PREDATOR CAMERA RESEARCH AND MONITORING AT LEAST TERN AND PIPING PLOVER OFF-CHANNEL NESTING SITES

I. INTRODUCTION

Reduction of losses to predation by avian and terrestrial predators was identified as an important objective for meeting the Program's management objective of increasing productivity of least terns and piping plovers. Predation was identified as a threat to productivity due to losses of nests and broods attributable to predation, high numbers of unknown outcomes for nest and brood fates during previous years, and recent decreases in fledge ratios especially for plovers. The Program implements several management actions to reduce the risk of predation for least terns and piping plovers at off-channel nesting sites (i.e., ≥100 feet wide moat surrounds the nesting peninsulas, permanent and temporary electrified fences are installed at all nesting peninsula entrances, panel wings are positioned on the ends of the predator fence and extend 1-2 meters into the water to deter terrestrial predators from swimming around, trees within ≥150 m radius of the nesting site are removed, avian spikes are placed on all potential avian perches, and the Program actively traps and removes terrestrial predators around the site). Despite the Program's efforts in minimizing predator presence, predation still occurs. In response, additional predator management and monitoring strategies have been implemented. These include predator monitoring with remote cameras, predator deterrent lights, turtle exclusion fencing, turtle trapping, and track surveys.

II. PREDATOR MONITORING WITH REMOTE CAMERAS

A. 2017-2018 Panel Wing Cameras

During 2017 and 2018, predator panel wing cameras were installed at Dyer, Broadfoot South - Kearney, and Leaman East to determine whether the predator panel wing system (predator panel wings and moat combined) was effective at deterring mammalian predators from accessing off - channel nesting sites. We used a wide detection angle camera of 150-degree field of view to document predator approaches and breaches. To do this, three cameras were installed at each study site entrance. Camera 1 was placed on the outside of the predator fence, centered, and facing outward. The other two cameras (2 and 3) were placed on the inside of the predator fence facing the predator panel wings and were 1.5 to 2 meters away from the fence (Figure 1). The cameras allowed us to identify mammalian predators that were approaching (camera 1) and those that were able to breach the panel wing system by swimming around, digging under, or climbing over the predator panel wings (cameras 2 and 3). Although some breaches occurred (9% of all registers), 91% of camera photos by the panel wing camera system were of predators approaching the predator fencing from the outside. Based on total registers (approaches and breaches combined) for both years, the top three most abundant mammalian predators registered by this system for each site were as follows: raccoon at Leaman East; coyote, raccoon, and badger at Dyer; and raccoon, fox, and badger at Broadfoot South-Kearney.

B. 2017-2018 Site-level Nesting Peninsula Cameras

Mammalian and avian predator presence and possible predation events at off-channel nesting sites were also studied at a site-level covering nesting peninsulas at Blue Hole, Broadfoot South - Kearney, Dyer,

Leaman East, and Lexington during 2017 and 2018. This research was conducted by installing predator monitoring cameras near the edges of the peninsulas facing inward, to document predator presence. The cameras were programed to take 5-minute interval time-lapse and motion triggered photos. No actual predation events were documented with this study design, but a great deal of predator presence on the off-channel nesting peninsulas was registered. There was a total of 251 (73%) avian and 95 (27%) mammalian predators registered on site cameras. The top four most abundant avian predators were great-horned owl, seagull, sub-adult bald eagle, and great blue heron. The top four most abundant mammalian predators were unknown terrestrial animal, coyote, skunk, and raccoon (Figure 2).

C. 2019-2020 Nest-level Cameras

To document predator presence at the nest level, remote cameras were installed at identified tern and plover nests. The number of cameras at each site varied depending on the number of nests identified by outside monitoring protocols. The 2019 nesting season was used as a pilot year to ensure camera placement, setup, and settings were adequate. The 2020 nesting season was the first official year predator identification research at the nest level was implemented at off-channel nesting sites. The sites included were Broadfoot South - Kearney, Leaman East, Newark East and Newark West. A total of 46 cameras were available and distributed among the four sites based on average number of nests observed at each site from 2016-2019. Remote cameras were placed 7-10 feet from the nest to capture any predator activity near or directly at the nest while minimizing disturbance to nesting adults. Both avian and mammalian predatory species were documented by nest monitoring cameras (Figure 3). Nest cameras documented one predation event by a red fox consuming eggs at a nest in 2019. In 2020 there were three documented predation events by great horned owls consuming eggs at nests.

III. ADDITIONAL PREDATOR MANAGEMENT

In 2020, the Program began a pilot year for additional predator management strategies —deterrent lights and turtle fencing. This season focused on identifying tern and plover interactions with and possible avoidance of the predator deterrent lights and turtle fence; as well as the overall feasibility of implementing these strategies. Our goal is to determine the efficacy of these methods in decreasing predator activities on the sites, and whether this leads to an increase in least tern and piping plover productivity.

A. Deterrent lights

Sets were placed on Blue Hole and Newark West at a density of one light set per five acres of suitable nesting habitat. Sets consisted of both random pattern lights and motion triggered lights. Each was set on 8 ft tall posts with avian spikes installed on top of the lights to prevent avian predators from perching. The set of lights at Blue Hole consisted of 3 motion sensor lights and 3 random pattern lights (Figure 4). Newark West had 2 motion sensor lights and 2 random pattern lights (Figure 5). Of the tern and plover nests monitored at Blue Hole in 2020, only 2 losses were attributed to predation, both at the western-most end of the site, furthest from the 3 sets of lights. Of the 10 tern and plover nests monitored at Newark West, no losses were attributed to predation. Based on outside observations of the birds' interactions with the lights, nesting location, and number of nests at each site, there did not appear to be any avoidance of the deterrent lights by terns or plovers.

B. Turtle Fencing

It was hypothesized that turtle nests may be an additional attractant to predators due to observations from previous years of predated turtle nests. Putting up an exclusion fence at the shoreline may serve to reduce the number of turtles that lay eggs on the site, lower predator attraction to those eggs, and serve as a physical barrier to predators that do manage to cross the moat. Fencing was deployed at two off-channel nesting sites; Broadfoot South – Kearney (BFS) and Blue Hole. Fencing at BFS was deployed to test bird interactions and possible aversion to the fence (Figure 6). To test these interactions, fence segments of approximately 325 linear feet were placed on the north and south shores of an area that had typically high nesting and foraging in previous years. Fencing at Blue Hole was deployed to focus on turtle interactions and the effectiveness of the fence in deterring turtle presence and nesting because it was connected to the river and sees the most turtle activity (Figure 4). Each section of fence consisted of two types of fencing: a 4-ft high wood slat snow fence with 2-inch slat spacing, and a 4-ft metal woven wire fence with 4x4 inch openings. Each segment consisted of equal lengths of both wood slat fence and metal woven wire. All fencing included an electrified top wire to prevent the fencing from becoming an avian predator perch. No avoidance by tern or plover adults and chicks was recorded at either site, or neither type of fence acted as a barrier. As 2020 was a pilot study to determine the feasibility of this potential management action in excluding turtles and reducing tern and plover losses due to predation, the data obtained from 2020 will be integrated into a larger data set as the study continues to evaluate the benefits of fencing in terms of improving tern and plover productivity.

IV. MOVING FORWARD

Based on predator data we have collected during previous years; we have been able to answer questions about predator communities outside of and on the nesting peninsulas and document a few nest predation events with remote cameras. However, we are currently researching options for better methods we may be able to employ. Twenty-four-hour video monitoring of nests could fill in any gaps we may have experienced with triggered remote cameras. We are also looking for alternative ways to remotely monitor mobile chicks and perhaps get better estimates of the impacts of predation on this cohort? If we move forward with 24-hour video monitoring of nests, we need to develop a way to efficiently and effectively utilize the data it provides to help improve site management to reduce avian and terrestrial predator presence and predation, One challenge we have faced in testing impacts of predation and effectiveness of predator management for improving tern and plover productivity has been the limited number of sites we monitor and the high variability among sites and years in both predator presence and bird productivity.

Figures

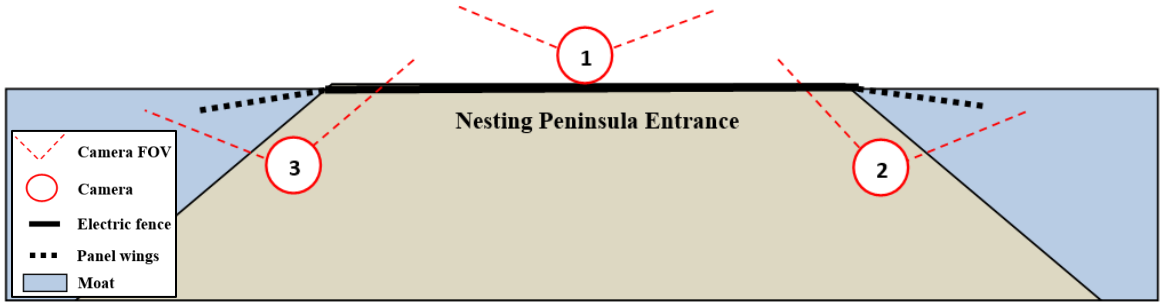

Figure 1. Diagram of the panel wing cameras and their location at the entrance of the land bridge at off channel nesting sites.

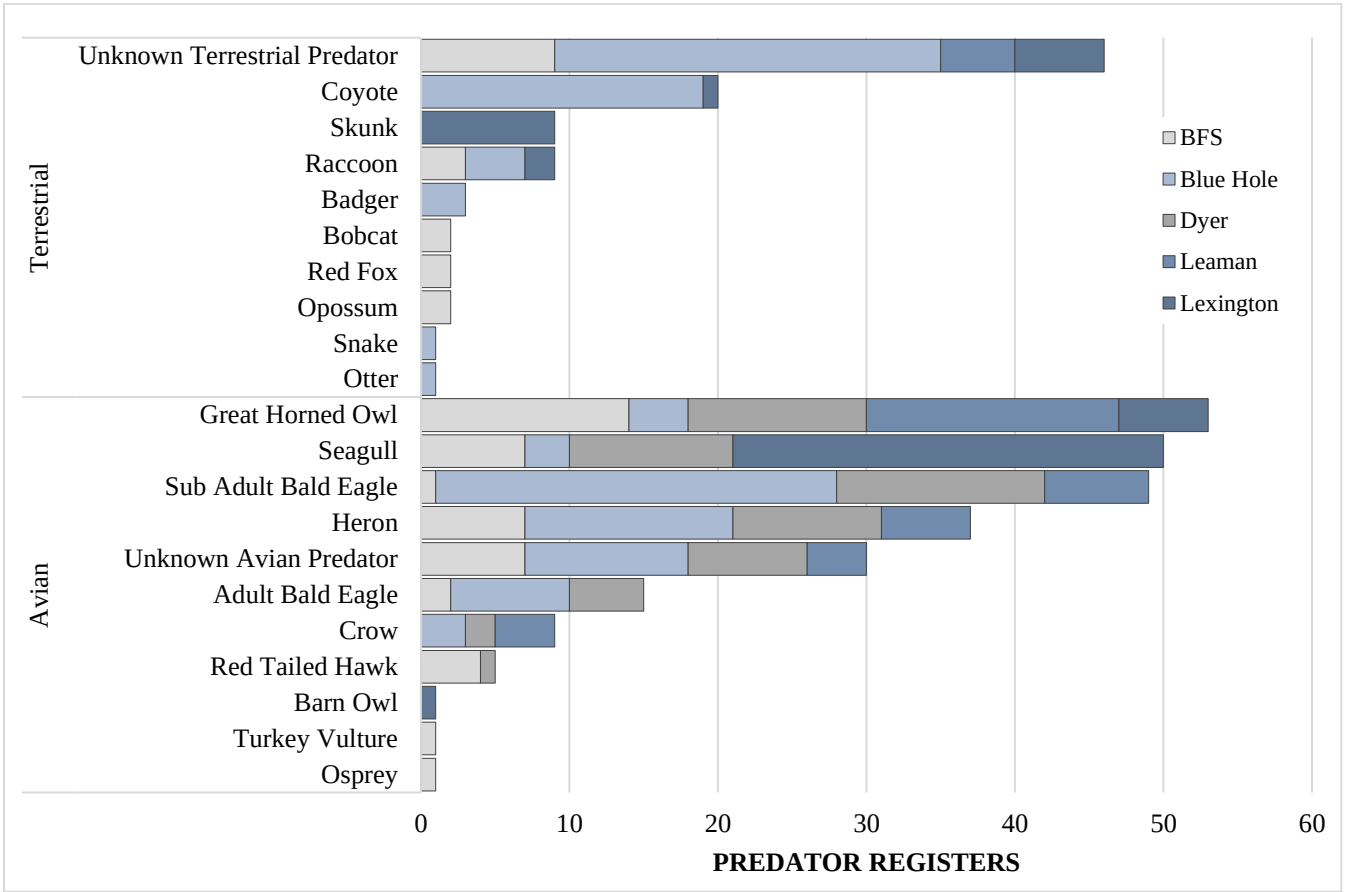

Figure 2. Predator registers of terrestrial and avian predators on site-level cameras at off-channel nesting sites during 2017 and 2018.

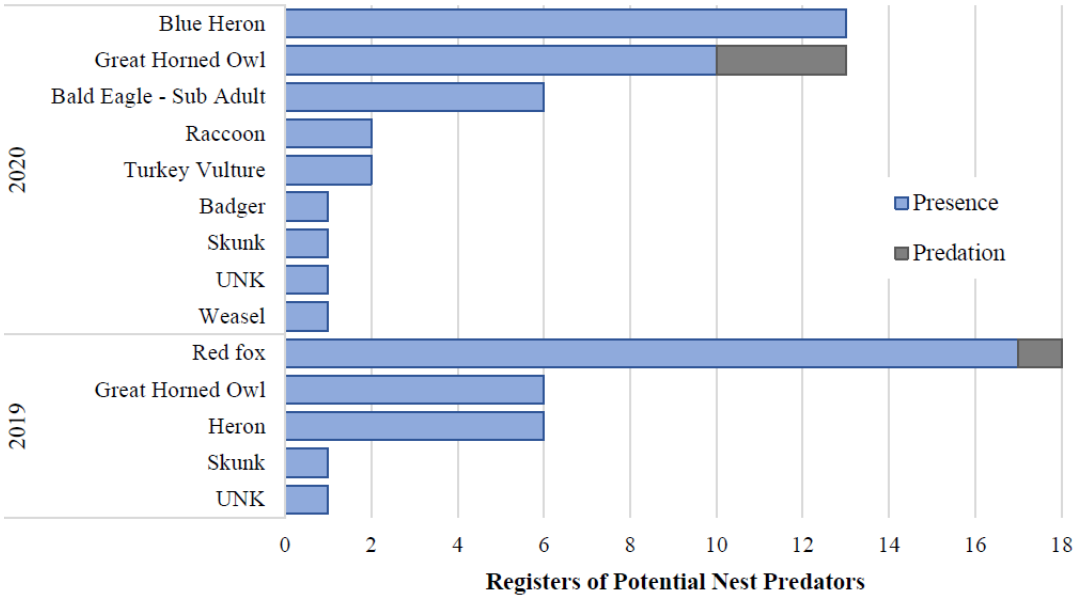

Figure 3. Registers of potential nest predator presence (blue) and predation events (grey) at least tern and piping plover nests at off-channel nesting sites; Broadfoot South–Kearney, Leaman East, Newark East and Newark West, during 2019 and 2020.

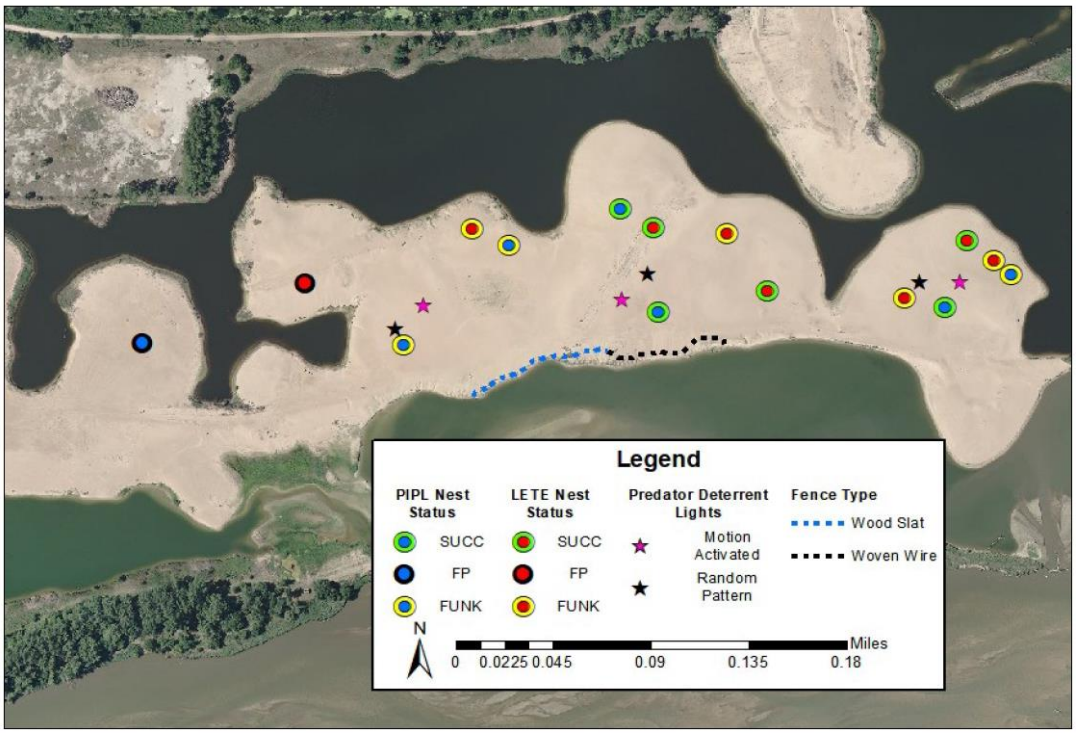

Figure 4. Motion activated lights (pink stars) and random pattern lights (black stars). Least tern (red inner dot) and piping plover (blue inner dot) nest locations, as well as location of wood slat fence (blue dashed line) and woven wire fence (black dashed line) locations on Bluehole. Final nest statuses are denoted by the colored outer rings. Successful (SUCC) nests have a green outer ring, predated (FP) nests black, and failed unknown (FUNK) nests are yellow.

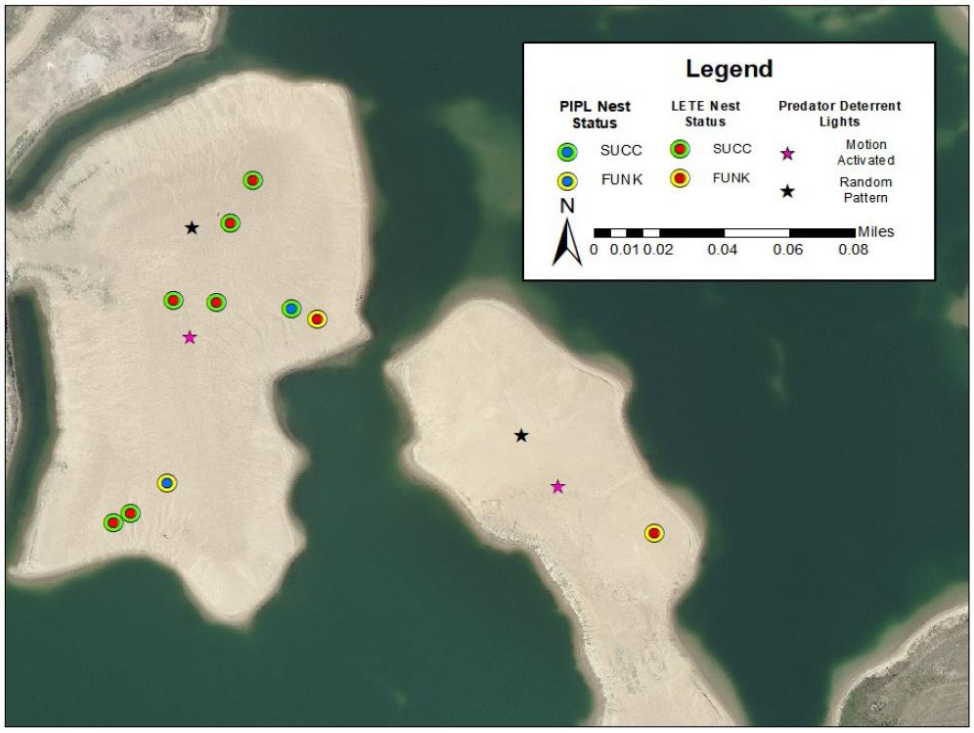

Figure 5. Locations of predator deterrent lights on Newark West. Motion activated lights (pink stars) and random pattern lights (black stars). Least tern nests (red dots) and piping plover nests (blue dots) are pictured in relation to the lights. Final nest statuses are denoted by the colored outer rings. Successful (SUCC) nests have a green outer ring and failed unknown (FUNK) nests are yellow. There were no predated (FP) nests at this site in 2020.

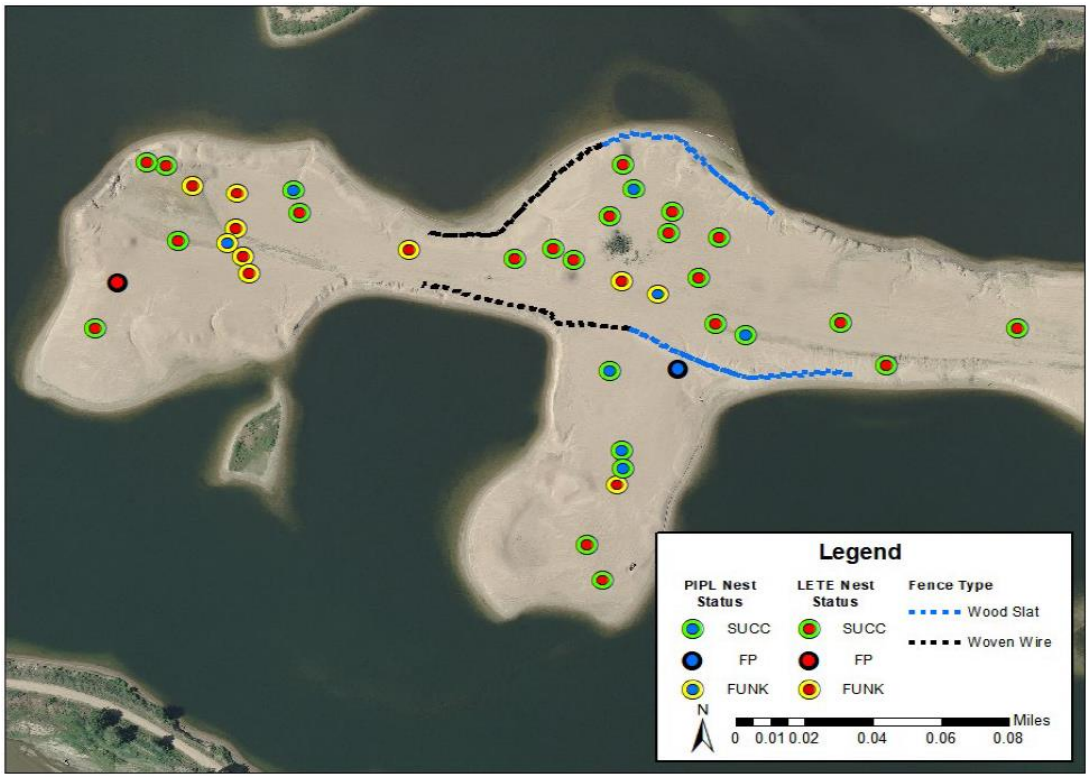

Figure 6. Least tern (red inner dot) and piping plover (blue inner dot) nest locations, as well as location of wood slat fence (blue dashed line) and 1 woven wire fence (black dashed line) locations on BFS. Final nest statuses are denoted by the colored outer rings. Successful 2 (SUCC) nests have a green outer ring, predated (FP) nests black, and failed unknown (FUNK) nests are yellow.