Birds of Northern Wisconsin Pine Forests

by Randy M. Hoffman and Michael J. Mossman

Travelers bound north through Wisconsin know they are approaching the "northwoods" when they see their first pine. This perception has an ecological significance, for, botanically, pines are important in distinguishing our state's northern, or "mixed hardwood-coniferous" forest from southern, or "eastern deciduous" forest. These two general forest biomes separate themselves along the tension zone, which extends roughly from Polk County on the northwest, to Milwaukee County on the southeast (Curtis 1959). These same travelers, however, may sometimes be fooled by pines growing in southern Wisconsin in the isolated relics of rocky slopes and draws and some Wisconsin River sand terraces, and in artificial pine plantations.

Wisconsin's northwoods actually include several related forest types, the most extensive of which is the hardwood-hemlock forest described by Curtis (1959) as "northern mesic." That forest type and its bird life were discussed by Hoffman (1989). Our present article deals specifically with those northern forests dominated by pines or by pines and hardwoods, particularly oaks. These forests cover a relatively wide range of structures, from the dense young stands of the central and northwestern sand barrens regions, where birdwatchers and biologists search for the elusive Kirtland's Warbler, to mature stands in which Blackburnian and Pine Warblers breed among towering old pines.

Curtis (1959) divided pine forests

An old-growth Red Pine stand (*photo by Robert Read*).

into "northern dry" and "northern dry-mesic" categories (Table 1). Northern dry forest has either jack pine or red pine as a canopy dominant. It occurs on sandy glacial outwash or lake plains and less commonly on sandy ridges. Balsam fir (*Abies balsamea*), red pine, white pine, and spruces often form a sub-canopy. Common shrub species are blueberry (*Vaccinium angustifolium*), dwarf blackberry (*Rubus pubescens*), bush honeysuckle (*Diervilla lonicera*), hazelnut (*Corylus americana*), and beaked hazelnut (*C. cornuta*). The most prevalent groundlayer species are Canada mayflower (*Maianthemum canadense*), bracken fern (*Pteridium aquilinum*), wild sarsaparilla (*Aralia nudicaulis*), false solomon's seal (*Smilacina racemosa*), starflower (*Trientalis borealis*), wintergreen (*Gaultheria procumbens*), pipsissewa (*Chimaphila umbellata*), large-leaved aster (*Aster macrophyllus*), dogbane (*Apocynum androsaemifolium*), and penn sedge (*Carex pennsylvanica*). Northern dry forest dominated by jack pine extends somewhat beyond the tension zone on the bed of extinct Glacial Lake Wisconsin, as far south as northern Sauk County.

Curtis' northern dry-mesic forest occurs principally on glacial outwash, glacial lake plain and thin drift over bedrock. White pine is nearly always present as a dominant, but occasionally red pine or hemlock (*Tsuga canadensis*) are dominant. Common shrub layer species are sapling maples, bush honeysuckle, beaked hazelnut, maple-leaved viburnum (*Vibernum acerifolium*), bunchberry (*Cornus canadensis*), alternate-leaved dogwood (*Cornus alternifolia*), and dogberry (*Ribes cynobasti*). The most prevalent ground layer species are Canada mayflower, wild sarsaparilla, large-leaved aster (*Aster macrophyllus*), bracken fern, starflower, bedstraw (*Galium triflorum*), false solomon's seal, wood anemone (*Anemone quinquefolia*), and bluebead lily (*Clintonia borealis*).

Thinned Red Pine plantation showing the absence of any shrubs or ground layer plants typical of natural stands (*photo by Cliff Germain*).

Hardwood trees associated with northern dry or dry-mesic forests include several oak species, aspens, paper birch, red maple, and on the most mesic sites, sugar maple (Table 1).

In the following discussion of pine forests, we distinguish types based on the dominant species of pine, and consider other important characteristics such as the age of a forest stand, and the extent to which oaks and other hardwoods are intermixed. Let us begin by considering the dominant pine species.

Jack pine is a short-lived, shade-intolerant, pioneer species that grows best in dry sandy and gravelly soils of glacial outwash. However it can also do quite well in moist soils and even in the poorly drained organic soils of bogs

Table 1. Comparison of the 5 most dominant canopy species in Curtis' (1959) pine forest types.

Species	Northern Dry Forest	Northern Dry-Mesic Forest
Jack pine	1	—
Red pine	2	—
White pine	3	1
Hill's oak	4	—
Trembling aspen	5	—
Red maple	—	2
Red oak	—	3
Paper birch	—	4
Sugar Maple	—	5

(Majcen 1980). Jack pines have serotinous cones that release seeds only after exposure to heat. Most naturally occurring jack pines are established after forest fires because the fire exposes a mineral soil seed bed and heats the cones enough to release their seeds. Thus, jack pine stands are usually "even-aged," that is, with all trees having originated at approximately the same time. Many of today's jack pine stands, especially on Glacial Lake Wisconsin sands, originated since settlement on sites where frequent fires previously maintained open, savanna-like "barrens"—a community to be discussed in a forthcoming article of this series. In the continued absence of fire, jack pine forest may in turn be succeeded by red pine, white pine, or oaks, particularly Hill's oak, which is a common associate of jack pine.

Red pine, often mistakenly called Norway pine, occurs in pure stands or mixed with white pine, jack pine, or hardwoods. It grows best on well drained sandy to loamy soils, but is most common on sands (Benzie 1977). This tree is intolerant of shade and is long-lived, and sometimes succeeds less tolerant and shorter-lived species such as jack pine, paper birch, and aspen (*Populus* sp.). Most stands live to about 200 years old; however, some individuals can reach 400 years. Natural regeneration usually depends on wildfire, although red pine is somewhat resistant to ground fires (Curtis, 1959). In the absence of major disturbance, especially on more mesic soils, red pine stands often succeed to hardwoods or white pine.

White pine is by far the largest tree that grows in Wisconsin. It can reach a height of nearly 200 feet, a diameter of twelve feet, and can live for up to 500 years. Ecologically, it is similar to red pine, but prefers more mesic sites, growing best in deep loams or sandy loams (Curtis 1959). It also grows in organic and sandy soils, but on these suboptimal sites it rarely dominates the forest (Wendel 1980). White pine establishes itself best on bare mineral soil. Scattered seeding occurs beneath small canopy openings and dense stands are sometimes established in larger openings, especially after a disturbance such as fire exposes mineral soil. If undisturbed, stands on more mesic sites tend to succeed to Curtis' northern mesic forest, with a canopy dominated by red oak, sugar maple, and hemlock. However because of white pine's longevity, individuals may persist in these mesic forests for decades or centuries as supercanopy giants.

Fire has long been identified as an important factor in the perpetuation of white pine (Maissurow, 1941; Mayall 1941), red pine (Spurr, 1954, Frissell, 1973) and jack pine (Eyre and LeBarron, 1944), and it was critical in producing the extensive pine forests that existed in northern Wisconsin

prior to settlement. During the last five centuries, about 95% of the forest in northern Wisconsin burned (Maissurow 1941). In general, pine forests were initiated when fire removed competing vegetation and prepared the soil for the next generation of forest. The pines then seeded in and grew to maturity, or were thinned and maintained by light disturbances, or were returned to an earlier successional stage by catastrophic disturbance. Hardwoods could also seed in, and species such as oaks and aspens could return as well from root or stump sprouts. While fire and windthrow could set back succession almost instantaneously, the progression to more mesic forest undoubtedly sometimes spanned centuries.

Fire return interval (the average number of years between naturally occurring fires) was very important in determining pine forest structure and composition. This return interval varied between sites due to various factors including soils, landforms, topography, lakes and streams. In the Boundary Waters Canoe Area, the fire return interval was determined to be about fifty years (Van Wagner 1971). Fire *intensity* was also important in determining the structure of pine forest. Red pine forests, for example, seem to do best with alternating light and intense fires (Heinselman, 1973, Bergeron & Brisson, 1990).

Presettlement conditions are rarely present today and the exacting conditions for regeneration by wildfire are rarely met, especially for red and white pine (Ahlgren, 1976). This is due primarily to a much smaller component of seed pine trees because of past logging, the abundance and aggressive nature of aspen, white pine blister rust, the fragmented nature of today's forest, and aggressive fire control practices.

The nature of the forests have changed greatly since settlement. The great pine forests were eagerly sought by the first wave of lumbermen. Logging continued, and by 1930 nearly all of the forest was cut at least once. Since that time large areas of northern Wisconsin have become reforested, due in part to the development of nurseries that supply the state with large numbers of pine seedlings. In a recent inventory (Smith 1986), jack pine and red pine greatly exceeded presettlement acreages (Table 2). However, these figures are misleading in that they include sapling and pole-sized stands, as well as plantations, which in aggregate comprise a large percentage of the pines growing in the state.

Forest resembling the old-growth stands of presettlement time today persists only in small, often isolated stands. To identify these areas of presettlement quality, the Wisconsin Natural Heritage Inventory conducted a county-by-county search for significant natural areas. This survey identified pine forests with a history of little or no human disturbance, especially logging; and stands that appeared to have recovered sufficiently from such past disturbance that forest structure and composition were effected primarily by the forces of natural disturbance and succession. These stands included forest of relatively old growth (generally greater than 100 years for red and white pine), and with a high floristic diversity in the shrub and ground layer. The survey found a drastic reduction in the extent of presettlement-quality pine forest (Table 2).

Table 2. Comparison of presettlement and current pine forest acreages.

Northern forest type[1]	Presettlement acreage	Current acreage[2,3] of presettlement quality
Dry	340,000	2,930
Dry-mesic	1,930,000	13,578
Total	2,270,000	16,508

[1]From Curtis (1959).
[2]Wisconsin Natural Heritage Inventory data.
[3]From Smith (1986).

We have very few data on the bird life of Wisconsin's pine forests prior to the early and extensive logging that changed these forest landscapes so drastically. However, the state's Natural Areas Breeding Bird Survey has provided substantial information on the present avifaunas of both natural and human-influenced stands. As one might expect, breeding-bird communities vary with the general successional changes and moisture regimes described above, but also with a host of other factors such as the relative proportions of pines and hardwoods, the specific sort of understory development and its pattern within the forest, local disturbances or variations in substrate, geographical location, and surrounding land uses.

For all 3 pine forest categories, for example, bird community succession following catastrophic fire or logging begins with open-country and shrub-loving species such as Brown Thrasher, Mourning Warbler, Common Yellowthroat, and the Clay-colored, Vesper, and Field Sparrows. It progresses, eventually, to those species such as Eastern Wood-Pewee, Ovenbird, and Pine Warbler that require relatively mature trees or a well-developed canopy. The historic and site-related factors that determine the prevalence of a stand's hardwood component will influence whether the bird community is dominated by species that prefer hardwoods (e.g., White-breasted Nuthatch, Red-eyed Vireo, Scarlet Tanager) or conifers (e.g., Red-breasted Nuthatch, Chipping Sparrow, and the Nashville Warbler, Blackburnian Warbler, Pine Warbler, and Yellow-rumped Warbler). A number of more generalized species would be expected to be fairly common regardless of the relative proportions of pines and hardwoods, so long as other general structural requirements are met. These include the Eastern Wood-Pewee, Blue Jay, Black-capped Chickadee, and Ovenbird.

At any successional stage bird species diversity within a forest stand may be increased by a high "horizontal diversity," that is, a variety of vertical forest structures among different parts of the stand. The greatest such diversity appears to occur in old-growth stands, which meet the requirements of species that prefer large trees (e.g., Pileated Woodpecker, Blackburnian Warbler, Pine Warbler) or a well developed, shaded, hardwood understory (e.g., Veery, Hermit Thrush, Connecticut Warbler), as well as some other species that require the various structures of earlier successional stages, which develop in gaps where the canopy has been opened by windthrow, disease, or local fire.

Table 3 summarizes the general composition of breeding-bird communities in the 3 types of pine forest. The most common species overall are the Blue Jay, Black-capped Chickadee, Nashville Warbler, Ovenbird, and Brown-headed Cowbird.

The jack pine forest bird community is distinctive in the high importance of Nashville Warbler and the scarcity of species that prefer large trees. Jack pine woods are relatively common in central and northwestern Wisconsin, because of the periodic occurrence of wildfire, which remains difficult to control in these sandy regions, and because of the relative lack of competition from other plants. However, very few stands are taller than about 45 ft., due to fire frequency, the species' value as a source of wood pulp, and its relatively short life span.

Jack pine forest usually begins in a barrens-like situation, often with scattered jack pine and hardwood trees and saplings, and a mixed ground cover of pine seedlings, heath, hazel shrubs, and grass or penn sedge. Common birds include Mourning Dove, Brown Thrasher, Northern Flicker, Eastern Kingbird, Cedar Waxwing, Eastern Bluebird, Brown-headed Cowbird, American Goldfinch, Rufous-sided Towhee, and the Vesper, Field, Chipping, and Clay-colored Sparrow. As pines seed in and then develop into a young woods with trees up to 20 ft tall, most open-country species become relegated to openings, Chipping Sparrows increase, and Blue Jays, chickadees, and Nashvilles appear in numbers. As stands continue to mature to a height of 40 ft, a separate understory layer typically develops, which may be variously dominated by penn sedge, heath, or hardwood shrubs and saplings. At this stage, Nashville Warblers and Ovenbirds are likely to be abundant, Hermit Thrushes may occur in the understory, and pewees and Least Flycatchers may appear among the lower canopy. When stands attain greater heights, Blackburnian Warblers and Pine Warblers may occur, and the flycatchers increase, often along with Red-breasted Nuthatch and Yellow-rumped Warbler. Throughout this progression, sites beneath an open or an especially thin canopy may develop hardwood shrub or sapling growth, therefore providing habitat for Black-billed Cuckoo, Gray Catbird, Veery, Common Yellowthroat, Mourning Warbler, Chestnut-sided Warbler, and Indigo Bunting. Species such as Blue Jay, Black-capped Chickadee, American Robin, and Brown-headed Cowbird generally remain fairly common throughout the life of a jack pine stand.

When Hill's oak becomes co-dominant with jack pine, or supersedes it, Nashvilles and Chipping Sparrows decline noticeably. Eventually, if all pines disappear, the succeeding oak forest is typically dominated by the following: Eastern Wood-Pewee, Least Flycatcher, Great Crested Flycatcher, Blue Jay, Black-capped Chickadee, White-breasted Nuthatch, Yellow-throated Vireo, Red-eyed Vireo, Chestnut-sided Warbler, Ovenbird, Scarlet Tanager, Rose-breasted Grosbeak, and Indigo Bunting. See Mossman and Lange (1982) for an example of changes in bird species along a cline from jack pine barrens and woods to oak forest.

One species that we have yet to discuss, but which is characteristic of a particular sort of jack pine forest, is

Table 3. Comparison of species abundance in 3 types of pine forests. Numbers indicate the ranking of top 9 species within each type.

Species	Forest Type		
	White Pine	Red Pine	Jack Pine
Great Blue Heron		*	
Sharp-shinned Hawk			R
Broad-winged Hawk	U	R	
Ruffed Grouse	U	R	U
Mourning Dove			U
Black-billed Cuckoo			R
Yellow-billed Cuckoo			R
Great-horned Owl		U	
Ruby-throated Hummingbird		U	
Yellow-bellied Sapsucker		FC	
Downy Woodpecker	R	U	U
Hairy Woodpecker	R	U	
Northern Flicker	R		U
Pileated Woodpecker	U		
Olive-sided Flycatcher		U	
Eastern Wood-Pewee		C(8)	U
Least Flycatcher		FC	
Crested Flycatcher	U	FC	C(8)
Tree Swallow			C(9)
Blue Jay	C(4)	C(6)	C(3)
Common Raven	U		
American Crow	U	FC	U
Black-capped Chickadee	C(7)	C(4)	FC
Red-breasted Nuthatch	C(8)	U	
White-breasted Nuthatch	U	U	R
Brown Creeper		U	
Winter Wren		R	
Golden-crowned Kinglet		R	
Eastern Bluebird			U
Veery	C(2)	FC	
Hermit Thrush		U	C(4)
Wood Thrush	R	R	
American Robin	R	U	U
Brown Thrasher		R	
Cedar Waxwing	FC	U	FC
Solitary Vireo		R	
Red-eyed Vireo		C(3)	U
Golden-winged Warbler	R		
Nashville Warbler	C(9)	FC	C(2)
Northern Parula		R	
Yellow Warbler		R	
Chestnut-sided Warbler		R	R
Yellow-rumped Warbler		R	U
Black-throated Green Warbler	U	C(9)	
Blackburnian Warbler	C(5)	C(7)	U
Pine Warbler	C(3)	A(2)	
Black-and-White Warbler	R	U	R
American Redstart		R	
Ovenbird	A(1)	A(1)	A(1)
Connecticut Warbler		U	U
Common Yellowthroat	U	U	U
Canada Warbler	C(6)	U	

(continued)

Table 3. *Continued*

Species	Forest Type		
	White Pine	Red Pine	Jack Pine
Scarlet Tanager	FC	U	R
Rose-breasted Grosbeak	R	R	U
Indigo Bunting	R		C(7)
Rufous-sided Towhee		R	U
Chipping Sparrow	R	U	C(6)
Song Sparrow	R	C(5)	U
White-throated Sparrow	R	FC	R
Red-winged Blackbird			R
Brown-headed Cowbird	FC	FC	C(5)
Northern Oriole	R		R
Purple Finch		FC	
Red Crossbill			R
American Goldfinch		R	R

FC = Fairly Common, U = Uncommon, R = Rare.
* = One colony was present on one stand.

the Connecticut Warbler. Bent (1963) states this species is a bird of vast tamarack and black spruce swamps, breeding from Ontario and northern Michigan northwestward to northern British Columbia. Bent also references habitat further west as being on dry, aspen ridges. More recent literature still refers to Connecticut Warbler habitat in the same terms (Terres, 1980, Peterson, 180, Ehrlich, 1988).

The Connecticut Warbler in Wisconsin does indeed occasionally inhabit areas as previously described. However, more often they breed here in an entirely different niche, that is, in areas of sandy or gravelly glacial outwash, among the dense shrub layer that occasionally forms under mid-aged to old-aged jack pine and sometimes red pine. The necessary shrub formation does not occur when tree densities are high enough to form a relatively closed canopy. Likewise, appropriate habitat often becomes unsuitable when a subcanopy layer of hardwood saplings develops.

A species that is even rarer than the Connecticut Warbler, and which occurs only in jack pines is the Kirtland's Warbler. Several territorial males have been found in recent years in dense young stands, but breeding has never been documented.

In general, the bird communities of red and white pine forests undergo similar stages of succession as do the jack pine communities. However, because of the greater lifespan of these latter species, succession more often continues to include birds that prefer larger trees or a more complex forest structure. If succession proceeds to more mesic, hardwood-dominated forest, the breeding avifauna approaches that described by Hoffman (1989).

Distinguishing features between the breeding-bird communities of Wisconsin red and white pine forests correspond with differences in the respective moisture regimes and degree of openness. This is somewhat exaggerated and obscured in Table 3, the white pine stands of which were concentrated in partially damp sites near streams in Jackson County. Neverthe-

less, the greater abundance, in white pine stands, of species such as Veery and Canada Warbler, and the relatively fewer Hermit Thrushes, American Robins, and Song Sparrows, are consistent with one or the other of these differences. The relatively common occurrence of Red-breasted Nuthatch, Blackburnian Warbler, and Pine Warbler reflects the presence of mature pines. However, of these 3 species, the nuthatch and Blackburnian Warbler often breed in other types of forest as well, where they associate with mature conifers such as hemlock, spruce, and fir. Only the Pine Warbler depends entirely on mature and old-growth pines. This species has an unusual geographic distribution. It occurs across the broad pinelands of the south, the pitch pinelands of the Atlantic coastal plain, and across the northern tier of states into Canada, where it utilizes red pine, jack pine and white pine. The species prefers somewhat open pine woods with large trees. It seems to shun dense stands of white pine (Bent, 1963) and most of the younger stands in the Midwest, although it is not uncommon in the scrub pine barrens of the east coast. The Pine Warbler is one of the few warblers that winters in part of its breeding range.

An artificial community that in some ways approximates natural pine forests is the conifer plantation, examples of which are scattered liberally throughout the entire state. Red pine is now by far the most commonly planted, often with the encouragement of state, county, or private foresters, and to the detriment of native or non-native grasslands, natural barrens communities, or naturally regenerating forest. Other plantations are maintained as Christmas tree farms, although these are usually dominated by spruces.

The Natural Areas Breeding Bird Survey includes data from several pine plantations of various ages and types from around the state (Table 4). When these plantations are young they often provide valuable breeding habitat for open-country bird species, especially if they are at least 80 acres in size or are part of a similar-sized tract that includes other appropriate "grassland" habitat. However, this lasts only until trees reach the height of about 8 ft., or until tree cover reaches about 75%. Species typical of this early stage of plantation development include many of those described previously for jack pine barrens-like habitat, especially on xeric sites. However, the community is generally dominated by Chipping Sparrows, Field Sparrows, and Clay-colored Sparrows. In southern Wisconsin, Clay-colored Sparrows are nearly limited to these young pine and, especially, spruce plantations.

Beyond this stage, plantations develop a very simple structure as understory plants are shaded out by the thick canopy. Chipping Sparrows and sometimes a few Black-capped Chickadees or Blue Jays inhabit these "biological deserts." Northern House Wrens may be attracted by piles of branches left behind by trimming operations. Other species such as American Robin, Brown-headed Cowbird, and Cedar Waxwing often occur in low numbers as well, but usually near edges. Like the chickadee and jay, they are often found to be dependent on adjacent forests, edges, or open lands for feeding or nesting.

This sterile condition usually prevails until the stand is harvested at the age of 30–40 years. Exceptions to this

Table 4. Examples of conifer plantation bird communities.

Species	Numbers of birds recorded during surveys in: Young red pine[1]	Closed-canopy red pine[2]	Mature jack pine[3]	Over-mature red/white pine[4]	Mature spruce[5]
Sharp-shinned Hawk	—	—	—	—	1
Mourning Dove	—	—	—	—	2
Northern Flicker	—	—	—	1	—
Acadian Flycatcher	—	—	—	5	—
Least Flycatcher	—	—	—	2	—
Eastern Wood-Pewee	—	—	3	—	—
Tree Swallow	4	—	—	—	—
Barn Swallow	—	—	—	—	2
Purple Martin	2	—	—	—	—
Blue Jay	—	3	5	2	8
American Crow	—	—	1	—	—
Black-capped Chickadee	—	3	2	2	5
White-breasted Nuthatch	—	—	1	—	—
Red-breasted Nuthatch	—	—	2	—	—
Northern House Wren	—	—	4	7	—
Brown Thrasher	—	—	—	—	4
American Robin	—	1	5	3	2
Hermit Thrush	—	—	3	—	—
Eastern Bluebird	1	—	—	—	—
Golden-crowned Kinglet	—	—	—	—	3
Cedar Waxwing	—	3	—	1	4
Solitary Vireo	—	—	2	—	—
Red-eyed Vireo	—	—	—	1	—
Nashville Warbler	—	—	1	—	—
Black-throated Green Warbler	—	—	—	1	—
Chestnut-sided Warbler	—	—	—	2	—
Pine Warbler	—	—	—	2	—
Ovenbird	—	—	—	5	—
Mourning Warbler	—	—	—	2	—
Brown-headed Cowbird	2	2	2	1	3
Northern Cardinal	—	—	—	1	7
Rose-breasted Grosbeak	—	—	2	—	—
Indigo Bunting	—	—	—	4	1
Pine Siskin	—	—	5	—	—
American Goldfinch	2	—	—	2	—
Rufous-sided Towhee	—	—	—	2	—
Vesper Sparrow	15	—	—	—	—
Chipping Sparrow	1	11	12	15	13
Clay-colored Sparrow	27	—	—	—	—
Field Sparrow	14	—	—	—	—
Song Sparrow	1	—	—	—	—

[1]Number recorded during 5 walk-5-minutes-and-stand-5-minutes periods at a 7-foot-tall stand in Adams Co.

[2]Number recorded during 3 walk-5-minutes-and-stand-5-minutes periods at a 45-foot-tall stand in Jackson Co.

[3]Number recorded during 5 walk-5-minutes-stand-5-minute periods at a 40-foot-tall stand in Douglas Co.

[4]Number recorded during 6 walk-5-minutes-stand-5-minutes periods at a 65-foot-tall stand at Waukesha Co.

[5]Number recorded during 10 walk-5-minutes-stand-5-minutes periods at a 40-foot-tall stand in Sauk Co.

scenario occur in situations where more natural conditions develop. For instance, plantations situated in a landscape of coniferous or mixed forests seem to provide some degree of habitat to locally occurring bird species that are adapted to using conifers for feeding or nesting, and which can include plantations within their breeding territories. Plantations within these situations are also more likely to incorporate, from local sources, plant and probably invertebrate species that are adapted to coniferous communities, thus creating less of a "desert" for breeding birds.

Plantations with a thin or broken canopy are also of value, because the penetration of sunlight encourages understory growth and consequently a more diverse structure that may satisfy the breeding requirements of bird species typical of the natural pine forest understory. Jack pine plantations are generally better than others, in that their foliage is naturally sparse, and they are practicably planted only in sandy sites that tend to succeed naturally to jack pine forest.

In those rare cases when a plantation is allowed to develop well beyond the recommended age of final harvest, natural attrition of senescent canopy trees occurs, and understory and subcanopy layers eventually develop. The plantation actually becomes dynamic, with a relatively complex structure, thus more closely approaching a true forest. The Southern Kettle Moraine State Forest has some examples of these old plantations, which provide for an unusual and rich breeding-bird fauna that includes both southern and northern species reliant on mature forests (Table 4).

Plantations of white, blue, and Norway spruce (*Picea glauca, P. pungens, P. abies*) develop through similar stages of structural complexity and bird diversity. However, even when stands are very dense and only 30 ft tall, habitat is often afforded for coniferous forest species such as Sharp-shinned Hawk and Golden-crowned Kinglet. This occurs even well south of the tension zone (Table 4).

The natural landscape in which the northwoods bird community evolved was a mosaic of types and successional stages. To maintain healthy populations of bird species and communities in northern Wisconsin, we should encourage this diverse sort of landscape, while accounting for the minimum habitat size requirements (Temple 1988) of these species. The management of the pine forest component of this mosaic presents a peculiar yet well-recognized problem, because sites protected from fire or certain human manipulations tend to succeed to hardwoods. This illustrates the fallacy of relying solely on the protection of relatively small natural areas in perpetuity, and argues convincingly for a landscape-scale approach that incorporates fire as a management tool. Perhaps only thus can we foster a dynamic mosaic that provides the full range of habitats required by northern forest wildlife.

Sites

The following 4 sites are offered as representative pine forest stands, with ready access to birdwatchers. Breeding-bird communities are summarized in Table 5.

Table 5. Comparison of the breeding birds on four stands of northern pine forests.

Species	Castle Mound	Moquah Barrens	Frog Lake	Brant Brook Pines
Osprey			X	
Cooper's Hawk	X			
Broad-winged Hawk	X		X	
Red-tailed Hawk	X			
American Kestrel	X			
Ruffed Grouse	X	X	X	
Black-billed Cuckoo	X	X		
Great-horned Owl	X			
Ruby-throated Hummingbird	X			
Yellow-breasted Sapsucker		X	X	X
Downy Woodpecker	X		X	
Hairy Woodpecker	X	X		
Northern Flicker	X	X	X	
Pileated Woodpecker	X			
Eastern Wood-Pewee	X	X	X	X
Alder Flycatcher			X	
Least Flycatcher		X	X	X
Eastern Phoebe	X			
Crested Flycatcher	X	X	X	X
Eastern Kingbird		X	X	
Purple Martin	X			
Tree Swallow		X	X	
Blue Jay	X	X	X	X
Northern Raven		X		
American Crow	X	X		X
Black-capped Chickadee	X	X	X	X
Red-breasted Nuthatch	X	X	X	
White-breasted Nuthatch	X	X	X	X
Brown Creeper		X		
House Wren	X	X		
Winter Wren			X	X
Sedge Wren			X	
Eastern Bluebird		X	X	
Veery		X	X	X
Hermit Thrush		X	X	
Wood Thrush		X	X	
American Robin	X	X	X	X
Gray Catbird	X	X		
Brown Thrasher		X		
Cedar Waxwing	X	X	X	
Solitary Vireo	X	X		
Yellow-throated Vireo				X
Red-eyed Vireo	X	X	X	X
Golden-winged Warbler				X
Nashville Warbler	X	X	X	
Northern Parula			X	X
Yellow Warbler		X		X
Chestnut-sided Warbler		X		X
Yellow-rumped Warbler		X	X	
Blue-throated Green Warbler	X	X	X	
Blackburnian Warbler			X	
Pine Warbler	X	X	X	X
Black-and-White Warbler	X	X	X	X
American Redstart	X	X		X
Ovenbird	X	X	X	X

(*continued*)

Table 5. *Continued*

Species	Castle Mound	Moquah Barrens	Frog Lake	Brant Brook Pines
Northern Waterthrush			X	
Connecticut Warbler		X		
Common Yellowthroat		X	X	X
Canada Warbler	X			X
Scarlet Tanager	X	X		X
Rose-breasted Grosbeak	X	X		
Indigo Bunting	X	X		
Rufous-sided Towhee	X	X		
Chipping Sparrow	X	X	X	X
Song Sparrow		X	X	
White-throated Sparrow		X	X	
Dark-eyed Junco		X		
Red-winged Blackbird		X		
Brown-headed Cowbird	X	X		
Northern Oriole		X		
American Goldfinch	X	X		

Castle Mound Pine Forest

Size.—Eighty acres, permanently separated from surrounding forest land by roads.

Location.—Jackson County, just south of the city of Black River Falls. The site is a disjunct part of Black River Falls State Forest. A state park sticker is required to enter.

Access.—Follow U.S. Hwy. 12 south one mile from bridge over the Black River in Black River Falls to Castle Mound Roadside Park.

Description.—Castle Mound is a weathering butte rising about 180 feet above the surrounding sand plain in the Driftless Area. It is composed of Cambrian sandstone about 400 million years old. Exposed and shaded cliff faces up to thirty feet high occur along the central backbone ridge, and sandstone boulders litter the sloping forest floor. The NW-SE trending mound has many different microclimates resulting in contrasting forest communities. The protected northeast slope is forested with a mixed pine forest of white and red pines with Hill's oak, white oak, paper birch, red maple, and large-toothed aspen. Groundlayer species typical of the northern forest—pipsissewa, large-leaved aster, partridge berry, and wintergreen—grow here. The dry southwest face is wooded with jack pine and oak.

Birds.—Most of the avifauna comprises birds that frequent hardwood forests and woodlots statewide, Red-tailed Hawk, Black-billed Cuckoo, Great-horned Owl, Black-capped Chickadee, White-breasted Nuthatch, House Wren, American Robin, Gray Catbird, Cedar Waxwing, Indigo Bunting, Rufous-sided Towhee, and Brown-headed Cowbird, Blue Jay, American Crow, Red-eyed Vireo, and Rose-breasted Grosbeak. Chipping Sparrows are also common. For the bird-watcher, the real significance of the site lies in a number of species regularly nest that usually nest much far-

ther north in Wisconsin: Red-breasted Nuthatch, Solitary Vireo, Nashville Warbler, Black-throated Green Warbler, Pine Warbler, and Canada Warbler.

Moquah Barrens

Size.—The site encompasses 640 acres. Forest road 236 bisects the area. Forest Service management to the south and west is creating an extensive open area for Sharp-tailed Grouse.

Location.—North central Bayfield county, entirely within the boundary of the Chequamegon National Forest.

Access.—From Ashland follow Highway 2 west to the village of Ino, then go north 7 miles on Forest Road 236 which traverses the area.

Description.—Moquah Barrens lies near the eastern edge of an extensive outwash sand plain in northwestern Wisconsin on rolling topography with sandy and sandy loam soils. The designated Natural Area was originally pine barrens, and has been set aside as a research area to study natural succession in the absence of fire. Jack and red pines are associated with red oak, red maple, trembling aspen, large-toothed aspen, and white birch. Protective management has allowed the forest to close in on the barrens openings, in contrast to adjacent fire-restored barrens. The shrub layer is dominated by serviceberry, dewberry, blueberry, sweetfern, hazel, honeysuckle, and sand cherry, and the groundlayer has an abundance of bracken fern, large-leaved aster, Canada mayflower, wintergreen and pearly everlasting. Breeding bird surveys have shown a gradual change from open barrens species through successional forest species to the closed-forest preference species now present.

Birds.—Surveys in the early 1970's indicated several species of open land including Red-tailed Hawk, Vesper Sparrow, Clay-colored Sparrow, and Field Sparrow. These species are rare or absent now. Since then the forest has closed its openings and grown into a mid-aged jack pine, aspen, oak forest. This aging of the forest has allowed appropriate habitat to develop for a new set of species which are now coming into the forest. Foremost among the recent user of the forest is the Connecticut Warbler. It first started showing up several years ago and is now regularly found in June. Other recent additions include Black-and-White Warbler, Black-throated Green Warbler, Yellow-rumped Warbler and Pine Warbler.

Frog Lake and Pines

Size.—There are 192 acres in the State Natural Area, but within the 5,460-acre Manitowish River Wilderness Area of the Northern Highland-American Legion State Forest.

Location.—Southeastern Iron County, just south of Manitowish.

Access.—From Manitowish go south on State Hwy. 47–188 for 0.6 mile to a gated access road, then walk into the site. A sign designating the site is located at the access road.

Description.—Frog Lake and Pines State Natural Area contains a red and white pine forest situated between

Frog Lake and the Manitowish River. The pines are in a medium-age class, the red pines to 2 feet in diameter at breast height and some white pines even larger. Other trees include white birch, aspen, red maple, and balsam fir. The largest pine timber lies south of the east-west woods road and closest to Frog Lake. White pine reproduction is more common southward. Reproduction is most evident where disturbance has occurred or where communities meet. North and east of the lake red pine occurs on soils with 1–3 inches of duff and organics over sandy loam. Frog Lake is a deep, soft, seepage lake with a sandy bottom overlain with muck in many areas. The lake is 45 feet deep with a Secchi disk reading of 8 feet. Submergent aquatics are dense and include bladderwort, Robbin's spike rush, watershield, white and yellow pond lilies, and pondweeds. About 80 percent of the shore is wetland; the remainder, upland pine forest.

Birds.—Frog Lake Pines State Natural Area by virtue of having relatively intact forest and lying within a much larger block of natural vegetation, contains nearly a full compliment of those species preferring older growth red and white pine. A larger area of pines continues west from the State Natural Area Boundary. This may be the largest unbroken tract of relatively large red and white pines anywhere in Wisconsin. In addition to the pines the site contains lakes and several large bogs and marshes which adds to the diversity of the site. Included in these bog areas are records of Palm Warbler and Lincoln's Sparrow.

Brant Brook Pines and Hardwoods

Size.—There are 190 acres surrounded by forest land to the east, north and south. To the west lies the St. Croix River.

Location.—Western Burnett County, within the Governor Knowles State Forest.

Access.—From the intersection of County Hwys. F and D at the north edge of Grantsburg go north on County F 3.25 miles, then west on Pete Nelson Road 2 miles to Gile Road. Proceed north on Gile Road 1.25 miles to the Brant Brook Pines Ski Trail parking lot at a right angle corner. Follow the hiking/ski trail into the area.

Description.—The old-growth northern dry-mesic forest, dominated by red pine, encompasses about 34 acres. Associated species include white pine, jack pine, red maple, red oak, large-toothed aspen, and white birch. A narrow swale of black ash nearly divides the area. The pine stand origin is estimated at 1894. Some wind throw occurred in a 1977 storm. On the level upland terrace above the pines is a dense forest of small oaks; on the low terrace below the pines a more mature swamp hardwood forest of oak, black ash, and red maple occurs. Soils consist of (1) Nymore sand, excessively drained deep sandy soils on the flat uplands; (2) Omega sand and loamy sands, well-drained sandy soils on the river terraces; and (3) rocky and seepage areas in the bottoms. Brant Brook, which contains native brook trout, is a steep gradient, cold water stream, 2–

4 feet wide and only several inches deep. The bottom is primarily sand.

Birds.—Brant Brooks birds are easily reached via hiking/ski trails. These trails enter the older growth red pines, but also go through extensive areas of mid-aged jack pine and oaks. These different habitats add to the diversity of the area. The exciting part of the old pines is the excellent forest structure, with a dense midstory and shrub layer. These lower layers provide habitat for Golden-winged Warbler, Chestnut-sided Warbler, American Redstart and Canada Warbler.

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