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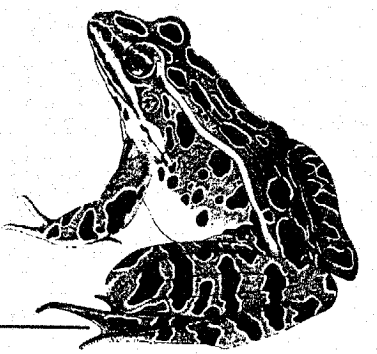
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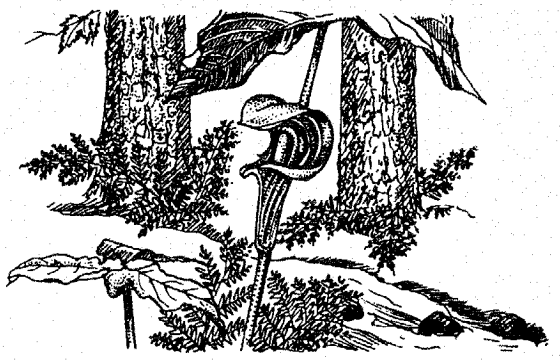
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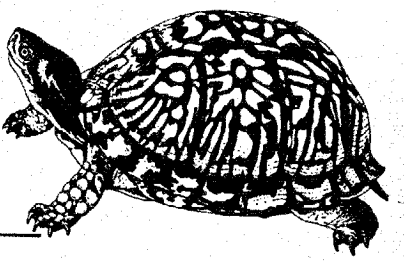
New England Wildlife:
Management of Forested Habitats

Richard M. DeGraaf, Mariko Yamasaki, William B. Leak, John W. Lanier

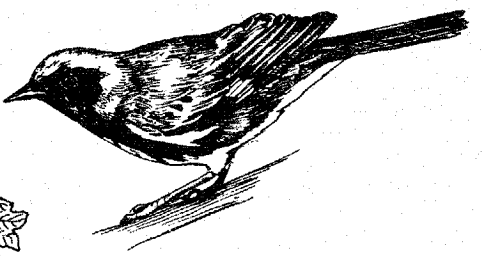


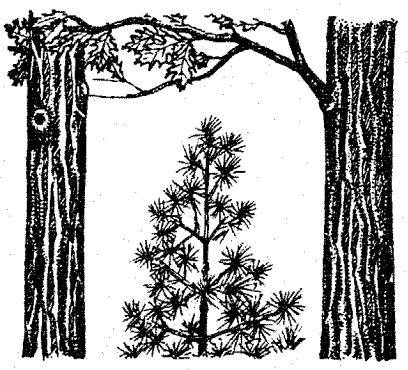














ABSTRACT

Presents silvicultural treatments for six major cover-type groups in New England to produce stand conditions that provide habitat opportunities for a wide range of wildlife species. Includes matrices for species occurrence and utilization by forested and nonforested habitats, habitat breadth and size class, and structural habitat features for the 338 wildlife species in New England.

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CONTENTS

Introduction 1
Using the Publication 3
  Application of Information 3
  Accuracy of Information 3
Background 4
  Historical Perspective 4
  Forest Disturbance 5
  Forest Regions 6
Understanding Wildlife Habitats 10
  Wildlife Habitat 10
  Community Organization and Structure 11
  Habitat Structure 13
  Other Factors Affecting Wildlife Distribution 14
  Management Objectives 15
Inventory and Prescription 17
  Assessment of Habitat Management Opportunities 17
  Inventory 18
  Prescription Key 23
  Prescription Key Recommendations 25
Habitat Relationships 27
  Area 27
  Habitat-Breadth Combinations 27
  Size-Class Combinations 37
  Structural Habitat Features 42
Silvicultural Methods 61
  Aspen-Birch 67
  Northern Hardwoods 72
  Swamp Hardwoods 79
  Spruce-Fir 84
  Hemlock 92
  Oak-Pine Types 97
Nonforested Habitats 107
  Upland Nonforested Habitats 108
  Wetland Nonforested Habitats 115
  Deepwater Habitats 118
  Special Features 122
Summary 129
Literature Cited 132
Appendix—Species/Habitat Matrices 137
  Forest Cover Types and Groups 138
  Terrestrial, Wetland, and Other Nonforested Habitat Types 143
  Habitat Breadth and Size Class 145
  Structural Habitat Features 145
  Species Activities/Season of Occurrence 146
  Habitat Suitability 146
Appendix A.—Species Occurrence and Utilization, by Forested Habitat 147
Appendix B.—Species Occurrence and Utilization, by Nonforested Habitat 175
Appendix C.—Species Occurrence and Utilization, by Habitat Breadth and Size Class 207
Appendix D.—Species Occurrence and Utilization, by Structural Habitat Feature 239

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PREFACE

This guide is the second in a two-volume set under the general title, *New England Wildlife.* The first, subtitled *"Habitat, natural history, and distribution,"* provided detailed information on the natural history, range, and habitats of 338 species of forest wildlife in New England. Forest managers need more than a compilation of the habitat requirements of individual species. Management affects whole groups—communities—of species; habitats for some species are enhanced, for others they are degraded.

In managed landscapes, habitats can be provided for all potential wildlife species. Across large landscapes, for example, national forests, habitats for all species can be provided simultaneously in a dynamic mosaic of cover types, successional stages and stand conditions. On smaller ownerships, depending upon the site(s) involved, habitats for several communities can be provided over time. On large and small units, the key is to know the potential wildlife communities that are associated with the various forest cover types, timber size classes, and nonforested habitats, and how these communities change and respond to management activities over time.

This volume presents:

1. A discussion of habitats, wildlife communities, and habitat relationships at various scales;

2. Procedures to inventory small nonindustrial ownerships for wildlife habitat opportunities;

3. Methods to develop wildlife habitat prescriptions that address owner goals and objectives; and

4. Alternative ways to carry out vegetative prescriptions that meet owner objectives.

Our aim is to provide forest managers, silviculturists, and wildlife biologists with the silvicultural information needed to increase the potential number of wildlife species.

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INTRODUCTION

Forest wildlife populations and their habitats are products of the land and how it is managed for wood fiber. Forest land management activities that are designed to accomplish only wood fiber objectives can significantly degrade a number of wildlife habitats when applied over large areas (Brown 1985). Yet, managing for a diverse range of vegetative conditions, size classes, and cover types is a major key to producing not only a diverse wildlife habitat, but also a diverse array of wood fiber products for a continually changing marketplace. So, integrated resource management approaches can be developed and utilized to accomplish multiple resource management objectives. Also, if a manager needs to produce an expanded range of habitat conditions to meet some broad habitat diversity objective, vegetative management practices could be developed to provide a range of vegetative structural features and combinations of cover types needed as habitat over time.

This publication was written for natural resources managers whose goals are to maintain and improve the quality of wildlife habitat for as many wildlife species as is reasonable, given the capacity of the land, by using integrated resource management.

Forest resource managers are responsible for developing management strategies based on landowner goals and objectives. The management of wildlife habitat traditionally has been the responsibility of the landowner or administering agency. Today, more than 90 percent of the commercial forest land in New England is privately owned (Irland 1982). Sixty-two percent of the commercial forest land is owned by more than 450,000 private nonindustrial landowners; thus, the responsibility of a majority of the available forest wildlife habitat in New England lies with a multitude of landowners in the private sector using a variety of public and private consulting services.

The federal land management process is to (1) determine long-term goals based on analysis of the local management problems; (2) characterize land capability and potential productivity for various outputs and associated costs; (3) define operational objectives that lead to achieving these goals; and (4) develop environmentally sound integrated implementation strategies that capitalize on wildlife habitat and forest management opportunities.

Managers of small nonindustrial private fores lands need management strategies for owner who are interested in wildlife habitat diversity goals. Managers also need operational objective that emphasize diverse habitat improvement through integrated vegetation management Currently, less than 10 percent of the private landowners in New England actively manage the timber resource (Alexander 1986; Birch 1986; Kingsley and Birch 1977); less than 10 percent of the commercial forest land in New England is managed primarily for the timber resource, except in the state of Maine where it approaches 60 percent.

New England private nonindustrial forest landowners are basically satisfied with the condition of their property at present, and they have a high regard for and interest in wildlife and wildlife habitat. New England landowners will do what they perceive is the "right thing." When these landowners can be convinced that vegetative management planning and practices can result in improved wildlife habitat and increased opportunities to see a wider assortment of species, they will become more inclined to implement these practices (Alexander 1986).

Nonetheless, most New England forests have been cut over at least once, if not several times. Intensive human activities within the forest—recreation, development, agriculture, and production of raw materials—have changed the "wild" complexion of the land. Even so, New England landscapes are some of the more diverse and complicated ecosystems found in temperate forest regions. There is a wealth of potential wildlife habitat opportunities, depending on how managers view the importance of biological diversity in managed forests. Working with landowners to provide a diverse and well-balanced area composition of cover types, size classes, and other important vegetative features is the key to successful wildlife habitat management for the broadest range of species in the future.

To develop management strategies that contribute to wildlife habitat diversity in New England:

1. Determine what kind of wildlife and wildlife habitat is important to the landowner. Are these species or habitats present on the ownership or surrounding area?

2. Determine the land capability of the ownership and surrounding area to provide the type and mixture of habitat features needed by the desired species group(s).

3. Determine, using state-of-the-art management methods, how to change an existing vegetative condition.

4. Determine the wildlife species-habitat trade-offs in each alternative, the implementation costs, and the acceptability of the strategy to the landowner.

5. Implement the strategy, supervise the activity closely, and monitor the resulting habitat feature(s) for wildlife use.

The purpose of this publication is to assist the land manager in making these determinations given the knowledge and working hypotheses presented here.

Most information presented in this publication has been extracted from the literature, with emphasis on local research findings whenever possible. Much of the literature was previously compiled by DeGraaf and Rudis (1986). When little or no published information was available relative to a particular wildlife species, habitat type, or silvicultural practice, the best local knowledgeable source was used after review and consensus by the authors. More intensively studied wildlife species, forest cover types, and silvicultural systems yielded more detailed and voluminous data than relatively obscure species, type groups, and silvicultural systems. As new and better information becomes available, it can be used to update this information base. The working guidelines that are presented require thorough testing and probably need modification, and can be regarded as a comprehensive set of research hypotheses.

We have presented various silvicultural and vegetative management practices for six major cover-type groups. These practices can produce a range of stand conditions that provide habitat opportunities for a wide range of wildlife species when diversity is an objective. We have attempted to use standard silvicultural practices, or modifications of them, to enable New England forest-land owners to concurrently produce habitat diversity and timber. We also have attempted to compare management effects of wildlife species/habitats between various silvicultural alternatives.

USING THE PUBLICATION

The compilation of natural history and habitat information for the inland (nonmarine) wildlife of New England can aid foresters and forest wildlife biologists in assessing the potential effects of proposed habitat management practices on wildlife species. It can also aid land managers in developing and evaluating resource management planning alternatives. All inland species are presented in terms of practical habitat classification schemes for forested and nonforested habitats, so that management objectives can be set and evaluated and costs assessed.

Application of Information

The information can be used for considering the potential responses of amphibians, reptiles, birds, and mammals to habitat alterations through forest management in New England. We stress the word potential. There is no substitute for sound field work and judgment in assessing the impacts of a specific project or proposed management action. From a research standpoint, the habitat associations provided here are essentially a set of hypotheses that can and should be tested further. The information in this publication is most useful for land management and project planning; the larger the unit considered, the more accurately the species occurrence can be predicted. Large areas will likely contain more of the special habitat requirements, more edges due to the interspersion of habitats, and more successional stages, hence more species. Conversely, the smaller (more site-specific) an area, the less accurate will be assumptions or predictions of species occurrence, and the greater the need for biological experience and detailed field work.

Users of this publication are urged to identify the species applicable to their area of interest or responsibility. These species can be checked in the local occurrence column on the matrix.

Accuracy of Information

This publication must be considered the beginning effort to assemble the natural history and habitat associations to enable sound management of New England wildlife. The data base needs to be expanded to other nonforested habitats, and entries need to be field-checked to improve accuracy. The limitations of the information point up some cautions:

- This publication is not a substitute for professional field work, nor for thoroughly checking each site proposed for management. At the very least, managers need field information on the special habitat requirements present or lacking on each site proposed for management.

- This publication lists the species potentially occurring in a given habitat. More are listed than will likely occur—the smaller the site, the fewer the species that will actually occur of those potentially able to occur. Factors other than habitat features affect a given species occurrence on a given area. This effect diminishes with increasing area of consideration. Still, several site visits will be required to determine whether a given species actually occurs on a given site.

- No information is included on habitat size. The best clue to help determine whether a given species will occur, after checking whether its special habitat requirements are present, is to compare its territory or home-range size with that of the proposed project. No detailed information, therefore, is provided here on how many of a given species will occur on a given area. Merely dividing the project area by the territory/home range area of a species is not recommended, because not all parts of the area will be occupied, and density will be overestimated. For an elaboration on these cautionary notes, see Verner and Boss (1980). We have provided sample densities when such information was reported. Note localities when consulting these entries.

BACKGROUND

Historical Perspective

New England's woodlands provide an array of habitats that support a wide range of wildlife communities. Now mostly forested, the New England landscape has changed dramatically over the last 350 years. Once covered by the primeval forest, land was cleared for agriculture—slowly until the mid-18th century—then at an increased pace until, between 1820 and 1840, 75 percent of the arable land in southern and central New England was in farm crops and pasturage. One hundred years later, New England was again mostly forested—the result of an era of farm abandonment that began in 1830 with the opening of rich farmlands of Ohio via the Erie Canal.

From 1880 to the 1940's, farming in New England slowly but steadily declined; around the turn of the century the cutting of white pine that had seeded into the fields and pastures constituted the last major land clearing in southern and central New England. Once cut, most sites grew up to hardwoods, which in the 1920's and 1930's produced the ruffed grouse shooting in New England's woodlands that is still remembered today.

Since about 1950, farming has declined dramatically, supplanted by suburban development; forests and woodlands have come to be viewed by many New Englanders as a "green backdrop" rather than a source of wood products (Irland 1982). Recreational development and the second-home market in the 1960's and 1970's brought many suburban New Englanders—commonly unfamiliar with forest management—into more rural areas where timber harvesting and hunting were accepted and regarded as economically important activities.

Patterns of wood use have changed over the centuries in New England. Fuelwood was the dominant use from colonial times until the widespread use of fossil fuels. Charcoal was an important forest product throughout southern New England in the 19th century and continued on a small scale through the 1940's. Wood use for paper pulp did not exceed fuelwood use until 1880; timber and pulpwood cutting have traditionally been important in northern New England, though timber output has risen and fallen since its peak in 1909 (Irland 1982).

Fuelwood cutting in the mid-1970's represented a dramatic increase in wood harvesting and exposed many New Englanders to the value of forest products and the need for forest management. For many it marked a change in attitude toward forests from one of protection or neglect to one of use and management. Recent increases in fuelwood use in the form of chips to generate electricity in northern New England may play an even larger part in forest product use in the near future. Biomass harvesting to produce chips entails complete utilization of all tree species and sizes.

Forests and woodlots still dominate the New England landscape; they have been important cultural and economic resources since colonial times. Most New England woodlands are privately owned—only 6 percent of the forest is in public ownership. Public lands are more intensively managed than are most private holdings, except for the industrial forest lands of northern New England.

Changes in wildlife populations have accompanied these shifts in land use. Habitat conditions changed dramatically; some species were extirpated for a time, others have extended their ranges into New England and others are extinct. Predators of livestock—wolves and mountain lions—were hunted and trapped intensively since earliest settlement. Other species retreated as the forest was cleared for agriculture: black bear, white-tailed deer, and wild turkey had disappeared from much of their former range by the mid-19th century. The heath hen—the eastern race of the greater prairie chicken—and the passenger pigeon became extinct largely through habitat alteration, though both were heavily hunted for food.

Most populations of woodland wildlife such as deer, ruffed grouse, and snowshoe hare returned with the reversion of the land to forest in the late 19th century. The wild turkey, reintroduced using wild birds in the 1960's and 1970's, is now thriving in all New England states. Pileated woodpeckers mourning doves, fishers, black bears, and eastern coyotes have become common in the last two decades, while ring-necked pheasants and bluebirds, once common in the small farm and orchard country of southern New England, have essentially disappeared as breeding birds in many areas. Several other birds associated with pastures and fields are declining along with dairying across New England—vesper sparrows, bobolinks, upland sandpipers, and even song sparrows, among others.

Other dramatic changes are the recent range extensions of more southerly birds into New England; cardinal, tufted titmouse, and mockingbird, species that thrive in suburban habitats. Chestnut-sided warblers—rare in the relatively unbroken forest of Audubon's day—are common in clearcuts and forest openings today.

Most of the New England landscape, especially the hills and mountains, is forested. Timber and pulpwood are important products from the land, especially in northern New England (Vermont, New Hampshire, and Maine). Maple syrup (especially in Vermont) and Christmas trees are important forest products. Forage and grains for dairy cattle are the principal crops. Wildlife constitutes an important recreational resource throughout the region. In the United States, the sport of birding or birdwatching essentially began in southern New England; birds were perceived as resources important to crop protection since the time of the early economic ornithologist—Henry Howe Forbush and Arthur Cleveland Bent, among others, and such naturalists as Willliam Brewster and Ludlow Griscom.

Game, of course, had been long important as food; upland hunting in New England probably reached its zenith from the turn of the century to about 1940, during which time the young hardwood forest succeeded the cutover old-field pine, and supported populations of ruffed grouse that can scarcely be imagined today.

Today in southern New England (Massachusetts, Connecticut, and Rhode Island) forest management usually involves uneven-age practices—selection or group selection, though small clearcuts are common when white pine is harvested. In general, about 60 percent of southern New England is in hardwood and pine types, most in small, private holdings. Fuelwood and sawlogs are the major products. Ruffed grouse habitat management is practiced locally and is increasing in popularity on private lands. Public land management is commonly concerned with maintenance of open habitats for stocked pheasants.

In northern New England, even-age practices are common. A long history of local public acceptance of even-age management prevails. About 80 percent of northern New England is in hardwood and conifer forests, much in small holdings. Sawlogs and pulpwood are major products; maple syrup is produced locally. Deer hunting is extensive.

Forest Disturbance

Four major types of disturbance have altered the New England landscape: fire, windthrow, agriculture, and logging. In addition, insects, disease, drought, flood, landslide, and avalanche have caused minor disturbances.

Catastrophes from fire and windthrow occur at intervals of about 800 and 1,150 years, respectively, in New England (Lorimer 1977). However, localized disturbances—sometimes severe—occur at much shorter intervals. Major hurricanes and windstorms occurred 4 to 5 times during the 20th century; the last severe fire period was during the late 1940's and the early 1950's. Although wind has a dramatic effect on forest overstories, it has little impact upon successional trends and overall species composition because of the presence of a tolerant understory and the aggressive nature of New England pioneer species. Wind has minimal effects upon soils except for some churning and mounding from uprooted trees.

Intense forest fires generally occur on dry sites; outwash sands and gravels, fractured or loose rock, or shallow-to-bedrock at high or low elevations. Generally, these sites support mixed-wood or softwood types such as white pine, oak-pine, pitch pine, or spruce-fir. The impact of fire on forest conditions is more severe than that of wind. Pitch pine barrens occur on repeatedly burned areas that often were in white pine or oak-pine. Most bare-rock mountain tops in New England are the result of fire. Productivity of outwash and shallow-bedrock sites seems to be reduced by fire because of the destruction of organic matter. However, even very large, intense burns revegetate with surprising rapidity; the 7,600-acre Beddington Burn in Maine was 97 percent stocked with tree species and other vegetation 5 years after the 1952 burn (Mills 1961).

In addition to natural fire disasters, fire was used by Native Americans in New England to drive game for hunting, clear fields for planting, and open the forest for traveling (Cronon 1983; Spurr and Barnes 1973). There is no strong evidence, however, that Native Americans intentionally burned large forested areas frequently (Russell 1983). Most of the burning was done in the local vicinity of villages. Accidental fires resulted from signal fires or campfires that escaped control (Russell 1983). The use and frequency of fire varied throughout New England. Native Americans in southern New England used

fire to cultivate the land and open the forest more than those in northern New England. They planted corn after burning around the bases of standing trees; fire destroyed the bark and eventually the trees died (Cronon 1983).

Only a few tracts in New England remain unlogged. Much of the logging (as opposed to land clearing in the 1700's) took place in the mid to late 1800's when the best softwoods in mixedwood stands were high-graded and the softwood stands were clearcut. Until recently, the only hardwood stands that were heavily cut were those along railroads and those cleared for agriculture in the past. Logging was similar to windthrow in that it did not have an impact on successional pathways or soils. However, intense fires fueled by slash sometimes followed, especially in softwood stands on dry sites.

More than half of New England was cultivated or grazed in the past, though much of the area has reverted to forest. The effects of agriculture have been described: loss of nutrients, changes in soil profiles, and major cover-type conversions from hardwoods to spruce-fir in the north and from hardwoods to old-field white pine farther south (Bormann 1982). Old-field conditions will revert to natural forest vegetation in one or two rotations (Goodlett 1960).

In summary, agriculture had the greatest impact on the forested landscape in New England because it caused major changes in cover types and soils over a wide range of sites. Although fire lowered productivity of dry-site softwood stands, which reverted to earlier successional stages, fires did not cause major shifts from hardwood to softwood successional paths. Windthrow and logging maintained diversity by initiating earlier successional stages, but had little impact on the forest ecosystem.

Forest Regions

There are more than 31.1 million acres of commercial forest land in New England today (Irland 1982; USDA Forest Service 1977), and forests cover more than 80 percent of the landscape. The percentages of forest land in New England by state range from 59 to 89; the lower percentages occur in southern New England (Massachusetts, Connecticut, and Rhode Island); while timberland dominates the northern New England landscapes of Maine (89%), New Hampshire (87%), and Vermont (76%) (Brooks et al. 1986;Brooks et al. 1987a, b; Kingsley 1985).

The ever-changing forests of New England have been classified into regions by various authors (Braun 1950; Hawley and Hawes 1912; Küchler 1964; Shantz and Zon 1924; Westveld et al. 1956) on the basis of presettlement forest conditions, original forest vegetation, or potential natural vegetation. Gradual transitions and distinct boundaries exist between these regions depending on physiography, climate, bedrock mineralogy, topography, and soils.

Six forest regions based on the work of Küchler (1964) and Braun (1950) are described in this publication (Fig. 1). Characteristic tree species in each region form the basis for the regional names. Physiographic features and climatic conditions characteristic of these forest regions are described (Fig. 2). Many of the 11 major forest-cover types found in New England forests and woodlands (DeGraaf and Rudis 1986) consistently occur throughout these forest regions and are mentioned briefly. (Note: the chapter on silvicultural methods discusses the ecological site associations and silvicultural systems used to regenerate and maintain selected cover-type groups and wildlife communities in northern New England).

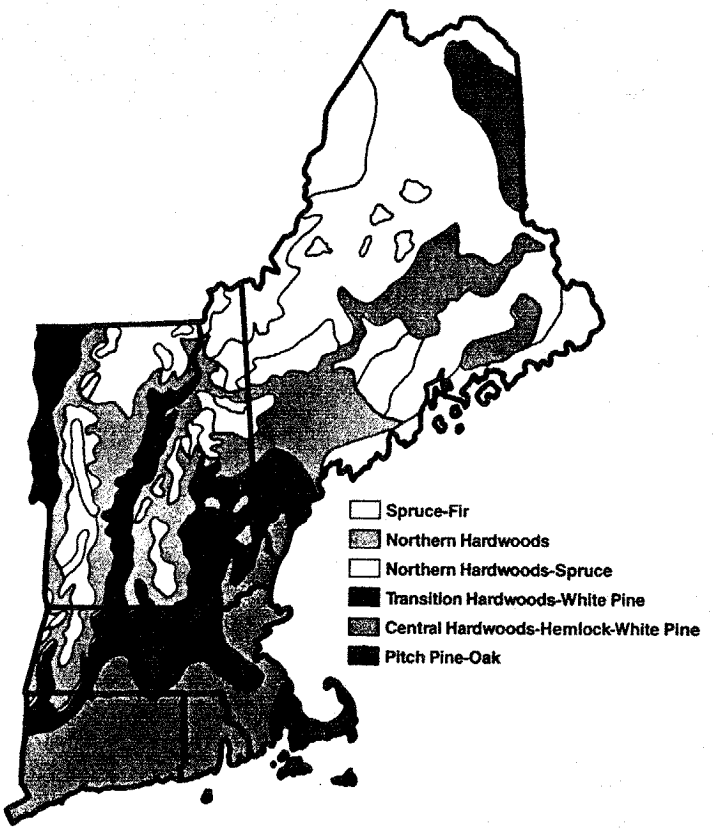


Figure 1. – Forest regions of New England.

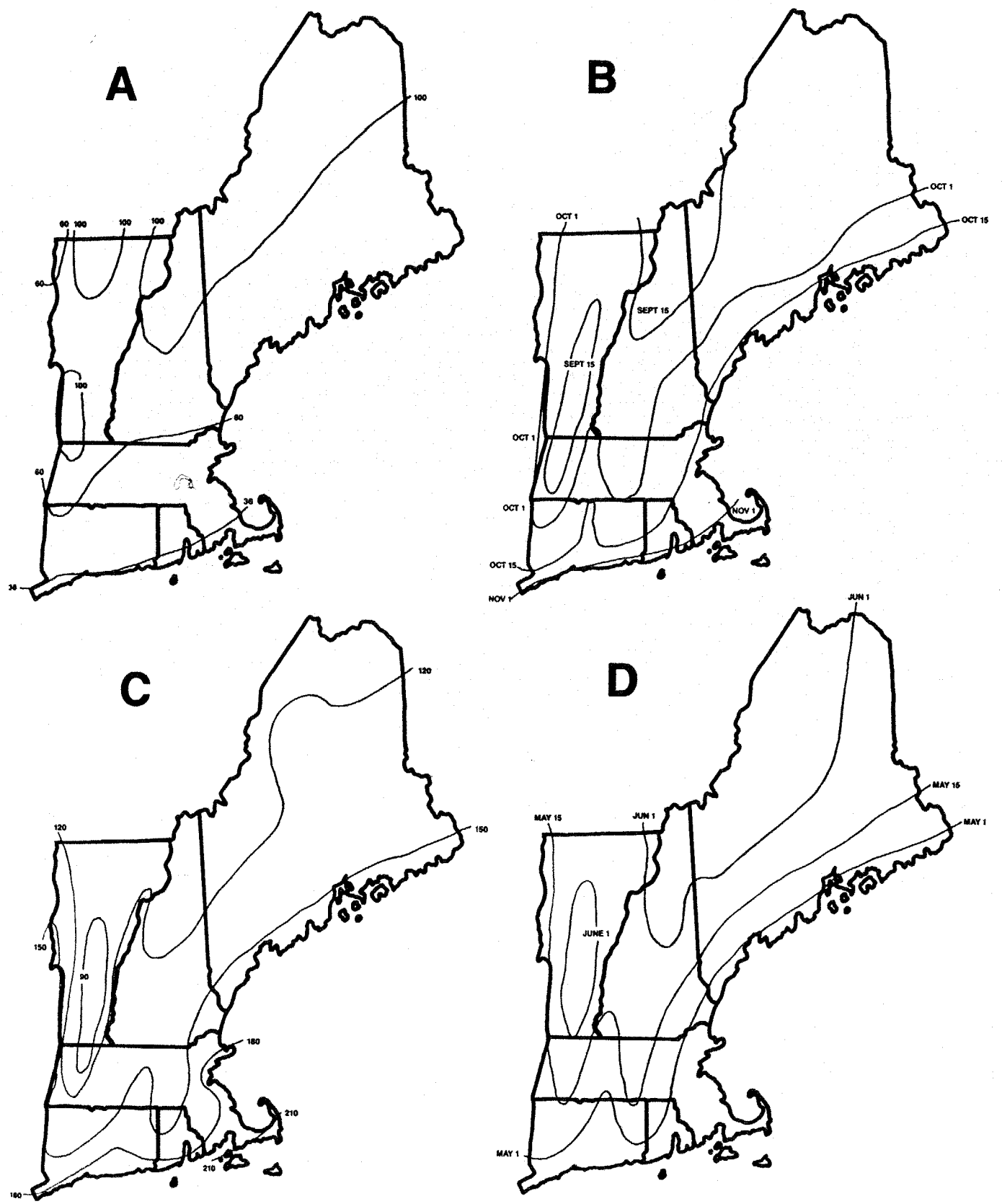


Figure 2. – Climatic variables important to New England forests: A–average annual snowfall (inches), B–average date of first frost, C–average number of frost-free days, and D–average date of last frost.

Spruce-Fir Forest Region. Red spruce and balsam fir are the major tree species in the spruce-fir forest region. Black spruce can be found in the colder, poorly drained to very poorly drained uplands, in addition to swamps and bogs. White spruce occurs frequently on abandoned agricultural fields. Other conifer associates of the spruce-fir forest region include tamarack and hemlock. Most characteristic of the hardwood component in the spruce-fir forest region are red maple, paper birch, quaking and bigtooth aspen, and mountain-ash.

The spruce-fir forest region occurs in the coolest sections of New England. It is predominant above elevations of 500 feet (Bormann et al. 1970) in the central, northern, and easterly coastal counties of Maine, and above elevations of 2,600 feet in the White and Green Mountains of New Hampshire and Vermont (Leak and Graber 1974). Krummholz is characteristic at high elevations. Average date of last frost is June 1; average date of first frost is September 15; with an average of 90 to 120 frost-free days. Mean annual total snowfall ranges from 96 to more than 160 inches (Kingsley 1985; Lull 1968).

Northern Hardwoods-Spruce Forest Region. The major tree species in the northern hardwoods-spruce forest region are beech, white and yellow birches, sugar maple, and associated conifers on the better drained soils. Hemlock is found at lower elevations in northern New England; red spruce and balsam fir replace hemlock at higher elevations. Imperfectly to poorly drained soils, mountain tops, and northerly exposures are characterized by spruce and fir stands. Hardwood stands with a component of hemlock and white pine characterize southerly exposures and the southern portion of this forest region. White pine is an early successional species that can be found on abandoned agricultural areas in river valleys and outwash plains.

Characteristic of lower elevations, this forest region occurs below 2,800 feet in the White and Green Mountains in northern and central New Hampshire (Leak and Graber 1974), and southern Vermont. Average date of last frost is June 1; average date of first frost is September 15; with an average of 90 to 120 frost-free days. Mean annual total snowfall ranges from 80 to 120 inches (Kingsley 1985; Lull 1968).

Northern Hardwoods Forest Region. The northern hardwoods forest region includes beech, sugar maple, and yellow birch. Hemlock, American elm, basswood, black cherry, and white ash are also components to a lesser extent. Quaking and bigtooth aspen and paper birch are early successional species across the range of sites in this forest region. Red maple, American elm, black ash, hemlock, white cedar, and red spruce are characteristic of wetter site conditions.

The northern hardwoods forest region occurs across the higher elevations of the New England upland, particularly in the Aroostook area and upper Penobscot, Kennebec, and Androscoggin River basins in Maine, portions of the Berkshires in western Massachusetts, and throughout the Champlain Valley in western Vermont. Elevations range from 500 to 2,600 feet. Average date of last frost is May 15; average date of first frost is October 1; with an average of 120 to 150 frost-free days. Mean annual total snowfall ranges from 80 to 96 inches (Kingsley 1985; Lull 1968).

Transition Hardwoods-White Pine Forest Region. This is a transition region. Northern hardwoods (yellow and paper birches, beech, and sugar and red maple) are the major species, with the oaks and hickories found on the warmer and drier site conditions of this region. Hemlock occurs on the cooler sites in this region. White pine is characteristic of the well-drained sandy sites. Red maple, black ash, and American elm can be found on the imperfectly drained to very poorly drained sites of this region.

The transition harawoods-white pine forest region occurs to 1,500 feet throughout the lower elevations (Bormann et al. 1970) of the New England upland in north central Massachusetts and southern New Hampshire, reaching northward through the Champlain and Connecticut River valleys. It also occurs in southwestern Maine and the lower reaches of the Androscoggin, Kennebec, and Penobscot River basins. Average date of last frost is May 15; average date of first frost is October 1; with an average of 120 to 150 frost-free days. Mean annual total snowfall ranges from 48 to 80 inches (Kingsley 1985; Lull 1968).

Central Hardwoods-Hemlock-White Pine Forest Region. This region is a mixture of northern and central hardwoods. Formerly, American chestnut

was the dominant tree species of this region. Now, however, red, black, and white oaks; the hickories; gray, yellow, and black birches; and beech are the major species. The primary conifers in the region are white pine and hemlock. Red maple occurs on the wetter sites. Pitch and red pine can be found on the sandy outwash sites.

The central hardwoods-hemlock-white pine forest region occurs across the southern portions of the New England upland and seaboard; throughout Massachusetts, Connecticut, and Rhode Island, and along the southwestern Maine and New Hampshrie coast. Elevations range from sea level to 1,000 feet. Average date of last frost is May1; average date of first frost is October 15; with an average of 150 to 180 frost-free days. Mean annual total snowfall ranges from 32 to 64 inches (Kingsley 1985; Lull 1968).

Pitch Pine-Oak Forest Region. The pitch pine-oak forest region is composed of pitch pine, scrub oak, and scarlet and black oaks. Repeated burning has created favorable conditions for pitch pine and scrub oak, occurring almost exclusively in places. Lowbush blueberry and other ericaceous shrubs abound on these burned areas.

The pitch pine-oak forest region of New England essentially lies on the northeastern extension of the coastal plain formation, represented by Cape Cod, and ranges in elevation from sea level to 150 feet. Much of the Cape is underlain with poorly stratified sheets of sand, gravel, and clay. The Montague Plain (MA) is an inland example of this region. Average date of last frost is May 1; average date of first frost is November 1; with an average of 180 to 210 frost-free days. Mean annual total snowfall is less than 32 inches (Kingsley 1985; Lull 1968).

UNDERSTANDING WILDLIFE HABITATS

Wildlife Habitat

Wildlife habitat is the sum of the environmental factors—food, water, cover, and their spatial distribution—that a given species needs to survive and reproduce in a given area (Schemnitz 1980). Wildlife species have specific habitat requirements that can vary between populations, such that the distribution and abundance of each species are limited by the quality and quantity of available habitat in any given area.

Wildlife populations change in response to several factors, such as diseases, predation, extremes of weather, exploitation, and habitat conditions. These factors are not mutually exclusive; several may act in concert or compensate for one another. When habitat conditions for a prolific prey species improve, its population will increase, other factors being unchanged, but opportunistic pedators will likely respond to that increase. Populations of all species are always in flux, responding to sets of factors that enhance survival and those that reduce survival. For migratory species, conditions on the wintering grounds or severe weather or accidents during migration are important factors. But by far, the most important factor is habitat condition. Habitat alterations, whether relatively slow as in succession or forest development, or rapid due to fire, logging, or hurricane, produce changes in species composition that are dramatic compared to effects of other factors affecting wildlife populations.

Habitats are typically named for wildlife species; for example, ruffed grouse habitat or deer winter habitat. Terms such as "woodcock covert" or "squirrel woods" imply that, within the overall forest, habitat conditions exist that meet the habitat needs for that species. Wildlife biologists use "habitat" to mean a set of conditions required or used by a given species or group of species with similar requirements, or a group of species whose various requirements are met in a given, visually identifiable or distinct environment. For example, sapling stands of northern hardwoods or aspen, well known as the drumming habitat or ruffed grouse, support a diverse community of other species such as redstarts, veeries, rose-breasted grosbeaks, red efts, and red-backed voles. A general overview of the factors that affect each member species is basic to understanding the nature of species-habitat relationships.

Each species has unique habitat requirements. To be resident in an area, each species must find its needs met within the daily activity zones of individual breeding adults. Otherwise, species occurrence is likely to be transitory, temporary, or seasonal. The factors affecting wildlife habitat—food, water, cover, and spatial relationships—are discussed separately and then collectively on a community basis.

Food. A source of energy for growth, maintenance, and reproduction is essential to each species. The plants eaten by grazing or browsing herbivores, such as white-tailed deer, are categorized as preferred, staple, or emergency. Fruits taken by birds can be similarly categorized by how readily they are taken. The foods consumed depend on presence and seasonal availability, and the physiological needs, morphology, and behavior of the consumer. There are also regional and seasonal differences in food preferences within species. For example, dark-eyed juncos feed in trees in the western United States, but are strictly ground-gleaners in the East; ruffed grouse are fairly dependent on aspen buds—especially male flower buds—in the Lake States, but consume a wide variety of winter foods in New England where aspen is much less common or when it is less abundant.

In New England, deep snows and ice storms commonly render food unavailable. Much woodland at higher elevations in Massachusetts and Vermont is unoccupied by wild turkeys because of severe winter conditions and deep snows that render food unavailable. Not all factors affecting food availability can be manipulated by the habitat manager, but to the extent possible or practical, wildlife food needs, especially of herbivores, should be considered in wildlife habitat management plans. Basic references on food preferences are *American Wildlife and Plants: A Guide to Wildlife Food Habits* (Martin et al. 1951) and *Trees, Shrubs, and Vines for Attracting Birds: A Manual for the Northeast* (DeGraaf and Witman 1979).

Water. Most wildlife species must consume water daily. Water is readily available in most New England woodlands and is rarely a limiting factor for terrestrial species. Aquatic habitats, however, have species compositions that are restricted in their

distributions because the species depend on water for breeding, feeding, or overwintering.

Cover. Cover provides an animal protection from the weather or predators; it also provides temporary specialized cover for reproduction, escape, roosting, sleeping, travel, or resting. The forest manager must be aware of the variety of wildlife cover needs, because forest management can provide the sites needed. Cavity trees are used by a succession of species—about 25 percent of New England forest wildlife species. Use of cavity trees ranges from perches, nest and roost holes, dens, foraging sites, and continues until the log falls and rots away. See *Managing Cavity Trees for Wildlife in the Northeast* (DeGraaf and Shigo 1985) and *Guide to Wildlife Tree Management in New England Northern Hardwoods* (Tubbs et al. 1986) for detailed information on cavity tree management.

Dense brush or seedling stands are uncommon in many New England woodlands unless even-age management has been practiced recently. In many woodlands, this cover is virtually absent, and such absence probably limits populations of species such as white-tailed deer, which use it for escape and resting cover. Many other species are associated with woodland thickets, such as ruffed grouse, cuckoos, whip-poor-will, red-backed vole, and catbird.

Cover includes nonforest features, such as fields and other grassy areas and water, which provide foraging, escape, and breeding habitat for many species, as well as cover. The cover requirements of all New England forest wildlife are too numerous to mention here. Many are known and readily identifiable, and are also routinely provided in normal silvicultural practices. Awareness of the values of wildlife cover in forest management planning will help the forest manager meet wildlife needs.

Spatial Relationships. The spatial relationships of these factors and their relative abundance and availability largely determine the wildlife species composition—the community—that can occur in a given woodland. Food, cover, and water are reflected to a large degree by the successional stages of various forest types and other cover types, both terrestrial and aquatic. There is a greater likelihood of meeting more species' requirements when more varied habitat conditions are present, and, thus, a higher degree of diversity can be expected. Even freedom from human disturbance during the breeding season is a requirement for great blue herons, goshawks, peregrine falcons, bald eagles, and martens, among others.

Certainly, the size of a habitat management unit can affect the potential wildlife species that will occupy the site relative to the condition surrounding the area. Species with small home ranges or territory sizes can be managed easily on smaller units. Portions of the year-round habitat conditions needed by species with large home ranges also can be managed on smaller units depending on the surrounding conditions. A 40-acre clearcut, 2 to 3 years old, in a northern hardwood forest typically provides breeding habitat for 20 to 30 pairs of willow flycatchers, 2 or 3 pairs of Swainson's thrushes, one pair of olive-sided fly-catchers, and many white-footed mice, but only a small part of the home range of a pair of red-tailed hawks that hunt over it and a very small part—about 1 percent—of a moose's home range, which is approximately 4,000 acres.

Species occurrence and utilization by forested habitat, nonforested habitat, habitat breadth and size class, and structural habitat features in Appendices A-D, respectively, provide a detailed description of the cover requirements of New England's wildlife species.

Community Organization and Structure

Plant communities each support more or less distinct wildlife communities. Here the term includes size classes of forest cover types and various upland and aquatic nonforested habitats.

The assemblages of plants, animals, and other organisms occupying the same area comprise a biotic community. These assemblages are mutually sustaining and interdependent; constantly fixing, utilizing, and dissipating energy (Smith 1966). The interacting populations of plants and animals are characterized by continual replacement of individuals, and fluctuate with seasonal and environmental changes.

Food chains, whether simple or complex, link assemblages of herbivores and carnivores to their ultimate plant foods through the process of eating and being eaten (Colinvaux 1986). Food webs integrate multiple food chains to describe the relationships and interactions between plants (producers), herbivores, insectivores, primary and secondary carnivores, and omnivores (all consumers), and decomposers. Within a food web, many plant species normally occur together, and most herbivores and browsers can eat several species. Food webs are systems in quasi-equilibrium; each species in the food web affects the fluctuations of all other species in some manner (Fig. 3). In this way, species in a community are determined not

only by interactions among themselves but also by adaptation of each species to different environmental conditions (Poole 1974).

These food web combinations provide some definition of the problem relating to assemblages of unrelated species and where they predictably occur. Habitat managers require methods that predictably relate the major aspects of wildlife species' natural histories (for example, food, water, cover, and spatial requirements) to recognized managed habitats (for example, the various successional stages of forest plant communities). These stages are thought to contain a unique set of

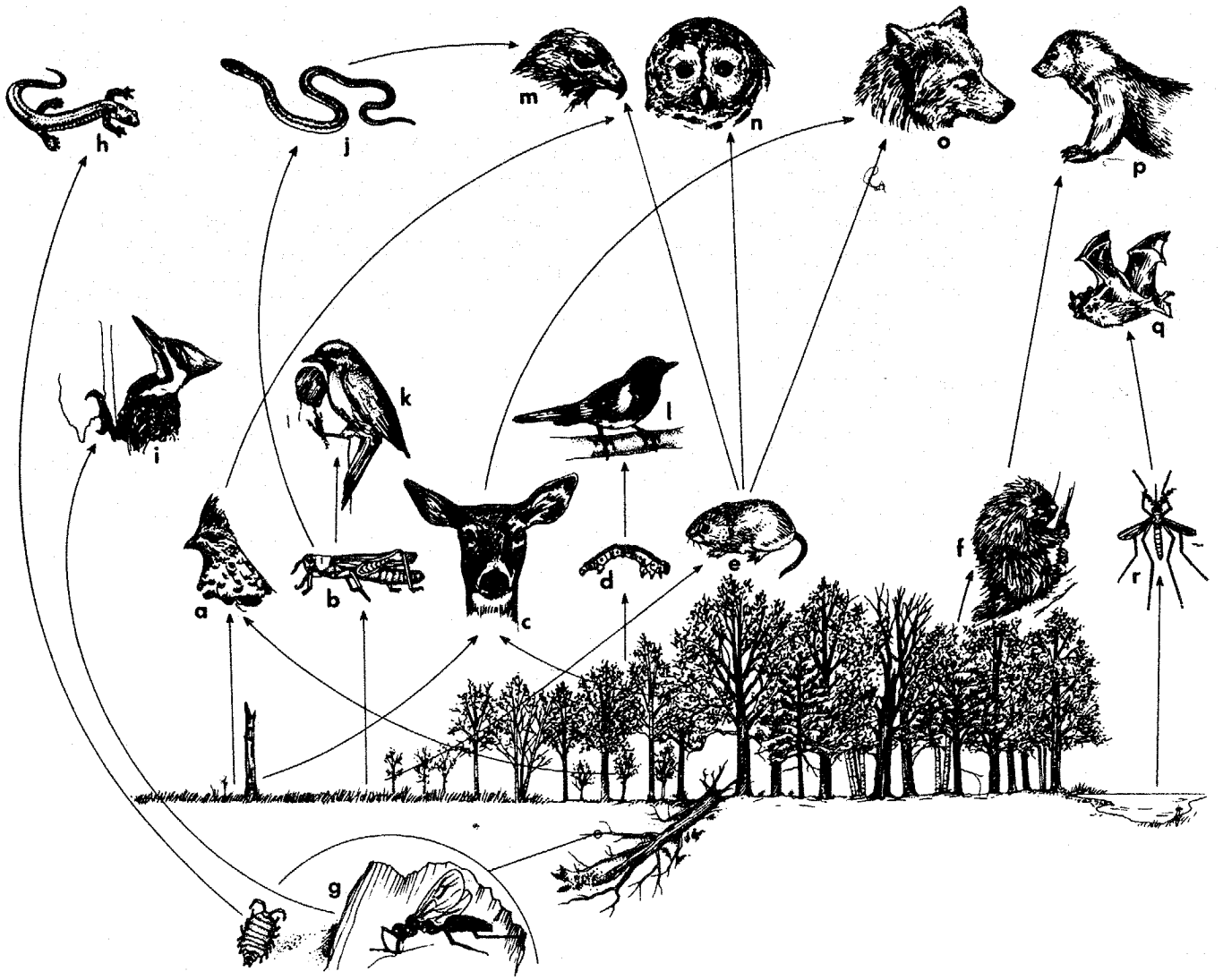


Figure 3. – A representative food web in a typical northern hardwood forest sere (northern New England). The plant-produced organisms are consumed by herbivores such as ruffed grouse (a), grasshoppers (b), white-tailed deer (c), Bruce spanworm (d), red-backed voles (e), and porcupines (f). Decomposers of plants include sowbugs and carpenter ants (g), which are preyed upon by redback salamanders (h) and pileated woodpeckers (i). Herbivorous insects are consumed by garter snake (j), eastern bluebird (k), and redstart (l) among others. Vertebrate herbivores are consumed by carnivores such as broad-winged hawk (m), barred owl (n), coyote (o), and fisher (p). Bats (q) consume mosquitos and other flying insects (r).

habitat niches—specific arrangements of food, cover, and water—that meet the requirements of particular species (Hanson 1962).

Habitat niches are, therefore, presumed to be occupied by a set of wildlife species unique to that habitat—species may be either seasonal or year-long habitat occupants (Meslow and Wight 1975; Thomas et al. 1975). For example, northern hardwood stands can be distinguished by their breeding bird composition into four habitats: (1) regenerating; (2) seedling/sapling; (3) poles; and (4) sawlogs, large sawlogs, and silviculturally uneven-aged stands (DeGraaf 1987).

The classification of vegetation into forest cover types and size classes, upland and wetland nonforest types, and various types of permanent aquatic habitats provides a partial basis for determining the habitat niche opportunities or habitat potential available on the site over time. A word of caution: similar cover types may occur across forest region boundaries. The combination of physiography, soils, climatic factors, successional patterns, and past management practices can produce very different habitat niches or potentials within these vegetative classifications over time. It is important to examine these habitat potentials within a regional ecosystem context.

Habitat Structure

The distribution or mixing of vegetative types, size classes, and an assortment of features to a large extent determines the wildlife communities that occur within forest vegetation (Smith 1962). Horizontal and vertical diversity are two components of habitat structure.

Horizontal Diversity. Horizontal diversity or "patchiness" refers to the complexity of the arrangement of plant communities and other habitats (Fig. 4). Different forest types have different wildlife communities. The greater the

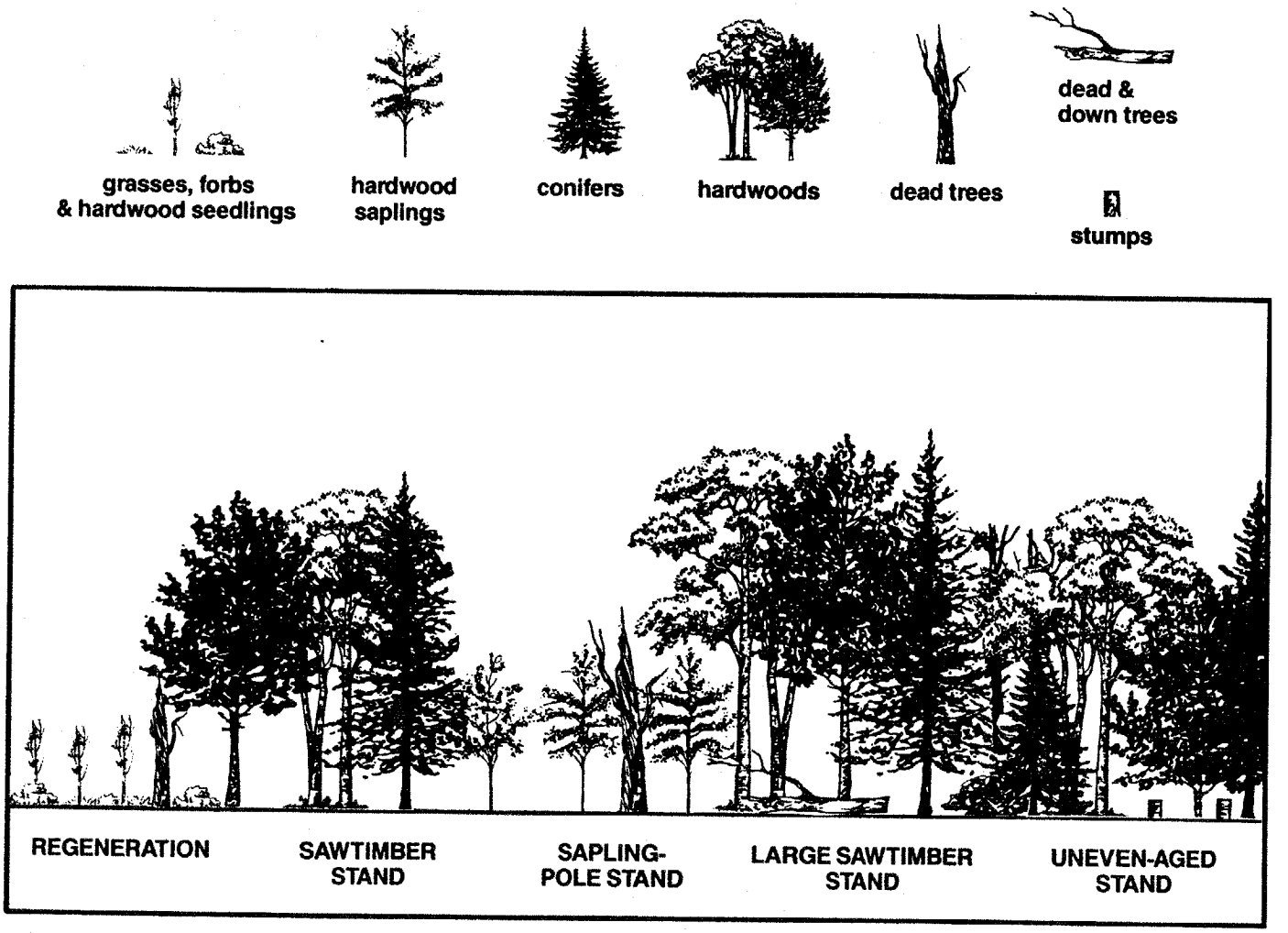


Figure 4.—Horizontal diversity depends on the type of area and size-class management used on a property.



Figure 5.—Vertical diversity depends on the number of vegetative layers present in a stand.

range of size classes present, the greater the potential that more wildlife species will be present. Still, many wildlife species occur in several forest types and size classes. The horizontal diversity provided by open and wetland habitats contributes greatly to the overall forest wildlife community because these nonforested habitats contain species not normally associated with forest vegetation and provide food, water, and cover opportunities not available in only forested areas.

Vertical Diversity. Vertical diversity refers to the extent to which plants are layered within a stand. The degree of layering is determined by the arrangement of growth forms (trees, vines, shrubs, herbs, and thallophytes (mosses and lichens)), by the distribution of different tree species having different heights and crown characteristics, and by trees of different ages of the same species. The extent to which vertical structure varies within the stand determines the degree of vertical diversity (Fig. 5). Stands with a high degree of vertical diversity characteristically develop multiple vegetative layers—overstories with a rich species composition and well-developed herbaceous, shrub understory, and woody midstory layers.

The number of species that occupy a given habitat is, in a large part, a function of vegetative composition and distribution—through both horizontal and vertical structural differences.

Vertical diversity is probably of greatest importance to most forest birds (Anderson and Shugart 1974; Balda 1975; James 1971; MacArthur et al. 1966); horizontal diversity is probably more important to open-country birds and mammals. Some species require both types of diversity (for example, ruffed grouse, wild turkey, black bear, white-tailed deer, and others).

Niche separation by specific habitat selection seems to be the most common mechanism of achieving competitive coexistence in temperate forest bird communities (Noon and Able 1978; Noon et al. 1979; Whitmore 1977). The variety of bird species present in such communities is directly related to habitat structure, especially in the breeding season.

Other Factors Affecting Wildlife Distribution

Other factors that permit many bird species to coexist in the same forest include separation of feeding times (for example, hawks feeding during the day and owls feeding at night), separation of breeding times (for example, American goldfinches nest in late summer, after other finches), and separation of feeding and nesting height. Many insectivorous, frugivorous, and seed herbivorous species forage within certain vegetative layers (for example, on the forest floor, in shrub understories and midstory layers, in tree holes, or in the upper canopy) and nest and raise young within other vegetative layers.

Factors that commonly influence amphibian and reptile occurrence are soil and moisture regimes, drainage (factors that influence forest type), and cover such as that provided by logs and debris (DeGraaf and Rudis 1983). Factors that occur independently of forest type, such as cliffs, talus and boulder areas, and those habitats produced by human activities (for example, logging roads, debris piles, agricultural fields, and old dwellings) also commonly influence reptile occurrence.

Small mammals (for example, moles, shrews, bats, mice and voles), many of which are seasonally herbivorous, insectivorous, or omnivorous, tend to be habitat generalists, and are not as responsive as birds to changes in forest structure (Gore 1986). Squirrels and other mammals that den in tree cavities are very much affected by the distribution and structural features of stands that contain both cavity trees and a variety of food sources. Carnivores and omnivores such as skunks, raccoons, coyotes, and foxes need a larger area for feeding than do more localized amphibians, reptiles, and small mammals. Large herbivores and omnivores such as white-tailed deer, moose, and black bear can cover large areas, feeding on mixtures of herbaceous, aquatic, and woody vegetation depending on availability and time of year. Additionally, black bears consume variable amounts of larval insects and carrion. Carnivores such as bobcat, lynx, eagles, and other large hawks and owls also cover large areas throughout the year, feeding on various prey depending on availability. The mountain lion and wolf have been replaced in New England by human hunters and coyotes at the top of an intricately intertwined food web.

Management Objectives

An understanding of the nature and structure of habitats and biotic communities provides a basis for defining wildlife habitat management objectives. Each species' habitat needs for food, cover, water, and spatial distribution within a limited space are provided by a definite set of physical and biological environmental conditions. And, there are many dependencies and interdependencies among the plants, insects, and wildlife species that comprise a biotic community. This means that wildlife habitat management (1) consists of providing the essential habitat features—some that are easily manipulated, some difficult to change, some relatively permanent, and some that change rapidly over time; and (2) involves entire communities, even if the primary interest is a certain group of animal species.

Wildlife habitat management is the art of applying ecological principles and manipulating vegetative conditions in a scientific manner to achieve a set of species/habitat goals (Bailey 1982).

To practice wildlife habitat management on a given ownership or unit of forest land;

- Know the habitat requirements of the concerned species;
- Know the forest cover types involved and their silvicultural characteristics;
- Inventory associated habitats;
- Develop a forest management plan with specific objectives for species and habitats, and management prescriptions for their accomplishments;
- Implement the management plan;
- Evaluate results and adjustment of management prescriptions as required to meet objectives.

Traditional approaches in wildlife habitat management usually have emphasized single species (featured species) management, combinations of different featured species management strategies, or a species richness (diversity) management strategy. Land managers have described emphasis areas, where single species habitat management goals and objectives can be identified and treatments implemented on the ground to produce suitable habitat conditions, particularly for game species such as ruffed grouse, turkey, and white-tailed deer. Specific rare, threatened, and endangered species habitat management strategies (for example, bald eagle and osprey nesting and various rookery protection zones) are examples of single species management approaches (Endangered and threatened wildlife and plants, 50 CFR 17.11 and 17.12 (Jan. 1, 1989) Washington, DC).

Another approach is to emphasize indicator species whereby the goal is to produce desired numbers of selected species in specific areas. Species are selected that represent larger groups of other species; adequate habitat quality and availability for the indicator species presume the availability of suitable habitat for the larger groups. The key to "success" is to select indicators that are indeed indicators of the habitats specified, and that the needs of all the other species are represented. This approach is currently being used on national forests.

The species richness or wildlife diversity approach consists of providing as varied a habitat as possible—both in vertical structure and horizontal patchiness. The species richness approach has many applications on both large and small management units.

Habitat manipulation becomes a major tool when the management objective is to increase the variety of wildlife species that potentially can occupy an area. Regardless of the approach, use of standard forest management and silvicultural practices, with some modifications, can be the most efficient way to manage forest wildlife habitats.

Our objective is to provide information in order to manage New England forests for the greatest variety of wildlife that is practical using various types of silvicultural practices. We want to provide either breeding or wintering habitat conditions for all wildlife species that can potentially occupy a given habitat. Individual species can be managed by emphasizing their habitat requirements.

There is an array of wildlife habitat improvement practices to benefit individual species or groups of species. Habitat improvement practices—erecting nest boxes or platforms, planting food patches, creating impoundments, and improving wetland conditions—while useful in certain situations, are beyond the scope of this publication. We refer the reader to the ***Wildlife Management Techniques Manual*** (Schemnitz 1980) and the ***Forestry Handbook*** (Wenger 1984) for details on these and other intensive practices.

INVENTORY AND PRESCRIPTION

This section outlines an inventory procedure to assess current wildlife habitat features for large or small parcels of land. A prescription key is provided to help users determine wildlife habitat needs and establish priorities for wildlife habitat management activities.

Assessment of Habitat Management Opportunities

Before the actual inventory, it is necessary to recognize the types and distribution of forested and nonforested landscapes.

There are four classes of landscapes with different wildlife habitat opportunities in the forested sections of New England (Brooks et al. 1986; Brooks et al. 1987 a,b; Frieswyk and Malley 1985 a,b; Powell and Dickson 1984):

1. *Habitat Opportunity Class I.* Landscapes that are at least 90 percent forested.

2. *Habitat Opportunity Class II.* Landscapes that are at least 90 percent forested with more than 5 percent in water and wetland nonforest types.

3. *Habitat Opportunity Class III.* Landscapes with at least 70 percent forested with less than 5 percent in water types.

4. *Habitat Opportunity Class IV.* Landscapes that are at least 70 percent forested with more than 5 percent in water and wetland nonforest types.

Table 1 – Habitat opportunity classes and composition goals for New England forested landscapes

Composition	Habitat opportunity class			
	I	II	III	IV
	Percent			
Habitat breadth:				
Forest	>90	>90	70-90	70-90
Nonforest	0-10	<5	5-30	5-30
Water	<5	>5	<5	>5
Krummholz	p / a[a]	p/a	p/a	p/a
Size-class distribution:				
Regeneration	5-15	5-15	5-10	5-15
Sapling-pole	30-40	30-40	25-35	30-40
Sawtimber	40-50	40-50	55-65	40-50
Large sawtimber	<10	<10	<10	<10
Cover-type distribution				
Deciduous (not oak)				
Short rotation [b]	5-15	10-25	5-10	5-20
Long rotation [c]	20-35	15-30	20-40	10-20
Hard mast - oak[d]	1-5	1-5	5-25	1-15
Coniferous [e]	35-50	35-60	10-35	25-50
Nonforest				
Upland openings	3-5	3-5	15-30	5-10
Wetlands	1-3	1-3	1-3	3-5

[a] Presence/absence.

[b] Short-rotation deciduous type includes the aspen-birch group.

[c] Long-rotation deciduous types include northern and swamp hardwoods groups.

[d] Hard mast includes oak-pine and oak-hickory groups.

[e] Coniferous type includes mixes of white/red pine-hemlock and spruce-fir groups.

Identification of such large-scale habitat opportunity classes (Table 1) helps managers to assess the capability of these predominantly forested New England landscapes to provide a range of vegetative compositions. Smaller area surveys of vegetative compositions and size-class distributions provide managers with an assessment of a specific piece of landscape in relation to its potential for providing a varied range of habitat opportunities. Because this publication is directed toward maintaining and improving habitat diversity, the resource capability data are crucial to determining what types of vegetative management prescriptions can improve the habitat potential for the broadest possible array of wildlife species, while protecting habitat requirements of those species currently present.

We suggest ranges of mixtures of habitat components for these four habitat opportunity classes as optimal goals for areas of 250 to 2,500 acres that can be used in the prescription development process. The estimates of these ranges (Table 1) can be used for developing prescriptions on both large and small properties.

We urge caution when using the prescription process on predominantly upland and wetland nonforested landscapes, where forested stands are the less common features. These broadly defined habitat opportunity classes are based on county-level summaries in New England—areas of at least 235,000 acres.

Inventory

The presence of a wildlife species or community in a specific location often depends on the surrounding habitat conditions. Ownerships smaller than 250 acres need to be examined within a larger context to determine the habitat management opportunities that may be effective and reasonable to pursue within the smaller tract. An extensive survey of the surrounding area to determine the relative cover type composition should cover about 10 times the area of the single ownership because, based on a 100-year rotation and a treatment cycle of 10 years, a small ownership represents a single stand within a larger management unit 10 times the size. In other words, even on a larger ownership under sustained production only one-tenth of the area is harvest cut within a 10-year period. Second, consideration of large-scale interdependent relationships is crucial to holistic management of habitats and vegetative landscapes. Finally, parcel size is an effective screen for what realistically can be done with wildlife habitat in the identified area during a 10-year planning period. An extensive survey can be estimated quickly and effectively from aerial photos.

For example, for a 10-acre tract, survey 100 acres; for a 250-acre tract, survey approximately 2,500 acres, and so on. It may be possible with some small ownerships to develop multi-owner management plans if landowners have common interests and are willing to cooperate on a joint land-management venture.

Small ownerships (<250 acres) present very limited opportunities to manage habitat conditions of resident wildlife species with large home ranges such as black bear, deer, and moose, and their diverse habitat requirements on a year-round basis. However, small ownerships are quite capable of supplying needed habitat components for these species, if the other required habitat components are predictably supplied somewhere within the surrounding area. Also, smaller ownerships are often capable of fully providing the diversity of habitat features needed by rare resident wildlife species such as the eastern spadefoot or those species with smaller home ranges such as cottontails. Resource managers of small ownerships need to know something about the diversity of the surrounding area, how it is managed, and the likelihood of those conditions changing to examine the habitat management opportunities.

Various migratory species have habitat needs and suffer population stresses in areas totally removed from influence by vegetation management in New England. Not even the 10-factor expansion of habitat survey can adequately address the full life cycle or year-round habitat requirements of these species. Nevertheless, specific seasonal habitat requirements for such species may be identified and provided for in the subject tract. The position of the subject tract in relation to horizontal and vertical vegetative diversity throughout the larger survey unit is especially relevant in this perspective.

To complete this step of the process, the survey area is outlined by landscape features that functionally define or limit access to habitat opportunities, without consideration of political division or current ownership. Natural boundaries such as watershed perimeters, large rivers, and major highways are suitable as approximate boundaries of the inventory unit.

This extensive part of the inventory should provide information on several levels of habitat features for the area surrounding the subject tract. Important general features of the surrounding area that need to be determined include: (1) the relative proportion of available habitats—forest, nonforest, krummholz, and water—to determine the habitat opportunity class; (2) the relative composition of forest cover types; and (3) the relative proportion of upland/wetland nonforest and water types. These general features can be surveyed using an ocular estimation method and aerial photos. Estimates of acreage are sufficient.

The next step of the inventory deals with the subject tract. Divide the tract into recognizable stands, identify cover types, and conduct ground inventories, especially of tree data and other within-stand vegetative features. Recording the presense or absence of these features gives some indication of the habitat opportunities available in the subject tract. It also rounds out the vegetative survey in places that a standard timber inventory does not cover. Listing of specific natural or man-made features on the subject tract can be very useful. We have designed a small ownership habitat evaluation form and stand tally sheet (Fig. 6) to assist a resource manager in this type of integrated vegetation-habitat evaluation. A list of the major habitat inventory features and a description of each is included.

General features, such as vegetative composition, both for forested and nonforested components, should be considered in terms of their percentage of the surrounding area and subject tract. Aerial photos, type maps, and area cover-type and size-class inventories are useful tools to complete this procedure. Acreage of brooks, streams and rivers is hard to estimate. To do so, use a rough width figure that includes the brook, stream, or river and the adjacent waterside area; then multiply by the approximate length.

To develop stand prescriptions, a resource manager needs to: (1) understand the goals of the landowners, (2) inventory and evaluate the resource capability of the subject tract and surrounding area, (3) make some judgment on the likelihood and type of vegetative change in the surrounding area over the next planning period. (4) develop a set of working objectives that addresses the goals of the landowner, and (5) decide on the stand prescriptions that best meet the landowner objectives, knowing that there are several prescriptions possible for any set of landowner goals and objectives.

Small ownership habitat evaluation form

General Features:

Owner Name:_____ **Location:**_____

Ownership acres:_____ **Description:**_____

Assessment Unit: Forest____% : Nonforest___% : Water___% : Krummholz___%

Forest Composition: Softwood____% : Hardwood____% : Mixed___%

Forest Size Composition: Regeneration___% Sawtimber +_____%

Nonforest Composition: Upland____% : Wetland____%

Forest Cover Type Distribution of Ownership (acres):

Cover Type	Regeneration	Sapling-pole	Sawtimber	Large Sawtimber	Uneven-aged	Cover Type Acres	% Forest Type	% Total Acreage
Total							100%	

Nonforest Type Distribution of Ownership (acres): **Water** (acres):

Upland	Wetland	Water
Type | Acres	Type | Acres	Type | Acres
Total ____ ____%	Total ____ ____%	Total ____ ____%

Ownership Summary:

Stand No.	Type Size Density	Acres	Ownership Objectives	Management Opportunities	Prescription Activities

Figure 6.—Small-ownership habitat evaluation form.

Ownership:_____ **Stand No.:**_____ **Acres:**_____ **Prescriber:**_____

Tree Data

Plot___	Plot___	Plot___	Plot___
No. Spec. DBH Qual	No. Spec. DBH Qual	No. Spec. DBH Qual	No. Spec. DBH Qual

Plot___	Plot___	Plot___	Plot___
No. Spec. DBH Qual	No. Spec. DBH Qual	No. Spec. DBH Qual	No. Spec. DBH Qual
Total:BA__ AGS__ UGS__ DGS__ Cull__ Mat__ X__	Total:BA__ AGS__ UGS__ DGS__ Cull__ Mat__ X__	Total:BA__ AGS__ UGS__ DGS__ Cull__ Mat__ X__	Total:BA__ AGS__ UGS__ DGS__ Cull__ Mat__ X__

Within-Stand Features (note presence = very apparent / absence = minimal):

Plot No.	Canopy	Exposed Perches	Inclusions	Large Cavity Tree Boles	Vegetation Layer	Dead / Down
	<30|30-70|>70	High| Low		Dead|Live	Midstory|Shrub| Herb	

Special Habitat, Human-made and/or Visual Features: _____

_____

_____

_____

Stand Summary:

Plot No.	Type Size Density	Basal Area	Key Within Stand Features	Management Possibilities
Stand Presc.				

List and description of habitat inventory features used.

***General Features*:**

1. **Forested Cover Types**: Descriptions can be found in *Forest Cover Types of the United States and Canada* (Eyre 1980).
   (a) **Softwoods**: Includes the following types: balsam fir; spruce/fir; spruce; pine; and eastern hemlock. Size classes of particular interest include: 0-10 year/regeneration through seedling class; and mature/small and large sawtimber classes.
   (b) **Hardwoods**: Includes the following types: aspen; paper birch; northern hardwoods; swamp hardwoods; and northern red oak. Size classes of particular interest include: 0-10 year/regeneration through seedling class; and mature/small and large sawtimber classes.
   (c) **Mixed**: Includes the oak-pine type. Size classes of particular interest are the same as hardwoods and softwoods.

2. **Nonforested Cover Types**:
   (a) **Upland**: See descriptions in DeGraaf and Rudis (1986).
   - Grass openings–hayfields, etc.
   - Forb openings–broad-leaved herbaceous cover like goldenrod (*Solidago*), sensitive fern (*Onoclea*) etc.
   - Shrub openings or old fields–abandoned agricultural fields reverting to forest, characterized by grasses, shrubs, and small trees.
   - Pastures–usually too wet or rocky for cultivation.
   - Savanna–grasslands with shrubs and widely scattered trees, resulting from disturbances like fire or grazing.
   - Orchard–fruit trees with a grassy ground cover.

   (b) **Wetland**: Palustrine descriptions can be found in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979).
   - Sedge meadow–dominated by sedges (*Carex*) and cattails (*Typha*); surface water depths to 6 inches in winter and spring; soil surface saturated in summer.
   - Shallow marsh–characterized by persistent emergent aquatic vegetation and water depths to 1.5 feet.
   - Deep marsh–characterized by persistent emergent and floating- leaved aquatic vegetation and water depths to 6 feet.
   - Shrub swamp–dominated by woody vegetation less than 20 feet tall; seasonally or permanently flooded to a depth of 1 foot.
   - Bog–characterized by peat (*Sphagnum*) accumulation; usually a floating mat of vegetation with pitcher plants (*Sarracenia*) and sundew (*Drosera*) common.
   - Pond–permanent water body less than 10 acres, characterized by emergent and floating-leaved aquatic vegetation.

3. **Water**: See lacustrine and riverine descriptions in Cowardin et al. (1979). Deepwater habitats situated in topographic depressions or dammed channels; lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage; and total area exceeds 10 acres. A channeled water flow characterizes riverine habitats.
   (a) Lakes–characterized by water depths greater than 6.5 feet.
   (b) Streams–intermittent or permanent up to 30 cubic feet per second at high flow.
   (c) Rivers–at least 30 cubic feet per second at low flow.

4. **Krummholz**: Subalpine forest and alpine zones usually above 3500 feet characterized by smaller, windsheared trees below timberline; above timberline, characterized by low shrubby, slow growing woody plants and ground cover of boreal lichens, sedges, and grasses (DeGraaf and Rudis 1986).

***Within-Stand Features*:**

1. **Overstory Canopy Closure**:
   (a) Less than 30%–characteristic of clearcuts, open shelterwood cuts, poorly stocked stands, and nonforested types with scattered trees present.
   (b) 30-70%–characteristic of shelterwood and partial cuts.
   (c) Greater than 70%–characteristic of individual selection cuts and dense first stage shelterwood cuts.

2. **Exposed Perches**: Dead/live woody perches of variable heights above the surrounding forest canopy or herbaceous ground vegetation.
   (a) High–supracanopy and pasture trees characterize hunting perches or nesting sites.
   (b) Low–shrubs, fenceposts, and dead stubs less than 10 feet high.

3. **Inclusions**:
   (a) Overstory–coniferous/deciduous inclusions in predominantly hardwood/softwood stands.
   (b) Other–any habitat features too small to be mapped or tallied.

4. **Large Cavity Tree Boles**: Dead/live stems larger than 18 inches dbh with at least two major defects such as large holes, large broken tops and limbs, and butt rot.

5. **Midstory Layer**: Deciduous/coniferous saplings and poles that occur within the 10-30 feet zone in forested stands; usually beneath an overstory canopy.

6. **Shrub Layer**: Deciduous/coniferous/ericaceous shrubs and seedlings that occur within the 2-10 feet zone in forested and nonforested stands.

7. **Herbaceous Vegetation Layer**: Forbs, grasses, and woody seedlings that occur in the 0-2 foot zone in forested and nonforested stands; usually with a ground coverage range greater than 50%.

8. **Dead and Down Material**: Results from stand mortality and harvesting activities; ranging from minimal amounts on biomass harvested stands to maximum amounts on some of the natural areas in New England.

***Other Special Habitat Features*:**

1. Agricultural Fields:
2. Cliff/Ledges/Talus/Outcrops:
3. Caves:
4. Seeps:
5. Gravel Pits/Bare Ground/Cut Bank
6. Slash Piles:
7. Hard/Soft Mast:

***Human-made Features*:**

1. Buildings/Bridge:
2. Junk Piles:

Prescription Key

Use the following key to identify the wildlife habitat opportunity class of the overall survey area:

Habitat Opportunity

I. Forest land in survey area >90%
  II. Water and wetland nonforest <5%.....Class I
  II. Water and wetland nonforest >5%.....Class II

I. Forest land in management unit/area between 70 and 90%
  II. Water and wetland nonforest <5%.....Class III
  II. Water and wetland nonforest >5%.....Class IV

A range of predictable wildlife habitat components around the overall survey area is described for each habitat opportunity class. The user can then find an approximation of the existing condition of these habitat components for a particular survey area. The key recommendations suggest a range of prescriptions and activities to consider in order to manage the subject ownership, given the user's knowledge of land capability of the overall survey area, in addition to the ownership goals, objectives, and limitations.

Prescription Key Recommendations

HABITAT OPPORTUNITY CLASS I

Ownership size is large (>250 acres); ownership and surrounding survey area (approximately 10X ownership area) is more than 90% forested

1 Upland nonforested and age/size class distribution meet composition objectives; cover types balanced between hardwood: softwood types .....a

1' Upland nonforest does not meet composition objectives 2

2 Age/size class distribution meets composition objectives; cover types balance hardwood: softwood types.....b

2' Age/size class distribution does not meet composition objectives: cover types not balanced between hardwood:softwood types .....b,c

Prescription Key Recommendations

Ownership size is small (<250 acres); ownership and surrounding survey area (approximately 10X ownership area) may be less than 90% forested.

1 Ownership and surrounding survey area meets composition objectives: more than 90% of survey area is forested; cover types balanced between hardwood: softwood types .....d

1' Ownership and surrounding survey area does not meet composition objectives 2

2 Upland and wetland nonforest and water components comprise more than 10% of the survey area; cover-type composition may or may not be balanced between hardwood:softwood types.....d,e

2' Upland and wetland nonforest and water components comprise no more than 10% of the survey area; cover-type composition unbalanced .....f

HABITAT OPPORTUNITY CLASS II

Ownership size is large (>250 acres); ownership and surrounding survey area (approximately 10X ownership area) is more than 90% forested; wetland nonforest and water components are greater than 5% of the area.

1 Upland nonforest and age/size class distribution meet composition objectives; cover-type compositions heavier to softwoods than hardwoods; water-influenced components present.....g

1' Upland nonforest distribution does not meet composition objectives; water-influenced components may or may not be present ..2

2 Upland and wetland nonforest and water components comprise more than 10% of the surrounding survey area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components present.....c,g

2' Upland and wetland nonforest and water components comprise less than 5% of the surrounding survey area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components not present .....b,c

Ownership size is small (<250 acres); ownership and surrounding survey area (approximately 10X ownership area) may be less than 90% forested with a wetland nonforest and water component greater than 5% of the area.

1 Ownership and surrounding survey area meets composition objectives; more than 90% forested; cover-type compositions heavier to softwoods than hardwoods; water-influenced components present...d,g

1' Ownership and surrounding survey area does not meet composition objectives 2

2 Upland and wetland nonforest and water components comprise more than 10% of the survey area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components present .....d,e,g,

2' Upland and wetland nonforest and water components comprise no more than 10% of the survey area: cover-type composition far from the desired composition; water-influenced components not present .....f

HABITAT OPPORTUNITY CLASS III

Ownership is large (>250 acres); ownership and surrounding survey area (approximately 10X ownership area) is at least 70-90% forested with a wetland nonforest and water component less than 5% of the area.

1 Upland and wetland nonforest and water components meet composition objectives; cover types balance between hardwood:softwood types .....h

1' Upland and wetland nonforest and water components do not meet composition objectives.....2

2 Upland and wetland nonforest and water components comprise more than 40% of the area; age/size class distributions and cover-type compositions may or may not meet composition objectives .....c,i

2' Upland and wetland nonforest and water components comprise less than 15% of the area; age/size class distribution and cover-type composition may or may not meet composition objectives .....b,c

Ownership size is small (<250 acres); ownership and surrounding survey area (approximately 10X ownership area) may be less than 70-90% forested with wetland nonforest and water components less than 5% of the area.

1 Ownership and surrounding survey area meets composition objectives; 70-90% of the area is forested; cover-type composition may or may not meet composition objectives .....d,h

1' Ownership and surrounding survey area is not 70-90% forested; composition of the survey area may not meet objectives 2

2 Upland and wetland nonforest and water components of the survey area comprise more than 30% of the area.....d,e

2' Upland and wetland nonforest and water components of the survey area comprise less than 10% of the area .....d,f

HABITAT OPPORTUNITY CLASS IV

Ownership size is large (>250 acres); ownership and surrounding survey area (approximately 10X ownership area) is at least 70-90% forested; wetland nonforest and water components greater than 5% of the area.

1 Upland and wetland nonforest and water components; and age/size class distribution meet composition and age/size class objectives; cover-type compositions heavier to softwoods than hardwoods; water-influenced components present .....g,h

Prescription Key Recommendations

1' Upland and wetland nonforest and water components may or may not meet composition objectives; cover-type compositions may be heavier to softwoods than hardwoods; water-influenced components may or may not be present 2

2 Upland and wetland nonforest and water components comprise more than 30% of the surrounding area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components present .....c,g,i

2' Upland and wetland nonforest and water components comprise less than 10% of the surrounding area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components not present.....b,c

Ownership size is small (<250 acres); ownership and surrounding area (approximately 10X ownership) is less than 70-90% forested; wetland nonforest and water components greater than 5% of the area.

1 Ownership and surrounding survey area meets composition objectives; 70-90% of the area is forested; cover-type compositions heavier to softwoods than hardwoods; water-influenced components present...d,g

1' Ownership and surrounding survey area does not meet composition objectives 2

2 Upland and wetland nonforest and water components comprise more than 30% of the survey area; cover-type composition may or may not be heavier to softwoods than hardwoods; water-influenced components present.....d,e,g

2' Upland and wetland nonforest and water components comprise no more than 10% of the survey area; cover-type composition far from the desired composition; water-influenced components not present .....d,f

Prescription Key Recommendations

a. Within balanced cover-type composition, consider the following small-scale manipulations:

(1) maintain aspen-birch short rotation component;
(2) maintain quantity and juxtaposition of regenerating acres in the surrounding area;
(3) increase the hard mast component (oak and beech primarily);
(4) improve quality and juxtaposition of dense conifer thermal cover;
(5) continue upland nonforest opening maintenance;
(6) recognize, protect, maintain, and develop within-stand features throughout the area where possible (for example, high exposed perches, raptor nesting sites, heron rookeries, large diameter cavity/den trees, shrub layers, herbaceous vegetation, dead and down material, water influence zones, wet swales, and so on) and where needed;
(7) recognize, protect, maintain, and develop special habitat (for example, cliffs and ledges, talus, outcrops, and caves) and human-made features (for example, agricultural fields, gravel pits, old buildings, bridge supports, and so on) where necessary.

b. Consider developing the upland nonforest opening component as a part of the logging operation using cleared and seeded log landings (>1/3 acres in size) and skid trails and roads to provide soft mast, shrub production, and an herbaceous and grassy ground cover and forage. Continue with recommendation a.

c. Evaluate the ownership area for opportunities to convert or maintain stand composition and structure according the following priority considerations: (1) site capability; (2) gradual attainment of the composition objectives; (3) current markets; and (4) within-stand features diversity. Look for opportunities to place key cover-type conditions where they can contribute needed habitat components to the surrounding area and still be re-entered for future treatment (for example, multiple size classes of aspen-birch and mixed hardwoods nearby in smaller sized stands for species such as ruffed grouse; herbaceous and grassy openings adjacent to aspen and conifer cover; distribution of dense conifer thermal cover, hard mast,

regenerating hardwood opportunities throughout the area). Continue with recommendation a.

d. Consider maintaining and developing as broad a range of growing stock conditions and sizes as possible, given the broad diversity of ownership goals and objectives present in populations of small landowners, site capability, and current market conditions. There is an opportunity to capitalize on the degree of horizontal and vertical diversity that can occur when many small ownerships form these larger habitat management units. Conversion or maintenance of cover-types depend on landowners' goals, management intensity, and aesthetic considerations. Within-stand feature manipulation and development will probably be emphasized to a greater extent in these situations. Continue with recommendation a.

e. Maintain upland and wetland nonforest and aquatic habitat diversity.

f. Look for opportunities to provide increased vertical diversity through intermediate treatments of existing stands that have limited conversion opportunities due to levels of management intensity, aesthetic considerations, or other landowner concerns. Look for regeneration and conversion opportunities at a smaller scale whenever possible. Consider developing the upland nonforest opening component as part of the aesthetic development of the ownership through vegetative manipulation. Continue with recommendation a.

g. Consider the management of water-influenced components or riparian zones carefully. These zones present more habitat management opportunities for increased vertical structural diversity than most upland stands. Transition zones such as these can be very important to wildlife species with significantly different habitat requirements for forested/nonforested nesting and denning, and aquatic feeding locations (for example, ducks, bald eagle, osprey, various herons, and furbearers such as mink and otter). Consider protecting, developing, and maintaining different types of water-influenced components for a broad range of species through appropriate vegetative manipulation practices. Protect and develop special within-stand features such as high exposed perches and nest trees for herons, eagles and ospreys; a large diameter cavity and den tree component; a dead and down woody component for various moist-ground dwelling species such as certain salamanders and frogs; and dense conifer-thermal cover areas where necessary and desired. Consider developing an aspen-birch component adjacent to these transition zones potentially influenced by beaver. Continue with recommendation a.

h. Maintain the diversity of upland nonforest cover types (for example, pastures, orchards, cultivated fields, old fields, and grass and forb openings) periodically. Maintain and develop the hard mast (primarily oak, beech, and hickories) component where possible. Maintain and develop a density of large-diameter cavity trees sufficient to provide adequate denning and nesting opportunities. Continue with recommendation a.

i. Maintain the diversity of upland nonforest cover types (for example, pastures, orchards, cultivated fields, old fields, and grass and forb openings) periodically.

HABITAT RELATIONSHIPS

Area

The area used by a given wildlife species can fluctuate greatly, depending on a number of different physical and biological factors. These factors can range from the available mixtures of habitat conditions present and type of habitat utilization in an area, to a species' relative abundance in a particular area, or the season of the year. Procedures for estimating area of free-ranging populations and individuals use an individual's response to a complex set of species' habitat requirements and wide range of habitat conditions presented across a given landscape. Many of these procedures are used to determine a year-round home-range size or some smaller seasonal territorial size. Exercise care when interpreting these types of area estimates for any type of vegetative management strategy.

Estimates of areas used in New England by taxonomic class are summarized in Table 2. Approximately 64 percent of the 338 forest wildlife species potentially occurring in New England have average home ranges or territories that are less than 10 acres. Most amphibians, reptiles, many migratory birds, and most small mammals are in this category. Fifteen percent of the 338 wildlife species occurring in New England have average home ranges greater than 50 acres. Most raptors and larger-bodied woodpeckers, and most medium and large-sized mammals are in this category. Table 3 lists wildlife species' occurrence by estimated home-range area size in New England.

Table 2 – Numbers of species by taxonomic class and average home-range area in New England

Taxonomic class	Average home-range area estimates (acres)				
	None reported/ not applicable	1-10	11-50	>50	Total
Amphibians	0	25	1	0	26
Reptiles	0	21	7	2	30
Birds	17	141	30	32	220
Mammals	9	31	5	17	62
Total	26	218	43	51	338

Thus, several concepts need to be considered when managing forested properties. Large forested tracts present more opportunities to manage more year-round habitats for permanent resident species with large home-range areas than small forested properties because all necessary habitats for such species are likely to be found on larger, more diverse properties. Also, for the same reason, large forested properties present more opportunities to manage more seasonal habitats for migratory species and species with smaller home-range areas.

Small forested properties present fewer opportunities to manage year-round habitats for permanent resident species with large home ranges, because it is difficult to find all the necessary habitats for such species on small, less diverse properties. However, small forested properties present many opportunities to manage a portion of the year-round habitat needs of permanent resident species with larger home ranges if they are coordinated with management activities on the surrounding area. Small forested properties still present opportunities to manage seasonal habitats for migratory species and species with smaller home-range areas, even though the range of necessary habitats will be considerably narrower and perhaps less diverse.

Habitat-Breadth Combinations

Wildlife use of various habitat combinations on a year-round basis should be examined before making forest management decisions. Species occurrences and utilization of forested and nonforested habitats are provided in Appendices A and B, respectively. Habitat-breadth combinations are provided in Appendix C. By taking the four seasonal-functional use combinations and finding the least common denominator for each species, we can identify groups of species that use similar combinations of habitats on a year-round basis.

For example, if we take four general habitat categories such as forest, nonforest, krummholz (includes subalpine forest), and water, there are 15 possible combinations of these categories.

We list species groups for 11 of these habitat-breadth categories (Table 4). The following section lists wildlife species' occurrence within habitat-breadth categories and indicates their conifer-

Table 3. – List of wildlife species, by estimated home-range area

Home-range area (acres)	Wildlife species	
	AMPHIBIANS	
1-10	Mudpuppy	Northern two-lined salamander
	Marbled salamander	Eastern spadefoot
	Jefferson salamander	Eastern American toad
	Silvery salamander	Fowler's toad
	Blue-spotted salamander	Northern spring peeper
	Tremblay's salamander	Gray treefrog
	Red-spotted newt	Bullfrog
	Northern dusky salamander	Green frog
	Mountain dusky salamander	Mink frog
	Redback salamander	Wood frog
	Slimy salamander	Northern leopard frog
	Four-toed salamander	Pickerel frog
	Northern spring salamander	
11-50	Spotted salamander	
	REPTILES	
1-10	Stinkpot	Northern redbelly snake
	Spotted turtle	Eastern garter snake
	Bog turtle	Maritime garter snake
	Wood turtle	Eastern ribbon snake
	Eastern box turtle	Northern ribbon snake
	Eastern painted turtle	Eastern hognose snake
	Blanding's turtle	Northern ringneck snake
	Eastern spiny softshell	Eastern worm snake
	Five-lined skink	Northern black racer
	Northern water snake	Eastern smooth green snake
	Northern brown snake	
11-50	Common snapping turtle	
	Map turtle	
	Red-eared slider	
	Plymouth redbelly turtle	
	Midland painted turtle	
	Northern copperhead	
	Timber rattlesnake	
>50	Black rat snake	
	Eastern milk snake	

Continued

Table 3.—Continued

Home-range area (acres)	Wildlife species	
	BIRDS	
1-10	Pied-billed grebe	Black-capped chickadee
	American bittern	Boreal chickadee
	Least bittern	Tufted titmouse
	Great-blue heron	Carolina wren
	Green-backed heron	House wren
	Black-crowned night heron	Winter wren
	Yellow-crowned night heron	Sedge wren
	Glossy ibis	Marsh wren
	Wood duck	Golden-crowned kinglet
	Green-winged teal	Ruby-crowned kinglet
	American black duck	Blue-gray gnatcatcher
	Mallard	Eastern bluebird
	Northern pintail	Veery
	Blue-winged teal	Hermit thrush
	Northern shoveler	Wood thrush
	Gadwall	American robin
	American wigeon	Gray catbird
	Canvasback	Northern mockingbird
	Ring-necked duck	Brown thrasher
	Common goldeneye	Cedar waxwing
	Hooded merganser	European starling
	Common merganser	White-eyed vireo
	Red-breasted merganser	Solitary vireo
	Northern bobwhite	Yellow-throated vireo
	Virginia rail	Warbling vireo
	Sora	Philadelphia vireo
	Killdeer	Red-eyed vireo
	Spotted sandpiper	Blue-winged warbler
	Common snipe	Golden-winged warbler
	Black tern	Tennessee warbler
	Rock dove	Nashville warbler
	Mourning dove	Northern parula
	Ruby-throated hummingbird	Yellow warbler
	Red-headed woodpecker	Chestnut-sided warbler
	Red-bellied woodpecker	Magnolia warbler
	Yellow-bellied sapsucker	Cape May warbler
	Downy woodpecker	Black-throated blue warbler
	Hairy woodpecker	Yellow-rumped warbler
	Northern flicker	Black-throated green warbler
	Olive-sided flycatcher	Blackburnian warbler
	Eastern wood-pewee	Pine warbler
	Yellow-bellied flycatcher	Prairie warbler
	Acadian flycatcher	Palm warbler
	Alder flycatcher	Bay-breasted warbler
	Willow flycatcher	Blackpoll warbler
	Least flycatcher	Cerulean warbler
	Eastern phoebe	Black-and-white warbler

Continued

Table 3.—Continued

Home-range area (acres)	Wildlife species	
	Great crested flycatcher	American redstart
	Eastern kingbird	Prothonotary warbler
	Tree swallow	Worm-eating warbler
	Gray jay	Ovenbird
	Blue jay	Northern waterthrush
	Louisiana waterthrush	Song sparrow
	Mourning warbler	Lincoln's sparrow
	Common yellowthroat	Swamp sparrow
	Hooded warbler	White-throated sparrow
	Wilson's warbler	Dark-eyed junco
	Canada warbler	Red-winged blackbird
	Yellow-breasted chat	Common grackle
	Scarlet tanager	Brown-headed cowbird
	Northern cardinal	Orchard oriole
	Rose-breasted grosbeak	Northern oriole
	Indigo bunting	Purple finch
	Rufous-sided towhee	House finch
	Chipping sparrow	Red crossbill
	Field sparrow	White-winged crossbill
	Vesper sparrow	Pine siskin
	Savannah sparrow	American goldfinch
	Grasshopper sparrow	Evening grosbeak
	Henslow's sparrow	House sparrow
	Fox sparrow	
11-50	Mute swan	Purple martin
	Canada goose	Northern rough-winged swallow
	Ring-necked pheasant	Bank swallow
	Ruffed grouse	Cliff swallow
	Black rail	Barn swallow
	King rail	Red-breasted nuthatch
	Common moorhen	White-breasted nuthatch
	American coot	Brown creeper
	Upland sandpiper	Gray-cheeked thrush
	American woodcock	Swainson's thrush
	Black-billed cuckoo	Loggerhead shrike
	Yellow-billed cuckoo	Bobolink
	Common nighthawk	Eastern meadowlark
	Whip-poor-will	Rusty blackbird
	Horned lark	Pine grosbeak
>50	Common loon	Spruce grouse
	Turkey vulture	Wild turkey
	Osprey	Common barn-owl
	Bald eagle	Eastern screech-owl
	Northern harrier	Great horned owl
	Sharp-shinned hawk	Barred owl

Continued

Table 3.—Continued

Home-range area (acres)	Wildlife species	
	Cooper's hawk	Long-eared owl
	Northern goshawk	Northern saw-whet owl
	Red-shouldered hawk	Chimney swift
	Broad-winged hawk	Belted kingfisher
	Red-tailed hawk	Three-toed woodpecker
	Golden eagle	Black-backed woodpecker
	American kestrel	Pileated woodpecker
	Merlin	American crow
	Peregrine falcon	Fish crow
	Gray partridge	Common raven
None reported/ not applicable	Bufflehead	Boreal owl
	Rough-legged hawk	Bohemian waxwing
	Ring-billed gull	Northern shrike
	Herring gull	American tree sparrow
	Great black-backed gull	Lapland longspur
	Snowy owl	Snow bunting
	Northern hawk-owl	Common redpoll
	Great gray owl	Hoary redpoll
	Short-eared owl	
	MAMMALS	
1-10	Masked shrew	Southern flying squirrel
	Water shrew	Northern flying squirrel
	Smoky shrew	Beaver
	Long-tailed shrew	Deer mouse
	Pygmy shrew	White-footed mouse
	Short-tailed shrew	Southern red-backed vole
	Least shrew	Meadow vole
	Hairy-tailed mole	Rock vole
	Eastern mole	Woodland vole
	Star-nosed mole	Muskrat
	Eastern cottontail	Southern bog lemming
	New England cottontail	Northern bog lemming
	Snowshoe hare	Norway rat
	Eastern chipmunk	House mouse
	Gray squirrel	Meadow jumping mouse
	Red squirrel	Woodland jumping mouse
11-50	Virginia opossum	Ermine
	European hare	Long-tailed weasel
	Porcupine	
>50	Woodchuck	Mink
	Coyote	Striped skunk
	Red fox	River otter
	Gray fox	Mountain lion

Continued

Table 3.—Continued

Home-range area (acres)	Wildlife species	
	Black bear Raccoon Marten Fisher	Lynx Bobcat White-tailed deer Moose
None reported/ not applicable	Little brown myotis Keen's myotis Indiana myotis Small-footed myotis Silver-haired bat	Eastern pipistrelle Big brown bat Red bat Hoary bat

Table 4. – Number of species that use various habitat-breadth combinations for 338 wildlife species in New England, by taxonomic class

Habitat-breadth combination	No. of species	Percent of total	Amphi-bians	Reptiles	Birds	Mammals
One habitat category						
Forest	18	5	0	1	15	2
Nonforest	35	10	0	0	33	2
Water	5	2	0	1	4	0
Krummholz [a]						
Two habitat categories						
Forest-Krummholz	10	3	0	0	7	3
Forest-Nonforest	146	43	7	7	111	21
Forest-Water	2	1	1	0	1	0
Nonforest-Water	31	9	1	8	21	1
Krummholz-Water[a]						
Nonforest-Krummholz[a]						
Three habitat categories						
Forest-Krummholz-Nonforest	28	9	0	1	10	17
Forest-Nonforest-Water	57	16	16	9	17	15
Nonforest-Krummholz-Water	1	<1	0	1	0	0
Forest-Krummholz-Water [a]						
Four habitat categories						
Forest-Krummholz-Nonforest-Water	5	2	1	2	1	1
Total	338	100	26	30	220	62

[a] Not all possible combinations have species that utilize these habitat-breadth combinations.

ous/deciduous or upland/wetland type preferences, if any. Key for taxonomic class is: A=amphibians, R=reptiles, B=birds, and M=mammals.

Forest Only. Wildlife species that use forested habitats exclusively include:

Taxonomic class	*Wildlife species (n=18)*	*Forest preference*
R	Five-lined skink	Deciduous
B	Pileated woodpecker	
B	Acadian flycatcher	
B	Swainson's thrush	
B	Wood thrush	
B	Solitary vireo	
B	Magnolia warbler	
B	Cape May warbler	Coniferous
B	Black-throated blue warbler	
B	Black-throated green warbler	
B	Blackburnian warbler	
B	Pine warbler	Coniferous
B	Cerulean warbler	
B	Worm-eating warbler	
B	Ovenbird	
B	Scarlet tanager	
M	Gray squirrel	
M	Northern flying squirrel	

Forest-Krummholz. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	*Wildlife species (n=10)*	*Forest preference*
B	Gray jay	Coniferous
B	Golden-crowned kinglet	
B	Ruby-crowned kinglet	
B	Gray-cheeked thrush	Coniferous
B	Blackpoll warbler	
B	Red crossbill	
B	White-winged crossbill	
M	Long-tailed shrew	
M	Red squirrel	
M	Marten	

Forest-Krummholz-Nonforest. Wildlife species tha use these habitat conditions during the year in clude:

Taxonomic class	*Wildlife species (n=28)*	*Preference*	
		Forest	*Nonforest*
R	Northern redbelly snake		
B	Golden eagle		
B	Spruce grouse	Coniferous	Wetland
B	Black-capped chickadee		Upland
B	Boreal chickadee		Wetland
B	Red-breasted nuthatch		
B	American robin		
B	Yellow-rumped warbler		
B	White-throated sparrow		Upland
B	Dark-eyed junco		Upland
B	Pine grosbeak		Upland
M	Masked shrew		
M	Pygmy shrew		
M	Short-tailed shrew		
M	Snowshoe Hare		
M	Eastern chipmunk		Upland
M	Deer mouse		Upland
M	White-footed mouse		
M	Southern red-backed vole		
M	Rock vole		Upland
M	Southern bog lemming		
M	Northern bog lemming	Coniferous	
M	Porcupine		
M	Coyote		
M	Red fox		
M	Fisher		
M	Lynx		
M	Bobcat		

Forest-Krummholz-Nonforest-Water. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	*Wildlife species (n=5)*	*Preference*
A	Wood frog	
R	Eastern garter snake	
R	Northern copperhead	
B	Common raven	
M	Moose	

Forest-Nonforest. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	Wildlife species (n=146)	Preference	
		Forest	Nonforest
A	Jefferson salamander		Wetland
A	Silvery salamander	Deciduous	Wetland
A	Blue-spotted salamander	Deciduous	Wetland
A	Tremblay's salamander	Deciduous	Wetland
A	Redback salamander		
A	Slimy salamander		Wetland
A	Eastern spadefoot		
R	Northern brown snake		
R	Eastern hognose snake		
R	Northern ringneck snake		Upland
R	Eastern worm snake		Upland
R	Northern black racer		
R	Eastern smooth green snake		
R	Black rat snake		Upland
B	Turkey vulture		Upland
B	Sharp-shinned hawk		Upland
B	Cooper's hawk		Upland
B	Northern goshawk		Upland
B	Red-shouldered hawk		Wetland
B	Broad-winged hawk		Upland
B	Red-tailed hawk		Upland
B	American kestrel		
B	Merlin	Coniferous	
B	Peregrine falcon		
B	Ruffed grouse		
B	Wild turkey		Upland
B	Northern bobwhite	Coniferous	Upland
B	American woodcock		
B	Mourning dove		Upland
B	Black-billed cuckoo		
B	Yellow-billed cuckoo		Upland
B	Eastern screech owl		
B	Great horned owl		
B	Northern hawk-owl	Coniferous	Wetland
B	Great gray owl	Deciduous	Wetland
B	Long-eared owl		
B	Boreal owl	Coniferous	Wetland
B	Northern saw-whet owl		Upland
B	Common nighthawk		
B	Whip-poor-will		Upland
B	Ruby-throated hummingbird		Upland
B	Red-headed woodpecker		Upland
B	Red-bellied woodpecker		Upland
B	Yellow-bellied sapsucker		Upland
B	Downy woodpecker		Upland
B	Hairy woodpecker		Upland
B	Three-toed woodpecker	Coniferous	Wetland
B	Black-backed woodpecker	Coniferous	Wetland
B	Northern flicker		Upland
B	Olive-sided flycatcher		Wetland
B	Eastern wood-pewee		Upland
B	Yellow-bellied flycatcher		Wetland
B	Alder flycatcher		
B	Willow flycatcher		Upland
B	Least flycatcher		Upland
B	Eastern phoebe		Upland
B	Great crested flycatcher		Upland
B	Eastern kingbird		Upland
B	Horned lark		Upland
B	Cliff swallow		
B	Blue jay		Upland
B	American crow		Upland
B	Tufted titmouse		Upland
B	White-breasted nuthatch		Upland
B	Brown creeper		
B	Carolina wren		Upland
B	House wren		Upland
B	Winter wren		Wetland
B	Blue-gray gnatcatcher		
B	Eastern bluebird		Upland
B	Veery		Upland
B	Hermit thrush		
B	Gray catbird		
B	Northern mockingbird		Upland
B	Brown thrasher		Upland
B	Bohemian waxwing		Upland
B	Cedar waxwing		
B	Northern shrike		
B	Loggerhead shrike	Coniferous	
B	European starling		
B	White-eyed vireo		
B	Yellow-throated vireo		Upland
B	Warbling vireo		Upland
B	Philadelphia vireo		Upland
B	Red-eyed vireo		Upland
B	Blue-winged warbler		
B	Golden-winged warbler		Wetland
B	Tennessee warbler		
B	Nashville warbler		
B	Northern parula		Wetland
B	Yellow warbler		
B	Chestnut-sided warbler		
B	Prairie warbler		Upland
B	Palm warbler	Coniferous	Wetland
B	Bay-breasted warbler	Coniferous	Upland
B	Black-and-white warbler		

Taxonomic class	Wildlife species	Preference	
		Forest	Nonforest
B	American redstart		Upland
B	Prothonotary warbler	Deciduous	Wetland
B	Louisiana waterthrush	Deciduous	Wetland
B	Mourning warbler		
B	Common yellowthroat		
B	Hooded warbler		
B	Wilson's warbler		Wetland
B	Canada warbler		Wetland
B	Yellow-breasted chat		Wetland
B	Rose-breasted grosbeak		Upland
B	Indigo bunting		Upland
B	Rufus-sided towhee		Upland
B	American tree sparrow		
B	Chipping sparrow		Upland
B	Field sparrow		Upland
B	Fox sparrow		Upland
B	Song sparrow		
B	Lincoln's sparrow		
B	Swamp sparrow		Wetland
B	Brown-headed cowbird		
B	Orchard oriole		Upland
B	Northern oriole		Upland
B	Purple finch		Upland
B	House finch	Coniferous	Upland
B	Common redpoll		Upland
B	Hoary redpoll		Upland
B	Pine siskin		
B	American goldfinch		
B	Evening grosbeak		Upland
M	Virginia opposum		
M	Smoky shrew		Wetland
M	Least shrew		
M	Hairy-tailed mole		Upland
M	Eastern mole		Upland
M	Eastern cottontail		
M	New England cottontail		
M	European hare		Upland
M	Woodchuck		Upland
M	Southern flying squirrel		Upland
M	Meadow vole		
M	Woodland vole		Upland
M	Meadow jumping mouse		
M	Woodland jumping mouse		
M	Gray fox		
M	Raccoon		
M	Ermine		
M	Long-tailed weasel		
M	Striped skunk		
M	Mountain lion		
M	White-tailed deer		

Forest-Nonforest-Water. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	Wildlife species (n=57)	Preference	
		Forest	Nonforest
A	Marbled salamander	Deciduous	Wetland
A	Spotted salamander		Wetland
A	Red-spotted newt		Wetland
A	Northern dusky salamander		
A	Four-toed salamander		Wetland
A	Northern spring salamander		Wetland
A	Northern two-lined salamander		
A	American toad		
A	Fowler's toad		
A	Northern spring peeper		Wetland
A	Gray treefrog		Wetland
A	Bullfrog		Wetland
A	Green frog		Wetland
A	Mink frog		Wetland
A	Northern leopard frog		
A	Pickerel frog	Deciduous	
R	Snapping turtle		
R	Bog turtle	Deciduous	
R	Wood turtle		
R	Eastern box turtle		
R	Eastern painted turtle	Deciduous	
R	Northern water snake	Deciduous	Wetland
R	Eastern ribbon snake		Wetland
R	Eastern milk snake		
R	Timber rattlesnake		Wetland
B	Great blue heron	Deciduous	
B	Green-backed heron	Deciduous	
B	Wood duck	Deciduous	Wetland
B	American black duck	Deciduous	
B	Common goldeneye		Wetland
B	Hooded merganser		Wetland
B	Common merganser		Wetland
B	Barred owl		Upland
B	Purple martin		
B	Tree swallow		
B	Northern rough-winged swallow		
B	Bank swallow		
B	Barn swallow		
B	Northern waterthrush		Wetland
B	Northern cardinal		
B	Rusty blackbird		Wetland
B	Common grackle		
M	Water shrew		Wetland
M	Star-nosed mole		Wetland
M	Little brown myotis		
M	Keen's myotis		
M	Indiana myotis		
M	Small-footed myotis		

Taxonomic class	Wildlife species	Preference	
		Forest	Nonforest
M	Silver-haired bat		
M	Eastern pipistrelle		
M	Big brown bat		
M	Red bat		
M	Hoary bat		
M	Beaver		Wetland
M	Black bear		
M	Mink		Wetland
M	River otter		Wetland

Forest-Water. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	Wildlife species (n=2)	Preference
A	Mountain dusky salamander	
B	Bald eagle	

Nonforest Only. Wildlife species that use these nonforest habitat conditions exclusively during the year include:

Taxonomic class	Wildlife species (n=35)	Preference
B	Least bittern	Wetland
B	Glossy ibis	Wetland
B	Green-winged teal	Wetland
B	Northern pintail	Wetland
B	Blue-winged teal	Wetland
B	Northern shoveler	Wetland
B	Northern harrier	
B	Rough-legged hawk	
B	Gray partridge	Upland
B	Ring-necked pheasant	Upland
B	King rail	Wetland
B	Virginia rail	Wetland
B	Sora	Wetland
B	Killdeer	
B	Upland sandpiper	Upland
B	Common snipe	Wetland
B	Rock dove	Upland
B	Common barn owl	Upland
B	Snowy owl	
B	Short-eared owl	
B	Chimney swift	
B	Sedge wren	Wetland
B	Marsh wren	Wetland
B	Vesper sparrow	
B	Savannah sparrow	
B	Grasshopper sparrow	Upland
B	Henslow's sparrow	
B	Lapland longspur	Upland
B	Snow bunting	
B	Bobolink	
B	Red-winged blackbird	
B	Eastern meadowlark	Upland
B	House sparrow	Upland
M	Norway rat	Upland
M	House mouse	Upland

Nonforest-Krummholz-Water. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	Wildlife species (n=1)	Preference
R	Maritime garter snake	

Nonforest-Water. Wildlife species that use these habitat conditions during the year include:

Taxonomic class	Wildlife species (n=31)	Preference
A	Mudpuppy	Wetland
R	Stinkpot	
R	Spotted turtle	
R	Map turtle	Upland
R	Red-eared slider	
R	Plymouth redbelly turtle	Wetland
R	Midland painted turtle	Wetland
R	Blanding's turtle	
R	Northern ribbon snake	Wetland
B	Common loon	Wetland
B	Pied-billed grebe	Wetland
B	American bittern	Wetland
B	Black-crowned night heron	Wetland
B	Yellow-crowned night heron	Wetland
B	Mute swan	
B	Canada goose	
B	Mallard	
B	Gadwall	Wetland
B	American wigeon	Wetland
B	Canvasback	Wetland
B	Ring-necked duck	Wetland
B	Red-breasted merganser	Wetland
B	Black rail	Wetland

Taxonomic class	Wildlife species	Preference
B	Common moorhen	Wetland
B	American coot	Wetland
B	Spotted sandpiper	
B	Ring-billed gull	
B	Black tern	Wetland
B	Belted kingfisher	Wetland
B	Fish crow	Wetland
M	Muskrat	Wetland

Water Only. When found in forested regions, these wildlife species use water habitat conditions exclusively:

Taxonomic class	Wildlife species (n=5)	Preference
R	Eastern spiny softshell	
B	Bufflehead	
B	Osprey	
B	Herring gull	
B	Great black-backed gull	

Habitat-breadth combinations contain several important management implications. Obviously the forest-nonforest combination is the most important category when considering the number of species it benefits. If a land manager is dealing with a forested condition that benefits 18 species, and the management objective is to increase habitat diversity, an obvious decision would be to establish a variety of nonforest components that could add an additional 146 species. If enough large (>100 acres) nonforest habitats are added, the potential for an additional 35 species is added.

Size-Class Combinations

The use of different size-class combinations by wildlife species on a year-round basis, or when they are present, can be examined in the same manner as habitat-breadth combinations (Appendix C). There are 15 possible forested combinations of four general size-class categories (for example, regeneration, sapling-pole, sawtimber, large sawtimber). We need to include one additional category for those species that do not use forested habitats for a total of 16 possible size-class combinations.

We report species groups for 10 of these size-class combinations (Table 5). The following section lists wildlife species occurrence within the size-class combinations.

Key for the taxonomic class is: A=Amphibians, R=Reptiles, B=Birds, and M=Mammals.

Key for habitat breadth is: BF=Both deciduous and coniferous forest cover types, CF=Coniferous only forest cover types, DF=Deciduous only forest cover types, BNF=Both upland and wetland nonforest types, UNF=Upland only nonforest types, WNF=Wetland only nonforest types, K=Krummholz type, and W=Water (lakes, streams, and rivers).

Regeneration, Sapling-pole, Sawtimber, and Large Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	Wildlife species (n=152)	Habitat breadth
A	Marbled salamander	DF-WNF-W
A	Jefferson salamander	BF-WNF
A	Silvery salamander	DF-WNF
A	Blue-spotted salamander	DF-WNF
A	Tremblay's salamander	DF-WNF
A	Spotted salamander	BF-WNF-W
A	Red-spotted newt	BF-WNF-W
A	Northern dusky salamander	BF-BNF-W
A	Mountain dusky salamander	BF-W
A	Redback salamander	BF-BNF
A	Four-toed salamander	BF-WNF-W
A	Northern two-lined salamander	BF-BNF-W
A	American toad	BF-BNF-W
A	Fowler's toad	BF-BNF-W
A	Gray treefrog	BF-WNF-W
A	Bullfrog	BF-WNF-W
A	Green frog	BF-WNF-W
A	Mink frog	BF-WNF-W
A	Wood frog	BF-BNF-W
A	Northern leopard frog	BF-BNF-W
A	Pickerel frog	DF-BNF-W
R	Snapping turtle	BF-BNF-W
R	Bog turtle	DF-BNF-W
R	Wood turtle	BF-BNF-W
R	Eastern box turtle	BF-BNF-W
R	Eastern painted turtle	DF-BNF-W
R	Five-lined skink	DF
R	Northern water snake	DF-WNF-W
R	Northern brown snake	BF-BNF
R	Northern redbelly snake	BF-BNF
R	Eastern garter snake	BF-BNF-W
R	Eastern ribbon snake	BF-WNF-W
R	Northern ringneck snake	BF-UNF

Table 5. -- Number of wildlife species that use various size-class combinations in New England, by habitat-breadth combinations and taxonomic class

Size-class combinations	No. of species	Percent of Total	F [a]	F K	F NF	FK NF	FK NFW	FNF W	F W	NF KW	NF	NF W	W	Amphi-bians	Reptiles	Birds	Mam-mals
No size class	72	21	0	0	0	0	0	0	0	1	35	31	5	1	10	58	3
One size class																	
Regeneration only	26	8	0	0	22	0	0	4	0	0	0	0	0	0	0	22	4
Sapling-pole only [b]																	
Sawtimber only [b]																	
Large sawtimber only	4	1	1	0	0	0	0	2	1	0	0	0	0	0	0	4	0
Two size classes																	
Regeneration-Sapling-pole	14	4	0	0	14	0	0	0	0	0	0	0	0	0	0	11	3
Regeneration-Sawtimber[b]																	
Regeneration-Large sawtimber	4	1	0	0	3	0	0	1	0	0	0	0	0	0	0	3	1
Sapling-pole-Sawtimber[b]																	
Sapling-pole-Large sawtimber[b]																	
Sawtimber-Large sawtimber	15	5	4	0	9	0	0	2	0	0	0	0	0	0	0	12	3
Three size classes																	
Regeneration-Sapling-pole-Sawtimber	4	1	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0
Regeneration-Sapling-pole-Large sawtimber [b]																	
Regeneration-Sawtimber-Large sawtimber	17	5	0	0	7	1	1	8	0	0	0	0	0	0	0	8	9
Sapling-pole-Sawtimber-Large sawtimber	30	9	3	5	14	3	1	4	0	0	0	0	0	4	4	18	4
Four size classes																	
Regeneration-Sapling-pole-Sawtimber-Large sawtimber	152	45	10	5	73	24	3	36	1	0	0	0	0	21	16	80	35
Total	338	100	18	10	146	28	5	57	2	1	35	31	5	26	30	220	62

[a]F=Forest, FK=Forest-Krummholz, FNF=Forest-Nonforest, FKNF=Forest-Krummholz-Nonforest, FKNFW=Forest-Krummholz-Nonforest-Water, FNFW=Forest-Nonforest-Water, FW=Forest-Water, NFKW=Nonforest-Krummholz-Water, NF-Nonforest, NFW=Nonforest-Water, and W=Water.

[b]Not all possible combinations have species that utilize these size-class combinations.

Taxonomic class	Wildlife species	Habitat breadth
R	Northern black racer	BF-BNF
R	Eastern smooth green snake	BF-BNF
R	Black rat snake	BF-UNF
R	Eastern milk snake	BF-BNF-W
B	Green-backed heron	DF-BNF-W
B	American black duck	DF-BNF-W
B	Turkey vulture	BF-UNF
B	Sharp-shinned hawk	BF-UNF
B	Cooper's hawk	BF-UNF
B	Northern goshawk	BF-UNF
B	Peregrine falcon	BF-BNF
B	Spruce grouse	CF-WNF
B	Ruffed grouse	BF-BNF
B	Wild turkey	BF-UNF
B	Mourning dove	BF-UNF
B	Black-billed cuckoo	BF-BNF
B	Yellow-billed cuckoo	BF-UNF
B	Eastern screech owl	BF-BNF
B	Great horned owl	BF-BNF
B	Northern hawk-owl	CF-WNF
B	Barred owl	BF-UNF-W
B	Long-eared owl	BF-BNF
B	Boreal owl	CF-WNF
B	Northern saw-whet owl	BF-UNF
B	Common nighthawk	BF-BNF
B	Whip-poor-will	BF-UNF
B	Ruby-throated hummingbird	BF-UNF
B	Red-headed woodpecker	BF-UNF
B	Downy woodpecker	BF-UNF
B	Hairy woodpecker	BF-UNF
B	Northern flicker	BF-UNF
B	Olive-sided flycatcher	BF-WNF
B	Yellow-bellied flycatcher	BF-WNF
B	Tree swallow	BF-BNF-W
B	Gray jay	CF-K
B	Blue jay	BF-UNF
B	Black-capped chickadee	BF-UNF
B	Brown creeper	BF-BNF
B	Carolina wren	BF-UNF
B	House wren	BF-UNF
B	Winter wren	BF-WNF
B	Golden-crowned kinglet	BF
B	Ruby-crowned kinglet	BF
B	Veery	BF-UNF
B	Gray-cheeked thrush	CF
B	Swainson's thrush	BF
B	Hermit thrush	BF-BNF
B	Wood thrush	BF
B	American robin	BF-BNF
B	Gray catbird	BF-BNF
B	Cedar waxwing	BF-BNF
B	Solitary vireo	BF
B	Red-eyed vireo	BF-UNF
B	Nashville warbler	BF-BNF
B	Magnolia warbler	BF
B	Cape May warbler	CF
B	Black-throated blue warbler	BF
B	Yellow-rumped warbler	BF-BNF
B	Pine warbler	CF
B	Bay-breasted warbler	CF-UNF
B	Black-and-white warbler	BF-BNF
B	American redstart	BF-UNF
B	Worm-eating warbler	BF
B	Ovenbird	BF
B	Northern waterthrush	BF-WNF-W
B	Louisiana waterthrush	DF-WNF
B	Common yellowthroat	BF-BNF
B	Canada warbler	BF-WNF
B	Northern cardinal	BF-WNF-W
B	Rose-breasted grosbeak	BF-UNF
B	Rufous-sided towhee	BF-UNF
B	Chipping sparrow	BF-UNF
B	Song sparrow	BF-BNF
B	White-throated sparrow	BF-UNF
B	Dark-eyed junco	BF-UNF
B	Rusty blackbird	BF-WNF-W
B	Common grackle	BF-BNF-W
B	Brown-headed cowbird	BF-BNF
B	Orchard oriole	BF-UNF
B	Pine grosbeak	BF-UNF
B	Purple finch	BF-UNF
B	House finch	CF-UNF
B	Pine siskin	BF-BNF
B	American goldfinch	BF-BNF
M	Virginia opossum	BF-BNF
M	Masked shrew	BF-BNF
M	Water shrew	BF-WNF-W
M	Smoky shrew	BF-WNF
M	Pygmy shrew	BF-BNF
M	Short-tailed shrew	BF-BNF
M	Hairy-tailed mole	BF-UNF
M	Red bat	BF-BNF-W
M	Hoary bat	BF-BNF-W
M	Snowshoe hare	BF-BNF
M	Eastern chipmunk	BF-UNF
M	Red Squirrel	BF-K
M	Beaver	BF-WNF-W
M	Deer mouse	BF-UNF
M	White-footed mouse	BF-BNF
M	Southern red-backed vole	BF-BNF
M	Rock vole	BF-UNF
M	Woodland vole	BF-UNF
M	Southern bog lemming	BF-BNF
M	Northern bog lemming	CF-BNF

Taxonomic class	Wildlife species	Habitat breadth
M	Woodland jumping mouse	BF-BNF
M	Porcupine	BF-BNF
M	Coyote	BF-BNF
M	Red fox	BF-BNF
M	Gray fox	BF-BNF
M	Black bear	BF-BNF-W
M	Raccoon	BF-BNF
M	Ermine	BF-BNF
M	Mink	BF-WNF-W
M	Striped skunk	BF-BNF
M	Mountain lion	BF-BNF
M	Lynx	BF-BNF
M	Bobcat	BF-BNF
M	White-tailed deer	BF-BNF
M	Moose	BF-BNF-W

This group of 152 species in our data base either uses distinct vegetative features found in the four different size-class conditions throughout the year, uses features found in all conditions, or disregards size-class conditions, as resource managers may perceive them.

Regeneration, Sapling-pole, and Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	Wildlife species (n=4)	Habitat breadth
B	American woodcock	BF-BNF
B	Great gray owl	DF-WNF
B	Northern shrike	BF-BNF
B	Philadelphia vireo	BF-UNF

Sapling-pole, Sawtimber, and Large Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	Wildlife species (n=30)	Habitat breadth
A	Slimy salamander	BF-WNF
A	Northern spring salamander	BF-WNF-W
A	Eastern spadefoot	BF-BNF
A	Northern spring peeper	BF-WNF-W
R	Eastern hognose snake	BF-BNF
R	Eastern worm snake	BF-UNF
R	Northern copperhead	BF-BNF-W
R	Timber rattlesnake	BF-WNF-W
B	Yellow-bellied sapsucker	BF-UNF
B	Eastern wood-pewee	BF-UNF
B	Least flycatcher	BF-UNF
B	Boreal chickadee	BF-WNF
B	Tufted titmouse	BF-UNF
B	Red-breasted nuthatch	BF-BNF
B	White-breasted nuthatch	BF-UNF
B	Blue-gray gnatcatcher	BF-BNF
B	Northern parula	BF-WNF
B	Black-throated green warbler	BF
B	Blackburnian warbler	BF
B	Blackpoll warbler	BF
B	Prothonotary warbler	DF-WNF
B	Scarlet tanager	BF
B	Northern oriole	BF-UNF
B	Red crossbill	BF-K
B	White-winged crossbill	BF
B	Evening grosbeak	BF-UNF
M	Long-tailed shrew	BF
M	Marten	BF
M	Fisher	BF-BNF
M	River otter	BF-WNF-W

Regeneration, Sawtimber, and Large Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	Wildlife species (n=17)	Habitat breadth
B	Great blue heron	DF-BNF-W
B	Red-shouldered hawk	BF-UNF
B	Broad-winged hawk	BF-UNF
B	Red-tailed hawk	BF-UNF
B	Golden eagle	BF-BNF
B	Northern bobwhite	CF-UNF
B	American crow	BF-UNF
B	Common raven	BF-BNF-W
M	Eastern mole	BF-UNF
M	Little brown myotis	BF-BNF-W
M	Keen's myotis	BF-BNF-W
M	Indiana myotis	BF-BNF-W
M	Small-footed myotis	BF-BNF-W
M	Silver-haired bat	BF-BNF-W
M	Eastern pipistrelle	BF-BNF-W
M	Big brown bat	BF-BNF-W
M	Woodchuck	BF-UNF

This group tends to use the regenerating forest habitat condition for foraging activities and the mature and overmature forest habitat conditions for suitable nesting and roosting activities.

Regeneration, and Sapling-pole Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	*Wildlife species (n=14)*	*Habitat breadth*
B	Alder flycatcher	BF-BNF
B	Eastern kingbird	BF-UNF
B	Horned lark	BF-UNF
B	Eastern bluebird	BF-UNF
B	Brown thrasher	BF-UNF
B	Loggerhead shrike	CF-BNF
B	White-eyed vireo	BF-BNF
B	Tennessee warbler	BF-BNF
B	Yellow warbler	BF-BNF
B	Chestnut-sided warbler	BF-BNF
B	Indigo bunting	BF-UNF
M	New England cottontail	BF-BNF
M	Meadow jumping mouse	BF-BNF
M	Long-tailed weasel	BF-BNF

Regeneration, and Large Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	*Wildlife species (n=4)*	*Habitat breadth*
B	European starling	BF-BNF
B	Prairie warbler	BF-UNF
B	Hooded warbler	BF-BNF
M	Star-nosed mole	BF-WNF-W

Sawtimber, and Large Sawtimber Size Class. Wildlife species that use these size classes during the year include:

Taxonomic class	*Wildlife species (n=15)*	*Habitat breadth*
B	Wood duck	DF-WNF-W
B	Common goldeneye	BF-BNF-W
B	Merlin	CF-BNF
B	Red-bellied woodpecker	BF-UNF
B	Three-toed woodpecker	CF-WNF
B	Black-backed woodpecker	CF-WNF
B	Pileated woodpecker	BF
B	Eastern phoebe	BF-UNF
B	Great crested flycatcher	BF-UNF
B	Yellow-throated vireo	BF-UNF
B	Warbling vireo	BF-UNF
B	Cerulean warbler	BF
M	Gray squirrel	BF
M	Southern flying squirrel	BF-UNF
M	Northern flying squirrel	BF

Regeneration Only. Wildlife species that use regenerating stands only during the year include:

Taxonomic class	*Wildlife species (n=26)*	*Habitat breadth*
B	American kestrel	BF-BNF
B	Willow flycatcher	BF-UNF
B	Purple martin	BF-BNF-W
B	Northern rough-winged swallow	BF-BNF-W
B	Bank swallow	BF-BNF-W
B	Cliff swallow	BF-BNF
B	Barn swallow	BF-BNF-W
B	Northern mockingbird	BF-UNF
B	Bohemian waxwing	BF-UNF
B	Blue-winged warbler	BF-BNF
B	Golden-winged warbler	BF-WNF
B	Palm warbler	CF-WNF
B	Mourning warbler	BF-BNF
B	Wilson's warbler	BF-WNF
B	Yellow-breasted chat	BF-WNF
B	American tree sparrow	BF-BNF
B	Field sparrow	BF-UNF
B	Fox sparrow	BF-UNF
B	Lincoln's sparrow	BF-BNF
B	Swamp sparrow	BF-WNF
B	Common redpoll	BF-UNF
B	Hoary redpoll	BF-UNF
M	Least shrew	BF-BNF
M	Eastern cottontail	BF-BNF
M	European hare	BF-UNF
M	Meadow vole	BF-BNF

Large Sawtimber Only. Wildlife species that use overmature forest habitat conditions during the year include:

Taxonomic class	*Wildlife species (n=4)*	*Habitat breadth*
B	Hooded merganser	BF-WNF-W
B	Common merganser	BF-WNF-W
B	Bald eagle	BF-W
B	Acadian flycatcher	BF

No Size Class. Wildlife species that use nonforest or aquatic habitats during the year include:

Taxonomic class	*Wildlife species (n=72)*	*Habitat breadth*
A	Mudpuppy	WNF-W
R	Stinkpot	BNF-W
R	Spotted turtle	BNF-W
R	Map turtle	UNF-W
R	Red-eared slider	BNF-W
R	Plymouth redbelly turtle	WNF-W
R	Midland painted turtle	WNF-W
R	Blanding's turtle	BNF-W
R	Eastern spiny softshell	WATER
R	Maritime garter snake	BNF-W
R	Northern ribbon snake	WNF-W
B	Common loon	WNF-W
B	Pied-billed grebe	WNF-W
B	American bittern	WNF-W
B	Least bittern	WNF
B	Black-crowned night heron	WBF-W
B	Yellow-crowned night heron	WNF-W
B	Glossy ibis	WNF
B	Mute swan	BNF-W
B	Canada goose	BNF-W
B	Green-winged teal	WNF
B	Mallard	BNF-W
B	Northern pintail	WNF
B	Blue-winged teal	WNF
B	Northern shoveler	WNF
B	Gadwall	WNF-W
B	American wigeon	WNF-W
B	Canvasback	WNF-W
B	Ring-necked duck	WNF-W
B	Bufflehead	WATER
B	Red-breasted merganser	WNF-W
B	Osprey	WATER
B	Northern harrier	BNF
B	Rough-legged hawk	BNF
B	Gray partridge	UNF
B	Ring-necked pheasant	UNF
B	Black rail	WNF-W
B	King rail	WNF
B	Virginia rail	WNF
B	Sora	WNF
B	Common moorhen	WNF-W
B	American coot	WNF-W
B	Killdeer	BNF
B	Spotted sandpiper	BNF-W
B	Upland sandpiper	UNF
B	Common snipe	WNF
B	Ring-billed gull	BNF-W
B	Herring gull	WATER
B	Great black-backed gull	WATER
B	Black tern	WNF-W
B	Rock dove	UNF
B	Common barn owl	UNF
B	Snowy owl	BNF
B	Short-eared owl	BNF
B	Chimney swift	BNF
B	Belted kingfisher	WNF-W
B	Fish crow	WNF-W
B	Sedge wren	WNF
B	Marsh wren	WNF
B	Vesper sparrow	BNF
B	Savannah sparrow	BNF
B	Grasshopper sparrow	UNF
B	Henslow's sparrow	BNF
B	Lapland longspur	UNF
B	Snow bunting	BNF
B	Bobolink	BNF
B	Red-winged blackbird	BNF
B	Eastern meadowlark	UNF
B	House sparrow	UNF
M	Muskrat	WNF-W
M	Norway rat	UNF
M	House mouse	UNF

Forest habitat conditions are not habitat factors for these 72 wildlife species in our data base. However, the presence of upland and wetland nonforest and water habitat conditions within largely forested areas increases the potential habitats for an even larger number of species.

Structural Habitat Features

The occurrence and distribution of many wildlife species are related to key structural habitat features within the various forest cover-type groups in New England. Prominent, well-known wildlife species whose habitats reflect those of a group of species have been called featured species. Species whose habitats needs are well understood, so that changes in their populations can be predicted given changes in their habitat availability, have been called management indicator species. The use of either featured species or management indicator species in habitat management implies that the management objectives are designed to produce habitat for a given species. The concepts imply that other species using similar habitat will likewise benefit. Either concept may be used; however, each species in the represented group has particular requirements of its own that must be recognized and planned for. The following section highlights some of the more important habitat (stand) features and species associated

with them (Appendix D). Habitat-breadth category associated with each species is also listed. Management prescriptions can be written to accommodate any combination of these features. The number of wildlife species that use different structural habitats, by taxonomic class and size class, is given in Table 6.

High Exposed Perches. High exposed perching sites are most often found in old fields, pastures, new clearcuts, roadsides with grassy rights-of-way, riparian corridors, and in stands where an overstory tree clearly towers above all other forest vegetation or where a single tree or group of trees stands considerably above the surrounding herbaceous ground vegetation. Bull pines, supracanopy white pines and hemlock, lone elms in a pasture, leave trees such as red oak seed trees, and large roadside sugar maples are examples of high exposed perching sites. The exposed nature of these high perches provides excellent hunting sites for various raptors such as osprey, bald eagle, red-tailed hawk, and kestrel that forage in nonforested cover types and open forests, and small perching birds such as the olive-sided flycatcher that hawk flying insects. These perches also provide nest sites for the red-tailed hawk, great blue heron, and for osprey and bald eagle when near (within 1/2 mile) water. Also, high perches are excellent sites for turkey vultures and ravens, scavengers that often look for carrion from these perches. Wildlife species that use high exposed perching sites include:

Wildlife species (n=10)	*Habitat-breadth category*
Great blue heron	Forest-Nonforest-Water
Turkey vulture	Forest-Nonforest
Osprey	Water
Bald eagle	Forest-Water
Red-tailed hawk	Forest-Nonforest
Rough-legged hawk	Nonforest
American kestrel	Forest-Nonforest
Olive-sided flycatcher	Forest-Nonforest
Common raven	Forest-Krummholz-Nonforest-Water
Brown-headed cowbird	Forest-Nonforest

Wildlife use of high exposed perches is lowest in the sapling-pole size classes (Table 6) and remains fairly constant in the other size classes. Pole-size stands are fairly uniform in tree distribution and lack the relatively distinct vegetative layers that can be found in sawtimber-size classes and some nonforest cover types. Clearcut prescriptions for aspen-birch; open shelterwood prescriptions for northern hardwoods and oak-pine; and group selection prescriptions for northern hardwoods and spruce-fir, especially close to water and other nonforested cover types, can provide such perching sites for immediate use by hunting hawks by retaining suitable wildlife trees. Long-term management of these habitat features would assure suitable nesting and perching sites for these types of wildlife species. If cowbirds are a problem, no effort to provide high exposed perches should be made within 3 to 4 miles of active farmland.

Low Exposed Perches. Exposed perches relatively close to the ground can be found in old fields, pastures, wetland nonforest cover-types, water-influenced areas, roadside rights-of-way, landscaped backyards, and recent clearcuts. Fences, utility lines, isolated deciduous shrubs, woody sprout clumps, dead stubs less than 10 feet high, or clearcutting residual can serve as exposed perches. These lower perches are suitable singing and insect-hawking perches for the following species:

Wildlife species (n=20)	*Habitat-breadth category*
Olive-sided flycatcher	Forest-Nonforest
Eastern wood-pewee	Forest-Nonforest
Yellow-bellied flycatcher	Forest-Nonforest
Acadian flycatcher	Forest
Eastern phoebe	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
Eastern bluebird	Forest-Nonforest
Northern mockingbird	Forest-Nonforest
Northern shrike	Forest-Nonforest
Loggerhead shrike	Forest-Nonforest
Northern cardinal	Forest-Nonforest-Water
Indigo bunting	Forest-Nonforest
Chipping sparrow	Forest-Nonforest
Field Sparrow	Forest-Nonforest
Vesper sparrow	Nonforest
Grasshopper sparrow	Nonforest
Henslow's sparrow	Nonforest
Song sparrow	Forest-Nonforest
Eastern meadowlark	Nonforest
Brown-headed cowbird	Forest-Nonforest

Wildlife use of exposed perches is highest in the regeneration size class and decreases with stand size class (Table 6).

Table 6. – Number of wildlife species that use different structural habitats, by taxonomic class and size class

Taxonomic class	Nonforest types	Size class			
		Regeneration	Sapling-pole	Sawtimber	Large sawtimber
		HIGH EXPOSED PERCH			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	2	7	3	6	7
Mammals	–	–	–	–	–
		EXPOSED PERCH			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	4	13	12	9	9
Mammals	–	–	–	–	–
		MINIMAL CANOPY			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	6	20	16	12	13
Mammals	–	7	4	4	4
		PARTIAL CANOPY			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	1	32	29	34	34
Mammals	–	9	7	7	7
		CLOSED CANOPY			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	–	24	27	31	32
Mammals	–	9	9	10	10
		TREE BOLE			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	1	19	22	29	32
Mammals	–	12	9	16	16
		MIDSTORY LAYER			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	–	18	22	21	21
Mammals	–	–	–	–	–

Continued

Table 6.—Continued

Taxonomic class	Nonforest types	Size class			
		Regeneration	Sapling-pole	Sawtimber	Large sawtimber
		SHRUB LAYER			
Amphibians	–	1	1	1	1
Reptiles	–	–	–	–	–
Birds	3	70	52	44	45
Mammals	–	24	18	18	19
		WETLAND SHRUB LAYER			
Amphibians	–	–	–	–	–
Reptiles	–	1	1	1	1
Birds	8	7	6	6	6
Mammals	–	4	4	3	3
		GROUND VEGETATION LAYER			
Amphibians	–	–	–	–	–
Reptiles	–	3	3	3	3
Birds	15	36	21	15	16
Mammals	–	12	8	7	7
		WETLAND GROUND VEGETATION LAYER			
Amphibians	–	9	10	10	10
Reptiles	1	2	2	2	2
Birds	25	8	5	6	5
Mammals	–	4	4	4	4
		WATERSIDE LOG			
Amphibians	–	–	–	–	–
Reptiles	8	2	2	2	2
Birds	1	–	–	–	–
Mammals	–	1	2	2	2
		DEAD AND DOWN MATERIAL			
Amphibians	—	10	11	11	11
Reptiles	—	5	6	6	6
Birds	—	4	4	4	4
Mammals	—	15	18	17	17
		LITTER			
Amphibians	–	2	3	3	3
Reptiles	–	1	2	2	2
Birds	–	12	12	11	11
Mammals	–	6	6	6	6
		SUBTERRANEAN			
Amphibians	–	7	11	11	11
Reptiles	–	10	13	13	13
Birds	1	2	–	–	–
Mammals	3	25	20	20	20

Continued

Table 6.—Continued

Taxonomic class	Nonforest types	Size class			
		Regeneration	Sapling-pole	Sawtimber	Large sawtimber
		OVERSTORY INCLUSION			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	–	42	49	55	55
Mammals	–	7	7	8	8
		SLASHPILE			
Amphibians	–	3	3	3	3
Reptiles	–	4	4	4	4
Birds	–	2	2	2	2
Mammals	–	6	5	4	4
		MAST AND FRUIT			
Amphibians	–	–	–	–	–
Reptiles	–	–	–	–	–
Birds	1	17	15	18	18
Mammals	–	15	15	17	17

Minimal Overstory Canopy Conditions. Minimal overstory canopy conditions are defined as those forested stands or nonforested cover types with overstory crown closures less than 15 percent. These conditions can be found in abandoned fields and old pastures, sedge meadows, savannas, open bogs, stands defined as commercially nonstocked, recently clearcut stands, and some shelterwood or seed tree cuts. Minimal overstory canopy conditions permit high insolation with a resulting response in the ground vegetation layer. The open nature of these stands can provide the foraging and nesting habitat for wildlife species such as:

Wildlife species (n=35)	*Habitat-breadth category*
Osprey	Water
Bald eagle	Forest-Water
Northern harrier	Nonforest
Cooper's hawk	Forest-Nonforest
Red-tailed hawk	Forest-Nonforest
Rough-legged hawk	Nonforest
Golden eagle	Forest-Krummholz-Nonforest
American kestrel	Forest-Nonforest
Snowy owl	Nonforest
Northern flicker	Forest-Nonforest
Willow flycatcher	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
Eastern bluebird	Forest-Nonforest
Gray catbird	Forest-Nonforest
Brown thrasher	Forest-Nonforest
Cedar waxwing	Forest-Nonforest
Northern shrike	Forest-Nonforest
Loggerhead shrike	Forest-Nonforest
Nashville warbler	Forest-Nonforest
Yellow warbler	Forest-Nonforest
Prairie warbler	Forest-Nonforest
Northern cardinal	Forest-Nonforest-Water
Indigo bunting	Forest-Nonforest
Rufous-sided towhee	Forest-Nonforest
White-throated sparrow	Forest-Krummholz-Nonforest
Red-winged blackbird	Nonforest
Eastern meadowlark	Nonforest
Northern oriole	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Nonforest
European hare	Forest-Nonforest
Woodchuck	Forest-Nonforest
Red fox	Forest-Krummholz-Nonforest
Black bear	Forest-Nonforest-Water
Ermine	Forest-Nonforest

Wildlife use of minimal overstory canopy conditions (Table 6) is highest in the regeneration size class, where the overstory canopy usually is minimal and where clearcutting is a standard practice. In older and larger size-class stands, minimal overstory canopy conditions usually exist in poorly stocked and commercially nonstocked forest stands, or where a low-stocking level is desired for aesthetic reasons.

Partial Overstory Canopy Conditions. Partial overstory canopy conditions are defined as forested stands with overstory crown closures between 15 and 70 percent. These conditions can occur in a number of forest cover types and size-class situations. Examples of more open canopy conditions include clearcuts, open shelterwoods, sugarbush stands, and low density pine stands. Intermediate thinnings and closed shelterwoods are examples of high canopy closure conditions approaching 70 percent closure. Partial overstory canopy conditions are often temporary—the overstory commonly fills in over several growing seasons. Other structural habitat features associated with partial overstory canopy conditions include developing shrub and midstory vegetation layers. Wildlife species that use partial overstory canopy conditions include:

Wildlife species (n=50)	*Habitat-breadth category*
Turkey vulture	Forest-Nonforest
Osprey	Water
Bald eagle	Forest-Water
Cooper's hawk	Forest-Nonforest
Northern goshawk	Forest-Nonforest
Red-shouldered hawk	Forest-Nonforest
Golden eagle	Forest-Krummholz-Nonforest
Merlin	Forest-Nonforest
Ruffed grouse	Forest-Nonforest
Wild turkey	Forest-Nonforest
Northern bobwhite	Forest-Nonforest
American woodcock	Forest-Nonforest
Mourning dove	Forest-Nonforest
Black-billed cuckoo	Forest-Nonforest
Yellow-billed cuckoo	Forest-Nonforest
Eastern screech owl	Forest-Nonforest
Northern hawk-owl	Forest-Nonforest
Northern saw-whet owl	Forest-Nonforest
Whip-poor-will	Forest-Nonforest
Ruby-throated hummingbird	Forest-Nonforest
Red-headed woodpecker	Forest-Nonforest
Downy woodpecker	Forest-Nonforest
Northern flicker	Forest-Nonforest
Pileated woodpecker	Forest-Nonforest
Olive-sided flycatcher	Forest-Nonforest
Acadian flycatcher	Forest
Alder flycatcher	Forest-Nonforest
Great crested flycatcher	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
Blue-gray gnatcatcher	Forest-Nonforest
Eastern bluebird	Forest-Nonforest
Veery	Forest-Nonforest
Hermit thrush	Forest-Nonforest
American robin	Forest-Krummholz-Nonforest
Bohemian waxwing	Forest-Nonforest
Yellow-throated vireo	Forest-Nonforest
Warbling vireo	Forest-Nonforest
Philadelphia vireo	Forest-Nonforest
Pine warbler	Forest
Chipping sparrow	Forest-Nonforest
Orchard oriole	Forest-Nonforest
Hairy-tailed mole	Forest-Nonforest
Eastern pipistrelle	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Krummholz-Nonforest
Deer mouse	Forest-Krummholz-Nonforest
White-footed mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Bobcat	Forest-Krummholz-Nonforest
White-tailed deer	Forest-Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: eastern wood pewee, least flycatcher, black-throated blue warbler.

Wildlife use of partial overstory canopy conditions does not seem to vary within the various forest cover-type and size-class groups (Table 6).

Closed Overstory Canopy Conditions. Closed overstory canopy conditions are defined as those forested stands with overstory crown closures greater than 70 percent. These conditions can occur in any number of forest cover-type and size-class situations, such as in uneven-age management of northern hardwoods, and in even-age management systems where stocking levels are maintained at these levels for maximum form, quality and growth. Other structural habitat features associated with closed overstory canopy conditions include minimal development of shrub, midstory, and ground vegetation layers. Wildlife species that use closed overstory canopy conditions include:

Wildlife species	*Habitat-breadth category*
Red-breasted nuthatch	Forest-Krummholz-Nonforest
White-breasted nuthatch	Forest-Nonforest
Brown creeper	Forest-Nonforest
House wren	Forest-Nonforest
Winter wren	Forest-Nonforest
Eastern bluebird	Forest-Nonforest
European starling	Forest-Nonforest
Prothonotary warbler	Forest-Nonforest
Virginia opossum	Forest-Nonforest
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Indiana myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Gray squirrel	Forest
Red squirrel	Forest-Krummholz
Southern flying squirrel	Forest-Nonforest
Northern flying squirrel	Forest
Porcupine	Forest-Krummholz-Nonforest
Gray fox	Forest-Nonforest
Black bear	Forest-Nonforest-Water
Raccoon	Forest-Nonforest
Marten	Forest-Krummholz
Fisher	Forest-Krummholz-Nonforest
Ermine	Forest-Nonforest
Long-tailed weasel	Forest-Nonforest

Wildlife use of all sizes and conditions of tree boles increases with size-class group (Table 6). The number of wildlife species that use tree boles tends to be higher in northern hardwood, swamp hardwood, and oak-pine cover-type groups; and tends to be lower in the hemlock cover-type group (Fig. 7). It seems that stands with large average stand diameters; a variety of tree conditions (including large-diameter dead stems; live trees with hollow stems and dead limbs, and small

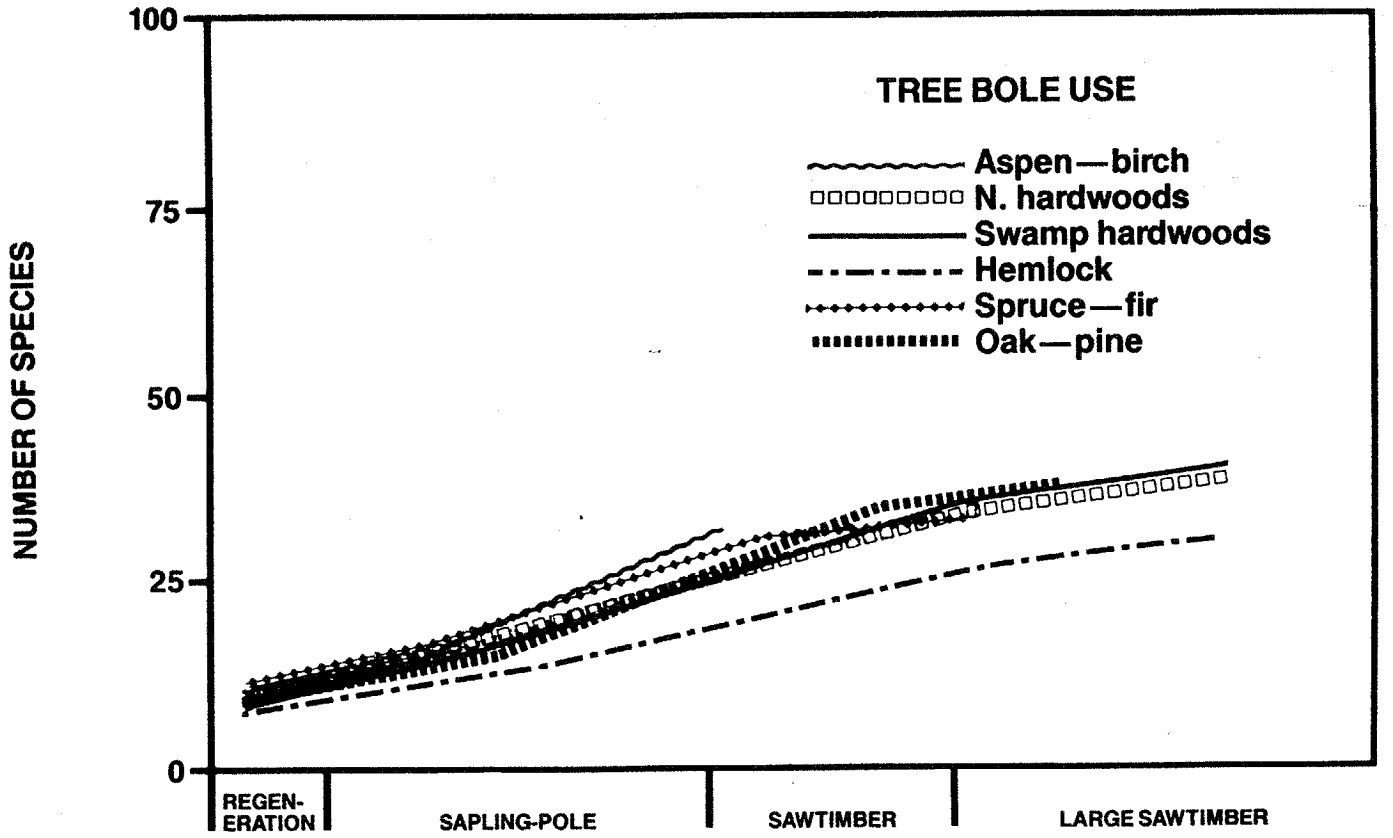


Figure 7.—Number of tree bole users, by cover type and size class (regeneration 0-10, sapling-pole 11-60, sawtimber 61-94, and large sawtimber >95).

diameter suppressed and dying stems), and nearby water have a high habitat potential for cavity-dwelling wildlife species in New England.

Midstory Layer. The midstory layer can be described as the deciduous and coniferous saplings and poles that occur within the 10- to 30-foot zone beneath the overstory canopy. Wildlife species that use a deciduous, coniferous, or mixed midstory layer in which to nest or forage also can find suitable conditions in certain krummholz, and nonforest cover-type conditions. Wildlife species that are associated with a midstory layer include:

Wildlife species (n=24)	*Habitat-breadth category*
Acadian flycatcher	Forest
Gray jay	Forest-Krummholz
Blue jay	Forest-Nonforest
Veery	Forest-Nonforest
Gray-cheeked thrush	Forest-Krummholz
Swainson's thrush	Forest
Wood thrush	Forest
American robin	Forest-Krummholz-Nonforest
White-eyed vireo	Forest-Nonforest
Solitary vireo	Forest
Philadelphia vireo	Forest-Nonforest
Northern parula	Forest-Nonforest
Magnolia warbler	Forest
Yellow-rumped warbler	Forest-Krummholz-Nonforest
Black-throated green warbler	Forest
Blackpoll warbler	Forest-Krummholz
American redstart	Forest-Nonforest
Worm-eating warbler	Forest
Wilson's warbler	Forest-Nonforest
Rose-breasted grosbeak	Forest-Nonforest
Pine grosbeak	Forest-Krummholz-Nonforest
Red crossbill	Forest-Krummholz
White-winged crossbill	Forest-Krummholz
Pine siskin	Forest-Nonforest

Wildlife use of a midstory layer increases slightly from the regeneration stage and then remains fairly even in the older size classes (Table 6).

Shrub Layer. A shrub layer is defined as the deciduous, coniferous, and ericaceous shrubs and seedlings that occur within the 2- to 10-foot zone in forested and nonforested cover types, usually but not always with an overstory canopy present. Wildlife species that use shrub layers, whether in forested or nonforested cover types, include:

Wildlife species (n=101)	*Habitat-breadth category*
Northern spring peeper	Forest-Nonforest-Water
Ring-necked pheasant	Nonforest
Wild turkey	Forest-Nonforest
Northern bobwhite	Forest-Nonforest
Common snipe	Nonforest
Black-billed cuckoo	Forest-Nonforest
Yellow-billed cuckoo	Forest-Nonforest
Whip-poor-will	Forest-Nonforest
Ruby-throated hummingbird	Forest-Nonforest
Olive-sided flycatcher	Forest-Nonforest
Yellow-bellied flycatcher	Forest-Nonforest
Acadian flycatcher	Forest
Alder flycatcher	Forest-Nonforest
Willow flycatcher	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
Carolina wren	Forest-Nonforest
House wren	Forest-Nonforest
Winter wren	Forest-Nonforest
Veery	Forest-Nonforest
Gray-cheeked thrush	Forest-Krummholz
Swainson's thrush	Forest
Hermit thrush	Forest-Nonforest
Wood thrush	Forest
Gray catbird	Forest-Nonforest
Northern mockingbird	Forest-Nonforest
Brown thrasher	Forest-Nonforest
Bohemian waxwing	Forest-Nonforest
Cedar waxwing	Forest-Nonforest
Northern shrike	Forest-Nonforest
Loggerhead shrike	Forest-Nonforest
White-eyed vireo	Forest-Nonforest
Solitary vireo	Forest
Philadelphia vireo	Forest-Nonforest
Blue-winged warbler	Forest-Nonforest
Golden-winged warbler	Forest-Nonforest
Tennessee warbler	Forest-Nonforest
Nashville warbler	Forest-Nonforest
Yellow warbler	Forest-Nonforest
Chestnut-sided warbler	Forest-Nonforest
Magnolia warbler	Forest
Black-throated blue warbler	Forest
Yellow-rumped warbler	Forest-Krummholz-Nonforest
Prairie warbler	Forest-Nonforest
Palm warbler	Forest-Nonforest
Blackpoll warbler	Forest-Krummholz
Black-and-white warbler	Forest-Nonforest
American redstart	Forest-Nonforest
Worm-eating warbler	Forest
Northern waterthrush	Forest-Nonforest-Water
Louisiana waterthrush	Forest-Nonforest
Mourning warbler	Forest-Nonforest

Wildlife species	*Habitat-breadth category*
Common yellowthroat	Forest-Nonforest
Hooded warbler	Forest-Nonforest
Wilson's warbler	Forest-Nonforest
Canada warbler	Forest-Nonforest
Yellow-breasted chat	Forest-Nonforest
Northern cardinal	Forest-Nonforest-Water
Rose-breasted grosbeak	Forest-Nonforest
Indigo bunting	Forest-Nonforest
Rufous-sided towhee	Forest-Nonforest
American tree sparrow	Forest-Nonforest
Chipping sparrow	Forest-Nonforest
Field sparrow	Forest-Nonforest
Fox sparrow	Forest-Nonforest
Song sparrow	Forest-Nonforest
Lincoln's sparrow	Forest-Nonforest
Swamp sparrow	Forest-Nonforest
White-throated sparrow	Forest-Krummholz-Nonforest
Dark-eyed junco	Forest-Krummholz-Nonforest
Red-winged blackbird	Nonforest
Rusty blackbird	Forest-Nonforest-Water
Common grackle	Forest-Nonforest-Water
Common redpoll	Forest-Nonforest
Hoary redpoll	Forest-Nonforest
Pine siskin	Forest-Nonforest
American goldfinch	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
Short-tailed shrew	Forest-Krummholz-Nonforest
Least shrew	Forest-Nonforest
Hairy-tailed mole	Forest-Nonforest
Eastern mole	Forest-Nonforest
Star-nosed mole	Forest-Nonforest-Water
Hoary bat	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Nonforest
Snowshoe hare	Forest-Krummholz-Nonforest
Eastern chipmunk	Forest-Krummholz-Nonforest
Woodchuck	Forest-Nonforest
White-footed mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Meadow vole	Forest-Nonforest
Woodland vole	Forest-Nonforest
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest
Meadow jumping mouse	Forest-Nonforest
Red fox	Forest-Krummholz-Nonforest
Black bear	Forest-Nonforest-Water
Ermine	Forest-Nonforest
Bobcat	Forest-Krummholz-Nonforest
White-tailed deer	Forest-Nonforest
Moose	Forest-Krummholz-Nonforest-Water

Note. Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: masked shrew, smoky shrew, pygmy shrew.

Wildlife use of shrub layer whether for foraging, nesting, or hiding is highest in the regeneration size class. Wildlife use of a shrub layer declines slightly but continues to be important in the sawtimber size-class group (Table 6).

The number of wildlife species that use a shrub layer is consistently higher in northern hardwood and swamp hardwood cover-type groups, and consistently lower in spruce-fir and hemlock cover-type groups (Fig. 8).

Wetland Shrub Layer. A wetland shrub layer is defined as the deciduous and ericaceous shrubs that occur within the 2- to 10-foot zone in forested and wetland nonforest cover types: usually, but not always, beneath minimal overstory canopy conditions. *Salix* spp., *Cornus* spp., *Alnus* spp., bog laurel *(Kalmia polifolia)*, and Labrador tea *(Ledum groenlandicum)* are examples of wetland shrubs. Wildlife species that use wetland shrub layers include:

Wildlife species (n=21)	*Habitat-breadth category*
Eastern ribbon snake	Forest-Nonforest-Water
Green-backed heron	Forest-Nonforest-Water
Black-crowned night heron	Nonforest-Water
Yellow-crowned night heron	Nonforest-Water
Glossy ibis	Nonforest
American black duck	Forest-Nonforest-Water
Blue-winged teal	Nonforest
Gadwall	Nonforest-Water
Ring-necked duck	Nonforest-Water
Common merganser	Forest-Nonforest-Water
Red-breasted merganser	Nonforest-Water
Common snipe	Nonforest
American woodcock	Forest-Nonforest
Northern waterthrush	Forest-Nonforest-Water
Louisiana waterthrush	Forest-Nonforest
Canada warbler	Forest-Nonforest
Swamp sparrow	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
New England cottontail	Forest-Nonforest
Raccoon	Forest-Nonforest
Mink	Forest-Nonforest-Water

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: hooded merganser.

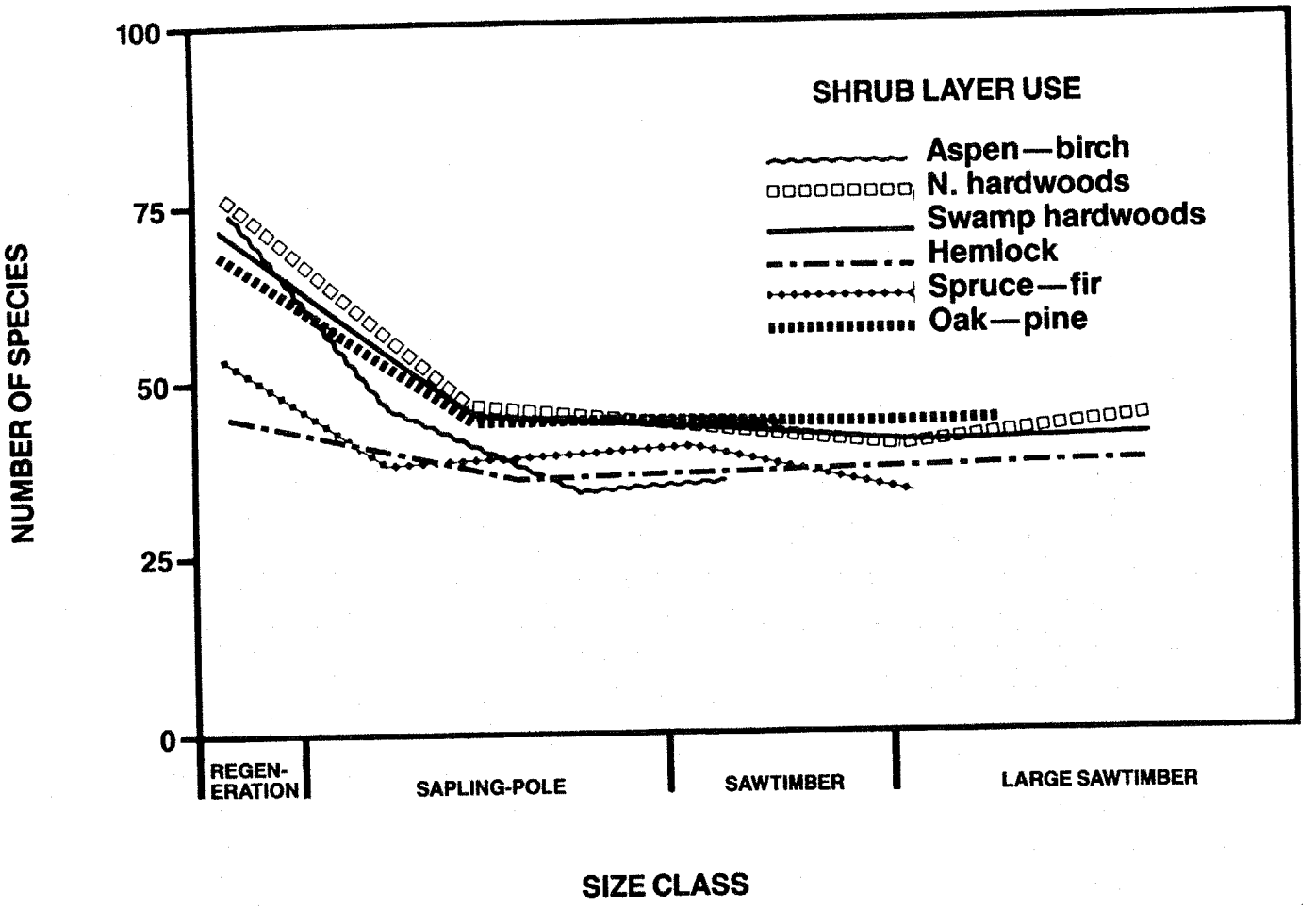


Figure 8. – Number of shrub layer users, by cover type and size class (regeneration 0-10, sapling-pole 11-60, sawtimber 61-94, and large sawtimber >95).

Wildlife use in all size-class groups (Table 6) is similar.

Ground Vegetation Layer. Ground vegetation layer coverage is defined as the forbs, grasses, and woody seedlings that occur in the 0- to 2-foot zone in forest and nonforest cover-types; usually with greater than 50 percent coverage. Wildlife species that use this vegetation layer, whether to forage, seek cover, or nest include:

Wildlife species (n=67)	*Habitat-breadth category*
Eastern garter snake	Forest-Krummholz-Nonforest-Water
Eastern ribbon snake	Forest-Nonforest-Water
Eastern smooth green snake	Forest-Nonforest
Rough-legged hawk	Nonforest
Gray partridge	Nonforest
Ring-necked pheasant	Nonforest
Ruffed grouse	Forest-Nonforest
Wild turkey	Forest-Nonforest
Spotted sandpiper	Nonforest-Water
Upland sandpiper	Nonforest
Great gray owl	Forest-Nonforest
Short-eared owl	Nonforest
Red-headed woodpecker	Forest-Nonforest
Least flycatcher	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
Purple martin	Forest-Nonforest-Water
Tree swallow	Forest-Nonforest-Water
Northern rough-winged swallow	Forest-Nonforest-Water
Bank swallow	Forest-Nonforest-Water
Cliff swallow	Forest-Nonforest
Barn swallow	Forest-Nonforest-Water
Eastern bluebird	Forest-Nonforest

Wildlife species	*Habitat-breadth category*
Northern shrike	Forest-Nonforest
Loggerhead shrike	Forest-Nonforest
European starling	Forest-Nonforest
Blue-winged warbler	Forest-Nonforest
Golden-winged warbler	Forest-Nonforest
Tennessee warbler	Forest-Nonforest
Nashville warbler	Forest-Nonforest
Yellow warbler	Forest-Nonforest
Prairie warbler	Forest-Nonforest
Palm warbler	Forest-Nonforest
Black-and-white warbler	Forest-Nonforest
Mourning warbler	Forest-Nonforest
Common yellowthroat	Forest-Nonforest
Hooded warbler	Forest-Nonforest
Indigo bunting	Forest-Nonforest
Field sparrow	Forest-Nonforest
Vesper sparrow	Nonforest
Savannah sparrow	Nonforest
Grasshopper sparrow	Nonforest
Henslow's sparrow	Nonforest
Song sparrow	Forest-Nonforest
Lincoln's sparrow	Forest-Nonforest
White-throated sparrow	Forest-Krummholz-Nonforest
Dark-eyed junco	Forest-Krummholz-Nonforest
Lapland longspur	Nonforest
Snow bunting	Nonforest
Bobolink	Nonforest
Red-winged blackbird	Nonforest
Eastern meadowlark	Nonforest
Common grackle	Forest-Nonforest-Water
Common redpoll	Forest-Nonforest
Hoary redpoll	Forest-Nonforest
American goldfinch	Forest-Nonforest
Least shrew	Forest-Nonforest
Hairy-tailed mole	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
European hare	Forest-Nonforest
Deer mouse	Forest-Krummholz-Nonforest
Meadow vole	Forest-Nonforest
Woodland vole	Forest-Nonforest
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest
Meadow jumping mouse	Forest-Nonforest
Woodland jumping mouse	Forest-Nonforest
White-tailed deer	Forest-Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: Masked shrew, smoky shrew, pygmy shrew, southern red-backed vole.

Wildlife use of ground vegetation layer is highest in the regeneration size-class (Table 6). The older size-class groups are used less, usually due to the lack of an herbaceous layer on the ground.

The number of wildlife species that use an upland ground vegetation layer is consistently higher in northern hardwood, swamp hardwood, and oak-pine cover-type groups; and consistently lower in spruce-fir and hemlock cover-type groups (Fig. 9).

Wetland Ground Vegetation Layer and Temporary Pools. Sedges, cattails, sphagnum, and other typical wetland plants can be found in small and large inclusions of somewhat poorly to very poorly drained soils in closed drainages of upland landscapes. Earthmoving activities can rearrange drainage patterns to create ponds and pools that remain full of water on a year-round basis. Ephemeral pools can be found in the early spring due to soil drainage type or litter accumulation; these pools provide egg-laying habitat for various woodland salamanders, frogs, and toads. Wildlife species that use large and small wetland herbaceous ground vegetation include:

Wildlife species (n=50)	*Habitat-breadth category*
Jefferson salamander	Forest-Nonforest
Northern two-lined salamander	Forest-Nonforest-Water
Eastern spadefoot	Forest-Nonforest
American toad	Forest-Nonforest-Water
Gray treefrog	Forest-Nonforest-Water
Bullfrog	Forest-Nonforest-Water
Green frog	Forest-Nonforest-Water
Mink frog	Forest-Nonforest-Water
Wood frog	Forest-Krummholz-Nonforest-Water
Northern leopard frog	Forest-Nonforest-Water
Bog turtle	Forest-Nonforest-Water
Eastern painted turtle	Forest-Nonforest-Water
Northern ribbon snake	Nonforest-Water
Pied-billed grebe	Nonforest-Water
American bittern	Nonforest-Water
Great blue heron	Forest-Nonforest-Water
Green-backed heron	Forest-Nonforest-Water
Canada goose	Nonforest-Water
Green-winged teal	Nonforest
American black duck	Forest-Nonforest-Water
Mallard	Nonforest-Water
Northern pintail	Nonforest
Blue-winged teal	Nonforest
Northern shoveler	Nonforest

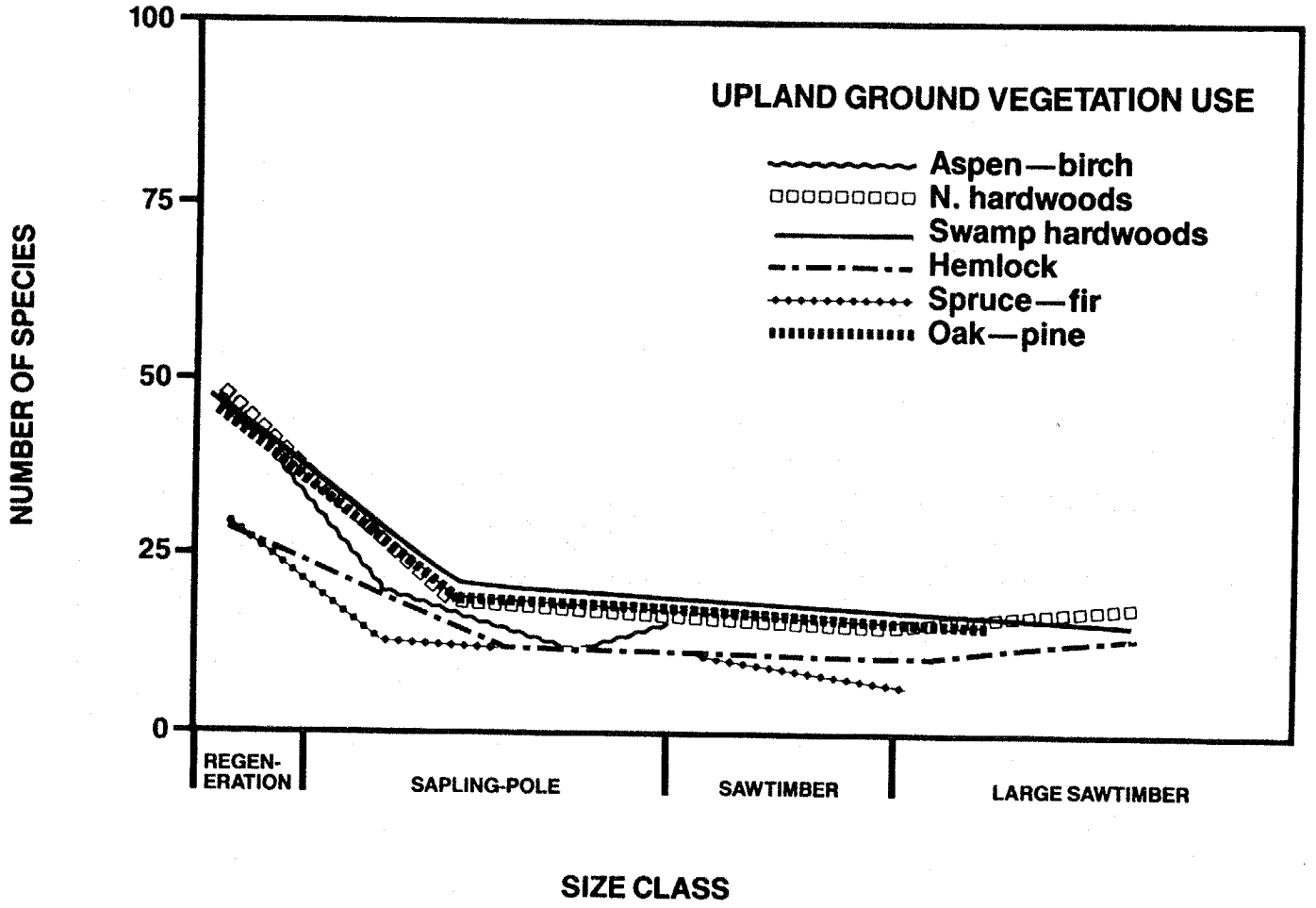


Figure 9. – Number of upland ground vegetation users, by cover type and size class (regeneration 0-10, sapling-pole 11-60, sawtimber 61-94, and large sawtimber >95).

Wildlife species	*Habitat-breadth category*
Gadwall	Nonforest-Water
American wigeon	Nonforest-Water
Northern harrier	Nonforest
Black rail	Nonforest-Water
King rail	Nonforest
Virginia rail	Nonforest
Sora	Nonforest
Common moorhen	Nonforest-Water
American coot	Nonforest-Water
Spotted sandpiper	Nonforest-Water
Common snipe	Nonforest
American woodcock	Forest-Nonforest
Black tern	Nonforest-Water
Short-eared owl	Nonforest
Sedge wren	Nonforest
Marsh wren	Nonforest
Northern waterthrush	Forest-Nonforest-Water
Henslow's sparrow	Nonforest
Lincoln's sparrow	Forest-Nonforest
Swamp sparrow	Forest-Nonforest
Red-winged blackbird	Nonforest
Common grackle	Forest-Nonforest-Water
Water shrew	Forest-Nonforest-Water
Rock vole	Forest-Krummholz-Nonforest
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: masked shrew, meadow vole, meadow jumping mouse.

Wildlife use of wetland ground vegetation conditions is highest (Table 6) in the wetland nonforest types and riparian (lakes, streams, and rivers) areas. Wildlife species that utilize nonforest

cover types and water exclusively will not primarily use small inclusions that commonly occur in various forest cover types and size-class groups. However, these small wetland inclusions and temporary pools provide habitat components for up to 24 forest dwelling species. The number of wildlife species that use wetland ground vegetation conditions is consistently higher in the swamp hardwood cover-type groups (Fig. 10).

Waterside Logs. Waterside logs are fallen logs in water and riparian areas. These structures provide basking locations for toads, turtles, and snakes; resting and nesting areas for ring-necked ducks; and dens for river otters. Wildlife species that use these structural habitat features include:

Wildlife species (n=14)	*Habitat-breadth category*
Northern leopard frog	Forest-Nonforest-Water
Stinkpot	Nonforest-Water
Spotted turtle	Nonforest-Water
Map turtle	Nonforest-Water
Red-eared slider	Nonforest-Water
Plymouth redbelly turtle	Nonforest-Water
Eastern painted turtle	Forest-Nonforest-Water
Midland painted turtle	Nonforest-Water
Blanding's turtle	Nonforest-Water
Eastern spiny softshell	Water
Northern water snake	Forest-Nonforest-Water
Ring-necked duck	Nonforest-Water
River otter	Forest-Nonforest-Water
Mink	Forest-Nonforest-Water

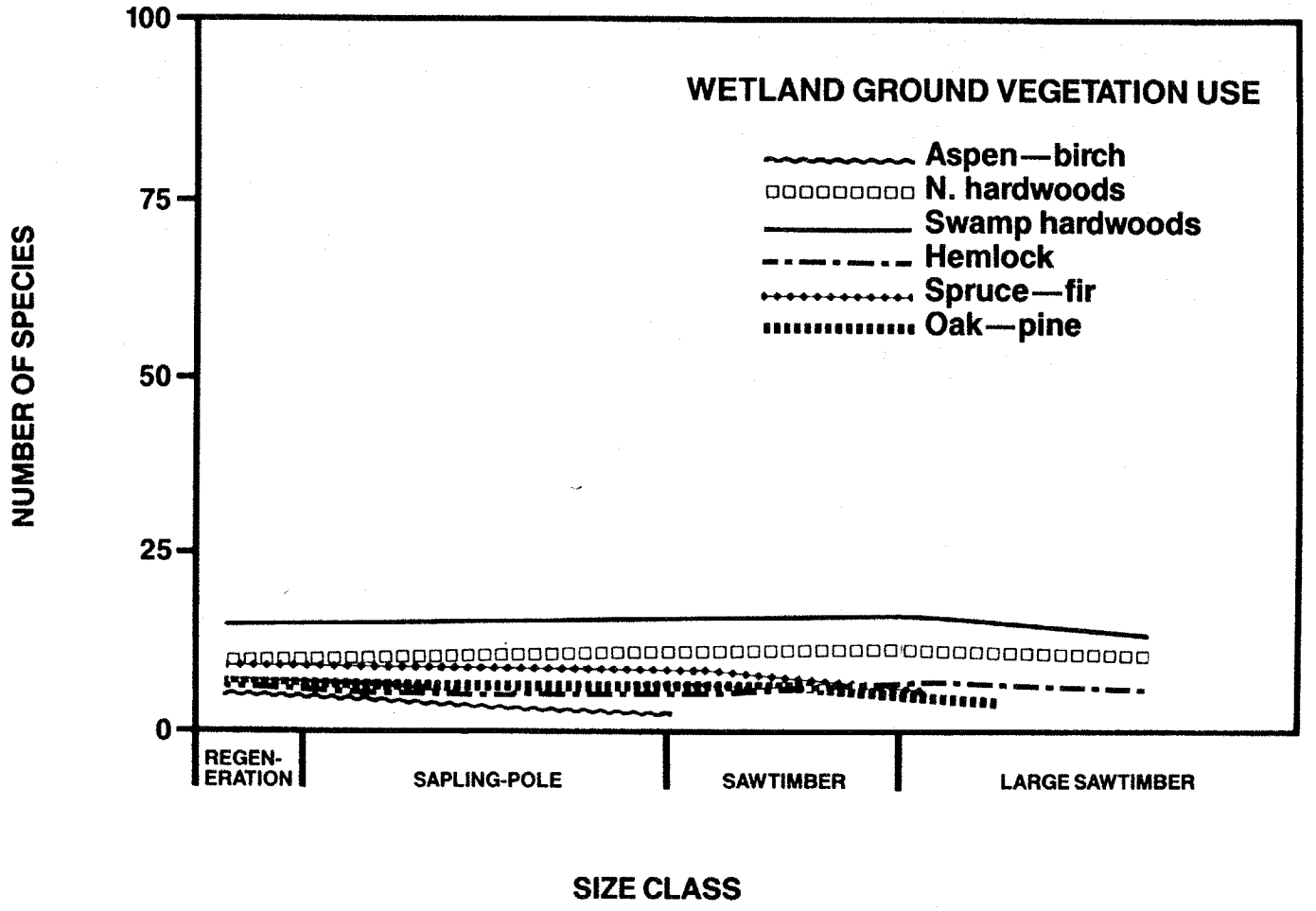


Figure 10. – Number of wetland ground vegetation users, by cover type and size class (regeneration 0-10, sapling-pole 11-60, sawtimber 61-94, and large sawtimber >95).

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: common merganser.

Wildlife use of waterside logs is highest in the wetland nonforest cover types and riparian (lake, stream, and river) areas (Table 6). Wildlife use of forest cover types and size-class groups is minimal, depending totally on the presence of permanent water within these stands.

Rocky Floor. Rocky forest floor, especially in moist woodlands, provides foraging and shelter sites for the following wildlife species:

Wildlife species (n=3)	*Habitat-breadth category*
Northern spring salamander	Forest-Nonforest-Water
Northern two-lined salamander	Forest-Nonforest-Water
Rock vole	Forest-Krummholz-Nonforest

Note: Long-tailed shrew may prefer rocky sites in Forest-Krummholz.

Dead and Down Material. Dead and down woody material provides foraging and shelter sites for the following wildlife species:

Wildlife species (n=39)	*Habitat-breadth category*
Marbled salamander	Forest-Nonforest-Water
Jefferson salamander	Forest-Nonforest
Silvery salamander	Forest-Nonforest
Blue-spotted salamander	Forest-Nonforest
Tremblay's salamander	Forest-Nonforest
Spotted salamander	Forest-Nonforest-Water
Red-spotted newt (eft)	Forest-Nonforest-Water
Mountain dusky salamander	Forest-Water
Redback salamander	Forest-Nonforest
Slimy salamander	Forest-Nonforest
Four-toed salamander	Forest-Nonforest-Water
Five-lined skink	Forest
Northern ringneck snake	Forest-Nonforest
Northern black racer	Forest-Nonforest
Black rat snake	Forest-Nonforest
Eastern milk snake	Forest-Nonforest-Water
Northern copperhead	Forest-Krummholz-Nonforest-Water
Ruffed grouse	Forest-Nonforest
Winter wren	Forest-Nonforest
Worm-eating warbler	Forest
Canada warbler	Forest-Nonforest
Virginia opossum	Forest-Nonforest
Masked shrew	Forest-Krummholz-Nonforest
Smoky shrew	Forest-Nonforest
Long-tailed shrew	Forest-Krummholz
Pygmy shrew	Forest-Krummholz-Nonforest
Eastern chipmunk	Forest-Krummholz-Nonforest
White-footed mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Gray fox	Forest-Nonforest
Black bear	Forest-Nonforest-Water
Marten	Forest-Krummholz
Fisher	Forest-Krummholz-Nonforest
Ermine	Forest-Nonforest
Long-tailed weasel	Forest-Nonforest
Mink	Forest-Nonforest-Water
Striped skunk	Forest-Nonforest
Lynx	Forest-Krummholz-Nonforest
Bobcat	Forest-Krummholz-Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: short-tailed shrew, deer mouse.

Wildlife use of dead and down woody material is similar throughout the sawtimber size-class groups; while use of the regeneration size-class group is slightly less (Table 6).

Forest Litter and Moss. Forest litter, duff, and mossy ground surfaces provide foraging and shelter sites for the following wildlife species:

Wildlife species (n=24)	*Habitat-breadth category*
Red-spotted newt	Forest-Nonforest-Water
Eastern spadefoot	Forest-Nonforest
Wood frog	Forest-Krummholz-Nonforest Water
Northern redbelly snake	Forest-Krummholz-Nonforest
Eastern hognose snake	Forest-Nonforest
Hermit thrush	Forest-Nonforest
Tennessee warbler	Forest-Nonforest
Nashville warbler	Forest-Nonforest
Black-and-white warbler	Forest-Nonforest
Worm-eating warbler	Forest
Ovenbird	Forest
Northern waterthrush	Forest-Nonforest-Water
Louisiana waterthrush	Forest-Nonforest
Wilson's warbler	Forest-Nonforest
Canada warbler	Forest-Nonforest
Northern cardinal	Forest-Nonforest-Water
Rufous-sided towhee	Forest-Nonforest
Masked shrew	Forest-Krummholz-Nonforest

Wildlife species	*Habitat-breadth category*
Smoky shrew	Forest-Nonforest
Pygmy shrew	Forest-Krummholz-Nonforest
Short-tailed shrew	Forest-Krummholz-Nonforest
Woodland vole	Forest-Nonforest
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest

Wildlife use of forest litter, duff and mossy ground surfaces remains constant throughout the size-class groups. (Table 6).

Subterranean Habitats. Wildlife species with fossorial (underground burrowing) habits abound in both moist and well-drained forested and non-forested environments. The mole salamanders use moist conditions under rotten logs and in somewhat poorly drained soils; eastern spadefoot and Fowler's toad burrow in sandy well-drained soils. Muddy streambanks and shorelines are ideal burrowing sites for muskrats. Rocky crevices, boulder piles, and talus slopes, especially near water, are ideal hibernacula for water snakes, black rat snake, northern copperhead, and timber rattlesnake. Dry sand and gravel banks that are stabilized by vegetation at the top are excellent nesting sites for belted kingfishers, northern rough-winged swallows, and bank swallows. Open non-forested areas on sandy loams such as grassy openings, abandoned fields, and pastures are ideal burrowing spots for hairy-tailed and eastern moles, woodchuck, meadow and woodland voles. Forest-dwelling fossorial mammals include the southern red-backed vole, northern and southern bog lemming, and woodland jumping mouse. Subterranean habitats are used by the following wildlife species:

Wildlife species (n=56)	*Habitat-breadth category*
Marbled salamander	Forest-Nonforest-Water
Spotted salamander	Forest-Nonforest-Water
Northern dusky salamander	Forest-Nonforest-Water
Redback salamander	Forest-Nonforest
Slimy salamander	Forest-Nonforest
Northern spring salamander	Forest-Nonforest-Water
Eastern spadefoot	Forest-Nonforest
American toad	Forest-Nonforest-Water
Fowler's toad	Forest-Nonforest-Water
Northern spring peeper	Forest-Nonforest-Water
Green frog	Forest-Nonforest-Water
Bog turtle	Forest-Nonforest-Water
Wood turtle	Forest-Nonforest-Water
Eastern box turtle	Forest-Nonforest-Water
Five-lined skink	Forest
Northern brown snake	Forest-Nonforest
Northern redbelly snake	Forest-Krummholz-Nonforest
Eastern ribbon snake	Forest-Nonforest-Water
Northern ringneck snake	Forest-Nonforest
Eastern worm snake	Forest-Nonforest
Northern black racer	Forest-Nonforest
Black rat snake	Forest-Nonforest
Northern copperhead	Forest-Krummholz-Nonforest-Water
Timber rattlesnake	Forest-Nonforest-Water
Belted kingfisher	Nonforest-Water
Northern rough-winged swallow	Forest-Nonforest-Water
Bank swallow	Forest-Nonforest-Water
Long-tailed shrew	Forest-Krummholz
Short-tailed shrew	Forest-Krummholz-Nonforest
Least shrew	Forest-Nonforest
Hairy-tailed mole	Forest-Nonforest
Eastern mole	Forest-Nonforest
Star-nosed mole	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
European hare	Forest-Nonforest
Eastern chipmunk	Forest-Krummholz-Nonforest
Woodchuck	Forest-Nonforest
Red squirrel	Forest-Krummholz
Beaver	Forest-Nonforest-Water
Deer mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Woodland vole	Forest-Nonforest
Muskrat	Nonforest-Water
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest
Norway rat	Nonforest
House mouse	Nonforest
Meadow jumping mouse	Forest-Nonforest
Woodland jumping mouse	Forest-Nonforest
Porcupine	Forest-Krummholz-Nonforest
Coyote	Forest-Krummholz-Nonforest
Red fox	Forest-Krummholz-Nonforest
Ermine	Forest-Nonforest
Long-tailed weasel	Forest-Nonforest
Mink	Forest-Nonforest-Water
Striped skunk	Forest-Nonforest

Wildlife use of the subterranean habitat is similar in all size classes (Table 6).

Overstory Inclusions. Overstory inclusions in forested stands depend on several factors: a minimum stand size and the level of detail in forest cover-type mapping and inventory. Large stands (larger than 10 acres) tend to obscure the isolated patches of conifer stems in hardwood stands, or hardwood stems in conifer stands, especially where the cover types change as rapidly as they do across New England landscapes (every 5 to 10 acres). Mixed-stand cover types such as in aspen-fir-spruce, oak-pine, and northern hardwoods-hemlock help identify large acreages where these conditions are present. Coniferous overstory inclusions of hemlock, spruce, fir, or pine can provide feeding, nesting, and winter shelter opportunities in deciduous stands that pure hardwood stands cannot provide. Likewise, deciduous overstory inclusions of oak, beech, and other hardwoods can provide mast and other foraging and nesting sites that pure conifer stands cannot provide. Wildlife species that use these inclusions, sometimes just a group of several stems or patches of 1/4 to 2 acres in size, include:

Wildlife species (n=65)	*Habitat-breadth category*
Sharp-shinned hawk	Forest-Nonforest
Cooper's hawk	Forest-Nonforest
Northern goshawk	Forest-Nonforest
Red-shouldered hawk	Forest-Nonforest
Broad-winged hawk	Forest-Nonforest
Red-tailed hawk	Forest-Nonforest
Ruffed grouse	Forest-Nonforest
Wild turkey	Forest-Nonforest
Eastern screech owl	Forest-Nonforest
Great horned owl	Forest-Nonforest
Barred owl	Forest-Nonforest-Water
Long-eared owl	Forest-Nonforest
Northern saw-whet owl	Forest-Nonforest
Whip-poor-will	Forest-Nonforest
Yellow-bellied sapsucker	Forest-Nonforest
Eastern wood-pewee	Forest-Nonforest
Least flycatcher	Forest-Nonforest
Eastern phoebe	Forest-Nonforest
Great crested flycatcher	Forest-Nonforest
Blue jay	Forest-Nonforest
American crow	Forest-Nonforest
Tufted titmouse	Forest-Nonforest
Red-breasted nuthatch	Forest-Krummholz-Nonforest
White-breasted nuthatch	Forest-Nonforest
Brown creeper	Forest-Nonforest
Golden-crowned kinglet	Forest-Krummholz
Ruby-crowned kinglet	Forest-Krummholz
Blue-gray gnatcatcher	Forest-Nonforest
Veery	Forest-Nonforest
Hermit thrush	Forest-Nonforest
Wood thrush	Forest
American robin	Forest-Krummholz-Nonforest
Solitary vireo	Forest
Yellow-throated vireo	Forest-Nonforest
Red-eyed vireo	Forest-Nonforest
Nashville warbler	Forest-Nonforest
Northern parula	Forest-Nonforest
Yellow warbler	Forest-Nonforest
Magnolia warbler	Forest
Black-throated blue warbler	Forest
Yellow-rumped warbler	Forest-Krummholz-Nonforest
Black-throated green warbler	Forest
Blackburnian warbler	Forest
Pine warbler	Forest
American redstart	Forest-Nonforest
Mourning warbler	Forest-Nonforest
Canada warbler	Forest-Nonforest
Scarlet tanager	Forest
Chipping sparrow	Forest-Nonforest
Dark-eyed junco	Forest-Krummholz-Nonforest
Rusty blackbird	Forest-Nonforest-Water
Common grackle	Forest-Nonforest-Water
Purple finch	Forest-Nonforest
House finch	Forest-Nonforest
Pine siskin	Forest-Nonforest
American goldfinch	Forest-Nonforest
Evening grosbeak	Forest-Nonforest
Smoky shrew	Forest-Nonforest
Short-tailed shrew	Forest-Krummholz-Nonforest
Gray squirrel	Forest
Red squirrel	Forest-Krummholz
Deer mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Porcupine	Forest-Krummholz-Nonforest
White-tailed deer	Forest-Nonforest

Wildlife use of overstory coniferous/deciduous inclusions increases with size class (Table 6). The nonforest cover types, krummholz, and water groups are also used by species that have a seasonal use for coniferous and deciduous overstory inclusions. However, more species use the sawtimber size class than the regeneration size class.

Seeps. Seeps occur across the New England landscape on lower slopes of glacial till hills and bedrock. The usually lush ground vegetation associated with seeps and the moist cool environment provides feeding and shelter sites for the following wildlife species:

Wildlife species (n=7)	*Habitat-breadth category*
Northern dusky salamander	Forest-Nonforest-Water
Mountain dusky salamander	Forest-Water
Northern spring salamander	Forest-Nonforest-Water
Northern two-lined salamander	Forest-Nonforest-Water
Green frog	Forest-Nonforest-Water
Wild turkey	Forest-Nonforest-Water
Southern red-backed vole	Forest-Krummholz-Nonforest

Gravel Pits and Bare Ground. Gravel pits and patches of well-drained bare ground can be found where upland landscapes have been created. Roadside edges, log decking areas, and recently plowed and bare fields are examples of similar habitat conditions where there is sparse ground vegetation, much grit, waste grass, and forb seeds. These conditions are favorable for the following wildlife species:

Wildlife species (n=6)	*Habitat-breadth category*
Killdeer	Nonforest
Common nighthawk	Forest-Nonforest
Horned lark	Forest-Nonforest
Chipping sparrow	Forest-Nonforest
Lapland longspur	Nonforest
Snow bunting	Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: ruffed grouse.

Woods Road. Grass covered or weedy woods roads provide herbs and insects, especially for ruffed grouse and wild turkey broods, when nonforest habitats are not present. Broad-winged hawks hunt snakes and other prey along these roads. Large yellow and paper birches along woods roads provide nesting sites for broad-winged hawks.

Slashpiles. Slashpiles usually result from land clearing or silvicultural activities. Piling brush, slash, or other logging residual in loose rows or piles creates denning, hiding, and other shelter areas for different types of wildlife species. The wildlife species that use slashpiles include:

Wildlife species (n=15)	*Habitat-breadth category*
Red-spotted newt (eft)	Forest-Nonforest-Water
Redback salamander	Forest-Nonforest
Wood frog	Forest-Krummholz-Nonforest-Water
Eastern box turtle	Forest-Nonforest-Water
Northern brown snake	Forest-Nonforest
Northern ringneck snake	Forest-Nonforest
Northern black racer	Forest-Nonforest
House wren	Forest-Nonforest
Winter wren	Forest-Nonforest
Virginia opossum	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Nonforest
Southern red-backed vole	Forest-Krummholz-Water
Black bear	Forest-Nonforest-Water
Ermine	Forest-Nonforest

Note: Also found using this feature on the Huntington Wildlife Forest in the Adirondack Mountains, New York: deer mouse, woodland jumping mouse.

Slashpiles most often are found in regeneration size-class stands or stands where some type of intermediate treatment has been completed. Piles of woody debris can provide hiding cover and denning sites for amphibians, reptiles, small mammals, and even several of the larger mammals such as bear, regardless of size class of the surrounding stand. House wrens and winter wrens are the birds most likely to use slashpiles.

Mast and Fruit. Hard mast refers to the nuts produced by trees and shrubs in New England, especially butternut, hickories, oaks, beech, and hazel. Fleshy fruits include the mountain ash, fruits of the various *Vaccinium* and *Rubus* spp., and fruits of herbs such as wild strawberry. Hard mast provides a variable but high caloric source of digestible lipids and carbohydrates needed by most resident and migratory wildlife species. A predictable seasonal and long-term availability of hard mast and fleshy fruits increases the foraging success and survivability of the following wildlife species:

Wildlife species (n=39)	*Habitat-breadth category*
Wood duck	Forest-Nonforest-Water
American black duck	Forest-Nonforest-Water
Mallard	Nonforest-Water
Ruffed grouse	Forest-Nonforest

Wildlife species	*Habitat-breadth category*
Wild turkey	Forest-Nonforest
Red-headed woodpecker	Forest-Nonforest
Hairy woodpecker	Forest-Nonforest
Blue jay	Forest-Nonforest
American crow	Forest-Nonforest
Common raven	Forest-Krummholz-Nonforest-Water
Black-capped chickadee	Forest-Krummholz-Nonforest
Tufted titmouse	Forest-Nonforest
White-breasted nuthatch	Forest-Nonforest
Brown creeper	Forest-Nonforest
Northern mockingbird	Forest-Nonforest
Brown thrasher	Forest-Nonforest
Bohemian waxwing	Forest-Nonforest
Cedar waxwing	Forest-Nonforest
Rufous-sided towhee	Forest-Nonforest
Common grackle	Forest-Nonforest-Water
Virginia opossum	Forest-Nonforest
Eastern chipmunk	Forest-Krummholz-Nonforest
Gray squirrel	Forest
Red squirrel	Forest-Krummholz
Southern flying squirrel	Forest-Nonforest
Northern flying squirrel	Forest
Deer mouse	Forest-Krummholz-Nonforest
White-footed mouse	Forest-Krummholz-Nonforest
Southern red-backed vole	Forest-Krummholz-Nonforest
Woodland vole	Forest-Nonforest
Meadow jumping mouse	Forest-Nonforest
Porcupine	Forest-Krummholz-Nonforest
Coyote	Forest-Krummholz-Nonforest
Red fox	Forest-Krummholz-Nonforest
Gray fox	Forest-Nonforest
Black bear	Forest-Nonforest-Water
Raccoon	Forest-Nonforest
Striped skunk	Forest-Nonforest
White-tailed deer	Forest-Nonforest

Wildlife use of hard mast and fleshy fruits is fairly even across the size-class groups because of the sometimes scattered nature of mast trees throughout stands of all size classes (Table 6).

No Special Requirements. Seventeen wildlife species in our data base do not fit this categorization of vertically distributed forested structural components. They either require aquatic habitats exclusively (mudpuppy), are essentially coastal (mute swan, fish crow), or are winter visitors to New England's estuarine habitats, open rivers, and lakes (bufflehead), occur on cliffs (peregrine falcon) or agricultural land (rock dove). Open landfills have contributed to the inland distribution of gulls. The mountain lion is extirpated from New England.

Wildlife species (n=17)	*Habitat-breadth category*
Mudpuppy	Nonforest-Water
Pickerel frog	Forest-Nonforest-Water
Common snapping turtle	Forest-Nonforest-Water
Maritime garter snake	Nonforest-Krummholz-Water
Common loon	Nonforest-Water
Least bittern	Nonforest
Mute swan	Nonforest-Water
Canvasback	Nonforest-Water
Bufflehead	Water
Peregrine falcon	Forest-Nonforest
Ring-billed gull	Nonforest-Water
Herring gull	Water
Great black-backed gull	Water
Rock dove	Nonforest
Fish crow	Water
House sparrow	Nonforest
Mountain lion	Forest-Nonforest

SILVICULTURAL METHODS

Silviculture deals with the cutting and cultural treatments applied to stands of trees. The objective usually is to produce stands of commercially valuable trees. In this report, silviculture includes the application of cutting and cultural treatments to produce wildlife habitats. In this section we use the following definitions:

A **stand** is an area of trees of a certain species composition (cover type), age class or size class distribution and condition (quality, vigor, risk), usually growing on a fairly homogeneous site. Stands of 5 acres and larger commonly are recognized, though minimum stand size depends upon size of ownership and intensity of management.

An **even-aged** stand contains trees in the main canopy that are within 20 years of being the same age. Even-aged stands sometimes are designated by age-class (10-year-old stand, 40-year-old stand) or broad size-class: seedling stand (most trees are <1 inch d.b.h.); sapling stand (trees 1-4 inches d.b.h.); poletimber stand (trees 5-10 inches d.b.h.); and sawtimber stand (trees $\geq$ 11 inches d.b.h.).

An **uneven-aged** stand contains trees of several 20-year age-classes. These stands generally contain trees of many sizes (seedlings through sawtimber) due to the range in age as well as differences in growth rate among species.

The **site** conditions representative of a stand are sometimes designated by soil factors (parent material, texture, drainage, or soil series), or by direct measurements such as site index -- the height of the dominant/codominant trees at a base age of usually 50 years.

A group of stands under one ownership or manager is a **forest.** Forest management includes silviculture, and also involves activities such as road construction, fire protection, pest management, regulating the cut of timber products, maintenance of wildlife habitat conditions, inventory, boundary maintenance, and recreational and aesthetic planning, and so on.

Silvicultural cuttings commonly are classified as **regeneration** cuttings (Fig. 11) or **intermediate** cuttings (Fig. 12). Regeneration cuttings are designed to naturally regenerate the stand by providing for seedling (or vegetative stems) establishment or development, or both. Four techniques are mentioned in this report: two for producing even-aged stands and two for maintaining uneven-aged stands:

Even-aged:

1. **Clearcutting**—removal of all stems in the stand. Strip cutting is a form of clearcutting.

2. **Shelterwood**—removal of the understory and lower crown canopy trees to allow the new stand to regenerate under shade. Subsequent removal of the overstory in one or several cuts.

Uneven-aged:

1. **Single-tree selection**—removal of trees singly or in groups of 2 or 3, which maintains a continuous crown and an uneven-aged or uneven-sized mixture.

2. **Group selection**—removal of trees in groups usually 1/10 to 2/3 acre in size, but sometimes up to 1 to 2 acres on large properties. Group selection can be applied in combination with single-tree selection between the groups.

Intermediate cuttings are applied in the culture of even-aged stands and are normally noncommercial (no products sold) or commercial thinnings (timber sold), designed to favor certain species, sizes, and qualities of trees by removal of competitors. Thinnings designed to grow quality timber commonly maintain a closed canopy; however, low-density thinning (50 to 70 percent residual crown cover) can be used to hasten diameter growth and stimulate understory development for wildlife purposes. At rotation age, the stand is considered to be mature, and a regeneration cutting is applied to produce a new stand.

Single-tree selection and group selection methods culture an uneven-aged stand, as well as regenerate it, so specific intermediate cuts are not used. However, the term **improvement cut** is sometimes used to describe a cut in a uneven-aged stand, designed especially to upgrade the quality or species composition. No rotation age is specified for uneven-aged stands. Instead, a very general maximum tree size is chosen, and residual stands after cutting are defined by maximum tree size, stand density, and stand structure—diameter distribution, proportion of sawtimber, and so on.

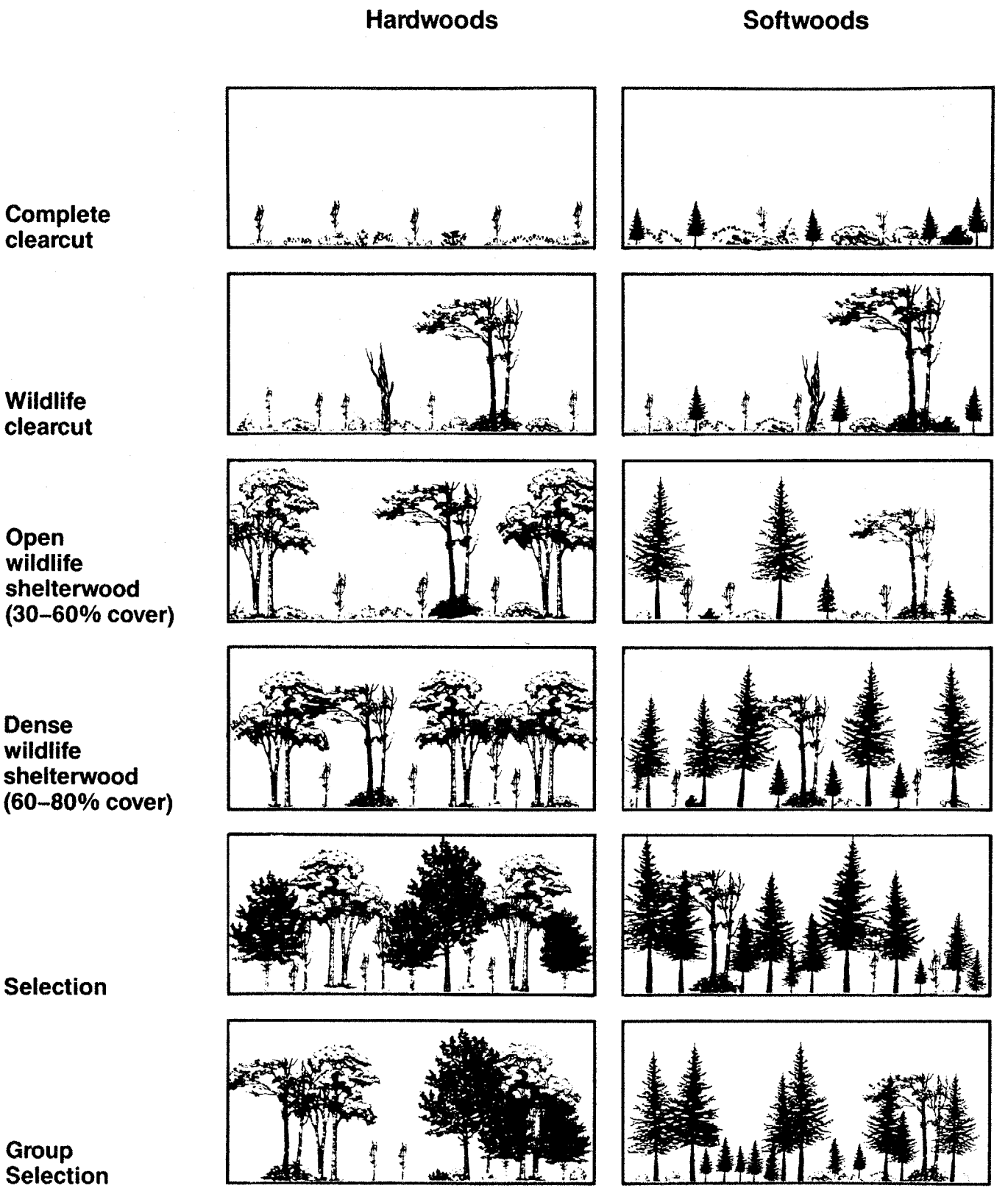


Figure 11. – Comparison of wildlife habitat conditions under several regeneration cutting practices.

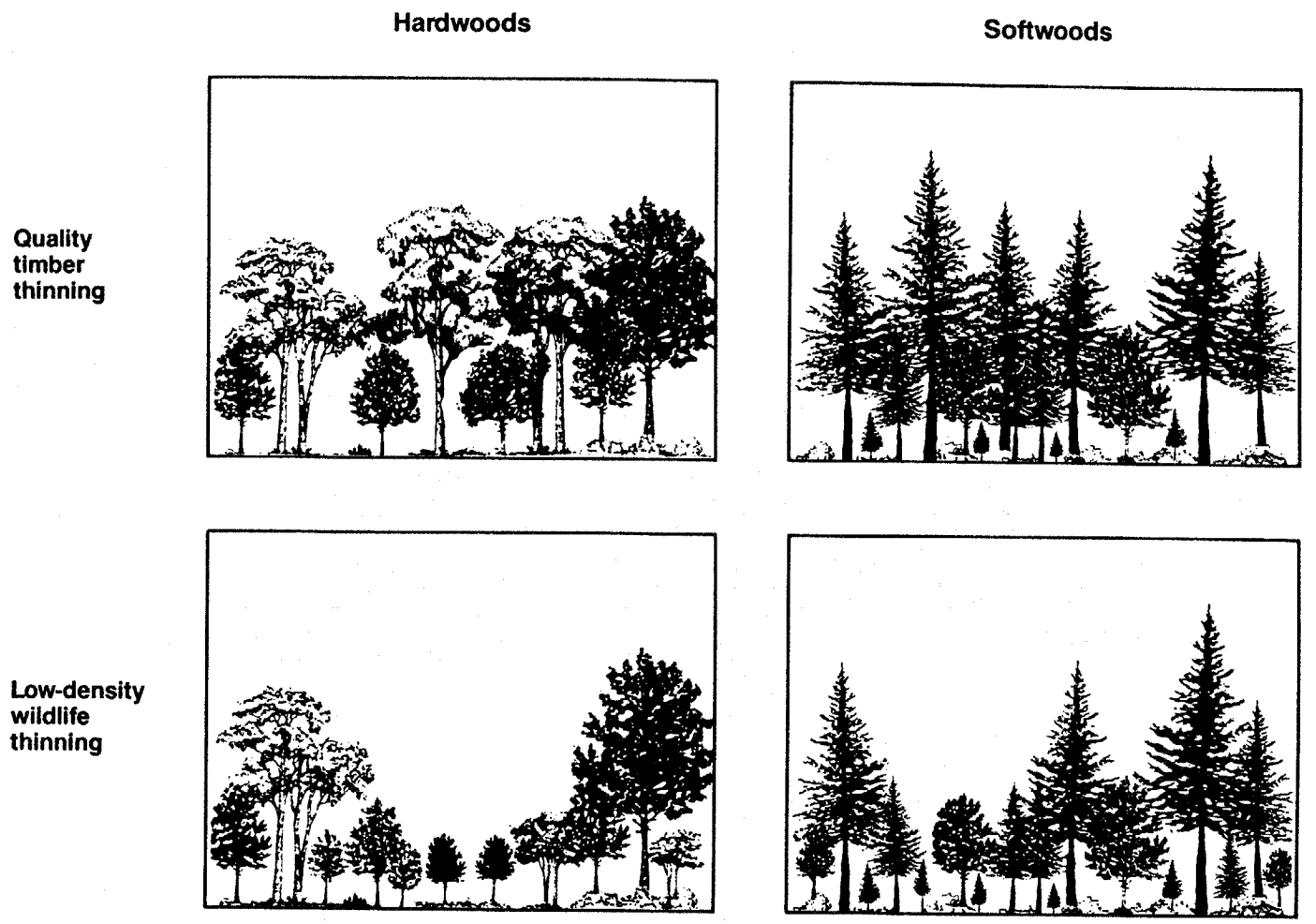


Figure 12. – General comparison of wildlife habitat conditions following quality timber thinning and low-density thinning with reserved wildlife trees.

Timber and wildlife silvicultural options are described below for six type groups: aspen-birch, northern hardwoods, swamp hardwoods, spruce-fir, hemlock, and oak-pine. These type groups are composites of 11 distinct community types described in DeGraaf and Rudis (1986). For each type group, we describe: (1) the component types and subtypes, including site relationships (Table 7); (2) treatment options including natural succession, intermediate thinnings (even-age management) directed toward timber or wildlife objectives; and regeneration cuttings; and (3) type conversion possibilities. Overall, we describe the effects of treatment options on the stand structural features that determine wildlife habitat values.

The responses of vegetation to treatments vary considerably across the New England region due to differences in past land use history, climate, geology, and so on. Therefore, it is difficult to predict vegetative responses exactly, especially for certain structural features such as the herbaceous/shrub layer. Uncertainty about vegetative responses may be resolved by on-site examination using the inventory procedures described earlier.

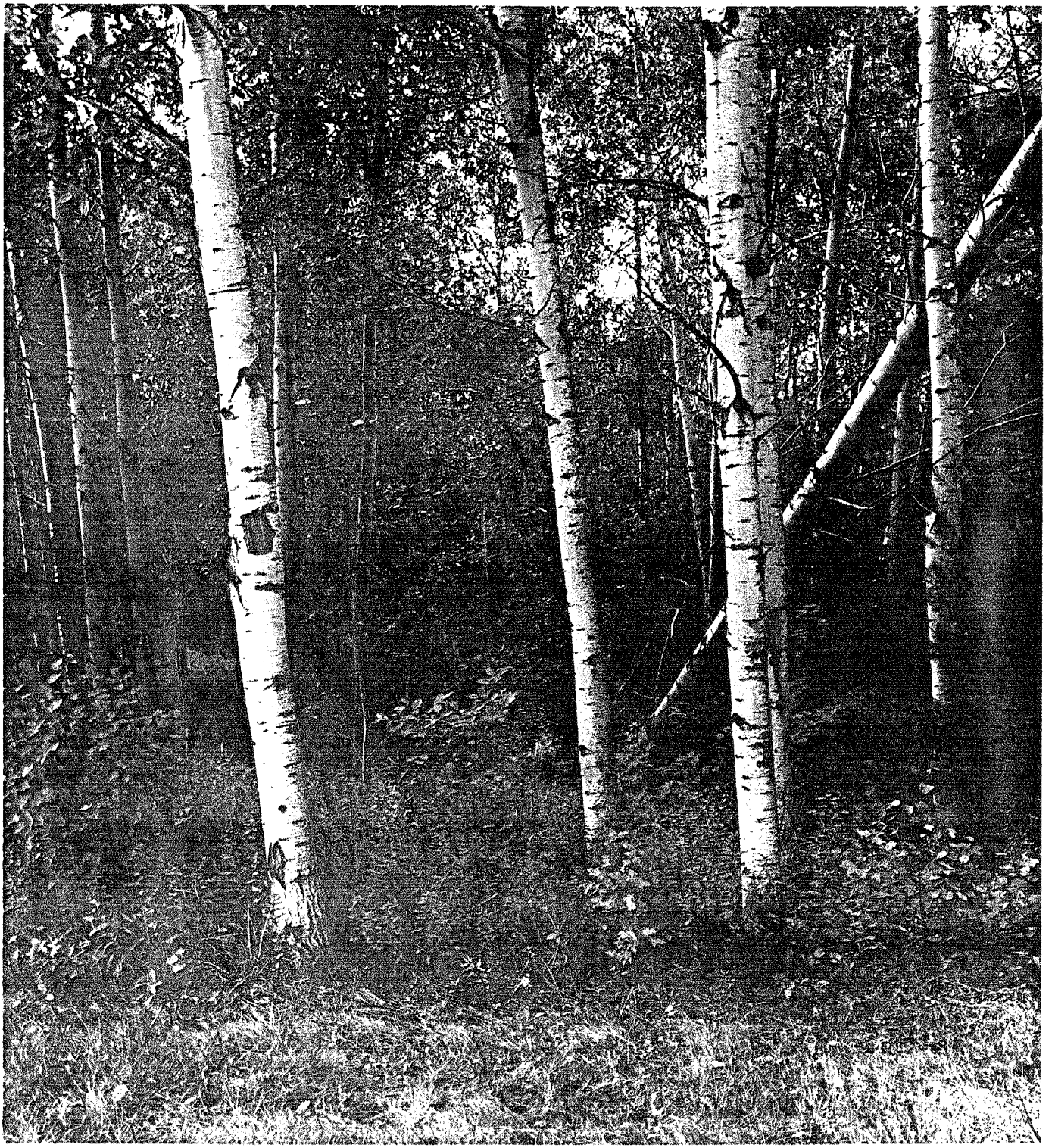
Table 7. – Occurrence of cover types and ranges of environmental sites in New England

Cover type	Imperfectly drained		Mesic	Dry-mesic	Excessively drained	
	Soggy wet	Moist			Dry	Dry-ledge
Aspen-birch						
Aspen	X	X	X	X	X	X
Paper birch	X	X	X	X	X	X
Northern hardwoods						
Northern hardwoods			X	X		
Northern hardwoods-conifer	X	X		X		
Swamp hardwoods						
Swamp hardwoods	X					
Spruce-fir						
Balsam fir	X	X			X	
Red spruce	X [a]	X		X [b]	X	X
Spruce-fir	X	X			X	X
Hemlock						
Eastern Hemlock	X		X		X	X
Oak-pine						
Northern red oak			X [c]	X		X
Oak-pine				X	X	
White pine			X [d]	X	X	

[a] Primarily black spruce.
[b] Occurs in northern New England.
[c] Occurs in southern New England.
[d] Occurs in old fields.

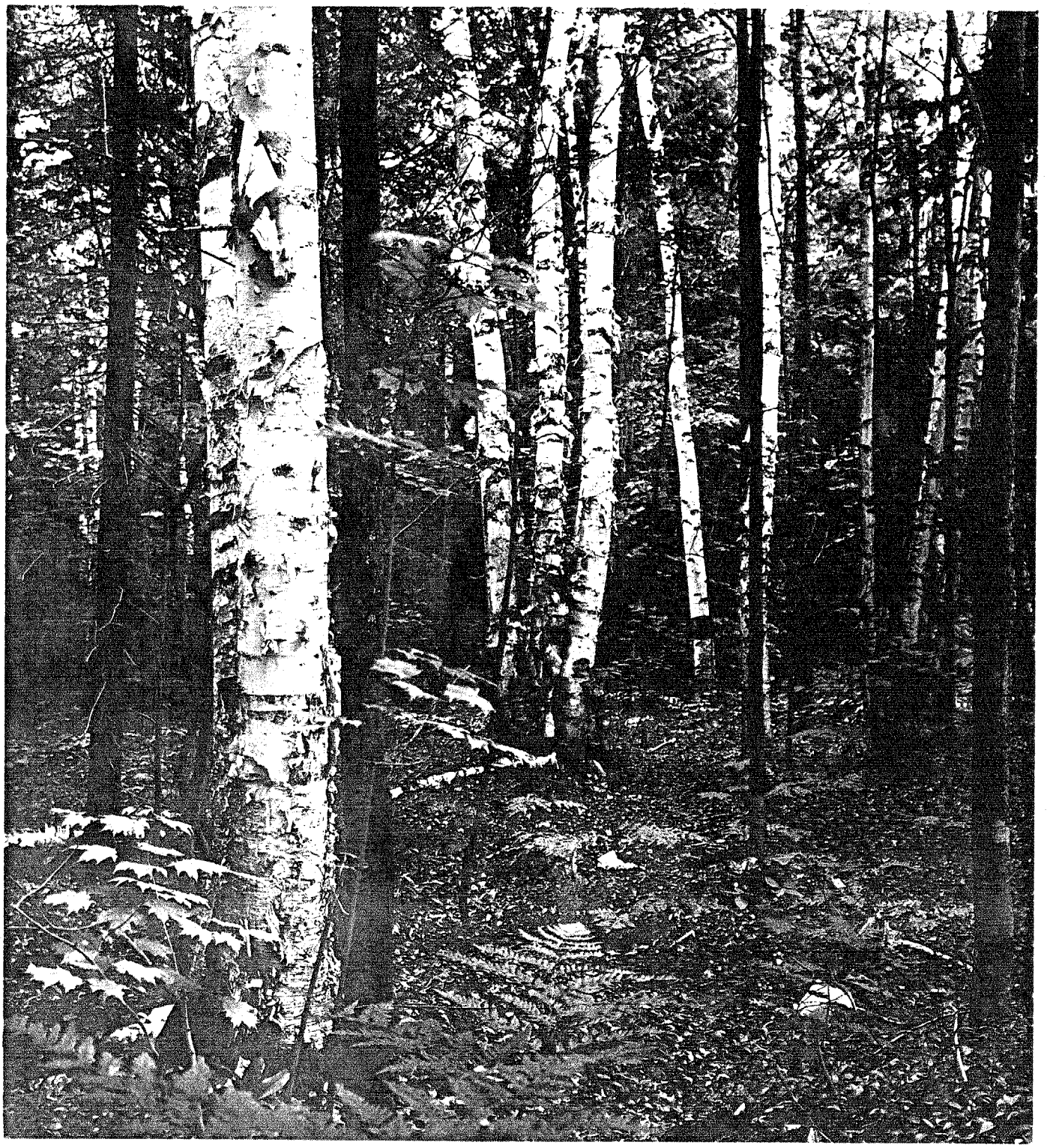
Forest cover types—aspen-birch, northern hardwoods, swamp hardwoods, spruce-fir, eastern hemlock, and oak-pine.

ASPEN



Twin Mountain, New Hampshire
August 1985

PAPER BIRCH



Gorham, New Hampshire
August 1985

Aspen-Birch

The aspen-birch type is an early successional type found throughout New England. As such, frequent disturbance is required to maintain its presence or it is rapidly replaced by late successional or climax types that contain very little birch or aspen.

Quaking aspen *(Populus tremuloides)* is the typical aspen species, though bigtooth aspen *(P. grandidentata)* becomes fairly common especially on good hardwood sites, and balsam poplar *(P. balsamifera)* becomes an associate in northern New England. The typical birch species is paper birch *(Betula papyrifera)*. Toward northern New England and at high elevations, mountain paper birch *(var. cordifolia)*—a longer lived species (approximately 200 years) than typical paper birch—is common. From mid-New England south, grey birch *(B. populifolia)* becomes more common. Common early to mid-successional associates of aspen-birch include pin cherry *(Prunus pensylvanica)*, yellow *(B. alleghaniensis)* and black *(B. lenta)* birches, and red maple *(Acer rubrum)*.

Both aspen and birch occur on a very wide range of sites. The proportion of aspen to birch varies widely depending mostly on stand history, origin, and treatment rather than site; nearly pure stands of each species sometimes occur, especially in small stands. The type occurs on three broad types of sites, reflecting soil and drainage conditions: (1) dry site, (2) wet site, and (3) mesic aspen-birch.

Dry-site Aspen-Birch. These stands occur on sands, gravel, sandy tills, and shallow-to-bedrock soils. Aspen-birch tends to be common on these soils, probably because of a past fire history rather than any competitive ability on dry sites.

On sands, gravel, and shallow bedrock, the climax type is spruce *(Picea rubens)*, fir *(Abies balsamea)*, or hemlock *(Tsuga canadensis)* in the north, oak-pine *(Quercus-Pinus)* or hemlock in the south. On sandy tills, beech *(Fagus grandifolia)* with some softwood component may be climax with red maple *(Acer rubrum)* as a common associate.

Quaking aspen grows to only moderate size on dry sites—8 to 12 inches in 40 to 50 years before cankers, rot, and mortality denote overmaturity.

When the stands are opened up through decadence, cutting, or windthrow, dry-site shrubs and herbs are quite abundant. Blueberry *(Vaccinium* spp.), beaked hazel *(Corylus cornuta)*, wintergreen *(Gaultheria* spp.), wild lily-of-the-valley *(Maianthemum canadense)*, dry-site clubmosses *(Lycopodium* spp.), and starflower *(Trientalis borealis)* are typical.

Wet-site Aspen-Birch. These sites have shallow pans or layers of fine-textured sediments so that drainage is moderate to somewhat poor. However, aspen-birch as a distinct type is not generally found in poorly drained swamps such as those occupied by red maple swamps or wetland shrub swamps.

The climax type on wet sites usually is softwoods, spruce-fir in the far north, and hemlock farther south. The tendency toward the climax is strong, and a softwood understory usually is present under the aspen-birch overstory. Quaking aspen grows to fairly large size on these wet sites in mid to southern New England—up to 14 to 16 inches d.b.h. in 50 years. Maximum sizes of 10 to 14 inches d.b.h. are more common in northern New England.

Wet-site shrubs and herbs include highbush blueberry *(Vaccinium corymbosum)*, mountain-holly *(Nemopanthus mucronata)*, common winterberry *(Ilex verticillata)*, *Rubus* spp., alders *(Alnus* spp.), several viburnums *(Viburnum* spp.), wood sorrel *(Oxalis* spp.), and goldthread *(Coptis groenlandica)*.

In central and southern New England, wet site shrubs and herbs tend to be more common and higher density than on dry sites. In northern New England, differences between dry and wet sites are not as distinct.

Mesic Aspen-Birch. These sites have fine-textured soils, sometimes with fairly deep pans, that normally support northern hardwood stands. The climax type is either sugar maple, beech, or a combination of the two; softwoods are not common. Aspen is not abundant on these sites, but it can be regenerated by appropriate procedures.

Quaking aspen easily attains 14 to 16 inches d.b.h. on these soils, and bigtooth aspen may grow to 20 to 24 inches d.b.h. However, some experience indicates that aspen mortality is high after 50 to 60 years on good hardwood sites. Paper birch attains comparable diameters to trembling aspen, but occasionally reaches 18 to 20 inches d.b.h.

Herbs and shrubs are not abundant. Herbs include woodfern (*Dryopteris* spp.), shining clubmoss (*Lycopodium lucidulum*), violets (*Viola* spp.), and partridgeberry (*Mitchella repens*). Hobblebush (*Viburnum alnifolium*) is found but not in great numbers. Understories under cutover or decadent aspen-birch are mostly deciduous.

Note: See the *Manager's handbook for aspen in the north-central states* (Perala 1977) and the *Silvicultural guide for paper birch in the Northeast* (Safford 1983) for further information on the management of aspen and birch.

Succession. Aspen-birch stands develop rapidly. The herb/shrub stage lasts only a year or two (Fig. 13). The seedling-sapling stage is characterized by high stem densities; at 1-inch average stand diameter (trees at least 0.6 inches d.b.h.), numbers of stems may be 4,000 to 6,000 per acre. These high stem densities provide ideal protection for ruffed grouse, especially drumming males, against avian predators. As succession proceeds, aspen-birch stands are characterized by (1) closed canopies up through the poletimber (approximately 25 to 45 years old) and small sawtimber (approximately 45 to 70 years old) stages; (2) increasing proportions of the fast-growing aspen over birch; and (3) small dead tree boles during the pole and sawtimber stages. Aspen generally is dead by age 75 and birch by age 100 in New England. Male aspen flower buds and catkins of mature birch and aspen are important foods for ruffed grouse.

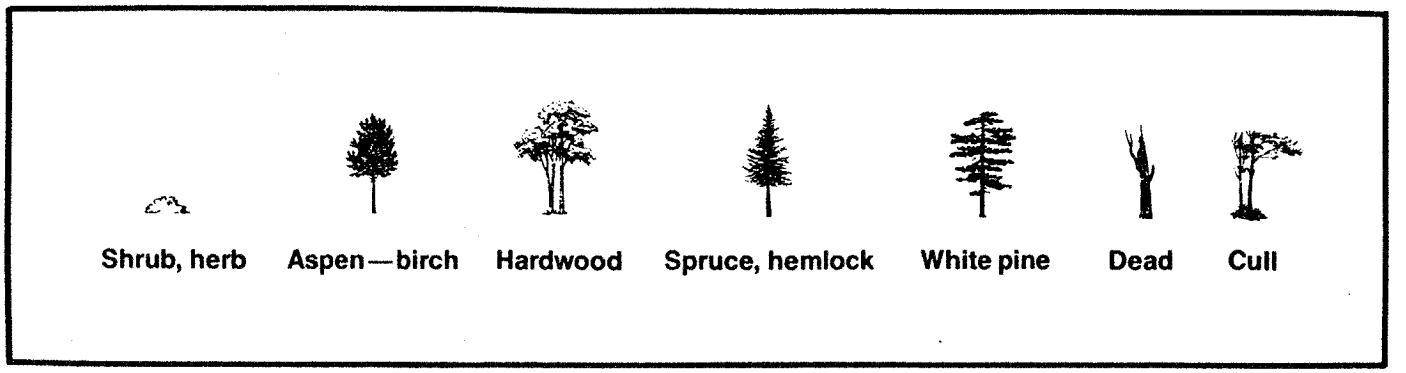
On mesic sites, a tolerant northern hardwood understory begins to develop early, and can dominate the stand in 40 to 50 years. On wet or dry aspen sites, a tolerant softwood understory develops and gradually predominates. In southern New England, mixed oak-pine may develop on certain dry sites.

Total numbers of wildlife species (amphibians, reptiles, birds, and mammals) in aspen-birch are highest in the early regeneration stage. Numbers of species using the shrub layer and herb/ground layer decline as stand development proceeds. However, numbers using tree boles increase (Fig. 13).

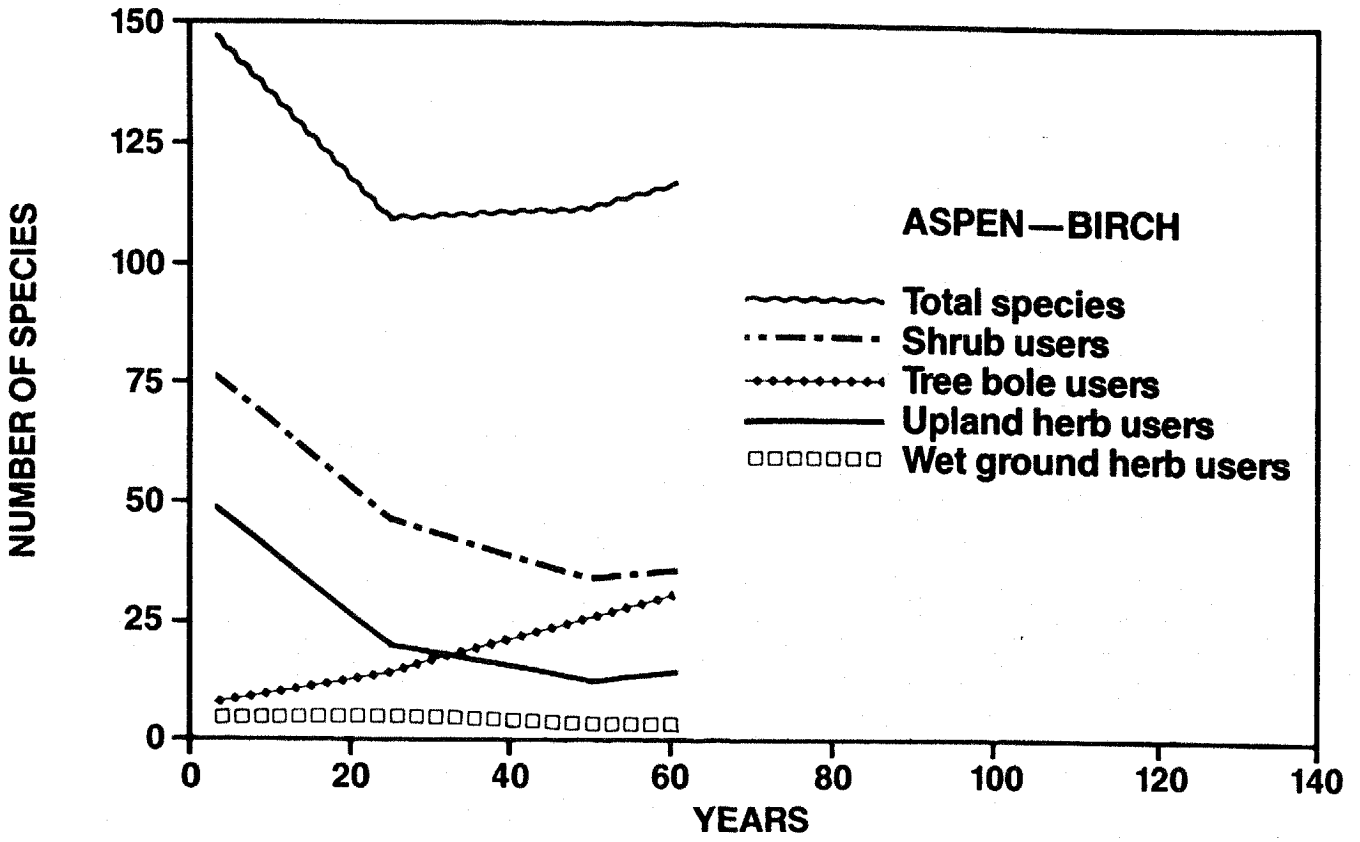
Numbers of species in Figure 13 include the total range of site and stand conditions that characterize each habitat component. For example, species using the shrub layer include all those that are found using deciduous, coniferous, ericaceous, and wetland shrubs. The wet and dry sites would tend to support a coniferous shrub layer used by Swainson's thrush, Wilson's warbler, Lincoln's sparrow, dark-eyed junco, pine grosbeak, snowshoe hare, and bobcat; and coniferous overstory inclusions used by northern goshawk, red-breasted nuthatch, hermit thrush, Nashville warbler, red squirrel, porcupine, and white-tailed deer. Mesic aspen-birch supports species that frequently produce a deciduous shrub layer that is used by black-billed cuckoo, yellow-billed cuckoo, gray catbird, and rufous-sided towhee, and midstory layers used by wood thrush, and white-eyed and Philadelphia vireos, and American redstart. The climax types will differ by site: northern hardwoods on mesic sites, and either spruce-fir or hemlock on wet and dry sites.

As in all forest types, birds comprise the majority of species with mammals second (Table 8). Numbers tend to be a little higher in aspen than in birch stands. A stand with 30 percent or more aspen probably qualifies as an aspen stand.

Intermediate Treatments. Thinning aspen (Table 9) is not a common silvicultural treatment in New



Key for figures 13 to 18.



Mean d.b.h. (in)	2–4	4–6	6–10	10–12
Basal area (ft^2)	60–80	90–120	100–140	100–140
No. stems per acre	2000–3000	700–1300	300–600	150–200
Maximum height (ft)	20–40	45–65	55–85	60–90
Maximum d.b.h. (in)	6–8	8–12	12–16	16–18



Figure 13. – Aspen/birch stand development and wildlife species occurrence.

Table 8. – Characteristic structural habitat features and potential number of species associated with natural succession in aspen-birch group

Size class	Site type	Structural habitat feature	Cover type	Taxonomic class				
				Amphibians	Reptiles	Birds	Mammals	Total
Regeneration	All	Shrub layer	Aspen	0	0	51	22	73
			Birch	0	0	43	20	63
		Herbaceous ground vegetation	Aspen	0	2	33	11	46
			Birch	0	2	30	9	41
Sapling-pole	All	Closed canopy	Aspen	0	0	7	3	10
			Birch	0	0	12	7	19
		Small dead trees	Aspen	0	0	5	1	6
			Birch	0	0	6	1	7
Sawtimber	All	Closed canopies	Aspen	0	0	15	8	23
			Birch	0	0	15	6	21
		Midstory	Aspen	0	0	9	0	9
			Birch	0	0	10	0	10
	Wet	Softwood inclusions	Aspen	0	0	15	4	19
			Birch	0	0	17	3	20
		Herbaceous ground vegetation	Aspen	0	2	4	6	12
			Birch	0	2	3	5	10
	Dry	Small dead trees	Aspen	0	0	7	3	10
			Birch	0	0	9	2	11
Large sawtimber	All	Partial canopy	Aspen	0	0	7	4	11
			Birch	0	0	7	3	10
		Midstory	Aspen	0	0	8	0	8
			Birch	0	0	9	0	9
		Small/medium dead trees	Aspen	0	0	13	4	17
			Birch	0	0	13	3	16
	Wet and dry	Softwood inclusions	Aspen	0	0	15	4	19
			Birch	0	0	16	3	19
		Herbaceous ground vegetation	Aspen	0	2	7	6	15
			Birch	0	2	6	5	13
All size classes	All	Duff and ground surfaces	Aspen	3	4	11	20	38
			Birch	2	4	10	19	35
	All	Subterranean	Aspen	1	7	0	23	31
			Birch	2	8	0	20	30

Table 9. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in the aspen-birch group

Stand treatment	Size class	Structural habitat feature affected	Cover type	Taxonomic class				
				Amphibians	Reptiles	Birds	Mammals	Total
Crop-tree thinning	Sapling-pole	Closed canopy	Aspen	0	0	7	3	10
			Birch	0	0	12	7	19
		Herbaceous ground vegetation	Aspen	0	2	11	7	20
			Birch	0	1	8	7	16
	Sawtimber	Closed canopy	Aspen	0	0	15	8	23
			Birch	0	0	15	6	21
		Softwood inclusions	Aspen	0	0	15	4	19
			Birch	0	0	17	3	20
		Herbaceous ground vegetation	Aspen	0	2	4	6	12
			Birch	0	2	3	5	10
Clear-cutting	Regeneration	High and exposed perches	Aspen	0	0	13	0	13
			Birch	0	0	11	0	11
		Shrub layer	Aspen	0	0	51	22	73
			Birch	0	0	43	20	63
		Herbaceous ground vegetation	Aspen	0	2	33	11	46
			Birch	0	2	30	9	41
		Slash	Aspen	0	5	4	16	25
			Birch	0	3	2	14	19
		Overstory inclusions	Aspen	0	0	28	6	34
			Birch	0	0	25	5	30

England. However, noncommercial thinning of saplings or small pole-sized aspen-birch to favor the best birch crop tees is a possible option. This type of thinning generally will be quite light, still maintaining a closed canopy; and reduces the aspen regeneration possibilities. The successional trends outlined in the previous section will be slightly hastened by this sort of treatment. It is likely that the herb/shrub layers will be slightly more dense for a short period, especially on the wet areas where thick herbaceous ground cover sometimes develops. However, the herbaceous cover may be suppressed by the developing hardwood or softwood understory (midstory). Ruffed grouse habitat can be affected adversely by this type of treatment. Because the treatment is light, there is little danger of a serious loss in dead or living wildlife trees that sometimes occurs with usual timber thinning practices (Fig. 12). The overall result is that numbers of wildlife species will be similar to those listed under natural succession (Table 8).

Regeneration and Type Conversion. The only regeneration option for aspen-birch is clearcutting of poletimber or small sawtimber stands at rotations of 50 to 60 years or earlier if rapid increases in the aspen component are desired (Fig. 13). Longer rotation will result in loss of aspen rootstocks, less vigorous aspen suckering, and the development of a denser understory of competing late successional species. Clearcutting during the dormant season apparently produces more vigorous suckering, though the effects are not always obvious. Scarification after or during logging will encourage seedling reproduction of aspen as well as birch. Prescribed burning can encourage aspen seedling regeneration also. Even light shade from overstories of 15 square feet basal area/acre will discourage aspen suckering. So, reserved wildlife trees should consist of only an occasional (1) high exposed perch tree—preferably of a long-lived species with potential for cavity development, or (2) low exposed perch tree/shrubs when spaced throughout the

regeneration area. During the cutting, it should be advantageous on dry and wet sites to reserve occasional groups of softwood saplings and poles to serve as future inclusions in the aspen-birch canopy.

The species present following clearcutting with reserved wildlife trees are about the same as those that occupy the regeneration stage under natural succession (Fig. 13). Retention of these wildlife trees —high and low exposed perches, cavity trees, and coniferous overstory inclusions—provides habitat features for more than 30 potential wildlife species over time. For example, red-tailed hawk, Cooper's hawk, turkey vulture, olive-sided flycatcher, common raven, and chipping sparrow require exposed perches; flicker, saw-whet owl, bluebird, tree swallow, house wren, and black bear use cavities; Swainson's thrush and purple finch are associated with coniferous overstory inclusions.

Northern Hardwoods

The northern hardwood type is the basic hardwood type in northern New England and occurs at elevations up to 2,500 feet. Details of the three subtypes—sugar maple/white ash, beech/birch/maple (typical northern hardwoods), and beech/red maple—follow. These subtypes tend to occupy distinct sites with different soil and vegetative features, though mixed subtypes do occur. Collectively, the subtypes are characterized by the presence of maple (sugar or red), the presence of beech (abundant or occasional), and a low proportion of softwoods (<20%). All are late-successional subtypes, approaching the climax, and are persistent under light to moderate disturbance or heavy disturbance (clearcutting) at long intervals (rotations) of 100 years or more.

These subtypes generally occur on well-drained to moderately well-drained upland soils between 500 and 2,500 feet elevations (Leak and Graber 1974). Stands representing a given subtype vary from small to moderate in size from a few to 100 acres or so. The subtypes occur throughout New England, though regional shifts in the abundance of certain species occur. For example, black birch (instead of yellow birch) and red oak *(Quercus rubra)* (with less beech) become more common south of southern New Hampshire, while the softwood component contains more hemlock and white pine *(Pinus strobus)*, and less red spruce.

Sugar Maple/Ash. This subtype occurs on the best soils in New England on well-drained, fine-textured tills derived from limestone and certain metamorphics, as well as moderately drained areas enriched by moving water and organic materials.

Although beech may be present, we will restrict our definition of this subtype to stands where sugar maple *(Acer saccharum)* is far more abundant and aggressive. Yellow birch and white ash *(Fraxinus americana)* are common associates of intermediate tolerance. The sites supporting this subtype have the capacity to grow large trees. In overmature stands, sugar maple, yellow birch, and ash commonly attain diameters of 30 to 40 inches. Trees larger than 22 to 24 inches d.b.h. commonly have seams and cavities (Leak 1985[1]).

The shrub layer (2 to 10 feet tall), including true shrubs, small-tree and large-tree species, is primarily deciduous, though occasional enriched sites contain colonies of Canada yew *(Taxus canadensis)*. The midstory canopy (10 to 30 feet tall) is almost completely deciduous. In a mature undisturbed stand, numbers of stems per acre in the shrub layer range around 2,000; and 300 stems per acre in the midstory layers (Bormann et al. 1970; Leak 1959[2]), a fairly sparse understory.

A hundred or more plant species can be found in the herbaceous layer (<2 feet) including herbs, shrubs, and tree seedlings. In mature stands of hardwood, ground cover occupies about 40 percent of the forest floor, but may attain higher percentages under sugar maple/ash because of the richer soils (Siccama et al. 1970).

Beech/Birch/Maple. The typical northern hardwood subtype occurs on well-drained sandy loams (occasionally moderately well drained) in New England. Beech commonly is as abundant or more abundant than sugar maple, especially in the understory. Yellow birch is a common intermediate, while in successional stands, paper birch is more common here than in the sugar maple/ash subtype. Ash is not abundant. Sugar maple and yellow birch in overmature stands reach 30 to 36 inches d.b.h., but defect is common

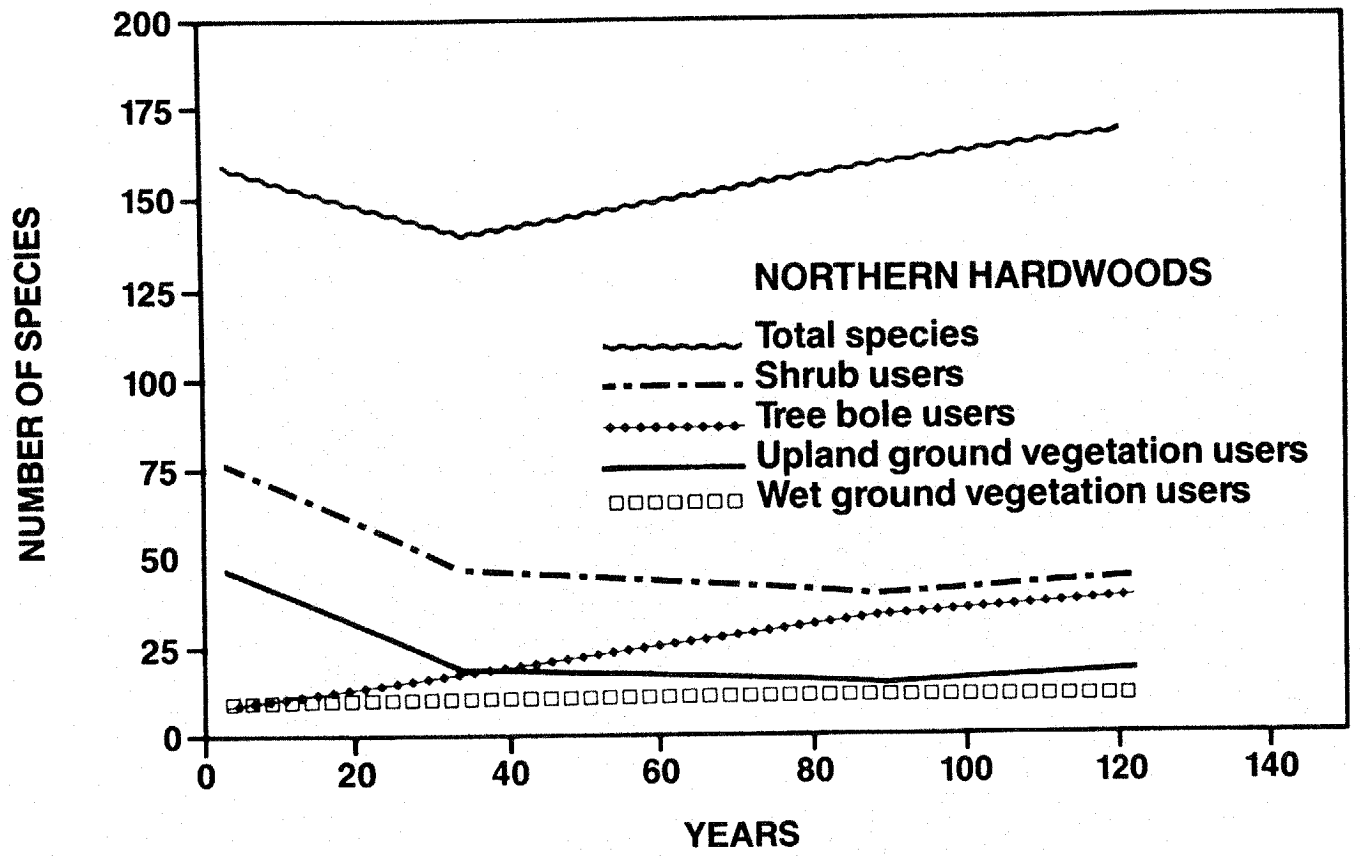
[1] Leak, W.B. 1985. Final report: effects of habitat on stand structure in old-growth hardwoods and mixedwoods. Durham, NH: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 8 p.

[2] Leak, W.B. 1959. Progress report: regeneration following cutting of old-growth northern hardwoods on the management intensity plot, Bartlett Experimental Forest. Durham, NH: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 22 p.

NORTHERN HARDWOODS



Berlin, New Hampshire
July 1984



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 14. – Northern hardwoods stand development and wildlife species occurrence.

in trees larger than 20 inches d.b.h. Because of the abundance of beech, dead and defective trees are more common—at an earlier age—in northern hardwood stands than in sugar maple/ash. In New England, the majority of beech have cavities and holes at 16 to 18 inches d.b.h. and few live trees are found larger than 22 inches d.b.h. (Leak 1985[1]).

The shrub and midstory layers are primarily deciduous, and are similar in general character to those under sugar maple/ash. However, in undisturbed mature stands, the shrub and midstory layers are less dense than in many other forest types—for example, less than 200 stems per acre in the midstory layer. Herbaceous layers in mature stands typically reach about 40 percent ground coverage, with lower plant diversity than under sugar maple/ash. Beech/birch/maple stands on acidic soils, such as those derived from granite, have sparse ground covers—probably less than 30 percent coverage in mature stands (Siccama et al. 1970).

Beech/Red Maple. In the beech/red maple subtype, beech is a predominant component and probably the climax species; red maple is more abundant and aggressive than sugar maple. Northern red oak is an associate from mid-New Hampshire south; the subtype often contains softwood components (spruce, hemlock, or white pine—up to 10 to 15 percent of the basal area). The soils generally are sandy, somewhat washed tills. In old stands, maximum tree sizes seldom exceed 20 to 22 inches d.b.h., and cavities are common in trees over 14 to 16 inches d.b.h. (Leak 1985[1]).

The shrub and midstory layers frequently contain some admixture of softwoods, though hardwoods are predominant. Midstory layers are more dense than those under typical northern hardwoods, containing twice the number of stems. This is probably due to the tendency of beech to form dense understory thickets. Herbaceous layers are sparse under undisturbed stands, less than 30 percent ground cover.

Note: See the *Silvicultural guide for northern hardwood types in the Northeast* (Leak et al. 1987) for further information on the management of these types.

Succession. Succession in the northern hardwood type group consists of a short (2 to 4 years) herbaceous/shrub stage followed by a predominance of hardwood species in the seedling/sapling (to 10 years), pole (10 to 59 years), and sawtimber stages (Fig. 14). Seedling-sapling stands in this type are less dense than in aspen-birch, and contain about 3,000 to 3,500 stems per acre at 1-inch mean stand diameter (stems >0.6 inches d.b.h.). During succession, canopies are closed; a range of d.b.h. classes is represented; and the herbaceous/shrub layer is sparse. One basic distinction is that beech-red maple stands (and beech-birch-maple with a high proportion of beech) develop an abundance of cavity trees earlier in the life of the stand. This subtype also develops small inclusions of softwoods. In old stands (>150 years), the few cavity trees in stands where sugar maple is abundant will be much larger (≤30 inches d.b.h.) than in beech-red maple (≤20 to 22 inches d.b.h.).

Numbers of species (Fig. 14) are high in regenerating stands and then drop off in pole stands, because of the rapid growth and decline of an herbaceous/shrub layer (used by species such as alder and willow flycatchers, brown thrasher, cedar waxwing, yellow warbler, chestnut-sided warbler, common yellowthroat, song sparrow, and American goldfinch). Eastern bluebirds have an extremely short tenure, being present only 1 or 2 years after clearcutting when stubs or snags with old woodpecker holes are retained. Numbers of species then increase to the maximum in mature, overmature and all-aged stands. The main reason for this increase with age is the increasing number of tree bole users (Fig. 14 and Table 10). Beech-red maple stands tend to have the highest number of tree bole users, though large boles for certain species such as the pileated woodpecker, porcupine, black bear, raccoon, fisher, and ermine are especially likely in overmature sugar maple stands. Beech-red maple also contains small overstory inclusions of coniferous species, which are utilized by 40 to 60 species including northern goshawk, great horned owl, red-breasted nuthatch, hermit thrush, Nashville warbler, northern parula, black-throated green warbler, blackburnian warbler, pine siskin, red squirrel, porcupine, and white-tailed deer (Table 10).

Intermediate Treatments. Commercial thinning in poletimber and sawtimber is a common option due to the wide range of markets for small trees in some areas (fuel, pulp, and bolts). As illustrated in Figure 12, the usual quality timber thinning in northern hardwoods tends to: (1) maintain an essentially closed canopy (>60 to 70%), which reduces the habitat opportunity for open canopy-using species; (2) cause a moderate development of a woody understory; and (3) most important reduce living/dead wildlife trees (as in cavity trees and coniferous overstory inclusions). However,

Table 10. – Characteristic structural habitat features and potential number of species associated with natural succession in northern hardwoods

Size class	Sub-type[a]	Structural habitat feature	Taxonomic class				
			Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Regenera-tion	All	Shrub layer	0	0	54	21	75
		Herbaceous ground vegetation	0	2	33	10	45
		Soft mast present	0	0	11	15	26
Sapling-pole	All	Closed canopy	0	0	14	8	22
	Be/RM	Small dead trees	0	0	10	1	11
Sawtimber	All	Closed canopy	0	0	21	10	31
	Be/YB/SM & Be/RM	Small/medium dead trees	0	0	15	4	19
		Beech mast	0	0	9	17	26
	Be/RM	Softwood inclusions	0	0	22	5	27
Large sawtimber	All	Closed canopy	0	0	25	10	35
		Large tree boles	0	0	15	16	31
		Midstory	0	0	15	0	15
		Dead and down material	9	4	3	16	32
	Be/YB/SM	Beech mast	0	0	9	17	26
	Be/RM	Softwood inclusions	0	0	24	5	29
All size classes	All sites	Duff and ground surfaces	13	5	13	22	53
		Subterranean	7	9	0	22	38

[a] Be/YB/SM = Beech - Yellow Birch - Sugar Maple; Be/RM = Beech-Red Maple

timber production is virtually unaffected by leaving 5 to 10 percent of the trees with wildlife cavity/perch tree and coniferous overstory inclusion potential. A low-density wildlife thinning (30 to 50% crown coverage) results in: (1) maintenance of a partial canopy, which tends to reduce the habitat opportunity for closed canopy-using species; (2) inclusion of some cavity trees and coniferous overstory inclusions; and (3) development of a dense woody understory. Low-density thinning, especially if begun too early, results in shorter merchantable tree lengths and lower long-term timber production, though diameter growth of individual trees is rapid.

The number of species affected by thinning treatments in a beech-red maple poletimber stand varies considerably (Table 11). Quality timber thinning without reserved wildlife trees effectively removes the coniferous overstory inclusions, and medium- and large-diameter cavity tree structural habitat features, and reduces the open overstory canopy conditions over time. Open overstory canopy users affected include Cooper's hawk, northern shrike, and northern oriole. Quality timber thinning with reserved wildlife trees affects only those species using the open overstory canopy as coniferous overstory inclusions and medium- and large-diameter cavity tree components are part of the stand prescription and management objectives. Low-density thinning with reserved wildlife trees develops a strong deciduous woody understory and maintains more open overstory canopy conditions over time. Closed overstory

Table 11. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in northern hardwoods

Stand treatment	Size class	Sub-type[a]	Structural habitat feature affected	Taxonomic class				
				Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Timber thinning	Sapling-pole	All	Closed canopy	0	0	14	8	22
	Sawtimber	All	Closed canopy	0	0	21	10	31
			Midstory	0	0	14	0	14
		Be/YB/SM & Be/RM	Beech mast	0	0	9	17	26
		Be/RM	Softwood inclusions	0	0	22	5	27
Thinning with wildlife trees	Sapling-pole	All	Closed canopy	0	0	14	8	22
		Be/RM	Small/medium dead trees	0	0	11	1	12
	Sawtimber	All	Closed canopy	0	0	21	10	31
			Midstory	0	0	14	0	14
		Be/YB/SM & Be/RM	Small/medium dead trees	0	0	15	4	19
			Beech mast	0	0	9	17	26
		Be/RM	Softwood inclusions	0	0	22	5	27
Low-density thinning	Sapling-pole	All	Partial canopy	0	0	7	3	10
			Shrub layer	0	0	29	17	46
		Be/RM	Small dead trees	0	0	10	1	11
	Sawtimber	All	Partial canopy	0	0	11	4	15
			Midstory	0	0	14	0	14
		Be/YB/SM &Be/RM	Small/medium dead trees	0	0	15	4	19
		Be/RM	Beech mast	0	0	9	17	26
			Softwood inclusions	0	0	22	5	27

Continued

Table 11.—Continued

Stand treatment	Size class	Sub-type[a]	Structural habitat feature affected	Taxonomic class: Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Clear-cutting with reserved wildlife trees	Regeneration	All	High and exposed perches	0	0	14	0	14
			Shrub layer	0	0	54	21	75
			Herbaceous ground vegetation	0	2	33	10	45
			Soft mast	0	0	11	15	26
			Slash/dead and down material	4	5	5	15	29
		Be/YB/SM & Be/RM	Small/medium dead trees	0	0	5	1	6
Shelter-wood	Sawtimber	All	Partial canopy	0	0	11	4	15
			Shrub layer	0	0	24	16	40
			Slash/dead and down material	10	6	4	16	36
		Be/YB/SM & Be/RM	Small/medium dead trees	0	0	15	4	19
		Be/RM	Beech mast	0	0	9	17	26
Selection	Sawtimber	All	Closed canopy	0	0	21	10	31
			Midstory	0	0	13	0	13
			Shrub layer (group selection only)	0	0	24	16	40
		Be/YB/SM & Be/RM	Small/medium dead trees	0	0	15	4	19
			Beech mast	0	0	9	17	26
			Softwood inclusions	0	0	22	5	27

[a] Be/YB/SM = Beech-Yellow Birch-Sugar Maple; Be/RM = Beech-Red Maple

canopy users affected include sharp-shinned hawk, northern goshawk, barred owl, scarlet tanager, red bat, and hoary bat. Deciduous midstory conditions would be present over time for species such as veery, Philadelphia vireo, and American redstart.

Regeneration. Northern hardwood stands (all subtypes) can be reproduced by clearcutting of mature hardwood stands, shelterwood cuts, and by single-tree or group-selection cuts (Fig. 11). Heavier cutting produces more intolerant to intermediate species, but the basic subtype remains the same. Rapid changes in bird species occur during the first few years after clearcutting (Table 12). Clearcuts (with and without reserved wildlife trees) produce a temporary herbaceous/shrub layer followed by distinct seedling/sapling age class (Table 11). The species present following clearcutting with reserved wildlife trees are similar to those that occupy the regeneration stage under natural succession (Fig.

Table 12.—Year in which breeding bird species first appear, become common, and decline in seedling and sapling stands of northern hardwoods in New England after clearcutting

Bird species	First appear	Become common	Decline
Eastern bluebird	1	1	2
Northern flicker	1	1	7-10
Willow flycatcher	1	4	7-10
Winter wren	1		2
Swainson's thrush	2	4	15*
Chestnut-sided warbler	2	4	10
Mourning warbler	2	5	7-10
Common yellowthroat	2	6	10
American goldfinch	2	6	7-10
Cedar waxwing	2	4	7-10
Veery	3	6	*
Black-and-white warbler	3	4	15*
Rose-breasted grosbeak	3	15	*
Canada warbler	5	15	*
Ruffed grouse	10	15	*
Wood thrush	10	15	*
Ovenbird	10	15	*
Black-throated blue warbler	15	*	*
Black-throated green warbler	15	*	*

*Present throughout the remainder of the developing stand.

14 and Table 10). The elimination of these wildlife trees (high and exposed perches, cavity trees, and coniferous overstory inclusions) affects the necessary habitat features for 40 wildlife species including red-tailed hawk, house wren, eastern bluebird, black bear, porcupine, ermine, and long-tailed weasel.

The lack of an overstory canopy (<15% crown closure) plus a vigorous herb/shrub layer in the first few years posttreatment combine to provide suitable hunting and feeding areas for species such as Cooper's hawk, red-tailed hawk, American kestrel, and olive-sided flycatcher. These are important considerations, especially where upland openings and wetlands that provide dense ground cover are infrequently scattered throughout an area. Shelterwood and large group selection cuts can also resemble patterns seen in mature and overmature naturally succeeding stands as well as in the various intermediate treatments described above. Open shelterwood cuts (30 to 40% crown closure) create more woody understory than dense cuts (60 to 80% residual crown closure). Open canopies (30 to 40% crown closure) and a vigorou herb/shrub layer combine to provide rapto hunting areas, where openings and wetlands ar uncommon. Single-tree selection maintains a range of age classes with the use of proportionc stocking or Q-factors; for example, large Q-factor of 1.8 resemble an all-aged low-density thinnin and small Q-factors of 1.3 resemble an all-age quality timber thinning.

Group-selection cuts mix small patch clearcut of 0.33 to 2.0 acres and selection cuts across a stand. Small patch clearcuts can maintair intolerant and mid-intolerant species components and for the first 5 to 10 years after cutting can provide structural habitat features for species such as ruffed grouse, white-tailed deer, and other early successional wildlife species.

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

Swamp Hardwoods

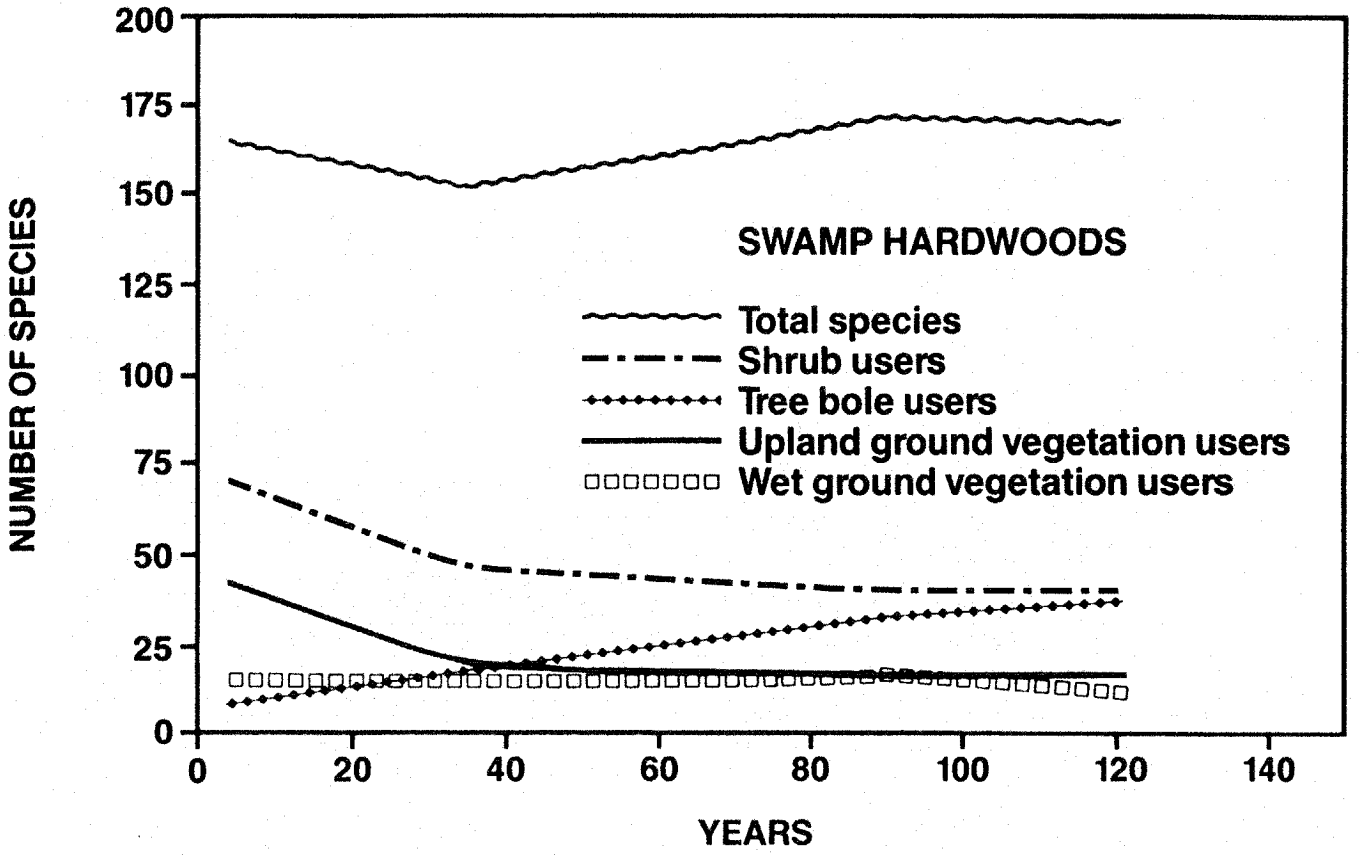
In New England, the usual swamp hardwood type is referred to as elm-ash-red maple. However, these areas are essentially red maple swamps. The elm *(Ulmus americana)* has been mostly eliminated by the Dutch elm disease, and black ash *(Fraxinus nigra)* in the north is rarely abundant. The elm-ash-maple type *per se* was most common along river floodplains in southern New England. The sites are very poorly drained—inundated part of the year—and commonly associated with slow moving streams and beaver flowages.

Common associates of the type are black spruce *(Picea mariana)* and white-cedar *(Thuja occidentalis)* to the north and Atlantic white-cedar *(Chamaecyparis thyoides)* and black gum *(Nyssa sylvatica)* in southern New England. Wetland understory shrubs are common, including alders, *Ilex* spp., mountainholly, blueberries, and others. Herbaceous vegetation is abundant, including sedges (*Carex* spp.), ferns, false-hellebore *(Veratrum viride)*, and skunk cabbage *(Symphiocarpus foedtidus)*.

SWAMP HARDWOODS



Amherst, Massachusetts
May 1990



Mean d.b.h. (in)	2–4	4–6	6–8	8–10	10–12	11–13	12–14
Basal area (ft^2)	40–60	60–70	70–80	80–90	90–100	100–120	100–120
No. stems per acre	1000–2000	400–700	250–350	165–250	125–165	125–150	110–125
Maximum height (ft)	30–40	40–50	50–60	60–70	70–80	70–80	70–80
Maximum d.b.h. (in)	6–8	10–12	12–14	14–16	16–18	16–18	16–18



Figure 15. – Swamp hardwoods stand development and wildlife species occurrence.

Successional trends in red maple swamps are not well understood. One possibility is that these areas were in softwoods such as hemlock, fir, cedar, or spruce. Heavy cutting and clearing for agriculture (wet meadows) have eliminated the softwoods. Over time, these areas may gradually return to softwoods, though many red maple swamps show no evidence of that trend as yet.

Succession. The seedling/sapling stage lasts about 10 years (Fig. 15 and Table 13). It begins as a dense mixture of stump sprouts and wetland shrubs, gradually developing a sapling overstory of nearly pure red maple. Approximately 148 wildlife species use the consistently available shrub and herbaceous ground vegetation layers in swamp hardwoods, including salamanders, frogs, turtles, snakes, green-backed heron, black-billed and yellow-billed cuckoos, gray catbird, least flycatcher, yellow warbler, chestnut-sided warbler, rose-breasted grosbeak, swamp sparrow, song sparrow, red-winged blackbird, common grackle, snowshoe hare, star-nosed mole, water shrew, cottontail, meadow vole, mink, bobcat, white-tailed deer, and moose.

The poletimber stage (10 to 59 years) consists of a closed canopy of red maple. In addition, red maple swamps are one of the few types of stands where a significant understory remains during the poletimber stage. In southern New England, escaped exotics such as tartarian honeysuckle, multiflora rose, and Japanese barberry can also be found in the understory. Some black alder and blueberry may be present, but the most noticeable component is the dense herbaceous ground vegetation—ferns, skunk cabbage, and sedges—and temporary pools of water that are key habitat features for species such as the northern two-lined salamander, American toad, wood and northern leopard frogs, northern water snake, green-backed heron, American black duck, northern waterthrush, and southern bog lemming.

In the sawtimber phase, the same types of conditions remain: (1) a closed canopy, and (2) herbaceous ground vegetation, which continue to provide habitat features for similar species mentioned in the younger age and smaller size classes previously. However, some small and medium sized (<14 inches d.b.h.) dead and defective stems develop.

The character of overmature red maple swamps can only be surmised because few, if any, exist. Certainly dead and defective trees would increase in number and size. We would anticipate some midstory trees and shrubs along with the herbaceous ground vegetation. Possibly, some trend toward a softwood understory would be evident. The number of species follows trends similar to other types: (1) high numbers of wildlife species in regenerating stands, and (2) increasing numbers in mature and overmature stands due to the tree-bole component.

Intermediate Treatment. Red maple swamps have little timber quality potential, and are difficult to manage intensively due to the wet operating conditions. The only intermediate treatment we will consider is a fuelwood cutting that removes about half the basal area from poletimber and sawtimber stands (Table 14). The cutting cycle would be long—20 years. Because of the low values involved, defective trees usually can be reserved with little or no economic impact.

In both poletimber and sawtimber stands, thinnings will result in partial canopies (< 70% closure). Midstories will develop—mostly stump sprouts, alders, and ericaceous shrubs. A vigorous woody understory continues to provide shelter and feeding sites in the shrub midstory zone (2 to 30 feet) for many vireos and warblers such as the white-eyed and yellow-throated vireos, American redstart, and common yellowthroat. An herbaceous ground vegetation layer with temporary pools of water will be common.

Regeneration. Clearcutting is the usual regeneration option in red maple swamps (Table 14). In thinned stands, clearcutting amounts to a natural shelterwood because red maple stump sprouts are already present in the understory. Regeneration following clearcutting is almost entirely from stump sprouts. Thus, it is advisable to clearcut unmanaged stands (without an understory or stump sprouts) when only 10 to 12 inches average diameter to ensure vigorous sprouting and reasonably close spacing.

Following clearcutting, a shrub/sapling layer develops. An herbaceous ground vegetation layer with temporary pools of water normally occupies a portion of the area. Because of the low economic values involved, it is feasible to reserve a variety of trees as cavity and den sites, and also to retain high and low exposed perches that benefit species such as the wood duck, hooded merganser, screech owl, great blue heron, common raven, acadian flycatcher, eastern kingbird, house wren, prothonotary warbler, Virginia opossum, various bats, porcupine, fisher, and ermine.

Table 13. – Characteristic structural habitat features and potential number of species associated with natural succession in swamp hardwoods

Size class	Structural habitat feature	Taxonomic class				
		Amphibians	Reptiles	Birds	Mammals	Total
Regeneration	Shrub layer	0	0	47	23	70
	Wetland herbaceous ground vegetation	4	2	7	2	15
Sapling-pole	Closed canopy	0	0	12	8	20
	Wetland herbaceous ground vegetation	8	2	4	2	16
Sawtimber	Closed canopy	0	0	16	8	24
	Small dead trees	0	0	13	2	15
	Wetland herbaceous ground vegetation	8	2	5	2	17
All size classes	Duff and ground surfaces	15	9	12	19	55
	Subterranean	10	11	0	24	45

Table 14. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in swamp hardwoods

Stand treatment	Size class	Structural habitat feature affected	Taxonomic class				
			Amphibians	Reptiles	Birds	Mammals	Total
Timber thinning	Sapling-pole	Partial canopy	0	0	7	3	10
		Midstory	0	0	8	0	8
		Wetland herbaceous ground vegetation	8	2	4	2	16
	Sawtimber	Partial canopy	0	0	10	4	14
		Small dead trees	0	0	13	2	15
		Midstory	0	0	9	0	9
		Wetland herbaceous ground vegetation	8	2	5	2	17
Clear-cutting with reserved wildlife trees	Regeneration	High and exposed perches	0	0	13	0	13
		Small dead trees	0	0	3	1	4
		Shrub layer	0	0	47	23	70
		Wetland herbaceous ground vegetation	4	2	7	2	15

Type Conversion. Converting red maple to other types is difficult. The only alternatives are: (1) repeated clearcutting to convert the area to a shrub swamp wetland, and (2) a long wait to see if a softwood component appears in the understory.

Spruce-Fir

The red spruce-balsam fir type occurs principally in northern New England and New York, adjacent Canada, and the highest elevations of the Appalachian range. White spruce becomes a more common associate in the northwest part of the type's range; hemlock increases toward the southern part at lower elevations. Black spruce and tamarack *(Larix laricina)* occur in wet areas toward the northern part.

Spruce-fir is a climax type and remains persistent under light to moderate disturbance. Heavy disturbance results in hardwood-softwood mixtures followed by a predominance of fir. Over time, without additional disturbance, the proportion of red spruce increases due to its longevity—about 400 years as compared to a maximum of 150 to 200 for fir.

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

Primary Sites. Primary softwood sites consist of moderately to somewhat poorly drained areas at lower elevations (spruce-flat, Westveld 1941); and shallow-to-bedrock areas at elevations above 1,500 to 2,500 feet in New England and New York (spruce-slope, Westveld 1941). Primary sites probably also include knolls of gravelly or sandy outwash at low elevations.

Although primary sites vary, they share certain vegetative characteristics. Primary softwood sites exhibit a high proportion of softwoods. When heavily disturbed (for example, by clearcutting), successional hardwoods such as aspen and paper birch rapidly invade, together with *Rubus* spp. and other shrubs. However, softwoods usually remain evident in the overstory or a coniferous understory rapidly develops, or both. Over time, these mixedwood stands revert to nearly pure (75%) spruce-fir as the early successional hardwoods die out.

Mixedwood stands on primary sites generally support a layer of deciduous shrubs and small trees in addition to the coniferous understory. At low elevations, these include hobblebush and striped maple *(Acer pensylvanicum)*, at higher elevations, mountain ash *(Sorbus americana)* and mountain maple *(A. spicatum)* are more common. On moist sites, *Oxalis* spp. and goldthread are common. On dry, sandy and gravelly sites, ericaceous plants and *Lycopodium* spp. are common.

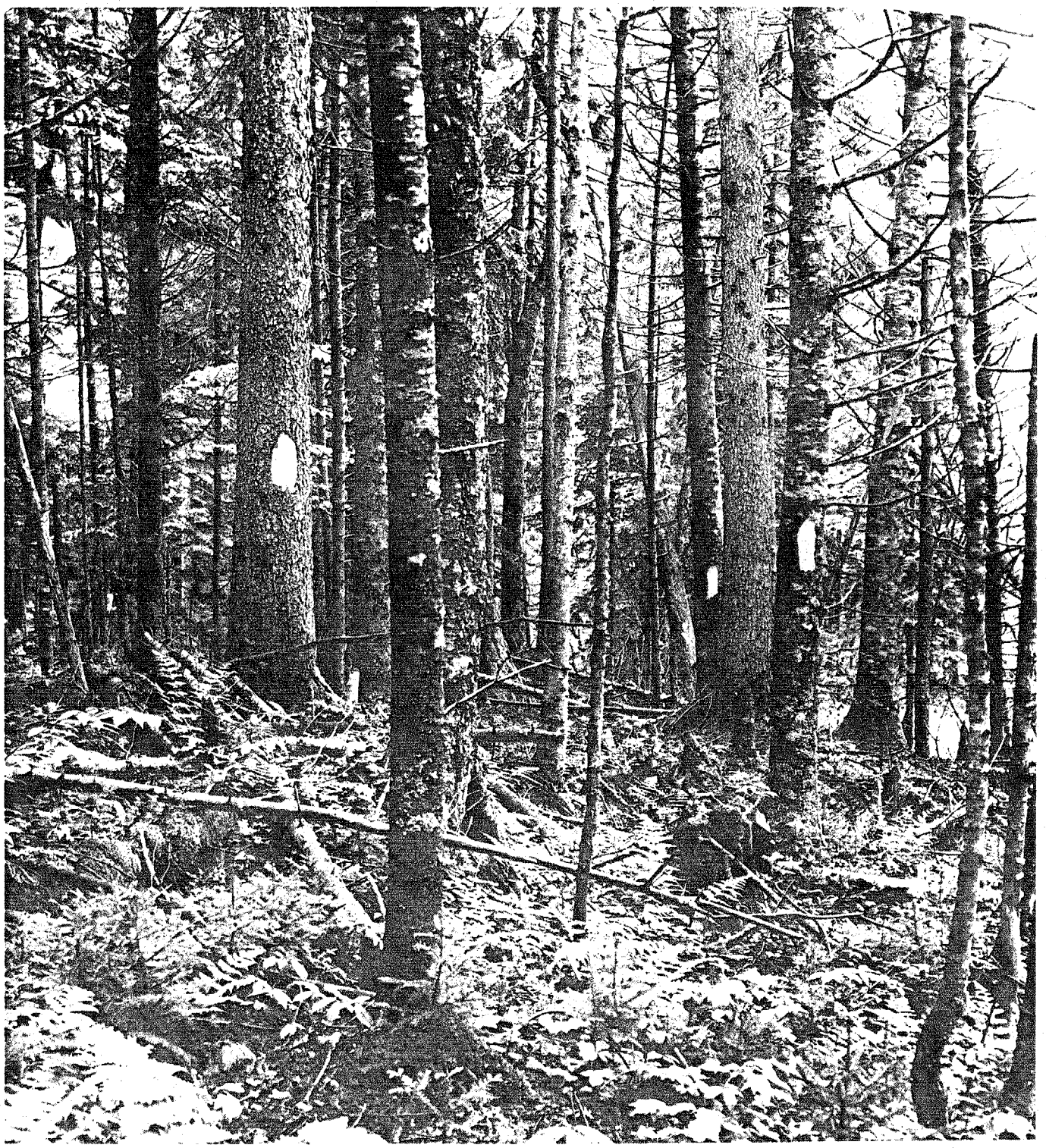
Pure softwood stands on the other hand, often contain sparse herbaceous and shrub layers until the canopy is broken by overmaturity, windthrow, or insect damage. On primary sites, spruce, fir, and hemlock attain maximum diameters of 20 to 22, 12 to 14, and 24 to 30 inches, respectively. However, decay and mortality are common at diameters of 12 to 14, 8 to 10, and 18 to 20 inches d.b.h., respectively.

Secondary Sites. These are well-drained to moderately well-drained side slopes at mid elevations. The soils vary from sandy tills to moderately well-drained pans. Soils are better than those found on primary sites, and competition from hardwoods is greater. Pole and sawtimber stands generally are mixed wood with less than 50 percent softwoods. Over long periods of time, these sites tend to revert to pure softwoods. If heavily disturbed (for example, by clearcutting), the new stand may be nearly pure hardwoods, but over time will gradually develop a softwood understory. In central New England, red spruce and balsam fir commonly seed into pastures and sometimes into old fields, commonly producing essentially pure stands. Farther north, white spruce commonly seeds into old fields.

Poletimber and sawtimber stands contain deciduous shrubs (for example, hobblebush) in the understory. Herbaceous layers vary greatly in species and density—up to 30 to 40 percent ground coverage.

Although spruce, fir, and hemlock tend to grow better on secondary rather than primary sites, tree sizes are not greatly different. Maximum sizes are approximately 20 to 24, 12 to 14, and 30 to 36 inches d.b.h. for spruce, fir, and hemlock, respectively, with overmature and defective sizes of 14 to 16, 10 to 12, and 20 to 22 inches d.b.h., respectively, on both primary and secondary sites. The hardwoods commonly found on secondary sites—including red maple, birches, and aspen—generally show defect and cavities at 14 to 16 inches d.b.h. (or earlier in the case of quaking aspen).

RED SPRUCE -- BALSAM FIR



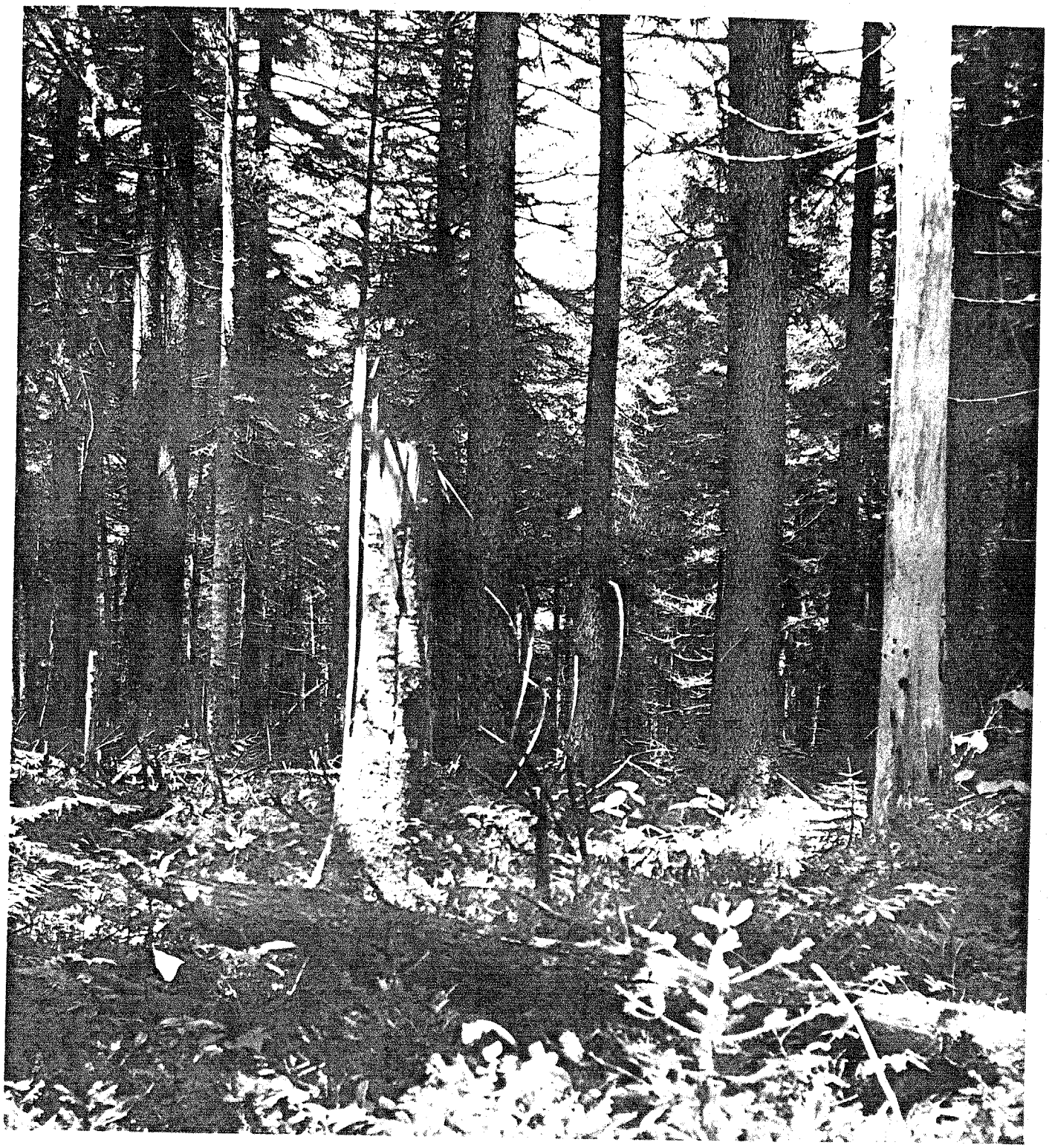
West Milan, New Hampshire
August 1985

BALSAM FIR

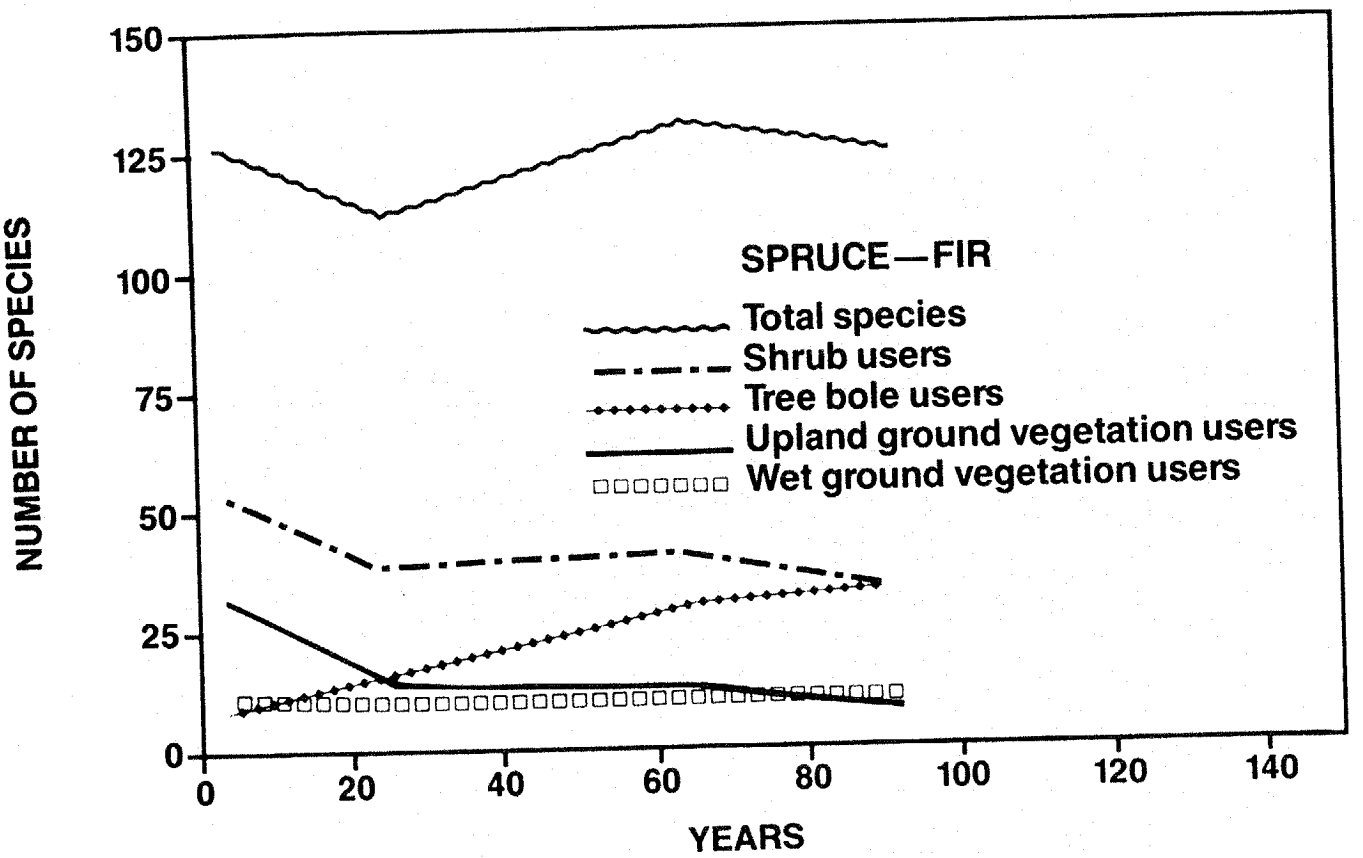


West Milan, New Hampshire
August 1985

RED SPRUCE



Mt. Tabor, Vermont
June 1948



Mean d.b.h. (in)	2–4	4–5	5–7	7–9	8–10	9–11	10–12
Basal area (ft^2)	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 16. – Spruce-fir stand development and wildlife species occurrence.

Succession. On wet primary sites, the herbaceous/shrub layer (*Rubus* spp. and sedges) following clearcutting of spruce-fir stands may last up to 10 to 15 years (Fig. 16). The period is much shorter on drier primary and secondary sites. The main difference between successional trends on primary sites and secondary sites is the hardwood component—mainly pure softwoods on primary sites and a mixture of hardwoods and softwoods on secondary sites. An associated characteristic is the relative abundance of deciduous cavity trees on secondary sites. On both sites, the successional trend is toward increasing proportions of softwoods.

Note: See *A silvicultural guide for spruce-fir in th Northeast* (Frank and Bjorkbom 1973) for furthe information on management of spruce and fi types.

Spruce-fir stands follow several alternative patterns during maturity and overmaturity. Those comprised primarily of balsam fir reach overmaturity at 60 to 70 years of age; the canopy dies over a period of a few years and the fi understory forms a new sapling stand. At high elevations, fir mortality proceeds across the landscape in "fir waves." In spruce-fir, the canopy

Table 15. – Characteristic structural habitat features and potential number of species associated with natural succession in the spruce-fir group

Size class	Site type	Structural habitat feature	Other associated cover types	Taxonomic class				
				Amphibians	Reptiles	Birds	Mammals	Total
Regeneration	Primary & secondary	Shrub layer	SPR,BF [a]	0	0	34	18	52
		Slash	SPR,BF	2	0	3	13	18
		Soft mast	SPR,BF	0	0	8	13	21
	Primary (wet)	Wetland herbaceous ground vegetation	SPR,BF	3	0	3	4	10
Sapling-pole	Primary & secondary	Closed canopy	SPR,BF	0	0	19	8	27
Sawtimber	Primary & secondary	Closed canopy	SPR,BF	0	0	22	9	31
		Overstory inclusions	SPR,BF	0	0	37	7	44
	Secondary	Large tree boles	SPR	0	0	11	13	24
		Midstory	SPR,BF	0	0	19	0	19
Large sawtimber	Primary	Partial canopy	SPR, BF	0	0	6	3	9
	Secondary	Closed canopy	SPR,BF	0	0	21	9	30
	Primary & secondary	Overstory inclusions	SPR,BF	0	0	33	7	40
		Large tree boles	SPR	0	0	14	13	27
		Small dead trees	BF	0	0	11	2	13
		Herbaceous ground vegetation	SPR,BF	0	1	21	8	30
All size classes		Duff and ground surfaces	SPR, BF	6	1	11	21	39
		Subterranean	SPR,BF	6	3	0	20	29

[a] SPR = Spruce; BF = Balsam Fir.

remains essentially closed until the stand is roughly 120 to 150 years old. After that, areas of a few 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 distinct. The stands maintain a more uneven-aged character due to differences in species longevity.

Numbers of wildlife species are high in the regeneration stage due to the herbaceous/shrub layer (Fig. 16 and Table 15). Numbers drop and then rise to a maximum in mature and overmature spruce-fir — again, due to the increasing numbers of tree-bole users. Fir and spruce-fir tend to support higher species numbers than pure spruce supports.

Intermediate Treatments. Early noncommercial weeding with brush saws is used at times in spruce-fir stands to increase the proportion of the spruce; later commercial thinnings are used to remove early maturing fir and hardwoods. The overall effects of quality timber thinning in spruce-fir are to increase the proportion of softwoods (spruce especially) and reduce the numbers of hardwood cavity trees (Fig. 12). With minimal

Table 16. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in the spruce-fir group

Stand treatment	Size class	Site type	Structural habitat feature affected	Other associated cover types	Taxonomic class				
					Amphibians	Reptiles	Birds	Mammals	Total
Quality timber thinning	Sapling-pole	Primary and secondary	Closed canopy	SPR,BF [a]	0	0	19	8	27
	Saw-timber	Primary and secondary	Closed-canopy	SPR,BF	0	0	22	9	31
			Midstory	SPR,BF	0	0	19	0	19
			Herbaceous ground vegetation	SPR,BF	0	1	5	5	11
		Secondary	Overstory inclusions	SPR,BF	0	0	37	7	44
Timber thinning with reserved wildlife trees	Sapling-pole	Primary and secondary	Closed canopy	SPR,BF	0	0	19	8	27
		Primary	Overstory inclusions	SPR,BF	0	0	32	7	39
		Secondary	Small dead trees	SPR,BF	0	0	7	1	8
	Saw-timber	Primary and secondary	Closed canopy	SPR,BF	0	0	22	9	31
			Overstory inclusions	SPR,BF	0	0	37	7	44
			Large tree boles	SPR	0	0	11	13	24
			Small dead trees	BF	0	0	11	2	13
			Midstory	SPR,BF	0	0	19	0	19
			Herbaceous ground vegetation	SPR,BF	0	1	5	5	11

Continued

Table 16.—Continued

Stand treatment	Size class	Site type	Structural habitat feature affected	Other associated cover types	Taxonomic class				
					Amphibians	Reptiles	Birds	Mammals	Total
Low-density thinning	Sapling-pole	Primary and secondary	Partial canopy	SPR,BF	0	0	5	3	8
			Shrub layer	SPR,BF	1	0	23	14	38
		Primary	Overstory inclusions	SPR,BF	0	0	32	7	39
		Secondary	Small dead trees	BF	0	0	7	1	8
	Saw-timber	Primary and secondary	Partial canopy	SPR,BF	0	0	7	3	10
			Overstory inclusions	SPR,BF	0	0	37	7	44
			Large tree boles	SPR	0	0	11	13	24
			Small dead trees	BF	0	0	11	2	13
			Midstory	SPR,BF	0	0	19	0	19
Shelter-wood	Saw-timber	Primary and secondary	Closed canopy	SPR,BF	0	0	22	9	31
			Overstory inclusions	SPR,BF	0	0	37	7	44
			Large tree boles	SPR	0	0	11	13	24
			Small dead trees	BF	0	0	11	2	13
			Herbaceous ground vegetation	SPR,BF	0	1	5	5	11
Selection	Saw-timber	Primary and secondary	Closed canopy	SPR,BF	0	0	22	9	31
			Overstory inclusions	SPR,BF	0	0	37	7	44
			Large tree boles	SPR	0	0	11	13	24
			Small dead trees	BF	0	0	11	2	13
			Midstory	SPR,BF	0	0	19	0	19
			Herbaceous ground vegetation	SPR,BF	0	1	5	5	11

[a] SPR = Spruce;BF = Balsam Fir.

losses in timber productivity, quality timber thinning can be combined with wildlife tree retention. Low-density (30 to 50% crown cover) thinning will provide 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 (Table 16).

Regeneration. The most effective way to regenerate spruce-fir is to use a high-density shelterwood system (Fig. 11). This produces an overstory of softwoods (with reserved hardwood wildlife trees) and an understory of spruce-fir, a few hardwoods, and an occasional area of herbs and shrubs on wet sites. Low-density shelterwoods produce a mixed understory and more patches of herbs and shrubs. Selection and group selection also are used to maintain spruce-fir stands, usually with some hardwood component. Group selection with openings up to 1 acre is similar to regeneration conditions due to blowdown. Three-cut shelterwoods simulate natural regeneration in old spruce-fir stands. Either method can be used to regenerate spruce-fir (Table 16).

Type Conversion. Complete clearcutting on long rotations (longer than 80 years) will convert spruce-fir stands to hardwoods that resemble beech-red maple type or aspen-birch type if the stand contains 10 to 20 percent aspen before cutting. Repeated clearcutting on short rotations of 15 to 60 years will favor the aspen-birch component.

Hemlock

Eastern hemlock is a ubiquitous species in the Northeast, and occurs across a wide range of sites with a broad array of associated species. Hemlock attains sizes of 32 inches d.b.h. and larger, even on fairly severe sites. However, many larger than 20 inches d.b.h. are defective (Leak 1985[1]), which makes eastern hemlock valuable for den- and cavity-using wildlife species. Hemlock often is considered an integral part of the northern hardwood forest. But typical northern hardwoods tend to predominate on reasonably fine-textured, fairly well-drained sites, whereas hemlock is climax and aggressive on sites that are either wetter or drier than normal. Following the terminology for spruce-fir, we can call these primary and secondary sites.

Primary Sites. These sites are mostly outwash sands and shallow pans that vary from moderately well-drained to somewhat poorly drained and fine-textured sediments with a predominance of silt or clay, or both. The wetter the site, the more aggressive the hemlock. At higher elevations and latitudes, spruce and fir become more common components.

With disturbance, hardwoods increase in abundance. Red maple and yellow and/or black birch are common along with many other species. Wet, shallow-to-pan areas tend to maintain a high proportion of softwoods. Sediments and moderately well-drained pans may support very few softwoods after heavy disturbance.

Common herbs and shrubs include wood sorrel (*Oxalis* spp.), goldthread *(Coptis groenlandica),* bluebead lily *(Clintonia borealis),* hobblebush, various ferns, and clubmosses.

Secondary Sites. These sites include areas shallow to bedrock, shallow to detached rock, outwash sands, very gravelly sandy tills, shallow well-drained pans, and areas of fine-textured but well-drained to moderately well-drained sediments. Hemlock is predominant (50 to 75%) in climax stands on these sites throughout New England. In mid to southern New England, white pine is often present in old stands on secondary sites, though it is gradually replaced by hemlock. In northern New England, red spruce is a common climax associate, becoming more abundant at higher elevations and latitudes. For example, in central New Hampshire red spruce becomes more aggressive than hemlock at about 1,800 feet elevation on the same soil materials.

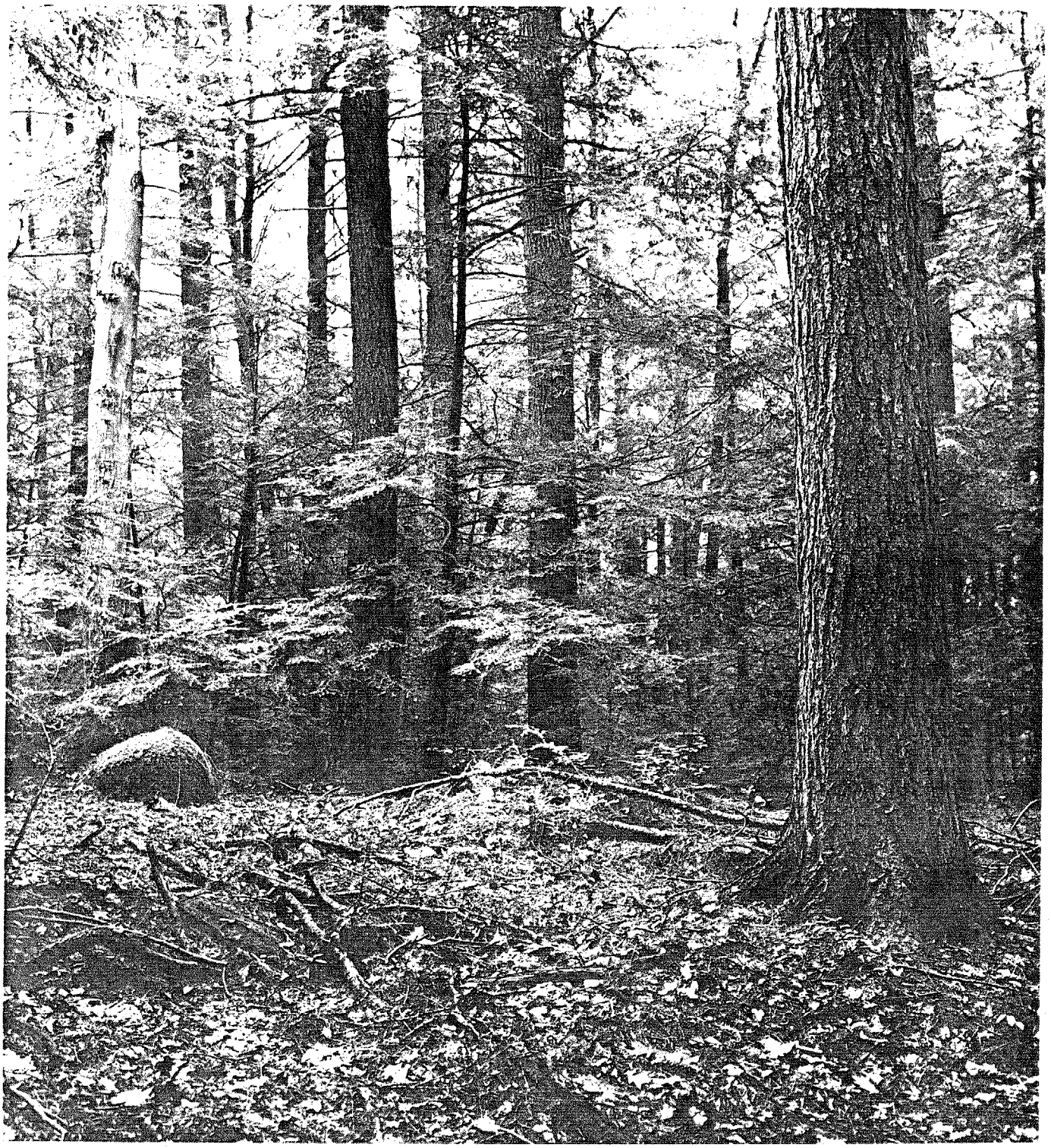
Disturbed hemlock stands on secondary sites show increased proportions of hardwoods in proportion to the amount of disturbance. Typical hardwoods include beech, oak, paper birch, aspen, and red maple among others. Prolonged single-tree selection cutting frequently converts mixed stands to hemlock in southern New England.

Although undisturbed hemlock stands on secondary sites contain very little shrubby or herbaceous understory, disturbed hemlock stands or mixed hardwood-hemlock support bracken *(Pteridium aquilinum),* various blueberries (*Vaccinium* spp.), *Aralia* spp., wintergreen, wild lily-of-the-valley, and other species typical of dry sites as well as mixed hardwood and softwood tree seedlings.

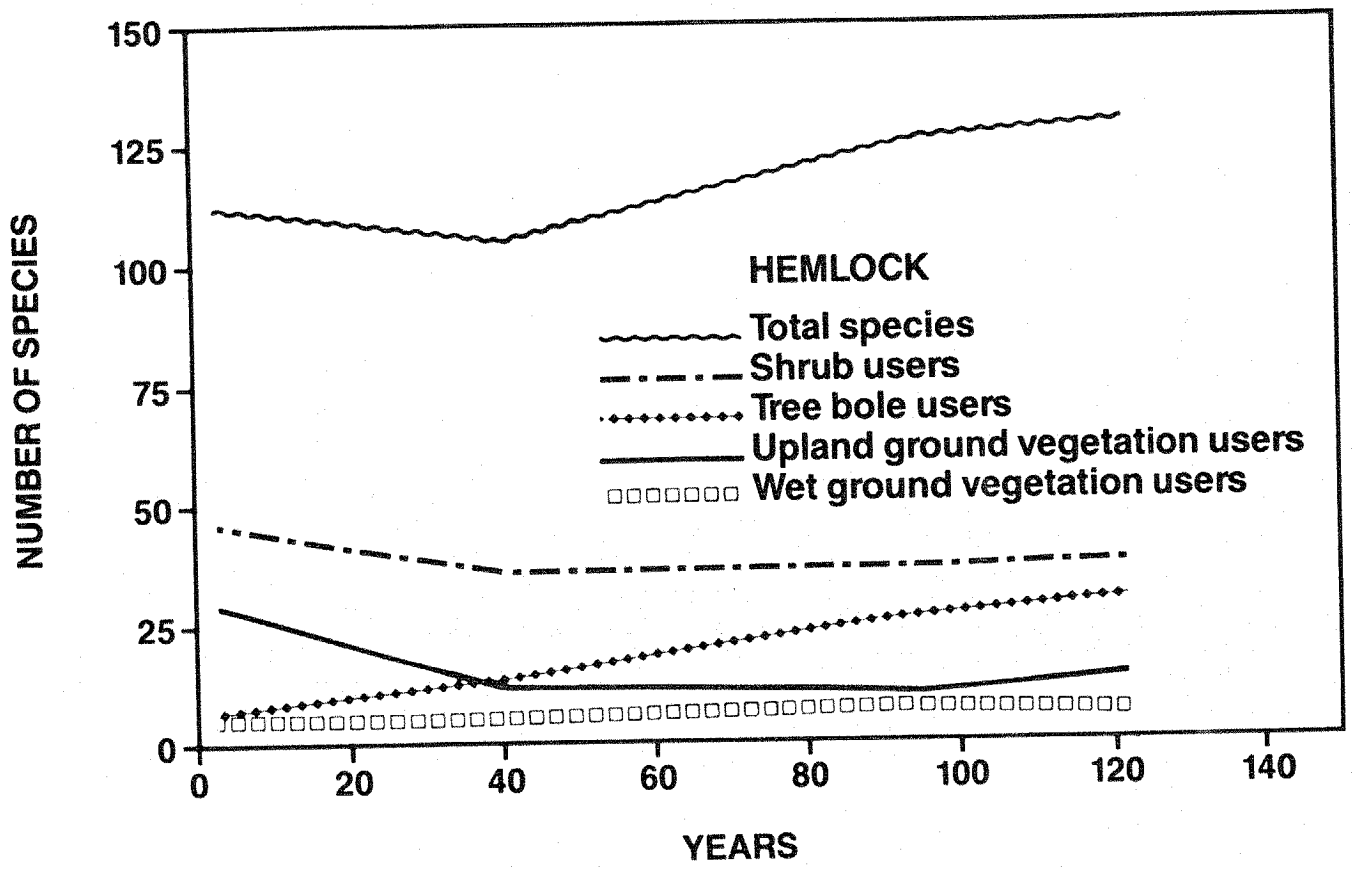
Succession. Succession in hemlock consists of gradually increasing proportions of softwoods over long periods of time (Fig. 17)—more rapidly on primary sites than on secondary sites. On both types of sites, the developing stands are typically characterized by closed canopies, hardwood cavity trees and inclusions, and sparse herbaceous ground cover (Table 17). Eventually (after 250 to 350 years), an old-growth stand develops, containing 75 to 80 percent softwoods, an uneven-aged structure, sparse ground flora, and a continuous but sparse understory of hemlock seedlings and saplings. These stands are long-lasting until windthrown by major storms. Species such as barred owl, pileated woodpecker, red-breasted nuthatch, brown creeper, golden-crowned and ruby-crowned kinglets, wood thrush, black-throated green warbler, blackburnian warbler, Canada warbler, pine grosbeak, pine siskin, hoary bat, porcupine, fisher, and white-tailed deer (especially where they yard in winter) can be found in hemlock stands, given the structural habitat features that are usually present.

Intermediate Treatments. Commercial or non-commercial thinning in hemlock is rare because of the low timber value. However, especially on secondary sites, commercial thinnings sometimes

EASTERN HEMLOCK



Petersham, Massachusetts
August 1985



Mean d.b.h. (in)	2–4	4–6	6–8	10–12	12–14	14–16	16–18
Basal area (ft^2)	80–100	100–140	140–200	200–240	240–260	240–280	240–280
No. stems per acre	1000–3500	700–1000	600–700	300–350	250–300	200–250	150–175
Maximum height (ft)	10–20	30–50	50–70	60–80	60–90	70–90	70–90
Maximum d.b.h. (in)	6–8	8–10	12–14	14–18	18–22	22–24	24–26



Figure 17. – Hemlock stand development and wildlife species occurrence.

Table 17. – Characteristic structural habitat features affected by and potential number of species associated with natural succession in the hemlock group

Size class	Site type	Structural habitat feature	Taxonomic class				
			Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Regeneration	Dry	Deciduous shrub layer	0	0	9	4	13
	Wet	Shrub layer	0	0	27	18	45
		Wetland herbaceous ground vegetation	0	0	2	3	5
Sapling-pole	Dry	Closed canopy	0	0	19	6	25
		Small dead trees	0	0	7	1	8
	Wet	Overstory inclusions	0	0	33	7	40
Sawtimber	Dry and wet	Closed canopy	0	0	23	7	30
		Overstory inclusions	0	0	39	7	46
		Midstory	0	0	18	0	18
		Small/medium dead trees	0	0	12	3	15
	Dry	Mast	0	0	6	12	18
Large sawtimber	Dry and wet	Closed canopy	0	0	26	7	33
		(sometimes partial canopy)	0	0	6	4	10
		Overstory inclusions	0	0	41	7	48
		Midstory	0	0	17	0	17
		Large tree boles	0	0	12	13	25
		Dead and down material	1	2	2	14	19
	Dry	Mast	0	0	6	12	18
All size classes	Dry and wet	Duff and ground surfaces	8	3	10	19	40
		Subterranean	8	6	0	18	32

are conducted in the hardwood (and pine if present) component to remove early maturing species. This sort of thinning reduces the hardwood cavity tree component and hastens the successional trend toward pure hemlock (Fig. 17) and may add temporarily to an otherwise sparse shrub layer.

Timber thinning with reserved wildlife trees (Table 18) results in species numbers similar to those in the stages of natural succession (Table 17). For wildlife purposes, leaving some hardwood cavity trees, especially the long-lived ones (red oak and beech), is advisable.

Regeneration. As with spruce, regeneration of hemlock using dense shelterwood treatment (60 to 80% residual canopy closure after the first cut) probably is most effective (Fig. 11), for example, a 3-stage shelterwood cutting. Different regeneration treatments present different arrays of structural habitat features (Table 18). Open shelterwood treatments (30 to 40 percent residual canopy closure after the first cut) produce more hardwoods, for example, as in a 2-stage shelterwood cutting or group-selection cuts (>0.5 acres). Scarification at the time of the first shelterwood cut apparently will increase hemlock germination and establishment. However, if advanced hemlock regeneration is already present, scarification will be self-defeating. A final stage shelterwood cut resembles the regeneration stage of natural succession. Single-tree selection treatment resembles the first cut of a dense shelterwood treatment. Small group selection cuts (<0.5 acres) also resemble the first cut of a dense shelterwood treatment.

Table 18. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in the hemlock group

Stand treatment	Size class	Site type	Structural habitat feature affected	Taxonomic class				
				Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Timber thinning	Sapling-pole	All	Closed canopy	0	0	19	6	25
	Sawtimber	All	Closed canopy	0	0	23	7	30
			Midstory	0	0	18	0	18
Timber/ wildlife thinning	Sapling-pole	All	Closed canopy	0	0	19	6	25
			Small dead trees	0	0	7	1	8
		Wet	Overstory inclusions	0	0	33	7	40
	Sawtimber	All	Closed canopy	0	0	23	7	30
			Large tree boles	0	0	9	13	22
			Midstory	0	0	18	0	18
			Overstory inclusions	0	0	39	7	46
		Dry	Beech mast	0	0	6	12	18
Low-density thinning	Sapling-pole	All	Partial canopy	0	0	5	3	8
			Small dead trees	0	0	7	1	8
			Shrub layer	1	0	21	14	36
		Wet	Overstory inclusions	0	0	33	7	40
	Sawtimber	All	Partial canopy	0	0	7	4	11
			Large tree boles	0	0	9	13	22
			Midstory	0	0	18	0	18
			Overstory inclusions	0	0	39	7	46
Shelter-wood	Sawtimber	All	Partial canopy	0	0	7	4	11
			Large tree boles	0	0	9	13	22
			Overstory inclusions	0	0	39	7	46
		Dry	Beech mast	0	0	6	12	18
Selection	Sawtimber	All	Closed canopy	0	0	23	7	30
			Large tree boles	0	0	9	13	22
			Midstory	0	0	18	0	18
			Overstory inclusions	0	0	39	7	46
		Dry	Beech mast	0	0	6	12	18

Type Conversion. Repeated complete clearcutting will tend to convert hemlock to beech-red maple or aspen-birch types as described under the section on spruce-fir. Large group-selection cuts will also tend to convert the type. On fine-textured soils, single-tree selection will convert hemlock to tolerant hardwoods.

Oak-Pine Types

Oak and pitch pine *(Pinus rigida)* are generally more important in southern New England, but white pine occurs throughout the region. In general, these types can be organized into four type and site combinations:

- The oak-pine type on sands, gravel, and sandy tills.
- The pitch-pine type on sandy and gravelly sites that have been repeatedly burned.
- Mixed oak-hardwood types on fine-textured soils from the White Mountains to southern New England.
- Temporary old-field pine on fine-textured soils.

Oak-Pine. Red oak (with mixtures of other oaks) and white pine are natural associates on outwash soils and sandy tills in central to southern New England. As soil texture becomes a little finer, red oak and other hardwoods become more competitive with pine. Oak-pine also occurs on shallow-to-bedrock soils. Common associates of oak-pine include black *(Quercus velutina)*, white *(Q. alba)*, and chestnut oak *(Q. prinus)*; as well as red maple, aspen, and gray birch.

Shrubs and herbs include dry-site species such as low blueberries *(Vaccinium spp.)*, wintergreen, clubmosses (*Lycopodium* spp.), beaked hazel *(Corylus cornuta)*, and so on. Occasionally, mountain laurel *(Kalmia latifolia)* occurs in abundance under oak stands on rocky side slopes, but its occurrence seems unpredictable. Otherwise, shrub and herb layers are not dense.

The climax is uncertain, because oak and pine tend to alternate in a series of harvests. North of southern New Hampshire, hemlock and spruce seem to be the ultimate climax on dry sandy soils, though oak and sometimes pine remain as persistent associates on south or west exposures.

Pitch Pine. Pitch pine occurs on very coarse gravelly soils that have been burned repeatedly in the past and so have little soil organic matter. Common overstory associates include aspen, gray birch, red maple, white pine, and black and white oaks. Shrub and midstory layers are dominated by bear oak *(Q. illicifolia)*, which is closely associated with the pitch pine type. The herb and low shrub layers are dense in patches and ericaceous, containing blueberry, wintergreen, sheep laurel *(Kalmia angustifolia)*, and bearberry *(Arctostaphylos uva-ursi)*.

Over long periods of time without fire, the pitch pine type may revert to oak-pine as described above.

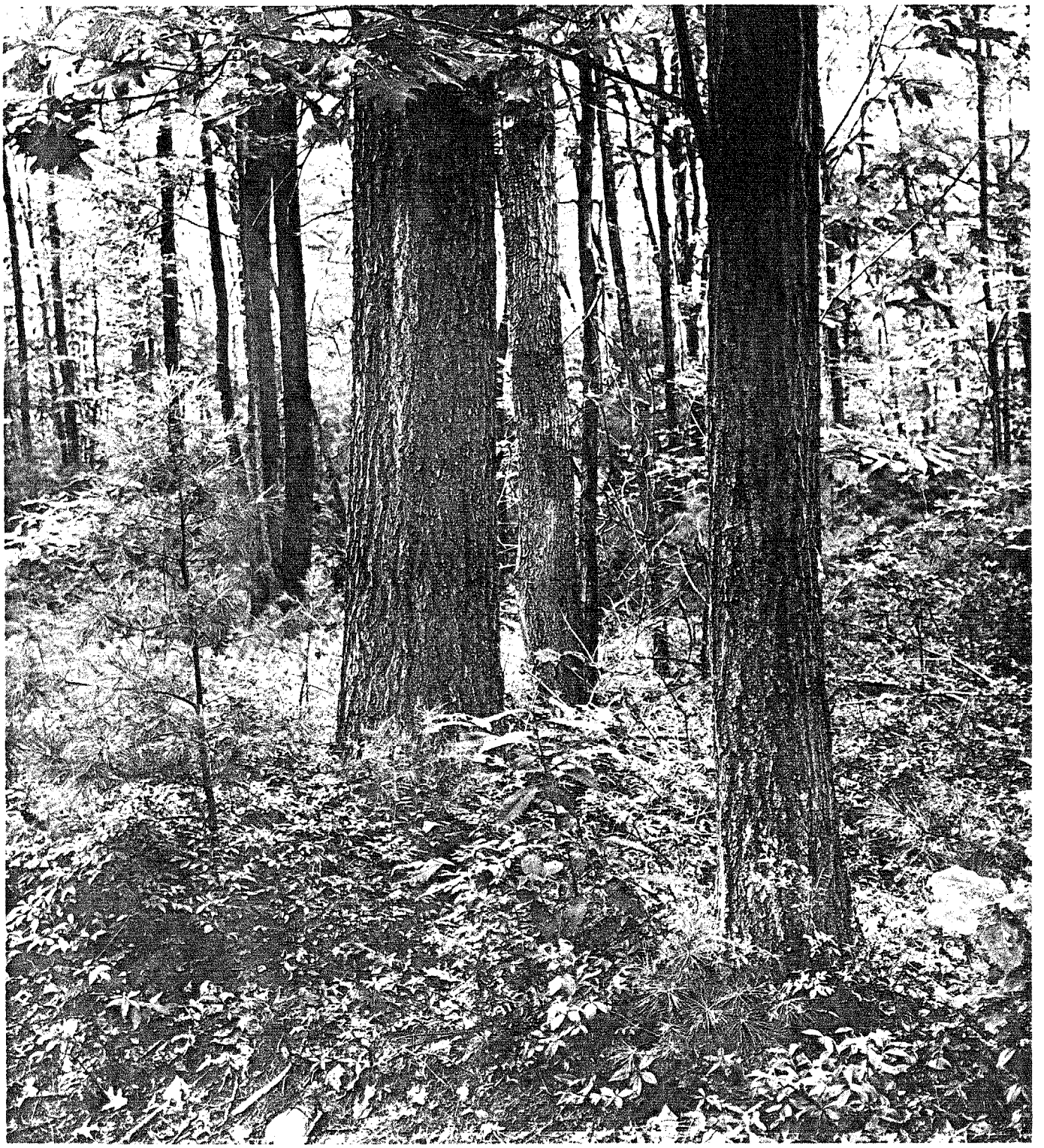
Mixed Oak-Hardwood. From the White Mountains southward, red oak occurs on fine-textured soils of various origins. Common associates include a mixture of maples, oaks, birches, ash, and hickories. Many herb and shrub species, including many spring ephemerals, may be present, but densities are not necessarily high until canopy closure is reduced.

The origin and succession of these stands are unclear. Many occur on abandoned agricultural lands, which may explain the oak component — oaks can withstand substantial grazing. Fire may have contributed to the oak component—older trees can survive light ground fire. The presence of sugar maple indicates that the successional trend may be toward northern hardwoods. In central to northern New England, stands growing on soils derived from silt and clay sediments have developed toward a hemlock climax, but only over a period of several rotations.

Old-field Pine. Although a temporary type resulting from farmland abandonment, old-field pine deserves mention due to its prevalence. Although it occurs on all types of sites, we restrict our discussion here primarily to old-field pine on fine-textured soils that rapidly succeed toward hardwoods. Old-field pine on sandy soils quickly takes on the character of oak-pine.

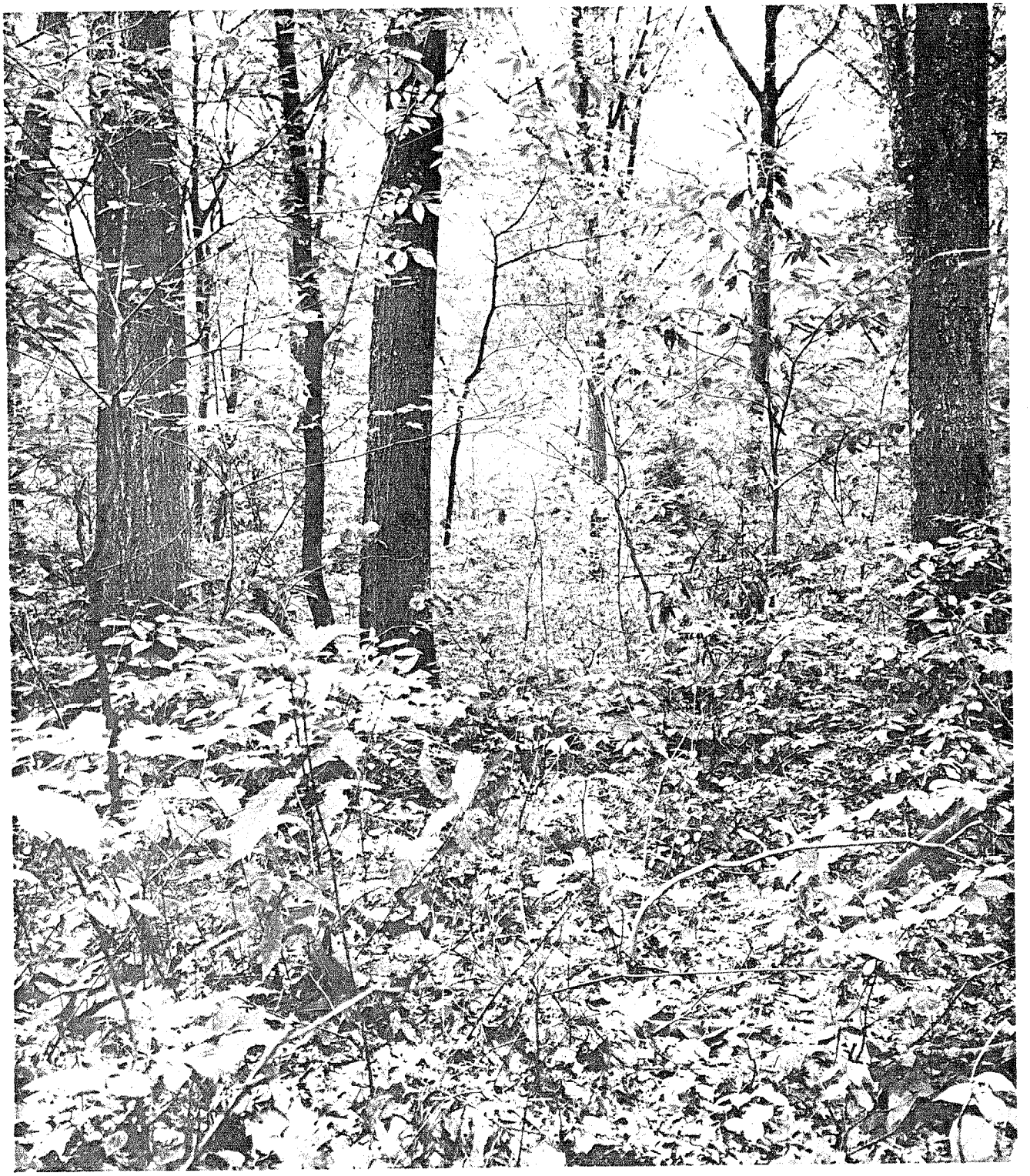
Old-field pine commonly develops as pure, dense stands of pine with a component of very coarse, large-limbed pine and an occasional wide-crowned hardwood that was left for shade on the now-abandoned pasture. Remnant clumps of juniper commonly can be found as part of the shrub layer openings. Woody understories are very sparse unless the stand is opened up (<70% crown closure) by cutting or windthrow. Under these situations, a hardwood understory of cherry, oak, red maple, and shrubs develops within 3 to 4 years, and becomes the midstory over the next decade. On coarse-textured soils, hemlock may

WHITE PINE–NORTHERN RED OAK–RED MAPLE



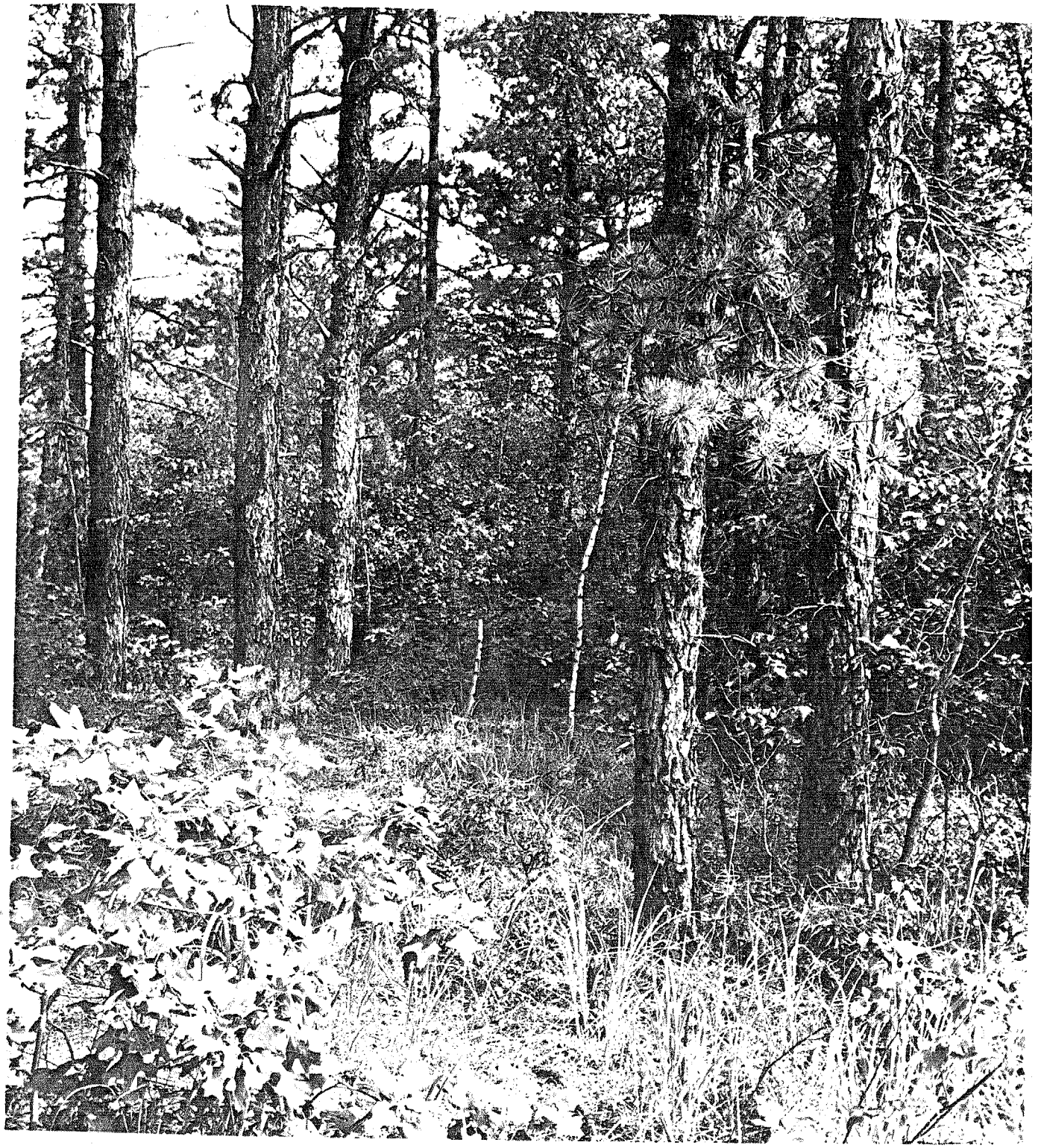
Belchertown, Massachusetts
August 1985

NORTHERN RED OAK



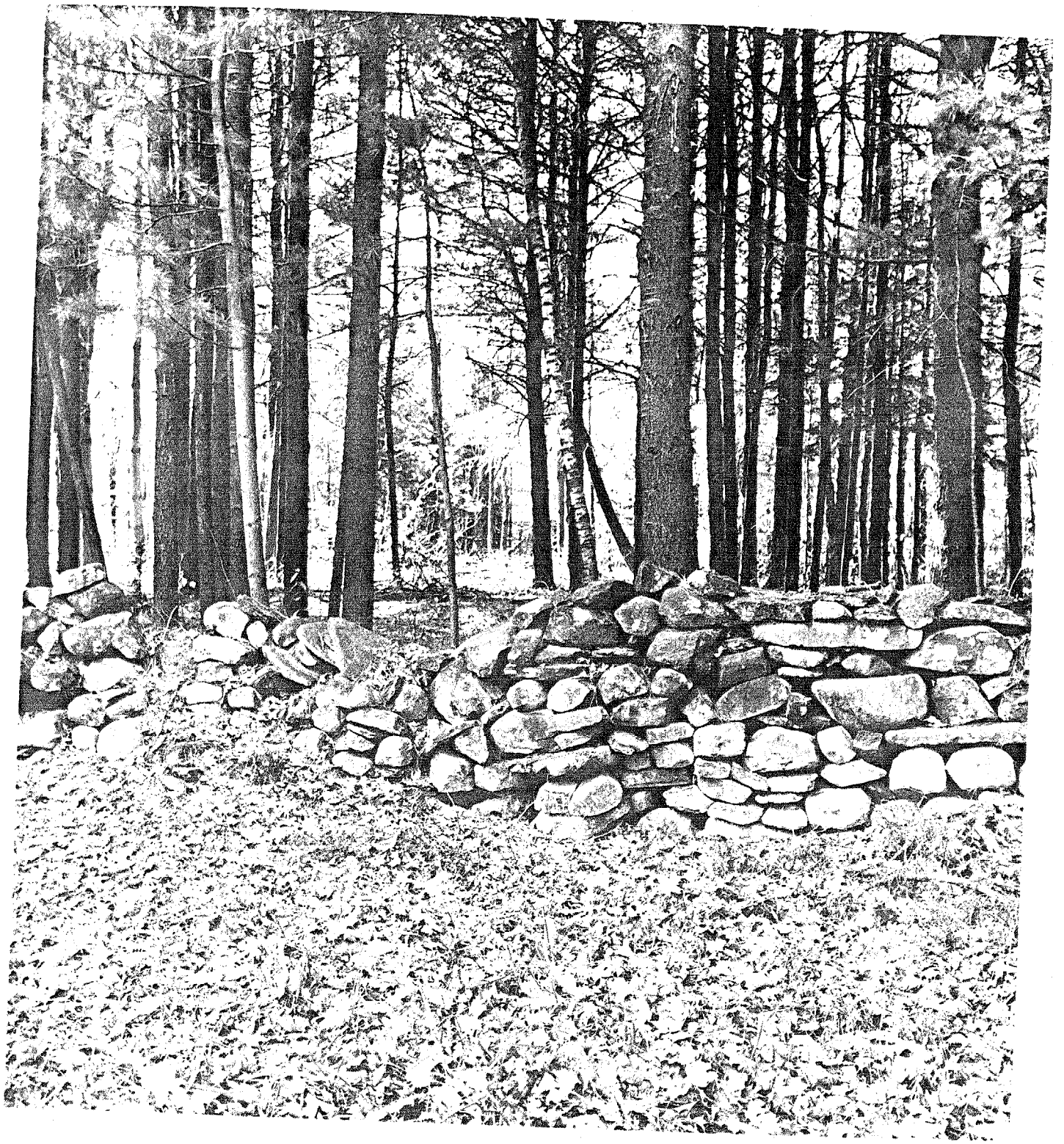
Ware, Massachusetts
August 1985

PITCH PINE



Montague, Massachusetts
August 1985

OLD FIELD WHITE PINE



Worthington, Massachusetts
October 1989

invade old-field pine and persist in developing hardwood stands.

Succession. Natural succession in the oak and pine types is variable and a little uncertain. Oak and pine on sandy soils tend to alternate—groups of oak often support an understory of pine and vice versa. These stands usually exhibit a closed canopy, stratified hardwood-softwood mixtures, and a sparse dry-site ground flora. The presence of large supracanopy pines is a common feature in sawtimber stands.

Old-field pine on fine-textured soils develops dense pure stands once the early successional species (for example, gray birch, aspen, juniper) disappear. The 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.

Pitch pine stands usually maintain a dense understory of bear oak and a dense dry-site herb and shrub layer (for example, blueberries and wintergreen). Without fire, pitch pine probably moves toward an oak-pine successional sequence.

Total numbers of wildlife species potentially occurring throughout the successional process (Fig. 18) tend to be higher in oak-pine than in either mixed oak-hardwoods or old-field pine. Numbers of species are high in regenerating stands (Table 19), then drop off in pole stands due to the decline of the herb and shrub layers, which were important for eastern bluebird, loggerhead shrike, blue-winged and golden-winged warblers, Tennessee warbler, meadow vole, meadow jumping mouse, long-tailed weasel. Numbers of species then rise in mature and overmature stands, mainly due to the increasing number of tree-bole users.

The usual presence of several "bull" pines in the supracanopy of the oak-pine group provides favorable perching and nesting sites for various hawks. Great blue herons, osprey, and bald eagles can also use the supracanopy features where the oak-pine group occurs near large water bodies and other wetlands.

The variety and production of hard mast reaches its peak in the oak-pine group, especially where various oak species, hickories, and beech are found together. Wildlife species that depend on sources of acorns and other hard mast include ruffed grouse, wild turkey, red-headed and red-bellied woodpeckers, blue jay, various squirrels, chipmunks, mice, gray fox, black bear, striped skunk, and white-tailed deer. Wood duck, American black duck, and mallard can also benefit from hard mast where the oak-pine group occurs adjacent to shallow water bodies, streams, and other wetlands.

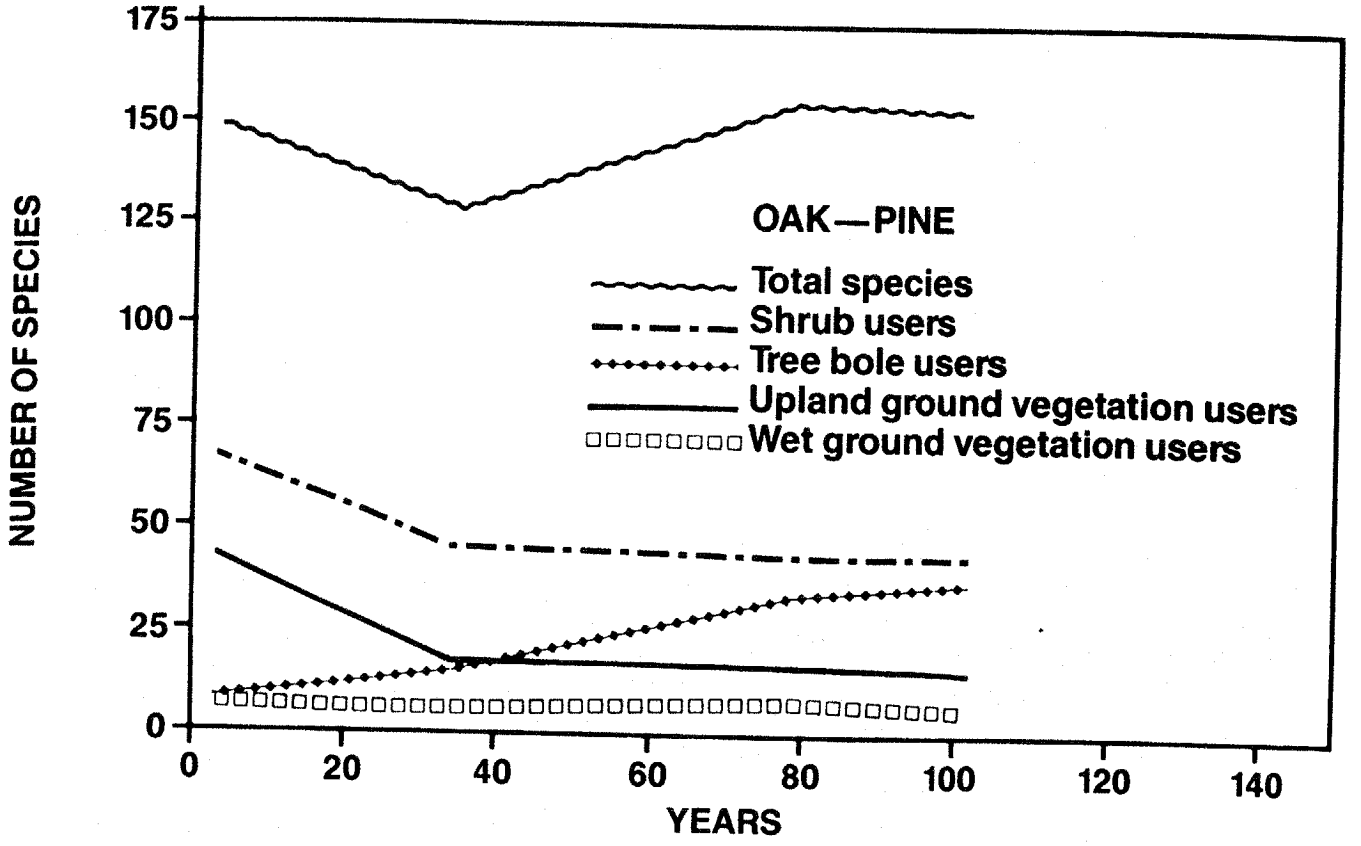
Species using the oak-pine cover type represent 93 percent of the species using the oak-pine group (red oak, oak-pine, and pine cover types combined). Tables 19 and 20 summarize potential wildlife species' use of structural habitat features associated with the oak-pine group with references to the red oak and pine types when noted.

Intermediate Treatment. In oak-pine on sandy soils, the usual intermediate treatments are non-commercial or commercial removal of hardwoods to favor pine, or the commercial thinning of oak stands to improve quality and growth. In these treatments it is important to maintain hardwood cavity trees (Fig. 12).

Low-density thinning in pine (oak-pine or old-field pine) is an accepted alternative in some areas. Midstory development is rapid, especially under old-field pine. Low-density treatments in oak are less common due to potential losses in quality from live-limb retention and epicormic branching. However, vigorous oak with well-formed crowns can be thinned gradually to low stand densities with no great loss in quality. In such low-density oak stands, midstory development of pine and some oak will be rapid.

Timber thinning with reserved wildlife trees (Table 20) results in habitats with potential species numbers similar to those in the stages of natural succession (Table 19). Timber thinning without reserved wildlife trees eliminates high exposed perches, medium- and large-diameter cavity trees, larger crowned nut-producing individuals, and reduces deciduous/coniferous overstory inclusions —features that are important to many wildlife species.

Regeneration. Oak and pine regenerate best under a moderately dense shelterwood series. Pine regenerates best when coupled with site preparation that eliminates unwanted understory stems and provides a mineral soil seedbed (Fig. 11). When the regeneration is roughly 4 feet tall, the overstory can be removed. However, with pine, the retention of scattered wildlife trees will help prevent weevil damage. First-stage dense shelterwood cuts in oak-pine resemble timber thinnings with reserved wildlife trees in the sawtimber-size classes (Table 20). The final cut in such a shelterwood series could resemble a clearcut with reserved wildlife trees.



Mean d.b.h. (in)	2–4	6–8	9–13	12–16	15–20	16–22	18–24
Basal area (ft^2)	60–120	180–240	220–280	240–300	250–320	250–320	250–320
No. stems per acre	1400–2000	600–1000	350–550	200–300	150–200	120–150	100–120
Maximum height (ft)	15–30	40–60	60–80	70–100	80–110	80–120	80–120
Maximum d.b.h. (in)	8–10	12–14	16–18	20–24	26–28	30–32	32–34

PINE FOLLOWED BY OAK



Mean d.b.h. (in)	3–4	5–7	7–9	9–11	11–14	12–16	13–17
Basal area (ft^2)	60–70	80–90	90–100	100–110	100–120	100–130	100–140
No. stems per acre	800–1200	350–600	250–350	160–250	120–160	95–125	90–100
Maximum height (ft)	30–50	40–70	50–80	65–90	70–100	75–100	80–100
Maximum d.b.h. (in)	8–10	10–14	14–16	16–20	20–24	24–26	24–28

OAK FOLLOWED BY PINE



Figure 18. – Oak-pine stand development and wildlife species occurrence.

Type Conversion. Oak-pine types in some areas can be converted to aspen-birch (which includes gray birch) by repeated clearcutting on a short rotation. Old-field pine naturally reverts to northern hardwoods, mixed oak-hardwoods, or hemlock—a process that is hastened by thinning.

Table 19. – Characteristic structural habitat features and potential number of species associated with natural succession in the oak-pine group

Size class	Structural habitat feature	Other associated cover types	Taxonomic class				
			Amphibians	Reptiles	Birds	Mammals	Total
Regeneration	Shrub layer	NRO,PP,WP [a]	0	0	46	21	67
	Herbaceous ground vegetation	NRO,PP,WP	0	2	29	11	42
Sapling pole	Closed canopy	NRO,PP,WP	0	0	14	8	22
	Overstory inclusions	PP	0	0	34	5	39
	Herbaceous ground vegetation	PP	0	1	10	7	18
Sawtimber	Closed canopy	NRO,PP,WP	0	0	22	9	31
	Overstory inclusions	PP	0	0	47	6	53
	Large tree boles	NRO	0	0	13	15	28
	Small dead trees	PP	0	0	11	3	14
	Midstory	PP	0	0	12	0	12
	Herbaceous ground vegetation	PP	0	1	10	6	17
	Mast	NRO,PP	0	0	13	18	31
Large sawtimber	High exposed perches		0	0	5	0	5
	Closed canopy	NRO,PP,WP	0	0	23	9	32
	Overstory inclusions	PP	0	0	46	6	52
	Large tree boles	NRO	0	0	16	15	31
	Small dead trees	PP	0	0	11	3	14
	Midstory	NRO,PP,WP	0	0	12	0	12
	Herbaceous ground vegetation	PP	0	1	9	6	16
	Mast	NRO,PP	0	0	11	18	29
All size classes	Duff and ground surfaces	NRO,PP,WP	9	6	11	19	45
	Subterranean	NRO,PP,WP	9	8	0	24	41

[a] PP = Pitch Pine; NRO = Oak-hardwood; WP = White Pine (old field).

Table 20. – Characteristic structural habitat features affected by and potential number of species associated with intermediate and regeneration cuttings in the oak-pine group

Stand treatment	Stand size	Structural habitat feature affected	Other associated cover types	Taxonomic class				
				Amphi-bians	Rep-tiles	Birds	Mam-mals	Total
Quality timber thinning	Sapling-pole	Closed canopy	NRO,PP,WP [a]	0	0	14	8	22
		Overstory inclusions	NRO,PP,WP	0	0	34	5	39
		Herbaceous ground vegetation	PP	0	1	10	7	18
	Sawtimber	Closed canopy	NRO,PP,WP	0	0	22	9	31
		Overstory inclusions		0	0	47	6	53
		Midstory	NRO,PP,WP	0	0	12	0	12
		Herbaceous ground vegetation	PP	0	1	10	6	17
		Mast	NRO	0	0	13	18	31
Timber thinning with reserved wildlife trees	Sapling-pole	Closed canopy	NRO,PP,WP	0	0	14	8	22
		Overstory inclusions	PP	0	0	34	5	39
		Small dead trees	NRO,PP	0	0	7	1	8
		Herbaceous ground vegetation	PP	0	1	10	7	18
	Sawtimber	Closed canopy	NRO,PP,WP	0	0	22	9	31
		Overstory inclusions	PP	0	0	47	6	53
		Large tree boles	NRO	0	0	13	15	28
		Herbaceous ground vegetation	PP	0	1	10	6	17
		Mast	NRO,PP	0	0	13	18	31
Low-density thinning	Sapling-pole	Partial canopy	NRO,PP,WP	0	0	13	4	17
		Overstory inclusions	PP	0	0	34	5	39
		Small dead trees	NRO,PP	0	0	7	1	8
		Shrub layer	NRO,PP,WP	0	0	29	16	45
		Herbaceous ground vegetation	PP	0	1	10	7	18
	Sawtimber	Partial canopy	NRO,PP,WP	0	0	13	4	17
		Overstory inclusions	PP	0	0	47	6	53
		Large tree boles	NRO	0	0	13	15	28
		Small dead trees	PP	0	0	11	3	14
		Midstory	NRO,PP,WP	0	0	12	0	12
		Herbaceous ground vegetation	PP	0	1	10	6	17
		Mast	NRO,PP	0	0	13	18	31

Continued

Table 20.—Continued

Stand treatment	Stand size	Structural habitat feature affected	Other associated cover types	Taxonomic class				
				Amphibians	Reptiles	Birds	Mammals	Total
Clear-cutting with reserved wildlife trees	Regeneration	High and exposed perches	NRO,PP,WP	0	0	15	0	15
		Large tree boles	NRO	0	0	3	4	7
		Small dead trees	PP	0	0	3	1	4
		Shrub layer	NRO,PP	0	0	46	21	67
		Herbaceous ground vegetation	PP	0	2	29	11	42
		Slash/dead and down material	NRO,PP,WP	1	4	4	15	24
		Mast	NRO,PP	0	0	13	16	29

[a] PP = Pitch Pine; NRO = Oak-hardwood; WP = White Pine (old field).

NONFORESTED HABITATS

Fields, wetlands, and other open or semi-open habitats are an integral part of the New England landscape. The decline of New England agriculture over the last 100 years has reduced these habitats to a fraction of their former extent. The open habitats maintained by agricultural activities remain an important cultural feature, especially in southern New England and portions of Vermont. The total proportion of such lands (cropland and pasture) in New England ranges from 3 to 13 percent as follows: Maine and New Hampshire, 3 percent each; Rhode Island, 4 percent; Massachusetts, 5 percent; Connecticut, 7 percent; and Vermont, 13 percent (U.S. Dep. Commer., Bur. Census 1989 a-f). The total proportion of freshwater wetlands in New England ranges from 4 to 25 percent as follows: New Hampshire and Vermont—4 percent each. Massachusetts, 9 percent; Connecticut and Vermont, 10 percent each; and Maine, 15 to 25 percent (Tiner 1984, 1989, and personal communication).

Nonforested habitats are important components of managed forests. Upland and wetland nonforest types provide basic habitats for distinct groups of species (that is, nonforest only and nonforest-water users) and seasonally important habitat elements for species that also use forest, krummholz, and water habitats (such as brood habitat for ruffed grouse and turkey, and early spring forage for deer after the stress of winter). Many bird species that breed in the Arctic spend the winter in open habitats in New England. Many types of nonforested habitats are important bird migration stops during northward and southward trips; wet fields are used by shorebirds, waterfowl, and pipits, among others. In the fall, seed-eating birds use upland and wetland nonforested habitats during southward migration. Wetlands tend to have different wildlife communities than do upland open habitats. These habitats also support species that are not found in forested habitats, such as box turtles, bank swallows, field sparrows, meadow voles, and many others.

The presence of upland and wetland nonforested habitats is necessary for almost 22 percent of the wildlife species found in New England today and seasonally important to another 70 percent of the region's species. Although these habitats constitute a relatively small proportion of the total landscape, nonforested habitats contribute a disproportionate share of potential wildlife habitat to the overa forest environment. The presence or absence c these habitats and water to a considerable exter limit the degree of forest diversity that can b achieved with respect to wildlife habitat.

Mixtures of habitat elements—forest types nonforest types, krummholz, and water — acros landscapes produce edges or boundaries betwee different habitats, successional stages, or plan communities. Two basic types of edges are: (1 those between mixtures of forest, nonforest krummholz, and water habitats; and (2) those produced by even-age management where stands of different ages abut one another.

Field-forest edges tend to be relatively long lasting and support distinct wildlife communities Mixtures of forested and nonforested habitats produce long-lasting brushy edge habitats for species that would not otherwise be found in either heavily forested or very open habitats. For example, one would expect to see Cooper's hawks, cardinals, indigo buntings, catbirds, song sparrows, cottontails, and foxes along these brushy edges between forested and nonforested habitat. Additionally, one might expect to see sharp-shinned hawks, ovenbirds, chipmunks, and weasels in the forest; and kestrels, field sparrows, and meadow voles in the field. The mix of forested and nonforested habitats produces a very diverse array of species in New England.

A distribution of stands of different size classes, on the other hand, produces edges that are relatively short-lived from a wildlife habitat standpoint and that do not support distinct wildlife communities. Although recognizable for decades, the importance of the edges to the bird community—the group of species most sensitive to habitat structure—ceases to be important after 10 to 15 years. For example, at the edge between a 5-year-old clearcut and a sawlog-sized stand of northern hardwoods, one would expect to see early successional species that will nest near the edge of the clearcut, such as chestnut-sided warblers, common yellowthroats, and willow flycatchers, and species from the mature stand such as black-capped chickadees, wood pewees, and downy woodpeckers that likewise will nest near the edge. In New England, edges between forest stands normally do not have unique assemblages of species as do ecotones—edges between different habitat types.

The following section describes upland and wetland nonforest and deepwater habitats that normally occur within forested habitats in New England. Several other special features, such as cliffs and caves are also described. Representative plant species are described as well as representative wildlife species.

Upland Nonforested Habitats

Under even-age management, timber harvest will provide early successional forested habitat. After clearcutting, woody growth usually occupies the site in 1 or 2 years, and the area left in grasses and other herbs is restricted to the landing and skid trails, and soon they too may begin to disappear as the regenerating stand develops. Old fields that contain a fair amount of shrubs and small trees have wildlife communities that are quite different from those communities found in regenerating stands. The difference is largely due to the amount of dense, continuous herbaceous cover, which lasts longer in old fields than in regeneration stands. Some species use both types of early successional uplands, for example, goldfinches, cedar waxwings, and song sparrows. But there are others that require fields, sedge meadows, or other primarily herbaceous openings, such as red-winged blackbirds; bobolinks; and savannah, vesper, and grasshopper sparrows. One would expect to see indigo buntings at forest-field edges, and northern orioles and warbling vireos singing and nesting near the tops of scattered trees in grassy openings. Regenerating clearcuts during the first 5 to 10 years support willow flycatchers, mourning and chestnut-sided warblers, Swainson's thrushes, rose-breasted grosbeaks, redstarts, and white-throated sparrows.

These examples demonstrate some of the differences in the wildlife communities that use grassy openings and forest regeneration. Both are early successional habitats, and fields will revert to forest eventually, but maintaining the full spectrum of potential wildlife species in an area requires the maintenance of some grassy habitats. Awareness of the differences in wildlife values of these early successional habitats is required to evaluate the availability of upland nonforested habitats and then recommend treatments that would maintain or develop these habitats through various management practices.

A well-developed herbaceous layer is possible on certain types of sites in New England, but it is usually a temporary condition in most stands with a significant overstory canopy. Frequent disturbance can maintain an herbaceous layer in managed stands, and this is one way of providing adequate brood habitat for ruffed grouse, for example, in lieu of grassy open habitats. Low-density thinnings or open shelterwood cuts also can be used to periodically develop an herbaceous layer. Although important to several forest-dwelling species, this type of temporary arrangement does not provide sufficient grassy habitat for those species that require only nonforested habitats.

Cultivated Fields. Tilled agricultural cropland provides preferred habitat for the following species:

Wildlife species	*Habitat-breadth category*
Eastern hognose snake	Forest-Nonforest
American kestrel	Forest-Nonforest
Ring-necked pheasant	Nonforest
Killdeer	Nonforest
Rock dove	Nonforest
Mourning dove	Forest-Nonforest
Common barn owl	Nonforest
Snowy owl	Nonforest
Northern flicker	Forest-Nonforest
Horned lark	Forest-Nonforest
Northern rough-winged swallow	Forest-Nonforest-Water
Barn swallow	Forest Nonforest-Water
American crow	Forest-Nonforest
American robin	Forest-Krummholz-Nonforest
European starling	Forest-Nonforest
Lapland longspur	Nonforest
Snow bunting	Nonforest
Red-winged blackbird	Nonforest
Common grackle	Forest-Nonforest-Water
Brown-headed cowbird	Forest-Nonforest
House sparrow	Nonforest
European hare	Forest-Nonforest
Woodchuck	Forest-Nonforest
Red fox	Forest-Krummholz-Nonforest
Raccoon	Forest-Nonforest
Striped skunk	Forest-Nonforest

Grass Openings. Upland grassy openings such as hayfields provide typical preferred habitats for the following species:

Wildlife species	*Habitat-breadth category*
Northern black racer	Forest-Nonforest
Eastern smooth green snake	Forest-Nonforest
Turkey vulture	Forest-Nonforest
Broad-winged hawk	Forest-Nonforest
Red-tailed hawk	Forest-Nonforest
Rough-legged hawk	Nonforest
American kestrel	Forest-Nonforest
Gray partridge	Nonforest

HAYFIELD



Lunenberg, Vermont
August 1987

Wildlife species	*Habitat-breadth category*
Ring-necked pheasant	Nonforest
Northern bobwhite	Forest-Nonforest
Horned lark	Forest-Nonforest
Northern rough-winged swallow	Forest-Nonforest-Water
Cliff swallow	Forest-Nonforest
Barn Swallow	Forest-Nonforest-Water
Northern shrike	Forest-Nonforest
Indigo bunting	Forest-Nonforest
Field sparrow	Forest-Nonforest
Vesper sparrow	Nonforest
Savannah sparrow	Nonforest
Grasshopper sparrow	Nonforest
Song sparrow	Forest-Nonforest
Bobolink	Nonforest
Eastern meadowlark	Nonforest
Common redpoll	Forest-Nonforest
Hoary redpoll	Forest-Nonforest
Pine siskin	Forest-Nonforest
Least shrew	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
Woodchuck	Forest-Nonforest
Meadow vole	Forest-Nonforest

Wildlife species that use only nonforest types tend to be found using larger grassy openings (more than 5 to 10 acres); species with wider habitat-breadth combinations (habitat generalists) can be found using smaller-size openings.

Forb Openings. Upland openings composed predominantly of broad-leaved herbaceous cover, for example, goldenrod (*Solidago* spp.), sensitive fern (*Onoclea* spp.), and various clovers, typically provide preferred habitat for the following species:

Wildlife species	*Habitat-breadth category*
Henslow's sparrow	Nonforest
Common redpoll	Forest-Nonforest
Hoary redpoll	Forest-Nonforest
Pine siskin	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
Woodchuck	Forest-Nonforest
Meadow vole	Forest-Nonforest

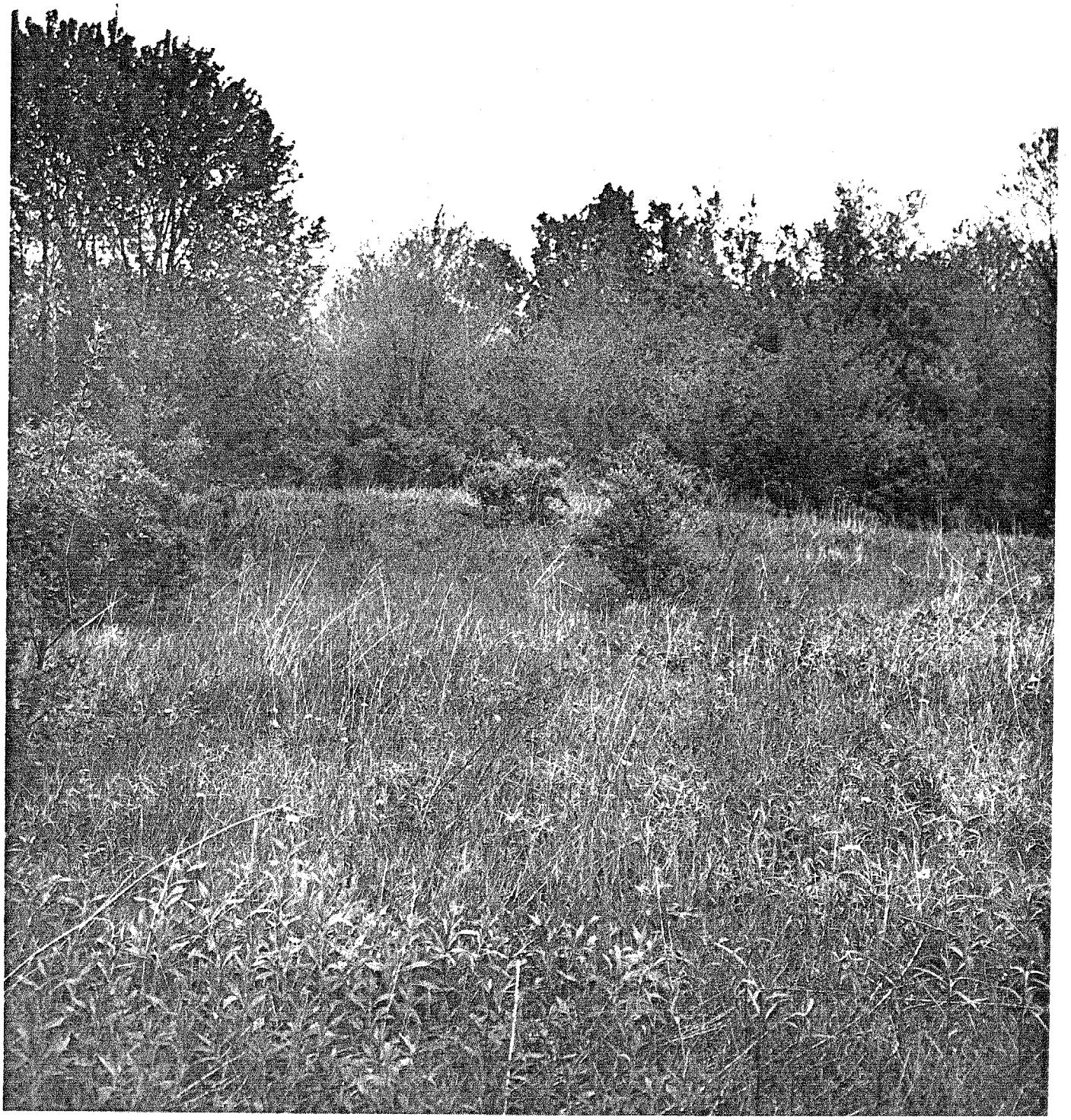
Shrub Openings. Abandoned agricultural fields reverting to forest and characterized by old-field grasses, shrubs, and small trees, or barrens on shallow or other dry sites persisting in shrubs such as blueberry, (*Vaccinium* spp.), or huckleberry (*Gaylussacia* spp.) provide typical preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Black rat snake	Forest-Nonforest
Ring-necked pheasant	Nonforest
Willow flycatcher	Forest-Nonforest
Northern mockingbird	Forest-Nonforest
Blue-winged warbler	Forest-Nonforest
Golden-winged warbler	Forest-Nonforest
Fox sparrow	Forest-Nonforest
White-throated sparrow	Forest-Krummholz-Nonforest
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Nonforest
Snowshoe hare	Forest-Krummholz-Nonforest
White-footed mouse	Forest-Krummholz-Nonforest
Ermine	Forest-Nonforest
Striped skunk	Forest-Nonforest

Pasture. Upland fields or meadows usually too wet or rocky for cultivation and grazed by cattle provide typical preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Spotted turtle	Nonforest-Water
Red-eared slider	Nonforest-Water
Eastern hognose snake	Forest-Nonforest
Eastern smooth green snake	Forest-Nonforest
Turkey vulture	Forest-Nonforest
Broad-winged hawk	Forest-Nonforest
Red-tailed hawk	Forest-Nonforest
Rough-legged hawk	Nonforest
American kestrel	Forest-Nonforest
Upland sandpiper	Nonforest
American woodcock	Forest-Nonforest
Brown thrasher	Forest-Nonforest
Northern shrike	Forest-Nonforest
Common yellowthroat	Forest-Nonforest
Yellow-breasted chat	Forest-Nonforest
Field sparrow	Forest-Nonforest
American goldfinch	Forest-Nonforest
Eastern mole	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
Woodchuck	Forest-Nonforest
Meadow vole	Forest-Nonforest

SHRUB–OLD FIELD



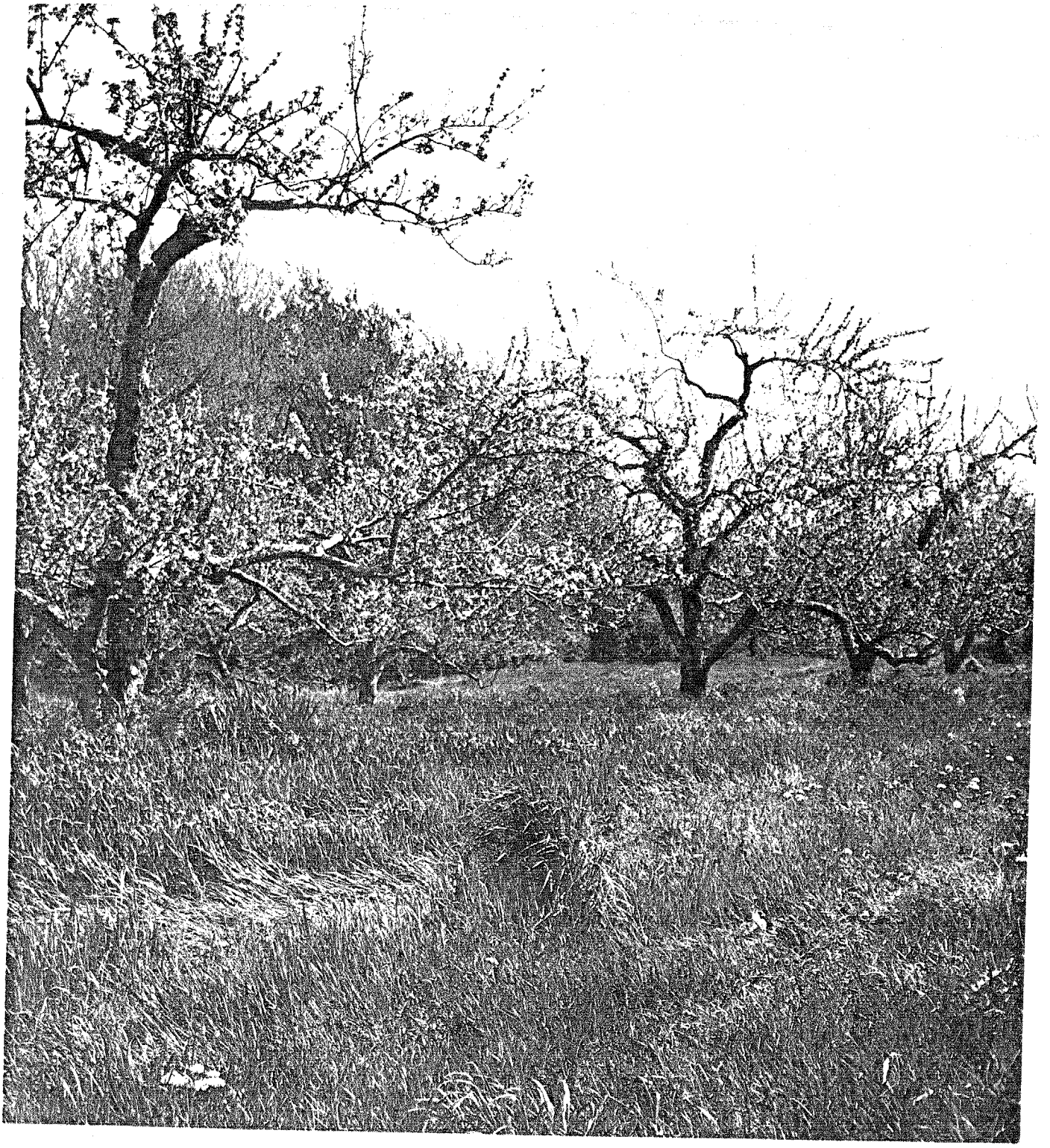
Belchertown, Massachusetts
May 1990

PASTURE



Montague, Massachusetts
May 1990

ORCHARD



Amherst, Massachusetts
May 1990

KRUMMHOLZ



Kilkenny, New Hampshire
June 1989

Savanna. A grasslands type with shrubs and widely and irregularly scattered trees, resulting from either soil-moisture regimes or disturbances such as fire and grazing provides typical preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Northern shrike	Forest-Nonforest
Loggerhead shrike	Forest-Nonforest
Chipping sparrow	Forest-Nonforest
Northern oriole	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
Woodchuck	Forest-Nonforest

Orchards. Stands of fruit trees, usually apples and not necessarily maintained for fruit production, with a dense grassy-herbaceous ground cover provide typical preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Yellow-bellied sapsucker	Forest-Nonforest
Eastern kingbird	Forest-Nonforest
White-breasted nuthatch	Forest-Nonforest
Eastern bluebird	Forest-Nonforest
Orchard oriole	Forest-Nonforest
Eastern cottontail	Forest-Nonforest
Woodchuck	Forest-Nonforest
Meadow vole	Forest-Nonforest
Woodland vole	Forest-Nonforest
Black bear	Forest-Nonforest-Water

Other species such as ruffed grouse and eastern screech owls also use orchards regularly for foraging and nesting.

Krummholz and Alpine Zones. The subalpine forest and alpine zones generally above 3,500 feet in elevation are characterized by smaller, windsheared trees (especially spruce) below timberline; and by low shrubby, slow-growing woody plants, and ground cover of boreal lichens, sedges, and grasses above timberline. This type provides typical preferred habitat for the following species:

Wildlife species	*Habitat-breadth category*
Gray-cheeked thrush	Forest-Krummholz
Blackpoll warbler	Forest-Krummholz
White-throated sparrow	Forest-Krummholz-Nonforest
Dark-eyed junco	Forest-Krummholz-Nonforest
Pine grosbeak	Forest-Krummholz-Nonforest
Snowshoe hare	Forest-Krummholz-Nonforest
Rock vole	Forest-Krummholz-Nonforest
Lynx	Forest-Krummholz-Nonforest
Moose	Forest-Krummholz-Nonforest-Water

Wetland Nonforested Habitats

Wetlands are transitional habitats between terrestrial (upland) and aquatic systems and here include various palustrine wetlands. In wetland habitats, the degree of water saturation largely determines the soil conditions and degree of soil development, and the types of plant and animal communities that the wetlands support. Hydrophytes are the dominant plants. The single feature that most wetlands share is soil or substrate that is at least periodically saturated or flooded by water.

Palustrine wetlands are dominated by emergents, mosses, lichens, persistent emergents, shrubs, and trees, and include sedge meadows, shallow and deep fresh marshes, shrub swamps, bogs, and ponds (Cowardin et al. 1979). Sedge meadow wildlife communities are somewhat similar to those in upland openings, but species such as ribbon snakes, rails, snipe, sedge wrens, and star-nosed moles are primarily associated with wetter sedge meadow community. The presence of water year-round in fresh marshes, shrub swamps, and ponds is essential to the various amphibians, turtles, waterfowl, and numerous aerial feeders that differentiate wetland from upland nonforested wildlife communities. Virtually all wetlands are important to aerial feeding birds and bats.

Sedge Meadows. Wetlands are characterized by sedges (***Carex*** spp.) and cattails (***Typha*** spp.), surface water depths to 6 inches in winter and early spring, and exposed but saturated soil surface in summer, and typically provide habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Northern leopard frog	Forest-Nonforest-Water
Spotted turtle	Nonforest-Water
Bog turtle	Forest-Nonforest-Water
Easter ribbon snake	Forest-Nonforest-Water
Northern snake	Nonforest-Water
Sedge wren	Nonforest-Water
Henslow's sparrow	Nonforest
Virginia opossum	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
Short-tailed shrew	Forest-Krummholz-Nonforest
Star-nosed mole	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
Southern bog lemming	Forest-Krummholz-Nonforest
Northern bog lemming	Forest Krummholz-Nonforest
Meadow jumping mouse	Forest-Nonforest

Shallow Marshes. Wetlands characterized by persistent emergent vegetation such as *Typha* and *Pontederia*, and water depths to 1.5 feet typically provide preferred habitat for the following species:

Wildlife species	*Habitat-breadth category*
Northern spring peeper	Forest-Nonforest-Water
Northern leopard frog	Forest-Nonforest-Water
Spotted turtle	Nonforest-Water
Midland painted turtle	Nonforest-Water
Blanding's turtle	Nonforest-Water
Northern ribbon snake	Nonforest-Water
Pied-billed grebe	Nonforest-Water
American bittern	Nonforest-Water
Least bittern	Nonforest
Great blue heron	Forest-Nonforest-Water
Green-backed heron	Forest-Nonforest-Water
Canada goose	Nonforest-Water
Green-winged teal	Nonforest
American black duck	Forest-Nonforest-Water
Mallard	Nonforest-Water
Blue-winged teal	Nonforest
Northern shoveler	Nonforest
Northern harrier	Nonforest
King rail	Nonforest
Virginia rail	Nonforest
Sora	Nonforest
Common moorhen	Nonforest-Water
Black tern	Nonforest-Water
Eastern screech owl	Forest-Nonforest
Tree swallow	Forest-Nonforest-Water
Red-winged blackbird	Nonforest
American goldfinch	Forest-Nonforest
Virginia opossum	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired myotis	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
Muskrat	Nonforest-Water
Southern bog lemming	Forest-Krummholz-Nonforest
Meadow jumping mouse	Forest-Nonforest
Raccoon	Forest-Nonforest
Mink	Forest-Nonforest-Water

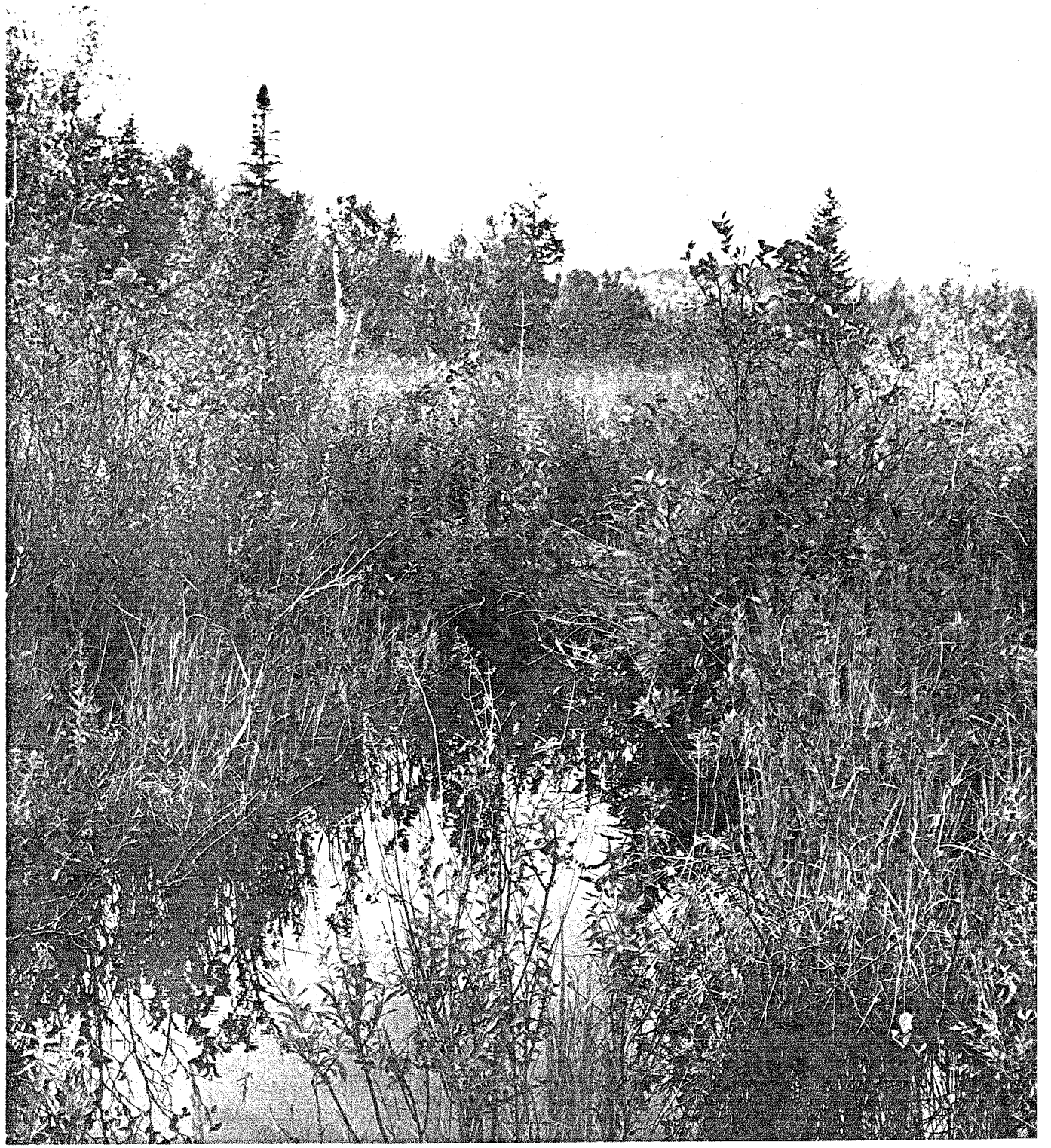
Deep Marshes. Wetlands characterized by emergent vegetation such as *Typha* and *Pontederia*, and floating-leaved plants such as *Nymphaea*, *Nuphar*, and *Brasenia*, and water depths to 6 feet typically provide preferred habitats for the following species:

Wildlife species	*Habitat-breadth category*
Red-spotted newt	Forest-Nonforest-Water
Spotted turtle	Nonforest-Water
Red-eared slider	Nonforest-Water
Eastern painted turtle	Forest-Nonforest-Water
Pied-billed grebe	Nonforest-Water
Gadwall	Nonforest-Water
American coot	Nonforest-Water
Virginia opossum	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Muskrat	Nonforest-Water
Raccoon	Forest-Water
Mink	Forest-Nonforest-Water
Moose	Forest-Krummholz-Nonforest-Water

Shrub Swamps. Wetlands dominated by woody shrubs such as buttonbush *(Cephalanthus occidentalis)*, alder (*Alnus* spp.), silky dogwood *(Cornus ammomum)*, and saplings of red maple *(Acer rubrum)* and white ash *(Fraxinus americana)* typically provide preferred habitat for the following species:

Wildlife species	*Habitat-breadth category*
Spotted turtle	Nonforest-Water
Blanding's turtle	Nonforest-Water
Black-crowned night heron	Nonforest-Water
Yellow-crowned night heron	Nonforest-Water
Glossy ibis	Nonforest
Red-shouldered hawk	Forest-Nonforest
Common snipe	Nonforest
Yellow-bellied flycatcher	Forest-Nonforest
Alder flycatcher	Forest-Nonforest
White-eyed vireo	Forest-Nonforest
Common yellowthroat	Forest-Nonforest

SHRUB SWAMP



Berlin, New Hampshire
July 1983

Wildlife species	*Habitat-breadth category*
Hooded warbler	Forest-Nonforest
Song sparrow	Forest-Nonforest
Swamp sparrow	Forest-Nonforest
Common grackle	Forest-Nonforest-Water
American goldfinch	Forest-Nonforest
Virginia opossum	Forest-Nonforest
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Eastern cottontail	Forest-Nonforest
New England cottontail	Forest-Nonforest
Snowshoe hare	Forest-Krummholz-Nonforest
Raccoon	Forest-Nonforest
Lynx	Forest-Krummholz-Nonforest

Bogs. Wetlands characterized by peat accumulation—usually as a floating mat of vegetation—due to cold acidic conditions typically provide preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Four-toed salamander	Forest-Nonforest-Water
Northern spring salamander	Forest-Nonforest-Water
Pickerel frog	Forest-Nonforest-Water
Spotted turtle	Forest-Nonforest-Water
Bog turtle	Forest-Nonforest-Water
Blanding's turtle	Nonforest-Water
Eastern ribbon snake	Forest-Nonforest-Water
Northern ribbon snake	Nonforest-Water
Northern hawk-owl	Forest-Nonforest
Great gray owl	Forest-Nonforest
Boreal owl	Forest-Nonforest
Olive-sided flycatcher	Forest-Nonforest
Palm warbler	Forest-Nonforest
Wilson's warbler	Forest-Nonforest
Lincoln's sparrow	Forest-Nonforest
Rusty blackbird	Forest-Nonforest-Water
Masked shrew	Forest-Krummholz-Nonforest
Water shrew	Forest-Nonforest-Water
Smoky shrew	Forest-Nonforest
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Snowshoe hare	Forest-Krummholz-Nonforest
Northern bog lemming	Forest-Krummholz-Nonforest
Raccoon	Forest-Nonforest

Ponds. Small (≤ 20 acres) permanent palustrine bodies of water characterized by emergent or floating-leaved plants, or both, typically provide preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Jefferson salamander	Forest-Nonforest
Silvery salamander	Forest-Nonforest
Blue-spotted salamander	Forest-Nonforest
Tremblay's salamander	Forest-Nonforest
Spotted salamander	Forest-Nonforest-Water
Fowler's toad	Forest-Nonforest-Water
Northern spring peeper	Forest-Nonforest-Water
Bullfrog	Forest-Nonforest-Water
Pickerel frog	Forest-Nonforest-Water
Stinkpot	Nonforest-Water
Red-eared slider	Nonforest-Water
Plymouth redbelly turtle	Nonforest-Water
Eastern painted turtle	Forest-Nonforest-Water
Midland painted turtle	Nonforest-Water
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Beaver	Forest-Nonforest-Water
Mink	Forest-Nonforest-Water
Moose	Forest-Nonforest-Water

Deepwater Habitats

Deepwater or lacustrine habitats are permanently flooded lands below the deepwater boundary of wetlands. Water is generally too deep to support emergent vegetation. The presence of these aquatic habitats within forested landscapes greatly increases the number of wildlife species that can potentially occur.

Lakes. Lacustrine habitats are characterized by the following features: (1) water depth at least 6.5 feet; (2) situated in topographic depressions or dammed river channels; (3) lack of trees, shrubs, persistent emergents, emergent mosses or lichens with more than 30 percent areal coverage, and (4) total area exceeds 10 acres. Lacustrine habitats and their associated lakeshore riparian zones typically provide preferred habitat for the following wildlife species:

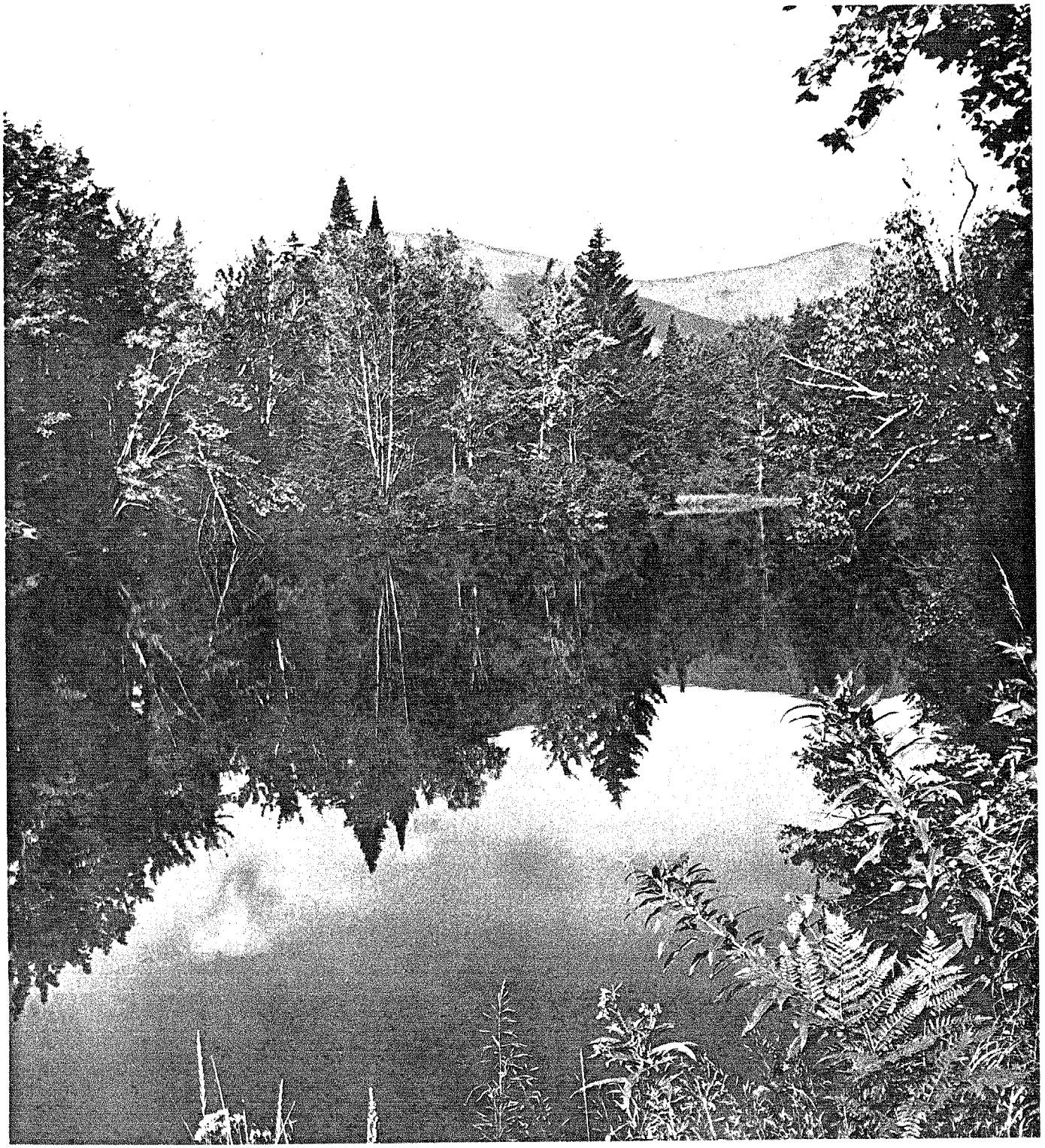
Wildlife species	*Habitat-breadth category*
Mudpuppy	Nonforest-Water
Marbled salamander	Forest-Nonforest-Water
Red-spotted newt	Forest-Nonforest-Water
Fowler's toad	Forest-Nonforest-Water
Bullfrog	Forest-Nonforest-Water

BEAVER POND



West Salem, Massachusetts
October 1989

LACUSTRINE HABITAT



Berlin, New Hampshire
July 1984

Wildlife species	*Habitat-breadth category*
Mink frog	Forest-Nonforest-Water
Pickerel frog	Forest-Nonforest-Water
Snapping turtle	Forest-Nonforest-Water
Stinkpot	Nonforest-Water
Map turtle	Nonforest-Water
Plymouth redbelly turtle	Nonforest-Water
Eastern painted turtle	Forest-Nonforest-Water
Blanding's turtle	Nonforest-Water
Northern water snake	Forest-Nonforest-Water
Common loon	Nonforest-Water
American wigeon	Nonforest-Water
Ring-necked duck	Nonforest-Water
Common goldeneye	Forest-Nonforest-Water
Hooded merganser	Forest-Nonforest-Water
Common merganser	Forest-Nonforest-Water
Red-breasted merganser	Nonforest-Water
Bald eagle	Forest-Water
Common raven	Forest-Krummholz-Nonforest-Water
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Beaver	Forest-Nonforest-Water
Mink	Forest-Nonforest-Water
River otter	Forest-Nonforest-Water
Moose	Forest-Krummholz-Nonforest-Water

Streams. Intermittent or permanent water courses with slow water velocities (<30 cubic feet per second at high-flow periods) typically provide preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Mudpuppy	Nonforest-Water
Marbled salamander	Forest-Nonforest-Water
Northern dusky salamander	Forest-Nonforest-Water
Mountain dusky salamander	Forest-Water
Northern spring salamander	Forest-Nonforest-Water
Northern two-lined salamander	Forest-Nonforest-Water
Mink frog	Forest-Nonforest-Water
Pickerel frog	Forest-Nonforest-Water
Spotted turtle	Nonforest-Water
Bog turtle	Forest-Nonforest-Water
Wood turtle	Forest-Nonforest-Water
Northern water snake	Forest-Nonforest-Water
Eastern ribbon snake	Forest-Nonforest-Water
Spotted sandpiper	Nonforest-Water
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Beaver	Forest-Nonforest-Water
Mink	Forest-Nonforest-Water
River otter	Forest-Nonforest-Water
Moose	Forest-Krummholz-Nonforest-Water

Rivers. Wetland and deepwater habitats that are contained in a channel through which the water flows (water velocities >30 cubic feet per second at low flow) and with the associated forested riparian zones typically provide preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Mudpuppy	Nonforest-Water
Marbled salamander	Forest-Nonforest-Water
Snapping turtle	Forest-Nonforest-Water
Stinkpot	Nonforest-Water
Map turtle	Nonforest-Water
Eastern spiny softshell	Water
Northern water snake	Forest-Nonforest-Water
Spotted sandpiper	Nonforest-Water
Water shrew	Forest-Nonforest-Water
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Beaver	Forest-Nonforest-Water
Mink	Forest-Nonforest-Water
River otter	Forest-Nonforest-Water
Moose	Forest-Krummholz-Nonforest-Water

Riparian zones are especially valuable habitat for many species such as mink, otter, beaver, and especially for cavity dwellers such as raccoons. Streams and rivers attract many kinds of wildlife; not only the water but also the ecotonal habitats usually associated with water courses provide habitats for species not directly associated with either the water or the adjacent forest or meadow. Forest management along water courses or shores probably has the potential to affect more wildlife species than anywhere else, because of the number of ecotonal microhabitats involved. Cavity trees along watercourses are preferentially used by many species—many large trees tend to occur in such habitats and those that lean are preferentially used by woodpeckers.

Special Features

Certain habitat components occur independently of forest cover type or management activity: streams, ponds, cliffs, caves, and even derelict buildings. These and other habitat features are important to many wildlife species, and their values differ depending on the surrounding or adjacent forest or nonforest types. Thus, wildlife species use is indirectly affected by forest management.

Stable Banks. Stable, grassy-topped sand or gravel banks resulting from excavation activities or naturally cut stream banks typically provide preferred habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Belted kingfisher	Nonforest-Water
Bank swallow	Forest-Nonforest-Water
Woodchuck	Forest-Nonforest
Coyote	Forest-Krummholz-Nonforest
Red fox	Forest-Krummholz-Nonforest
Gray fox	Forest-Nonforest

Cliffs, Ledge, Talus, and Outcrops. These geological features typically provide preferred nesting and denning sites for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Northern copperhead	Forest-Krummholz-Nonforest-Water
Timber rattlesnake	Forest-Nonforest-Water
Golden eagle	Forest-Krummholz-Nonforest
Peregrine falcon	Forest-Nonforest
Common raven	Forest-Krummholz-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Porcupine	Forest-Krummholz-Nonforest

Caves. Caves provide a unique and preferred habitat for the following wildlife species:

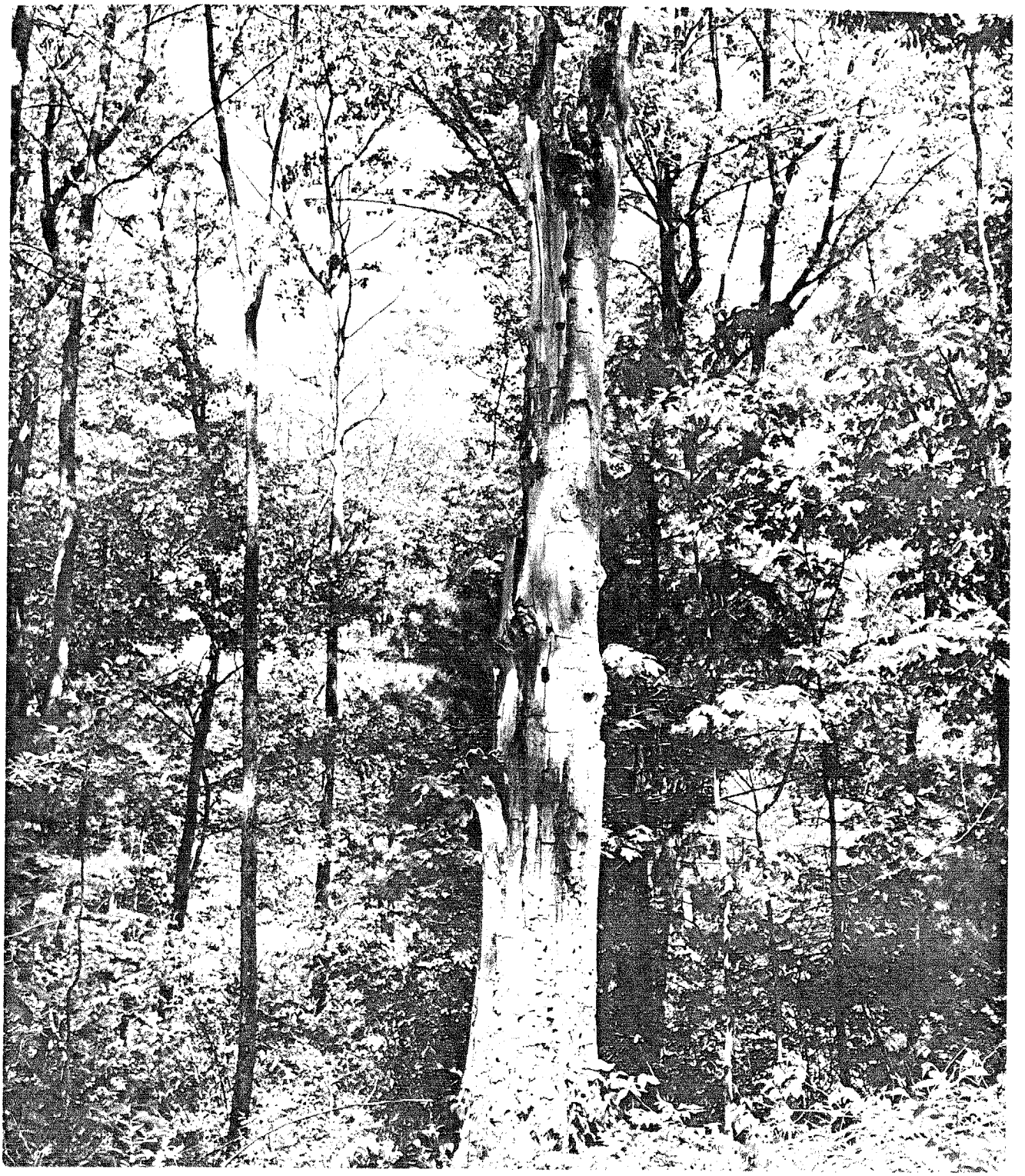
Wildlife species	*Habitat-breadth category*
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Indiana myotis	Forest-Nonforest-Water
Small-footed myotis	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Porcupine	Forest-Krummholz-Nonforest

Structures. Derelict and rarely used buildings and barns, and structures such as bridge supports provide preferred nesting habitat for the following wildlife species:

Wildlife species	*Habitat-breadth category*
Eastern milk snake	Forest-Nonforest-Water
Rock dove	Nonforest
Common barn-owl	Nonforest
Chimney swift	Nonforest
Eastern phoebe	Forest-Nonforest
Cliff swallow	Forest-Nonforest
Barn swallow	Forest-Nonforest-Water
European starling	Forest-Nonforest
House sparrow	Nonforest
Little brown myotis	Forest-Nonforest-Water
Keen's myotis	Forest-Nonforest-Water
Silver-haired bat	Forest-Nonforest-Water
Eastern pipestrelle	Forest-Nonforest-Water
Big brown bat	Forest-Nonforest-Water
Deer mouse	Forest-Krummholz-Nonforest
Norway rat	Nonforest
House mouse	Nonforest

Other habitat features-cavity tree, high exposed perch, partial overstory, understory and midstory development, and softwood inclusion in hardwood forest.

CAVITY TREE



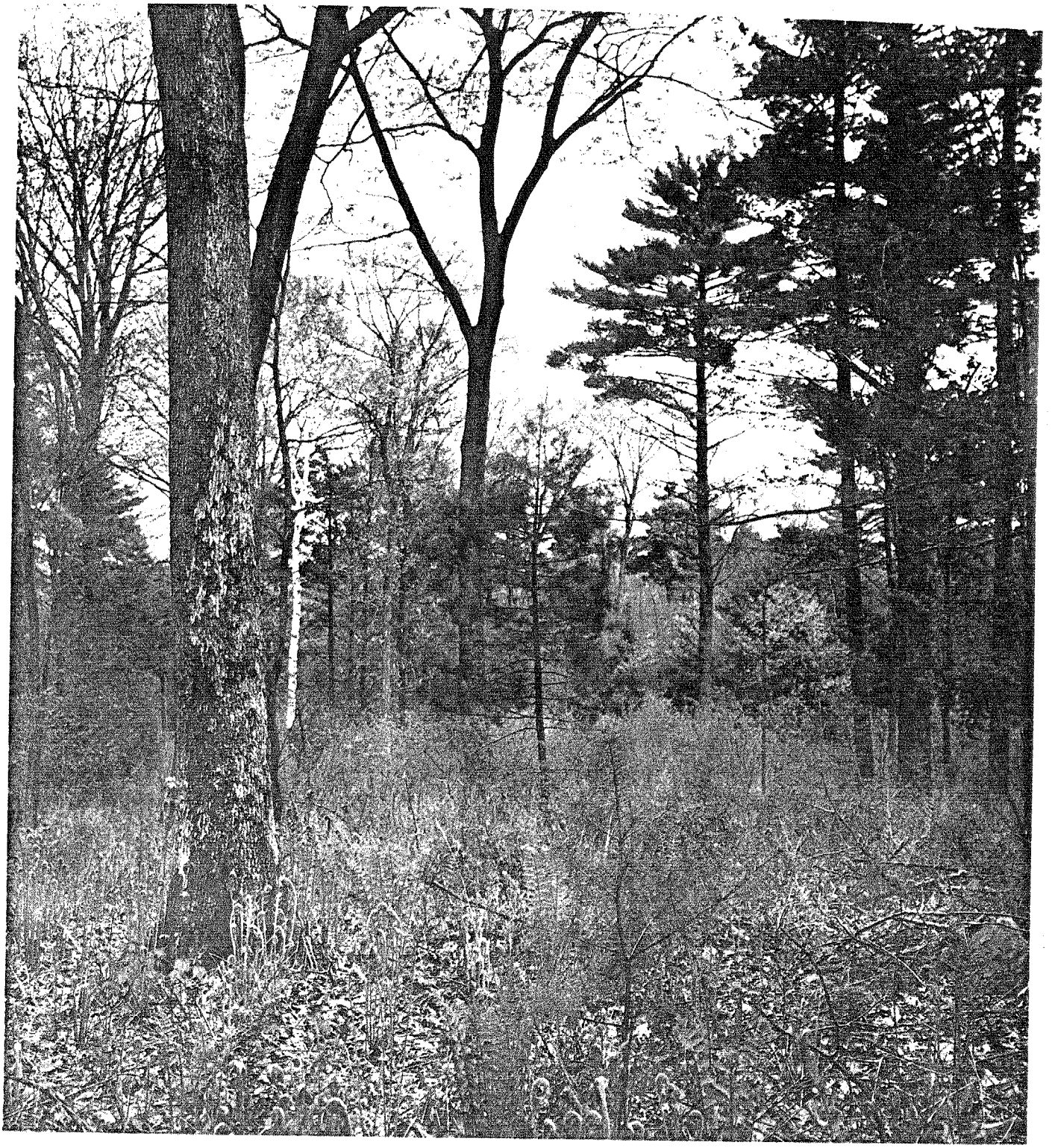
Belchertown, Massachusetts
June 1990

HIGH EXPOSED PERCH



West Milan, New Hampshire
July 1986

PARTIAL OVERSTORY



Belchertown, Massachusetts
May 1990

UNDERSTORY AND MIDSTORY DEVELOPMENT



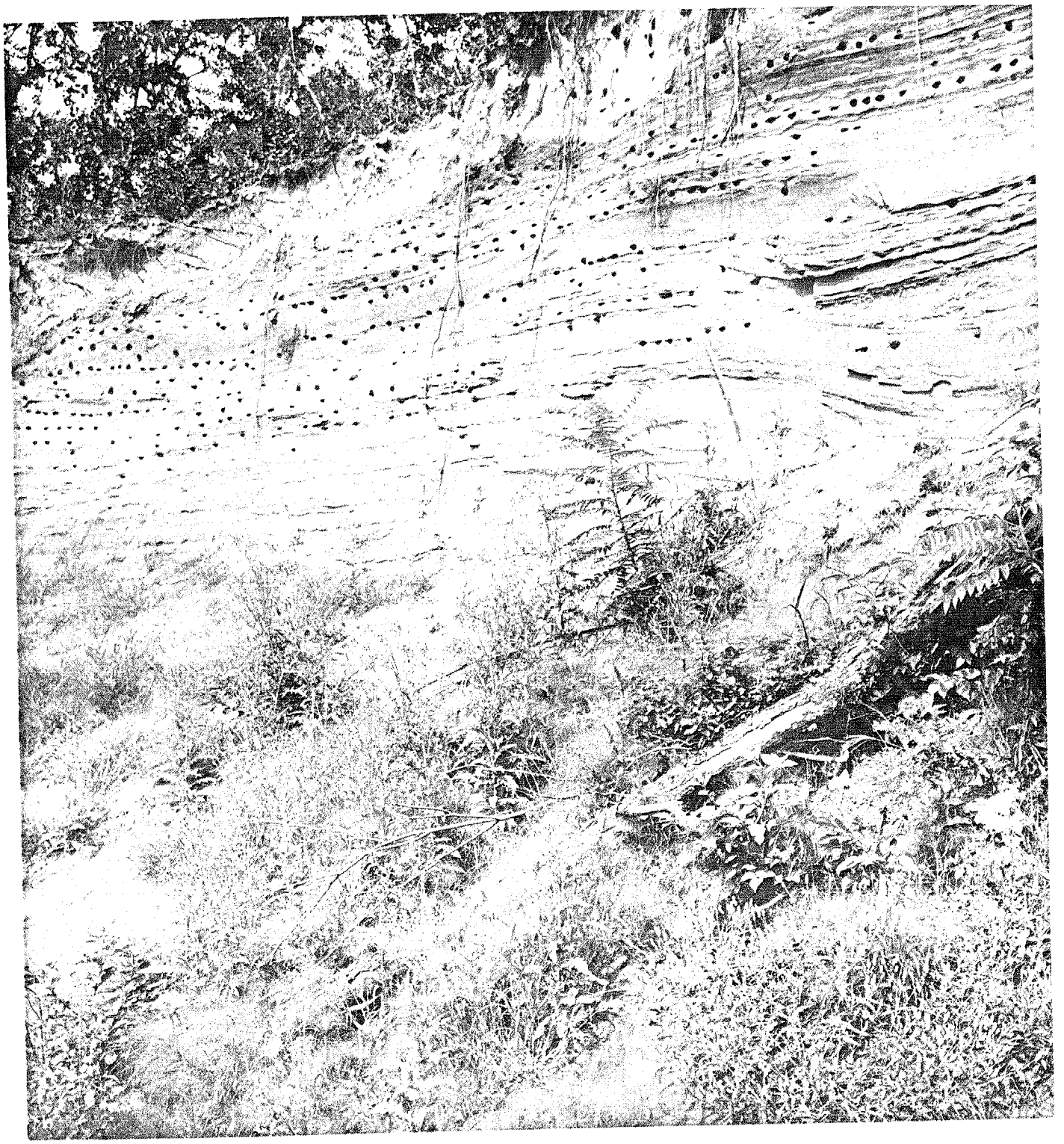
Bartlett, New Hampshire
June 1990

SOFTWOOD INCLUSION IN HARDWOOD FOREST



Guilford, Vermont
May 1990

BANK SWALLOW COLONY



Bellows Falls, Vermont
August 1990

SUMMARY

When a landowner's primary goal is to maintain or enhance wildlife habitat diversity, a habitat composition goal, based on the inherent capability and diversity of the landscape, needs to be applied. The following steps can be taken to develop management strategies and prescriptions for these habitat composition goals. These steps take into account the complex nature of species' food chains and food webs of various wildlife communities, as well as the capability of the landscape to provide a variety of needed habitat conditions across a range of sites.

The first step is to evaluate the potential wildlife habitat capability of the property or forest, which depends foremost on the combinations of forest, nonforest, water, and krummholz habitat conditions that exist on the property and surrounding area. Landscapes with all four habitat conditions have more potential wildlife habitat capability than landscapes with only one or two broad habitat conditions.

The second step is to inventory the existing cover-type and size-class distribution, and compare existing vegetation with desired habitat composition goals. Goals need to reflect the breadth of forest habitat conditions desired, range of site conditions available, and the types of forest products currently available and desired throughout the property and surrounding area. No individual cover-type group or size class supplies all of the habitat requirements needed by the 266 wildlife species using New England forested habitats throughout the year (Fig.19).

After establishing habitat composition goals: (a) determine the silvicultural options needed to

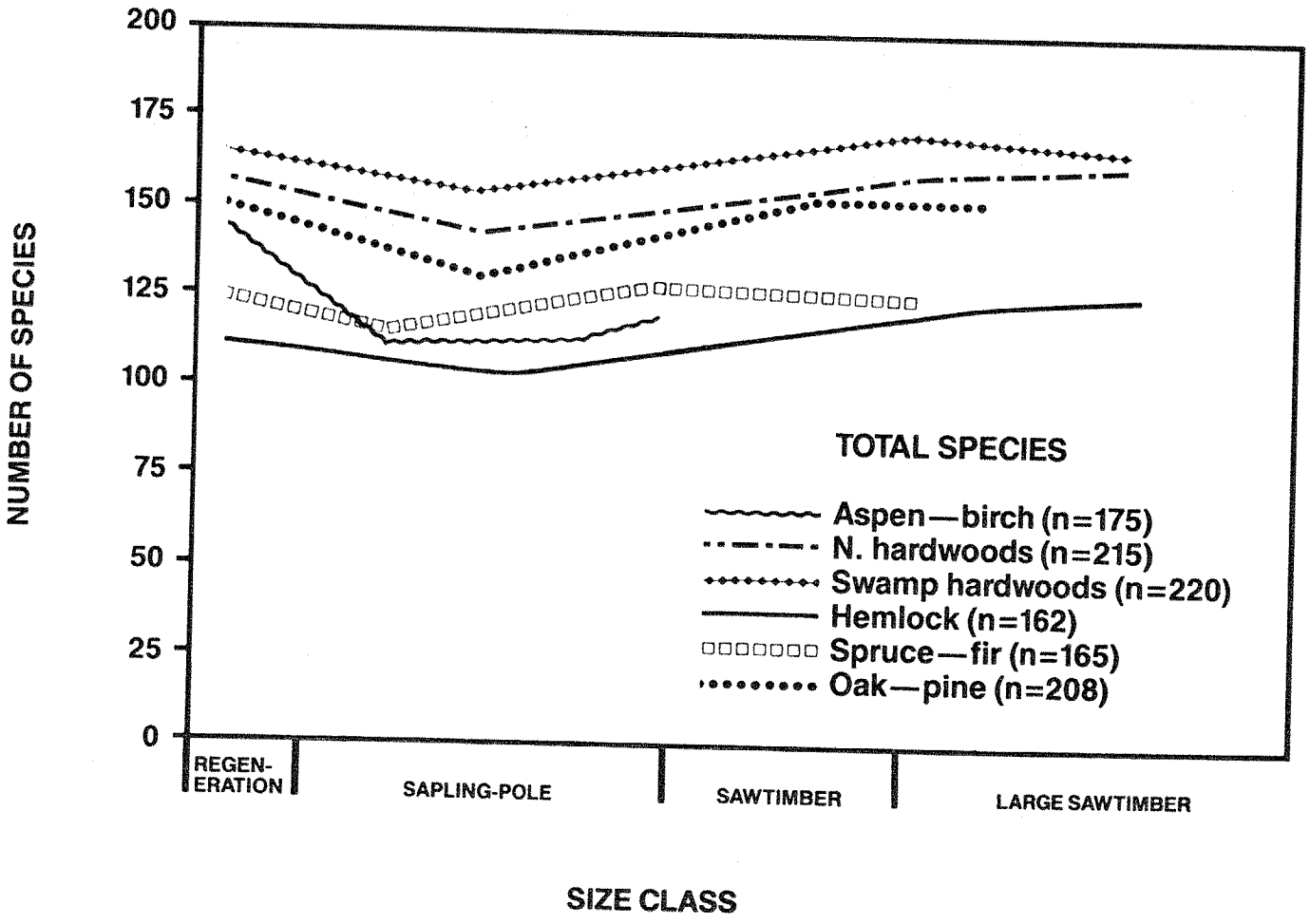


Figure 19. – Total number of species that use forested habitats, by cover-type group.

regenerate the existing cover types given; (b) determine the silvicultural options needed to begin adjusting size-class considerations; (c) determine the limitations of ownership constraints (for example, size of canopy breaks, silvicultural practices not allowed, size of ownership, management cycle or time to stand re-entry) and alternative ways to proceed; and (d) decide with the landowner which vegetative management treatments need to be completed first to meet the short-term management objectives.

After completing steps 1 and 2, the third step for the forest manager is to decide how to provide the important structural habitat features for a wide range of wildlife species in time and space on a property or forest. Various silvicultural treatments provide established ways of manipulating vegetative structure either through direct or indirect effects over time.

Direct effects include overstory removals and intermediate thinnings that (a) remove live and dead standing stems and increase residual basal-area growth, (b) affect the degree of canopy closure, (c) retain or remove cavity and mast trees, and (d) affect the amount of dead and down woody material on the forest floor. Dead and live trees with cavities, mast tree retention and development, and dead and down woody material can be provided adequately through even-age and uneven-age management. High exposed perches and low perches are usually associated with even-age management, though high supra-canopy nesting opportunities can be developed with uneven-age methods.

Indirect effects include changes in herbaceous, shrub, and midstory layer responses to overstory removals, improvement cuts, and intermediate thinnings across the range of site conditions. Even-age and uneven-age management routinely produce changes in these vegetative layers.

Even-age management provides opportunities to regenerate intolerant hardwoods such as aspen and paper birch cover types by clearcutting, opportunities that uneven-age management systems do not provide. The indirect effects on harvested areas include a flush of herbaceous ground cover after the first several years, followed by the development of a significant shrub layer of commercial and noncommercial woody seedlings and sprouts within 5 years. This shrub layer usually grows into a densely stocked sapling stand within 10 years after cutting. Shelterwood systems with residual canopy closures less than 50 percent provide some of these habitat conditions for several years post-harvest also. These types of stand regeneration practices produce distinct and recognizable forage and shelter opportunities for numerous species that are not usually available when using uneven-age management (Fig. 20).

Even-age management provides more potential habitat conditions for up to 26 percent more species that uneven-age management that regenerates similar cover types. Bird species display a greater sensitivity to silvicultural treatment than other taxonomic groups. Forests that contain a distribution of regeneration, sapling-poletimber, sawtimber, and large sawtimber in distinct units of 5 acres and larger and treated with even-age management can provide more potential habitats than uneven-age management, when applied at a appropriate scale so that entire landscapes are not affected during any one management period.

Uneven-age management provides opportunities to manage large and small properties for essentially continuous overstory canopies and intermixed size classes of tolerant hardwoods and softwoods by single-tree selection. Indirect effects on harvested areas vary with the degree of residual canopy closure and range of site conditions. With residual canopy closures usually greater than 70 percent, minimal herbaceous ground cover and shrub conditions are expected, and midstory layers usually develop. Proportions of intolerant and midtolerant tree species 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 broken up by discontinuity in soils, geology, elevation, and drainage pattern that lead to variation in species composition, variation in response to treatment, and sometimes it is necessary to use even-age methods interspersed with the general uneven-age method.

Group selection, using openings up to 1 to 2 acres in size, is a form of uneven-age management that provides habitat conditions 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 the openings. Intolerant species regenerate in the larger groups, while intermediate and tolerant species dominate the small openings.

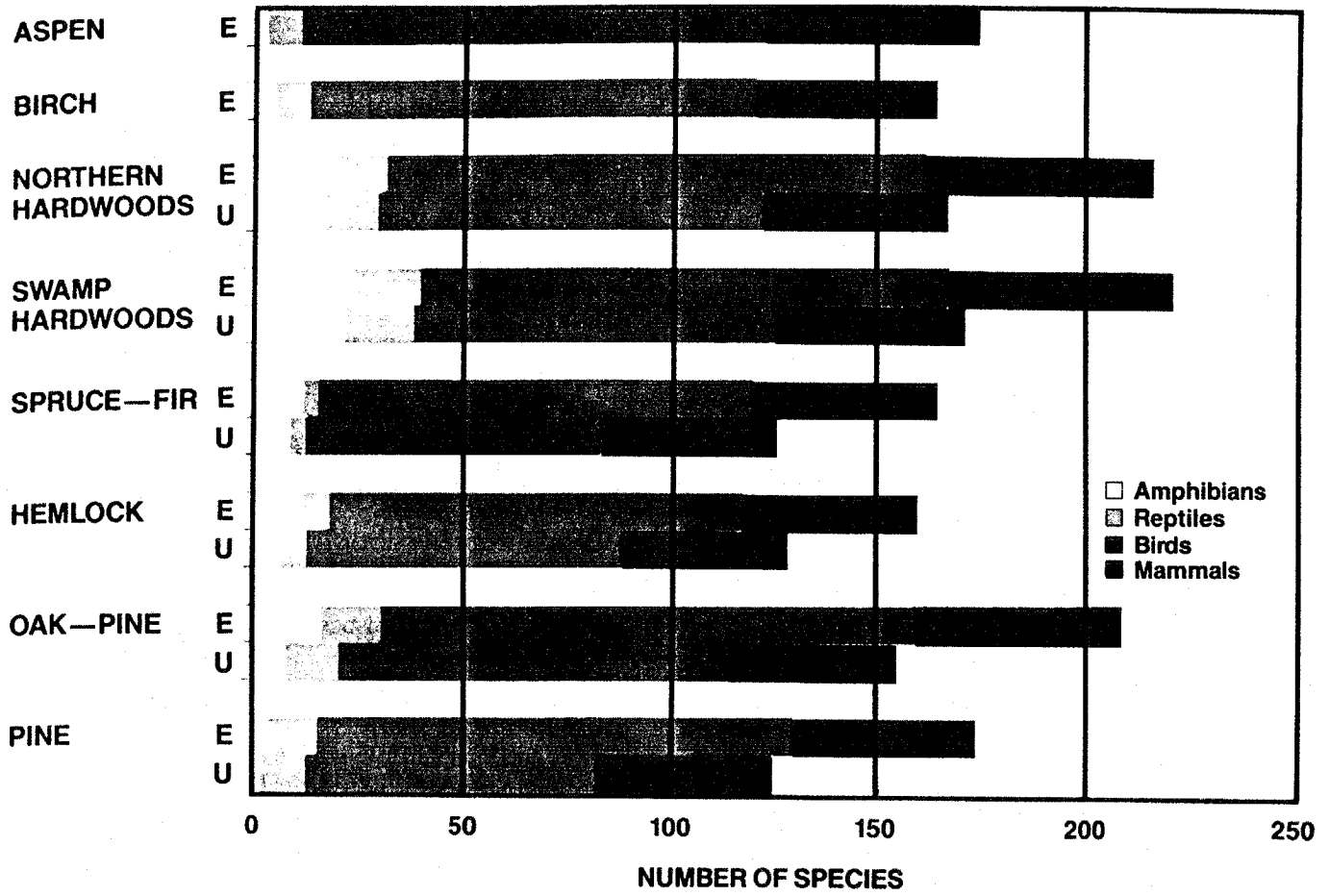


Figure 20.—Potential number of wildlife species by silvicultural system and cover-type group. E = even-aged forests containing regeneration, sapling-pole, sawtimber, and large sawtimber stands in distinct units of 5 acres and larger. U = uneven-aged forests with essentially continuous canopies and intermixed size classes produced by single-tree selection.

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 for a potential number of species between that suggested for even-age and typical uneven-age approaches (Fig. 20).

Combinations of these systems, rather than strict adherence to one, increases the habitat conditions possible through vegetative management. The special care that is taken to provide a range of diverse habitat conditions throughout a forest or property eventually will result in increased use by a wider variety of wildlife species than might otherwise be expected.

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SPECIES/HABITAT MATRICES

Species habitat matrices present summary information in a simple, condensed, tabular form. These matrices are an integral part of the report. Familiarize yourself with their arrangement and the elements that they contain (Fig. 21). Four sets of matrices that indicate the habitat associations of inland New England wildlife species are included: (1) forested habitats, (2) nonforested habitats, (3) habitat breadth and size-class relationships, and (4) key structural habitat features.

Special habitat features are listed for many species. These features are considered essential for a species to occur regularly or to reproduce. Many species are generally associated with a given forest type or group of types—cavity-nesting waterfowl, for example. However, in this example, the special habitat feature—tree cavities and water—must also be present. Thus, the species/habitat associations must be viewed as a complex of within-stand or special habitat requirements occurring in species' overall or general habitat. Some special habitat features can be provided through forest management—the aforementioned cavities, for example, either by delayed rotation or streamside buffer strips where timber harvest is prohibited—but the stream or pond cannot.

Forest Cover Types and Groups

The six forest types and groups of types used to describe forest habitats are condensed from the 11 forest cover types used to present forest/wildlife habitat association in *New England wildlife: habitat, natural history, and distribution* (DeGraaf and Rudis 1986). The 11 forest cover types used in that publication were based on the classification *Forest cover types of the United States and Canada* (Eyre 1980). Similar types are grouped, especially when they reflect similarities in wildlife species composition and responses to silvicultural treatment and are shown in Appendix A.

Forest development is indicated by size class as follows:

S — *Regeneration through seedlings:* Live trees and associated vegetation less than 1.0 inch (2.5 cm) d.b.h. and at least 1 foot (30 cm) in height.

Sp — *Sapling through poletimber:* Saplings are live trees 1.0 to 3.9 inches (2.5 to 9.9 cm) d.b.h.; poles are live trees 4.0 to 8.9 inches (10.0 to 22.0 cm) d.b.h. for softwoods and 4.0 to 11.9 inches (10.0 to 30.0 cm) d.b.h. for hardwoods. The matrix assumes that stands are fully stocked, that is, contain approximately 75 square feet of basal area per acre.

St — *Sawtimber:* A stand with at least half of the stocking in sawtimber-size trees—at least 9.0 inches (23 cm) d.b.h. for softwoods or 12.0 inches (31 cm) for hardwoods.

L — *Large sawtimber:* A stand with at least half of the stocking in large-sawtimber trees—at least 20 inches (51.0 cm) d.b.h. for softwoods and 24 inches (61.0 cm) d.b.h. for hardwoods.

U — *Uneven-aged:* Stands of northern hardwood cover types that contain trees of all size classes.

These apply to all forest cover types under even-age management, with one exception. Only in the northern hardwoods cover-type group do we list wildlife habitat associations for uneven-aged stands.

Common and scientific names of trees follow Little's (1979) *Checklist of United States trees.* Names of understory plants follow *Gray's manual of botany* (Fernald 1950).

The forest cover types and groups are:

Aspen-Birch

- *Aspen:* This type includes quaking aspen *(Populus tremuloides)* and the bigtooth aspen *(P. grandidentata)* but in New England, quaking aspen is more likely to occur in pure stands. Common associates are paper birch *(Betula papyrifera)* and pin cherry *(Prunus pensylvanica),* which, when occurring in admixture, die out early. These species occur on a variety of sites and soil types. The aspen type occurs on most soils except very dry sands or very wet swamps. Aspen is unique in that almost all stands originate as suckers arising from existing roots systems. It will sometimes reproduce from seed on burns, clearcuts, and other scarified sites.

Aspen is a relatively short-lived pioneer type—it does not reproduce under its own shade. On dry sites it is replaced by red pine, red maple, or oaks,

on mesic sites by white pine, and on fertile sites by northern hardwoods, and on fertile wet sites by balsam fir (Brinkman and Roe 1975).

• *Paper birch:* Paper birch is pure or dominant. Associated species include quaking and bigtooth aspen, balsam fir, red spruce *(Picea rubra)*, white pine *(Pinus strobus)*, yellow birch *(Betula alleghaniensis)*, and, in southern New England, hemlock *(Tsuga canadensis)*. The type pioneers on burned areas and clearcuts, and grows best on deep fertile, well-drained sites. Raspberries and blackberries (*Rubus* spp.) make up a high proportion of the ground cover at the time of establishment of paper birch stands. These are shaded out in about 10 years, but pin cherry can persist for 30 or more years. Paper birch is succeeded by spruce-fir in northern parts of its range, and to the south by northern hardwoods and hemlock on fertile, well-drained sites (Safford 1980).

Northern Hardwoods

• *Northern hardwoods* (including sugar maple/ash, sugar maple/beech/yellow birch, and beech/red maple): True northern hardwoods are dominated by sugar maple *(Acer saccharum)*, beech *(Fagus grandifolia)*, and yellow birch and occur widely as a pure type in northern New England. It grades into a mixed hardwood or transition type in southern New England; associated species throughout the region include basswood *(Tilia americana)*, red maple *(Acer rubrum)*, hemlock, white ash *(Fraxinus americana)*, white pine, balsam fir, black cherry *(Prunus serotina)*, paper birch, sweet birch *(Betula lenta)*, and red spruce. Northern hardwood is the basic hardwood type in northern New England, and occurs to an elevation of 2,500 feet (760 m). It prefers fertile loamy soils and good moisture conditions. Striped maple *(Acer pensylvanicum)*, witch-hazel *(Hamamelis virginiana)*, and hobblebush *(Viburnum alnifolium)* are common in the understory throughout the region. Best development of the type occurs on moist, fertile, well-drained loamy soils. On drier sites, beech becomes more prominent. On wet sites, the type blends into a red maple/yellow birch/hemlock or a red spruce mixture. The type tends to be climax. From New England to Pennsylvania, the beech *Nectria* complex has gradually reduced the proportion of beech in many stands (Berglund 1980).

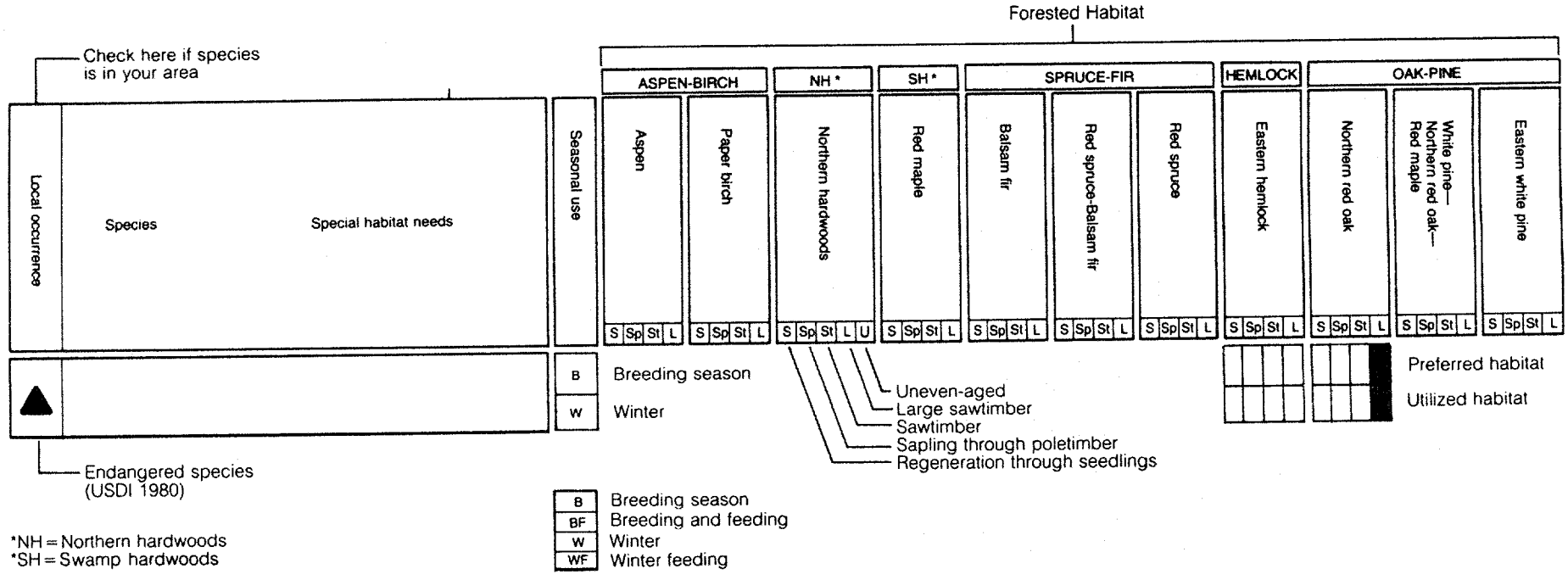
Swamp Hardwoods

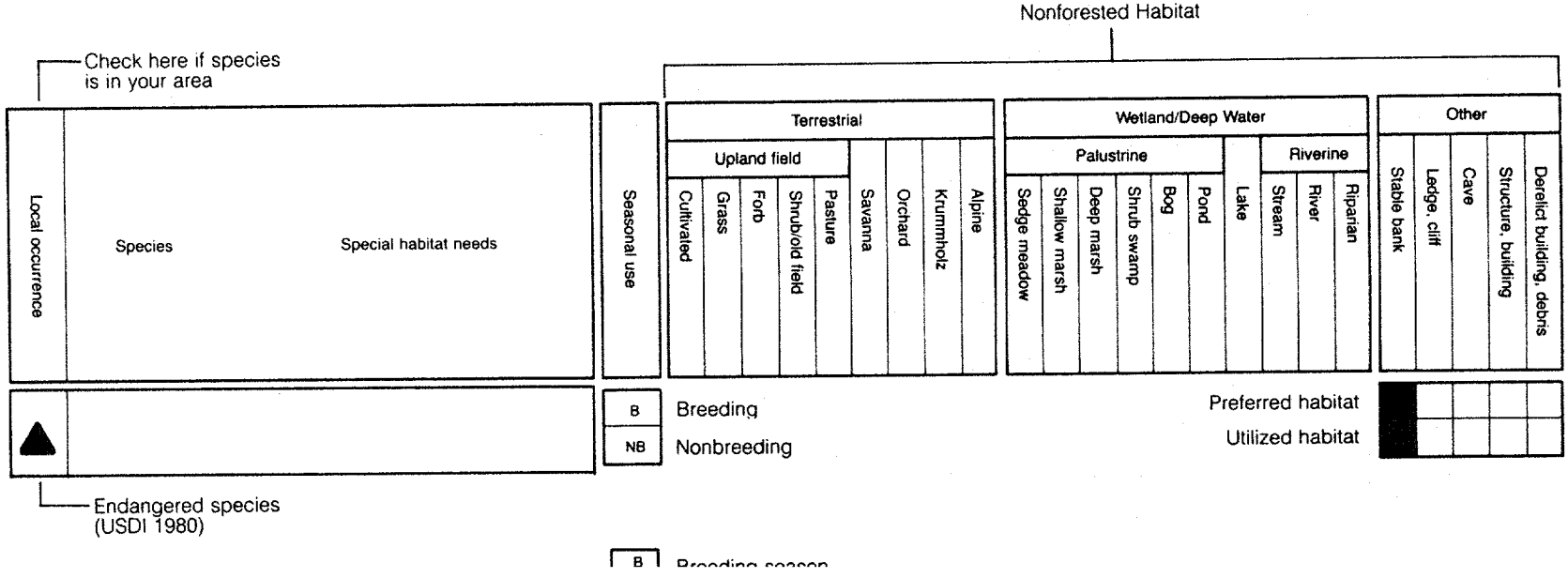
• *Red maple:* Red maple *(Acer rubrum)* is pure or dominant. In New England, red maple and associated species are common on wet sites; the type is essentially pure in southern New England. Associates are yellow birch, balsam fir, and sugar maple in northern New England; black gum *(Nyssa sylvatica)*, sycamore *(Platanus occidentalis)*, and silver maple *(Acer saccharinum)* in southern New England. In New England and the Upper Peninsula of Michigan, it occupies moist to wet muck or peat soils in swamps, depressions, or along sluggish streams, and so is often found as an inclusion in northern hardwoods on wetter sites (Powell and Erdmann 1980). It can be differentiated readily from northern hardwoods by the absence of beech and the increased proportion of yellow birch and red spruce.

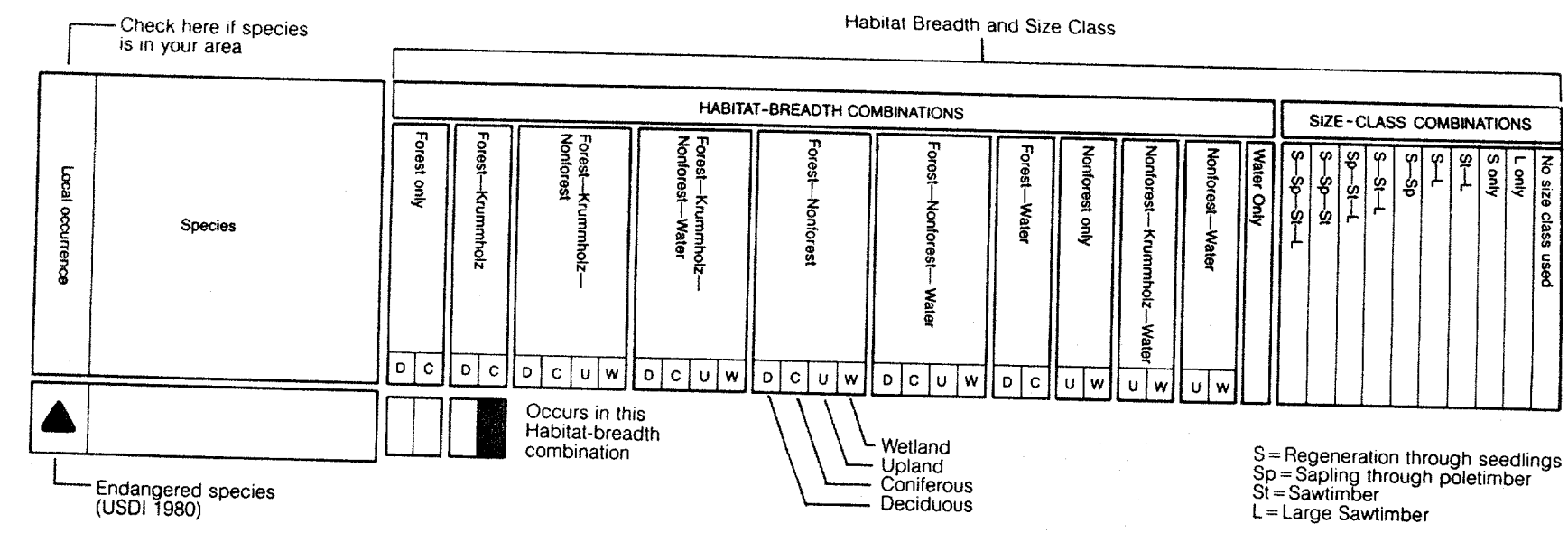
Spruce-Fir

• *Balsam fir:* Balsam fir *(Abies balsamea)* is characteristically pure or predominant. There are many associates mostly on moist or wet-site soils in northern New England; these include paper birch, quaking and bigtooth aspen, red spruce, and in swamps northern white-cedar *(Thuja occidentalis)*. In southern New England, hemlock and red maple are common associates. The type is common in northern New England, occurring on upland sites, on low-lying moist flats, and in swamps. Pure stands result (usually) from heavy cutting, blowdown, or following infestation of spruce budworm. This type is common in northern New England, and may be climax in the zone below timberline. Only black spruce *(Picea mariana)* grows above it (Westveld 1953).

The type occurs extensively in Quebec, where five distinct subtypes are recognized. In the United States, the type is not as complex; however, balsam fir is an important component in the following types in northern New England: red spruce/balsam fir, black spruce, aspen, and paper birch. Common understory species include speckled alder *(Alnus rugosa)*, mountain maple *(Acer spicatum)*, and pin cherry *(Prunus pensylvanica)*, among large shrubs and small trees. Low understory plants include Canada yew *(Taxus canadensis)*, red raspberry (*Rubus* spp.), blueberries (*Vaccinium* spp.), and hobblebush (Frank et al. 1980).


Forested Habitat
Check here if species is in your area
Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH *
SH *
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L U
B Breeding season
W Winter
Uneven-aged
Large sawtimber
Sawtimber
Sapling through poletimber
Regeneration through seedlings
Preferred habitat
Utilized habitat
Endangered species (USDI 1980)
*NH = Northern hardwoods
*SH = Swamp hardwoods
B Breeding season
BF Breeding and feeding
W Winter
WF Winter feeding


Nonforested Habitat
Check here if species is in your area
Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B Breeding
NB Nonbreeding
Preferred habitat
Utilized habitat
Endangered species (USDI 1980)



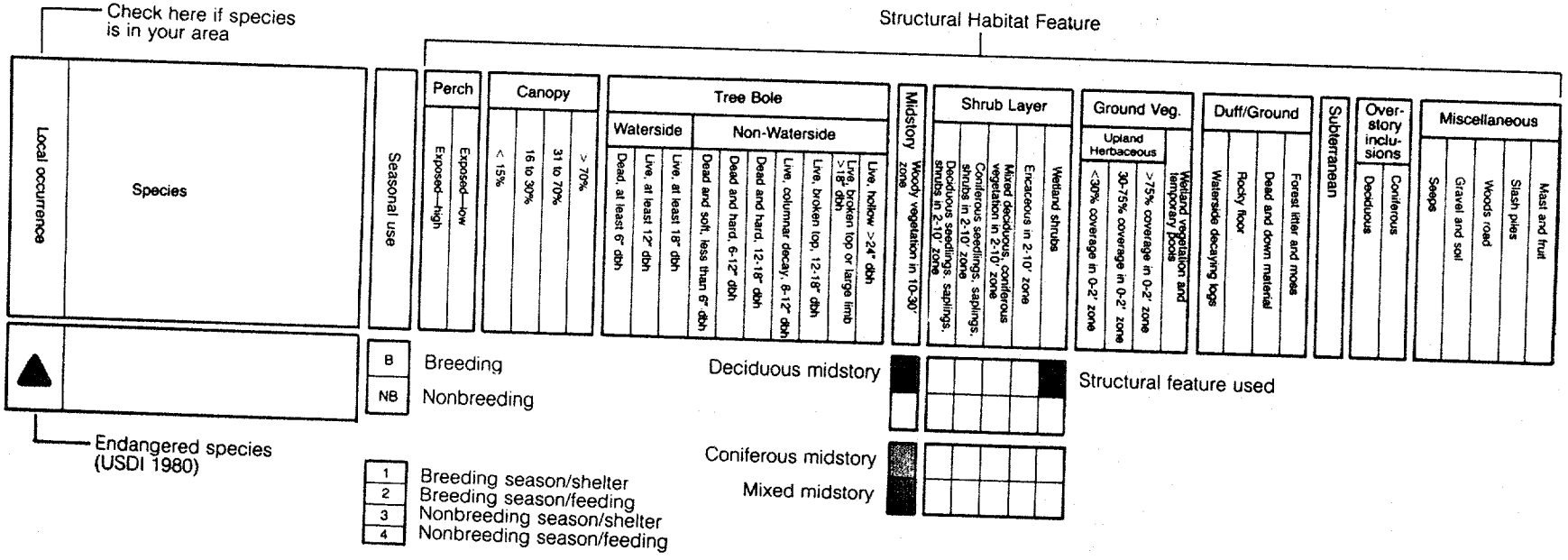


Figure 21. – The key to elements in the species/habitat matrices.

• *Red spruce/Balsam fir:* The type may consist of red spruce and balsam fir or together they may predominate in a mixture of associates—the composition varies by site and disturbance history. We include here the northern white-cedar type and associates, which are commonly associated in northern New England. This is a northern New England type, occupying moderately to poorly drained flats, but not swamps. Associates are red maple, paper and yellow birch, and aspens, primarily, but also white pine, hemlock, and occasionally black spruce and tamarack *(Larix laricina).*

The type occurs near sea level in eastern Maine, from an elevation of 2,400 to 4,500 feet (730 to 1,370 m) in the White Mountains of New Hampshire, from an elevation of 2,500 to 3,800 feet (760 to 1,160 m) in the Green Mountains of Vermont, and occurs on the tops of some of the higher Berkshire Hills in western Massachusetts.

The type occurs on two kinds of sites in New England: (1) poorly drained flats and ridges or benches at lakeshores, streams, and swamps and bogs; and (2) well-drained to dry; shallow soils on steep, rocky, upper mountain slopes.

Stands are usually very dense; the ground may be essentially devoid of plants except for mosses and few seedlings of red spruce and balsam fir. Regenerated stands, however, produce a thick growth of blueberry *(V. augustifolium),* creeping snowberry *(Symphoricarpos mollis),* mountain holly *(Nemopanthus mucronata),* raspberry (*Rubus* spp.), and downy serviceberry *(Amelanchier arborea),* among others (Griffin 1980).

• *Red spruce:* Red spruce is pure or accounts for a majority of the stocking; common associates in northern New England are balsam fir, paper and yellow birch; others include sugar maple, red maple, mountain ash *(Sorbus americana),* eastern white pine and eastern hemlock. Red spruce occurs near sea level in eastern Maine and from an elevation of 1,500 to 4,500 feet (450 to 1,370 m) inland throughout northern New England on moderately well-drained to poorly drained flats (but not true swamps), and on well drained slopes, including thinly soiled upper slopes. Red spruce pioneers on abandoned fields and pastures in northern New England, and on these fairly well-drained it is usually replaced by shade tolerant hardwoods, especially sugar maple and beech. Red spruce is long-lived and, barring major disturbance, is very stable. Older stands develop an uneven-aged character even though of even-aged origin. The understory is frequently sparse, or even absent; the ground beneath red spruce stands is covered with tree litter and patches of short-lived red spruce seedlings.

Old-field red spruce contains a ground cover of bunchberry *(Cornus canadensis)* on wet sites and hobblebush on well-drained sites. Regenerated stands usually produce raspberries in abundance (Blum 1980).

Hemlock

• *Eastern hemlock:* Eastern hemlock is pure or predominant over any associate, but associates are numerous; these commonly include beech, sugar maple, yellow birch, red maple, black cherry, white pine, northern red oak, white oak, sweet birch, and in northern New England, paper birch, balsam fir, and red spruce. In southern New England, the type prefers cool locations such as moist ravines and north-facing slopes; in the northern parts of its New England distribution, warmer drier sites are tolerated. Occurs from sea level to an elevation of 3,000 feet (915 m) in New England.

Eastern hemlock is very shade tolerant. Its long life span and ability to respond to release after almost two centuries of suppression have allowed the type to persist; early logging, and the fires that followed, greatly reduced the occurrence of this shallow-rooted climax species. Under mature stands, understory development is sparse; openings to admit light commonly produce striped maple, hobblebush, mapleleaf viburnum, among others. False lily-of-the-valley *(Maianthemum canadense)* is probably the most common herb (Wiant 1980).

Oak-Pine

Northern red oak: Northern red oak *(Quercus rubra)* accounts for a majority of the stocking. Associates vary according to site and locale, and include black oak *(Q. velutina),* scarlet oak *(Q. coccinea),* and chestnut oak *(Q. prinus),* hickories (*Carya* spp.), and red maple. In New England, the type has a spotty distribution, occupying ridge crests and upper north slopes. On better sites, associates are black cherry, sugar maple, white ash *(Fraxinus americana),* and American beech. The type is rare in northern New England and reaches best development in New England in western Massachusetts and northern Connecticut on loam and silt-loam soils. The type is sub-climax; shade-tolerant species such as beech and sugar

maple increase in proportion over time (Trimble 1980).

- *White pine/Northern red oak/Red maple:* Northern red oak, eastern white pine *(Pinus strobus)*, and red maple predominate; white ash is the most common associate, but others include paper birch, yellow birch *(B. alleghaniensis)*, sweet birch *(B. lenta)*, sugar maple, beech, hemlock, and black cherry. Occurs across southern and central New England to an elevation of 1,500 feet (450 m), generally on deep, well-drained fertile soils.

This type is common in the transition between northern hardwoods and spruce-fir types in northern New England, and between northern hardwoods and oak types—characteristic of central types—in southern New England. The type often follows "old field" white pine in New England, where hardwood seedlings and saplings form the understory (Baldwin and Ward 1980). Common understory shrubs include witch-hazel, alternate-leaf dogwood *(Cornus alternifolia)*, mapleleaf viburnum *(Viburnum acerifolium)*, and mountain-laurel *(Kalmia latifolia)*.

- *Eastern white pine:* Eastern white pine is pure or usually predominant. We include red pine *(Pinus resinosa)*, which has a spotty distribution throughout New England on sandy, gravelly or sandy loam soils, and white pine/hemlock, a common subtype in central and southern New England, where it occupies a range of soil types in cool locations such as ravines and north slopes (in the southern parts of its range). These other pine types are included primarily because they support similar wildlife communities.

Eastern white pine frequently occurs in pure stands; common New England associates on light soils are pitch pine *(P. rigida)*, gray birch *(Betula popufolia)*, quaking and bigtooth aspen, red maple, and white oak *(Quercus alba)*. On heavier soils, paper birch, sweet birch, yellow birch, white ash, black cherry, northern red oak, sugar maple, hemlock, red spruce and northern white cedar are associated in New England, but none are characteristic. The type is widespread in central New England from sea level to an elevation of 2,500 feet (760 m). This type occurs over a wide range of conditions and sites; establishment is often easier on poor sites because hardwood competition is less. Once established on better sites, white pine will usually grow faster than hardwoods.

White pine commonly pioneers on abandoned agricultural land in New England. The type seldom succeeds itself, but on dry sandy soils it may persist a long time and even approach permanence. On heavier soils, white pine is usually succeeded by northern hardwoods, white pine/hemlock, or white oak.

Eastern white pine is a major component of two other New England forest cover types—white pine/northern red oak/red maple, and white pine/hemlock—occurs in various proportions in other types throughout the region.

In pure or almost pure white pine stands, the understory is composed primarily of ericaceous shrubs such as blueberries, huckleberries (*Gaylussacia* spp.), azaleas (*Azalea* spp.), and mountain-laurel. In New England, common ladyslipper (*Cypripedium* spp.) is common on light soils and highbush blueberry *(V. corymbosum)* on wetter sites (Wendel 1980).

Terrestrial, Wetland, and Other Nonforested Habitat Types

The matrix of wildlife species occurrence in nonforested habitats includes entries for terrestrial, wetland, and other habitat types (Appendix B). Many wildlife species that occur in forested habitats either prefer or require one or more nonforested habitats, usually for breeding. For example, eastern American toad *(Bufo a. americanus)* and mole salamanders (*Ambystoma* spp.) occur throughout many woodlands, except for brief, critical breeding periods in wetlands.

The nonforested habitat types are:

- *Terrestrial:*

  Upland Fields

  Cultivated—tilled agricultural crop land.

  Grass—hayfields, etc.

  Forb—broadleaved herbaceous cover, e.g., goldenrod *(Solidago)*, sensitive fern *(Onoclea)*.

  Shrub/old fields—abandoned agricultural fields reverting to forest, characterized by grasses, shrubs, small trees.

Pastures—usually too wet or rocky for cultivation.

Savanna—grasslands with shrubs and widely, irregularly scattered trees, resulting from either soil-moisture regimes or disturbances such as fire or grazing.

Orchard—fruit trees, grass ground cover.

Krummholz zone—the transition zone from subalpine forest to alpine tundra characterized by dwarfed, deformed, wind-sheared trees. Includes subalpine forest.

Alpine zone—elevated slopes above timber line characterized by low, shrubby, slow-growing woody plants and a ground cover of boreal lichens, sedges, and grasses.

• *Wetland/Deep Water:* In general, wetlands are lands where saturation with water largely determines the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The dominant plants are hydrophytes. The single feature that most wetlands share is soil or substrate that is at least periodically saturated or covered by water.

Wetlands are transitional sites between terrestrial and aquatic systems where the water table is usually at or near the surface, or where the land is covered by shallow water.

Deepwater habitats are permanently flooded lands lying below the deepwater boundary of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate. As in wetlands, the dominant plants are hydrophytes; however, the water is generally too deep to support emergent vegetation.

Palustrine—non-tidal wetlands dominated by emergent mosses, lichens, persistent emergents, shrubs, or trees (Cowardin et al. 1979).

Sedge meadow—dominated by sedges *(Carex)*, cattails *(Typha)*, etc.; surface water depths to 6 inches in winter and early spring; soil surface exposed but saturated in summer.

Shallow marsh—characterized by persistent emergent vegetation and water depths to 1.5 feet.

Deep marsh—characterized by emergent and floating-leaved plants and water depths to 6 feet.

Shrub swamp—dominated by woody vegetation less than 20 feet tall, soil seasonally or permanently flooded to a depth of 1 foot.

Bog—characterized by peat accumulation due to cold, acidic conditions; (usually) a floating mat of vegetation; generally sundew *(Drosera)* and pitcher plant *(Sarracenia)* are common.

Pond—Permanent palustrine water body, characterized by emergent and/or floating-leaved plants, up to 20 acres in size.

Lacustrine—deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage, and (3) total area exceeds 10 acres.

Lake—characterized by water depth of 6.5 feet.

Riverine—wetlands and deepwater habitats contained within a channel through which the water flows.

Stream—intermittent or permanent, up to 30 cubic feet per second at high flow.

River—at least 30 cubic feet per second at low flow.

Riparian zone—stream and river banks and associated vegetation.

- ***Other:***

Stable banks—excavated sand or gravel banks or naturally cut stream banks topped by an overhanging grassy top.

Ledge, cliff
Cave
Structure, building
Derelict building, debris

Habitat Breadth and Size Class

Habitat breadth—the range of habitats that is used or is acceptable to wildlife species—is presented in terms of four basic habitats (Appendix C). Size-class relations are presented for four timber size classes. The habitats are the most general categories to describe wildlife habitat relationships, because they transcend forest cover types, the various nonforest habitats, and of course structural features within stands. Species with the narrowest range of utilized habitats are associated with only one of the habitats or size classes. Species with the widest range are associated with all four habitats or size classes; others are intermediate. The four general habitats are:

- Forest—any forest regardless of type, age, or size class.

- Nonforest—any terrestrial or aquatic habitat that does not currently support trees.

- Krummholz—subalpine birch, red spruce, and balsam fir forests at elevations above managed forest.

- Water—any palustrine, lacustrine, or riverine habitat.

The four timber size classes are:

S = regeneration through seedlings
Sp = saplings through poletimber
St = sawtimber
L = large sawtimber

Structural Habitat Features

Within-stand features and their associatio with forest wildlife species are shown in Append D, and include components of forest layers fro the uppermost canopy to the forest floor, overstor inclusions, and several miscellaneous features:

Perches:
High
Low

Canopy Closure:
<15% - very open canopy
16 to 30% - open canopy
31 to 70% - intermediate
>70% - closed canopy

Tree Boles:
Waterside - at water's edge:
Dead, > 6 in. d.b.h.
Live, > 12 in. d.b.h.
Live, > 18 in. d.b.h.

Nonwaterside:
Dead and soft, <6 in. d.b.h.
Dead and hard, 6-12 in. d.b.h.
Dead and hard, 12-18 in. d.b.h.
Live, columnar decay, 8-12 in. d.b.h.
Live, broken top, 12-18 in. d.b.h.
Live, broken top or large limb >18 in. d.b.h.
Live, hollow >24 in. d.b.h.

Midstory: woody vegetation in 10-30 ft. zone

Shrub Layer:
Deciduous seedlings, saplings, shrubs in 2-10 ft. zone
Coniferous seedlings, saplings, shrubs in 2-10 ft. zone
Mixed deciduous, coniferous vegetation in 2-10 ft. zone
Ericaceous shrubs in 2-10 ft. zone
Wetland shrubs

Ground Vegetation:
Upland herbaceous:
<30% ground cover in 0-2 ft. zone—sparse
30–75% ground cover in 0–2 ft. zone—intermediate
>75% ground cover in 0–2 ft. zone—abundant
Wetland vegetation and temporary pools

Duff/Ground Layer:
- Waterside decaying logs
- Rocky forest floor
- Dead and down trees, limbs, branches
- Forest litter and moss—leaves, twigs, moss

Subterranean Habitats—burrows, root channels

Overstory Inclusions:
- Deciduous—one tree or stand of deciduous trees in a coniferous forest
- Coniferous—one tree or a stand of coniferous trees in a deciduous forest

Miscellaneous Features:
- Seeps—wet places where ground water emerges on the surface
- Gravel and soil—exposed gravel, sand, or soil as in open gravel pits
- Woods road—unpaved roads through forests
- Slash piles—piled logging debris

Mast and fruit—hard nuts and fleshy fruits of trees and shrubs.

Species Activities/Season of Occurrence

Habitat utilization by species is rated separately for life history activities and seasons as follows for birds and mammals:

B— Breeding season (for mammals, refers to the period when young are born and are being nurtured).

BF— Breeding season, feeding

W— Winter

WF— Winter feeding

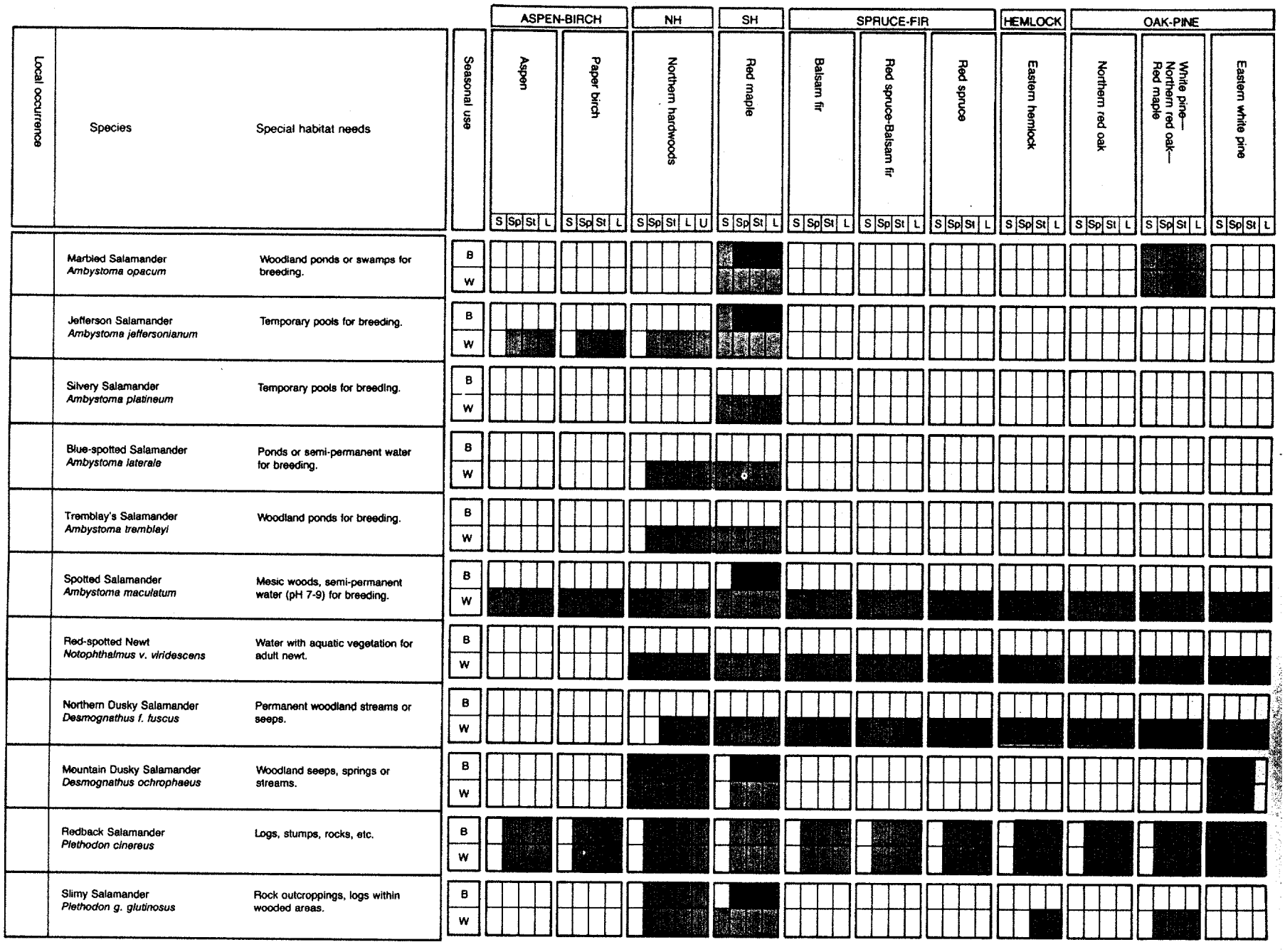
For amphibians and reptiles, habitat use is shown for breeding (B) and nonbreeding (NB) seasons only, because, with few exceptions, they are inactive during winter, and overwinter underground or in bottom sediments, etc.

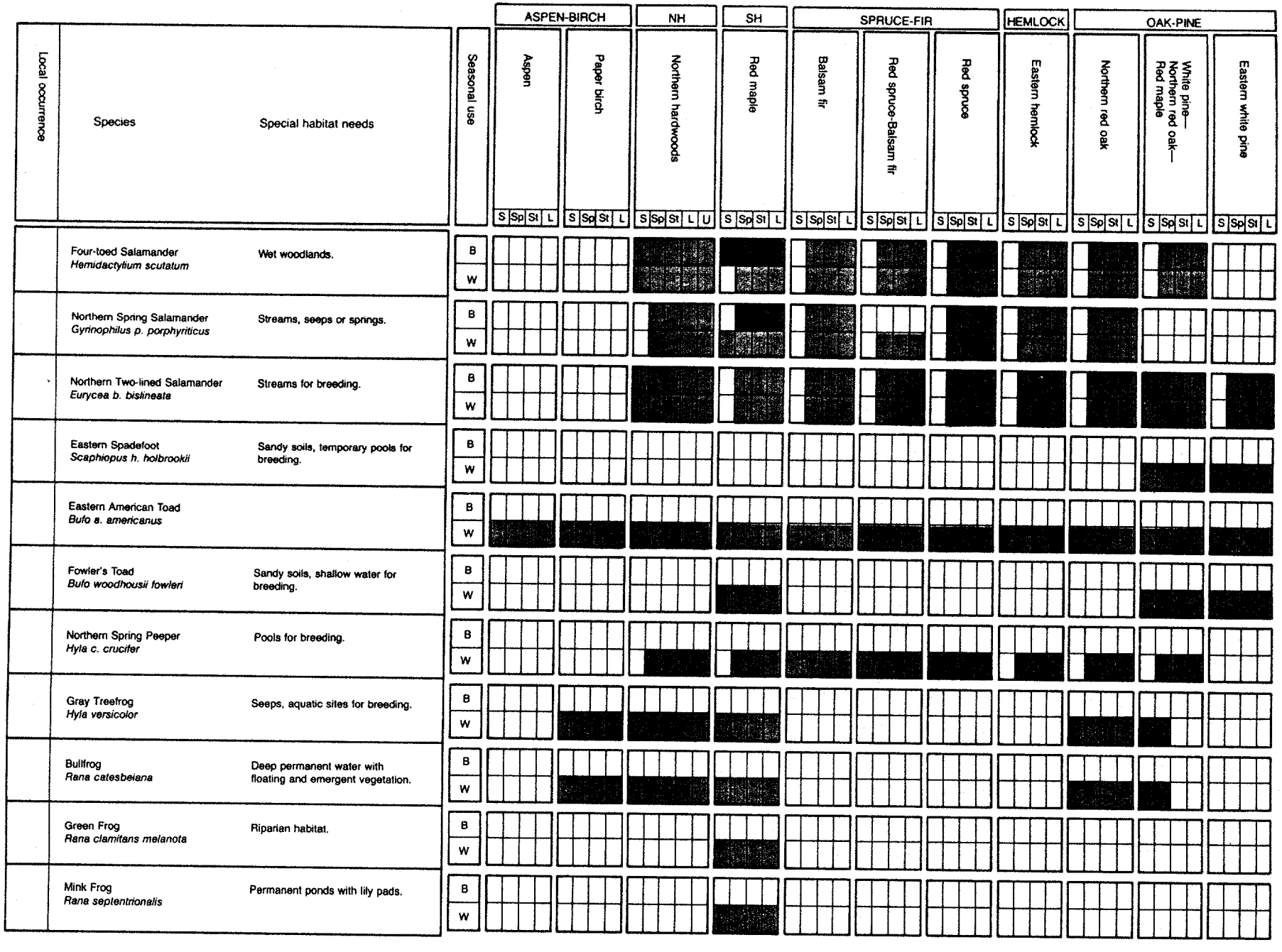
Consult the species accounts in *New England wildlife: habitat, natural history, and distribution* (DeGraaf and Rudis 1986) for the time periods of these activities.

Habitat Suitability

The suitability (quality) of each community type for a given species was based on ratings by the experts acknowledged, and on our field experience. Although they are subjective, they represent the best estimates currently available. On the matrix, the light shading indicates utilized habitat, and the dark shading with bullet indicates preferred habitat. If specific habitat components are required by a species for its regular occurrence, these are listed under special habitat needs.

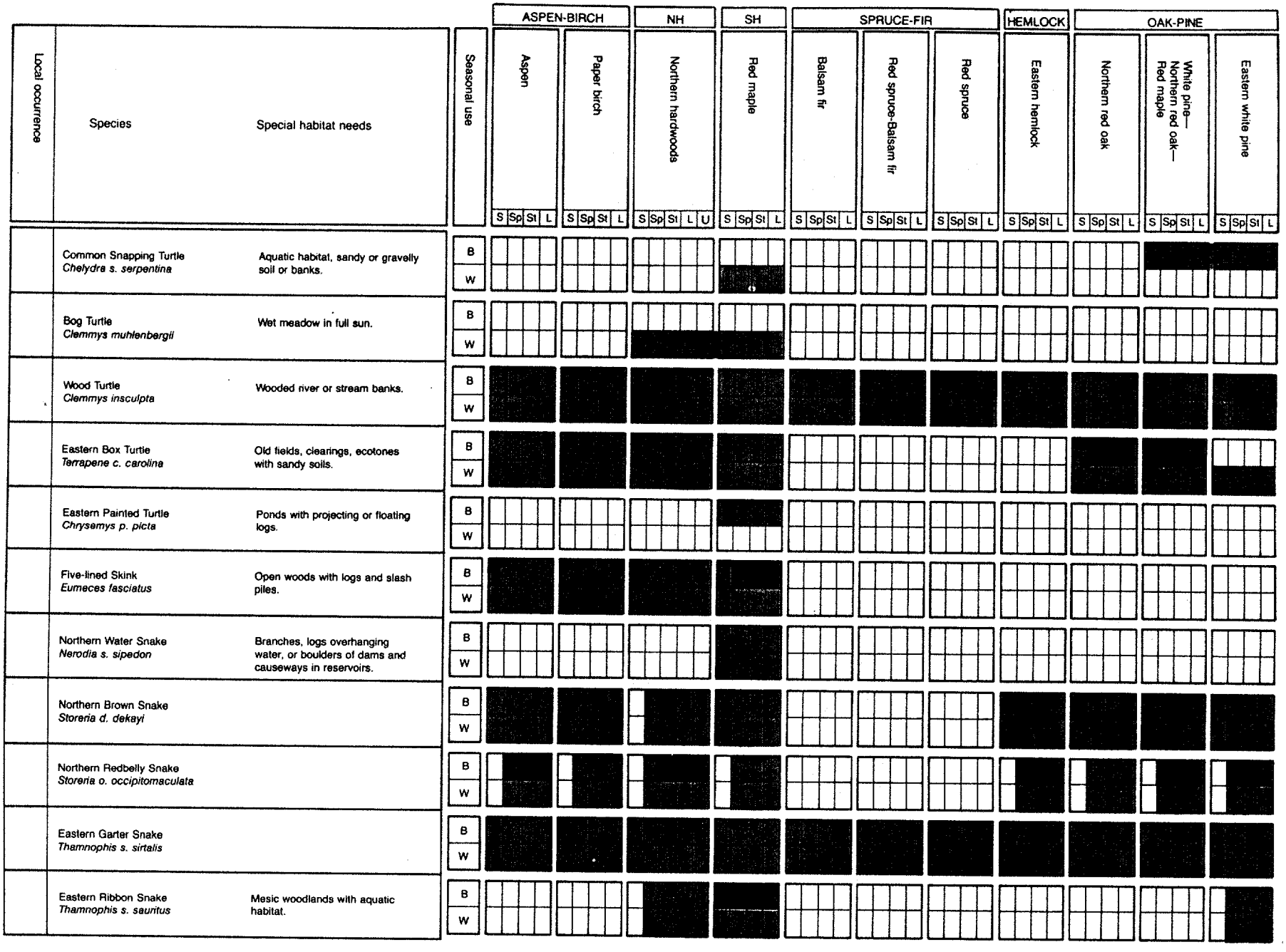
Species Occurrence and Utilization, by Forested Habitat
Amphibians

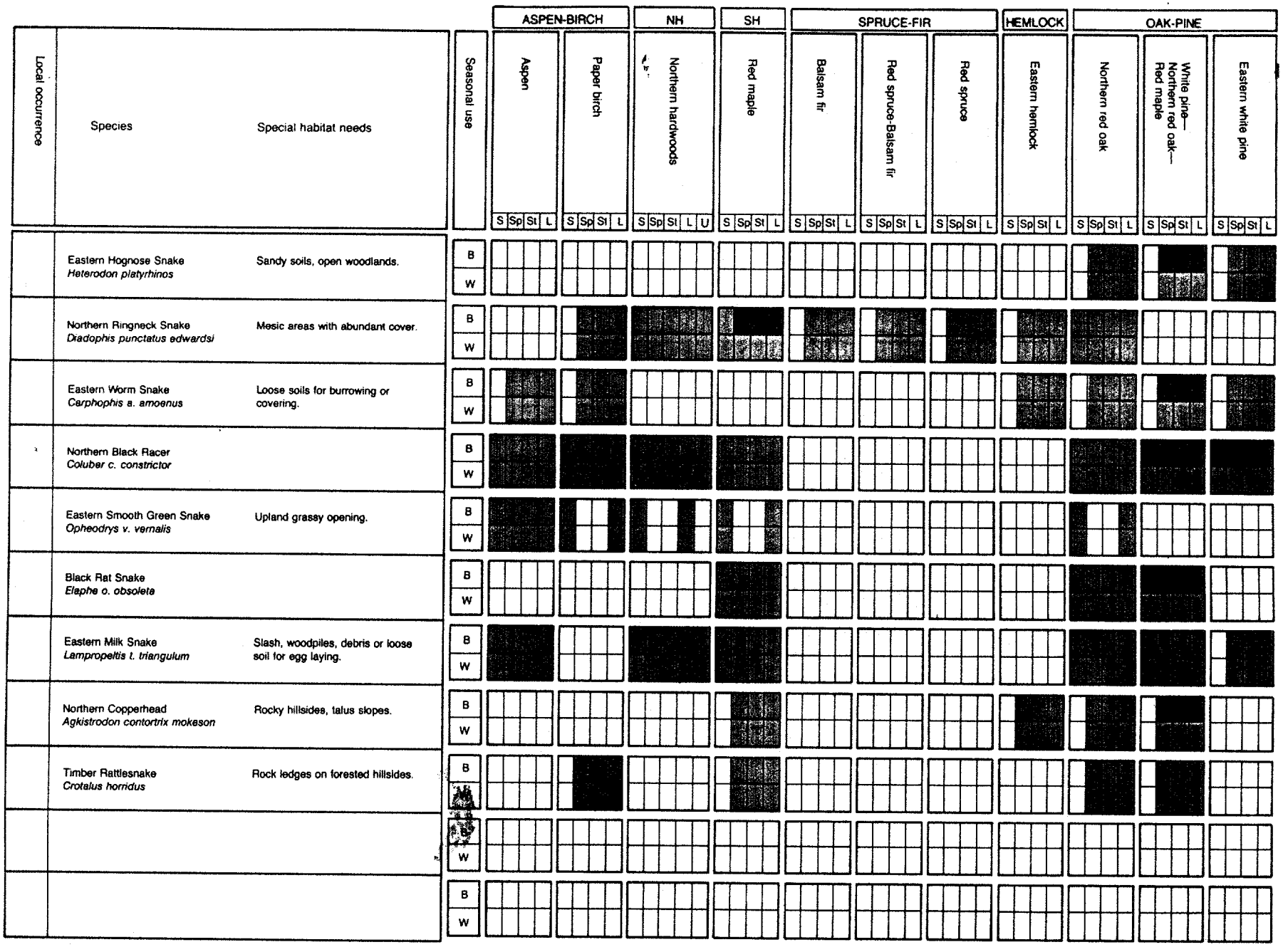



Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
W
Four-toed Salamander
Hemidactylium scutatum
Wet woodlands.
Northern Spring Salamander
Gyrinophilus p. porphyriticus
Streams, seeps or springs.
Northern Two-lined Salamander
Eurycea b. bislineata
Streams for breeding.
Eastern Spadefoot
Scaphiopus h. holbrookii
Sandy soils, temporary pools for breeding.
Eastern American Toad
Bufo a. americanus
Fowler's Toad
Bufo woodhousii fowleri
Sandy soils, shallow water for breeding.
Northern Spring Peeper
Hyla c. crucifer
Pools for breeding.
Gray Treefrog
Hyla versicolor
Seeps, aquatic sites for breeding.
Bullfrog
Rana catesbeiana
Deep permanent water with floating and emergent vegetation.
Green Frog
Rana clamitans melanota
Riparian habitat.
Mink Frog
Rana septentrionalis
Permanent ponds with lily pads.

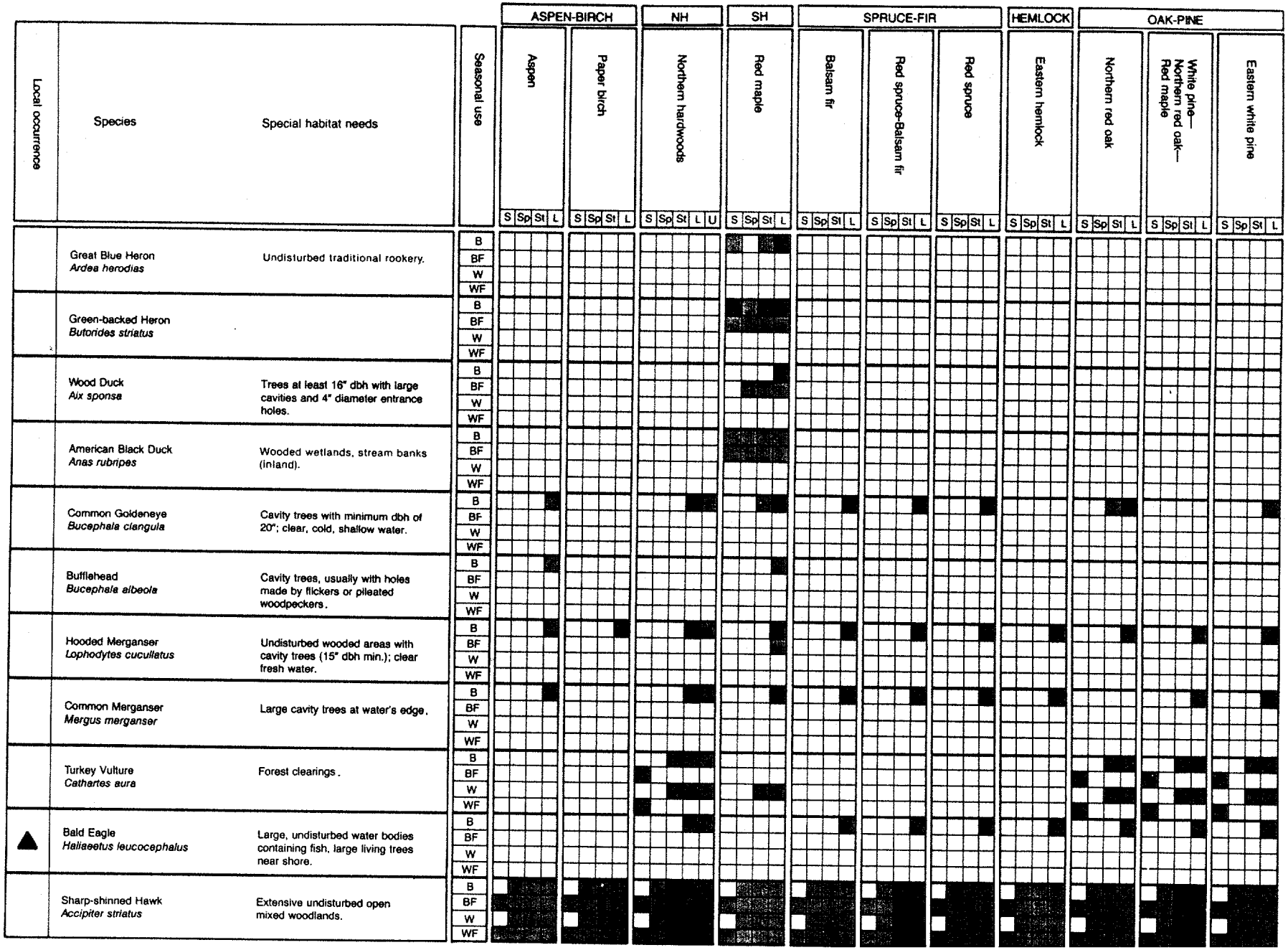
Local occurrence	Species	Special habitat needs	Seasonal use	ASPEN-BIRCH: Aspen (S Sp St L)	ASPEN-BIRCH: Paper birch (S Sp St L)	NH: Northern hardwoods (S Sp St L U)	SH: Red maple (S Sp St L)	SPRUCE-FIR: Balsam fir (S Sp St L)	SPRUCE-FIR: Red spruce-Balsam fir (S Sp St L)	SPRUCE-FIR: Red spruce (S Sp St L)	HEMLOCK: Eastern hemlock (S Sp St L)	OAK-PINE: Northern red oak (S Sp St L)	OAK-PINE: White pine—Northern red oak—Red maple (S Sp St L)	OAK-PINE: Eastern white pine (S Sp St L)
	Wood Frog *Rana sylvatica*	Vernal woodland pools, back-waters of slow-moving streams.	B W											
	Northern Leopard Frog *Rana pipiens*	Wet meadows.	B W											
	Pickerel Frog *Rana palustris*	Shallow, clear water of bogs or woodland streams.	B W											
			B W											
			B W											
			B W											
			B W											
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			B W											
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			B W											

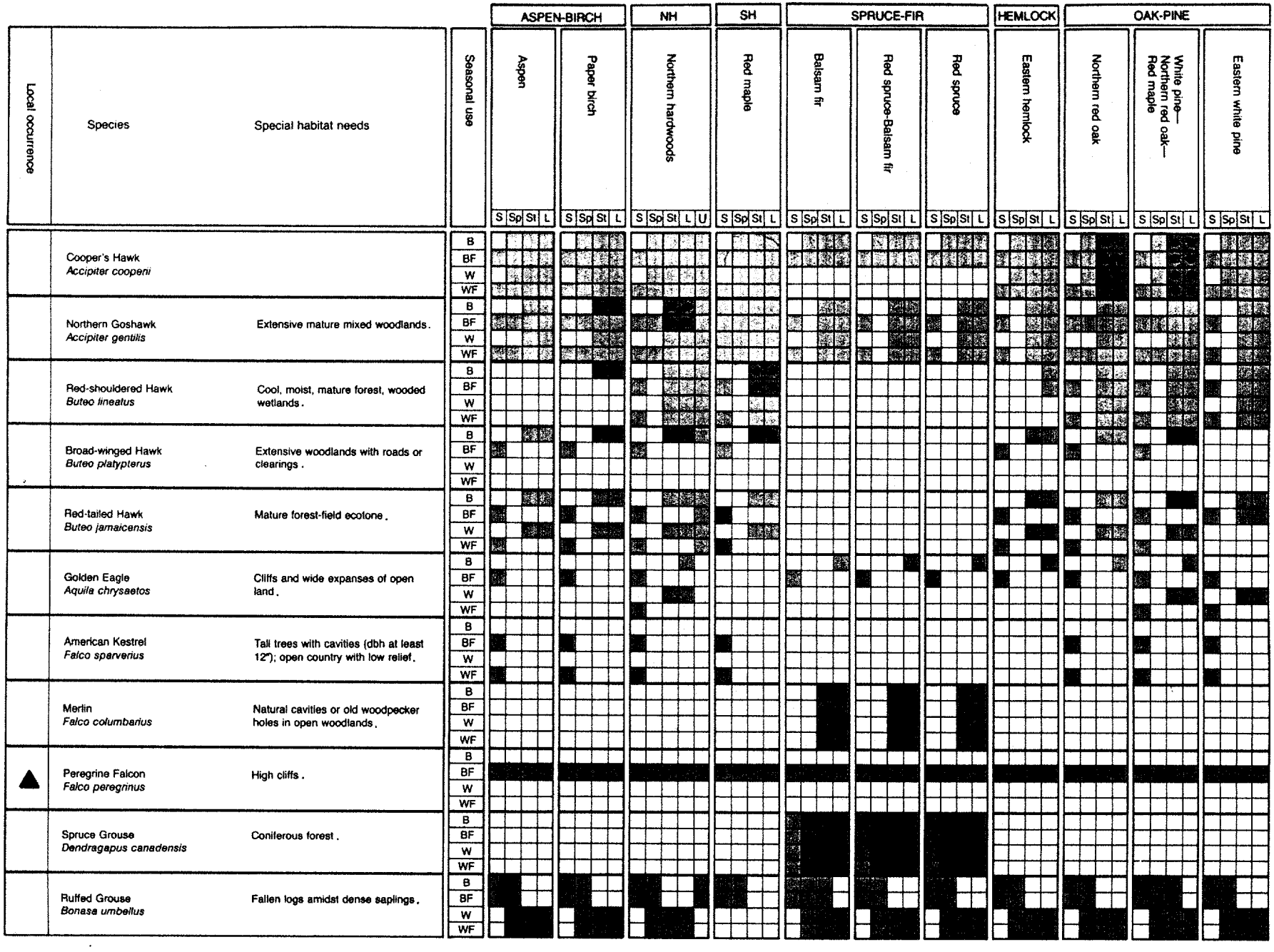
Species Occurrence and Utilization, by Forested Habitat
Reptiles

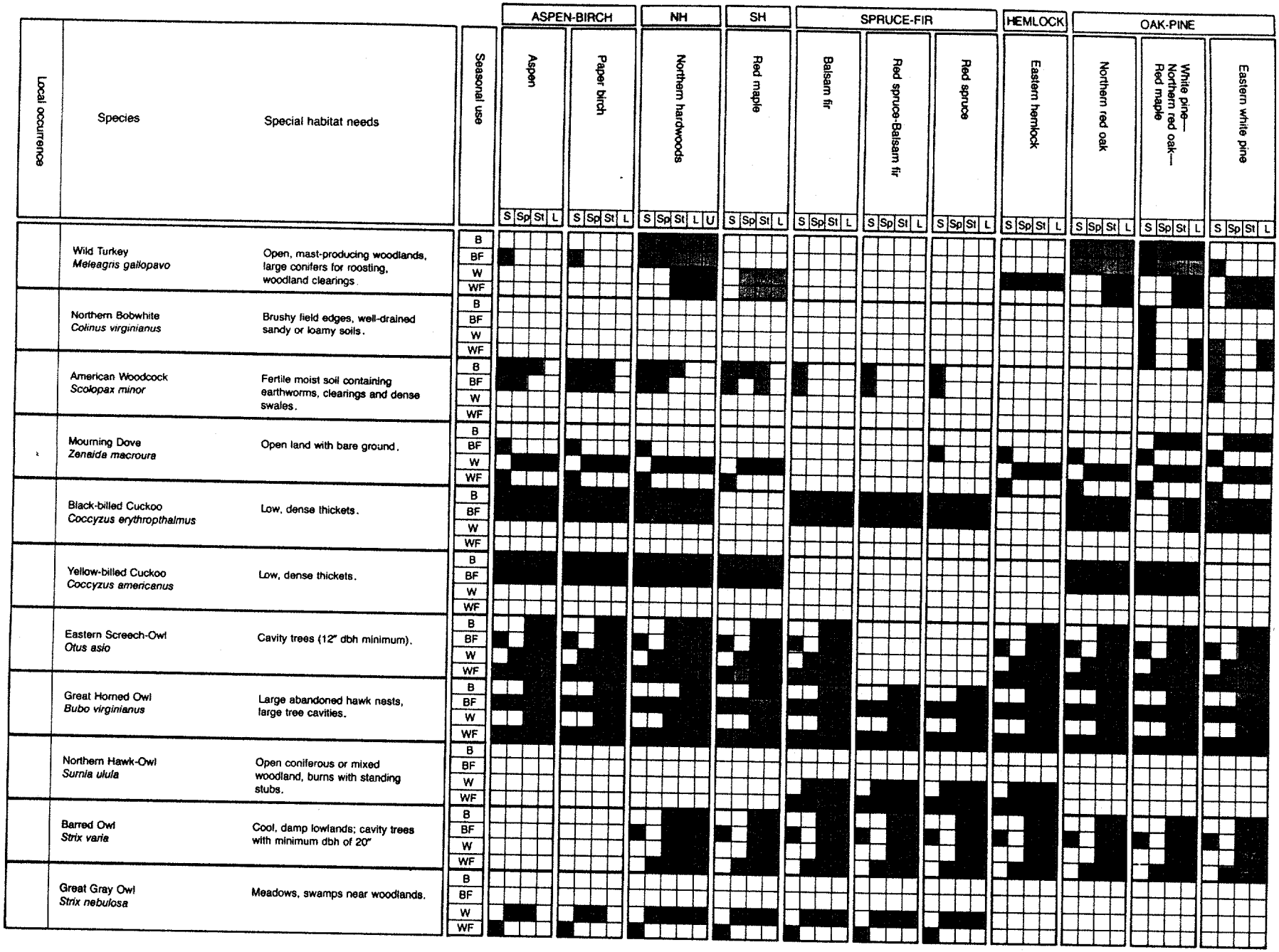


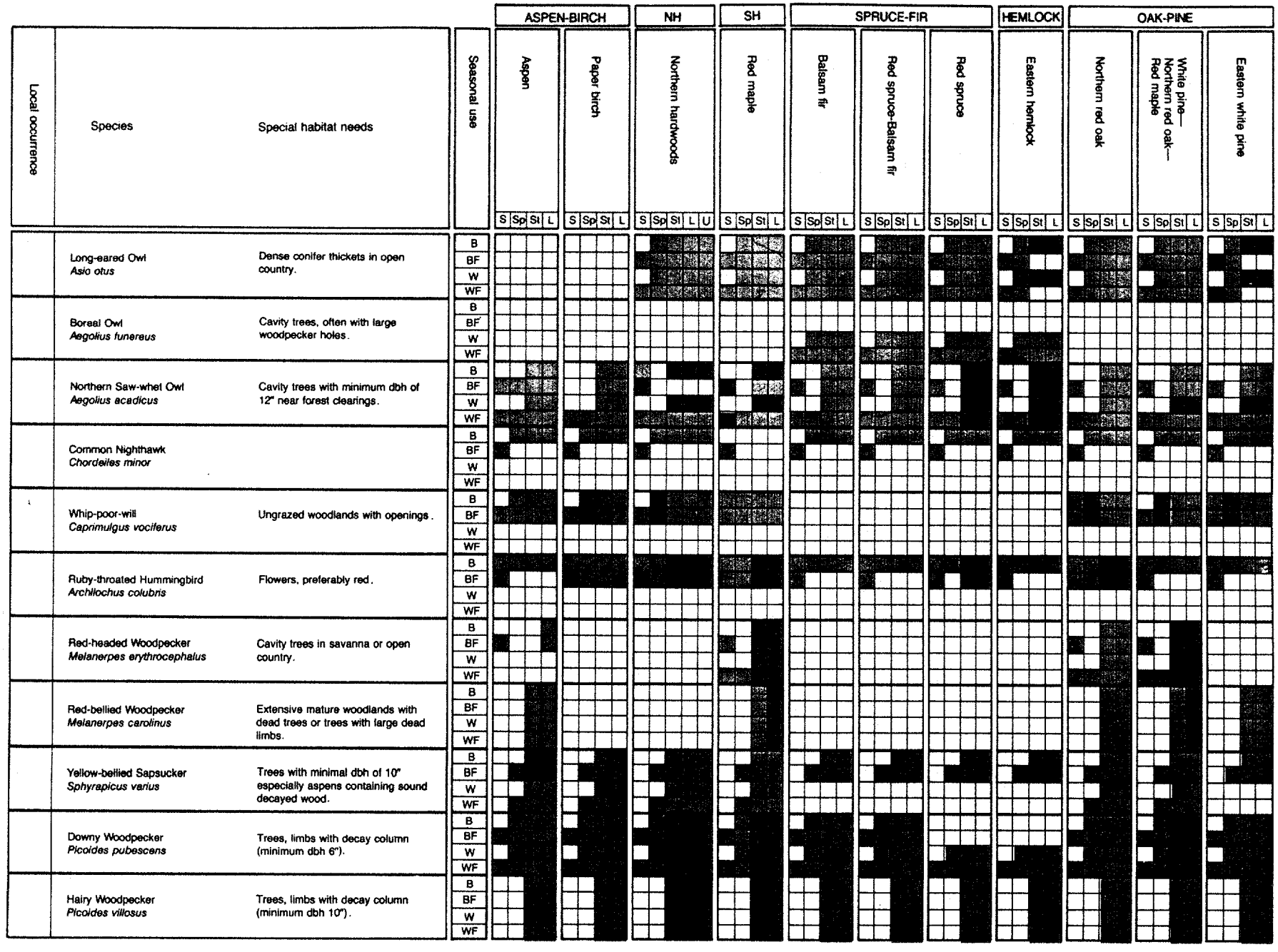

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
W
Eastern Hognose Snake
Heterodon platyrhinos
Sandy soils, open woodlands.
Northern Ringneck Snake
Diadophis punctatus edwardsi
Mesic areas with abundant cover.
Eastern Worm Snake
Carphophis a. amoenus
Loose soils for burrowing or covering.
Northern Black Racer
Coluber c. constrictor
Eastern Smooth Green Snake
Opheodrys v. vernalis
Upland grassy opening.
Black Rat Snake
Elaphe o. obsolete
Eastern Milk Snake
Lampropeltis t. triangulum
Slash, woodpiles, debris or loose soil for egg laying.
Northern Copperhead
Agkistrodon contortrix mokeson
Rocky hillsides, talus slopes.
Timber Rattlesnake
Crotalus horridus
Rock ledges on forested hillsides.

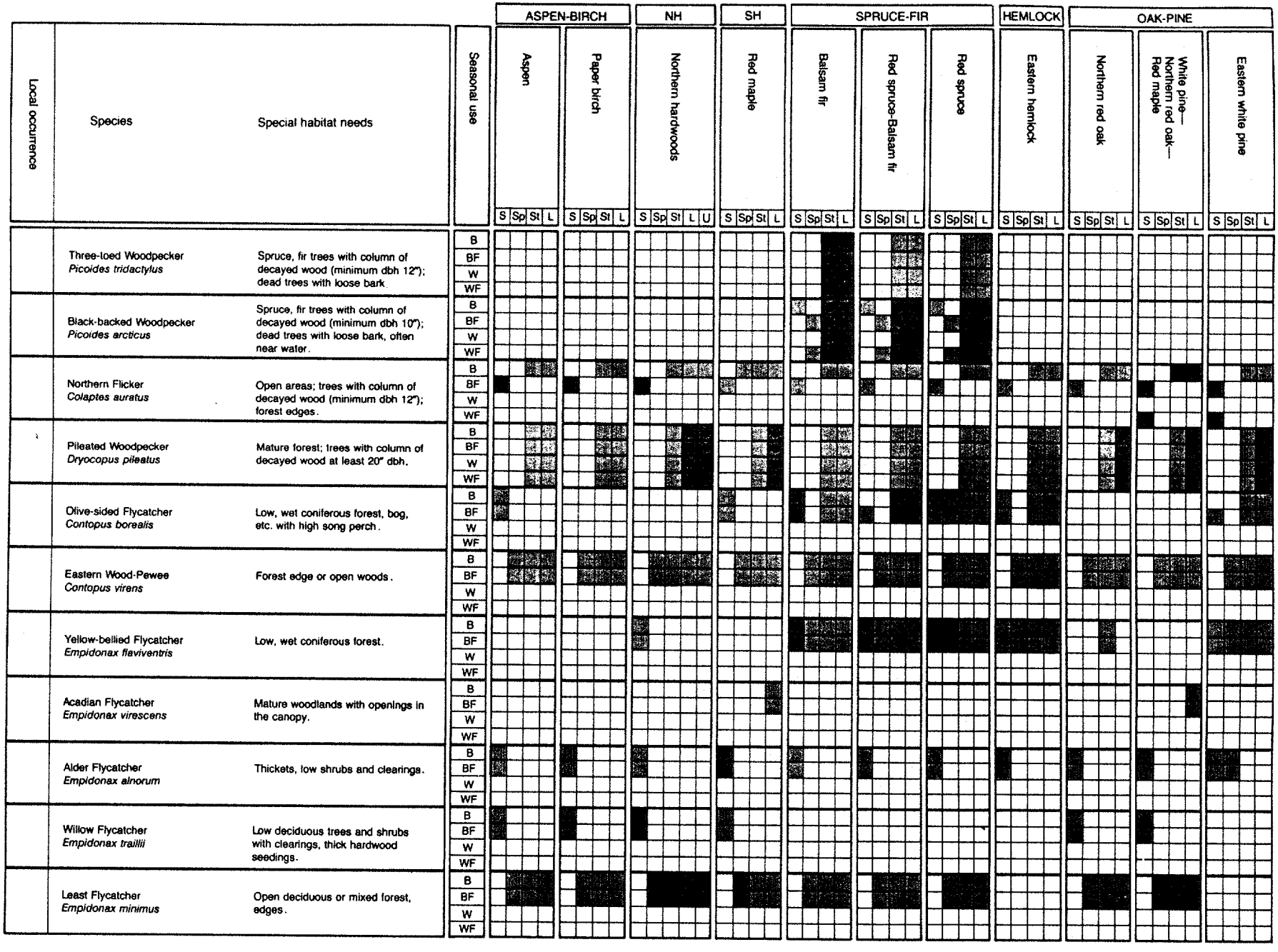
Species Occurrence and Utilization, by Forested Habitat
Birds

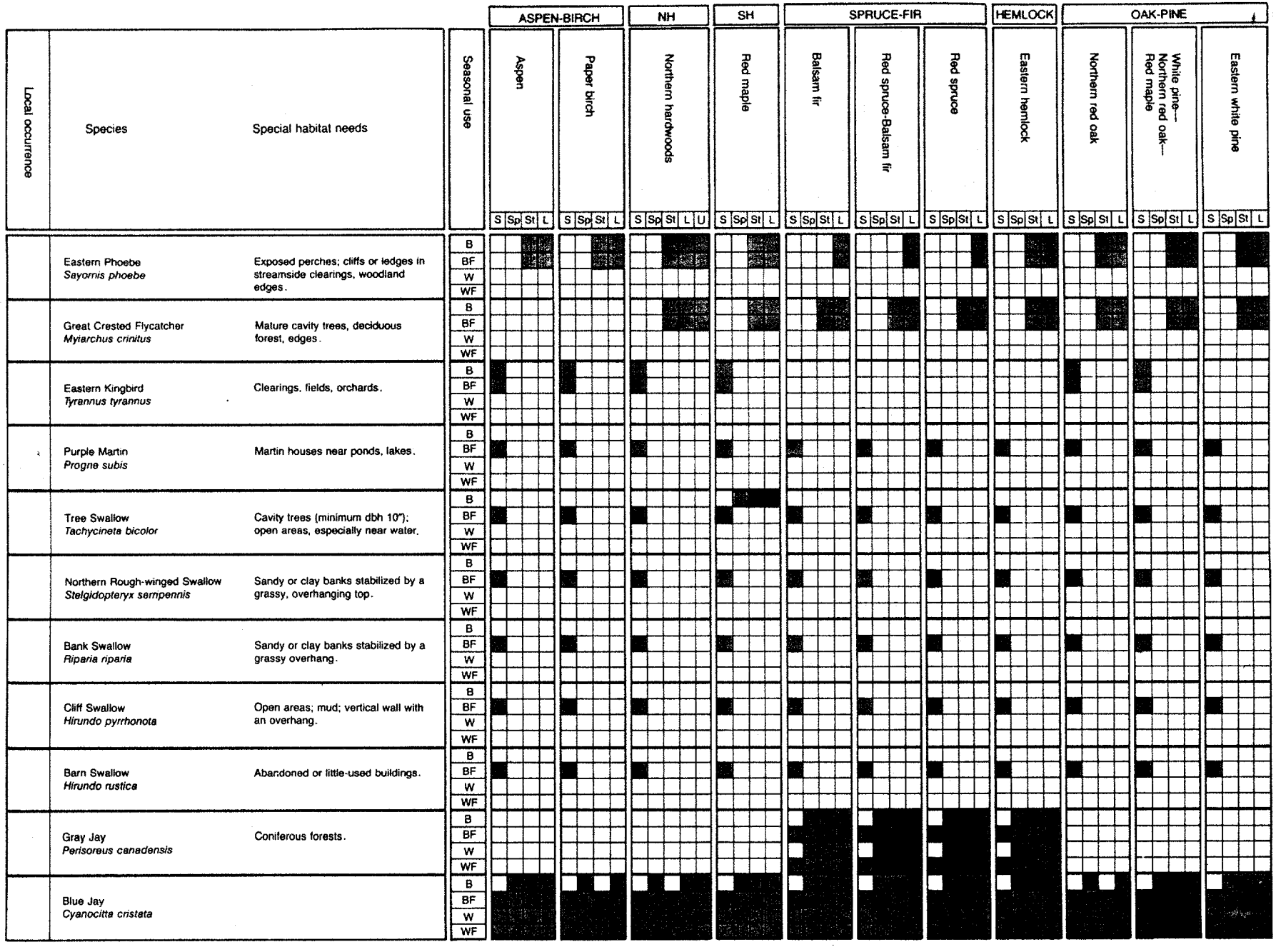



Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Cooper's Hawk
Accipiter cooperi
Northern Goshawk
Accipiter gentilis
Extensive mature mixed woodlands.
Red-shouldered Hawk
Buteo lineatus
Cool, moist, mature forest, wooded wetlands.
Broad-winged Hawk
Buteo platypterus
Extensive woodlands with roads or clearings.
Red-tailed Hawk
Buteo jamaicensis
Mature forest-field ecotone.
Golden Eagle
Aquila chrysaetos
Cliffs and wide expanses of open land.
American Kestrel
Falco sparverius
Tall trees with cavities (dbh at least 12"); open country with low relief.
Merlin
Falco columbarius
Natural cavities or old woodpecker holes in open woodlands.
Peregrine Falcon
Falco peregrinus
High cliffs.
Spruce Grouse
Dendragapus canadensis
Coniferous forest.
Ruffed Grouse
Bonasa umbellus
Fallen logs amidst dense saplings.

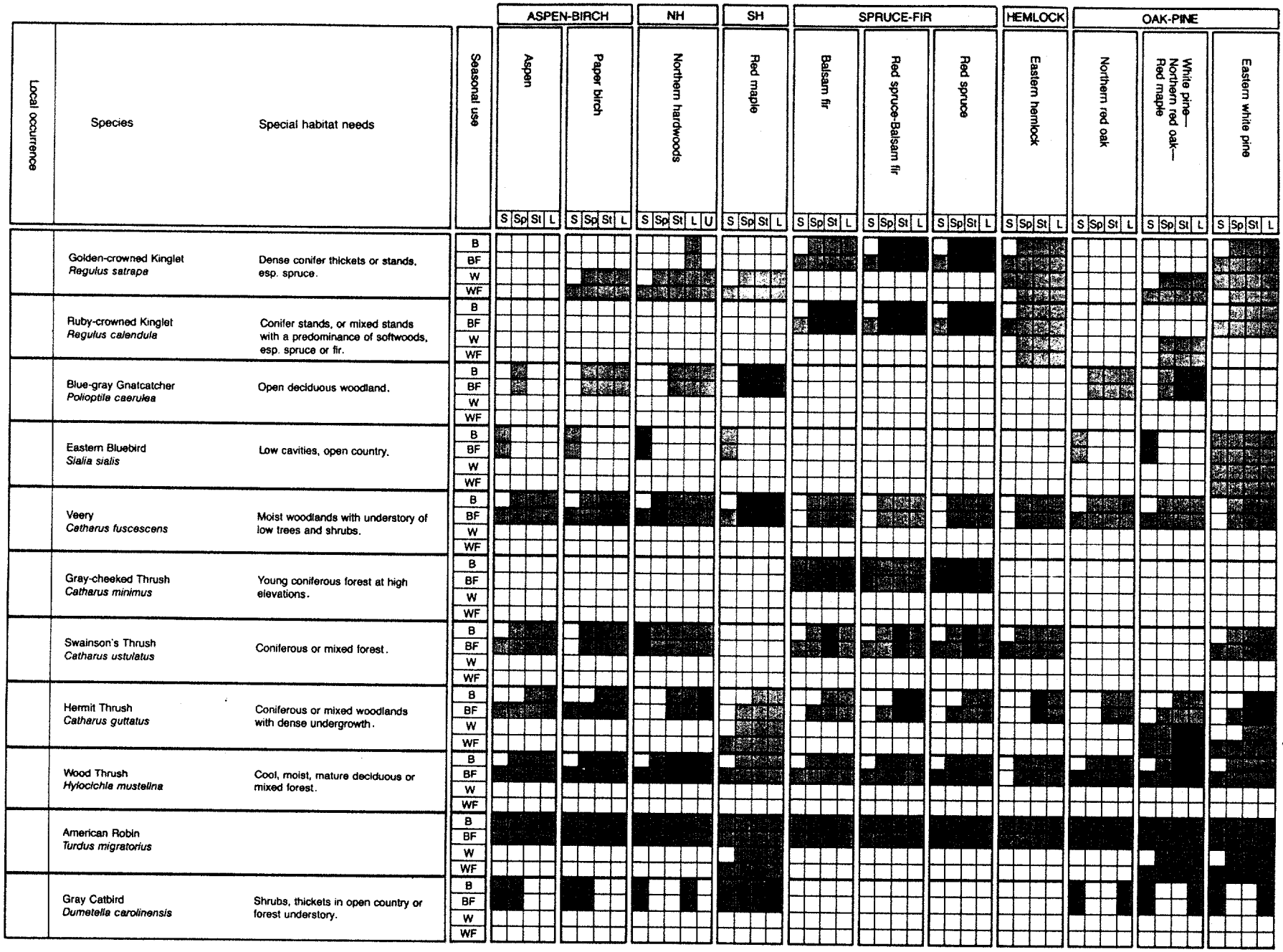

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Wild Turkey
Meleagris gallopavo
Open, mast-producing woodlands, large conifers for roosting, woodland clearings.
Northern Bobwhite
Colinus virginianus
Brushy field edges, well-drained sandy or loamy soils.
American Woodcock
Scolopax minor
Fertile moist soil containing earthworms, clearings and dense swales.
Mourning Dove
Zenaida macroura
Open land with bare ground.
Black-billed Cuckoo
Coccyzus erythropthalmus
Low, dense thickets.
Yellow-billed Cuckoo
Coccyzus americanus
Low, dense thickets.
Eastern Screech-Owl
Otus asio
Cavity trees (12" dbh minimum).
Great Horned Owl
Bubo virginianus
Large abandoned hawk nests, large tree cavities.
Northern Hawk-Owl
Surnia ulula
Open coniferous or mixed woodland, burns with standing stubs.
Barred Owl
Strix varia
Cool, damp lowlands; cavity trees with minimum dbh of 20"
Great Gray Owl
Strix nebulosa
Meadows, swamps near woodlands.

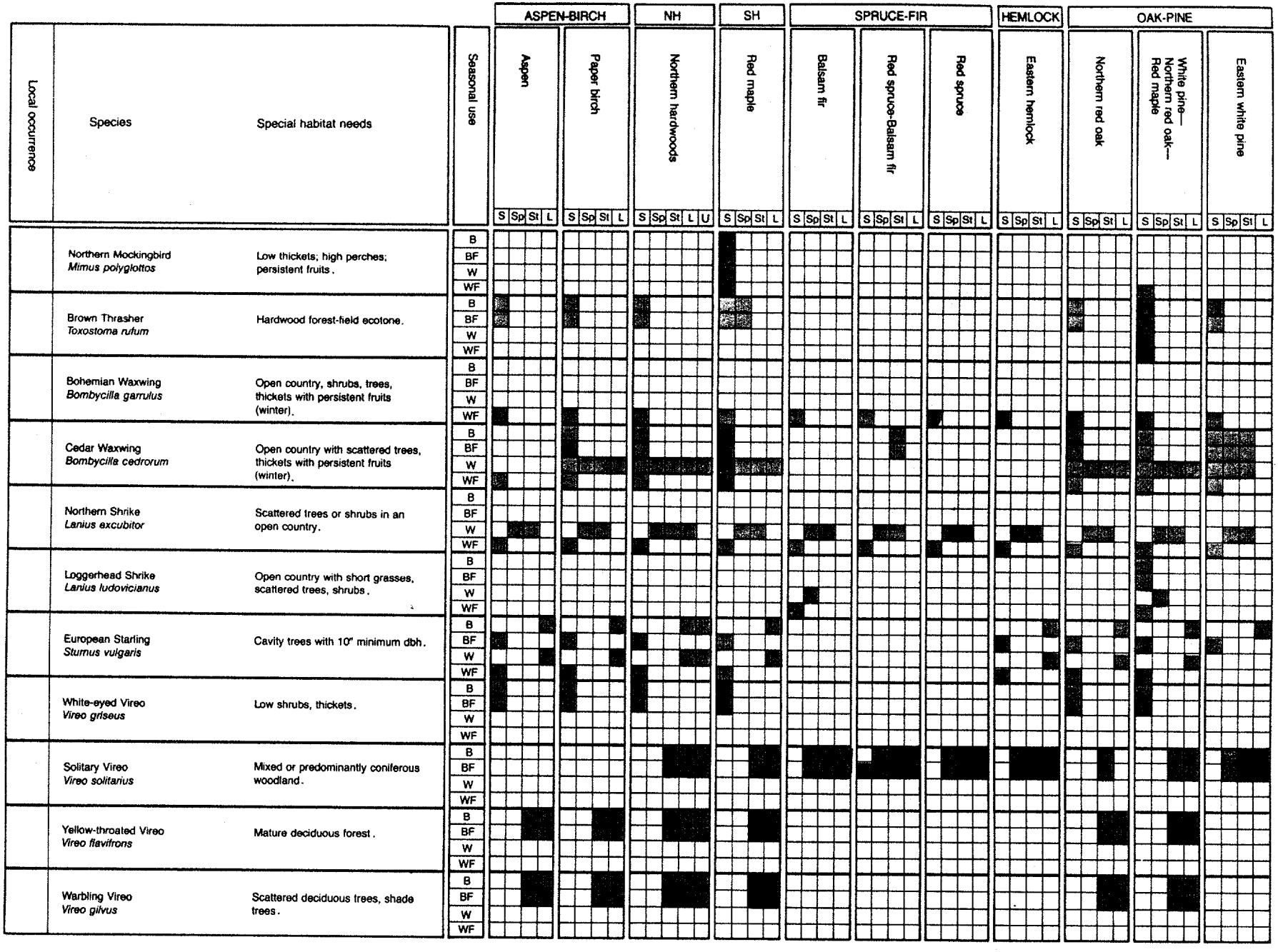

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
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Aspen
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Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Long-eared Owl
Asio otus
Dense conifer thickets in open country.
Boreal Owl
Aegolius funereus
Cavity trees, often with large woodpecker holes.
Northern Saw-whet Owl
Aegolius acadicus
Cavity trees with minimum dbh of 12" near forest clearings.
Common Nighthawk
Chordeiles minor
Whip-poor-will
Caprimulgus vociferus
Ungrazed woodlands with openings.
Ruby-throated Hummingbird
Archilochus colubris
Flowers, preferably red.
Red-headed Woodpecker
Melanerpes erythrocephalus
Cavity trees in savanna or open country.
Red-bellied Woodpecker
Melanerpes carolinus
Extensive mature woodlands with dead trees or trees with large dead limbs.
Yellow-bellied Sapsucker
Sphyrapicus varius
Trees with minimal dbh of 10" especially aspens containing sound decayed wood.
Downy Woodpecker
Picoides pubescens
Trees, limbs with decay column (minimum dbh 6").
Hairy Woodpecker
Picoides villosus
Trees, limbs with decay column (minimum dbh 10").

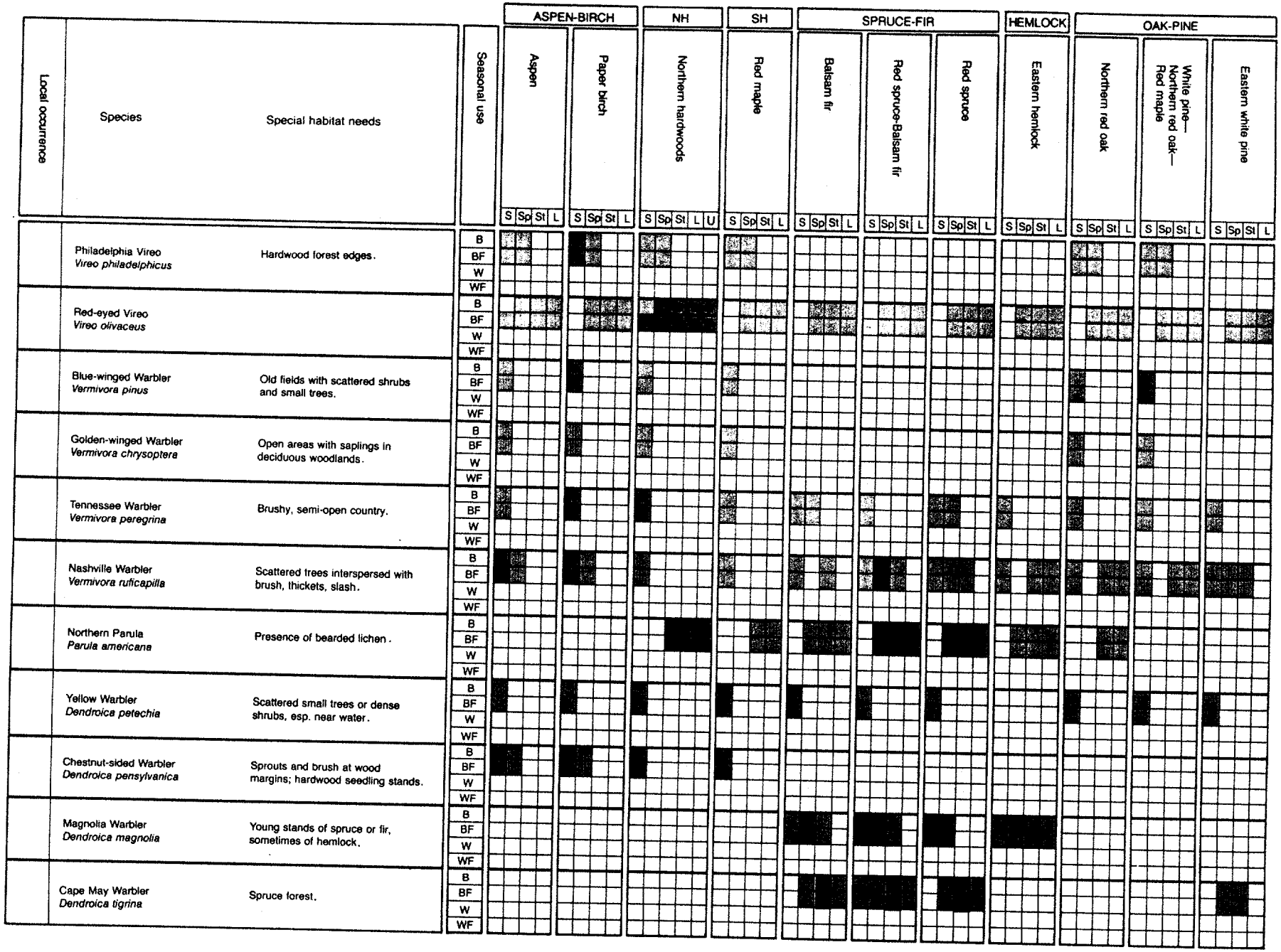

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Three-toed Woodpecker
Picoides tridactylus
Spruce, fir trees with column of decayed wood (minimum dbh 12"); dead trees with loose bark.
Black-backed Woodpecker
Picoides arcticus
Spruce, fir trees with column of decayed wood (minimum dbh 10"); dead trees with loose bark, often near water.
Northern Flicker
Colaptes auratus
Open areas; trees with column of decayed wood (minimum dbh 12"); forest edges.
Pileated Woodpecker
Dryocopus pileatus
Mature forest; trees with column of decayed wood at least 20" dbh.
Olive-sided Flycatcher
Contopus borealis
Low, wet coniferous forest, bog, etc. with high song perch.
Eastern Wood-Pewee
Contopus virens
Forest edge or open woods.
Yellow-bellied Flycatcher
Empidonax flaviventris
Low, wet coniferous forest.
Acadian Flycatcher
Empidonax virescens
Mature woodlands with openings in the canopy.
Alder Flycatcher
Empidonax alnorum
Thickets, low shrubs and clearings.
Willow Flycatcher
Empidonax traillii
Low deciduous trees and shrubs with clearings, thick hardwood seedings.
Least Flycatcher
Empidonax minimus
Open deciduous or mixed forest, edges.

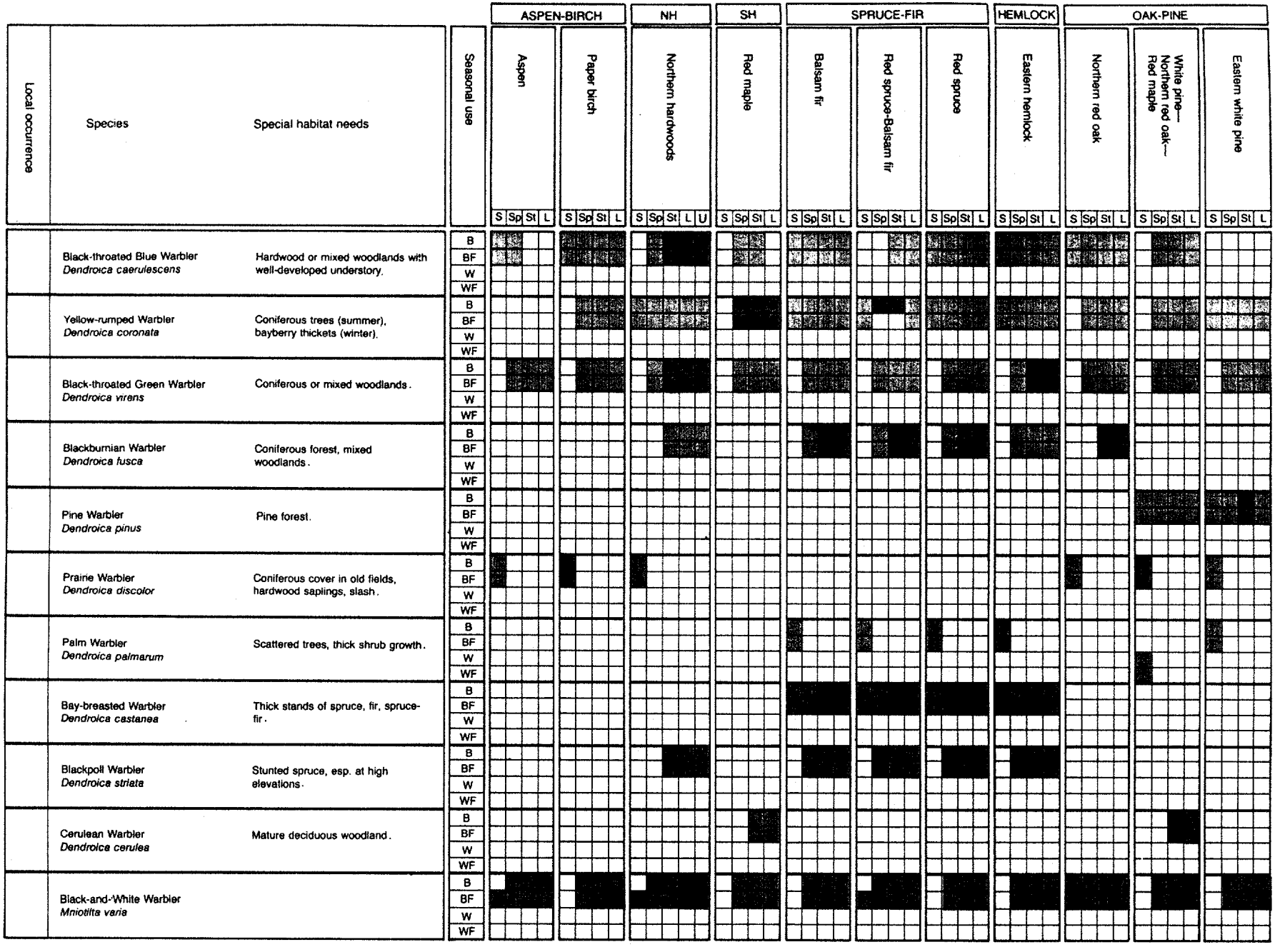

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
Aspen
Paper birch
NH
Northern hardwoods
SH
Red maple
SPRUCE-FIR
Balsam fir
Red spruce-Balsam fir
Red spruce
HEMLOCK
Eastern hemlock
OAK-PINE
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L U
B BF W WF
Eastern Phoebe
Sayornis phoebe
Exposed perches; cliffs or ledges in streamside clearings, woodland edges.
Great Crested Flycatcher
Myiarchus crinitus
Mature cavity trees, deciduous forest, edges.
Eastern Kingbird
Tyrannus tyrannus
Clearings, fields, orchards.
Purple Martin
Progne subis
Martin houses near ponds, lakes.
Tree Swallow
Tachycineta bicolor
Cavity trees (minimum dbh 10"); open areas, especially near water.
Northern Rough-winged Swallow
Stelgidopteryx serripennis
Sandy or clay banks stabilized by a grassy, overhanging top.
Bank Swallow
Riparia riparia
Sandy or clay banks stabilized by a grassy overhang.
Cliff Swallow
Hirundo pyrrhonota
Open areas; mud; vertical wall with an overhang.
Barn Swallow
Hirundo rustica
Abandoned or little-used buildings.
Gray Jay
Perisoreus canadensis
Coniferous forests.
Blue Jay
Cyanocitta cristata

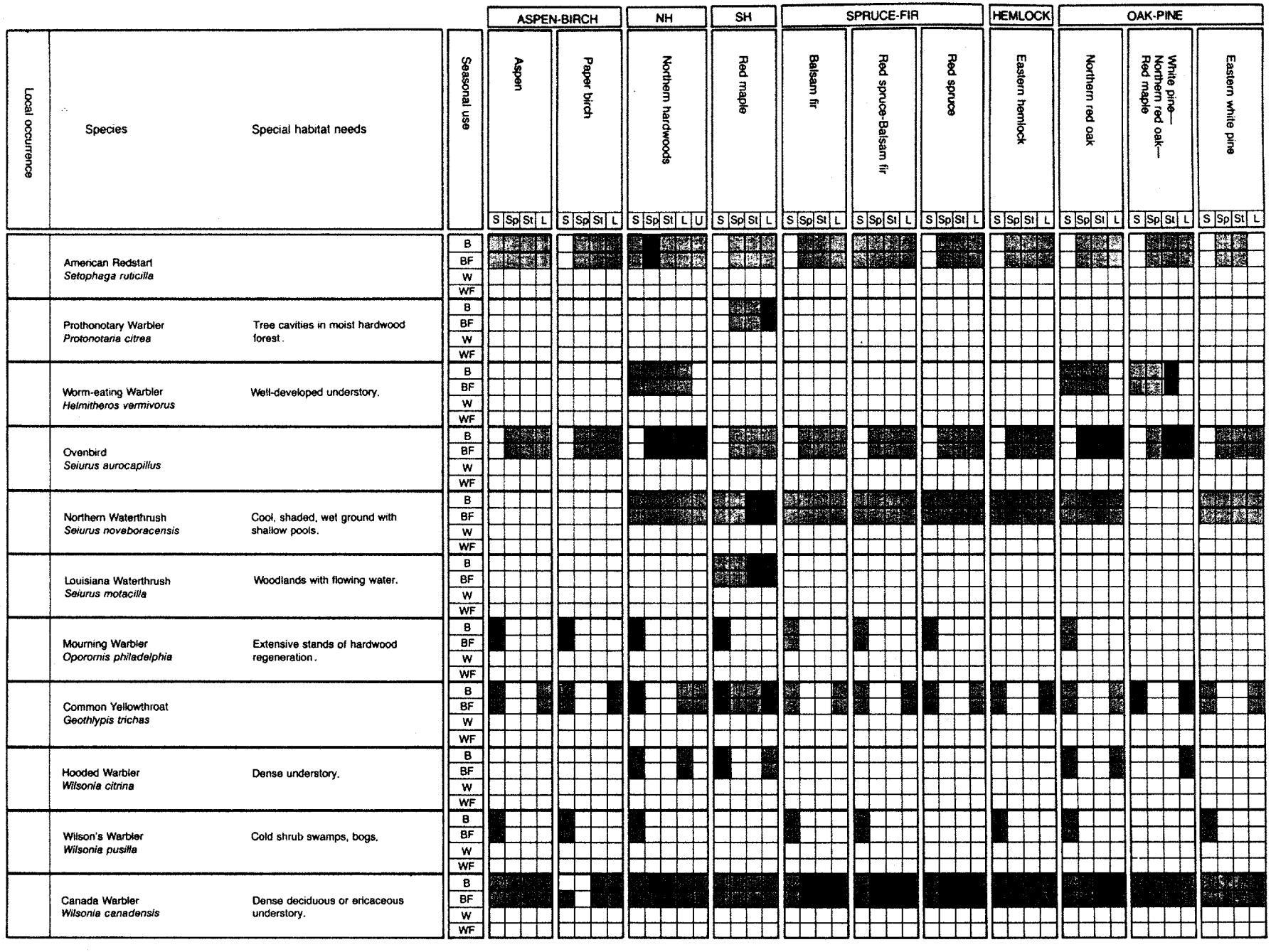
ASPEN-BIRCH
Aspen
Paper birch
NH
Northern hardwoods
SH
Red maple
SPRUCE-FIR
Balsam fir
Red spruce-Balsam fir
Red spruce
HEMLOCK
Eastern hemlock
OAK-PINE
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L U
Seasonal use
B
BF
W
WF
Local occurrence
Species
Special habitat needs
American Crow
Corvus brachyrhynchos
Common Raven
Corvus corax
Cliffs
Black-capped Chickadee
Parus atricapillus
Cavity trees or stubs in small woodlands; clearings or open woodlands.
Boreal Chickadee
Parus hudsonicus
Softwood snags, stubs.
Tufted Titmouse
Parus bicolor
Cavity trees at least 8" dbh.
Red-breasted Nuthatch
Sitta canadensis
Cavity trees in mixed or coniferous woods (minimum dbh 12").
White-breasted Nuthatch
Sitta carolinensis
Cavity trees in hardwoods or mixed woods (minimum dbh 12").
Brown Creeper
Certhia americana
Woodlands containing trees with sloughing or loose bark.
Carolina Wren
Thryothorus ludovicianus
Cavity trees amid brushy vegetation, thickets, swamps.
House Wren
Troglodytes aedon
Cavity trees, shrubs.
Winter Wren
Troglodytes troglodytes
Moist, mixed or coniferous woodlands with down logs; low woody vegetation.

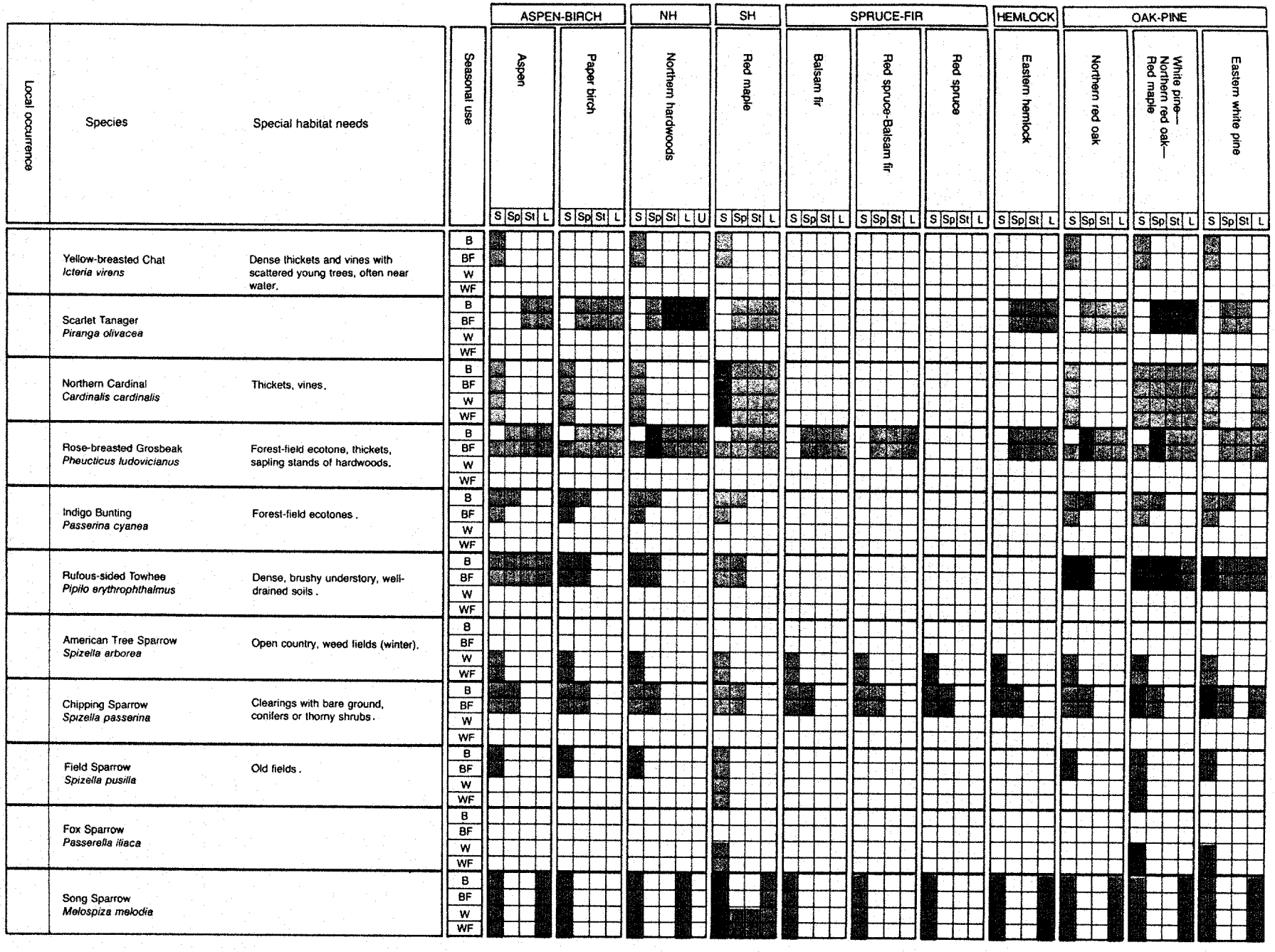

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
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Red spruce-Balsam fir
Red spruce
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Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Golden-crowned Kinglet
Regulus satrapa
Dense conifer thickets or stands, esp. spruce.
Ruby-crowned Kinglet
Regulus calendula
Conifer stands, or mixed stands with a predominance of softwoods, esp. spruce or fir.
Blue-gray Gnatcatcher
Polioptila caerulea
Open deciduous woodland.
Eastern Bluebird
Sialia sialis
Low cavities, open country.
Veery
Catharus fuscescens
Moist woodlands with understory of low trees and shrubs.
Gray-cheeked Thrush
Catharus minimus
Young coniferous forest at high elevations.
Swainson's Thrush
Catharus ustulatus
Coniferous or mixed forest.
Hermit Thrush
Catharus guttatus
Coniferous or mixed woodlands with dense undergrowth.
Wood Thrush
Hylocichla mustelina
Cool, moist, mature deciduous or mixed forest.
American Robin
Turdus migratorius
Gray Catbird
Dumetella carolinensis
Shrubs, thickets in open country or forest understory.


Local occurrence
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Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
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Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Northern Mockingbird
Mimus polyglottos
Low thickets; high perches; persistent fruits.
Brown Thrasher
Toxostoma rufum
Hardwood forest-field ecotone.
Bohemian Waxwing
Bombycilla garrulus
Open country, shrubs, trees, thickets with persistent fruits (winter).
Cedar Waxwing
Bombycilla cedrorum
Open country with scattered trees, thickets with persistent fruits (winter).
Northern Shrike
Lanius excubitor
Scattered trees or shrubs in an open country.
Loggerhead Shrike
Lanius ludovicianus
Open country with short grasses, scattered trees, shrubs.
European Starling
Sturnus vulgaris
Cavity trees with 10" minimum dbh.
White-eyed Vireo
Vireo griseus
Low shrubs, thickets.
Solitary Vireo
Vireo solitarius
Mixed or predominantly coniferous woodland.
Yellow-throated Vireo
Vireo flavifrons
Mature deciduous forest.
Warbling Vireo
Vireo gilvus
Scattered deciduous trees, shade trees.


Local occurrence
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Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
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Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B BF W WF
Philadelphia Vireo
Vireo philadelphicus
Hardwood forest edges.
Red-eyed Vireo
Vireo olivaceus
Blue-winged Warbler
Vermivora pinus
Old fields with scattered shrubs and small trees.
Golden-winged Warbler
Vermivora chrysoptera
Open areas with saplings in deciduous woodlands.
Tennessee Warbler
Vermivora peregrina
Brushy, semi-open country.
Nashville Warbler
Vermivora ruficapilla
Scattered trees interspersed with brush, thickets, slash.
Northern Parula
Parula americana
Presence of bearded lichen.
Yellow Warbler
Dendroica petechia
Scattered small trees or dense shrubs, esp. near water.
Chestnut-sided Warbler
Dendroica pensylvanica
Sprouts and brush at wood margins; hardwood seedling stands.
Magnolia Warbler
Dendroica magnolia
Young stands of spruce or fir, sometimes of hemlock.
Cape May Warbler
Dendroica tigrina
Spruce forest.

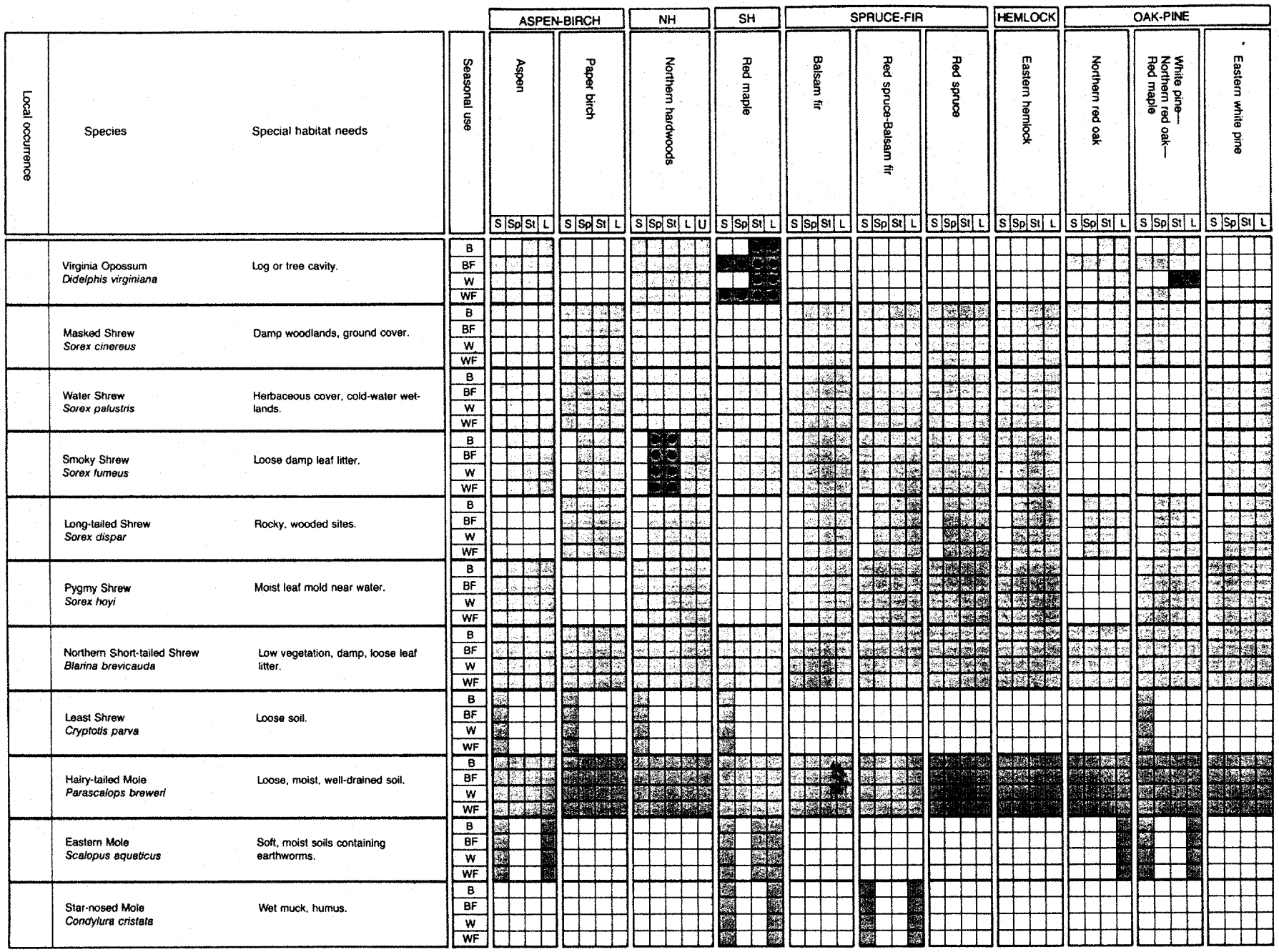

ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Local occurrence
Species
Special habitat needs
Seasonal use
Aspen
Paper birch
Northern hardwoods
Red maple
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Red spruce-Balsam fir
Red spruce
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Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Black-throated Blue Warbler
Dendroica caerulescens
Hardwood or mixed woodlands with well-developed understory.
Yellow-rumped Warbler
Dendroica coronata
Coniferous trees (summer), bayberry thickets (winter).
Black-throated Green Warbler
Dendroica virens
Coniferous or mixed woodlands.
Blackburnian Warbler
Dendroica fusca
Coniferous forest, mixed woodlands.
Pine Warbler
Dendroica pinus
Pine forest.
Prairie Warbler
Dendroica discolor
Coniferous cover in old fields, hardwood saplings, slash.
Palm Warbler
Dendroica palmarum
Scattered trees, thick shrub growth.
Bay-breasted Warbler
Dendroica castanea
Thick stands of spruce, fir, spruce-fir.
Blackpoll Warbler
Dendroica striata
Stunted spruce, esp. at high elevations.
Cerulean Warbler
Dendroica cerulea
Mature deciduous woodland.
Black-and-White Warbler
Mniotilta varia

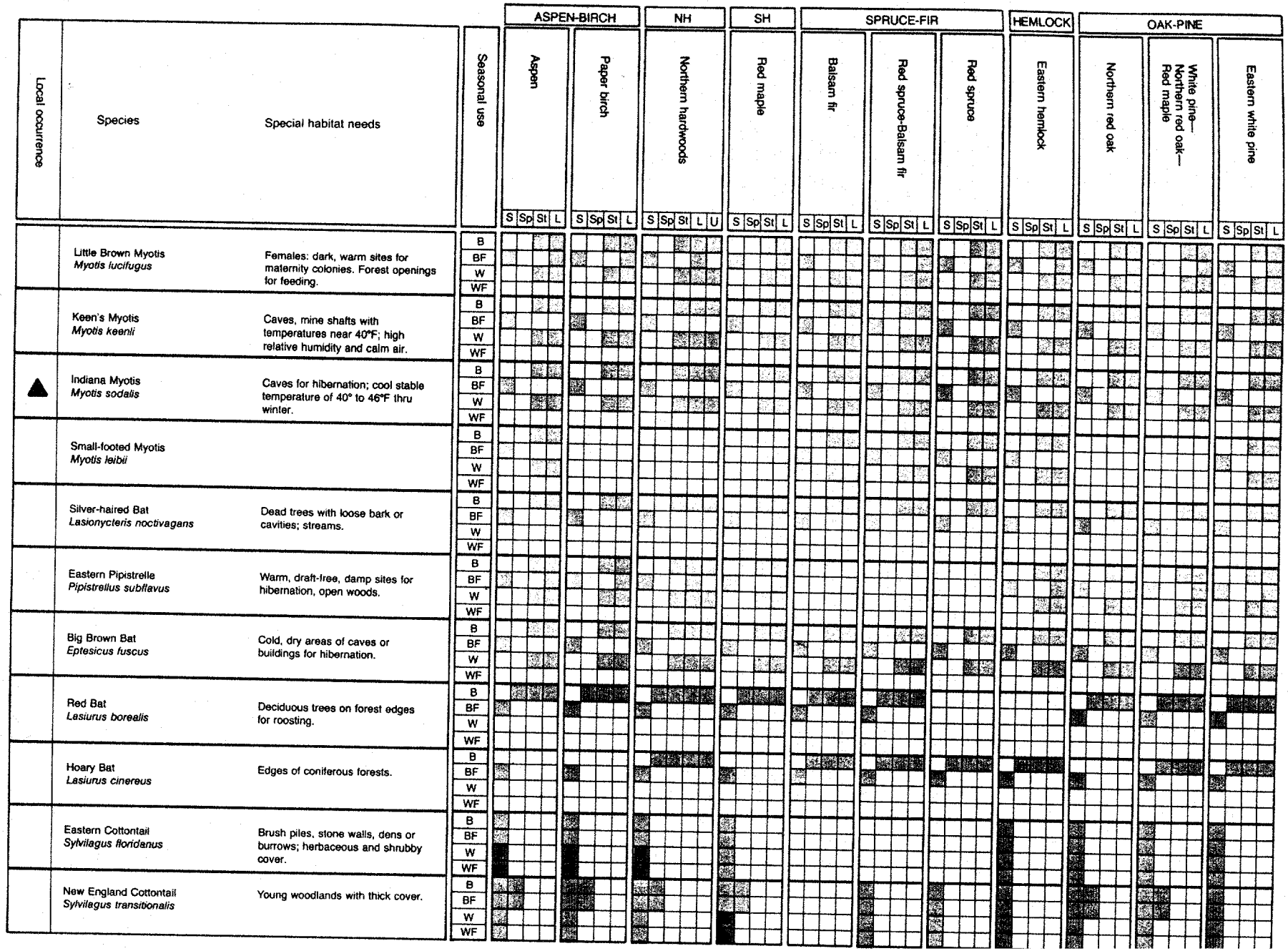

ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Local occurrence
Species
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Aspen
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Red spruce
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White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
American Redstart
Setophaga ruticilla
Prothonotary Warbler
Protonotaria citrea
Tree cavities in moist hardwood forest.
Worm-eating Warbler
Helmitheros vermivorus
Well-developed understory.
Ovenbird
Seiurus aurocapillus
Northern Waterthrush
Seiurus noveboracensis
Cool, shaded, wet ground with shallow pools.
Louisiana Waterthrush
Seiurus motacilla
Woodlands with flowing water.
Mourning Warbler
Oporornis philadelphia
Extensive stands of hardwood regeneration.
Common Yellowthroat
Geothlypis trichas
Hooded Warbler
Wilsonia citrina
Dense understory.
Wilson's Warbler
Wilsonia pusilla
Cold shrub swamps, bogs.
Canada Warbler
Wilsonia canadensis
Dense deciduous or ericaceous understory.

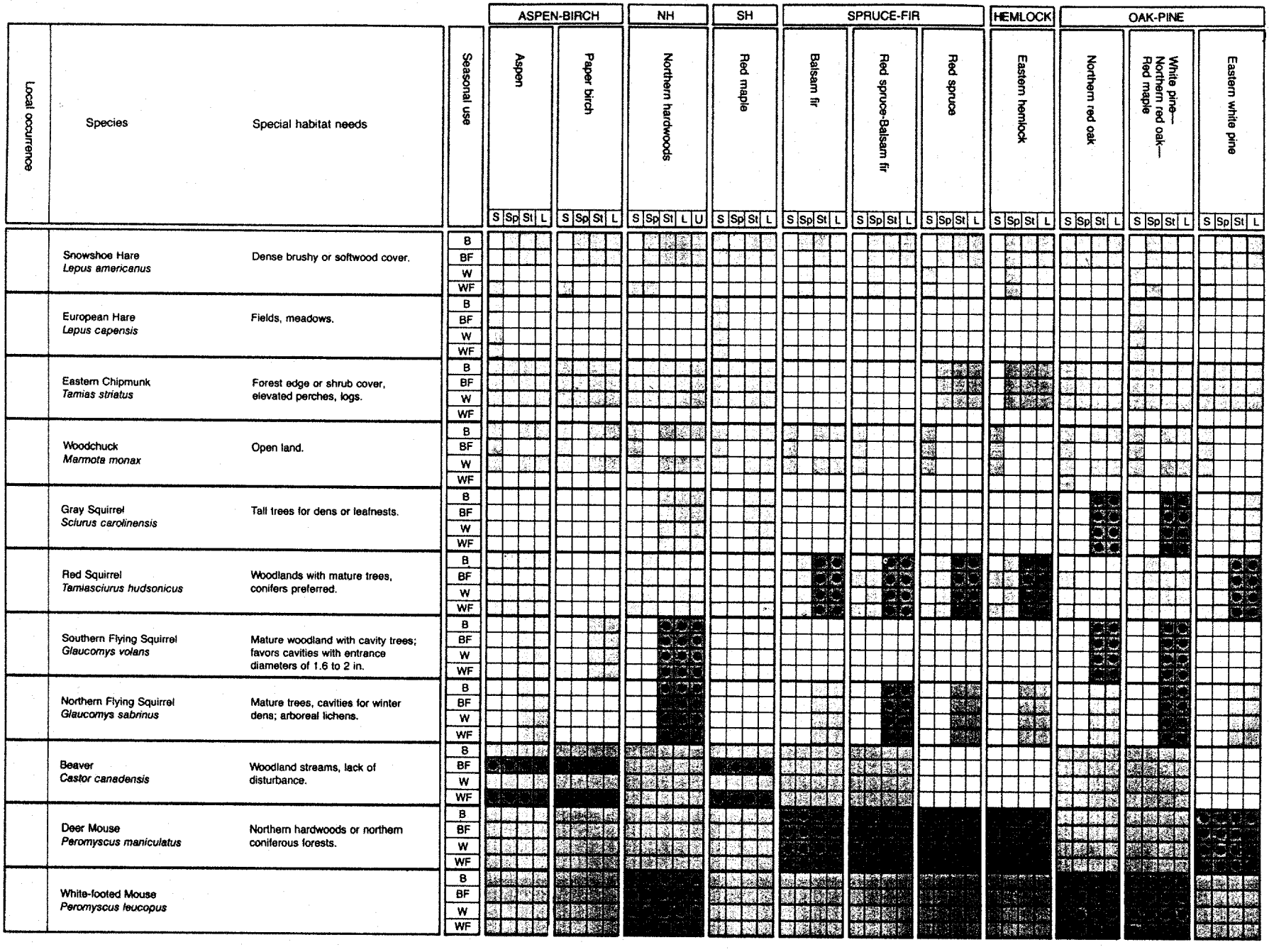

Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Yellow-breasted Chat
Icteria virens
Dense thickets and vines with scattered young trees, often near water.
Scarlet Tanager
Piranga olivacea
Northern Cardinal
Cardinalis cardinalis
Thickets, vines.
Rose-breasted Grosbeak
Pheucticus ludovicianus
Forest-field ecotone, thickets, sapling stands of hardwoods.
Indigo Bunting
Passerina cyanea
Forest-field ecotones.
Rufous-sided Towhee
Pipilo erythrophthalmus
Dense, brushy understory, well-drained soils.
American Tree Sparrow
Spizella arborea
Open country, weed fields (winter).
Chipping Sparrow
Spizella passerina
Clearings with bare ground, conifers or thorny shrubs.
Field Sparrow
Spizella pusilla
Old fields.
Fox Sparrow
Passerella iliaca
Song Sparrow
Melospiza melodia

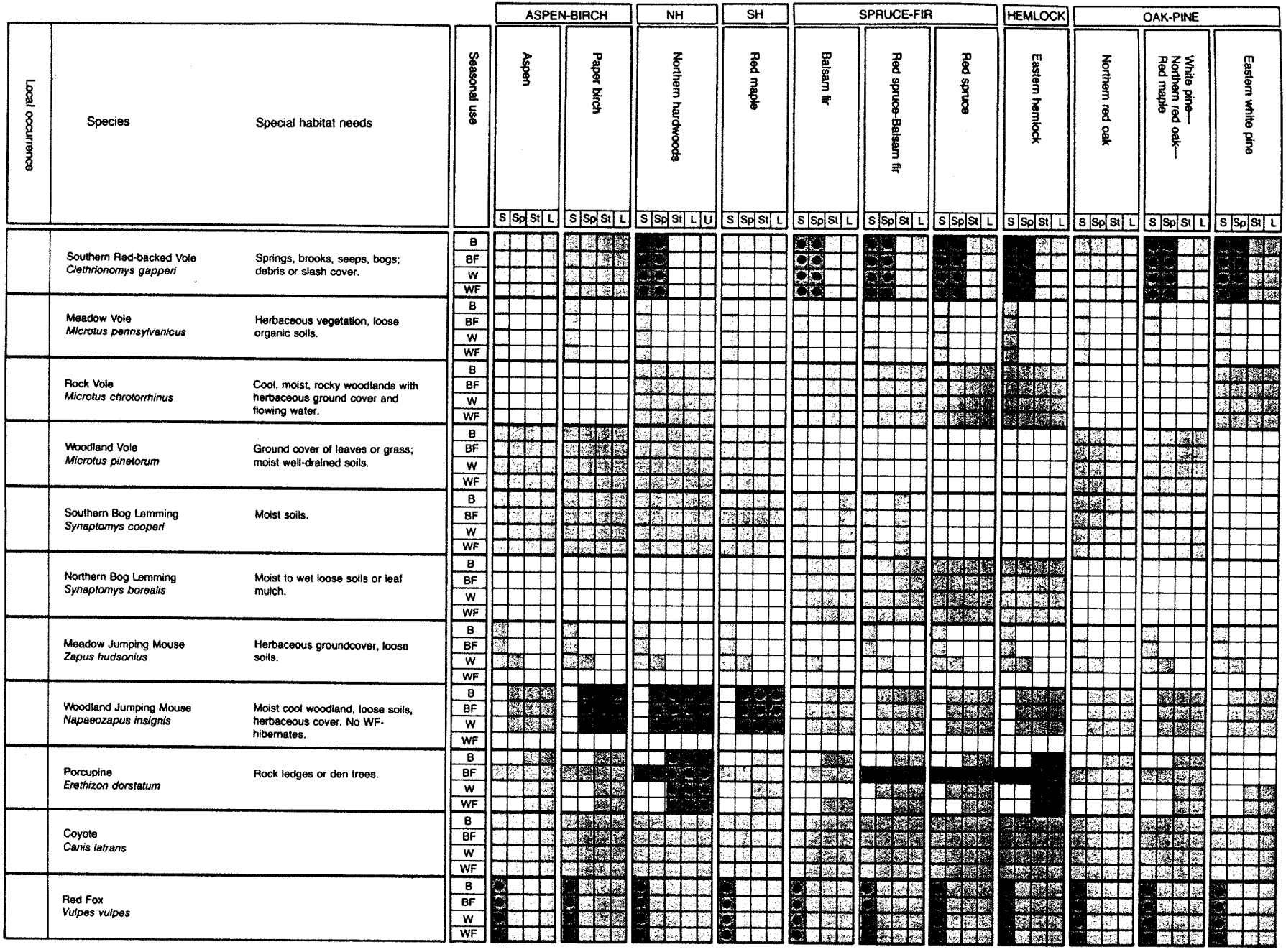
Local occurrence	Species	Special habitat needs	Seasonal use	ASPEN-BIRCH: Aspen (S Sp St L)	ASPEN-BIRCH: Paper birch (S Sp St L)	NH: Northern hardwoods (S Sp St L U)	SH: Red maple (S Sp St L)	SPRUCE-FIR: Balsam fir (S Sp St L)	SPRUCE-FIR: Red spruce-Balsam fir (S Sp St L)	SPRUCE-FIR: Red spruce (S Sp St L)	HEMLOCK: Eastern hemlock (S Sp St L)	OAK-PINE: Northern red oak (S Sp St L)	OAK-PINE: White pine—Northern red oak—Red maple (S Sp St L)	OAK-PINE: Eastern white pine (S Sp St L)
	Purple Finch *Carpodacus purpureus*	Coniferous trees.	B, BF, W, WF											
	House Finch *Carpodacus mexicanus*	Open ground with low seed-producing plants.	B, BF, W, WF											
	Red Crossbill *Loxia curvirostra*	Northern coniferous trees.	B, BF, W, WF											
	White-winged Crossbill *Loxia leucoptera*	Northern coniferous trees.	B, BF, W, WF											
	Common Redpoll *Carduelis flammea*	Open country.	B, BF, W, WF											
	Hoary Redpoll *Carduelis hornemanni*	Open country.	B, BF, W, WF											
	Pine Siskin *Carduelis pinus*	Conifers.	B, BF, W, WF											
	American Goldfinch *Carduelis tristis*	Open, weedy fields with scattered small trees.	B, BF, W, WF											
	Evening Grosbeak *Coccothraustes vespertinus*	Spruce and fir forest (breeding season).	B, BF, W, WF											
			B, BF, W, WF											
			B, BF, W, WF											

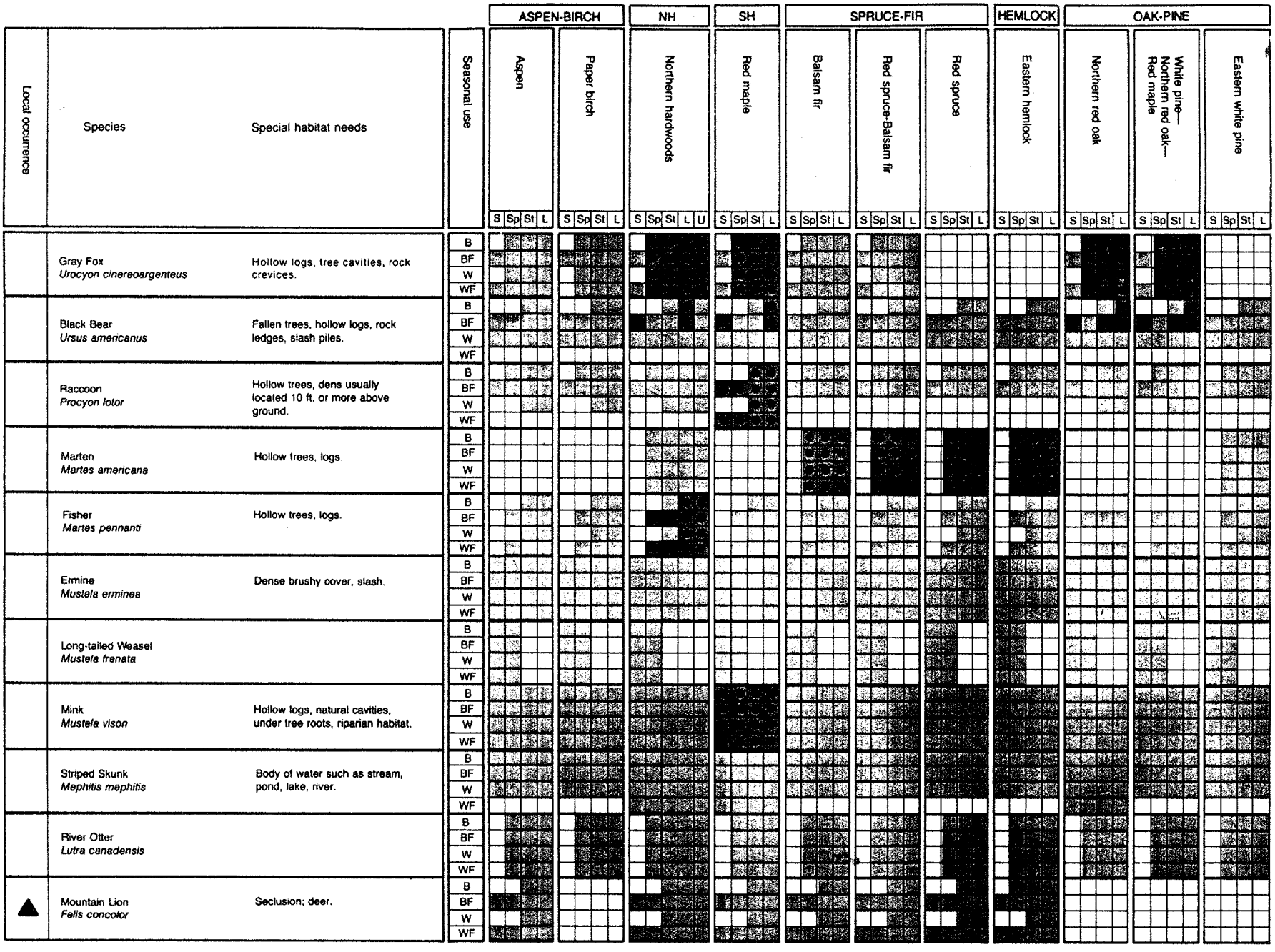
Species Occurrence and Utilization, by Forested Habitat
Mammals




Local occurrence
Species
Special habitat needs
Seasonal use
ASPEN-BIRCH
NH
SH
SPRUCE-FIR
HEMLOCK
OAK-PINE
Aspen
Paper birch
Northern hardwoods
Red maple
Balsam fir
Red spruce-Balsam fir
Red spruce
Eastern hemlock
Northern red oak
White pine—Northern red oak—Red maple
Eastern white pine
S Sp St L
S Sp St L U
B
BF
W
WF
Little Brown Myotis
Myotis lucifugus
Females: dark, warm sites for maternity colonies. Forest openings for feeding.
Keen's Myotis
Myotis keenii
Caves, mine shafts with temperatures near 40°F; high relative humidity and calm air.
Indiana Myotis
Myotis sodalis
Caves for hibernation; cool stable temperature of 40° to 46°F thru winter.
Small-footed Myotis
Myotis leibii
Silver-haired Bat
Lasionycteris noctivagans
Dead trees with loose bark or cavities; streams.
Eastern Pipistrelle
Pipistrellus subflavus
Warm, draft-free, damp sites for hibernation, open woods.
Big Brown Bat
Eptesicus fuscus
Cold, dry areas of caves or buildings for hibernation.
Red Bat
Lasiurus borealis
Deciduous trees on forest edges for roosting.
Hoary Bat
Lasiurus cinereus
Edges of coniferous forests.
Eastern Cottontail
Sylvilagus floridanus
Brush piles, stone walls, dens or burrows; herbaceous and shrubby cover.
New England Cottontail
Sylvilagus transitionalis
Young woodlands with thick cover.


Local occurrence
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Red spruce
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Northern red oak
White pine—Northern red oak—Red maple
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S Sp St L
S Sp St L U
B
BF
W
WF
Snowshoe Hare
Lepus americanus
Dense brushy or softwood cover.
European Hare
Lepus capensis
Fields, meadows.
Eastern Chipmunk
Tamias striatus
Forest edge or shrub cover, elevated perches, logs.
Woodchuck
Marmota monax
Open land.
Gray Squirrel
Sciurus carolinensis
Tall trees for dens or leafnests.
Red Squirrel
Tamiasciurus hudsonicus
Woodlands with mature trees, conifers preferred.
Southern Flying Squirrel
Glaucomys volans
Mature woodland with cavity trees; favors cavities with entrance diameters of 1.6 to 2 in.
Northern Flying Squirrel
Glaucomys sabrinus
Mature trees, cavities for winter dens; arboreal lichens.
Beaver
Castor canadensis
Woodland streams, lack of disturbance.
Deer Mouse
Peromyscus maniculatus
Northern hardwoods or northern coniferous forests.
White-footed Mouse
Peromyscus leucopus

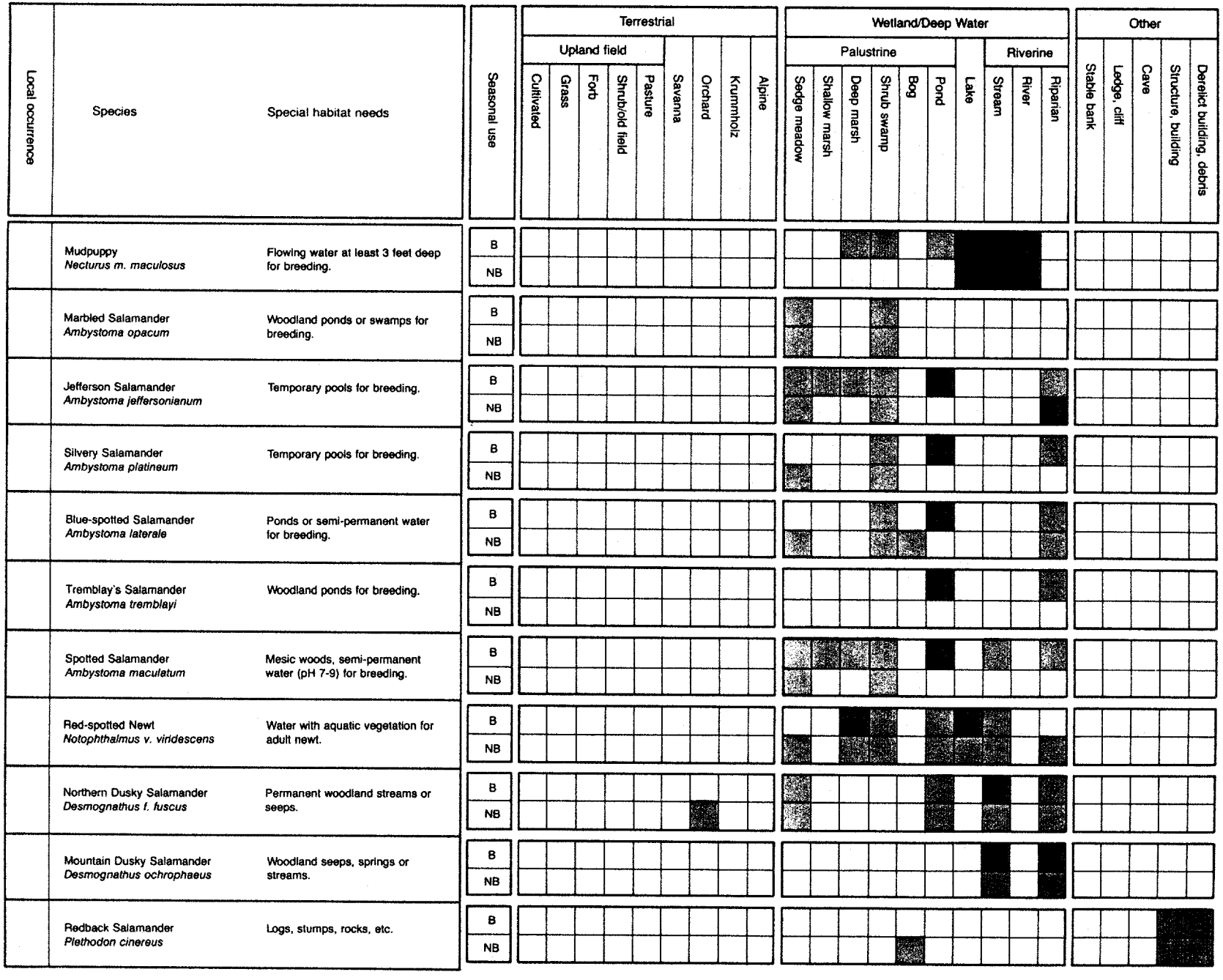

Local occurrence
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ASPEN-BIRCH
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S Sp St L
S Sp St L U
B
BF
W
WF
Southern Red-backed Vole
Clethrionomys gapperi
Springs, brooks, seeps, bogs; debris or slash cover.
Meadow Vole
Microtus pennsylvanicus
Herbaceous vegetation, loose organic soils.
Rock Vole
Microtus chrotorrhinus
Cool, moist, rocky woodlands with herbaceous ground cover and flowing water.
Woodland Vole
Microtus pinetorum
Ground cover of leaves or grass; moist well-drained soils.
Southern Bog Lemming
Synaptomys cooperi
Moist soils.
Northern Bog Lemming
Synaptomys borealis
Moist to wet loose soils or leaf mulch.
Meadow Jumping Mouse
Zapus hudsonius
Herbaceous groundcover, loose soils.
Woodland Jumping Mouse
Napaeozapus insignis
Moist cool woodland, loose soils, herbaceous cover. No WF-hibernates.
Porcupine
Erethizon dorstatum
Rock ledges or den trees.
Coyote
Canis latrans
Red Fox
Vulpes vulpes


ASPEN-BIRCH
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Eastern white pine
S Sp St L U
B BF W WF
Gray Fox
Urocyon cinereoargenteus
Hollow logs, tree cavities, rock crevices.
Black Bear
Ursus americanus
Fallen trees, hollow logs, rock ledges, slash piles.
Raccoon
Procyon lotor
Hollow trees, dens usually located 10 ft. or more above ground.
Marten
Martes americana
Hollow trees, logs.
Fisher
Martes pennanti
Hollow trees, logs.
Ermine
Mustela erminea
Dense brushy cover, slash.
Long-tailed Weasel
Mustela frenata
Mink
Mustela vison
Hollow logs, natural cavities, under tree roots, riparian habitat.
Striped Skunk
Mephitis mephitis
Body of water such as stream, pond, lake, river.
River Otter
Lutra canadensis
Mountain Lion
Felis concolor
Seclusion; deer.

Local occurrence	Species	Special habitat needs	Seasonal use
	Lynx *Felis lynx*	Secluded den sites, extensive forests.	B BF W WF
	Bobcat *Felis rufus*	Rock ledges, under windfalls or in hollow logs.	B BF W WF
	White-tailed Deer *Odocoileus virginianus*	Softwood yarding cover in North.	B BF W WF
	Moose *Alces alces*	Wetlands (in summer).	B BF W WF
			B BF W WF
			B BF W WF
			B BF W WF
			B BF W WF
			B BF W WF
			B BF W WF
			B BF W WF

ASPEN-BIRCH		NH	SH	SPRUCE-FIR			HEMLOCK	OAK-PINE			
Aspen	Paper birch	Northern hardwoods	Red maple	Balsam fir	Red spruce-Balsam fir	Red spruce	Eastern hemlock	Northern red oak	White pine—Northern red oak—Red maple	Eastern white pine	
S Sp St L	S Sp St L	S Sp St L U	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	S Sp St L	

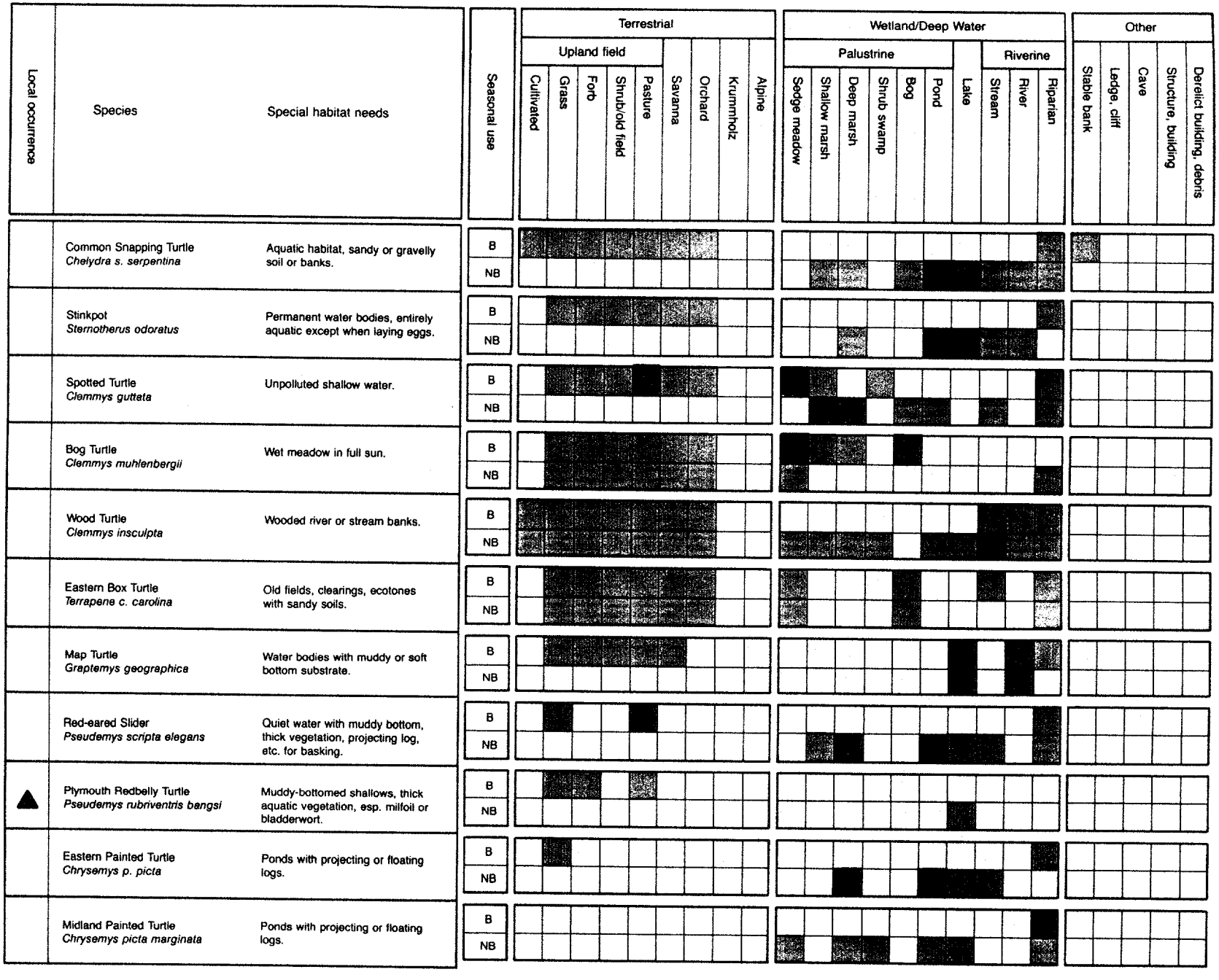
Species Occurrence and Utilization, by Nonforested Habitat
Amphibians

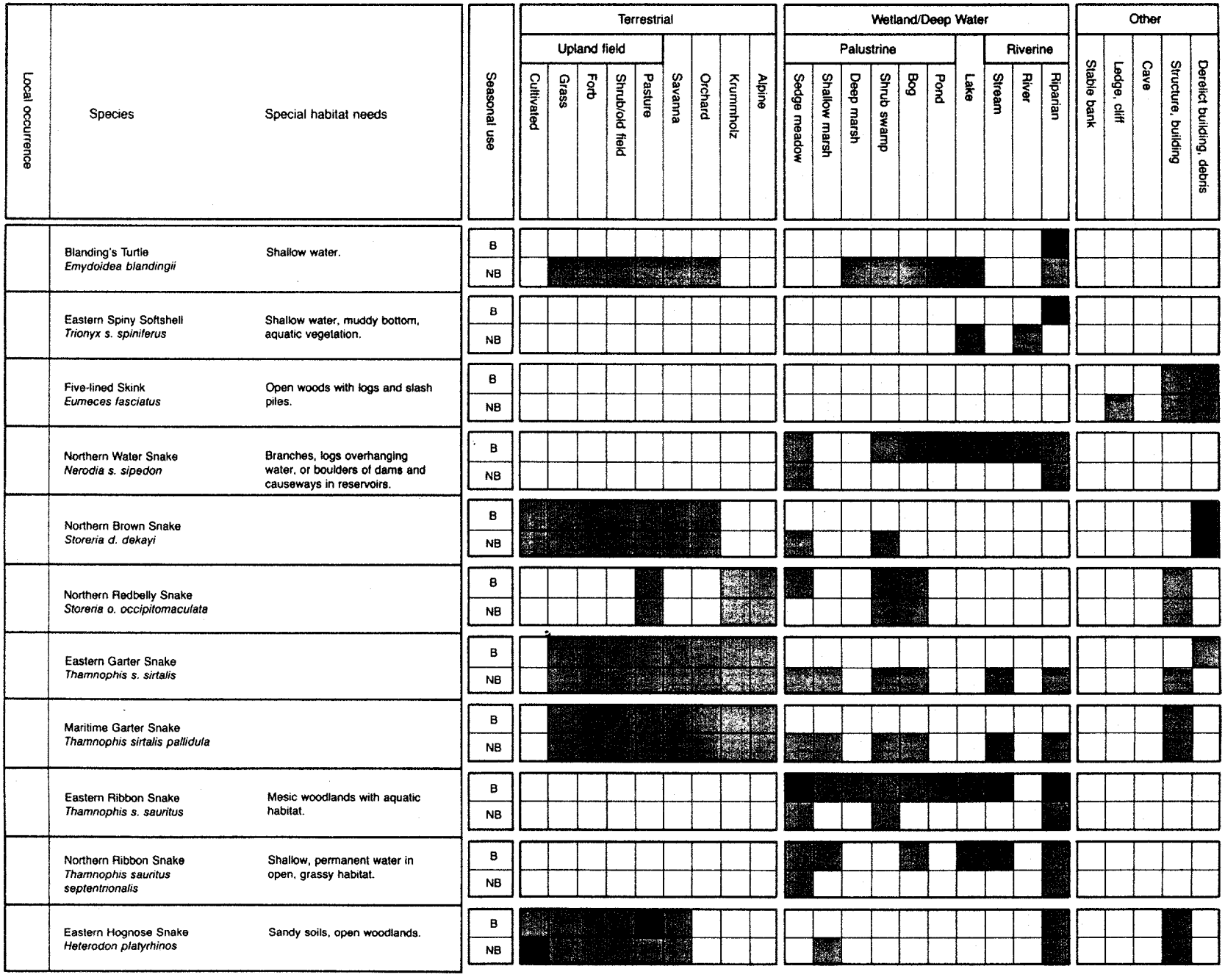


Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Grass	Forb	Shrub/old field	Pasture	Savanna	Orchard	Krummholz	Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Shallow marsh	Deep marsh	Shrub swamp	Bog	Pond	Lake	Riverine: Stream	River	Riparian	Other: Stable bank	Ledge, cliff	Cave	Structure, building	Derelict building, debris
	Slimy Salamander *Plethodon g. glutinosus*	Rock outcroppings, logs within wooded areas.	B NB																								
	Four-toed Salamander *Hemidactylium scutatum*	Wet woodlands.	B NB																								
	Northern Spring Salamander *Gyrinophilus p. porphyriticus*	Streams, seeps or springs.	B NB																								
	Northern Two-lined Salamander *Eurycea b. bislineata*	Streams for breeding.	B NB																								
	Eastern Spadefoot *Scaphiopus h. holbrookii*	Sandy soils, temporary pools for breeding.	B NB																								
	Eastern American Toad *Bufo a. americanus*		B NB																								
	Fowler's Toad *Bufo woodhousii fowleri*	Sandy soils, shallow water for breeding.	B NB																								
	Northern Spring Peeper *Hyla c. crucifer*	Pools for breeding.	B NB																								
	Gray Treefrog *Hyla versicolor*	Seeps, aquatic sites for breeding.	B NB																								
	Bullfrog *Rana catesbeiana*	Deep permanent water with floating and emergent vegetation.	B NB																								
	Green Frog *Rana clamitans melanota*	Riparian habitat.	B NB																								

Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Grass	Forb	Shrub/old field	Pasture	Savanna	Orchard	Krummholz	Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Shallow marsh	Deep marsh	Shrub swamp	Bog	Pond	Lake	Riverine: Stream	River	Riparian	Other: Stable bank	Ledge, cliff	Cave	Structure, building	Derelict building, debris
	Mink Frog *Rana septentrionalis*	Permanent ponds with lily pads.	B															■	■								
			NB											■	■			■	■									
	Wood Frog *Rana sylvatica*	Vernal woodland pools, back-waters of slow-moving streams.	B								▒			▒	▒	▒	▒		■			▒					
			NB							▒	▒		▒	▒	▒	▒												
	Northern Leopard Frog *Rana pipiens*	Wet meadows.	B					▒					■	▒	▒				■	■						▒		
			NB											■	▒		▒	■	■	■								
	Pickerel Frog *Rana palustris*	Shallow, clear water of bogs or woodland streams.	B															■	■						▒		
			NB															▒	■	■	■							
			B																									
			NB																									
			B																									
			NB																									
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Species Occurrence and Utilization, by Nonforested Habitat
Reptiles



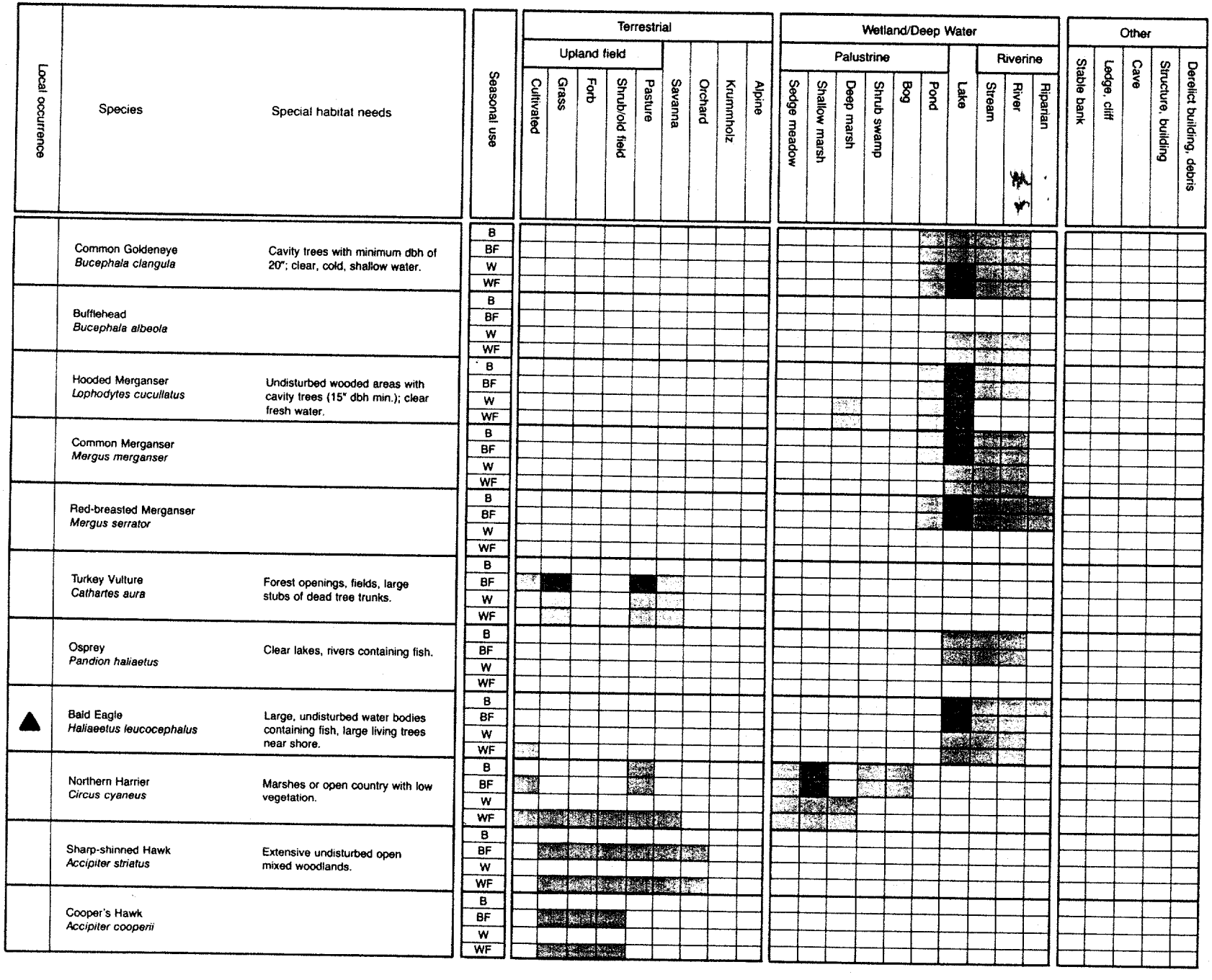

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Blanding's Turtle
Emydoidea blandingii
Shallow water.
Eastern Spiny Softshell
Trionyx s. spiniferus
Shallow water, muddy bottom, aquatic vegetation.
Five-lined Skink
Eumeces fasciatus
Open woods with logs and slash piles.
Northern Water Snake
Nerodia s. sipedon
Branches, logs overhanging water, or boulders of dams and causeways in reservoirs.
Northern Brown Snake
Storeria d. dekayi
Northern Redbelly Snake
Storeria o. occipitomaculata
Eastern Garter Snake
Thamnophis s. sirtalis
Maritime Garter Snake
Thamnophis sirtalis pallidula
Eastern Ribbon Snake
Thamnophis s. sauritus
Mesic woodlands with aquatic habitat.
Northern Ribbon Snake
Thamnophis sauritus septentrionalis
Shallow, permanent water in open, grassy habitat.
Eastern Hognose Snake
Heterodon platyrhinos
Sandy soils, open woodlands.
B
NB

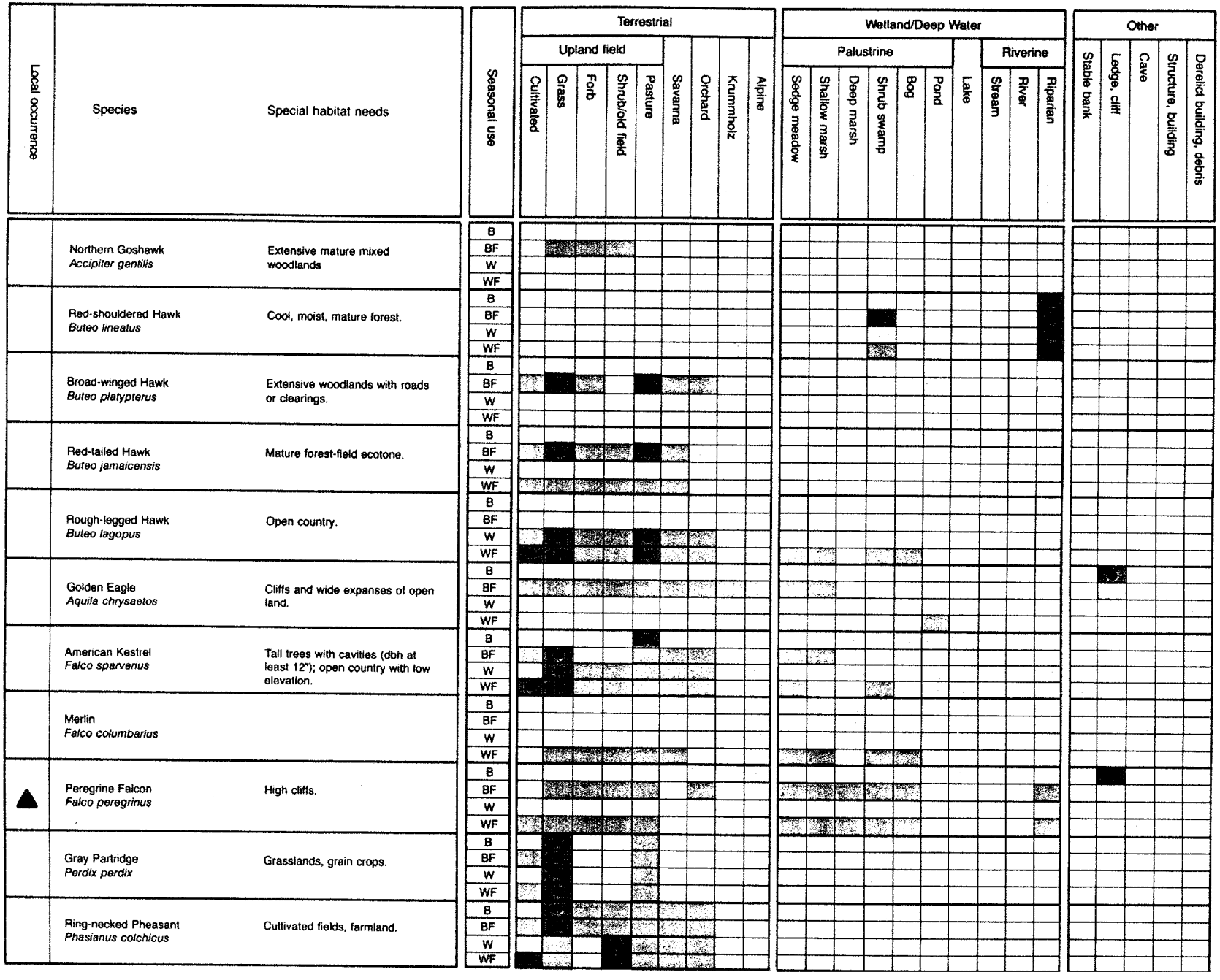
Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Grass	Forb	Shrub/old field	Pasture	Savanna	Orchard	Krummholz	Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Shallow marsh	Deep marsh	Shrub swamp	Bog	Pond	Lake	Riverine: Stream	River	Riparian	Other: Stable bank	Ledge, cliff	Cave	Structure, building	Derelict building, debris
	Northern Ringneck Snake *Diadophis punctatus edwardsi*	Mesic areas with abundant cover.	B																								
			NB																								
	Eastern Worm Snake *Carphophis a. amoenus*	Loose soils for burrowing or covering.	B																								
			NB																								
	Northern Black Racer *Coluber c. constrictor*		B																								
			NB																								
	Eastern Smooth Green Snake *Opheodrys v. vernalis*	Upland grassy opening.	B																								
			NB																								
	Black Rat Snake *Elaphe o. obsoleta*		B																								
			NB																								
	Eastern Milk Snake *Lampropeltis t. triangulum*	Slash, woodpiles, debris or loose soil for egg laying.	B																								
			NB																								
	Northern Copperhead *Agkistrodon contortrix mokeson*	Rocky hillsides, talus slopes.	B																								
			NB																								
	Timber Rattlesnake *Crotalus horridus*	Rock ledges on forested hillsides.	B																								
			NB																								
			B																								
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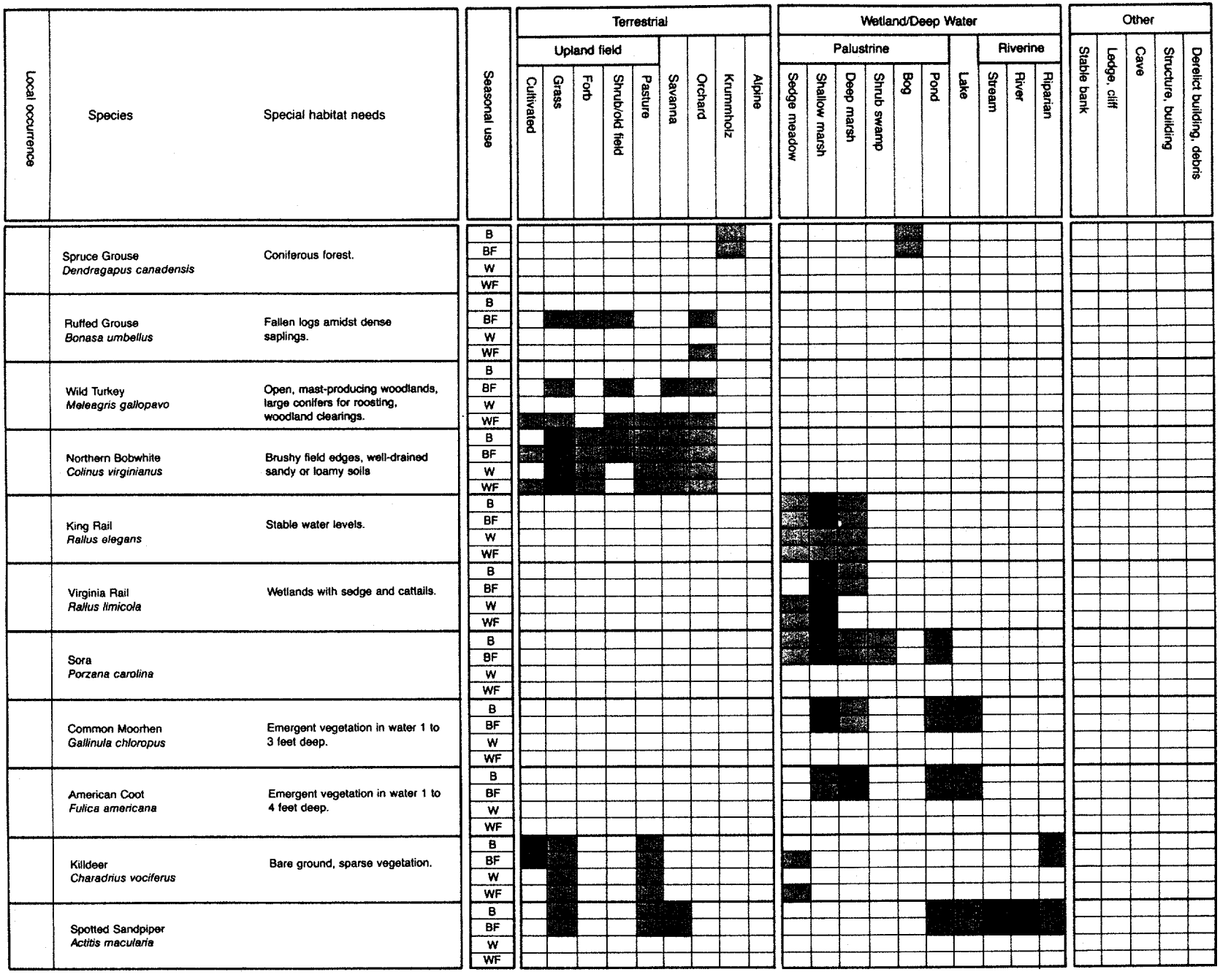
Species Occurrence and Utilization, by Nonforested Habitat
Birds

Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Grass	Forb	Shrub/old field	Pasture	Savanna	Orchard	Krummholz	Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Shallow marsh	Deep marsh	Shrub swamp	Bog	Pond	Lake	Riverine: Stream	River	Riparian	Other: Stable bank	Ledge, cliff	Cave	Structure, building	Derelict building, debris
	Common Loon *Gavia immer*	Large undisturbed bodies of water with stable water levels and islands.	B																								
			BF																								
			W																								
			WF																								
	Pied-billed Grebe *Podilymbus podiceps*	Marshes with water and emergent vegetation.	B																								
			BF																								
			W																								
			WF																								
	American Bittern *Botaurus lentiginosus*	Undisturbed tall marsh vegetation.	B																								
			BF																								
			W																								
			WF																								
	Least Bittern *Ixobrychus exilis*	Deep marshes with clumps of emergent vegetation.	B																								
			BF																								
			W																								
			WF																								
	Great Blue Heron *Ardea herodias*	Tall trees.	B																								
			BF																								
			W																								
			WF																								
	Green-backed Heron *Butorides striatus*		B																								
			BF																								
			W																								
			WF																								
	Black-crowned Night-Heron *Nycticorax nycticorax*		B																								
			BF																								
			W																								
			WF																								
	Yellow-crowned Night-Heron *Nycticorax violaceus*		B																								
			BF																								
			W																								
			WF																								
	Glossy Ibis *Plegadis falcinellus*		B																								
			BF																								
			W																								
			WF																								
	Mute Swan *Cygnus olor*	Shallow ponds, rivers with abundant aquatic vegetation.	B																								
			BF																								
			W																								
			WF																								
	Canada Goose *Branta canadensis*		B																								
			BF																								
			W																								
			WF																								

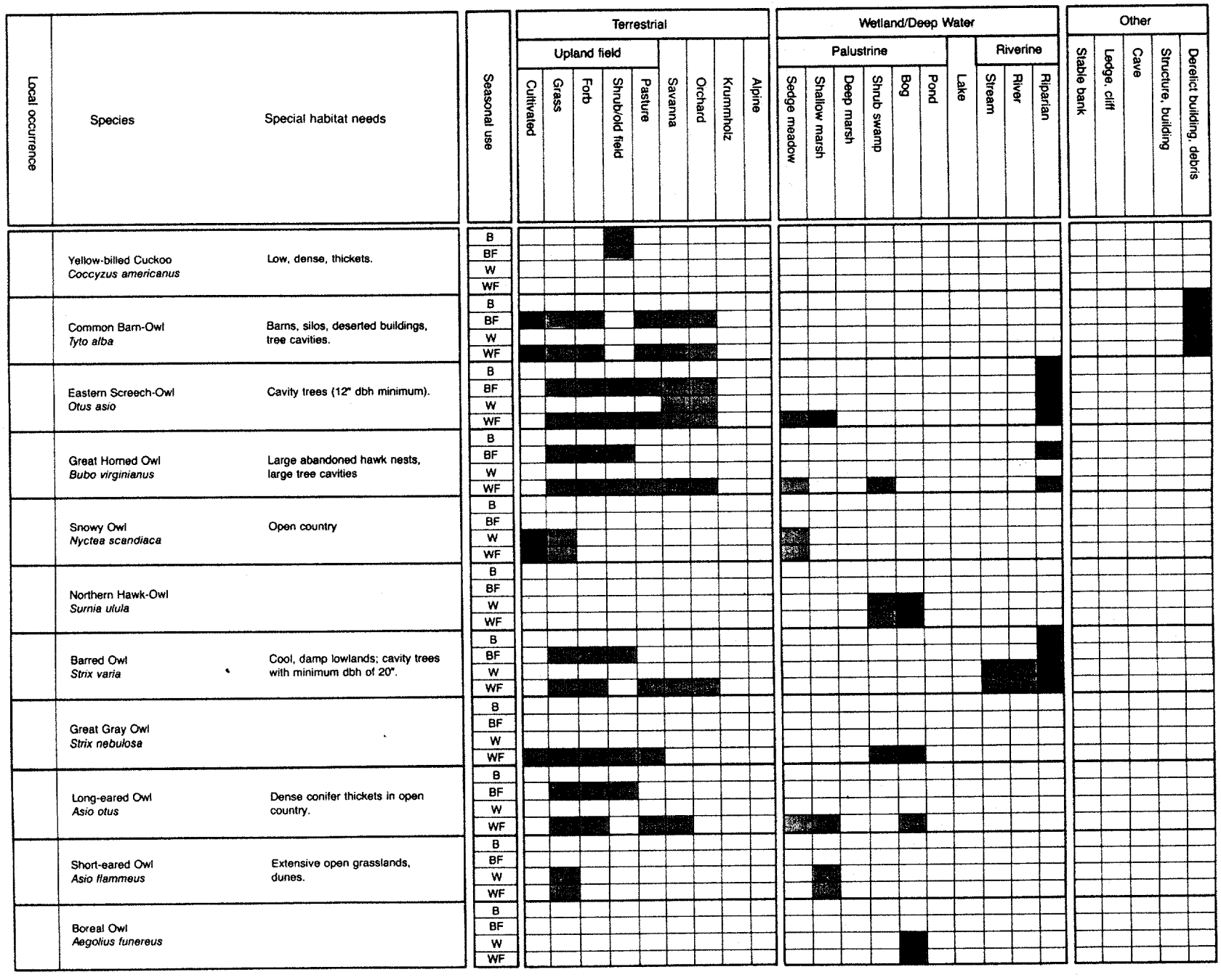
Local occurrence	Species	Special habitat needs	Seasonal use
	Wood Duck *Aix sponsa*	Trees at least 16" dbh with large cavities and 4" diameter entrance holes.	B, BF, W, WF
	Green-winged Teal *Anas crecca*		B, BF, W, WF
	American Black Duck *Anas rubripes*		B, BF, W, WF
	Mallard *Anas platyrhynchos*		B, BF, W, WF
	Northern Pintail *Anas acuta*	Drakes need mudbanks or exposed shorelines.	B, BF, W, WF
	Blue-winged Teal *Anas discors*		B, BF, W, WF
	Northern Shoveler *Anas clypeata*	Shallow water with muddy bottom, surrounded by dry grassy areas.	B, BF, W, WF
	Gadwall *Anas strepera*	Moderate to large bodies of water, with submerged aquatic plants.	B, BF, W, WF
	American Wigeon *Anas americana*		B, BF, W, WF
	Canvasback *Aythya valisineria*	Stretches of open water and emergent vegetation.	B, BF, W, WF
	Ring-necked Duck *Aythya collaris*	Expanse of open water.	B, BF, W, WF

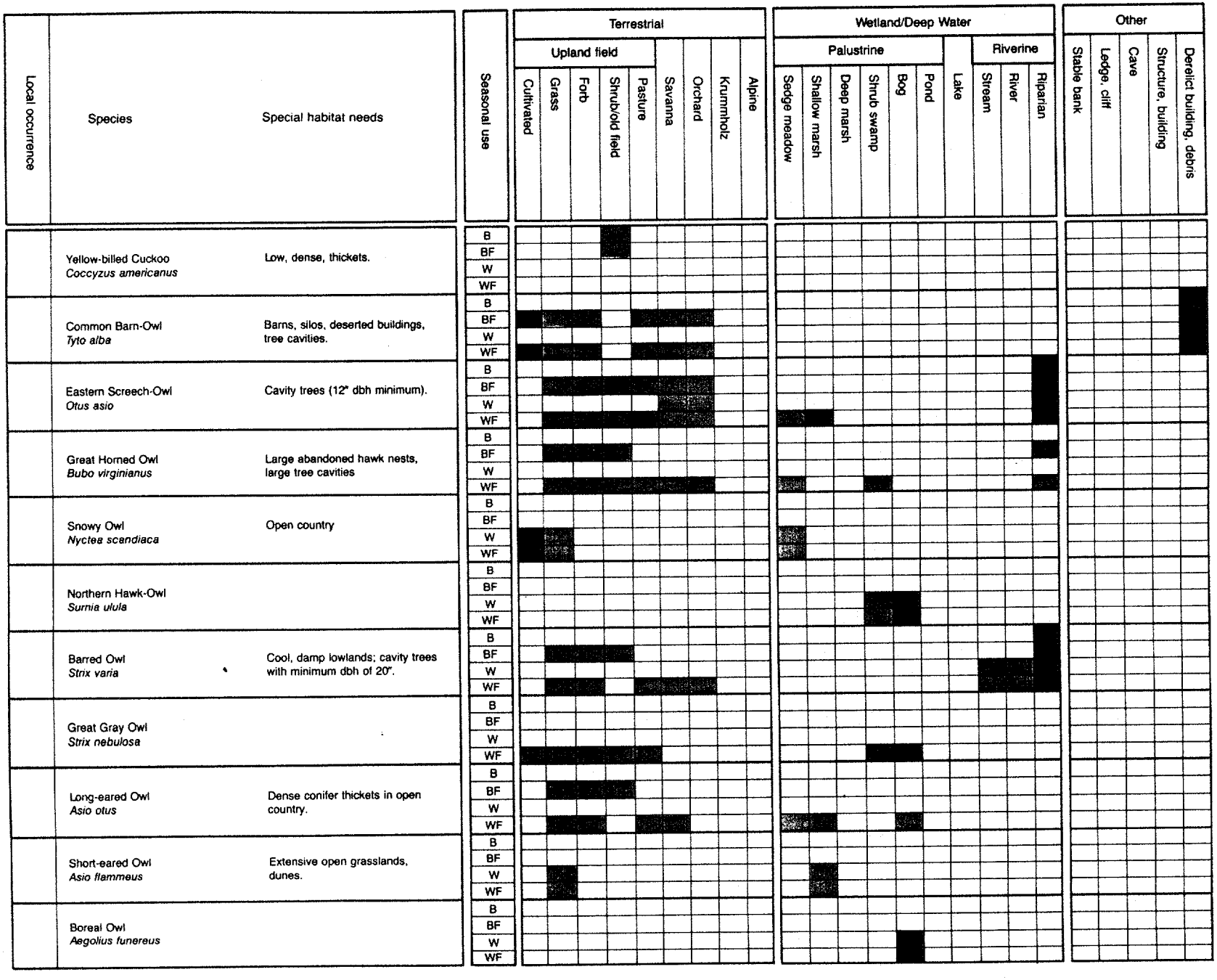

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Common Goldeneye
Bucephala clangula
Cavity trees with minimum dbh of 20"; clear, cold, shallow water.
Bufflehead
Bucephala albeola
Hooded Merganser
Lophodytes cucullatus
Undisturbed wooded areas with cavity trees (15" dbh min.); clear fresh water.
Common Merganser
Mergus merganser
Red-breasted Merganser
Mergus serrator
Turkey Vulture
Cathartes aura
Forest openings, fields, large stubs of dead tree trunks.
Osprey
Pandion haliaetus
Clear lakes, rivers containing fish.
Bald Eagle
Haliaeetus leucocephalus
Large, undisturbed water bodies containing fish, large living trees near shore.
Northern Harrier
Circus cyaneus
Marshes or open country with low vegetation.
Sharp-shinned Hawk
Accipiter striatus
Extensive undisturbed open mixed woodlands.
Cooper's Hawk
Accipiter cooperii
B
BF
W
WF


Local occurrence
Species
Special habitat needs
Seasonal use
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Upland field
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Alpine
Wetland/Deep Water
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Sedge meadow
Shallow marsh
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Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Northern Goshawk
Accipiter gentilis
Extensive mature mixed woodlands
Red-shouldered Hawk
Buteo lineatus
Cool, moist, mature forest.
Broad-winged Hawk
Buteo platypterus
Extensive woodlands with roads or clearings.
Red-tailed Hawk
Buteo jamaicensis
Mature forest-field ecotone.
Rough-legged Hawk
Buteo lagopus
Open country.
Golden Eagle
Aquila chrysaetos
Cliffs and wide expanses of open land.
American Kestrel
Falco sparverius
Tall trees with cavities (dbh at least 12"); open country with low elevation.
Merlin
Falco columbarius
Peregrine Falcon
Falco peregrinus
High cliffs.
Gray Partridge
Perdix perdix
Grasslands, grain crops.
Ring-necked Pheasant
Phasianus colchicus
Cultivated fields, farmland.


Local occurrence
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Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Spruce Grouse
Dendragapus canadensis
Coniferous forest.
Ruffed Grouse
Bonasa umbellus
Fallen logs amidst dense saplings.
Wild Turkey
Meleagris gallopavo
Open, mast-producing woodlands, large conifers for roosting, woodland clearings.
Northern Bobwhite
Colinus virginianus
Brushy field edges, well-drained sandy or loamy soils
King Rail
Rallus elegans
Stable water levels.
Virginia Rail
Rallus limicola
Wetlands with sedge and cattails.
Sora
Porzana carolina
Common Moorhen
Gallinula chloropus
Emergent vegetation in water 1 to 3 feet deep.
American Coot
Fulica americana
Emergent vegetation in water 1 to 4 feet deep.
Killdeer
Charadrius vociferus
Bare ground, sparse vegetation.
Spotted Sandpiper
Actitis macularia

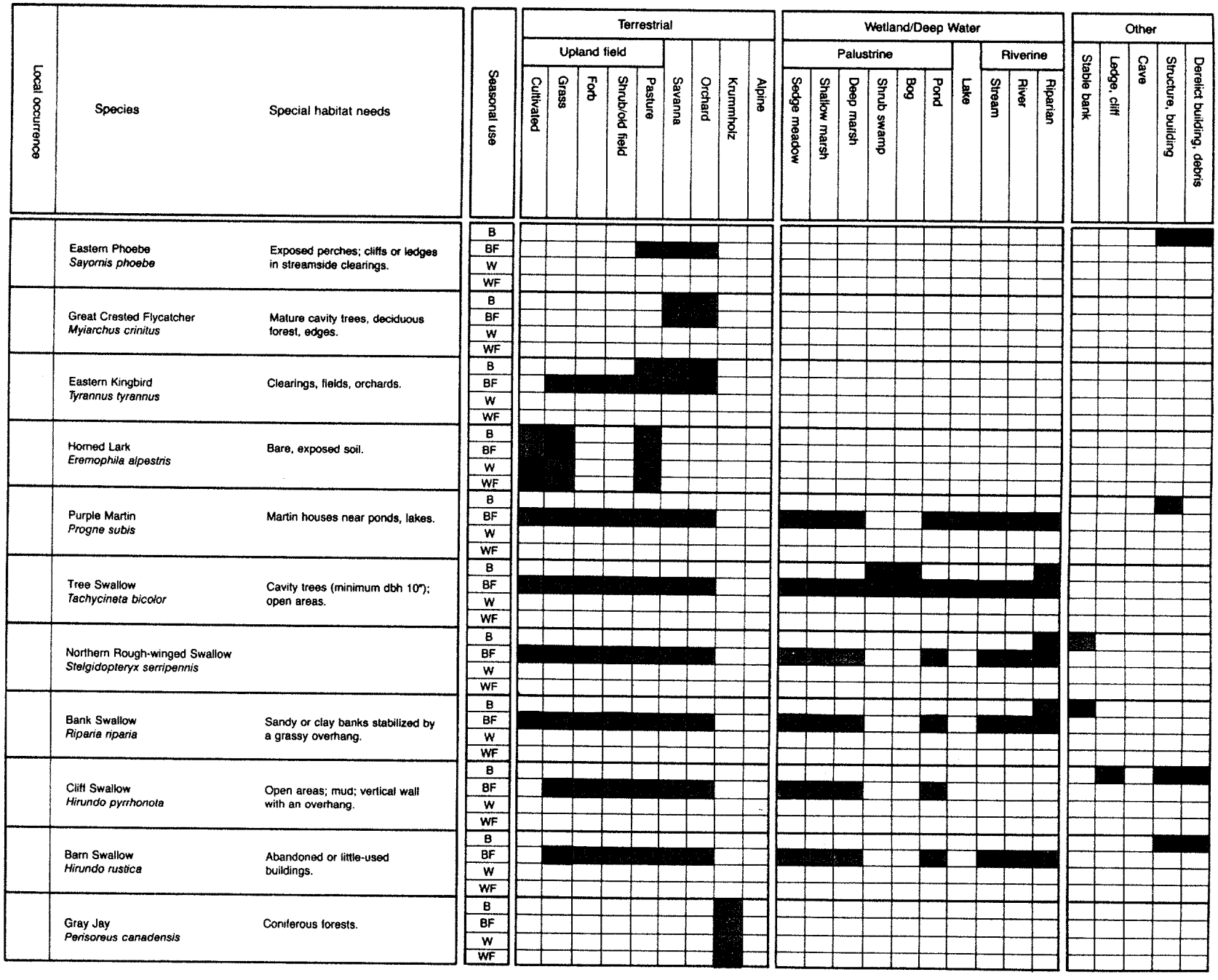
Local occurrence
Species
Special habitat needs
Seasonal use
B
BF
W
WF
Terrestrial
Upland field
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Grass
Forb
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Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Upland Sandpiper
Bartramia longicauda
Common Snipe
Gallinago gallinago
Moist organic soils, low scattered vegetation, bogs, swamps, large open spaces.
American Woodcock
Scolopax minor
Fertile moist soil containing earthworms, small clearings and dense swales
Ring-billed Gull
Larus delawarensis
Herring Gull
Larus argentatus
Great Black-backed Gull
Larus marinus
Common Tern
Sterna hirundo
Black Tern
Chlidonias niger
Fresh marsh in breeding season.
Rock Dove
Columba livia
Mourning Dove
Zenaida macroura
Open land with bare ground.
Black-billed Cuckoo
Coccyzus erythropthalmus
Low, dense, thickets.

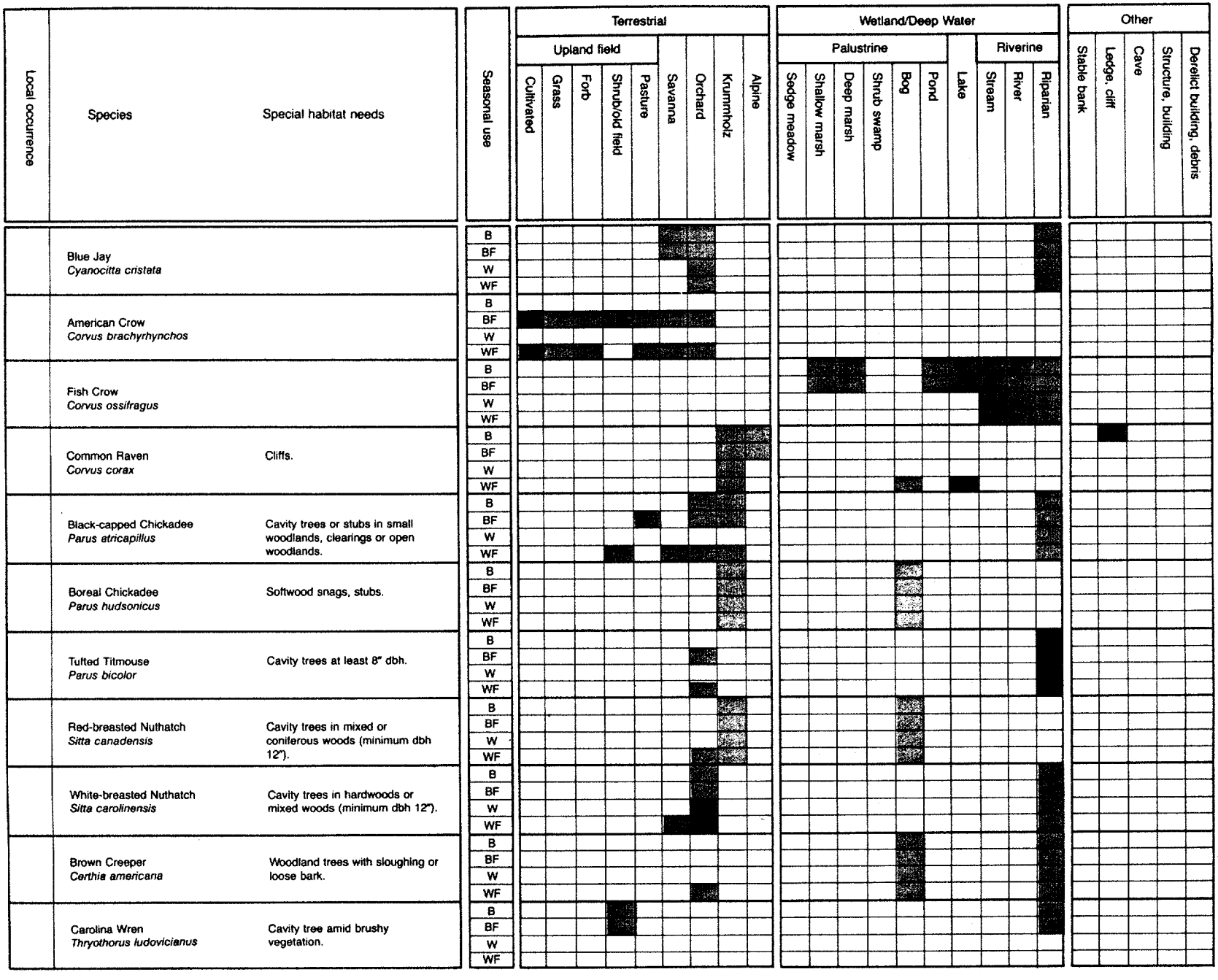

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
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Palustrine
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Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Yellow-billed Cuckoo
Coccyzus americanus
Low, dense, thickets.
Common Barn-Owl
Tyto alba
Barns, silos, deserted buildings, tree cavities.
Eastern Screech-Owl
Otus asio
Cavity trees (12" dbh minimum).
Great Horned Owl
Bubo virginianus
Large abandoned hawk nests, large tree cavities
Snowy Owl
Nyctea scandiaca
Open country
Northern Hawk-Owl
Surnia ulula
Barred Owl
Strix varia
Cool, damp lowlands; cavity trees with minimum dbh of 20".
Great Gray Owl
Strix nebulosa
Long-eared Owl
Asio otus
Dense conifer thickets in open country.
Short-eared Owl
Asio flammeus
Extensive open grasslands, dunes.
Boreal Owl
Aegolius funereus

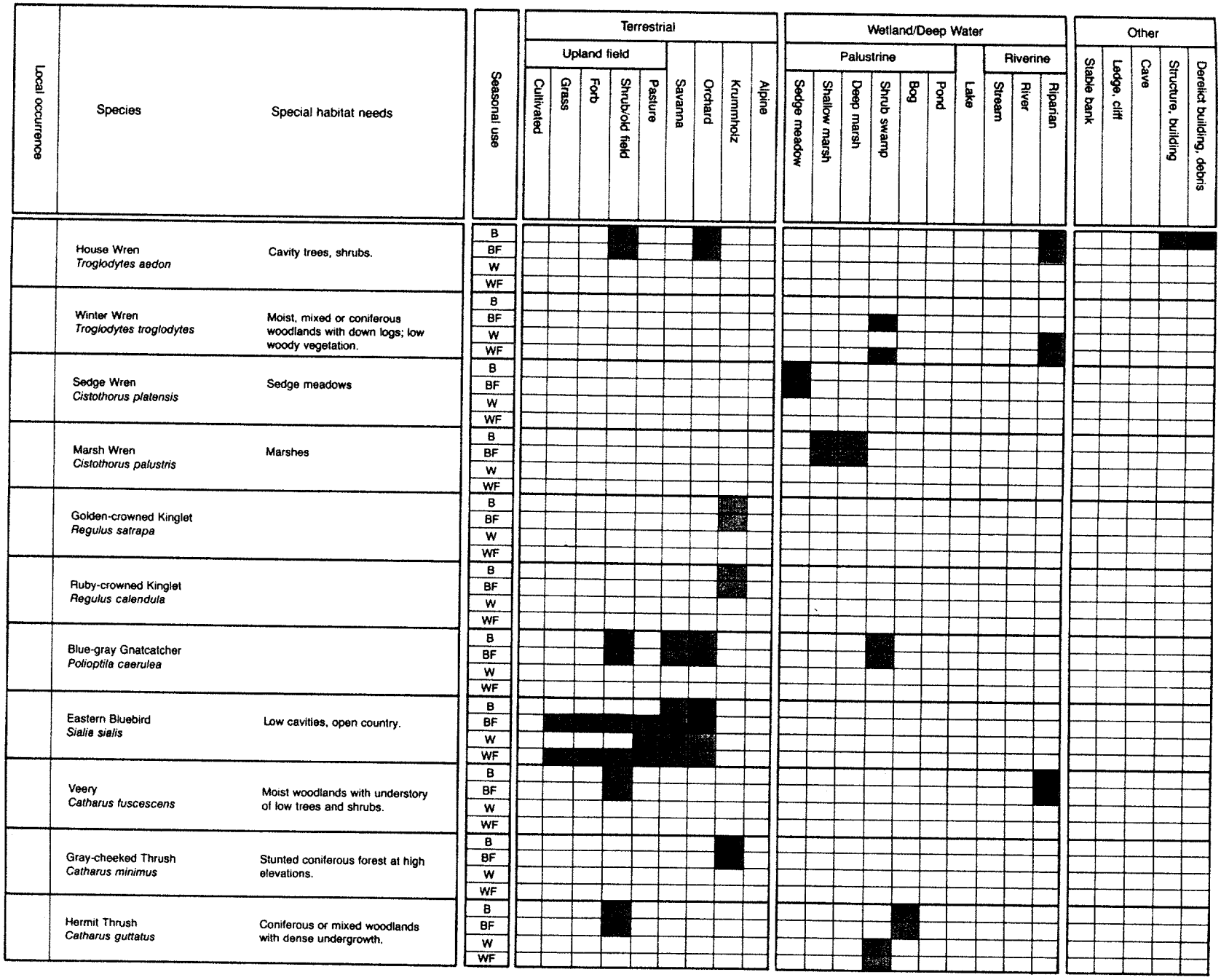

Local occurrence
Species
Special habitat needs
Seasonal use
B
BF
W
WF
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
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Structure, building
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Asio flammeus
Extensive open grasslands, dunes.
Boreal Owl
Aegolius funereus

Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Terrestrial: Upland field: Grass	Terrestrial: Upland field: Forb	Terrestrial: Upland field: Shrub/old field	Terrestrial: Upland field: Pasture	Terrestrial: Savanna	Terrestrial: Orchard	Terrestrial: Krummholz	Terrestrial: Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Wetland/Deep Water: Palustrine: Shallow marsh	Wetland/Deep Water: Palustrine: Deep marsh	Wetland/Deep Water: Palustrine: Shrub swamp	Wetland/Deep Water: Palustrine: Bog	Wetland/Deep Water: Palustrine: Pond	Wetland/Deep Water: Lake	Wetland/Deep Water: Riverine: Stream	Wetland/Deep Water: Riverine: River	Wetland/Deep Water: Riverine: Riparian	Other: Stable bank	Other: Ledge, cliff	Other: Cave	Other: Structure, building	Other: Derelict building, debris
	Northern Saw-whet Owl *Aegolius acadicus*	Cavity trees with minimum dbh of 12".	B																								
			BF		■																						
			W																								
			WF		■	■		■	■	■																		
	Common Nighthawk *Chordeiles minor*		B																								
			BF	■	■	■	■	■	■	■			■									■				■		
			W																								
			WF																								
	Whip-poor-will *Caprimulgus vociferus*		B					■	■	■																	
			BF	■	■	■	■	■	■	■														■				
			W																								
			WF																								
	Chimney Swift *Chaetura pelagica*	Chimneys.	B																								
			BF	■	■	■	■	■	■	■			■														
			W																								
			WF																								
	Ruby-throated Hummingbird *Archilochus colubris*	Flowers, preferably red.	B				■	■			■																	
			BF			■	■				■																	
			W																								
			WF																								
	Belted Kingfisher *Ceryle alcyon*	Perches over streams, ponds; banks for nest sites.	B																								
			BF																								
			W																								
			WF															■	■	■	■	■	■					
	Red-headed Woodpecker *Melanerpes erythrocephalus*	Cavity trees in savanna or open country.	B						■	■																		
			BF					■	■	■																		
			W							■																		
			WF							■																		
	Red-bellied Woodpecker *Melanerpes carolinus*	Extensive mature woodlands with dead trees or trees with large dead limbs.	B																								
			BF																								
			W							■																		
			WF																								
	Yellow-bellied Sapsucker *Sphyrapicus varius*	Trees with minimum dbh of 10".	B																								
			BF																								
			W							■																		
			WF							■																		
	Downy Woodpecker *Picoides pubescens*	Trees, limbs with decay column (minimum dbh 6").	B																								
			BF																								
			W							■																		
			WF							■																		
	Hairy Woodpecker *Picoides villosus*	Trees, limbs with decay column (minimum dbh 10").	B																								
			BF																								
			W							■																		
			WF							■																		

Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Terrestrial: Upland field: Grass	Terrestrial: Upland field: Forb	Terrestrial: Upland field: Shrub/old field	Terrestrial: Upland field: Pasture	Terrestrial: Savanna	Terrestrial: Orchard	Terrestrial: Krummholz	Terrestrial: Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Wetland/Deep Water: Palustrine: Shallow marsh	Wetland/Deep Water: Palustrine: Deep marsh	Wetland/Deep Water: Palustrine: Shrub swamp	Wetland/Deep Water: Palustrine: Bog	Wetland/Deep Water: Palustrine: Pond	Wetland/Deep Water: Lake	Wetland/Deep Water: Riverine: Stream	Wetland/Deep Water: Riverine: River	Wetland/Deep Water: Riverine: Riparian	Other: Stable bank	Other: Ledge, cliff	Other: Cave	Other: Structure, building	Other: Derelict building, debris
	Three-toed Woodpecker *Picoides tridactylus*	Spruce, fir trees with decay (minimum dbh of 12"); dead trees with loose bark.	B																								
			BF																								
			W																								
			WF																								
	Black-backed Woodpecker *Picoides arcticus*	Spruce, fir trees with decay (minimum dbh of 10"); dead trees with loose bark.	B																								
			BF																								
			W																								
			WF																								
	Northern Flicker *Colaptes auratus*	Open areas; trees with heartrot (minimum dbh of 12").	B																								
			BF																								
			W																								
			WF																								
	Pileated Woodpecker *Dryocopus pileatus*	Mature forest; trees with decay at least 20" dbh.	B																								
			BF																								
			W																								
			WF																								
	Olive-sided Flycatcher *Contopus borealis*	Tall perch adjacent to low, wet thicket.	B																								
			BF																								
			W																								
			WF																								
	Eastern Wood-Pewee *Contopus virens*		B																								
			BF																								
			W																								
			WF																								
	Yellow-bellied Flycatcher *Empidonax flaviventris*	Low, wet coniferous forest.	B																								
			BF																								
			W																								
			WF																								
	Acadian Flycatcher *Empidonax virescens*	Mature, woodlands with open spaces in the canopy.	B																								
			BF																								
			W																								
			WF																								
	Alder Flycatcher *Empidonax alnorum*	Thickets, low shrubs and clearings.	B																								
			BF																								
			W																								
			WF																								
	Willow Flycatcher *Empidonax traillii*	Low deciduous trees and shrubs with clearings, thick hardwood seedlings.	B																								
			BF																								
			W																								
			WF																								
	Least Flycatcher *Empidonax minimus*	Open deciduous or mixed forest, edges.	B																								
			BF																								
			W																								
			WF																								

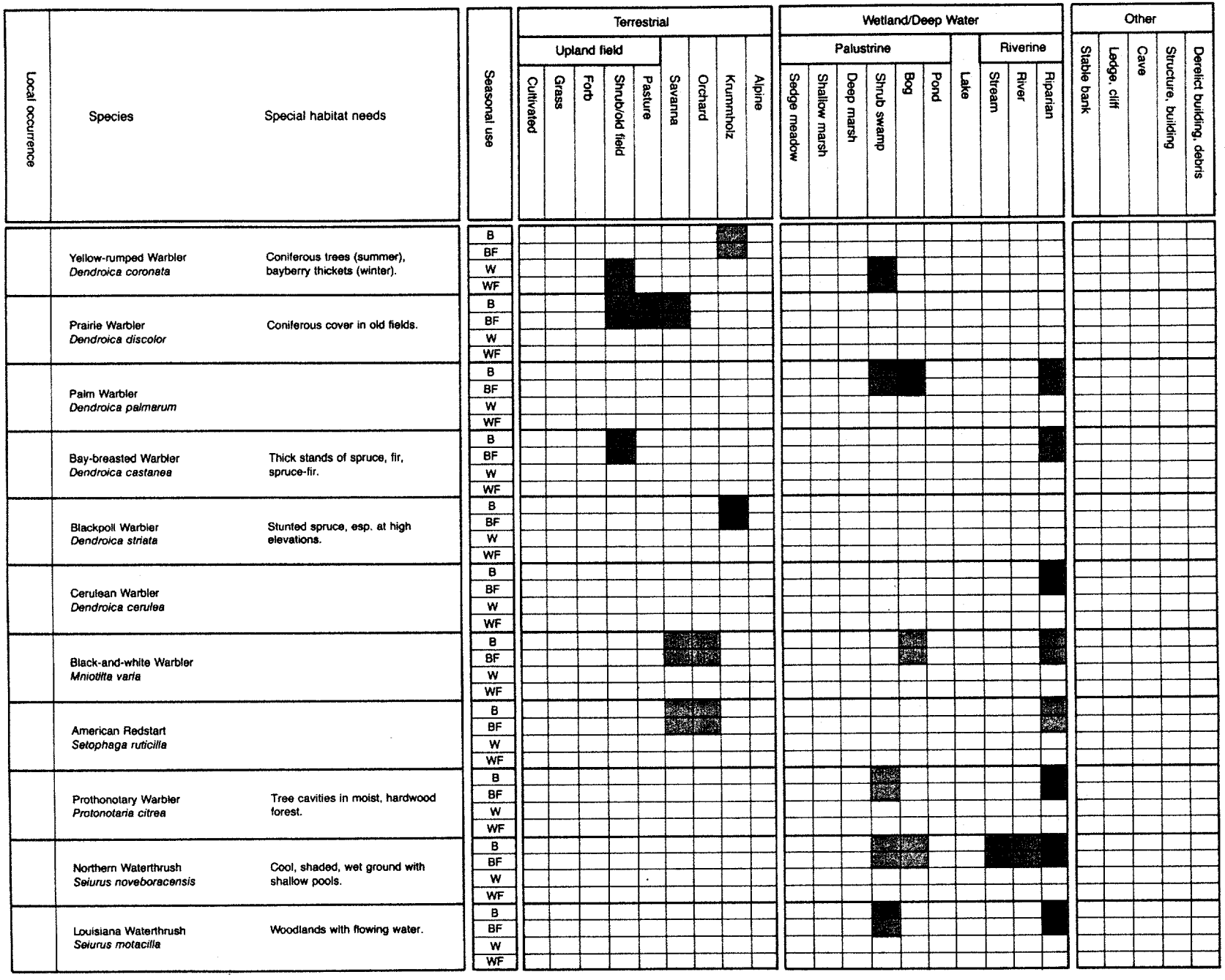

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Eastern Phoebe
Sayornis phoebe
Exposed perches; cliffs or ledges in streamside clearings.
Great Crested Flycatcher
Myiarchus crinitus
Mature cavity trees, deciduous forest, edges.
Eastern Kingbird
Tyrannus tyrannus
Clearings, fields, orchards.
Horned Lark
Eremophila alpestris
Bare, exposed soil.
Purple Martin
Progne subis
Martin houses near ponds, lakes.
Tree Swallow
Tachycineta bicolor
Cavity trees (minimum dbh 10"); open areas.
Northern Rough-winged Swallow
Stelgidopteryx serripennis
Bank Swallow
Riparia riparia
Sandy or clay banks stabilized by a grassy overhang.
Cliff Swallow
Hirundo pyrrhonota
Open areas; mud; vertical wall with an overhang.
Barn Swallow
Hirundo rustica
Abandoned or little-used buildings.
Gray Jay
Perisoreus canadensis
Coniferous forests.
B
BF
W
WF

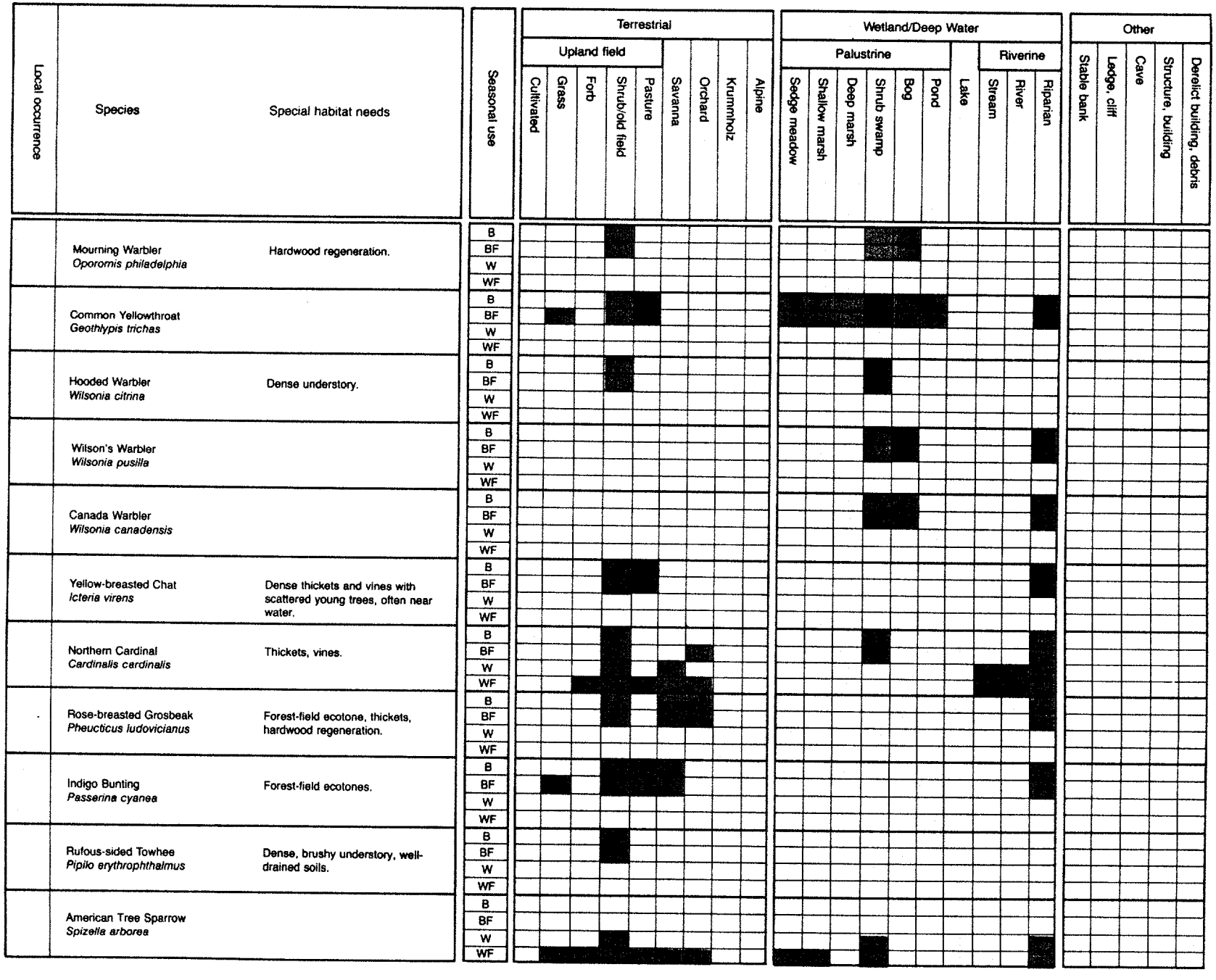

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
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Pasture
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Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Blue Jay
Cyanocitta cristata
American Crow
Corvus brachyrhynchos
Fish Crow
Corvus ossifragus
Common Raven
Corvus corax
Cliffs.
Black-capped Chickadee
Parus atricapillus
Cavity trees or stubs in small woodlands, clearings or open woodlands.
Boreal Chickadee
Parus hudsonicus
Softwood snags, stubs.
Tufted Titmouse
Parus bicolor
Cavity trees at least 8" dbh.
Red-breasted Nuthatch
Sitta canadensis
Cavity trees in mixed or coniferous woods (minimum dbh 12").
White-breasted Nuthatch
Sitta carolinensis
Cavity trees in hardwoods or mixed woods (minimum dbh 12").
Brown Creeper
Certhia americana
Woodland trees with sloughing or loose bark.
Carolina Wren
Thryothorus ludovicianus
Cavity tree amid brushy vegetation.

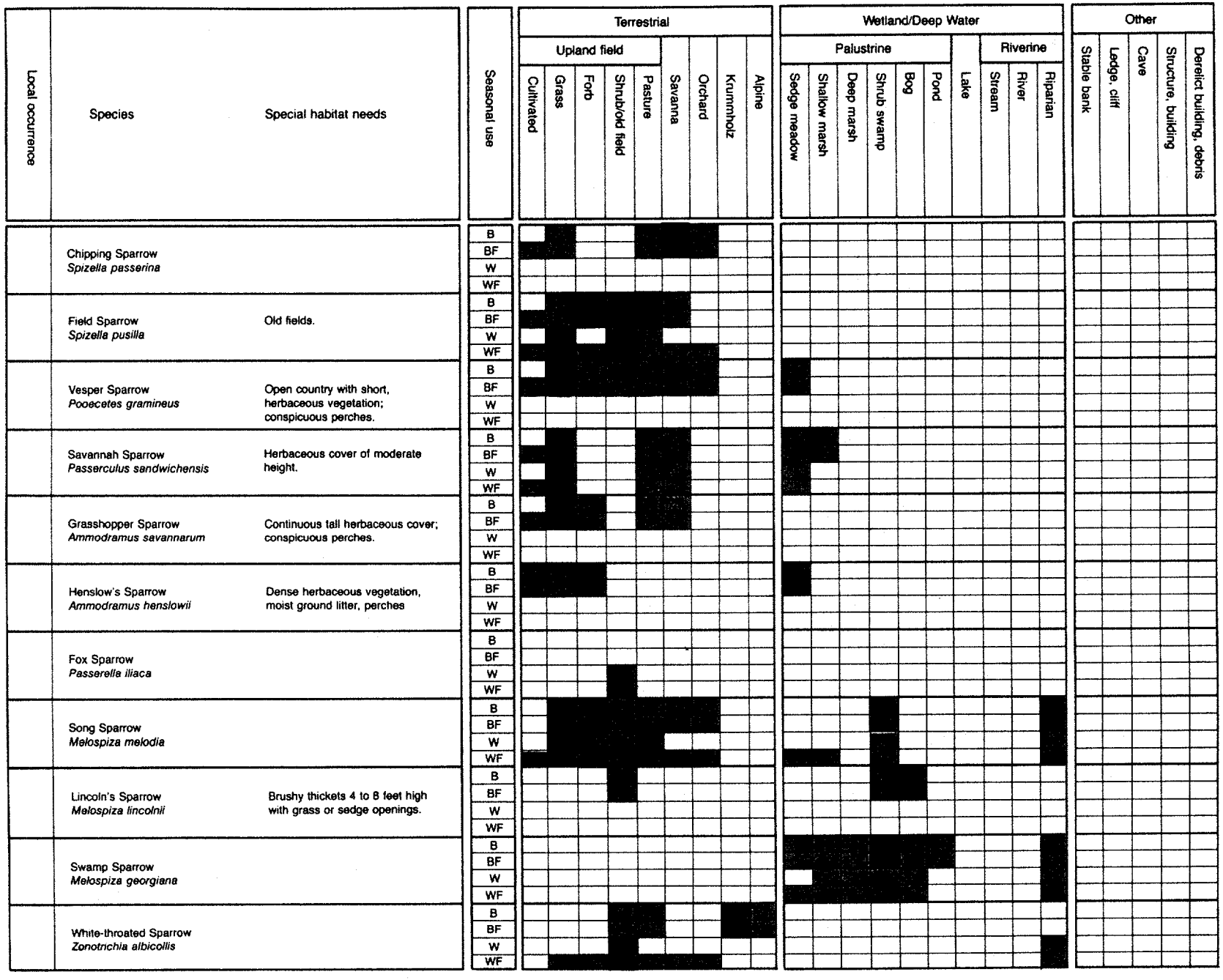

Local occurrence
Species
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Upland field
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Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
House Wren
Troglodytes aedon
Cavity trees, shrubs.
Winter Wren
Troglodytes troglodytes
Moist, mixed or coniferous woodlands with down logs; low woody vegetation.
Sedge Wren
Cistothorus platensis
Sedge meadows
Marsh Wren
Cistothorus palustris
Marshes
Golden-crowned Kinglet
Regulus satrapa
Ruby-crowned Kinglet
Regulus calendula
Blue-gray Gnatcatcher
Polioptila caerulea
Eastern Bluebird
Sialia sialis
Low cavities, open country.
Veery
Catharus fuscescens
Moist woodlands with understory of low trees and shrubs.
Gray-cheeked Thrush
Catharus minimus
Stunted coniferous forest at high elevations.
Hermit Thrush
Catharus guttatus
Coniferous or mixed woodlands with dense undergrowth.

Local occurrence
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Seasonal use
B
BF
W
WF
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Savanna
Orchard
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Shrub swamp
Bog
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Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Wood Thrush
Hylocichla mustelina
Cool, moist, mature deciduous or mixed forest.
American Robin
Turdus migratorius
Gray Catbird
Dumetella carolinensis
Shrubs, thickets in open country or forest understory.
Northern Mockingbird
Mimus polyglottos
Low thickets; high perches; persistent fruits.
Brown Thrasher
Toxostoma rufum
Hardwood forest-field ecotone.
Bohemian Waxwing
Bombycilla garrulus
Cedar Waxwing
Bombycilla cedrorum
Northern Shrike
Lanius excubitor
Scattered trees or shrubs in open country.
Loggerhead Shrike
Lanius ludovicianus
Open country with short grasses; scattered trees, shrubs.
European Starling
Sturnus vulgaris
Cavity trees with 10" minimum dbh.
White-eyed Vireo
Vireo griseus
Low shrubs, thickets.

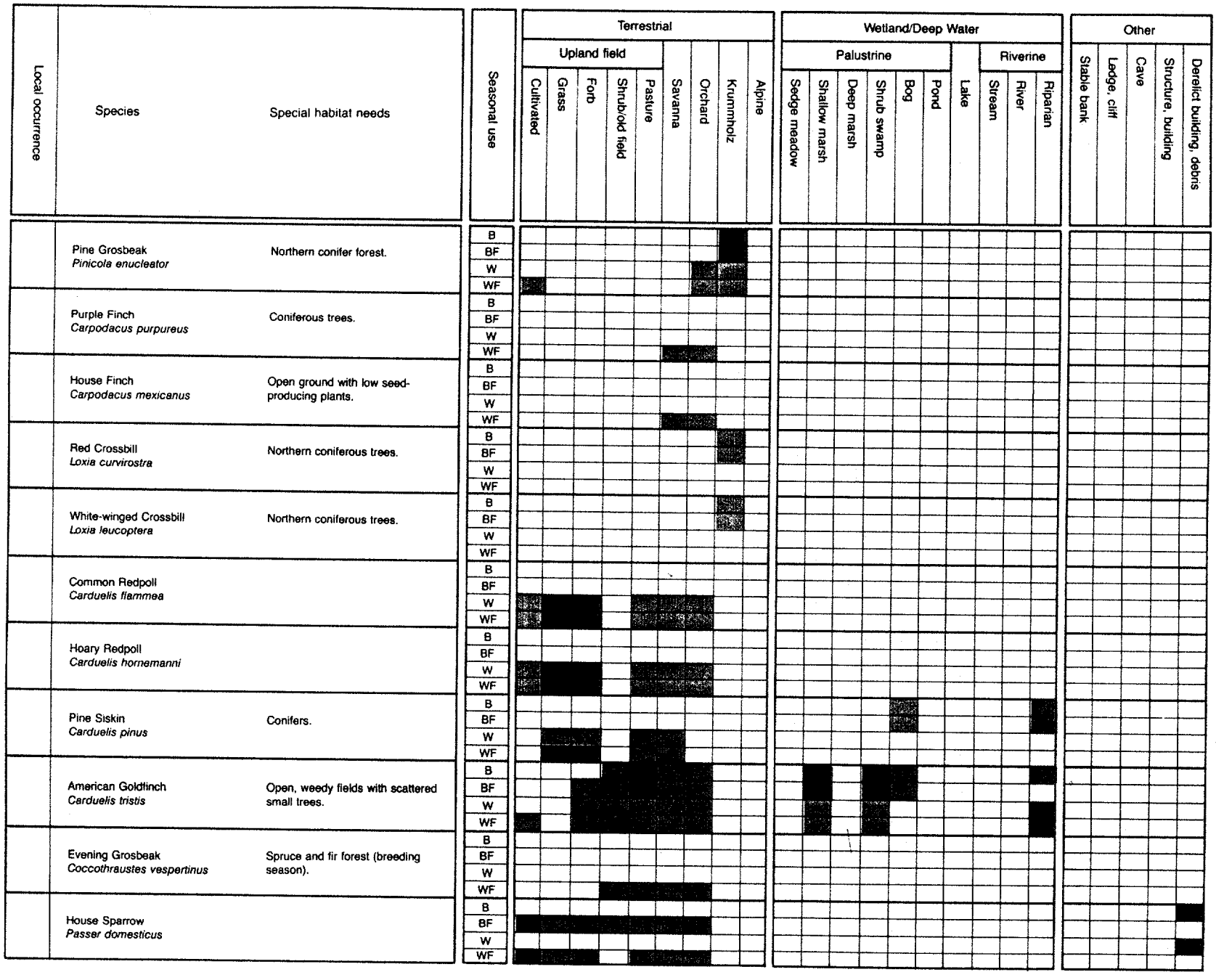
Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial: Upland field: Cultivated	Grass	Forb	Shrub/old field	Pasture	Savanna	Orchard	Krummholz	Alpine	Wetland/Deep Water: Palustrine: Sedge meadow	Shallow marsh	Deep marsh	Shrub swamp	Bog	Pond	Lake	Riverine: Stream	River	Riparian	Other: Stable bank	Ledge, cliff	Cave	Structure, building	Derelict building, debris
	Yellow-throated Vireo *Vireo flavifrons*	Mature deciduous forest.	B						■	■																	
			BF						■	■																	
			W																								
			WF																								
	Warbling Vireo *Vireo gilvus*	Scattered deciduous trees, shade trees.	B						■	■												■					
			BF						■	■												■					
			W																								
			WF																								
	Philadelphia Vireo *Vireo philadelphicus*	Hardwood forest edges.	B				■																				
			BF				■																				
			W																								
			WF																								
	Red-eyed Vireo *Vireo olivaceus*		B							■													■				
			BF							■													■				
			W																								
			WF																								
	Blue-winged Warbler *Vermivora pinus*	Old fields with scattered shrubs and small trees.	B		■		■	■	■							■											
			BF		■		■	■	■							■											
			W																								
			WF																								
	Golden-winged Warbler *Vermivora chrysoptera*	Open areas with saplings in deciduous woodlands.	B				■																				
			BF				■																				
			W																								
			WF																								
	Tennessee Warbler *Vermivora peregrina*	Brushy, semi-open country	B				■											■	■								
			BF				■											■	■								
			W																								
			WF																								
	Nashville Warbler *Vermivora ruficapilla*	Scattered trees interspersed with brush, thickets.	B					■										■									
			BF					■										■									
			W																								
			WF																								
	Northern Parula *Parula americana*	Presence of bearded lichen.	B														■	■									
			BF														■	■									
			W																								
			WF																								
	Yellow Warbler *Dendroica petechia*	Scattered small trees or dense shrubs.	B				■	■	■	■							■						■				
			BF				■	■	■	■							■						■				
			W																								
			WF																								
	Chestnut-sided Warbler *Dendroica pensylvanica*	Sprouts and brush at wood margins; hardwood seedlings stands.	B				■	■									■										
			BF				■	■									■										
			W																								
			WF																								


Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Yellow-rumped Warbler
Dendroica coronata
Coniferous trees (summer), bayberry thickets (winter).
Prairie Warbler
Dendroica discolor
Coniferous cover in old fields.
Palm Warbler
Dendroica palmarum
Bay-breasted Warbler
Dendroica castanea
Thick stands of spruce, fir, spruce-fir.
Blackpoll Warbler
Dendroica striata
Stunted spruce, esp. at high elevations.
Cerulean Warbler
Dendroica cerulea
Black-and-white Warbler
Mniotilta varia
American Redstart
Setophaga ruticilla
Prothonotary Warbler
Protonotaria citrea
Tree cavities in moist, hardwood forest.
Northern Waterthrush
Seiurus noveboracensis
Cool, shaded, wet ground with shallow pools.
Louisiana Waterthrush
Seiurus motacilla
Woodlands with flowing water.

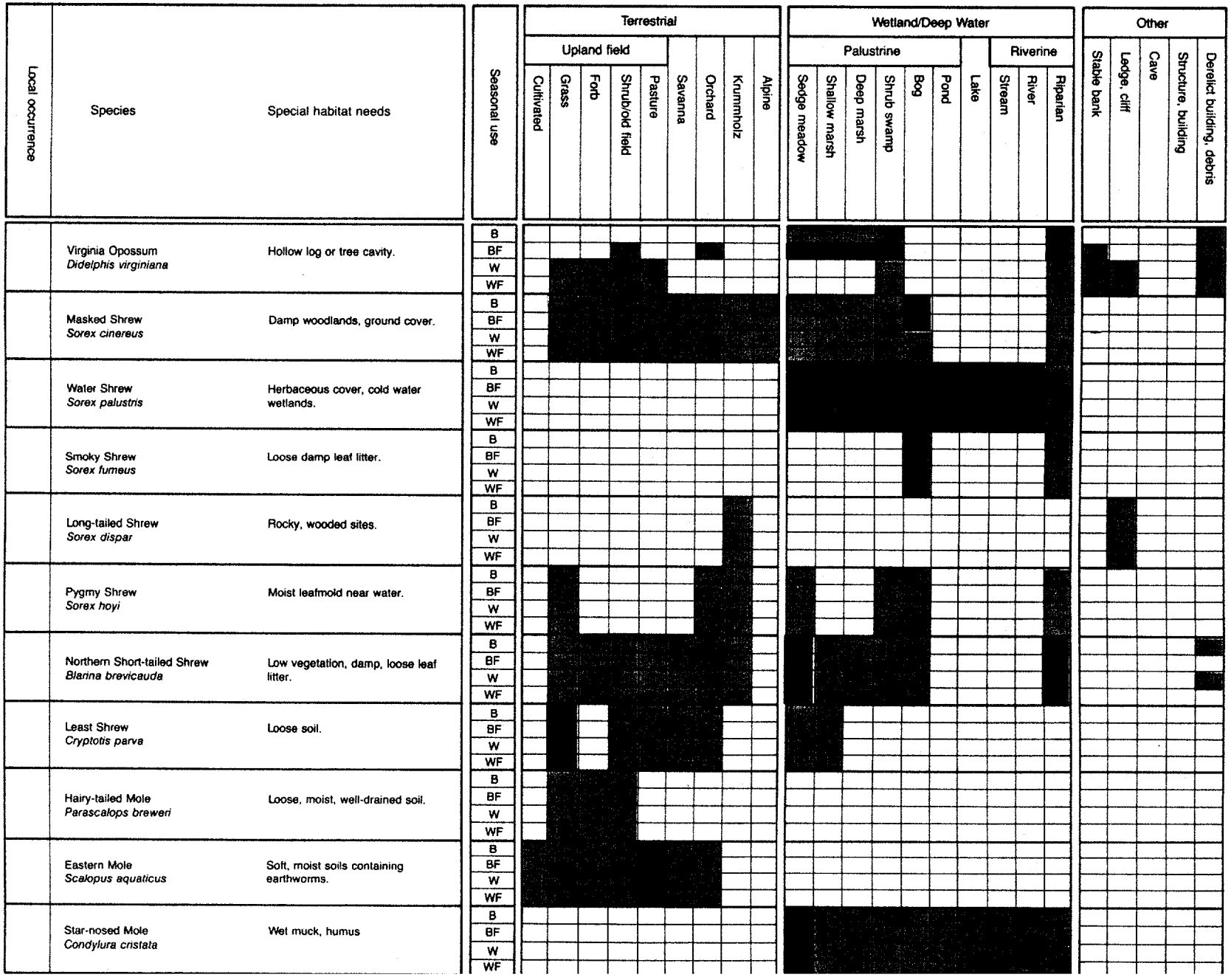

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
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Forb
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Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Mourning Warbler
Oporornis philadelphia
Hardwood regeneration.
Common Yellowthroat
Geothlypis trichas
Hooded Warbler
Wilsonia citrina
Dense understory.
Wilson's Warbler
Wilsonia pusilla
Canada Warbler
Wilsonia canadensis
Yellow-breasted Chat
Icteria virens
Dense thickets and vines with scattered young trees, often near water.
Northern Cardinal
Cardinalis cardinalis
Thickets, vines.
Rose-breasted Grosbeak
Pheucticus ludovicianus
Forest-field ecotone, thickets, hardwood regeneration.
Indigo Bunting
Passerina cyanea
Forest-field ecotones.
Rufous-sided Towhee
Pipilo erythrophthalmus
Dense, brushy understory, well-drained soils.
American Tree Sparrow
Spizella arborea
B
BF
W
WF

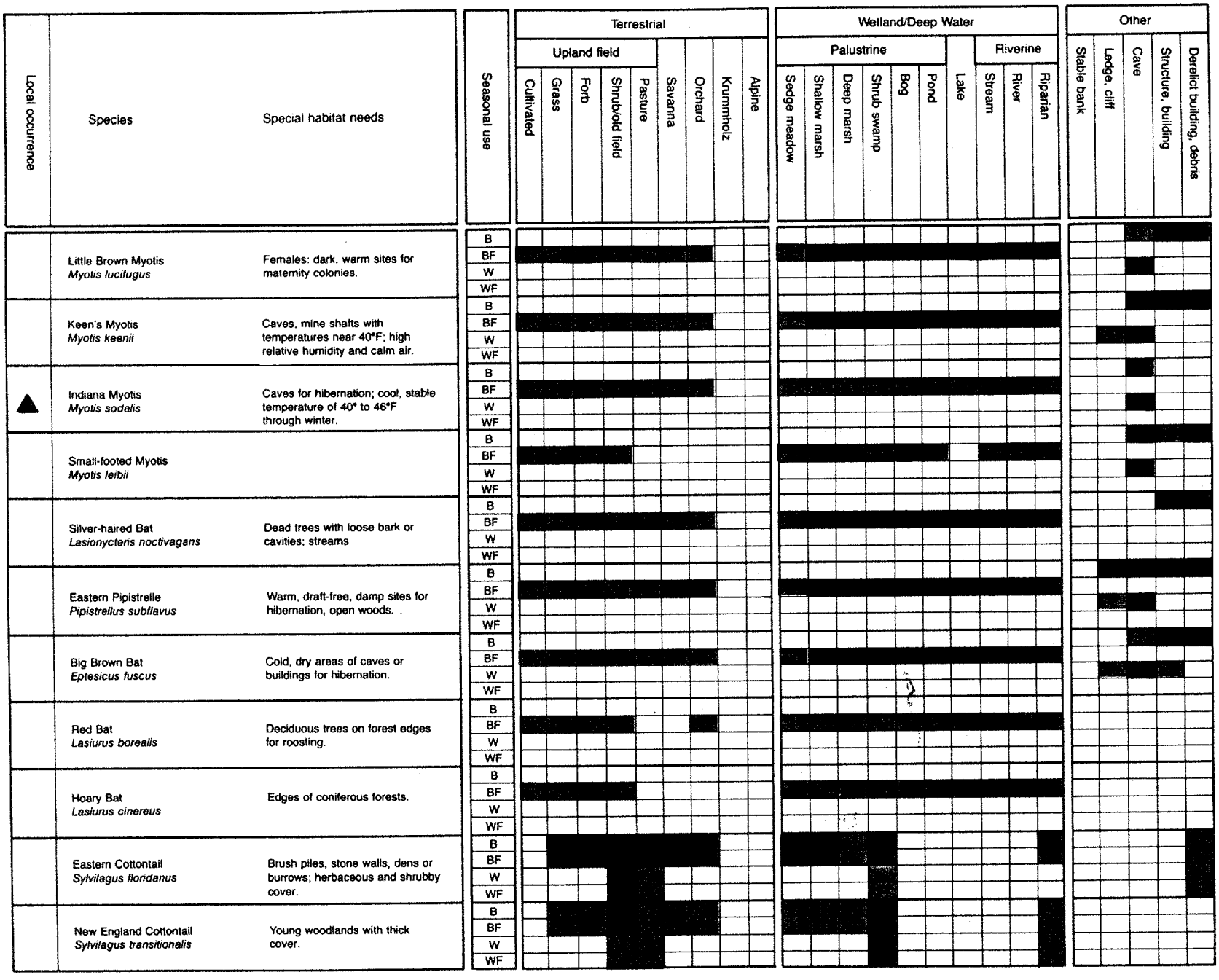

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Chipping Sparrow
Spizella passerina
Field Sparrow
Spizella pusilla
Old fields.
Vesper Sparrow
Pooecetes gramineus
Open country with short, herbaceous vegetation; conspicuous perches.
Savannah Sparrow
Passerculus sandwichensis
Herbaceous cover of moderate height.
Grasshopper Sparrow
Ammodramus savannarum
Continuous tall herbaceous cover; conspicuous perches.
Henslow's Sparrow
Ammodramus henslowii
Dense herbaceous vegetation, moist ground litter, perches
Fox Sparrow
Passerella iliaca
Song Sparrow
Melospiza melodia
Lincoln's Sparrow
Melospiza lincolnii
Brushy thickets 4 to 8 feet high with grass or sedge openings.
Swamp Sparrow
Melospiza georgiana
White-throated Sparrow
Zonotrichia albicollis
B
BF
W
WF

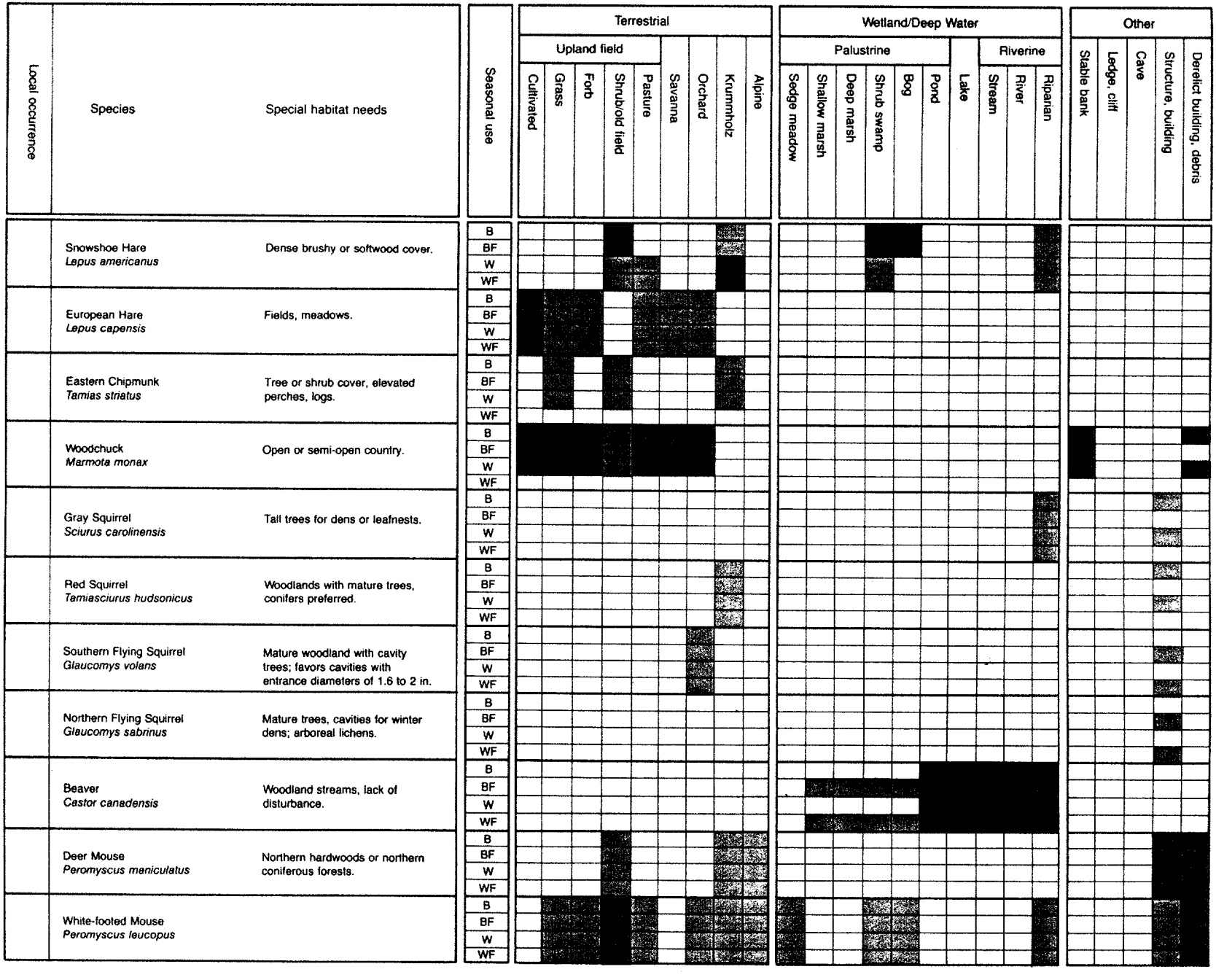
Local occurrence	Species	Special habitat needs	Seasonal use	Terrestrial		Wetland/Deep Water		Other
				Upland field		Palustrine	Riverine	
					Alpine			Derelict building, debris
					Krummholz			Structure, building
					Orchard			Cave
					Savanna			Ledge, cliff
				Pasture				Stable bank
				Shrub/old field			Riparian	
				Forb		Lake	River	
				Grass		Pond	Stream	
				Cultivated		Bog		
						Shrub swamp		
						Deep marsh		
						Shallow marsh		
						Sedge meadow		
	Dark-eyed Junco *Junco hyemalis*		B, BF, W, WF					
	Lapland Longspur *Calcarius lapponicus*		B, BF, W, WF					
	Snow Bunting *Plectrophenax nivalis*		B, BF, W, WF					
	Bobolink *Dolichonyx oryzivorus*	Wide expanses of grassland.	B, BF, W, WF					
	Red-winged Blackbird *Agelaius phoeniceus*		B, BF, W, WF					
	Eastern Meadowlark *Sturnella magna*	Grasslands, elevated perches.	B, BF, W, WF					
	Rusty Blackbird *Euphagus carolinus*		B, BF, W, WF					
	Common Grackle *Quiscalus quiscula*		B, BF, W, WF					
	Brown-headed Cowbird *Molothrus ater*		B, BF, W, WF					
	Orchard Oriole *Icterus spurius*		B, BF, W, WF					
	Northern Oriole *Icterus galbula*	Tall scattered deciduous (preferably elm) trees.	B, BF, W, WF					

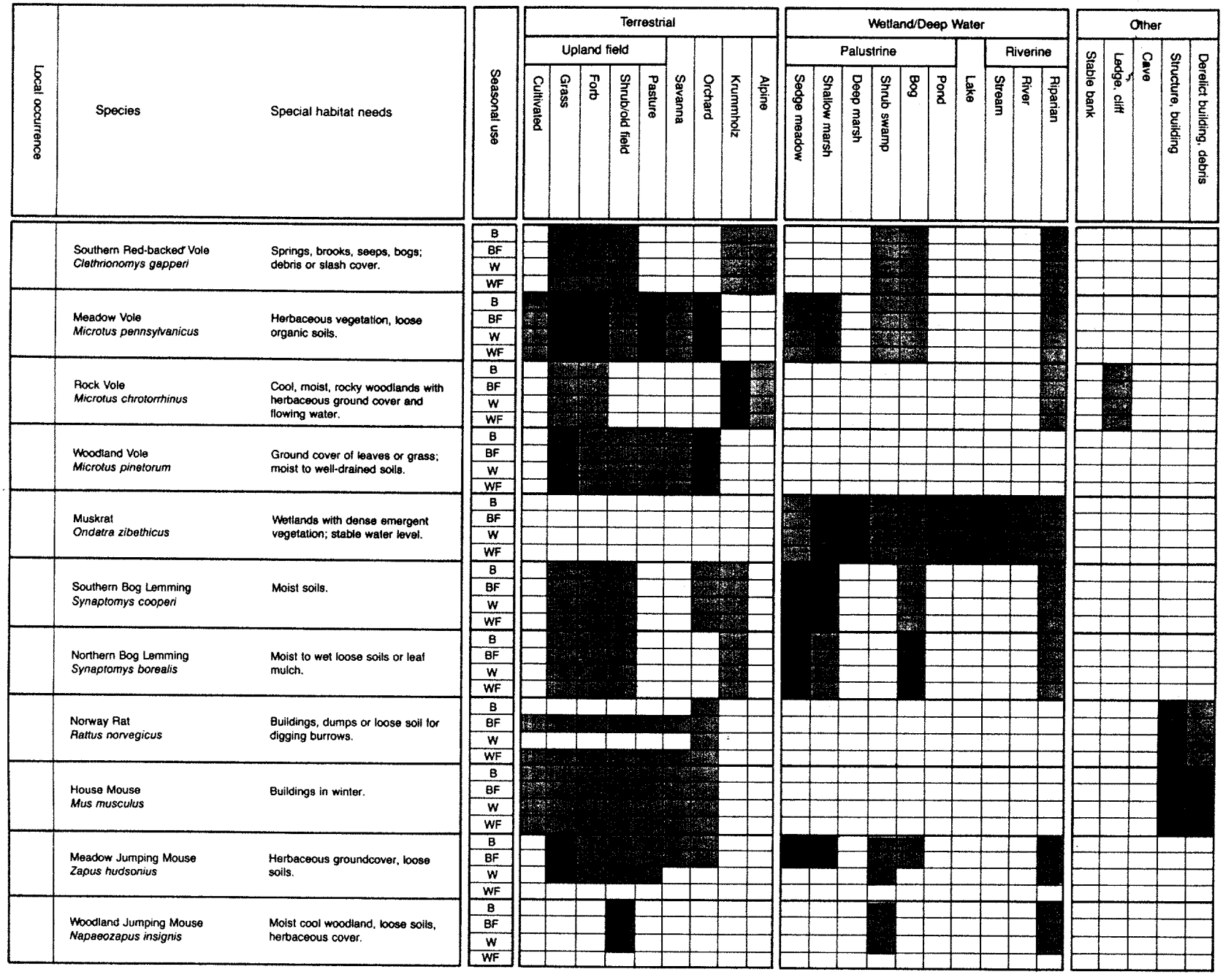

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
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Shallow marsh
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Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Pine Grosbeak
Pinicola enucleator
Northern conifer forest.
Purple Finch
Carpodacus purpureus
Coniferous trees.
House Finch
Carpodacus mexicanus
Open ground with low seed-producing plants.
Red Crossbill
Loxia curvirostra
Northern coniferous trees.
White-winged Crossbill
Loxia leucoptera
Northern coniferous trees.
Common Redpoll
Carduelis flammea
Hoary Redpoll
Carduelis hornemanni
Pine Siskin
Carduelis pinus
Conifers.
American Goldfinch
Carduelis tristis
Open, weedy fields with scattered small trees.
Evening Grosbeak
Coccothraustes vespertinus
Spruce and fir forest (breeding season).
House Sparrow
Passer domesticus
B
BF
W
WF

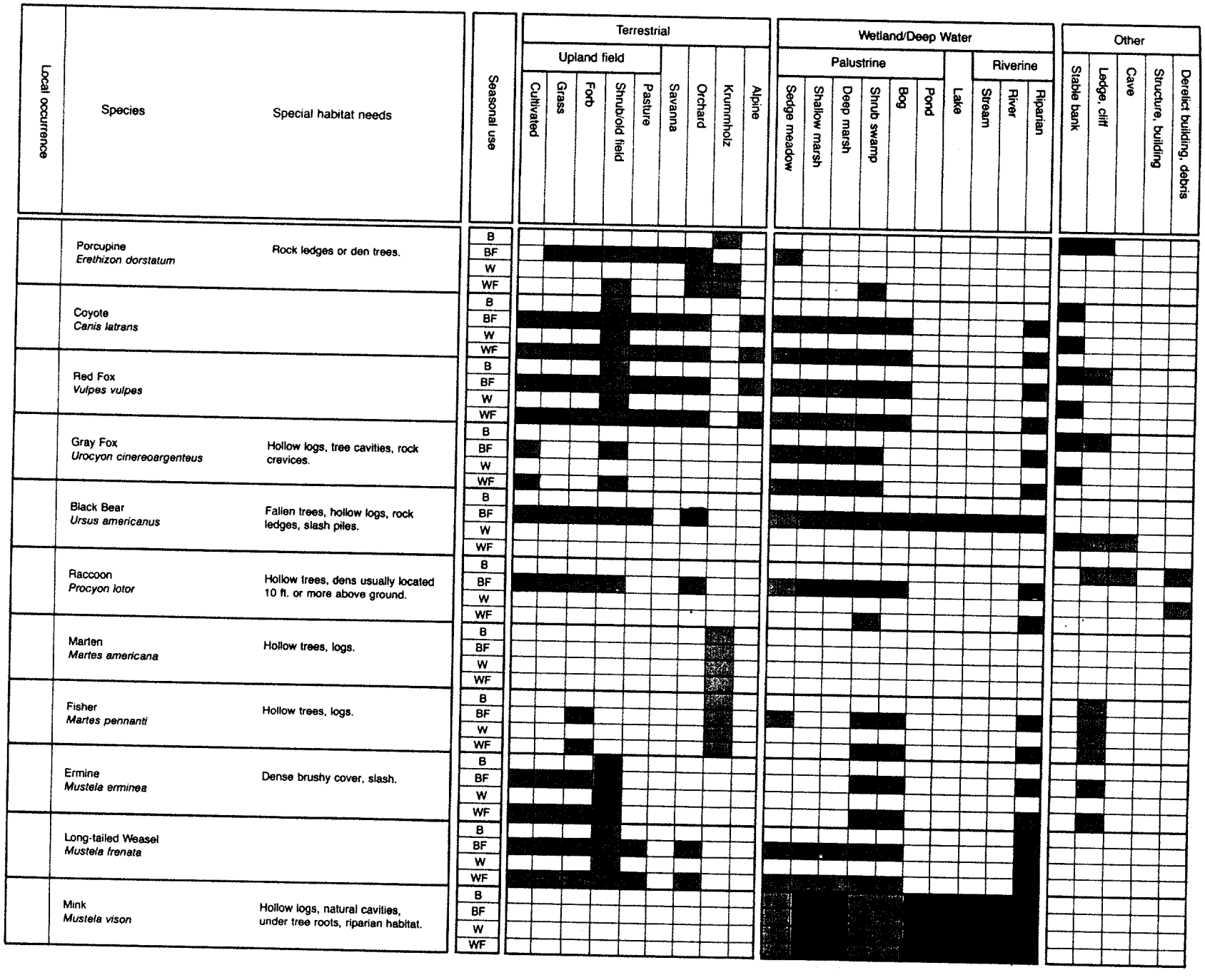
Species Occurrence and Utilization, by Nonforested Habitat
Mammals

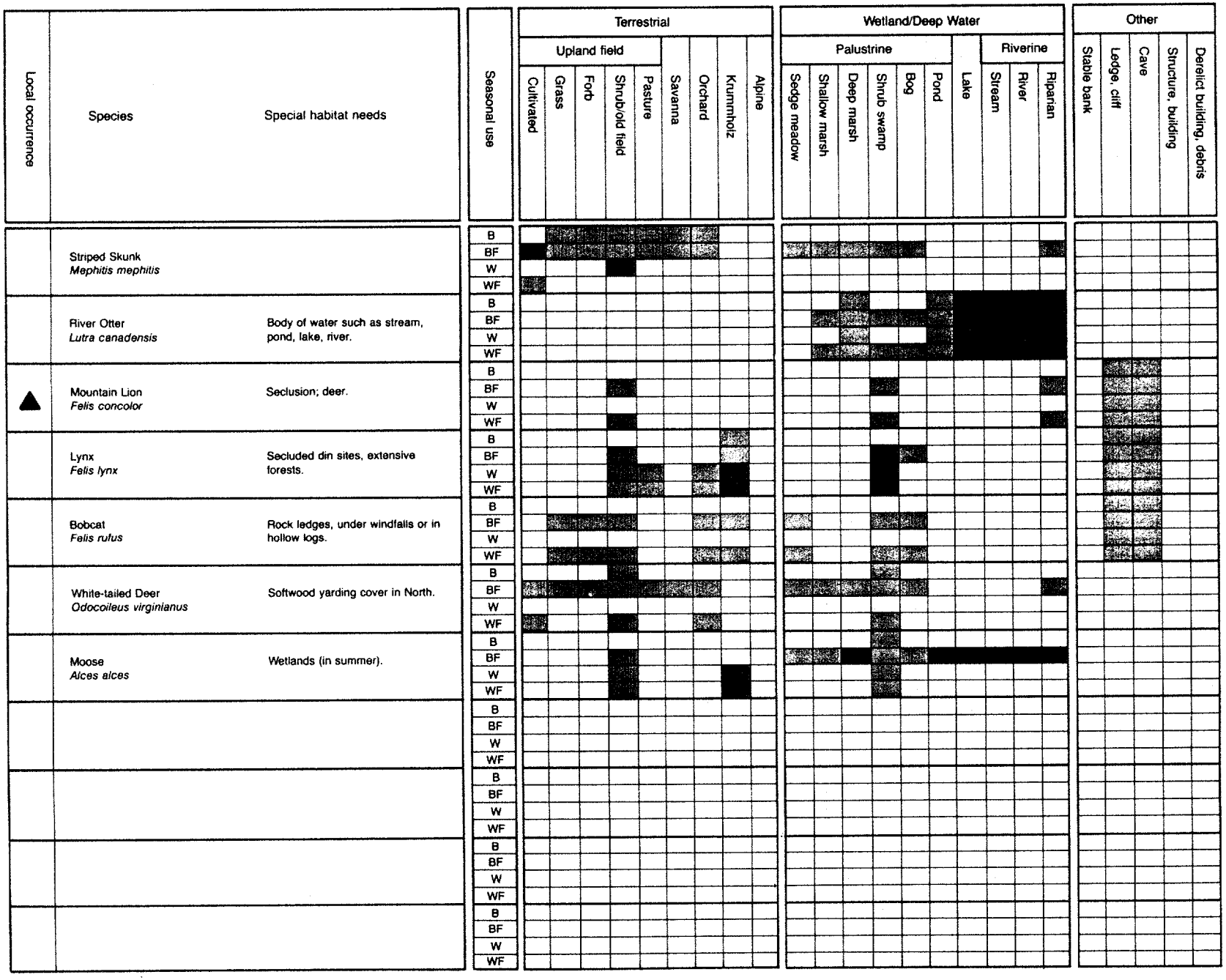



Local occurrence
Species
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Upland field
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Forb
Shrub/old field
Pasture
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Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
B
BF
W
WF
Little Brown Myotis
Myotis lucifugus
Females: dark, warm sites for maternity colonies.
Keen's Myotis
Myotis keenii
Caves, mine shafts with temperatures near 40°F; high relative humidity and calm air.
Indiana Myotis
Myotis sodalis
Caves for hibernation; cool, stable temperature of 40° to 46°F through winter.
Small-footed Myotis
Myotis leibii
Silver-haired Bat
Lasionycteris noctivagans
Dead trees with loose bark or cavities; streams
Eastern Pipistrelle
Pipistrellus subflavus
Warm, draft-free, damp sites for hibernation, open woods.
Big Brown Bat
Eptesicus fuscus
Cold, dry areas of caves or buildings for hibernation.
Red Bat
Lasiurus borealis
Deciduous trees on forest edges for roosting.
Hoary Bat
Lasiurus cinereus
Edges of coniferous forests.
Eastern Cottontail
Sylvilagus floridanus
Brush piles, stone walls, dens or burrows; herbaceous and shrubby cover.
New England Cottontail
Sylvilagus transitionalis
Young woodlands with thick cover.

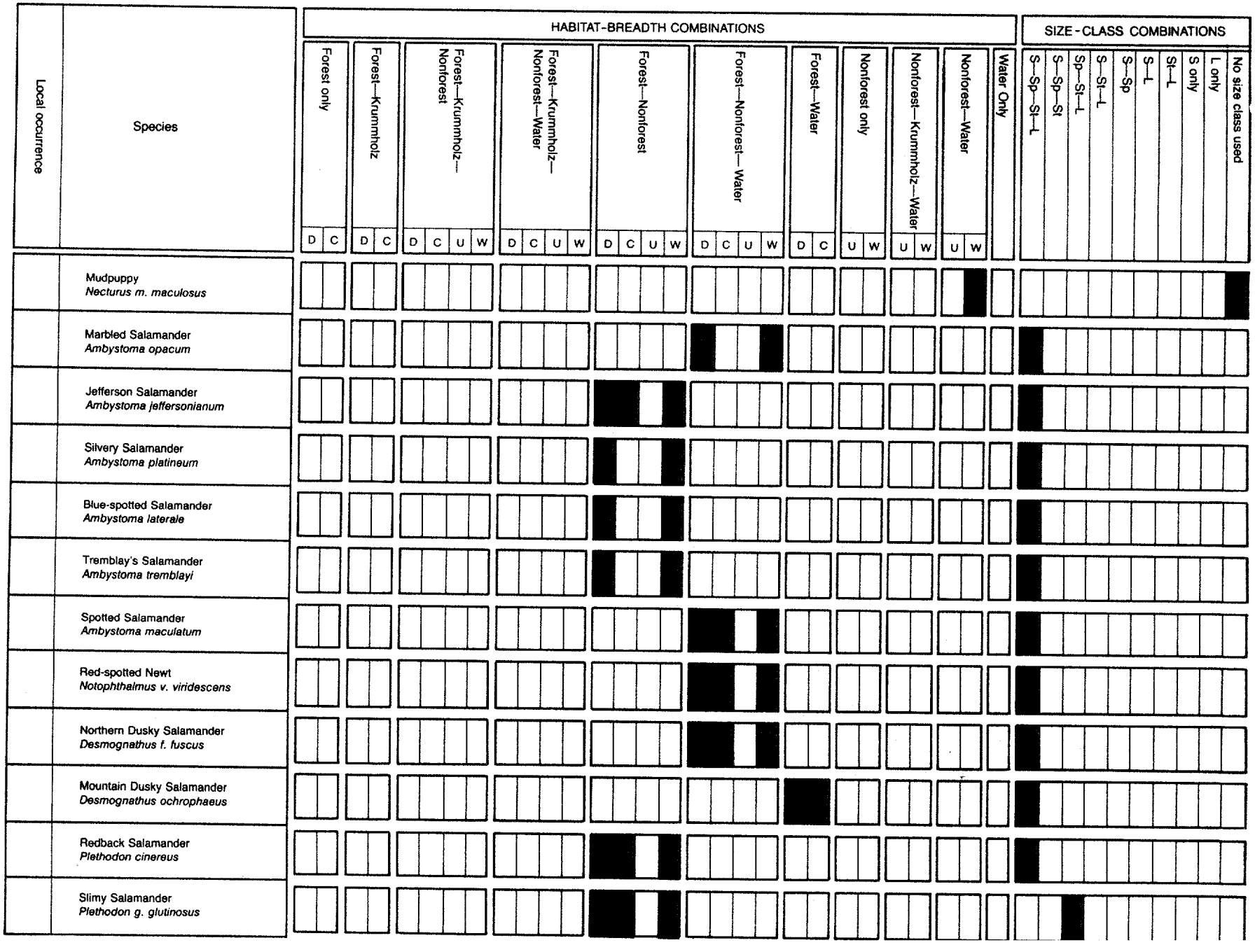

Local occurrence
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Terrestrial
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Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Snowshoe Hare
Lepus americanus
Dense brushy or softwood cover.
European Hare
Lepus capensis
Fields, meadows.
Eastern Chipmunk
Tamias striatus
Tree or shrub cover, elevated perches, logs.
Woodchuck
Marmota monax
Open or semi-open country.
Gray Squirrel
Sciurus carolinensis
Tall trees for dens or leafnests.
Red Squirrel
Tamiasciurus hudsonicus
Woodlands with mature trees, conifers preferred.
Southern Flying Squirrel
Glaucomys volans
Mature woodland with cavity trees; favors cavities with entrance diameters of 1.6 to 2 in.
Northern Flying Squirrel
Glaucomys sabrinus
Mature trees, cavities for winter dens; arboreal lichens.
Beaver
Castor canadensis
Woodland streams, lack of disturbance.
Deer Mouse
Peromyscus maniculatus
Northern hardwoods or northern coniferous forests.
White-footed Mouse
Peromyscus leucopus
B
BF
W
WF

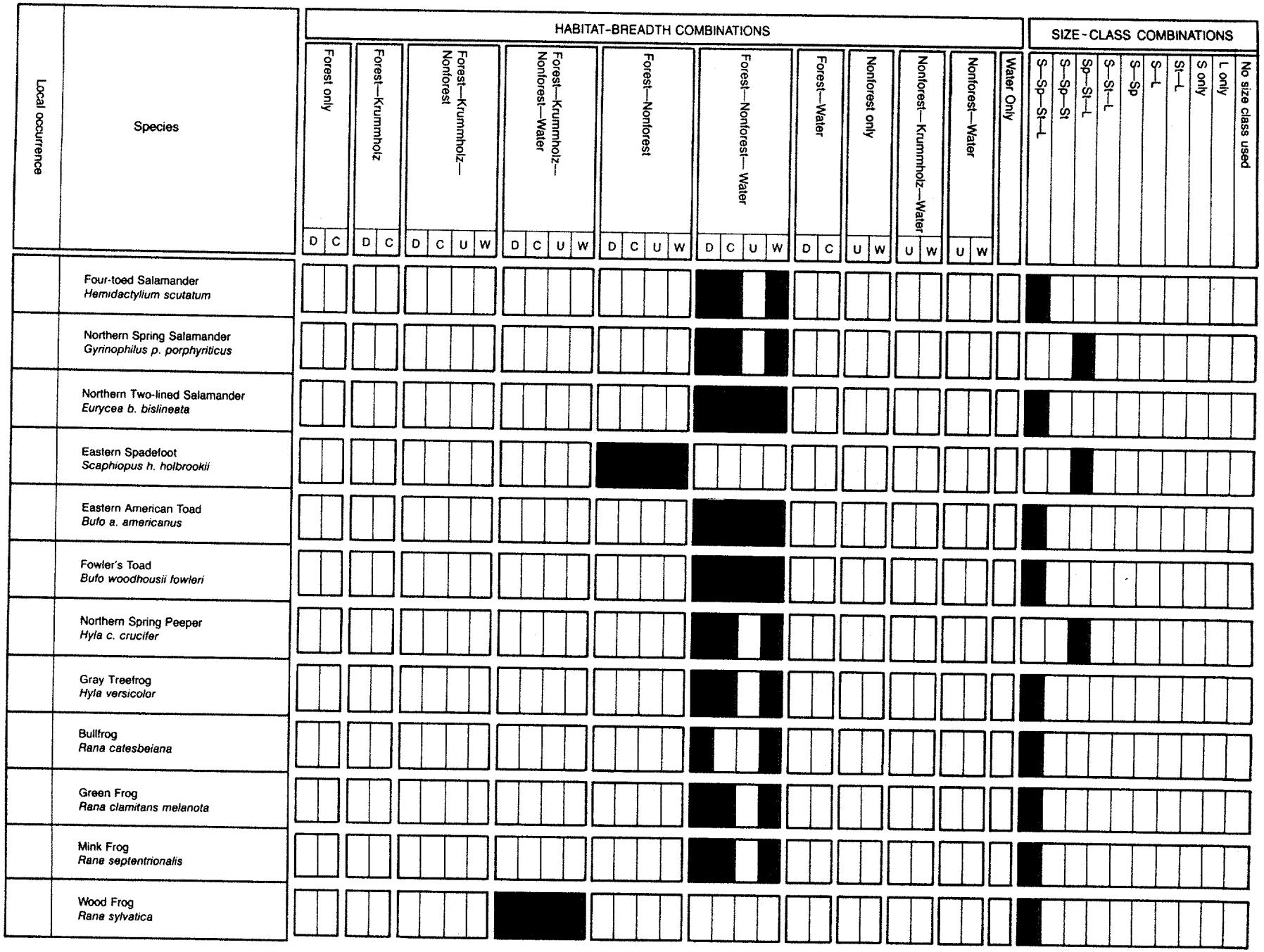

Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Southern Red-backed Vole
Clethrionomys gapperi
Springs, brooks, seeps, bogs; debris or slash cover.
Meadow Vole
Microtus pennsylvanicus
Herbaceous vegetation, loose organic soils.
Rock Vole
Microtus chrotorrhinus
Cool, moist, rocky woodlands with herbaceous ground cover and flowing water.
Woodland Vole
Microtus pinetorum
Ground cover of leaves or grass; moist to well-drained soils.
Muskrat
Ondatra zibethicus
Wetlands with dense emergent vegetation; stable water level.
Southern Bog Lemming
Synaptomys cooperi
Moist soils.
Northern Bog Lemming
Synaptomys borealis
Moist to wet loose soils or leaf mulch.
Norway Rat
Rattus norvegicus
Buildings, dumps or loose soil for digging burrows.
House Mouse
Mus musculus
Buildings in winter.
Meadow Jumping Mouse
Zapus hudsonius
Herbaceous groundcover, loose soils.
Woodland Jumping Mouse
Napaeozapus insignis
Moist cool woodland, loose soils, herbaceous cover.
B
BF
W
WF


Local occurrence
Species
Special habitat needs
Seasonal use
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Porcupine
Erethizon dorstatum
Rock ledges or den trees.
Coyote
Canis latrans
Red Fox
Vulpes vulpes
Gray Fox
Urocyon cinereoargenteus
Hollow logs, tree cavities, rock crevices.
Black Bear
Ursus americanus
Fallen trees, hollow logs, rock ledges, slash piles.
Raccoon
Procyon lotor
Hollow trees, dens usually located 10 ft. or more above ground.
Marten
Martes americana
Hollow trees, logs.
Fisher
Martes pennanti
Hollow trees, logs.
Ermine
Mustela erminea
Dense brushy cover, slash.
Long-tailed Weasel
Mustela frenata
Mink
Mustela vison
Hollow logs, natural cavities, under tree roots, riparian habitat.
B
BF
W
WF


Local occurrence
Species
Special habitat needs
Seasonal use
B
BF
W
WF
Terrestrial
Upland field
Cultivated
Grass
Forb
Shrub/old field
Pasture
Savanna
Orchard
Krummholz
Alpine
Wetland/Deep Water
Palustrine
Sedge meadow
Shallow marsh
Deep marsh
Shrub swamp
Bog
Pond
Lake
Riverine
Stream
River
Riparian
Other
Stable bank
Ledge, cliff
Cave
Structure, building
Derelict building, debris
Striped Skunk
Mephitis mephitis
River Otter
Lutra canadensis
Body of water such as stream, pond, lake, river.
Mountain Lion
Felis concolor
Seclusion; deer.
Lynx
Felis lynx
Secluded din sites, extensive forests.
Bobcat
Felis rufus
Rock ledges, under windfalls or in hollow logs.
White-tailed Deer
Odocoileus virginianus
Softwood yarding cover in North.
Moose
Alces alces
Wetlands (in summer).

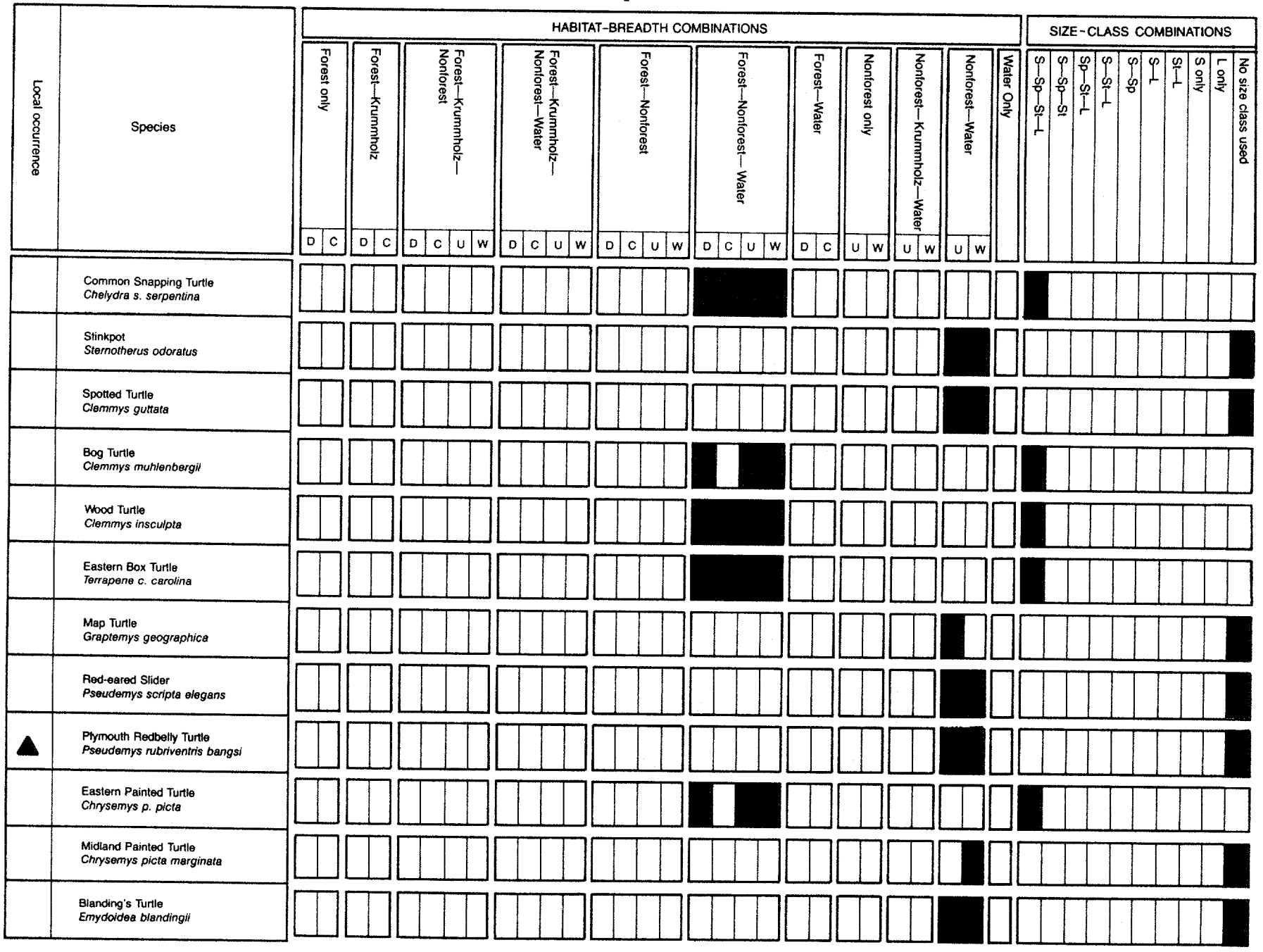
Species Occurrence and Utilization, by Habitat Breadth and Size Class
Amphibians

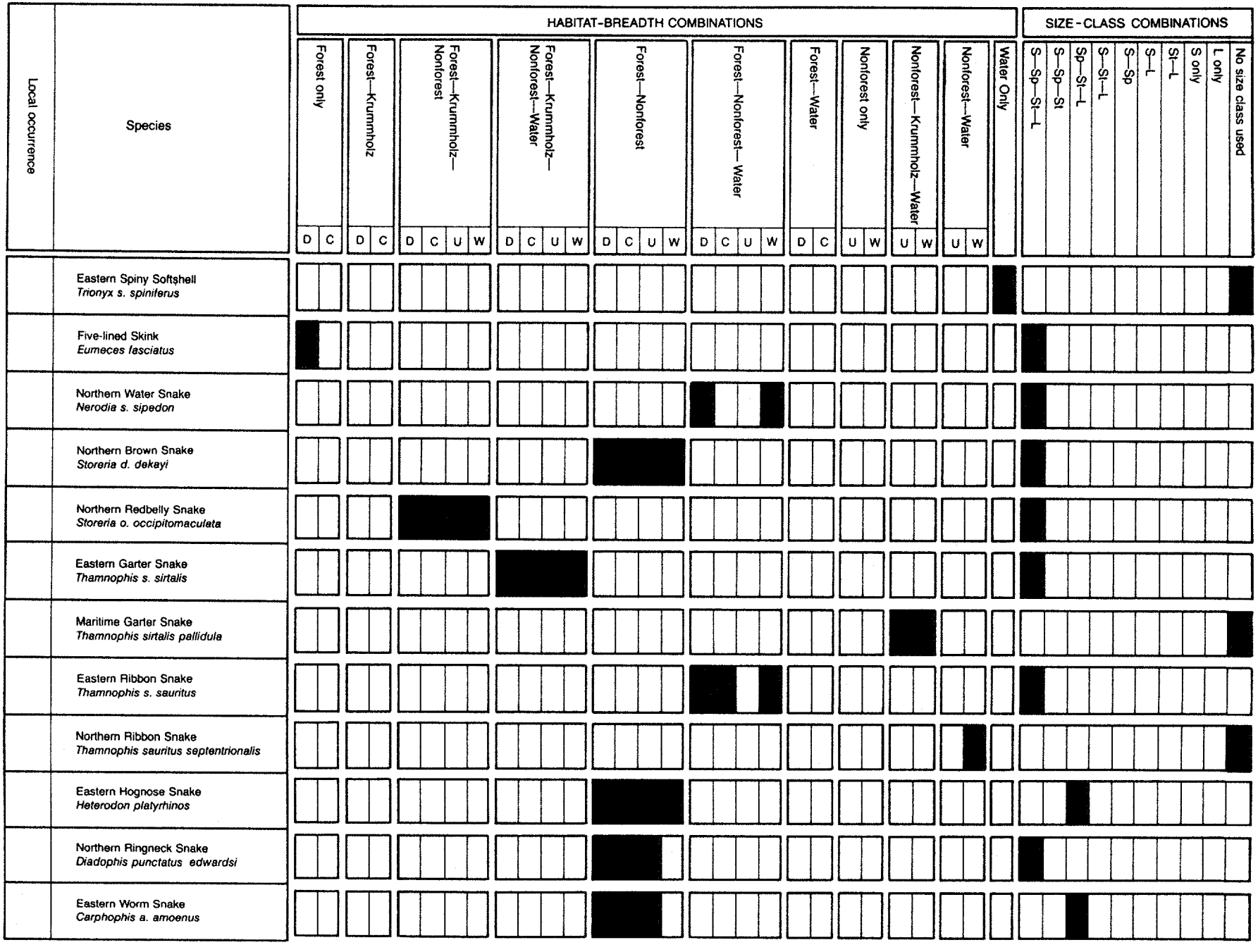



Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Four-toed Salamander
Hemidactylium scutatum
Northern Spring Salamander
Gyrinophilus p. porphyriticus
Northern Two-lined Salamander
Eurycea b. bislineata
Eastern Spadefoot
Scaphiopus h. holbrookii
Eastern American Toad
Bufo a. americanus
Fowler's Toad
Bufo woodhousii fowleri
Northern Spring Peeper
Hyla c. crucifer
Gray Treefrog
Hyla versicolor
Bullfrog
Rana catesbeiana
Green Frog
Rana clamitans melanota
Mink Frog
Rana septentrionalis
Wood Frog
Rana sylvatica

| | | |

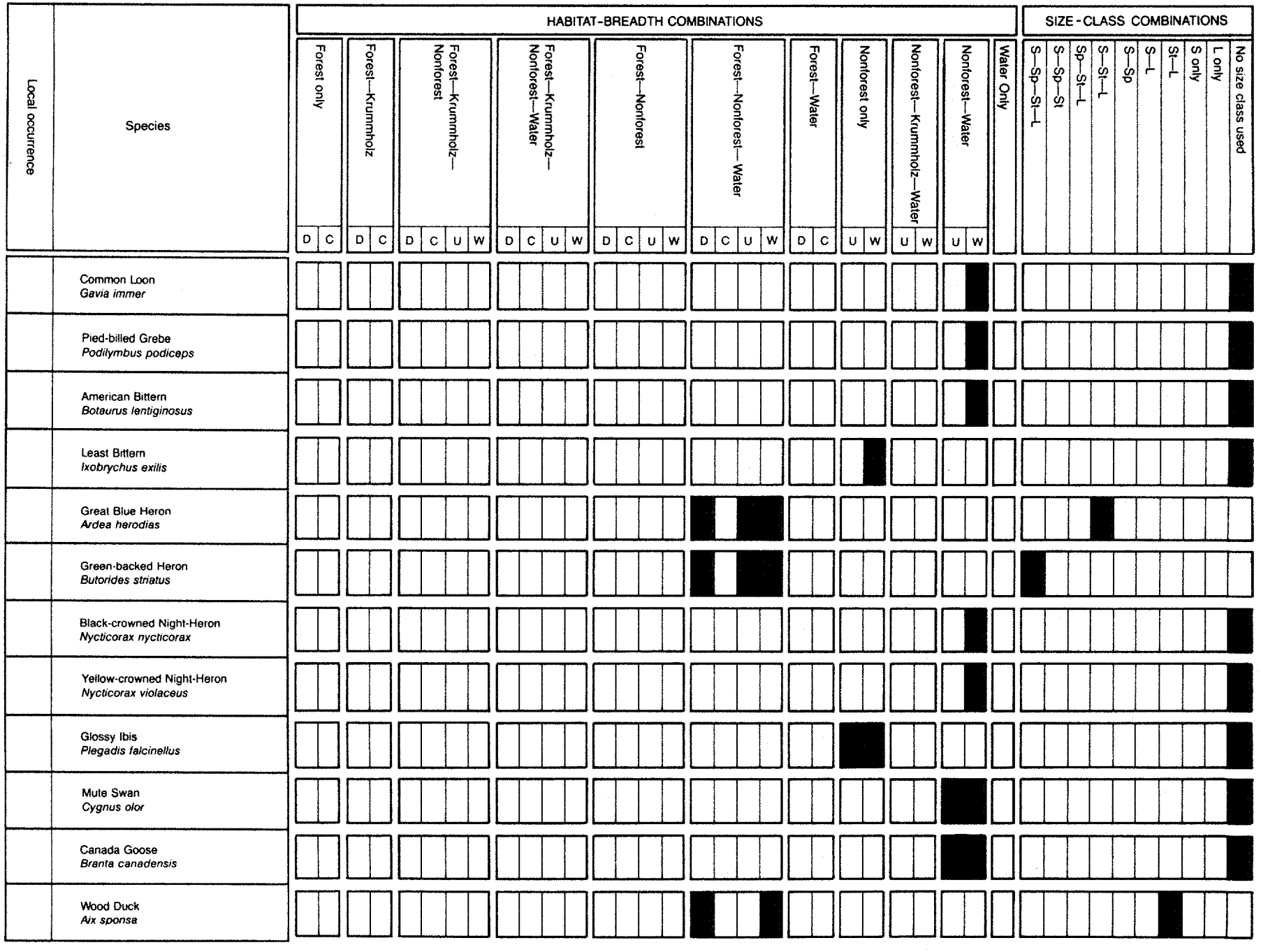
Species Occurrence and Utilization, by Habitat Breadth and Size Class
Reptiles

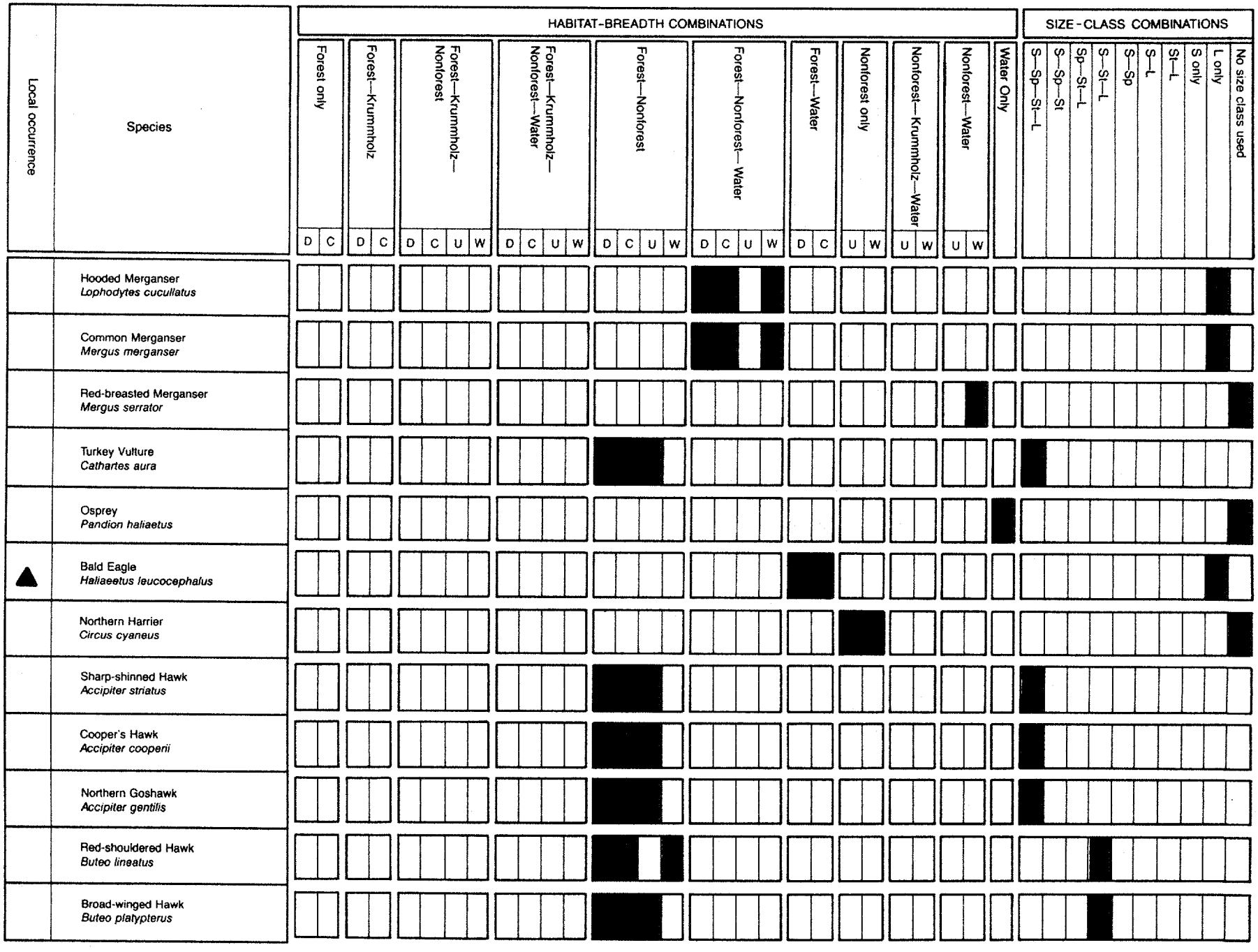



Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Eastern Spiny Softshell
Trionyx s. spiniferus
Five-lined Skink
Eumeces fasciatus
Northern Water Snake
Nerodia s. sipedon
Northern Brown Snake
Storeria d. dekayi
Northern Redbelly Snake
Storeria o. occipitomaculata
Eastern Garter Snake
Thamnophis s. sirtalis
Maritime Garter Snake
Thamnophis sirtalis pallidula
Eastern Ribbon Snake
Thamnophis s. sauritus
Northern Ribbon Snake
Thamnophis sauritus septentrionalis
Eastern Hognose Snake
Heterodon platyrhinos
Northern Ringneck Snake
Diadophis punctatus edwardsi
Eastern Worm Snake
Carphophis a. amoenus

SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
W
U
Nonforest—Krummholz—Water
W
U
Nonforest only
W
U
Forest—Water
C
D
Forest—Nonforest— Water
W
U
C
D
Forest—Nonforest
W
U
C
D
Forest—Krummholz—Nonforest—Water
W
U
C
D
Forest—Krummholz—Nonforest
W
U
C
D
Forest—Krummholz
C
D
Forest only
C
D
Species
Local occurrence
Northern Black Racer
Coluber c. constrictor
Eastern Smooth Green Snake
Opheodrys v. vernalis
Black Rat Snake
Elaphe o. obsoleta
Eastern Milk Snake
Lampropeltis t. triangulum
Northern Copperhead
Agkistrodon contortrix mokeson
Timber Rattlesnake
Crotalus horridus

Species Occurrence and Utilization, by Habitat Breadth and Size Class
Birds

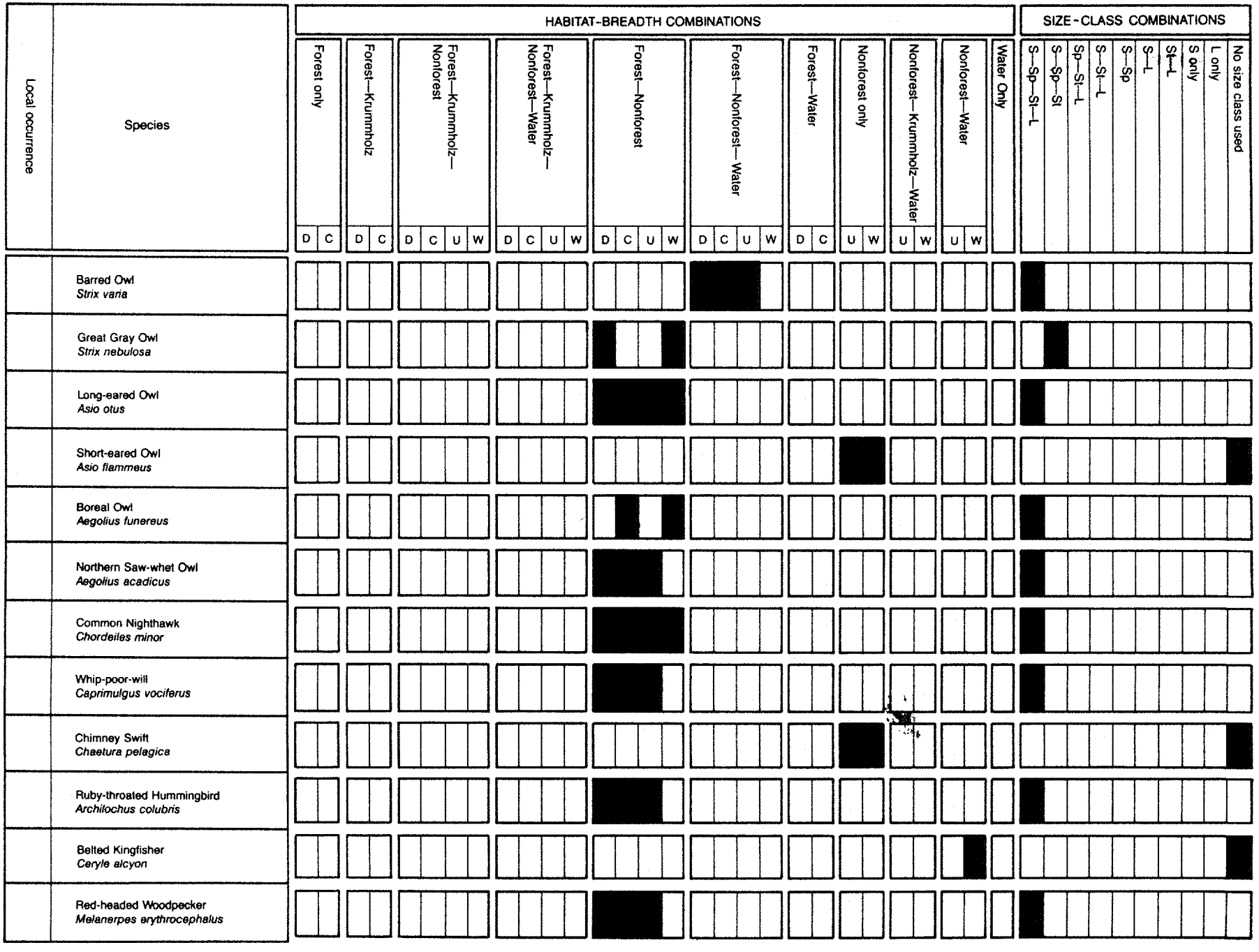


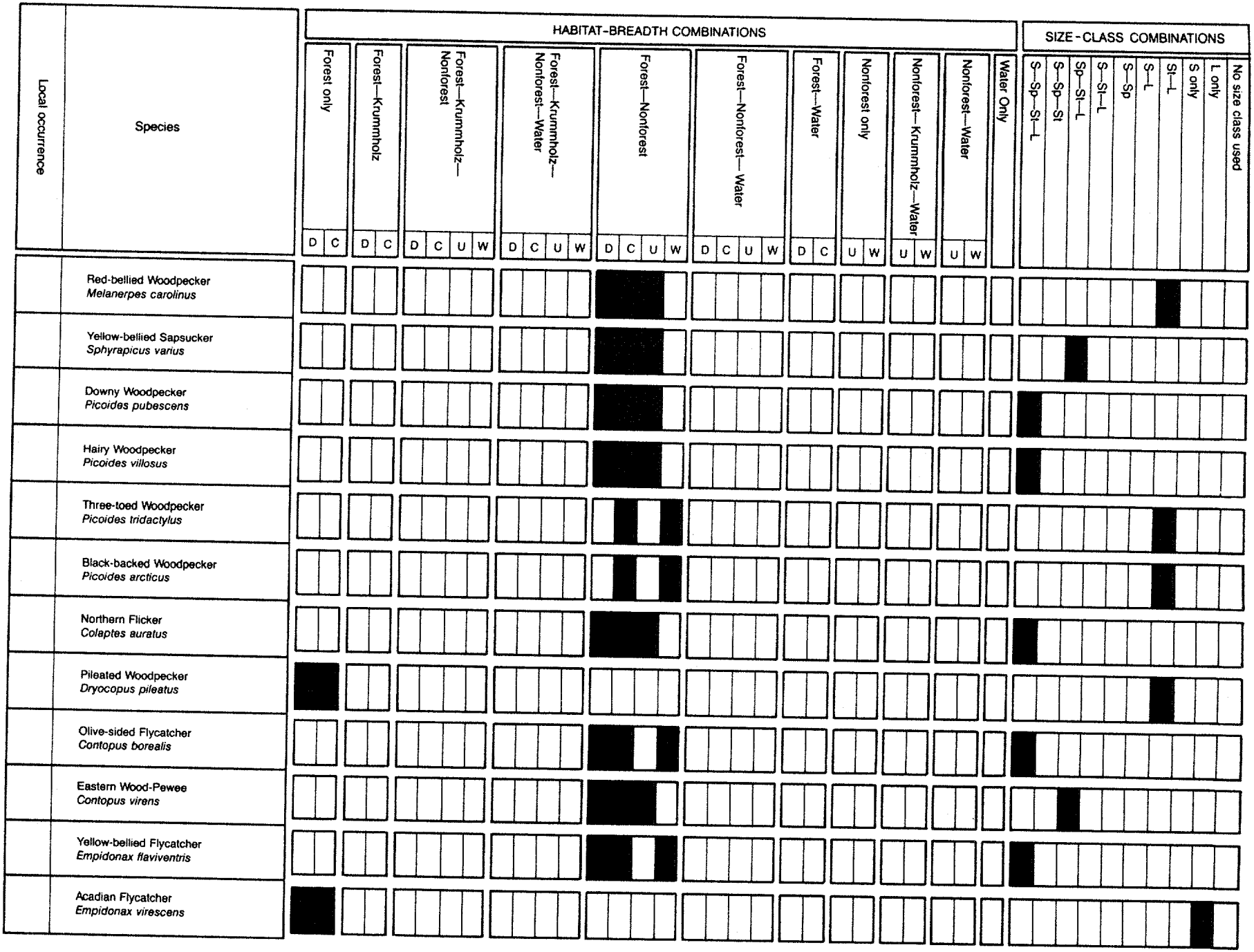

Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Hooded Merganser
Lophodytes cucullatus
Common Merganser
Mergus merganser
Red-breasted Merganser
Mergus serrator
Turkey Vulture
Cathartes aura
Osprey
Pandion haliaetus
Bald Eagle
Haliaeetus leucocephalus
Northern Harrier
Circus cyaneus
Sharp-shinned Hawk
Accipiter striatus
Cooper's Hawk
Accipiter cooperii
Northern Goshawk
Accipiter gentilis
Red-shouldered Hawk
Buteo lineatus
Broad-winged Hawk
Buteo platypterus

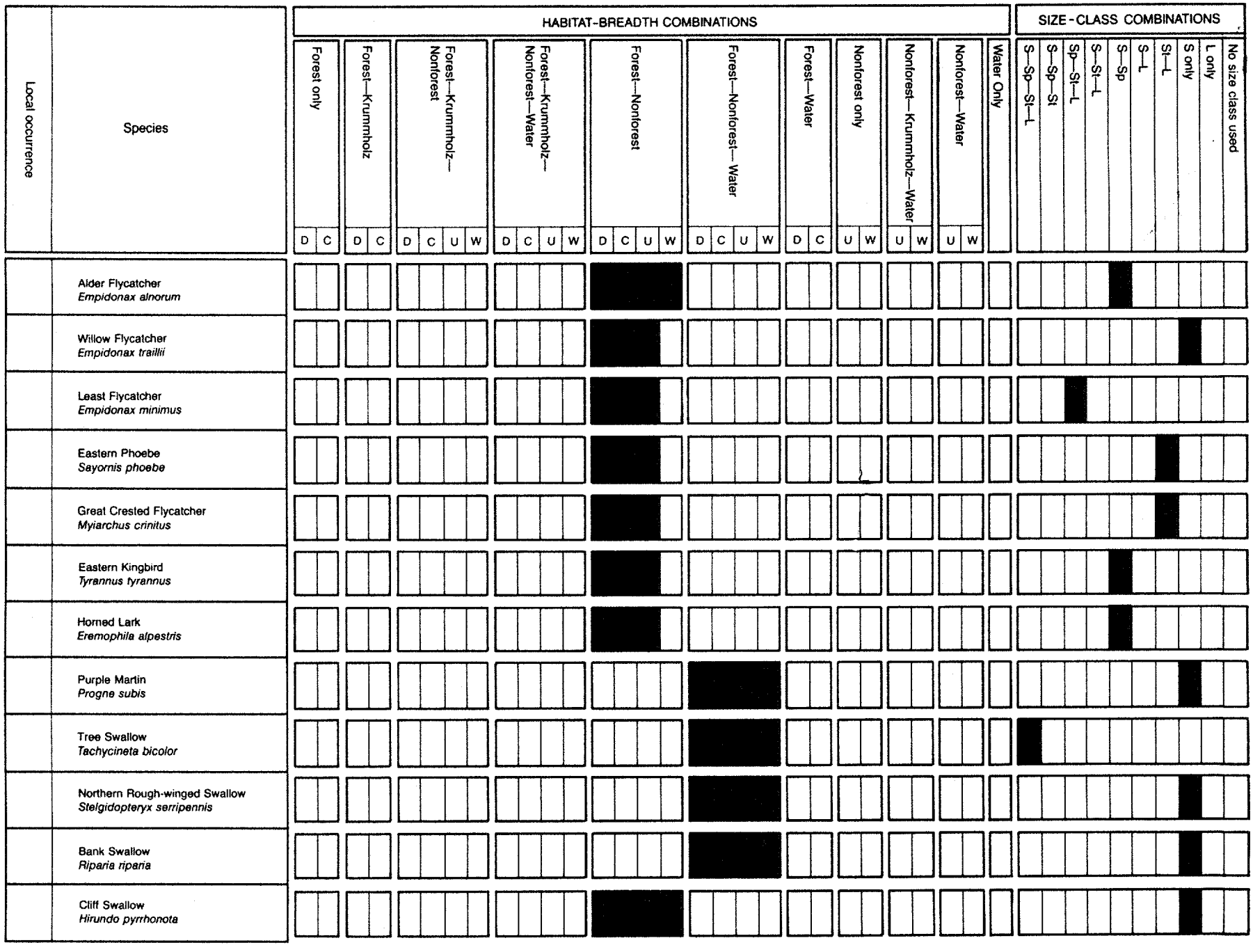
SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
D C U W
Species
Local occurrence
Red-tailed Hawk
Buteo jamaicensis
Rough-legged Hawk
Buteo lagopus
Golden Eagle
Aquila chrysaetos
American Kestrel
Falco sparverius
Merlin
Falco columbarius
Peregrine Falcon
Falco peregrinus
Gray Partridge
Perdix perdix
Ring-necked Pheasant
Phasianus colchicus
Spruce Grouse
Dendragapus canadensis
Rufted Grouse
Bonasa umbellus
Wild Turkey
Meleagris gallopavo
Northern Bobwhite
Colinus virginianus

SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
W
U
Nonforest—Krummholz—Water
W
U
Nonforest only
W
U
Forest—Water
D
C
Forest—Nonforest—Water
W
U
C
D
Forest—Nonforest
W
U
C
D
Forest—Krummholz—Nonforest—Water
W
U
C
D
Forest—Krummholz—Nonforest
W
U
C
D
Forest—Krummholz
D
C
Forest only
D
C
Species
Local occurrence
Black Rail
Laterallus jamaicensis
King Rail
Rallus elegans
Virginia Rail
Rallus limicola
Sora
Porzana carolina
Common Moorhen
Gallinula chloropus
American Coot
Fulica americana
Killdeer
Charadrius vociferus
Spotted Sandpiper
Actitis macularia
Upland Sandpiper
Bartramia longicauda
Common Snipe
Gallinago gallinago
American Woodcock
Scolopax minor
Ring-billed Gull
Larus delawarensis

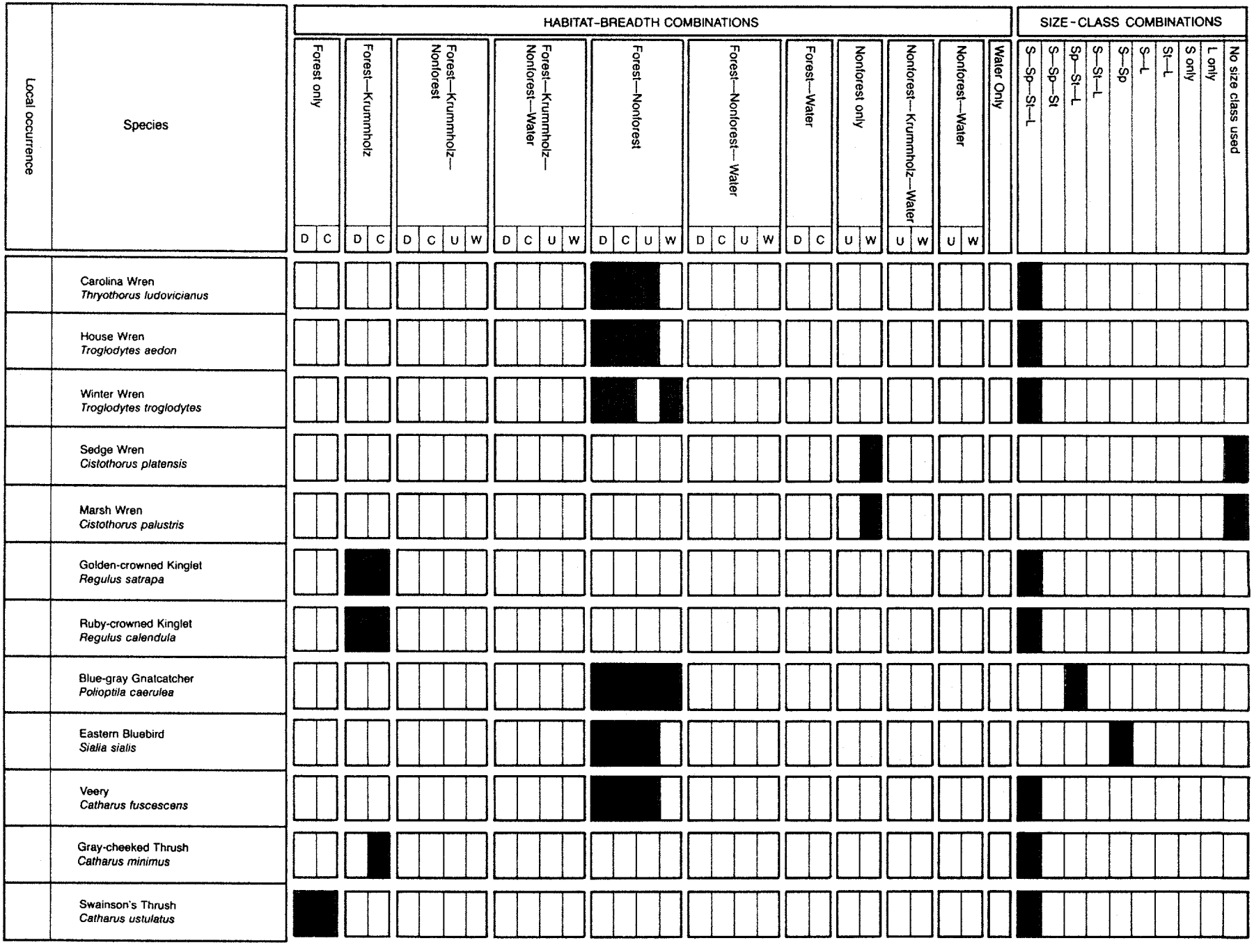
SIZE - CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
W
U
Nonforest—Krummholz—Water
W
U
Nonforest only
W
U
Forest—Water
D
C
Forest—Nonforest—Water
W
U
C
D
Forest—Nonforest
W
U
C
D
Forest—Krummholz—Nonforest—Water
W
U
C
D
Forest—Krummholz—Nonforest
W
U
C
D
Forest—Krummholz
D
C
Forest only
D
C
Species
Local occurrence
Herring Gull
Larus argentatus
Great Black-backed Gull
Larus marinus
Black Tern
Chlidonias niger
Rock Dove
Columba livia
Mourning Dove
Zenaida macroura
Black-billed Cuckoo
Coccyzus erythropthalmus
Yellow-billed Cuckoo
Coccyzus americanus
Common Barn-Owl
Tyto alba
Eastern Screech-Owl
Otus asio
Great Horned Owl
Bubo virginianus
Snowy Owl
Nyctea scandiaca
Northern Hawk-Owl
Surnia ulula


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Barred Owl
Strix varia
Great Gray Owl
Strix nebulosa
Long-eared Owl
Asio otus
Short-eared Owl
Asio flammeus
Boreal Owl
Aegolius funereus
Northern Saw-whet Owl
Aegolius acadicus
Common Nighthawk
Chordeiles minor
Whip-poor-will
Caprimulgus vociferus
Chimney Swift
Chaetura pelagica
Ruby-throated Hummingbird
Archilochus colubris
Belted Kingfisher
Ceryle alcyon
Red-headed Woodpecker
Melanerpes erythrocephalus

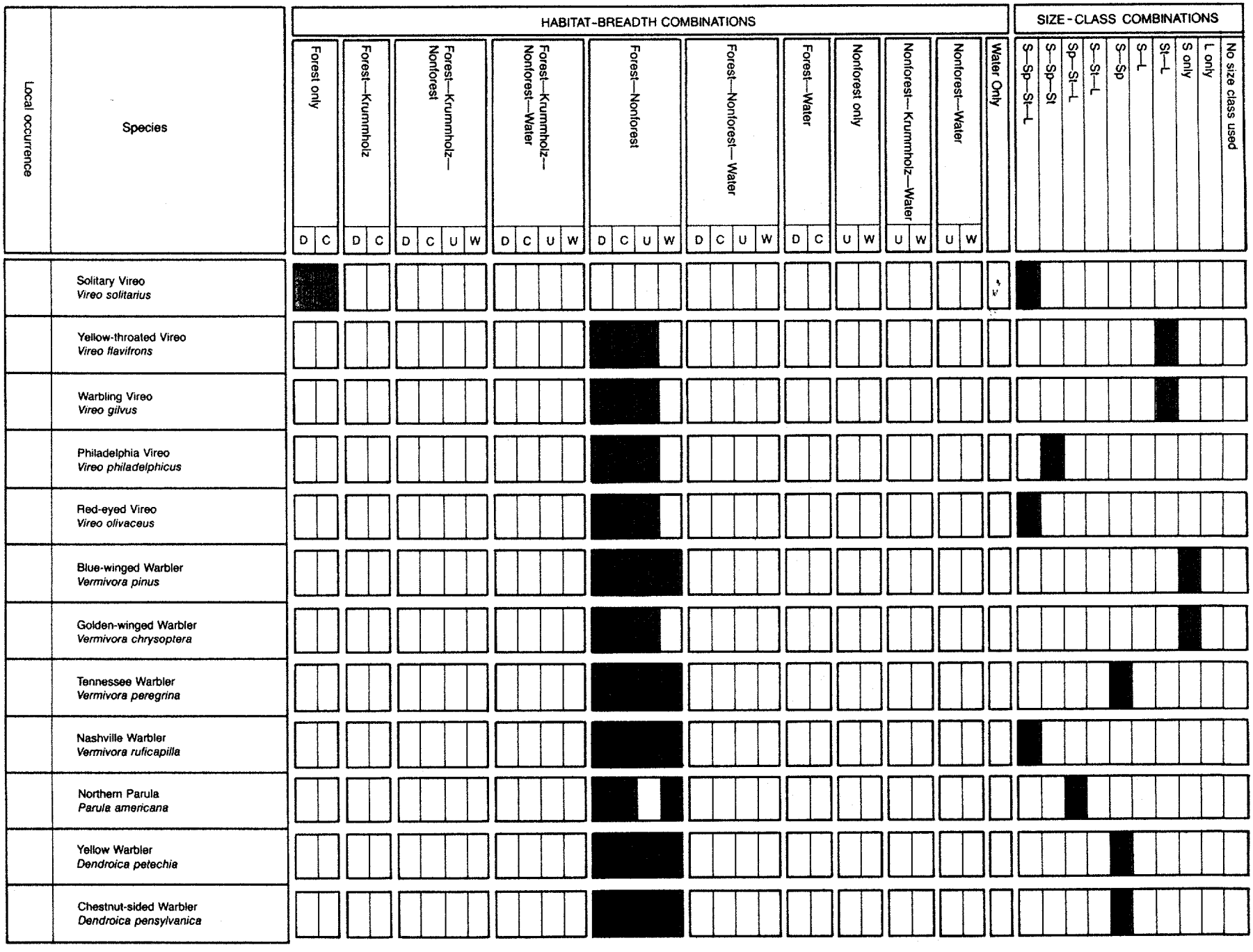

Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Red-bellied Woodpecker
Melanerpes carolinus
Yellow-bellied Sapsucker
Sphyrapicus varius
Downy Woodpecker
Picoides pubescens
Hairy Woodpecker
Picoides villosus
Three-toed Woodpecker
Picoides tridactylus
Black-backed Woodpecker
Picoides arcticus
Northern Flicker
Colaptes auratus
Pileated Woodpecker
Dryocopus pileatus
Olive-sided Flycatcher
Contopus borealis
Eastern Wood-Pewee
Contopus virens
Yellow-bellied Flycatcher
Empidonax flaviventris
Acadian Flycatcher
Empidonax virescens


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Alder Flycatcher
Empidonax alnorum
Willow Flycatcher
Empidonax traillii
Least Flycatcher
Empidonax minimus
Eastern Phoebe
Sayornis phoebe
Great Crested Flycatcher
Myiarchus crinitus
Eastern Kingbird
Tyrannus tyrannus
Horned Lark
Eremophila alpestris
Purple Martin
Progne subis
Tree Swallow
Tachycineta bicolor
Northern Rough-winged Swallow
Stelgidopteryx serripennis
Bank Swallow
Riparia riparia
Cliff Swallow
Hirundo pyrrhonota

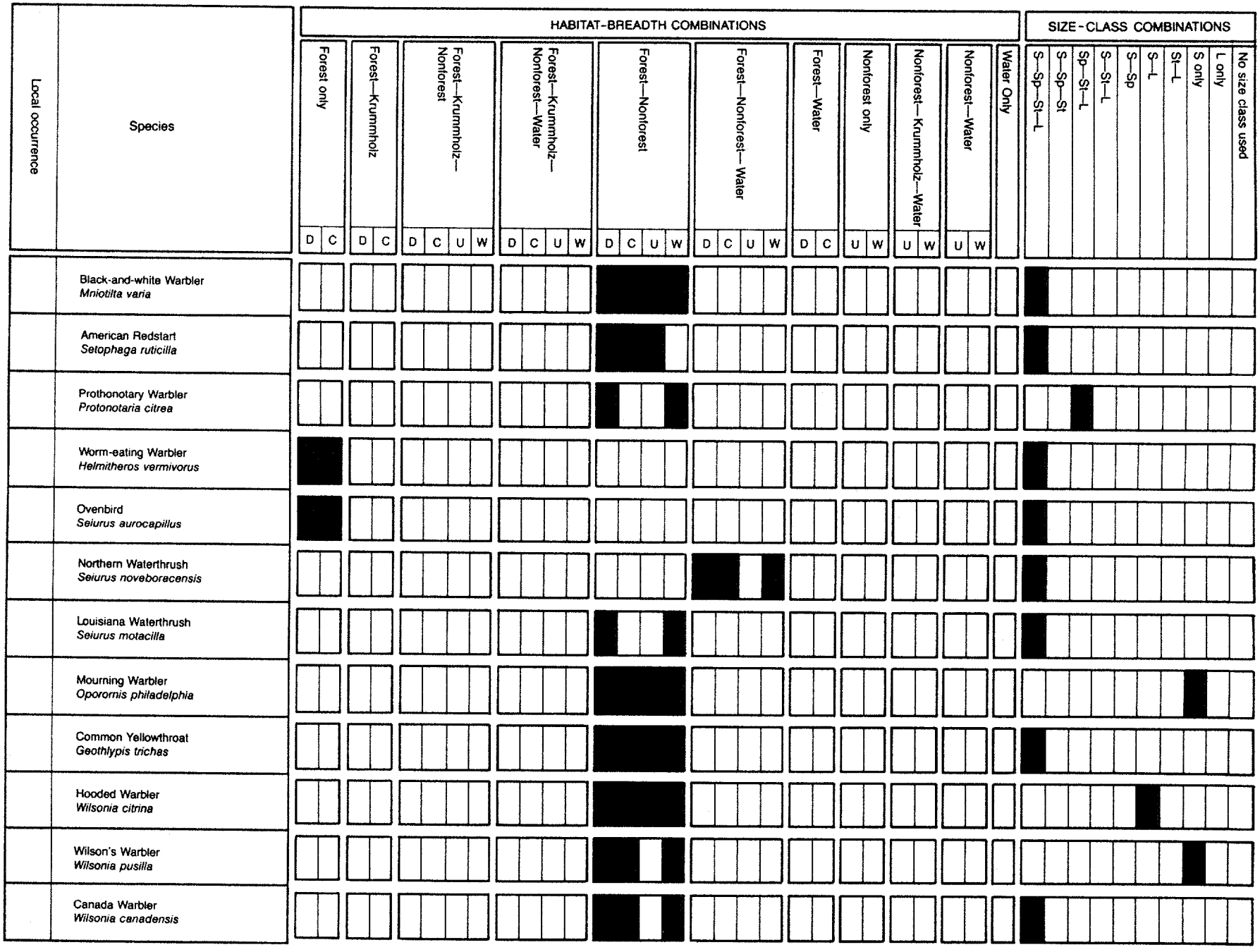
SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest— Water
Forest—Nonforest
Forest—Krummholz— Nonforest—Water
Forest—Krummholz— Nonforest
Forest—Krummholz
Forest only
W
U
C
D
Species
Local occurrence
Barn Swallow
Hirundo rustica
Gray Jay
Perisoreus canadensis
Blue Jay
Cyanocitta cristata
American Crow
Corvus brachyrhynchos
Fish Crow
Corvus ossifragus
Common Raven
Corvus corax
Black-capped Chickadee
Parus atricapillus
Boreal Chickadee
Parus hudsonicus
Tufted Titmouse
Parus bicolor
Red-breasted Nuthatch
Sitta canadensis
White-breasted Nuthatch
Sitta carolinensis
Brown Creeper
Certhia americana


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Carolina Wren
Thryothorus ludovicianus
House Wren
Troglodytes aedon
Winter Wren
Troglodytes troglodytes
Sedge Wren
Cistothorus platensis
Marsh Wren
Cistothorus palustris
Golden-crowned Kinglet
Regulus satrapa
Ruby-crowned Kinglet
Regulus calendula
Blue-gray Gnatcatcher
Polioptila caerulea
Eastern Bluebird
Sialia sialis
Veery
Catharus fuscescens
Gray-cheeked Thrush
Catharus minimus
Swainson's Thrush
Catharus ustulatus

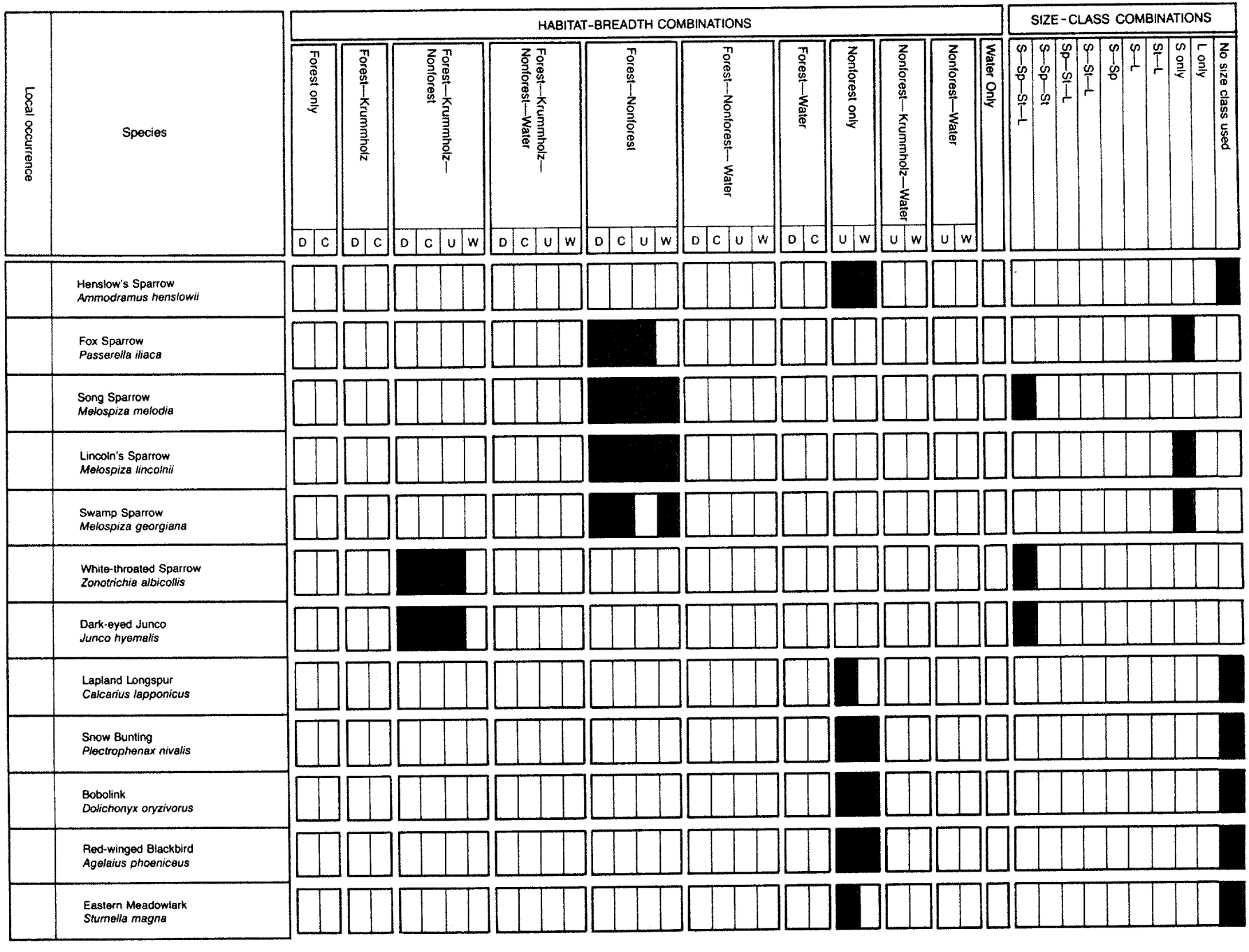
SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
D C U W
Species
Local occurrence
Hermit Thrush Catharus guttatus
Wood Thrush Hylocichla mustelina
American Robin Turdus migratorius
Gray Catbird Dumetella carolinensis
Northern Mockingbird Mimus polyglottos
Brown Thrasher Toxostoma rufum
Bohemian Waxwing Bombycilla garrulus
Cedar Waxwing Bombycilla cedrorum
Northern Shrike Lanius excubitor
Loggerhead Shrike Lanius ludovicianus
European Starling Sturnus vulgaris
White-eyed Vireo Vireo griseus


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
Solitary Vireo
Vireo solitarius
Yellow-throated Vireo
Vireo flavifrons
Warbling Vireo
Vireo gilvus
Philadelphia Vireo
Vireo philadelphicus
Red-eyed Vireo
Vireo olivaceus
Blue-winged Warbler
Vermivora pinus
Golden-winged Warbler
Vermivora chrysoptera
Tennessee Warbler
Vermivora peregrina
Nashville Warbler
Vermivora ruficapilla
Northern Parula
Parula americana
Yellow Warbler
Dendroica petechia
Chestnut-sided Warbler
Dendroica pensylvanica

SIZE - CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
W
U
C
D
Species
Local occurrence
Magnolia Warbler
Dendroica magnolia
Cape May Warbler
Dendroica tigrina
Black-throated Blue Warbler
Dendroica caerulescens
Yellow-rumped Warbler
Dendroica coronata
Black-throated Green Warbler
Dendroica virens
Blackburnian Warbler
Dendroica fusca
Pine Warbler
Dendroica pinus
Prairie Warbler
Dendroica discolor
Palm Warbler
Dendroica palmarum
Bay-breasted Warbler
Dendroica castanea
Blackpoll Warbler
Dendroica striata
Cerulean Warbler
Dendroica cerulea


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Black-and-white Warbler
Mniotilta varia
American Redstart
Setophaga ruticilla
Prothonotary Warbler
Protonotaria citrea
Worm-eating Warbler
Helmitheros vermivorus
Ovenbird
Seiurus aurocapillus
Northern Waterthrush
Seiurus noveboracensis
Louisiana Waterthrush
Seiurus motacilla
Mourning Warbler
Oporornis philadelphia
Common Yellowthroat
Geothlypis trichas
Hooded Warbler
Wilsonia citrina
Wilson's Warbler
Wilsonia pusilla
Canada Warbler
Wilsonia canadensis

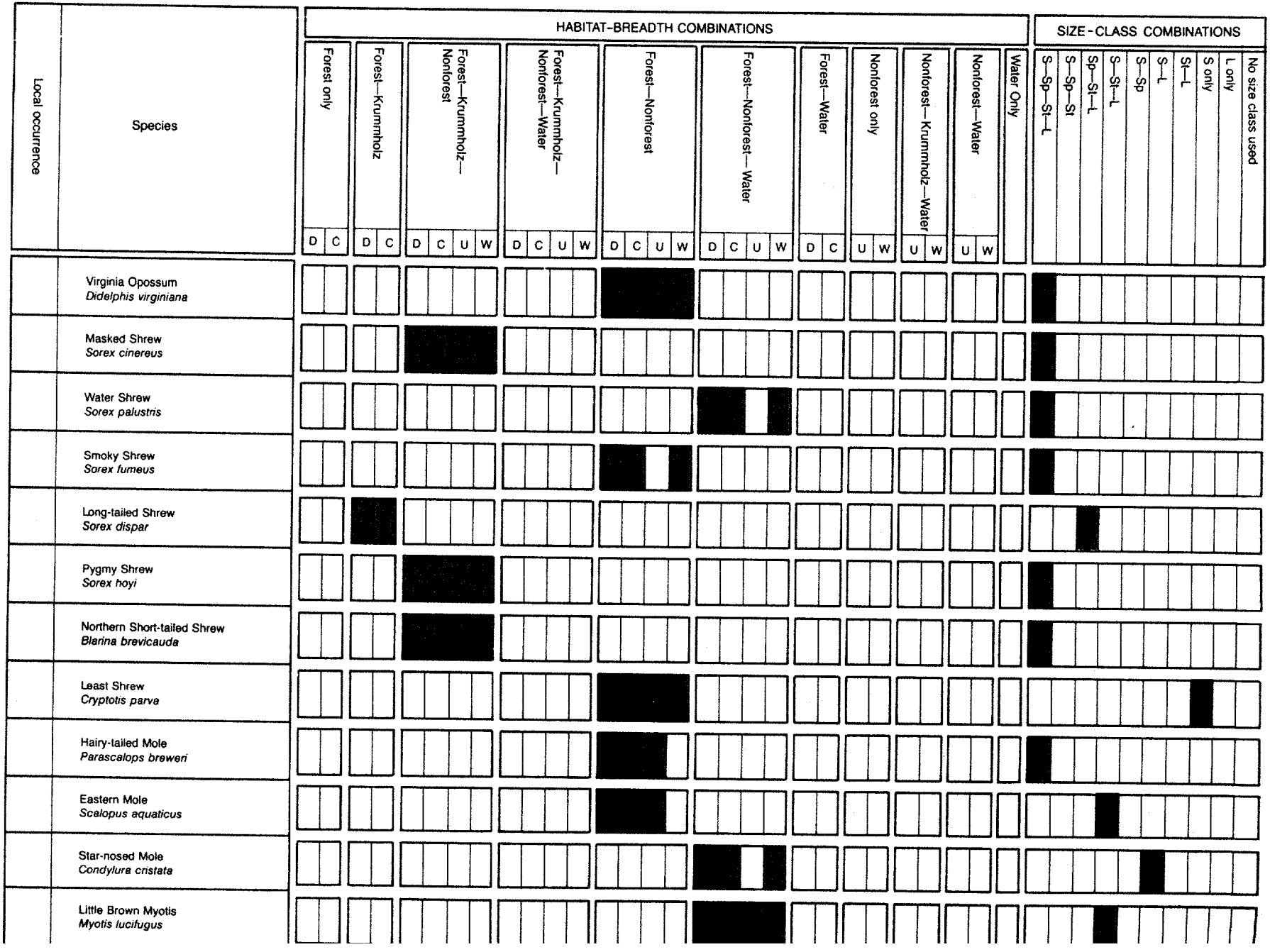
SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
W
U
C
D
Species
Local occurrence
Yellow-breasted Chat
Icteria virens
Scarlet Tanager
Piranga olivacea
Northern Cardinal
Cardinalis cardinalis
Rose-breasted Grosbeak
Pheucticus ludovicianus
Indigo Bunting
Passerina cyanea
Rufous-sided Towhee
Pipilo erythrophthalmus
American Tree Sparrow
Spizella arborea
Chipping Sparrow
Spizella passerina
Field Sparrow
Spizella pusilla
Vesper Sparrow
Pooecetes gramineus
Savannah Sparrow
Passerculus sandwichensis
Grasshopper Sparrow
Ammodramus savannarum

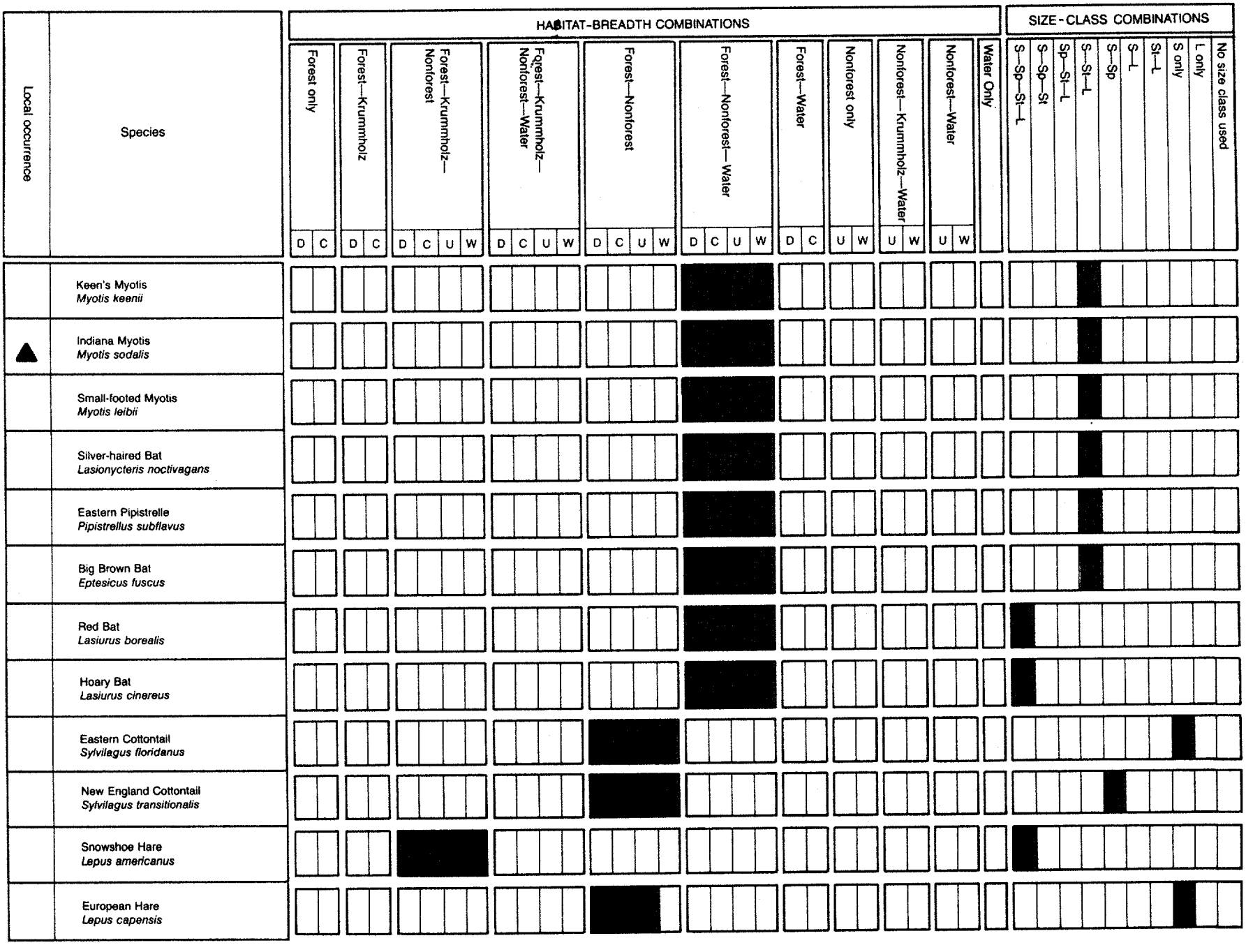

Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Henslow's Sparrow
Ammodramus henslowii
Fox Sparrow
Passerella iliaca
Song Sparrow
Melospiza melodia
Lincoln's Sparrow
Melospiza lincolnii
Swamp Sparrow
Melospiza georgiana
White-throated Sparrow
Zonotrichia albicollis
Dark-eyed Junco
Junco hyemalis
Lapland Longspur
Calcarius lapponicus
Snow Bunting
Plectrophenax nivalis
Bobolink
Dolichonyx oryzivorus
Red-winged Blackbird
Agelaius phoeniceus
Eastern Meadowlark
Sturnella magna

SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
W
U
C
D
Species
Local occurrence
Rusty Blackbird Euphagus carolinus
Common Grackle Quiscalus quiscula
Brown-headed Cowbird Molothrus ater
Orchard Oriole Icterus spurius
Northern Oriole Icterus galbula
Pine Grosbeak Pinicola enucleator
Purple Finch Carpodacus purpureus
House Finch Carpodacus mexicanus
Red Crossbill Loxia curvirostra
White-winged Crossbill Loxia leucoptera
Common Redpoll Carduelis flammea
Hoary Redpoll Carduelis hornemanni

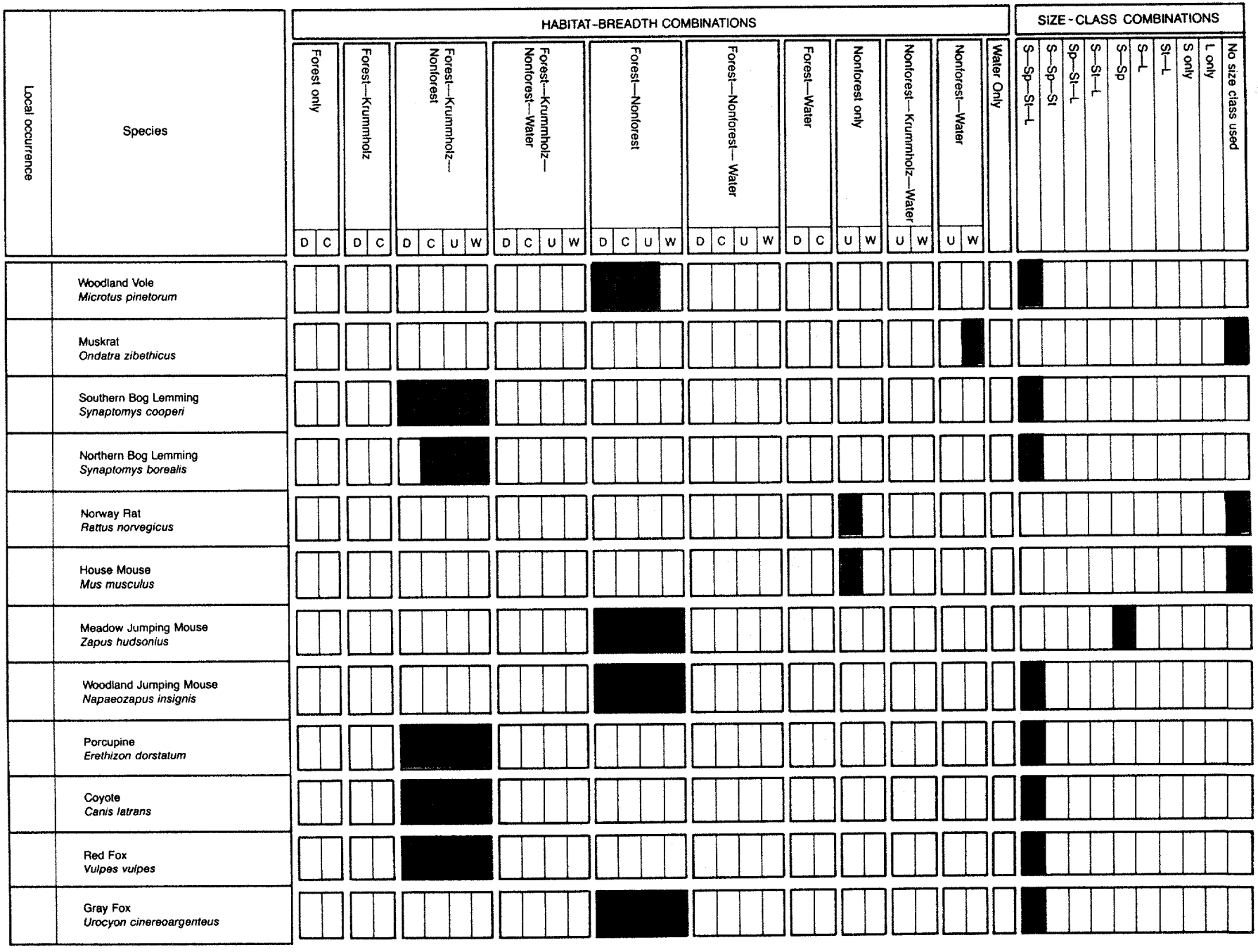
Local occurrence	Species	HABITAT-BREADTH COMBINATIONS																						SIZE-CLASS COMBINATIONS									
		Forest only		Forest—Krummholz		Forest—Krummholz—Nonforest				Forest—Krummholz—Nonforest—Water				Forest—Nonforest				Forest—Nonforest—Water				Forest—Water		Nonforest only		Nonforest—Krummholz—Water		Nonforest—Water		Water Only	S—Sp—St—L	S—Sp—St	Sp—St—L	S—St—L	S—Sp	S—L	St—L	S only	L only	No size class used
		D	C	D	C	D	C	U	W	D	C	U	W	D	C	U	W	D	C	U	W	D	C	U	W	U	W	U	W										
	Pine Siskin *Carduelis pinus*													■	■	■	■														■									
	American Goldfinch *Carduelis tristis*													■	■	■	■														■									
	Evening Grosbeak *Coccothraustes vespertinus*													■	■	■																	■							
	House Sparrow *Passer domesticus*																							■	■														■

Species Occurrence and Utilization, by Habitat Breadth and Size Class
Mammals

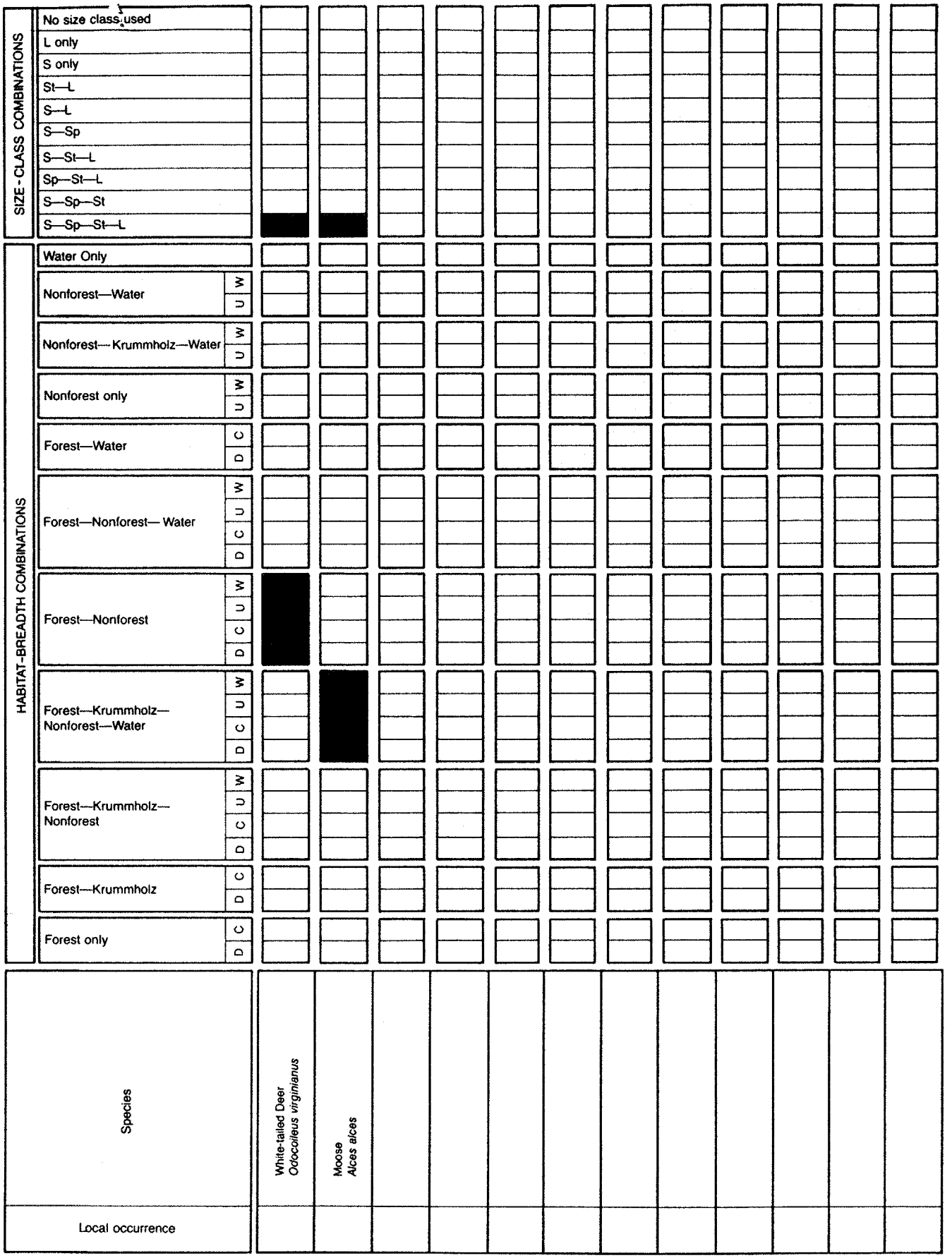



Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Keen's Myotis
Myotis keenii
Indiana Myotis
Myotis sodalis
Small-footed Myotis
Myotis leibii
Silver-haired Bat
Lasionycteris noctivagans
Eastern Pipistrelle
Pipistrellus subflavus
Big Brown Bat
Eptesicus fuscus
Red Bat
Lasiurus borealis
Hoary Bat
Lasiurus cinereus
Eastern Cottontail
Sylvilagus floridanus
New England Cottontail
Sylvilagus transitionalis
Snowshoe Hare
Lepus americanus
European Hare
Lepus capensis

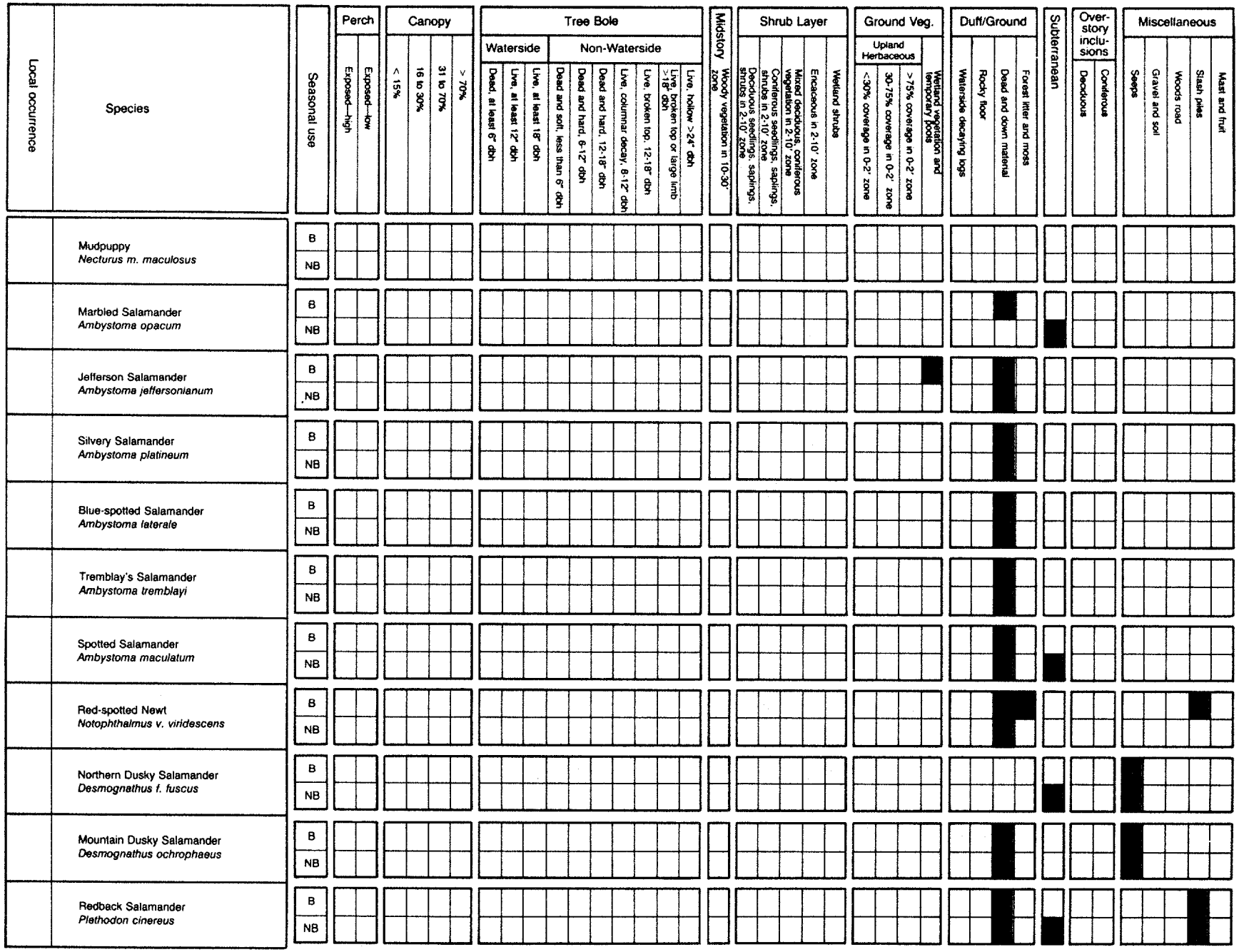
SIZE - CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
D C U W
Species
Local occurrence
Eastern Chipmunk Tamias striatus
Woodchuck Marmota monax
Gray Squirrel Sciurus carolinensis
Red Squirrel Tamiasciurus hudsonicus
Southern Flying Squirrel Glaucomys volans
Northern Flying Squirrel Glaucomys sabrinus
Beaver Castor canadensis
Deer Mouse Peromyscus maniculatus
White-footed Mouse Peromyscus leucopus
Southern Red-backed Vole Clethrionomys gapperi
Meadow Vole Microtus pennsylvanicus
Rock Vole Microtus chrotorrhinus


Local occurrence
Species
HABITAT-BREADTH COMBINATIONS
Forest only
Forest—Krummholz
Forest—Krummholz—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Nonforest
Forest—Nonforest—Water
Forest—Water
Nonforest only
Nonforest—Krummholz—Water
Nonforest—Water
Water Only
D C
D C
D C U W
D C U W
D C U W
D C U W
D C
U W
U W
U W
SIZE-CLASS COMBINATIONS
S—Sp—St—L
S—Sp—St
Sp—St—L
S—St—L
S—Sp
S—L
St—L
S only
L only
No size class used
Woodland Vole
Microtus pinetorum
Muskrat
Ondatra zibethicus
Southern Bog Lemming
Synaptomys cooperi
Northern Bog Lemming
Synaptomys borealis
Norway Rat
Rattus norvegicus
House Mouse
Mus musculus
Meadow Jumping Mouse
Zapus hudsonius
Woodland Jumping Mouse
Napaeozapus insignis
Porcupine
Erethizon dorstatum
Coyote
Canis latrans
Red Fox
Vulpes vulpes
Gray Fox
Urocyon cinereoargenteus

SIZE - CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
Nonforest—Krummholz—Water
Nonforest only
Forest—Water
Forest—Nonforest—Water
Forest—Nonforest
Forest—Krummholz—Nonforest—Water
Forest—Krummholz—Nonforest
Forest—Krummholz
Forest only
W
U
C
D
Species
Local occurrence
Black Bear Ursus americanus
Raccoon Procyon lotor
Marten Martes americana
Fisher Martes pennanti
Ermine Mustela erminea
Long-tailed Weasel Mustela frenata
Mink Mustela vison
Striped Skunk Mephitis mephitis
River Otter Lutra canadensis
Mountain Lion Felis concolor
Lynx Felis lynx
Bobcat Felis rufus


SIZE-CLASS COMBINATIONS
No size class used
L only
S only
St—L
S—L
S—Sp
S—St—L
Sp—St—L
S—Sp—St
S—Sp—St—L
HABITAT-BREADTH COMBINATIONS
Water Only
Nonforest—Water
W
U
Nonforest—Krummholz—Water
W
U
Nonforest only
W
U
Forest—Water
C
D
Forest—Nonforest—Water
W
U
C
D
Forest—Nonforest
W
U
C
D
Forest—Krummholz—Nonforest—Water
W
U
C
D
Forest—Krummholz—Nonforest
W
U
C
D
Forest—Krummholz
C
D
Forest only
C
D
Species
White-tailed Deer
Odocoileus virginianus
Moose
Alces alces
Local occurrence

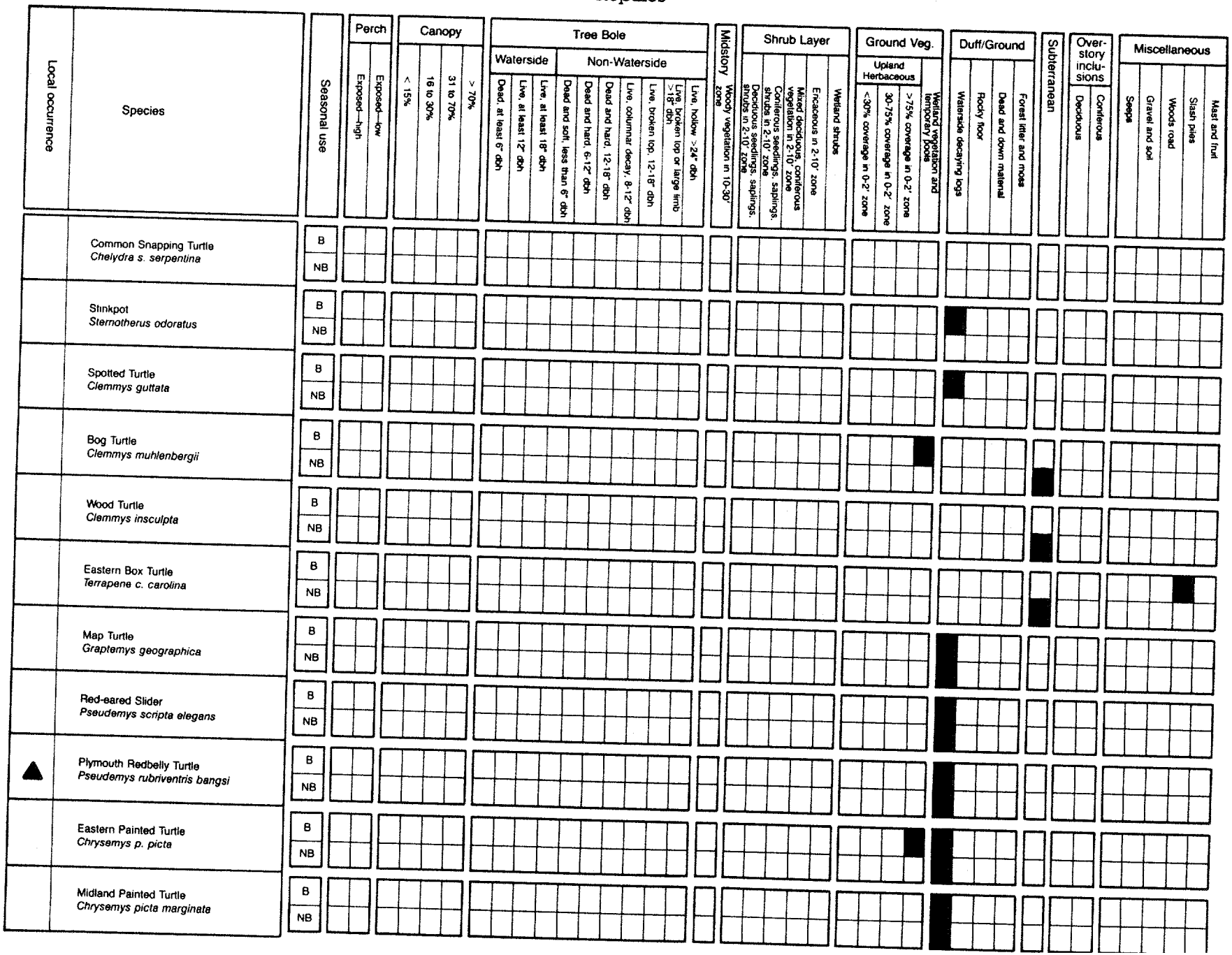
Species Occurrence and Utilization, by Structural Habitat Feature
Amphibians



Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
B
NB
Species
Local occurrence
Slimy Salamander
Plethodon g. glutinosus
Four-toed Salamander
Hemidactylium scutatum
Northern Spring Salamander
Gyrinophilus p. porphyriticus
Northern Two-lined Salamander
Eurycea b. bislineata
Eastern Spadefoot
Scaphiopus h. holbrookii
Eastern American Toad
Bufo a. americanus
Fowler's Toad
Bufo woodhousii fowleri
Northern Spring Peeper
Hyla c. crucifer
Gray Treefrog
Hyla versicolor
Bullfrog
Rana catesbeiana
Green Frog
Rana clamitans melanota

| | | |

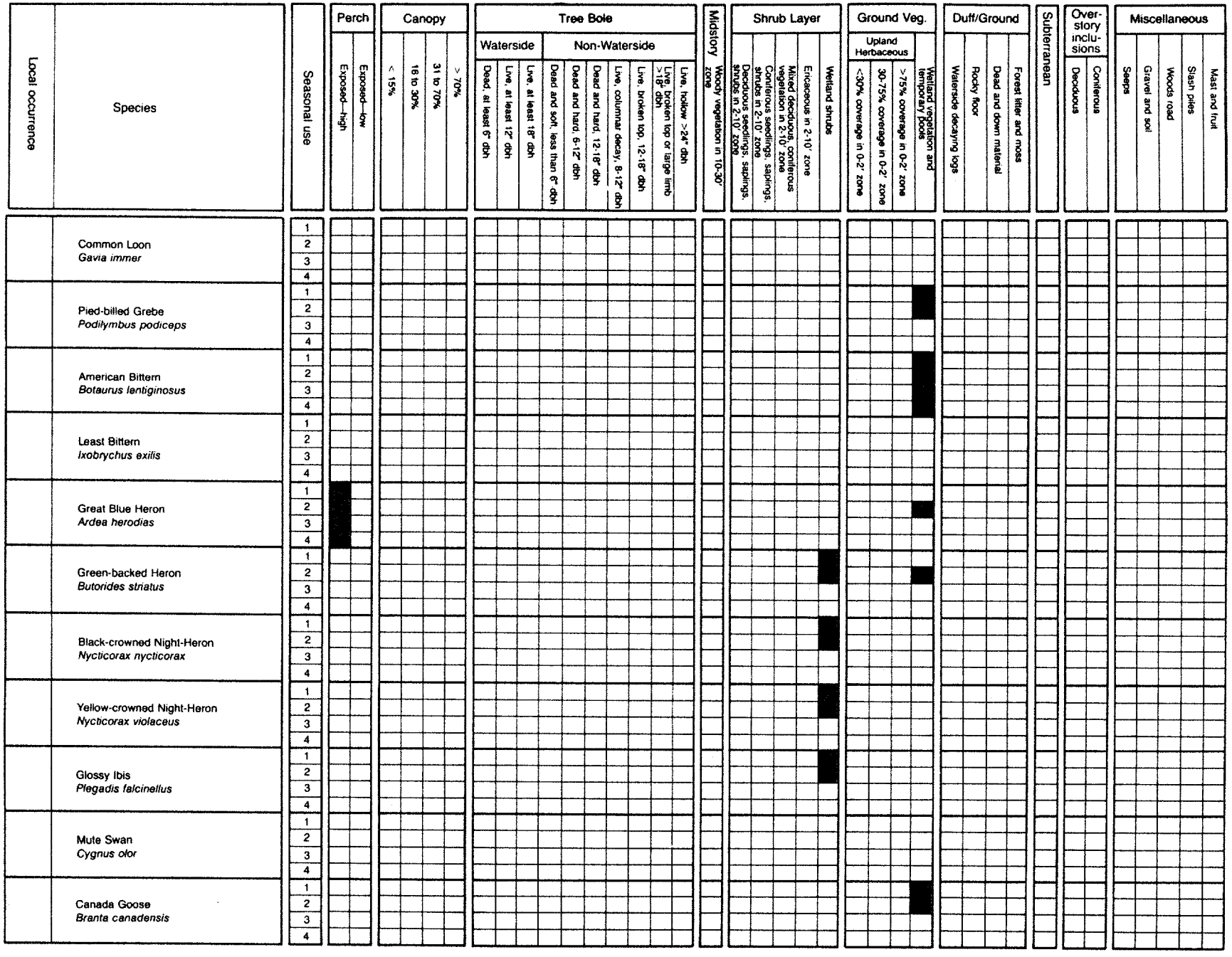
Species Occurrence and Utilization, by Structural Habitat Feature
Reptiles



Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
B
NB
Species
Local occurrence
Blanding's Turtle
Emydoidea blandingii
Eastern Spiny Softshell
Trionyx s. spiniferus
Five-lined Skink
Eumeces fasciatus
Northern Water Snake
Nerodia s. sipedon
Northern Brown Snake
Storeria d. dekayi
Northern Redbelly Snake
Storeria o. occipitomaculata
Eastern Garter Snake
Thamnophis s. sirtalis
Maritime Garter Snake
Thamnophis sirtalis pallidula
Eastern Ribbon Snake
Thamnophis s. sauritus
Northern Ribbon Snake
Thamnophis sauritus septentrionalis
Eastern Hognose Snake
Heterodon platyrhinos

Species	Local occurrence	Seasonal use	Perch	Canopy	Tree Bole		Midstory	Shrub Layer	Ground Veg.		Duff/Ground	Subterranean	Over-story inclu-sions	Miscellaneous
					Waterside	Non-Waterside			Upland Herbaceous					
Northern Ringneck Snake *Diadophis punctatus edwardsi*		B / NB	Exposed—low Exposed—high	> 70% 31 to 70% 16 to 30% < 15%	Dead, at least 6" dbh Live, at least 12" dbh Live, at least 18" dbh	Dead and soft, less than 6" dbh Dead and hard, 6-12" dbh Dead and hard, 12-18" dbh Live, columnar decay, 8-12" dbh Live, broken top, 12-18" dbh Live, broken top or large limb >18" dbh Live, hollow >24" dbh	Woody vegetation in 10-30' zone	Deciduous seedlings, saplings, shrubs in 2-10' zone Coniferous seedlings, saplings, shrubs in 2-10' zone Mixed deciduous, coniferous vegetation in 2-10' zone Ericaceous in 2-10' zone Wetland shrubs	<30% coverage in 0-2' zone 30-75% coverage in 0-2' zone >75% coverage in 0-2' zone Wetland vegetation and temporary pools		Waterside decaying logs Rocky floor Dead and down material Forest litter and moss		Deciduous Coniferous	Seeps Gravel and soil Woods road Slash piles Mast and fruit
Eastern Worm Snake *Carphophis a. amoenus*		B / NB												
Northern Black Racer *Coluber c. constrictor*		B / NB												
Eastern Smooth Green Snake *Opheodrys v. vernalis*		B / NB												
Black Rat Snake *Elaphe o. obsoleta*		B / NB												
Eastern Milk Snake *Lampropeltis t. triangulum*		B / NB												
Northern Copperhead *Agkistrodon contortrix mokeson*		B / NB												
Timber Rattlesnake *Crotalus horridus*		B / NB												
		B / NB												
		B / NB												
		B / NB												

Species Occurrence and Utilization, by Structural Habitat Feature
Birds



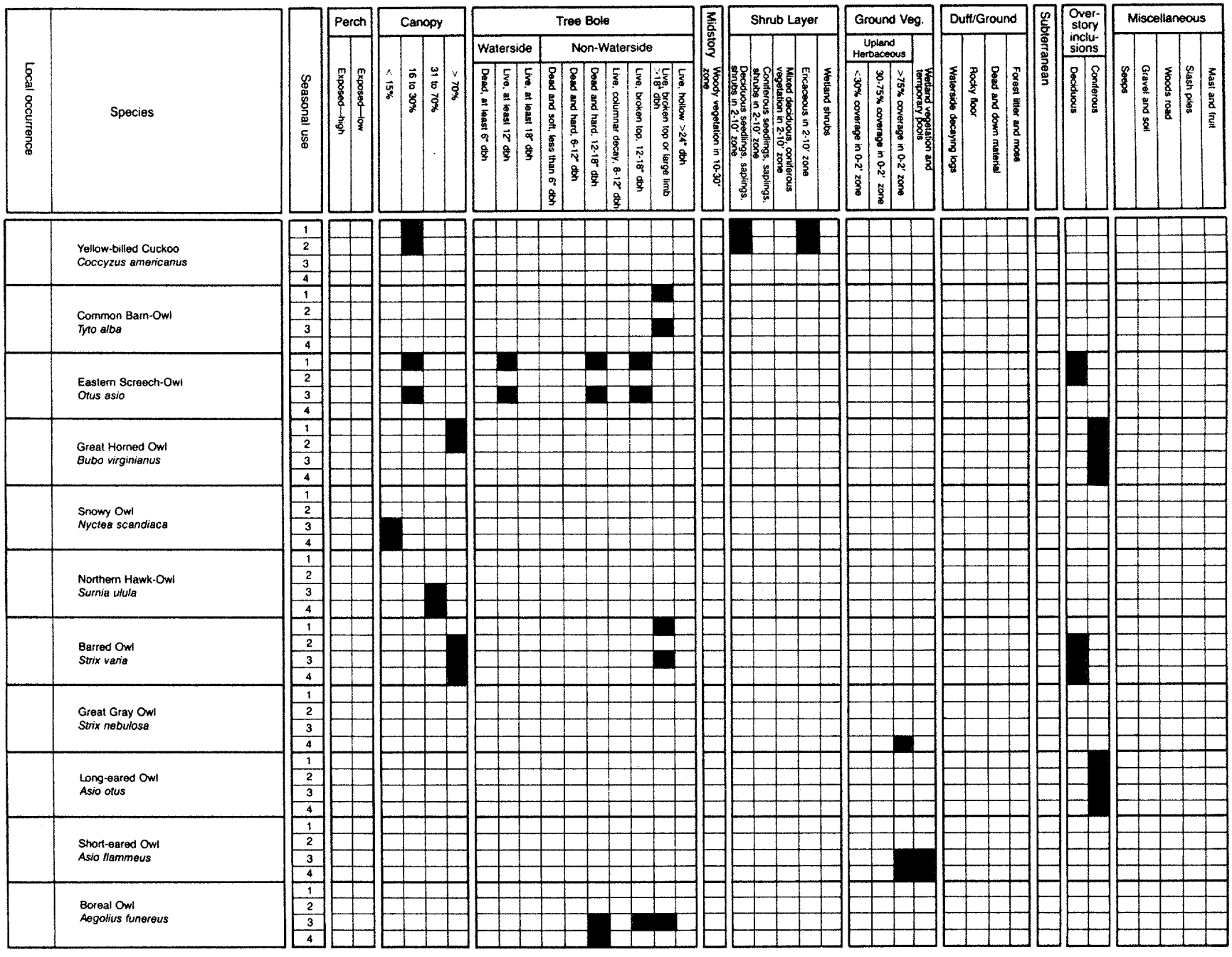
Species
Local occurrence
Seasonal use
1 2 3 4
Perch
Exposed—low
Exposed—high
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Midstory
Woody vegetation in 10-30' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Subterranean
Over-story inclu-sions
Coniferous
Deciduous
Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Wood Duck
Aix sponsa
Green-winged Teal
Anas crecca
American Black Duck
Anas rubripes
Mallard
Anas platyrhynchos
Northern Pintail
Anas acuta
Blue-winged Teal
Anas discors
Northern Shoveler
Anas clypeata
Gadwall
Anas strepera
American Wigeon
Anas americana
Canvasback
Aythya valisineria
Ring-necked Duck
Aythya collaris

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Common Goldeneye
Bucephala clangula
Bufflehead
Bucephala albeola
Hooded Merganser
Lophodytes cucullatus
Common Merganser
Mergus merganser
Red-breasted Merganser
Mergus serrator
Turkey Vulture
Cathartes aura
Osprey
Pandion haliaetus
Bald Eagle
Haliaeetus leucocephalus
Northern Harrier
Circus cyaneus
Sharp-shinned Hawk
Accipiter striatus
Cooper's Hawk
Accipiter cooperii

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
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Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Northern Goshawk
Accipiter gentilis
Red-shouldered Hawk
Buteo lineatus
Broad-winged Hawk
Buteo platypterus
Red-tailed Hawk
Buteo jamaicensis
Rough-legged Hawk
Buteo lagopus
Golden Eagle
Aquila chrysaetos
American Kestrel
Falco sparverius
Merlin
Falco columbarius
Peregrine Falcon
Falco peregrinus
Gray Partridge
Perdix perdix
Ring-necked Pheasant
Phasianus colchicus

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
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Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Spruce Grouse
Dendragapus canadensis
Ruffed Grouse
Bonasa umbellus
Wild Turkey
Meleagris gallopavo
Northern Bobwhite
Colinus virginianus
Black Rail
Lateralilus jamaicensis
King Rail
Rallus elegans
Virginia Rail
Rallus limicola
Sora
Porzana carolina
Common Moorhen
Gallinula chloropus
American Coot
Fulica americana
Killdeer
Charadrius vociferus
Local occurrence

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
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Coniferous seedlings, saplings, shrubs in 2-10' zone
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Midstory
Woody vegetation in 10-30' zone
Tree Bole
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Live, hollow >24" dbh
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Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Spotted Sandpiper Actitis macularia
Upland Sandpiper Bartramia longicauda
Common Snipe Gallinago gallinago
American Woodcock Scolopax minor
Ring-billed Gull Larus delawarensis
Herring Gull Larus argentatus
Great Black-backed Gull Larus marinus
Black Tern Chlidonias niger
Rock Dove Columba livia
Mourning Dove Zenaida macroura
Black-billed Cuckoo Coccyzus erythropthalmus
Local occurrence


Local occurrence
Species
Seasonal use
Perch
Exposed—low
Exposed—high
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Tree Bole
Waterside
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Midstory
Woody vegetation in 10-30' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Ground Veg.
Upland Herbaceous
<30% coverage in 0-2' zone
30-75% coverage in 0-2' zone
>75% coverage in 0-2' zone
Wetland vegetation and temporary pools
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Subterranean
Over-story inclu-sions
Deciduous
Coniferous
Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Yellow-billed Cuckoo
Coccyzus americanus
Common Barn-Owl
Tyto alba
Eastern Screech-Owl
Otus asio
Great Horned Owl
Bubo virginianus
Snowy Owl
Nyctea scandiaca
Northern Hawk-Owl
Surnia ulula
Barred Owl
Strix varia
Great Gray Owl
Strix nebulosa
Long-eared Owl
Asio otus
Short-eared Owl
Asio flammeus
Boreal Owl
Aegolius funereus

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
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Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Northern Saw-whet Owl
Aegolius acadicus
Common Nighthawk
Chordeiles minor
Whip-poor-will
Caprimulgus vociferus
Chimney Swift
Chaetura pelagica
Ruby-throated Hummingbird
Archilochus colubris
Belted Kingfisher
Ceryle alcyon
Red-headed Woodpecker
Melanerpes erythrocephalus
Red-bellied Woodpecker
Melanerpes carolinus
Yellow-bellied Sapsucker
Sphyrapicus varius
Downy Woodpecker
Picoides pubescens
Hairy Woodpecker
Picoides villosus

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
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<30% coverage in 0-2' zone
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Wetland shrubs
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Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Three-toed Woodpecker
Picoides tridactylus
Black-backed Woodpecker
Picoides arcticus
Northern Flicker
Colaptes auratus
Pileated Woodpecker
Dryocopus pileatus
Olive-sided Flycatcher
Contopus borealis
Eastern Wood-Pewee
Contopus virens
Yellow-bellied Flycatcher
Empidonax flaviventris
Acadian Flycatcher
Empidonax virescens
Alder Flycatcher
Empidonax alnorum
Willow Flycatcher
Empidonax traillii
Least Flycatcher
Empidonax minimus

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
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Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Eastern Phoebe
Sayornis phoebe
Great Crested Flycatcher
Myiarchus crinitus
Eastern Kingbird
Tyrannus tyrannus
Horned Lark
Eremophila alpestris
Purple Martin
Progne subis
Tree Swallow
Tachycineta bicolor
Northern Rough-winged Swallow
Stelgidopteryx serripennis
Bank Swallow
Riparia riparia
Cliff Swallow
Hirundo pyrrhonota
Barn Swallow
Hirundo rustica
Gray Jay
Perisoreus canadensis

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Blue Jay
Cyanocitta cristata
American Crow
Corvus brachyrhynchos
Fish Crow
Corvus ossifragus
Common Raven
Corvus corax
Black-capped Chickadee
Parus atricapillus
Boreal Chickadee
Parus hudsonicus
Tufted Titmouse
Parus bicolor
Red-breasted Nuthatch
Sitta canadensis
White-breasted Nuthatch
Sitta carolinensis
Brown Creeper
Certhia americana
Carolina Wren
Thryothorus ludovicianus
Local occurrence

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
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Shrub Layer
Wetland shrubs
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Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb 18"-18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
House Wren
Troglodytes aedon
Winter Wren
Troglodytes troglodytes
Sedge Wren
Cistothorus platensis
Marsh Wren
Cistothorus palustris
Golden-crowned Kinglet
Regulus satrapa
Ruby-crowned Kinglet
Regulus calendula
Blue-gray Gnatcatcher
Poliophila caerulea
Eastern Bluebird
Sialia sialis
Veery
Catharus fuscescens
Gray-cheeked Thrush
Catharus minimus
Swainson's Thrush
Catharus ustulatus

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
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Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Hermit Thrush
Catharus guttatus
Wood Thrush
Hylocichla mustelina
American Robin
Turdus migratorius
Gray Catbird
Dumetella carolinensis
Northern Mockingbird
Mimus polyglottos
Brown Thrasher
Toxostoma rufum
Bohemian Waxwing
Bombycilla garrulus
Cedar Waxwing
Bombycilla cedrorum
Northern Shrike
Lanius excubitor
Loggerhead Shrike
Lanius ludovicianus
European Starling
Sturnus vulgaris

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
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Wetland shrubs
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Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
White-eyed Vireo
Vireo griseus
Solitary Vireo
Vireo solitarius
Yellow-throated Vireo
Vireo flavifrons
Warbling Vireo
Vireo gilvus
Philadelphia Vireo
Vireo philadelphicus
Red-eyed Vireo
Vireo olivaceus
Blue-winged Warbler
Vermivora pinus
Golden-winged Warbler
Vermivora chrysoptera
Tennessee Warbler
Vermivora peregrina
Nashville Warbler
Vermivora ruficapilla
Northern Parula
Parula americana

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
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>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
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Wetland shrubs
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Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Yellow Warbler
Dendroica petechia
Chestnut-sided Warbler
Dendroica pensylvanica
Magnolia Warbler
Dendroica magnolia
Cape May Warbler
Dendroica tigrina
Black-throated Blue Warbler
Dendroica caerulescens
Yellow-rumped Warbler
Dendroica coronata
Black-throated Green Warbler
Dendroica virens
Blackburnian Warbler
Dendroica fusca
Pine Warbler
Dendroica pinus
Prairie Warbler
Dendroica discolor
Palm Warbler
Dendroica palmarum

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
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Shrub Layer
Wetland shrubs
Encaceous in 2-10' zone
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Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Bay-breasted Warbler
Dendroica castanea
Blackpoll Warbler
Dendroica striata
Cerulean Warbler
Dendroica cerulea
Black-and-White Warbler
Mniotilta varia
American Redstart
Setophaga ruticilla
Prothonotary Warbler
Protonotaria citrea
Worm-eating Warbler
Helmitheros vermivorus
Ovenbird
Seiurus aurocapillus
Northern Waterthrush
Seiurus noveboracensis
Louisiana Waterthrush
Seiurus motacilla
Mourning Warbler
Oporornis philadelphia

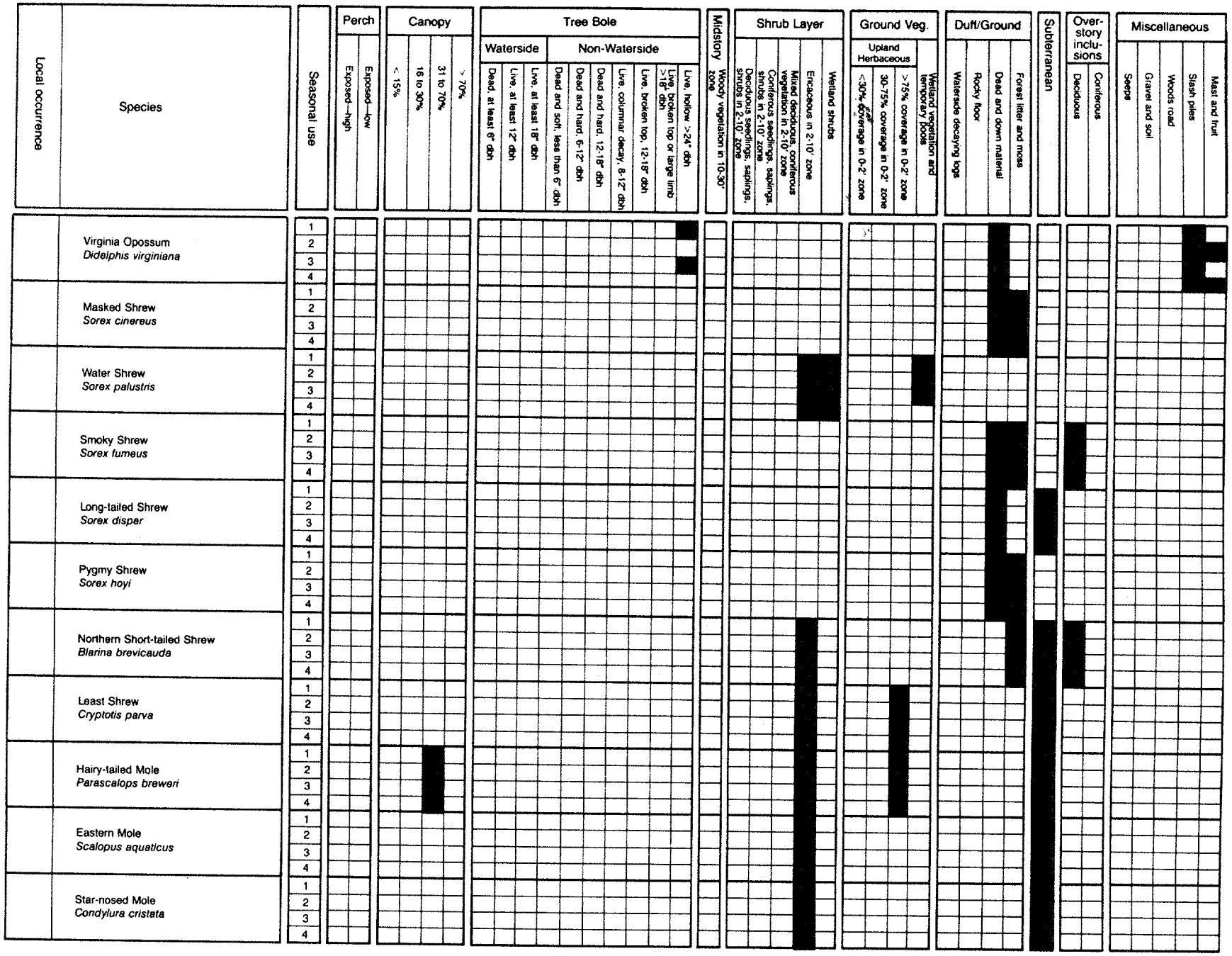
Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
Forest litter and moss
Dead and down material
Rocky floor
Waterside decaying logs
Ground Veg.
Wetland vegetation and temporary pools
Upland Herbaceous
>75% coverage in 0-2' zone
30-75% coverage in 0-2' zone
<30% coverage in 0-2' zone
Shrub Layer
Wetland shrubs
Ericaceous in 2-10' zone
Mixed deciduous, coniferous vegetation in 2-10' zone
Coniferous seedlings, saplings, shrubs in 2-10' zone
Deciduous seedlings, saplings, shrubs in 2-10' zone
Midstory
Woody vegetation in 10-30' zone
Tree Bole
Non-Waterside
Live, hollow >24" dbh
Live, broken top or large limb >18" dbh
Live, broken top, 12-18" dbh
Live, columnar decay, 8-12" dbh
Dead and hard, 12-18" dbh
Dead and hard, 6-12" dbh
Dead and soft, less than 6" dbh
Waterside
Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Common Yellowthroat
Geothlypis trichas
Hooded Warbler
Wilsonia citrina
Wilson's Warbler
Wilsonia pusilla
Canada Warbler
Wilsonia canadensis
Yellow-breasted Chat
Icteria virens
Scarlet Tanager
Piranga olivacea
Northern Cardinal
Cardinalis cardinalis
Rose-breasted Grosbeak
Pheucticus ludovicianus
Indigo Bunting
Passerina cyanea
Rufous-sided Towhee
Pipilo erythrophthalmus
American Tree Sparrow
Spizella arborea
Local occurrence

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
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Coniferous
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Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Chipping Sparrow Spizella passerina
Field Sparrow Spizella pusilla
Vesper Sparrow Pooecetes gramineus
Savannah Sparrow Passerculus sandwichensis
Grasshopper Sparrow Ammodramus savannarum
Henslow's Sparrow Ammodramus henslowii
Fox Sparrow Passerella iliaca
Song Sparrow Melospiza melodia
Lincoln's Sparrow Melospiza lincolnii
Swamp Sparrow Melospiza georgiana
White-throated Sparrow Zonotrichia albicollis
Local occurrence

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
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Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Dark-eyed Junco
Junco hyemalis
Lapland Longspur
Calcarius lapponicus
Snow Bunting
Plectrophenax nivalis
Bobolink
Dolichonyx oryzivorus
Red-winged Blackbird
Agelaius phoeniceus
Eastern Meadowlark
Sturnella magna
Rusty Blackbird
Euphagus carolinus
Common Grackle
Quiscalus quiscula
Brown-headed Cowbird
Molothrus ater
Orchard Oriole
Icterus spurius
Northern Oriole
Icterus galbula
Local occurrence

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
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Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Pine Grosbeak
Pinicola enucleator
Purple Finch
Carpodacus purpureus
House Finch
Carpodacus mexicanus
Red Crossbill
Loxia curvirostra
White-winged Crossbill
Loxia leucoptera
Common Redpoll
Carduelis flammea
Hoary Redpoll
Carduelis hornemanni
Pine Siskin
Carduelis pinus
American Goldfinch
Carduelis tristis
Evening Grosbeak
Coccothraustes vespertinus
House Sparrow
Passer domesticus

Species Occurrence and Utilization, by Structural Habitat Feature
Mammals



Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
Coniferous
Deciduous
Subterranean
Duff/Ground
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Waterside decaying logs
Ground Veg.
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Live, at least 18" dbh
Live, at least 12" dbh
Dead, at least 6" dbh
Canopy
> 70%
31 to 70%
16 to 30%
< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Little Brown Myotis
Myotis lucifugus
Keen's Myotis
Myotis keenii
Indiana Myotis
Myotis sodalis
Small-footed Myotis
Myotis leibii
Silver-haired Bat
Lasionycteris noctivagans
Eastern Pipistrelle
Pipistrellus subflavus
Big Brown Bat
Eptesicus fuscus
Red Bat
Lasiurus borealis
Hoary Bat
Lasiurus cinereus
Eastern Cottontail
Sylvilagus floridanus
New England Cottontail
Sylvilagus transitionalis

Miscellaneous
Mast and fruit
Slash piles
Woods road
Gravel and soil
Seeps
Over-story inclu-sions
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31 to 70%
16 to 30%
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Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Snowshoe Hare
Lepus americanus
European Hare
Lepus capensis
Eastern Chipmunk
Tamias striatus
Woodchuck
Marmota monax
Gray Squirrel
Sciurus carolinensis
Red Squirrel
Tamiasciurus hudsonicus
Southern Flying Squirrel
Glaucomys volans
Northern Flying Squirrel
Glaucomys sabrinus
Beaver
Castor canadensis
Deer Mouse
Peromyscus maniculatus
White-footed Mouse
Peromyscus leucopus
Local occurrence

Miscellaneous
Mast and fruit
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31 to 70%
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Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Southern Red-backed Vole
Clethrionomys gapperi
Meadow Vole
Microtus pennsylvanicus
Rock Vole
Microtus chrotorrhinus
Woodland Vole
Microtus pinetorum
Muskrat
Ondatra zibethicus
Southern Bog Lemming
Synaptomys cooperi
Northern Bog Lemming
Synaptomys borealis
Norway Rat
Rattus norvegicus
House Mouse
Mus musculus
Meadow Jumping Mouse
Zapus hudsonius
Woodland Jumping Mouse
Napaeozapus insignis

Miscellaneous
Mast and fruit
Stash piles
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Seeps
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Canopy
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31 to 70%
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< 15%
Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Local occurrence
Porcupine
Erethizon dorsatum
Coyote
Canis latrans
Red Fox
Vulpes vulpes
Gray Fox
Urocyon cinereoargenteus
Black Bear
Ursus americanus
Raccoon
Procyon lotor
Marten
Martes americana
Fisher
Martes pennanti
Ermine
Mustela erminea
Long-tailed Weasel
Mustela frenata
Mink
Mustela vison

Miscellaneous
Mast and fruit
Slash piles
Woods road
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Canopy
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Perch
Exposed—low
Exposed—high
Seasonal use
1 2 3 4
Species
Striped Skunk
Mephitis mephitis
River Otter
Lutra canadensis
Mountain Lion
Felis concolor
Lynx
Felis lynx
Bobcat
Felis rufus
White-tailed Deer
Odocoileus virginianus
Moose
Alces alces
Local occurrence

DeGraaf, Richard M.; Yamasaki, Mariko; Leak, William B.; Lanier, John W. 1992. **New England wildlife: management of forested habitats.** Gen. Tech. Rep. NE-144, Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 271 p.

Presents silvicultural treatments for six major cover-type groups in New England to produce stand conditions that provide habitat opportunities for a wide range of wildlife species. Includes matrices for species occurrence and utilization by forested and nonforested habitats, habitat breadth and size class, and structural habitat features for the 338 wildlife species in New England.

ODC 151:221:(74)

Keywords: Forest wildlife, forest management, wildlife habitats, silvicultural systems

Headquarters of the Northeastern Forest Experiment Station is in Radnor, Pennsylvania. Field laboratories are maintained at:

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Burlington, Vermont, in cooperation with the University of Vermont

Delaware, Ohio

Durham, New Hampshire, in cooperation with the University of New Hampshire

Hamden, Connecticut, in cooperation with Yale University

Morgantown, West Virginia, in cooperation with West Virginia University

Orono, Maine, in cooperation with the University of Maine

Parsons, West Virginia

Princeton, West Virginia

Syracuse, New York, in cooperation with the State University of New York, College of Environmental Sciences and Forestry at Syracuse University

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Warren, Pennsylvania

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