United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213

December 20, 2013

IN REPLY REFER TO:
2013-F-466

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., N.E., Room 1A
Washington, DC 20426

Dear Secretary Bose:

This document is the Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed Gulf South Pipeline Company's (Gulf South) Southeast Market Expansion Project in Jasper, Forrest, Perry, Greene, George, and Jackson Counties, Mississippi; and Mobile County, Alabama, and its effects on the gopher tortoise (*Gopherus polyphemus*) per section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code [U.S.C.] 1531 et seq.). Your August 2013 Environmental Assessment (EA) including your request for formal consultation was received on September 5, 2013.

This biological opinion is based on information provided in the EA and other sources of information. A complete administrative record of the consultation is on file at the Mississippi Field Office, Jackson, Mississippi.

Consultation History

Gulf South conducted field surveys of the proposed project alignment between September and November of 2012.

The Service determined in December of 2012 that the Mississippi Field Office would coordinate and consult on both the Mississippi and Alabama portions of the proposed natural gas pipeline project.

On March 7, 2013, Gulf South submitted to the Service a draft biological assessment for our review. Also, several phone calls and electronic mails where exchanged during March and April regarding project impacts to the gopher tortoise and how tortoises would be relocated.

On September 5, 2013, the Service received the final EA, which included the Federal Energy and Regulatory Commission's (FERC) biological assessment (BA) and a request to initiate formal consultation under section 7 of the ESA.

The Service accepted the request to enter into formal consultation with the FERC by letter dated September 24, 2013.

The Service sent FERC a draft biological opinion on December 2, 2013. FERC completed the review of the draft biological opinion on December 10, 2013.

FWS log No: 43910-2013-F-466 **Docket No. CP13-96-000**
Date Started: September 24, 2013 **Ecosystem: Central Gulf**
Action Agency: FERC
Project Title: Southeast Market Expansion Project
Applicants: Gulf South Pipeline Company, LP and Petal Gas Storage, LLC
Counties: Jasper, Forrest, Perry, Greene, George, and Jackson Counties, Mississippi; and Mobile County, Alabama

Table 1. Species considered in the 2013 BA analyses for the proposed action and effect determinations.

Common Name	Scientific Name	Federal Status	Conclusion[1]	Rationale
Mammals				
Louisiana black bear	*Ursus americanus luteolus*	Threatened	NLAA	Conservation measures adequate
West Indian manatee	*Trichechus manatus*	Endangered	No Effect	Habitat not affected
Birds				
Mississippi sandhill crane	*Grus Canadensis pulla*	Endangered	No Effect	Habitat not affected
Piping plover	*Charadrius melodus*	Threatened	No Effect	Habitat not affected
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No Effect	Not present
Wood stork	*Mycteria americana*	Endangered	No Effect	Not present
Fish				
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	NLAA	Conservation measures adequate
Pearl darter	*Percina aurora*	Candidate	NLAA	Conservation measures adequate
Reptiles				
Alabama red-bellied turtle	*Psuedemys alabamensis*	Endangered	No Effect	Habitat not affected
Black pine snake	*Pituophis melanoleucus* spp. *lodingi*	Candidate	NLAA	Conservation measures adequate
Eastern indigo snake	*Drymarchon couperi*	Threatened	NLAA	Conservation measures adequate
Gopher tortoise	*Gopherus polyphemus*	Threatened	MALAA	Habitat and Individuals adversely affected
Green sea turtle	*Chelonia mydas*	Threatened	No Effect	Habitat not affected
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	No Effect	Habitat not affected
Kemp's ridley turtle	*Lepidochelys kempii*	Endangered	No Effect	Habitat not affected
Leatherback sea turtle	*Dermochelys comacea*	Endangered	No Effect	Habitat not affected
Loggerhead sea turtle	*Caretta caretta*	Threatened	No Effect	Habitat not affected
Yellow-blotched map turtle	*Graptyemys flavimaculata*	Threatened	No Effect	Habitat will be avoided
Amphibians				
Dusky gopher frog	*Rana sevosa*	Endangered	NLAA	Conservation measures adequate
Plants				
Louisiana quillwort	*Isoetes louisianensis*	Endangered	NLAA	Not present

[1] NLAA – May affect, not likely to adversely affect
MALAA – May affect, likely to adversely affect

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The proposed Southeast Market Expansion Project (project) would consist of approximately 70.1 miles of 30-inch diameter and 24-inch diameter natural gas pipeline that would be installed from the Petal Gas Storage, LLC's transmission facilities in Forrest County, Mississippi, to Gulf South's existing Index 311 pipeline tie-in, approximately 4.5 miles west of Semmes, Alabama. The proposed facilities would include the following:

- 70.1 miles of 30-inch-diameter and 24-inch-diameter natural gas pipeline;
- one new 15,900-horsepower (hp) compressor station located in Forrest County at the beginning of the project pipeline;
- one new 15,900-hp compressor station located at the intersection of Gulf South's existing Index 818 pipeline and Petal Gas Storage transmission facilities in Jasper County, Mississippi;
- one new 2,415-hp compressor station located at the intersection of Gulf South's existing Index 300 pipeline and the Pascagoula Lateral in Jackson County, Mississippi;
- a new meter and regulatory station and pig launcher/receiver facility at milepost 42.3 at the interconnect with Florida Gas Transmission Company, LLC's existing pipeline, and
- associated appurtenant aboveground facilities along the proposed pipeline.

The pipeline construction right-of-way (ROW) would be 100 feet wide, including a 50 foot wide permanent easement and a 50 foot wide temporary easement. A reduced 75 foot wide construction corridor would be utilized in wetlands.

Construction of the project would affect approximately 1,161.7 acres of land. Following construction, 749.2 acres would be allowed to revert to previous conditions, and the remaining 412.5 acres would be retained to operate and maintain the facilities. Gulf South proposes to commence construction of the project in April of 2014, and anticipates that all facilities would be placed in service by November of 2014.

Conservation Measures

The BA proposes a conservation strategy to reduce the amount or extent of incidental take of the gopher tortoise associated with the project. Gulf South's proposal includes the following conservation measures:

- Resurveying previously identified burrows/colonies and all areas containing potentially suitable gopher tortoise habitat prior to construction;
- examine all known burrows to identify occupancy/status;

- capturing gopher tortoises within the proposed construction ROW and moving them elsewhere in the colony **OR** moving them to off-site conservation banks if the captured tortoises are not associated with a colony;
- identifying and marking captured tortoise;
- collapsing vacant burrows;
- installing silt fencing between construction ROW and displaced tortoise's new burrow;
- conducting regular surveys of construction work areas;
- training construction personnel on tortoise identification, procedures, etc;
- documenting efforts and submitting reports to the Service, and
- post-construction monitoring of gopher tortoises.

A more detailed account of Gulf South's Conservation Strategy is contained in their August 2013 EA/BA.

The biological surveys were conducted between September and November of 2012. The survey area included a 200-foot wide corridor in areas where the proposed pipeline would be collocated with adjacent ROW's, and a 300-foot wide corridor in areas where green-field conditions exist. Approximately 79 percent of the proposed pipeline would be collocated with existing pipeline and power-line ROW's.

A total of 99 burrows were identified (39 active, 46 inactive, and 14 abandoned) during the 2012 surveys. A single juvenile gopher tortoise was also observed in George County, Mississippi.

The Service has described the **action area** to include the construction corridor (100 foot ROW), as well as all work areas and access roads associated with the project. The action area also consists of adjacent upland areas with actual or potentially interconnected gopher tortoise habitat, for reasons that will be explained and discussed in the "EFFECTS OF THE ACTION" section of this consultation.

STATUS OF THE SPECIES/CRITICAL HABITAT

This section summarizes the biology and ecology as well as information regarding the status and trends of the covered species throughout their entire range. The Service uses this information to assess whether a federal action is likely to jeopardize the continued existence of the aforementioned species. The "Environmental Baseline" section summarizes information on status and trends of the species specifically within the action area. This summary provides the foundation for the Service's assessment of the effects of the proposed action, as presented in the "Effects of the Action" section.

Gopher Tortoise

Species/critical habitat description

The gopher tortoise is the only tortoise (family Testudinidae) east of the Mississippi River. It is larger than any of the other terrestrial turtles in this region, with a domed, dark-brown to grayish-black shell (carapace) up to 14.6 inches long, weighing up to 13 lbs (6 kg). The lower shell (plastron) is yellowish and hingeless. Tortoises cannot completely withdraw their limbs, which remain visible when folded and retracted. The hind feet are elephantine or stumpy, and the forelimbs are shovel-like, with claws used for digging. In comparison to females, males are smaller; usually have a larger gland under the chin, a longer gular projection, and more concave plastron. Hatchlings are up to 2 inches in length, with a somewhat soft, yellow-orange shell. As with other chelonians, gopher tortoises possess a keratinized beak, and lack teeth. Critical habitat has not been designated.

Life history

The gopher tortoise is a long-lived, native burrowing species of the open, fire-maintained longleaf pine ecosystem. Historically, typical gopher tortoise habitat consisted of open, frequently burned longleaf pine or longleaf pine/scrub oak uplands and flatwoods on moderately well drained to xeric soils. Such habitat provided adequate sunlight reaching the forest floor to stimulate the growth and development of the herbaceous plant stratum for forage, with sufficient warmth for basking and the incubation of eggs.

The burrows of a gopher tortoise are the habitat and center of normal feeding, breeding, and sheltering activity. Gopher tortoises excavate and use more than one burrow for shelter beneath the ground surface. Burrows, which may extend for more than 30 feet, provide shelter from canid predators, winter cold and summer heat. Dogs and large canids are the most common predator (Causey and Cude 1978).

In stable populations with fire-maintained, open longleaf pine habitat, females may use an average of five burrows each while males occupy an average of 10 burrows (Eubanks *et al.* 2003). In poor habitat due to encroaching, fire intolerant shrubs and hardwoods, gopher tortoises tend to excavate and use fewer burrows, probably because of limited sites that are sufficiently open. Males tend to use more burrows and move more frequently among their different burrows than females as they seek breeding opportunities with females (McRae *et al.* 1981; Diemer 1992a, 1992b; Smith 1995; Tuma 1996a; Boglioli *et al.* 2000; Eubanks *et al.* 2003). The term "active burrow" is applied to burrows exhibiting indications it is likely inhabited by a gopher tortoise. Characteristics of active burrows include fresh soil excavated from the interior of the burrow, deposited on the apron at the burrow entrance; tortoise feces on the apron or near the burrow entrance; and eggshells and tracks. Inactive burrows, which display conditions of recent use and occupancy by a tortoise, are considered to be used as part of the annual home range of one or more tortoises, but are not currently occupied by a tortoise. Indicators of inactive burrows include suitable size and shape of the burrow entrance; a recognizable

apron of bare soil without encroachment of grasses or shrubs; and small amounts of leaf litter in the entrance that have not been moved by a tortoise. Abandoned burrows are unlikely to be used by a tortoise and, normally, exhibit indications of erosion, a loss of shape and structure, and no apron.

Tortoises spend most of their time within burrows and emerge during the day to bask in sunlight, to feed, and reproduce. Tortoises are active above ground during the growing season when daytime temperatures range from 75 - 87 °F (McRae *et al.* 1981; Butler *et al.* 1995). Daily active periods usually are unimodal in spring, followed by bimodal periods (early to mid-morning, middle to late afternoon) during the hotter temperatures of summer (McRae *et al.* 1981). Daily activity above ground becomes significantly reduced by the end of the growing season during October with cooler temperatures. Tortoises take shelter within their burrows during the dormant season, become torpid, do not eat, and rarely emerge except during periods of warm days to bask in sunlight at the burrow entrance. Tortoises become active again during April.

Tortoises mostly forage on foliage, seeds, and fruits of grasses and forbs, generally in an area of about 150 feet surrounding each burrow (McRae *et al.* 1981; Diemer 1992b). The diet of adults resembles that of a generalist herbivore, with at least some preference for some plants over others, and may also include insects and carrion (MacDonald and Mushinsky 1988; Birkhead 2001). Juvenile tortoises tend to forage on fewer plant species, eat fewer grasses, and select more forbs, including legumes, than adults (Mushinsky *et al.* 2003).

Burrows are not randomly located in the environment. Tortoises select and prefer burrow sites in open sunny areas (Boglioli *et al.* 2000; Rostal and Jones 2002). Such sites reflect areas where herbaceous plants for food are more abundant on the forest floor and, for females, sunlight and soil temperatures for egg incubation are more suitable. Also, males select sites and burrows that increase their proximity to females and breeding opportunities (Boglioli *et al.* 2000; Eubanks *et al.* 2003). The repeated use and travel to the same burrows by individual tortoises in stable habitat reveal that tortoises know the geography of their home range, burrows, and the location of neighboring tortoises (Eubanks *et al.* 2003).

Tortoises breed from May through October (e.g. Landers *et al.* 1980; McRae *et al.* 1981; Taylor 1982; Wright 1982; U.S. Fish and Wildlife Service 1987; Diemer 1992a; Eubanks *et al.* 2003). Females ovulate during spring, but likely store sperm so that active breeding during ovulation may not always be required for fertilization. Males travel to female burrows and copulation occurs above ground at the burrow entrance, more frequently during July to September, a period of peak sex and adrenal steroid hormones (Ott *et al.* 2000; Eubanks *et al.* 2003). Females may mate with several males during a single mating season, as males search for prolonged periods for receptive females in a form of scramble-competition polygyny (Boglioli *et al.* 2003). The multiple paternities of about 30 percent of the clutches in a Florida population, as confirmed by an analysis of parentage with microsatellite DNA, also indicates a promiscuous breeding system, with males fertilizing multiple clutches and females with multiple mates (Colson-Moon

2003b, 2003a). Paternity analysis indicates that larger males may have a reproductive advantage over smaller males in mating with females (Colson-Moon 2003a). However, the mean body mass of males mounting females did not differ from the mean mass of all other males from a study of 20 females that received 286 visits from males in a large population in southwestern Georgia (Boglioli et al. 2003). In earlier work by Douglass (1986), he described gopher tortoise "colonial" tendencies with aggregations of burrows in which dominant males competitively and behaviorally exclude other males at female burrows to maintain a loose female harem as a mating system. These more recent studies do not indicate the clear existence of an exclusive dominance hierarchy. Also, aggregations of burrows in some habitat and study sites probably is an artifact of fragmentation and the concentration of burrows in the available remaining suitable habitat (Mushinsky and McCoy 1994; Boglioli *et al.* 2003).

Females do not reproduce every year. In the listed range, about 80 percent of the females at Marion County Wildlife Management Area (WMA) in Mississippi and 85 percent of the females at Ben's Creek WMA in Louisiana were gravid each year (Smith *et al.* 1997). Females excavate a shallow nest to lay and bury eggs, usually in the apron of soil at the mouth of the burrow, but they may lay elsewhere if the apron is excessively shaded (Landers and Buckner 1981). Range-wide, average clutch size varies from about four to 12 eggs/clutch. Average clutch size in the listed range, from 4.8 - 5.6 eggs/clutch, is comparably low (Seigel and Hurley 1993; Seigel and Smith 1995; Tuma 1996a; Epperson 2003). Clutch size generally is positively correlated with adult female size (Diemer and Moore 1994; Smith 1995; Rostal and Jones 2002).

Females usually lay about five to seven eggs from mid-May through mid-July in the soil of the apron at the burrow entrance (Butler and Hull 1996; Smith *et al.* 1997) and egg incubation lasts 80 - 110 days (Diemer 1986; Smith *et al.* 1997). In Mississippi, nests are up to 16 cm in depth, located about 46 cm from the opening of the burrow (Epperson and Heise 2003). Incubation at temperatures from 27°C to 32°C is required for successful development and hatching (e.g. Spotila *et al.* 1994; Burke *et al.* 1996; DeMuth 2001; Rostal and Jones 2002; Noel and Quall 2004). As in other species, sex determination is temperature dependent (Burke *et al.* 1996; DeMuth 2001).

Nest depredation by vertebrates typically has been considered substantial, although little quantitative data is available. From studies in southern Georgia, Landers *et al.* (1980) estimated about 90 percent of nests were destroyed by predators. In a much smaller study from southern Alabama, about 46 percent of nests (n = 11) were destroyed by raccoons, opossums, and armadillos (Marshall 1986). Egg hatching success at experimentally protected nests has ranged from 28 - 97 percent in Florida and Georgia (92 percent, Arata 1958; 86 percent, Landers *et al.* 1980; 28 percent, Linely 1986; 67 to 97 percent, Smith 1995; 80.6 percent, Butler and Hull 1996). In the listed range in Mississippi, mean hatching success from protected nests in the field has ranged from 28.8 - 56 percent (Epperson and Heise 2003; Noel and Quall 2004).

Hatchlings excavate themselves from the nest and emerge from the middle of August through September in the listed range (e.g. Epperson and Heise 2003). Hatchlings and

yearlings (zero to one year old) may temporarily use the adult burrow, bury under sand or leaf litter, or excavate a small burrow nearby (Douglass 1978; Wilson *et al.* 1994; Butler *et al.* 1995; Pike 2006). Growth is most rapid during the juvenile stage, becoming slower at the onset of adulthood and reproductive maturity, followed by little or no adult growth (Mushinsky *et al.* 1994; Aresco and Guyer 1998, 1999a). Generally, tortoises become adults at about 20 years of age, although the minimal stage to reach reproductive maturity is determined by size rather than age. Growth rates and sizes at sexual maturity can vary among populations and habitat types (Landers *et al.* 1982; Mushinsky *et al.* 1994; Aresco and Guyer 1998, 1999a).

Hatchlings/yearlings initially move up to about 50 feet (15 m) from their nest to establish their first burrow, from which they will subsequently excavate and use about five burrows in a home range as small as about 0.5 acres (0.2 ha), to as large as 11.8 acres (4.8 ha) (Mushinsky *et al.* 1994; Butler *et al.* 1995; Epperson and Heise 2003; Pike 2006). Yearlings move, on average, relatively short distances to establish new burrows, although they are known to have traveled up to 1,485 feet (450 m) to new burrows (Butler *et al.* 1995; Epperson and Heise 2003). Hatchlings and yearlings may take shelter beneath litter and woody debris during longer distances or times encountered to move to a new burrow (Diemer 1992b; Butler *et al.* 1995). Yearlings and juveniles usually forage within about 23 feet (7 m) from their burrow (McRae *et al.* 1981; Wilson *et al.* 1994; Butler *et al.* 1995; Epperson and Heise 2003).

Home range size and movements increase with age and body size. The burrows of a gopher tortoise represent the general boundaries of a home range, which is the area used for feeding, breeding, and sheltering. Home range area tends to vary with habitat quality, becoming larger in areas of poor habitat (Auffenberg and Iverson 1979). Males typically have larger home ranges than females. Mean home ranges of individual tortoises in Alabama, Florida, and Georgia outside the federally listed area have varied from 1.3 - 5.2 acres (3.2 - 2.2 ha) for males and 0.2 - 2.5 acres (0.09 - 1.0 ha) for females (McRae *et al.* 1981; Auffenberg and Franz 1982; Diemer 1992b; Tuma 1996a; Ott 1999; Eubanks *et al.* 2003; Guyer 2003). In comparison to females, male tortoises use more burrows, and during breeding season, move among burrows more frequently over longer distances (McRae *et al.* 1981; Auffenberg and Franz 1982; Diemer 1992b; Smith 1995; Tuma 1996a; Ott 1999; Eubanks *et al.* 2003; Guyer 2003).

A burrow may or may not be exclusively used by just one gopher tortoise. Two or more tortoises may share the same burrow, although the burrow is used at different times of the year by different individuals. Home ranges overlap when a burrow is used by more than one tortoise. About 50 percent of the area occupied by 123 tortoises was shared by two or more tortoises in relatively pristine, stable habitat in southwestern Georgia (Eubanks *et al.* 2002).

Home range studies have been conducted at only two sites or populations in the listed range of the gopher tortoise. At Camp Shelby, Mississippi, average home range varied from 7.3 - 10.4 acres (2.7 ha) for males and 12.1 - 32.9 acres for females (Tuma 1996a; Guyer 2003). At another population on timber industry land in Alabama, average home

range was 10.4 acres (4.2 ha) for males and 32.9 acres (13.3 ha) for females. These home ranges are larger than those typically determined for tortoises at populations in Alabama, Georgia, and Florida outside the listed range. Since gopher tortoise movements and distance increase as herbaceous biomass and habitat quality decrease (Auffenberg and Iverson 1979; Auffenberg and Franz 1982), larger home ranges at these two study sites in the listed range probably reflect differences in habitat quality. Habitat conditions on the timber industry study site were highly heterogeneous, with patches and stands of suitable habitat mixed among patches of unsuitable habitat. These tortoises moved among relatively long distances to different burrows located in suitable habitat patches within a matrix of poor and unsuitable habitat.

As distances increase between gopher tortoise burrows, isolation among tortoises also increases due to the decreasing rate of visitation and breeding (Boglioli *et al.* 2003; Guyer 2003). Using extensive data from individual tortoise interburrow movements and home range size, Eubanks *et al.* (2003) found that most colonies or breeding population segments would consist of burrows no greater than about 558 feet (170 meters) apart. Guyer (2003) found that males only rarely will move from their burrows up to 1,640 feet (500 meters) to a female burrow for mating opportunities, and females typically experience a visitation rate of near zero when their burrows are 460 - 623 feet (140 - 190 meters) from nearest neighbors. Demographically, tortoises located at distances of about 600 feet (200 meters) from other tortoises are functionally isolated and subdivided as separate breeding populations. Thus, breeding populations or colonies likely consist of tortoises and burrows in suitable, unfragmented habitat within 600 feet or less from each other.

Population dynamics

As long-lived animals, gopher tortoises naturally experience delayed sexual maturity, low reproductive rates, high mortality at young ages and small size-classes, and relatively low adult mortality. The growth and dynamics of populations are stochastically affected by natural variation due to demographic rates, the environment, catastrophes, and genetic drift (Shaffer 1981). Factors affecting population growth, decline, and dynamics include the number or proportion of annually breeding and egg-laying females (breeding population size), clutch size, nest depredation rates, egg hatching success, mortality (hatchling/yearling, juvenile-subadult, adult), the age or size at first reproduction, age- or stage-class population structure, maximum age of reproduction, and immigration/emigration rates.

These factors and data have been evaluated in several investigations of population viability to estimate the probabilities of gopher tortoise population extinction over time and the important factors affecting persistence (Cox *et al.* 1987; Cox *et al.* 1994; Miller 2001; Epperson 2003; Wester 2004; McDearman 2006). These gopher tortoise population models and simulations varied with regard to specific objectives, model structure, transparency, simulation time, and actual demographic parameters. Nevertheless, the various projections of population growth, decline, and persistence time in different scenarios are plausible, coarse consequences of sufficiently reliable data. In

general, populations as small as 50 - 60 gopher tortoises have good chances of persisting up to 200 years under optimal habitat and management conditions. With more moderate and probably realistic conditions in the federally listed range, individual populations of 100 or more tortoises may be required to avoid extirpation during this time period. Plausible conditions also exist where populations of 60, 100, or more gopher tortoises will become extirpated within 200 years.

Using demographic data from various tortoise populations primarily in Florida, Cox *et al.* (1987) found that more than 90 percent of simulated populations with 50 annually breeding individuals can persist up to 200 years under favorable habitat and management conditions. Favorable conditions reflected relatively high survival and fecundity, in habitat maintained by prescribed fire and protected from human disturbances. Populations of this size and demographic characteristics were considered the smallest potentially viable by their definition of persistence for at least 200 years. However, in another viability analysis using a different model with slightly different demographic parameters, Cox *et al.* (1994) reported that larger populations of about 200 gopher tortoises were required to achieve a 0.9 or greater probability of persisting for 200 years.

Populations as small as 50 tortoises, as modeled with VORTEX (Lacy *et al.* 2005) by Miller (2001) using demographic data from the Florida panhandle, also exhibited positive growth rates and persistence. The potential effect of upper respiratory tract disease (URTD) was evaluated by increasing annual mortality as compared to a baseline model. URTD reduced the stochastic population growth rate, particularly in the panhandle population models, to such an extent that populations declined to eventual extirpation.

Epperson (2003) used RAMAS to simulate the potential additive effects of fire ant predation on hatchling mortality, based on field and experimental data for clutch size, hatching success, and predation in the federally listed range from study sites at Camp Shelby and DeSoto National Forest, Mississippi. Without fire ants, the annual multiplicative population growth rate (lambda, λ) was 1.018, with stable, slightly growing populations. With fire ants, λ was 0.977, with a declining population trend and eventual extirpation. McDearman (2006) used Epperson's (2003) data with VORTEX to evaluate persistence and extinction time for smaller populations. If the mortality from fire ant depredation is additive to other mortality sources, then all populations with an initial size from 10 - 200 tortoises were extirpated within 200 years, with a mean time to extinction from 32.2 - 80.9 years.

Population dynamics of turtles, as long lived animals, have commonly been considered sensitive to demographic changes in adult survival and, in some cases, juvenile survival (Gibbons 1987; Congdon *et al.* 1993; Heppell and Crowder 1996). Likewise, models and simulations of gopher tortoise populations are most sensitive to adult, hatchling, and juvenile survival rates (Miller 2001; Epperson 2003; Wester 2004). For example, the small but positive population growth rates modeled for a stable base population became negative when mortality of the 3 - 4+ year age class increased from 3.0 to 5.0 percent, or the yearling (0 - 1 year age class) mortality increased from 95 to 97 percent (Table 2; Figure 1) (Miller 2001; McDearman 2006).

Changes in other vital parameters also affect population growth, although generally not to the proportionate extent of mortality (McDearman 2006). The finite rate of increase (λ) changed from 1.002 to 1.006 when the minimum age of first reproduction was reduced from 20 to 17 years, and independently, average clutch size was increased from 4.79 to 5.60 (Table 3) (McDearman 2006). In Miller's (2001) analysis, an increase in juvenile (0 - 1 year) mortality from 94.89 percent to 96.89 percent effectively reduced successful reproduction for each female by 40 percent and eliminated population growth, leading to long-term decline and/or extirpation. Adult survival was the most sensitive parameter in Epperson's (2003) model, although relatively small change in hatchling mortality by the additive effects of fire ant predation was sufficient to eliminate any population growth.

Because the difference between gopher tortoise population growth and decline is sensitive to small changes in mortality, impracticably large sample sizes (number of tortoises or population size) will be required in many instances to measure and detect true differences for threshold mortality parameters at an acceptable level of statistical power. For example, if the estimated mortality rate from a mark-recapture or other study is 0.95 (P_i=0.95), then the null statistical hypotheses of interest could be that the rate or proportion is equal to or greater than 0.97 (H_0: $P_i \geq 0.97$), which is the threshold value for population growth and viability given other suitable demographic parameters (Base and S1, Table 3; Figure 1). The alternative, H_1, is $P_i < 0.97$, which would be associated with a declining population for these parameters. Power ($1 - \beta$) is the probability of correctly rejecting a false null hypothesis (population growth), and accepting the alternative of a declining population. The Type I error rate (α) is the probability of rejecting a true null hypothesis.

In this case, the 0.95 mortality rate would have to be determined from sample sizes of 500 or more tortoises to achieve a power of 0.8 or greater (Figure 3). Thus, a statistically correct determination and forecast of a declining population trend (e.g., rejecting a false null hypothesis) could be made only 80 percent of the time. In a small population of 100 adults, with every adult monitored to determine a 0.95 mortality rate, the statistical power diminishes substantially to only about 0.3 (Figure 3).

Highly accurate measurements and assessments of sensitive demographic parameters affecting population for growth and viability likely will be difficult to attain with confidence, particularly in small populations. Studies from large populations or cross sectional studies from several populations may be required, if environmental heterogeneity can be controlled. With uncertainty in measuring key demographic and environmental factors, the goals and objectives for establishing viable populations and habitat should include larger populations than those identified as minimally viable.

Status and distribution

Listing - The gopher tortoise is listed as a threatened species in the western part of its range, from the Tombigbee and Mobile Rivers in Alabama west to southeastern Louisiana on the lower Gulf Coastal Plain (U.S. Fish and Wildlife Service 1987). The

listed range of the gopher tortoise includes three counties in southeastern Alabama, 14 counties in southern Mississippi, and three parishes in Louisiana. Most gopher tortoise habitat is privately owned (70 percent), while about 20 percent is owned by the Forest Service, and 10 percent by other public agencies (Noss 1988). No critical habitat has been designated for this species.

The decline of the gopher tortoise has been linked to the decline of the open, fire maintained longleaf pine forest and ecosystem (U.S. Fish and Wildlife Service 1990). About 80 percent of the original habitat for the gopher tortoise within its listed range has been lost due to urbanization and agriculture (McDearman 2005). In remaining forests, management practices involving dense pine stands for pulpwood production, the silvicultural conversion from longleaf to other pines, and fire exclusion or infrequently prescribed fire have further reduced habitat for the species. These practices eliminate the open, sunny forest with a well developed groundcover of grasses and forbs needed by tortoises for burrowing, nesting, and feeding (Landers and Buckner 1981; Auffenberg and Franz 1982). Other threats and causes for decline include habitat fragmentation, fire ants, predation, and human-caused mortality as a result of roads and heavy equipment operations during forest site preparation and timber harvest (U.S. Fish and Wildlife Service 1990).

Upper respiratory tract disease - An additional threat is the incidence of URTD. This highly contagious disease, most likely transmitted by direct contact among tortoises, is caused by at least one bacterium, *Mycoplasma agassizi* (Brown *et al.* 1994; Jacobson *et al.* 1995; McLaughlin *et al.* 2000). The disease has been associated with the significant decline of certain gopher tortoise populations in Florida (Berish *et al.* 2000) and the desert tortoise (*Gopherus agassizii*) (Jacobson *et al.* 1995; Berry 1997). Tortoises with antibodies specific to URTD have been found in Alabama, Louisiana, and Mississippi, indicating these animals have been exposed to the pathogen. In contrast to areas of Florida, there is no evidence of sudden or potentially catastrophic mortality and population declines in the listed range associated with URTD. Only one clinically symptomatic tortoise has been detected in the listed range (Tuma 1996b) with conjunctivitis, nasal discharge, ocular discharge, and related symptoms (e.g., Jacobson *et al.*, 1991). Tortoises exposed to URTD may not test antibody seropositive or display external signs of an infection if convalescent, a silent carrier, or in the early stages of infection (Schumacher *et al.* 1997).

Tortoises have tested seropositive for URTD at one site in Alabama, three general localities in Mississippi, and two sites in Louisiana. One tortoise was seropositive in Mobile Co., Alabama, where over 100 tortoises have been tested (Porter 2005). In Mississippi at Camp Shelby/DeSoto National Forest, five tortoises were seropositive, four suspect, and 48 negative (Epperson and Heise, 2001). Fourteen of 15 tortoises tested seropositive in the Marion County WMA (Smith *et al.* 1998). Elsewhere from various locations in Forrest, George, Greene, Harrison, and Lamar Counties, no seropositive tortoises were detected among more than 50 tortoises tested (e.g. U.S. Fish and Wildlife Service, unpub. data; Thomas and Blankenship 2002). In Louisiana from seven locations, 15 of 58 tortoises were serologically suspect or positive for URTD,

mostly from the Florida Gas pipeline and Ben's Creek WMA in Washington Parish (Diaz-Figueroa 2003).

Surveys - Gopher tortoises occur in a variety of habitat types in the listed range. Habitat in upland forests include stands of longleaf pine, pine-scrub oaks, as well as sufficiently open sites converted to loblolly pine and slash pine production. Tortoises also occur in open ROWs for roads, gas and electric utilities, as well as pastures.

Systematic surveys have been based on standard methods and techniques to estimate the number and density of burrows and, with burrow occupancy or conversion factors, the number and density of tortoises in survey areas of interest (e.g. Cox *et al.* 1987; Carthy *et al.* 2005). Most of the systematic gopher tortoise surveys in the listed range have been comprehensive, in which the total number burrows (active, inactive, and abandoned) in the population or area of interest is counted by surveyors walking parallel line transects of various widths to allow the ground between to be visually covered (Landers and Speake 1980; Wester 1995b; Wester and Haas 1995; U.S. Fish and Wildlife Service 2000; Epperson and Heise 2001; Wester 2003). In at least one survey, strip transects (long, rectangular plots) were used as random samples stratified by habitat types to estimate burrow number and density and extrapolate such estimates over the larger study area (Jones *et al.* 1995; U.S. Fish and Wildlife Service 2000). Estes and Mann (1996) used comprehensive surveys (total count) of habitat blocks as samples for a larger study area. Line transects, using distance measurements to burrows to estimate density (e.g. Burnham *et al.* 1980), have not been commonly used, but were the basis of Lohoefener and Lohmeier's (1984) status survey of the western population and Mann's (1995) comparative study of burrow density estimates by comprehensive and distance methods.

Determining the number of tortoises in a population by trapping at each burrow can be a time consuming, intensive task. Consequently, biologists frequently estimate population size according to an index based on the number of active and/or inactive burrows, as adjusted by a correction factor to account for the fact that every burrow is not inhabited by a tortoise (Cox *et al.* 1987). The correction factor expresses the percentage of burrows that are occupied by tortoises. Correction factors are generated by studies determining the rates at which burrows classified as active and/or inactive actually are occupied by tortoises.

Gopher tortoise occupancy of burrows in some surveys has been directly determined by burrow video cameras, at least for those burrows that could be completely scoped without obstructions. Over 2,500 burrows have been scoped in the listed range (e.g. Mann 1995; Wester 1995a; Wester and Kolb 1997). The overall percentage of active and inactive burrows occupied by tortoises has been similar, at 44.1 percent in pipeline construction ROWs (Wester and Kolb 1997), 47.7 percent at Camp Shelby and DeSoto National Forest (Wester 1995a), and 41.4 percent at Marion County WMA, Camp Shelby, and DeSoto National Forest study areas (Mann 1995). Nevertheless, burrow occupancy rates are known to vary among sites depending on habitat conditions and other factors (e.g. Breininger *et al.* 1991; McCoy and Mushinsky 1992). In Mississippi, site specific occupancy of active and inactive burrows at 20 study sites ranged from 14.3 percent to 57.1 percent, and varied according to the number of burrows at a site (Mann 1995). The

percentage of burrows occupied by tortoises in Mississippi is greater at sites with proportionately more active than inactive burrows.

Simple linear regression models have been used to account for this variation and more accurately predict the number of gopher tortoises (dependent variable) according to the number of active and inactive burrows (predictor variable) (e.g. McCoy and Mushinsky 1992; Mann 1995). Mann's regression model, however, is limited to a study of 20 sites, and regression equations are not available for most of the other surveys and sites (e.g. Wester 1995b) with occupancy data. Thus, estimates of the number of tortoises from burrow data usually have been made from the overall or average burrow occupancy rates. For large surveys in the absence of any site specific occupancy data, the Service normally has used Mann's (1995) overall burrow (active and inactive) occupancy rate, at 0.414, as an average, conservative conversion factor. A potential advantage of using an active plus inactive burrow conversion factor, instead of an active burrow factor, is that the estimate is not affected by errors and difficulties in distinguishing active and inactive burrows, since both are used as estimators.

In Mississippi and Alabama, more than 69,000 acres of potential forest habitat types have been systematically surveyed by comprehensive, strip, and line transects for burrows and tortoises in the federally listed range (e.g. Lohoefener and Lohmeier 1984; Jones *et al.* 1995; Mann 1995; Wester 1995b, 1995a; Wester and Haas 1995; Estes and Mann 1996; U.S. Fish and Wildlife Service 2000; Epperson and Heise 2001; Wester 2003). These major surveys on Camp Shelby (MS), DeSoto National Forest (MS), Mississippi 16th section lands, International Paper Co. (MS and AL), and elsewhere each covered more than 1,000 acres (Table 4). In addition, many other smaller tracts and parcels have been surveyed either systematically or incidentally in Alabama, Mississippi, and Louisiana (e.g. Nelson *et al.* 1992; Nelson 1993, Mississippi Natural Heritage Program data, Alabama Natural Heritage Program data, Louisiana Natural Heritage Program data).

Number and distribution of burrows and tortoises - The numbers of burrows, tortoises, and, in some instances, colonies have been estimated on at least 451,000 acres in Alabama and Mississippi from major surveys (Table 5). The largest land ownership type for which samples of the number of burrows and tortoises have been used to extrapolate estimates to the larger surrounding habitat area is on private lands (278,770 acres) previously owned and managed by International Paper Company (U.S. Fish and Wildlife Service 2000).

Estes and Mann (1996) concluded that the total number of gopher tortoises in the listed range in Mississippi probably exceeds the upper range of 13,986 tortoises originally estimated from line-distance surveys by Lohoefener and Lohmeier (1984). Their conclusion was based on the results of earlier surveys on Camp Shelby and DeSoto National Forest, and the fact that their survey of Mississippi 16th section lands represented only about three percent of the land in the listed range of the tortoise. Also, the survey and estimates by Lohoefener and Lohmeier (1984) were concentrated on deep, sandy (priority) soils, while later surveys were not limited to habitat with these soil types. From other more recent surveys, a substantial number of tortoises are now known on other non-priority soils (e.g. Jones *et al.* 1995; Wester 1995a; Estes and Mann 1996;

Epperson and Heise 2001). These major and other recent surveys indicate at least 20,000 gopher tortoises occur in the listed range.

The greater number of tortoises known today, relative to that estimated when federally listed (Lohoefener and Lohmeier 1984), reflects the completion of more extensive surveys rather than a natural increase in the total population. While gopher tortoises remain relatively abundant and widely distributed in the listed range, individual population segments are small, fragmented, typically non-viable, and exhibit low reproductive success in poor habitat of declining quality that is insufficient to maintain most existing populations (Jones *et al.* 1995; Mann 1995; Wester 1995b; Wester and Haas 1995; Estes and Mann 1996; Smith *et al.* 1997; Wester 2003, 2004).

Potentially viable populations - There are only seven known potentially viable populations; three in DeSoto National Forest; one in the Marion County WMA; one in Stone Co., MS on 16th section land; one on county land in Mobile Co., Alabama (Mobile Water and Sewer Board gopher tortoise mitigation bank); and another in Mobile Co., managed by the Alabama Department of Transportation-Federal Highway Administration (FHwA). Each of these populations consists of at least 50 tortoises. Spatially, a tortoise population is defined by aggregations of active and inactive burrows within 600 feet of each other, sufficiently close for potential breeding (e.g. Guyer 2003). The largest of these populations consists of at least 114 tortoises, censused by a burrow scope, on DeSoto National Forest within the Camp Shelby special use permit area. Two other populations recently surveyed within the buffer zone surrounding Camp Shelby's High Explosive Impact Area probably consist of 50 or more tortoises, for which GIS analysis is ongoing for such confirmation.

The actual demographic viability of these populations, however, has not been established. As indicated by gopher tortoise viability models (Cox *et al.* 1987; Cox *et al.* 1994; Miller 2001; Epperson 2003; Wester 2004; McDearman 2006), populations of this minimal size require favorable to optimal demographic rates which have not been fully assessed or directly measured for any population in the listed range. The low egg hatching success and fire ant depredation measured at sites in Camp Shelby and DeSoto National Forest are indicative of factors that can seriously impair viability at these sites as well as elsewhere. In addition, long-term habitat management and restoration with frequent prescribed fire to maintain an open understory is crucially required.

Limiting factors in forest habitat - On the DeSoto National Forest and adjacent Camp Shelby, including the Shelby special use permit area in DeSoto National Forest, comprehensive surveys of over 44,500 acres of potential habitat have identified at least 162 tortoise populations/colonies (Landers *et al.* 1980; Wester 1995b, 2003). At least 1,343 adult gopher tortoises reside on Camp Shelby, most of the habitat for which is managed by the Forest Service in the special use permit area. However, the vast majority (85 percent) of populations/colonies in the Camp Shelby and DeSoto National Forest are small, with less than 10 tortoises, and highly vulnerable to local extirpation (Table 5).

Other tortoises and populations exist on Desoto National Forest, although they have not been comprehensively surveyed. Previous surveys were concentrated in areas with priority soil types, which are deep, excessively well drained, sandy soils. This focus reflects the Service's gopher tortoise recovery objective on habitat most capable of supporting 3 - 7 burrows/ha (1.2 - 2.8 burrows/acre), which is "likely underlain by Lakeland, Troup, or one of the more rarely encountered sandy soils in excess of 1.5 meters (5 feet)" (U.S. Fish and Wildlife Service 1990). Priority soil types include Typic Quartzipsamments in the Lakeland and Alaga series, and siliceous Paleudults in the Eustis and Wadley (Troup) series (e.g. McDearman 2005).

Soil series with gopher tortoises have been collectively classified as either priority, suitable, marginal, and unsuitable based on factors such as texture, permeability, and depth to soil water table, argillic horizon, fragipan, plinthite, and other factors (U.S. Forest Service 1990; Jones *et al.* 1995; Epperson and Heise 2001; McDearman 2005). Of the seven known potentially viable populations, only two (Camp Shelby and Marion Co. WMA) are not associated with priority soil types (Table 4). The greatest overall density of burrows on federal and non-federal lands is on priority soils, but substantial and important numbers of tortoises also exist on suitable soil types (Lohoefener 1982; Jones *et al.* 1995; Wester 1995b; Estes and Mann 1996; U.S. Fish and Wildlife Service 2000; Epperson and Heise 2001; Jones and Dorr 2004).

In large populations in good habitat in Florida and Georgia, from 36 to 52 percent of the population consists of reproductively immature subadults and juveniles (e.g. Alford 1980; Kushlan and Mazzotti 1984; Linely 1986; Godley 1989; McCoy and Mushinsky 1992). In the listed range, the typical age and size-class structure of tortoise populations is dominated by adults, with excessively low numbers of juvenile and young tortoises, indicative of inadequate reproduction and recruitment to maintain a stable population (Lohoefener and Lohmeier 1984; Marshall 1986; Nelson 1993; Seigel and Hurley 1993; Mann 1995; Wester 1995b; Tuma 1996a; Smith *et al.* 1997; Epperson and Heise 2001; Wester 2003). A number of factors contribute to low recruitment of offspring into populations, including natural and introduced predators (fire ants) of eggs and hatchlings (Jennings and Fritts 1983; Tuma 1996a), and historical effects of poaching that may have eliminated cohorts of reproductive age classes (Tuma 1996a). Overall, however, poor habitat quality for reproduction and nesting in managed forests has been attributed to inadequate sunlight from densely planted pines and/or understory encroachment of shrubs and hardwoods in the absence of frequent fire (Auffenberg and Franz 1982; Lohoefener 1982; Lohoefener and Lohmeier 1984; Marshall 1986; Nelson 1993; Seigel and Hurley 1993; Mann 1995; Wester 1995b, 1995a; Tuma 1996a; Mushinsky *et al.* 1997; Aresco and Guyer 1999a, 1999b; Epperson and Heise 2001; Rostal and Jones 2002; Wester 2003).

Reproduction and recruitment is evident at some sites with good habitat in the listed range, as on Marion County WMA where about 22 percent of the population is subadults (Mann 1995; Seigel and Smith 1995). On Mississippi 16th section lands, subadults and juveniles comprise more than 30 percent of the site population on 16 of 81 sites surveyed. At eight of these sites, subadults represent 50 to 69.9 percent of the local population.

Some colonies within Camp Shelby and sites on former International Paper Co. lands also exhibit recent reproduction. Egg hatching success and recruitment is expected to be greater, on average, on excessively well drained and sandy gopher tortoise priority soils.

Soil depth, texture, and drainage directly and indirectly affect several important ecological factors. For example, burrows are longer, deeper, and more easily excavated on deep, upland sandy soils than others with a clay fraction or fragipan (Ultsch and Anderson 1986). Egg and hatchling mortality from nests of tortoises on moderately to poorly-drained soils of gopher tortoise marginal soils tends to be greater than for tortoises nesting on more well-drained soils (Brode 1959; Auffenberg and Franz 1982; Seigel and Hurley 1993; Seigel and Smith 1995; Smith *et al.* 1997; Noel and Quall 2004). Such mortality appears to be developmental due to seasonally saturated soils and, for hatchlings, death by suffocation in hard packed soils with higher clay content. Furthermore, soil moisture and drainage affect the development of plant community types and, in the absence of frequent fire, the rate of shrub-scrub encroachment and succession to poor or closed forest community types with unsuitable structure.

Gopher tortoises currently inhabit longleaf, slash, and loblolly pine stands in sapling, pole, and sawlog stages with a suitably open canopy, understory, and well-developed herb layer. Tortoises also occupy clear-cut and young regenerated stands of timber that are not dense or closed. Habitat suitability in managed stands is affected by site preparation techniques, tree planting density, stocking, soils, and prescribed fire history. In dense plantations with fire exclusion, the woody vegetation may close at the sapling or early pole phase (ca. 10 years of age) causing tortoises to abandon the stand (Landers and Buckner 1981; Jones *et al.* 1995). Tortoises in dense stands with poor habitat experience slower rates of growth that, for young animals, delays their sexual maturation as breeders in the population (Mushinsky *et al.* 1997; Aresco and Guyer 1999b). In stands with infrequent fire and greater canopy and vegetation closure, tortoise clutch size and the mass of eggs and hatchlings is lower than in open stands with better habitat (Rostal and Jones 2002).

Tortoises eventually abandon their burrows as stands become closed, or at least when the total basal area of trees reaches 304 ft^2/acre (70 m^2/ha) (Aresco and Guyer 1999a). Closure of the canopy, sub-canopy, and shrub strata also may occur at lower total basal areas, accompanied by the abandonment of tortoises. Tortoises remain in stands with active burrows when the average total pine basal area is approximately 60 ft^2/acre (13.8 m^2/ha) (Aresco and Guyer 1999a). Habitat recommendations or guidelines to maintain tortoises in open stands commonly involve timber thinning to maintain a pine basal area of no more than 50 - 70 ft^2/acre (11.5 – 16.1m^2/ha), with a canopy cover no greater than 60 - 80 percent, and frequent prescribed growing season fire (1 - 3 year intervals) to control encroaching hardwoods and shrubs (Cox *et al.* 1987; Means 1988; U.S. Forest Service 1990; Aresco and Guyer 1999a).

As tortoises are forced to abandon burrows in deteriorating habitat, they disperse and may become temporary or permanent residents along open roadsides, in pastures or fields, and in other open ruderal areas when other suitable forest habitat is unavailable. Tortoises

experience higher mortality rates when they reside along roads and highways (Landers and Buckner 1981; Lohoefener and Lohmeier 1984). Dispersing tortoises may find suitable forest habitat patches elsewhere, but they are not expected to emigrate in unison and inhabit the same area after dispersal. Thus, the periodic cycle of dispersal after abandoning burrows in unsuitable habitat disrupts breeding structure and reproduction and reduces population density over long periods (Diemer 1992b; Guyer and Herman 1997; Aresco 1998; Aresco and Guyer 1999a).

Declining populations and habitat - Surveys and monitoring of gopher tortoise populations in DeSoto National Forest and Camp Shelby, mostly on priority soils, have confirmed a net declining population trend, attributed to poor habitat quality due to understory woody encroachment and closure in the absence of frequent prescribed fire (Wester 1995b; Epperson and Heise 2001; Wester 2003). The total number of active burrows on priority soil survey areas in the DeSoto National Forest declined significantly by 35 percent in the Black Creek District (north DeSoto District) and 28.6 percent in the Chickasawhay District between 1995 and 2002 (Wester 2003). The population, as indexed by active burrows, did not change significantly on the Biloxi District (south Desoto District) for the same time period (Wester 2003).

At Camp Shelby, the number of adult gopher tortoises declined by 33 percent between 1995 and 2004, at an average annual rate of about 4.9 percent. The decline occurred on property owned and managed by the MS Army National Guard as well as Forest Service (Desoto National Forest) land under a special use permit for military training activities, but where forests are otherwise managed by the Forest Service. For example, adult tortoises on the T-44 gopher tortoise refuge, which consists of longleaf pine stands managed by DeSoto National Forest, declined by 47 percent during this period. Overall, there was no statistically significant difference in the decline among sites used for military training and limited or no training activity.

The observed decline at DeSoto National Forest and Camp Shelby includes the loss of adults by natural mortality and, based on size class structure, low rates of recruitment due to poor reproduction. However, most of the loss is apparently due to low burrow fidelity and high rates of burrow abandonment at sites where poor habitat conditions have been observed. This pattern is similar to that reported by Diemer (1992a; 1992b) elsewhere, where deteriorating habitat conditions were associated with low recapture rates for adults and a continual cycle of burrow abandonment and tortoise movement to other habitats. When adults disperse because of unsuitable habitat, breeders are lost in the local population. Biologically, this loss is equivalent to increasing adult mortality rates in the local population and reducing population viability (Seigel and Dodd 1999).

No long-term monitoring data is available for populations on private lands, but the overall low density of burrows from surveys on privately owned forestlands and the generally poor condition of habitat are indicative of declining populations. No potentially viable populations currently are known from industrial or non-industrial private forestlands. On lands formerly managed by International Paper Co., about 8,400 gopher tortoises on 278,000 acres of potential habitat were estimated by stratified surveys

(U.S. Fish and Wildlife Service 2000). Based on estimates of population/colony density and the number of active and inactive burrows per colony, there were about 642 tortoise populations, although populations were small with only about 2 – 10 tortoises per colony (U.S. Fish and Wildlife Service 2000). As in other areas, priority soil sites with deep sandy soils were important predictors of burrow and colony density (Jones *et al.* 1995; U.S. Fish and Wildlife Service 2000; Jones and Dorr 2004). Similar patterns of widely distributed tortoises at low densities and small, demographically vulnerable populations/colonies also are expected on other industrially managed lands because of similar silvicultural methods.

On predominately non-industrial lands, McDearman *et al.* (2003) rated habitat conditions as mostly poor to unsuitable on priority soil patches with pine forests of at least 150 acres in seven Mississippi counties. Habitat conditions on priority soils generally are better, typically with greater burrow densities than on suitable and marginal gopher tortoise soil types (Jones *et al.* 1995; U.S. Fish and Wildlife Service 2000; Epperson and Heise 2001; Jones and Dorr 2004). This is because in the absence of frequent fire, the expected rate of woody plant succession, growth, understory encroachment, and stand closure on the deep, excessively well-drained sandy soils is less than that on suitable and marginal gopher tortoise soil types with greater soil moisture holding capacities (McDearman 2005). Priority gopher tortoise soil sites tend to retain an open vegetation structure for longer periods than vegetation associated with suitable and marginal gopher tortoise soil types in the absence of frequent fire.

Nevertheless, high burrow densities and large populations can be sustained on frequently burned, stable, open, longleaf pine sites on suitable soils (Typic Paleudults), such as that in southern Georgia at Green Grove on the Ichauway ecological reserve, where a population of about 123 tortoises occupy a 100 acre (40 ha) tract (e.g. Boglioli *et al.* 2000; Eubanks *et al.* 2002). Resident populations of this size or density are not known in the listed range on private or public lands with suitable soils, primarily due to past forest management practices and insufficient fire. The generally poor to unsuitable habitat conditions observed on most priority soil sites on private lands indicate that, on average, habitat conditions at other sites with suitable and marginal gopher tortoise soils will be more degraded.

Expanding urban areas and infrastructure - Urban expansion, real estate development, and the construction of highways have increased in the past decade, particularly for that associated with the westward expansion from the Mobile, Alabama, metropolitan area and north from the Mississippi Gulf Coast. Following the destruction of Hurricane Katrina in 2005, a residential shift from more coastal areas northward to expanding smaller communities such as Lucedale, Wiggins, Picayune, and Hattiesburg appears to be in progress. Forests with occupied and potential habitat have been converted with this expansion, and remaining tracts have become smaller and more highly fragmented. The wildland-urban interface has increased, particularly in Alabama and southern Mississippi, which has further limited the ability to prescribe frequent fire and maintain habitat due to smoke management issues.

As of October 2004, the Service had approved the relocation of about 529 gopher tortoises as a result of 37 formal section 7 consultations with federal agencies and four habitat conservation plans (HCPs) and section 10 incidental take permits to non-federal entities due to unavoidable impacts associated with construction (McDearman *et al.* 2004) (Table 6). Most of the tortoises relocated due to federal agency activities were associated with pipeline construction through the Federal Energy Regulatory Commission (FERC). Pipeline construction, however, typically had the least adverse effects since gopher tortoises are temporarily moved from the construction corridor, and returned to the open ROW following construction, which remains as suitable habitat (e.g. Wester and Kolb 1997). In contrast, highway construction by the FHwA and real estate, certain military training activities, and commercial or industrial development with section 404 wetland permits from the U.S. Army Corps of Engineers are associated with permanent habitat destruction. Highways typically are selected on uplands, frequently through upland habitat, where remaining tortoise populations are further fragmented. The recent establishment and use of conservation banks by FHwA, AL Department of Transportation, and MS Department of Transportation has reduced adverse effects of fragmentation by consolidating affected tortoises and augmenting resident populations in larger managed tracts of habitat, particular for the Mobile County, AL, bank.

Similarly, the Mobile Area Water and Sewer System (MAWSS) HCP and mitigation bank functions as a relocation site for relatively isolated gopher tortoises in fragmented habitat subject to real estate development (Mobile Board of Water and Sewer Commissioners 2001). From a small resident population of about 15 tortoises, the bank site now is occupied by population of about 115 tortoises (Porter 2006). Three gopher tortoise conservation banks are operating in Mobile County: the MAWSS, the FHwA, and the most recent South Alabama Utilities bank. Additional conservation banks for both federal and non-federal activities are needed in the listed range.

Recovery criteria

The Service's recovery plan for the gopher tortoise establishes short-term and long-term criteria involving public and private lands to delist the species (U.S. Forest Service 1990). The DeSoto National Forest represents a core area where management actions are required to prevent this threatened species from becoming endangered. This is the first and most immediate objective of the recovery plan. The long-term objective, delisting, involves substantial voluntary commitments from private landowners.

The short-term objective is to establish and maintain populations on the DeSoto National Forest, including Camp Shelby, on 18,144 acres (7,343 ha) at densities of 1.2 - 2.8 burrows/acre (3-7 burrows/ha). This is the acreage estimated to consist of deep sandy soils (Arnold 1989), designated as priority soils, and at burrow densities indicative of large, stable populations on such soils in Florida. By these criteria and using a 0.61 burrow occupancy rate, the Service's recovery plan estimates the total recovery population on DeSoto National Forest would consist of 13,437 - 31,354 tortoises. More recent data on the average percentage of active and inactive burrows inhabited by tortoises in the listed range reveals that the 0.61 burrow conversion factor is too large (e.g. Mann 1995; Wester 1995b). Using Mann's (1995) correction factor of 0.414, then

9,120 - 21,280 tortoises would occur on DeSoto National Forest by this acreage with burrow density criteria at 0.5 - 12 tortoises/acre. For a minimally viable population of at least 75 tortoises, the lower range of the recovery criterion of about 9,120 tortoises would represent up to 122 viable populations, or less with larger individual populations.

On July 26, 1990, the Forest Service and Service completed formal section 7 consultation on the effect of a proposed management plan for the gopher tortoise on DeSoto National Forest. The objective of the Forest Service's plan is to promote recovery by maintaining and improving gopher tortoise habitat. Management measures to attain these objectives included prescribed fire, timber thinning, and regeneration to longleaf pine. Because of recent surveys documenting a declining gopher tortoise population, primarily due to poor habitat associated with encroaching shrubs and hardwoods in response to infrequent fire, the Service and Forest Service have reinitiated an informal section 7 consultation phase to remedy management problems that have impaired successful habitat restoration and maintenance. The successful implementation of a modified gopher tortoise habitat management plan is crucial to stabilize declining populations and to prevent the species from becoming endangered. This will require an increase in the frequency of growing season prescribed fire, with thinning and selective herbicide treatment in some areas with inadequate ground fuels to restore and maintain habitat. Also, management needs to be prioritized and designated on core patches of priority soils as well as adjoining areas of suitable soils to establish and maintain habitat areas of sufficient size for future viable populations. Depending on burrow density and home range overlap, the minimal reserve size for a single minimally viable population may range from 50 – 200 acres (19 – 81 ha) (Eubanks *et al.* 2002).

On private lands, the long-term objective for recovery is the establishment of 1.2 gopher tortoise burrows per acre (3 burrows/ha) on 45,945 acres (18,594 ha) of sandhill communities, where such burrow densities are most likely (U.S. Forest Service 1990). This acreage represents the area of privately-owned upland forests on sandy soils estimated by Lohoefener and Lohmeier (1984) at about the time of listing, although recovery objectives for private lands are not necessarily restricted to priority soil types. Using the 0.414 burrow conversion factor, recovery on private lands would represent about 23,094 tortoises by these criteria, or about 300 or fewer individual populations, each with 75 or more tortoises with good, long-term habitat management commitments.

Most of the timberland in the listed range of gopher tortoise is privately owned. In south Mississippi, for example, only about 14 percent of upland pine forests are publicly-owned and managed (Kelly and Sims 1987). Recovery for the gopher tortoise on private lands will require substantial voluntary commitments. Private landowners are not required by the Act to implement voluntary management to restore or maintain habitat by preventing or controlling forest succession that leads to habitat degradation in the absence of frequently occurring natural fire. A primary limiting factor for the recovery of the gopher tortoise is the absence of habitat restoration, which includes frequent prescribed fire and other active management measures to control and eliminate encroaching hardwoods and shrubs.

About 400,500 acres of longleaf pine stands remained within the listed range of the gopher tortoise by the 1990's (Table 7). Gopher tortoises are not restricted to longleaf pine stands, but the best opportunity for recovery on both public and private lands will be in managed longleaf stands. The normal silviculture for the production of longleaf pine timber for poles and sawlogs, with frequent prescribed fire, is highly compatible with gopher tortoise habitat. In the listed range, voluntary landowner programs and technical assistance to private landowners by the Service, state, and private organizations recently have been initiated or are being planned as further incentives to the economic and ecological benefits for longleaf pine habitat restoration. These programs include Partners for Wildlife, Mississippi Partners for Fish and Wildlife, the Healthy Forest Reserve Program, the Emergency Conservation Reserve Program, and the Safe Harbor Program. Currently, about 2,000 acres of longleaf pine and potential gopher tortoise habitat has been treated by some form of habitat restoration management. These and other efforts will have to increase substantially to achieve recovery on private lands.

Table 2. Principal parameters modeled for different scenarios affecting gopher tortoise population viability and persistence with VORTEX from McDearman (2006). Alternative parameters, relative to the base model, are indicated in bold font.

Scenario	Age of 1st repro	Max age of reproduction	Percent females breeding/year (EV)	Mean # offspring per female per year ± SD	Age class mortality (%) (EV)			
					0 – 1	1 - 2	2 - 3	3 – 4+
Base	20	60	95 (1.5)	4.79 ± 1.91	95 (3.5)	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S1	20	60	95 (1.5)	4.79 ± 1.91	95 (3.5)	27.1 (3.0)	8.4 (1.0)	***5.0*** ***(0.5)***
S2	20	60	95 (1.5)	4.79 ± 1.91	***97*** ***(3.5)***	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S3	20	60	95 (1.5)	4.79 ± 1.91	***93*** ***(3.5)***	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S4	***17***	60	95 (1.5)	4.79 ± 1.91	95 (3.5)	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S5	20	***50***	95 (1.5)	4.79 ± 1.91	95 (3.5)	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S6	20	60	***90 (1.5)***	4.79 ± 1.91	95 (3.5)	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)
S7	20	60	95 (1.5)	***5.60 ± 1.42***	95 (3.5)	27.1 (3.0)	8.4 (1.0)	3.0 (0.5)

Table 3. Deterministic finite rate of increase (λ), deterministic exponential growth rate (r), and stochastic exponential growth from gopher tortoise population models with parameters listed in Table 2, from McDearman (2006).

Model	λ	R	Stochastic r
Base	1.002	0.002	-0.002 – 0.001
S1	0.983	-0.017	-0.020 – -0.021
S2	0.988	-0.012	-0.014 – -0.015
S3	1.012	0.012	0.009 – 0.011
S4	1.006	0.006	-0.001 – 0.005
S5	0.998	-0.002	-0.004 – -0.007
S6	1.001	0.001	-0.003 – 0.000
S7	1.006	0.006	0.003 – 0.006

Table 4. Summary of major gopher tortoise surveys in the listed range, in which the area actually surveyed is at least 1,000 acres.

Land	Survey Year	Acres	Burrows	Gopher Tortoises	Tortoise Colonies	Tortoises in Colonies
MS (Lohoefener and Lohmeier 1984)	1984	1,241[1]	-----	29	-----	-----
MS range wide estimate from transect samples		252,249[2]	-----	7,370-13,986	-----	-----
Camp Shelby, MS (Wester 1995, e.g., Wester 2005)	1989-95	125,000[1]	1,807	1,062	146	877
DeSoto National Forest (Wester and Haas 1995)	1988-91	9,520[1]	2,128	881	147	685
MS 16th Section Land (Estes and Mann 1996)	1995-96	2,693[1]	1,211	501	-----	-----
16th Section estimate from survey sample		40,465[2]	18,165	7,558	-----	-----
International Paper Co., MS & AL (Jones *et al.* 1995; U.S. Fish and Wildlife Service 2000)	1996-98	3,720[1]	411	170	18	95
IP MS & AL estimate from survey sample		278,770[2]	23,170	9,589	720	3,785
IP MS & AL additional surveys (U.S. Fish and Wildlife Service 2000)	1998-2000	17,669[1]	514	213	37	-----
DeSoto National Forest[3] (Wester 2003)	2002	4,485[1]	1,502	622	74	410
Camp Shelby[4] (Wester 2005)	2003-04	35,000[1]	3,973	1,645	-----	-----

[1]Acres surveyed on belt or line transects.
[2]Study area for which the number and density of burrows was estimated from samples (transects).
[3]Survey represented a resurvey of 81 of the 87 sites previously surveyed during 1988-91.
[4]Survey covered all areas previously surveyed as well as additional sites not previously surveyed.

Table 5. Number of gopher tortoise populations by population size-class. Data from Wester (2002, 2005) and a GIS analysis of Wester's data.

Area	Tortoise Population-colony size 2-10	11-20	21-50	50+	Total
DeSoto District, DNF[1]	42	2	1	2	47
Chickasawhay District, DNF	30	2	1	0	33
Camp Shelby[2]	66	10	5	1	82
Total	138	14	7	3	162

[1]DeSoto National Forest, excluding Camp Shelby special use permit area.
[2]Camp Shelby, including DeSoto National Forest special use permit area.

Table 6. Summary number of gopher tortoises relocated as a result of authorized federal and non-federal projects pursuant to section 7 formal consultations and section 10(a)(1)(B) HCPs and incidental take permits, since listing, as of October 2004.

Entity	Agency/Organization	Projects	Tortoises Relocated
Federal (Section 7)	Federal Energy Regulatory Commission	8	168
	Army Corps of Engineers	5	96
	Federal Highway Administration	5	94
	Department of Defense-Army National Guard	2	34
Non-federal (HCPs)	Pine Belt Regional Landfill	1	3
	Lamar County School Board	1	2
	Perry County	1	2
	Mobile Water and Sewer Board	1	85

Table 7. Acres of longleaf pine stands in the listed range of the gopher tortoise and percent change by land ownership type. Data and analysis by Rudis (1998).

Class	Acres (x 1,000) of longleaf pine dominated stands 1970's	1980's	1990's	percent Change
Industry	350.2	265.1	266.2	-24.0
Other private	87.5	44.1	22.6	-74.2
Total private	437.7	309.2	288.8	-34.0
National forest	110.9	99.8	90.3	-18.6
Other public	21.8	16.0	21.4	-1.8
Total public	132.7	115.8	117.7	-15.8
TOTAL	570.4	425.0	400.5	-29.8

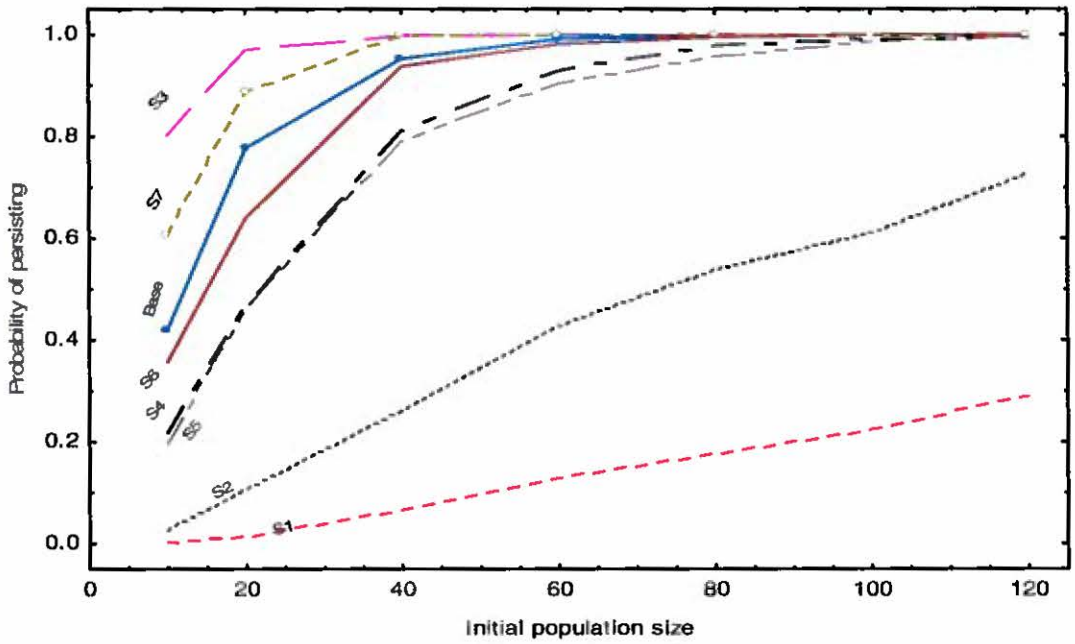

Figure 1. Probability of gopher tortoise population persistence, for different model scenarios and parameters, Base and S1 – S2 (Tables 2 and 3), from McDearman (McDearman 2006).

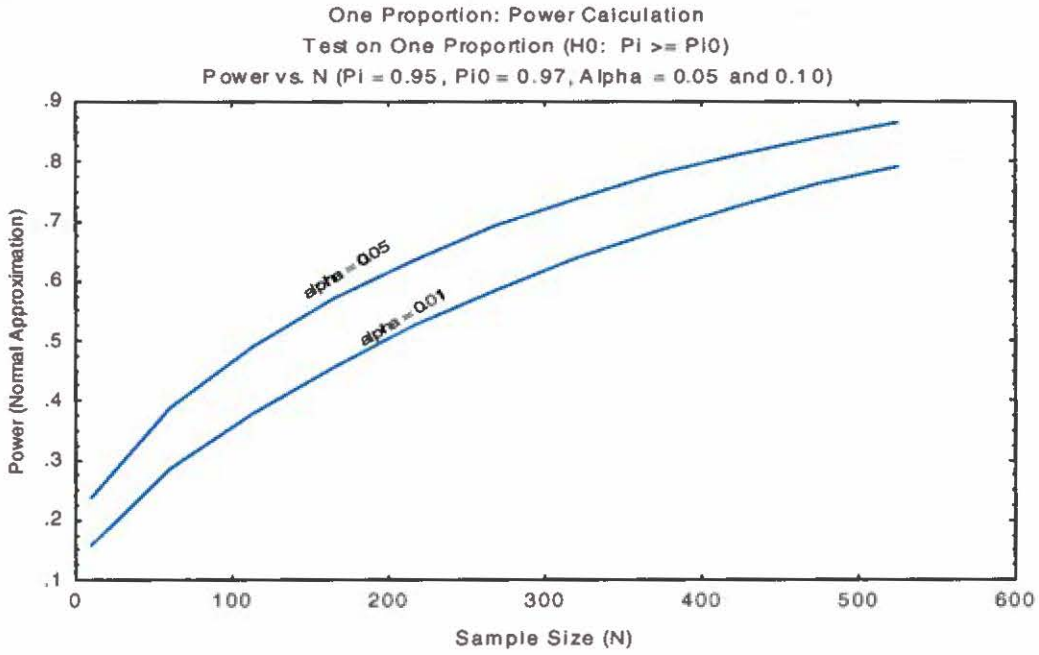

Figure 2. Effect of sample size (number of tortoises) for mortality estimates and power, to determine if an observed 0.95 mortality rate is less than the 0.97 rate required for a stable population, given other suitable demographic and environmental parameters.

Analysis of the species/critical habitat to be affected

The Service's recovery plan for the gopher tortoise establishes short-term and long-term criteria involving public and private lands to de-list the species (U.S. Fish and Wildlife Service, 1990). The DeSoto National Forest represents a core area where management actions are required to prevent this threatened species from becoming endangered, which is the first and most immediate objective of the recovery plan. The long-term objective, delisting, involves substantial commitments from private landowners.

The short-term objective is to establish and maintain populations on the DeSoto National Forest, including Camp Shelby, on 18,144 acres at densities of 1.2 - 2.8 burrows/acre. This is the acreage estimated to consist of deep sandy soils at burrow densities indicative of large, stable populations on such soils in Florida. By these criteria and using a 0.61 burrow occupancy rate, the Service's recovery plan estimates the total population on DeSoto National Forest would consist of 13,437 - 31,354 tortoises. More recent data on the average percentage of active and inactive burrows inhabited by tortoises in Mississippi reveals that the 0.61 burrow conversion factor is too large (Mann, 1995; Wester 1995). Using Mann's (1995) correction factor of 0.414, then 9,120 - 21,280 tortoises would occur on the DeSoto National Forest by this acreage and burrow density criteria, at 0.5 -12 tortoises/acre. This could represent 182 - 486 viable populations, each with at least 50 tortoises.

Recent surveys on the DeSoto National Forest have documented a declining gopher tortoise population, primarily due to poor habitat associated with encroaching shrubs and hardwoods in response to infrequent fire (Wester, 2003). On July 26, 1990, the Forest Service and Service completed formal section 7 consultation on the effect of a proposed management plan for the gopher tortoise on DeSoto National Forest. The objective of the Forest Service's plan was to promote recovery by maintaining and improving gopher tortoise habitat. Management measures to attain these objectives included prescribed fire and habitat restoration using timber thinning, mechanical methods, and herbicides to eliminate shrubs and hardwoods. On June 24, 2004, the Service requested that the Forest Service reinitiate an informal phase of consultation to remedy management problems that have impaired successful habitat restoration and maintenance.

On private lands, the long-term objective for recovery is the establishment of 1.2 burrows/acre on 45,945 acres of sandhill communities (U.S. Fish and Wildlife Service, 1990). This acreage represents the area of privately owned upland forests on sandy soils estimated by Lohoefener and Lohmeier (1984) at about the time of listing. Using the 0.414 burrow conversion factor, recovery on private lands would represent 23,094 tortoises by these criteria, or up to 462 potentially viable populations each with 50 tortoises.

Recovery for the gopher tortoise on private lands will require substantial voluntary commitments. Private landowners are not required by the Act to implement voluntary management to restore habitat. Likewise, the Act does not require private landowners to

implement active management that would prevent the natural processes of forest succession, leading to a further decline of habitat in the absence of a frequently occurring natural fire. A primary limiting factor for the recovery of the gopher tortoise is the absence of habitat restoration, with frequent prescribed fire and other active management measures to control and eliminate encroaching hardwoods and shrubs. The gopher tortoise will not be recovered simply by landowners complying with the prohibitions of section 9 of the Act to avoid incidental take. Active management to restore habitat is required, as well as active fire management to sustain existing suitable habitat.

Since the gopher tortoise was listed, 66 formal consultations with federal agencies and biological opinions have been completed (Table 8), including formal intra Service consultations. Roughly 1276 gopher tortoises have been authorized for relocation to reduce adverse effects of these projects. Based on various gopher tortoise surveys (Wester, 1995; Jones et al., 1995; Estes and Mann, 1996; Epperson and Heise, 2001), the Service estimates that at least 20,000 gopher tortoises occur in the federally listed range. The number relocated to reduce unavoidable adverse impacts represents about 6.38 percent or less of the estimated range wide population.

TABLE 8. Previous biological opinions completed for the gopher tortoise.

	Year	Agency	Consultation	Office	Monitoring Reports Received?	Project Active?
1	1989	DOD	Camp Shelby T44	JAMS	Yes	Yes
2	1990	USFS	DeSoto National Forest	JAMS	Yes	Yes
3	1991	FERC	Gateway Pipeline	DAAL	Yes	No
4	1992	DOD	Camp Shelby Tank Range	JAMS	Yes	Yes
5	1992	COE	Mobile Airport	DAAL	No	No
6	1993	USFS	Camp Shelby SUP	JAMS	Yes	Yes
7	1993	FERC	Florida Gas III	JAFL	Yes	No
8	1993	FHWA	Hwy 63	DAAL	Yes	No
9	1995	FHWA	Hwy 42	JAMS	N/A	No
10	1995	USFWS	Pine Belt	JAMS	No	Yes
11	1996	FHWA	Hwy 45	JAMS	No	No
12	1997	FERC	Destin Pipeline	JAMS	Yes	No
13	1997	USFS	Camp Shelby MPRCH	JAMS	Yes	Yes
14	1998	COE	Salco	DAAL	No	No
15	1998	FHWA	Hwy 63S	JAMS	No	No
16	1999	FHWA	Hwy 63N	JAMS	No	No
17	1999	USFWS	Lamar Co.	JAMS	Yes	No
18	1999	COE	Shell Landing	DAAL	No	No
19	1999	FERC	Florida Gas IV	JAFL	Yes	No
20	2000	FERC	PGS 5.5 mi pipeline	JAMS	Yes	No
21	2000	USFWS	Perry Co.	JAMS	Yes	No
22	2000	FHWA	Hwy 67	JAMS	No	No
23	2001	COE	Waste Industries	JAMS	N/A	No
24	2001	FERC	Florida Gas V	JAFL	Yes	No

	Year	Agency	Consultation	Office	Monitoring Reports Received?	Project Active?
25	2001	FHWA	Schillinger Rd	DAAL	Yes	No
26	2001	COE	Traditions	JAMS	N/A	Yes
27	2001	USFWS	Mobile GT Bank	DAAL	N/A	No
28	2001	FERC	PGS 58mi pipeline	JAMS	Yes	N/A
29	2002	FERC	PGS 58mi pipeline Amend	JAMS	Yes	No
30	2002	FERC	Florida Gas Amend	DAAL	Yes	No
31	2002	FERC	SGRM 1	JAMS	Yes	No
32	2002	FERC	Florida Gas VI	JAFL	Yes	No
33	2002	FHWA	Hwy 98	DAAL	Yes	No
34	2002	FHWA	Schillinger Amend	DAAL	Yes	No
35	2003	FERC	Transco Lateral	DAAL	Yes	No
36	2004	FERC	PGS Storage Cavern 3 & 8	JAMS	Yes	No
37	2004	FHWA	Hwy 63	JAMS	Yes	No
38	2004	FHWA	Mobile Bank	DAAL	Yes	No
39	2004	EPA	South AL Utilities	DAAL	Yes	No
40	2005	FERC	SGRM I Amend	JAMS	Yes	No
41	2005	FHWA	Hwy 98 Connector	DAAL	No	No
42	2005	FHWA	Hwy 63	JAMS	Yes	No
43	2005	FHWA	Hwy 84	JAMS	Yes	No
44	2006	FERC	SGRM I Amend II	JAMS	Yes	No
45	2006	FHWA	USFS 201,202,206	JAMS	Yes	No
46	2006	DOD	Camp Shelby WTF	JAMS	No	No
47	2007	NRCS	HFRP PBA/PBO	JAMS	No	No
48	2007	FERC	SGRM II Pipeline	JAMS	No	No
49	2007	DOD	Camp Shelby 20yr SUP	JAMS	No	No
50	2007	COE	Harrison Co. DPS complex	JAMS	No	No
51	2007	FERC	Southeast Expansion Project	JAMS	Yes	No
52	2007	FERC	Southeast Supply Header	JAMS	Yes	No
53	2007	HUD	Lamar County Industrial Park	JAMS	No	No
54	2008	FERC	Hi Fields Lateral	JAMS	No	No
55	2008	COE	Lamey Bridge	JAMS	N/A	No
56	2008	COE	Black Creek	JAMS	Yes	No
57	2009	COE	House Creed Estates	LALA	Yes	No
58	2009	COE	Turkey Trot Landfill	DAAL	Yes	No
59	2009	COE	MS Export RR	JAMS	Yes	No
60	2009	COE	South AL Utility Amend	DAAL	No	Yes
61	2010	FERC	FGT Phase VIII	DAAL	Yes	No
62	2010	COE	Bay Gas	DAAL	Yes	No
63	2010	HUD	S26 MGWWP	JAMS	Yes	No
64	2011	PHMSA	Gulf South Index 311	JAMS	N/A	No
65	2011	FAA	Wiggins Airport	JAMS	Yes	Yes
66	2012	COE	Allred Subdivision	JAMS	N/A	Yes

COE = U.S. Army Corps of Engineers, DOD = Dept. of Defense, FERC = Federal Energy Regulatory Commission, FHWA = Federal Highway Administration, USFS = U.S. Forest Service, USFWS = U.S. Fish

and Wildlife Service. DAAL-Daphne Field Office, JAFL-Jacksonville Field Office, JAMS-Jackson Field Office.

ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all federal, tribal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The action area is the area affected directly and indirectly by the federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] § 402.02).

The **action area** consists of the proposed ROW and adjacent upland areas with actual or potentially interconnected gopher tortoise habitat. Action area boundaries represent man-made or natural features that are likely to significantly fragment and isolate actual or potential tortoise populations within the action area from adjacent populations and habitat. This action area is where tortoises will be directly affected by habitat modification and destruction due to construction activities and indirectly affected by fragmentation.

Status of the species within the action area

The project area, as described in the BA, includes the 100 foot wide ROW corridor, compressor stations, meter stations, pressure limiting facility, access roads, and temporary work spaces. The Service concurs with this project area description.

Since only burrows, not individuals, were counted, the absolute number of gopher tortoises within the action area is unknown. Gulf South identified 99 burrows within or near the proposed construction ROW. Using Mann's (1995) correction factor of 0.414 (99 burrows X 0.414 = 41 tortoises); we can estimate that there are approximately 41 tortoises within or near the proposed construction ROW.

Factors affecting the species environment within the action area

The proposed project is located within the Southern Pine Hills Region of the East Gulf Coastal Plain section. The project would impact approximately 279 acres of upland natural forest (mixed hardwood, longleaf pine, and bottomland hardwoods), 273 acres of agricultural land, 236 acres of open land, 225 acres of managed forest (loblolly pine plantations), 145 acres of industrial/commercial/residential lands, and 87 acres of wetlands/open water.

Approximately 79 percent of the project pipeline would be collocated with existing pipeline and powerline ROW's. Many of the gopher tortoises found in the action area can be found living and foraging within these existing ROW's. Historically, the action area would have consisted primarily of longleaf forests where natural forest fires would have maintained an open mid-story with abundant herbaceous ground cover for gopher

tortoises. However, much of this land has been converted to dense loblolly pine plantations or natural forests where natural/prescribed forest fires are absent. When this occurs, tortoises are forced to move to man-made open habitat such as mowed ROW's, food-plots, and along the edges of fields, yards, etc.

Primary impacts of the proposed project on land usage include clearing the corridor, temporary restrictions on existing land uses during construction, and some restrictions on future land uses along the pipeline permanent easement. Land on the pipeline permanent easement would be maintained in an open vegetative state following completion of construction.

EFFECTS OF THE ACTION

The effects of the action are the direct and indirect impacts of the proposed federal action on the species and critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR § 402.02). The gopher tortoise is the only listed species known to be directly and indirectly affected by this action. Critical habitat has not been designated for this species.

Indirect impacts are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects primarily relate to land changes to adjacent lands. Given that most adjacent lands will continue to be managed in the manner they were prior to project completion, it is not foreseeable in the near future that indirect impacts will occur as a result of the proposed project.

Analyses for effects of the action

Gulf South's conservation strategy is to relocate or displace tortoises that are found within the 100 foot wide construction corridor. Gulf South identified 34 gopher tortoise burrows within the 100 foot construction ROW (out of a total of 100 burrows found within the action area). Assuming every burrow is active and may contain a gopher tortoise, then up to 34 tortoises could be relocated. Relocated tortoises will be collected and moved to an unoccupied burrow within the same colony, but outside the construction ROW. When a tortoise is found within the construction corridor that is not associated with a larger colony, Gulf South proposes to relocate such tortoises to an approved off-site gopher tortoise conservation bank. Gulf South believes its conservation strategy will effectively avoid or minimize adverse effects to the maximum extent practicable; and that construction impacts will be limited to stresses associated with capture, handling, displacement, and possible short term disruption of essential behavior patterns of displaced tortoises and those near construction activities.

As part of Gulf South's conservation strategy, barricade fencing will be placed along the construction corridor where gopher tortoises are relocated to unoccupied burrows outside the construction ROW. Fencing placed at the edge of the construction zone will prevent

tortoises from entering the area of heavy equipment operation, trenching, and backfilling where they could be killed or injured.

The barricade fencing, however, will also temporarily alter the movement of tortoises associated with nearby colonies. Tortoises typically use multiple burrows in their home range. When the burrow is occupied, it is a temporary center of activity from which a tortoise emerges and moves for feeding and breeding. Tortoises with multiple burrows periodically move and temporarily use different burrows during the season. Movements to other burrows reflect behavioral decisions to use other sites for forage and reproduction. Furthermore, a burrow may or may not be exclusively used by just one gopher tortoise. Two or more tortoises may share the same burrow, although the burrow normally is used at different times of the year by different individuals.

This restriction will alter normal tortoise behavior, but only temporarily. No mortality is expected by this temporary restriction, when tortoises would be expected to either adjust their foraging behavior elsewhere in suitable habitat or experience a temporary, short-term reduction in foraging opportunities.

The loss of burrows would alter the home range and use of burrows for feeding and breeding by tortoises in the colony. Also, competition for remaining burrows can increase following the loss of these burrows, causing negative behavioral interactions that may lead to an abandonment of the home range or colony. Alternatively, one or more of the remaining tortoises could excavate additional burrows to replace or compensate for the destruction of unoccupied burrows.

The relocation plan would avoid killing, injuring, or harming such tortoises in the construction zone that could not otherwise be protected from trench excavation or burrow collapse by heavy vehicular construction equipment. However, the capture and relocation of tortoises in itself is a potential source of death, injury, and harm to these individuals. The controlled excavation to carefully remove a tortoise from its burrow by qualified staff using appropriate procedures, as generally described in the Gulf South plan, is not expected to injure any tortoises. Under such conditions, less than 1.5 percent of such controlled excavations have been found to injure or kill resident tortoises (Wester and Kolb; 1997).

The risk of harm is greatest upon actually relocating a tortoise to another burrow. Harm in this instance is caused by an unsuccessful relocation, when the tortoise abandons the release burrow or site, disperses, encounters poor or unsuitable habitat, experiences disrupted reproduction, feeding, and/or shelter, and is exposed to higher mortality during dispersal. The success or failure of relocating tortoises can be affected by the extent of behavioral disturbance, habitat quality at the recipient site, positive or negative behavioral interactions with tortoises at the recipient site, and interactions among all of these factors. Since the proposed relocation is a short distance within the same colony and likely within portions of the tortoise's preexisting home range, the extent of behavioral disturbances and negative interactions with other tortoises should be less than that associated with long-distance relocations to a new habitat and recipient population.

Most research indicates that a minimum holding time for relocated tortoises increases site fidelity and therefore improves relocation success (Seigel *et al*, 2005). However, there can also be negative impacts associated with temporary penning, such as increased stress, vandalism and or capture for human consumption. Penning also requires permission from adjacent landowners, which if access is denied, creates the dilemma of having to pen a tortoise somewhere outside its colony range. Gulf South does not propose penning because tortoises are only being moved short distances, often times less than 300 feet from the original burrow, and that the benefits that may be gained by temporary penning tortoises are outweighed by the negative impacts that could be associated.

Wester and Kolb (1997) found that most all tortoises relocated and displaced along pipeline construction ROWs relatively short distances to other burrows in the ROW, in a manner similar to this proposed action, remained in the general vicinity of their relocation burrow. They found in a radio telemetry study, however, that relocated tortoises from the ROW moved greater distances from their release burrow than did control tortoises from their resident burrow (Florida Gas Transmission Company; 1995). These relocated tortoises moved an average distance of 160 meters from their release burrow.

While the project will not permanently destroy foraging habitat along the pipeline ROW construction area, there will be a temporary reduction in forage until the pipeline trench is completely re-vegetated. In the long-term, successful re-vegetation with grasses may actually increase forage for gopher tortoises along the ROW. Pipeline and similar ROWs in many instances provide the only potentially suitable habitat for gopher tortoises when adjacent forest stands have become closed and unsuitable. In these situations, tortoises will establish burrows in open sunlit conditions and have a greater amount of herbaceous forage at their disposal. At the same time, this causes gopher tortoises to concentrate along a linear alignment in an open situation. This may predispose them to increased rates of predation on eggs, juveniles, and adults, and possible harm from ROW maintenance activities. Landers and Buckner (1981) showed that among 42 clutches laid along roads or fire-lanes, there were no successful hatches, with 87 percent being lost to predators and 13 percent to heavy equipment. Lohoefener (1982) believes the realignment along corridor situations facilitates human predation because mounds are more easily seen than in sites with woody vegetation.

Construction activities in or near gopher tortoise colonies may adversely affect normal behavior. Lander and Buckner (1981) describe the pronounced hearing ability for this species. Using radio telemetry, they found that tortoises would back down into the burrow when they detected a person on foot at a distance of 75 meters or a vehicle at 100 meters.

Thus, one behavioral response to the disturbance caused by nearby heavy construction equipment is that tortoises could take shelter in their burrows for longer than normal periods, reducing the time above ground for feeding. Alternatively, tortoises can be harassed to such an extent that they temporarily or permanently abandon their burrows, move to other inactive burrows in their home range, or abandon their home range

entirely. The activity of tortoises at Ft. Benning, Georgia in areas with and without frequent disturbances from heavy tracked vehicles was not significantly different (Guyer et al.; 1996). Also, the establishment and continued existence of gopher tortoise colonies at tank firing points at Camp Shelby, MS indicates that relatively frequent, habitual disturbance by heavy equipment does not cause significant rates of gopher tortoise dispersal or burrow abandonment.

In this project, however, tortoises have not been habitually exposed to such disturbance and their response may differ to that observed at Ft. Benning and Camp Shelby. For example, a gopher tortoise in Lamar County, MS abandoned its burrow during construction of a nearby (100 feet) electric power substation. Burrow abandonment, as a possible response to nearby construction disturbance (noise, ground vibration, etc.) remains difficult to precisely predict for tortoises that are not habitually exposed. If theses tortoises are disturbed but to a lesser extent than causing burrow abandonment, then time spent above ground for feeding would temporarily be reduced during construction. No mortality would be expected as a result of temporarily reducing foraging activity.

Gulf South has proposed a conservation strategy to minimize the temporary impact of its construction activities on gopher tortoises along the project. Unlike other ROW construction projects, such as highway construction, pipeline construction does not permanently destroy gopher tortoise habitat (Wester et. al. 1997). The effects are usually temporary and are associated primarily with the actual construction phase of the project. Provided the procedures outlined in the BA are properly carried out, the short-term nature of Gulf South's activities should not adversely affect the long-term viability of the affected gopher tortoise colonies.

Gulf South will also need to relocate tortoises along the construction corridor that are not associated with a larger colony. A colony represents a loose aggregation of spatially clustered individuals with overlapping home ranges. The Service defines a colony as two or more active or inactive burrows within 600 feet of each other. There are numerous explanations for why a tortoise may be isolated from a larger colony; however, the primary reason is due to a fragmented landscape where suitable tortoise habitat is limited. When suitable foraging and burrowing habitat becomes limited within a colony, tortoises are forced to leave the colony in search of available habitat, which often is found in disturbed, mowed habitat such a food plots and ROW's (i.e. powerline, pipeline, and roads).

Gulf South's conservation strategy is to relocate isolated tortoises to a gopher tortoise conservation bank. The benefit of this conservation strategy is that a long term viable tortoise population will be created on well managed, permanently protected land through the combining of isolated tortoises found within the construction ROW. A conservation bank by definition is a parcel of land containing natural resource values (tortoise habitat) that are conserved and managed in perpetuity, through a conservation easement held by a third party entity responsible for enforcing the terms of the easement, for specific listed species and used to offset impacts occurring elsewhere to the same resource. There is

currently one approved conservation bank in Mississippi (Chickasawhay Conservation Bank, Greene County). For additional information about this bank, contact the Jackson MS Field Office.

Tortoises relocated to the conservation bank will be tested for upper respiratory tract disease (URTD) as well as placed in a temporary enclosure for one year to acclimate to the bank site and reduce subsequent dispersal during a period of stress and behavioral disturbance.

ROW management and maintenance may also adversely affect tortoises, directly or indirectly. Cogongrass (*Imperata cylindrica*) is expected to increase along the project corridor as a result of soil disturbance and other related activities. Cogongrass is an aggressive species that is expanding its range in Mississippi, particularly along highway ROWs, by natural dispersal as well as transport by mowers. Tortoises do not feed on cogongrass, probably due to its high silica content. The grass forms dense monotypic stands that exclude native grasses, legumes, and other forage. Once established along ROWs, cogongrass invades adjacent property where it can modify gopher tortoise habitat. Efforts to control this exotic grass are very difficult, requiring repetitive site-specific measures including herbicide applications.

Gulf South has created an Exotic and Invasive Species Control Plan which outlines procedures to control the spread of cogon grass. Such measures include: pressure washing all equipment before introduction to the construction area for the first time, monitoring and selective spot treatment of cogongrass encountered during construction and during the first 3-5 years of normal pipeline monitoring.

Based on the above information and the assumed limits of the direct impact zone, the project could adversely affect 34 tortoises. However, due to the uncertainty of how many actual burrows are occupied along the corridor, this number may change. Therefore, the Service anticipates that up to 40 tortoises could be directly impacted by the proposed project. This impact could result from construction and maintenance activities (e.g., land clearing/filling/ excavation, material and equipment storage, movement of heavy equipment, and noise) that can collapse burrows, destroy habitat, alter behavior patterns, or crush adults, juveniles, and eggs. In addition, some of these project activities could modify normal behavior patterns, such as feeding, reproduction and/or sheltering.

CUMULATIVE EFFECTS

Cumulative effects include the impacts of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

An estimated 70 percent of all threatened gopher tortoise habitat is under private ownership. Habitat modification and destruction resulting from silviculture, agriculture,

and urban development, combined with the gopher tortoise's low natural reproductive potential, slow maturation, and low recruitment rates, have been the primary factors responsible for this species' present status. Significant habitat modification within the project area is not reasonably foreseeable.

CONCLUSIONS

After reviewing the status of the gopher tortoise, the environmental baseline for the action area, the effects of the proposed road paving project and the cumulative effects, it is the Service's biological opinion that the natural gas pipeline project, as proposed, is not likely to jeopardize the continued existence of the gopher tortoise, and is not likely to adversely modify designated critical habitat. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation under section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behaviors which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the FERC so that they become binding conditions of any grant, permit, agreement, or contract issued to, for the exemption in section 7(o)(2) to apply. The FERC has a continuing duty to regulate the activity covered by this incidental take statement. If the FERC: (1) fails to assume and implement the terms and conditions or (2) fails to require the contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grand document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FERC must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(I)(3)]

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service believes that up to forty (40) gopher tortoises could be taken through harm or harassment during construction activities, and up to two (2) per year through harm and harassment during operation and maintenance of the project. The incidental take will be in the form of harm and harassment due to the destruction of resident habitat and the capture, transport, and relocation of tortoises to new burrows on-site. This harm also includes the alteration of essential feeding, breeding, and sheltering behaviors of resident tortoises and relocated tortoises that disperse from the relocation site upon their release.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of expected take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and minimize impacts of incidental take of gopher tortoises.

Modify the existing relocation procedures contained in the August 2013 EA to include the following Service guidelines set forth in the following terms and conditions.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FERC must comply with the following terms and conditions, which carry out the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Tortoise Relocation Guidelines

a. All tortoise burrows found within the 100 foot construction ROW, regardless of activity status (active, inactive or abandoned) will be excavated using the backhoe method described in the BA to definitively determine that the burrow is unoccupied.

b. When a gopher tortoise is relocated on-site (part of larger colony), and when no unoccupied burrow exists, then the displaced tortoise will be provided with a starter burrow and will be temporary penned for a minimum of 14 days. Temporary pens will consist of a 25 foot diameter enclosure per starter burrow with adequate forage and include a mix of shaded/open areas.

c. Post construction Maintenance and Operation:

If future ground disturbing activities within the existing, pre-disturbed, graded and maintained facility yards or ROW's (i.e. meter/valve replacement, pipe removal, anode bed replacement, pipe maintenance, pipe inspections, loop lines, etc.) require displacement of gopher tortoises, the relocation procedures outlined in the BA will be followed. The MS Field Office will be contacted prior to such post construction tortoise relocations.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental takes that might otherwise result from the proposed action. With implementation of these measures, the Service believes that up to forty (40) gopher tortoises could be taken through harm or harassment during preconstruction and construction of the project, and up to two (2) per year through harm and harassment during operation and maintenance of the project. If, during the course of the action, this level of incidental takes is exceeded, such incidental takes represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

This incidental take statement is based on full implementation of the proposed project as described in the DESCRIPTION OF THE ACTION section and inclusion of the TERMS AND CONDITIONS section of this biological opinion. Failure to implement the project as proposed (including any relevant conservation measures), or implementation of the project in a manner that causes an effect to listed species not adequately considered in this opinion, may cause coverage of section 7(o)(2) to lapse and require re-initiation of consultation to ensure compliance with section 7(a)(2) of the ESA.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitats, to help carry out recovery plans, or to develop information.

1. Avoid identifying gopher tortoise burrow locations to the public. Undue public attention to gopher tortoise colonies may increase the risk of human harassment, injury and/or capture.

2. Conduct a gopher tortoise burrow inventory of all Gulf South ROW's within the range of the federally protected gopher tortoise. This inventory should be completed on a 5 year rotation and the results should be sent to the Service and

the Mississippi Museum of Natural Science for inclusion into the states tracking database.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the conservation recommendations carried out.

REINITIATION NOTICE

This concludes formal consultation on the proposed Southeast Market Expansion Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary FERC involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of an incidental take is exceeded; (2) new information reveals effects of the FERC action that may affect listed species or critical habitats in a manner or to an extent not considered in this opinion; (3) the FERC action is latter modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or a critical habitat designated that may be affected by the action. In instances where the amount or extent of an incidental take is exceeded, any operations causing such a take must cease until reinitiation.

The Service appreciates the cooperation of the FERC during this consultation. We would like to continue working with you and your staff regarding this project. For further coordination please contact David Felder in our office, telephone (601) 321-1131.

Sincerely,

Stephen Ricks

Stephen Ricks
Field Supervisor

cc: MDWFP, Jackson, MS
Attn: Scott Peyton

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