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WILDLIFE MANAGEMENT THROUGH SOIL CONSERVATION ON FARMS IN THE NORTHEAST

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WILDLIFE is a product of the land; hence, it is obvious that patterns of land use developed in pursuit of agriculture will in a large measure determine the abundance or scarcity of wildlife.

The increasing destruction of soil by erosion and, in good part, the decreasing populations of farm wildlife have both resulted from misuse of land. The great need for reversing this process of waste has long been apparent. Some of the possible ways of checking erosion and increasing wildlife in the 12 Northeastern States are considered here. The principles and some of the practices apply to an area embracing the whole northeastern quarter of the country.

Soil conservation as well as the conservation of wildlife depends fundamentally on the establishment and maintenance of vegetation. Soil will erode unless it is protected from rain and wind. Wildlife disappears unless there is a place for it to live. How wildlife habitats may be developed with vegetation used to protect the soil is told in this bulletin.

Washington, D. C.

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WILDLIFE MANAGEMENT THROUGH SOIL CONSERVATION ON FARMS IN THE NORTHEAST

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Contents

WILDLIFE MANAGEMENT ON A FARM

BANISH the bluebird from the orchard, the squirrels from the old oak tree, and the drum of the grouse from the farm woods and you have removed much of the spirit that makes of the farm a home. In fields and orchards birds help to keep insects, rodents, and other farm pests under control. Other forms of wildlife also contribute to the welfare of the farm. Many of the mammals aid in controlling insects and rodents, and some are a source of valuable raw furs. Game species furnish sport and recreation for those who enjoy hunting or fishing. The usefulness of birds as insect destroyers, of minnows as food for the game fishes, of predatory species as an agency of rodent control, of vultures and gulls as scavengers is often too little appreciated.

The wildlife on a farm is a product of the soil, as are field crops or domestic livestock. Wild animals are dependent on plants for food or on other animals, which in turn are dependent on plants; and the plants grow in the soil. Wild animals also use vegetation as shelter. Wildlife management, which strives to maintain animal populations at a desirable level through the provision of a good habitat, is therefore to a large extent simply good land management. Insofar as it is land management, it is closely allied with soil conservation. Good vegetation on the land—farm crops, hay, pasture, trees, and shrubs—is

the foundation of a wholesome environment for wildlife as well as the best means of protecting the soil against erosion.

Present wildlife populations are generally far below a desirable level because ruinous land use practices have destroyed their habitat—the places where the animals live. In building up these populations, therefore, farmers have more concern with the animals' habitat than with the animals themselves. Provision of suitable habitats is at present the chief problem in the management of wildlife on farms. Vegetation that gives food and shelter to wildlife also protects the land from erosion if it is selected and used with both these ends in mind.

On all parts of the farm there is need for conservation farming practices, and these practices may be carried on so as to benefit wildlife. Revegetation of eroding areas that are unadapted to the production of crops is often needed. Gullies, stream banks, small uncultivable areas in the midst of field or pasture may well be planned to provide wildlife habitats, for the plants that give food and shelter to wildlife are as effective in conserving soil and moisture as those less suitable for wildlife habitats.

In the woodland, planting and cutting may be done so as to favor the shrubs and trees that give food and shelter to wildlife, without diminishing the volume of woodland products or the amount of protection the trees give the soil.

On cultivated fields farmed to protect the soil from erosion, wildlife finds better food and shelter than on one-crop, straight-rowed fields. On contour strip-cropped fields, a diversity of crops gives a better distribution of food. Contour hedges make lanes along which wildlife can travel from field to field.

Most soil conservation practices contribute to the improvement of the wildlife habitat on the farm; and wildlife management, in turn, contributes to the conservation of farm resources by making a profitable use of plants that protect the soil.

CHANGES IN WILDLIFE POPULATIONS

Habitat, whether natural or modified by man's occupation of the land, has always played a large part in determining wildlife populations. As the habitat has changed with variations in land use, wildlife populations have changed. The shifts in wildlife populations in the Northeast from colonial days to the present parallel closely modifications in wildlife habitats and the use man has made of the land.

Legendary are the tales of great numbers of wildlife in this country before the white man came. Of certain species, in some regions, these tales unquestionably approach the truth; of the others they are largely illusory. Relative to man's needs, the native species of wildlife were no doubt normally plentiful around the clearings made by the Indians and the early settlers, but the numbers of many species were far less in those early years of settlement than they have been in recent years.

Many people think that the primeval wilderness abounded in wildlife. It has been considered self evident that if wildlife was abundant around the settlers' clearings, it must have been more abundant where man had not intruded. The fallacy of this belief is brought out by the word "Adirondack," the name of the mountain wilderness in

northern New York. Adirondack was a term applied by the down-State Indians to the Indians who lived in this mountainous region. It means "eaters of bark" and was used in a derogatory sense because there was little game for the inhabitants of the mountains to shoot, and figuratively they had to subsist on bark.

Even in colonial times, when wildlife was generally plentiful as measured in terms of man's needs, there were years of scarcity. Indian lore tells of these famine years, and Longfellow in Hiawatha refers to hard winters, when game was scarce.

As the Colonies grew, the land cover changed and cities developed. The changing habitat was improved for some species, destroyed for others. The restriction of habitat for woodland animals was accompanied by an expanding commercialization of such species as deer, ruffed grouse, and wild turkey. Commercial exploitation and changes in habitat gradually resulted in scarcity of nearly all game species or their extermination.

Although the disappearance of the passenger pigeon and a reduction in the numbers of wild turkey, deer, and grouse during the latter half of the nineteenth century may be laid squarely at the door of man's greed, overkilling has taken more than its share of blame for loss of the exterminated forms. Some species would have been extinguished in the Northeast even if guns had played no part. Such species as the bison and panther, for example, simply could not adapt themselves to changing conditions.

The period of unregulated plundering of wildlife has been replaced by one of restricted use. Today we find in moderate or great abundance some of the species that were once threatened with extinction; the white-tailed deer, the ruffed grouse, the beaver, and many songbirds. There are probably more deer in the Northeast today than ever existed there in earlier times.

The most significant change has taken place in the land cover itself. With changes in the land cover, some species extended their range or increased in numbers as conditions favored them. These have been mainly the open-land species, as for example, the bobwhite quail, crow, cottontail rabbit, and many song and insectivorous birds. It is surprising that the cottontail rabbit was unknown in the upper Hudson River Valley of New York, before 1850, and not until 20 years later did it reach the Niagara frontier.

The present animal life, in comparison with that of colonial times, has shifted from a preponderance of woodland species to a preponderance of open-land species in our northeastern farms. But the woodland species, with few exceptions, remain in considerable numbers, and hence the animal life is more varied than formerly. The 12 States in the Northeastern Region [1] contain approximately 410 species of birds and 85 species of mammals.

Today, even though there may be more of some species of wildlife than in earlier days, many forms are scarce relative to man's needs. This is particularly true of the game species and fur bearers. Whereas 200 years ago the hunters and trappers numbered a few thousand, today there are millions.

[1] The Northeastern Region comprises Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia.

HOW MUCH IS WILDLIFE WORTH?

From its beginning as a source of home necessities, wildlife has passed through a period of commercialization into the present, when most of the hunting is done for recreation. These changes have progressed with the development of our populations and land use practices.

To the early settler, game was a staple food; today it is a table delicacy, legally obtainable only a part of the year. In our early export trade, furs were a major item; today we import furs. Except for fur-bearing animals and commercial fish, the economic species are now taken in sport rather than as a business.

Although the volume of domestic furs in our trade channels is relatively small, they bring in 20 to 60 million dollars annually, the

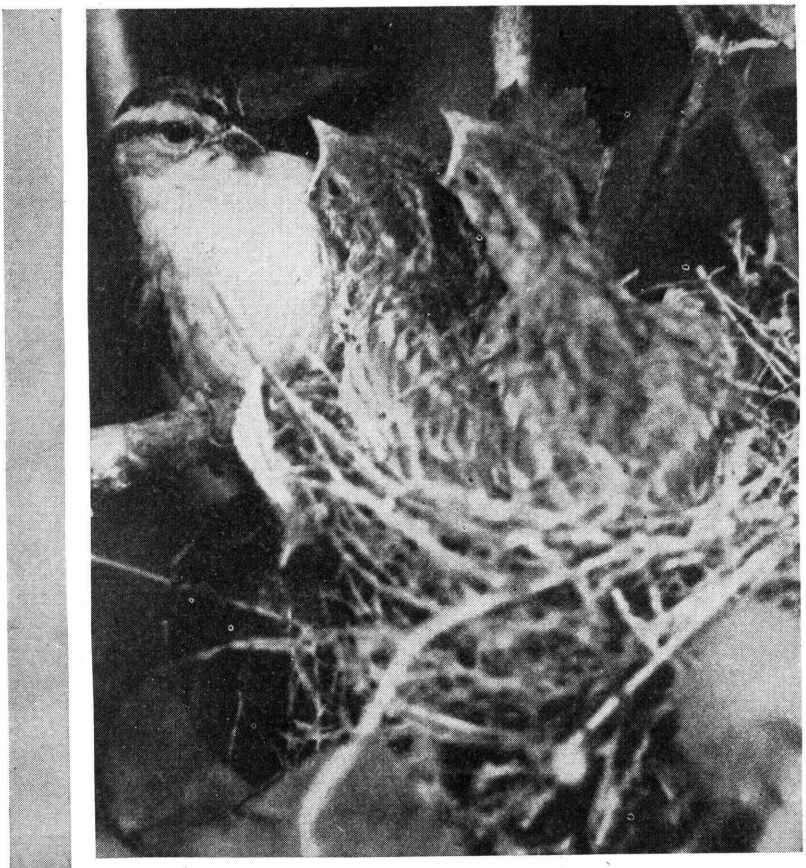

FIGURE 1.—This family of chipping sparrows spend their lives protecting crops. Two families of insect-eating birds on every acre of a 160-acre farm would devour as many as 40 million insects in a cropping season. Pa. 160, 558

latter figure applying in years when fur prices are high. A considerable part of this money goes to farmers. In the Northeast alone the value of the annual wildlife take in meat and raw furs amounts to 10 to 15 million dollars. This figure does not include products of commercial fisheries. The total volume of wildlife products is today probably as great or greater than formerly, although in comparison with some items of trade it is small.

Greater than the dollar value of the animals themselves is the money spent for equipment and services by those who harvest wildlife. Today 1 person out of every 10 (or a considerably higher proportion of adults) finds sport and healthful recreation in the pursuit of wildlife. Sportsmen and nature lovers spend an estimated 700 million dollars each year in the United States for such things as sport clothing, guns, fishing tackle, transportation while hunting and fishing, lodging, guide services, and licenses. A considerable part of this money is spent in rural communities, which are the farmer's trading centers.

These expenditures indicate clearly that the material return is not the major incentive of the most of those who hunt. The difference between the money paid out for hunting and what the game is worth as meat is what the public is willing to spend for sport and recreation.

The dollar-and-cents worth of wildlife in the operation of a farm is more difficult to estimate. The few individuals who have had the opportunity to observe a pair of bobolinks feeding their young may appreciate the effectiveness of our insect-eating birds in combating pests. Bobolinks are only one of scores of species of birds (fig. 1) that spend their lives, however unwittingly, protecting the farmers' crops.

It is evident from the difficulty farmers have in keeping insects and rodents in control that a better biologic balance is needed on our farms. With improved habitats we would have more birds, and hence a better balance of animal life on our farms.

FACTORS THAT DETERMINE WILDLIFE POPULATIONS

Under any given conditions, some factor such as scarcity of food, inadequate shelter, severe weather, or the hunter's gun, prevents a species from increasing beyond the level it actually maintains. This is called the limiting factor. If the limiting factor of one year is eliminated the next, another will take its place. There is always something to limit each species, and in the Northeast it is very often food. The size, quality, and distribution of the food supply will determine the number of a species that will survive unless some other factor is more limiting. Other conditions, whether favorable or not, have no effect in determining the number of animals that survive, though they may make a difference in the length of time they survive. The limiting factor does not kill all the animals that must die but only those that have not already met death in some other way. It determines the maximum number that can survive on a particular area.

The eight major factors that control animal populations may best be grouped into two types, as illustrated in figure 2. Those that make

up the environment are in one group, and those that are inherently a part of each species are in the other.

These factors are substantially the same for all species, although their relative importance differs with different animals. Wildlife management strives to keep wildlife population at levels in balance with a favorable environment by controlling wildlife food and shelter.

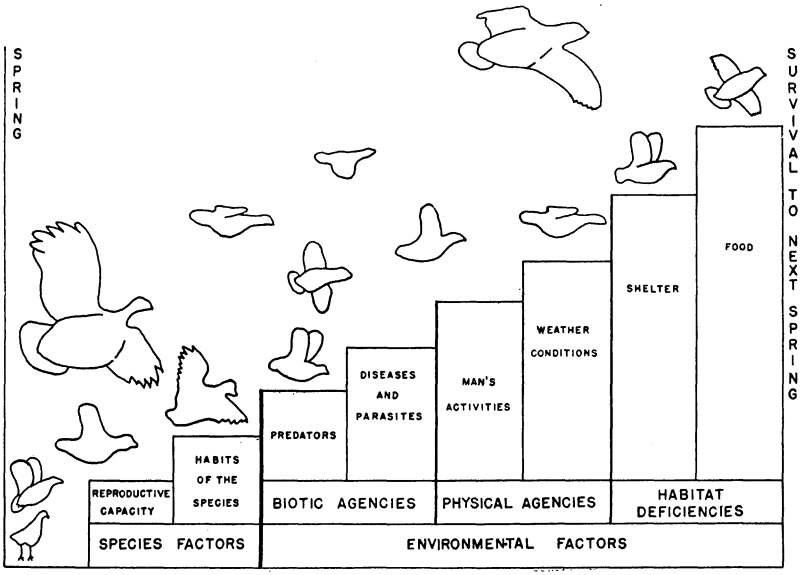

FIGURE 2.—The 14 game birds represent the parents and brood of a family of quail. They might be any wild species. The parents have survived a winter and bred on an area that can support but 2 quail. Therefore 12 of this family are destined to die by the next spring if conditions remain the same. The birds are represented as flying into the elements that may reduce their numbers. The higher the element the greater the toll it may possibly take. The highest element, food, is here the limiting factor. Only 2 quail are able to surmount it; 1 is an adult, 1 a youngster. The elimination of any of the other 7 lower elements would not result in an increased survival, but merely a delayed mortality, since there is food sufficient for only 2 quail. This illustration is adapted from Joseph A. Hagar's We Need More Realism In Conservation. N-3024

FOOD

An adequate supply of food for health at all seasons of the year is essential for wildlife. The supply during the period of the year when there is least food, usually late winter, sets a definite limit to the carrying capacity of any given area, just as the amount of forage in a pasture sets its carrying capacity for livestock. If no other factor sets a lower limit for an area, the food supply will determine the amount of wildlife that can be maintained. For many species, winter food is the limiting factor in parts of the Northeast. Water and grit requirements are included under this heading.

SHELTER

Vegetation that permits escape from enemies, refuge from the elements, and a safe haven for feeding, roosting, bedding, and making a home is termed shelter. Shelter includes not only vegetation but also such havens as rock-ledge caves for raccoons; ground holes for woodchucks, rabbits, and foxes; hollow trees for squirrels; extensive open-water areas for ducks.

Shelter provided by vegetation is a limiting factor for many species in a large part of the Northeast; overcutting of conifers (pines, spruces, cedar and the like—the trees that bear cones), cutting all the vegetation in fence rows, the grazing of woodlands, swamp drainage, and other practices, have played their part in restricting wildlife shelter. Practically all species are affected. Many birds, including both quail and pheasant, are in many farm areas unable to maintain desirable numbers without overgrown fence rows. Among the woodland species, lack of conifers and undergrowth limit grouse and turkey severely and will markedly reduce the carrying capacity for most other species. The drainage of swamp and marsh lands has completely destroyed much of the original waterfowl habitat, both shelter and food.

MAN'S CONTROL OF WILDLIFE HABITATS

Man's activities may be either beneficial or destructive to wildlife. As a hunter or fisherman, he is a killing agent—yet the removal of surplus populations may be beneficial to the species he kills. As a farmer, he both improves and destroys habitat, plowing, cutting, and fencing; he constantly arrests and alters the natural plant succession. His use of fire is often detrimental to wildlife. His livestock and his pets affect both plants and wild animals on the farm.

Man as a lumberman created desirable openings and bushy growth by breaking up the forest cover. But by making forests into open land he has also completely changed the habitat for wildlife. As an industrialist, he sometimes pollutes waters, thereby destroying both animals and plants. As a conservationist, he re-creates habitat, offers protection in refuges and sanctuaries, and makes laws to improve wildlife conditions. With some definite limitations, it may be said that the future of wildlife rests with him, for he can modify wildlife habitats.

OTHER FACTORS

Parasites and diseases may cause the death of substantial numbers of wildlife but usually only in dense populations, where infestations spread more easily. Predators—species that prey on other animals—rarely act as a limiting factor unless the habitat is inadequate. Improvement of food and cover usually gives sufficient control of predatory animals. Under ordinary conditions, improvement in food and cover will also modify the effects of extreme weather conditions, over which we have no other control. The habits of the species and its reproductive capacity are inherent factors that cannot be altered by management.

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DEVELOPMENT OF WILDLIFE HABITAT THROUGH SOIL AND WATER CONSERVATION PRACTICES

A farmer can increase the wildlife populations on his farm without interfering with the regular use of his land. It is not expected that every possible improvement of wildlife habitat will be made. Nor is it necessary to have any more vegetation on the farm than can be effectively used in protecting the soil. All that is required is that the species of plants selected furnish food and cover for wildlife when and where they are needed. The arrangement and care of vegetation that make possible its fullest use by wildlife are in harmony with the usual conservation-farming practices.

PROTECTION FROM FIRE AND GRAZING

Fields should be protected from fire at all times. The burning of plant cover destroys valuable organic matter that is needed to maintain the fertility of the soil and often exposes soil to washing and blowing. The utmost care should be used in handling fire on the land to prevent its escape from control. Fields, woods, or swamps should never be burned deliberately. Fire usually destroys the wildlife cover completely, making the burned area useless as a habitat for wildlife until a new growth of plants appears.

Equally important to soil conservation and the provision of wildlife habitats is the control of grazing by livestock. Only fields properly devoted to pasture should be regularly accessible to livestock. All woodland and brush areas, stream banks, and swamps not needed to furnish adequate shade and water for the animals should be excluded from pasturing. Protection of these areas is well worth the expense and trouble of putting up a few extra rods of fence. The protection of the soil, the improvement in the conditions of woodland reproduction, and the increase in wildlife will amply repay a farmer for the small amount of forage made inaccessible to livestock by fencing such areas (fig. 3). It is impossible to have a good woodland and a good pasture on the same ground.

CULTIVATED FIELDS

Contour cultivation of fields, crop rotations, and terracing, now widely used in the Northeast for controlling erosion, improve the crop growth and produce a more luxuriant vegetation than can be expected on fields where these practices are not carried out. They make the farm environment more suitable for wildlife, because the more vegetation there is on the land the better the food and cover for wildlife. Other conservation practices, the use of strip cropping and cover crops and the planting of diversion terraces and field drainageways, give more specific benefits.

Strip Cropping [2]

Strip cropping, the alternation of narrow bands of close-growing erosion-resistant crops with tilled crops, gives a desirable interspersion of different types of vegetation (fig. 4). The summer resident birds,

[2] See Farmers' Bulletin 1776, Strip Cropping for Soil Conservation.

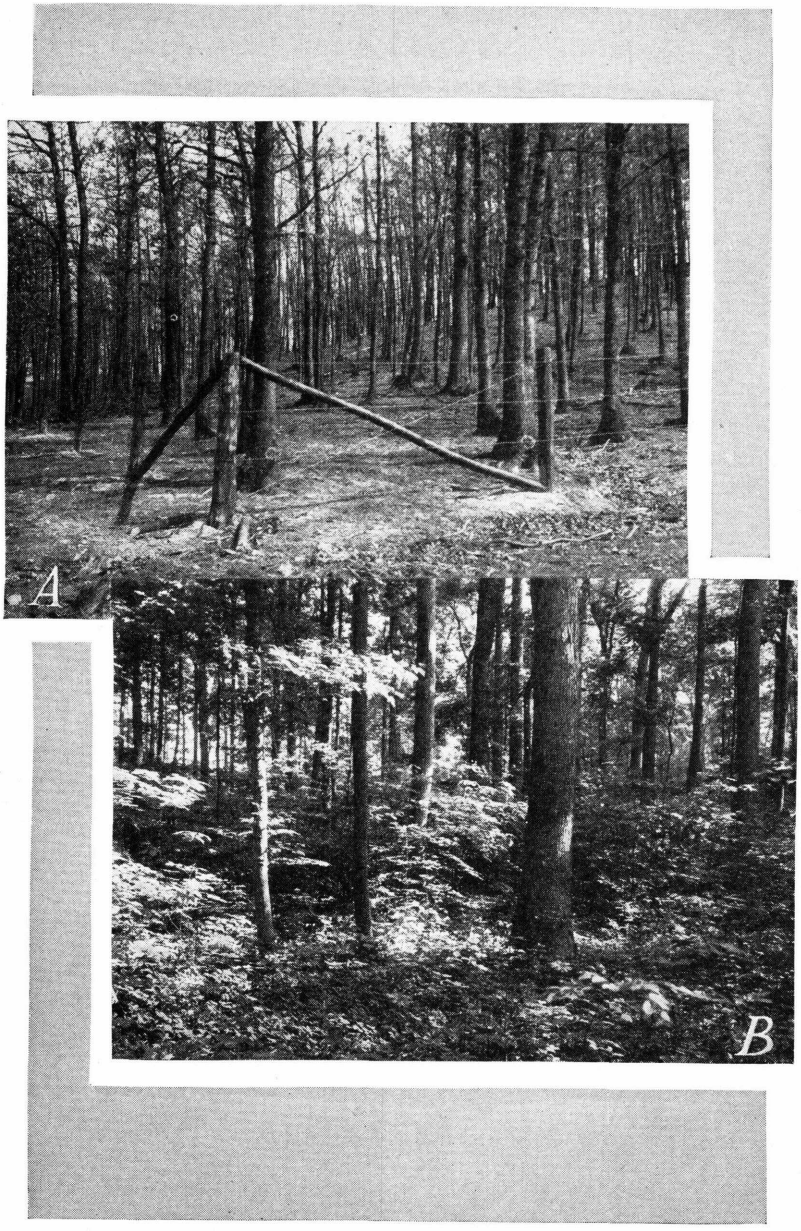

FIGURE 3.—*A*, Trees are not reproducing in this heavily grazed farm woods. The soil is compacted and erodible. Wildlife would find here little food and cover. The fence has just been put up. This woodland will now have a chance to become more like the woodland in *B*, where the understory makes good cover for wildlife. This protected woodland contains trees of all ages and therefore produces a sustained crop. W. Va. 19,008: Md. 10,077

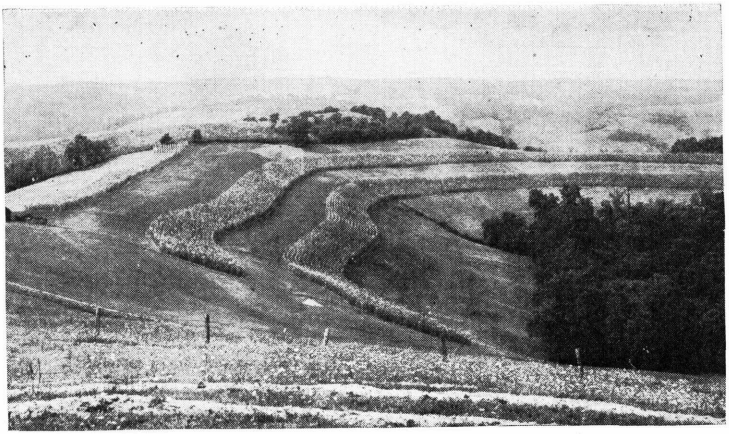

FIGURE 4.—Strip-cropped fields provide different kinds of well-distributed cover for summer birds. W. Va. 10,080

particularly, benefit from strip cropping, for on a strip-cropped field an extensive area is not denuded of cover by harvesting. Parts of a strip-cropped field remain in cover throughout the summer. Fields of small grains and hay laid out in contour strips have been found to contain two to four times as many birds as block fields of comparable area planted to these same crops.

Cover Crops

Through the use of winter cover crops following corn, potatoes, or other clean-harvested crops, a fairly even distribution of cover is maintained during the fall and winter months. These cover crops, if properly used, help to build up the soil and prevent soil and water

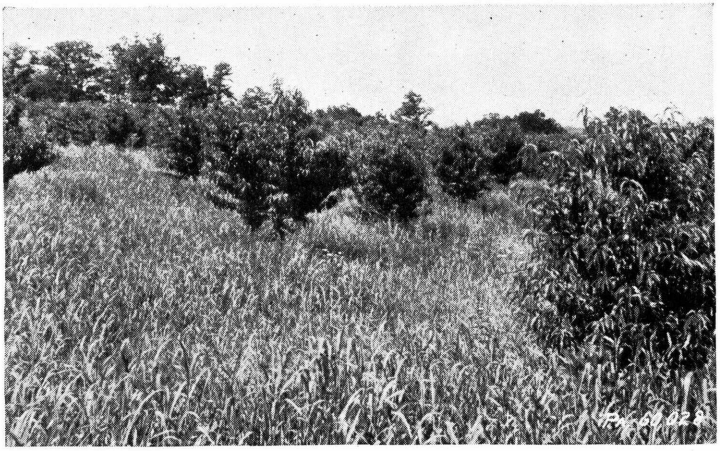

FIGURE 5.—A cover crop of millet in this peach orchard protects the soil and makes a good ground cover for birds. Pa. 60,028

losses. They also help to improve the habitat for wildlife in fields, orchards, and vineyards that would otherwise be barren during the winter months.

Some cover crops are more useful to wildlife than others. If the cover crop is to be cut for hay or turned under for green manure before maturing, it may make little difference what crops are used. But if the crop is to be matured, the use of the lespedezas, millets (fig. 5), clovers, and Sudan grass is recommended, where they are adapted to the conditions of the soil and the requirements of the farm, for these crops furnish food for wildlife, as well as cover.

Diversion Terraces

Another conservation practice that offers an excellent opportunity for the improvement of wildlife cover is the use of diversion terraces.

FIGURE 6.—The sod filter strip above the diversion terrace provides a travel lane and nesting cover for wildlife. Md. 20,029

A diversion terrace carries surplus water from sloping land. Wherever possible, it should empty into a natural drainageway, a woodland, or a pasture, where the water may either be carried in an established stream channel or spread on a safe ground cover to seep into the soil. The diversion terrace may empty into a constructed outlet, which carries the water from the low end of the diversion terrace to the nearest watercourse or other place of disposal. This outlet should be in permanent sod except at points where overfall structures may be needed.

The diversion terrace and the strip of land above it, called a filter strip, must be in permanent vegetation. The waterway portion of the diversion terrace and the outlet should be mowed frequently to maintain a pasture-type sod that will carry off the water without loss of soil. The filter strip and at least one of the banks of the terrace and outlet may be mowed for hay. If not needed for hay, they may be mowed as required to maintain the hay-type growth.

The strip of relatively permanent grass and legume vegetation in

the diversion terrace and outlet furnishes a desirable nesting area for birds and a travel land for all wildlife. Many of these diversion terraces will serve as a cover lane connecting one woodland with another or linking other areas that provide cover for wildlife. The filter strip above the diversion terrace (fig. 6), which should be at least 40 feet wide, produces an area of protected cover in a field that would otherwise be completely cropped.

Natural Drainageways

Natural drainageways on cropland, even though shallow enough to traverse with farm machinery, should be permanently protected by a good sod so that they will carry off excess water without gullying. The drainageway will furnish cover for field birds. Since these grass strips go up and down the hill, many of them form cross-connecting links of cover with diversion terraces and contour hedges, thus markedly improving the distribution of wildlife habitat in open fields.

FIELD HEDGES

Contour field-boundary hedges of woody vegetation help to control erosion; if well managed, they moderate the effect of winds on the crops in adjacent fields. They serve as travel lanes for wildlife, especially in areas of extensive open fields. A good field hedge also gives harbor to the birds that control insect pests. For many kinds of insect-eating birds hedges are preferred cover. Most of these birds will not be present in a field without hedges. Besides the songbirds, hedges attract most farm game birds and many other species. The better the hedge, the greater will be the number of desirable birds that live in it. The many benefits derived from contour field hedges will usually justify the 6 to 8 feet of ground they cover, and a well-planned hedge adds beauty to the farm scene (fig. 7).

A Managed Hedge

A managed hedge is one that is planned as to location and the composition and arrangement of species. It is cared for during the period of growth and is then maintained in the desired form. Natural hedges, even though their location has not been planned, may often become managed hedges by selective cutting and maintenance. The hedge should be composed of species that will not grow too high or wide. The desired height depends on what crops are grown in adjacent fields and whether protection from wind erosion is needed. (If a field is to be fully protected from wind erosion, a windbreak type of planting (pp. 15–16) should be used instead of a hedge.)

If a new hedge planting is subjected to excessive competition by grass, it is well to mow the strip once a year until the shrubs have attained enough height to stand over the grass. Mowing must be at the height of the top of the planted shrubs. If a hedge is to be continually effective and retain the desired form and composition, occasional maintenance may be required. When a plant attains too great a height or branches too widely, it must be cut back. Occasionally, unwanted species may seed in. Such encroaching plants should be pulled or cut out. When individual plants in the hedge die, they should be replaced as soon as possible with other plants. The care exercised will be repaid in the quality of the hedge.

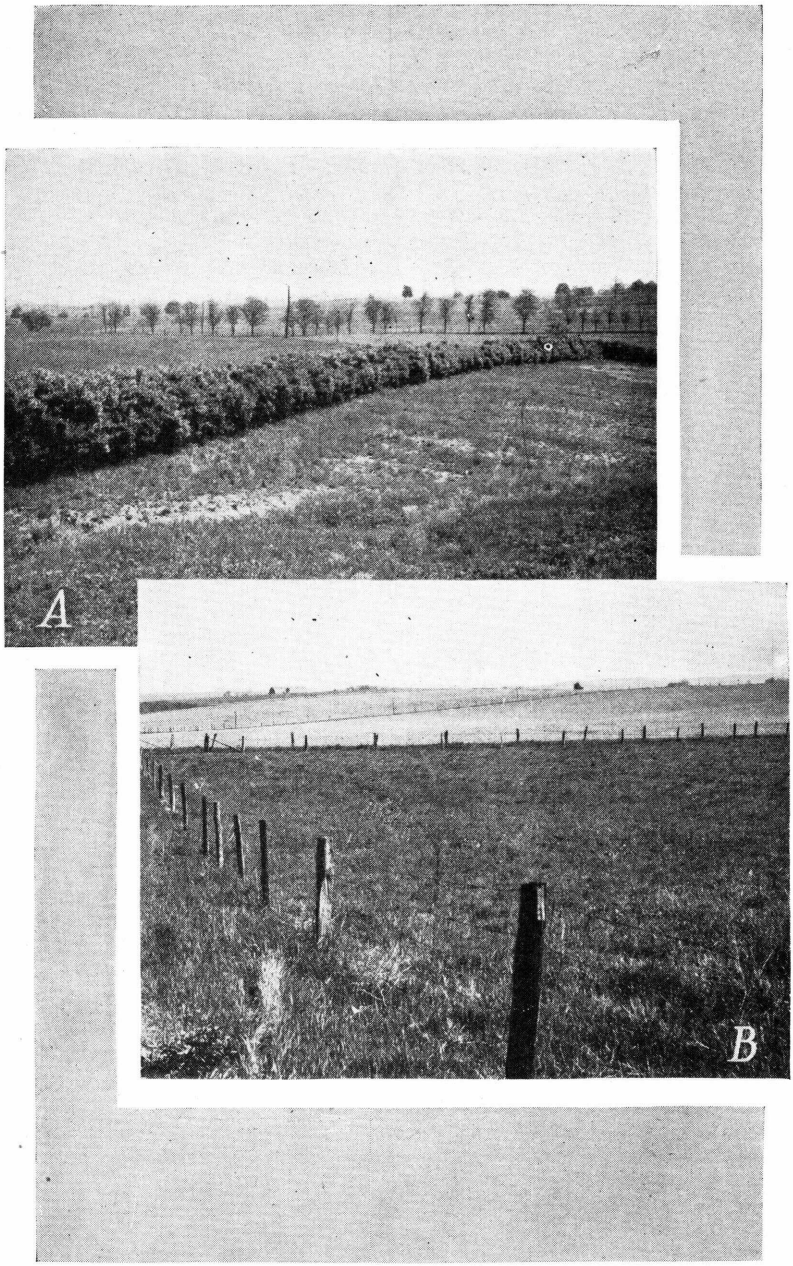

FIGURE 7.—*A*, A contour hedge of low, thick-growing shrubs vastly improves open fields for wildlife. These hedges are easy to maintain. *B*, Few birds can inhabit this area of extensive fields and bare fences. Pa. 40,532: Pa. 60,231

Location of Hedges

On a number of types of locations field hedges may serve both to conserve soil and supply cover for wildlife. Usually it is convenient to plant a hedge on a field boundary—often a strip-crop boundary. The top edge of the filter strip above a diversion terrace is another suitable location. Permanent contour fences, except those between pastures, are generally acceptable sites. To provide for future fence maintenance, plantings should be made on only one side of a contour fence, and not on a pasture side. Hedges should connect with other hedges, swales, woodlands, or swamps wherever this is practicable so that wildlife may use them as avenues of travel between coverts. On sloping lands it is generally urgent that hedges be kept on the contour.

Contour Hedges

Hedges give better protection against soil loss and run-off if planted on the contour. A thick stand of shrubs on the contour will aid in controlling soil loss and run-off by slowing down the velocity of the run-off. The water drops part of its load of sediment as its speed decreases, and more of the water seeps into the soil.

Contour hedges tend to break up wind motion near the ground. They thereby lessen the effect of drying winds, so that more moisture is retained in the soil near the hedge. They also retain a more even snow cover in the winter, which makes for better distribution of moisture. A hedge planted on the contour also makes a permanent contour marker that facilitates contour cultural operations on adjacent fields. If placed at the top of diversion-terrace filter strips, the hedge helps to protect the diversion terrace and assures the permanency of the filter strips. If prevailing winter winds come from above the diversion terrace, it may be more desirable to place the hedge below the terrace to prevent clogging with snow.

Selection of Planting Stock for Hedges

The utmost care should be exercised in the choice of species for hedge plantings. Species should be chosen and arranged so as to get a thick-growing hedge of the desired height that is easily maintained and will not spread or allow weeds to encroach.

There are many desirable shrubs for planting in hedges. Those most generally adapted for this use in the Northeast are listed here in two height classes, those under 6 feet high and those 6 to 15 feet high. This list should not exclude consideration of other shrubs in any locality. The two vines in this list are recommended only for fence plantings.

Shrubs under 6 feet high:
- Black chokeberry
- Thunberg barberry
- Gray dogwood
- American hazelnut
- Bayberry
- Swamp rose
- Snowberry
- Coralberry

Shrubs 6 to 15 feet high:
- Silky cornel
- Tatarian honeysuckle
- American elder
- Arrowwood
- Highbush cranberry

Vines:
- Climbing bittersweet
- Virginia creeper

The species used should be adapted to the existing soil conditions and climate. The soils to which the recommended species are adapted

and their geographic range are indicated in the list of plants beginning on page 45. The shrubs that normally exceed 6 feet in height require pruning unless the height is not objectionable. Similarly conifers such as the pines, spruces, or cedars may be used, with the knowledge that they will attain excessive height if they are not cut back.

The species recommended for hedges will not provide a hedge of the type that serves as a fence to turn livestock. If a fence hedge is desired, Osage-orange, honey locust, or hawthorn may be used. It should be recognized, however, that these species will require cutting annually to maintain their effectiveness.

Arrangement of Plants

The hedge may be planted as either a single row with a 1-foot spacing or a double row with a 2×2-foot staggered spacing. The latter arrangement is usually the better, for it enables one to use two species of plants and still gain uniformity. Two or more species should be used in each hedge; the lower growing ones in the uphill row and the higher ones in the row below. If conifers are used, it is best to put them in the lower row in clumps of three or four, about 50 feet apart. These clumps furnish excellent winter shelter.

The distance between contour hedges on a long slope of open fields will depend on individual circumstances, but a spacing of 200 to 600 feet is generally satisfactory.

WINDBREAKS

Windbreaks are often desirable where wind erosion is serious or where winds cause an excessive drying of the soil in some seasons of the year. In parts of the Northeast, windbreak plantings are also useful as natural snow fences paralleling highways.

Windbreaks differ from hedges in that they are higher and wider and are usually composed of different plant species. They are placed primarily with reference to winds rather than slopes. A good windbreak is triangular in cross section, largely evergreen, and composed of both trees and shrubs.

A windbreak should be placed perpendicular to the direction of the prevailing winds and on the prevailing windward side of the field it is to protect. Where damaging winds come from different directions in different seasons, plantings should be made in more than one direction. If planted as a snow fence to protect roads from drifting, the windbreak should be placed with regard to both the direction of the road and the direction of the prevailing winter winds. It must be as nearly parallel to the road as is possible and at the same time crosswise to the direction of the wind. Plantings 50 to 100 feet from the road, depending on the height of the trees, allow for settling of the snow.

Windbreaks should be at least four rows wide, the two rows on the windward side being low and medium-height shrubs spaced 3 to 4 feet apart. The third and fourth rows should be evergreen trees placed at 6-foot intervals in rows 6 feet apart with the inner row 6 feet from the inner shrub row. The trees in the two rows of conifer should be stagger-spaced, as should the plants in the two shrub rows. Where destructive winds come from all directions or from opposite directions, the planting should be widened to include a double row of shrubs on each side of the conifers.

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Any of the evergreen conifers adaptable to the locality and site can be used in windbreaks. Pines, spruces, and cedars are excellent. Among the shrubs, those that grow thick are best, especially if evergreen. Bayberry is especially good. All shrubs listed on page 14 for use in hedge plantings may also be used in windbreaks.

Spacing of windbreaks is determined by the anticipated height of the conifers and the amount of protection desired. A safe assumption is that a good windbreak is effective for a horizontal distance equal to about 15 to 20 times its height. It will usually take 25 to 30 years for a windbreak to attain an effective height of 30 feet. After about 30 years, therefore, windbreaks may be expected to give protection for 500 to 600 feet. If full protection is desired before the trees have had time to attain a height of 30 feet, a spacing closer than 600 feet should be used.

Besides affording shelter for wildlife where none would otherwise exist, the shrubs used in a windbreak furnish a variety of fruits for food.

FIELD BORDERS

Field borders are the margins of cropland, pasture land, or hayfields adjacent to woodland or other high woody vegetation. A strip 10 to 50 feet wide along the edge of a field or pasture, particularly on moderate to steep slopes, may be eroding and unproductive. On cropland this severe erosion is often largely due to the turning of machinery at the end of crop rows, but the removal of moisture and plant food from the field by the long roots of the nearby trees also makes the soil more subject to erosion. The shade produced by the trees sometimes hinders good crop growth.

A field border, then, is a strip of land that not only fails to produce the intended crop but impairs the stability of other land by speeding up erosion (fig. 8, *A*). It is no loss to remove from cultivation a strip of land that gives no economic return anyway.

The economically unproductive land at the edge of field or pasture should be retired from crop or pasture and planted as a field border. The border will be as wide as the unproductive strip it replaces. It should be put into permanent erosion-controlling vegetation of a type that will not, in years to come, create another eroding and unproductive border (fig. 8, *B*). This condition excludes the use of trees and admits the planting of herbaceous plants and shrubs.

The most generally adapted cover for these eroding field borders is a hay-type sod. If put in sod, the strip retired from a field can be used as a turning ground for farm machinery. It can also be maintained simply by mowing and disking or reseeding occasionally.

The use of shrubs on a part or all of the border is sometimes the best practice. If the border to be retired is 30 feet wide or more, it is generally advisable to devote the half of the strip next to the woods to shrubs and the other half to grasses and legumes. A border retired from pasture should be fenced, and it is generally best to plant the entire border to shrubs. The use of shrubs in plantings along woodlands is discussed on pages 21 and 24.

Perennial grasses and legumes are usually more desirable for field borders than short-lived species. Some annuals or biennials that

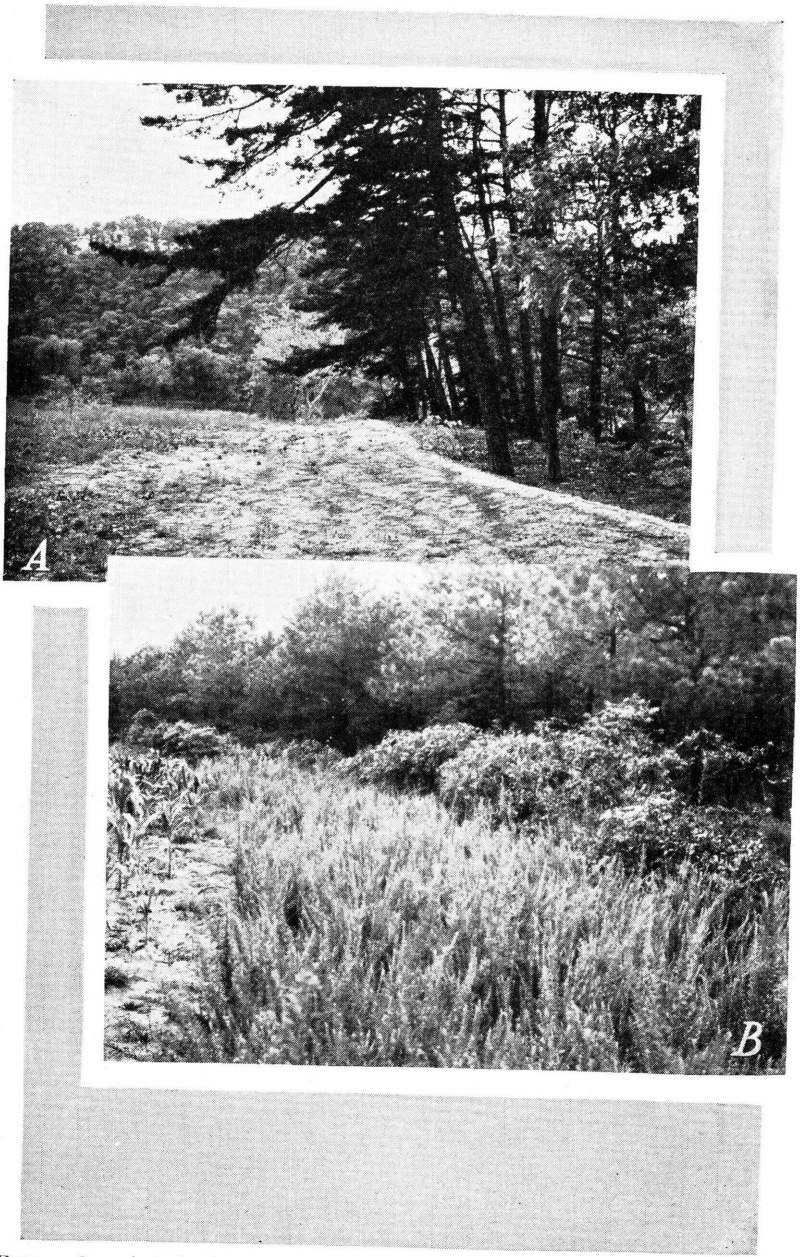

FIGURE 8.—*A*, A field border unproductive for a width of 25 feet. The soil is eroded, and the tree roots take plant nutrients and moisture from the soil. A mixture of perennial grasses and legumes would stop erosion on this border. *B*, This border seeded to *Lespedeza sericea* makes a headland for turning farm machinery and provides cover for wildlife. Sericea is adapted only to the southern part of the Northeastern States. In New England, New York, and northern New Jersey and Pennsylvania other legumes may be used.

Md. 333; Ga. 10,078

reseed readily are satisfactory, if they are preferred to perennials. On some borders it may be advisable to seed an annual along with the perennials to give a quick cover, since the perennials often take more than 1 year to make a satisfactory stand.

The species used for border seedings should be chosen for their adaptability to the soil and the locality. If possible, one or more legumes should be included in the mixture. Species that provide both food and cover for wildlife are to be perferred.

Table 1 gives some of the more desirable species for seedings of this type. Local conditions may require changes from the mixtures recommended. From his knowledge of his land, each farmer must determine which mixtures are suitable for his use.

TABLE 1.—*Mixtures of grasses and legumes for seeding field borders and gullies for erosion control and the development of wildlife cover in the Northeastern States*

States [1]	Seeding dates	Mixture to contain						Rate of seeding the entire mixture
		Reed canary grass	Timothy or orchard grass or tall oatgrass	Domestic ryegrass	White sweetclover [2] or alsike clover, [3] or birdsfoot trefoil	Korean lespedeza	Sericea	
		Lbs. per acre	*Lbs. per acre*	*Lbs. per acre*	*Lbs. per acre*	*Lbs. per acre*	*Lbs. per acre*	*Lbs. per acre*
New England, New York, northern Pennsylvania and New Jersey, high altitudes of West Virginia.	Before August 15	0	6	5	4	0	0	15
	or April–May	8	0	0	7	0	0	15
Delaware, Maryland, southern Pennsylvania and New Jersey, low altitudes in West Virginia.	August–September	0	4	4	0	3	4	15
	or February–March	0	0	0	0	0	20	20

[1] Recommendations for any specific locality may need modification to fit local conditions.
[2] Neutral or sweet soil, pH over 5.5.
[3] Sour or acid soil, pH under 5.6.

Two mixtures are given for each of the two areas. For the southern part of the region, *Lespedeza sericea* with a nurse crop is suggested for the more sterile and difficult sites. On certain sites other species may be more adapted than some of those listed. Any of the vetches, trefoils, sweetclovers, and other legumes may often be suited and are desirable for field-border plantings.

The seedbed should be prepared by plowing or disking the soil lightly. A light mulch of manure, barn sweepings, straw, or similar material should be applied if available. If erosion is severe it is desirable to use some coarse mulch of evergreen or hardwood boughs. Where a good catch and satisfactory growth cannot be reasonably expected because of lack of fertility or lime, the required fertilizer or lime should be applied before seeding. Sometimes the use of manure will take the place of lime in sweetening the soil.

GULLY PLANTINGS

Planning a gullied area for wildlife should not be undertaken apart from a consideration of the cropping plan for the surrounding fields. The best treatment for a gullied area can be determined only when a gully is thought of as part of a drainage area, because treatment of a gully may often have to be begun on the drainage area itself rather than in the gully. Questions of cultural practices on the drainage area, the diversion of water from the gully head, and the placing of temporary check dams or other mechanical controls within the gully should be thought through before a decision is made about the vegetation to be used in the gullies and the methods of planting. A discussion of gully control in relation to farm practices on the drainage area of gullies is given in Farmers' Bulletin 1813, Prevention and Control of Gullies.

If study of a gullied area shows that shrubs and trees can be used in controlling erosion, species of woody plants that provide food and cover for wildlife should be selected for planting.

Since gullies are often exceedingly sterile and dry, those species most tolerant of dry and infertile soil are best. (See pp. 46–50.) The following woody plants are recommended for gully plantings:

Woody plants best adapted to top and upper part of gully:	Woody plants best adapted to lower parts of gully banks and bottom:
Thunberg barberry	Silky cornel
Climbing bittersweet	Gray dogwood
Shrub bushclover	Persimmon
Hall Japanese honeysuckle	Jack pine
Tatarian honeysuckle	Virginia pine
Bayberry	Black locust
Virginia creeper	Basket willow
Snowberry	American elder
Coralberry	
Blackhaw	
Fox grape	

The pattern of the gully plantation should be decided before planting is begun. Generally, the lower growing shrubs and vines are used on the upper banks and top edges of the gully and the higher shrubs and trees on the lower part of the banks and in the bottom. This arrangement is particularly desirable if the adjacent land is cropped, for trees down the sides of the gully or in its bottom do not shade the fields nor take the moisture from the crops.

The spacing of the plants used in gullies is important. The standard 6 × 6-foot spacing of a woodland plantation is satisfactory only if the flow of water through the gully is small. If the gully banks are steep and much water flows through the gully, plantings may be spaced as close as 3 × 3 feet.

Grass may be seeded in a gully to give temporary control while shrubs or trees are becoming established (fig. 9). It should be used with the woody plantings in any gully that is causing damage to lower-lying land if it is desired to protect that land from further damage within 1 or 2 years.

The seeding mixtures recommended for field borders may be used. If grasses are seeded in the spring, the shrubs should be planted first or delayed until the succeeding spring. If the seeding is made in the

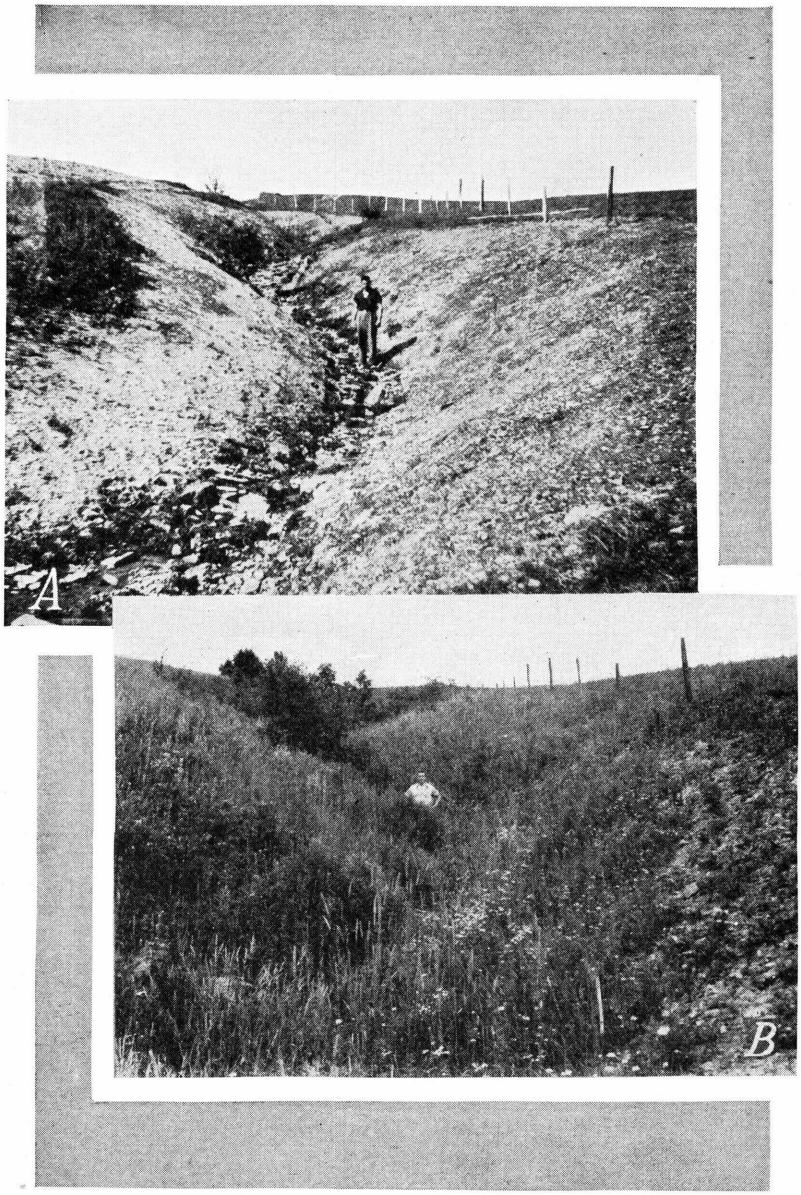

FIGURE 9.—*A*, This bare, active gully affords no haven for wildlife. The overhanging tops of the banks have been sloped preparatory to seeding and planting. *B*, The same gully 2 years after having been seeded with a mixture of perennial grasses and legumes and planted to shrubs. The draw is used as an outlet for two diversion terraces. During this second year since treatment, a brood of 16 pheasants used the gully as headquarters. N. Y. 317; N. Y. 317d

fall, the woody planting may be made during the preceding or following spring.

Special precautions should be taken in seeding gullies. The bank slopes should not overhang at the top, nor should the slope exceed 60 percent, a 6-foot vertical rise to 10 feet on the horizontal. In preparing the seedbed and raking in the seed, all raking should be done on the contour, not up and down the slope. The seeding should be heavier than average at the top of the slope and lighter at the bottom, to offset the effect of washing. Thorough mixture of the seed with sand or fine soil will help in getting a satisfactory distribution.

The mulch used should be heavier than that recommended for field borders. A brush mulch held down with willow stakes is often needed in the bottom of gullies in addition to the lighter mulch. Where sufficient moisture is present, the willow stakes will sprout and assist in the control.

THICKET PLANTINGS ON SMALL NONFARMABLE AREAS

There are small areas on most farms that cannot be profitably used for crops or pasture and are not adapted for a woodland planting—sink holes, rock outcrops (fig. 10, *A*), farm roadbanks, wet spots, field corners (fig. 10, *B*), woodland borders (fig. 11), or idle places that do not fit into the field plan. Many of these areas are severely eroded. Except for the areas of tillable land that do not fit into the lay-out of crop fields, these places should be devoted to woody plants that birds and the wildlife can utilize. On the tillable areas a wildlife food-patch planting of cereals may be made in place of the thicket-type planting.

Thicket plantings are of two general types, the border type, those that are adjacent to existing or future woodland, and the island type, those that are isolated in open land (fig. 12). Both shrubs and trees may be used in either type of planting if there is enough room for trees.

Both types of thicket plantings give a cover of progressively higher vegetation from open land to low shrubs, then to high shrubs and trees. This arrangement prevents shading of adjacent crop fields and the depletion of soil fertility. The border thickets protect the woodland from drying and damaging winds.

The arrangement of the border-type planting along a woodland differs from that of the island-type planting in open land. In the island planting at least two of the outer rows are of low-growing shrubs, and these are backed up by two or more rows of medium to high shrubs. The center is planted to trees, among which conifers are often included. If the plot is less than 40 feet across, it is best not to plant any trees.

In the border-type planting the three plant groups are arranged in bands paralleling the existing woodland. These groups will follow the same sequence as in the island arrangement; low shrubs next to the open field, then medium to high plants, and, if room is left, small trees next to the woodland. It is often advisable, as stated on p. 16, to combine the woodland-border thicket planting with an herbaceous field-border seeding.

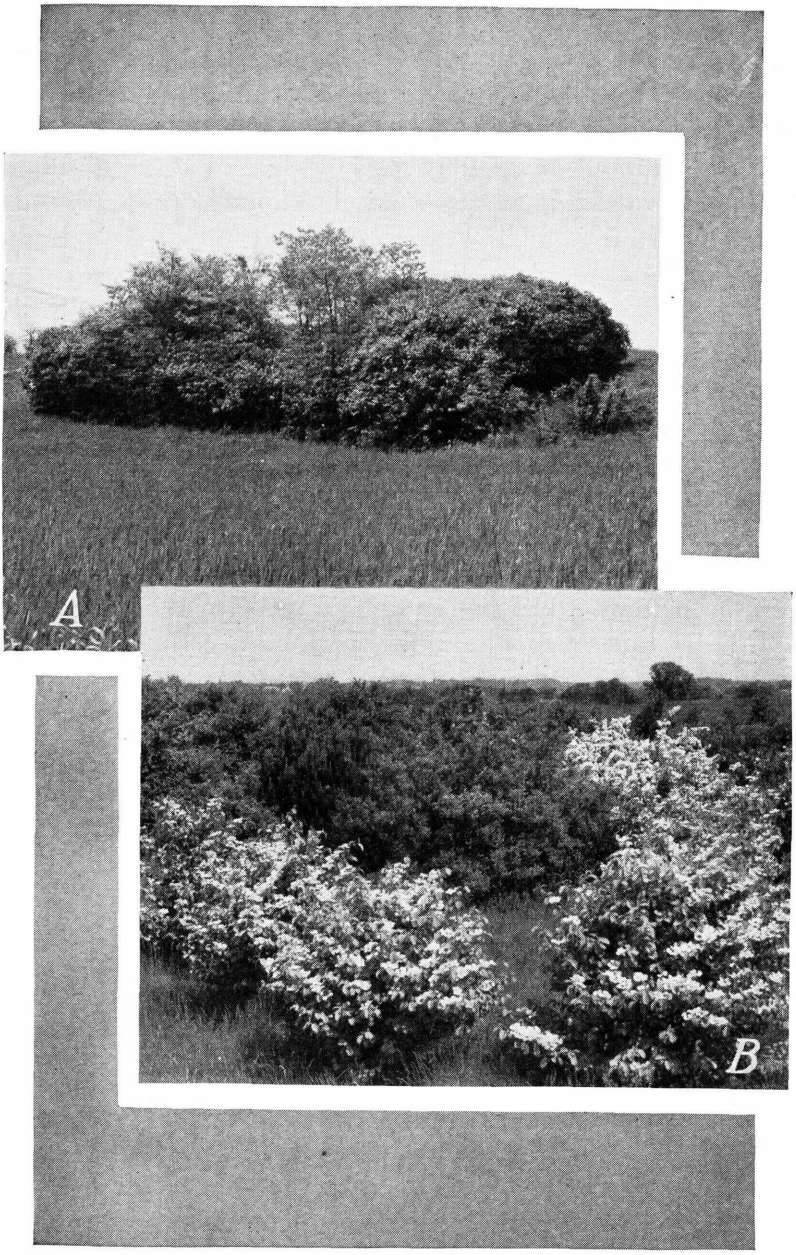

FIGURE 10.—*A*, In this thicket planting on a rocky outcrop, wildlife finds cover in the midst of a large crop field. *B*, A thicket planting in this field corner enhances the beauty of the farm. On the edge of the thicket are privet, rose, and viburnum; in the center are spruce and pine. Dogwood is conspicuously in bloom. Pa. 60,225 and Pa. 60,239

FIGURE 11.—A thicket planted along an existing woodland. The same type of planting is recommended as a border for woodland plantation. N. Y. 50,250

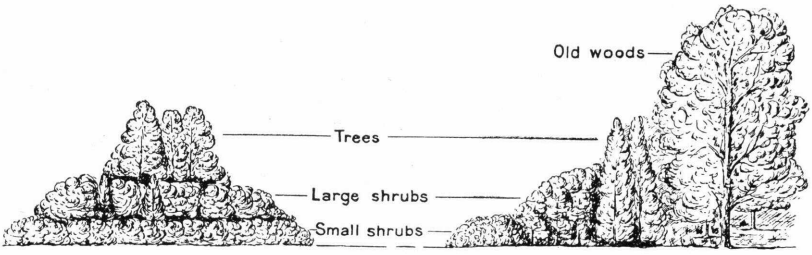

FIGURE 12.—The island type (*A*) and border type (*B*) of thicket plantings.

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The shrub border should be composed of at least four kinds of plants in at least four rows, arranged as illustrated in fig. 12. The usual spacing of 6×6 feet is recommended, although it is desirable not to plant the shrubs in perfectly even rows. The shrubs will appear more natural if they are spaced somewhat carelessly. Straight-line divisions between the species should also be avoided, though it is best to plant according to height.

For planting in shrub borders those species should be chosen that will provide food for the wildlife species especially to be encouraged. For example, a four-row border planned for ruffed grouse might include dwarf rose and black chokeberry in the outer row, gray dogwood, arrowwood, and bear oak in the two middle rows, and wild crabapple in the row next to the trees. Information on the utilization of shrubs by wildlife is given on pages 47 to 49. The shrubs used, of course, must be adapted to the soil and must have the desired height characteristics.

In both isolated and border-type thicket plantings the shrubs should provide the best possible balance of wildlife foods for all seasons. The needed plants that are not present in adjacent or nearby coverts should be included in the thicket planting.

The following trees and shrubs are recommended for thicket and woodland plantings:

Low shrubs:	Medium to high shrubs:	Trees:
Black chokeberry	Silky cornel	Sugar maple
Thunberg barberry	Flowering dogwood (fig. 13)	Hackberry
Climbing bittersweet	Gray dogwood	Persimmon
American hazelnut	Tatarian honeysuckle	Red mulberry
Bayberry (fig. 14)	American crabapple	Norway spruce
Virginia creeper	Wild plum	Red pine (fig. 14)
Swamp rose	Bear oak	White pine
Snowberry (fig. 15)	American elder	Virginia pine
Coralberry	Arrowwood (fig. 14)	White oak
Mapleleaf viburnum	Nannyberry	Red oak
Fox grape	Blackhaw	Mountain-ash (fig. 14)
	Highbush cranberry	White cedar

FIGURE 13.—Flowering dogwood, a shrub for thicket and woodland plantings: *A*, bloom; *B*, growth habit.

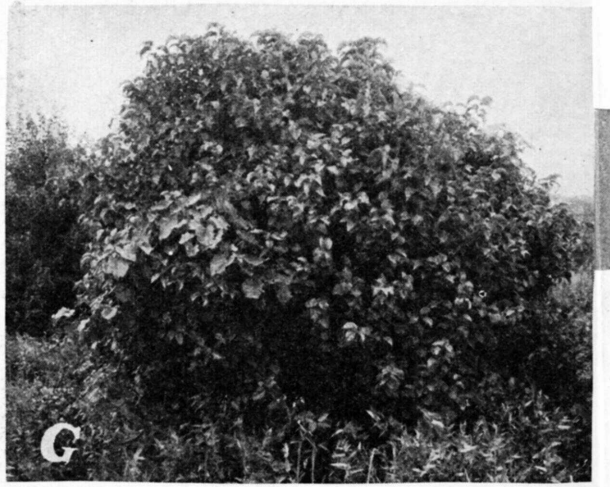

FIGURE 14.—Woody plants recommended for wildlife plantings: Red osier, growth habit (*A*) and fruit (*B*); bayberry, fruit (*C*) and growth habit (*D*); growth habit of mountain ash and red pine (*E*); mountain ash fruit (*F*); arrowwood, growth habit (*G*) and fruit (*H*).

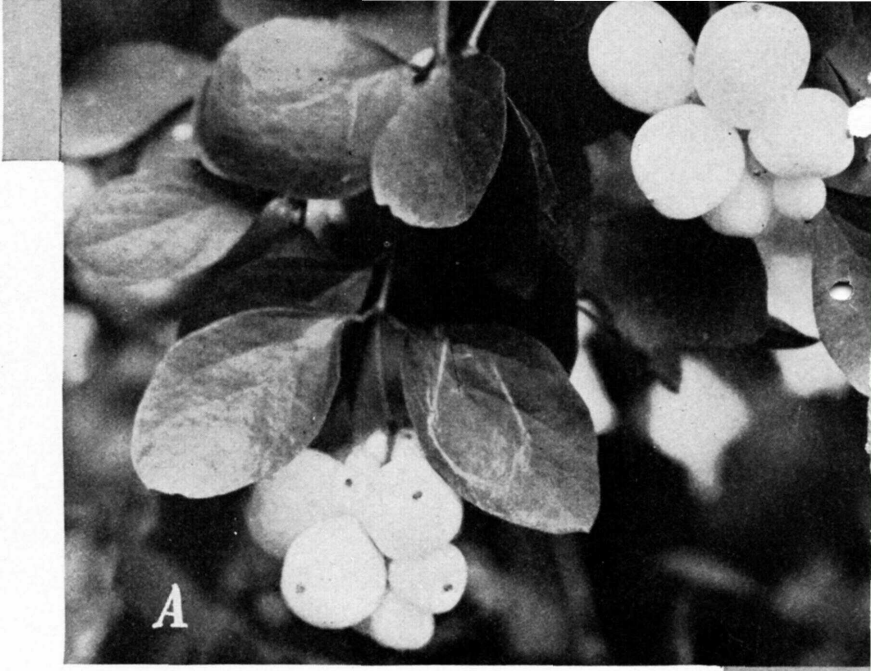

FIGURE 15.—Snowberry is used for wildlife plantings in gullies and woodland borders: *A*, fruit; *B*, growth habit.

WOODLANDS

Woodlands usually occupy the most erodible lands on the farm—the steep slopes, rough areas, ravines, and stream banks. They should therefore provide a good cover of vegetation to hold the soil in place. Once a woodland is abused, it deteriorates, and the soil begins to wash away. Farm woodlands, both new and old, are also among the most valuable cover types for wildlife. A woodland must be thought of as a community in which many species of both plants and animals live together, in ways as yet but little understood. The animals inhabiting it continually affect the woodland, and practically all wood-cutting operations in turn affect them.

It is therefore important that woodland-management practices provide for the maintenance of wildlife in order to insure the maximum combined crop of wood, wildlife, and other products and the continued healthful survival of the woodland. In managing a woodland for multiple use, a course of moderation must be pursued. The highest possible development of any one product occasionally must be modified in favor of others. The plan of management should assure a reasonable crop of both wildlife and wood products.

An Ideal Woodland for Wildlife

The ideal woodland for wildlife is one in which sound principles of forestry, soil conservation, and wildlife management are applied. Since good forestry requires that all trees except den trees should be harvested for their wood products on reaching their greatest growth of sound wood, the woodland will be an uneven-aged stand, predominantly second growth and immature. Any community, to continue to thrive, must be composed of individuals of all ages. Exclusion of livestock from the woodland and protection from fire are other fundamental forestry practices.

For wildlife a mixed woods of both hardwoods and conifers is best (fig. 16). A balance of hardwood and coniferous trees and shrubs also makes the best cover for the protection of the soil and produces the greatest amount of timber. Single-species stands are more subject to disease and injury by insects than mixed stands. At best, they furnish a restricted food supply and a single type of cover for wildlife. They provide neither a balanced diet nor satisfactory protection. It is also well to maintain a scattering of all species native to the type, if not as crop trees, at least as fillers and wildlife cover and food.

In a woodland suitable for wildlife, all shelter and food types needed by a species must exist within the area covered by an individual of the species. If, for example, an animal travels over an area having a radius of only a quarter of a mile, all its requirements must be provided within that area; otherwise, it cannot occupy the area at all. Thus, all types needed by an animal should be near enough together to permit the use of them all.

Woodland Plantations

Areas too steep or eroded to continue in crops or pasture should be retired to woodland. In planting a new woodland, hardwood trees and conifers should be mixed according to site adaptability. The

species within both groups may also be mixed, and fruit-producing trees such as hackberry and mountain ash used along the exterior next to the shrub border. This insures adequate light for good fruiting. The type of thicket planting recommended as a border for woodlands (pp. 21 and 24) should also be provided for woodland plantations. Some of the trees suitable for woodland plantations that provide food

FIGURE 16.—A woodland of mixed hardwoods and conifers composed of trees and shrubs of all ages produces the best wildlife cover. Woodlands such as this produce a sustained yield of a variety of wood products. 36-651

and shelter for wildlife are listed on page 24, but many other timber species may also be used.

The size and arrangement of the types within the woodland are also important. Wildlife is a product of edges; that is, the borders between different types of vegetation. The first 100 feet of any type is highly productive of wildlife; the second 100 feet is still productive, but less so than the first; the third less than the second, and so on. In the Northeast, as a general rule, it is best if the width of a single type of woodland does not exceed 600 feet so that no point will be more than 300 feet from an edge. Within each type a variety of species is generally desirable.

Sources of Planting Stock for Woodland Plantations

Nursery-grown seedlings or transplants are preferred to cuttings or wild plants. Nursery stock is available from commercial nurseries, State nurseries, and through the facilities of soil conservation districts (in cooperation with the Federal Government).

Some species may be handled satisfactorily as cuttings or wild plants if due precautions are taken. Methods of propagating stock from cuttings or by transplanting are described in Farmers' Bulletin 1567, Propagation of Trees and Shrubs.

The Planting and Care of Woody Plantations

Planting should be done as early in the spring as weather conditions permit. It is advisable for two persons to work together, one digging holes with a mattock, grub hoe, or spade, the other setting the plants. Dig the holes deep enough to accommodate the roots without doubling them. If the sod is heavy, it should be removed for 1 foot all around the plant. Remove the plant from the supply, which is carried in a pail with a little water in the bottom, and hold in the hole so that the roots are well spread and the junction of roots and top is just at the ground level. Press loose earth around the roots with the free hand and tamp down firmly with the foot to the ground level.

The first rule in caring for a plantation is to exclude fire and livestock from the area. The rest of the maintenance required is an occasional weeding out of any unwanted species that may have seeded in naturally. About once every 4 or 5 years, or more often if necessary, remove all encroaching undesirable trees and shrubs with the ax or brush hook.

After the plantation is 2 years old, it may need some replanting. If the survival has been 70 percent or better and fairly even, it is just as well to let the few open spots fill in themselves, but all sizable failure spots should be replanted.

Improving the Woodland for Wildlife

The first step in wildlife management is to study the distribution of food and shelter. As already explained, all shelter and food types needed by an animal should lie within the range it covers. An area deficient in either food or shelter is unsatisfactory.

To improve stands deficient in shelter, these practices may be employed: (1) Liberation of suppressed conifers and other shelter-producing species, (2) interplanting of conifers in poorly stocked stands adjacent to food-producing cover if protecting the stands from grazing is not likely to result in satisfactory natural seeding, (3) construction of brush piles from cuttings, and (4) hastening development of potential den trees by girdling.

To improve stands deficient in food, the following practices will be helpful: (1) Liberation of food-producing trees and shrubs, especially those adjacent to existing shelter units and near the border of the woodland; (2) selective cutting to create small openings to admit sunlight to the forest floor and induce germination and fruiting of many food species, and (3) planting woodland margins to borders of food-producing woody and herbaceous vegetation as described on pages 21 and 24. A good system of roads is helpful in making the openings mentioned in (2).

Interplanting Conifers

In woodlands from which the conifers have been eliminated, there may be no reasonable expectation of natural reproduction of these species. In such woodlands, if wildlife shelter is markedly deficient and the crown canopy of hardwoods relatively sparse, interplantings of conifers may be made in clumps in the crown openings. The standard plantation spacing should be the goal, and usually shade-tolerant species, such as Norway spruce or white pine, should be used.

Where the crown openings are fairly large and understory competition is not too severe, less shade-tolerant species may be included.

Selective Cutting for Woodland Borders

The woodland border usually is an edge between two types of vegetation, the woodland itself and some open-field type. The amount of desirable edge may be increased by a shrub border between these two.

If a planting is not feasible along a woodland border it is advisable to make a selective cutting of the tree species from the edge of the woods over a period of years. Usually there are enough of the

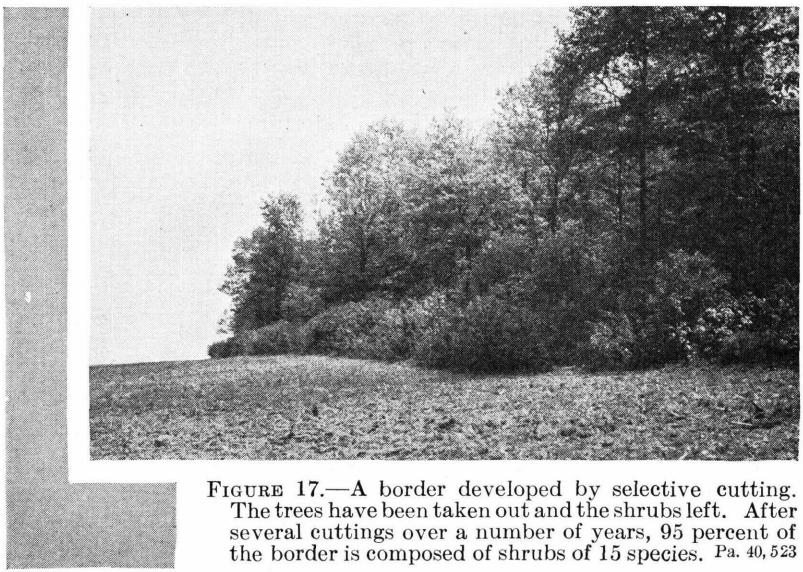

FIGURE 17.—A border developed by selective cutting. The trees have been taken out and the shrubs left. After several cuttings over a number of years, 95 percent of the border is composed of shrubs of 15 species. Pa. 40, 523

desirable kinds of shrubs to establish a border thicket after the tree sprouts have been summer-cut several times (fig. 17). A depth of 25 feet or more is needed in such a cutting.

Selective Cutting in the Woodland Interior

The composition, quality, and density of a woodland stand may be modified by selective cutting. In these operations, consideration should be given to providing the food and shelter needed for wildlife.

Woodland edges provide the best wildlife habitat, and the part of the woodland proper next to the edge is also of special usefulness to wildlife. It is therefore often desirable in managing the woodland to treat the outer 100- to 200-foot zone in a special manner. In this zone a reasonable number of food-producing trees should be favored.

Each piece of woodland must be studied to determine which species are to be favored. Those species that shall be left to produce food depend on the kinds of wildlife wanted. For ruffed grouse it might

be desirable to pay particular attention to poplar, hophornbeam, and yellow birch, whereas for gray squirrels the oaks and hickories would be best. Usually it is desired to manage more than a single species of wildlife, and the requirements of all must be planned together.

After the species to be favored have been decided on, cutting is directed to encourage them. This sometimes is accomplished by the release of suppressed individuals through removing the competing plants. Some species may be increased by making small openings in the woodland to induce the germination of seed on the forest floor.

Where den-inhabiting animals such as squirrels and raccoons are

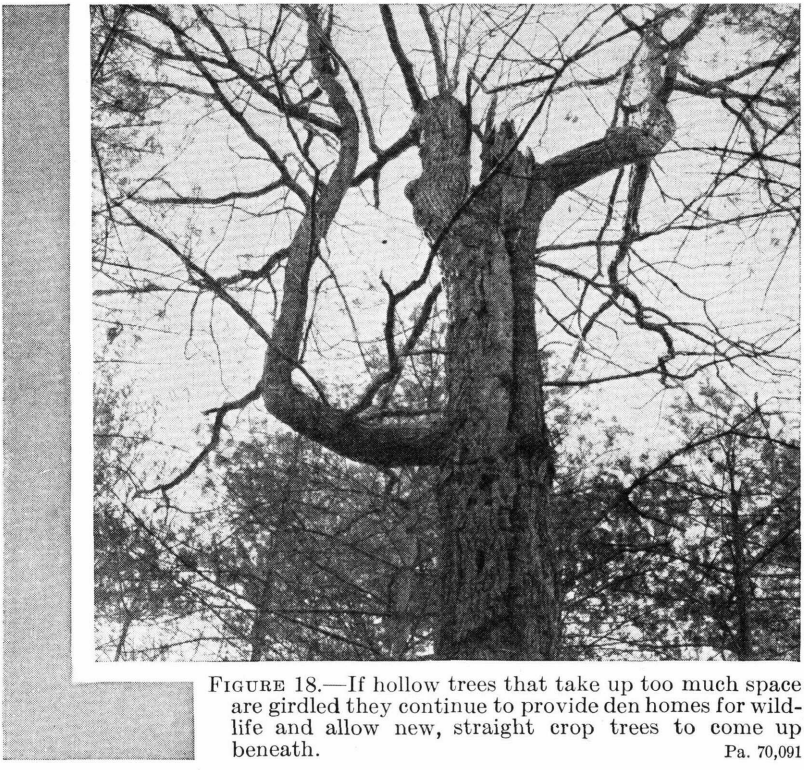

FIGURE 18.—If hollow trees that take up too much space are girdled they continue to provide den homes for wildlife and allow new, straight crop trees to come up beneath. Pa. 70,091

wanted, hollow trees, or "wolf" trees in the process of becoming hollow should be left, no fewer than two per acre. Girdling sometimes may be used to speed up the development of hollows and eliminate dominating foliage (fig. 18).

Improvement of the quality of the stand is a matter of selective cutting of individual specimens rather than of species. In woodland management for timber this is done by removing the defective trees, thereby providing space for other trees of better form. Likewise trees desirable for wildlife may sometimes be inferior because of an unhealthy condition, in which case they should be removed. But if a tree valuable to wildlife is retarded for want of light, the remedy is to remove enough of the competing stems to provide light for the

retarded tree, with due consideration, of course, for the value of the other trees. Other things being equal, individuals of seedling origin should be favored over those grown from sprouts. Plants furnishing browse become unavailable as food for animals such as deer if they grow too high. Thinning cuttings of hardwood species will cause sprout growth that provides needed browse.

Forest Canopy

A crown cover of at least 60 percent (three-fifths of the ground shaded at mid-day by tree foliage) should be maintained in all woodlands. Even if most of the trees are inferior in quality, excessive cutting should be avoided and a 60-percent crown maintained to provide adequate erosion control and to serve as a nurse crop for more valuable species. Living trees should be cut only to release more desirable individuals, to improve conditions for seeding and germination, to decrease overstocking, or to remove plants that are seriously diseased.

FIGURE 19.—The removal of trees in the foreground helped to reduce the crown density to about 70 percent. The density of the understory will increase. Slash has been used to build a brush-pile shelter. Pa. 40,208

The forest canopy should include some trees that bear food for wildlife. Many of these are included in the list beginning on page 46. Others equally valuable are such trees as hophornbeam, red maple, beech, and all the oaks and birches. In the outer part of the woodland the number of wildlife food trees encouraged may be much larger than in the interior. It may be composed entirely of food-producing trees if most of them also furnish harvestable wood products.

The density of the understory is controlled largely by crown density. The crown should be open enough to permit a good understory of shrubs and young trees, yet not so open that the undergrowth becomes rank over large areas (fig. 19). A density of 60 to 80 percent usually yields an understory of desirable spacing.

Brush Piles

Where shelter of a natural type is inadequate, some of the slash from cutting operations may be piled. This is always beneficial where rabbits are especially desired. Brush piles should be fairly large and loosely constructed. The brush should be piled on a stump or other object in order to ensure looseness at the bottom. Care should be taken to place the coarser limbs at the bottom, and the remaining brush should be piled at random. About 12 feet in diameter and 8 feet in height is a good size, and two to four such piles per acre is a good spacing, depending on the need for additional shelter.

STREAM-BANK PLANTINGS

Flowing water, running clear and pure, furnishes water for livestock and other farm uses. It provides a habitat for many fish and animals. A stream properly controlled throughout its course remains relatively steady in flow and is less likely to dry up or flood. Planting the stream banks helps to keep sediment from streams. A good covering of vegetation on stream banks not only holds the banks in place but shades the stream, reduces evaporation, and helps to hold down the temperature of the water (fig. 20.).

The most adaptable type of bank cover for most farm streams is shrubs. Large trees should be kept back of the bank so they will not uproot. Moisture-loving shrubs are best for the planting of bare and eroding stream banks. The following are especially recommended:

Woody plants well adapted to the top and upper part of the bank:

Silky cornel
Virginia creeper
American elder
Arrowwood
Nannyberry
Highbush cranberry

Woody plants well adapted close to the water:

Red-osier (fig. 14).
Winterberry
Basket willow
Arrowwood
Highbush cranberry

The method of planting a stream bank depends on the severity of the wash against the bank during seasonal high water. Overtopping banks should be graded to a 60-percent slope or less. If high water is likely to cut badly, and especially if ice damage accompanies the high water in the spring, mechanical measures will be required to protect the plantings until they attain enough growth to hold by themselves. A mat of cut brush, either hardwood or conifer, securely held down with wire staked into the ground has proved to be the best protection (fig. 21). If willow stakes are used, they will serve as a part of the planting, since willow readily sprouts from fresh-cut stakes. Care should be taken to make the cuttings from a desirable type of willow. Specimens should be selected that are known to have remained as shrubs for some time, for the tree species are not so desirable. Willows should be selected from a damp, but not a boggy location.

Planting should be done early in the spring and after any needed brush matting has been applied. Spacing must be determined according to the need for rapid coverage of the bank, but it should be close, generally 3 × 3 feet.

If trees are desired near the stream, they should be planted back from the top of the bank at standard 6 × 6-foot spacing.

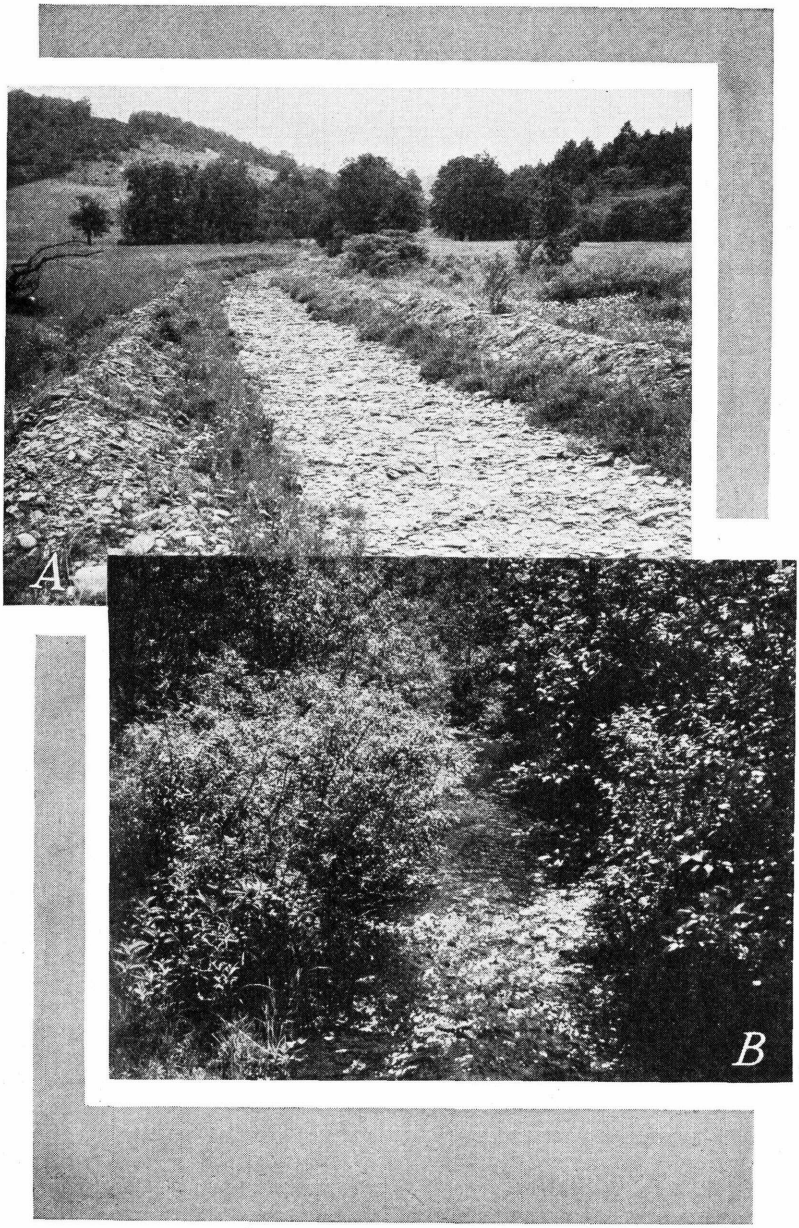

FIGURE 20.—*A*, Dry streams are mainly the result of exploitive farming and lumbering on the drainage area of the stream. *B*, A stream protected by conservation farming on the lands draining into the stream provides a continuous water supply. If the banks are well covered with vegetation, less of the water evaporates from the stream and less soil washes over the banks into the water. N. Y. 20,986; N. Y. 60,255

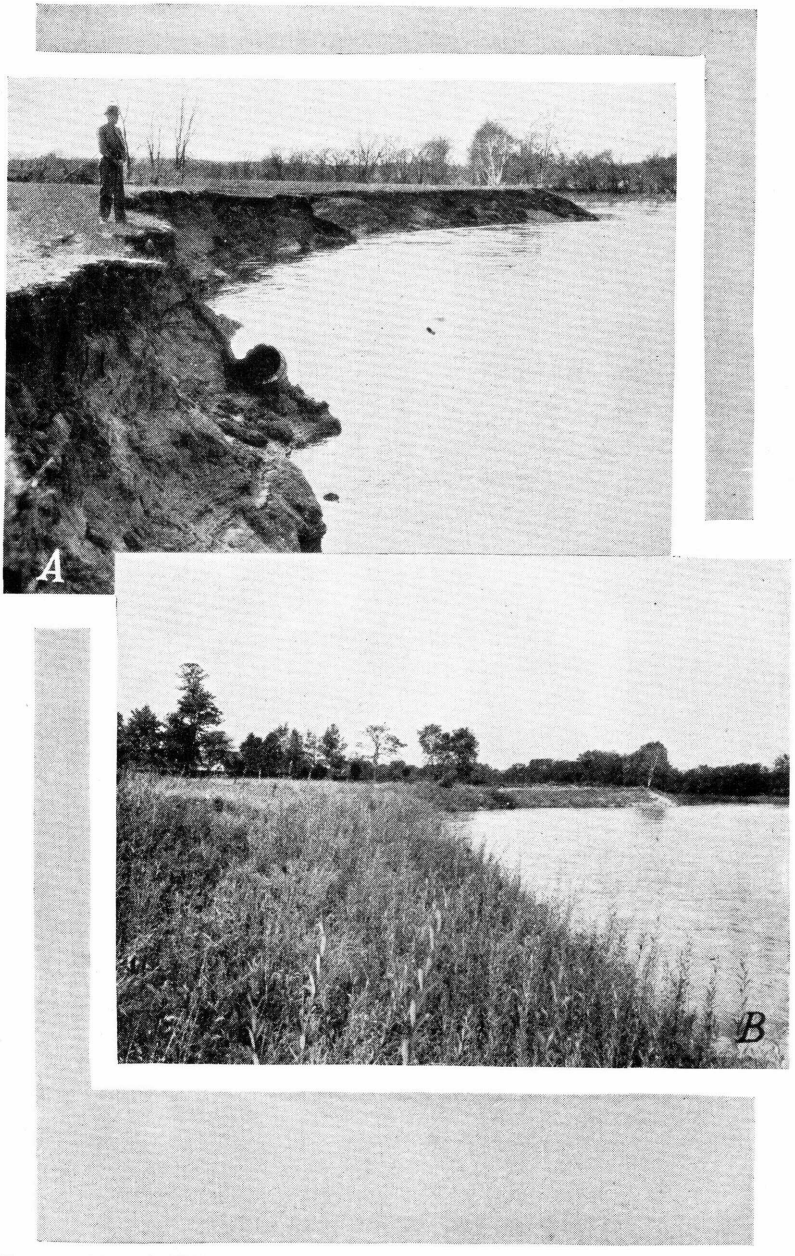

FIGURE 21.—*A*, This stream is taking some of the best soil on the farm; and once in the stream, good soil becomes only a load of sediment. *B*, The same stream bank 2 years later. It has been sloped, planted to willows, and held with a temporary brush matting. Vt. 30; Vt. 30-D

WATER AREAS AND SWAMPS

Taking proper care of water areas and swamps assists in maintaining water tables. These areas may also serve as reservoirs to slow up and store water that might otherwise cause damage to lower-lying areas.

Frequently a farmer may obtain monetary returns, as well as pleasurable sport, if wildlife inhabit and utilize aquatic and marshy areas on his farm (fig. 22). Among the fur bearers the muskrat ranks

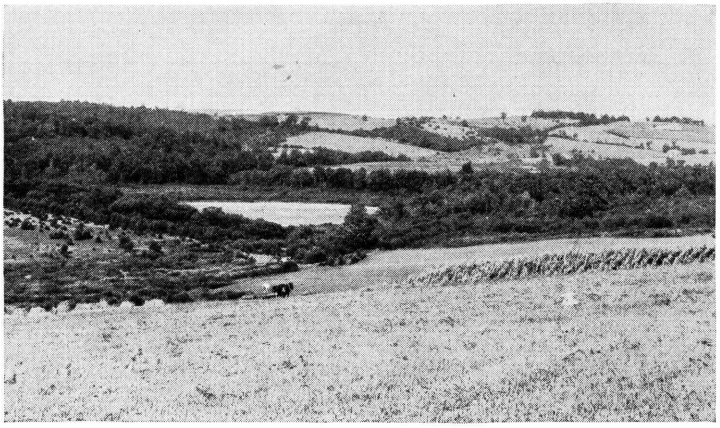

FIGURE 22.—Small ponds and marsh areas help to maintain the water table and provide storage for water. They make a place for the production of fur-bearing animals, waterfowl, and other birds. N. Y. 20,200

first in economic value. A good muskrat marsh may return as high an income per acre as a moderately fertile cultivated field. Mink, skunk, and raccoon are among the four most valuable wild fur species.

Waterfowl and marsh birds are important as game, and the fishes provide food as well as sport.

There are numerous species of water-growing, or aquatic, plants adapted to the control of wave action and the prevention of silting that provide excellent food and shelter for wildlife (fig. 23). Table 2 shows the planting stock recommended, type of planting, and the sites on which planting should be made.

Roots, tubers, and plants should be planted in the spring from April to the middle of June. Wild stock is practically the only source available at present. Seeds, unless stored, should be planted in the early fall. Seed storage of most species should be in water kept at a temperature of from 1° to 4° above freezing. Three times the bulk of seed is the best rule of thumb for the amount of water. Containers should be loosely covered.

The planting of submerged and emergent species of aquatic plants, roots, and tubers may be accomplished by attaching stones or balls of clay to the stock. The spacing may be 6×6 feet in the deeper areas and may gradually narrow to 3×4 feet as the depth decreases. Belts of plants paralleling the shore are recommended. Plantings

made across an inlet to prevent silting may be made as solid belts across the flow or as staggered, broken blocks to encourage meandering of the water. Direct seeding on the surface of the water is the most common seeding method but should not be used if aquatic birds are common, for they will consume the seed. Either seeds or tubers may be planted by encasing them in balls of clay and dropping them carefully under the water.

Marsh plantings are those made on sites between normal low-water level and normal high-water level. The species recommended are those that are emergent and capable of thriving on wet soil. The rushes, water smartweed, and wild duck millet are well adapted for these sites.

Near the low-water margin, plantings spaced 3×3 feet are recommended. The spacing may gradually increase shoreward to the standard 6×6 feet. Planting of roots and plants may be accomplished with spade or mattock. Seeding here may be directly broadcast and should be lightly mulched.

It may be desirable to use fertilizer in both marsh and aquatic

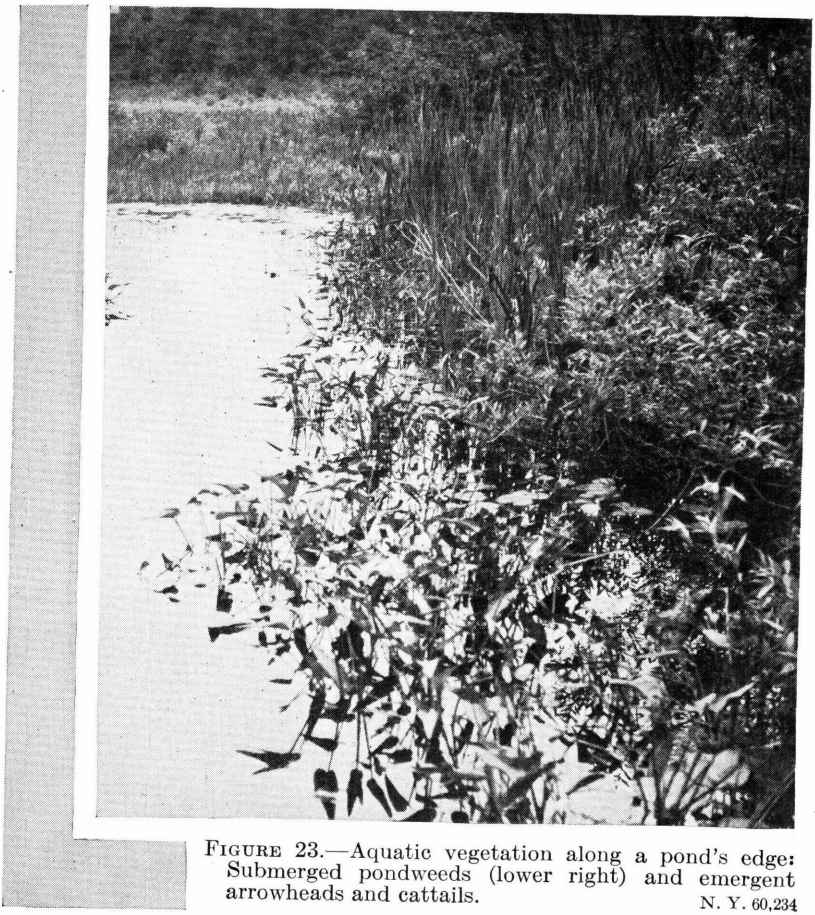

FIGURE 23.—Aquatic vegetation along a pond's edge: Submerged pondweeds (lower right) and emergent arrowheads and cattails. N. Y. 60,234

TABLE 2.—*Recommended aquatic plants and type of soil and planting*

Plant [1]	Type of bottom or soil	Water flow	Water depth	Type of planting	Stock recommended
			Feet		
Sago pondweed [2]	Sandy mud	Quiet and slow	1 to 10	Submergent or emergent	Seed (7 months' storage), plants, tubers, leafy stems.
Bushy pondweed	Sandy	do	do	Submergent	Seed (7 months' storage), plants.
Arrowhead	Mud	do	0 to 1	Emergent	Seed (7 months' storage), tubers, plants.
Wildcelery	Sand or coarse silt	do	1 to 10	Submergent	Seed (5 months' storage, 60 pounds per acre), plants.
Wildrice	Deep muck or soft silt.	Slow	½ to 3	Emergent	Seed (7 months' storage, 60 pounds per acre).
Wild millet	Wet soil				Seed (20 pounds per acre).
Common three-square bulrush	Sandy wet soil	Quiet	0 to 2	Emergent	Roots.
Hardstem bulrush	Wet soil	Quiet and slow	do	do	Do.
Duckweed		Quiet	[3]	Floating	Plants.
Dotted smartweed [2]	Wet soil	do	0 to 1	Emergent	Seed, plants.

[1] Scientific names are given on pp. 51–52.
[2] Others of this genus are also good.
[3] May be any depth.

planting. This is particularly true in new and sterile ponds. The use of sheep manure and superphosphate in equal parts at a rate of 500 pounds per acre is recommended. This should be spread in small amounts throughout the summer in order to avoid concentrations detrimental to aquatic life.

In all aquatic plantings, protection from livestock is necessary. Fencing is the most satisfactory means of protection, but brush and treetops may be spread over or around the area. Marsh plantings should be protected from fire at all times.

Plant succession in marshlands may often be rapid, causing a decrease of water area. Woody plants tend to take over, giving rise to a swampy condition. This is particularly true when silt deposition is rapid. The presence of muskrats in marshes tends to keep the area in balance by holding the vegetation in check. Muskrats also dig channels and keep existing channels open. The farmer should leave an adequate seed stock of muskrats after each trapping season to insure the maintenance of a proper balance of vegetation. A good rule-of-thumb is to trap muskrats intensively only in years when there is evidence that they have begun to overeat the vegetation. In these years it is safe to trap half the colony.

NEW PONDS [2]

The impounding of water in new ponds improves the water table and provides water for livestock and cover for furbearers, fish, and waterfowl. These and many other advantages make it advisable to

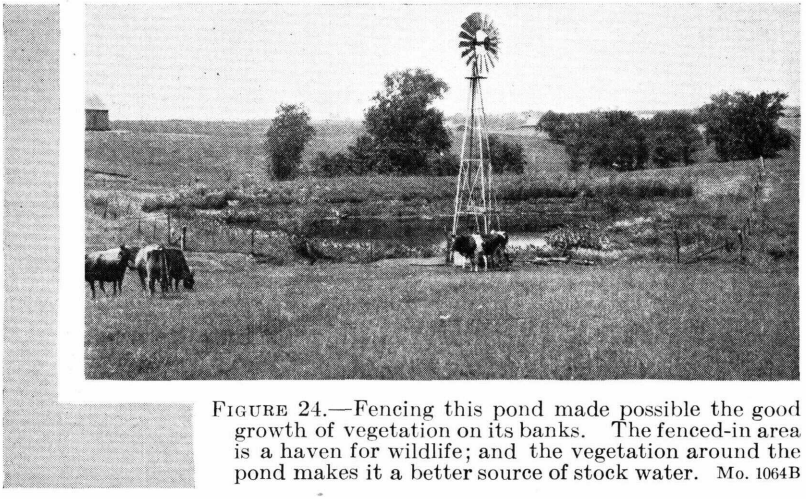

FIGURE 24.—Fencing this pond made possible the good growth of vegetation on its banks. The fenced-in area is a haven for wildlife; and the vegetation around the pond makes it a better source of stock water. Mo. 1064B

build ponds where stream flow and topography create a good pond site. Before it is flooded, the ponded area should be denuded as completely as practicable of any woody vegetation that may be present in order to prevent too great acidity of the water. After the area has been flooded, plantings of aquatic and marsh plants should be made in the same way that they are made in old ponds. It is also well to

[2] See Farmers' Bulletin 1859, Stock-Water Developments: Wells, Springs, and Ponds, and Farmers' Bulletin 1879, Ponds for Wildlife.

plant the dry pond banks to shrubs and evergreens in clumps. The shrubs recommended for pond banks are the same as for stream-bank planting (p. 35).

New ponds should be fenced if built in pastures and provision made for watering livestock from a tank (fig. 24).

WHERE WILDLIFE MANAGEMENT DOVETAILS WITH LAND MANAGEMENT

Before the farm in figure 25 was laid out as shown on the map, all crops had been in block fields with straight rows, pastures were overgrazed and untreated, no care had been given to woodlands, and no attention paid to wildlife. In the new plan wildlife management dovetails with land management.

Along with soil-conserving practices and improvement in general farm-management operations many wildlife benefits were incorporated in the farm plan. Shrub borders, hedges, stream-bank and gully plantings, field borders, wildlife food patches, thickets, and improved woodlands protect the soil and make the farm a suitable place for wildlife.

SPECIAL PRACTICES BENEFICIAL TO WILDLIFE

The development and maintenance of good habitat can be accomplished as a part of the complete farm plan for conserving soil and wildlife. There are a number of special practices supplemental to the basic plan for wildlife conservation that are often useful in maintaining wildlife populations on the farm.

The restocking of depleted coverts with game farm-reared quail or pheasant to restore breeding stock quickly to an overshot area will help to maintain desirable numbers of wildlife. Nesting boxes for birds, especially around the home and orchards, are also useful.

Control of predators, especially hawks and owls, is not normally warranted. Fur-bearing predators may be maintained at a desirable level by moderate trapping during the prime pelt season.

Winter feeding and the provision of food patches and game refuges are sometimes needed if lack of food or overshooting is not to reduce the wildlife population below a desirable level.

FOOD PATCHES

Many species of farm wildlife, and notably the two most prevalent farm game birds, the pheasant and quail, are primarily grain eaters. The number of either species a farm will support is often determined by the amount and availability of winter food. Both species, but more particularly the pheasant, are largely dependent on corn for sustenance during the winter. The best food patch for these game species is therefore some variety of corn that keeps well on the stalk throughout the winter. Any variety of flint or yellow dent corn adapted to the local conditions is recommended.

The simplest way to provide food patches of corn on farms where corn is included in the crop system is to leave a strip uncut along the margin of a cornfield. This strip can be used best when located next

to a hedge or other type of permanent escape cover such as thickets or swamps. Other crop edges that may be left uncut for food patches are soybeans and millet. On farms where these crops are not regularly grown the patches must be made as a special planting. When this is done the corn strip should be planted in a rotation with other crops. Rotations recommended by the experiment stations should be

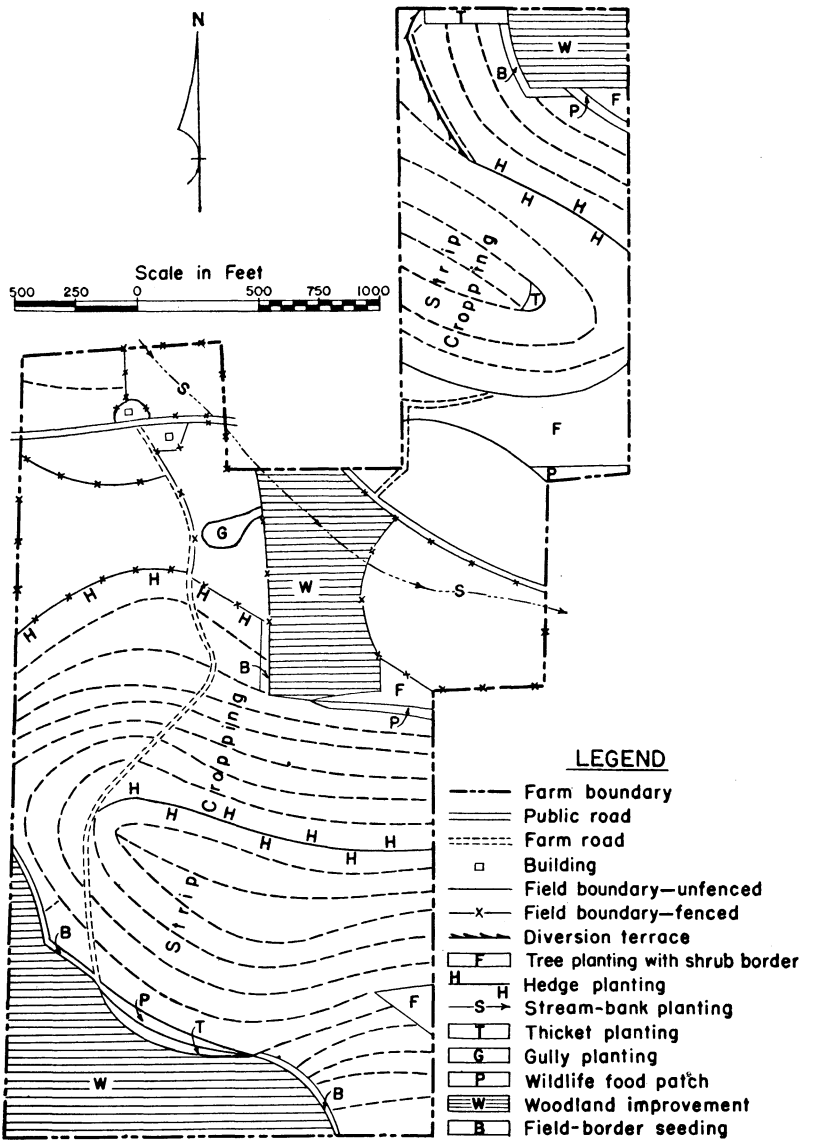

FIGURE 25.—A farm typical of those in the Northeast on which wildlife management and land management are directed toward the same end. N-3033

followed. Throughout most of the Northeast 1 or 2 years of corn may be included in a rotation with 2 years or more of hay and 1 year of small grain.

It is advantageous to wildlife if in the regular harvest the corn can be hand-picked and the stalks left in the field throughout the winter either uncut or in shocks. In this way the waste grain remains above the snow.

Species other than corn may be desirable in planted food patches. Sunflower, especially, attracts songbirds. Soybeans improve the soil and provide a food high in protein. The best variety for local conditions should be used. Millet, of which the Japanese variety is especially good, is another grain suitable for wildlife. From New Jersey and southern Pennsylvania south, plantings of partridge-peas are excellent for quail. This species may be used with an annual lespedeza.

Food patches are generally most effective in long, narrow strips—one, two, or more widths of the harrow. Care should be taken to make all cultural operations on the contour. Food patches should always be close to permanent escape cover such as thickets or swamp.

Table 3 gives suggestions as to seeding rates and time of planting.

TABLE 3.—*Wildlife food-patch mixtures*

Planting	Amount of seed per acre					
	Corn (flint or yellow dent)	Soybeans	Sunflower	Japanese millet	Partridge-pea	Annual lespedeza
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Corn	7					
Corn and sunflower	5		2			
Soybeans		30–40				
Soybeans and Japanese millet		20		10		
Sunflower and Japanese millet			2	15		
Japanese millet				20		
Partridge-pea and annual lespedeza					15	10
Annual lespedeza						20
Time of seeding	May 1 to June 1	Apr. 1 to July 1	May 1 to June 1	May 15 to June 15	Mar. 1 to June 1	Mar. 1 to May 15

WINTER FEEDING

A good habitat will not always prevent heavy losses in abnormally severe winter weather. In order to cope with emergencies created by winter weather, it is necessary to plan for them. Artificial feeding done after an emergency exists is largely wasted effort.

Corn is the best grain for feeding. The best method of handling it is to put the corn in shocks along hedges, woodland borders, the edges of swamps or thickets. This should be done soon after harvesttime and as often as needed through the winter. If corn cannot be fed in shocks feeding shelters may be constructed in the same locations, with the corn fed either on the ear or loose. If corn is not available, other grains may be used. Grit such as fine gravel should also be supplied at feeding stations.

The shelter should be near good escape cover and protected from

the prevailing winter winds. Feeding stations should be within the known territory of coveys of quail or pheasants, and at least two shelters should be located within the range of each covey.

Feed should be placed in small quantities in each station not later than December 1 and at 2-week intervals thereafter. When an emergency occurs, feeding should be increased to meet the need and should be maintained throughout the critical period.

Two types of feeding devices are recommended. The lean-to shelter with automatic hopper for loose grain and the spiked pole for feeding ear corn. For construction details refer to Farmers' Bulletin 1783, Feeding Wildlife in Winter.

GAME REFUGES

Escape refuges are desirable for pheasants, quail, waterfowl, and deer where hunting may endanger the breeding stock. The object of a refuge on private farm land is to provide an escape area for hunted game. It should be strategically located so that it is readily accessible from all portions of the farm inhabited by the species for which the area is provided. One or more units may be needed on a farm. The area chosen for a refuge should possess adequate food and shelter, well interspersed, so that the birds may remain there in concentration for a considerable period. Refuges for farm birds should be from 1 to 10 acres, according to conditions; those for waterfowl or deer should be much larger.

The refuge area should contain more than one type of cover. Shrub thickets, woodland borders, swamps, or swales for shelter, combined with a cornfield or other grainfield for a food supply gives an ideal combination. It may be desirable to plant food patches within refuge areas if sites cannot be found that contain an adequate food supply.

A refuge boundary that is already fenced is desirable, but if there is no fence on the boundary, a single-strand smooth wire fence should be erected. A refuge should be marked clearly with signs at frequent intervals along the boundary. Care should be taken to place the signs close enough together to be legally effective under the State laws. It may be possible to establish refuges in cooperation with the State game officials. Information on this subject can be obtained by writing to your State game agency.

CHARACTERISTICS OF PLANTS RECOMMENDED FOR WILDLIFE HABITAT

In the following pages the plants referred to in this bulletin are described briefly, and the animals that use the plants as food are named. This information should prove helpful in selecting the right species to use on each site to be planted.

The list is alphabetized under five different heads: Trees, shrubs, vines, grasses and legumes, and aquatic plants. The shrubs are described as low if under 6 feet, medium if from 6 to 15 feet, and high if over 15 feet.

The range of each plant is named and tolerance of shade is indicated. Soils are described in terms of dryness, acidity, sterility. A dry soil

is one that does not retain moisture well; a well-drained soil is one that holds moisture well but without puddling; a moist soil does not drain off well. An acid or sour soil is one with a pH of less than 6.0; a neutral soil has a pH of 6.0 to 7.0; an alkaline or sweet soil has a pH of over 7.0. The pH, the degree of soil acidity or alkalinity, may be learned by having a soil sample tested.

The degree of fertility is expressed by three different terms. A soil may be classed as sterile or as having low, or moderate to high fertility. A sterile soil is without plant food. A soil of low fertility has little plant food. A fertile soil or one moderately or highly fertile has adequate plant food for normal crop growth.

WOODY PLANTS

Trees

American crab apple (*Malus coronaria*). A small thicket-forming tree that provides fall and winter staple food for ruffed grouse, deer, rabbit, and red fox; is also eaten by pheasant, quail, gray squirrel, and songbirds. Found on dry to well-drained, acid to alkaline, moderately fertile soils, in full sun, over the entire region.

Black locust (*Robinia pseudoacacia*). A valuable tree for fence posts and wildlife shelter. Adapted to dry to moist, acid to alkaline soils of low to high fertility, in full sun. Found over entire region.

European mountain-ash (*Sorbus aucuparia*). A small tree that furnishes fall and early winter food for ruffed grouse, deer, and songbirds. *Sorbus americana* is equally good. Susceptible to San Jose scale and should not be planted close to orchards. Found on dry to well-drained, neutral to alkaline soils of moderate to high fertility, in full sun, over the entire region except the Coastal Plain.

Flowering dogwood (*Cornus florida*). A small tree that furnishes fall and early winter food for ruffed grouse, quail, gray squirrel, deer, and songbirds. Requires dry to well-drained, acid to neutral, sterile to fertile soils, in full sun to full shade. Found in Massachusetts, central New York, and southward.

Hackberry (*Celtis occidentalis*). A large tree that provides fall and winter food for pheasant, quail, and songbirds. Found on dry to well-drained, neutral to alkaline soils of moderate to high fertility, in full sun to full shade in Massachusetts, New York, and southward.

Jack pine (*Pinus banksiana*). A tree that makes a good shelter plant on sterile sand. Grows on dry to well-drained, acid to neutral soils, sterile or low in fertility, in full sun. Found in northern Pennsylvania, New York, and northern New England.

Northern red oak (*Quercus borealis*). A large, valuable timber tree that furnishes staple fall food for ruffed grouse and fall and winter food for the gray squirrel. It is also eaten by quail and some fur bearers. Found on dry or well-drained, acid to neutral soils of low to high fertility, in full sun to full shade, over the entire region.

Northern white cedar (*Thuja occidentalis*). A tree valuable for timber and a good shelter species. Provides staple winter food for deer; is also eaten by ruffed grouse, rabbit, and songbirds. Found on well-drained to moist, acid to alkaline soils of moderate to high fertility, in full sun to full shade, over the entire region except the Coastal Plain.

Norway spruce (*Picea excelsa*). An excellent shelter tree valuable for wood products, eaten somewhat by ruffed grouse, deer, rabbit, and songbirds. Grows on well-drained, neutral to alkaline soils of low to high fertility, in full sun to full shade, over the entire region except the Coastal Plain.

Persimmon (*Diospyros virginiana*). A tree that provides fall and winter food for quail, deer, rabbit, gray squirrel, opossum, and songbirds. Grows on dry to well-drained, acid to alkaline soils of low to high fertility, in full sun, in Pennsylvania, New Jersey, and southward.

Quaking aspen (*Populus tremuloides*). A tree that provides staple winter food for deer and ruffed grouse; is also eaten by rabbits. It is valuable as a source of pulpwood. *Populus grandidentata* is equally valuable. Found on dry to well-drained, acid to neutral soils of low fertility, in full sun, over the entire region except the Coastal Plain.

Red mulberry (*Morus rubra*). A tree that furnishes summer food for ruffed grouse and quail and is highly relished by songbirds. Grows on dry to well-drained, acid to alkaline soils of moderate to high fertility, in full sun to half shade, in Massachusetts, central New York, and southward.

Red pine (*Pinus resinosa*). A large tree that provides good timber and wildlife shelter. It is used somewhat as food by deer, ruffed grouse, and songbirds. Found on dry to well-drained, acid to neutral soils of low to moderate fertility, in full sun to half shade, over the entire region except the Coastal Plain and lowlands of West Virginia.

Sugar maple (*Acer saccharum*). A large tree that provides good timber. It is a staple food (browse) for deer; also eaten by rabbits. Adapted to neutral or alkaline, dry to well-drained soils of moderate to high fertility, over the entire region.

Virginia pine (*Pinus virginiana*). A tree that is a good shelter species in the more southern parts of the region. Eaten somewhat by quail, deer, and songbirds. Found on dry to well-drained, acid soils, sterile to high in fertility, in full sun. Adapted to New Jersey, Pennsylvania, and southward.

White oak (*Quercus alba*). A large tree, a valuable timber species that provides staple fall food for ruffed grouse and fall and winter food of gray squirrels; is also eaten by pheasant, quail, rabbit, and deer. Found on dry to well-drained, acid to neutral soils of low to high fertility, in full sun to full shade, in New Hampshire, Vermont, New York, and southward.

White pine (*Pinus strobus*). A large tree, excellent for timber and wildlife shelter. It is used somewhat as food by quail, ruffed grouse, gray squirrel, rabbit, deer, and songbirds. Found on dry to moist, acid to neutral, sterile to fertile soils, in full sun to full shade, over the entire region except the Coastal Plain.

Shrubs

American elder (*Sambucus canadensis*). A medium-sized thicket-forming shrub, a staple summer food of ruffed grouse and pheasant; is also eaten by quail, deer, gray squirrel, fur bearers, and songbirds. Found on dry to well-drained, acid to alkaline soils of low to high fertility, in full sun to half shade, over the entire region.

American hazelnut (*Corylus americana*). A low thicket-forming shrub that supplies staple fall food for ruffed grouse, deer, and gray

squirrel; also eaten by pheasant, quail, and rabbit. Found on dry to well-drained, acid to neutral soils, sterile or low in fertility, in full sun to half shade, in New Hampshire, Vermont, and southward.

Arrowwood (*Viburnum dentatum*). A medium-sized, thicket-forming shrub that supplies fall and early winter staple food for ruffed grouse and is eaten by various songbirds. Requires well-drained to moist, moderately fertile, acid or neutral soil, in full sun to full shade. Found over the entire region.

Basket willow (*Salix purpurea*). A medium-sized shrub, well-adapted for stream-bank shelter planting. Requires well-drained to moist soils of low to high fertility, in full sun. Found in New Hampshire, Vermont, New York, and southward except on the Coastal Plain.

Bayberry (*Myrica carolinensis*). A low thicket-forming shrub that furnishes fall and winter food for ruffed grouse, quail, pheasant, and songbirds. Found on dry or well-drained, sterile to fertile, acid soils, in full sun to half shade, throughout the region.

Bear oak (*Quercus ilicifolia*). A medium-sized, thicket-forming shrub that supplies fall food for ruffed grouse, quail, pheasant, deer, gray squirrel, and some fur bearers. Found on well-drained, acid soils, sterile to low in fertility, in full sun, from Massachusetts and central New York southward.

Black chokeberry (*Aronia melanocarpa*). A low thicket-forming shrub that furnishes fall and winter staple food for ruffed grouse and deer; is eaten by pheasant, rabbit, and songbirds. Found on dry or well-drained, sterile to fertile, acid soils, in full sun to half shade, throughout the entire region.

Blackhaw (*Viburnum prunifolium*). A high, thicket-forming shrub that provides fall and winter food for quail, deer, and songbirds. Found on dry to well-drained, acid or alkaline soils of low to high fertility, in full sun or half shade, in Massachusetts, central New York, and southward.

Coralberry (*Symphoricarpos orbiculatus*). A low thicket-forming shrub that furnishes fall and winter food for ruffed grouse, quail, pheasant, deer, and songbirds. Found on dry to well-drained, sterile to fertile, acid to alkaline soils, in full sun to half shade, in Massachusetts and central New York and southward.

Gray dogwood (*Cornus paniculata*). A low to medium sized thicket-forming shrub. A staple fall and early winter food of ruffed grouse, pheasant, and songbirds; it is also eaten by quail. Requires dry to well-drained, acid to neutral soils, sterile or low in fertility, in full sun. Found in New Hampshire, Vermont, and southward except the Coastal Plain.

Hall Japanese honeysuckle (*Lonicera japonica halliana*). A mat-forming vine that is very easily transplanted from wild stock. It is eaten by quail and songbirds and is adapted for dry or well-drained, acid to alkaline soils, sterile to moderately fertile, in full sun to full shade. Found in central New York and Massachusetts and southward.

Highbush cranberry (*Viburnum trilobum*). A medium-sized shrub that provides fall and winter food for ruffed grouse, pheasant, and songbirds. Found on well-drained to moist, acid to alkaline soils of low to moderate fertility, in full sun to full shade, over the entire region except the Coastal Plain.

Mapleleaf viburnum (*Viburnum acerifolium*). A low shrub that supplies staple fall and winter food for ruffed grouse; is also eaten by deer and songbirds. Found on dry to well-drained, acid soils, sterile to moderate in fertility, in full sun to full shade, over the entire region.

Nannyberry (*Viburnum lentago*). A medium-sized to high, thicket-forming shrub, a staple fall and winter food for ruffed grouse; is also eaten by pheasant, rabbit, gray squirrel, and songbirds. Found on dry to well-drained, acid to alkaline soils of moderate to high fertility, in full sun to half shade, over the entire region except the Coastal Plain.

Red-osier (*Cornus stolonifera*). A medium-sized shrub that furnishes staple fall and winter food of deer. It is also eaten by ruffed grouse, quail, rabbit, and songbirds. Found on well-drained to moist, acid to alkaline soils of moderate fertility, in full sun to half shade, over the entire region.

Shrub bushclover (*Lespedeza bicolor*). A low shrub that often dies back to the roots each year and sprouts again in the spring; eaten by quail, turkey, and songbirds. Adapted to dry or well-drained, acid to neutral soils, sterile to moderately fertile, in southern New Jersey and Pennsylvania and southward.

Silky cornel (*Cornus amomum*). A medium-sized thicket-forming shrub that supplies fall food for ruffed grouse, pheasant, quail, and songbirds. Found on well-drained to moist, acid to alkaline soils of moderate fertility, in full sun to full shade, in New Hampshire, Vermont, New York, and southward.

Snowberry (*Symphoricarpos albus*). A low, thicket-forming shrub that provides fall and winter food for ruffed grouse, pheasant, quail, deer, and songbirds. Found on dry to well-drained, acid to alkaline soils of moderate fertility, in full sun to half shade, over the entire region except the Coastal Plain.

Swamp rose (*Rosa carolina*). A low, thicket-forming shrub that furnishes fall and winter staple food for ruffed grouse and quail. *R. Multiflora*, with somewhat drooping branches and very small fruit, and *R. rugosa*, with very large fruit, are also recommended. Found on dry to well-drained, acid or alkaline soils of low to high fertility, in full sun to full shade, over the entire region except Maine.

Tatarian honeysuckle (*Lonicera tatarica*). A medium-sized shrub, eaten by songbirds. Adapted to dry to well-drained, acid to alkaline soils of sterile to high fertility, in full sun, in Massachusetts and central New York and southward.

Thunberg barberry (*Berberis thunbergii*). A low, thicket-forming shrub that provides winter food for ruffed grouse, pheasant, quail, and songbirds. Adapted to dry to well-drained, neutral to alkaline, sterile to fertile soils, in full sun, in Massachusetts and central New York and southward.

Wild plum (*Prunus americana*). A high, thicket-forming shrub that provides fall food for pheasant, quail, and songbirds. Found on dry to well-drained, acid to neutral soils of low to high fertility, in full sun to half shade, in Massachusetts and central New York and southward.

Winterbury (*Ilex verticillata*). A medium-sized shrub that furnishes staple fall and winter food for ruffed grouse; is also eaten by pheasant, quail, and songbirds. Found on well-drained to moist, acid soils, sterile or low in fertility, in full sun, over the entire region.

Vines

Climbing bittersweet (*Celastrus scandens*). A vine that furnishes fall and winter food of ruffed grouse, pheasant, quail, and songbirds. Requires dry to well-drained, sterile to fertile, acid or neutral soils, in full sun to half shade. Found over the entire region.

Fox grape (*Vitis labrusca*). A vine that provides staple fall and winter food for ruffed grouse and quail; is eaten by pheasant, red fox, and songbirds. Found on dry to well-drained, neutral to alkaline soils of moderate to high fertility, in full sun to full shade, over the entire region except the Coastal Plain.

Virginia Creeper (*Parthenocissus quinquefolia*). A vine that supplies fall and early winter food of ruffed grouse, pheasant, quail, deer and songbirds. Found on well-drained, acid to alkaline soils of moderate fertility, in full sun to half shade, in Massachusetts and central New York and southward.

GRASSES AND LEGUMES

Alsike clover (*Trifolium hybridum*). A perennial legume, eaten by rabbit and songbirds. Grows on well-drained to moist, acid to alkaline soils of low to high fertility, over the entire region. Preferably used for seedings in mixture.

Birdsfoot trefoil (*Lotus corniculatus*). A perennial legume eaten by some birds. Adapted to dry or well-drained, acid to alkaline soils, from sterile to high fertility, throughout the region.

Common lespedeza (*Lespedeza striata*). An annual legume that provides food for quail; is also eaten by deer and songbirds. It is used alone or in mixtures. Adapted to dry to well-drained, acid to neutral soils of low to high fertility, in New Jersey and southern Pennsylvania southward.

Corn (*Zea mays*). An annual grass. Staple fall and winter food of pheasant and quail; is also eaten by waterfowl, gray squirrel, and songbirds. Adapted to well-drained, neutral to alkaline soils of moderate to high fertility, in New Hampshire, Vermont, and New York and southward. Requires cultivation.

Domestic ryegrass (*Lolium multiflorum* and *L. perenne*). A mixture of annual and perennial ryegrasses, used in mixtures. Adapted to well-drained, slightly acid to alkaline, moderate to fertile soils, over the entire region.

Japanese millet (*Echinochloa crusgalli* var. *frumentacea*). An annual grass, eaten by quail, pheasant, waterfowl, and songbirds. Grows on well-drained to moist, acid to alkaline soils, sterile to moderate in fertility over the entire region.

Korean Lespedeza (*Lespedeza stipulacea*). An annual legume, eaten by quail and songbirds. Used alone or in mixtures. Grows in dry to well-drained, acid to neutral soils of low to high fertility in New Jersey and southern Pennsylvania and southward.

Orchard grass (*Dactylis glomerata*). A perennial grass used in mixtures; grows on most soils of moderate fertility, on dry to well-drained sites, throughout the region.

Partridge-pea (*Chamaecrista fasciculata* or *Chamaecrista procumbens*). An annual or sometimes perennial legume that reseeds readily. It is a staple food for quail; is also eaten by songbirds. Grows on

dry to moist, acid to neutral soils, sterile or low in fertility. Used alone or in mixtures with lespedezas. Adapted to New Jersey and southern Pennsylvania and southward.

Reed canary grass (*Phalaris arundinacea*). A perennial grass eaten by many songbirds. Adapted to well-drained to moist, acid to neutral soils of low to high fertility, throughout the Region.

Sericea (*Lespedeza sericea*). A perennial legume, eaten by quail, rabbit, and songbirds. Makes excellent shelter for quail. Used with nurse crop or in perennial mixture. Grows on dry to well-drained, acid to neutral soils, sterile or low in fertility, in New Jersey and southern Pennsylvania and southward.

Sudan grass (*Sorghum vulgare* var. *sudanense*). An annual grass, eaten by pheasants, quail, and songbirds. Used as a nurse crop in mixtures. Grows on dry to well drained, acid to alkaline soils of low to high fertility, in New Hampshire, Vermont, New York, and southward.

Sunflower (*Helianthus annuus*). An annual herb, much relished by songbirds. Grows on dry to well-drained, acid to alkaline soils of low to high fertility, over the entire region.

Tall oatgrass (*Arrhenatherum elatius*). A perennial grass used in mixtures. Grows on any dry to well-drained soil, throughout the region.

Timothy (*Phleum pratense*). A perennial grass used in mixtures. Grows on dry to well-drained, acid to alkaline soils of low to high fertility, over the entire region.

White sweetclover (*Melilotus alba*). A biennial legume that reseeds readily, used in mixtures. Eaten by quail, pheasants, waterfowl, deer, rabbit, and songbirds. Adapted to dry or well-drained, neutral to alkaline soils of low to high fertility, over the entire Region.

AQUATIC PLANTS

Arrowhead (*Sagittaria latifolia*). A perennial herb with large tubers which are good duck food. Adapted to the entire region.

Bushy pondweed (*Naias flexilis*). An annual herb, the seeds and leafy parts of which are excellent duck food. Grows best on sandy bottoms. Adapted to the entire region.

Common three-square bulrush (*Scirpus americanus*). A perennial sedge, the seeds of which are good duck food. Is a good shelter plant. Prefers sandy soil and is adapted to the entire region.

Dotted smartweed (*Polygonum punctatum*). A perennial herb that is excellent duck food; the seeds are also eaten by pheasant, quail, and songbirds. Adaptable either to shallow aquatic planting or to marsh or moist soils over the entire region. Other species of perennial smartweeds equally good are *Polygonum amphibium* (water smartweed) and *Polygonum hydropiperoides* (swamp smartweed). Tolerant of both mild acidity and mild alkalinity.

Duckweed (*Lemna minor*). A perennial floating herb that is good duck food (whole plant). Thrives in acid to alkaline water. Plants sink to bottom in fall and rise again in spring. Adapted to the entire region.

Hardstem bulrush (*Scirpus acutus*). A perennial sedge, the seeds of which are good duck food. Is a good shelter plant and wave breaker. Tolerant of a wide variety of soils in Pennsylvania, northern New Jersey, and northward.

Sago pondweed (*Potamogeton pectinatus*). An annual herb that regenerates readily. Its tubers, seeds, and root stalks are the best of all duck foods. Best adapted to sandy mud bottoms, over the entire region.

Wildcelery (*Vallisneria spiralis*). A perennial herb, the underground parts, leaves, and pods of which make excellent duck food. Grows best on bottoms of sand or coarse silt. Is adapted to the entire region except northern Maine.

Wild millet (*Echinochloa crusgalli*). An annual grass the seeds of which are good duck food. Adapted to the entire region.

Wildrice (*Zizania aquatica*). An annual grass, the seeds of which make excellent duck food. A good shelter plant, adapted to the entire region. Prefers bottom of deep muck or soft fine silt.

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