MSRP Seabird Restoration Program – San Nicolas Island, California

Annual Report on Island Fox Care and Monitoring Provided in Support of the San Nicolas Island Seabird Restoration Program– 2009

Prepared by:

David Garcelon
Institute for Wildlife Studies
P.O. Box 1104
Arcata, CA 95518

September 2010

INTRODUCTION

There is a substantial body of evidence on the ecological impacts caused by invasive or introduced species on insular environments. A large percentage of recent documented extinctions have been of island species, and more than half of those have been the direct result of the effects of invasive species (IUCN 2006). One introduced species, the feral cat (*Felis catus*), has been responsible for the extinction of at least 33 bird species worldwide (Lever 1985). On San Nicolas Island, feral cats are known to kill western gulls (*Larus occidentalis*), the federally threatened island night lizard (*Xantusia riversiana*), and the endemic deer mouse (*Peromyscus maniculatus exterus*). They also compete with the state threatened San Nicolas island fox (*Urocyon littoralis dickeyi*) for food and habitat.

In an effort to help restore seabird populations on San Nicolas Island, the U.S. Fish and Wildlife Service, in cooperation with the U.S. Navy, initiated a program to remove feral cats from the island. The program was funded by the Montrose Settlements Restoration Program as part of an overarching plan to restore some of the resources affected by discharge of DDT into the southern California marine ecosystem (MSRP 2005). The Final Environmental Assessment (EA) for the proposed seabird restoration program outlined a number of methods to remove feral cats (USFWS 2009). One of the primary methods to remove feral cats employs the use of padded leg-hold traps. Because the resident island fox has very similar habits to the feral cat and would be captured in padded leg-hold traps set for cats, the EA stipulated efforts that would be adopted to reduce impacts on island foxes as well as mitigate any injuries that might occur to island foxes captured in leg-hold traps. The EA further proposed monitoring the fox population to determine any changes that might occur associated with the removal of feral cats from the island.

The Institute for Wildlife Studies (IWS) was contracted to provide medical services to care for any island foxes found injured during the feral cat removal effort. This included establishing a veterinary clinic on the island that could accommodate all foreseeable circumstances and not require any injured animals to be transported to the mainland. It also included conducting a limited amount of monitoring of the fox population in an attempt to detect any effects the leg-hold trapping effort might be having on the foxes. IWS also provided training in fox handling to personnel of Island Conservation (IC), the contractors conducting the feral cat removal. When it was determined that feral cats would be removed using non-lethal means whenever possible and transferred to The Humane Society of the United States (The HSUS), IWS also undertook the responsibility of conducting health checks on all captured cats and provided for their husbandry until they were removed off of San Nicolas Island.

In July 2009 leg-hold trapping was initiated on the island. This report covers project activities between conducted July through December 2009.

METHODS

Substantial effort went into developing and implementing the project such that impacts to the island fox were minimized and mitigated as much as possible. The Final EA outlined a series of measures to reduce fox impacts, including: 1) no trapping during the island fox breeding season, 2) use of the state-of-the-art trap telemetry system, 3) modification of padded leg-hold traps, and 4) care of foxes in a well-equipped hospital trailer. IC's 2009 Annual Report provides additional information about the traps and telemetry system (Hanson et al. 2010). In addition to providing care for island foxes that were injured as part of the project, IWS also treated additional foxes that were injured due to non-project related reasons (e.g., hit by a car). These additional foxes were considered "mitigation cases."

Hospital Trailer

To provide a medical care facility we converted a 48' gooseneck cargo trailer into a mobile hospital. The hospital was constructed from a bare-shell trailer specifically for the purpose of meeting the requirements of this project. The trailer was divided into three rooms: 1) laboratory/office space, 2) treatment/holding cages, and 3) surgery suite. The laboratory area was equipped with storage space for medical supplies and also had counter space for laboratory equipment (Fig. 1). This includes a blood serum chemistry analyzer, a hematology analyzer, centrifuge, autoclave, refrigerator/freezer, -80ºC tissue freezer, and a compound microscope. This section of the hospital also contained a computer to maintain all patient records and project databases. A telephone and internet connection allowed for communication with the IWS veterinarian on the mainland and for ordering supplies. The office area also had a VHF radio and external antenna to allow for communication with staff while in the field and with the trappers who were capturing the feral cats.

Figure 1. Hospital laboratory area.

The treatment room contained cage space for nine animals. The stainless steel cages were veterinary grade and were easily cleaned (Fig. 2). The treatment area (Fig. 3) contained all of the standard veterinary hospital equipment necessary to conduct diagnostic evaluations on the incoming patients. These included: 1) digital scale, 2) digital thermometer, 3)

Figure 2. Dr. Winston Vickers observes a fox patient.

ophthalmoscope and otoscope, 4) stethoscope, 5) x-ray machine, 6) x-ray developer, and 7) PIT tag reader. Support equipment included fluid infusion pumps, syringe pumps, oxygen generator, heating pads, pulse oximeters and hair clippers. A stainless steel wash basin with a hot water heater allowed patients to be washed and prepped for surgery if necessary, and food and water bowls could be washed between uses.

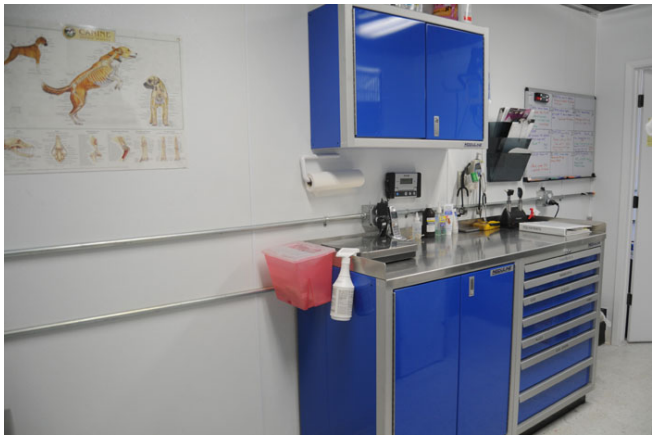

Figure 3. Patient examination and treatment area.

The surgery room was designed to provide a veterinarian the support equipment necessary to conduct orthopedic surgeries and other procedures on the island (Fig. 4). The air conditioned room contained the following equipment: 1) stainless steel surgery table, 2) wall-mounted surgery light, 3) oxygen generator, 4) back-up oxygen tanks, 5) anesthetic machine, 6) stainless steel cabinet for surgical supplies, 7) circulating hot water pad, and 8) wall-mounted radiograph viewer. There was also a hospital-grade patient monitor that provided for monitoring of patient temperature (rectal and surface), heart rate, oxygen saturation, blood pressure, and electro cardiac rhythm.

The trailer was connected to 120-volt house current when put in place on the island, but also had a 5,500-watt gasoline-powered backup generator in the event of power failures. Two ceiling-mounted air conditioners provided cooling on warm days to keep the patients comfortable, and a ceramic heater helped maintain a comfortable temperature in the patient room during cold nights.

Figure 4. Surgery room.

An emergency pack was available for attending to foxes in the field that might be too critical to immediately transport. The pack was stocked with emergency support drugs, intravenous fluids, portable fluid pump, oxygen tank and mask, and fracture support devices.

Additional Facilities

In addition to the hospital trailer, two annex buildings were used to house animals temporarily. A concrete block building located adjacent to the offices of the Navy's on-island Environmental program was

used to house feral cats that were being held prior to transport off the island. Racks of shelves were arranged to hold the cages containing the cats. The cages were 14 x 12 x 36 inches (Tru-Catch, Model 36D) and had access doors at each end. When cleaning and providing food and water, divider tongs were inserted into the cage from the outside to confine the cat to one end while the other end was being cleaned. The process was repeated to clean the other half of the cage. Twice daily the cats were fed a combination of dry and wet cat food along with water. A cover was placed over each cage to reduce the visual stimulus of seeing other cats.

Another building with a concrete floor and fiberglass panel walls and roof was used for feral cats when the other structure reached capacity. Because it was located adjacent to the hospital trailer, it was also used for holding fox patients when the hospital trailer exceeded capacity. Feral cats and foxes were never concurrently housed at this facility.

When ready for transport off of San Nicolas Island, the cats were transferred to commercial airline carriers, and the doors were secured with zip-ties to prevent accidental escape. The cats were flown to the mainland on a chartered twin-engine aircraft funded by The HSUS and were taken to the Fund for Animals Wildlife Rehabilitation Center in Ramona, California for permanent care.

Staff and Training

IWS project staff included four wildlife biologists, the project veterinarian (Dr. Winston Vickers), and the project manager (David Garcelon), who had significant experience with island foxes and with providing medical care to wildlife. The biologists had previous experience working in veterinary hospitals or in care of injured wildlife. The project veterinarian provided on-site training to the biologists in various aspects of physical examinations, fracture stabilization, intravenous catheter placement, x-ray techniques, and anesthesia. The veterinarian went over the function and use of various commonly used veterinary drugs and provided fox-specific dosage information. Foxes captured as part of field training were brought into the hospital trailer for examination and to demonstrate some of the medical procedures.

The project manager stayed on the island during the first two months of the project to continue medical training and provide program oversight. The veterinarian made periodic visits as necessary and was available for consultation by telephone and email. Throughout the project, diagnostic test results, x-ray films and patient history information was digitized and sent electronically to the veterinarian for evaluation and to prescribe appropriate treatments.

Feral Cat Examinations

All feral cats captured in leg-hold traps were given a thorough examination post-capture. The cats were presented in a burlap sack which was used to transport them from the field by the IC trappers. IWS staff would estimate the weight of the cats and then anesthetize them with an intramuscular injection of ketamine hydrochloride and atropine sulfate.

The cats were then weighed on a digital pan scale and brought into the surgery room for examination (Fig. 5). They were connected to the patient monitor to track their vital signs during the examination. We recorded their sex, reproductive condition (palpating for fetuses in females), noted any injuries, carefully checked the leg that had been caught in the leg-hold trap, examined dentition, collected a blood sample from the jugular or femoral vein, collected a tissue sample from the inside of the ear pinna for DNA, and inserted a passive integrated transponder (PIT) tag under the skin at the base of the neck (Fig. 6). Starting on 9 August (with cat #31), each cat was vaccinated against common felines diseases during their health exam.

Figure 5. Anesthetized feral cat on scale.

The blood sample was split between a tube containing no anticoagulant (red top tube) and one with sodium EDTA (lavender top tube) to prevent coagulation. The red top tube was centrifuged for 10 minutes and then the serum portion was removed by pipette. A small portion of the serum was placed in an Abaxis serum chemistry analyzer and the remainder was placed in cryotubes and frozen for archival purposes. The lavender tube was inserted into a Heska CBC analyzer to obtain hematology parameters. Typically, we also filled 2-4 microhematacrit tubes with whole blood and centrifuged those for a secondary method of determining values for total protein and packed cell volume. Blood slides were also made and then stained and stored in case needed for differential blood cell counts. After completion of the examination, the cats were placed in a cage and allowed to recover.

Figure 6. Conducting full physical examination on a feral cat.

<u>Trapping Efforts to Monitor Island Foxes</u>

As part of the effort to determine the potential effects of leg-hold trapping on the San Nicolas Island fox population, we conducted trapping efforts using box traps (Tomahawk Live Trap, model 106) in an attempt to capture and examine foxes that had been caught in leg-hold traps. Box traps were placed along transects in various locations around the island where leg-hold traps had been or were being operated. The traps were set in the afternoon, baited with wet and/or dry cat food

and checked daily in the morning. Each trap was equipped with a cover to provide shade and some protection from the elements.

RESULTS

Island Fox Patients

Despite the efforts to minimize impacts to the island fox, IWS admitted a total of 99 fox patients into the clinic from June – December 2009. A patient is defined as a fox being admitted for examination, regardless if it was found to be ill or injured. In some cases, individual foxes were admitted more than one time. Of the 99 admissions, 89 were brought in by IC staff. Of those, 73 patients required some form of treatment,11 were foxes that were released within 48 hours of being admitted when no treatable condition was detected (e.g., old healed injuries), and 5 foxes were considered "mitigation" cases. These five foxes were found with injuries or conditions unrelated to being caught in a leg-hold trap. The remaining 10 patients were mitigation patients brought in by IWS for evaluation.

The 73 admitted fox patients associated with leg-hold trapping represented 63 individual foxes. Nine individual foxes were admitted on two different occasions and one was admitted on five occasions (in some cases additional visits were as mitigation cases or with no treatment necessary).

The 73 fox admissions that had injuries/medical conditions were placed into the general categories shown in Table 1. In some cases a patient may have had more than one injury/condition (e.g., a fracture and exposure) and therefore may be represented in more than one category. Older age class foxes made up a larger proportion of the foxes brought into the clinic (Fig. 7).

Table 1. List of injury conditions and number of times they occurred in patients admitted to the clinic on San Nicolas Island during 2009.

Injury/Condition	**No. of Occurrences[1]**
Fractures:	
Ulna	6
Radius	1
Metatarsal	6
Digits	1
Elbow	2
Luxations:	
Femur	1
Elbow	1
Sub-luxations	
Carpal	11
Dehydration	8

Hypothermia	15
Hyperthermia	13
Shock	1
Abrasions/Lacerations/Puncture	22
Palate Trauma	2

[1]As individuals may have had multiple conditions, total number of injury conditions exceeds the number of animals treated.

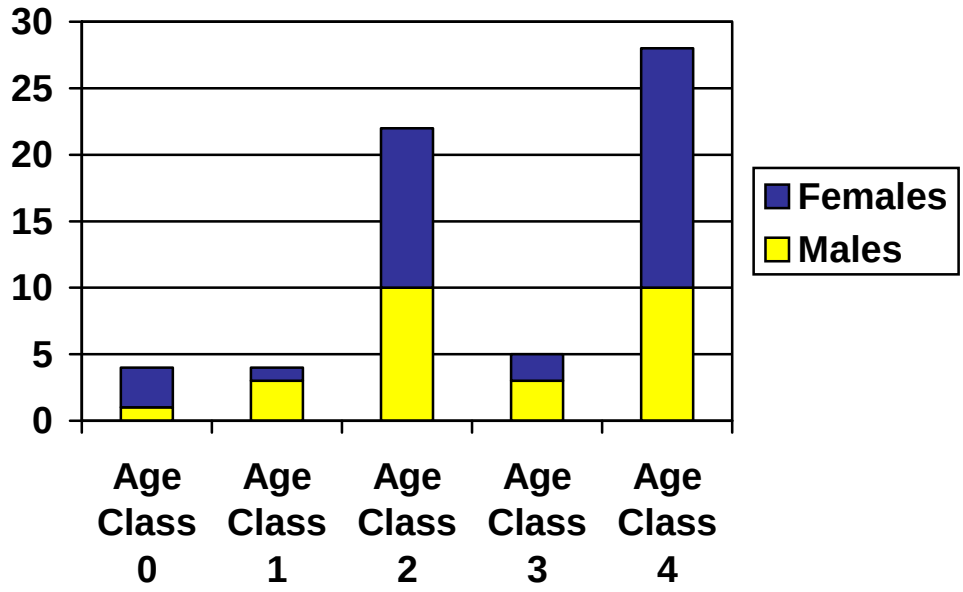

Figure 7. Sex and age class of 63 leg-hold trap-related fox patients admitted to the clinic on San Nicolas Island during 2009.

The most common fractures have been broken ulna (6) or radius (1), and metatarsal fractures (6). Because the ulna can generally be well supported if the radius is left intact, these types of fractures were treated by splinting the leg and with cage rest (Figure 8). Luxation injuries are fully dislocated joints that are unlikely to reinsert into the socket or remain in place unless approached surgically or through splinting. These are likely caused through twisting actions of the fox after having its leg caught in the trap.

Figure 8. Island fox undergoing treatment at the IWS clinic on San Nicolas Island.

Sub-luxations are partial or incomplete dislocations where there is laxity in the joint likely caused by stretching of the tendons and may be a result of the fox pulling against the trap. These are relatively minor injuries and the foxes are typically treated with cage rest.

Foxes suffering from exposure were classified either as hyperthermic (elevated body temperatures) or hypothermic (lowered body temperature) and were a result of struggling in the trap during the heat of the day or being in the traps overnight during cool temperatures. Older age class foxes (age class 4) made up 12 of the 15 individuals suffering from hypothermia. This was likely due to reduced body fat and the overall poor body condition of older age class foxes compared to younger age class animals.

Various other lacerations, abrasions and puncture wounds occurred on the patients and were cleaned and treated as necessary. Most were considered minor although a few abrasions required staples to hold the skin in place for healing.

Two more serious injuries that were not fracture related occurred when the trap transmitters failed to send a signal that a capture had occurred (Hanson et al. 2010). In these cases the foxes had been in the traps for extended periods and had developed extensive swelling of the captured limb. In addition to being dehydrated and in one case in shock, both animals suffered tissue loss due to lack of blood supply to the affected areas. One fox was given oxygen and intravenous fluids to treat shock, and later was given a blood transfusion to treat an autoimmune anemia condition. One fox had two toes removed surgically. Both foxes were eventually released to the wild after several weeks of treatment.

Between 27 June and when trapping stopped in December, IC recorded a total of 957 fox captures, representing 437 individual foxes. The overall injury rate for individuals has been approximately 14.0% (63 individual foxes trapped with discernable conditions/437

individual foxes), and the injury rate for total fox captures in leg-hold traps has been approximately 7.4% (71 foxes/957 fox captures brought in with discernable conditions) (Fig. 9). While only 63 unique foxes were brought into the clinic requiring care, we counted individuals brought in more than once if their conditions were different or they had a reoccurrence of a previous condition. Excluding the more serious long-term cases and mitigation patients, the average time a fox was cared for in the clinic was 7 days.

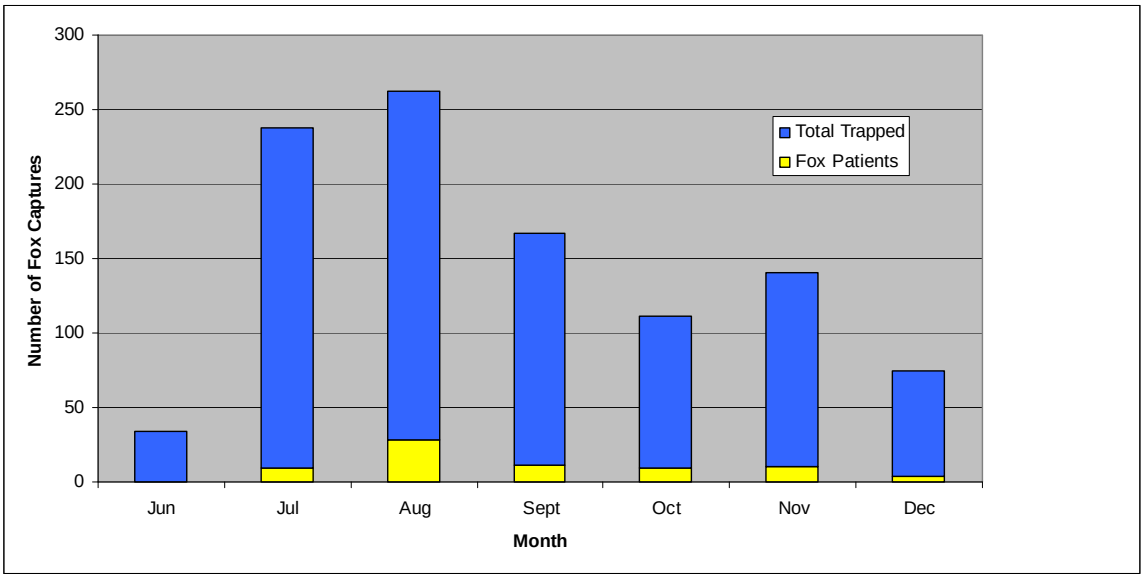

Figure 9. Total number of fox captures per month in padded leg-hold traps and proportion that were admitted as patients to the fox hospital.

Mitigation Cases

During 2009, we admitted 15 fox patients to the hospital that were considered mitigation cases. These foxes had preexisting injuries unrelated to leg-hold trapping efforts. Injuries included bone fractures, lacerations or abscesses from intraspecific interactions, and individuals that had been hit by vehicles. Surgery was required in some of the fracture cases in an attempt to stabilize the effected bones. With one exception noted below, all injuries were successfully treated and the foxes were returned to the field.

Feral Cats Held in Captivity

We handled and provided care for a total of 52 feral cats trapped from June - December 2009. This included 31 females and 21 males, of which 46 were considered adults and 6 were kittens/juveniles (i.e., body weight under 1.5 kg). The majority of the cats were captured during July, but at least two cats were captured during every month except December, when no cats were captured (Fig. 10).

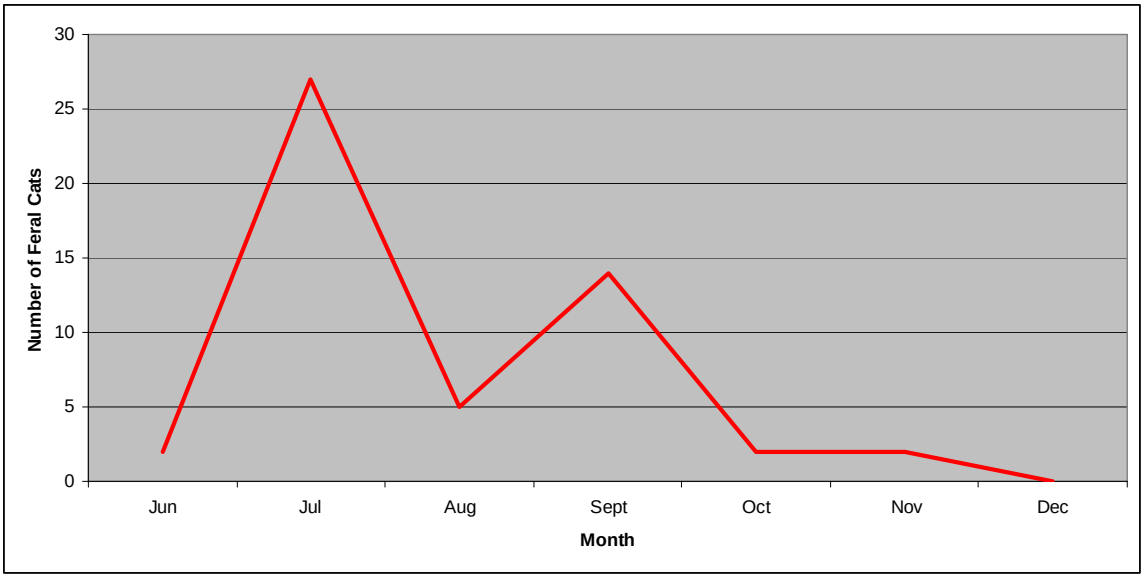

Figure 10. Number of feral cats captured in leg-hold traps per month from June through December 2009.

Three female cats were pregnant at the time they were trapped and brought into captivity. Two gave birth within two days after being captured, and the third gave birth 21 days after capture. A total of 10 kittens were born (litters of 3, 3 & 4), and all were healthy and developed normally (Fig. 11). The females with kittens were separated from the other cats being held in captivity to reduce the stress on the mothers.

In a few cases, the cats developed intestinal disorders, likely due to the change in diet after being brought into captivity. Symptoms such as loose stools were treated with special diets and, if needed, anti-diarrhea medications. If blood analysis indicated elevated total white-cell counts, suggesting an infection, individuals were placed on a short-term antibiotic therapy to help treat the condition.

Each cat was screened for feline immunodeficiency virus (FIV) and feline leukemia virus (FeLV) during their initial examination. All individuals were negative for these feline diseases.

Figure 11. Three healthy kittens born after capture of their mother.

It was common that the foot/leg that the cat was captured by in the padded leg-hold trap would be swollen upon presentation at the hospital. In the few cases where the swelling was more extensive, steroids were administered to reduce the inflammation. We detected no evidence of fractures or dislocations in the limbs of cats captured in the traps. We also saw no mouth injuries, tooth loss or injury, or mutilation of captured

limbs that suggested the cats were biting at the trap or on their own limbs.

Cats were held an average of 13 days in captivity on the island (SD = 9.5 days; range 0-44 days). Seven transport events took place to transfer the cats from the island to mainland and their eventual permanent accommodations. As few as three and as many as 13 cats were transported during any one event (Table 2). The three females that had given birth while in captivity were held until their kittens were large enough to go without nursing for an extended period. This was done to avoid nutritional impacts on the kittens if the mother was stressed by the transport and did not immediately nurse.

Table 2. Dates of flights and number of feral cats removed from San Nicolas Island on each flight.

Date of Flight	Number of Cats Transported	Comments
21 July 2009	9	
22 July 2009	7	
5 August 2009	13	
29 August 2009	5	Plus 6 kittens from two litters
25 September 2009	12	
15 October 2009	3	Plus 4 kittens from one litter
1 December 2009	3	
Total	52	

Project-Related Mortalities

A total of 4 foxes have died as a direct effect of the feral cat removal efforts. One animal died on 29 June shortly after the start of the project. This age class 2 female fox, which appeared otherwise healthy, was found dead in the trap 2 hours and 18 minutes after the telemetry system indicated its capture. Gross examination at the time suggested it had succumbed to hyperthermia while struggling during the heat of the day after being captured. A necropsy conducted at U.C. Davis confirmed this assessment.

A second fox was killed by an IC project dog during nighttime operations to locate feral cats. It was the youngest of the three dogs used in the program and was subsequently equipped with a muzzle whenever in the field.

A third fox was an age class 4 (older) female that was captured in a trap overnight and was hypothermic. While immediate efforts were made by the trappers to bring the fox to the clinic for care, it died en route.

The forth death involved another age class 4 fox that was captured at night during a rain event. It was hypothermic and was treated with warm intravenous solutions and a heating pad. By mid morning her temperature was normal and she consumed food, but

the following morning she was very hypothermic and had vomited. Various medical procedures were prescribed by the veterinarian to stabilize her condition, but she died early the following morning while being monitored.

An additional age class 3 female fox was recovered dead in Nictown on 12 July and was missing all of the tissue from its front right foot. IWS staff had captured this fox in a box trap on 23 June and had given it a full examination at the clinic. It appeared in good health and weighed 2.23 kg. It was captured again on 29 June by its front right foot in a leg-hold and then released. The necropsy report by Dr. Linda Munson at U.C. Davis reported the front right foot had a traumatic amputation with necrosis. The report stated "extensive inflammation and bacteria in the tissues proximal to the forelimb amputation site indicated fox lost her distal front limb days to weeks before death and then likely succumbed to secondary bacterial infection at the amputation site". It appears that this fox may have sloughed the tissue below the leg-hold capture point and finally succumbed to bacterial infection.

Only one fox has died while in the clinic. This fox was a mitigation case that had likely been hit by a car and had its femur fractured in multiple locations. As the injury was already a few weeks old and was severe, veterinarians determined that amputation was the only viable alternative. Unfortunately, the animal died during surgery.

Follow-up Trapping to Investigate Fox Health Status

IWS used box traps from 20 September through 6 December to run transects in areas of the island where leg-hold traps were already in operation to evaluate foxes that had been previously captured. In 485 trap-nights we captured 70 individual foxes which had been previously caught in leg-hold traps. We found no injuries in the foxes that were associated with their previous captures. We also evaluated nine additional foxes that were caught in leg-hold traps (not patients) and then recaptured as part of other trapping efforts. The 70 total foxes evaluated is approximately 16% of the 437 individual foxes captured in leg-hold traps.

To provide continuing training to IC trappers, IWS conducted 12 days of site visits where we accompanied trappers in the field and evaluated their skills on providing health evaluations of trapped foxes. We examined 22 foxes with various IC trappers and found no situations where our evaluation differed from that of the IC trappers.

DISCUSSION

Island Fox Injuries and Population Monitoring

One of the goals of the feral cat removal program was to ensure that there were minimal impacts on native wildlife, and specifically that potential impacts on island foxes would be minimized and mitigated. That objective was met with combination of quick response

times to captured animals due to the automated trap monitoring system (Will et al. *in review*) and a hospital facility on the island to handle any foxes that were found injured.

The four or five known fox mortalities associated with capture in the leg-hold traps represented 0.9% of all individual foxes captured. While any mortalities of non-target species associated with a trapping program should be met with concern, the percentage of foxes lost due to trap-related circumstances is low considering the annual apparent adult mortality rate of foxes on San Nicolas Island (24%, Hudgens and Garcelon 2010).

The overall injury rate of 14% was similar to what was expected, but the number of more severe injuries was less than expected. We had originally anticipated a greater number of long bone fractures (e.g., ulna, radius, tibia) from the foxes struggling after being captured. The configuration of the traps (multiple swivels, short anchor attachment length) likely prevented the foxes from being able to get the momentum necessary to sustain fractures while trying to escape, or to get twisted in the anchor chain. The more common leg bone fracture occurred at the distal end of the radius just above the wrist. We suspect that this was the site where the leg-hold trap most commonly closed on a fox's leg and resulted in fractures on some individuals. The luxations and sub-luxations were likely a result of twisting actions that occurred after the limb was caught in the trap.

Other than the fractures, the most serious injuries/conditions were the extreme cases of hypothermia and hyperthermia, and the two cases where the trap transmitters failed to register a capture of an animal resulting in extended periods held in the trap. Hyperthermia likely resulted in the death of one animal and required quick response in the field and the hospital for treatment of other individuals. After the death of the first fox, IWS supplied IC staff with rectal thermometers to check body temperatures on animals suspected of being heat or cold stressed, and we trained them on how to provide first aid in the field (e.g., placing animals in the shade, applying isopropyl alcohol to dissipate heat, chemical heat packs for hypothermic animals).

The value of the automated trap monitoring system for allowing rapid response to trapped animals was exemplified by the injuries that occurred during the two times when the system did not function correctly. The foxes that remained in the traps for >24 hours sustained injuries that required intensive and extensive care. Loss of blood flow to extremities for extended periods sets off a cascade of physiological responses as the body attempts to maintain homeostasis. The instantaneous release of the constriction can lead to further complications as biological waste products that were confined behind the constriction are introduced systemically. One fox patient in this condition developed an autoimmune anemia and eventually required a blood transfusion. Both patients ended up sloughing tissue that died due to lack of blood supply and one required surgery to remove two digits. These observations help strengthen the opinion that removing animals from constriction type traps (e.g., leg-holds, snares) as quickly as possible reduces the possibility of serious physical injury, and promotes the concept that animals held in these traps for long periods may suffer from serious complications that are not immediately apparent at time of capture.

Follow-up trapping conducted to evaluate possible lingering injuries to foxes associated with captures in leg-hold traps did not find any significant issues. Reevaluation of foxes previously captured in leg-hold traps, as well as some former hospital patients, showed the animals to be in good condition with respect to the leg they were captured on and no foxes were brought in for additional treatment. While foxes with a serious protracted condition might not have survived to be later captured for evaluation, we would have expected to capture some individuals with an intermediate or chronic condition if they were present. Furthermore, during our follow-up training sessions with IC trappers we were in agreement with their evaluation of foxes captured and examined, further supporting the belief that foxes were not being released with injuries requiring treatment.

Feral Cats

The feral cats that were trapped and brought to IWS for care were mostly found to be in good health and suffered no lasting effects from being captured in the leg-hold traps. Cats have more robust bones in legs than do island foxes, which likely contributed to their absence of fractures, luxations and sub-luxations. From previous experience, the lack of disturbance around leg-hold traps containing feral cats suggests that they are less aggressive in their attempts to escape from the traps. Most cats showed swelling on the leg held in the trap, but this quickly diminished and the cats demonstrated no lameness while held in captivity.

The cages used to house the feral cats evolved somewhat during the course of the project. The original cages, which were 36" long and 12" wide with an access door at each end, provided security for project staff when separator bars were inserted into the cages to confine the cats at one end during cleaning/feeding. However, the cages did not offer a lot of space for the cats to move around. Based on suggestions from The HSUS, we began using a larger dog kennel with a single door (Fig. 12). A small airline carrier cage was placed inside the larger cage, which the cats used to "hide" when personnel were present. The door on the smaller cage could be secured to prevent the cats from escaping during cleaning.

Figure 12. Feral cat in larger holding cage with cubby.

The birth of three litters of kittens was not something foreseen when the plan to hold the feral cats in captivity for transport off of the island was instituted. The desire to separate the pregnant females from the other captive cats in order to reduce stress required maintaining a separate facility, and extra care had to be taken to ensure that sufficient food and water were available for the nursing mothers. The kittens were removed and examined periodically to evaluate their condition. Mothers with dependent kittens were held longer on the island than other feral cats due to our desire to be cautious about the impact

of transport stress on the family. If the female was stressed due to transport and did not nurse the kittens for an extended period, it would have led to heath concerns and necessary intervention on the part of the mainland caretakers.

Overall, the process with The HSUS went relatively smoothly after the establishment of the permanent holding facility on the mainland. We coordinated with their staff to arrange for transport of feral cats off of the island, at which point responsibility for the cats shifted to The HSUS. We provided them with identification information (PIT tag numbers) and health histories on the cats for their records.

ACKNOWLEDGMENTS

We would like to acknowledge the dedicated assistance of IWS biologists Hower Blair, Kari Signor, Daniel Jackson and Thomas Thein. They put in long hours to provide round-the-clock care for foxes that were brought into the clinic trailer, as well as care of the captive feral cats and conducting trapping to examine possible effects of leghold traps on the foxes. Their dedication to the project is greatly appreciated. Winston Vickers, DVM, provided on-site training to clinic staff, was always available for consultation on patient care, and made several trips to the island to examine animals and perform surgeries. We also thank Dr. Kristi Krause who provided surgical assistance when Dr. Vickers was not available.

Annie Little of the U.S. Fish and Wildlife Service provided great assistance on many facets of the program, including organizing communication among all the cooperating groups to ensure that the project ran smoothly. We thank Jennifer Boyce of NOAA and the Montrose Council for her insights in development of the overall program, and Lisa Wolfe-Kolb of the California Department of Fish and Game for her assistance in some of the interagency communications and agreements.

We thank Grace Smith of the U.S. Navy for all of her tireless efforts to make the program a success on San Nicolas Island, including arranging for space for the trailer clinic, setting up housing, manifesting flights, dealing with access issues, and everything else required to make life work on the island.

We worked closely with the staff of Island Conservation, and thank Brad Keitt, Chad Hanson, and the rest of their island-based staff for their partnering with us during the entire project. David Will provided data collected on fox captures that allowed to us maintain a good history of all of the animals captured on the island for long-term monitoring.

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