

SPOTTED TURTLE ASSESSMENT

March 26, 1991

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NATURAL HISTORY

Description

The spotted turtle (*Clemmys gruttata*) is a small aquatic turtle (Figure 1). An adult's carapace (upper shell), 8.0 - 12.5 cm long (3.5 to 5 inches), is blue-black with yellow spots on the scutes. The yellow or orangish plastron (lower shell) is not hinged and has large black blotches on the outer margins. The skin is gray to black, and there are occasional yellow spots on the head, neck, and limbs. The head has a broken yellow band near the tympanum that extends back from the eye in some individuals.

Males have slightly concave plastrons; tan chins; brown eyes; and long, thick tails with the anal opening near the tip. Females have yellow chins, orange eyes, and flat or convex plastrons, which are slightly longer than those of the males and extend closer to the carapacial margin.

Distribution

Spotted turtles range from Maine southward along the Atlantic coastal plain to northern Florida (Figure 2). Their range also extends west through southern Ontario, New York, Pennsylvania, central Ohio, northern Indiana, and Michigan to northeastern Illinois. In Maine, spotted turtles have been documented in York, Cumberland, Oxford, Sagadahoc, Somerset, and Waldo Counties (Figure 3).

Populations are uncommon to rare in New England (DeGraaf and Rudis 1983). Spotted turtles are a state listed Threatened species in Maine; species of Special

Figure 1. A spotted turtle.

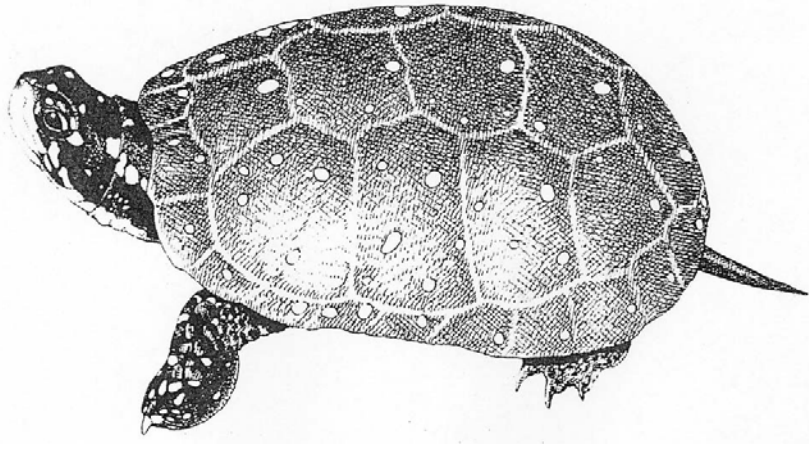


Figure 2. Range of the spotted turtle in the United State (Ernest and Barbour 1972).

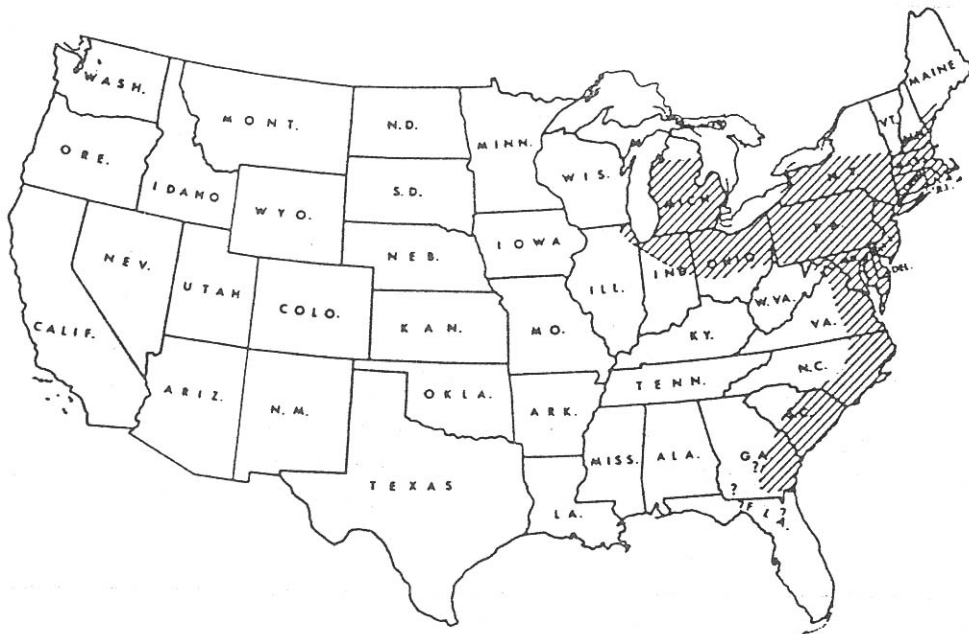
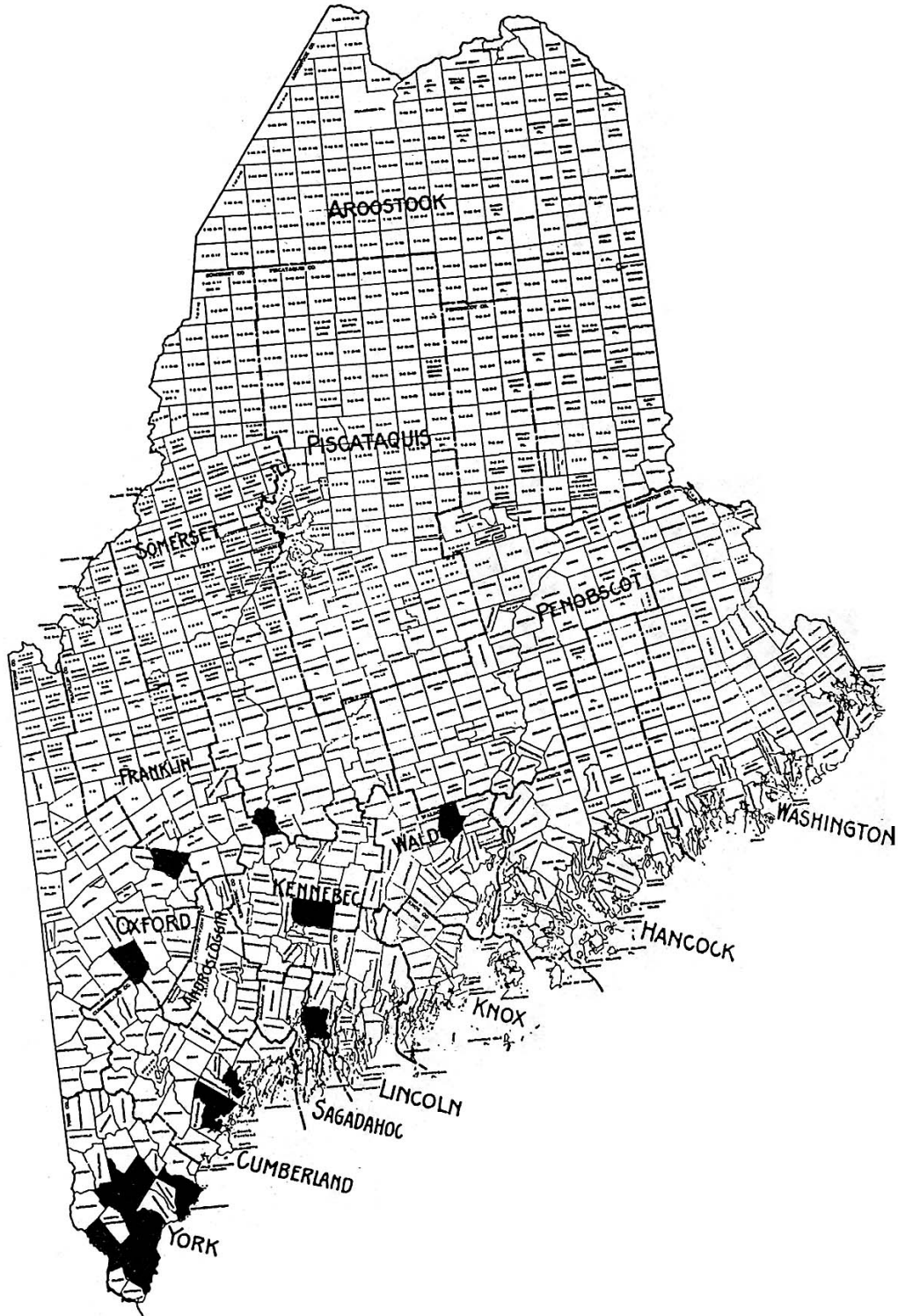


Figure 3. Distribution of spotted turtles in Maine.



Concern in Vermont, Massachusetts, and New York; and Endangered in Ontario (Table 1).

Life History

Reproductive Ecology

Ernst (1970) estimated that both sexes probably mature at 80 mm plastron length (or about 7 years-of-age Graham [1970]). Courtship and mating occur in the spring shortly after emerging from hibernation. Ernst (1970) observed mating in late March and April in Pennsylvania. Spotted turtles sometimes form mating aggregations (Ernst 1967). Ernst (1970) observed one to several males chasing a female in shallow water. Once caught, the male mounted the female and mating occurred underwater. Copulation may also occur on land (Carr 1952).

Twelve nests were examined by Ernst (1970) in Pennsylvania. All were in well-drained loamy soil in a marshy pasture exposed to full sunlight. Nesting takes place in June (Babcock 1919, Ernst 1970) and occurs in the evening (Ernst 1970). The 12 clutches studied by Ernst (1970) contained 3-5 eggs (average 3.58). DeGraaf and Rudis (1983) report a clutch size of 1 to 8 and an average of 3 to 5. Apparently, only one clutch is laid each year (Ernst 1967).

Estimated incubation was 70-83 days in Pennsylvania (Ernst 1970) and hatching occurred from mid-August (Ernst 1970) to September (Finneran 1948). Some hatchlings may overwinter in the nest (Conant 1951, Nemuras 1967, Ernst 1970). Spotted turtles likely have temperature-dependent sex determination. For example, painted turtle (*Chrysemys picta*) eggs incubated at 25.72-27.70 C result in males, and

Table 1. Status of spotted turtles in New England.

State/Province	Presence/absence	Status	TNC ¹ Status
Ontario	Present	Endangered	-
Maine	Present	Threatened	S3
New Hampshire	Present	None	
Vermont	Present	Special Concern	
Massachusetts	Present	Special Concern	
Connecticut	Present	No lists	
Rhode Island	Present	None	
New York	Present	Special Concern	
Pennsylvania	Present	None	
New Jersey	Present	Undetermined	

- ¹The Nature Conservancy Natural Heritage Program state ranking:
- S1 Critically imperiled because of extreme rarity (< 5 occurrences) or because some aspect of its biology makes it especially vulnerable to extirpation in the state.
 - S2 Imperiled because of rarity (6-20 occurrences) or because other factors making it vulnerable to further decline.
 - S3 Rare in the state (20+ occurrences).
 - S4 Apparently secure in the state..
 - S5 Demonstrably secure in the state.
 - SH Occurred historically with the expectation that it may be recovered.
 - SU Possibly in peril but status uncertain; need more information.

eggs at 28.70 C result in similar proportions of males and females (Packard et al. 1989).

Ernst (1976) estimated an average mortality of 45k for a Pennsylvania population, but assumed that most mortality occurred in the lower size and age classes. Once Spotted turtles reach maturity, mortality is likely Substantially reduced although Ernst (1976) believed they were more vulnerable to predation as adults than larger turtle species.

Survival and Longevity

Pope (1939) reported a longevity of 42 years for a captive Spotted turtle, and Graham (1970) found a 26-year old wild individual.

Habitat, Diet, and Movements

Although spotted turtles have a large range and are abundant in some areas, their habitat requirements are poorly understood. Spotted turtles are generally characterized as aquatic, although they are frequently found wandering over land (Ernst and Barbour 1972). In New England, they have been found in unpolluted, small shallow bodies of water with aquatic vegetation such as woodland streams, wet meadows, cranberry bogs, bog holes, small ponds, marshes, swamps, roadside ditches, and brackish tidal creeks IDeGraaf and Rudis 19831, In Rhode Island, spotted turtles are sometimes found in salt marshes and small bogs or ponds with adjacent dry upland oak-pine forest (C. Raithel, pers. comm. i-n DeGraaf and Rudis 1983). Spotted turtles often bask along the water's edge or in brush piles, logs, or stumps and hide in mud and detritus when disturbed. In the North, they hibernate in muddy bottoms of wetlands

during the coldest winter months and may estivate during the hottest periods in summer. In Maine, spotted turtles were observed in shallow fresh marshes, shrub swamps, or roadside ditches (Haskins 1990).

Telemetry studies indicated tagged spotted turtles travel overland between wetlands in a wetland complex (Lovich 1990). In Maryland, spotted turtles were tracked intermittently using radiotantalum pins affixed to the carapace (Ward et al. 1976). They documented turtles leaving shallow aquatic habitats in late May and burrowed into litter and vegetation in early successional hardwood forests to estivate. In late fall, they reoccupied the shallow pools and remained there for the winter. Ward et al. (1976) surmised these movements reflected behavioral adaptations for thermoregulation, avoidance of desiccation and predators, and exploitation of food resources.

Ernst (1970) estimated home range of spotted turtles in Pennsylvania by recapturing marked individuals. Home ranges (minimum area polygon) ranged from 1.23 to 1.39 acres. Home ranges overlapped, and there was no evidence of territoriality. Females migrated out of their home range to nest.

Spotted turtles are omnivorous. Surface (1908) found animal food in all 27 stomachs examined and vegetation in 3. Animals eaten included worms, slugs, snails, small crustaceans, crayfish, millipedes, spiders, and insects. Conant (1951) observed spotted turtles eating frogs, earthworms, grubs and the grass growing in a flooded meadow. Two stomachs of Pennsylvania specimens examined by Ernst (1970) included only filamentous green algae.

HISTORY

Habitat Trends

Knowledge of the primary components of spotted turtle habitat in Maine is limited, but likely include shallow, freshwater marshes with appropriate nesting habitat nearby. Throughout their extensive distribution spotted turtles are localized and continue to decline because of habitat destruction and over-collecting (Lovich 1987). Rapidly increasing human population and associated residential development have reduced the quantity and quality of wetlands used by spotted turtles in New England and other parts of their range (DeGraaf and Rudis 1983, Lovich 1987).

Increased development pressures (commercial and residential development), especially in York, Cumberland, and Sagadahoc Counties, have been the primary source of wetland loss in Maine since European settlement (Widoff 1988) and contribute to a national trend (Tiner 1984). The extent and nature of such wetland losses are not well documented. While some wetlands may have been lost or filled outright, many have deteriorated water quality or degraded habitats (Adamus 1986, Woodlot Alternatives 1989). Habitat destruction and alteration, grazing, and draining of wetlands are generally believed to cause declines in spotted turtles populations (Lazell 1976, Lovich 1987).

The following trends reflect potential loss of existing spotted turtle habitat in Maine:

- In the last decade (1981-1991), the human populations in spotted turtle range (York, oxford, Cumberland, Androscoggin, Kennebec, Knox, Lincoln, and Waldo

Counties) has grown by lot (635,650 in 1981 and projected 697,400 in 1991).

The human population in York, Cumberland, and Sagadahoc Counties approximately doubles during the summer. The number of households increased in York, Cumberland, and Sagadahoc Counties by 30-44% from 1970-1980 and reflects greatly increased residential development (Southern Maine Regional Planning Commission 1986).

- From 1970 to 1979, at least 1k of the total land area of Cumberland County was lost as wildlife habitat in Site Location Development permits alone (Mann 1980). Total habitat loss is substantially greater than this figure, because subdivisions < 20 acres were not included in calculations, and other state and local permitting actions were not considered.
- From 1970 to 1985, approximately 83%- of all land use permitting activity in 9 York County towns occurred at the local level and was not eligible for state review (Southern Maine Regional Planning Commission 1986). municipal permits also contribute greatly to habitat loss.
- The Southern Maine Regional Planning Commission (1986) stated that most York County town zoning ordinances and subdivision regulations do not recognize water-related resources and wildlife habitat values.
- Approximately 72% of all wetlands in Old Orchard Beach have been altered in some way. More than 50%- have been significantly altered or adversely affected by development (Woodlot Alternatives 1989).
- The U.S. Fish and Wildlife Service reported that Maine has lost 20% of its wetlands in the last two centuries (Dahl 1990).

- The U.S. Fish and Wildlife Service report on coastal wetlands (USFWS 1965) documented most wetland loss occurred in York and Cumberland Counties.
- In 1974, the Army Corps of Engineers documented 30 violations of illegal fill of wetlands associated with one project of the Wells Sanitary District (Widoff 1988).
- 85% of 321 wetlands of "outstanding" value studied in 9 York County towns have disturbances in their immediate watersheds that could affect their ability to function, particularly as valuable habitat for wildlife or aquatic resources (Adamus 1986).
- The Maine Wetland Conservation Priority Plan (Widoff 1988) found that wetlands in York County and southern coastal areas have experienced the greatest loss in the state - especially freshwater marshes and some wooded swamps.

These trends indicate that residential growth has increased dramatically in southern Maine in the last two decades. This growth (primarily residential development) has already resulted in the loss of appreciable wildlife habitat, especially small wetlands. Permit review is occurring primarily on the municipal level and, thus is escaping state-level agency review. Undocumented habitat *loss is* occurring at a great level from locally-permitted activities. It is likely that the rate of wetland loss in York County has accelerated greatly in the last decade and will continue to do so in the future. Continuation of this trend may further jeopardize the existence of spotted turtles in Maine.

Population Trends

Josselyn (1672) may have been the first to record spotted turtles in Maine in the vicinity of Scarborough Maine. His description of a "Pond Turtle" may have been derived from spotted turtle observations (Norton 1929). Similarly, Williamson (1832) described a "speckled land turtle" that was believed by Norton (1929) to represent a spotted turtle. The first nominal list of Maine herpetofauna included the "Yellow-spotted turtle" (Fogg 1862), although localities of collection have perished in fires at the Portland Museum of Natural History. Verrill (1863) collected a spotted turtle in the vicinity of Norway, Maine in the mid-1800's.

Babcock (1919) believed the spotted turtle (with the exception of the painted turtle, Chrysemys picta) was the most common turtle in New England. The turtle was reported as rare in Norway, Maine in the 1800's (Verrill 1863).

Population size or trends for spotted turtles in Maine are unknown. However, their numbers in New England are thought to be declining. Babcock (1919) characterized spotted turtles as extremely abundant in all of New England, except Maine. Now the species is described as "uncommon to rare" (DeGraaf and Rudis 1983) and declining in numbers (Lazell 1976). This trend is reflected by the species' Threatened or Special Concern status in 4 of 7 New England states.

Information on the distribution of this species improved dramatically in the last decade as the result of the Maine Amphibian and Reptile Atlasing Project and a survey conducted by Haskins (1990). Verified specimens have been captured or observed at 34 sites in 18 towns (Table 2). The known distribution of spotted turtles extends from Maine's western border with New Hampshire to the Penobscot River. The northern

Table 2. Verified records of spotted turtles in Maine.

Town	Year	No.	Location	Source
Norway	1863	?	?	Verrill (1863)
Augusta	?	?	?	Babcock (1919)
Sanford	1964	2+	Branch Brook	MDIFW ¹
Dixfield	1965	1	Mill Pond, Holmann	MDIFW/TNC ²
Falmouth	1968	1	Woodville Rd. Stream	MDIFW
Portland	1982	1	Long Island	MDIFW/TNC
Falmouth	1984	1	Presumscot R. pwrline	MARAP
Sanford	1984	1	?	MARAP
Woolwich	1985	1	Woolwich, Rt. 128	MDIFW/TNC
Yarmouth	1985	1	Sligo Road	MDIFW/TNC
Kennebunkport	1985	1	?	MDIFW/TNC
Mercer	1985	1	Mercer Bog	MARAP ³
York	1985	1	?	MARAP
Kennebunkport	1986	1	Lester Wildes Rd.	MARAP
Monroe	1986	1	Marsh St. Flowage, Brooks Rd.	MARAP
York	1985	1	Bell Marsh	Graham (1985)
Portland	1986	1	Summit St.	MARAP
Biddeford	1987	1	Biddeford Pool Rd.	MARAP
York	1987	1	Mt. Agamenticus Pond	MARAP
Alfred	1988	1	Kennebunk Rd.	MARAP
Berwick	1990	2	Back Sanford Rd.	Haskins (1990)
So. Berwick	1990	2	County Rd. Pond	Haskins (1990)
So. Berwick	1990	2	Ogunquit Rd. Swamp	Haskins (1990)
So. Berwick	1990	1	Bennett Lot Rd. Pond	Haskins (1990)
So. Berwick	1990	3	Chick's Brook Ponds	Haskins (1990)
So. Berwick	1990	5	County Rd. Pond	Haskins (1990)
Biddeford	1990	3	Newtown Rd. Pond	Haskins (1990)
Biddeford	1990	4	Newtown Rd. Pond	Haskins (1990)
Lyman	1990	1	Williams Rd.	Haskins (1990)
Wells	1990	1	Hilton's Lane	Haskins (1990)
Wells	1990	1	Chaney Woods Rd.	Haskins (1990)
York	1990	19	Agamenticus Rd. Pond	Haskins (1990)
York	1990	1	Josias Brook	Haskins (1990)
York	1990	1	High Rock Rd.	Haskins (1990)

¹Maine Department of Inland Fisheries and Wildlife²Maine Department of Inland Fisheries and Wildlife/The Nature Conservancy³Maine Amphibian and Reptile Atlas Project

edge of their range extends in a line from Grafton Township to Dixfield, Mercer, and Monroe (Figure 3). The greatest numbers of spotted turtles found to date are from York County (Haskins 1990), although searching time has been greatest there.

Use and Demand Trends

In the last two decades, there has been growing public expectations of federal and state natural resource agencies to address the conservation of all fish, wildlife and plants. This need for a more holistic approach to wildlife management was first manifested in Maine by a departmental name change from "Inland Fisheries and Game" to "Inland Fisheries and Wildlife,, in 1973. A commitment to preserve Maine's natural heritage was further supported by the creation of the Maine Endangered Species Act in 1975. In 1984, the Endangered and Nongame Wildlife Program was initiated and funded largely by an income tax checkoff.

Further commitment to preserve Maine's biological diversity occurred in 1988 with an amendment to the Maine Endangered Species Act and passage of the Natural Resource Protection Act. Both Acts provide a clear regulatory mandate to protect habitat of endangered, rare, and other wildlife. In 1990, MDIFW shifted from a dedicated funding base (primarily license sales and federal aid) to the state's General Fund. This move acknowledges the responsibility of all Maine citizens to share in wildlife conservation initiatives.

In the last decade, scientific interest in preserving biologic diversity has increased and resulted in a new discipline of conservation biology. Practitioners of this new science attempt to understand the extinction process and document the requirements

needed for a species, persistence. Emerging concepts such as population viability, conservation genetics, and preserve design will become increasingly important in endangered species conservation in Maine.

Inconspicuous species, such as spotted turtles, are of increasing social and scientific value as appreciation of their contribution to Maine's biological diversity and natural heritage grows. Recent interest in the importance of Maine's reptiles and amphibians has grown, especially as a result of projects like the Maine Amphibian and Reptile Atlas Project. The plight of reptiles and amphibians, which have undergone drastic, unexplained world-wide reductions in numbers, has been widely reported and is of great social and scientific concern (Wyman and Hawksley-Lescault 1990, Master 1990). These trends have greatly increased public acceptance and endorsement of endangered species conservation in Maine (Hutchinson 1990).

REGULATIONS

Protection of Maine's Reptiles and Amphibians

Maine law provides only minimal protection for reptiles and amphibians. Maine Department of Inland Fisheries and Wildlife is charged to "preserve, protect and enhance the inland fisheries and wildlife resources of the state; to encourage the wise use of these resources; to ensure coordinated planning for the future use and preservation of these resources; and to provide for the effective management of these resources" (Section 7011). "wildlife" is defined as "any species of the animal kingdom, except fish, which is wild by nature, whether or not bred in captivity, and includes any part, egg or offspring thereof, or the dead body parts thereof" (Section 7001).

There are no restrictions against molesting, taking, or destroying reptiles and amphibians (except Endangered and Threatened species and snapping turtles, Chelydra serpentina, see below). Under Maine law there is "a perpetual closed season on hunting any **wild animal** or **wild bird**" (Section 7401). "Hunting" means to "pursue, molest, shoot, catch, take, kill, wound or destroy wild animals and wild birds" (Section 7001). However, "**wild animals**" are not synonymous with "wildlife" and includes only mammals (Section 7001).

Anyone in Maine may possess non-Endangered or Threatened reptiles and amphibians (except snapping turtles) as Maine law only prohibits possession of "wild animals" (mammals) during the closed season (Section 7406). A wildlife exhibit permit is needed to breed, exhibit, purchase, sell, import or transport reptiles and amphibians for the purpose of exhibits because these laws include all "wildlife" (Sections 7231,

7232, 7233, and 7234). An importation permit is needed to introduce or import reptiles and amphibians ("wildlife") into the state (Section 7237). A permit from the Commissioner is needed to transport reptiles and amphibians ("wildlife") in the state "for breeding and advertising purposes" (Section 7241). A scientific permit is not needed to hunt, trap, possess, band and transport reptiles and amphibians in Maine for scientific purposes as this section only applies to "wild animals" (mammals) and birds. The Maine Endangered Species Act of 1975 (Section 7756) prohibits the exportation, hunting, trapping, selling, transporting, feeding, baiting or harassing any Endangered or Threatened species of fish and wildlife including reptiles and amphibians.

In summary, if spotted turtles are down-listed from Threatened status, they will receive the same degree of protection as the remainder of Maine's reptiles and amphibians. At this time, Maine law does not protect these species from harassment, taking, killing, or possession except when they are exhibited, imported, or transported in the state for breeding or advertising purposes.

Habitat Protection

Federal, state, and municipal regulations exist for protecting some wetlands used by spotted turtles in southern and south-central Maine. At present, these are the most important management tools for protecting spotted turtle habitat.

Section 404, Clean Water Act

Section 404 of the federal Clean Water Act provides the Army Corps with regulatory authority to control filling of waters and wetlands. The 404 Program is

administered jointly by the Army Corps of Engineers (which has permit authority) and the Environmental Protection Agency (EPA). Guidelines, as defined by EPA, prohibit projects that would adversely affect Endangered and Threatened species (federally listed), violate water quality standards, or involve toxic discharges, and they require mitigation of unavoidable impacts.

The Corps has three categories of permits enabling filling of wetlands. In New England, certain projects affecting isolated wetlands less than one acre are permitted by Nationwide Permit #26 authorization. Activities in wetlands < 10 acres may require a permit. General permits may be issued by the Corps for certain activities in small geographic areas. Such permits are in effect for 5 years and may be modified or revoked if adverse environmental impacts increase. Individual permits are required for projects that do not qualify for Nationwide and General permits. These permits are generally needed for larger projects affecting wetlands, they have a 30 - day public comment period, and provide for input on fish and wildlife values.

In most cases, the EPA, Corps, and other federal review agencies (including the U.S. Fish and Wildlife Service) attempt to reach a consensus decision on project applications. In general, the Corps makes most decisions, but the EPA may veto Corps issued permits based on a determination of unacceptable adverse impacts on wildlife areas and other criterion. This authority may be exercised by EPA to designate areas in advance of discharge or filling. This planning process of Section 404, labeled "Advanced Identification of Disposal Sites", allows EPA and the Corps to work in cooperation with state and local authorities to identify sites unsuitable for filling. In New

England, it is expected that Advanced Identification will be more actively used as a planning tool for increased wetland protection (Widoff 1988).

Section 404 holds promise as a tool for protecting spotted turtle habitat in southern Maine, especially because this Act can protect small wetlands < 10 acres. For example, in 18 York County towns, the Nationwide permit pertaining to the discharge of fill into waters and wetlands above headwaters has been suspended, and an area of Advanced Identification has been established whereby individual permit applications are now required for these activities. This Advanced Identification notification indicates to the public that for all wetlands (including those under 10 acres) in the 18-town area, applications for filling for development are unlikely to be permitted.

Used in this fashion, Advanced Identification is not a site-specific tool, but rather a planning tool to prevent potential conflicts. Unfortunately, in many instances, the Corps simply has not been notified of filling small wetlands despite these regulations (Widoff 1988). Potential exists for closer cooperation and communication between MDIPW and the Corps to intensify wetland protection, especially in southern Maine where development pressures are greatest. Potential also exists to prepare lists of spotted turtle sites or habitats in southern Maine that merit protection through Advanced Identification. These wetlands could be added to an EPA list of priority wetlands already developed for Maine (Widoff 1988). This list is updated periodically and recommendations for additions may be proposed at any time.

The Maine Endangered Species Act and The Natural Resource Protection Act of 1988

The spotted turtle is classified as "Threatened" by MDIFW. A 1988 amendment to the Maine Endangered Species Act of 1975 enables the Commissioner of Inland Fisheries and Wildlife to designate areas currently or historically providing physical or biological features essential to the conservation of Endangered or Threatened species as "Essential Habitat". Within these areas, the Commissioner may promulgate rules outlining special management considerations. Under the Act, state agencies and municipal governments may not permit, license, fund, or carry out projects that significantly alter designated Essential Habitats or violate protection guidelines.

The Natural Resource Protection Act of 1988 (NRPA) provides for designation of "Significant Wildlife Habitat" for state listed Endangered and Threatened species, and certain other wildlife, and contains provisions for protecting freshwater wetlands. The NRPA prohibits dredging, bulldozing, removing soil, sand, vegetation; draining; filling; or construction, repair or alterations of permanent structures without a permit in areas designated as Significant wildlife Habitat. Significant wildlife Habitats for species on the Maine or federal lists of Endangered or Threatened species are identified by MDIFW and adopted by the Maine Department of Environmental Protection (DEP). Habitat protection guidelines are developed by MDIFW for Significant Wildlife Habitats and may include acceptable types of development, recommended set-backs or buffers, and recommendations for timing of development activities. Management guidelines are also adopted as part of DEP regulations.

Maine's Comprehensive Growth Management Act similarly enables Significant Wildlife Habitats of rare species to be identified and submitted to the Department of

Economic and Community Development for use by towns for comprehensive planning purposes. MDIFW reviews town comprehensive plans and permit applications in NRPA Significant Habitat.

The NRPA also contains provisions for protection of some freshwater wetlands. The Act provides that a permit is needed for most development activities involving wetlands of > 10 acres, or of wetlands < 10 acres and adjacent to a surface water body of combined area of 10 acres. The Maine Department of Environmental Protection reviews freshwater wetlands permits (in many instances in consultation with MDIFW). Both the Maine Endangered Species Act and the NRPA provide mechanisms for rigorous protection of Maine's Threatened and Endangered species. Essential habitat was first designated to protect bald eagle (Haliaeetus leucocephalus) nest sites in Maine in 1989. MDIFW rule-making identifies (maps) essential habitat, enumerates acceptable development activities within essential habitat, and provides management guidelines. Significant Wildlife Habitat has yet to be designated by MDIFW via the NRPA. However, once defined by MDIFW, a similar rule-making procedure is instituted by the Department of Environmental Protection. Management guidelines will also become part of the rule-making process. Essential and Significant Wildlife Habitats are intended to be implemented as "consultation zones" and flag development projects within Endangered and Threatened species, and other unique wildlife habitats for MDIFW review. Essential and Significant Wildlife Habitat hold tremendous potential for protection of spotted turtle habitat.

The major weakness of NRPA freshwater wetland provisions is the exclusion of most wetlands smaller than 10 acres (Freshwater wetlands are defined as > 10 acres.).

These small wetlands, of great importance to spotted turtles, are experiencing high rates of loss to development activities (Widoff 1988). Although NRPA freshwater wetland provisions may only protect larger wetlands, smaller wetlands utilized by spotted turtles may be protected on a site-by-site basis by designating them as Significant Wildlife Habitat.

Mandatory Shoreland Zoning

Individual towns and municipalities are required by the Mandatory Shoreland Zoning Law to pass ordinances that establish a shoreland zone in all districts within 250 feet of the upland edge of freshwater wetlands > 10 acres and designate resource protection in those areas that are rated "moderate" or "high" value by MDIPW (Jones 1986). Within resource protection districts, agriculture, new buildings, campsites, road construction, and parking facilities are prohibited and other development activities require permit applications for approval. MDIFW generally does not review town permit applications but occasionally is consulted by the towns. Towns are permitted to adopt wetland protection guidelines more stringent than those mandated by the Mandatory Shoreland Zoning Law.

Similar to the NRPA, usually only wetlands > 10 acres are protected by municipal Mandatory Shoreland Zoning. However, there is tremendous potential for towns to develop innovative, more stringent wetland protection regulations. A few towns, particularly those under greatest development pressure, have adopted more restrictive wetland protection standards than recommended by the state. The town of York has implemented their own wetland protection measures (Southern Maine Regional

Commission 1986). In Kennebunk, for example, all wetlands have been mapped, and wetlands may not be included in the net development area of any subdivision or development. Thus, wetlands are considered undevelopable and not included in calculating lot size (Widoff 1988).

Other state environmental regulations, such as the Site Location of Development Act, may also be applied occasionally to protect spotted turtle habitat. MDIFW reviews over 5,000 permit applications annually through regional offices. Regional staff consult with the Endangered and Nongame Wildlife Project biologists for permit applications involving Endangered and Threatened species. These species, and their habitats, are granted protection in accordance with pertinent regulations.

PAST AND CURRENT MANAGEMENT

Spotted turtles in Maine have received little management attention. Surveys by Graham (1985) and Haskins (1990) have expanded knowledge on the distribution of spotted turtles in Maine. Turtle sites have been registered in MDIFW's Natural Heritage data base and will be submitted to towns in Maine preparing comprehensive plans. MDIPW regional biologists screen permit applications for those influencing Endangered and Threatened species and consult with Assessment Section biologists. MDIPW will review town comprehensive plans and permits submitted to DEP involving proposed development at known spotted turtle sites.

HABITAT ASSESSMENT

Habitat Availability

Status

There are no published studies that quantify spotted turtle habitat. All 44 spotted turtles captured or observed in Maine by Haskins (1990) were in wetlands < 10 acres. Habitats used included shallow ponds with aquatic beds and emergent vegetation, shallow wooded and shrub swamps, and roadside swales and ditches.

According to MDIFW's Maine Wetland Inventory (MWI), 320,982 acres of freshwater wetland habitats, primarily open fresh water, freshwater meadows and marshes, shrub and wooded swamps, bogs, and coastal fresh and salt marshes exist in spotted turtle's range in Maine (Table 3). This figure is likely low, because the MWI only includes wetlands > 10 acres.

Only one-third of this acreage (108,853) is functionally suited for spotted turtles (not including Open Fresh Water and Salt Marsh). Even so, these figures suggest that habitat is restricted, and continued wetland loss and habitat fragmentation may endanger spotted turtles in Maine.

Without additional research on habitat use, it will be impossible to characterize the habitat types and sizes of wetlands used by spotted turtles in southern and south-central Maine. Although spotted turtles were found only in small wetlands, this may be attributed to the ease of finding them in such habitats (Haskins 1990). Spotted turtles in New Hampshire use a variety of wetlands associated with larger ponds to small ephemeral vernal pools (D. Carroll, pers. comm.).

Changes

Data on the rate and extent of wetland losses and adjacent upland nesting areas within the range of spotted turtles in Maine are not available. Trends in greatly increased human population growth and residential development throughout much of their range suggest that habitat quality for spotted turtles has deteriorated. Wetland losses may be somewhat offset by creation of new wetlands.

Projections

The Southern Maine Regional Planning Commission (1986) predicts that in the next decade the human population of southern Maine (York, Cumberland, and Sagadahoc Counties) will grow by 10 to 15%. This growth will result in increased residential development and urbanization and could result in further fragmentation, pollution, and deterioration of spotted turtle habitat. Strict adherence to environmental laws protecting wetlands and other components of spotted turtle habitat could help secure the future for this species in Maine.

POPULATION ASSESSMENT

Status

The current population of spotted turtles in Maine is poorly known.

Haskins (1990) captured 2 or more adult spotted turtles (including gravid females) at Agamenticus Road Pond, York ($\underline{n} = 20+$); County Road Woods Pond, South Berwick ($\underline{n} = 5+$), County Road Stream Pond, South Berwick ($\underline{n} = 2$), Ogunquit Road Swamp, South Berwick ($\underline{n} = 2$); Chick's Brook Bog Ponds, South Berwick ($\underline{n} = 3+$); Back Sanford Road Marsh, Berwick ($\underline{n} = 2$); and Newtown Road Ponds, Biddeford ($\underline{n} = 8+$) (Table 1). These findings indicate the likelihood of breeding populations in these localities.

Graham (1985) caught an immature spotted turtle in Bell Marsh, York. Only 1 or 2 of 30 spotted turtles caught by Haskins (1990) could be classified as immature (plastron length < 80 mm). Similarly, Ernst (1976) noted few hatchling or subadult spotted turtles in Pennsylvania. Ernst stated that the secretive habits of young turtles made hand collecting the only feasible method of capture, and many were likely missed.

Changes

Past changes in Maine's spotted turtle population are unknown, although habitat trends and data from elsewhere in New England (DeGraaf and Rudis 1983) suggest the species has declined in number.

Projections

Without effective habitat protection measures, Maine's spotted turtle population will likely continue to decline. With aggressive management (e.g. establishment of preserves, creating or maintaining travel corridors between wetlands, or creating wetlands suitable for spotted turtles), declines in spotted turtle populations could be halted.

Limiting Factors

Wetland and upland habitat destruction, climate (soil temperature), deteriorating water quality, nest predation and habitat fragmentation are potential factors limiting the abundance and distribution of spotted turtles in Maine. Accelerated rates of wetland loss, especially in York, Cumberland and Sagadahoc Counties, have likely caused attrition of existing or potential spotted turtle habitat that would be expected to result in corresponding population declines.

Nest predation is not well documented but may also contribute to population declines. Ernst (1976) monitored 43 eggs in 12 clutches in Pennsylvania. Eighteen of 43 eggs did not survive; 6 were destroyed by predators or drought and 12 were either infertile or experience prehatching mortality. Potential nest predators such as raccoons (*Procyon lotor*), skunks (*Mephitis mephitis*), and red fox (*Vulpes vulpes*) have undoubtedly increased in southern Maine in historic times in response to increased urbanization and decreased trapping effort (MDIFW, unpub. data).

Spotted turtle populations seem to be patchily distributed in Maine. Increased urbanization and road building may further isolate populations and prevent genetic

interchange. Fragmented populations are less able to survive random environmental fluctuations. Numbers in isolated populations inevitably fluctuate low enough to jeopardize population persistence (Gilpin and Soule 1986).

Habitat fragmentation also alters patterns of habitat use (i.e. roads blocking migration routes from wetlands to nesting areas) and prohibits recolonization following local extinctions (Shafer 1985). Increased traffic on roads bisecting spotted turtle habitat has diminished Massachusetts populations (Lazell 1976) and resulted in road-killed individuals in Maine (Haskins 1990). Some suspected spotted turtle populations, such as freshwater ponds in Biddeford Pool, are already isolated by urbanization and are prime candidates for local extinction.

Carrying Capacity

Spotted turtle abundance in New England is described as "uncommon to rare" (DeGraaf and Rudis 1983). Ernst (1976) used mark-recapture techniques to estimate a population of spotted turtles in an isolated Pennsylvania marsh. The population increased from 127 to 258 turtles between 1967 and 1974. As there were only 8 acres of suitable habitat, population density ranged from 16-32 turtles/acre.

According to the Maine Wetlands Inventory (MWI), at least 108,853 acres of freshwater wetlands are available to spotted turtles in Maine (Table 3). Carrying capacity cannot be determined until population parameters and habitat utilization are better understood. There is no doubt that loss of wetlands, particularly those < 10 acres, is reducing carrying capacity for spotted turtles in Maine. Future carrying capacity will depend on the ability of natural resource protection statutes to control

wetland loss and degradation, especially in southern Maine. Creation of wetland habitats suitable for spotted (and Blanding's) turtles should also be considered.

Estimated Population

It is not possible to estimate Maine's spotted turtle population at this time. Additional surveys are needed to determine population size and distribution. Surveys by Graham (1985) and Haskins (1990) were designed to expand understanding of the distribution of spotted turtles in Maine. Their data suggest spotted turtles are more numerous than the Blanding's turtles (another threatened turtle sharing similar wetland habitats in York County).

The demography of spotted turtles is such that very high egg and juvenile mortality is perhaps offset by unusual longevity of adult females. The apparent rarity of juvenile turtle sightings, however, further magnifies concern for this species' status.

USE AND DEMAND ASSESSMENT

The demand for conservation of rare flora and fauna, especially those listed as Threatened or Endangered, is unequivocally mandated in the preamble to the Maine Endangered Species Act of 1975:

"The Legislature finds that various species of fish or wildlife have been and are in danger of being rendered extinct within the State of Maine, and that these species are of esthetic, ecological, educational, historical, recreational and scientific value to the people of the State. The Legislature, therefore, declares that it is the policy of the State to conserve, by according such protection as is necessary to maintain and enhance their numbers, all species of fish or wildlife found in the State, as well as the ecosystems upon which they depend."

As such, MDIFW is committed to preserving the biologic diversity of all wildlife in the state and is entrusted with the preservation of Maine's natural heritage for future generations. This responsibility is manifested by an increasing commitment to management and research programs that protect and enhance Endangered and Threatened species of all taxa.

The protection and ecological understanding of inconspicuous species, such as the spotted turtle, are vital to proper ecosystem management and to the preservation of Maine's natural heritage. Spotted turtles contribute to the biological diversity of our state, and their presence adds to the ecological value of wetlands and adjacent upland

habitats in southern Maine. An unknown number of people gain enjoyment from actively seeking and observing spotted turtles. In 1990, J. Haskins (pers. comm.) found support from many individuals in York County who were familiar with spotted and Blanding's turtles. Reported sightings from the public has helped improve effectiveness of searching for new spotted turtle sites.

The importance of spotted (and Blanding's) turtles will increase markedly because of their role as "flagship" species (Gibbons 1988). Their legal Threatened status enables designation of Significant and Essential habitats according to Maine statute. These powerful habitat protection tools will likely become catalysts for wetland protection efforts in southern Maine that, in turn, will serve as a level of environmental protection for fauna and flora of wetland communities where they occur.

A recent study of the economic values of Maine's wildlife resources (Boyle et al. 1990) provides insights into the nonconsumptive use of, and demand for, wildlife. An estimated 91k of the state's adult population participate in nonconsumptive use of wildlife. Fifty-five percent of households in Maine actively attract wildlife to their homes or camps, and 35k made trips annually to view wildlife. Eighty percent believed the opportunity to view wildlife in Maine is very important, and 40t indicated the presence of wildlife influenced where they chose to live.

This high public demand for nonconsumptive use of wildlife is of considerable value to Maine's economy (Boyle et al. 1990).

In 1989, expenditures to attract and observe wildlife totaled \$50.3 million (this figure represents a minimum expenditure for Maine residents and -does not include expenditures of nonresidents). The aggregate annual surplus value of 10 federally-

listed Endangered species in Maine was valued at \$5.1 million. Thus, a very conservative estimate of the nonconsumptive value of wildlife in Maine was \$55.4 million annually and was comparable to the economic contribution of resident hunting. As the popularity of photography and nature study and appreciation grows, and as the awareness of the diversity of Maine's wildlife resources grows, the demand for observational and photographic use of rare species such as the spotted turtle will increase. Moderate increase in recreational activity in wetlands will unlikely influence spotted turtle behavior. As interest in spotted turtles intensifies, there will likely be increased public demand for interpretive and educational materials to explain and justify wetland protection measures. Recreational experience of some boaters and anglers will be heightened simply by knowing the spotted turtles are coexisting in the same wetlands.

Increasing numbers of citizens desire preservation of the greatest diversity of species possible, at state, national, and global levels (Kellert 1980). These desires are based on increasing public perception of scientific, utilitarian, and cultural values of biological diversity, as well as ethical arguments for preserving plant and animal species that are endangered by the actions of human society. At the state level, public support for the preservation of biodiversity in Maine is growing and is reflected in strong state legislation to protect Endangered and Threatened wildlife and their habitats.

SUMMARY AND CONCLUSION

The spotted turtle was listed as "Threatened" by MDIFW in 1986 because of their regional rarity, localized small populations, and threats to existing habitat within their range (Ritter 1985). At the time of listing it was believed the species could easily become Endangered (Ritter 1985). This species was once extremely abundant in Maine and New England (Babcock 1919), and population declines in recent decades are pronounced (DeGraaf and Rudis 1983).

Like many other freshwater turtles, recruitment of spotted turtle is low. Clutch size is moderate (3 to 5 eggs), but juvenile mortality is relatively high and greatly reduces survival to adult (at about age 7 to 10). Low survival of young turtles is apparently offset by the longevity of mature individuals (up to 40 years). Spotted turtles have evolved to live in stable environments and have little tolerance to change (Bury 1979). Because of their evolutionary history, they have a moderate ability for populations to recover and recolonize after an environmental disturbance, their population fluctuations are not dramatic, and in most instances, considerable time is required for populations to become extirpated. Because of these attributes, spotted turtles are extremely vulnerable to habitat perturbation, loss of adults, or even slight decreases in the number of young reaching adulthood.

Loss and deterioration of wetlands has been demonstrated to cause a slow but irreversible decline toward extinction (Lovich 1987). In Maine, spotted turtles were found in several wetlands surveyed by Haskins (1990), but cannot, of itself, be considered proof that healthy populations exist. Although it will be important to continue

surveys and determine their abundance, the species' status cannot be completely assessed until population size and reproductive success are better documented.

Spotted turtles are inexorably tied to wetlands/wetland complexes. Surveys by Haskins (1990) suggest that some areas of less-developed areas of York County may have healthy, viable populations. However in much of their range in Maine, populations are likely small and isolated. Small, patchily-distributed populations are extremely vulnerable to extinction (Diamond 1980). Habitat 10SB in some areas of York, Cumberland, and Sagadahoc County may be of a magnitude to increase the risk of extinction. Their future will likely depend on innovative habitat protection measures that halt the deterioration of habitat. Ideally, sufficient habitat should be secured to support several viable populations with the ability for dispersal and genetic interchange between populations.

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SPOTTED TURTLE GOAL AND OBJECTIVES

Recommended by Working Group on 1/14/92

GOAL: Maintain a self-sustaining population of spotted turtles in Maine.

OBJECTIVES

INFORMATION OBJECTIVE:

Estimate population distribution and abundance, population trend, population dynamics, self-sustaining population, limiting factors, habitat requirements, available habitat, and amount and type of protection provided spotted turtle habitat in Maine by the year 1996.

POPULATION OBJECTIVE:

Increase the population of spotted turtles to the self-sustaining population level by the year 2000 (if not already at that level).

HABITAT OBJECTIVE:

Conserve the quantity and quality of habitat necessary to support the self-sustaining population of spotted turtles by the year 2000.

Spotted Turtle: Capability - Feasibility Statement

Capability of Habitat: The types of habitats utilized by spotted turtles in Maine are unknown. The Quantity, quality, availability, and distribution of their habitats is unknown. The population size, status, density, and dynamics of spotted turtles in Maine is unknown. Therefore, we do not know if there is sufficient habitat available to support a self-sustaining population in Maine.

Feasibility: Most of the informational objectives must be achieved before the feasibility of protecting spotted turtle habitat can be assessed. Sufficient information could be attained with 3 to 5 years of intensive study. One year of survey work and one year of telemetry and population studies have been completed. A graduate student at the University of Maine will continue studies through 1993. The feasibility of achieving informational objectives hinges on the Department's ability to obtain funding for these research and inventory programs.

Desirability: There is widespread public interest and support for restoration of Endangered and Threatened Species and growing support for Maine's reptiles and amphibians. The Maine Endangered Species Act is explicit in its charge to maintain or enhance populations of rare and endangered species and the ecosystems on which they depend. The public has demonstrated its support of this through voluntary financial support of the existing turtle research program. There is a growing desire in the public for perpetuation of intact natural ecosystems including their flora and fauna. The Blanding's and spotted turtle have become cornerstone species in regards to wetland conservation in southern Maine, and as such, their perpetuation is greatly desired by many.

Possible consequences: Wetland loss and degradation, habitat fragmentation, and nest predation are believed to be the major factors limiting this species. Habitat protection will be needed to conserve the quantity and quality of habitats necessary to support a self-sustaining population. Habitat protection could entail acquisition, voluntary agreements, easements, and Essential and Significant Wildlife Habitats zoning. Some land uses, activities, or development could be restricted to conserve turtle habitats. These actions will be viewed as undesirable by some people.

SPOTTED TURTLES - PROBLEMS AND STRATEGIES

Problem 1: Basic life history, population, and habitat utilization and availability data are available to make management decisions.

- Strategy 1: Initiate intensive studies of population abundance and habitat utilization on study area(s) in southern Maine.
- Strategy 2: Conduct a systematic survey of population distribution and abundance throughout spotted turtle range in southern Maine.
- Strategy 3: Initiate long-term (minimum 5 to 7 year) studies of a marked population to document population trends, and population dynamics (natality, mortality, survival).
- Strategy 4: Use population data to conduct a minimum viable population analysis to define "Self-sustaining population."
- Strategy 5: Use habitat utilization data, wetland inventory, remote sensing, and cartographic data to conduct a landscape analysis to assess habitat availability.
- Strategy 6: Design a habitat protection strategy for spotted turtles by 1996.

Problem 2: Population and habitat enhancement techniques are relatively undeveloped for this species.

- Strategy 1: Investigate techniques for population enhancement for this species including captive rearing of young, excluding predators from nests, and minimizing vehicle mortality.
- Strategy 2: Investigate techniques for habitat enhancement including assessing the affects of impounded wetlands, creation of nesting habitat, and creating wetlands especially on state-owned land.

Problem 3: Interim protection measures are needed to maintain habitat suitability until a more comprehensive habitat protection program is developed.

Strategy 1: Track current occurrences in the Natural Heritage Database.

Strategy 2: Develop management guidelines for tracked sites.

Strategy 3: Review all permit applications that could affect tracked sites to minimize habitat loss.

Strategy 4: Encourage revision of state wetland protection measures to include small wetlands (< 10 acres) and vernal pools in southern Maine.

Problem 4: Management benefitting spotted turtles and their habitats requires cooperation, support, and funding from landowners, land managers, and the public.

Strategy 1: Provide technical assistance on spotted turtle management, especially wetland protection, to state, federal, and private entities that own or manage land with supporting spotted turtle populations.

Strategy 2: Prepare and distribute interpretive and informational materials including magazine articles, brochures, interpretive posters, press releases, and public service announcements.