4. Status of forest communities and associated species of concern

This indicator focuses on elements of biological diversity of conservation concern. Although all species are important, some are of greater conservation concern than others because of their sensitivity to management, regional scarcity, or past declines. Some characteristics of species that warrant special concern are those with: 1) low population densities that require large territories or home ranges (e.g. large-bodied animals), 2) poor dispersal and colonizing abilities, 3) local endemism or restricted geographic distributions, 4) specialized habitat requirements, 5) migratory species, and 6) rare species (Crow 1990).

This indicator discusses the occurrence of high quality community types and habitat availability for some habitat specialists. It references rare and uncommon species, including endangered and threatened species, and species of greatest conservation need. This indicator uses the population trends of selected species as a surrogate measure of the biological diversity supported by Wisconsin's forests. Changes in these species' abundance can indicate environmental stress, including unfavorable changes in forest habitat.

In general, data that directly address Indicator 4 are lacking. Monitoring of forest associated animal and plant populations and knowledge concerning responses to habitat changes are limited. Population monitoring and research that links species population changes directly to changes in forest composition and structure are needed. Population viability and response to environmental change provide direct measures and interpretation of potential trends in biodiversity.

4.1 Forest and woodland communities

Three major biomes—temperate grasslands, temperate broadleaf and mixed forests, and boreal forests—converge in Wisconsin, and conditions here allow for a diverse set of natural community types, or plant species assemblages, including several forested types. The Wisconsin Natural Heritage Inventory (NHI) program tracks high-quality examples of communities using a system derived from work by John Curtis in 1959. This system was recently used for both the Wisconsin Wildlife Action Plan and the Ecological Landscapes of Wisconsin Handbook, two sources that provide extensive information for the material covered in this metric.

It is difficult to assess the statewide condition of forested communities, as they are not represented by any comprehensive statewide maps or spatial data sets. In addition, although we can examine very broadly where forests occur in the state and use extrapolated data to assess general trends, several important metrics of community structure and function are unavailable. For example, data related to trends in understory composition are notably lacking, and these data are routinely collected for only a very small portion of the forests in the state.

Several of Wisconsin's key trends described in Indicators 1-3 impact forested communities including changes in overstory species composition, lack of older forests, forest simplification, lack of certain structural features in many forests, forest fragmentation, invasive species, intense deer herbivory, and expected climate change effects. All of these factors play a significant role in the structure and function of Wisconsin's forested communities. Also, there have been significant changes to the understory composition of many forested communities in the state. Studies examining over 150 forest sites in northern (Wiegmann and Waller 2006) and southern (Rogers et al. 2008) Wisconsin highlight significant changes to our flora over the last 50 years. These studies found overall decreases in understory species richness with rates of species loss in

the south almost double those in the north. Both studies cite general losses in native species and increases in exotic species. Plant species faring best in these studies were often known to be regionally common and widespread, and in some cases grasses and sedges were "winners" over many of the less common forbs. It is unclear how these changes to species composition will affect overall ecosystem function.

The Wisconsin NHI Program recognizes 22 natural community types that can be broadly categorized as either upland or wetland forests. It is important to note that many of these communities often occur in close association with non-forested types, forming continuums, rather than discrete, definable units. Therefore, although we focus on forested types in this chapter, their use by animal and plant species may be influenced by other related communities. For example, a Northern Dry Forest could be closely linked to an adjacent Pine Barrens community, a globally rare and dynamic type that would fall under a barrens or savanna group, rather than a forest group. These associated communities often provide important, sometimes essential, rare species habitat.

Forested communities in Wisconsin can be separated into northern and southern groups, roughly corresponding to the location of the Tension Zone (Curtis 1959) and the two Ecological Provinces discussed earlier. However, some parts of the state contain both northern and southern types; the Central Sands Ecological Landscape is a notable example where both groups co-occur along with numerous plant and animal species near the northern or southern edges of their ranges.

Northern forests

Northern Wisconsin once contained the largest and most contiguous expanse of hemlock-hardwood forest in the Lake States (WDNR in prep). Although there have been many changes to the composition, structure, and function of these forests (e.g., see Indicator 2), the northern half of the state continues to provide excellent opportunities for maintaining large patches of interior forest used by numerous animals such as large predators and forest interior raptors and songbirds. Northern Wisconsin forests sometimes contain specialized microhabitats such as Ephemeral Ponds, Forested Seeps, and cliffs supporting significant plant and animal diversity including several rare species. Forests also provide important buffers for numerous high-quality lakes, streams and other aquatic features and wetlands. Wet forest types are abundant in the north, including extensive conifer swamps harboring specialized groups of plant and animal species. Relatively large acreages of public lands and larger private ownerships exist in the north, although the recent trend toward parcelization of larger tracts is a concern.

Reducing fragmentation and invasive species effects, improving forest species composition, developing more complex structure, developing old-growth forests, reducing the impacts of deer herbivory, and identifying areas in which to manage across broad ecologically-based landscapes are all examples of important opportunities for maintaining biodiversity in the northern forest. Table 4.a summarizes the natural community types identified by NHI for the Northern Forest group.

Table 4.a: Northern forest community types recognized by the Wisconsin Natural Heritage Inventory (NHI) program

	State Rank	Global Rank	Related Forest Habitat Types (Kotar et al. 2002)
Upland Forests			
Boreal Forest	S2	G3?	ArAbSn; ArAbVCo; ASnMi
Mesic Cedar Forest	S1	G3?	n/a
Mesic Floodplain Terrace	S2	GNR	n/a
Northern Dry Forest	S3	G3?	PArV; PArVAm; PArVAo; PArVHa; PArVPo; PArV-U; PEu; PQE; PQG; PQGCe; PVG; PVGy; QAp
Northern Dry-mesic Forest	S3	G4	AAt; ACl; AFVb; AVb; AVb-V; AVCl; AVDe; AVVb; PArVAa; PArVAa-Po; PArVAa-Vb; PArVAm; PArVHa; PArVPo; QAp; TFAa
Northern Mesic Forest	S4	G4	AAs; AAt; AAtRp; ACaCi; ACaI; ACl; AFAd; AFAl; AFAs; AFAs-O; AFH; AFTD; AFVb; AH; AHI; AHVb; AOCa; ASaI; ATAtOn; ATD; ATDH; ATFD; ATFPo; ATFSt; ATiCa-La; ATiSa-De; ATM; ATTr; TMC
Wetland Forests			
Black Spruce Swamp	S3?	G5	n/a
Forested Seep	S2	GNR	n/a
Hardwood Swamp	S3	G4	n/a
Northern Wet Forest	S4	G4	n/a
Northern Wet-mesic Forest	S3S4	G3?	n/a
Tamarack (Poor) Swamp	S3	G4	n/a
See the NHI Working List (*dnr.wi.gov/org/land/er/wlist/*) for more information about state and global ranks.			

The following examples highlight two of Wisconsin's northern forest communities. See the Wisconsin DNR Web for more information about each of the forested community types (*dnr.wi.gov/org/land/er/communities/*), including rare animals associated with each of the types and areas of the state with the best opportunities to maintain them.

Northern Mesic Forest:

- Classic "northern hardwood" and "hemlock hardwood" forests once covering the largest acreage of any Wisconsin community; they are still widespread and both ecologically and economically important
- A very broadly-defined community type with more or less distinct variants. Floral and faunal composition can vary significantly among examples and across landscapes in different ecological settings
- Provides habitat for many common and some rare species. Some notable rare species

examples are the Northern Goshawk, American marten, Black-throated Blue Warbler, and four-toed salamander

- Structure and species composition are greatly simplified from pre-European settlement conditions. Overall, forests are younger, and conifers such as hemlock and white pine are greatly reduced (see Indicator 2). Many historic mesic forests were replaced by aspen forests and now exhibit reduced structural and species diversity.
- Examples of current issues include: lack of older forest and associated structural attributes, intense deer herbivory, impacts of exotic earthworms, declining conifer component now lacking in many stands (particularly in smaller size classes), parcelization, and major threats from invasive plants.
- Major opportunities exist in some areas to develop old-growth forests at a landscape scale.

Northern Wet-mesic Forest

- Familiar "cedar swamps" of the north providing habitat for numerous plant and animal species
- One of a handful of forested peatland types in the state, they occur on richer, less acidic environments than the other forested peatlands and are often fed by nutrient-rich groundwater providing specialized habitats
- Cedar swamps are especially notable for the many rare plant species they support. Several rare plants occur most frequently in these communities, utilizing the numerous microhabitats present
- Although many examples have been logged, there are comparatively more old-growth or old examples of this type compared with most other forest communities. Many examples still retain a complex structure and mostly intact groundlayer and hydrology
- Examples of current issues: the future of these forests is uncertain as cedar regeneration is almost non-existent in most cases. Deer browse can be extremely heavy as deer often "yard" in these swamps, invasives such as glossy buckthorn and Eurasian swamp thistle are a significant threat in many areas, and fragmentation can greatly diminish ecosystem function. Maintaining hydrology is critical to maintaining this community.

Southern Forests

The forests of the southern half of the state differ in many ways from their northern counterparts. Conifers, although locally abundant in certain community types, play a much smaller role in the south. Oaks are currently widespread, and a number of other deciduous trees found here are rare north of the Tension Zone. Species composition is shifting away from oaks, as oak regeneration on all but the more xeric sites has proven quite difficult.

In general, southern forests have experienced more dramatic changes following European settlement than the forests of the north due to the effects of human disturbances such as land conversion to agriculture, fragmentation, and persistent grazing. Many southern forests were former savanna communities that succeeded to forests through many decades of fire suppression. Lack of fire impacted many otherwise intact dry and dry-mesic oak forests, as well. Rich mesic forests were often converted to agriculture, and most remaining examples are small patches in highly fragmented areas. Old-growth forests, while very rare in the north are almost completely

absent in the south. Similarly, invasive species, while a threat in many parts of the north, are quite widespread in much of the south and can be extremely difficult to control and virtually impossible to eradicate.

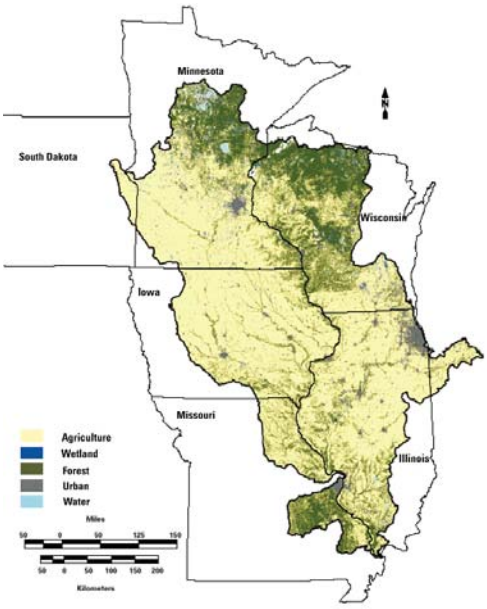


Figure 4.a: Forest cover of the Upper Mississippi watershed
Source: DNR, 2009

Public lands are much less abundant in the southern half of the state, with the exception of the Central Sand Plains Ecological Landscape, and many of the heavily forested areas are comprised of smaller landholdings than those found in the north with several notable exceptions such as the Black River State Forest, the Kettle Moraine State Forest, the Kickapoo Valley Reserve, and the Lower Wisconsin State Riverway. These properties provide essential habitat for a large suite of plant and animal species and will become increasingly important for maintaining biological diversity as future ecological impacts continue to decrease other opportunities in much of the south.

Many generalist species such as white-tailed deer, Brown-headed Cowbird, raccoon, and Wild Turkey have thrived in the modern landscape of southern Wisconsin which is now composed of a mosaic of agricultural lands, forest fragments, and urban-industrial areas. Most of the large herbivores (bison, elk) and carnivores (gray wolf, cougar) are gone. Some area-sensitive birds successfully reproduce, and can even be locally abundant in parts of southern Wisconsin, but others have shown population declines. As with the northern forests, many rare plants and animals utilize specific microsites within the forest, such as cliffs, seeps, and springs.

Despite numerous ecological perturbations, southern Wisconsin forests are important for the state's biodiversity and provide habitat largely absent from much of the surrounding areas in adjacent states or from most other areas in southern Wisconsin. For example, a large portion of the "Driftless Area" forests occur in Wisconsin and harbor numerous rare birds and many other species. For southern forest types, this area offers one of the best opportunities in the Upper Midwest for conserving forest interior habitats (Wilson 2008). Figure 4.a illustrates the forest cover of the Upper Mississippi Watershed, highlighting the importance of the forests in

Wisconsin's "Driftless Area" in a landscape that is largely dominated by agriculture. Table 4.b summarizes the natural community types identified by NHI for the Northern Forest group.

Table 4.b: Southern forest community types recognized by the Wisconsin Natural Heritage Inventory (NHI) program

	State Rank	Global Rank	Related Forest Habitat Types
Upland Forests			
Central Sands Pine-Oak Forest	S3	G3	PEu; PVCr; PVG; PVGy; PVHa; PVRh
Hemlock Relict	S2	G2Q	ATTr
Pine Relict	S2	G4	PVCr; PVGy; PVHa
Southern Dry Forest	S3	G4	PEu; PVCr; PVG; PVGy; PVHa; PVRh
Southern Dry-mesic Forest	S3	G4	AArL; AArVb; AFrDe(Vb); AQVb-Gr; ArCi; ArCi-Ph; ArDe; ArDe-V; ATiAs(De); ATiCr(As); ATiCr(O); ATiDe; ATiDe(Pr); ATiDe-As; ATiFrCa(O); ATiFrCi; ATiFrVb; ATiFrVb(Cr); ATiH; ATiSa
Southern Mesic Forest	S3	G3?	ACaCi; AFAs; AFAs-O; AFH; AFrDe; AFrDeO; ATiAs(De); ATiCa; ATiCa-Al; ATiCa-La; ATiDe; ATiFrCa; ATiFrCa(O); ATiFrVb; ATiH; ATiSa; ATiSa-De
Wetland Forests			
Floodplain Forest	S3	G3?	n/a
Southern Hardwood Swamp	S2	G4?	n/a
Southern Tamarack Swamp (Rich)	S3	G3	n/a
White Pine-Red Maple Swamp	S2	G3G4	PArVRh; PVRh
See the NHI Working List (*dnr.wi.gov/org/land/er/wlist/*) for more information about state and global ranks.			

The following examples highlight two of Wisconsin's southern forest communities. See the Wisconsin DNR Web for more information about each of the forested community types (*dnr.wi.gov/org/land/er/communities/*), including rare animals associated with each of the types and areas of the state with the best opportunities to maintain them.

Southern Dry-mesic Forest

- Oak forests, most often dominated by red and white oak with numerous tree associates and historically common. This continues to be one of the more common

forest types in the south.

- Provides important habitat for numerous rare species including forest interior birds such as Cerulean Warbler, Acadian Flycatcher, and Hooded Warbler, all State Threatened species
- Species composition is shifting away from oaks and toward more shade-tolerant deciduous species such as sugar maple, red maple, and the "central hardwood" species. Oaks are getting older on average, but are often lacking in both the smallest and largest size classes.
- Examples of current issues: lack of large contiguous blocks, increased fragmentation, oak regeneration is very difficult on most sites, deer herbivory impacts are high, high-grading often accelerates shift in species composition, invasive species threats include potential impacts from gypsy moths, as well as from many already established invasive plants.
- Select areas may still provide opportunities for landscape-scale planning and large-scale management

<u>Floodplain Forest</u>

- Wetland forests occurring most commonly along major river systems; most of the large examples are south of the Tension Zone. This type has never been widespread due to the specialized conditions needed to create and maintain it. Relative to upland types, a higher proportion of these forests have persisted to modern times but species composition changed including the loss of mature American elm trees.
- A regionally important community; some of the best and most extensive examples in the Upper Midwest occur in Wisconsin.
- Provides habitat for many rare species, including the most SGCN of any forested community type (See Figure 4.b). Species utilizing Floodplain Forests include specialists such as Prothonotary Warbler. Other rare species can often be found here in high numbers including wood turtle and Red-shouldered Hawk (both state threatened).
- Examples of current issues: many of these forests are compromised by invasive plants, and regeneration can be difficult in part due to reed canary grass infestations. Hydrological alterations have had dramatic impacts, and future successional patterns in some areas are uncertain, as large dams influence both flood timing and magnitude. This community will likely be further impacted by exotic insects and diseases (Dutch elm disease, Emerald ash borer).

4.2 Forest Associated Species of Concern

Wisconsin supports almost 700 species of vertebrates, well over 2000 native plant taxa, and tens of thousands of invertebrates, along with numerous lichens and non-vascular plant species. Although not all of these organisms use forested habitats, Wisconsin forests provide important, sometimes critical, habitat for many of them.

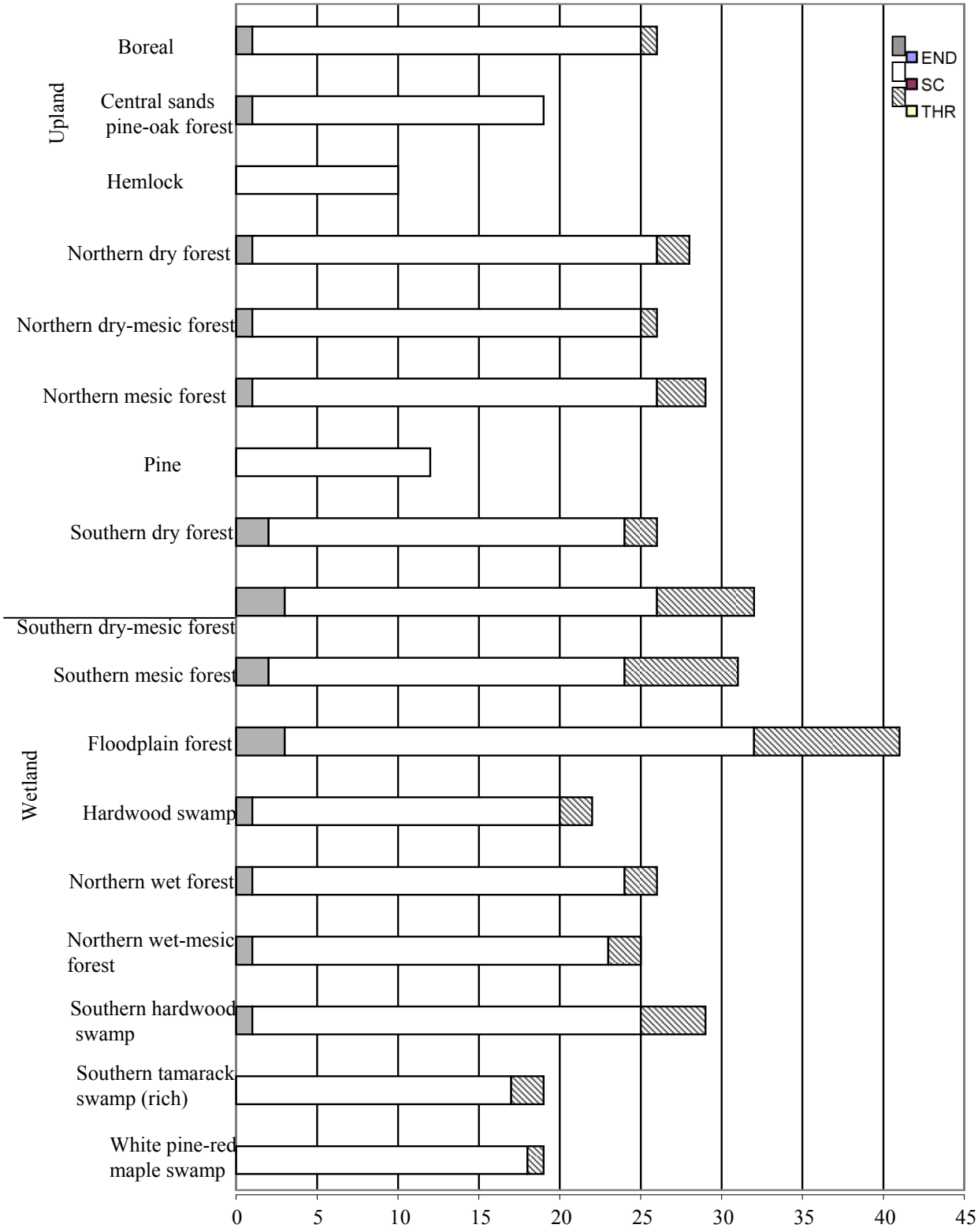
Rare plant and animal species, as described in this Indicator, are those found on the NHI Working List (*dnr.wi.gov/org/land/er/wlist/*). The Working List includes those species "listed" by state and/or federal laws as threatened or endangered, as well as "special concern" species that may be at risk of becoming threatened or endangered in the future. For animals, the Working List species closely correspond to the Species of Greatest Conservation Need (SGCN) described in the Wildlife Action Plan.

Wisconsin has 15 species that are federally threatened or endangered, and 3 species that are candidates for federal listing. State threatened or endangered species include 139 plants, 40 invertebrates, 25 birds, 21 fish, 10 herptiles, and one mammal. Some species have recovered sufficiently in Wisconsin to be removed from state and/or federal listing in recent years, including Bald Eagle, Osprey, Trumpeter Swan, and gray wolf. Others not yet listed as threatened or endangered have experienced substantial declines in numbers, either locally or across their ranges, and may require future protection; for animals, the Wisconsin Wildlife Action Plan is designed to outline steps to conserve these species before this happens.

The Wisconsin Wildlife Action Plan identifies 152 vertebrate and 530 invertebrate SGCN. Of these, 63 vertebrates are associated with the 17 forested community types described in the plan. All but two of the forested community types are used by at least 15 vertebrate SGCN, and some SGCN are limited to only a single forested community type. Of these forested communities, Floodplain Forests support the highest number of rare vertebrates, based on Wildlife Action Plan data. Over 40 vertebrate SGCN (11 of these state threatened or endangered) are known to be associated with Floodplain Forest habitats in Wisconsin. Figure 4.b illustrates the number of SGCN associated with each of Wisconsin's forested communities. Table 4.c shows individual vertebrate SGCN associated with each Wisconsin forested community. Natural community associations are not available for invertebrates at this time.

In general, there is a lack of detailed life history information for many rare species, so planning forest management activities to best conserve biodiversity can be a challenge. There is a need to develop this information, as the majority of the forested communities in the state are actively managed through timber harvest. The Wildlife Action Plan identifies 200 vertebrates and 420 invertebrates as "Species of Information Need," i.e., species lacking the basic inventory and/or life history information needed to determine their conservation needs in the state. For some species, life history and status information exists, but there is much uncertainty regarding the impacts of various management activities. This uncertainty is often compounded by local landscape factors, as management activities often focus on small areas, sometimes out of necessity, rather than considering the larger landscape. Finally, although they play integral roles in every community type and support many ecosystem-level biological processes, detailed information is particularly lacking for the invertebrates. Although some groups of invertebrates are better understood as a result of modern efforts, proper identification of others can be a

challenge, and it may not even be possible to create a comprehensive species list for certain groups due to the paucity of information.



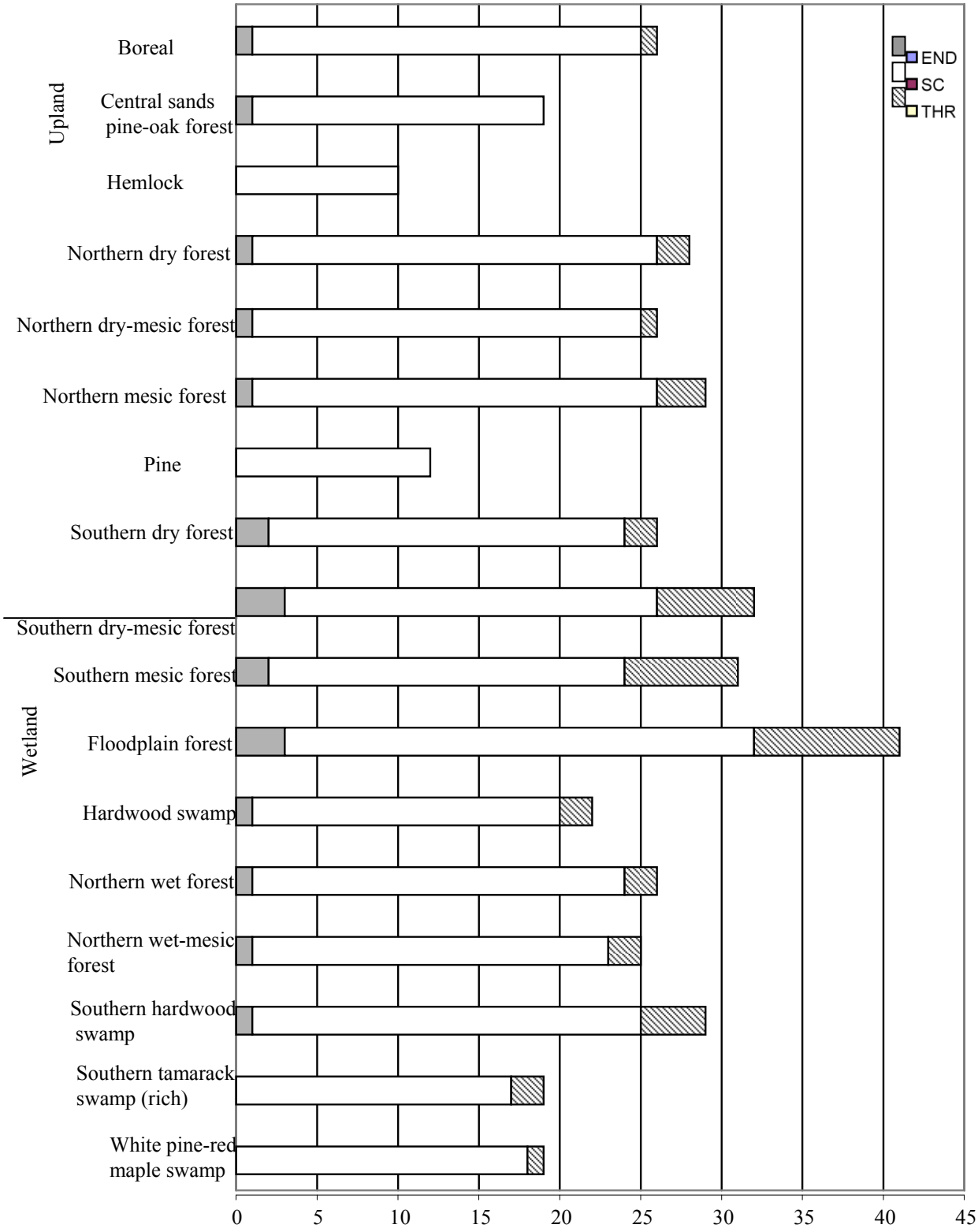


Figure 4.b: Numbers of Species of Greatest Conservation Need (SGCN) that are State Endangered, State Threatened, or Special Concern
Source: DNR, 2005

Data are from the Wildlife Action Plan, and only the 17 forested natural communities included in the plan are shown, as some NHI communities were lumped together. Data may be incomplete for some uncommon relict types such as Hemlock Relict and Pine Relict. See *dnr.wi.gov/org/land/er/wwap* for more information.

Table 4.c: Vertebrate Species of Greatest Conservation Need (SGCN) associated with forested communities in Wisconsin

Numbers shown are degrees of association between each species and a particular community type (3=significant association, 2=moderate association, and 1=low association). Where no number is shown, a species is not known to use a particular community type.

	Upland Forests										Wetland Forests						
	Northern				Southern						Northern			Southern			
Common Name (State Status)*	Boreal forest	Northern dry forest	Northern dry-mesic forest	Northern mesic forest	Central sands pine-oak forest	Hemlock relict	Pine relict	Southern dry forest	Southern dry-mesic forest	Southern mesic forest	Hardwood swamp	Northern wet forest	Northern wet-mesic forest	Floodplain forest	Southern hardwood swamp	Southern tamarack swamp (rich)	White pine-red maple swamp
Acadian Flycatcher (THR)								1	3	3				2			
American Marten (END)	3	1	3	3							1	1	1	1			
American Woodcock (SC)	1	1	1	2	1			1			2	1	1	1	1	2	1
Bald Eagle (SC)														1			
Black Rat Snake (SC)							3	3	3	3				2	2		
Black-backed Woodpecker (SC)	2	2	1	1								3	1				
Black-billed Cuckoo (SC)	1	1	1	2							1	1		2	1	2	
Black-throated Blue Warbler (SC)	1		2	3													
Blanding's Turtle (THR)									2	2				2	2	2	
Blue-winged Teal (SC)														2	1		
Blue-winged Warbler (SC)		1			1			2	2	2				2	1	2	1
Boreal Chickadee (SC)	2											3	1				
Brown Thrasher (SC)		1															
Bullsnake (SC)					2		2	2	2	2							
Butler's Garter Snake (THR)														2			
Canada Warbler (SC)	3	1	2	2	1	2	2				3	2	3			1	2
Cerulean Warbler (THR)				1				1	3	2				3			
Connecticut Warbler (SC)	1	3	1									2					
Eastern Massasauga Rattlesnake (END) (and a federal candidate)														3	2		

Eastern Red Bat (SC)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2
Four-toed Salamander (SC)	2			3						3	2	2	3	3	3	2	
Golden-winged Warbler (SC)	1	2	2	2	1			1	1	1	2	2	1		1	1	1
Gray Wolf (SC)	3	2	3	3	3	1	1	2	2	2	2	3	3	2	1	1	1
Great Egret (THR)														2			
Hoary Bat (SC)	2	2	2	2	2	2	2	1	1	1	2	2	2	2	1	1	2
Hooded Warbler (THR)									3	3							
Kentucky Warbler (THR)									2	3				3			
Kirtland's Warbler (SC) (and Federally Endangered)		3															
Least Flycatcher (SC)	2	2	2	3	1			1	1	1	2		1	2	1		1
Louisiana Waterthrush (SC)									3	3							
Mink Frog (SC)	1			1							1	1	1				
Moose (SC)	3	1	1	2							3	2	3	2			
Northern Flying Squirrel (SC)	3	2	3	3	1	2	2	1	1	1	2	3	3	2	1	1	1
Northern Goshawk (SC)	2	1	2	3							1		1				2
Northern Long-eared Bat (SC)	1	2	2	2	2	2	1	2	2	2	2	1	1	2	2		2
Northern Prairie Skink (SC)		2	2					2	2								
Olive-sided Flycatcher (SC)	2	1	1									3	2				
Ornate Box Turtle (END)					3			3	3	2							
Pickerel Frog (SC)				2						2		2	2	2	2		
Prairie Ringneck Snake (SC)					2			2	2								
Prothonotary Warbler (SC)														3			
Red Crossbill (SC)	1	3	3	1	1	1	2					1					
Red-headed Woodpecker (SC)		1	1		2			2	2					2			
Red-shouldered Hawk (THR)		1	2	2					2	2	1		1	3	1	1	2
Rusty Blackbird (SC)														3	3	2	1
Silver-haired Bat (SC)	2	2	2	2	2	2		1	1	1	2	2	2	2	1	1	2
Solitary Sandpiper (SC)														3	1		
Spruce Grouse (THR)	2	2										3					
Timber Rattlesnake (SC)							3	3	3	3				2	2		
Veery (SC)	3	1	2	2		2	2		2	2	3	2	1	2	1	1	3
Water Shrew (SC)	3			2						2	3	3	3	2	2	1	1
Western Worm Snake (SC)								2	2								
Whip-poor-will (SC)		2	2	1	3	1	2	3	3	1				1			
Willow Flycatcher (SC)														1	1	1	
Wood Thrush (SC)			1	2	1			2	3	3	1	1	1	2	1	1	1
Wood Turtle (THR)				3						2	2	2	2	3	2		
Woodland Jumping Mouse (SC)	2	1	1	3						2	2	2	2	2	2		1
Woodland Vole (SC)					2			3	3	1				1			
Worm-eating Warbler (END)								2	3	2							
Yellow-bellied Racer (SC)								2	2								

Yellow-billed Cuckoo (SC)	1		1	2	2		3	2	1	1
Yellow-crowned Night-Heron (THR)							3	2		
Yellow-throated Warbler (END)				2			3			

* END = State Endangered, THR = State Threatened, SC = special concern. Note that some special concern species are protected by other state and federal laws. See the NHI Working List (*dnr.wi.gov/org/land/er/wlist/*) for more information. Data are from the Wildlife Action Plan - see *dnr.wi.gov/org/land/er/wwap*.

4.3 Bird Populations

This section uses a selection of common or uncommon forest birds as indicators of broad-scale habitat changes in northern and southern forest ecosystems of Wisconsin. Birds were selected that have a narrow niche breadth relative to different forest habitats and were common enough to generate population trends at the state level. Note that these aren't necessarily the most abundant birds in that habitat type, but rather, the majority of their breeding habitat was contained in a specific forest habitat type. Forest bird information was gathered from sources cited in the Wisconsin All-bird Plan species accounts for each individual species and was largely dependent on data gathered from the Federal Breeding Bird Survey.

Using forest breeding birds as indicators requires a number of assumptions about their populations and the impacts of forest change. These assumptions include: (1) Changes in forest types and amounts on a coarse scale will result in changes in forest breeding bird populations (2) changes in bird populations are due principally to the amount of breeding habitat acreage and not to changes in migratory stopover or wintering ground habitat and (3) coarse scale forest acreages are more important than site-level habitat quality factors or landscape structure, quantified by metrics like patch size distribution, area of edge, etc. These are all very tenuous assumptions and the information presented here should be used cautiously. Surprisingly, despite the wealth of bird survey information over many different forested areas in Wisconsin, there is a lack of coordinated information relating bird species abundances to different forest habitats or cover types.

Future revisions to this assessment process would be greatly assisted through additional monitoring efforts suggested in the text below. In addition, efforts to better correlate bird counts to a common forest habitat "language" would offer additional insights on forest bird habitat selection and value as forest indicators.

<u>Statewide Trends in Forest Birds</u>

In general, forest birds increased in Wisconsin over the last 40 years based on Federal Breeding Bird Survey data. This is especially true for birds that nest in middle-aged to older forests and for the wide range of conifer-dependent species. There are exceptions, including some birds that are associated with a declining habitat type (i.e. Connecticut Warbler - Jack Pine) or are sensitive to forest fragmentation (i.e. Least Flycatcher). The status of some of our rare, forest obligate species like Red-shouldered Hawk, Cerulean Warbler, Northern Goshawk, and Spruce Grouse is

not precisely known. Data on these species exists at a statewide scale, but finer scale data is often unavailable. Efforts are underway to gather more data. This result is expected as forested acreage increased in Wisconsin and the average age of conifers and forests increased over the last half of the last century. There are still forest birds that are declining and are of high concern, but there is no apparent pattern based on habitat type that can explain these declines. Reasons for these declines are not always well understood but may be related to any of the following:

- *Gross habitat changes* – Large-scale loss of habitat quality through conversion, succession, or fragmentation. Examples include Connecticut Warbler declines and the loss of jack pine acreage.
- *Loss of habitat on non-breeding habitat* – The vast majority of Wisconsin's forest birds migrate to areas south of the United States during the non-breeding season. Land use changes and habitat conversion place them under stress during those periods.
- *Lowered survival rates during migration* – many long-distance migrants are under increasing stress from a loss of migratory stopover habitat or increased mortality risk from tall towers or windows. Changes in adult survival rates are especially detrimental to this group of birds.

Maple-Beech-Birch: Overall, birds that use the generalized maple-hardwood-hemlock forest types are stable or increasing (Figure 4.c). The one exception is Least Flycatcher. This species is declining range-wide but less rapidly than it is in Wisconsin and the other Western Great Lakes states. It appears to be sensitive to fragmentation from temporary or permanent creation of hard edges. Future iterations of this assessment could include some measure of fragmentation at various spatial scales. Blackburnian Warbler was included as it is very abundant in hardwoods stands that retain hemlock. Red-shouldered Hawk is not well monitored at a statewide level, but offers a species that would track older hardwood forests as a monitoring program is established into the future.

Black-throated Blue Warblers offer a species that might serve as a valuable ecological indicator for this forest type over the life of the assessment and an appropriate conservation target. This species prefers mature hardwood forests with a strong shrub understory. This species should respond positively to efforts to move the resource base to an un-even aged or more structurally complex forest stand. The slow increase in Black-throated Blue Warbler populations since the early 1980's probably generally reflects the recovery of this forest type from the Cutover over a century ago across the western Great Lakes.

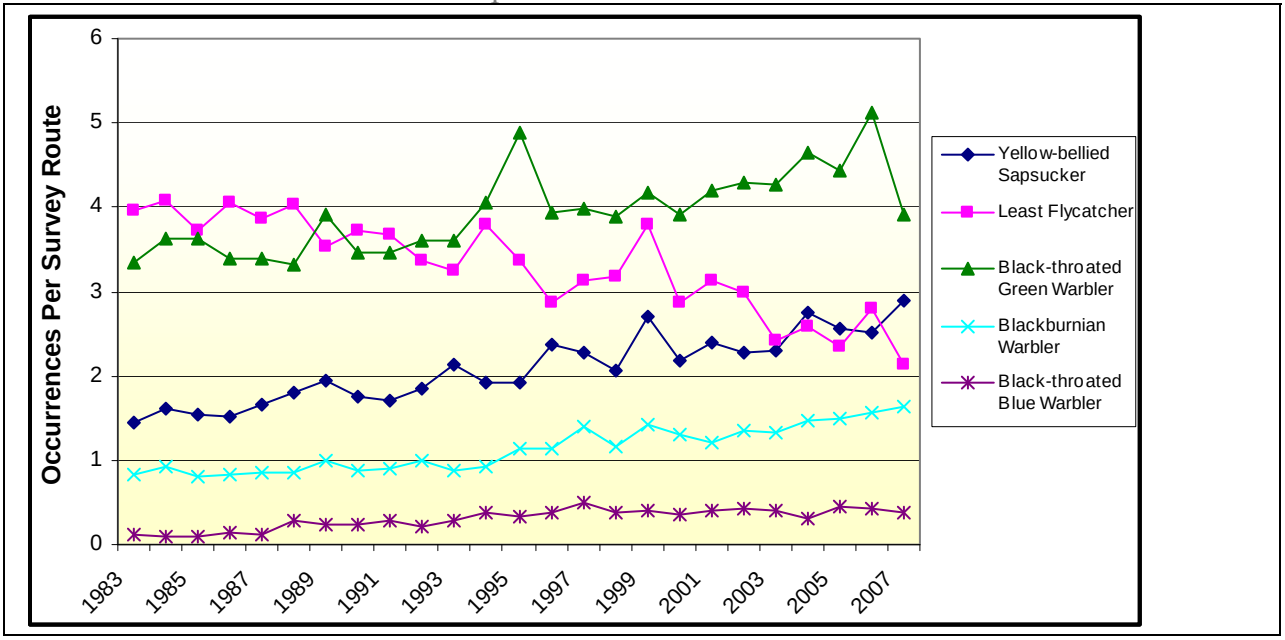


Figure 4.c: Population trends of birds associated with northern hardwood forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Oak-Hickory: Bird species that utilize young oak/hickory forests show a mixed set of population trends (Figure 4.d). Brown Thrasher and other grass-shrub birds that prefer open oak barrens, shrub rows in agricultural landscapes or scattered shrubs within a grassy matrix are all declining. This is consistent with land use trends away from hedgerows in agricultural landscapes, forest succession, and a lack of forest management on the drier oak types in sandy northern forest landscapes which is allowing stands to age and reducing the amount of early successional habitat.
Eastern Towhee, Blue-winged Warbler and other forest edge/shrub birds are increasing or remaining relatively stable over time. It remains to be seen if this trend will hold as these forests age or succeed to other types.

Bird species that utilize more mature oak/hickory forests are stable or increasing during the forest assessment time period (Figure 4.e). Cavity nesters such as White-breasted Nuthatch and forest canopy breeders like Scarlet Tanager and Yellow-throated Vireo are stable or increasing over this time period. Many species that use older, structurally complex oak-hickory forests are not well monitored by the Federal Breeding Bird Survey in Wisconsin due to their limited distribution south of the tension zone. These include Cerulean Warbler, Kentucky Warbler, Hooded Warbler, Acadian Flycatcher and other high priority species. Forests south of the Tension Zone are heavily impacted by fragmentation and resulting edge effects. Future assessments would benefit from a monitoring program that targets existing and potential habitat for this suite of forest birds.

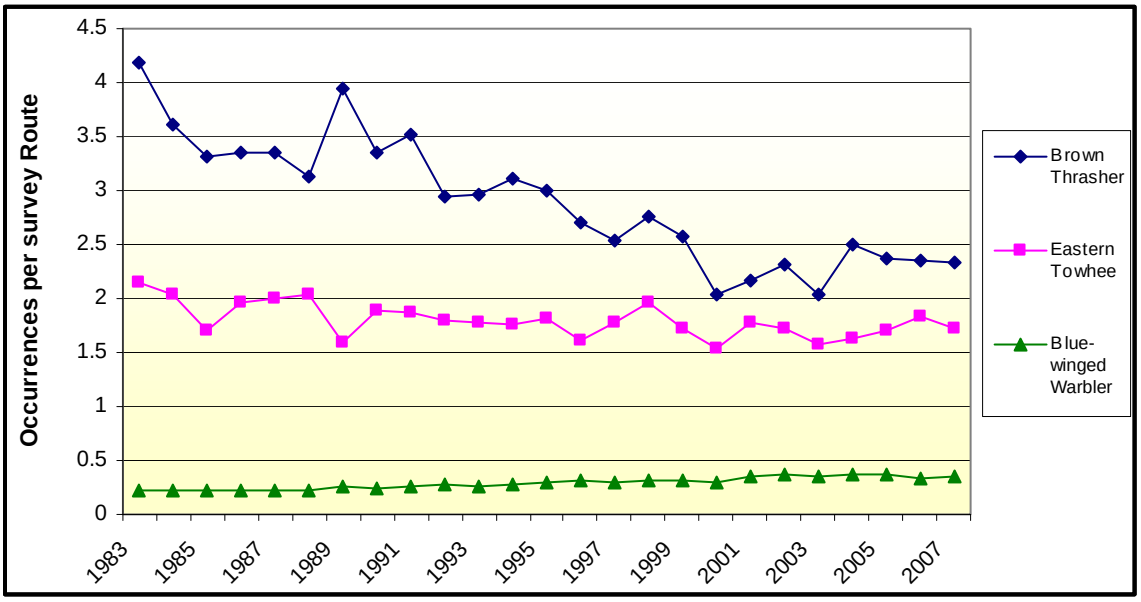


Figure 4.d: Population trends associated with early successional oak/hickory forests (1983-2007).
Source: Sauer, Hines, Fallon, 2008

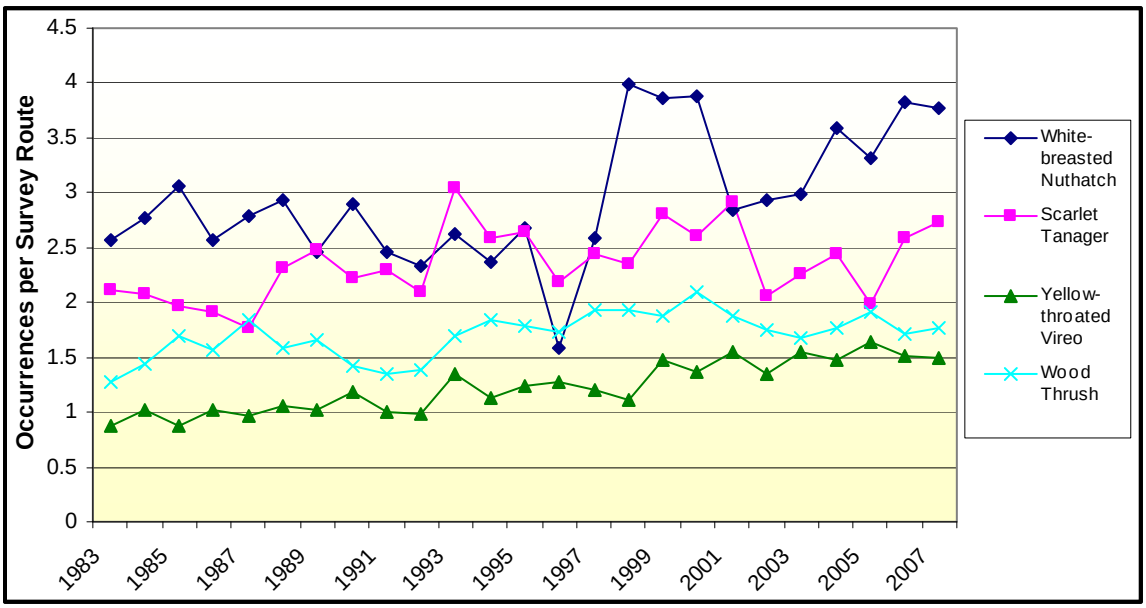


Figure 4.e: Population trends of bird species associated with mature oak/hickory forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Aspen-Birch: Golden-winged Warbler, Chestnut-sided Warbler, Mourning Warbler and other early successional birds experienced a peak in the mid 1990's and have since declined (Figure 4.f). This is consistent with declines in the amount of young, high stem-density aspen forests over the same time period. These species also utilize shrub wetlands and other early seral deciduous habitats, but the changes in aspen-birch forests will probably be the primary influence on their populations over the short-term.

Species that utilize older aspen forests including those with higher amounts of conifer inclusions have increased since the early 1980's (Figure 4.g). These species also utilize other deciduous forest types and are less sensitive to changes in the amount of older aspen-birch than the species listed above. Maintaining conifer within aspen-birch stands appears to have positively impacted Black-throated Green Warbler and many of the other spruce-fir birds graphed in Figure 4.g.

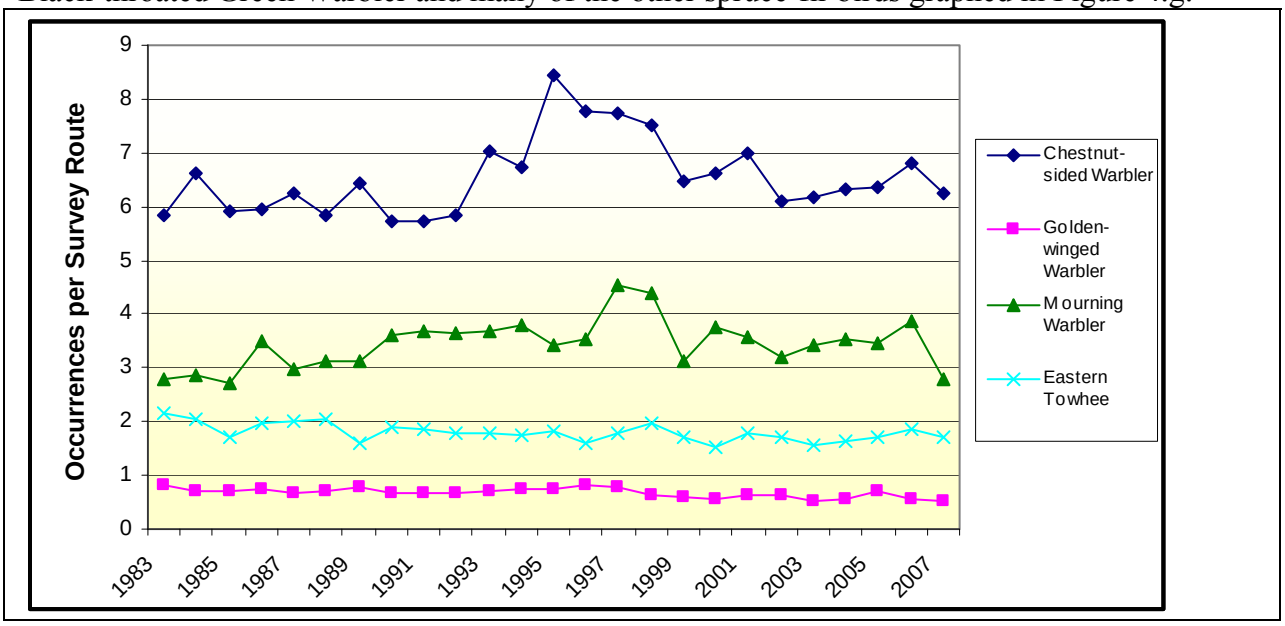


Figure 4.f: Population trends of bird species associated with early seral aspen-birch forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

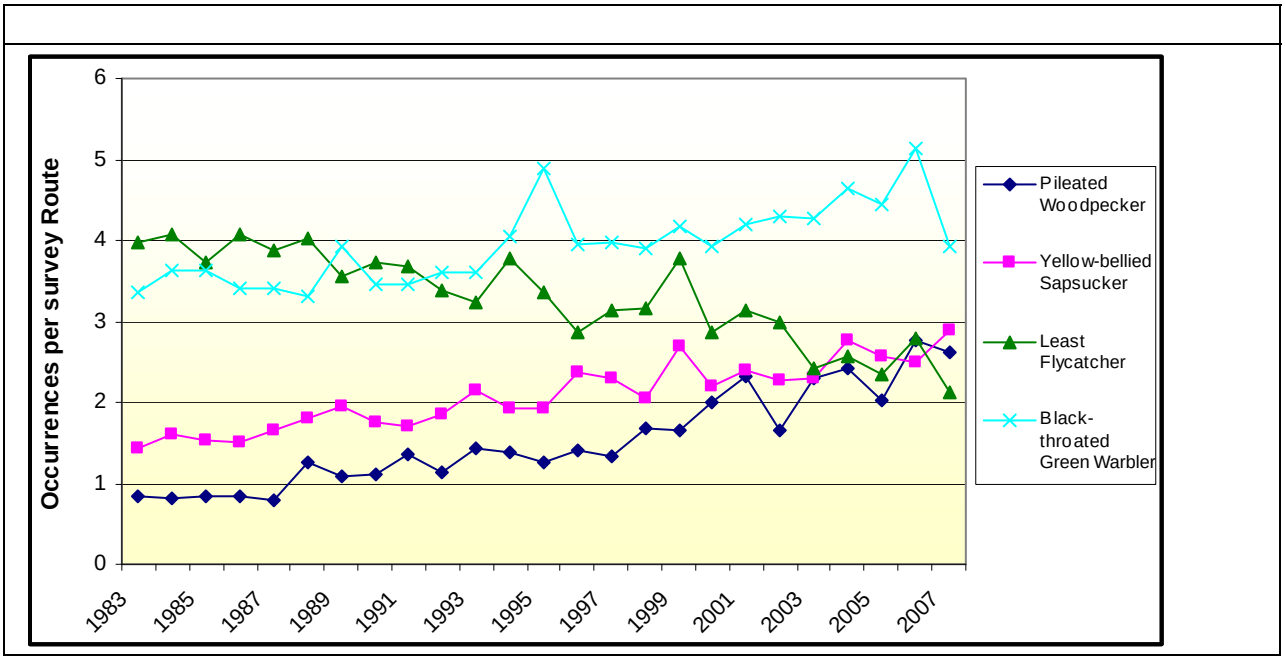


Figure 4.g: Population trends of bird species associated with older aspen-birch forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Pine (white, red, jack): The jack pine cover type declined substantially in Wisconsin over the past 50 years. Bird species that utilize the early seral stages of this cover type have also declined including Brown Thrasher and Vesper Sparrow (Figure 4.h). This cover type is very important for Jack Pine specialists like Kirtland's Warbler and Connecticut Warbler and for the suite of species that prefer open barrens including Sharp-tailed Grouse, Vesper Sparrow, Clay-colored Sparrow and Upland Sandpiper.

In contrast to the early seral jack pine species, bird species that utilize mature coniferous forests have increased rapidly in response to large-scale pine plantings and conifer regeneration since the Cutover. This is most easily seen by looking at the population trend of Pine Warbler (Figure 4.i). Pine Warblers nest in the canopy of mature pines. Since 1983 this species has increased by 8%/yr and is one of the fastest increasing species in Wisconsin. In contrast, Connecticut Warblers have declined rapidly due to their preference for older Jack Pine forests. Canada Warblers and other forest gap specialists have remained stable or are increasing due to the aging of many of these pine forests allowing more light to penetrate the canopy and subsequent understory development. These species will all benefit from management that allows for more complexity in pine plantations or mimics disturbance patterns in natural stands.

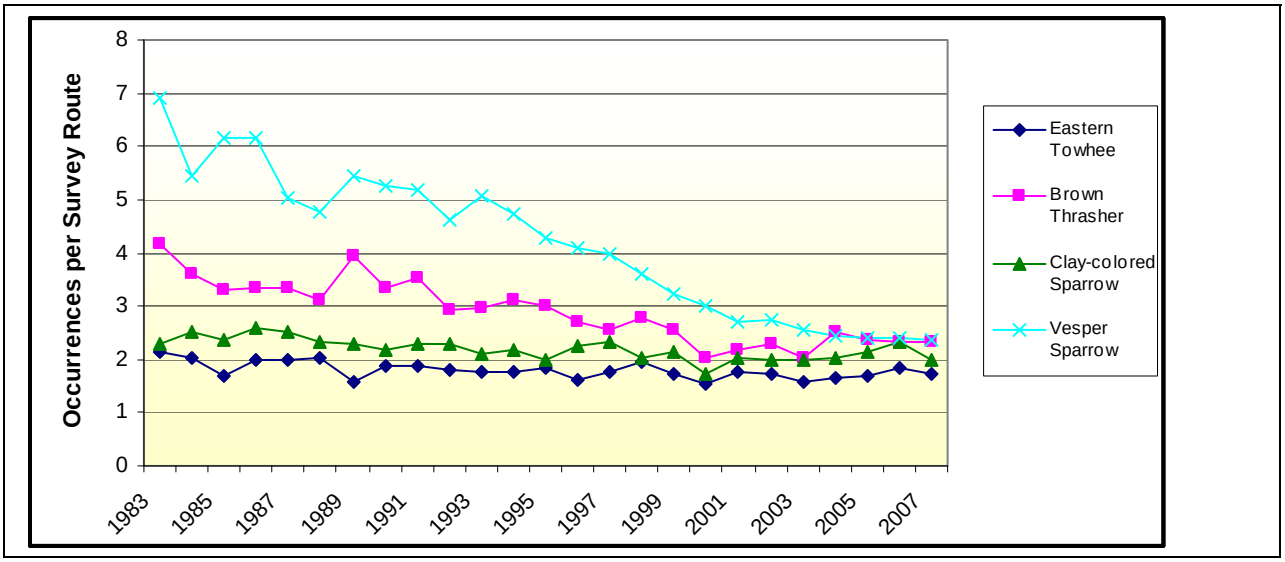


Figure 4.h: Population trends of bird species associated with young pine forests (1983-2007)

Source: Sauer, Hines, Fallon, 2008

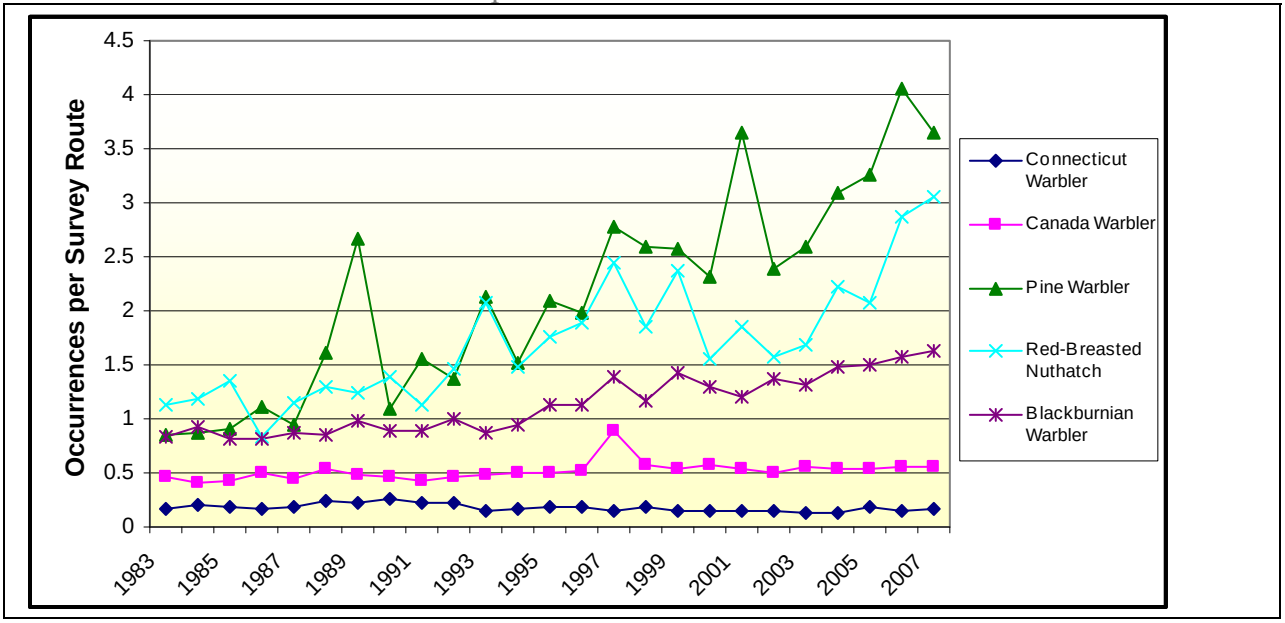


Figure 4.i: Population trends of bird species associated with older pine forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Elm-Ash-Cottonwood: This class was split into a floodplain forest (bottomland hardwoods) type and a northern ash swamp type. Both of these communities have distinctive bird communities. Because both types are wetlands, road-based breeding bird surveys do not monitor bird species dependent on this type well overall.

Black ash swamps, or hardwood swamps, have a distinctive bird community but few birds that specialize in this type (Figure 4.j). Species listed (Veery, Canada Warbler, Black-and-white Warbler) are abundant in ash swamps but also are found in a number of other habitat types that might regulate their overall population trend. Birds that nest in this type are attracted to multi-layered forests with significant wetness. Species in this type are largely stable with the exception of Veery. The Veery prefers wet forests with high stem densities and the general trend across this type and the aspen-birch type for older forests would likely explain some of these declines. It's not clear how the emerald ash borer invasion will impact birds in this habitat type over the long-term. It may be necessary to set up wetland forest bird surveys to augment the lack of data from the Federal Breeding Bird Survey.

The floodplain forest birds are not well monitored by the Federal BBS. In order to properly use this indicator a monitoring program should be established specific to this habitat type. There are a number of birds that are restricted to this habitat type or are most abundant in this type. These include Prothonotary Warbler, Red-shouldered Hawk, Cerulean Warbler, Yellow-crowned Night Heron and others. Since these species are not well monitored and most are species of greatest conservation need (SGCN) in the Wisconsin Widlife Action Plan (WAP) a habitat-based monitoring program that evaluates the status of these species relative to short-term and long-term habitat change is warranted.

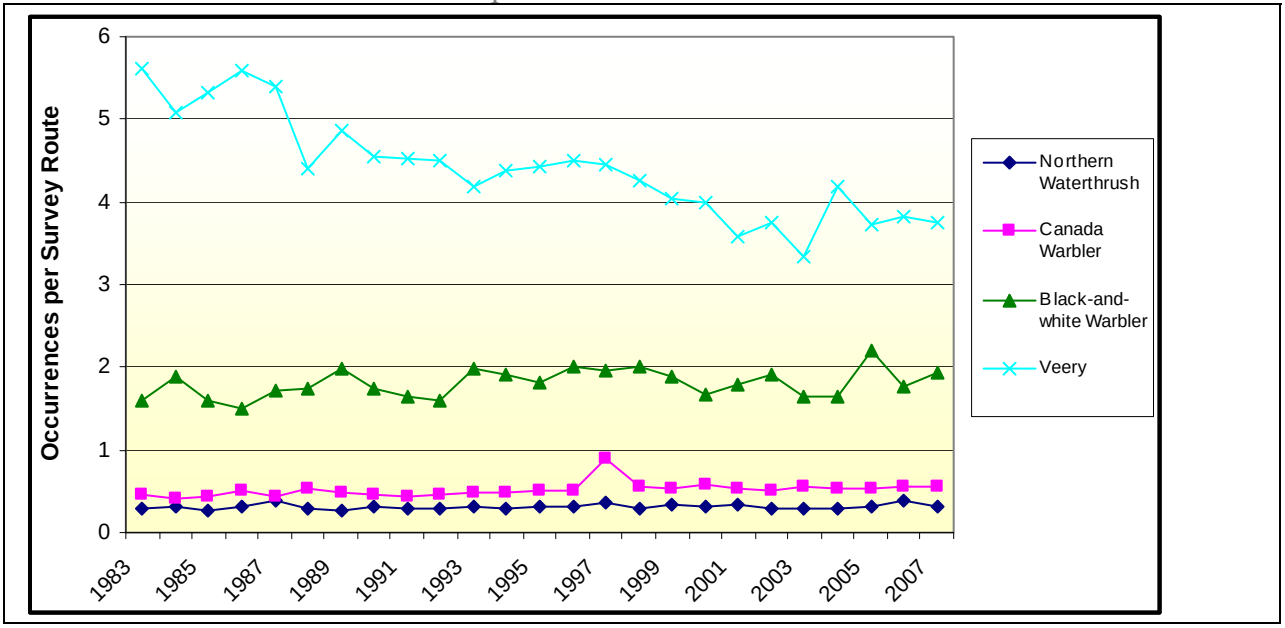


Figure 4.j: Population trends of bird species associated with northern hardwood swamps (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Spruce-Fir: For the purposes of this indicator, the spruce/fir forest type was split into lowland and upland ecological groups. Upland white spruce-fir forests and lowland swamp conifer stands contain a number of conifer dependent birds that add a substantial amount of diversity to Wisconsin's avifauna. Picking indicator species for the type is somewhat difficult due to the road-based surveys not sampling wetlands and the general rarity of many of these species due to edge-of-range issues. Other characteristic species like Black-backed Woodpecker, Gray Jay, and Spruce Grouse are early breeders and should be incorporated into an indicator in the long-term due to their non-migratory status and use of the system as a whole.

Lowland coniferous forests contain a distinctive "boreal" assemblage of bird species. Most of these species are at the southern edge of their range in the Western Great Lakes. This type has probably been the least impacted by wide-scale timber management or conversion and has probably served as refugia for many species of conifer dependent birds. The Federal Breeding Bird Survey does not monitor many of these species well enough to say much about the long-term status of these species. Some, like the Yellow-bellied Flycatcher and Blue-headed Vireo appear to be more abundant today than they were in the early 1980's (Figure 4.k). Others, like the Ruby-crowned Kinglet and Olive-sided Flycatcher, have declined significantly despite no apparent gross habitat changes within the past few decades. This forest type would be a good candidate for a habitat-based bird monitoring program that generates status and trends for many under sampled species as well as providing information on these species response to management and climate change.

Upland spruce-fir forests are similar to lowland coniferous forests in that they have a unique assemblage of largely boreal birds. These include Cape May Warbler, Golden-crowned Kinglet, Magnolia Warbler and others. Many of these species are at the edge of their range in Wisconsin and are not well monitored as a group due to species rarity. However; based on available data

(Figure 4.l) many of these species are increasing as these forests age and become more structurally complex. Since many of these older spruce-fir forests are the result of deliberate planting, it's unclear if this trend will continue. In addition, these forests may be under pressure from climate change over the coming decades. This group of birds would offer good candidates for evaluating the impacts of climate change on Wisconsin's avifauna.

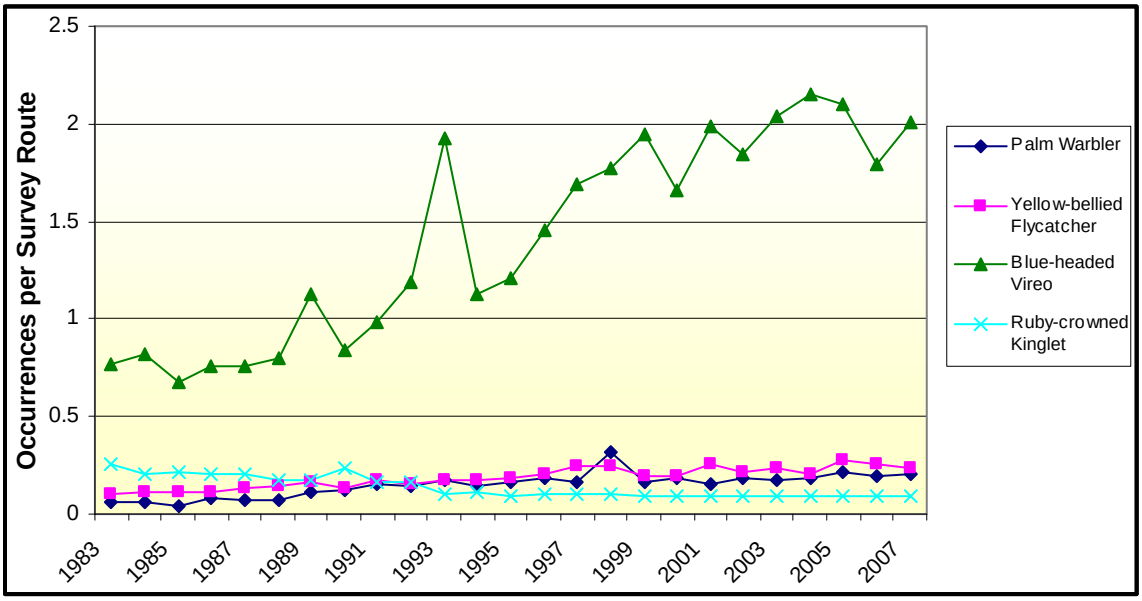


Figure 4.k: Population trends of bird species associated with lowland coniferous forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

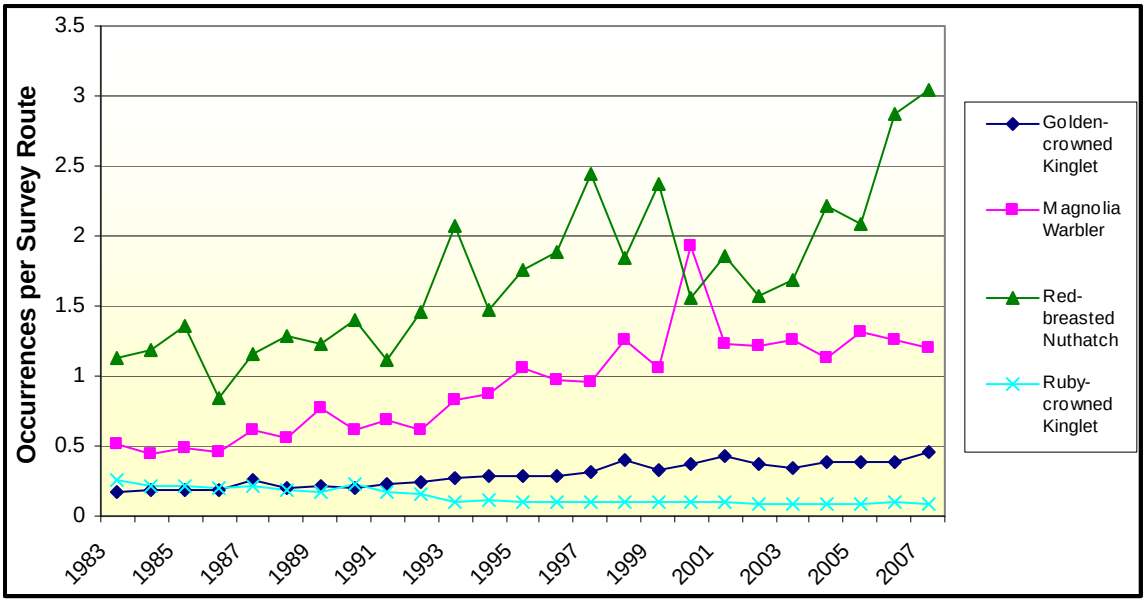


Figure 4.l: Population trends of bird species associated with upland spruce-fir forests (1983-2007)
Source: Sauer, Hines, Fallon, 2008

Based on Federal Breeding Bird Survey data, most forest birds have been stable or increasing in Wisconsin during the last 40 years. This is especially true for birds that nest in mid- to older-aged forests and for conifer-dependent species. However, it is difficult to link population changes to specific types of forest management, or to determine whether birds are responding to forest changes or some other factor.

Species utilizing deciduous and mixed-deciduous forests were stable or increasing over the 40 years reported, except for Least Flycatcher. Birds associated with younger oak-hickory forests showed mixed trends, while those associated with older oak forests were stable or increasing. Birds which utilize early-seral aspen exhibited population peaks in the 1990's, and have since returned to levels similar to the 1980s, except for Golden-winged Warbler which has gradually declined over the 40 year time period. Species of older aspen forests have increased, although this may not be due to changes in the aspen forest. An increase in the conifer component of aspen forests appears to have positively impacted Black-throated Green Warbler. Bird species associated with young jack pine have followed the decreasing trend of the extent of these forests, while those associated with older conifer forests have increased, apparently due to the widespread planting and recovery of conifers since the Cutover. Trends for birds of lowland forests, both deciduous and conifer are poorly estimated by existing surveys.

4.4 Mammal Populations

In general, data that directly address Indicator 4 and Metric 4.4 are lacking. Forest associated mammal population monitoring and knowledge concerning responses to habitat changes are limited. Population monitoring and research that links species population changes directly to changes in forest composition and structure are needed.

The forest associated mammal species included here—American marten, fisher, bobcat, wolf, and deer—do have relatively consistent, long-term, statewide population data, and habitat preferences are relatively well understood. However, many different factors can cause animal populations to fluctuate, and it is difficult to directly link population change with specific changes in forest habitat (cause and effect). These five species are top-level carnivores and/or keystone species; they can strongly influence the composition, structure, and function of their communities and habitats. Their populations and habits influence the populations and habits of many other species. Their population status and trends can indicate habitat suitability for a range of associated species, and thus provide a surrogate measure of some components of biological diversity supported by Wisconsin's forests.

American (Pine) Marten

In northern Wisconsin forests, American marten were abundant prior to Euro-American settlement. The species was extirpated from Wisconsin by the 1920's, due to loss of habitat and unregulated harvest. Marten were reintroduced into the Nicolet National Forest from 1975-1983 (N = 172 animals), and the Chequamegon National Forest from 1987-1990 (N = 139 animals). Subsequent estimates for the Nicolet population were approximately 100-150 animals in 1985 and 221 (160-280) animals in 2005. No population estimate has occurred for the Chequamegon population. Current marten distribution in Wisconsin (Figure 4.m) includes much of the original reintroduction areas (called marten restoration areas) along with portions of central Iron and western Douglas Counties. Currently, American marten are rare and their persistence is tenuous.

Two major issues that may be limiting the viability of American marten are competition from fisher and habitat suitability. Where snow depth is not limiting, fisher may outcompete marten through occupation of habitat (food and space) and direct predation. Marten are probably associated with forest landscapes containing mature forests that are structurally complex; important habitat features include: closed canopy, conifer dominated forest or hardwood forest with patches of conifers, coniferous understory, cavity trees greater than 22 inches dbh, large coarse woody debris, fine woody debris piles, and abundant prey (small mammals). These habitat features, occurring in concert, are uncommon in northern Wisconsin.

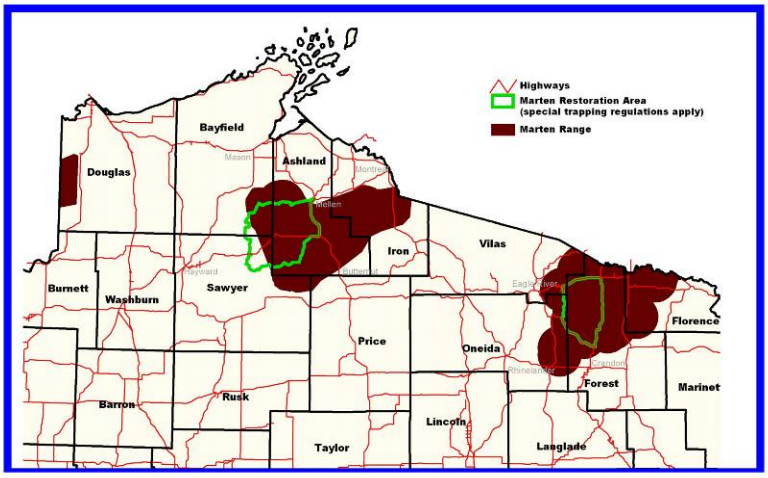


Figure 4.m: American marten distribution in Wisconsin, 2008
Source: DNR, 2008

Fisher

In Wisconsin, fisher mostly live in heavily forested northern and central regions, preferring large areas of contiguous forest cover. Dense, mostly mature forests comprised of interspersed patches of conifers, hardwoods, uplands, and lowlands can provide a diversity of resources and high quality habitat. The inclusion of dense mature conifer patches provides a preferred habitat element. Well developed structural characteristics improve habitat quality; large diameter cavity trees, snags, and coarse woody debris are important habitat elements. Maternity dens are usually located in large cavity trees and snags (mostly hardwoods). Den sites and temporary shelters include cavity trees, snags, coarse woody debris (e.g. hollow logs), brush piles, rock crevices, burrows of other animals, and temporary snow dens. Fisher are predominantly carnivorous, consuming a wide variety of prey; principal prey species are porcupine, snowshoe hare, grouse, squirrels, mice, voles, and shrews. Winter conditions characterized by extended periods of deep snow are a limiting factor for suitable fisher habitat.

In Wisconsin forests, fisher were common prior to Euro-American settlement. They were extirpated by the mid-1900's. Beginning in the 1950's, fisher were reintroduced on national forests in northeastern and north-central Wisconsin. Reintroductions were successful and populations expanded; once again, fisher are common in the forests of northern Wisconsin. Winter track surveys, harvest registration, and carcass collections have provided data and information concerning fisher population trends and ecology. Annual population estimates are modeled based on survey data (Figure 4.n).

Annual, regulated harvests of fisher began in 1985 and have continued since. In 2004, all of Wisconsin was opened to regulated harvests. The annual harvest of fisher has fluctuated over the years, due to population fluctuations and weather conditions during the harvest seasons (Figure 4.n).

In general, the statewide fisher population is viable and expanding (Figure 4.o). Prey is abundant. Relatively mild winter conditions have facilitated over-winter survival of both fisher and prey populations, particularly in the more northern reaches of the state. Northern forests are expansive and current conditions provide acceptable (although probably not optimal) habitat for

fisher. As forests continue to mature habitat should improve; habitat elements that could be encouraged include increased landscape representation of conifers, large trees and cavity trees, and large snags and coarse woody debris. Forest fragmentation and parcelization are concerns owing to potential impacts on interior forest conditions. In southern Wisconsin, large areas providing interior forest conditions will probably remain a limiting factor.

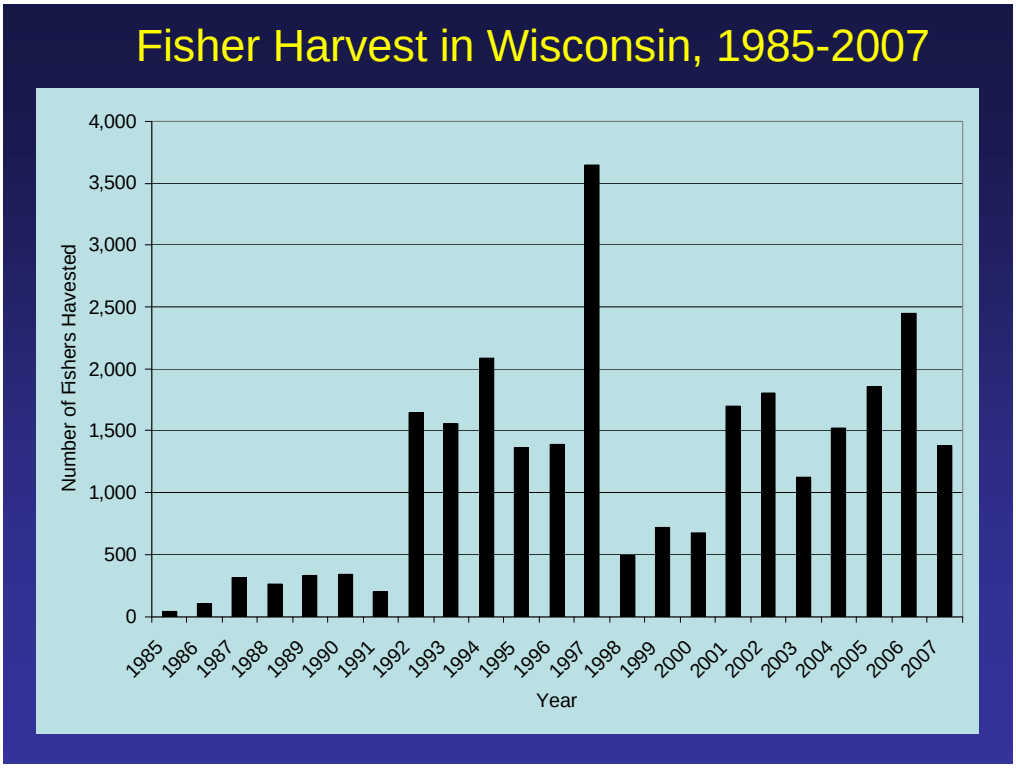


Figure 4.n: Fisher harvest in Wisconsin 1985-2007
Source: DNR, 2007

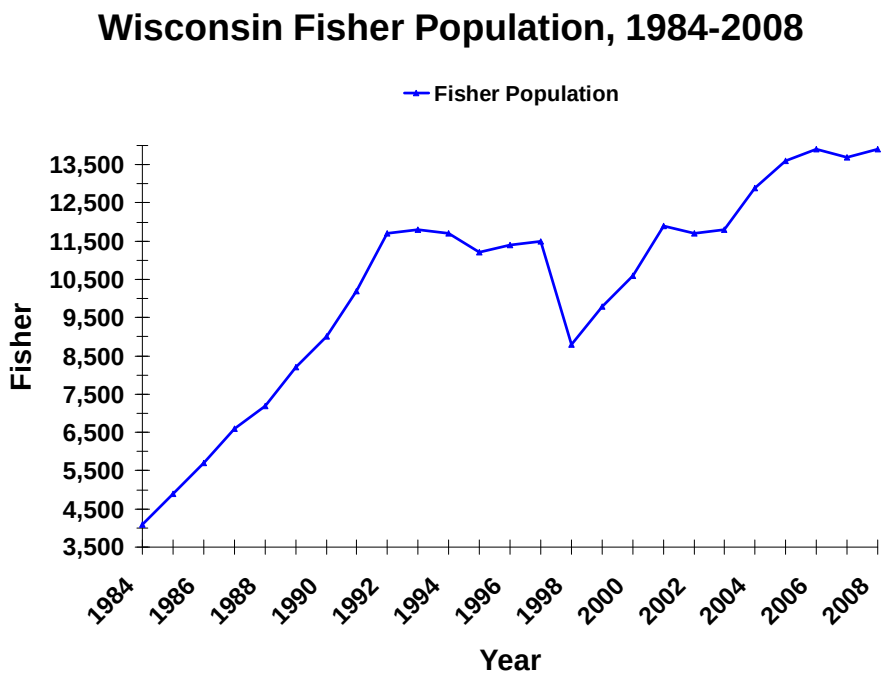


Figure 4.o: Wisconsin fisher population 1984-2008
Source: DNR, 2008

Bobcat
In Wisconsin, bobcats mostly live in the heavily forested northern regions. Coniferous forests, particularly conifer swamps, provide preferred habitat, with shelter, cover, and prey. Alder thickets and swamp hardwoods are also frequently used. Upland hardwood forests are sometimes used as primary habitat, particularly in more southern areas where conifers are sparse. Long-distance dispersal sometimes follows river corridors. Preferred den sites include caves, rock crevices, hollow trees, hollow logs, beneath large downed trees, and brush piles. Bobcat are carnivores; preferred prey species are snowshoe hare, cottontail rabbit, squirrel, porcupine, and white-tailed deer, but they will also consume woodchucks, birds, bats, mice, voles, shrews, reptiles, and insects.

Wisconsin is on the northern edge of bobcat range in North America, and historic populations ranged from low to common. Climate is a limiting factor for bobcat habitat, particularly snow duration and depth; winter weather impacts bobcat survival and population dynamics. However, since the mid-1990's, bobcat populations have been increasing (Figure 4.p). Relatively mild winter conditions have facilitated over-winter survival of predator and prey populations including bobcats, fishers, raccoons, coyotes, wolves, white-tailed deer, and small mammals. The concurrent increase in deer populations may provide a more stable food supply, through direct predation on fawns and indirectly through the use of carrion.

Traditionally, bobcat population management in Wisconsin has been somewhat conservative, because climate was a limiting factor. Harvest seasons have been structured to only occur in northern Wisconsin, where a sustainable population exists. As the bobcat population began to grow, harvests were structured to maintain an overall harvest level of 15-17% of the population. In 2008, the bobcat management population goal was increased from 1,800 to 2,500 north of Highway 64 (Figure 4.p). Bobcat populations and annual harvests have increased over time (Figure 4.q). However, there has been a recent decline in bobcat populations in the North, and management strategies will probably remain cautious and conservative. Management of bobcats in Wisconsin will require additional ecological research and monitoring to facilitate understanding of behavior, population dynamics (e.g. reproduction and survival), and responses to changing habitat conditions (e.g. possible range expansion into central Wisconsin).

The northern Wisconsin bobcat population is small, but apparently viable and expanding. Prey is abundant. Relatively mild winter conditions have facilitated over-winter survival of both bobcat and prey populations. Northern forests are expansive and current conditions provide acceptable (although probably not optimal) habitat for bobcat. As forests continue to mature habitat should improve; habitat elements that could be encouraged include increased landscape representation of conifers, large trees and cavity trees, and large snags and coarse woody debris. Forest fragmentation and parcelization are concerns owing to potential impacts on interior forest conditions. In southern Wisconsin, large areas providing interior forest conditions with interspersed conifer patches will probably remain a limiting factor.

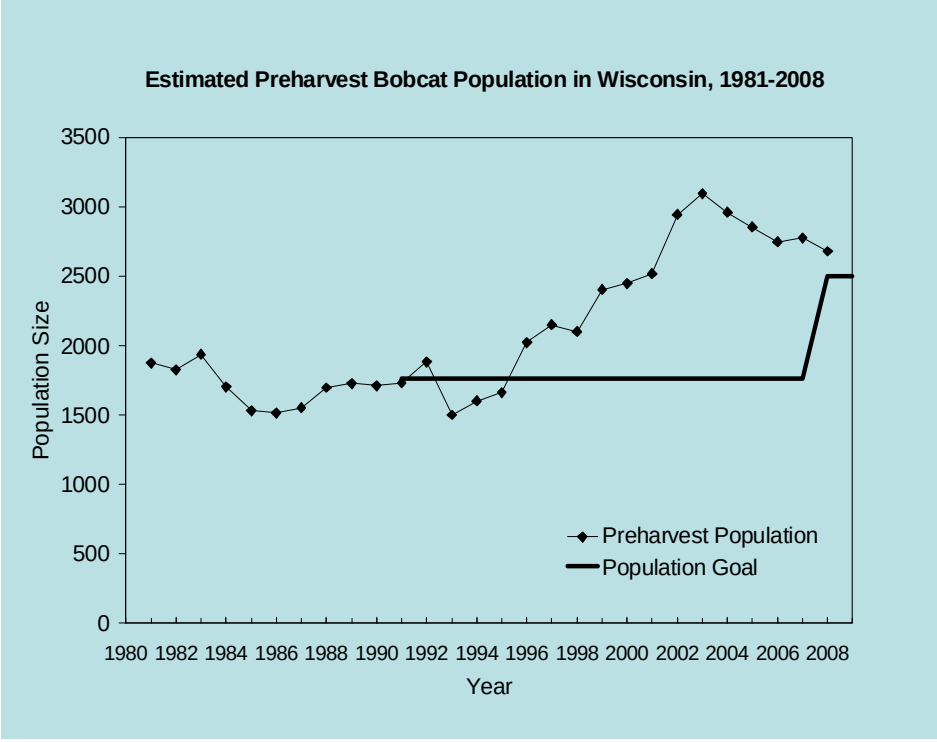


Figure 4.p: Bobcat populations and management goals
Source: DNR, 2008

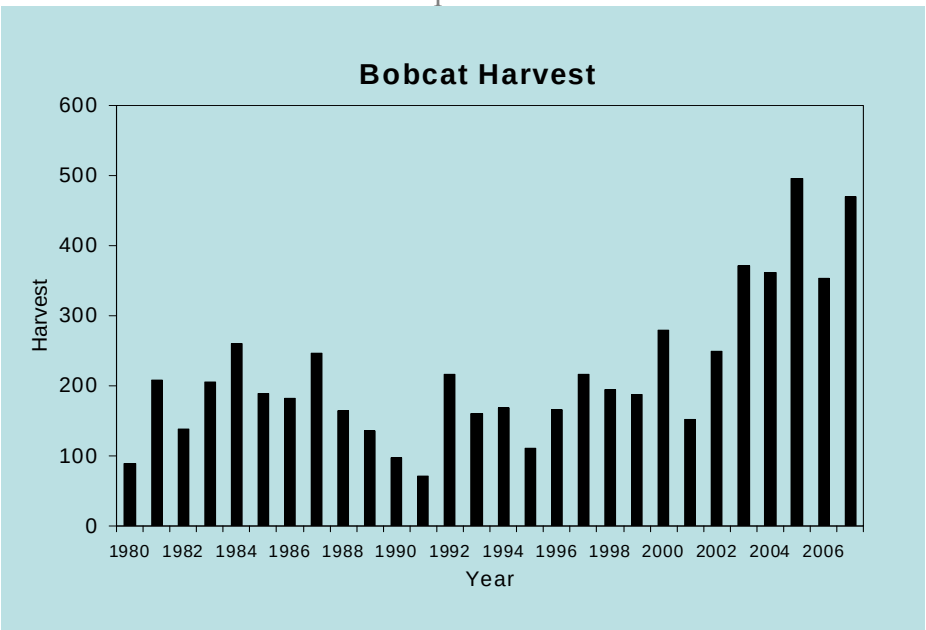


Figure 4.q: Bobcat harvests 1980-2007
Source: DNR, 2007

Timber (Gray) Wolf
Wisconsin wolves mostly live in the heavily forested northern and central sands regions. These large, wide-ranging carnivores have large home ranges and can inhabit most native ecosystems. Prey, principally deer, is abundant. The principle limiting factor for wolf populations in Wisconsin is intentional and accidental killing by humans; wolves require refuge from human contact. The best predictors of suitable wolf habitat are the lack of agricultural land and low road density; road densities <1 km/km^2 may provide suitable habitat, but densities <0.45 km/km^2 are preferred. Wisconsin offers extensive areas of suitable habitat, but core habitat is fragmented.

In Wisconsin, wolves were common prior to Euro-American settlement, and inhabited most major ecosystems. They were extirpated from the state by the mid-1900's. Wolves recolonized Wisconsin in the mid-1970's, and populations have been monitored since 1979 (Figure 4.r). As of late winter 2008, the statewide wolf population was 537 to 564 wolves in 144 packs and 24 loners. At least 520 wolves occurred outside of Indian reservations; the 2008 population exceeded the management goal of 350 wolves outside of Indian reservations by at least 170 wolves. Wolves were reported in 44 counties, and packs occurred in 34 counties in Wisconsin. Based on 2007 data, mean territory size was 30.5 square miles for adult wolves, and 6499 square miles of the state were estimated to be occupied by territorial wolves (Figure 4.s).

In 1975, The Wisconsin DNR listed the gray wolf as a state endangered species. In 1999, the wolf was downlisted to threatened status. In 2004, the gray wolf was removed from the list of threatened species and re-classified as a state protected wild animal.

In 1967 and 1974, the U.S, Fish and Wildlife Service listed gray wolves in the eastern U.S. as endangered. In 2003, the eastern gray wolf was downlisted to threatened status. In 2005, the wolf was relisted as endangered. Although the Western Great Lakes Distinct Population Segment of the eastern gray wolf was temporarily delisted in March of 2007, it is again listed at endangered

Following federal delisting, the state now has full management authority. However, intensive population surveys are required for the first five years following delisting; these surveys will provide data for future management decisions by the state. Currently, the 1999 Wisconsin Wolf Management Plan and the 2007 Wolf Plan Addendum guide wolf management in Wisconsin.

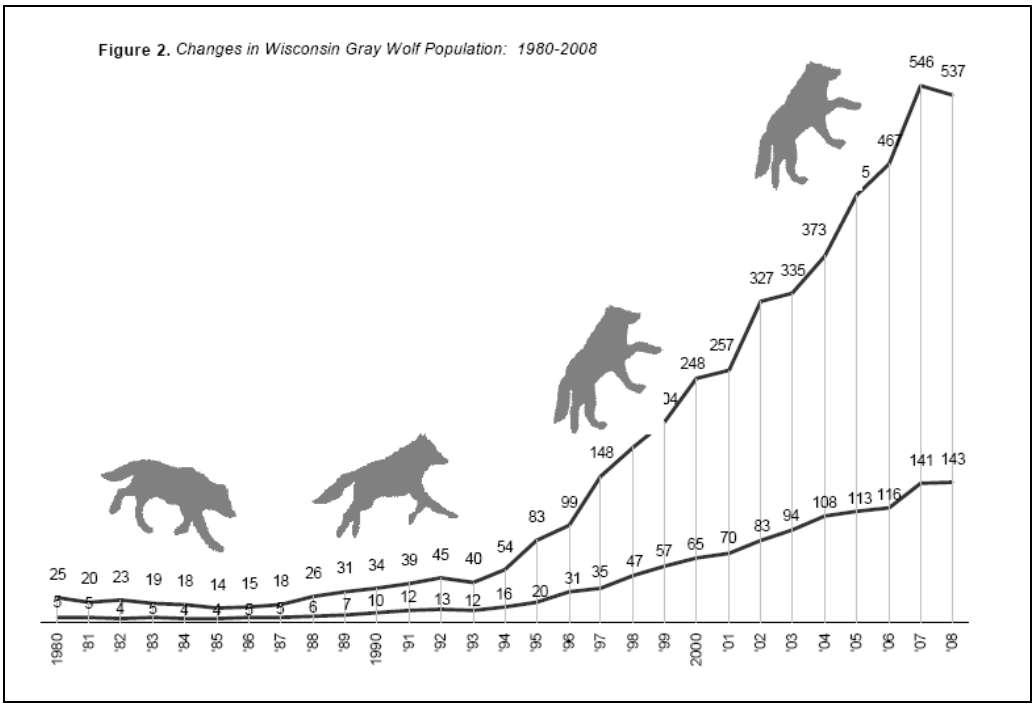


Figure 4.r: Changes in Wisconsin gray wolf population and number of wolf packs 1980-2008
Source: DNR, 2008

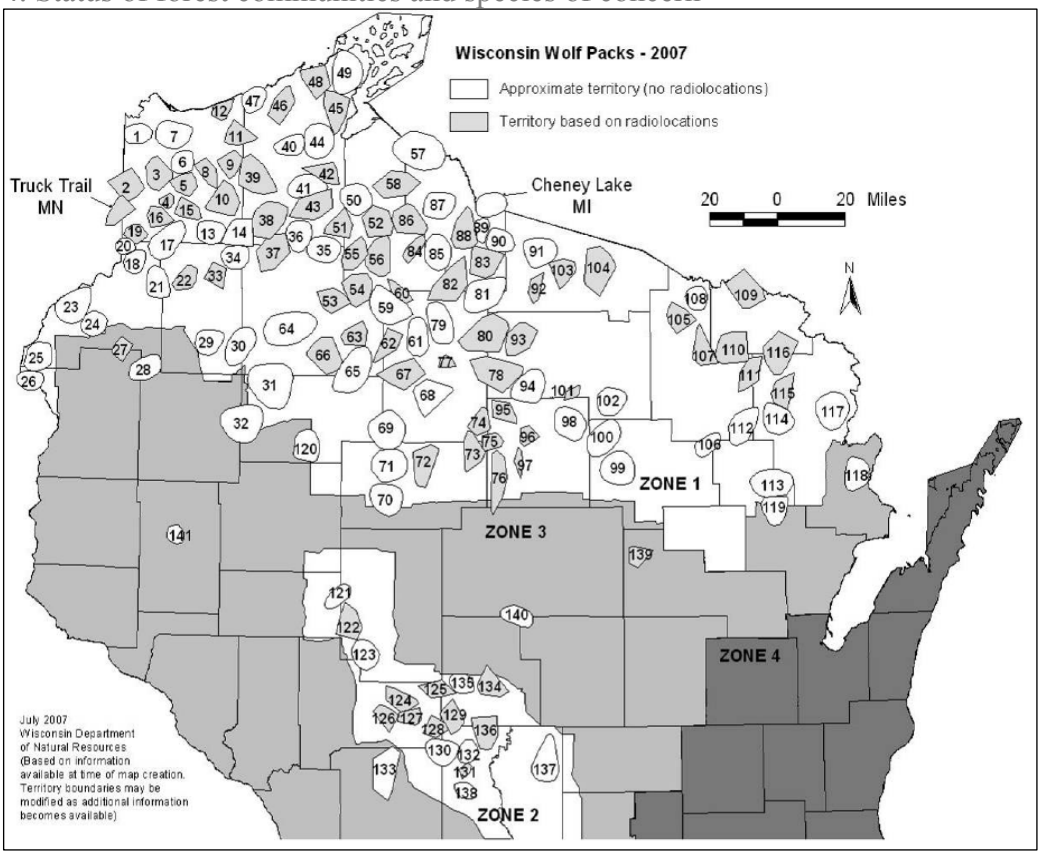


Figure 4.s: Gray wolf distribution in Wisconsin (winter 2006-2007)
Source: DNR, 2007

White-tailed Deer

In northern forests in Wisconsin, deer occurred at low relative abundance prior to Euro-American settlement; deer were much more common in the southern savannas and prairies. Following the Cutover, deer became abundant in the mid-1900's. The statewide deer population exploded in the 1980's (Figure 4.t). Statewide deer populations over the last twenty-five years have been historically unprecedented and are causing significant negative impacts to biodiversity, forest ecosystems, and sustainable forest management efforts.

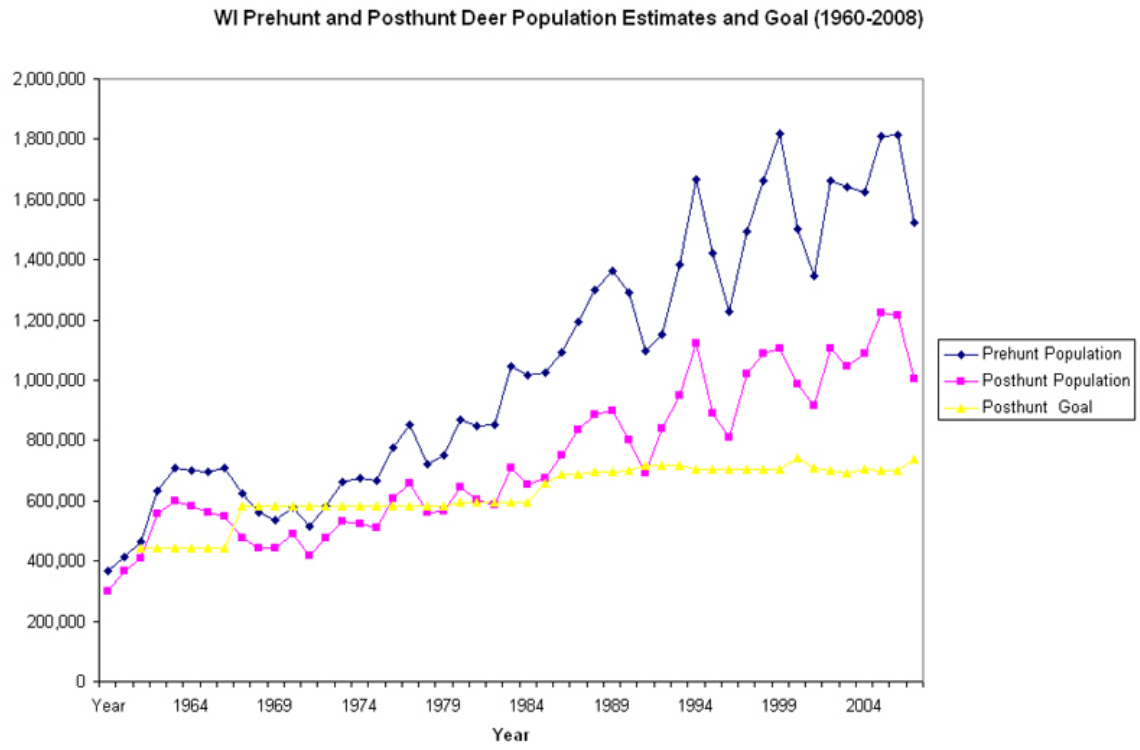


Figure 4.t: Wisconsin deer populations and goals, 1960-2008
Source: DNR, 2008

Table 4.d: Deer population and harvest data highlights since 1960

Year	Estimated population	Total kill	Comments
1962	400,000		
1970		73,000	
1981-1991		167,000 to 352,000	eight record kills
1992-1993	populations decline		deer control relaxed
1995		398,000	record harvest
1999	>1.5 million	402,000	record harvest
2000		615,000	national record
2001-2007	1.4-1.7 million	gun harvests vary 278,000-414,000	
2007		519,000	
2008		453,000	
2009	990,000 statewide post hunt population estimate	329,103	

Source: DNR, 2009

Since 1960, biologists have used hunter harvest and population modeling techniques to estimate herd size. Population goals were first established in 1962. Deer Management Unit population goals are determined by a variety of factors associated with biological and social carrying

capacity. Approximately every 3 years deer population goals are reviewed through a collaborative process between stakeholders, public input and the DNR.

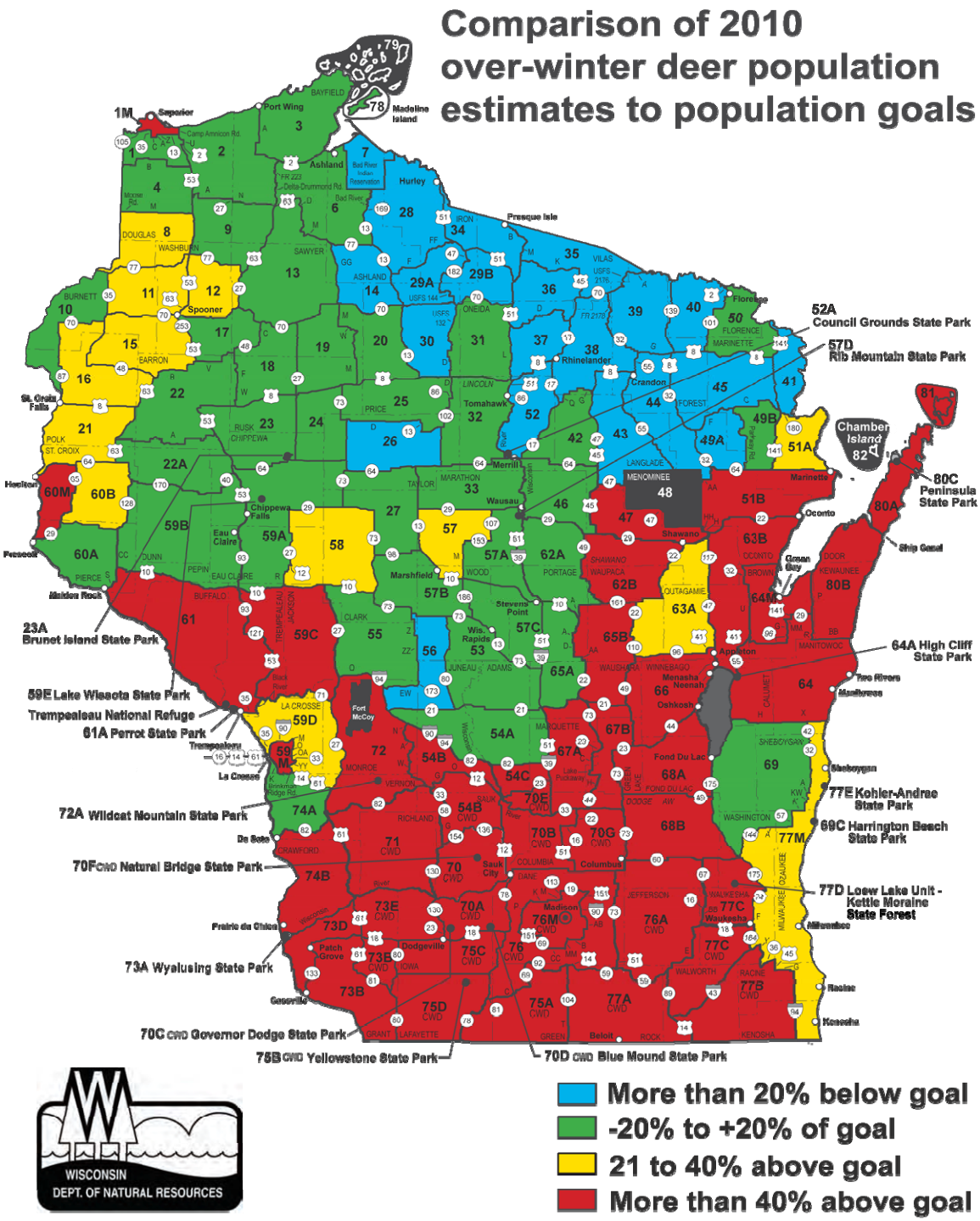
Biological carrying capacity (K) is the maximum number of deer the landscape can support over a prolonged period of time. A deer herd managed at "K" will result in heavy competition between deer, over browsing, and a high percentage of winter mortality. Generally, population goals in forested units are set about 60-65% of K. A deer population managed at these levels has shown to result in a long-term sustainable harvest and a healthy deer herd.

In units that are more agricultural or urbanized, social carrying capacity is usually a bigger factor in determining deer goals. The social carrying capacity is the number of deer that is less likely to cause excessive property damage, while still providing good recreational opportunities for hunting and viewing deer. Generally these units have more nutritional resources which create a higher K. However, if these units were managed at 60-65% of K, controlling the herd would be very difficult and the level of damage caused would be intolerable to many property owners. The goals in these units are set significantly below K to maintain this balance.

Between 1962 and 1984, the post-hunt estimate averaged 1% over goal. Between 1985 and 1994, the post-hunt estimate averaged 16% above goal, and between 1995 and 2009 the average was 47% over goal. The post-hunt estimate indicates that the statewide deer herd has been at or within 5% of goal only once in the last 20 years.

Overall, Wisconsin's estimated post-hunt deer population is above goal. At the end of the 2009 deer season, however, statewide harvest data suggests progress toward goal. Most units within farmland regions are still above goal, while most units in the north are currently near or below goal (Figure 4.u).

The original over winter (1960 - post hunting season) goal for the Wisconsin deer herd was 441,900 deer. As deer range expanded and hunting interest increased, the post-hunt goal grew until it stood at 794,000 in 2010, an increase of approximately 80% from the original goal and 8% higher than in 2009. Overwinter goals were raised by 10-67% in 43 deer management units, and lowered 17-20% in 2 deer management units around the state. The last time deer populations were near goal (early 90's), hunter pressure resulted in the relaxing of herd control, which was followed by an exploding population and soon thereafter a national record deer harvest.



DMU goals are established in the Wis Adm Code, NR 10.107

Map 4.a: Comparison of 2010 over-winter deer population estimates to goals
Source: DNR, 2010

Deer damage to forest regeneration and forest ecosystems has been in evidence since at least the 1950's. Over time and with exploding deer populations, negative impacts have increased, effects continue to accumulate over time and space, and some effects are becoming difficult, if not

impossible, to reverse. Sustained high deer populations, particularly over the past twenty-five years (with only brief intermittent population declines), are significantly impacting ecosystem processes and the practice of sustainable forestry, causing ecological and economic losses. Deer browsing of forest vegetation can alter community composition and structure, change habitat, and reduce or eliminate populations of plants and animals. Deer browsing of tree regeneration can cause regeneration failures, increase regeneration costs, and reduce timber productivity. These losses affect most citizens of Wisconsin through impacts on ecosystem services, recreation, and economics. Overabundant deer in some zones will continue to be a significant barrier to sustainable forest management and the conservation of biodiversity.