1985. Island birds: will the future repeat the past? Pp. 3-15 in: P. J. Moors (Ed.), Conservation of Island Birds. ICBP Tech. Publ. No. 3, International Council for Bird Preservation, Cambridge, UK.
- Luginbuhl, J. M., J. M. Marzluff, J. E. Bradley, M. G. Raphael, and D. E. Varland. 2001. Corvid survey techniques and the relationship between corvid relative abundance and nest predation. *J. Field Ornithol.* 72(4):556-72.
- Manley, S. J., and D. K. Garcelon. 2015. Predator research and management in support of the protection of the western snowy plover and California least tern on Naval Base Coronado. Final Annual Report - 2015. Unpubl. report prepared by the Institute for Wildlife Studies for the United States Navy, Naval Base Coronado, Natural Resources Office, San Diego, CA. 49 pp.
- Martin, T. E. 1992. Breeding productivity considerations: what are the appropriate habitat features for measurement? Pp. 455-473 in: J. M. Hagan III and D. W. Johnson (Eds.), Ecology and Conservation of Neotropical Migrant Land-Birds. Smithsonian Institution Press, Washington, D.C.
- Massey, B. W., and J. M. Fancher. 1989. Re-nesting by California least terns. *J. Field Ornithol.* 60:350-357.
- Merton, D. V. 1977. Controlling introduced predators and competitors on islands. Pp. 121-128 in: S. Temple (Ed.), Endangered Birds: Management Techniques for Preserving Threatened Species. Univ. of Wisconsin Press, Madison, WI.
- Mitchell, N., R. Haeffner, V. Veer, M. Fulford-Gardner, W. Clerveaux, C. R. Veitch, and G. Mitchell. 2002. Cat eradication and the restoration of endangered iguanas on Long Cay, Caicos Bank, Turks and Caicos Islands, British West Indies. Pp. 206-212 in: C. R. Veitch and M. N. Clout (Eds.), Turning the Tide: The Eradication of Invasive Species. Occ. Paper of the IUCN Species Survival Commission, No. 27. IUCN, Gland, Switzerland, and Cambridge, UK.
- National Audubon Society. 2011. Data synthesis and management plan development for California least tern and western snowy plover at Marine Corps Base Camp Pendleton. Unpubl. report prepared for the Environmental Core, Naval Facilities Engineering Command Southwest, San Diego, CA. 216 pp.
- Neuman, K. K., G. W. Page, L. E. Stenzel, J. C. Warriner, and J. S. Warriner. 2004. Effect of mammalian predator management on snowy plover breeding success. *Waterbirds* 27:257-263.
- Page, G. W., L. E. Stenzel, J. S. Warriner, J. C. Warriner and P. W. Paton. 2009. Snowy plover (*Charadrius alexandrinus*). The Birds of North America online (A. Poole, Ed.), Cornell Lab of Ornithology, Ithaca, NY. <http://bna.birds.cornell.edu/bna/species/154/> Accessed 23 July 2010.
- Page, G. W., L. E. Stenzel, D. W. Winkler, and C. W. Swarth. 1983. Spacing out at Mono Lake: breeding success, nest density, and predation in the snowy plover. *Auk* 100:13-24.
- Pauliny, A., M. Larsson, and D. Blomqvist. 2008. Nest predation management: effects on reproductive success in endangered shorebirds. *J. Wildl. Manage.* 72(7):1579-1583.
- Powell, A. N. 2001. Habitat characteristics and nest success of snowy plovers associated with California least tern colonies. *The Condor* 103(4):785-792.
- Rangen, S. A., R. G. Clark, and K. A. Hobson. 2000. Visual and olfactory attributes of artificial nests. *Auk* 117(1):136-146.
- Shields, M. A., and J. F. Parnell. 1986. Fish crow predation on eggs of the white ibis at Battery Island, North Carolina. *Auk* 103:531-539.
- Smith, P. A., H. G. Gilchrist, and J. N. M. Smith. 2007. Effects of nest habitat, food, and parental behavior on shorebird nest success. *The Condor* 109:15-31.
- Smith, R. K., A. S. Pullin, G. B. Stewart, and W. J. Sutherland. 2010. Effectiveness of predator removal for enhancing bird populations. *Conserv. Biol.* 24:820-829.
- Thomas, S. M., J. E. Lyons, B. A. Andres, E. E. Smith, E. Palacios, J. F. Cavitt, J. A. Royle, S. D. Fellows, K. Maty, W. H. Howe, E. Mellink, S. Melvin, and T. Zimmerman. 2012. Population size of snowy plovers breeding in North America. *Waterbirds* 35(1):1-14.