Camp Shelby Field Office
The Nature Conservancy
2006 Annual Report

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Acknowledgements

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We look forward to continuing with these projects and starting new projects in 2007.

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APPENDICES (ATTACHED FILES):

1.0 GOPHER TORTOISE RESEARCH AND MANAGEMENT

1.1 Wastewater Treatment Facility Tortoise Relocation Summary

As part of the United States Fish & Wildlife Service's May 18, 2006 Biological Opinion, all gopher tortoise burrows within the construction area of a new Wastewater Treatment Facility (WTF) were assessed for activity, trapped, and excavated to remove all individuals from the area. Sixteen gopher tortoise burrows were identified at the construction site during surveys; all were examined in late May 2006 for signs of activity and scoped using a remote camera system. Seven were classified as abandoned, and nine classified as either active or inactive (Figure 1.1-1). Traps were set at the nine active/inactive burrows: seven traps on 6/2/06 (burrows R2348, R2757, R2758, E2581, E2582, E2585, and an unmarked burrow); one trap on 6/3/06 (burrow R2350); and one trap on 6/4/06 (burrow R2349). All traps were checked twice daily, and traps were re-set when a tortoise was captured.

A new relocation site was established 4.4 km west of the construction site, and five abandoned burrows within a colony of approximately 20 adult tortoises were identified to be the release burrows (Figure 1.1-2). The area was given a prescribed burn in the spring of 2006, and wire fences (40' diameter) were constructed around each of the five release burrows, where relocated tortoises were to be penned for at least seven days.

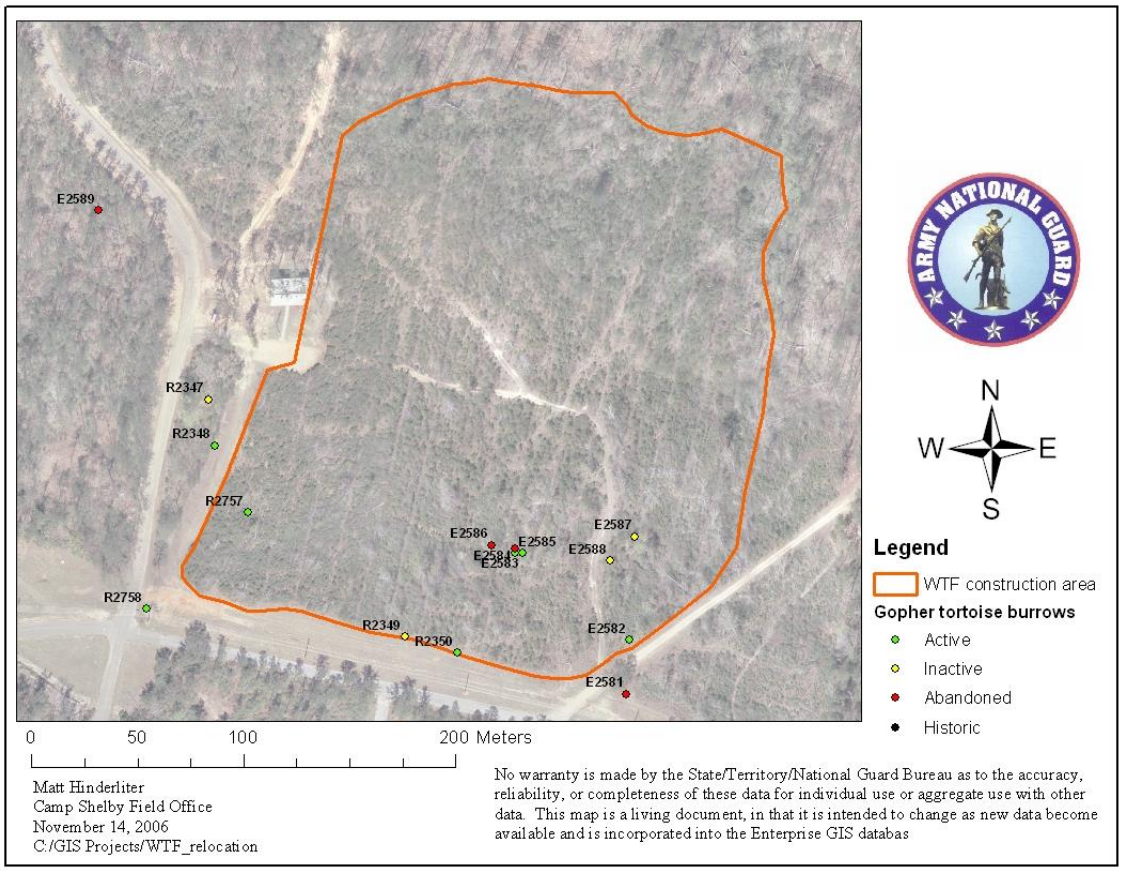


Figure 1.1-1. Locations of the Camp Shelby Wastewater Treatment Facility construction area and affected gopher tortoise burrows.

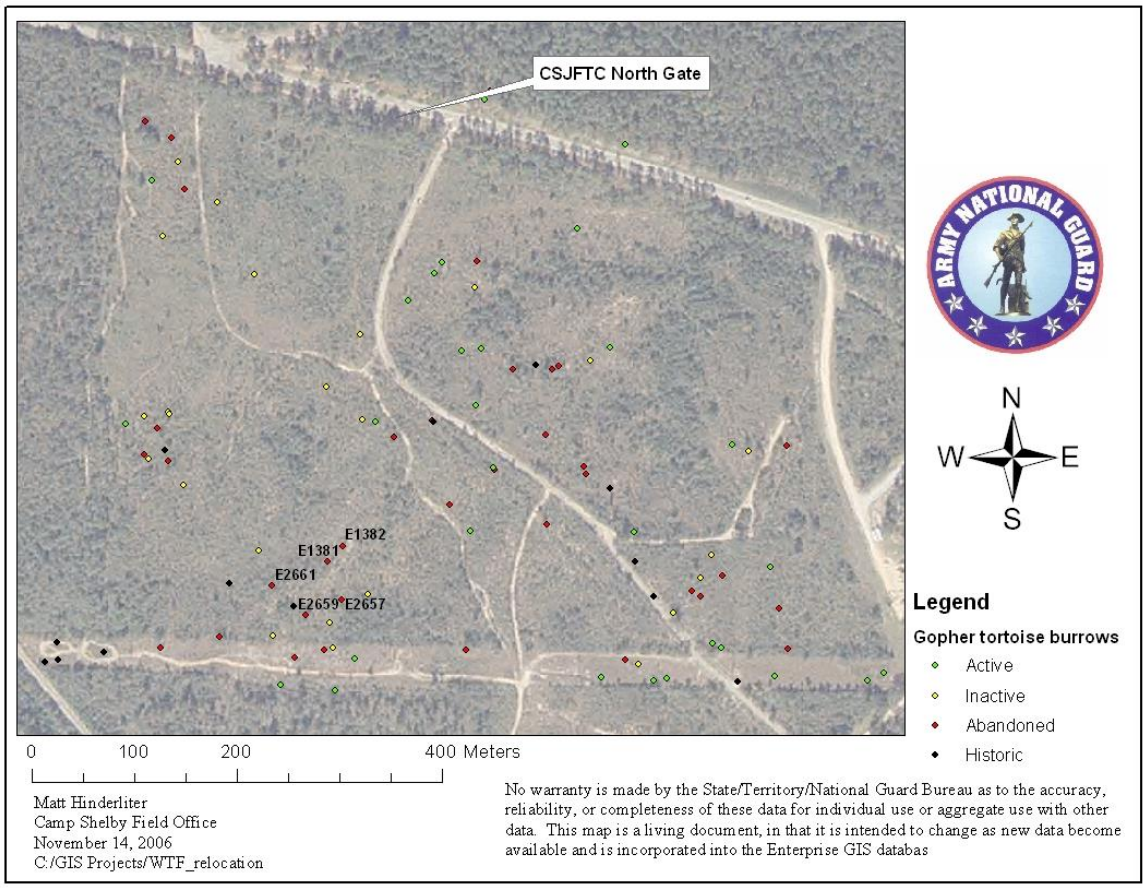


Figure 1.1-2. Location of release burrows for relocated gopher tortoises from Wastewater Treatment Facility construction site.

Capture timeline

- Tortoise R1 (female) was captured at burrow R2758 on 6/4/06, and was relocated to burrow E2661 on 6/5/06.
- Tortoise R2 (male) was captured at burrow R2348 on 6/5/06, and was relocated to burrow E2659 on 6/7/06.
- Tortoise R3 (male) was captured at burrow E2585 on 6/10/06, and was relocated to burrow E1381 on 6/12/06.
- Tortoise R4 (female) was captured at burrow R2348 on 6/17/06, and was relocated to burrow E1382 on 6/19/06.
- On 6/21/06 (19 days after initial traps were set), all nine burrows were scoped. No tortoises were seen in any of the burrows, so all traps were removed. At burrow E2581, a tortoise had been heard inside several times, but the configuration of the burrow would not allow the burrow camera in more than ~10ft. A bucket trap was placed in the apron of this burrow, to try a different method of capture. Sticks were placed in the ground at the entrances of all nine burrows, to document any movements in or out of the burrows.

- On 6/27/06, no sticks from any of the nine burrows had been disturbed, and nothing had been trapped in the bucket, so burrows R2350, R2349, R2348, R2347, R2757, E2581, and E2582 were excavated. Prior to excavation, burrow aprons were probed and dug up to look for eggs; none were found. Burrow R2757 had apparently flooded and collapsed ~15ft. in. Tortoise R5 (male) was removed from burrow E2581, and the only other vertebrate inhabitants were two *Peromyscus* spp.; one each from burrows R2350 and R2349. Since burrow R2758 was in close proximity to fiber optic cables running in the powerline, it could not be excavated. Therefore, it was scoped (the end of the burrow was definitively reached) and then collapsed.
- On 6/28/06, burrow E2585 was excavated (no vertebrates found); burrows E2583, E2584, E2586, E2587, E2588, E2589, and the unmarked burrow were collapsed. Tortoise R5 was relocated to burrow E2657 on 6/29/06.
- On 7/11/06, results from the tortoise plasma testing were received from the University of Florida *Mycoplasma* Research Lab. All five of the relocated tortoises and 18 of the 20 resident tortoises tested seronegative for presence of *Mycoplasma* antibodies; the other two residents had suspect results. After consultation with Will McDearman from USFWS, we decided to open up the relocation pens and re-test the two suspect animals at a later date.
- On 7/13/06, the pens around burrows E2661 and E2659 were completely removed. These were the pens around tortoises R1 and R2, which had been penned for 37 days and 36 days, respectively. On 7/14/06, the pens around burrows E1381 and E1382 were opened to allow free movement in and out of the penned area. These were the pens around tortoises R3 and R4, which had been penned for 32 days and 24 days, respectively. On 7/31/06, the pen around burrow E2657 was opened; this was the pen around tortoise R5, which had been penned for 32 days.

All relocated gopher tortoises will be radio-tracked for one year. If during that time any individual is located outside of the colony boundary, it will be trapped, re-penned at one of the release burrows for a period of at least four weeks, and re-released. As of December 2006, none of the five relocated individuals has moved outside of the colony boundary, although several have dug new burrows.

1.2 Effects of Military Training and Habitat Quality on Gopher Tortoises

In 2005 we initiated a collaborative project with the Oak Ridge National Laboratory (ORNL) and the United States Army Corps of Engineers Construction Engineering Research Laboratory (CERL) to work with gopher tortoises (*Gopherus polyphemus*) on the Camp Shelby Joint Forces Training Site (CSJFTC). Objectives of the ORNL collaborative research were to determine: 1) if the health of organisms is being impaired by environmental factors from military and non-military sources; 2) if observed effects are due to military activities; and 3) if so, can such effects be related to the type and magnitude of specific military activities. For the CERL collaborative research project, the primary objective of the study is to determine the effects of military training activities and associated sound levels on the activity patterns and movement rates of

gopher tortoises. Projects are complementary and should provide valuable information regarding military impacts on gopher tortoises. Progress of the CERL project is summarized in Appendix 1a (Use of Automated Radio Telemetry to Monitor Gopher Tortoise
Response to Military Training on Camp Shelby, MS). Sample collection and processing of gopher tortoise data for the ORNL project are summarized below. Results will be presented at a later date when analyses are complete.

Sample collection and processing

At each of the 20 sample sites (two treatments had 4 replicate sites and four treatments had 3 replicate sites), live traps were placed at the entrance of each active burrow. Burrow camera surveys were first conducted using underground scoping techniques to determine which burrows on each of the 20 sample sites harbored gopher tortoises. Active burrows, or those containing a tortoise, were identified to confirm that a tortoise was present before a live trap was placed at the entrance. Traps were placed at each burrow in late afternoon and checked at mid-morning and mid-afternoon of the following day. Population estimates for each site and treatment type were obtained based on the catch statistics and number of active burrows on the site. This population estimate included the number of tortoises that were actually captured at each site along with the burrows that were identified as active from the camera burrow scoping surveys.

Immediately upon capture, blood samples were taken in the field from the brachial vein using heparinized syringes and the blood samples and tortoises then transported to a central processing facility (laboratory) on the base. At the laboratory, basic morphological statistics were taken on each tortoise and recorded on field data sheets including total weight, total length, plastron length, thoracic height, and width of anal scutes. The sex of each tortoise was also determined and, for females, additional procedures were preformed to determine their reproductive condition. Females with eggs were given an injection of oxytoxin to induce egg laying, and the deposited eggs were then placed in trays in a constant temperature incubator in the laboratory for the purpose of ultimately determining hatching success and hatchling survival. Females that did not respond to the oxytoxin injection were taken to a local veterinarian and full-body X-rays taken. The X-rays were used to determine clutch size (number) and egg quality (size) by measuring the short and long dimensions of each egg shown on the X-ray.

In the laboratory, blood samples were processed and some immunological analyses were conducted on site. Each blood sample was processed and divided into several aliquots and prepared for a variety of analysis to be performed at a later time including (1) hematology (blood smears for differential cell counts and basic hematological analysis), (2) immunological and corticosteroid stress hormone analysis including the bacterial killing assay which was performed on site, (3) serum chemistry profile analysis, (4) reproductive hormones, (5) biomolecular analysis including indicators of DNA damage and oxidative stress, (6) population genetics, and (7) upper respiratory tract disease (URTD). The sample analysis completed to date for this report includes the hematological, immunological and stress hormones, and URTD, along with the reproductive biology and population level analysis. Analyses of serum chemistry,

biomolecular markers, reproductive hormones, and population genetics are currently being conducted.

Sample analysis

Hematology - The hematocrit or percentage of whole blood composed of red blood cells was determined by the microhematocrit tube method. Blood cell differentials or the complete blood count (CBC) was accessed by smearing two drops of blood on a microscope slide, drying, and counting the number of leucocytes (white blood cells) and the different types of leucocytes including lymphocytes, monocytes, eosinophils, basophils and heterophils. Cell differential counts were performed on two male and two female tortoises from each sample site.

Blood chemistry profile -Whole blood was centrifuged and the remaining serum was transferred to separate vials, labeled, and frozen for later analysis. The following analyses are being performed on serum samples using a standard clinical blood analyzer to generate a blood chemistry profile for each tortoise: (1) indicators of electrolyte homeostasis including phosphorus, calcium, magnesium, sodium, potassium, chloride, bicarbonate, anion gap, NA/K ratio, and osmolality, (2) an indicator of carbohydrate metabolism and general stress (glucose), (3) indicators of protein metabolism (total protein, albumin, globulin, alb/glob ratio), and (4) indicators of tissue/organ dysfunction (urea nitrogen, uric acid, bilirubin, alkaline phosphatase, aspartate aminotransferase or AST, lactate dehydrogenase or LDH, creatine kinase, and gammaglutamyl transferase or GGT).

Immunological response: The bacterial killing assay - This procedure measures the ability of the immune system to destroy pathogens in the blood using a bactericidal or phagocytic assay. Whole blood collected from the field was diluted to 1:50 in CO_2-independent media and *E. coli* (ATCC 8739; Microbiologics, USA) was diluted to 1:1000 using sterile phosphate buffered saline (PBS). A total of 140µl of diluted blood was mixed with 10µl of diluted bacteria. A total of 50µl of this combined blood/bacteria solution was spread onto individually labeled trypticase soy agar plates (BD Diagnostic systems, USA) at 0 and 60 minutes post-mixing. Two control plates of CO_2-independent media with diluted bacteria (no blood) were used. All plates were incubated at 37°C for 24 hours. Colonies of *E. coli* were then visually counted and recorded.

An index of the bactericidal (phagocytic) ability of the blood was calculated that assigns large positive values to tortoises with increased phagocytic activity against the bacteria, and negative values to tortoises whose blood had little or no phagocytic activity, which in some cases resulted in an increase in bacterial colonies due to growth instead of elimination during incubation. By incorporating the control measures, this index also takes into account bacterial die-off within each assay that may have been caused by factors unrelated to the blood's bactericidal ability.

Adrenal stress hormone response - The glucocorticoid hormones or corticosterone are good indicators of chronic or sublethal stress (Rice and Arkoosh, 2002). Baseline cortisol or corticosterone was measured in the blood of tortoises collected from each site.

In the laboratory, male tortoises also received an IP injection of adrenocorticotropic hormone (ACTH) to stimulate the adrenal cortex to produce cortisol (e.g., the ACTH challenge test). Four hours following injection, a small blood sample (200 µl) was taken from each male tortoise and cortisol was again measured. The difference between the initial (baseline) cortisol levels and that produced from the ACTH challenge is a measure of the ability of the immune system of the tortoise to respond to environmental stressors, with a high response indicating a healthy immune system.

Upper respiratory tract disease (URTD) - An aliquot of the blood (serum) collected from tortoises in the field was sent to the Department of Infectious Diseases and Pathology, College of Veterinary Medicine, University of Florida to analyze for the presence of *Mycoplasma agassizii,* which is the etiological agent of chronic upper respiratory tract disease in the gopher tortoise (Brown et al. 1994). An enzyme-linked immunosorbent assay (ELISA) was used for the detection of *M. agassizii*-specific antibodies in the tortoise and was developed with a monoclonal antibody with specificity for the tortoise immunoglobulin light chain (Brown et al. 1999).

1.3 Low Hatching Success in Eggs of Gopher Tortoises in South Mississippi

Due to low hatching success of gopher tortoise eggs in the DeSoto National Forest of south Mississippi including the CSJFTC special use permit, the Camp Shelby Field Office has worked with Dr. Carl Qualls, of the University of Southern Mississippi to investigate biological and environmental factors responsible for this low hatching success. Summary of research progress and preliminary results by Dr. Qualls is provided in **Appendix 1b** (Intrinsic Causes of Low Hatching Success in Eggs of Threatened Gopher Tortoises in South Mississippi).

1.4 Incubation of Gopher Tortoise Eggs

As part of the ORNL study on CSJFTC (see Section 1.2), gravid female tortoises that were ascertained to be ready to oviposit were induced with oxytocin so that the eggs could be collected on-site and immediately transferred into an incubator. This aspect of the study had two purposes: 1) to determine the reproductive success of each female; and 2) to provide hatchlings for the headstarting study (see Section 1.4). Additionally, eggs from nests that were found in the field at our study sites (and were determined to be recently oviposited) were also transferred into incubators.

Methods

To ascertain gravidity, all captured adult females were palpated for presence of eggs. Additionally, they were checked for a slight flexibility in the plastron between the femoral and abdominal scutes, indicative of readiness to oviposit. Although the ultrasound that was supposed to be used to determine readiness was malfunctioning, we were able to radiograph 60 of the 76 females to determine presence and number of eggs.

Induction and egg handling procedures were determined from conversations with Dr. Tom Ricks, Dr. Lori Wendland, and Paula Kahn. Females that were determined to

be ready to oviposit were first given an intramuscular injection of calcium gluconate, at a dosage of 1ml/kg. The injection was given in the proximal forelimb, in the triceps brachii muscles, and was split between the forelimbs. Thirty minutes after this injection, they were given Oxytocin (also at a dosage of 1ml/kg) in the same area as the Ca gluconate injection. This was split between the two forelimbs as well. Each injected female was placed in a clean kiddie pool with fresh hay. Oviposition typically began within 90 minutes post-injection, and took up to five hours. Since all injected females had previously been radiographed, we knew beforehand how many eggs to expect. Eggs were caught by hand to make sure the females did not break them, and sometimes it was necessary to lift up the back of the carapace to get to the egg. On four occasions, additional Oxytocin injections were necessary to induce oviposition; in two out of the four occasions, the females never passed their eggs. These two females were radiographed again to ensure that the eggs were not causing any blockage or distress, and the females were subsequently released. All three eggs in one induced female's clutch broke when she tried to oviposit, and there was another female who broke one of her six eggs while ovipositing. All eggs were cleaned, weighed, measured (a maximum diameter and the diameter perpendicular to the maximum), and given an identification number with a grease pencil. The orientation of the egg was maintained throughout measuring and marking. Eggs were placed into a container containing a mixture of one part vermiculite : one part distilled water (by weight), making sure that at least ¾ of the egg was covered. All the eggs of a single clutch were put into the same plastic container, and sometimes several small clutches would get combined in one container. Between May 2, 2006 and June 20, 2006, the eggs from 18 clutches were placed in incubators:

- 42 eggs from 10 clutches from induced females
- 41 eggs from 8 clutches dug up in the field

Information on environmental conditions of the incubators, as well as substrate and egg maintenance, was obtained from the literature (Spotila *et al*. 1994; Burke *et al*. 1996; Demuth 2001; Rostal and Jones 2002) and from personal communications (Dr. Carl Qualls; Dr. Lori Wendland; Krista Noel; Paula Kahn; Ray Ashton). A constant-temperature incubator was purchased for the study (Lyon Electric, model Profi-R), and set at a temperature of 29.3°C. This temperature has been documented in the literature as resulting in a 50:50 sex ratio, and the temperature of the incubator did not fluctuate more than ± 1.0°C during incubation. Humidity inside the incubator was maintained between 70-80% by filling trays at the bottom of the unit with distilled water. Eggs were initially misted every three days with distilled water, but when it appeared that several were starting to grow mold, the misting schedule was reduced to every seven to ten days. All the containers had plastic wrap loosely stretched over them for the first ⅔ of the incubation; the wrap was removed after that to allow for sufficient oxygen exchange to the developing embryos.

Results

The incubation study was not successful; only two of the 83 incubated eggs hatched, and these two eggs were from a clutch that was excavated 57 days post-oviposition. Therefore, all eggs (both from induced females and from field nests) that

were in an incubator for the duration of incubation failed to hatch. Once a reasonable period of time had passed (maximum documented incubation at CSJFTC is 109 days), all eggs were dissected to look for signs of fertilization. Thirty-four of the 83 eggs had discernible embryos at various stages of development (11 from induced eggs, 23 from dug up eggs). Therefore, adding the two hatchlings, there were at least 36 fertilized eggs out of a total of 83 (43.4%). Interestingly, as has been seen in hatching studies by USM on CSJFTC, most of the clutches showed either a complete failure (9 out of the 18 clutches had no eggs with embryos) or complete "success" (5 out of the 18 clutches had embryos in all eggs). Obviously we cannot say with certainty that all fertilized eggs would have hatched under optimal conditions, but it is still a supporting observation to previous results.

Almost all of the dissected eggs appeared to have severely desiccated, which supports a hypothesis that the eggs were not misted adequately or frequently enough. Since the literature repeatedly documents using the same temperature, substrate, and humidity that we used, these variables do not appear to be the issue. One theory to explain the hatch failure is that the embryos were developing normally until the plastic wrap was removed from the containers. At that point, the eggs should have been misted more frequently due to an increased loss of moisture; without their moisture barrier, they dried out quickly. From extensive discussion, this theory was supported by Dr. Carl Qualls and Dr. Deborah Epperson. However, another contributing theory was brought to light from discussions with Dr. Dave Rostal in October 2006. He speculated that an additional factor with the induced eggs was that the females were forced to oviposit earlier than they would have naturally, and that an additional protective layer would have been added to those eggs that would have made them less susceptible to water loss.

Future Research

We are examining the procedures for acquiring hatchlings in the summer of 2007, to augment the headstarting population already in place. Since induction may have contributed to hatching failure, we will not be inducing any more females. Several other options exist, all of which are being currently considered:

- locate newly-deposited nests in the field, dig them up, and put them in the incubator
- locate newly-deposited nests in the field, place nest protectors over them, and monitor the nests at hatching time
- locate newly-deposited nests in the field, place nest protectors over them, leave them in the ground for ~ 60 days, then transfer the eggs and surrounding soil to a container in the incubator. The rationale behind this is that the eggs were developing in that substrate already, and the initial time has passed when the embryos can be harmed by being moved (D. Rostal, pers. comm.).

All incubation procedures will be revisited prior to addition of tortoise eggs, through additional literature searches, professional communications, and, hopefully, trials with purchased reptile eggs.

1.5 Headstarting Gopher Tortoise Hatchlings

Most estimates of pre-adult gopher tortoise mortality rates have come from multi-year burrow survey comparisons and telemetry studies of hatchlings. Mortality rates of hatchlings have been documented as 90 - 100% in two years in Mississippi and Florida, with the most common cause of mortality being predation. This fall we started a 3-5 year headstarting study on CSJFTC, using a modified predator-proof hatchling pen modeled after the juvenile desert tortoise hatchery at Edwards Air Force Base. The design of the pen should prohibit any mammalian, fire ant, snake and raptor predation. Each year, some of the yearlings/juveniles will be released to their point of origin and radio-tracked, which should provide valuable information on: 1) growth; 2) home range; 3) burrow use and construction; 4) movement patterns; and 5) cause and extent of mortality. Since adult gopher tortoises are not considered prey for most of the hatchling predators, there must be a size threshold in the younger age classes that, when reached, reduces their susceptibility to these different types of predation. These predation questions will be addressed in the study, as well as questions of site fidelity.

Enclosure construction

In August 2006, construction began on the six-foot chain link fence that acts as the primary support for the enclosure. The 250m fence encloses an area of 2082m^2, and is located near the North Gate of the CSJFTC Cantonment Area (Figure 1.5-1). Once the fence was completed, CSFO staff dug a trench under the fence and installed four-foot-high ¼" mesh hardware cloth at a depth of 8-10". The hardware cloth was attached to the chain-link fence and curved outward at the top to prevent mammalian and snake predators from easily entering the enclosure (Figure 1.5-2a). The small mesh size was chosen to prevent the lethal entanglement of snakes. Additionally, ½" mesh bird netting was stretched over the top of the enclosure, attached to the chain-link fence top rails, and supported inside the enclosure with poles (Figures 1.5-2b). The enclosure was completed in October 2006. Prior to release of hatchlings, the entire area was treated with fire ant bait. This included the area inside the enclosure as well as a 25ft. buffer around the perimeter, following USDA recommendations. Initially, fire ant mounds were spot-treated separately from the broadcast application, and any mounds discovered within the area during the study will be spot-treated.

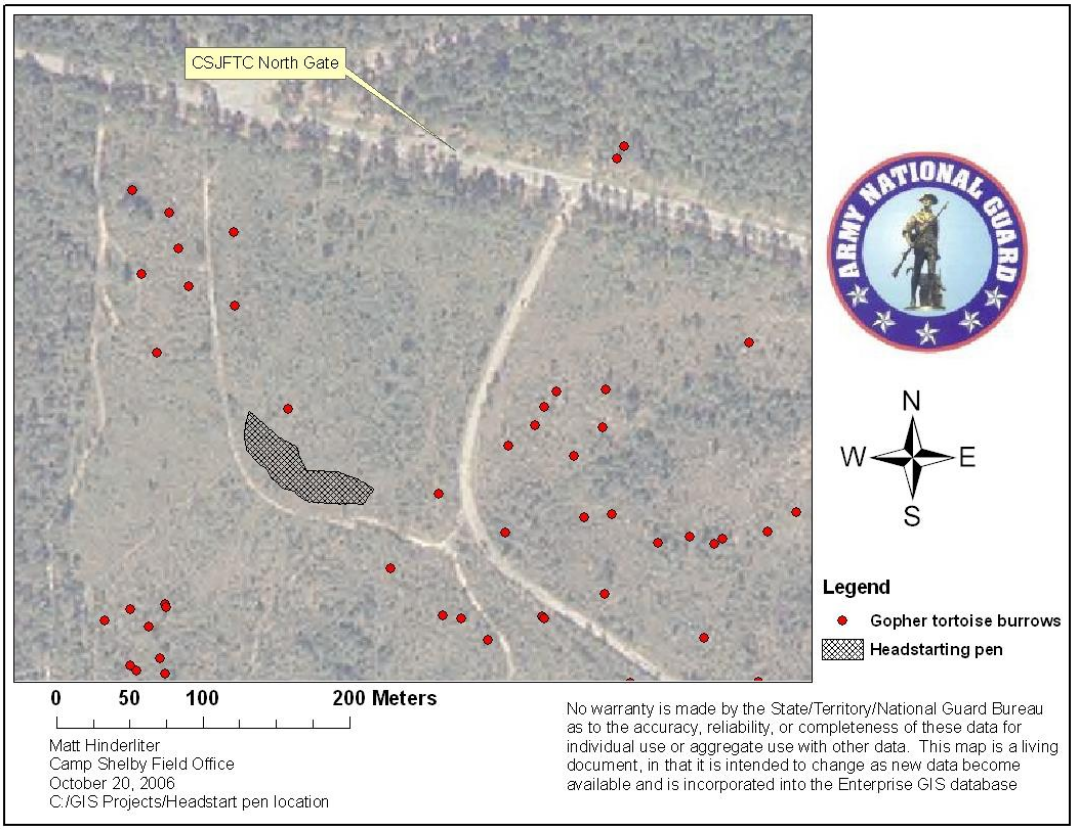


Figure 1.5-1. Location of the gopher tortoise hatchling headstart enclosure

a)  b) 

Figures 1.5-2a & 1.5-2b. Photographs showing the design of the gopher tortoise hatchling headstart chain-link enclosure, with curved-out hardware cloth (a), and bird netting (b).

Hatchling care

Gopher tortoise hatchlings were acquired from: 1) the ORNL egg incubation project detailed in Appendix 1.a (*N* = 2); 2) the USM tortoise genetics project detailed in Section 1.2 (*N* = 28); and 3) hatchlings discovered in the field that were determined to be neonates (*N* = 1). All hatchlings were measured (weight, carapace length, maximum width, maximum thickness, plastron length), then again every 2-3 weeks after that to ensure that they were gaining weight. They were each given identification marks by notching the marginal scutes. Since the headstarting enclosure was not completed by the time most of the tortoises hatched, they were held on-site at the CSFO until the enclosure was finished (maximum holding time was 51 days). Hatchlings were kept in a kiddie pool filled with sand, were supplied with several large pieces of bark under which to hide, and had heat lamps set up over one end of the pool that cycled between visible light during the day and black light at night (Figure 1.5-3).

Figure 1.5-3. Gopher tortoise hatchling pool at feeding time, showing positioning of heat lamps and cover bark.

The following protocol was developed to care for hatchlings based upon information gathered from the literature and discussion with experts (Table 1.5-1). Fresh food was replaced at least every other day, and consisted of minced romaine lettuce, minced kale, and wild grasses/legumes that have been documented as good tortoise forage in the literature. Food was distributed around the pool and then the tortoises were observed until it was determined that all of them were eating. All hatchlings were submerged halfway in warm tap water every 2-3 days for 10-15 minutes, and all food preparation equipment and holding containers were disinfected between uses.

In addition, within the first few days, hatchling tortoises were also offered scat from adult tortoises that had tested negative for URTD. This was due to a theory (Tom Mann, pers. comm.) that young tortoises may ingest scat in the wild to establish proper digestive flora and fauna. All hatchlings that encountered scat in the pool ingested some.

Every day, the following things were checked: 1) heat lamps functioning properly; 2) ample water in dish; 3) no animals flipped onto their backs; and 4) temperature in the building between 73-88°F. If temperature was near one extreme, appropriate measures were taken (opening outside door, turning on/off AC, etc.).

Hatchling release and monitoring

Prior to release, measurements were taken again on all hatchlings, and then they were each fitted with a 0.1g radio frequency identification (RFID) tag on the fifth vertebral scute using waterproof epoxy (Figure 1.5-4). Great care was taken to ensure that the seams between scutes were not bridged, which could potentially result in shell deformities. At release, the lightest hatchling weighed 24 grams, so at most the RFID tags represented 0.4% of the total body weight of each animal.

Figure 1.5-4. Gopher tortoise hatchling with an RFID tag attached

Starter burrows were installed inside the headstarting enclosure by burying half-pipe PVC pieces (Figure 1.4-5a). Hatchlings were then released into the starter burrows on October 4 & 5, 2006 (Figure 1.4-5b). Using an RFID tag reader (similar in reception range to a metal detector), hatchlings can be located and identified from approximately 10-15" away. As of December 2006, 16 of the 31 hatchlings released have remained in one of the starter burrows.

Table 1.5-1. Summary of literature and expert opinions regarding care of tortoise hatchlings.

From: Demuth, J. P. 2001. The effects of constant and fluctuating incubation temperatures on sex determination, growth, and performance in the tortoise *Gopherus polyphemus*. Canadian Journal of Zoology 79: 1609-1620. "Hatchlings were housed in individual plastic boxes without lids. Full-spectrum heat lamps were set on a 12 h light: 12 h dark cycle and the temperature fluctuated from 31 ± 2°C during light hours to 22 ± 2°C during dark hours (~ 71-88°F). The small water dish initially provided to each hatchling was rarely used for purposes other than hiding under, so the dishes were removed when hatchlings were between 3 and 5 months of age. After that time, all tortoises were soaked weekly for 1 h in large tubs containing 4–6 cm of water. ...food consisted of a mixture of carrots, broccoli, spinach, and commercial iguana pellets fed ad libitum. I replaced uneaten food with fresh food every other day."
From: Spotila, J. R., Zimmerman, L. C., Binckley, C. A., Grumbles, J. S., Rostal, D. C., List Albert, J., Beyer, E. C., Phillips, K. M., & Kemp, S. J. 1994. Effects of incubation conditions on sex determination, hatching success, and growth of hatchling desert tortoises, *Gopherus agassizii*. Herpetological Monographs 8: 103-116. "After hatching, tortoises were raised in plastic containers (35 x 40 x 15cm) and fed three times a week. They ate a mixture of carrots, broccoli, spinach, and lettuce that was blended with a palletized version of an iguana diet, and was provided ad libitum. Containers were washed with water and food dishes were washed with a mixture of bactericidal soap, bleach, and hot water three times a week. Hatchlings were washed with water to remove fecal material and dried food from their skin and shell. Containers were kept in a room at 30 ± 2°C. Fluorescent lights were suspended 40cm above the containers and maintained on a photoperiod of 12:12::L:D. Tortoises and their containers were examined three times a week for general health, evidence of feeding activity, and presence of feces and urine."
From: Paula Kahn (personal communication) "For the hatchlings, after they pip, leave them in the incubator for 2-3 days until they absorb most of their yolk. When you decide they're ready to be moved because they have absorbed a lot of their yolk, I put them in an aquarium lined with reptile sand. I put a very shallow swiming pool on one side and an upside down shoe box with an entrance on the other side to serve as a makeshift burrow. I also sat a heating lamp on a screen cover on top of the aquarium on one side so they could move in and out of the heat. It is really important to soak them every day for the first 3-4 weeks after they hatch (after they absorb the yolk). Usually, I soaked them in warm water in a long shallow rubbermaid bin and then I placed them in another bin full of greens (mostly kale with some endive and romaine lettuce). I sprinkled calcium powder on the greens and whatever they didn't finish, I put in the cool side of the aquarium so they could graze later (I cleaned out the aquarium every day while they were soaking). You can soak them every other day after the first 3 or 4 weeks, and progressively make it so you only soak them once a week, but it's really important to soak them frequently early on so you can make sure they are healthy, and eating well. You can start giving them berries and prickly pears as treats after a couple of months. I also kept a black heat lamp on them at night in case they got cold (I had the two lamps on timers, both on top of the aquarium). The best food source for them is kale but they prefer romaine lettuce which is less nutrient rich."
From: Dr. Lori Wendland (personal communication) "Soak hatchlings in room-temperature tap water once a week; feed them leafy greens, change food every other day."

a)  b) 

Figures 1.4-5a & 1.4-5b. Photographs of starter burrows inside the gopher tortoise hatchling headstarting enclosure (a), and of one of the hatchlings being released into a starter burrow (b).

1.6 Update of Gopher Tortoise Database

Surveys for gopher tortoise burrows were conducted within areas as requested by the MSARNG. Additionally, sites from the ORNL and CERL studies (Section 1.2) have been surveyed extensively in 2006 to ensure that all individuals at each site were sampled. At the start of 2006, there were 7,451 burrows identified in the SDE Geodatabase in the MSARNG.DBO.fauna_special_species_point file (including historic entries). There were 213 burrows added to the geodatabase in 2006, bringing the total number of burrows documented on CSJFTC to 7,664.

2.0 LOUISIANA QUILLWORT MONITORING

Our office has been responsible for monitoring Louisiana quillwort (LAQ), *Isoetes louisianensis*, colonies in the Poplar Creek watershed south of the Multi-Purpose Range Complex – Heavy (MPRC-H) construction box. This monthly monitoring was initiated in December 1999 after quillworts were discovered in Poplar Creek, Range 43, and Range 45.

Permanent Plots

Seven permanent plots consisting of an upstream and a downstream quadrat ($0.5m^2$) for counting and measuring growth of quillworts are monitored monthly. Initially these plots were intended to document possible negative impacts from construction of the MPRC-H and training activities in upstream ranges (40-45) if such impacts began to occur. The site 6 colony is also monitored monthly to provide data on LAQ outside the influence of the MPRC-H and Range 45 training and maintenance, but still within the Poplar Creek watershed. Photographs are taken. Number of visible LAQ and maximum leaf length for selected quillworts are recorded for each plot.

Quillwort did not reemerge on the upstream plot at site 4 or both plots of site 1 which had been buried under leaf packs in the previous years. Nor did quillwort reemerge at the downstream plot of site 6. Plants in the downstream plot on site 1 declined from 3 to 1 and then 0 plants. Plants have not reappeared in plots 1d and 2d since they disappeared in 2005. Although no plants were documented in the Bridge plot in 2005 after channel cutting in 2004, new plants have been documented in the Bridge plot this year. Site 5 plots were not monitored due to high water resulting from a beaver dam downstream. Evidence of herbivory (clipped leaf tips) was occasionally observed.

Trees were cut within the drainages of Sites 2, 3 and 4 on Range 45 for line of sight clearance in April 2003. New plants were observed in plot 3d, but otherwise numbers in permanent plots are generally declining. Plants in and outside of plots in cutover areas appear vigorous.

MPRC-H was officially opened in December 2005. LAQ within the Poplar Creek watershed did not appear to decline as a result of MPRC-H construction activities, since LAQ numbers and growth in Bridge and Site 2 colonies followed a similar pattern to LAQ in Site 6 plots (Figure 2.0-1).

Precipitation for 2006 was 136.7 cm which was lower than that received in 2005 (140.8 cm), 2004 (193.7 cm), 2003 (206.5 cm), 2002 (185.6 cm), and 2001 (205 cm), but higher than what was received in 2000 (103 cm). No 24-hour rainfall events of greater than 10.2 cm (4 inches) occurred in April 2004.

Colony Counts

On April 1 and 5, 2006 a census of quillworts at colony 1,2,3, 4, 6 and the bridge were counted before trees were cut for line of sight on Range 45. Quillwort numbers were higher than in 2005 with the exception of the bridge and colony 3 site (Table 2.0-1). The many windthrows within site 6 from Hurricane Katrina does not appear to have

negatively impacted quillwort; nor did burning in and near colonies on Range 45 (colonies 2,3, and 4).

Trees and shrubs were cut and removed for the full extent of the stream channels containing colonies 3 and 4 in April 2003. Trees and shrubs were also cut and removed for the upstream portion of colony 2 in April 2003, but woody vegetation was left intact over the downstream portion. For the cutover sites, colony 3 and 4 numbers were still low compared to years prior to 2004; but numbers were increasing for colony 4 and colony 2 LAQ numbers were greater than number recorded in 2004 (Table 2.0-1).

Future Monitoring

Established monitoring procedures will be continued throughout 2007.

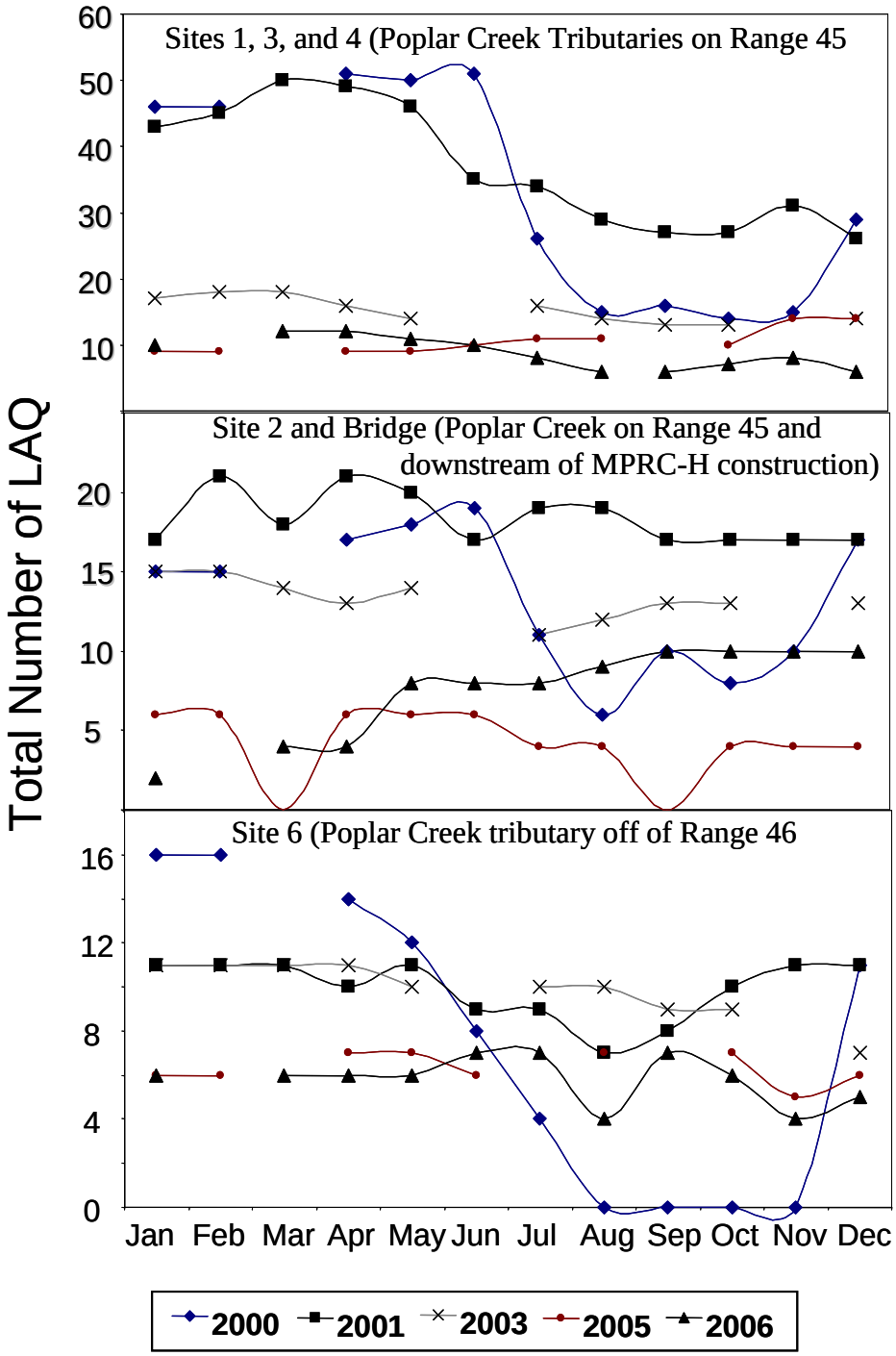


Figure 2.0-1. Total number of Louisiana quillwort counted monthly from 2000-2006 in permanent plots located in Poplar Creek watershed. Site 5 plots were excluded as they became inundated from beaver activities in the watershed midway through 2000.

Table 2.1 Number of Louisiana quillworts counted for colonies within the Poplar Creek watershed, Ranges 43-46, CSJFTC, Mississippi. Counts previous to April 2001 were performed by Steve Leonard; counts for April 2001 and after were performed by Lisa Yager, Brian Mitchell, CJ Sabette and Steve Leonard.

	Colony 1	Colony 2	Colony 3	Colony 4	Colony 5	Colony 6	Bridge
July-99	25	150	25	260	109	400	16
November-99	37	141	7	268	78	*	16
January-00	*	*	*	*	*	464	*
April-00	44	200?	24	*	*	*	*
April-01	36	192	11	274	beaver	472	37
May-02	27	*	21	*	beaver	*	*
January-02	*	202	25	210	beaver	*	40
April-02	13	213	29	232	beaver	489	44
April-03	13	242	32	274	beaver	555	46
April-04	14	387	54	142	beaver	589	28
April-05	9	309	35	148	beaver	501	31
April-06	15	467	29	176	beaver	697	18

3.0 CAMP SHELBY BURROWING CRAYFISH

Based upon the Camp Shelby Burrowing Crayfish (CSBC), *Fallicambarus gordoni*, Candidate Conservation Agreement, USFWS has removed CSBC from the federal list of candidates for listing as threatened or endangered. Under terms of this agreement the MSARNG and USFS have agreed to monitor populations and manage habitat for CSBC. CSFO has assisted the MSARNG with this process by monitor habitat and populations of CSBC. CSBC are generally associated with current or historical pitcher plant wetlands. Therefore decreases in herbaceous abundance and increases in woody abundance are indicators that habitat quality is declining. Abundance and condition of pitcher plants would also be an indicator of habitat quality. To determine effects of habitat change and management on CSBC, it is important to monitor the species itself. Therefore, in order to evaluate habitat conditions at known locations of CSBC and determine trends in CSBC populations in association with habitat change we continued to collect habitat and burrow density data at 30 plots established in August 2004 or February 2005. Sampling protocols are described below. Because directly sampling CSBC would likely be destructive to individuals and their habitat, changes in burrow densities is used as an index of changes in populations. Burrow densities were sampled in February/March 2006. Habitat data was collected in August 2006. Data attached in excel spreadsheet: CSBC 2006 Habitat Monitoring.xls.

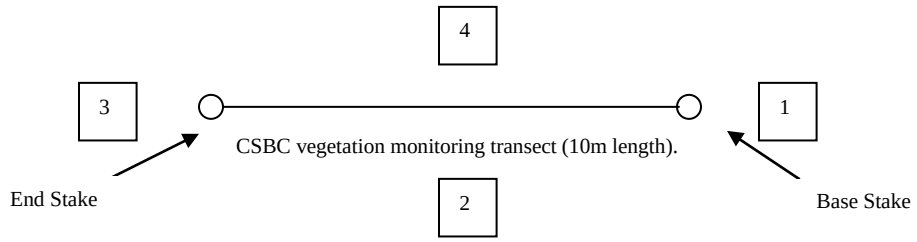
Habitat Protocol

A 10 m transect was oriented to cross wetland habitat at each location and ends were permanently marked with rebar. To estimate percent cover of groundcover, we recorded presence of bareground, litter, and vegetation functional groups every 0.5m along the transect. Vegetation functional group variables were: forbs, graminoids (grasses and grasslikes), vines, shrubs, and pitcher plants. Presence of pitcher plants in the area, regardless of whether they were encountered along the transect, was noted; and abundance and condition (evidence of shade effects-compressed tube, poorly developed hood, light green color with no red streaks, etc.) were described. Midstory cover was estimated by recording length of intersection of shrubs/trees between 1 and 3.5m in height with transect. At midpoint of transect, basal area was estimated using a wedge prism (basal area factor 10) and canopy cover was estimated using a densiometer. Evidence of soil disturbance (ATV use, etc), sedimentation, fire, and water status of area was documented. Finally, the sample location at the plot was photographed.

CSBC Monitoring Protocol

Camp Shelby Burrowing Crayfish monitoring quadrats ($1m^2$) were located 2m from the CSBC vegetation monitoring transect base stake, end stake and either side of the transect midline (i.e. 5m). See diagram below. Quadrat corners were marked with pin flags. Within each quadrat the number of chimneys and burrows were counted. A CSBC chimney is a mound, whereas a burrow is a mere hole (or what is observed when a chimney is removed). Because quantifying the number of mounds and burrows within

the quadrats may be biased by the observer's interpretation, two people performed a count for each quadrat and the average was taken.



CSBC Burrow Densities

Mean burrow densities in Feb/Mar 2006 ($\bar{x}$ = 13.6) were similar to the previous year ($\bar{x}$ = 10.9). Habitat differed little between years as indicated by August 2004 and 2005 habitat sampling which may be why densities were stable.

Habitat Condition

There was no evidence of sedimentation or soil disturbance from human activities at any of the plots. None of the plot sites had been burned in the previous year. Three of the plots had a few downed trees from Hurricane Katrina nearby and salvage operations were evident in uplands for some sites. However, overall Katrina appeared to have had minimal impact within these crayfish habitats.

The majority of the plots (86%) had > 30% herbaceous ground cover indicating that conditions are probably somewhat favorable for CSBC. A little over a third of the plots (37%) had > 50% shrub groundcover. From August 2005 to August 2006, mean shrub cover for the plots increased from 31% to 40% . To prevent further encroachment of shrubs, burning needs to be implemented as soon as possible (this year) for most sites and then regularly thereafter. The CSBC Candidate Conservation Agreement indicates that burning will occur on a 2-3 year interval. Accordingly, over 2/3 of the plot sites should be burned some time this year and any of the plots would benefit from it.

Katrina is probably responsible for the decrease in sites with canopy cover greater than 50% from August 2005 to 2006. Canopy cover was still greater than 50% in 26% (8) of the plots indicating that thinning may be needed in those sites to maintain the open conditions considered favorable to CSBC. Thinning should be followed by a prescribed fire as soon as the slash from removal is dry enough to remove scattered slash and prevent shrub and hardwood encroachment. I would suggest prioritizing pine removal in wetlands in the following USFS compartments in this order: 70, 81, 71, 73, 74, 56, 54, 62, and 57.

4.0 COGONGRASS RESEARCH AND CONTROL

Accidentally and intentionally introduced into the United States in the early 1900's, cogongrass, *Imperata cylindrica*, has since invaded natural ecosystems such as sand hills, flatwoods, and hammock edges and become a serious weed problem in pastures, plantations, mine sites, and roadsides throughout the southeastern United States (Shilling et al., 1997). Cogongrass occurs on Camp Shelby Joint Forces Training Center and Desoto National Forest in Mississippi in a wide variety of habitats (e.g. roadsides, training sites, pine forests, and wetlands) and is widespread throughout the local area along roadsides and in pastures and pine plantations. Its continued spread threatens military training operations, the habitat of the federally-listed-as-threatened gopher tortoise, and other biologically significant areas.

In 2006 CSFO continued efforts to assist with control of this invasive species. We added to the Cogongrass GIS database developed by our office by mapping newly-found cogongrass patches as they were encountered. CJ Sabette treated 34.5 acres of cogongrass with herbicide and posted new infestations of cogongrass on military training areas. In addition, our office assessed effects of herbicide treatments applied in previous years.

2004 Herbicide Treatment Assessment

Control of cogongrass was initiated in 2004 within T43, T44, T19 and T28 using either a 2% mixture of glyphosate and 6% mixture of BASF OneStep® Herbicide (0.5016% imazapyr and 1.3278% glyphosate active ingredients). All known cogongrass patches were treated in T44 (Gopher Tortoise Refuge), T43, and T19 and a large portion of T28 was also treated. Unfortunately in 2005, many patches were not re-treated due to Hurricane Katrina. A few patches did receive a second treatment and infestations on several firing points were treated for the first time in 2005. Herbicide was applied using handsprayers attached to ATV or backpack mounted tanks.

In late summer, 2006, cogongrass control and regrowth of other vegetation were assessed in 62 cogongrasss patches treated with OneStep in 2004 or 2005. Patches were surveyed and cover of each species present within the 2004 spray boundary was estimated in 25% increments. If cogongrass regrowth was noted, then location of regrowth (patch edge, center, or both) and pattern of regrowth (small clumps, uniform throughout patch) was also recorded. This was done to assess whether regrowth was the result primarily of missing the patch edge or other factors. At patch edges a few sparse cogongrass shoots might be missed if mixed with other vegetation or may have been present in the soil, but not emerged above ground at time of spraying. Pattern of regrowth may be important for determining effort needed to retreat patches.

In August-September, 2005, we evaluated 30 patches treated in 2004. Of these 30 patches, 37% percent showed no regrowth of cogongrass. Cover of cogongrass in the remaining patches was much less than 25% and was generally in a few, fairly small clumps. Results were similar in the 62 patches evaluated this year. Thirty-three percent had no regrowth and, where regrowth occurred, regrowth was < 25% of the area treated and was in a few small patches. Seven patches of cogongrass were treated in both 2004 and 2005. Of these patches, 4 experienced regrowth of cogongrass. Again regrowth

consisted of a few shoots of cogongrass. Obviously monitoring treated infestations is important if this weed is to be eradicated from a site.

At least 166 plant species were found in the treated patches (Table 4.0-1). Most were native species; however some were exotic pests. Plant species richness within treated patches ranged from 10 to 46 species/patch. Species that exhibited > 25% cover at one or more treated areas include: *Paspalum notatum*, *Chamaechrista fasciculata*, *Croton capitatus*, *Rubus* spp. (probably *R. trivialis*), *Diodia teres*, *Eupatorium capillifolium*, and *Tridens flavus.*

Table 4.0-1 Plant species documented in late summer/early fall 2006 sampling in 62 cogongrass patches treated with herbicide in fall 2004 or summer 2005. Frequency indicates the % of patches which contained a species. Non-native origins are indicated by an e; invasiveness is indicated by an i. An asterisk indicates that it can be invasive in natural areas.

Species	Frequency (%)	Species	Frequency (%)
Acalypha gracilens	3.23	*Digitaria sanguinalis*	3.23
Acer rubrum	1.61	*Digitaria* spp.	35.48
Agalinis fasciculata	25.81	*Diodia teres*	25.81
Allium bivalve	1.61	*Diodia virginiana*	8.06
Ambrosia artemisiifolia	35.48	*Diospyros virginiana*	35.48
Aristida purpurescens	1.61	*Echinochloa colona*	1.61
Asclepias spp.	6.45	*Elephantopus elatus*	1.61
Aster adnatus	6.45	*Elephantopus tomentosus*	9.68
Aster dumosus	40.32	*Erigeron strigosus*	30.65
Aster patens	17.74	*Erigeron* spp.	3.23
Aster tortifolius	17.74	*Eryngium yuccifolium*	6.45
Aster spp.	29.03	*Eupatorium album*	1.61
Baccharis halimifolia	8.06	*Eupatorium capillifolium*	64.52
Brachiaria ramosa	8.06	*Eupatorium compositifolium*	35.48
Callicarpa americana	9.68	*Eupatorium pilosum*	19.35
Carex spp.	6.45	*Eupatorium rotundifolium*	8.06
Carya tomentosa	4.84	Eupatorium spp.	1.61
Ceanothus americanus	4.84	*Euphorbia corollata*	9.68
Chamaecrista fasciculata	56.45	*Euphorbia* spp.	9.68
Chamaesyce spp.	12.90	*Euthamia tenuifolia*	33.87
Cirsium spp.	17.74	*Gaillardia aestivalis*	1.61
Clitoria mariana	3.23	*Galactia volubilis*	4.84
Cnidoscolus stimulosus	4.84	*Galium pilosum*	1.61
Conoclinium coelestinum	16.13	*Gaura filipes*	1.61
Conyza canadensis	67.74	*Gaylussacia* spp.	1.61
Coreopsis major	6.45	*Gelsemium sempervirens*	1.61
Coreopsis tinctoria	3.23	*Geranium* spp.	3.23
Crotalaria purshii	3.23	*Gnaphalium obtusifolium*	45.16
Crotalaria sagittalis	8.06	*Gymnopogon brevifolius*	3.23
Croton capitatus	38.71	*Helianthus angustifolius*	8.06
Cucumis melo	3.23	*Helianthus radula*	4.84
Cyperus spp.	1.61	*Helianthus* spp.	1.61
Dactyloctenium aegyptium	1.61	*Hibiscus aculeatus*	12.90
Desmodium ciliare	20.97	*Hypericum gentianoides*	48.39
Desmodium viridiflorum	8.06	*Hypericum hypericoides*	16.13
Desmodium spp.	1.61	*Hypericum* spp.	8.06
Dichanthelium spp.	17.74	*Hyptis alata*	1.61

Table 4.0-1 (continued) Plant species documented in late summer/early fall 2006 sampling in 62 cogongrass patches treated with herbicide in fall 2004 or summer 2005. Frequency indicates the % of patches which contained a species. Non-native origins are indicated by an e; invasiveness is indicated by an i. An asterisk indicates that it can be invasive in natural areas.

Species	Frequency (%)	Species	Frequency (%)
Ilex glabra	25.81	*Pycnanthemum* incanum.	6.45
Ilex vomitoria	22.58	*Quercus falcata*	4.84
Ipomoea spp.	3.23	*Quercus laevis*	1.61
Jacquemontia tamnifolia	1.61	*Quercus marilandica*	1.61
Lactuca canadensis	4.84	*Quercus* spp.	8.06
Lechea minor	1.61	*Rhexia alifanus*	11.29
Lechea mucronata	1.61	*Rhus copallina*	33.87
Lespedeza cuneata	32.26	*Rhynchosia reniformis*	11.29
Lespedeza hirta	6.45	*Rhynchosia tomentosa*	1.61
Lespedeza striata	12.90	*Rubus* spp.	72.58
Lespedeza virginica	1.61	*Rudbeckia hirta*	3.23
Liatris squarrosa	6.45	*Ruellia caroliniensis*	3.23
Licania michauxii	3.23	*Ruellia pinetorum*	1.61
Linum medium	3.23	*Salvia azurea*	14.52
Liquidambar styraciflua	9.68	*Sambucus* spp.	1.61
Lobelia puberula	3.23	*Schizachyrium scoparium*/ *Andropogon* spp.	75.81
Lonicera japonica	4.84	*Schizachyrium tenerum*	14.52
Lygodium japonicum	6.45	*Schrankia microphylla*	1.61
Mikania scandens	19.35	*Scleria* spp.	3.23
Muhlenbergia capillaris	8.06	*Senna obtusifolia*	1.61
Myrica cerifera	17.74	*Sesbania* spp.	4.84
Nyssa biflora	1.61	*Setaria glauca*	6.45
Osmunda regalis	1.61	*Setaria parviflora*	8.06
Oxalis stricta	33.87	*Smilax glauca*	9.68
Panicum anceps	17.74	*Smilax laurifolia*	3.23
Panicum verrucosum	6.45	*Smilax pumila*	3.23
Panicum virgatum	1.61	*Solanum* spp.	1.61
Panicum spp.	64.52	*Solidago altissima*	53.23
Parthenocissus quinquefolia	1.61	*Solidago odora*	29.03
Paspalum dilatatum	1.61	*Solidago rugosa*	16.13
Paspalum floridanum	6.45	*Sonchus* spp.	1.61
Paspalum notatum	62.90	*Spiranthes* spp.	3.23
Paspalum urvillei	54.84	*Stylosanthes biflora*	29.03
Paspalum spp.	6.45	*Symplocos tinctoria*	6.45
Passiflora incarnata	1.61	*Tephrosia florida*	27.42
Physalis spp.	4.84	*Tephrosia virginiana*	27.42
Pinus palustris	11.29	*Toxicodendron radicans*	12.90
Pinus taeda	40.32	*Tragia smallii*	11.29
Pityopsis graminifolia	16.13	*Trichostema dichotomum*	33.87
Polygala nana	6.45	*Tridens flavus*	4.84
Polypremum procumbens	25.81	*Vaccinium arboreum*	12.90
Prunus serotina	4.84	*Vaccinium darrowii*	6.45
Pteridium aquilinum	4.84	*Verbena brasiliensis*	27.42
Pycnanthemum albescens	3.23	*Verbena rigida*	8.06

Table 4.0-1 (continued) Plant species documented in late summer/early fall 2006 sampling in 62 cogongrass patches treated with herbicide in fall 2004 or summer 2005. Frequency indicates the % of patches which contained a species. Non-native origins are indicated by an e; invasiveness is indicated by an i. An asterisk indicates that it can be invasive in natural areas.

Species	Frequency (%)
Viola pedata	1.61
Viburnum dentatum	1.61
Vitis rotundifolia	4.84
Wisteria sinensis	1.61
Unk Forb	4.84
Unk Sedge	4.84
Unk Graminoid	1.61

2006 Treatment

In 2006, we treated approximately 184 patches of cogongrass totaling 34.5 acres with 6% solution of BASF OneStep® Herbicide using an 18-ft. boom sprayer attached to the back of the Polaris Ranger 6 X 6 or a nozzle sprayer attached to the back of a Honda ATV (Table 4.0-2 and Figure 4.0-1). Application rates were approximately 24 ounces of imazapyr/acre and 55 ounces of glyphosate/acre.

Table 4.0-2. 2006 cogongrass treatment on CSJFTC by training area. Patches were treated with a 6% solution of BASF OneStep® Herbicide (active ingredients: glyphosate and imazapyr).

Location	Firing Point	# Patches	Total Acres
July			
State Lands near Armory		5	0.37
August			
Cantonment		1	0.69
State Lands near Armory		4	0.50
T-19		6	1.10
T-28	517	4	1.05
T-44	116	1	0.46
T-44/South Tank Trail		66	4.84
September			
East Air to Ground		8	7.57
T-40	509	4	0.50
T-46	196	13	0.44
October			
ASP		2	2.91
Cantonment		1	0.19
East Air to Ground		1	3.31
T-28	503	1	0.47
	514	8	2.77
T-32	77	2	0.03
	78	1	0.07
T-34	511	3	0.71
	512	6	0.59
T-40	508	9	1.00
	509	4	0.23
West Grapevine Road		13	0.57
November			
T-10	136	1	0.08
T-11	130	1	0.35
	131	1	0.09
T-25	68	2	1.20
T-26	126	6	1.30
	84/85	2	0.29
T-33	65	1	0.07
West Grapevine Road		6	0.78
Total		183	34.51

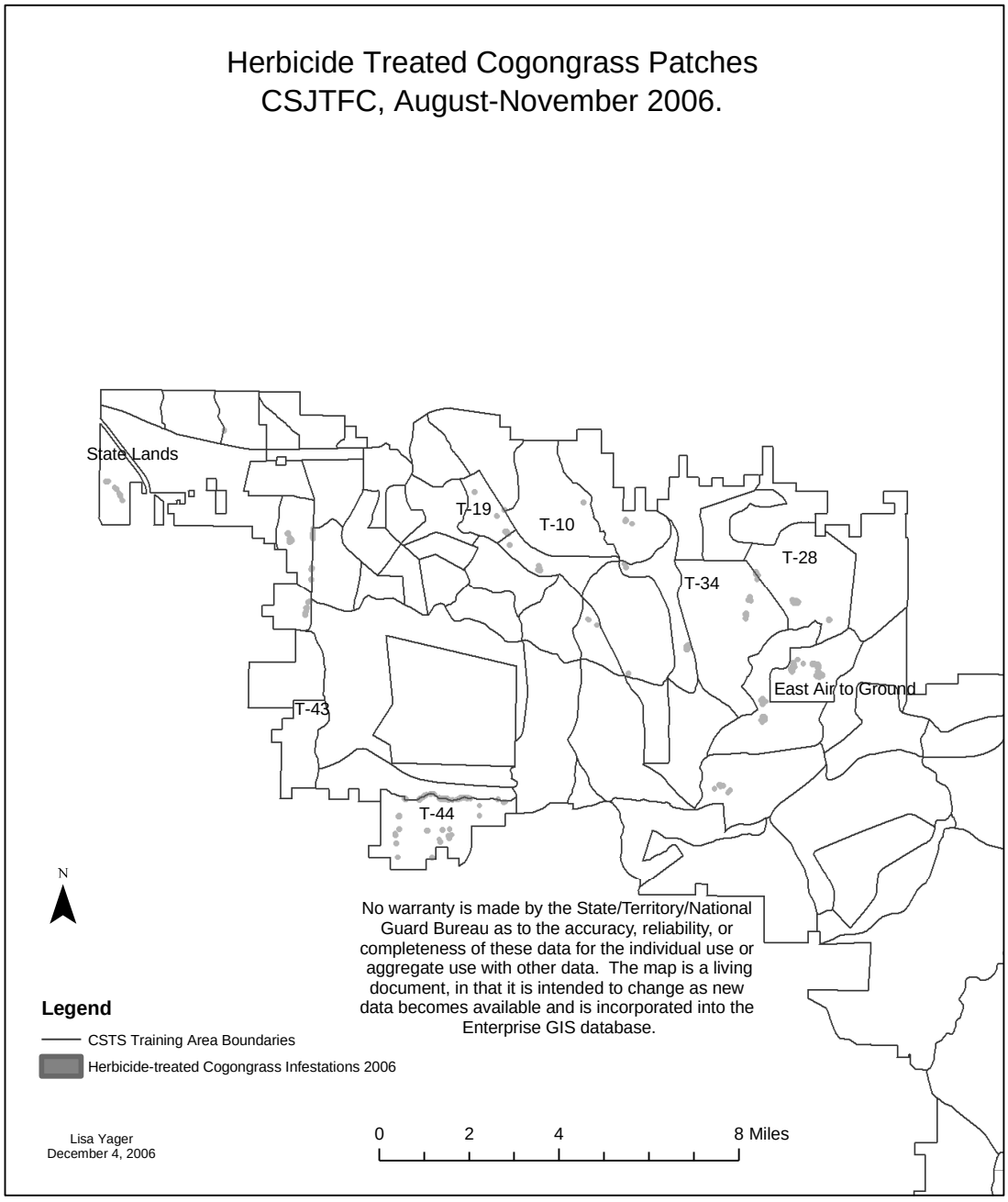


Figure 4.0-1. Location of cogongrass infestations treated with One-Step® Herbicide on CSJFTC in late summer/early fall 2006.

5.0 BLACK PINESNAKE

In 2004 an investigation into the movement patterns and habitat utilization of the Black Pinesnake (*Pituophis melanoleucus lodingi*) was initiated on the Camp Shelby Joint Forces Training Center (CSJFTC), and this project has continued through 2006. A description of the project's scope, general Black Pinesnake background information, and the pre-existing state of knowledge pertaining to *P. m. lodingi* for a variety of topics (*i.e.* General Captures, Radio-telemetry, Food Items, Parasitology, and Seasonal Activity), as well as the methodologies employed for those topic areas were reported in the TNC CSFO 2005 Annual Report and are not repeated here in. This report merely presents our 2006 findings for the major topic areas (as they relate to the previous year's), comments on the significance of these findings, and discusses additional and future projects pertaining to the topic area.

5.1 General Captures

In 2006 15 (8 M: 7 F) new pinesnakes were captured and marked (*i.e.*, scale clip and PIT tag), and two individuals (1 M captured earlier in 2006 and 1 F originally captured in 2005) were recaptured. As in 2005, the majority of the pinesnakes found this year were captured in traps (Table 5.1-1). Additionally, the newly developed trap design (first described in the 2005 Annual Report) accounted for 87.5% of the pinesnake trap captures in 2006 (85% of the total pinesnake trap captures in 2005); again supporting the inference that the longer the trap the better the chances of capturing a pinesnake.

Table 5.1-1. Capture method and number of *Pituophis melanoleucus lodingi* found on the Camp Shelby Joint Forces Training Center from 2004 - 2006. C.M. = capture method, M = male, F = female, U = unknown, AOR = alive on road, DOR = dead on road, Field = incidental field captures, YP = yearly percentage, OP = Overall percentage. (N = 49).

	2004				2005			2006			All Years			
C.M.	M	F	U	YP	M	F	YP	M	F	YP	M	F	U	OP
Road														
AOR	1	1	2	25%	0	4	22%	1	3	27%	2	8	2	25%
DOR	2	1	0	19%	2	0	11%	1	0	6%	5	1	0	12%
Trap	2	2	0	25%	3	7	56%	4	2	40%	9	11	0	41%
Field	2	3	0	31%	0	2	11%	2	2	27%	4	7	0	22%

The fact that 33% of all the pinesnakes found crossing the road over the past three years were found dead on the road (DOR) is quite disturbing (6 of 18 individuals), as is the fact that these six individuals represent 12% of all the pinesnakes found from 2004 - 2006 (Table 5.1-1). Of the pinesnakes found crossing roads, the majority (of both AOR and DOR individuals) were found during the last two weeks of May – first two weeks of June (Figure 5.1-1); a time period when Black Pinesnakes are known to breed (J. Lee, Unpublished data), and corresponds with the peak activity for Black Pinesnakes (both in Mississippi and on Camp Shelby, See 2005 Annual Report). This time period may also

correspond with increased traffic patterns on the Camp Shelby Joint Forces Training Center as a result of

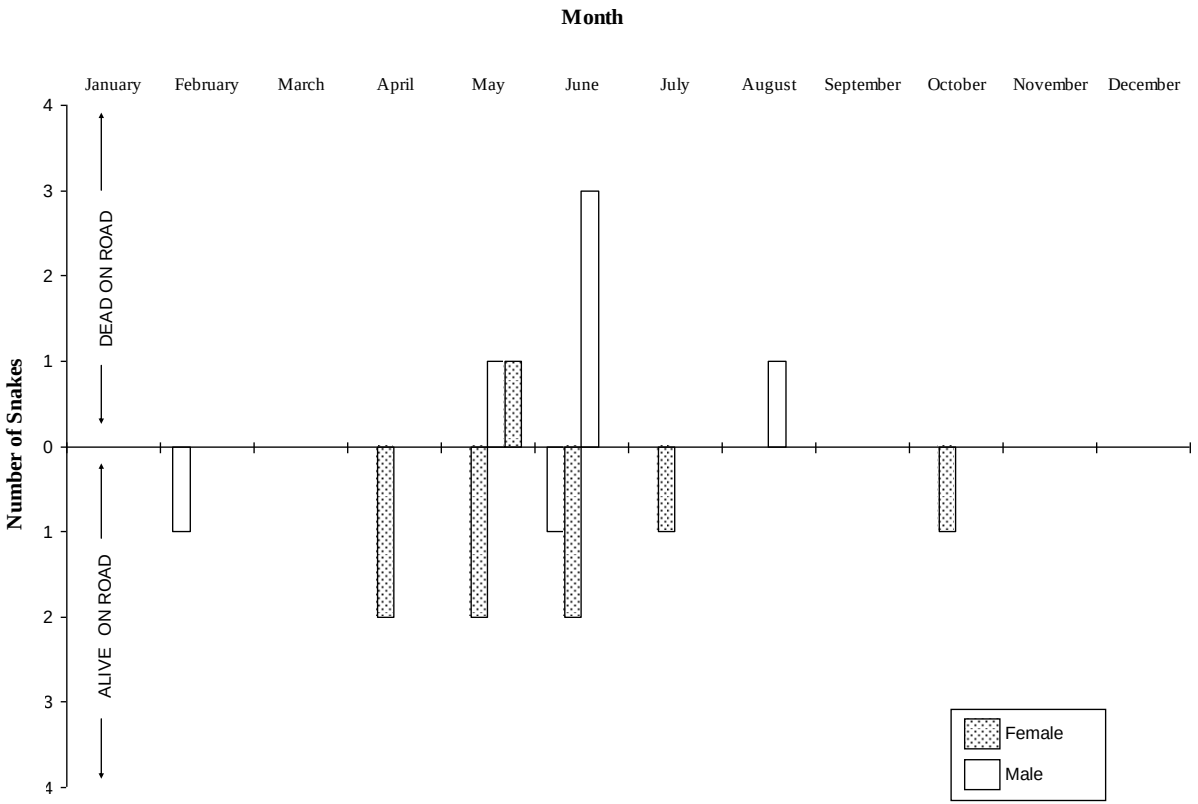


FIG. 5.1-1: Number and sex of *Pituophis melanoleucus lodingi* found either dead on the road (top section) or alive on the road (bottom section) by month on the Camp Shelby Joint Forces Training Center, Mississippi from 2004- 2006 (See Text). n = 16.

annual training (but more data is needed). It is very disconcerting to see that of the 10 snakes found crossing the road during the breeding season, only 50% were found AOR (Figure 5.1). The effects that roads have upon the Black Pinesnake population on Camp Shelby and in southern Mississippi warrant further investigation. Efforts to minimize the impact of roads (*e.g.* fences in conjunction with culvert pipes, or road closures) should be taken if the animals' long-term viability is valued.

In the 2005 Annual report four size/ age classes for Black Pinesnakes (*i.e*. Hatchling = < 55 cm, First Year = 56 – 85 cm, second year = 86 – 119 cm, and Adult > 119 cm) were identified based upon the published literature for other pinesnake species; however, as a result of the growth rate data collected from individuals recaptured this year, and the growth patterns exhibited by the pinesnakes implanted with radio transmitters these age/ size classes designations need to be reconsidered. While analysis of these data are still pending it can safely be assumed that Black Pinesnakes do not reach sexual maturity until after their fourth, possibly fifth year of life under natural conditions (total length of 134.1 -146.7 cm).

5.2 Radio-telemetry

Seven (2 M: 5 F) pinesnakes were implanted with radio-transmitters in 2006, bringing the total number of individuals that have been surgically implanted up to 23 (6 M: 17 F). Average home-range sizes for male and female snakes are not presented in this report, since these data are pending further analysis.

While a few problems associated with the surgical implantation of radio transmitters were experienced (*e.g*., internal migration of radio transmitter in two individuals, See 2005 Annual report), we have been afforded the opportunity to make a number of observations upon wild pinesnakes that would have otherwise been very difficult or impossible to make without implanting transmitters. Such observations include: the latest known seasonal instance of mating for any wild pinesnake species (Lee, *In Press*), the duration of the black pinesnakes breeding season (Lee, *In Prep*), male combat and dominance behavior during the breeding season (Lee, *In Prep*), Tree climbing behavior exhibited by pinesnakes (Olsen and Lee, *In Press*), Carrion feeding (Lee, *In Press*). Additionally, radio-telemetry has allowed us to identify two predators of the black pinesnake (raccoon and Red-tailed hawk), and has helped us quantify the impact that predation events have upon adult pinesnakes in this population [8.7 – 17.4% of our 23 individuals have been predated primarily during the winter months (J. Lee unpublished data]. We have also been able to get an idea of how stochastic and anthropogenic events (*i.e*., hurricane Katrina and salvage operations, respectively) effect the black pinesnake population; however, more data is needed to truly determine the effects that timber harvests and other various management activities may have upon these snakes.

From our telemetry work we have discovered that individual Black Pinesnakes show an exceptionally high degree of site fidelity; the behavior of returning repeatedly to the same location within or among seasons. This suggests that the removal or destruction of even one of the 50 or so rotted pine stumps that an adult snake may use over the course of a year may be detrimental to the individual, and in turn may negatively impact the local population. The movement patterns of Snake #3 are a good example of how management activities may indirectly affect a pinesnake's behavior (Figure 5.2-1). Snake #3, a male, was surgically implanted with a radio transmitter on 1 August 2004, released at his point of capture on 2 August 2004, and his movement patterns have been monitored three times a week since. In 2004 he

remained in the Active area (*i.e*. shelterwood) until late September 2004, before moving southeast (south of South Tank Trail Extension) (Figure 5.2-1). He made a few short distance movements during October 2004, before moving 1000+ m east to the point where he eventually hibernated in a small rotted out pine stump hole (Figure 2; In-active area, red dot). The In-active area was a much denser stand of pines ($\bar{x}$ canopy closure = 92.5%; range = 85 – 100%), with very little understory, and a thick midstory, compared to the Active area ($\bar{x}$ canopy closure = 42.5%; range = 0 – 100%; dense understory, and moderate midstory). The snake emerged from hibernation in mid February 2005, but remained within the In-active area until late March 2005, and then made another long distance move northeast back to the Active area. For the most part he remained in the Active area until late September 2005, and then he repeated the same movement patterns exhibited the previous fall/ winter (utilizing a number of the exact same stump holes that

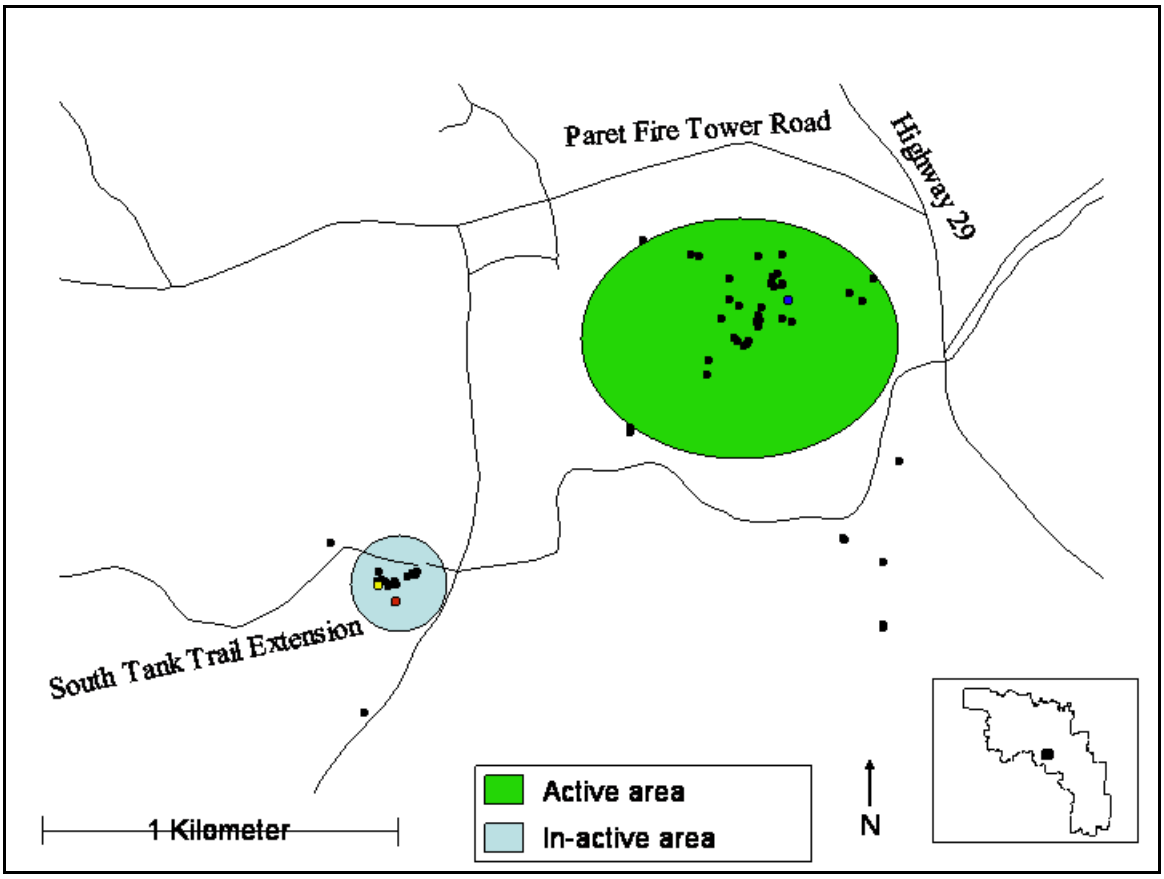


FIG. 5.2-1: Movement patterns exhibited by Snake #3 from 2004 -2006. Red dot = Winter hibernacula 2004-2005; Yellow dot = Winter hibernacula 2005-2006; Blue dot = Winter hibernacula 2006-2007. Note: the "In-active Season" area was subject of an intensive salvage operation during the winter of 2005-2006 (see text).

were used the previous year during his migration), ultimately returning to the In- active area where he hibernated in a larger rotted pine stump hole, 30 m from the previous hibernacula (Figure 5.2; yellow dot). As a result of hurricane Katrina the canopy closure of the In-active area was greatly altered, however the thick mid-story remained. When the damaged trees in the area were salvaged in early (January or February) 2006 the midstory was removed and the spot where

the snake hibernated was scrapped down to the mineral soil. The snake emerged from hibernation in late February 2006, and then moved immediately back to the Active area (no lingering as in the previous year). In September 2006 it was thought the snake would again resume the "normal" migration to the In-active area to hibernate, however it never did and he eventually chose a new spot (non-salvaged) in the Active area to hibernate (1.7 Km from his two previous hibernaculas). The snake was found dead on 11 December 2006. The fact that the snake returned to the In-active area in 2005 and remained there throughout the hibernation period, despite Katrina's effects, suggests the area was not rendered unsuitable for hibernation. The immediate movement back to the Active area, after the salvage suggests the area was now "considered" unsuitable. This same general pattern has been exhibited by a number of the telemetered snakes in our study; snakes are hibernating in the same area they used in previous years only if the area has not been salvaged, and other snakes are using new areas to hibernate if their "old" hibernaculas where salvaged.

5.3 Parasitology

In 2005 we initiated a pilot study examining the internal parasites of five Black Pinesnakes (results in the 2005 Annual Report). In 2006 we expanded this project to included 20 snakes (10 M: 10 F), started examining the blood parasites that pinesnakes host and have continued to identify organisms from oral and cloacal swabs. The complete blood count (CBC) for each snake is also determined. These data will be useful as baseline data for future investigations interested in assessing the health of Black Pinesnake populations. Lab results are still pending and should be available for the 2007 CSFO report.

5.4 Genetic Analysis/ Taxonomic Re-assessment

This year we initiated a collaborative research project with the University of Southern Mississippi to examine the phylogenetic relationships among the Eastern Pine Snake clade. This project will allow us to better determine the extent to which *Pituophis melanoleucus lodingi* is evolutionarily distinct from other *Pituophis melanoleucus*, and whether the Black Pinesnake is sufficiently distinct to warrant elevation to specific status [See Appendix 5a, "Re-assessment of the Phylogenetic Relationships among the Eastern Pine Snakes (*Pituophis melanoleucus, Pituophis melanoleucus lodingi*, and *Pituophis mugitus*): A Preliminary Report"].

6.0 PLANT INVENTORY

This MSARNG GIS database of state-listed plant species has grown to 87 species with 775 entries (element occurrences) (Table 6.0-1). Species profiles added during the year are Red Milkweed (*Asclepias rubra*), Bird-beak Chasmanthium grass (*Chasmanthium ornithorhynchum*), LeConte's thistle (*Circium* lecontei), Canby Bulrush (*Schoenoplectus etuberculatus*), Black Highbush Blueberry (*Vaccinium fuscatum*), and Death Camas (*Zigadenus leimanthoides*) (Appendix 6a). A previous entry, Stalked Adder's-tongue (*Ophioglossum petiolatum*), was removed and then re-instated due to its listing as a species of local concern on DeSoto Ranger District. A recent paper on the mint genus *Collinsonia* shows three species present in Mississippi with two species documented from fewer than five counties. These will likely be added to the list of tracked plants during 2007. The new species--awaiting accceptance and designation by NatureServe--of witch-hazel for Camp Shelby (and Mississippi) is expected to be listed by the Natural Heritage Program in early 2007.

Table 6.0-1. Summary of records of occurrences of plant species tracked by the Mississippi Natural Heritage Program on Camp Shelby Joint Forces Training Center in 2006.

Scientific name	# Occurrences	G Rank	MS Rank	USFS
Agalinis aphylla	27	G3G4	S2S3	
Agalinis filicaulis	2	G3G4	S2?	
Agalinis viridis	1	G4?	S2S3	
Agrimonia incisa	17	G3	S3S4	S-C
Andropogon gyrans var. stenophyllus	1	G5T3T4	S1S2	
Aristida condensata	1	G4?	Watch	
Aristida simpliciflora	5	G3G4	S1	S-P
Asclepias rubra	2	G4G5	Watch	
Botrychium jenmanii	10	G3G4	S1S2	S-C
Botrychium lunarioides	2	G4?	S1?	
Calopogon barbatus	21	G4?	S2S3	
Calopogon oklahomensis	7	G4?	S1	
Carex impressinervia	1	G1G2	S1	S-P
Carex picta	6	G4G5	Watch	
Carex tenax	1	G5	S2	
Chamaecyparis thyoides	2	G4	S2	
Chasmanthium ornithorhynchum	1	G4	S1S2	
Chromolaena ivifolia	1	G5	Watch	
Chrysogonum virginianum	6	G5	S3	
Circium lecontei	1	G2G3	S1S2	
Cleistes bifaria	27	G4?	S3	S-C
Collinsonia anisata	1		unlisted	
Collinsonia punctata	2		unlisted	
Coreopsis helianthoides	4	G3G4Q	S1?	

Cornus alternifolia	5	G5	S2	
Dalea carnea var. gracilis	2	G5T3T4	S2S3	
Dichanthelium erectifolium	1	G4	Watch	
Dichanthelium nudicaule	18	G3Q	S2	
Dryopteris ludoviciana	1	G4	S1	
Eleocharis melanocarpa	1	G4	S1	
Eleocharis robbinsii	2	G4G5	S2	
Eleocharis tricostata	1	G4	S1	
Epidendrum conopseum	1	G4	S2	

Table 6.0-1 (continued). Summary of records of occurrences of plant species tracked by the Mississippi Natural Heritage Program on Camp Shelby Joint Forces Training Center in 2006.

Scientific name	**# Occurrences**	**GRANK**	**MS RANK**	**USFS**
Epigaea repens	33	G5	Watch	
Gaylussacia nana	1	G5	S2S3	
Gentiana catesbaei	2	?	unlisted	
Gordonia lasianthus	30	G5	S3	
Hamamelis ovalis	9	*G1*	*S1*	
Hexalectris spicata	1	G5	S2	
Ilex amelanchier	4	G4	S3	
Ilex myrtifolia	7	G5?	Watch	
Isoetes louisianensis	65	G2	S2	E
Juncus gymnocarpus	24	G4	S3	
Lachnocaulon digynum	1	G3	S2	S-C
Lindera subcoriacea	12	G2	S2	S-C
Lycopodiella cernua	2	G5	S2	
Macranthera flammea	22	G3	S3?	S-C
Marshallia trinervia	7	G3	Watch	S-C
Matelea obliqua	2	G4?	S2?	
Melanthium virginicum	62	G5	Watch	
Mikania cordifolia	3	G5	Watch	
Myriophyllum laxum	1	G3	S1	S-C
Nymphoides aquatica	3	G5	S2S3	
Nymphoides cordata	3	G5	S1S2	
Ophioglossum petiolatum	9	G5	S4	
Parnassia grandifolia	13	G3	S2	
Peltandra sagittifolia	31	G3G4	S3	
Pinguicula primuliflora	6	G3G4	S3	S-C
Platanthera blephariglottis	5	G4G5	S2	
Platanthera cristata	2	G5	S3	
Platanthera integra	4	G3G4	S3	S-C
Polygala hookeri	6	G3	S1S2	S-C

Polygala leptostachys	5	G3G4	S1	S-C
Pteroglossaspis ecristata	1	G2G3	S1	S-?
Rhapidophyllum hystrix	6	G4	S3	
Rhynchospora crinipes	1	G2	S1	S-C
Rhynchospora harveyi	1	G4	SNA (P)	
Rhynchospora macra	8	G3	S3	S-C
Rhynchospora stenophylla	11	G4	S2S3	
Ruellia pedunculata ssp. pinetorum	35	G5T3T4	S3	
Sagittaria isoetiformis	2	G4?	S1	

Table 6.0-1 (continued). Summary of records of occurrences of plant species tracked by the Mississippi Natural Heritage Program on Camp Shelby Joint Forces Training Center in 2006.

Scientific name	**# Occurrences**	**GRANK**	**MS RANK**	**USFS**
Sarracenia rubra ssp. wherryi	1	G3T3	S1	
Schisandra glabra	3	G3	S3?	S-C
Schoenoplectus etuberculatus	2	G3G4	Watch	
Selaginella ludoviciana	1	G3G4	S1S2	
Sorghastrum apalachicolense	52	G3Q	Watch	
Stewartia malacodendron	26	G4	Watch	
Stylisma aquatica	2	G4	S1	
Stylisma pickeringii	1	G4	S1	
Tridens carolinianus	31	G3G4	Watch	S-P
Tridens flavus var. chapmanii	15	G5T3T5	Watch	
Triphora trianthophora	1	G3G4	S2S3	
Utricularia olivacea	1	G4	S1	
Utricularia purpurea	1	G5	S2S3	
Uvularia floridana	3	G3	S1	S-C
Vaccinium fuscatum	2	?	unlisted	
Xyris drummondii	4	G3	S3	S-C
Xyris scabrifolia	10	G3	S2S3	S-C
Zigadenus leimanthoides	4	G4Q	S1?	

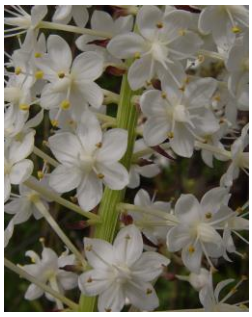
Hamelis ovalis S.W. Leonard

The highlight of the year was publication by the Botanical Research Institute of Texas (BRIT) in its flagship journal, Sida, the scientific description of the big-leaved, red-flowered Camp Shelby witch-hazel, currently known only from the headwaters (6 ravine systems) of Garraway Creek. The colonies are spread intermittently across CSJFTC Training Areas T-16, T-17, T-21, and TA-23 on both US Forest Service and DoD lands (Tract 17).

Other Plant Investigations

In April, Dr. Douglas Goldman, a research associate at Harvard University came to Camp Shelby in mid-month to observe and collect a grasspink orchid, *Calopogon oklahomensis*, that he had described in 1995. The largest population occurs in Range 45 on both sides of Poplar Creek, consists of several hundred plants, and the Camp Shelby colonies (Ranges 45, 48, and 50) are the only extant sites known in Mississippi for Oklahoma grasspink. The species is abundant and widespread in Louisiana and westward.

Goldman mentioned another researcher at Harvard, Chinese botanist Li Jianhua, working on the yellow jessamines, *Gelsemium*, and in May, live material of the two native yellow jessamine species was collected from Camp Shelby and sent to Dr. Li for further study.



During April trips into Range 45 for orchid study and Louisiana quillwort monitoring, the death camas, *Zigadenus* was observed flowering in mid-April. In late May in the same training range another group of death camas flowered. Disparity in flowering dates suggested two different species. Collections were made and sent to authorities in North Carolina for investigation. The issue has not been resolved.

Also in early April in Training Area 13 during rare species surveys for proposed wetland crossings, a single small tree of an unknown buckthorn was found. Specimens were collected on April 27 and sent to a buckthorn specialist at Florida State University. The question of this plant's identity has not been resolved.

A request from US Dept. of Agriculture, ARS, Ft. Lauderdale, FL for live material of water hyacinth from at least two locations was received. This exotic invasive plant is not known to occur at Camp Shelby but specimens were obtained from Ashe Lake on DeSoto National Forest and from an MDOT borrow pit pond in George County.

A climbing milkweed, collected on upper slopes in Ragland Hills in May 1994 by D. Wyrick was tentatively identified as *Matelea obliqua*, an NHP listed species. A few weak, non-flowering and fruiting plants were subsequently found in the vicinity of Wyrick's location. In May 2006 excellent flowering material and young fruiting material was located near the original site but floral characteristics did not fit precisely the published description of *M. obliqua*. An expert at NC State University was contacted who recommended a specialist in Oregon. No action has been taken as of this date.

7.0 ANIMAL INVENTORY

7.1 Amphibian and Reptile Captures

In order to assess the amphibian and reptile diversity of the Camp Shelby Joint Forces Training Center (CSJFTC) a variety of standard methods were used: aquatic traps, terrestrial box traps (See Black Pinesnake General Captures, in 2005 Annual Report), pit-fall traps, calling surveys, cover objects, pedestrian surveys, and road cruising. The goal of this project was to determine what amphibian and reptile species inhabit CSJFTC and then to publish these findings in a peer-reviewed journal so that the information would be readily available for future researchers. All captured snake and turtle species were measured (snout to vent length, tail length; carapace length, plastron length; respectively), weighed to the nearest gram and marked following the procedures described by Brown and Parker (1976) or Cagle (1939). In addition to scale clipping (e.g. Brown and Parker 1976), some adult snake species (*Crotalus adamanteus*, *Farancia abacura*, *Lampropeltis calligaster rhombomaculata*) and most hatchling snakes were implanted with a Passive Integrated Transponder (PIT) tag (AVID). An updated list of the 82 (58% of the states known herpetofauna) reptile and amphibian species that have been documented on CSJFTC from 2004 – 2006 is presented below (Table 7.1-1). The and the number of individual snake and turtle species captured (excluding recaptures) are included. The list includes *Gopherus polyphemus*, although the number of individuals captured is not presented, since the G.T. Biologist reports on these data. The number of individuals captured does not necessarily indicate how abundant the species is; rather it should be viewed more as a reflection of how detectable the species was. This should not be considered a finalized list, and a number of additional species are thought to occur on CSJFTC.

Table 7.1-1. Amphibian and reptile species found on CSJFTC from 2004 - 2006. The number of individual snake and turtle species are given in parenthesis following the common name. Asterisk (*) indicates individuals appear to exhibit characters of more than one subspecies. New species found in 2006 are denoted.

Latin name	Common name
	Anurans
Acris crepitans	Northern Cricket Frog
Acris gryllus	Southern Cricket Frog
Bufo fowleri	Fowler's Toad
Bufo terrestris	Southern Toad
Bufo quercicus	Oak Toad
Gastrophryne carolinensis	Eastern Narrow-mouthed Toad
Hyla avivoca	Bird-voiced Treefrog
Hyla chrysoscelis	Cope's Gray Treefrog
Hyla cinerea	Green Treefrog
Hyla femoralis	Pine Woods Treefrog
Hyla gratiosa	Barking Treefrog
Hyla squirella	Squirrel Treefrog
Pseudacris crucifer	Spring Peeper

Table 7.1-1. (continued) Amphibian and reptile species found on CSJFTC from 2004 - 2006. The number of individual snake and turtle species are given in parenthesis following the common name. Asterisk (*) indicates individuals appear to exhibit characters of more than one subspecies. New species found in 2006 are denoted.

Latin name	Common name
Pseudacris feriarum	Southeastern Chorus Frog
Pseudacris nigrita	Southern Chorus Frog
Pseudacris ornate	Ornate Chorus Frog
Rana catesbeiana	Bullfrog
Rana clamitans	Bronze Frog
Rana palustris	Pickerel Frog
Rana sphenocephala	Southern Leopard Frog
Scaphiopus holbrookii	Eastern Spadefoot
	Salamanders
Ambystoma opacum	Marbled Salamander
Ambystoma talpoideum[2006]	Mole Salamander
Amphiuma means	Two-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Desmognathus conanti	Spotted Dusky Salamander
Eurycea cirrigera	Southern Two-lined Salamander
Eurycea guttolineata	Three-lined Salamander
Eurycea quadridigitata	Dwarf Salamander
Necturus alabamensis	Blackwarrior Waterdog
Notophthalmus viridescens	Central Newt
Plethodon mississippi	Mississippi Slimy Salamander
Pseudotriton ruber	Southern Red Salamander
Siren intermedia	Western Lesser Siren
	Crocodilians
Alligator mississippiensis	American Alligator
	Turtles
Chelydra serpentina	Eastern Snapping Turtle (8)
Deirochelys reticularia[2006]	Chicken Turtle (1)
Gopherus polyphemus	Gopher Tortoise (see text)
Kinosternon subrubrum	Mississippi Mud Turtle (25)
Pseudemys concinna	Eastern River Cooter (34)
Sternotherus odoratus	Stinkpot (125)
*Terrapene carolina**	Eastern Box Turtle (58)
Trachemys scripta	Red-eared Slider (44)
	Lizards
Anolis carolinensis	Green Anole
Cnemidophorus sexlineatus	Eastern Six-lined Racerunner
Eumeces fasciatus	Common Five-lined Skink

Table 7.1-1. (continued) Amphibian and reptile species found on CSJFTC from 2004 - 2006. The number of individual snake and turtle species are given in parenthesis following the common name. Asterisk (*) indicates individuals appear to exhibit characters of more than one subspecies. New species found in 2006 are denoted.

Latin name	Common name
Eumeces inexpectatus	Southeastern Five-lined Skink
Eumeces laticeps	Broad-head Skink
Ophisaurus attenuatus[2006]	Slender Glass Lizard
Ophisaurus ventralis[2006]	Eastern Glass Lizard
Sceloporus undulatus	Southern Fence Lizard
Scincella lateralis	Little Brown Skink
	Snakes
Agkistrodon contortrix	Southern Copperhead (54)
Agkistrodon piscivorus	Eastern Cottonmouth (51)
Cemophora coccinea	Northern Scarletsnake (13)
Coluber constrictor	Southern Black Racer (144)
Crotalus adamanteus	Eastern Diamondback Rattlesnake (44)
Diadophis punctatus	Southern Ring-necked Snake (8)
Elaphe guttata	Cornsnake (28)
Elaphe obsoleta	Gray Ratsnake (29)
Farancia abacura	Western Mudsnake (5)
Heterodon platirhinos	Eastern Hog-nosed Snake (40)
Lampropeltis calligaster	Mole Kingsnake (4)
Lampropeltis getula	Speckled Kingsnake (13)
Lampropeltis triangulum	Scarlet Kingsnake (20)
Masticophis flagellum	Eastern Coachwhip (64)
Micrurus fulvius	Harlequin Coralsnake (1)
Nerodia erythrogaster	Yellow-bellied Watersnake (10)
Nerodia fasciata	Banded Watersnake (1)
Nerodia sipedon	Midland Watersnake (7)
Opheodrys aestivus	Northern Rough Greensnake (14)
Pituophis melanoleucus	Black Pinesnake (49)
Regina rigida	Gulf Crayfish Snake (9)
*Sistrurus miliarius**	Pygmy Rattlesnake (6)
Storeria dekayi	Midland Brownsnake (4)
Storeria occipitomaculata	Redbelly Snake (2)
Tantilla coronata	Southeastern Crowned Snake (8)
Thamnophis sauritus	Common Ribbonsnake (2)
Thamnophis sirtalis	Eastern Gartersnake (43)
Virginia striatula[2006]	Rough Earth Snake (1)
Virginia valeriae[2006]	Smooth Earth Snake
	Introduced reptiles
Hemidactylus turcicus	Mediterranean Gecko

7.2 Fish

A brown bullhead (*Ameiurus nebulosus*) was captured during aquatic trapping. This represents the first record of this species on Camp Shelby Joint Forces Training Center and also for Perry County, MS.

7.3 Understanding Impacts of Military Specific Activities on Reptilian Species

In support of a USACE-ERDC Environmental Laboratory (EL) study to evaluate contaminant availability and toxicity on installations and training ranges, 23 Fence Lizard (*S. undulatus*) were collected from CSJFTC (TA-44, TA-46, and the Cantonment Area) during the summer and fall of 2006. USACE-ERDC will use lizards to screen for effects of xenobiotics produced on military installations on reproductive toxicity in oviparous vertebrates.

8.0 BIOLOGICAL ASSESSMENT, SURVEYS AND DOCUMENT REVIEW

We provide biological assessments and surveys for endangered, threatened, and rare species on an as needed basis. In addition, we review MSARNG environmental documents as relevant to rare species. In 2007 we provided a biological assessment for the proposed renewal of the CSJFTC Special Use Permit, as well as several surveys. After conducting the surveys, any findings and management recommendations are summarized and submitted to the MSARNG.

Biological Assessment

Programmatic Biological Assessment Of Actions Proposed for the Camp Shelby Joint Forces Training Center Special Use Permit (2007-2027), Lisa Yager and Matt Hinderliter, October 2006

Rare Animal and GT Burrow Surveys

- TA 10 wetland crossings (salamander)
- TA 12 wetland crossing (Camp Shelby Burrowing Crayfish habitat assessment)
- Wastewater Treatment Facility Construction Site and Gopher Tortoise Relocation Area
- Rare animal survey for FS blocks 110 and 111 (18 October 2006).
- Range 5, 6, 7, 8, 10, 18, 19, 40, 41, 42, 43, 44, 45,
- Training areas 8, 9, 19, 25, 28 (platoon lane 1-2 and 3-4), 43, East Air To Ground
- OP 12, 13, & 14
- FPs 20, 21, 23, 24, 25, 26, 27, 34, 61, 62, 63, 64, 65, 68, 70, 71, 72, 76, 77, 78, 79, 81, 82, 83, 84, 85, 86, 87, 91, 96, 97, 98, 99, 100, 101, 103, 105, 106, 107, 111, 115, 116, 120, 121, 122, 125, 127, 128, 130, 131, 134, 136, 137, 140, 143, 147, 148, 150, 501, 502, 504, 505, 507, 512, 519, & 520 (gopher tortoise surveys for mowing)

Rare Plant Surveys

- TA11 wetland crossings
- TA13 wetland crossings

Other

- Habitat assessment of Forest Service Land (within Cantonment area) to be transferred to MSARNG

Document Review Related to Rare Species

- Draft EIS for Renewal of Special Use Permit on Forest Service Lands
- DRAFT 2006 Update Integrated Natural and Cultural Resources Management Plan and Environmental Assessment-Camp McCain
- DRAFT 2006 Update Integrated Natural and Cultural Resources Management Plan and Environmental Assessment-Camp Shelby
- DRAFT 2006 Update Integrated Natural and Cultural Resources Management Plan and Environmental Assessment-MSARNG Armories

9.0 PROFESSIONAL PRESENTATIONS, POSTERS, AND PUBLICATIONS

Adams, S.M., M.S. Greeley, M.J. Peterson, M.G. Hinderliter, L.Y. Yager, P.F. Khan. 2006. Using multiple bioindicators to assess the health and fitness of gopher tortoises experiencing varying levels of military activity and habitat disturbance. SERDP & ESTCP's Partners in Environmental Technology Technical Symposium & Workshop, November 28-30, 2006, Washington, D.C.

Hinderliter, M. G. and Lee. J. R. 2006. *Masticophis flagellum* Ophiophagy. Herpetological Review. 37 (2): 232-233.

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10.0 WORKSHOPS/FIELD TRIPS/ETC.

Our office organized workshops and field trips relating to conservation of rare species management on CSJFTC. We participated in planning meetings hosted by the USFS to address management for rare species.

TNC Organized Workshops:

2006 Annual Gopher Tortoise Inspection Tour
Participating organizations: MSARNG, TNC, USFS, USFWS, MDWF&P, USM

Field Trips and Educational Presentations:

Cogongrass/Gopher Tortoise Habitat Management Field Trip. Timberline Magazine, Andrea Cuff, journalist for Timberline magazine, 25 April 2006 (Lisa Yager, Matt Hinderliter, James Lee, CJ Sabette)

Black Pine Snake Field Trip, John Cancalosi - free lance photographer, 26 April 2006. (James Lee)

Botanical Presentation, Dixie Attendance Center School, 5th grade classes, 21 September 2006 (Steve Leonard)

Gopher Tortoises and Turtles Presentation, Dixie Attendance Center School, 5th grade classes, 24 October 2006 (Matt Hinderliter)

Field Trips to Gopher Tortoise Refuge, William Carey University, Conservation Classes, 5 January 2006 and 7 December 2006 (Matt Hinderliter)

Meetings:

59th Annual Meeting Southern Weed Science Society January 23-25, 2006. San Antonio, Texas
Attended by: Lisa Yager

US Forest Service, "Vision for the Future", Wiggins, MS; 23 February 2006
Attended by: Lisa Yager, Steve Leonard

SE-Partners in Amphibian and Reptile Conservation meeting in Andalusia, Alabama 23-25 February 2006
Attended by: James Lee and TG Jackson

MS-Exotic Pest Plant Council Meeting, 26 June 2006
Attended by: Lisa Yager, Jennifer Frey, and CJ Sabette

Louisiana Pine Snake candidate conservation meeting, Nacogdoches, Texas,1-2 August 2006
Attended by: James Lee

11th Annual Conference Texas Society of Ecological Restoration, August 18-20, 2006, Hunt, Texas
Attended by: Lisa Yager

The Wildlife Society annual conference, Anchorage, Alaska, 22-28 September 2006
Attended by: James Lee

2006 Gopher Tortoise Council Meeting, Valdosta, Georgia, 26-29 October 2006
Attended by: Matt Hinderliter, Jennifer Frey, and Idun Guenther

MS-Exotic Pest Plant Council Meeting, 9 November 2006
Attended by: Lisa Yager, Jennifer Frey, and CJ Sabette

Identification and management of invasive terrestrial and aquatic plants common to coastal Mississippi, Workshop presented by MS Coastal Plains, RC&D Council, Jackson County Soil and Water Conservation District and MS Dept. of Marine Resources' Grand Bay National Estuarine Research Reserve, November 16, 2006, Gautier, MS
Attended by: Lisa Yager.

Other:

Prescribed Fire training (S-190, S-130) at Camp Shelby, MS 28 November-2 December, 2006, completed by Idun Guenther and Jennifer Frey

Wild-land fire training refresher course (RT-180, LT-130), Camp Shelby, MS, 31 May 2006, completed by Lisa Yager, CJ Sabette, and James Lee

Mississippi Pesticide Applicator's Certificate, July 2006 obtained by Jennifer Frey

ArcGIS Training, 8-10 May 2006 completed by Jennifer Frey

Trimble GPS Training, 19-20 September 2006 completed by James Lee, Jennifer Frey, and Idun Guenther

Professional Memberships-Cogongrass Task Force, Mississippi Exotic Pest Plant Council (Secretary), Gopher Tortoise Council, American Fern Society, Longleaf Alliance, Wildlife Society, Partners in Amphibians and Reptiles Conservation