Technical Note EMRRP-SI-08
April 1999

Terrestrial Turtle Habitats Potentially Impacted by USACE Reservoir Operations

Ornate Box Turtle
photo by Dena Dickerson

BACKGROUND: Changing water levels or other operations at U.S. Army Corps of Engineers (USACE) reservoirs may impact critical habitat parameters for terrestrial turtle species. This technical note identifies terrestrial turtle species and habitats potentially impacted by USACE reservoir or other water-control projects as reported by resource managers (Table 1). Current state and/or Federal legal protection status as well as the distribution of USACE Districts and reservoir projects potentially impacted by terrestrial turtle conservation issues are summarized (Figure 1, Table 2) . Life-history summaries and habitat requirement descriptions are given for each terrestrial turtle species identified as potentially impacted at reservoir operations. This group includes the tortoises and box turtles with two species Federally threatened and three species having protection in at least one state. Three of these protected species are associated with environmental issues at 21 USACE projects from 5 USACE Districts (3 USACE Divisions).

Juvenile Gopher Tortoise
photo by Dena Dickerson

The three species of tortoises occur in three isolated regions of the United States (southwest, southern Texas, and coastal southeast) (Figure 2). The two protected species of box turtles occur throughout a wide range of the eastern United States but maintain protection in only certain states for various reasons (Figure 3). Although both tortoises and box turtles are terrestrial, their preferred habitats are quite varied between these two groups as well as between species. Habitats include strictly desert, longleaf pine, prairie, and open woodlands. These turtles are known to

Terrestrial Turtles Potentially Impacted by Reservoir Operations

Turtle Common Name	Scientific Name	Protection Status
Ornate box	*Terrepene o. ornata*	State protected
Eastern box	*Terrepene c. carolina*	State protected
Gopher tortoise	*Gopherus polyphemus*	Federally threatened

have well-defined home ranges within a habitat. Gopher tortoises are strictly herbivorous and feed primarily on grasses, whereas box turtles are omnivorous. Habitat destruction, pesticide poisoning, collection for food and pet trade, and disease have all been attributed to dramatic declines in populations.

Table 1
Summary of Survey Results, Terrestrial Turtles

Species	Protection Status		Divisions Identified	Districts Identified	Number	
	State	Federal			District	Total
Ornate box turtle	State protected		LRD MVD	Louisville Rock Island	1 1	2
Eastern box turtle	State protected		LRD	Huntington	1	1
Gopher tortoise		Federally threatened	SAD	Jacksonville Mobile	14? 4?	18
		Summary	LRD SAD MVD	Huntington Louisville Jacksonville Rock Island Rock Island	1 1 14 4 1	21

? Questions remain about survey response

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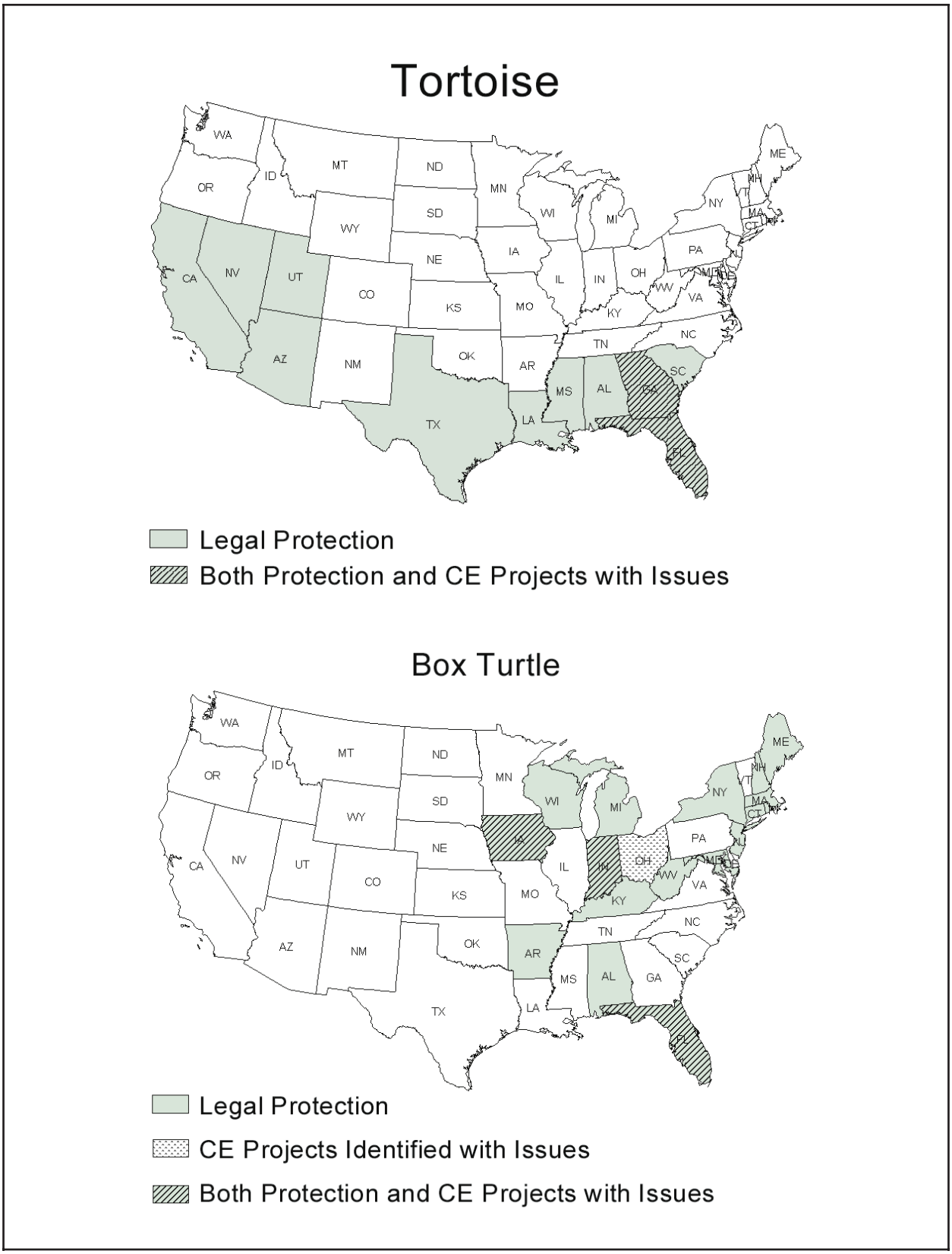

Figure 1. Legal protection status

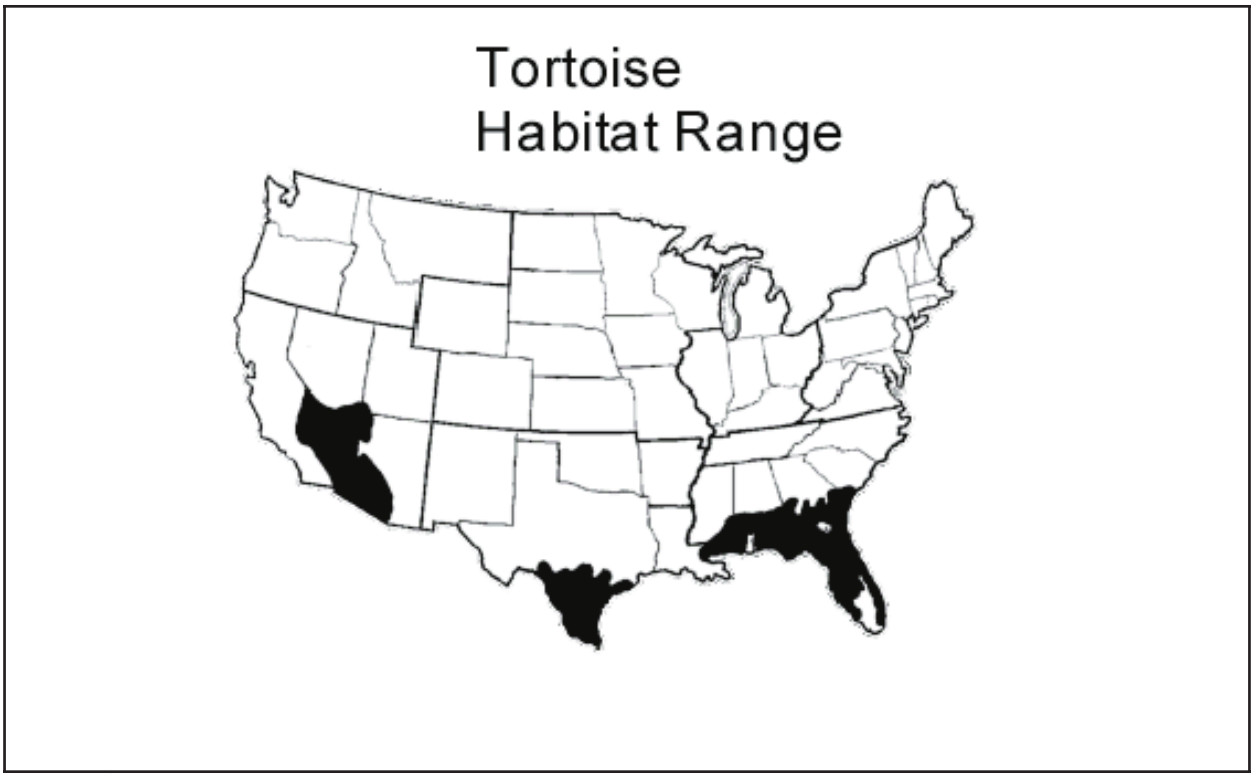

Figure 2. Tortoise habitat range

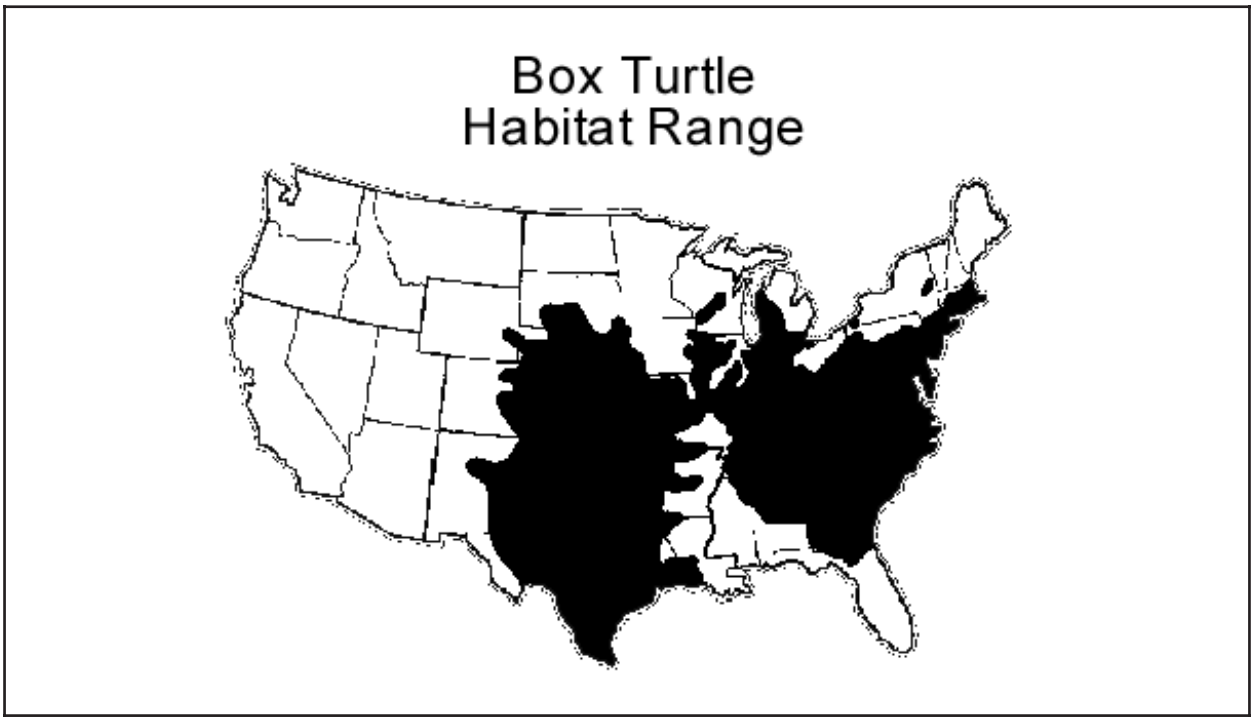

Figure 3. Box turtle habitat range

Table 2
Turtle Protection Status by Species

Turtle Species	North Atlantic States												South Atlantic States			
	ME 1/95	NH 1/98	VT 3/98	MA 11/97	CT 95	RI 95	NY 2/97	PA 1/94	NJ 6/96	DE 3/97	MD 11/94	VA 5/92	NC 9/94	SC 1/98	GA 10/97	FL 8/97
Ornate box turtle																
Eastern box turtle	E	SSC		SSC	PHR	SSC	SSC		SSC		PHR					PHR
Gopher tortoise **FT**														SE/FT	FT	SSC
Desert tortoise **FT**																
Texas tortoise																

Turtle Species	Midwest States								Southwest States				Pacific States				
	ID 9/97	MT 3/97	WY 1/97	CO 7/95	KS 6/93	NE 5/94	ND 97	SD 3/96	NM 12/97	AZ 1/97	NV 5/94	UT 3/97	CA 3/97	OR 12/96	WA 7/93	HI 1/97	AK 9/93
Ornate box turtle																	
Eastern box turtle																	
Gopher tortoise **FT**																	
Desert tortoise **FT**										FT	FT	SE/FT	FT				
Texas tortoise																	

Turtle Species	North Central States										Gulf States						
	KY 11/97	MO 6/97	IA 1/98	MN 7/96	WI 12/97	In 4/97	IL 94	OH 9/97	MI 6/94	WV 1/97	TX 11/97	LA 1/97	MS 6/96	AL 11/97	OK 4/93	AR 6/96	TN 9/94
Ornate box turtle			T		E											SSC	
Eastern box turtle	PHR					E			SSC	PHR				PHR			
Gopher tortoise **FT**												FT	E/FT	FT			
Desert tortoise **FT**																	
Texas tortoise											T						

FT Federally threatened
FC Candidate for Federal protection
SSC State species of special concern
T or ST State threatened
E or SE State endangered
PHR Possession and/or harvesting regulations
Shading Indicates species with potential issues at CE Reservoirs

Profile: Gopher tortoise (*Gopherus polyphemus*)

Distribution: *Gopherus polyphemus* (gopher tortoise) is found from extreme southern South Carolina south through peninsular Florida and west through southern Georgia, Florida, southern Alabama, and Mississippi to extreme southeastern Louisiana.

Habitat: Typically found on well-drained, deep, sandy soils in contiguous areas consisting of primarily longleaf pine (*Pinus palustris*), xerophytic oak (*Quercus* spp.), woodlands (sandhills) but also xeric hammock, sandpine (*P. clausa*) and oak scrub, pine flatwoods, coastal grasslands, dry prairie, and a variety of ruderal and successional habitat types (Diemer 1992 a, b; Wilson et al. 1997). Adequate herbaceous foods and sunny nesting sites must be present.

Behavior: In Florida the gopher tortoise is generally active all year; however, it may remain in the burrow during cold weather. In its northern reaches, it may become torpid during severe winter weather. Peak activity occurs from May to August (Douglass and Layne 1978). Tortoises are most active during the warmest part of the day (1000-1400 hr). They characteristically bask with their head in an elevated position in sharp contrast to *G. berlandieri* and *G. agassizii*. This species of turtle is capable of withstanding high body temperatures. Douglass and Layne (1978) reported an average body temperature of 34.7 ^{o}C for active turtles. An accomplished burrower, the gopher tortoise digs burrows (straight and unbranched) in sandy soil with its forelimbs and feet, which are specialized for this purpose. An excavation may be as long as 35 ft (about 10 m), and wide enough so the turtle can turn around at any point along its length. It may occupy the abandoned burrow of other tortoises (Diemer 1992a). The gopher tortoise has a well-defined home range, which tends to increase in size with maturity. It is capable of swimming in either fresh or brackish water.

Reproduction: Gopher tortoises mate during spring and fall, but peak mating occurs during spring (May and June) (Diemer 1992b). When seeking a female, a male will move to the mouth of a burrow occupied by a female and display a head-bobbing behavior (Wright 1982). Eggs are generally deposited from late April to mid-July, but most nesting occurs from mid-May to mid-June. Nests are dug with hind limbs only, usually near the burrow, and in areas that receive direct sunlight for most of the day. Only one clutch is laid per year and may contain 1-25 eggs; however, mean clutch size varies by population. Hatching and emergence occur from August to October. Incubation varies geographically and ranges from 80-90 days in Florida (Iverson 1980), 97-106 days in Georgia (Landers et al. 1980), and as long as 110 days in South Carolina (Wright 1982).

Food habits: Gopher tortoises are herbivorous and feed primarily on grasses and other herbaceous plants. In Florida and Georgia, gopher tortoises forage mainly on wiregrass (*Aristida stricta*) (Wilson et al. 1997). In the western part of its range, it often consumes bluestem (*Andropogon* spp.), crabgrass (*Digitaria sanguinalis*), and panic grasses (*Panicum* spp.) (Garner and Landers 1981). Fleshy fruits such as blackberry (*Rubus cunefolius*), maypop (*Passiflora incarnata*), and sloeplum (*Prunus umbellata*) are also consumed when available. The gopher tortoise will drink water when available. This is usually rainwater that has accumulated at the entrance of the burrow.

Populations: The range of this species has decreased dramatically owing to habitat destruction. Major threats to survival include land conversion for urbanization, agriculture, forest management, mining, collection for food, the pet trade, and many other factors (Dodd 1986). They may also be killed during rattlesnake roundups, when snake collectors use gasoline to drive snakes out of burrows.

Remarks: *Protection Status:* Federally threatened: South Carolina, Georgia, Louisiana, Mississippi, Alabama; Endangered: South Carolina, Mississippi; Species of special concern: Florida

Profile: Eastern box turtle (*Terrapene carolina*) (Linnaeus 1758)

Distribution: The U.S. range of *Terrapene carolina* (Eastern box turtle) extends from southern Maine south to the Florida Keys and west to Michigan, Illinois, eastern Kansas, Oklahoma, and Texas. It has been reported in isolated localities in New York and western Kansas.

Habitat: Habitat consists primarily of open woodlands, but the eastern box turtle can be found in pastures and marshy meadows, and in Florida may be found in palmetto thickets. Reagan (1974) reported a seasonal shift in habitat from grasslands (late spring and early fall) to forested areas (summer, early spring, and late fall). Activity in grasslands coincided with moderate temperatures and peak moisture conditions.

Behavior: Activity in most of the United States begins in early April and ends in October; however, in the south, turtles may emerge from hibernation in March and in Florida may be active in every month during warm years. In the northern portion of its range, hibernation may occur as early as September, and emergence may be delayed until late April or early May during cold springs. Juveniles emerge later in spring than adults and become inactive in fall before adults. Daily activity involves morning basking (usually on logs or on very low branches) followed by a period of foraging in the afternoon (Carr and Houseal 1981). A second period of basking may follow foraging. Evening activity is largely restricted to nesting females. Little or no nocturnal activity occurs. Turtles will avoid the heat of the day by sheltering under rotting logs or decaying leaves, in mammal burrows, or in mud. In the hottest weather they frequently enter shaded shallow pools and puddles and remain there for a period varying from a few hours to days. When entering hibernation they burrow into loose soil, sand, vegetable debris, the mud of ponds or stream bottoms, or old stump holes, or may enter mammal burrows. The same hibernaculum may be used in successive winters. Ranges of box turtles of all ages and both sexes overlap and frequently occur together. Nichols (1939) found most adults (89.5 percent) showed some homing tendency.

Reproduction: Courtship and mating usually begin in May, although Dundee and Rossman (1989) and Jackson (1991) reported March and April copulations in Louisiana and Florida, with extensions to October (Williams and Parker 1987; Jackson 1991). Mating takes place on land or in water and one male may mate with more than one female. A female may lay fertile eggs for up to 4 years after one successful mating (Ewing 1943). Nesting occurs from May through July (Jackson 1991). Most nests are started in the evening and finished after dark; however, some females have been observed excavating nests in the morning. Nest sites are usually located in an open elevated patch of sandy or loamy soil, although some females will nest in the woods (Ernst et al. 1994). Nests are dug with the hind feet and depth is correlated with the length of the hind leg. Most nests are dug on stormy evenings (Congello 1978), either to aid in digging or to hide the odor from predators. Two clutches of 1-11 eggs ($\bar{x}$ range = 4-5) are usually deposited each year (Jackson 1991). Incubation period depends on soil temperature and ranges from 70-80 days. Hatchlings emerge from early September into October, but overwintering may occur (Gibbons and Nelson 1978).

Food habits: Feeding may take place on land or in shallow water. Young are chiefly carnivorous, but become more herbivorous with age. Strang (1983) found that the eastern box turtle did not eat green leaves in nature, but instead consumes fruits (e.g., strawberries, blackberries), fungi (mushrooms), invertebrates (e.g. snails, slugs, earthworms), insects (e.g. grasshoppers, crickets); vertebrates (e.g., fish, frogs), and carrion (e.g., ducks, amphibians) (Alsop and Wallace 1978; Anton 1990).

Populations: A substantial proportion of a box turtle population at any time and place consists of transients (Williams and Parker 1987). This makes estimation of population size and density difficult. Population density estimates range from 8.9 turtles/hectare in Woods, Indiana (Williams 1961) to 22 turtles/hectare in Knoxville, Tennessee (Dolbeer 1969). Studies have shown declining populations in Maryland (Stickel 1978) and Indiana (Williams and Parker 1987). Pesticide poisoning and the pet trade are suspected to be major factors in population decline (Stickel 1978).

Remarks: *Protection Status*: Endangered: Indiana, Maine; State species of special concern: Michigan, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey; Possession and/or harvesting regulations: West Virginia, Alabama, Kentucky, Connecticut, Maryland, Florida.

Profile: Ornate box turtle (*Terrapene ornata)*

Distribution: *Terapene ornata* (Ornate box turtle) is typically found from northwestern Indiana, Illinois, south-central Wisconsin, eastern and western Iowa, southern South Dakota, and eastern Wyoming south to southwestern Louisiana, Texas, eastern and southern New Mexico, southeastern Arizona, and Sonora, Chihuahua, and southwestern Coahuila, Mexico. Found from near sea level to over 2,000 m in elevation.

Habitat: The ornate box turtle is considered to be a prairie turtle, inhabiting treeless, sandy plains and gently rolling country with grass and scattered low brush as the dominant vegetation. However, it may enter woodlands, particularly along streams, and in Arizona and New Mexico, may also be found on the fringes of deserts.

Behavior: Activity has been observed from March through November. The ornate box turtle emerges from hibernation (at body temperature ≥24 ^{o}C) around the middle of April, but may emerge as early as March. Hibernation begins in September in the north (Doroff and Keith 1990) and October in the south. Most or all turtles are underground by the end of November. Most activity occurs from late April through June (reproductive season), but a second peak of movement may occur in September (migration back to hibernation areas). Daily activities consist of periods of basking, foraging, and rest that vary in duration depending on environmental conditions. Turtles emerge shortly after dawn and ordinarily bask for a short time before setting off to forage. Foraging usually ceases between midmorning and noon, when the turtle seeks shelter; however, some may continue to forage throughout the day in shady locations. Another period of foraging occurs in the mid- or late afternoon after a mid-day rest period. All activity, with the exception of nesting females, ceases at dusk. In the southwestern portion of its range, activity seems to be largely controlled by rainfall: it becomes increasingly active during and after thunderstorms. In the northern part of its range, it is less active during rains or on cool, overcast days. Body temperature is raised to optimum through basking. The ornate box turtle is a relatively good swimmer, and on extremely warm days, it often enters puddles or cattle ponds to cool itself. Air temperature is probably the primary stimulus for hibernation. Ornate box turtles hibernate alone (Ernst et al. 1994).

Reproduction: Sexual maturity seems more closely correlated with size than with age (Legler 1960). Mating is most common in spring, soon after emergence from hibernation, but sometimes occurs in summer and fall. Nesting extends from early May to mid-July and is most frequent in June. Nesting sites that are open, well drained, and have a soft substrate are preferred. The flask-shaped nests are excavated with the hind limbs beginning in the evening hours and completed after dark. Clutch size ranges from two to eight eggs; however, four to six are typical. Natural incubation ranges from 79-84 days ($\overline{x}$ = 80).

Food habits: This species is predominately carnivorous under natural conditions. Insects (chiefly beetles, caterpillars, and grasshoppers) compose approximately 90 percent of the diet (Legler 1960). Other food sources include carrion, mulberries, cantaloupes, tomatoes, strawberries, and blackberries.

Populations: Densities in Kansas ranged from 6.4 to 15.6 turtles per hectare for studies conducted by Legler (1960) to 15 to 44 turtles per hectare (Metcalf and Metcalf 1978). At the northern limits of the range, densities were recorded at 2.9 to 5.0 turtles per hectare in Wisconsin. Doroff and Keith (1990) reported sex ratios of male to female turtles at 1:1.56 (Doroff and Keith 1990).

Remarks: *Protection status:* Threatened: Iowa; Endangered: Wisconsin; Species of special concern: Arkansas.

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