

CONSERVING WILDLIFE



in Maine's Developing Landscape

SOUTHERN MAINE'S POPULATION IS GROWING. More importantly, people are moving away from town centers and cities into rural areas. A 1997 State Planning Office study reports that the fastest growing areas in Maine are 10 to 25 miles from metropolitan areas. Two- to ten-acre house lots in fields and forests are common. As people move into these areas, new and wider roads follow and additional services are needed such as sewers, water, and convenience stores. As a result, habitat for some species of wildlife is becoming increasingly fragmented and lost. According to a study by Witham and Hunter (1992), southern Maine and New Hampshire forest area decreased by 7%, agriculture by 9%, and non-forested upland by 12%, while rural residential area increased by 23% and urban/industrial by 4% in a twenty-year period from the mid 1960s to the mid 1980s. When habitat is altered, the numbers and types of wildlife present on the landscape can change dramatically.

Maine Audubon Society believes we should strive to maintain healthy populations of all our native wildlife species and the habitat or plant communities upon which they depend. We recognize that change is inevitable, but believe the land use decisions we make now can minimize impacts to wildlife as development of the rural landscape continues across Maine. With thoughtful planning and management of both developed and open space, people and wildlife can successfully coexist. In Maine, we are in the fortunate situation, if we act now, of being able to avert the types of wildlife and habitat losses often experienced by our neighbors to the south. Over half of all owl, salamander, frog and toad species that breed in Maine are listed as special concern, threatened or endangered in other northeastern states. We have a chance of keeping new species from being added to Maine's list of endangered species and to protect species that are still common but add greatly to our enjoyment of nature.

Open space can help conserve wildlife, provide recreational opportunities, enhance quality of life for residents and provide an economic benefit to the town. In this piece we focus on how landowners, land trusts, and municipalities involved with protecting green space can actively conserve wildlife and wildlife habitat as part of their protection efforts.

What happens to Wildlife as we develop the landscape?

WE KNOW FROM STUDIES done in the agricultural Midwest and the suburbanized Mideast coast that as human development increases, wildlife habitat is destroyed, and only small habitat fragments remain. Some common wildlife species thrive in this human altered habitat. These animals are opportunistic generalists that can be found in large numbers living near and benefiting from humans, such as house sparrows, grackles, blue jays, skunks and raccoons. Often, species that depend on large contiguous tracts of forest, such as fisher, wood thrush, and American redstart begin to disappear or decline in numbers. These animals are easily disturbed by human activity or fall prey to the more abundant generalists.

Habitat specialists are also vulnerable to habitat loss. Specialists are species that are tied to one or more type of plant community to complete their life cycle. For example, spotted salamanders need vernal pools for breeding and upland forests for feeding and hiding, and piping plovers need frontal dunes for nesting and sand and mud flats for feeding. If either one of these habitat types is lost, the species will no longer thrive.

In addition to the direct loss of usable habitat, small isolated habitat patches can be “population sinks” from a regional landscape perspective. Individuals who can not reproduce successfully in the altered habitat may still use the remaining small patches. The results may be a reduced regional population. A study by Robinson (1989) in central Illinois showed that neo-tropical (long-distance) migrant birds were unsuccessful at breeding in forest tracks because of increased predation in these small habitat patches. A different study by Friesen (1995) in Ontario found fewer neo-tropical migrants in forest tracts adjacent to a high amount of residential housing.

Initially these species become extinct locally, then regionally, and finally a species may become extinct throughout its range. As development increases, regional diversity decreases, leaving us with a subset of animals that thrive in an urban/suburban environment.

What happens to Plant Communities as we develop the landscape?

THROUGH SEVERAL MECHANISMS, habitat fragmentation may also have significant impacts on plant communities. First and most importantly, fragmentation reduces available habitat size. Native plants, like animals, need minimum population sizes to remain viable. As habitat patches decrease in size, the amount of suitable microhabitat needed to maintain individual plant populations decreases. The end result is often the reduction of native plant diversity (Carleton and Taylor 1993, Gibson et al. 1988). This is particularly true in Southern Maine, where some of the state’s rarer plant communities have been lost or altered due to development.

Secondly, just as fragmentation often favors wildlife generalists at the expense of specialists, the same pattern is true for plants. Roads and fragmentation alter patterns of sunlight and moisture, creating habitat more suitable to generalists. Plants adapted to interior mature forests typically have low dispersal capacities as compared to aggressive “weedy” plants adapted to disturbed areas and younger forests (Harris and Silva-Lopez 1992). Those weedy plants — often non-native — colonize forest edges and may penetrate over 330 feet into the forest interior, altering or eliminating habitat for native plants. With roughly one-third of Maine’s flora comprised of non-native plant species (and most of these in the southern part of the state), the linkage between fragmentation and non-native plant species forms a significant threat to native habitats.

Edges and reduced habitat size may also affect plant reproduction through changes in the way seeds are produced and released. Moreover, studies have shown that development and habitat fragmentation may also affect the way plants and animals interact. A proliferation of non-native plants can have a direct negative effect on wildlife species by replacing traditional foods with inedible alternatives. Effected animals would include pollinators (such as bees, moths, beetles and hummingbirds), fruit and seed eaters (such as fox, squirrels, cedar waxwings and bears), and herbivores (such as cottontails, deer and moose).

Could this happen in Maine?

IN SOME AREAS OF MAINE SIGNIFICANT HABITAT loss has already begun, especially in York and Cumberland counties, and it is likely to spread in the foreseeable future. In Maine, it is unclear which of the following issues are causing the most problems for wildlife at this time. Maine is different from many of the states where research on the effects of development on wildlife have been conducted in that we are still primarily a forested landscape rather than an agricultural or suburban landscape dotted with remnant forest blocks. There has been little direct research on these issues in the state. However, as development continues it is likely that all or some of the following issues will become problems for Maine's wildlife sometime in the next 50 years depending on the part of the state.



These aerial photographs show changes in the landscape in Scarborough, Maine.

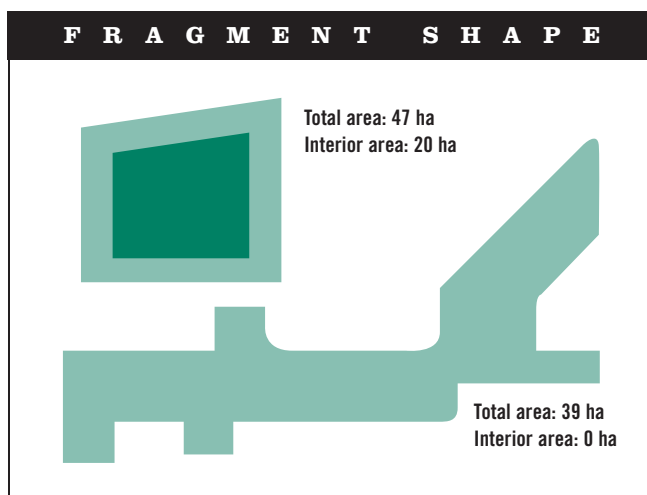
Photographs courtesy of Greater Portland Council of Governments

LOST HABITAT

The greatest threat to wildlife is the direct loss of habitat. Habitat is each animal's home and provides food, water, shelter, and a place to raise their young. As we convert a field, forest or wetland into a parking lot, store, house, or road, we destroy that habitat, reducing the area available for wild animals to live. When an old field reverts back to a forest, this change benefits species that can use forest habitat, but some species can only survive in an open environment. Many species in Maine that rely on field habitat or early successional habitat are declining, such as the eastern meadowlark, bobolink, American woodcock and New England cottontail. Grassland habitats and the birds associated with them, including the upland sandpiper, northern harrier, short-eared owl, horned lark, vesper sparrow, savannah sparrow, grasshopper sparrow, dickcissel and sedge wren, are particularly at risk. Wetland habitats are also at risk in Maine, especially those that are not adequately protected by regulations including vernal pools and forested wetlands. Many species depend on wetlands for part or all of their life cycle including frogs, salamanders, American bittern, least bittern, and great-blue heron. In addition, habitat can be changed or lost due to an invasion of exotic species and loss of native plant species, and through degradation from soil erosion, nutrient overload, decreased water quality, and contaminants.

FRAGMENTED HABITAT

Development fragments, or breaks apart, wildlife habitat. Fragmentation occurs when roads, utility corridors, buildings, parking lots, or clearings create breaks in the natural landscape. For some species, the roads, clearings, and corridors act as barriers, preventing animals from using habitat that is nearby for breeding or feeding. Populations become subdivided and eventually animal species are lost from an area as it gets too small to support an isolated population.



A comparison of the interior area available in two different shaped blocks of land. Adapted from Verner et al. *Wildlife 2000* 1986, reprinted by permission of University of Wisconsin Press.

HABITAT SIZE

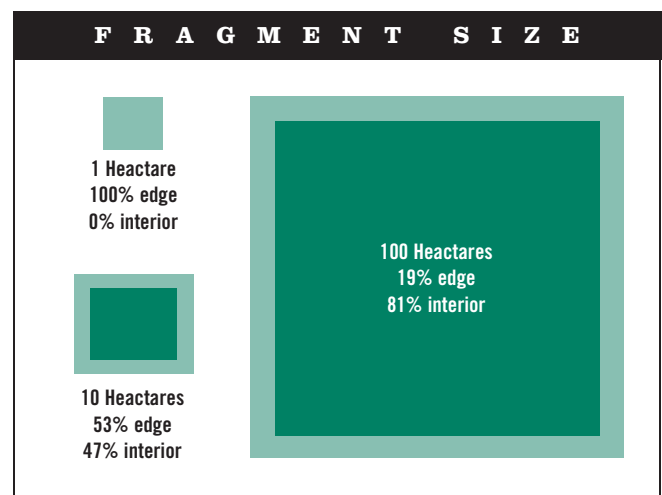
Different types of wildlife need different amounts of habitat to thrive. A mouse needs less than an acre compared to a moose that needs hundreds of acres. When we fragment habitat, the size of the remaining block of habitat limits the type of animals that can live there. As habitat size decreases, bobcat will start disappearing, then moose, osprey, beaver, turtles and so on.

Some species of wildlife, called “area-sensitive species”, need large blocks of uninterrupted habitat. They are sensitive to human disturbance and are often preyed by species that are found on the edge of two different habitat types. Some area-sensitive birds in Maine include the upland sandpiper, wood thrush, northern parula warbler, rose-breasted grosbeak, and pileated woodpecker. Other wildlife species need access to more than one habitat type in order to maintain a population. For example, Blanding's and spotted turtles need multiple wetlands for feeding and resting and upland areas for breeding. In this case a large block must consist of multiple habitats to be of value.

At another scale, enough habitat must be available for the minimum number of individuals of a given species to interbreed and maintain a healthy and genetically diverse population. Animals must be able to travel to habitat nearby if enough habitat is not present within one block. Though few parcels of land will be large enough to support a self-sustaining population of most vertebrates, a well-placed parcel can contribute towards the total amount of habitat needed for the survival of a mobile population.

HABITAT EDGE

‘Edge’ is the area where two habitat types meet. For example, edge would be the place where a field and forest meet, or where a road corridor ends and a forest begins. It can be a natural transition between two habitat types such as a pond and upland



A comparison of the interior area of 3 different size blocks. As fragment size increases, the relative proportion of edge habitat decreases, and interior habitat increases.

Adapted from *Landscape and Urban Planning*, (36) Collinge, pg. 64, 1996, reprinted by permission of Elsevier Science.

forest, or a human-made border like a road, backyard, parking lot or utility corridor.

For certain types of animals such as deer and grouse, edge habitat is favored. The animals that are attracted by edge are opportunists, such as crows, blue jays, deer, and raccoons, which can use a variety of habitats. Many of these animals prey on area-sensitive species. Many studies show that neotropical migrant birds that nest in open cups on the ground or in low shrubs are not breeding successfully in edge habitat.



Backyard birdfeeders can increase numbers of these cute and feisty red squirrels who are serious predators of nesting forest songbirds.

This is due to highly elevated rates of parasitism by brown headed cowbirds (currently not a big problem in Maine) or predation by small mammals such as red squirrels and birds such as blue jays.

In urban/suburban areas, a study by Matlack (1993) found that human activity could extend up to 270 feet

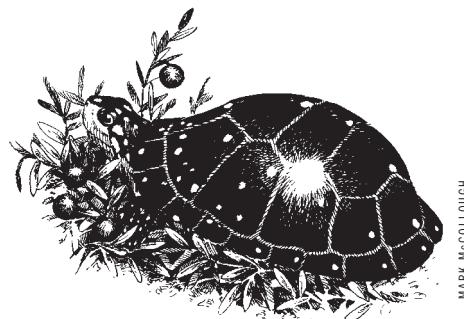
into natural areas on the edge of human development. These activities can reduce the value of the edge habitat for wildlife. Dumps, litter, pruned and hacked trees, cleared understory vegetation, established campsites and extensive firewood gathering, can all reduce the vegetation birds use to nest and cause general disturbance which may keep animals out of the area. In addition, habitat adjacent to residential housing often has elevated numbers of gray squirrels (due to supplemental feeding at bird feeders) and house cats, both of which are effective predators on nesting birds.

ROADS

Roads have many negative effects on wildlife in addition to fragmenting habitat (Andrews 1990). Roads are often a conduit for invasive plant species such as the purple loosestrife and Eurasian milfoil that can degrade wildlife habitat. Roads that go into or through a natural area bring the edge effect into the area, reducing its value for area-sensitive species. Where roads are built, habitat is lost or changed and development often follows along the road. In addition, roads increase human access to natural areas and bring increased human disturbance and poaching. Traffic lights and noise disturb some individual animals and vehicles kill many animals. For example, since many turtle species spend at least some of their life traveling in uplands, either feeding or nesting or both, they inevitably cross roads. Mortality from roads may be enough to wipe out an entire local population over time. In Connecticut, there are no wood turtle populations found within a mile of paved roads (Line 1998).

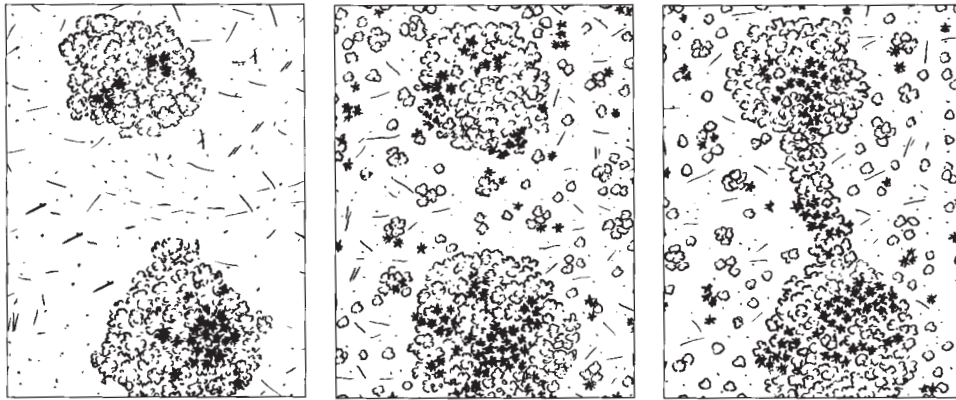
SUMMARY

If we act now, we will be able to avert the type of wildlife habitat loss being experienced in so many other parts of the country. Fragmentation of habitat, the edge effect, and habitat destruction are all factors which can cause a decline in wildlife. In some places their cumulative effect has been shown to be devastating to wildlife. In Maine, it is unclear whether all or just one of these elements is affecting wildlife at this time. Based on current research, it is clear that over time, if Maine loses enough habitat to development, fragmentation and edge effect will become serious problems for many of our wildlife species.



DESIGN CRITERIA:

What to Consider When Conserving Open Space for Wildlife



ANDREA SULZER

Habitat blocks that are **(left)** isolated from one another and surrounded by unusable, different or inhospitable habitat are less valuable for wildlife than blocks that are either **(center)** isolated but surrounded by marginal but still usable habitat or **(right)** connected by the same type of habitat and surrounded by marginal but still usable habitat.

MOST PARCELS OF LAND CAN CONTRIBUTE to maintaining Maine's diverse wildlife for both local communities and a larger region. To stretch limited conservation dollars, plans to protect open space for aesthetics or recreation can also incorporate some of these principles benefiting wildlife, in addition to achieving the primary goals for the open space. When human recreation and wildlife conservation are both goals for conserving open space, it is important to assess whether there may be any conflicts between the goals. If identified and addressed during the planning process, it is usually possible to provide for and to balance many different uses.

Because resources are limited, it may be best to prioritize protection of the largest parcels first. In addition, lands adjacent to conservation parcels where land-use practices allow dispersal of wildlife between tracts are more valuable than narrow corridors (Wilcove et al. 1986). Looking beyond the boundaries of the parcel to the present and future potential uses of the surrounding land is critical to achieving the original goals of conserving wildlife in a parcel. The following criteria can be used to help evaluate a parcel for its value to wildlife.

SIZE

Larger is better and is usually the most important design criteria. Larger pieces of land provide habitat for more types of animal species, are generally less influenced by the 'edge effect', and may be less influenced by human activities surrounding the open space. Many parcels over 250 acres start to have productive breeding habitat for forest interior nesting bird species. These are birds that nest away from the edge where two habitat types meet (Yahner 1988). Parcels of 30 acres or more will provide valuable habitat for many grassland bird species. Large contiguous tracts of grasslands, from 250 to 500 acres and larger, are needed to support a greater diversity of grassland birds including the grasshopper sparrow and upland sandpiper. "To conserve regional biodiversity, maintenance of habitats for species with large-area needs is essential" (Schroeder 1996).

SHAPE

Minimize the amount of edge habitat by designing open space to have a generally circular shape. Assuming edge effects have impacts as far as 650 to 2000 feet into a parcel (Andren 1988 & Yahner 1988), a 7000-acre circular parcel will be comprised of 90% interior habitat (Collinge 1996). Long narrow parcels are often entirely edge and provide no productive habitat for interior species. Open space along waterways needs to be as wide as possible to minimize the amount of edge habitat. Buffers on waterways of 250 feet or less, which is Maine's current shoreland zoning, will function primarily as edge habitat if not adjacent to a larger parcel.

PROXIMITY

Whenever possible, maximize the size of an open space parcel by selecting one adjacent to or in close proximity to existing conservation land or lands likely to remain undeveloped, including certain wetlands, land in conservation easements, tree growth, or open space status. In addition, take into consideration the neighboring land use, such as zoning for rural residential versus urban or commercial. For those parcels less than 250 acres, the smaller parcels adjacent to parcels with compatible land use may be more valuable than larger parcels in highly urban/suburban areas.

BARRIERS

Barriers such as roads, railroads, utility corridors and fences may be difficult or dangerous for some animals to cross. Avoid parcels (especially small parcels) completely surrounded by barriers, particularly major highways.

CORRIDORS

Corridors are sections of habitat that may be used by some wildlife species to travel from one habitat block to another. The value of corridors is not clearly understood and may vary greatly in individual situations. On the positive side, the corridor itself serves as wildlife habitat; may provide travel lanes for wildlife movement; links habitat that was originally interconnected; may minimize pollution by preventing runoff into a body of water; and may provide













recreational trails for people. One of the best examples of this would be a buffer along side streams, rivers, ponds, lakes, and wetlands, typically referred to as a riparian area. On the negative side, the corridor may create more edge habitat and be a breeding sink for some wildlife; may not be needed by many bird species; provides travel lanes for predators including domestic predators that already may be found in elevated numbers due to proximity to humans; may increase the transmission of contagious diseases such as rabies; and may take a large amount of funds that could be applied better elsewhere.

HABITAT TYPE

Certain habitats in southern Maine are in decline, including uncultivated (fallow) fields, small wetlands, grasslands, and both early successional and old forests. Consider conserving parcels that include these habitats and be sure to consider what types of management activities would be necessary to maintain these habitats. If ongoing management is necessary (e.g. old field habitat must be maintained by mowing, brush hogging or prescribed burning), it is also important to devise a plan that includes how the management will be paid for over the years.

CONCLUSION

These recommendations are based on the best available information from an evolving body of scientific literature. They are meant to be guidelines and not prescriptive in nature. We have included a listing of related bird, turtle and mammal species home range or area requirements to help emphasize points made in the text regarding fragmentation, size requirements and edge effect. In addition, we have listed all species that are either currently designated as an endangered, threatened or special concern species, in decline, or useful as an umbrella species (one whose protection ensures protection of a host of other species along with it). We hope this information can help guide specific protection efforts.

Reserve Design Principles	
BETTER	WORSE
	
	
	
	
	
	

Reprinted from *Biological Conservation*, (7) Diamond, pg. 143, 1975, with permission of Elsevier Science.

Table 1. Area requirements of selected Maine wildlife species.

I. Area-Sensitive+ Forest Birds Found in Maine

Bird Species	Area Requirements			
	May Occur in Blocks <250 Acres	Occur in Blocks 250-500 Acres	Occur in Blocks 500-1000 Acres	Occur in Blocks > 1000 Acres
Red-shouldered hawk			X	X
Yellow-billed cuckoo**	X	X	X	X
Downy woodpecker**	X	X	X	X
Hairy woodpecker		X	X	X
Pileated woodpecker*			X	X
Least flycatcher		X	X	X
Great crested flycatcher*	X	X	X	X
Common crow	X	X	X	X
Tufted titmouse*	X	X	X	X
White-breasted nuthatch	X	X	X	X
Brown creeper*			X	X
Blue-gray gnatcatcher				X
Veery		X	X	X
Hermit thrush			X	X
Wood thrush			X	X
Gray catbird**	X	X	X	X
Yellow-throated vireo*	X	X	X	X
Red-eyed vireo*	X	X	X	X
Northern parula				X
Chestnut-sided warbler*		X	X	X
Black-throated blue warbler				X
Black-throated green warbler*			X	X
Black-and-white warbler			X	X
American redstart		X	X	X
Ovenbird			X	X
Northern waterthrush			X	X
Louisiana waterthrush			X	X
Mourning warbler			X	X
Canada warbler				X
Scarlet tanager		X	X	X
Rose-breasted grosbeak*	X	X	X	X
Rufous-sided towhee**		X	X	X

(See bibliography for references)

* Bird species that are uncommon in smaller forests.

* Some studies did not classify these species as area-sensitive.

** Some studies classified these species as area-sensitive, but most did not. These are more likely not area-sensitive.

II. Area-Sensitive+ Grassland Birds found in Maine

Bird Species	Minimum Block Size	Preferred Block Size
Upland Sandpiper	150 acres	500 acres
Bobolink	5 acres	75 acres
Eastern meadowlark	15 acres	20 acres
Grasshopper sparrow	30 acres	250 acres
Vesper sparrow	30 acres	50 acres
Savannah sparrow	20 acres	40 acres

(Jones & Vickery 1997; Vickery et al. 1997)

+ Bird species that are uncommon in smaller grasslands.

III. Large Mammals Found in Southern and Central Maine

Species	Home Range*
Black Bear	19,200 acres
Bobcat	5760 acres
Fisher	4747-9600 acres
Mink	20-50 acres (females), 1280-2010 acres (males)
Moose	1280-12,800 acres
River Otter	15-30 linear miles

(DeGraaf & Rudis 1986)

IV. Turtles Found in Maine

Species	Home Range*	Additional Distances Traveled (for nesting, migrating, feeding)
Snapping Turtle	4.50-22 acres	Up to 5 miles
Common Musk Turtle	2.4 (females) acres 4.4 (males)	Less than 0.5 miles
Spotted Turtle	5-7 acres	Up to 1.25 miles
Wood Turtle	1446 river feet	Up to 6 river miles Up to 0.10 miles over land (500 feet)
Eastern Box Turtle	0.8-3 acres	Up to 0.2 miles
Eastern Painted Turtle	0-2 acres	Up to 1 mile or more
Blanding's Turtle	0-300 acres	Up to 4.20 miles

(DeGraaf & Rudis 1986; Ernst et al. 1994; Hunter, Albright & Arbuckle 1992; McCollough per comm.)

* Home range is the primary area in which an individual animal lives, and includes areas for resting, sleeping, feeding and breeding.

Table 2. Wildlife Species that occur in southern and central Maine likely to decline or whose local populations may be lost due to increased development.

Each species is followed by their Maine State endangered and threatened status (**E**=endangered, **T**=threatened, **SC**=special concern). Bird and mammal species are followed by their area requirements (**AS**=area-sensitive, **LA**=requires large area, **W**=requires water front habitat). In addition, bird species are followed by their United States Fish & Wildlife Service breeding bird survey status (–=declining, +=increasing, blank=not encountered in survey)

Butterflies & Moths

Spicebush Swallowtail	SC
Clayton's Copper	E
Edwards' Hairstreak	E
Olive Hairstreak	SC
Hessel's Hairstreak	E
Bog Elfin	SC
Western Pine Elfin	SC
Regal Fritillary	SC
Barrens Itame	SC
Twilight Moth	T
Pine-Devil Moth	SC
Inland Barrens Buck Moth	SC
Pine Sphinx	SC
Huckleberry Sphinx	SC
Pine Barrens Zanclognatha	T
Oblique Zale	SC
Pine Barrens Zale	SC
Precious Underwing	SC
Similar Underwing	SC
Acadian Swordgrass Moth	SC
Pine Pinion	SC
Thaxter's Pinion	SC
Ceromatic Noctuid Moth	SC
Red-winged Sallow	SC
A Noctuid Moth	SC
Trembling Sallow	SC
Broad Sallow	SC

Damselflies & Dragonflies

Ring Boghaunter	E
Pygmy Snaketail	T
Harpoon Clubtail	SC
Extra-striped Snaketail	SC
Zigzag Darner	SC
Muskeg Darner	SC
Ocellated Darner	SC
Ebony Boghaunter	SC
Delicate Emerald	SC
Warpaint Emerald	SC
Black Meadowfly	SC
Superb Jewelwing	SC
Subartic Bluet	SC
New England Bluet	SC
Turquoise Bluet	SC
Big Bluet	SC
Pine Barrens Bluet	SC
Citrine Forktail	SC
Lilypad Forktail	SC
Cyrano Darner	SC
Boreal Snaketail	SC

Single-striped Clubtail	SC
Rapids Clubtail	SC
Cobra Clubtail	SC
Riverine Clubtail	SC
Elusive Clubtail	SC

Mollusks

Tidewater Mucket	T
Yellow Lampmussel	T
Brook Floater	SC
Triangle Floater	SC
Squawfoot	SC

Fish

Swamp Darter	T
Redfin Pickerel	SC

Amphibians

Northern Leopard Frog	SC
Spring Salamander	SC
Four-toed Salamander	SC

Reptiles

Wood Turtle	SC
Common Musk Turtle	SC
Ribbon Snake	SC
Blanding's Turtle	E
Box Turtle	E
Black Racer	E
Spotted Turtle	T

Mammals

Southern Flying Squirrel	SC
New England Cottontail	SC
Little Brown Bat	SC
Eastern Small-footed Myotis	SC
Northern Long-eared Bat	SC
Silver-haired Bat	SC
Eastern Pipistrelle	SC
Big Brown Bat	SC
Red Bat	SC
Hoary Bat	SC
Black Bear	LA
Fisher	LA
River Otter	LA
Bobcat	LA
Moose	LA
Mink	W

Birds

Common loon	–
Leach's storm-petrel	SC
Great blue heron	–
Black-crowned night heron	SC
Least bittern	SC
American bittern	–
Northern goshawk	SC
Cooper's hawk	SC
Red-shouldered hawk	AS
Bald eagle	T
American kestrel	–
Ruffed grouse	–
Common gallinule	SC
American coot	SC
Killdeer	–
Piping plover	E
Whimbrel	SC
Upland sandpiper	T
Common snipe	–
Laughing gull	SC
Common tern	SC
Least tern	E
Black tern	E
Yellow-billed cuckoo**	AS
Eastern	SC
Reech owl	SC
Short-eared owl	SC
Chimney swift	–
Belted kingfisher	–
Yellow-shafted flicker	–
Pileated woodpecker*	+AS
Hairy woodpecker	+AS
Downy woodpecker**	+AS
Eastern kingbird	–
Great crested flycatcher*	+AS
Alder flycatcher	–
Least flycatcher	–AS
Eastern wood-pewee	–
Olive-sided flycatcher	SC
Tree swallow	–
Bank swallow	–
Barn swallow	–
American crow	+AS
Tufted titmouse*	AS
White-breasted nuthatch	+AS
Brown creeper*	–AS
House wren	–
Gray catbird**	–AS
Brown thrasher	–
American robin	–

Wood thrush	–AS
Hermit thrush	+AS
Swainson's thrush	–
Veery	–AS
Blue-gray gnatcatcher	AS
Ruby-crowned kinglet	–
Loggerhead shrike	SC
Yellow-throated vireo*	AS
Red-eyed vireo*	+AS
Black-and-white warbler	–AS
Tennessee warbler	–
Nashville warbler	–
Northern parula	–AS
Yellow warbler	–
Magnolia warbler	–
Cape May warbler	–
Black-throated blue warbler	+AS
Black-throated green warbler*	+AS
Chestnut-sided warbler*	–AS
Bay-breasted warbler	–
Ovenbird	+AS
Northern waterthrush	+AS
Louisiana waterthrush	AS
Mourning warbler	+AS
Common yellowthroat	–
Canada warbler	–AS
American redstart	–AS
House sparrow	–
Bobolink	–
Eastern meadowlark	SC
Red-winged blackbird	–
Orchard oriole	SC
Baltimore oriole	–
Common grackle	–
Brown-headed cowbird	–
Scarlet tanager	+AS
Rose-breasted grosbeak*	–AS
Indigo bunting	–
Purple finch	–
Rufous-sided towhee**	–AS
Grasshopper sparrow	E
Vesper sparrow	SC
Slate-colored junco	–
White-throated sparrow	–
Song sparrow	–

* Some studies classified these species as not area-sensitive

** Some studies classified these species as area-sensitive, but most did not. These are more likely not area-sensitive.

BIBLIOGRAPHY

- Andren, H. (1988). "Elevated Predation Rates as an Edge Effect in Habitat Islands: Experimental Evidence." *Ecology* 69 (2): 544-547.
- Andrews, A. (1990). "Fragmentation of Habitat by Roads and Utility Corridors: A Review." *Australian Zoologist* 26(3 & 4): 130-141.
- Carleton, T. J. and S. J. Taylor (1983). "The Structure and Composition of a Wooded Urban Ravine System." *Canadian Journal of Botany* 61: 1392-1401.
- Collinge, S. K. (1996). "Ecological Consequences of Habitat Fragmentation: Implications for Landscape Architecture and Planning." *Landscape and Urban Planning* 36: 59-77.
- Friesen, L.E. (1995). "Effects of Residential Development on Forest-Dwelling Neotropical Migrant Songbirds." *Conservation Biology* 9(6): 1408-1414.
- Gibson, D. J., S. L. Collins, and R. E. Good (1988). "Ecosystem Fragmentation of Oak-Pine Forest in the New Jersey Pinelands." *Forest Ecology and Management* 25:105-122
- Harris, L.D. and G. Silva-Lopez (1992). "Forest Fragmentation and the Conservation of Biological Diversity" *Theory and Practice of Nature Conservation, Preservation, and Management*. P.L. Fiedler and S.K. Jain. Chapman and Hall.
- Line, L. (1998). "Fast Decline of Slow Species." *National Wildlife* 36(6): 22-31.
- Matlack, G. R. (1993). "Environmental Auditing - Sociological Edge Effects: Spatial Distribution of Human Impact in Suburban Forest Fragments." *Environmental Management* 17(6): 829-835.
- Robinson, S. K. (1989). Population Dynamics of Breeding Neotropical Migrants in a Fragmented Illinois Landscape. *Ecology and Conservation of Neotropical Migrant Landbirds*. J. M. Hagen III and D. W. Johnston. Washington, Smithsonian Institution Press: 408-418.
- Schroeder, R. L. (1996). Wildlife Community Habitat Evaluation Using a Modified Species-Area Relationship. Washington, DC, U.S. Army Corps of Engineers.
- Wilcove, D. S., C. H. McLellan, et al. (1986). Habitat Fragmentation in the Temperate Zone. *Conservation Biology: The Science of Scarcity and Diversity*. M. E. Soule: 237-256.
- Witham, J. W., Hunter, Jr., Malcolm L. (1989). Populations Trends of Neotropical Migrant Landbirds in Northern Coastal New England. *Ecology and Conservation of Neotropical Migrant Landbirds*. J. M. Hagen III and D. W. Johnston. Washington, Smithsonian Institution Press: 85-95.
- Yahner, R. H. (1988). "Changes in Wildlife Communities Near Edges." *Conservation Biology* 2(4): 333-339.



ANDREA SUIZER

An extensive bibliography is available upon request for more detailed and technical information. Another fine resource that complements this piece titled *Integrating Wildlife Habitat Into Local Planning: A Handbook for Maine Communities*, by Sharri Venno and published by the Maine Agricultural Experiment Station of the University of Maine in 1991, should be available at your town office. In addition, all towns should have maps of state significant wildlife habitats and many have National Wetland Inventory maps.

CREDITS & ACKNOWLEDGEMENTS

Researched and written by Barbara Charry

Edited by Sally Stockwell

Plant community section contributed by Andy Cutko

Designed by O'Brien Design

A special thanks to the following people for reviewing this piece.

Andy Cutko, Arnold Banner, Barbara Vickery, Bill Krohn, Bos Savage, Debbie Gross, Geoffrey Coombs, George Hyde, Joe Wiley, Keel Kemper, Mark Stadler, Molly Docherty, Nancy Coverstone, Phillip deMaynadier, Sarah Evans



MAINE AUDUBON SOCIETY

20 Gilsand Farm Rd. Falmouth, Maine 04105-6009
(207) 781-2330 www.maineaudubon.org