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THE PRESERVATION OF BOG TURTLE METAPOPULATION DYNAMICS BY A TRANSPORTATION IMPROVEMENT PROJECT IN SOUTHEASTERN PENNSYLVANIA

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Abstract: The Pennsylvania Department of Transportation is currently performing bog turtle radio-tracking and environmental compliance monitoring as required by the U.S. Army Corps of Engineers 404 permit and U.S. Fish and Wildlife Service biological opinion. Radio tracking of bog turtles was initiated in 1999 and will continue to one year post-construction, anticipated to be in 2006.

The biological opinion for the project required the department to minimize direct and indirect impacts to bog turtles and critical habitat through innovative highway engineering design modifications, specialized containment fencing, and seasonal constraints for certain construction activities. Pre-construction provisions in compliance with the biological opinion include vegetation community mapping; ground water monitoring; invasive species management and monitoring; and bog turtle behavior and movement patterns.

The research has confirmed many of the natural history characteristics of the species cited in previous studies in the scientific literature. However, behavior and movement patterns previously undocumented have been recorded. Telemetry data from this transportation project continues to expand our understanding of this federally threatened species. Monitoring throughout construction of the project will confirm if the implemented engineering design modifications have avoided and minimized potential impacts to the species metapopulation. This project is an example of a transportation undertaking that is designed and constructed in such a manner as to fulfill the project purpose and promote the conservation of a threatened species.

Introduction

This project was the result of a roadway relocation/ reconstruction design in southeastern Pennsylvania conducted by the Pennsylvania Department of Transportation (PENNDOT). The roadway project, if constructed as planned, encroached on a known metapopulation of bog turtles *(Clemmys muhlenbergii).* Bog turtles are listed as a Pennsylvania endangered, federally threatened species. Four palustrine wetlands within the project limits were found to harbinger bog turtles. Each of these wetlands consisted of palustrine emergent areas associated with a riparian complex adjacent to the roadway slated for reconstruction/ relocation.

In preparation for the relocation and reconstruction of this roadway, environmental studies were performed in 1977 and 1978. The project was deactivated due to lack of funding in 1978. An upgrade on an existing realignment was selected as the preferred alternative by the resource agencies in March 1989.

On February 19, 1992, in response to a request from the project consultant, the United States Fish and Wildlife Service (USFWS) acknowledged that, except for transient species, no federally threatened or endangered species were present in the proposed project area. At that time, the bog turtle *(Clemmys muhlenbergii)* was listed as State-endangered by Pennsylvania and as a Category 2 Candidate[1] species by the USFWS.

A reproducing population of bog turtles was located approximately 1.5 miles downstream from the project area; however, there were no historical records of bog turtle occurrences within the proposed project area. This fact, in combination with a technical review by the Pennsylvania Fish and Boat Commission (PAFBC), led to the conclusion that the project would have no adverse impacts to any federally listed threatened or endangered species (Environmental Impact Statement, January 1997; Record of Decision by the Federal Highway Administration, July 16, 1997). The PAFBC has jurisdictional oversight of reptiles and amphibians that are considered species of concern in Pennsylvania.

The subsequent Federal listing of the bog turtle as threatened under the Endangered Species Act (ESA) on November 4, 1997, and the proximity of a known bog turtle site in the same watershed required that the USFWS re-evaluate the potential adverse affects of the project on a listed species. On May 19, 1998, the USFWS initiated informal consultation with the Baltimore District of the Army Corp of Engineers (ACOE). The USFWS identified four areas of potential bog turtle habitat. These areas were surveyed for bog turtles. Two additional wetlands were later identified by the USFWS as areas of potential habitat and were surveyed by PENNDOT consultants.

Phase II surveys performed on May 14, 22, and 26, 1998, confirmed the presence of bog turtles at four of the six palustrine emergent (PEM) wetlands. In addition to being active bog turtle habitat, these wetlands were determined to be areas that would be affected by the proposed highway project. On October 15, 1998, a field view of the four wetlands by the resource agencies was convened. Participants included PENNDOT consultants, representatives from the USFWS, and representatives from the ACOE. During the field view,

measures to avoid or minimize adverse effects to the bog turtle were discussed. Efforts designed to minimize adverse effects to the species were incorporated into the biological assessment (BA) for this project.

On March 4, 1999, the BA for the project was submitted by the ACOE. The ACOE entered into formal consultation (Section 007) with the USFWS. The USFWS delivered a draft biological opinion (BO) to the ACOE on September 17, 1999. PENNDOT issued comments, and the revised final BO was transmitted to the ACOE on November 1, 1999. The purpose of the BO was to address potential direct and indirect impacts of the action on a federally threatened/state endangered species and designated critical habitat and to develop protocols in order to prevent adverse effects to the species.

A description of the proposed "action area" was presented within the BO. The "action area" is defined as the area in which all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States. The "action area" includes all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. In keeping with the measures set forth within the Environmental Impact Statement, the BO addressed several issues in regard to the project. These issues include design modifications; invasive and vegetative control and monitoring; hydrological changes and monitoring; construction monitoring; and a radio-tracking study of the species within the project limits. The Section 404 Wetland Permit for the project was (and remains) contingent upon PENNDOT's adherence to the BO for the project. The BA and resultant BO were the first associated with the species within the northern population range of the bog turtle. Currently, two BO's have been issued for the northern population, both associated with projects within the state of Pennsylvania.

Natural History of the Species

The bog turtle is the smallest member of the genus *Clemmys*. Adults may range from 100 to 120 millimeters in length. The species is recognized by its light brown to ebony carapace and bright yellow, red, or orange blotch on each side of the head.

The preferred habitat of the bog turtle is typically characterized as early successional wet meadows that often have a scrub/shrub border component. The dominant vegetation associated with bog turtles consists of low forbs and sedge species. Bog turtles inhabit areas with specific soil and hydrological qualities. The typical substrate often consists of six to eight inches of organic muck, or in some areas peat may replace this material. This type of substrate is crucial for certain behaviors including predator avoidance; thermoregulation; and hibernation. In addition to the proper soil requirements, the species appears to require specific hydrological components within a wetland complex. These include groundwater seep wetlands in conjunction with limestone fracture areas containing slow-moving subterranean and surface water.

Several threats to the northern population have been identified. These include but may not be limited to the loss, degradation, and fragmentation of suitable habitat; natural succession; invasive species; and illegal collection and trade. In May 2001, the final *Northern Population Bog Turtle Recovery Plan* was developed by the USFWS. The objectives with the recovery plan include protocols to protect and maintain the northern population of the species and its habitat, enabling the eventual de-listing of the species by 2050 (if the recovery objectives are met).

The recovery plan contains goals including the long-term protection secured for existing identified populations through monitoring until the results illustrate stability or expansion. The Recovery Plan also addresses illicit collection and trade in that they will be eliminated or reduced to a level that no longer constitutes a threat. In addition to protection and stability, monitoring on a long-term basis should investigate habitat dynamics including succession, invasive species, hydrology, and predation until these factors are fully understood. The Recovery Plan also designates specific individuals throughout the northern range of the bog turtle population who are considered qualified to conduct research, surveys, and obtain permits to handle the species.

Design Modifications

Certain design modifications were integrated as directives within the BO for the project. These design changes included the replacement of a box culvert with a 65-foot span bridge for the purpose of maintaining a travel corridor for bog turtles and other wildlife. In order to reduce the likelihood of destruction of habitat during the bridge construction, no wetland crossings were permitted. All of the bridge construction activity must occur from the footprint of the bridge ramps located on either side of the wetland corridor.

The construction sequence required the removal and replacement of an existing bridge structure. The BO required the removal of this bridge to be conducted from the footprint of the existing roadway. None of the old bridge material will be permitted to drop into the stream. Likewise, the new bridge construction will be conducted from the footprint of the roadway, minimizing stream and surrounding wetland damage.

The placement of exclusionary fencing was required around all construction areas to prevent the movement of turtles into the work sites. The exclusionary fencing consists of chain link fencing four feet high wrapped with geotextile fabric that is stapled in place to insure a firm hold. The fence is buried to a depth of 12 inches to prevent turtles from burrowing or tunneling under the barrier and the geotextile fabric prevents sediment laden run-off from discharging into the wetland areas. Orange safety fencing was attached to the perimeter of the exclusion fence to serve as a visual barrier to prevent construction activities from compromising the barrier.

In addition to the above changes, special curbing designs to prevent turtles from traveling onto designated access roads are incorporated into the project. Permeable barriers are designed within retaining walls to prevent drastic hydrological changes in areas of higher habitat importance. Grass-lined swales (instead of rip-rap) to direct overflow from roadways are incorporated into the design to prevent sudden rises in water flow to the wetland areas during rain events. Portions of the roadway have been realigned to avoid areas deemed higher in habitat quality. Finally, seasonal limitations on specific construction activities are incorporated into the construction schedule to minimize the likelihood of harm to the species. These seasonal constraints include the confinement of certain activities to the warmer months to insure that bog turtles may be more easily seen should they be located in construction areas and so as not to interfere with periods of hibernation.

Invasive Vegetative Control and Monitoring

Because construction sites are disturbed areas, the potential exists for the introduction of invasive vegetative species into the construction site. The BO introduced protective measures against the introduction of invasive or exotic plant species into any of the bog turtle sites. These protective measures included the following:

- A list of undesirable plant species were obtained from the USFWS and used to evaluate all borrow areas for fill material. Should any of the invasive species on the list be identified, this fill material would not be used for construction at any of the known bog turtle sites.
- All designated fill areas adjacent to known bog turtle sites will be treated with an herbicide prior to construction.
- All fill and disturbed sites will be inspected during post-construction monitoring to identify and eradicate any invasive plant species that may colonize these areas.
- An invasive vegetative species monitoring plan was developed for the project and sent to the USFWS and the PAFBC for approval. The monitoring plan includes maps of the existing vegetation to be used as baseline data in evaluating the advancement of invasive species.
- A yearly report will be developed detailing the status of invasive vegetation monitoring and include recommendations to control invasive species disturbance to the biota of the wetlands, if necessary.

Construction Monitoring

A construction monitoring plan in reference to the wetlands in which bog turtles are known to occur was developed for the project. The construction monitoring plan includes detailed protocols for a variety of possible construction activity/bog turtle interactions. Some examples of these protocols included but were not limited to:

- Exclusionary fence monitoring and inspection in the event of a breach.
- Measures to be taken in the event of a fence breach.
- Measures to be taken in the event of a bog turtle entering the work area.
- Threatened and endangered species training for the contractors.
- The proper protocol for handling or reporting a dead or injured bog turtle.
- Monitoring changes in hydrology within known bog turtle wetlands.
- Protocols for accidental chemical discharges in or near the bog turtle wetlands.
- Persons delegated to be responsible for reporting an incident that results in the death of or injury to a bog turtle.

Hydrological Monitoring

In order to measure the direct or indirect impacts of the construction on bog turtle wetland hydrology, shallow peizometers were installed in two of the four wetlands. Two wetlands were selected for monitoring due to the proximity of construction to bog turtle populations within these wetlands. The peizometers are auto recording instruments that may be down-loaded in the field onto laptop computers. In addition to hydrological monitoring, all four wetlands are tested monthly at designated locations for temperature, pH, and conductance. Any significant changes are required to be immediately reported to the PENNDOT project manager, the USFWS, and the PAFBC.

Radio-Tracking Project

The radio-tracking project was required in the BO for the project. The purpose of the study consists of the following:

- To aid in the prevention of the migration of turtles into the work sites.
- To glean information regarding habitat and life history of the species.
- To identify nesting and hibernacula locations.
- To provide information in order that the agencies and PENNDOT may assess the indirect and direct impacts of highway construction during the life of the project.
- To gain a better understanding of the species as a whole in order to allow the agencies responsible for oversight of the species to make more accurate recommendations for future transportation projects that involve bog turtles.

The radio-tracking for the project began in the fall of 2000. During the interim between the onset of radio-tracking and the actual construction, baseline data where collected regarding species movement, behavior, and habitat preference. Base maps of the four wetland complexes were created using both hydrological information as well as vegetative communities. A radio-tracking protocol was developed for the project and was approved by the USFWS and the PAFBC.

The study plan included details such as the frequency for relocation of the bog turtles, the types of information to be recorded, the number of individual turtles within a wetland to be fitted with radio-tracking devices, the types of materials and products to be used for the radio-tracking, and the individuals responsible for conducting the study.

Construction began in the winter of 2003. During construction, monitoring of changes in behavior and habitat use is ongoing. Maps detailing bog turtle habitat use and movement are developed on a yearly basis. These maps are included in a yearly radio-tracking report that is sent to PENNDOT, the USFWS, the ACOE, and the PAFBC.

Conclusion

To date, the mandates of the BO have been met successfully. All the protocols for each portion of the project have been followed. One incident of a bog turtle migrating under the fencing occurred immediately prior to the onset of construction. This turtle was located by means of the radio-tracking equipment. The turtle was hibernating in an area scheduled to be stripped of soil and prepared for the construction of a bridge face. A bog turtle surveyor removed the turtle during a warm weather period at the request of the agencies; however, there was concern that other bog turtles may have been hibernating in the area. A protocol to survey outside the normal search window (April 15 to June 15) was developed by a task force consisting of members of the USFWS, the PAFBC, PENNDOT, ACOE, and Skelly and Loy, Inc. This protocol consisted of three bog turtle surveyors using one-meter quadrats hand sifting through the parcel of wetland. The wetland area to be surveyed was approximately 20 feet wide and 70 feet long. The surveyors wore protective gloves to safeguard them from the cold and therefore allow tactile sensitivity. The survey was completed in approximately eight hours, utilizing a total of 24 person-hours of survey time. No bog turtles were observed within the fence, and the construction schedule could proceed as planned.

Since construction has been initiated, two incidents of fence breaches have occurred as a result of the substrate falling away from the exclusionary barrier. In each instance, construction within 100 feet of the breach (as pursuant to the construction monitoring plan for the project) stopped while a bog turtle surveyor arrived on site, surveyed the area, and made recommendations for repair of the fence. Neither incident involved a bog turtle observation. The total construction time lost in the immediate vicinity of the breaches consisted of approximately one hour in each instance, though the contractor was able to continue working in nearby areas.

The projected date of completion of the roadway is fall of 2006. The radio-tracking project is ongoing until the roadway is completed; however, monitoring for bog turtles (live, dead, or injured) on or near the completed roadway will continue for five years post-construction. Construction monitoring, invasive vegetation tracking, hydrological monitoring, and exclusionary fence monitoring will also continue for the life of the project.

Biographical Sketch: Teresa McElhenny graduated from Penn State University at DuBois in 2000 with a degree in wildlife biology. She has been working in the Endangered Species Group as a wildlife biologist for Skelly and Loy, Inc., for the past two years. She has been conducting research on the bog turtle (*Clemmys muhlenbergii*) for the past three years. The bog turtle is currently listed as a Pennsylvania State endangered and federally threatened species. She is an active member of The Nature Conservancy; the Ned Smith Center for Nature and Art; and the Muhlenberg Botanical Society. She is currently serving as the Present of the Pennsylvania Chapter of the Wildlife Society.

Andy Brookens is an aquatic biologist and regional director for natural resources with Skelly and Loy, Inc., Engineers-Environmental Consultants. In his 11 years with the company, he has been responsible for the execution of wetland/aquatic resource evaluations, threatened and endangered species assessments, and federal/state permit acquisition and compliance.

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