Management of New England Northern Hardwoods, Spruce-Fir, and Eastern White Pine for Neotropical Migratory Birds

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Abstract — Habitat management for neotropical migratory birds must be based upon land capability, vegetation, successional patterns, response to treatments, landscape diversity, and species/habitat relationships. Neotropical migratory birds use diverse arrays of aquatic, early successional, and forest habitats. Management of neotropical migratory birds involves enhancement of habitat diversity. We describe a process that includes evaluation of potential habitat capability, inventory of existing conditions, and prescriptions for necessary structural features for species diversity. Silvicultural treatments to manipulate vegetation structure are presented for major forest cover types in New England, and applicability to other regions is discussed.

INTRODUCTION

In the northeastern United States, neotropical migratory birds (NTMB) represent up to 75 percent of the breeding avifauna in deciduous forests during summer. Bird communities in coniferous forests are less variable seasonally. In deciduous forests there is a pattern of bird density increasing with plant succession, a manifestation of the ecological requirements of forest birds.

We address extensively forested landscapes in northern New England, not isolated forest patches. Our findings, specific to this area, suggest a general outline for developing procedures in other regions with extensive northern temperate forests. Population trends in large forested tracts do not clearly show widespread declines in forest-dwelling NTMB (see Askins et al., 1990 for review); NTMB utilize all stages of forest development, stand conditions, within-stand features, and types of disturbance.

Neotropical Migratory Bird Habitat Concerns

Assessment of NTMB habitat in northern temperate forests include: 1) forest size as a major predictor of bird community composition; 2) species diversity related to habitat scales; 3) vegetative structure; 4) prey base densities; and 5) human-related impacts (from Askins et al., 1990; Terborgh, 1989; Whitcomb et al., 1981). New England landscapes encompass many land types and are much more heterogeneous in site conditions than other parts of the northern temperate forest (Leak, 1982). Larger forest areas have more NTMB; some of these species are absent or less abundant (Askins et al., 1990) in smaller forest patches, surrounded by urban, suburban, or agricultural land uses.

Four factors shape quality and quantity of NTMB habitat: 1) land use history and current trends in forest cover; 2) existing and potential habitat capability; 3) silviculture that creates or alters habitat structure and prey base densities; and 4) management goals and process.

BACKGROUND

Once covered by primeval forest, up to 75 percent of New England was cleared for agriculture by 1840. Farm abandonment allowed forest regrowth. Northern New England is now a rural forest landscape, and southern New England largely a wooded suburban landscape.

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Forests now cover 60 to 90 percent of the various New England states; forests comprise a much smaller component of landscapes in regions surrounding New England, ranging from 40 to 60 percent coverage (Woddell, et al. 1989).

Habitat Relationships

NTMB habitat relationships need to be considered hierarchically at different scales of management: landscape level; between stand level; and within stand level.

Landscape Level:

Northern New England is at least 75 percent forested; upland nonforest, wetland, and aquatic habitats are very minor components in most cases (DeGraaf et al. 1992). Urban and suburban sprawl is limited. Isolation of forest fragments does not appear to be a factor at the present time. Interspersion of agricultural land use is minimal. Urban and suburban sprawl, though limited, continues to slowly increase. Increased predation rates by suburban wildlife, cats, and dogs is expected. Year-round bird feeding encourages brown-headed cowbird occurrence, as do some agricultural activities (Yamasaki, unpubl. data). Breeding bird surveys in forest-dominated areas on the White Mountain National Forest reveal few cowbirds away from these food sources.

Upland nonforest, wetland, and aquatic habitats are more abundant components in southern New England. Urban/suburban sprawl is much more pervasive, even though it is up to 60 percent forested.

Most forest-dwelling NTMB have home ranges smaller than 10 acres (Table 1). Large forested properties present more opportunities to concurrently manage seasonal habitats for more NTMB species, resident species with small and large home-ranges, and short distant migrants.

Table 1. — Comparison of home-range area for birds in New England (modified from DeGraaf et al. 1992).

	Average home-range area estimates (acres)				
	None reported/ not applicable	1-10	11-50	>50	Total
Neotropical migrants	3	111	19	15	148
Resident/ Short distance migrants	14	30	11	17	72
Total Species	17	141	30	32	220

Small properties within extensive forest landscapes present opportunities to supply a portion of year-round habitat needs of wide-ranging resident species, if coordinated with surrounding area conditions. These same small properties also present opportunities to manage seasonal habitats for NTMB species and possibly complete habitats for small range residents.

Extensive forests of uniform age provide habitat for a limited number of avian species (Fig. 1). When a variety of nonforest habitats are available within extensive forest areas, a significantly larger number of habitat conditions is available. If a variety of aquatic habitats are also present, the number of available habitats again increases. Finally, the presence of high elevation sites add the krummholz and alpine habitats that complete the range of available habitats in New England. Thus, habitat breadth is useful in examining species / habitat potential.

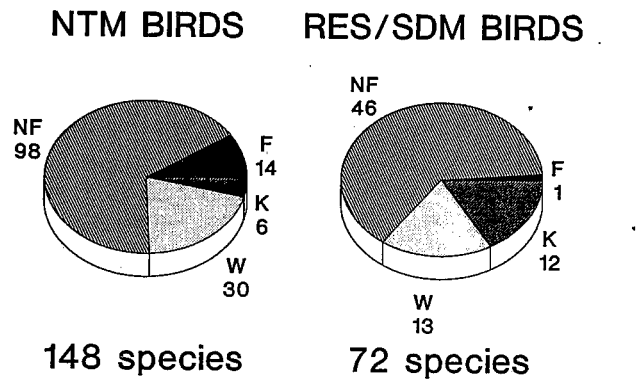


Figure 1. — Comparison of habitat breadth use by New England birds (NTM=neotropical migratory birds; RES/SDM=residents and short distance migratory birds; F=forest; NF=nonforest; W=aquatic habitats; K=krummholz and alpine habitats).

Between-stand Level:

Size-class combination (after DeGraaf et al., 1992: regeneration, sapling-pole, sawtimber, and large sawtimber stands) also describes habitat relationships at the between-stand level. Large forests of a single size-class limit habitat for birds and other species (Fig. 2). If two size-classes are available within an extensive forest area, the potential number of habitats doubles. With all four size-classes present, potentially available habitats again increase. Size-class combination does not pertain to NTMB that only use nonforest, wetland, and aquatic habitats within the forest.

Within-stand Level:

The distribution of many wildlife species, including NTMB, is related to structural habitat features within cover-type groups (Table 2). Many features are created or altered when forest

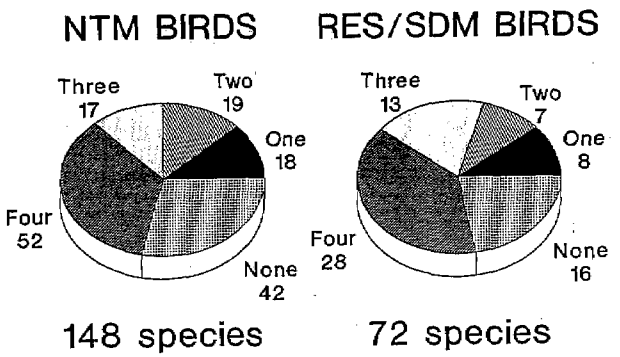


Figure 2. — Comparison of size-class use by New England birds (NTM=neotropical migratory birds; RES/SDM=residents and short distance migratory birds; One=one size-class used; Two=two different size-classes used; Three=three size-classes used; Four=four size-classes used; None=no forest size-classes used).

Table 2. — Comparison of neotropical migratory and all birds combined relationship to structural habitat features in New England by size-class (NTM=neotropical migratory birds; AB=all birds combined). (Modified from DeGraaf et al. 1992).

Feature	Number NTM/AB	Regeneration NTM/AB	Sapling-pole NTM/AB	Sawtimber NTM/AB	Large sawtimber NTM/AB
High perches	7/10	6/ 7	3/ 3	5/ 6	5/ 7
Exposed perches	15/20	9/13	9/12	6/ 9	7/ 9
Minimal canopy	20/25	15/20	12/16	7/12	8/13
Partial canopy	27/41	22/32	20/29	22/34	22/34
Closed canopy	25/32	18/24	21/27	25/31	25/32
Tree boles	12/35	4/19	6/22	8/29	9/32
Midstory layer	18/24	14/18	16/22	15/21	15/21
Shrub layer	56/75	51/70	41/52	32/44	33/45
Ground vegetation	33/52	21/36	10/21	6/15	7/16
Litter	11/12	10/12	10/12	11/11	11/11
Overstory inclusions	40/57	26/42	33/49	37/55	37/55
Mast/fruit	6/39	3/17	3/15	3/18	3/18

stands are treated. No single silvicultural treatment can provide all conditions at any given time, but a range of conditions can be provided over time and space with some planning. No single habitat management practice covers all necessary conditions for all NTMB. A variety of management goals, objectives, silvicultural methods, site conditions, management intensities, and habitat improvement practices is required across landscapes to provide a diversity of habitats for the full range of wildlife species and NTMB potentially inhabiting New England forests.

Silvicultural Methods

Silvicultural cuttings are usually classified as regeneration treatments (Fig. 3) or intermediate treatments (Fig. 4). Four techniques are discussed: two for producing even-aged stands and two for producing uneven-aged stands:

Even-aged:

1. Clearcutting--removal of all stems in the stand includes strip cutting, coppice, coppice with standards, and seed tree cuts.
2. Shelterwood--removal of the understory and lower crown canopy trees to allow the new stand to regenerate under shade. Subsequent cuts remove the overstory.

Uneven-aged:

1. Single-tree selection--removal of trees singly or in groups of 2 or 3, to maintain a continuous crown and uneven-aged or sized mixture. Can be used between groups.
2. Group selection--removal of trees in groups usually 1/10 to 2/3 acre in size, but sometimes up to 2 acres.

Intermediate treatments are applied in the culture of even-aged stands. Quality timber thinnings commonly maintain a closed canopy; however, low-density thinning (50-70% residual crown cover) can be used to hasten diameter growth and stimulate understory development for wildlife purposes.

Single-tree and group selection methods culture uneven-aged stands. Instead of a specified rotation age, a general maximum tree size is chosen, and residual stands are defined by maximum tree size, stand density, and stand structure.

Other intermediate treatments utilized in either even-aged or uneven-aged stands are pruning, prescribed burning, sanitation cutting, or salvaging (after Hunter, 1990).

Even-aged and Uneven-aged Management Comparisons:

Even-age management provides opportunities to regenerate shade intolerant hardwoods by clearcutting, opportunities that uneven-age management does not provide. Indirect effects of harvesting include a flush of herbaceous growth, followed by development of a shrub layer of woody seedlings and sprouts. This shrub layer usually grows into a densely stocked sapling stand within 10 years. Shelterwood techniques with residual canopy closures less than 50 percent provide some of these habitat conditions for several years after harvest. Such regeneration treatments produce distinct forage and shelter opportunities for numerous species that are not usually available under uneven-age management (Fig. 5).

Even-age management provides potential habitat for up to 26% more species than uneven-aged management that regenerates similar cover types. Bird species display greater sensitivity to silvicultural treatment than do other taxa. Forests that contain a distribution of each size-class in distinct even-age

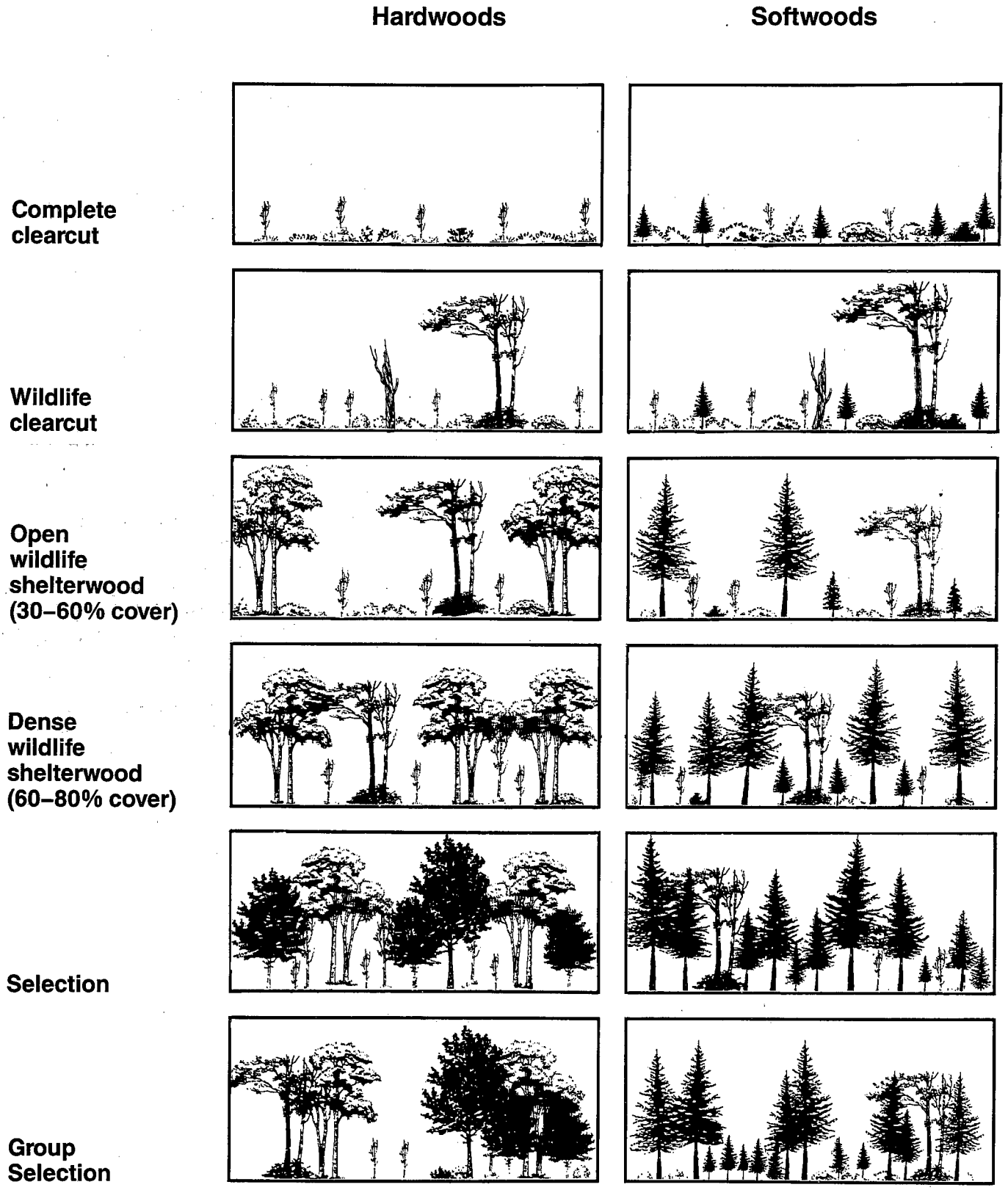


Figure 3. — Comparison of wildlife habitat conditions under several regeneration treatments (taken from DeGraaf et al. 1992).

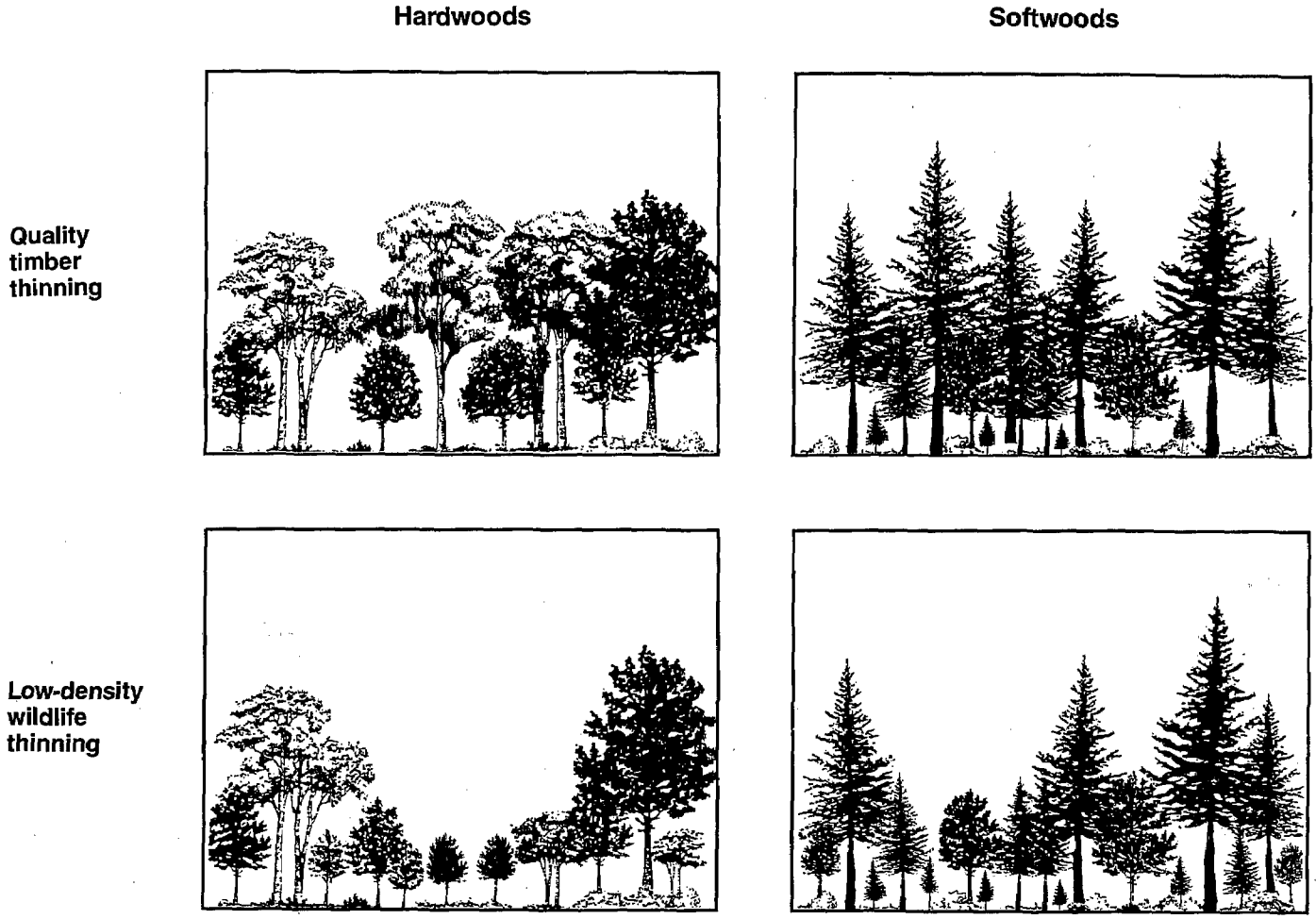


Figure 4. — General comparison of wildlife habitat conditions following quality timber thinning and low-density thinning with reserved wildlife trees (taken from DeGraaf et al. 1992).

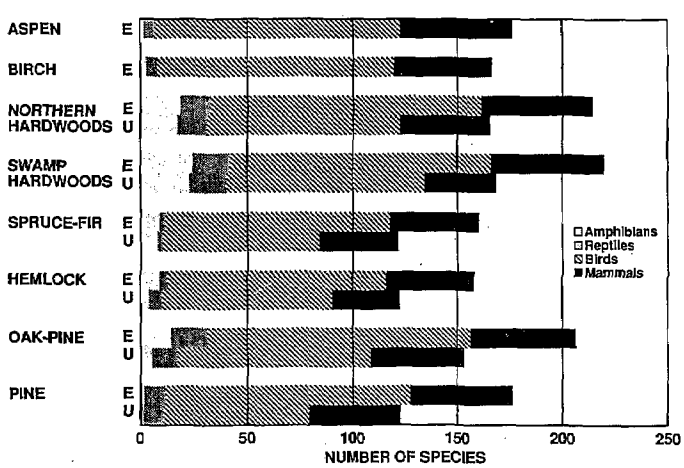


Figure 5. — Potential number of wildlife species by silvicultural system and cover-type group. E=even-age forests containing regeneration, sapling-pole, sawtimber, and large sawtimber stands in distinct units of 5 acres and larger. U=uneven-aged forests with essentially continuous canopies and intermixed size- classes produced by single-tree selection (taken from DeGraaf et al. 1992).

units of 5 acres and larger can provide more potential habitats than uneven-age management, when applied at intervals so entire landscapes are not affected during any one management period.

Uneven-age management can provide continuous overstory canopies and intermixed size-classes of tolerant hardwoods and softwoods by single-tree selection. With residual canopy closures greater than 70 percent, minimal herbaceous ground cover and shrub conditions are expected, and a midstory layer usually develops. Intolerant and midtolerant tree species are few and decrease over time. Uneven-age management applied across large homogeneous areas tends to limit early successional habitat conditions and intolerant cover types. In much of New England, however, large areas are discontinuous in soils, geology, elevation, and drainage patterns. This leads to variation in species composition and response to treatment, indicating use of even-age methods interspersed with the general uneven-age method.

Group selection provides habitat conditions that range between single-tree selection and even-age approaches. At regular intervals (10 to 20 years), up to about 10 percent of the stand is regenerated in groups, while single-tree selection is sometimes applied between openings. Intolerant species regenerate in larger groups, while intermediate and tolerant

species dominate small openings. Distinct size-classes are recognizable for a few decades following cutting. The main limitation on wildlife habitat is the small size of the openings. Group selection provides habitat for a potential number of species between that suggested for even-age and typical uneven-age approaches. Combinations of these systems, rather than strict adherence to one, increases the habitat conditions possible through vegetative management. Care taken to provide a range of diverse habitat conditions throughout a forest or property will eventually result in increased use by a wider variety of wildlife species.

PROCESS

Five steps are required to consider NTMB throughout the public and private management planning process.

1. **Goals**--need to identify current and potential habitat opportunities, public concerns, and political or economic issues (local and regional). Goal statements require understanding and agreement by the divergent publics and private landowner.
2. **Inventory**--gather information to address key issues at the appropriate scale. Hierarchical resolution of NTMB habitat management concerns requires placing the planning area within a landscape composition; estimating the likelihood of change/disturbance frequencies (Lorimer 1977) and extent of forest cover; identifying site capability and spatial heterogeneity (after Hunter 1990); and describing existing cover type composition and size-class distribution.
3. **Prescription**--develop working objectives for the management period from goal statements, site capability, and existing vegetative condition. Prescriptions can be written to develop the amount and location of early successional habitats, regeneration quantities, softwood composition, or the types of structural habitat features.
4. **Implementation**--involves a large degree of integration with other resource considerations and activities to do an environmentally sensitive and thorough job.
5. **Monitoring**--should determine what was really done, and how successful was the prescription in getting the desired habitat conditions established.

NTMB MANAGEMENT CONSIDERATIONS

Managed stands of hardwoods and softwoods support different breeding bird communities, and stands can be grouped by type and/or size-class by the similarity of their breeding bird compositions.

The most dramatic differences occur in the smallest size-classes (youngest stands), and breeding bird composition is essentially unchanged in stages beyond the poletimber stage. Even-aged sawtimber, large sawtimber, and uneven-aged stands have similar avifaunas. Species richness is similar in regeneration/seedling, sapling, and mature stands; poletimber stands have the fewest breeding bird species (DeGraaf, 1987). No breeding bird species are unique to old growth or virgin stands (Absalom, 1988).

Northern hardwood and aspen sapling stands have similar breeding bird compositions, as do poletimber stands of paper birch, northern hardwoods, and swamp hardwoods. White pine and red spruce poletimber stands have similar breeding avifaunas, as do poletimber and mature stands of both spruce-fir and balsam fir. Mature white pine stands have distinct breeding avifaunas, and eastern hemlock stands, whether poletimber, mature, or overmature present another (DeGraaf, unpubl. data -- for survey methods see DeGraaf and Chadwick, 1987).

Neotropical migrants comprise a higher proportion of breeding birds in smaller diameter size stands than larger diameter size stands in northern hardwoods (Table 3). The same general pattern holds for even-aged stands of spruce-fir and white pine, but the percentages are slightly lower.

Table 3. — Neotropical migratory bird occurrence in (% of breeding avifauna) northern hardwood, spruce-fir, and eastern white pine cover types and size-classes in New England (from DeGraaf and Rudis, 1986). Spruce-fir and pine types are not managed using uneven-age techniques.

Cover Type	Regen-eration	Sapling-pole	Saw-timber	Large sawtimber	Uneven-age
Northern hardwoods	61(71)	38(70)	44(64)	50(64)	45(62)
Spruce-fir	40(64)	38(65)	42(61)	42(57)	--
Eastern white pine	46(65)	41(74)	43(64)	41(59)	--

These final three sections are unavoidably brief management summaries from DeGraaf et al. (1992), and the following silvicultural guides: *Silvicultural guide for northern hardwood types in the Northeast (revised)* (Leak et al., 1987); *Ecology and management of the northern hardwood forests in New England* (Hornbeck and Leak, 1992); and *A silvicultural guide for spruce-fir in the Northeast* (Frank and Bjorkbom, 1973).

Northern Hardwoods Management

The northern hardwood type occurs at elevations up to 2,500 feet. Three subtypes--sugar maple/white ash, beech/birch/maple and beech/red maple tend to occupy distinct sites with different soil and vegetative features.

These subtypes generally occur on well-drained to moderately well-drained upland soils (Leak and Graber, 1974). Stands of a given subtype vary in size from small to moderate, from a few to 100 acres or so. The subtypes occur throughout New England, though regional shifts in abundance of certain species occur.

Sugar Maple/Ash:

Occurs on well-drained, fine-textured tills derived from limestones and certain metamorphics, as well as moderately drained areas enriched by moving water and organic materials.

Sugar maple is aggressive and abundant on this subtype. Yellow birch and white ash are mid-tolerant common associates. Beech is a minor component. These sites have the capability to grow large trees. Trees larger than 22-24 inches dbh commonly have seams and cavities (Leak, 1985).

The shrub layer (2-10 feet tall) is primarily deciduous. The midstory (10-30 feet tall) is deciduous. In mature undisturbed stands, numbers of stems per acre in the shrub layer range around 2,000; and 300 stems per acre in the midstory layer, a fairly sparse understory (Bormann et al., 1970; Leak, 1959).

A hundred or more plant species can be found in the herbaceous layer (feet) including herbs, shrubs, and tree seedlings. Ground cover occupies about 40 percent of the forest floor in mature hardwood stands, but can attain higher percentages on this subtype due to the richer soils (Siccama et al., 1970).

Beech/Birch/Maple:

This subtype occurs on well and moderately well-drained sandy loams. Beech is as abundant or more so than sugar maple, especially in the understory. Yellow birch is a common mid-tolerant associate; paper birch is more common in this subtype than in the sugar maple/ash subtype. Ash is not abundant. Defect is common in trees larger than 20 inches dbh. The presence and abundance of beech increases proportion of dead and defective trees, at earlier ages than in the sugar maple/ash subtype. Beech usually has cavities at 16-18 inches dbh, and few live trees are found larger than 22 inches dbh (Leak, 1985).

Shrub and midstory layers are deciduous and similar to sugar maple/ash understory layers. In undisturbed mature understories the stem densities are even less than sugar maple/ash. Herbaceous layers in mature stands typically reach 40 percent ground coverage, with lower floral diversity than sugar maple/ash.

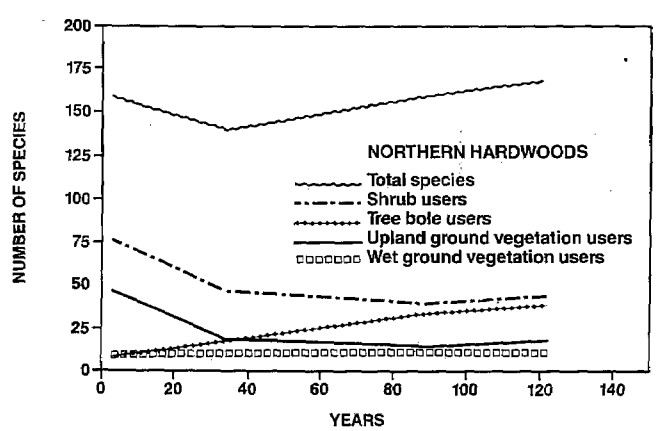
Beech/Red Maple:

Beech is a predominant component and probably the climax species on this subtype. Red maple is more abundant and aggressive than sugar maple. Northern red oak is an associate; a softwood component up to 10-15 percent is often present. Soils are generally sandy, somewhat washed tills. Cavities are common in trees over 14-16 inches dbh (Leak, 1985).

Shrub and midstory layers frequently contain some softwoods admixture, but hardwoods are predominant. Midstory layers are more dense, and herbaceous layers are sparse.

Succession:

Succession in the northern hardwood type consists of a short (2-4 years) herbaceous/shrub stage followed by a hardwood dominated seedling/sapling stage (to 10 years), pole (10-59 years), and sawtimber stages (Fig. 6). During succession, canopies are closed, a range of dbh classes is represented, and the herbaceous layer is sparse. Beech/red maple subtype develops an abundance of cavity trees due to the beech component; and softwood inclusions.



Mean d.b.h. (in)	2–4	4–6	6–8	8–10	10–12	11–13	12–14
Basal area (ft^2)	50–70	90–100	100–110	100–120	100–120	100–130	100–130
No. stems per acre	1000–2000	500–1000	300–500	200–300	150–200	100–150	80–120
Maximum height (ft)	30–40	40–60	50–70	60–80	70–90	80–100	80–100
Maximum d.b.h. (in)	8–10	10–12	12–14	16–18	18–20	20–24	20–26

Figure 6. — Northern hardwoods stand development and wildlife species occurrence (taken from DeGraaf et al.

Numbers of potential species are high in regenerating stands and drop off in the pole stage. Neotropical migrants particularly associated with this habitat structure include alder and willow flycatchers, cedar waxwing, yellow warbler, chestnut-sided warbler, and common yellowthroat.

Numbers of species then increase with stand age to the maximum in mature and overmature stands. Species using tree boles account for some of this increase. Softwood inclusions in the beech/red maple subtype account for increasing use of older stands by hermit thrush, solitary vireo, magnolia warbler, blackburnian warbler, and black-throated green warbler.

Intermediate Treatments:

Quality timber thinning (Fig. 4) tends to maintain a closed canopy, which reduces habitat for open canopy birds; develops a woody understory; and reduces the wildlife tree component. Low-density thinning results in a partial canopy, with cavity trees, and coniferous overstory inclusions if desired, and a dense woody understory. If begun too early, this method results in shorter merchantable tree lengths and lower long-term timber production. Diameter growth is rapid.

Regeneration:

All northern hardwood subtypes can be regenerated by clearcutting mature stands, shelterwood cuts, and single-tree or group selection cuts (Fig. 3). Heavier cutting produces more shade-intolerant to intermediate tree species composition, important to neotropical migrant prey bases. Rapid NTMB composition change occurs during the first few years following clearcutting. **Clearcuts** produce a temporary herbaceous/shrub layer followed by a distinct seedling/sapling class (Fig. 4).

Shelterwood and large group selection cuts can also resemble natural patterns seen in mature and overmature stands as well as those in various intermediate treatments. Open shelterwood cuts create more woody understory than dense cuts.

Group selection cuts mix small patch clearcuts of 0.33 to 2 acres and selection cuts across a stand. Small patch clearcuts can maintain intolerant and mid-tolerant tree species composition; and for 5-10 years after cutting may provide some habitat structure needed by some early successional wildlife species.

Type Conversion:

Converting to aspen/birch is the most feasible option. The beech/red maple subtype probably is easiest to convert to aspen/birch, by a series of short-rotation complete clearcuttings. Cuttings at rotations of 25-30 years will result in most rapid conversion, if costs or markets permit. Conversion is easier if some aspen is available for root-sucker regeneration. Otherwise, consider scarification (and perhaps liming) to encourage aspen and birch seedling regeneration.

Spruce-Fir Management

The red spruce-balsam fir type occurs principally in northern New England and New York, adjacent Canada, and highest elevations of the Appalachians. White spruce is a common associate in the northwest part of this range; hemlock is found in the south at lower elevations. Black spruce and tamarack occur in northern wet areas. Spruce-fir is a climax type and is persistent under light to moderate disturbance. Heavy disturbance results in hardwood-softwood mixtures followed by a predominance of fir. Undisturbed over time, the proportion of red spruce increases due to its longevity.

Two broad types of spruce-fir sites are recognized: primary and secondary according to Frank and Bjorkbom (1973).

Primary Sites:

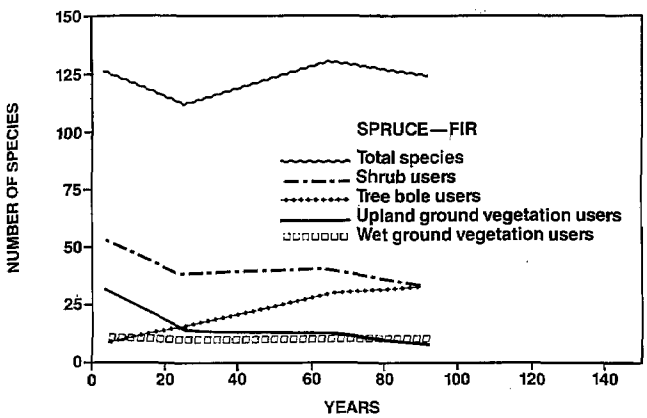
Primary softwood sites consist of moderately to somewhat poorly drained areas at lower elevations; and shallow-to-bedrock areas at elevations above 1,500 to 2,500 feet in New England. When heavily disturbed, successional hardwoods and shrubs rapidly invade. In time, these stands revert to nearly pure (75%) spruce-fir as the hardwoods die out. Mixedwood stands on primary sites support a layer of deciduous shrubs and small trees in addition to the coniferous understory. Pure softwood stands, often contain sparse herbaceous and shrub layers until canopy is broken by overmaturity, windthrow, or insect damage.

Secondary Sites:

These are well-drained to moderately well-drained side slopes at mid elevations. Soils are better than primary sites, and hardwood competition is greater. Pole and sawtimber stands are mixedwood with less than 50 percent softwoods. Eventually, these sites revert to pure softwoods. If heavily disturbed, the new stand may be nearly pure hardwoods, but will develop a softwood understory. Pole and sawtimber stands contain deciduous shrubs. Herbaceous layers vary greatly in species and density, up to 30 to 40 percent ground coverage. Hardwoods found on secondary sites generally show considerable defect and cavities at 14-16 inches dbh (or earlier in the case of quaking aspen).

Succession:

On wet primary sites, the herbaceous/shrub layer following clearcutting of spruce-fir stands may last up to 10-15 years (Fig. 7). The period is much shorter on drier primary and secondary sites. The main difference is the hardwood component--mainly pure softwoods on primary sites and a mixture of hardwoods and softwoods on secondary sites. Relative abundance of deciduous cavity trees is associated on secondary sites. Both successional trends are towards increasing softwood proportions.



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Basal area (ft²)	80-120	100-150	160-230	200-250	210-270	220-280	220-280
No. stems per acre	1500-3500	1000-1200	800-1000	550-750	500-600	400-500	300-400
Maximum height (ft)	10-20	30-50	50-70	60-80	65-90	70-90	70-90
Maximum d.b.h. (in)	6-8	8-10	10-12	12-14	14-16	16-18	18-20

Figure 7. — Spruce-fir stand development and wildlife species occurrence (taken from DeGraaf et al. 1992).

Spruce-fir stands follow several patterns during maturation. Stands comprised primarily of balsam fir reach overmaturity at 60-70 years of age; the canopy quickly dies and the fir understory forms a new sapling stand. This creates "fir waves" at high elevations. Spruce-fir canopies remain closed until the stand is roughly 120-150 years old. Then, areas up to many acres begin to die and regenerate to mixed spruce-fir-hardwood seedling/sapling stands. Canopy openings in overmature spruce-hemlock and spruce-hardwood (secondary sites) are smaller and less apparent. The stands maintain a more uneven-aged character due to differences in species longevity.

Numbers of potential wildlife species are high in the regeneration stage due to the herbaceous/shrub layer response (Fig. 7). Numbers drop and then rise to a maximum in mature and overmature spruce-fir--again due tree-bole users (mainly residents and short-distance migrants). Spruce-fir supports higher potential numbers of species than pure spruce.

Intermediate Treatments:

Quality timber thinning in spruce-fir increases the softwood proportion (especially spruce) and reduces the proportion of hardwood cavity trees. Quality timber thinnings (Fig. 4) can be combined with wildlife tree retention with minimal losses in timber productivity. Low-density (30-50% crown closure) thinning provides a prominent midstory of conifer or mixed hardwood and conifer on secondary sites, and some patchy areas of herbs and shrubs, especially on wet primary sites.

Regeneration:

Spruce-fir is most effectively regenerated with a high-density shelterwood system (Fig. 3). This produces a softwood overstory (with reserved hardwood wildlife trees) and a spruce-fir understory, several hardwoods, and occasional herbs and shrubs on wet sites. Low-density shelterwoods produce a mixed understory and more patches of herbs and shrubs. Single-tree and group selection are both used to maintain spruce-fir stands, usually with a hardwood component. Group selection with openings up to 1 acre is similar to regeneration conditions created by blowdown. Three-cut shelterwoods simulate natural regeneration in old spruce-fir stands. Either method can be used to regenerate spruce-fir.

Type Conversion:

Complete clearcutting on rotations longer than 80 years converts spruce-fir stands to hardwoods, resembling beech-red maple subtype or aspen-birch type, if the stand contains 10-20% aspen before cutting. Repeated clearcutting on short rotations of 15-60 years favor aspen - birch.

Eastern White Pine Management

Eastern white pine occurs throughout the region. Pine types can be organized into two type and site combinations:

1. Oak-pine type on sands, gravel, and sandy tills.
2. Temporary old-field pine on fine-textured soils.

Oak-Pine:

Red oak (with some other oaks) and white pine are associates on outwash soils and sandy tills in central and southern New England. Usually, shrub and herb layers are not dense.

The climax is uncertain, because oak and pine alternate in a series of harvests. Further north, hemlock and spruce seem to be the ultimate climax on dry sandy soils, with oak and pine as persistent associates on south or west exposures.

Old-field Pine:

Old-field pine is prevalent, although a temporary type resulting from farmland abandonment. It commonly develops as pure, dense stands of pine with an occasional wide-crowned hardwood. Woody understories are very sparse unless the stand is opened up (< 70% crown closure) by cutting or windthrow. Old-field pine on sandy soils rapidly assumes the characteristics of oak-pine.

Succession:

On sandy soils, groups of oak often support a pine understory and vice versa. These stands usually exhibit a closed canopy, stratified hardwood-softwood mixtures and a sparse dry-site ground flora.

Old-field pine on fine-textured soils develops dense pure stands once early successional species (like gray birch, aspen, juniper) disappear. Understory and ground flora are almost nonexistent until the canopy is broken by damage, cutting, or overmaturity (150+ years). Then a dense hardwood understory develops.

Numbers of wildlife species potentially occurring throughout the successional process tends to be higher in oak-pine than old-field pine. Numbers of potential species are high in regenerating stands (Fig. 8), then drop off in pole stands. Numbers rise in older stands, due to the increasing number of residents and short distance migrants using tree boles.

Several "bull" pines in the supracanopy of the oak-pine group can provide raptor perching and nesting sites. Great-blue heron, osprey, and bald eagle can use these features near open water and other wetlands. The oak-pine type is also managed for production of hard mast for resident wildlife and short distance migrants.

Intermediate Treatments:

Usual treatments in oak-pine on sandy soils are hardwood removals, to favor pine, or thinning of oak stands to improve quality and growth. Low-density thinning in pine is an accepted alternative in some areas. Midstory development is rapid, especially under old-field pine.

Timber thinning with reserved wildlife trees results in habitat potential similar to that in natural succession. Thinnings without reserved wildlife trees eliminates high exposed perches, medium-and large-diameter cavity trees, larger crowned nut-producing trees, and reduces overstory inclusions--important features to many NTMB and resident species.

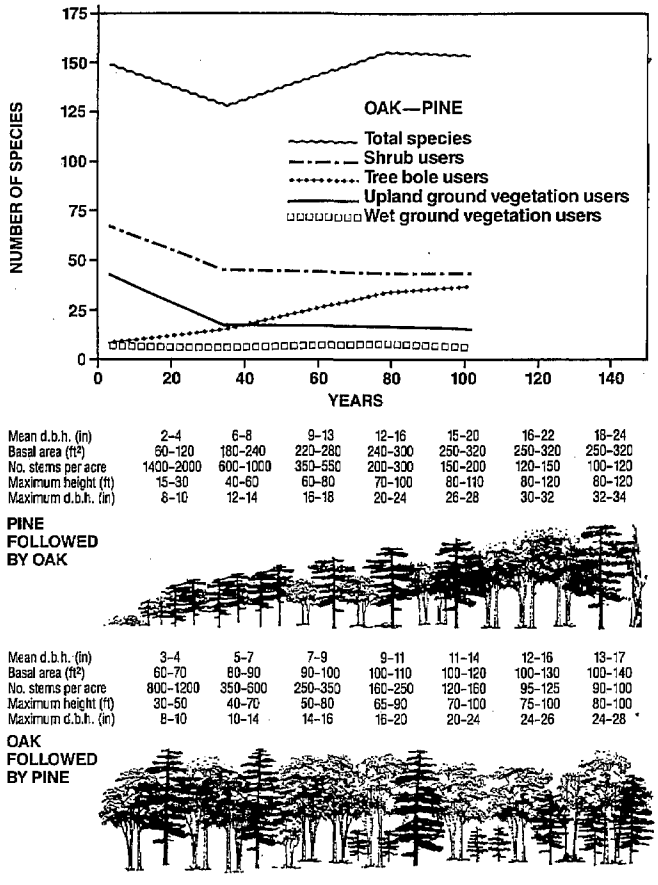

Figure 8. — Oak-pine stand development and wildlife species occurrence (taken from DeGraaf et al. 1992).

Regeneration:

Pine regenerates best under a moderately dense shelterwood series, especially when coupled with site preparation that eliminates unwanted understory stems and provides a mineral soil seedbed. When regeneration is roughly 4 feet tall, overstory can be removed. With pine, retention of scattered wildlife trees will help prevent weevil damage, as well as add much habitat structure to regenerating stands. First-stage dense shelterwood cuts (Fig. 3) resemble timber thinnings with reserved wildlife trees in the sawtimber-size-class. The final cut in such a shelterwood series could resemble a clearcut with reserved wildlife trees.

CONCLUSION

In the forest dominated rural landscape of northern New England, no one site, cover type, size- class, silvicultural practice, or habitat structure will meet all the needs of NTMB. NTMB habitat management needs to focus on: 1) maintaining

a range of forest, nonforest, aquatic, and high elevation habitat; 2) developing and maintaining a variety of cover type compositions and size-class distributions that provide a range of habitat structures, in a mix of area sizes, disturbance scales, and managed and wild conditions; to meet the diverse NTMB habitat needs; and 3) developing ways to offset the consequences of suburbanization of the northeastern forest.

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