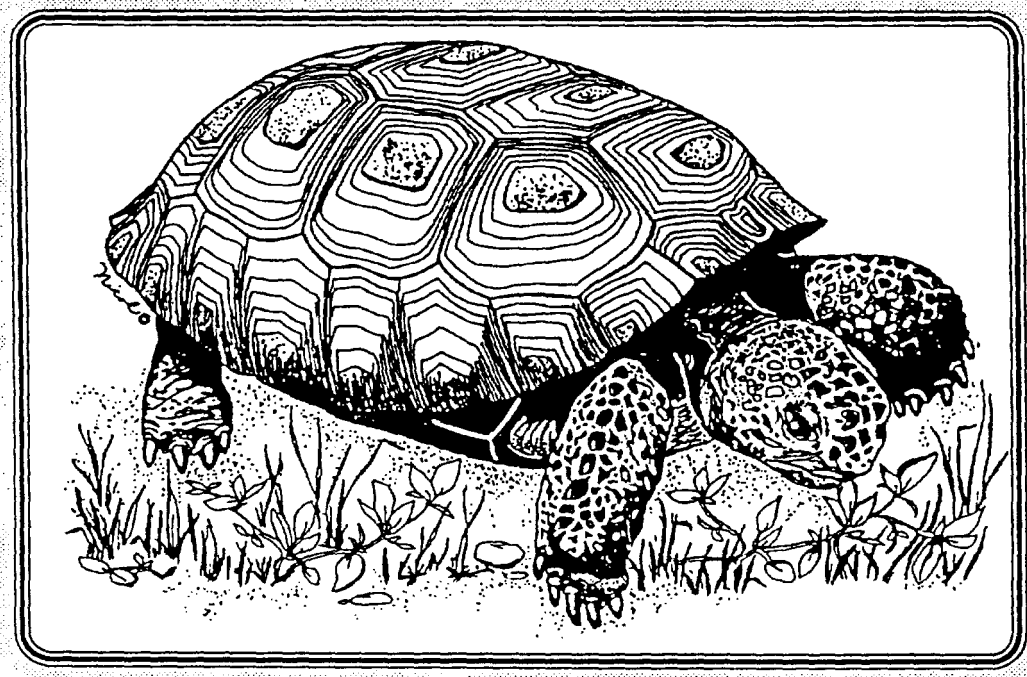
Gopher Tortoise

(Gopherus polyphemus)

Recovery Plan



U.S. FISH AND WILDLIFE SERVICE
Southeast Region, Atlanta, Georgia

GOPHER TORTOISE

Gopherus polyphemus

RECOVERY PLAN

Prepared by
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for

Southeast Region
U.S. Fish and Wildlife Service
Atlanta, Georgia

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: December 26, 1990

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the listed species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions or approvals of any individuals or agencies, other than the U.S. Fish and Wildlife Service, involved in the plan formulation. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species' status, and the completion of recovery tasks.

Literature Citations should read as follows:

U.S. Fish and Wildlife Service. 1990. Gopher Tortoise Recovery Plan. U.S. Fish and Wildlife Service, Jackson, Mississippi. 28 pp.

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The U.S. Fish and Wildlife Service thanks Ellen Nicol, an artist, writer, and reptile breeder from Anthony, Florida, for the cover sketch.

EXECUTIVE SUMMARY

Current Status: The western population of the gopher tortoise is listed as threatened. This population lies west of the Tombigbee and Mobile Rivers in Alabama, across south Mississippi and including extreme southeastern Louisiana. Threats include habitat alterations and illegal taking.

Habitat Requirements and Limiting Factors: The species is found on droughty, deep sand ridges which originally supported longleaf pine and patches of scrub oak. The most significant threats to the species are adverse habitat alteration, taking, and development of occupied habitats.

Recovery Objective: The two objectives of this plan consist of an immediate objective which is prevention of the listed population from becoming endangered and a long-term objective which is delisting.

Recovery Criteria: The necessary criteria for the above objectives are:

(1) Successful prevention of endangered status would be considered by evidence of an average of 5 gopher tortoise burrows per hectare (ha) on deep sandy soils (1.52 meters(+)) for a period of 30 years on the DeSoto National Forest. This would equate to an estimated population of 22,400 gopher tortoises on 7,343 ha of suitable habitat.

(2) For delisting, evidence is required of an average of 3 gopher tortoise burrows per ha on deep sandy soils (1.52 meters(+)) on private lands. This would equate to an estimated population of 34,000 gopher tortoises on 18,594 ha on privately-owned lands.

Actions Needed:

(1) Survey, monitor and assess status of populations as baseline for recovery actions.
(2) Protect and manage habitat on Federal lands.
(3) Encourage management of populations on private lands.
(4) Develop law enforcement strategy to curb illegal taking.
(5) Conduct population viability studies.
(6) Conduct telemetry studies to determine extent of reproductive isolation as a threat.
(7) Conduct genetic studies.
(8) Relocate threatened isolated individuals/colonies to protected and managed lands.

Total Estimated Costs of Recovery: Implementation of the recovery tasks for which cost estimates have been made total $433,000.00.

Date of Recovery: Unable to determine at this time due to the unknown response of the gopher tortoise population to improved management activities.

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I. INTRODUCTION

A. Background

The gopher tortoise (Gopherus polyphemus) is the only tortoise indigenous to the southeastern United States. It is found in varying numbers in xeric sandy habitats from South Carolina through Florida and west to extreme southeastern Louisiana. Within xeric sandy habitats, the range of G. polyphemus nearly coincides with the original range of the longleaf pine (Pinus palustris).

On July 18, 1984, Drs. Ren Lohoefener and Lynn Lohmeier petitioned the U.S. Fish and Wildlife Service to list the population of G. polyphemus west of the Tombigbee and Mobile Rivers under provisions of the Endangered Species Act. The petition and accompanying report (Lohoefener and Lohmeier 1984) presented substantial information on numbers and distribution of the western population. The Fish and Wildlife Service reviewed the petitioned action and on July 7, 1987, listed the western population as threatened under the Endangered Species Act (52 FR 25376-25380).

The basic biology of the tortoise has been reasonably well documented, although many specific details remain unknown. Many biological parameters for this species vary considerably, including: age (or size) at sexual maturity, clutch size, growth rates, phenological characteristics, burrow depths, specific food habits, and others (Diemer 1986). Biological information on G. polyphemus mostly originates from Georgia and Florida. This plan draws primarily from the research in Georgia by Landers and Buckner (1981) since their study sites are more similar to the western population (by latitude) than to populations in Florida. This recovery plan is aimed specifically at the western population, but of necessity relies greatly upon data sources and expertise developed elsewhere.

B. ~~Description and Taxonomy~~

Gopherus polyphemus (Testudines, Testudinidae), described in 1802 by F.M. Daudin, is the only Gopherus in the southeastern United States. The gopher tortoise has a large shell, 15-37 centimeters (cm) (5.9-14.6 inches) long. It is a dark-brown to grayish-black terrestrial turtle with elephantine hind feet, shovel-like forefeet, and a gular projection beneath the head on the yellowish, hingeless plastron or undershell (Ernst and Barbour 1972). Gopher tortoise hatchlings are yellowish-orange, have a soft shell, and are 4-5 cm (1.5-2.0 inches) long at hatching.

Gopherus polyphemus is sexually dimorphic. In most cases, the sex of adults can be determined by shell dimensions. The male has a greater degree of plastral (lower shell) concavity, and a longer gular projection. However, the sex of tortoises around the size of maturity can be almost impossible to assess.

C. Life History and Ecology

Distribution

Historically, the western population was found in the longleaf pine hills of northern Mobile, Washington, and southeastern Choctaw Counties in Alabama; in the southeastern upland areas of the pinehills province in Mississippi (a 14-county area); and in the upland pine ridges in St. Tammany, Washington, and Tangipahoa Parishes, Louisiana (Lohoefener and Lohmeier 1984) (Figure 1). The amount of gopher tortoise habitat, as defined by Lohoefener and Lohmeier (1984), for the listed population by State is as follows: southwestern Alabama - 40,770 hectares (ha) or 100,741 acres (A); Louisiana - 4,815 ha or 11,898 A; and Mississippi - 102,084 ha or 252,246 A. The entire western population is found within the original range of the longleaf pine.

Habitat

Gopher tortoises occupy a wide range of upland habitat types; however, general physical and biotic features provided by Landers (1980) with slight modifications, characterize most suitable habitat. These are:

1. the presence of well-drained, sandy soils, which allow easy burrowing (because of lower ambient temperatures, the western population may require a meter or more of sandy soil depths);

2. an abundance of herbaceous ground cover; and

3. a generally open canopy and sparse shrub cover, which allow sunlight to reach the forest floor.

Juvenile habitat is generally considered to be similar to that of adults.

The traditional habitats of the western population of gopher tortoises are natural xeric communities, mostly of the longleaf-pine-scrub oak type, located on sand ridges. The original ecology of these xeric, fire-dependent communities

has been significantly altered. Gopher tortoises may also be found in ruderal habitats such as fence rows, pastures, and field edges and power lines.

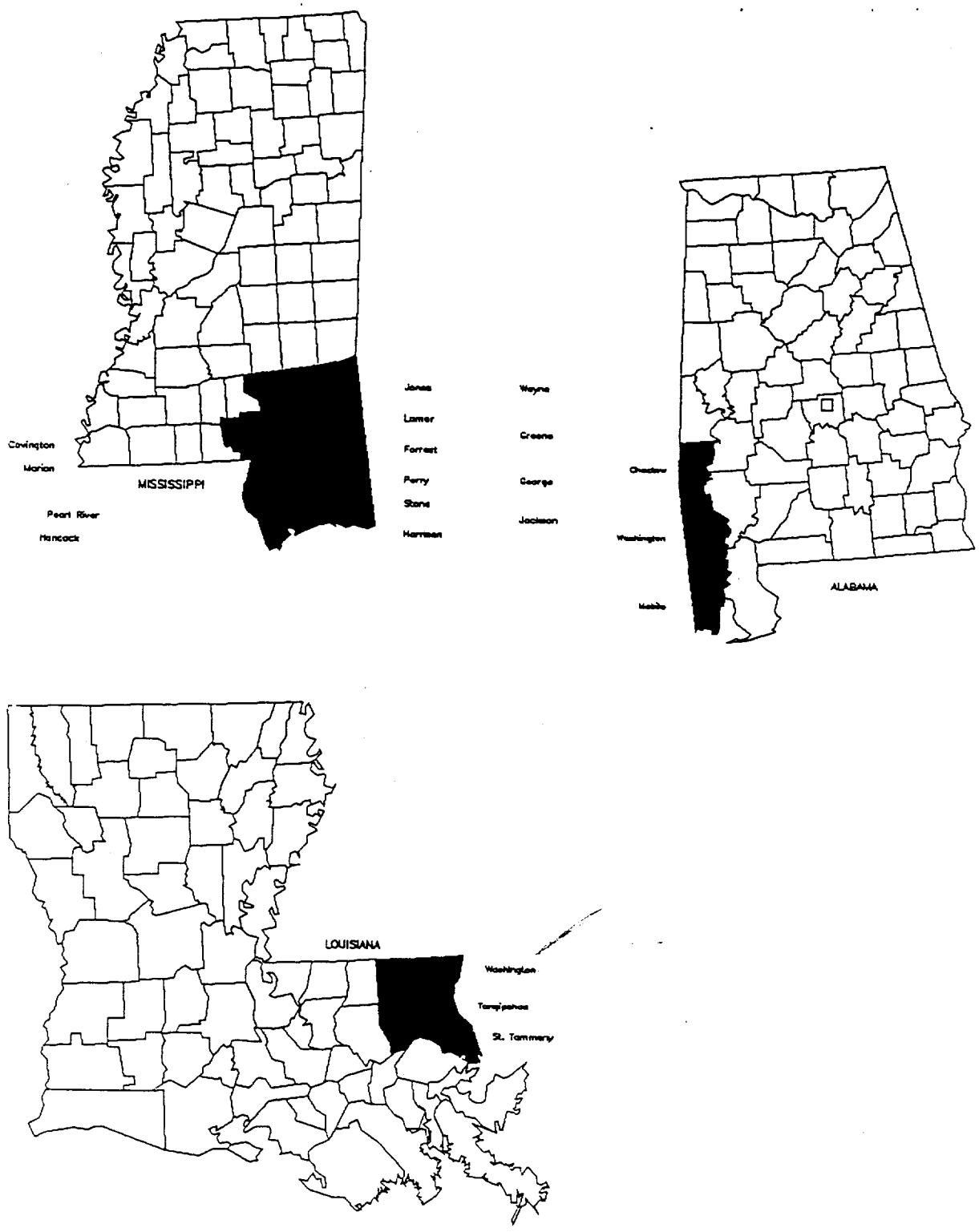

Figure 1. Range of Western Population of the Gopher Tortoise.

Soil conditions are responsible for the xerophytic nature of gopher tortoise habitats. Auffenberg and Iverson (1979) report a positive correlation between the amount of herbaceous ground cover and tortoise density, with grasses, grass-like plants and legumes being the most important food plants (Garner and Landers 1981). The amount and kind of low growing (within reach of a gopher tortoise) herbaceous plants may be a function of many variables, including timber age, density and species composition, burning history, nature and timing of past soil disturbance, and inherent soil fertility.

A relatively open canopy is necessary not only for herbaceous food plants but also for egg incubation. The female gopher tortoise selects a bare spot for nest excavation, normally in the mound of excavated sand at the burrow entrance. Landers and Buckner (1981) noted that when overstory overshadowed the burrow entrance, nests were selected in openings such as firelanes or roadsides.

The burrow is the focal point of many above ground activities and a major portion of the gopher tortoise's life is spent in the burrow. Most burrows have a single entrance, and adult burrows average about 4.5 meters (m) (15 feet) in length with a depth of 1.8 m (6 feet) (Hansen 1963). Small juveniles use similarly small burrows, often as shallow as a few inches. Single tortoises often excavate more than one burrow. Lohoefener and Lohmeier (1984) reported a correction factor of 0.625 in Mississippi for converting burrows counted to burrows occupied. The burrow provides protection from fire, predators, and climatic extremes, and habitat for a host of unique species. Jackson and Milstrey (1989) reported more than 60 vertebrate and 302 invertebrates species using gopher tortoise burrows. Some of the more commonly known burrow associates include the eastern diamondback rattlesnake (Crotalus adamanteus), the gopher frog (Rana areolata), and the eastern indigo snake (Drymarchon corais couperi).

Longevity and Reproduction

Longevity is estimated at 40-60 years (Landers 1980) and may extend to 80-100 years (Landers et al. 1982). Growth annuli on scutes become worn at 20-40 years, making age determination imprecise. Age at sexual maturity in the Georgia study (Landers et al. 1982) ranged from 19-21 years for females. These animals had a plastral length of 25-26.5 cm (9.8-10.4 inches). Males normally reach reproductive maturity at a smaller size and younger age than females. Growth rates vary with environmental and genetic factors among gopher tortoise populations.

Breeding periods may begin as early as February and extend into September, depending on location. The period of maximum reproductive activity reported by Landers et al. (1980) is May 18 through June 27. Iverson (1980) reported the nesting peak in Florida also to be May and June. Clutch sizes in Mississippi average 4.8 eggs (Lohoefener and Lohmeier 1984); however, this report was based on a rather small sample (N=14). Landers et al. (1980) reported a range in clutch size of 4-12 eggs with a mean and SD of 7.0 ± 1.7. He also found that clutch size increased with the size of the female. The lower value reported by Lohoefener and Lohmeier (1984) may have been due to limited sampling, the result of human depredation (leaving primarily smaller nesting females), or a combination of both. The nest is usually 15-25 cm (6-10 inches) beneath the surface (Landers et al. 1980). Incubation periods range from 80-90 days in northern Florida (Iverson 1980) to 110 days in South Carolina, the northern limit of the gopher tortoise's range (Wright 1982). Most gopher tortoise eggs never hatch because of predation.

Food

The gopher tortoise is the primary grazer in its xeric habitats (Landers 1980) and aids in seed dispersal for native grasses (Auffenberg 1966). Observations and studies of food habits come mainly from Georgia and Florida where wiregrass (Aristida stricta) is often considered an important food plant and is a common member of the longleaf-scrub oak community. However, in western parts of the coastal plain, bluestem grasses (Andropogon) are often the most common herbaceous species in mature longleaf pine forests (Wahlenberg 1946). Lohoefener and Lohmeier (1981) observed tortoises in Mississippi eating crabgrass (Digitaria sanguinalis) and panic grasses (Panicum). Garner and Landers (1981) found that broad-leaved grasses were staple foods while wiregrass was used mainly in early spring and summer. Their study also showed that wild legumes (Fabaceae), which are high in protein, were used extensively by juveniles. Garner and Landers (1981) also found that fleshy fruits were readily consumed, including blackberry (Rubus cunefolius), sloeplum (Prunus umbellata), blueberry (Vaccinium), maypop (Passiflora lutea), and hawthorne (Crataegus). Regardless of the specific plants available for forage, the conclusion reached by Garner and Landers (1981) that "grasses, grass-like plants and legumes are the most important food plants and evidently determine carrying capacity" is likely a statement equally applicable to the western population.

Activity/Movement

McRae et al. (1981) found activity to be very restricted during winter months. In fact, from late November through February, feeding activity was observed only five times. On unusually warm winter days when maximum temperature exceeded 26° Celsius (C) or 79° Fahrenheit (F), tortoises were occasionally observed at the burrow entrance (McRae et al. 1981). No crepuscular or nocturnal activity is reported. As temperatures rose during the spring (March and April), outside burrow activity was most often observed in the Georgia study during the warmest part of the day, 1600-1800h (hours). During July and August, McRae et al. (1981) found a bimodal movement pattern, the feeding forays peaking at mid-morning (1000-1200h) and mid-afternoon (1600-1800h), with much reduced activity during the hottest part of the day, 1300-1500h. They concluded that "activity throughout the year was correlated with ambient temperature; movement from the burrow was rare at coolest temperatures (<22° C or 72° F), was greatest at 28 to 31° C (82 to 88° F), and was curtailed at >32° C (90° F)."

Adult Movements

McRae et al. (1981) studied movement related to feeding separately from movements related to other behavior and determined 95 percent of all feeding activity took place within 30 m (33 yards) of the burrow being used. Auffenberg and Iverson (1979) reported increasing foraging radii from the burrow in areas with reduced ground cover. This suggests that food availability can increase or decrease foraging distances. McRae et al. (1981) trailed 13 adults and determined their movements to be in a nearly circular or elliptical pattern around the burrow. Depletion of preferred foods near burrows by late summer is thought to contribute to larger movements later in the year. In the Georgia study, the home ranges of males were much larger than females; males had a home range of 0.06-1.44 ha (0.14-3.56 A) with a mean of 0.47 ha (1.16 A), while females had a home range of 0.04-0.14 ha (0.10-0.35 A) with a mean of 0.08 ha (0.20 A) (McRae et al. 1981). The sexual differences are attributed to breeding forays by the males. Landers and Speake (1980) found the average colony typically used an area less than 4 ha (9.88 A).

Behavior

Gopher tortoises have a well-developed social structure, courtship, and territorial combat (Auffenberg 1966, Douglass 1976, McRae et al. 1981). Males bob their heads to attract females during the breeding season. The speed and amplitude

of the head bobbing increases as the male draws closer to a reproductively active female, and the first contact between individuals consists of males biting females on the forelimbs and around the gular area, perhaps seeking olfactory cues (Auffenberg 1966). When males confront each other, there is usually some manifestation of dominance or submissive behavior. According to McRae et al. (1981), there is a dominance hierarchy in males based on size. In dense populations, smaller males are found around the colony's periphery rather than in the middle, close to the breeding females, as is the case with larger males.

D. Threats and Causes for Decline

Habitat Alteration

An understanding of the reasons behind the threatened status of G. polyphemus is perhaps the most essential step in developing this recovery plan. The gopher tortoise, historically and currently, is a component of xeric plant communities originally identified mostly by the occurrence of longleaf pine. The changes altering the original longleaf pine communities also changed the ecosystem of the gopher tortoise. This species was an animal of these forests, and to the extent maintenance of the listed population is possible, that goal is inextricably tied to forestland conditions.

Before the arrival of European colonists in the New World, the longleaf pine was the principal tree species on southeastern coastal plain upland soils. Croker (1987) cites 60 million acres in the original stands which he concludes are now reduced to about 4 million acres. After the red and white pine forests of New England and the Great Lake States were cut, lumbermen turned to the virgin longleaf stands, the mining of which peaked in 1909 (Croker 1987). Power skidders and railroad logging supported these final assaults.

Second growth longleaf pine stands came from the ruins of timber mining operations, but these second forests constituted a small fraction of the area of virgin stands. Because of planting difficulties with the longleaf pine, these droughty sites were often planted in slash (P. elliottii) and loblolly (P. taeda) pines. This practice, along with excessive burning intervals and intensive site preparation methods, continues on soils which originally supported longleaf pine.

Artificial planting of longleaf is now successful and many foresters are rediscovering the valuable traits of longleaf pine, including the fact that it can be successfully

regenerated naturally through a shelterwood system of cutting combined with burning just in advance of an adequate seed fall. The U.S. Forest Service recently has adopted a practice of regenerating only longleaf pines on longleaf sites in the DeSoto National Forest. However, the agency's preferred method is by planting. Most private landowners continue to regenerate longleaf pine sites to off-site species.

The original longleaf pine community burned and reseeded naturally. It contained trees of many ages and a diverse ground cover with much edge, which would be of particular importance to the gopher tortoise. Landers and Speake (1980) found better gopher tortoise densities in longleaf pine - scrub oak stands that were thinned and burned every 2-4 years. Slash pine plantations, with a similar system of thinning and burning, had sparser population densities. While it is apparent that gopher tortoises can be maintained under a modified (heavily thinned, frequently burned) plantation system of management, Landers and Buckner (1981) showed that gopher tortoise densities are significantly greater (32 percent) in more naturally managed stands of longleaf.

The natural longleaf pine community and its associated biological diversity represent optimal forest habitat for the gopher tortoise. This community occurred in pure stands, constantly trending toward small even-aged groups of a few hundred square feet (Chapman 1909). Larger even-aged patches and strips were found following blowdowns from severe weather. These were often interspersed with patches or single survivors, creating open glades and a patchiness which favored the gopher tortoise. Management practices which alter this system include: clearcuts of large blocks (including the crowded planting of off-site species), diversity-diminishing soil churning activities that often accompany even-aged timber management, and prolonged burning intervals. Timber practices that most nearly mirror the natural system, such as a shelterwood regeneration system with frequent burning and natural regeneration, improve the soil and herbaceous cover condition to optimally support the gopher tortoise.

Longleaf pine trees, as well as fire-dependent annuals and perennials, originally existed in a summer burning cycle which has long since been interrupted. The change in fire frequency and timing may be the single most important factor influencing other alterations which have changed the original xeric communities. For example, it has been a common practice to remove most of the longleaf pines from these dry ridges and then to exclude fire (or at least fail

to burn). This allows eventual occupancy by poor site oaks (Quercus laevis, Q. incana, Q. marilandica, and Q. margaretta) and woody shrubs such as yaupon (Ilex vomitoria) and gallberry (I. glabra). When the leaf litter from oaks becomes a thick mat, it retards fires that would otherwise be carried by longleaf pine needles and the common grass associates under the open longleaf pine canopy. Fire exclusion allows the oaks to mature and shade out herbaceous ground cover needed by gopher tortoises. This situation is not uncommon throughout the range of the gopher tortoise. Landers and Speake (1980) provided substantial evidence that these altered sites originally were good gopher tortoise habitat but now support the fewest gopher tortoises.

Hedrick and Zimmermann (1988) monitored gopher tortoise densities in various forest types and classes for a two-year period on the Conecuh National Forest in Alabama. Their unpublished data indicate gopher tortoise densities through three stand conditions (seedling/sapling stands, pole stands, and sawtimber stands). Gopher density was greatest (1 active burrow/1.51 ha or 3.73 A) in the seedling/sapling stands, greatly reduced (200 percent) in pole stands (1 active burrow/3.10 ha or 7.66 A) and followed by a large recovery (177 percent) in sawtimber (1 active burrow/1.75 ha or 4.32 A).

The current threats to the western population of the gopher tortoise in terms of habitat loss or degradation consist of certain forest management practices, conversion of dry sites to agriculture, road placement and other developments on these higher ridges, and urbanization (Lohoefener and Lohmeier 1984).

Predation

The gopher tortoise was a significant food source during the Great Depression, as reflected in the name "Hoover Chicken" (Hutt 1967). Gopher pulling removes an average of 20 percent of the larger tortoises, according to Taylor (1982). The taking of gopher tortoises by pulling (use of a long flexible rod with a hook) remains a cultural ethos in rural areas where the western population is found. The gopher tortoise's low reproductive rate, high mortality of eggs and young, slow growth to sexual maturity, and long life indicate a K-selected strategy adapting to xeric communities (Landers 1980). Annual population growth may only be 3-5 percent (Landers et al. 1980); accordingly, human predation on mature adults may produce long term adverse effects which are difficult to overcome. Because many gopher tortoises exist in degraded or declining habitats

and populations are often fragmented, the adverse effects of even limited taking may be exacerbated. Lohoefener and Lohmeier (1984) report a significant number of Mississippi gopher tortoises being taken for pets.

Gopher tortoise predators, other than human beings, are many. The most important egg and hatchling predator appears to be the raccoon (Procyon lotor) (Landers and Speake 1980); however, a variety of mammals are reported predators of G. polyphemus, including gray foxes (Urocyon cinereoargenteus), striped skunks (Mephitis mephitis), opossums (Didelphis virginiana), armadillos (Dasypus novemcinctus) (Landers et al. 1980), and dogs (Canis domesticus) (Causey and Cude 1978). Imported fire ants (Solenopsis saevissima and/or S. victa) are reported as hatchling predators (Landers et al. 1980, Lohoefener and Lohmeier 1984). Snakes and raptors have also been reported as preying on G. polyphemus. Reported clutch and hatchling losses often approach 90 percent (Landers et al. 1980).

Other Mortality

Road mortality is reported by Landers and Buckner (1981) and Lohoefener and Lohmeier (1984) as a significant mortality factor. Lohoefener and Lohmeier (1984) believe nests and juveniles are often destroyed by intensive site preparation (heavy equipment). Tanner and Terry (1981) report a major reduction in burrow density in Florida which was believed attributable to roller chopping or web plowing. Diemer and Moler (1982) demonstrated that tortoises are able to dig out following chopping treatment on deep sandy soils, but concluded that additional data were needed regarding tortoise response to various site preparation techniques in different soil types.

Lohoefener and Lohmeier (1981) believed that a serious problem for the Mississippi gopher tortoise was isolation of sexually mature animals because of habitat fragmentation aggravated by forest management practices. Only 14 percent of the tortoises encountered in density survey transects by Lohoefener and Lohmeier (1981) in Mississippi were considered so situated that interactions with other sizeable (sexually mature) tortoises might occur. As further support for this hypothesis, the discontinuous nature and small size of Mississippi sand ridges, which are often separated by streams or wet boggy areas, may serve as impediments to courtship travels of adult males (Lohoefener and Lohmeier 1984).

Population Viability

Local populations of the western gopher tortoise can in theory become extirpated through chance events and these extirpations (and thus more rangewide extirpations) are inversely related to population size. Shaffer (1981) cites four sources of uncertainty to which a population may be subject: (1) demographic stochasticity, which arises from chance events in the survival and reproductive success of a finite number of individuals; (2) environmental stochasticity due to temporal variation of habitat parameters and the populations of competitors, predators, parasites, and diseases; (3) natural catastrophes, such as floods, fires, and droughts, which may occur at random intervals through time; and (4) genetic stochasticity resulting from changes in genetic frequencies due to founder effect, random fixation, or inbreeding. Based on the concern expressed by Lohoefener and Lohmeier (1984) regarding reproductive isolation, genetic drift and inbreeding may already be occurring.

Recovery, therefore, must consider population viability in establishing both the objectives and the procedures for meeting those objectives.

II: RECOVERY

A. Biological Perspective

The listed population of G. polyphemus could be considered relatively abundant. Lohoefener and Lohmeier (1984) estimated 10,923 tortoises of >23 cm (9.1 inches) carapace length (CL) in 102,084 ha (252,246 A) of Mississippi habitat; and 12,900 tortoises >23cm (9.1 inches) CL were estimated to occur in 40,370 ha (99,753 A) of Alabama habitat west of the Tombigbee and Mobile Rivers. However, the species is nearing extinction in an estimated 4,815 ha (11,898 A) of Louisiana habitat. About 80 percent (121,000 ha) of the available habitat occurs on corporately-owned lands.

Despite the relatively large number of extant individuals estimated, the long-term prospects for survival of the western population are dimming. In view of past, current, and predicted forest management practices, continued illegal taking, development on dry uplands, and private ownership of much of the gopher tortoise's habitat, this species is truly threatened in the western portion of its range. According to Donner and Hines (1987), timberland ownership in south Mississippi is mostly private (85 percent belonging to individuals, the forest industry and corporations, 11 percent belonging to the Federal government, with the remainder in State or county ownership).

Section 7 of the Endangered Species Act requires Federal agencies to insure that their actions do not jeopardize the continued existence of listed species. Beyond the jeopardy prohibition, Section 7 requires Federal agencies to use their authorities to further the purpose of the Act. The essential purpose of the Act is conservation of listed species. Section 7 is limited in scope to Federal actions. Thus, the role of Section 7 in recovery of this species will be limited because the majority of habitat is in non-Federal ownership. However, any advice given by Federal foresters or soil scientists to manage forests on state, local, and private lands is also subject to Section 7. Outside of Section 7, the Act may serve in protection, and therefore, possibly contribute to recovery, through exposure of certain activities under Section 9 (prohibition of take).

Through consultations with Federal landowners, it is expected that forest management practices will be designed to contribute significantly to recovery on these lands. However, because Federal ownership is comparatively small, rangewide recovery for this population requires significant success on privately-owned lands as well. Examples of such activities can be found in Mount et al. (1988).

Unfortunately, among private timberland owners, there are perceived problems with longleaf pine, its growth, value, and availability of seed stock. Individual small landowners often high grade their longleaf stands with little forethought to long-term timber production; they then exclude fire, thus creating a situation where the longleaf pine sites convert to scrub oak stands. If these landowners decide to regenerate, they will most often, on the advice of foresters, choose the off-site slash or loblolly. Such advice from Federal foresters or foresters supported by Federal monies should be subject to Section 7 consultation. The corporate or industrial landowner usually farms these sandy sites by clearcutting, replanting to off-site species, and starting over with the same practices at a 25-35 year rotation, devoting little attention between planting and harvest. These management policies, along with intensive site preparation, thick planting rates, and fire exclusion continue to threaten the existence of the western population.

B. Recovery Objectives

The immediate recovery objective is to prevent the western population from becoming an endangered species. To achieve this, the species' overall status must be stabilized or enhanced. Lohoefener et al. (in review) considers three to seven burrows per hectare as representing a recovered population density for a land unit the size of DeSoto National Forest. The upland forested habitat expected to support this density is likely underlain by Lakeland, Troup, or one of the more rarely encountered deep, sandy soils in excess of 1.52 meters (5 feet). On the Desoto National Forest, these soils are estimated to comprise 7,343 ha (18,144 A) (Arnold 1989). The best hope for recovery of the gopher tortoise is on these 7,343 ha of deep sands that represent original sandhill communities [and potentially provide the best chance for a large block of contiguous habitat being made available to gopher tortoises]. A range of three to seven burrows per ha = 22,029-51,401 x 0.61 (correction factor of tortoises per burrow) = 13,437-31,354 gopher tortoises. If a mid-range density of five gopher tortoise burrows per ha (approximately equating to a total of 22,400 gopher tortoises]) is accomplished on the Desoto National Forest, and maintained for a period of 30 years, the immediate goal of preventing the listed population from becoming endangered would be reached. Although little is known about the rates of gopher tortoise recruitment and present age-class

distribution, this recovery objective assumes that once the stated density is maintained for 30 years that the recruitment rate is adequate for short-term stability.

A long-term objective, that of recovery to the point of no longer requiring protection of the Act, requires significant successes on the privately-owned lands having these deep sand ridges. Within the range of the western population, on private land, there are approximately 18,594 ha (45,945 A) of what originally constituted sandhill communities. Attaining the lower range of the recovery density for deep sands based on Lohoefener et al. (in review) would mean three burrows per ha (18,594 x 3 x 0.61) = (approximately 34,000 gopher tortoises on privately owned forested deep sands. To measure these goals, some form of survey is necessary and must be comparable to the original statistically derived estimate (Lohoefener and Lohmeier 1984).

C. Narrative Outline

1. Survey, monitor, and assess the status of populations. The original survey work by Lohoefener and Lohmeier (1984) needs to be updated to monitor status. There remains controversy about the abundance of the gopher tortoise. A survey will clarify the tortoise's status; moreover, it will provide an essential baseline for measuring the effectiveness of recovery activities. Surveys should also attempt to determine recruitment rates and age-class distribution, if possible.

   1.1 Survey gopher tortoise populations on Federal and other public lands not previously surveyed. Baseline surveys will be necessary to track the effectiveness of habitat management.

      1.1.1 Conduct status surveys on Camp Shelby. This requirement is incorporated into Section 7 compliance.

      1.1.2 Conduct status surveys on DeSoto National Forest. This requirement is incorporated into Section 7 compliance.

      1.1.3 Conduct surveys on State-owned Parklands, Wildlife Management Areas and 16th Section School lands. Colonies on public lands offer possibilities for conservation unavailable on private lands.

1.2 Conduct rangewide surveys at 5-year intervals on public and private land. This is necessary to determine the effectiveness of recovery activities. Surveys must be comparable by technique to existing data (Lohoefener and Lohmeier 1984), repeatable, and carried out during the same month because tortoise movements and burrow use may vary monthly.

1.2.1 Assess the status of individual populations and of the species rangewide. The goal of the recovery plan is to eliminate factors detrimental to the survival and recovery of the gopher tortoise. As data are acquired, the status of populations throughout the range will be reviewed and assessed as appropriate.

2. Implement protection and management of habitat on Federal lands. The principal threats on Federal lands, specifically the DeSoto National Forest, have been: (1) adverse timber management practices on the high, dry ridges where gopher tortoises occur, and (2) the military use of about 136,000 acres. These threats are being addressed through Section 7 consultation involving both Camp Shelby's land-altering activities and a habitat management plan by the Forest Service. The review of these actions will be an ongoing activity.

2.1 Protect and manage all existing gopher tortoise colonies. The colony sites on Camp Shelby will be protected either by staking burrows with steel posts or by fencing the colony site. For management purposes, a gopher colony is defined as three or more active adult burrows ($\geq$9 inches in width) within 300 feet of each other, or any combination of active adult and active hatchling/sub-adult burrows within 100 yards of each other; the colony site is defined as the active burrows making up a colony plus a 200-foot buffer around them.

Timber stands on Federal lands, where a colony is located, will be managed primarily for the gopher tortoise. Such management considerations will address: canopy closure in the stand, mid-story management, regeneration and site-preparation, planting rates, thinnings, burning and/or chemical treatment of hardwoods for colony site reclamation, and scheduling of harvest to avoid disturbance during nesting periods.

2.2 Manage habitat for present and future expansion. In order to reverse declines in gopher tortoise populations, it will be necessary to manage for optimum habitat conditions on some part of Federal ownerships. The Camp Shelby Section 7 consultation has resulted in the establishment of a 2,200-acre gopher refuge where military use is restricted and forest management is aimed at achieving and maintaining optimal habitat conditions.

2.3 Assess adequacy of established and proposed management plans. This is a continuous task accomplished largely through Section 7 of the Endangered Species Act. All Federal agencies must review their established and proposed programs, and for those that may affect the species, initiate consultation with the Fish and Wildlife Service. The Service will then review the action and prepare a biological opinion which addresses the likelihood of jeopardy to the continued existence of the species if the action is carried out. If jeopardy is likely, alternatives to remove jeopardy are presented in the opinion. All management programs for the species represent a "may affect" situation requiring consultation.

3. Encourage protection and management on private lands. Private lands contain the vast majority of forest possibly containing gopher tortoises. Accordingly, maintenance of the population is not possible without some significant successes on privately-owned timberlands. Promotion of protection and management of habitat on private lands is difficult because of the few legal responsibilities and the perceived economic interests of landowners. Therefore, special efforts are needed on private lands.

3.1 Provide information on management and legal requirements to private landowners and managers.

3.1.1 Develop informational articles and management guidelines oriented to private lands. Informational articles and management guidelines oriented to private lands should be developed. These articles and guidelines should include information and visual aids which identify the habitat of the species, and give detailed options by which the species' welfare can be

maintained or enhanced without altering the total land management objectives of the owner or manager. These educational efforts could also emphasize the compatibility of gopher tortoise management with deer and quail management. Legal responsibilities of private landowners, through Sections 7 and 9 of the Endangered Species Act, should also be explained.

3.1.2 Distribute information to private landowners and managers through professional and industrial associations. The information developed in 3.1.1 should be distributed through a variety of professional and industrial associations and agencies, such as the State and private forestry branch of the U.S. Forest Service, county agricultural extension agents, and State forestry and wildlife associations.

3.2 Develop a cooperative agreement between the Fish and Wildlife Service and private landowners and implement where feasible. This agreement should specify management actions needed to protect the species and should identify the party responsible (landowner or Federal agency) for implementing the various actions. The agreement should set forth the total commitments of the two parties including land base, funds, equipment, manpower, and time period, and provide a means and a time frame for terminating the agreement.

3.3 Protect gopher tortoise habitat through easements, acquisitions, and donations. Lands containing gopher tortoises should receive special consideration when these lands would consolidate Federal ownership or control or would contribute to overall resource management objectives of the agencies. Private landowners should be encouraged to avail themselves of these options.

3.4 Recognize or reward protection and management efforts. Management efforts on private lands should be recognized and rewarded in view of the limited legal responsibilities involved. News media should be contacted and encouraged to provide favorable publicity to deserving landowners. News articles should be prepared for the news media where desirable or requested.

4. Develop law enforcement strategy to curb illegal taking of gopher tortoises. Gopher tortoise depredation by humans remains a practice in the rural areas where the listed population occurs. Habitat protection may be for naught if "taking" pressures continue to impact populations. Law enforcement must be a cooperative effort among the Fish and Wildlife Service, U.S. Forest Service, and the States. This effort may or may not involve the use of publicity.

5. Conduct research on population viability. This is needed to determine what densities and distributions are necessary to achieve minimum viable populations necessary for recovery goals. These factors are still unknown; yet they may eventually control the results of any scheduled recovery activity. Three areas, critical to understanding population viability, requiring baseline data, are (1) recruitment rates, (2) present age-class distribution, and (3) what constitutes contiguous habitat for the species.

6. Conduct telemetry studies. This is needed to determine whether or not seemingly isolated tortoises (particularly males) are in fact interacting with other tortoises. Data from telemetry studies will also yield information on what constitutes contiguous habitat for gopher tortoises.

7. Conduct genetic studies. This is needed to answer questions on the effects of augmentation and relocation efforts.

8. Relocate reproductively isolated individuals to existing protected and managed colonies. Animals that are determined to be in this category add nothing to maintenance or recovery. If introduced into an existing small colony which is protected and managed, they may contribute to the recovery goal. Such relocation should be done in accordance with the procedures outlined in Mount et al. (1988).

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PART III

IMPLEMENTATION SCHEDULE

Priorities in column one of the following implementation schedule are assigned as follows:

1. Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2. Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

3. Priority 3 - All other actions necessary to meet the recovery objective.

Key to Acronyms Used in This Implementation Schedule

MDWFP	=	Mississippi Department of Wildlife, Fisheries and Parks
USFS	=	U.S. Forest Service
LDWF	=	Louisiana Department of Wildlife and Fisheries
ALDNR	=	Alabama Department of Natural Resources

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS/NOTES *
				USFWS						
				Region	Program	Other	FY 1991	FY 1992	FY 1993	
1	2	Protection and management of publicly-owned habitat	continuous	4	FWE	MDWFP/ USFS	25			*Other agencies' responsibilities will be a cooperative nature, possibly on projects funded
2	1.1.1	Camp Shelby survey	<1 year	4	FWE	MDWFP/ USFS	3			under a Service contract. In some cases contracts may be let to
2	1.1.2	DeSoto National Forest survey	<1 year	4	FWE	MDWFP/ USFS	25			private individuals. The Army National Guard and USFS are
2	1.1.3	State/School lands survey	< year	4	FWE	MDWFP/ USFS	20			obligated to certain actions through Section 7 of the Act.
2	1.2	Population survey/ entire population	2 years	4	FWE	MDWFP/ USFS	35			Repeat every 5 years.
2	1.2.1	Assess rangewide status	2 years	4	FWE	MDWFP/ USFS	5			Repeat every 5 years.
3	3	Protection and management of private lands	Continuous	4	FWE	MDWFP/ USFS	10			
3	3.2	Cooperative agreements	<1 year	4	FWE	MDWFP/ USFS	5	5	5	Costs to be determined.
3	3.3	Easements/donations	<1 year	4	FWE	MDWFP/ USFS	5	5	5	Costs to be determined.

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS/NOTES *
				USFWS						
				Region	Program	Other	FY 1991	FY 1992	FY 1993	
3	3.4	Rewards	<1 year	4	FWE	NDWFP/ USFS	5	5	5	Costs to be determined.
2	4	Law enforcement strategy	<1 year	4	FWE	NDWFP/ USFS	5	5	5	Continuous
3	5	Research population viability	3 years	4	FWE	NDWFP/ USFS	20	20	20	
3	6	Research genetics	1 year	4	FWE	University	20			
3	7	Telemetry studies	3 years	4	FWE	NDWFP/ USFS	15	15		
3	8	Relocate reproductively isolated tortoises	Continuous	4	FWE	NDWFP/ USFS NDWF ALDNR	15	10		
3	3	Protection and management of private lands	Continuous	4	FWE	NDWFP/ USFS	10			
3	3.2	Cooperative agreements	<1 year	4	FWE	NDWFP/ USFS	5	5	5	Costs to be determined.
3	3.3	Easements/donations	<1 year	4	FWE	NDWFP/ USFS	5	5	5	Costs to be determined.

IV: APPENDIX

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