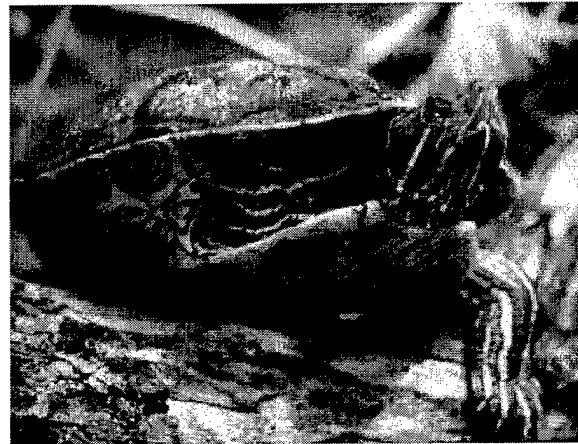




Riverine Turtle Habitats Potentially Impacted by USACE Reservoir Operations

BACKGROUND: Changing water levels or other operations at U.S. Army Corps of Engineers (USACE) reservoirs may impact critical habitat parameters for riverine turtle species. This technical note identifies riverine turtle species and habitats potentially impacted by USACE reservoir or other water-control projects as reported by resource managers. Current state and/or Federal legal protection status is summarized as is the distribution of USACE Districts and reservoir projects potentially impacted by riverine turtle conservation issues (Table 1). Life-history summaries and habitat requirements are given for each riverine turtle species identified as potentially impacted at reservoir operations. This group includes the largest number of species, of which 13 have state protection, 2 are listed as Federally endangered, and 1 is a Federal candidate for legal protection (Figure 1, Table 2). Although the riverine turtle group contains the most species, only 3 species were reported as having potential environmental issues at some USACE projects (19 projects from 5 USACE Districts and 4 USACE Divisions).



Red-eared Turtle
photo by Dena Dickerson

Distributions of these turtles are species specific; however, the collective range of this group covers all but the Pacific coastal, southwestern, and midwestern regions of the United States (Figure 2). These turtles occupy most freshwater habitats within their range but prefer quiet waters with soft bottoms, an abundance of aquatic plants, and suitable basking sites. Adults of these turtles primarily feed opportunistically as omnivorous scavengers. Young turtles in this group are primarily carnivorous. Large volumes of literature are available for some species within this group, whereas very sparse information exists on other species in this same group. Environmental contamination (i.e., pesticide poisoning) and excessive collecting for the pet trade have severely impacted populations in some areas.

Riverine Turtles Potentially Impacted by Reservoir Operations		
Turtle Common Name	Scientific Name	Protection Status
Western chicken	<i>Deirochelys reticularia (ssp)</i>	State protected
Painted (western and southern)	<i>Chrysemys picta (ssp)</i>	Species of special state concern
Red-eared	<i>Trachemys scripta elegans</i>	Species of special state concern

DTIC QUALITY INSPECTED 4

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

19990521 165

Table 1
Summary of Survey Results, Riverine Turtles

Species	Protection Status		Divisions Identified	Districts Identified	Number	
	State	Federal			District	Total
Western chicken turtle	State protected		MVD	Rock Island	1	1
Painted turtle (western and southern)	Species of special state concern		SWD MVD	Little Rock St. Paul	4 11	15
Red-eared turtle	Species of special state concern		LRD NWD MVD	Huntington Portland Rock Island	1 1* 1	3
Summary			LRD SWD NWD MVD	Huntington Little Rock Portland Rock Island St. Paul	1 4 1* 2 11	19

* Exotic species issue

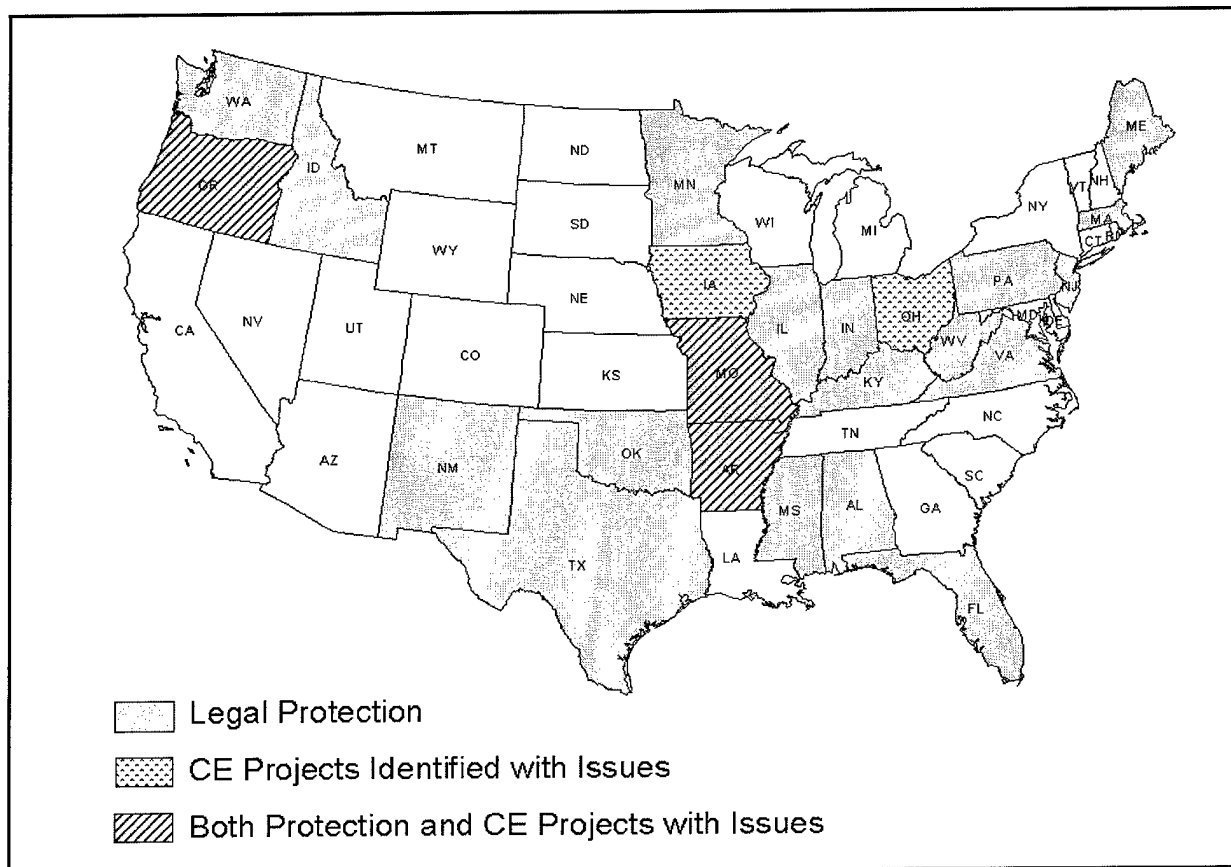


Figure 1. Legal protection status

EMRRP-SI-05
 April 1999

Table 2 (Page 2)

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
Western chicken turtle																	
Eastern chicken turtle																	
Southern painted turtle																	
Midland painted turtle																	
Western painted turtle														SSC			
Eastern painted turtle																	
Red-eared turtle																	
Big bend slider																	
River cooter									SSC								
Western river cooter																	
Hieroglyphic river cooter																	
Suwannee cooter																	
Alabama red-bellied																	
Mississippi red-bellied																	
(Plymouth) red-bellied																	
Eastern red-bellied																	

FT Federally threatened
 FC Candidate for Federal protection
 SSC State species of special concern

T or ST State threatened
 E or SE State endangered

Shading PHR Indicates species with potential issues at CE Reservoirs
 Possession and/or harvesting regulations

Table 2 (Page 3)

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
Western chicken turtle		E											SSC		PHR	SSC	
Eastern chicken turtle																	
Southern painted turtle	SSC									PHR							
Midland painted turtle																	
Western painted turtle				PHR						PHR							
Eastern painted turtle										PHR							
Red-eared turtle										PHR							
Big bend slider											SSC						
River cooter						E				PHR							
Western river cooter																	
Hieroglyphic river cooter						E				PHR							
Suwannee cooter																	
Alabama red-bellied														FE			
Mississippi red-bellied													SSC				
(Plymouth) red-bellied																	
Eastern red-bellied										PHR							

FT Federally threatened
 FC Candidate for Federal protection
 SSC State species of special concern

T or ST State threatened
 E or SE State endangered

Shading PHR Indicates species with potential issues at CE Reservoirs
 PHR Possession and/or harvesting regulations

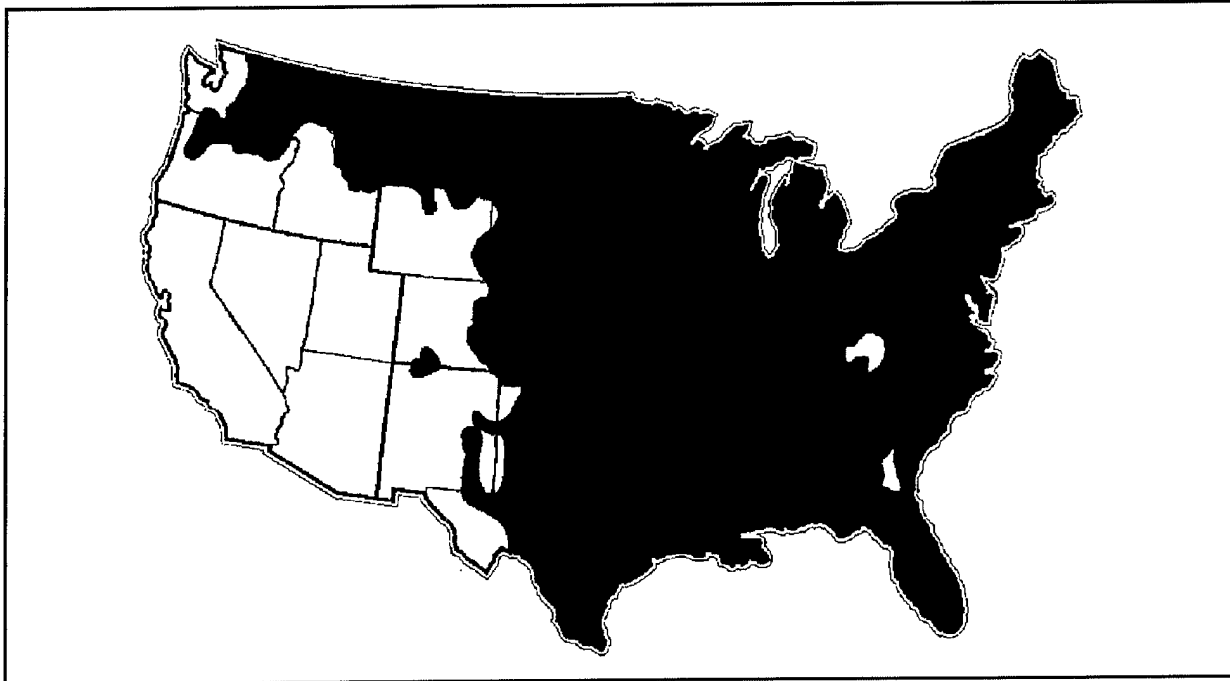


Figure 2. Riverine turtle habitat range

POINT OF CONTACT: For additional information, contact one of the authors, Ms. Dena D. Dickerson, (601-634-3772, dickerd@ex1.wes.army.mil), Mr. Kevin J. Reine, (601-634-3436, reinek@ex1.wes.army.mil), or Ms. Kim L. Herrmann, (601-634-3689), or the manager of the Ecosystem Management and Restoration Research Program, Dr. Russell F. Theriot, (601-634-2733), therior@ex1.wes.army.mil). This technical note should be cited as follows:

Dickerson, D. D., Reine, K. J., and Herrmann, K. L. (1999). "Riverine turtle habitats potentially impacted by USACE reservoir operations," *EMRRP Technical Notes Collection* (TN EMRRP-SI-05), U.S. Army Engineer Research and Development Center, Vicksburg MS. www.wes.army.mil/el/emrrp

Profile: Western chicken turtle (*Deirochelys reticularia*)

Distribution: Range extends from southeastern Virginia (Mitchell and Buhlmann 1991) and eastern North Carolina south along the Atlantic Coast to southern Florida, west along the Gulf Coast to Texas, and northward, west of the Mississippi River, to southeastern Oklahoma and southeastern Missouri. Although present in some Atlantic coastal localities, the species is found on few barrier islands (Gibbons and Coker 1978).

Habitat: Found primarily in still waters of ponds, lakes, ditches, marshes, cypress swamps, and Carolina bays. Habitats are usually characterized as having ample aquatic vegetation and a soft bottom.

Behavior: Limited data exist for this species. Gibbons (1969) and Gibbons and Semlitsch (1981) determined that terrestrial activity is evident from March through April, and some individuals were captured entering a Carolina bay in August when other habitats dried up (Gibbons and Greene 1978). Both sexes migrate periodically between habitats, although males move greater distances than females (Gibbons 1986). The species is well-adapted to living in ephemeral habitats and coping with varying water levels (Gibbons and Greene 1990). While terrestrially active, individuals may burrow during periods of prolonged drought (Gibbons 1983). Basking is a regular daily activity, although little has been reported on the thermal ecology of the species. In the northern part of its range, the chicken turtle hibernates in mud and aquatic vegetation. In Florida it does not hibernate, but remains active except on cold days.

Reproduction: *Deirochelys* is one of the few North American turtle species with a "winter" nesting pattern (Jackson 1988). Although Iverson (1977) suggested that the chicken turtle nested throughout the year, no studies have been able to confirm this theory. In South Carolina, egg laying occurs in two periods: a late winter and spring period from mid-February to May, and a fall and early winter period from August to November (Gibbons and Greene 1979, 1990). In the southern part of its range (Florida), nesting may be continuous from mid-September until early March, but may be delayed temporarily by cold weather (Jackson 1988). Limited data have been published on their nesting. David (1975) described one nest as being located 50 m from the water, excavated in sandy soil, on a 15-deg slope in an area with low weeds and grass and no trees or brush within 50 m of the nest site. Clutch size in South Carolina usually ranges from 5 to 12 eggs ($\bar{x} = 8$) (Gibbons et al. 1982) and 2 to 19 eggs in Florida ($\bar{x} = 9$) (Jackson 1988). Turtles in South Carolina lay two clutches a year, while two to four clutches are laid by Florida turtles. Eggs of South Carolina *Deirochelys* hatch in 152 days at 29 °C (Congdon et al. 1983), while those laid in Florida hatch in 78-89 days at temperatures from 25 to 29 °C (Iverson 1977). Some hatchlings in South Carolina overwinter in the nest (Gibbons et al. 1982). Gender determination is influenced by incubation temperature.

Food habits: During the first year of life, chicken turtles are carnivorous, but adults are probably more omnivorous. Carr (1952) observed chicken turtles eating tadpoles and crayfish. Cagle (1950) reported that chicken turtles respond best to decayed bait in traps, whereas other turtles may not enter a trap containing rotten bait. Bramble (1973) describes the feeding method of this turtle as "pharyngeal" in that it captures aquatic arthropods with a well-developed hyoid apparatus, which allows it to suck in food items.

Populations: Density of up to 40 turtles per hectare has been reported for Carolina Bay in South Carolina by Iverson (1982). Sex ratios for South Carolina populations range from 1.12 to 2.79 adult males for every adult female (Gibbons 1990). Cagle and Chaney (1950) reported that chicken turtles accounted for 4.4 percent of the turtles trapped in southwestern Louisiana during 456 trap hours. Survivorship curves indicate that fewer than 10 individuals out of 1,000 live past the age of 15 years (Gibbons 1987).

Remarks: *Protection Status:* Endangered: Montana; State species of special concern: Arkansas, Mississippi; Possession and/or harvesting regulations: Oklahoma.

Profile: Painted turtles (*Chrysemys picta* spp.)

Distribution: Range includes southern Canada, from New Brunswick and Nova Scotia to British Columbia, and south to Georgia, Alabama, Mississippi, Louisiana, northeastern Texas, Oklahoma, eastern Colorado, Wyoming, Idaho, and Oregon. The species is also found in scattered localities in central and western Texas, New Mexico, southwestern Colorado, Arizona, Utah, and Chihuahua, Mexico.

Habitat: Prefers slow-moving shallow water, as in ponds, marshes, lakes, sloughs, oxbows, and creeks. A soft bottom, basking sites, and aquatic vegetation are preferred. Along the Atlantic Coast, it occasionally enters brackish water.

Behavior: Most active from March through October but basking has occurred throughout the year in some locations (Vogt 1981a; Ross 1989). Species is diurnal, spending nights sleeping at the bottom or on a partially submerged object, becoming active about sunrise and basking (most frequent from April through September) for several hours (average 2 hr) before beginning to forage. This is followed by another period of basking and foraging in the late afternoon into the early evening. Basking peaks around 1100 hr and may occur alone or with large groups and with turtles of other species. Northern populations may remain dormant for 5 or 6 months, but elsewhere hibernation is not prolonged. Burial in soft mud bottoms or the use of muskrat lodges or bank burrows is common. Homing capabilities when displaced 100 m, but limited or nonexistent when tested at 1.6 km.

Reproduction: Sexual maturity correlated more with size than age (males: 70-95 mm at 3-4 years; females 97-128 mm at 6-10 years) (Mitchell 1985, 1988). Mating usually occurs from March to mid-June but has been observed in August and September (Ernst 1971a). Nesting occurs from late May until mid-July, with peak activity in June and early July. Females lay at least 2 clutches and possibly as many as 3 to 5 during the season. Number of eggs varies by subspecies, but ranges from 1 to 23. Overwintering may occur in the nest especially for clutches laid late in the season (Gibbons and Nelson 1978). The flask-shaped nests are dug with the hind limbs in loamy or sandy soil, in the open usually in the late afternoon or early evening, but morning nesting is not uncommon. Natural incubation ranged from 72-80 ($x = 76$) days.

Food habits: Adults will opportunistically consume most species of plants and animals (living or as carrion), found in their habitat. Known prey include, but are not limited, to algae (several species), earthworms, leeches, slugs, snails, small clams, crayfish, various insects (some adults but mostly larval), fish (probably taken as carrion), and frogs (MacCulloch and Secoy 1983; Brown 1992). Young painted turtles are carnivorous at first, but become more herbivorous as they mature.

Populations: Numerous studies estimating density in various geographic locations have produced mean density rates of 104 turtles/hectare (central Wisconsin), 590 turtles/hectare (Pennsylvania), and 838 turtles/hectare (Michigan) (Ernst 1971b; Ross 1989; Frazier et al. 1991). Adult sex ratios found in most long-term studies have been 1:1 (Zweifel 1989). Age classes in most populations are skewed toward adults; however, small turtles may just be more difficult to find and catch. Since this species is one of the more easily observable and popular experimental turtles, a large amount of literature exists and is reviewed by Ernst (1971c; 1988).

Remarks: *Protection Status:* State species of special concern: Kentucky (southern painted turtle), Oregon, Washington (western painted turtle).

Profile: Red-eared turtle (*Trachemys scripta elegans*)

Distribution: Range extends throughout the Mississippi Valley from Illinois to the Gulf of Mexico.

Habitat: Occupies most freshwater habitats within its range, but prefers quiet waters with soft bottoms, an abundance of aquatic plants, and suitable basking sites (Ernst and Barbour 1972).

Behavior: Red-eared turtles are typically active in every month in the southern part of their range, but farther north, they must hibernate in winter. They are not active until water temperatures reach 10 °C or higher. Below this temperature they hibernate in muskrat burrows or hollow stumps. *Trachemys* spp. are primarily diurnal. At night, turtles sleep by resting on the bottom or floating on the surface. Feeding activity is greatest in early morning but may occur throughout the day (Cagle 1950). A significant part of the daily activity cycle is basking, a well-developed practice even in hatchlings (Janzen et al. 1992). Basking, primarily for thermoregulation (Moll and Legler 1971), typically begins around 0800 and peaks between 1000 and 1100 hr in August and September. Basking activity shifts later in the day during October and November. Individuals may have extensive home ranges which may include several bodies of water between which they make frequent overland journeys (Cagle 1944). Little is known of the movements within a population. *Trachemys* spp are occasionally known to be aggressive, particularly among melanistic males (Lovich et al. 1990). Aggressive behavior includes biting, shoving, and ramming other turtles of similar size and color.

Reproduction: Courtship behavior is traditionally thought to occur in spring and fall. Cagle (1950) observed that in Illinois, *T. s. elegans* mating activity peaks in May and September, but in Louisiana similar peaks occur in April and October, and in Kentucky, courtship lasts from March to early June (Ernst and Barbour 1972). The nesting season generally occurs between April and July, with May and June the most important months (Gibbons et al. 1982; Jackson 1988). Nests are excavated using the hind limbs in locations characterized as being open-unshaded areas where the soil is not muddy and usually less than 180 m from water to nest (Carr 1952). In areas with limited nest sites, levees, drainage ditches and railroad embankments are often sites of concentrated nesting. Nesting activity generally takes place in the early morning or late evening (Cagle 1937). As many as five clutches of 2 to 23 eggs ($\bar{x} = 6.1$ eggs) may be deposited by an individual in a single year (Jackson 1988). Incubation time ranges from 60-80 days (Ewert 1979a). Eggs hatch in the late summer or early fall, although hatchlings in some populations overwinter in the nest, emerging the following spring (Gibbons and Nelson 1978). Gender determination is correlated with incubation temperature.

Food habits: The red-eared turtle diet consists of a variety of plant and animal foods, to include algae (e.g. *Cladophora*), vascular plants (e. g. *Azolla*), sponges, snails, clams, crayfish, shrimp, spiders, adult and larval insects (e.g. mayflies, dragonflies), frogs (eggs, tadpoles, and adults) and snakes (Ernst and Barbour 1972; Hart 1983; Parmenter and Avery 1990). Juveniles studied in Louisiana predominantly feed on insects (mostly hemipteran and dragonfly nymphs), but shift gradually to plants (mostly waterweeds and duckweed) with increasing plastron length (Hart 1983).

Populations: In most well-studied populations, males outnumber females, primarily as a result of males maturing earlier than females. Maximum longevity in natural populations is about 30 years. Gibbons and Semlitsch (1981) reported a constant rate of mortality for all ages. Overall *Trachemys* spp account for 71-87 percent of the total population in southern Illinois and Louisiana (Cagle 1950). Environmental contamination, such as pesticide poisoning (Hall 1980) and exportation resulting from the pet trade industry, has impacted populations in some areas (Warwick et al. 1990).

Remarks: *Protection Status:* State species of special concern: New Jersey; Possession and/or harvesting regulations: West Virginia.

REFERENCES

- Bramble, D. M. (1973). "Media dependent feeding in turtles," *American Zoologist* 13:1342.
- Brown, E. E. (1992). "Notes on amphibians and reptiles of the western Piedmont of North Carolina," *Journal of the Elisha Mitchell Science Society* 108:38-54.
- Cagle, F. R. (1937). "Egg laying habits of the slider turtle (*Pseudemys troostii*), the painted turtle (*Chrysemys picta*), and the musk turtle (*Sternotherus odoratus*)," *Journal of the Tennessee Academy of Science* 12:87-95.
- Cagle, F. R. (1944). "Home range, homing behavior and migration in turtles," Miscellaneous publication, Museum of Zoology, University of Michigan (61) 1-34.
- Cagle, F. R. (1950). "The life history of the slider turtle, *Pseudemys scripta troostii* (Holbrook)," *Ecological Monographs* 20:31-54.
- Cagle, F. R., and Chaney, A. H. (1950). "Turtle populations in Louisiana," *American Midland Naturalist* 43:383-88.
- Carr, A. F., Jr. (1952). "Handbook of turtles," *The turtles of the United States, Canada, and Baja California*. Comstock Publishing Association, Cornell University Press, Ithaca, NY.
- Congdon, J. D., Gibbons, J. W., and Greene, J. L. (1983). "Parental investment in the chicken turtle (*Deirochelys reticularia*)," *Ecology* 64:419-25.
- David, W. D., Jr. (1975). "Notes on the egg laying habits of *Deirochelys reticularia*," *Herpetological Review* 6:127.
- Ernst, C. H. (1971a). "Sexual cycles and maturity of the turtle, *Chrysemys picta*," *Biological Bulletin* 140:191-200.
- Ernst, C. H. (1971b). "Population dynamics and activity cycles of *Chrysemys picta* in southeastern Pennsylvania," *Journal of Herpetology* 5:151-60.
- Ernst, C. H. (1971c). "*Chrysemys picta*," *Catalog of American Amphibians Report* 106:1-4.
- Ernst, C. H. (1988). "*Chrysemys*," *Catalog of American Amphibians Report* 438:1-8.
- Ernst, C. H., and Barbour, R. W. (1972). *Turtles of the United States*. University of Kentucky Press, Lexington.
- Ewert, M. A. (1979a). "The embryo and its egg: Development and natural history," *Turtles: Perspectives and research*. M. Harless and H. Morlock, ed., John Wiley & Sons, New York, 333-413.
- Frazier, N. B., Gibbons, J. W., and Greene, J. L. (1991). "Growth, survivorship and longevity of painted turtles, *Chrysemys picta* in a southwestern Michigan marsh," *American Midland Naturalist* 125:245-58.
- Gibbons, J. W. (1969). "Ecology and population dynamics of the chicken turtle *Deirochelys reticularia*," *Copeia* 1969:669-76.
- Gibbons, J. W. (1983). "Reproductive characteristics and ecology of the mud turtle, *Kinosternon subrubrum*," *Herpetologica* 39:254-71.
- Gibbons, J. W. (1986). "Movement patterns among turtle populations: Applicability to management of the desert tortoise," *Herpetologica* 42:104-13.
- Gibbons, J. W. (1987). "Why do turtles live so long?" *Bioscience* 37:262-69.
- Gibbons, J. W., and Coker, J. W. (1978). "Herpetofaunal colonization patterns of Atlantic Coast barrier islands," *American Midland Naturalist* 99:219-33.
- Gibbons, J. W., and Greene, J. L. (1978). "Selected aspects of the ecology of the chicken turtle, *Deirochelys reticularia* (Latreille) (Reptillia, Testudines, Emydidae)," *Journal of Herpetology* 12:237-41.
- Gibbons, J. W., and Greene, J. L. (1979). "X-ray photography: A technique to determine reproductive patterns of freshwater turtles," *Herpetologica* 17:242-46.
- Gibbons, J. W., and Greene, J. L. (1990). "Reproduction in the slider and other species of turtles," Life history and ecology of the slider turtle. J. W. Gibbons, ed., Smithsonian Institution Press, Washington, DC, 124-34.
- Gibbons, J. W., Greene, J. L., and Patterson, K. K. (1982). "Variation in reproductive characteristics of aquatic turtles," *Copeia* 1982:776-84.

- Gibbons, J. W., and Nelson, D. H. (1978). "The evolutionary significance of delayed emergence from the nest by hatchlings turtles," *Evolution* 32:297-303.
- Gibbons, J. W., and Semlitsch, R. D. (1981). "Terrestrial drift fences with pitfall traps: An effective technique for quantitative sampling of animal populations," *Brimleyana* (7):1-16.
- Hall, R. J. (1980). "Effects of environmental contaminants on reptiles: A review," U.S. Fish and Wildlife Service Special Science Report on Wildlife (228):1-12.
- Hart, D. R. (1983). "Dietary and habitat shift with size of red eared turtles (*Pseudemys scripta*) in a southern Louisiana population," *Herpetologica* 39:285-90.
- Iverson, J. B. (1977). "Reproduction in freshwater and terrestrial turtles of North Florida," *Herpetologica* 33:205-12.
- Iverson, J. B. (1982). "Biomass in turtle populations: A neglected subject," *Oecologia* (Berlin) 55:69-76.
- Jackson, D. R. (1988). "Reproductive strategies of sympatric freshwater Emydid turtles in northern peninsular Florida," *Bulletin of the Florida State Museum Biological Science* 33:113-58.
- Janzen, F. J., Paukstis, G. L., and Brodie, E. D. III. (1992). "Observations on basking behavior of hatchling turtles in the wild," *Journal of Herpetology* 26:217-19.
- Lovich, J. E., Garstka, W. R., and McCoy, C. J. (1990). "The development and significance of melanism in the slider turtle," *Life history and ecology of the slider turtle*. J. W. Gibbons, ed., Smithsonian Institution Press, Washington, DC, 233-54.
- MacCulloch, R. D., and Secoy, D. M. (1983). "Demography, growth, and food of western painted turtles, *Chrysemys picta bellii* (Gray), from southern Saskatchewan," *Canadian Journal of Zoology* 61:1499-509.
- Mitchell, J. C. (1985). "Variation in the male reproductive cycle in a population of painted turtles, *Chrysemys picta*, from Virginia," *Herpetologica* 41:45-51.
- Mitchell, J. C. (1988). "Population ecology and life histories of the freshwater turtles *Chrysemys picta* and *Sternotherus odoratus* in an urban lake," *Herpetological Monographs* 2:40-61.
- Mitchell, J. C., and Buhlmann, K. A. (1991). "Eastern chicken turtle. *Deirochelys reticularia reticularia* (Latreille)," *Virginia's endangered species*. K. Terwilliger, ed., McDonald and Woodward Publishing Company, Blacksburg, VA, 459-61.
- Moll, E. O., and Legler, J. M. (1971). "The life history of a neotropical slider turtle, *Pseudemys scripta* (Schoepff), in Panama," *Bulletin of the Los Angeles County Museum of Natural History* (11) 1-102.
- Parmenter, R. R., and Avery, H. W. (1990). "The feeding ecology of the slider turtle," *Life history and ecology of the slider turtle*. J. W. Gibbons, ed., Smithsonian Institution Press, Washington, DC, 247-66.
- Ross, D. A. (1989). "Population ecology of painted and Blanding's turtles (*Chrysemys picta* and *Emydoidea blandingii*) in central Wisconsin," *Wisconsin Academy of Science Arts and Letters* 77:77-84.
- Vogt, R. C. (1981a). *Natural history of amphibians and reptiles of Wisconsin*. Milwaukee Public Museum, Milwaukee, WI.
- Warwick, C., Steedman, C., and Holford, T. (1990). "Ecological implications of the red-eared turtle trade," *Texas Journal of Science* 42:419-22.
- Zweifel, R. G. (1989). "Long-term ecological studies on a population of painted turtles *Chrysemys picta*, on Long Island, New York," *American Museum Novitates* (2952) 1-55.