

BLANDING'S TURTLE ASSESSMENT

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Prepared by:

Maine Department of Inland Fisheries and Wildlife
Wildlife Division
Wildlife Resource Assessment Section
Endangered and Threatened Species Group

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NATURAL HISTORY

Description

The Blanding's turtle (*Emydoidea blandingii*) is a medium-sized to large turtle of shallow freshwater wetlands (Figure 1). An adult's carapace (upper shell), 12.5 - 26 cm long (5 to 10.5 inches), is helmet-shaped, black, and has tan to yellowish spots or slightly radiating lines. The plastron (lower shell) is hinged, yellow, and has large, dark symmetrically arranged blotches (which may be sufficiently large to obscure most of the yellow color). The turtle's head is black or dark brown with scattered small yellow spots. The chin is a distinctive chrome yellow and distinguishes it from the box turtle (*Terrapene ornata*).

Sexual dimorphism is not pronounced. In males, the anal opening is behind the edge of the carapace (anterior to the edge of the carapace in females). The male's plastron is slightly concave.

Distribution

It was proposed that Blanding's turtles evolved in prairie or boreal environments (Preston and McCoy 1971, Smith 1957). Paleoenvironmental data now indicates that, at the extent of the Wisconsinian glaciation, this species lived in marshes in jack-pine and pine-parkland boreal communities (Van Devender and King 1975). Today, their preferred habitat includes marshes in both boreal and prairie areas.

Blanding's turtles range from southern Quebec and Ontario south through the Great Lakes region and west to eastern Nebraska (Figure 2). Its range in the East

Figure 1. A Blanding's turtle.

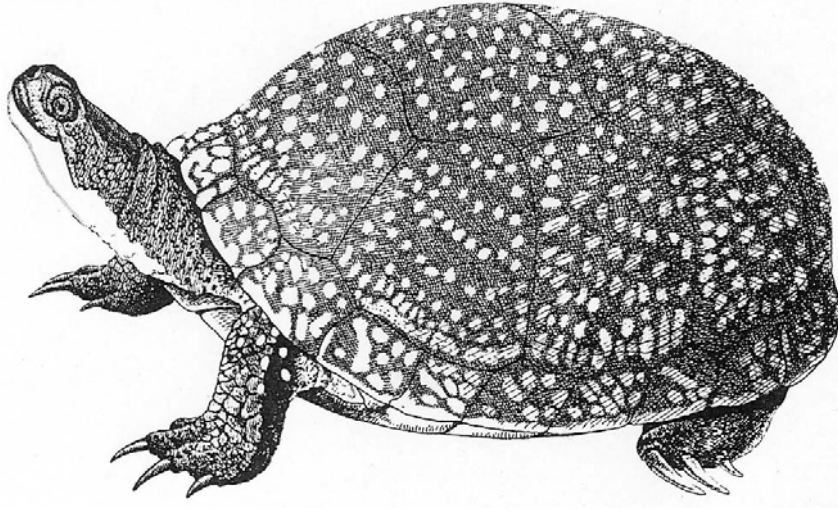


Figure 2. Range of the Blanding's turtle in the United States (Ernest and Barbour 1972).



consists of scattered colonies in northern and eastern New York; southern Maine and New Hampshire and eastern Massachusetts; and southwestern Nova Scotia. In Maine, Blanding's turtles have only been documented in York County.

Populations are localized, and its distribution is spotty throughout its range (McCoy 1973). Generally, Blanding's turtles are scarce or rare. They are a federally listed Endangered Species in Canada; state listed Endangered Species in Pennsylvania; and Threatened in Maine, Massachusetts and New York (Table 1).

Life History

Reproductive Ecology

Males attain sexual maturity at approximately 12 years-of-age, when plastron length measured 18.1 to 19.0 cm in Massachusetts (Graham and Doyle 1977) and 13.1 to 19.0 cm in Michigan (Gibbons 1968). Size differences between these populations is likely attributed to differences in food quality and availability (Graham and Doyle 1977). Females are suspected to mature at 15-16 years in Nova Scotia (T. Hermon, pers. comm.). Plastron lengths of adult females in Michigan ranged from 15.7 to 21.0 cm (Congdon et al. 1983) and 15.2 to 18.1 cm in Ontario (MacCulloch and Weller 1987).

Copulation has been recorded from early spring to October, but most often occurs from March to May (Ernst and Barbour 1972). Ovulation presumably occurs in May in Ontario (Gibbons 1968). Mating occurs in water (Richmond 1970).

Blanding's turtles in Michigan and New York initiated nesting in late May to early June, and most nests were completed in a three week period in June (Congdon et al.

Table 1. Status of Blanding's turtles in New England and the Maritime Provinces.

State/Province	Presence/absence	Status	TNC ¹ Status
Nova Scotia	Present	Endangered	-
New Brunswick	Absent	-	-
Newfoundland	Absent	-	-
Prince Edward Island	Absent	-	-
Quebec	Present	Endangered	S1
Maine	Present	Threatened	S2
New Hampshire	Present	None	S3
Vermont	Present	None	-
Massachusetts	Present	Threatened	S2
Connecticut	Present	No lists	-
Rhode Island	Present	None	SR
New York	Present	Threatened	S2
Pennsylvania	Present	Endangered	S1
New Jersey	Absent	None	-

- 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.
 - SR Existence is rumored, but not verified.

1983, Eckler and Breisch 1988). Blanding's turtles leave wetlands in the evening to excavate their nest in upland sandy soils.

Clutch size seems to be highly variable. It ranged from 3-19 eggs in Michigan (Congdon et al. 1983) and 9-16 eggs in Massachusetts (De Pari et al. 1987), but averaged 10-12 eggs. Clutches from two gravid Blanding's turtles captured in Berwick in 1986 were 12 and 13 (Graham and Forsberg 1986). Clutch size seems to be positively related to body size of females (MacCulloch and Weller 1987). Ernst and Barbour (1972) report that two clutches may be laid each season, however in Nova Scotia, females may only nest once every 2 or 3 years (T. Herman, pers. comm.). Congdon et al. (1983) never recorded multiple clutches, and estimated that as few as 23% of the females reproduce in a given year.

Incubation time is influenced by ambient temperature. Eggs at 31°C required approximately 49 days to hatch, but those at 26.5°C needed 62-61 days (Gutzke and Packard 1986). Embryos do not develop at temperatures < 22°C. Blanding's turtles, like many other turtle species, have temperature-dependent sex determination. Males arise from eggs incubated at moderate soil temperatures (< 28°C) whereas females arise from eggs incubated at high soil temperatures (> 31°C) (Gutzke and Packard 1986). Male hatchlings are larger than females. Temperature requirements for hatching likely restrict the northward range of Blanding's turtles in Maine. In Nova Scotia, summer temperatures are sometimes low enough to result in low hatching success. Hatching and emergence likely occur in late August or September or perhaps the next spring (T. Herman, pers. comm.).

Survival and Longevity

Survival rates for Blanding's turtles have not been measured. Marked Blanding's turtles in Nova Scotia and Minnesota have been documented to be 70-80 years old. T. Herman (Acadia Univ., pers. comm.) suspects females may have a reproductive age of up to 40-50 years.

Habitat, Diet, and Movements

Habitat requirements for Blanding's turtles are poorly known (Graham and Doyle 1977). Their habitat was characterized by Ernst and Barbour (1972) as shallow, freshwater wetlands with soft bottom and abundant aquatic vegetation found in lakes, ponds, marshes, creeks, and sloughs and adjacent upland areas for nesting.

Kofron and Schreiber (1985) and Ross and Anderson (1990) found that Blanding's preferred aquatic habitats, especially ponds, and may reach their greatest density there. In Maine, Blanding's turtles were observed or captured in shallow fresh marshes, shrub swamps, streams, or margins of ponds especially having floating sphagnum mat, fineleaved emergent vegetation (sedges), or water-tolerant shrubs (high bush blueberry, buttonbush) (Haskins 1990). Other studies show that Blanding's use marsh habitats (Gibbons 1968, Graham and Doyle 1977, Congdon et al. 1983).

Nova Scotia researchers are developing a habitat model that suggests Blanding's turtles prefer highly colored, organic, acidic waters associated with peat deposits. Telemetry studies in Wisconsin (Ross and Anderson 1990) demonstrated this species shifts habitats to take advantage of ephemeral food resources. D. Carroll (pers. comm.) in New Hampshire, often finds Blanding's turtles in vernal pools shortly after coming out

of hibernation where they feed on amphibian eggs and larvae. Wisconsin turtles used aquatic habitat having abundant open water and aquatic vegetation suitable for cover in early summer. Upland habitats, ditches, and streams were used more frequently in mid-summer as travel corridors while searching for suitable feeding areas. In mid-to-late summer, some individuals aestivate in upland or aquatic habitats (Ross and Anderson 1990). Blanding's turtles in Wisconsin overwintered (sometimes communally) in the mud bottoms of ponds and creeks. Their diet consisted of insects, crustaceans, mollusks, fish, and aquatic plants. New York Blanding's turtles used a single 5 ha wetland year round. They only left the wetland to travel approximately 1 km to a traditional nesting area (A. Breisch, pers. comm.).

Nesting habitat is highly variable, but generally consists of non-forested habitats within 1 km of a wetland. Michigan and Wisconsin nests averaged 175 m (Range 2-1115 m) and 168 m from nearest water, respectively (Congdon et al. 1983, Ross and Anderson 1990). Female Blanding's turtles in New York may leave their wetland for several weeks and travel up to 1100 m to traditional nest sites (Eckler and Breisch 1988).

Most researchers document Blanding's nests in grasslands with well-drained, sandy loam soil or sand (Ross and Anderson 1990, Graham and Doyle 1979). Blanding's turtles will nest in man-altered habitats such as newly created yards or driveways (Eckler and Breisch 1988). Turtles show a fidelity to traditional nesting areas associated with their resident wetland (Congdon et al. 1983; A. Breisch, pers. comm.). Home ranges of Wisconsin and Illinois Blanding's turtles ranged from 0.12 - 0.94 ha and 1.7 - 22 ha, respectively, and were centered on "highly productive" ponds (Rowe 1987,

Ross and Anderson 1990). Home range size may be directly related to habitat availability (Buriel 1979) and juxtaposition. Home ranges of Blanding's turtles overlap greatly (Ross and Anderson 1990) and apparently there is no evidence of territoriality. In most instances, home range shape reflects the configuration of the occupied wetland(s). Daily movements of radiotagged individuals in Wisconsin and Illinois ranged from 0-130 m (Rowe 1987, Ross and Anderson 1990). In New York, movements of gravid females traveling to nest sites were up to 500 m daily (Eckler and Breisch 1988).

HISTORY

Habitat Trends

Knowledge of the primary components of Blanding's turtle habitat in Maine is limited, but likely includes shallow, freshwater wetlands with appropriate nesting habitat nearby. Rapidly increasing human population and associated residential development have likely deteriorated the quantity and quality of these habitats in York County.

Sufficient habitat has likely been present to support a population of Blanding's turtles in Maine since prehistoric times. In 1966, remains of this species were found at an archaeological site on Hog Island in Muscongus Bay (Lincoln Co.)(French 1986). Babcock (1919) did not include Maine in the species' range. A Blanding's turtle found on Mt. Desert Island in the 1950's was most likely an escapee (Cowan 1981). The first substantiated reports of a Blanding's turtle in the state were individual turtles found in Waterboro and Acton (Mousam Lake) in 1960 (Packard 1960).

The continued existence of Blanding's turtles in Maine likely depends on maintaining the quality and quantity of freshwater wetland habitats in York County and suitable upland habitats for nesting. Unfortunately, this is one of the most rapidly developing regions of the state. According to MDIFW's Maine Wetland Inventory, York County is ranked 12th of Maine's 16 counties for total wetland acreage (Widoff 1988). More than 27,691 acres of wetlands, primarily open fresh water, shrub and wooded swamp, and salt marsh exist in the County (Table 2). Increased development pressures (commercial and residential development), especially in York Co., have been the primary cause for loss of vegetated wetlands in Maine since European settlement

Table 2. Maine Wetland Inventory of Wetlands in York County.

Type	Acreage
Fresh Meadow	835
Open Fresh Water	13,552
Fresh Marsh	1,140
Shrub Swamp	4,346
Wooded Swamp	4,174
Bog	296
Coastal Fresh Marsh	44
Coastal Open Fresh Water	50
Salt Marsh	4,254
Total	27,691

(Widoff 1988). The extent and nature of such wetland losses are not well documented. Although certain wetlands may not have been lost or filled outright, many developments have secondary influence such as water quality deterioration, chemical pollution, and habitat degradation. Habitat loss and deterioration in the Midwest were suspected to have caused declines in Blanding's turtles populations (Smith 1961, Minton 1971, Christiansen 1981).

The following trends suggest loss of existing Blanding's turtle habitat in Maine:

- Since Blanding's turtles were first discovered in Maine in 1960, York Counties human population has grown by 58* (99,402 in 1960 and projected 170,150 in 1991, Southern Maine Regional Planning Commission 1986). The human population in this area approximately doubles during the summer. The number of households increased by 44% from 1970-1980 and reflects greatly increased residential development.
- 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).
- From 1970 to 1979, at least 1% 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 thus, was not eligible for

state review (Southern Maine Regional Planning Commission 1986).

Municipal permits also contribute greatly to wildlife 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 resource and wildlife habitat values.
- The U.S. Fish and Wildlife Service reports that Maine has lost 20% of its wetlands since 1780 (Dahl 1990).
- The U.S. Fish and Wildlife Service report on coastal wetlands (USFWS 1965) documented most wetland loss in Maine 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 indicated 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 jeopardize the future existence of Blanding's turtles in Maine.

Population Trends

Population size or trends for Blanding's turtles in Maine are unknown. 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 surveys conducted by Graham et al. (1987) and Haskins (1990). Verified specimens have been captured or observed at 19 sites in 13 towns and all are in York County. (Table 3, Figure 3). Unconfirmed Blanding's turtles reports come from Cumberland County (Scarborough marsh)(Graham 1986b) and Androscoggin County (Lake Auburn, Auburn)(Graham 1986a).

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

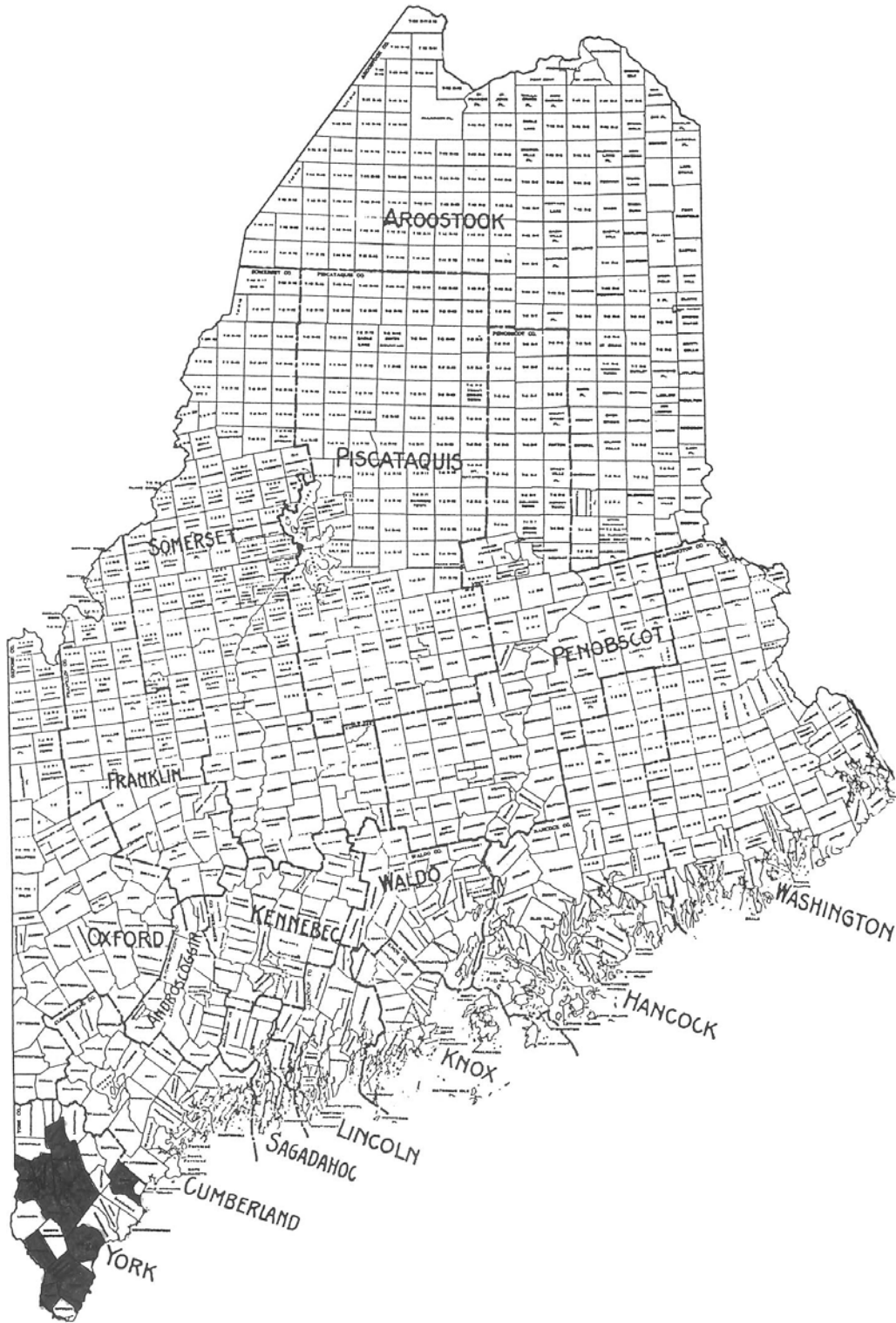
Table 3. Verified Records of Blanding's turtles in Maine.

Town	Year	No.	Location	Source
Acton	1960	1	Mousam Lake	Packard (1960)
Waterboro	1960	1	Unknown roadway	Packard (1960)
Eliot	1966	1	Unknown pond	Graham and Doyle (1973)
Lyman	1980	1	Sunken Brook	MARAP ¹
Saco	1984	1	Ferry Beach St. Park	MARAP
Sanford	1985	1	Ell Pond	MARAP
York	1985	2	Bell Marsh	Graham and Forsberg (1986)
	1990	3	Bell Marsh	Haskins (1990)
Shapleigh	1985	1	Goose Pond	Graham and Forsberg (1986)
Sanford	1985	1	near Curtis Pond	Graham and Forsberg (1986)
Alfred	1985	1	Gebung Road	MARAP
Waterboro	1986	1	Little Ossipee River	MDIFW/TNC ²
Berwick	1986	2	Beaver Dam Pond	Graham and Forsberg (1986)
	1990	1	Beaver Dam Pond	Haskins (1990)
Sanford	1988	1	Mousam River	MARAP
York	1990	5	Ogunquit Rd farm pond	Haskins (1990)
S. Berwick	1990	1	Bennett Lot Road	Haskins (1990)
S. Berwick	1990	3	County Rd woods pond	Haskins (1990)
Lyman	1990	1	Robert's Pond	Haskins (1990)
Wells	1990	1	Chaney Woods Rd.	Haskins (1990)
Eliot	1990	1	York Pond	Haskins (1990)

¹MARAP = Maine Amphibian and Reptile Atlas Project

²MDIFW/TNC = Maine Dept. Inland Fisheries and Wildlife/The Nature Conservancy

Figure 3. Distribution of Blanding's turtles in Maine.



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. Shortly thereafter, in 1984, the Endangered and Nongame Wildlife Program was initiated and funded largely by an income tax check-off.

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 dedicated funds (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. This new body of theory attempts to understand the extinction process and elucidate requirements for 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 Blanding's 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 herpetofauna has grown, especially as a result of projects like the Maine Amphibian and Reptile Atlas Project. The plight of herpetofauna, which have undergone drastic, unexplained, worldwide 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.

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, 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).

Habitat Protection

Federal, state, and municipal regulations exist for protecting some wetlands used by Blanding's turtles in York County. At present, these are the most important management tools for protecting Blanding's turtle habitat.

Section 40A 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 it requires 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 (this means that no written notification or authorization is generally required to fill a Maine wetland < 1 acre). Activities in wetlands 1 to 10 acres in size 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 criteria. 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 Blanding's 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 sitespecific 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 in York County. Potential also exists to prepare lists of Blanding's turtle sites or habitats in York County that merit protection through Advanced Identification. These wetlands could be added to an EPA list of

priority wetlands already developed for Maine (EPA 1987 in 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 Blanding's 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 Habitats". 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 are to be identified by MDIFW and adopted by the Maine Department of Environmental Protection (DEP). Habitat protection guidelines are to be developed by MDIFW for Significant Wildlife Habitats and may include acceptable types of development, recommended setbacks or buffers, and recommendations for timing of development activities.

Management guidelines are also to be adopted as part of DEP regulations. Maine's Comprehensive Growth Management Act similarly enables Significant Wildlife Habitats to be identified and submitted to the Department of Economic and Community Development (DECD) 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 requires a permit for most development activities involving wetlands of >10 acres, streams and associated flood plains. DEP reviews freshwater wetlands permits (in many instances in consultation with MDIFW).

Both the Maine Endangered Species Act and 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. Essential and Significant Wildlife Habitats are intended to be implemented as "consultation zones" and identify proposed development projects within Endangered and Threatened species, habitat for MDIFW review and discussion with landowners. Essential and Significant Wildlife Habitats hold tremendous potential for protection of Blanding's turtle habitat and could be instituted as part of this species' management.

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 are of great importance Blanding's turtles, and 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 Blanding's turtles may be protected on a site-by-site basis by designating them significant habitat.

Mandatory Shoreline 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 MDIFW (see 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.

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 Planning 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 Blanding's 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 protected according to the pertinent regulation.

Past and Current Management

Blanding's turtles in Maine have received little management attention. Studies by Graham (1986a) and Haskins (1990) have expanded knowledge on the distribution of Blanding's turtles in Maine. Turtle sites have been registered in MDIFW's Natural Heritage data base and are being submitted to towns in York County preparing comprehensive plans. MDIFW regional biologists screen permit applications for those influencing Endangered and Threatened species and consult with Assessment Section biologists. MDIFW will review town comprehensive plans and permits submitted to DEP involving proposed development at known Blanding's turtle sites.

HABITAT ASSESSMENT

Habitat Availability

Status

Telemetry studies in Wisconsin (Ross and Anderson 1990), Michigan (Congdon et al. 1983), New York (Eckler and Breisch 1988), and Nova Scotia (T. Herman pers. comm.) demonstrate that Blanding's turtles are quite mobile and will readily travel over land to use diverse aquatic and upland nesting habitats within their home range. Ten of 16 (63%) Blanding's turtles captured or observed in Maine by Haskins (1990) were in wetlands < 10 acres. Habitats used were diverse (Table 2) and included a farm pond with emergent border (used by 5 individuals), a shallow wooded and shrub swamp (used by 3 individuals), and marshes with floating sphagnum/sedge mats adjacent to ponds. Wetlands <10 acres would not be eligible for protection under existing state and municipal wetland regulations.

According to the Maine Wetland Inventory (MWI), over 27,000 acres of wetlands exist in York County (Table 3). However, only 9,885 acres are functionally suited for Blanding's turtles (not including Open Fresh Water and Salt Marsh). This figure is undoubtedly greater as the MWI only inventories wetlands > 10 acres. Even so, these figures suggest that habitat is limited, and additional wetland loss and habitat fragmentation could result in further population declines.

Without additional research on habitat use, it is impossible to characterize the habitat types and sizes of wetlands used by Blanding's turtles in Maine. Information available to date suggests that Blanding's turtles may use wetlands of all types and sizes,

including ephemeral vernal pools. Upland nesting areas are a critical habitat component that has not been characterized in Maine.

In summary, Blanding's turtle habitat use in York County is poorly documented. It will be difficult to implement habitat protection measures without a better understanding of habitat requirements for nesting, feeding, estivating, and hibernating.

Changes

Data on the rate and extent of wetland losses and adjacent upland nesting areas in York County in the last 15 years are not available. Trends in greatly increased human population growth and residential development suggest that habitat quality for Blanding's turtles has deteriorated rapidly. Wetland loss may be mitigated somewhat by creation of wetlands by beavers.

Projections

The Southern Maine Regional Planning Commission (1986) predicts that in the next decade the human population of York County will increase by about 10 to 15%. This growth will result in increased residential development and urbanization and could result in deterioration of Blanding's turtle habitat. Strict adherence to environmental laws protecting wetlands and other components of Blanding's turtle habitat could help secure a future for this species in Maine.

POPULATION ASSESSMENT

Status

The current population of Blanding's turtles in Maine is unknown.

Changes

Past changes in Maine's Blanding's 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

Insufficient data are available to project future population trends for Blanding's turtles in Maine. With aggressive management (e.g. establishment of reserves, creating or maintaining travel corridors between wetlands, or creating wetlands suitable for Blanding's turtles), some populations could be secured and possible declines may be halted.

LIMITING FACTORS

Wetland and upland habitat deterioration, climate, nest predation, and habitat fragmentation are potential factors limiting the abundance and distribution of Blanding's turtles in Maine. Accelerated rates of wetland loss in York County have likely caused attrition of existing or potential Blanding's turtle habitat that would be expected to result in corresponding population declines.

Wetlands having high water quality (higher dissolved oxygen, lower biochemical oxygen demand) would be expected to foster invertebrate prey populations used by Blanding's turtles.

However, Ross and Anderson (1990) found that Wisconsin Blanding's turtles preferred productive, eutrophic wetlands. Similarly, Graham and Doyle (1977) hypothesized that Blanding's turtles at Great Meadows Wildlife Refuge, Massachusetts, may have increased growth rates and reduced age to maturity resulting from cultural eutrophication from sewage plant effluent. They suspect effluent stimulated growth and abundance of pond weed (Potamogeton sp.), golden shiners (Notemigoneus crysoleucas), and brown bullheads (Ictalurus nebulosus), all of which were consumed by Blanding's turtles.

Nest predation is high for Blanding's turtles. Nest predation is reported to be near 100% in Nova Scotia (T. Herman, pers. comm.) and Wisconsin (Ross and Anderson 1990) studies. Congdon et al. (1983) reported an average of 67% nest predation (range 42-93%) over a six year period in Michigan. Predation was greater in open fields than along ecological edges and predator travel lanes. Nest predation in

Wisconsin, Nova Scotia and Michigan was primarily attributed to raccoons (Procyon lotor), skunks (Mephitis mephitis), and red fox (Vulpes vulpes). Congdon et al. (1983) found raccoons to be the most common predator of Blanding's turtle nests in Michigan, where only 22k of 73 nests were successful. Populations of these predators have undoubtedly increased in southern Maine in response to increased urbanization and decreased trapping effort (MDIFW, unpub. data). Researchers in New York and Nova Scotia have radically improved nest survival by fencing Blanding's turtle nests (Eckler and Breisch 1988, Hermon, pers. comm.).

Blanding's turtle populations seem to be patchily distributed in Maine. Increased urbanization and road building further isolates populations, prevents dispersal and genetic interchange between populations, and inhibits recolonization of habitats following local extinctions (Shaffer 1985). Fragmented populations are less able to survive random environmental fluctuations. Numbers eventually fluctuate low enough to jeopardize population persistence (Gilpin and Soul6 1986).

Habitat fragmentation also alters patterns of habitat use (i.e. roads blocking migration routes from wetlands to nesting areas). Increased traffic on roads bisecting Blanding's turtle habitat, an artifact of greatly increased residential development, has already resulted in road-killed individuals in Maine (Haskins 1990). Some suspected Blanding's populations, such as in Ferry Beach State Park, Saco, and Curtis Pond, Sanford, are already isolated by urbanization and are prime candidates for local extinctions.

Carrying Capacity

Blanding's turtle distribution and population in New England are described as "localized, spotty, and rare", (DeGraaf and Rudis 1983). Even Babcock (1919) described the species as rare in New England around the turn of the century. Graham and Doyle (1977) used mark-recapture techniques to estimate a population of 135 turtles (> 110 mm plastron length) in 840 ha Great Meadows marsh (0.16 turtle/ha wetland) in Massachusetts.

According to the Maine Wetlands Inventory (MWI), at least 9,885 acres of freshwater wetlands are available to Blanding's turtles in York County (Table 3). Far less habitat is likely functionally suited to Blanding's turtles because of habitat deterioration and fragmentation. Carrying capacity cannot be determined until population parameters and habitat utilization are better understood. However, there is no doubt that habitat destruction is reducing carrying capacity for Blanding's turtles in Maine. Future carrying capacity will depend on the ability of natural resource protection statutes to control wetland loss and degradation in York County.

Estimated Population

It is not possible to estimate Maine's Blanding's turtle population at this time. Additional surveys are needed to determine population size and distribution. Surveys by Graham (1986a) and Haskins (1990) were designed to expand understanding of the distribution of Blanding's turtles in Maine. Their data suggest Blanding's turtles are much rarer than the spotted turtle (*Clemmys guttata*); another Threatened turtle in York County wetlands. Multiple sightings or captures of Blanding's turtles have only occurred

at Bell marsh, York ($n = 2$), Ogunquit Road Farm Pond, York ($n = 5$) and county Road Woods Pond, South Berwick ($n = 3$) which may indicate viable populations in the vicinity of these sites.

All turtles captured by Graham (1986a) ($n = 3$) and Haskins (1990) ($n = 12$) were adults (plastron length 167-205 mm). No smaller (younger) turtles were observed in either study. Similarly, a paucity of hatchling or subadult Blanding's turtles were recorded in life history studies conducted in Massachusetts (Graham and Doyle 1977), Michigan (Congdon et al. 1983 and Gibbons 1968), and Missouri (Kofron and Schreiber 1985). The rarity of juveniles has been attributed to an "undetermined behavioral difference by juveniles or adults" (Gibbons 1968). However, Congdon et al. (1983) demonstrated that no behavioral or habitat differences exist between juveniles and adults, and the rarity of young turtles reflects very high egg and juvenal mortality. Thus, the demography of Blanding's turtles is such that very high egg and juvenile mortality is perhaps offset by unusual longevity of adult females. An apparent paucity of juvenile turtle sightings further magnifies concern for this species status.

USE AND DEMAND ASSESSMENT

The demand for 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 Blanding's turtle, are vital to proper ecosystem management and to the preservation of Maine's natural heritage. Blanding's turtles contribute to the biological diversity of our state, and their presence adds to the ecological value of wetlands in southern Maine. In 1990 J. Haskins (pers. comm.) found support from many individuals in York County who

were familiar with Blanding's and spotted turtles. Reported sightings from the public has helped improve effectiveness of searching for new Blanding's turtle sites.

The importance of Blanding's (and spotted) 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 could 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 and demand of wildlife. An estimated 9it 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 35t made trips annually to view wildlife. Eighty percent believed the opportunity to view wildlife in Maine is very important, and 40* 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 Blanding's turtle will increase. Moderate increases in recreational activity in wetlands will unlikely influence Blanding's turtle behavior. As interest in Blanding's 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 Blanding's 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 CONCLUSIONS

The Blanding's 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). Although the species has probably always been rare and patchily-distributed in New England by ecological factors that remain to be clarified, these features have become more pronounced in recent decades.

Like many other freshwater turtles, low survival of nests and young are apparently offset by the unusual longevity of those few adults that do survive. Age to first reproduction is estimated to be 12 (for males) to 16 years (for females). Blanding's turtles have evolved these traits to live in stable environments, and thus, have little tolerance for environmental change. Because of their evolutionary history, they have little ability for to recover and recolonize after an environmental disturbance, their populations fluctuate little, and because of their potential longevity, a long time is required for populations to become extirpated.

Blanding's turtles seem to be dangerously concentrated at a few widely-distributed sites in Maine where populations could be affected seriously by any number of adverse changes. Patchily-distributed populations are extremely vulnerable to extinction (Diamond 1980). Habitat requirements for Blanding's turtles are poorly understood, but the species, survival undoubtedly depends on the existence of sufficient wetlands/wetland complexes for feeding and hibernating and suitable upland habitat for travel corridors and nesting.

Although ecological factors may be responsible for the initial rarity of Blanding's turtles throughout much of their range, human-induced limiting factors (increased populations of nest predators, wetland loss and degradation, and habitat fragmentation) likely threaten the continued existence of this species in Maine. Habitat loss in York County in the last three decades is undoubtedly of a magnitude to seriously 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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BLANDING'S TURTLE GOAL AND OBJECTIVES

Recommended by Working Group on 10/10/91
Revised on 1/14/92

GOAL: Maintain a self-sustaining population of Blanding's 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 Blanding's turtle habitat in Maine by the year 1996.

POPULATION OBJECTIVE:

Increase the population of Blanding's 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 Blanding's turtles by the year 2000.

Blanding's Turtle: Capability - Feasibility Statement

Capability of Habitat: The types of habitats utilized by Blanding's turtles in Maine are unknown. The quantity, quality, availability, and distribution of their habitats is unknown. The population size, status, density, and dynamics of Blanding's 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 Blanding's 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.

BLANDING'S TURTLE PROBLEMS AND STRATEGIES

Problem 1: Basic life history, population, and habitat utilization and availability data are not 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 Blanding's 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 Blanding's 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 effects 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 benefiting Blanding's turtles and their habitats requires cooperation, support, and funding from landowners, land managers, and the public.

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

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