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**Chernobyl Doses,  
Volume 3—Habitat and Vegetation Near the Chernobyl  
Nuclear Reactor Station**

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## PREFACE

This volume is the third in a series of three volumes composing the final report to the Defense Nuclear Agency (DNA) for contract DNA001-87-C-0104, Chernobyl Doses. It was prepared at Colorado State University from locally available literature under a consulting agreement with Pacific-Sierra Research Corporation (PSR). It was generated as a topical report for that contract, but is being published as a volume of the final report. It provides a detailed exposition on the soils, climate, and vegetation of the Poles'ye region of the Ukraine and Belorussia with emphasis on the area around the Chernobyl Nuclear Reactor Station. This data provides background for the interpretation of satellite imagery of the area. Volume 2, *Conifer Stress Near Chernobyl Derived from Landsat Imagery*, describes the acquisition and processing of satellite multispectral imagery of the area containing the Chernobyl Nuclear Reactor Station and presents the exploratory analysis of the imagery using PSR's proprietary Hyperscout™ change detection algorithm. Volume 1, *Analysis of Forest Canopy Radiation Response from Multispectral Imagery and the Relationship to Doses*, presents the analytical work that connects these multispectral observations of pine forests in the images to the nuclear radiation dose received by the trees as a consequence of the reactor accident of 26 April 1986 and summarizes other work conducted for the contract.

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# CONVERSION TABLE

Conversion factors for U.S. customary to metric (SI) units of measurement

| To Convert From                                  | To                                                 | Multiply                   |
|--------------------------------------------------|----------------------------------------------------|----------------------------|
| angstrom                                         | meters (m)                                         | 1.000 000 X E-10           |
| atmosphere (normal)                              | kilo pascal (kPa)                                  | 1.013 25 X E+2             |
| bar                                              | kilo pascal (kPa)                                  | 1.000 000 X E+2            |
| barn                                             | meter <sup>2</sup> (m <sup>2</sup> )               | 1.000 000 X E-28           |
| British Thermal unit (thermochemical)            | joule (J)                                          | 1.054 350 X E+3            |
| calorie (thermochemical)                         | joule (J)                                          | 4.184 000                  |
| cal (thermochemical)/cm <sup>2</sup>             | mega joule/m <sup>2</sup> (MJ/m <sup>2</sup> )     | 4.184 000 X E-2            |
| curie                                            | giga becquerel (GBq)**                             | 3.700 000 X E+1            |
| degree (angle)                                   | radian (rad)                                       | 1.745 329 X E-2            |
| degree Fahrenheit                                | degree kelvin (K)                                  | $t_K = (t_F + 459.67)/1.8$ |
| electron volt                                    | joule (J)                                          | 1.602 19 X E-19            |
| erg                                              | joule (J)                                          | 1.000 000 X E-7            |
| erg/second                                       | watt (W)                                           | 1.000 000 X E-7            |
| foot                                             | meter (m)                                          | 3.048 000 X E-1            |
| foot-pound-force                                 | joule (J)                                          | 1.355 818                  |
| gallon (U.S. liquid)                             | meter <sup>3</sup> (m <sup>3</sup> )               | 3.785 412 X E-3            |
| inch                                             | meter (m)                                          | 2.540 000 X E-2            |
| jerk                                             | joule (J)                                          | 1.000 000 X E+9            |
| joule/kilogram (J/Kg) (radiation dose absorbed)  | Gray (Gy)                                          | 1.000 000                  |
| kilotons                                         | terajoules                                         | 4.183                      |
| kip (1000 lbf)                                   | newton (N)                                         | 4.448 222 X E+3            |
| kip/inch <sup>2</sup> (ksi)                      | kilo pascal (kPa)                                  | 6.894 757 X E+3            |
| kta                                              | newton-second/m <sup>2</sup> (N-s/m <sup>2</sup> ) | 1.000 000 X E+2            |
| micron                                           | meter (m)                                          | 1.000 000 X E-6            |
| mil                                              | meter (m)                                          | 2.540 000 X E-5            |
| mile (international)                             | meter (m)                                          | 1.609 344 X E+3            |
| ounce                                            | kilogram (kg)                                      | 2.834 952 X E-2            |
| pound-force (lbf avoirdupois)                    | newton (N)                                         | 4.448 222                  |
| pound-force inch                                 | newton-meter (N-m)                                 | 1.129 848 X E-1            |
| pound-force/inch                                 | newton/meter (N/m)                                 | 1.751 268 X E+2            |
| pound-force/foot <sup>2</sup>                    | kilo pascal (kPa)                                  | 4.788 026 X E-2            |
| pound-force/inch <sup>2</sup> (psi)              | kilo pascal (kPa)                                  | 6.894 757                  |
| pound-mass (lbm avoirdupois)                     | kilogram (kg)                                      | 4.535 924 X E-1            |
| pound-mass-foot <sup>2</sup> (moment of inertia) | kilogram-meter <sup>2</sup> (kg-m <sup>2</sup> )   | 4.214 011 X E-2            |
| pound-mass/foot <sup>3</sup>                     | kilogram/meter <sup>3</sup> (kg/m <sup>3</sup> )   | 1.601 846 X E+1            |
| rad (radiation dose absorbed)                    | Gray (Gy)**                                        | 1.000 000 X E-2            |
| roentgen                                         | coulomb/kilogram (C/kg)                            | 2.579 760 X E-4            |
| shake                                            | second (s)                                         | 1.000 000 X E-8            |
| slug                                             | kilogram (kg)                                      | 1.459 390 X E+1            |
| torr (mm Hg, 0°C)                                | kilo pascal (kPa)                                  | 1.333 22 X E-1             |

\*The becquerel (Bq) is the SI unit of radioactivity; Bq = 1 event/s.

\*\*The Gray (Gy) is the SI unit of absorbed radiation.

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# **SECTION 1**

## **INTRODUCTION**

This report was prepared to support the use of satellite multispectral imagery to detect changes in the vegetation near the Chernobyl Nuclear Reactor Station that were caused by the release of radioactive material during the accident of 26 April 1986. It is based on a review of literature available locally at Colorado State University.

The review covered information on the Poles'ye region of the Ukraine and Belorussia, republics of the former Soviet Union. This area contains the 30 kilometer danger zone that was evacuated in the aftermath of the accident. The information is intended to aid in the interpretation of features and vegetation types in the imagery of the area within the danger zone.

Section briefly describes the geography, Section 3 the soils, and Section 4 the climate of the Poles'ye, with emphasis on the area near the reactor station. Section 5 presents an extensive discussion of vegetation of the region. Sections 6, 7, and 8 describe succession, bog drainage, and typical crops, respectively. Appendixes A, B, and C provide descriptions of the more important species of trees and shrubs, herbs, and crop plants, respectively.

## SECTION 2

### GEOGRAPHY<sup>1</sup>

The Chernobyl Nuclear Reactor Station (NRS) and much of the area within 30 kilometers (km) around it are located in the Poles'ye<sup>2</sup> region of the Ukrainian and Belorussian<sup>3</sup> Soviet Socialist Republics. The power plant itself and the cities of Pripyat<sup>4</sup> and Chernobyl are in northeastern Kievskaya Oblast, in the interfluvium of the Pripyat and Teterev Rivers, in the Ukrainian SSR. It lies at about 51°12'N longitude 30°8'E latitude.

The Poles'ye lies in the Pripyat River basin and in part of the Dnepr<sup>5</sup> River basin and includes the area called the Pripyat marshes or bogs. It is a vast lowland (more than 13 million hectares) on a large, morainal outwash and outwash-alluvial plain on the Russian platform. It is bounded on the north, east, and south by greater rises in elevation than can be found within the region itself. The area has a very nonhomogeneous geological structure. From west to east, it occupies the various geostructural regions of the Russian platform: the Galician-Volyn lowland, the Ukrainian crystalline shield, the Dnepr-Donestsk depression, with the east approaching the Voronezh crystalline shield.

The terrain is almost uniformly low, broken only by low moraine hills, sandy knolls or mounds (usually old dunes), and slightly elevated plains. The relief from the center to the edges of the basin is only 50 to 150 meters (m). Some areas possess eolian relief, often in the form of parabolic, west-facing dunes, but maximum heights within the Poles'ye are only 200 m. The interfluvium of the Pripyat and Teterev Rivers has an unusual morainal-hilly relief with some relatively deep erosion. Poorly drained sandy plains are located between the moraine hills.

The Poles'ye is often divided into three sections: the western, the central (or right bank—on the right bank of the Dnepr River), and the eastern (or left bank). In the Ukraine, the central section is divided into the Kiev Poles'ye and the Zhitomir Poles'ye. The Kiev Poles'ye lies on the

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<sup>1</sup>Geological information has been synthesized from Keller 1927, Berg 1950, Akademiya Nauk SSSR 1963, Lydolph 1964, Fridland 1976, Golovina et al. 1980, Lysenko and Golovina 1982, USSR 1987.

<sup>2</sup>Polesye, Poles'e, Poles'ya, Polesie, Polessie, Polesiye, Pollessic lowlands, Polyesye (Where there are multiple spellings of a Russian name in English, the one most frequently encountered in Soviet literature has been used. All others are listed in a footnote.)

<sup>3</sup>Byelorussian or White Russian.

<sup>4</sup>Pripyat', Prip'at, Pripiat, Pripet.

<sup>5</sup>Dnieper.

middle Dnepr slope, in the interfluvium of the Pripyat and Teterev Rivers, extending east to the Dnepr River, and includes the Chernobyl NRS and the area immediately around it. The Zhitomir is west of the Kiev Poles'ye.

## SECTION 3

### SOILS<sup>6</sup>

Glaciofluvial plains are formed by deposition from thaw waters of glaciers. They consist of outwash and broken-up moraine materials. The soils in the Poles'ye formed in a humid climate on glaciofluvial plains from a blanket of unconsolidated Quaternary outwash deposits of sand and loamy sand over- and underlying a terminal glacial moraine. Glaciofluvial sediments are sandy or gravelly-pebbly stratified sediments of flowing glacial waters. Outwash plains are relatively smooth sandy surfaces deposited near the edges of continental ice. The thickness of these deposits range from 1.5 m in the southeast to 150 m in the northwest. Moraines are deposits of continental ice, consisting mostly of unstratified, unsorted, nonuniform materials of varying mechanical composition. The Poles'ye terminal moraine is mostly loamy sand. Medium and clay-loam lake deposits are rare in the Poles'ye and loesses, even rarer.

The parent materials are course-textured, very bouldery, and gravelly; fine particles are usually leached or washed away. In the Kievskaya Oblast, glacial waters were active for a long time during the formation of the parent material. The soils generally lack carbonates in the parent materials. Most of the soils are at least periodically waterlogged (with spring and autumn floods, and sometimes after prolonged summer rains).

Most of the Poles'ye soils are poor in humus; soils in the western and central Poles'ye often have 1 to 1.5 percent humus and can have less than 1 percent. The soils are mostly noncalcareous. They generally are acid, with a pH of 4.5 to 5.5, and are low in available nutrients, including boron, zinc, phosphorus, potassium, and nitrate.

The soils in the Poles'ye are podzolic,<sup>7</sup> peaty bog, and peaty-gley meadow soils. More than 75 percent of the soils are meadow or bog soils. Soils on floodplains may be bog, meadow, or podzols. Parent materials around the Chernobyl NRS is from the Ukrainian crystal shield and is mainly sands or sandy-loams. Many of the soils in the northeastern part of the Kiev Poles'ye, in the interfluvium of the Pripyat and Teterev Rivers, are weakly podzolic (frequently gleyed) sods.

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<sup>6</sup>Descriptions, distributions, and definitions of soils have been synthesized from Sukachev 1928, Berg 1950, Vilenskii 1960, Lydolph 1961, Fridland 1965, Symons 1972, Brady 1974, Krupskiy et al. 1970, Walter 1978, Smith 1980, Golovina et al. 1980, Oleynik 1981, Lysenko and Golovina 1982, USSR 1986, USSR 1987.

<sup>7</sup>The soil classification system found in the Soviet literature surveyed for this report is not the system currently being used in much of the western world. Podzols have been placed in a group called "spodosols," most bog soils in "histosols," and most gley soils in "inceptisols" (Brady 1974, Smith 1980). This report continues to use the classification used in the USSR. Many of the old soil names come originally from Soviet soil literature. "Podzol" is a Russian word, and "gley" is Ukrainian.

The soils of the area frequently are flooded or contain excess soil water, at least part of the year. There are three sources of excess soil water in the Poles'ye: (1) in the spring and often in the autumn from stream overflow; (2) from a groundwater table that is very close to the soil surface; and (3) from high amounts of atmospheric precipitation. The banks of the streams and floodplain terraces are both very low. In the spring and autumn, and after heavy summer rains, streams overflow onto floodplain terraces and into interfluvial moraine plains between neighboring streams, and water from one stream sometimes passes into another.

Much of the area around the Chernobyl NRS is poorly drained and contains a large block of low-lying wetlands with bog soils. Because bog soils receive excessive moisture for the greater part of the year, are sometimes covered with shallow water, and have poor drainage, they become peaty.

Podzols have a very thin organic layer on top of a gray, leached eluvial layer, which in turn overlies a dark brown horizon. Podzols develop in cool, moist climates under coniferous forest. Podzolization occurs when rainfall in forests is sufficient to carry away many elements, especially calcium, magnesium, potassium, iron, and aluminum. Because the needles of coniferous trees are acid, conifers generally return insufficient bases to the surface soil, which becomes acid. The distribution of podzols is patchy in the Poles'ye.

There are large quantities of weakly podzolic sandy soils ("bor sands"). ("Bor" is a pine woodland on poor, sandy soil.) Dry bor sands are found on eolian and moraine hills in the Poles'ye.

Meadow soils are derived from bog or podzolic soils and are also called "halfbog," "turf-podzol," or "sod-podzol" soils. "Half-bog" soils develop when herbaceous plants and/or deciduous trees grow on drained bogs. These are often found under wet meadows. Deciduous trees growing on podzols add nitrogen and other minerals. An herbaceous understory can develop, transforming the upper horizons of podzols into "sod-" or "turf-podzols." Such soils are found under fresh meadows. Soddy, moderately podzolic soils have formed on moraine outcrops in the Kiev Poles'ye.

When forests are cleared but not adequately drained, the podzols deteriorate. Deterioration is marked by formation of gley horizons. Gleyed soils include gley, gley-podzol, and sod-gley soils. Gleization occurs when the iron in soils where water is at or near the surface is usually reduced to ferrous compounds, having a gray or bluish color. These soils therefore have a more or less dense but not unusually viscous layer of loamy or clayey material of a gray color. Gley are also found in seasonally waterlogged sites. Sod-gley soils are found in meadows that have become boggy; areas with gleyed soils often become sphagnum bogs.

Some parts of the Poles'ye contain "islands" of soils foreign to it. There are small loess islands in both the Zhitomir Poles'ye to the west of the Kiev Poles'ye and the left bank to the east. One

such island occurs on the Ovruch ridge (about 90 km west of Chernobyl). This ridge is 320 m above sea level and 60 m above the surrounding lowland.

## SECTION 4

### CLIMATE<sup>8</sup>

The Poles'ye has a humid temperate-continental climate, influenced by maritime, continental, and local factors.

Bogs, which are common around the Chernobyl NRS, influence the microclimate. These areas have high humidity, low temperature minima, evening and morning mists close to the soil surface, and frequent frosts.

Forests, which are common, also influence the microclimate. The air temperatures are lower than in the open; the daily temperature ranges are smaller; the snow cover is less thick; and winds are stilled.

The moisture from the Baltic Sea and the "great valley" region of Poland influences the Poles'ye. Because there is unrestricted passage of marine winds, unhindered by major land relief, there is considerable marine influence on the climate.

A small local maximum of relative humidity, caused by the intensified evaporation of water from wetlands, is noticed over the Poles'ye wetlands. The minimum relative humidity at 1 p.m. in May is 50 to 55 percent. The mean humidity for June, July, and August is 56 to 60 percent.

The Poles'ye has hot summers and relatively mild winters. Mean temperatures in the region are -6 to -7 °C in January, 6 to 7 °C in April, 19 °C in July, and 7 °C in October. Absolute minimum temperatures are -30 to -35 °C in January, while summer maximums range up to 40 °C.

The growing season (days with mean temperatures above 5 °C) is about 160 days. The growing season in bogs begins 8 to 10 days later than in the surrounding nonbog habitat and ends 10 to 12 days earlier.

Summer precipitation exceeds winter by a factor of 2. In any season, there is precipitation every 2 to 3 days. In the warm season (April to September), the amount of precipitation in the interior of the European USSR is much greater (350 to 500 millimeters [mm]) than on the coasts (200 to 300 mm). During the cold half of the year (November to March) in the central belt of European USSR, the precipitation amounts are 100 to 300 mm.

A precipitation maximum is situated on the Pripyat and the upper reaches of the Dnepr and Western Dvina Rivers. The maximum precipitation in the Pripyat basin is 680 to 695 mm/year. Precipitation diminishes eastward from the Pripyat. In the specific region of interest, mean precipitation is 500 to 600 mm/yr, with around 180 days/year recording precipitation. Two-thirds

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<sup>8</sup>Information about the climate has been synthesized from Kendrew 1942, Berg 1950, Anonymous 1962, Borisov 1965, Szafer 1966, Skoropanov 1968, Lysenko and Golsvina 1982, USSR 1987.

of the precipitation is received in the warm season (April to September). The mean intensity of precipitation amounts to 8 to 10 mm/hr in the central belt of the country (51 to 59°N).

At 50°N by the second 10-day period in November snow cover is continuous. In western European USSR, snow cover is usually continuous by the last 10 days in October or the first 10 days in November. At 55°N 30°E, there is an average of 2.5 temporary snow covers before the onset of winter. In central European USSR, winter temperatures and precipitation are highly variable. Mean maximum snow depth is 10 to 30 centimeters (cm). Continuous snow cover generally lasts about 80 days. Rivers and streams are generally frozen for about 100 days/year.

## SECTION 5

### VEGETATION

On a global scale, the Poles'ye is in the Eastern European vegetation province, whose northern, eastern, and southeastern boundaries correspond to the distributions of *Quercus robur*, *Acer platanoides*, and *Corylus avellana* (Takhtajan 1986). In the Flora of the USSR, the Poles'ye is in the Upper Dnepr floral region (Komarov 1968). According to Lydolph (1964), Poles'ye means "woodland" and much of the natural vegetation was once pine-dominated woodlands. About 30 percent is still forested.

Habitats in the region are classified by how wet they are and whether the vegetation includes trees. The basic plant community types in the region are wetlands, meadows, carrs, woodlands, and forests.<sup>9,10,11</sup> These may grade into one another. In the Chernobyl district, natural vegetation (mostly forest, woodlands, and wetlands) covers nearly 50 percent of the terrain (USSR 1987). This does not include the meadows that have been created from draining mires or felling forests, in which the natural vegetation is often augmented with pasture grasses and legumes. In all, only one-third of the landscape is croplands.

Much of the Kiev Poles'ye is floodplain terraces. Floodplains are usually divided into the area adjacent to the streambed (the streamside zone), a central zone, and an "upper" zone. The streamside zone has the thickest silt deposit and relatively high mesorelief (depressions and ridges<sup>12</sup>). Ridges in this zone are usually 1 to 10 m high and depressions are quite shallow. The central zone is usually undulating, with low mesorelief and shallow groundwater. Ridges in the central zone usually are not flooded and may even experience some drought. Depressions are

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<sup>9</sup>While the vegetation types are specific to the Poles'ye, the species lists are those known to occur in that type of vegetation in northern Ukraine, southern Belorussia, and/or adjacent areas in Poland.

<sup>10</sup>Definitions and descriptions of habitat, vegetation types, succession, bog drainage, and reclamation have been synthesized from Keller 1927, Berg 1950, Vilenskii 1960, Akademiya Nauk SSSR 1963, Viktorov et al. 1964, Pyavchenko 1965, Szafer 1966, Skoropanov 1968, Stankevich and Rubin 1968, Remezov and Pogrebnyak 1969, Ivanov 1972, Fridland 1976, Walter 1978, Komarov 1980, Smith 1980, Moore 1984, USSR 1987.

<sup>11</sup>Information on the flora of vegetation types and descriptions on the species lists was synthesized from Keller 1927, Sukachev 1928, Wulff 1943, Berg 1950, Vilenskii 1960, Larin 1962a,b, 1964, Akademiya Nauk SSSR 1963, Komarov 1963, 1964, 1967, 1968, 1970, 1971a,b, Tutin 1964, 1968, 1972, Pyavachenko 1965, Szafer 1966, Remezov and Pogrebnyak 1969, Ivanov 1972, Bialobok and Zelawski 1976, Leathart 1977, Phillips 1978, Walter 1978, Hora 1981, Oleynik 1981, Moore 1984, Takhtajan 1986, USSR 1987.

<sup>12</sup>Mesorelief ridges and depressions are geomorphic in origin and are not synonymous with hummocks and hollows, which are formed by the vegetation and are much smaller in scale than ridges and depressions. There are some differences in flood meadow species distribution related to mesorelief. These can be found with the individual species in the species lists that follow.

flood-prone. The central zone can contain areas in which flooding is prolonged (greater than 40 days), moderate (20 to 40 days), and short (fewer than 20 days), and areas that do not experience annual flooding; the vegetation in them varies accordingly. The "upper" zone is the lowest in absolute elevation and is usually flat and excessively wet. Fen, bog, meadow, and woodland vegetation may all occur on floodplains. Fens and carrs are usually found close to the stream. Transitional bogs are usually found in the central zone. Annually flooded meadows are found both close to the stream and in the central zone. Fresh meadows and moist forests, habitats that do not experience annual are usually in the central zone. Floodplain bogs, boggy wet forests, and wet meadows are found in the upper zone.

There are also extra- (or supra-) floodplain areas. The interfluvium of the Pripyat and Teterev Rivers is unusually morainal-hilly. There are poorly drained sandy plains located between the moraine hills. Dry woodlands and forests are found on the moraine hills. Sphagnum bogs and wet forests occur on the poorly drained moraine plains and fresh meadows in better drained areas.

Immense tracts of the Poles'ye are occupied by wetlands. The Russian word "botolo" is a general term for wetlands. It is translated in a number of ways, but the best may be mire: a peatland,<sup>13</sup> a wetland with considerable water retained by an accumulation of partially decayed organic matter, including wetlands with or without flowing water. There are a number of English terms used to describe different types of mires. Marshes are wetlands with emergent vegetation (i.e., plants with their leaves above water but their roots in soil that is covered [part or all of the time] with water). Marshes include both fens, swamps, and bogs. Fens are mires fed by moving water, either surface or ground water. Swamps are fens with only surface water influence. If woody vegetation is added to a fen, these communities are called carrs. Fens are sometimes called low moors or low moor bogs. The community closest to a stream is usually a fen or carr. Fens are also frequently found at the edges of lakes. Bogs are mires where water is supplied exclusively by atmospheric precipitation. The terms "high moor" bog and "raised" bog are sometimes used to distinguish true bogs from fens. Transitional bogs are intermediate between fens and bogs. The term "marsh" is sometimes reserved for transitional bogs. Most bogs are not flat but consist of hummocks, hollows, and intermediate sites.<sup>14</sup>

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<sup>13</sup>In geological terms, a mire must have a layer of peat at least 20 to 30 cm deep (Walter 1978). "Moor" means mire in German; in English it is used for transitional bogs.

<sup>14</sup>Information about which species grow on hummocks, hollows, and intermediate sites can be found with the plant descriptions in the species list.

The dominant vegetation in sedge fens (swamp) is usually sedges, horsetails, and/or cottongrass. Plants<sup>15</sup> include *Equisetum arvense*,<sup>16</sup> *E. palustre*, *E. pratense*, *E. variegatum*, *Carex acutiformis*, *C. appropinquata*, *C. aquatilis*, *C. caespitosa*, *C. canescens*, *C. chordorrhiza*, *C. diandra*, *C. dioica*, *C. gracilis*, *C. heleonastes*, *C. lasiocarpa*, *C. limosa*, *C. panicea*, *C. paniculata*, *C. pseudocyperus*, *C. riparia*, *C. stellulata*, *C. vesicaria*, *C. vulpina*, *Cyperus flavescens*, *C. panonicus*, *Eriophorum angustifolium*, *E. gracile*, *E. latifolium*, *Scirpus lacustris*, *silvaticus*, *Juncus compressus*, *J. inflexus*, *J. tenageia*, *Alopecurus arundinaceus*, *A. geniculatus*, *Glyceria aquatica*, *Leersia oryzoides*, *Phragmites communis*, *Poa palustris*, *Setaria glauca*, and *S. viridis*. In colored aerial photographs,<sup>17</sup> fens appear smooth dark green (the darker, the wetter the mire). In black and white photos, they appear dark, either without outlines or with an elongated outline. Soils beneath sedge fens become peaty.

Reed-bulrush fens (swamps) also have peat soil. The vegetation includes *Phragmites communis*, *Scirpus acicularis*, *S. eupalustris*, *S. holoschoenus*, *S. lacuster*, *S. mamillatus*, *S. ovatus*, *S. pauciflorus*, *S. sylvaticus*, *Beckmannia eruciformis*, *Calamagrostis neglecta*, *Glyceria aquatica*, *G. fruitans*, *G. hemoralis*, *Leersia oryzoides*, *Phalaris arundinacea*, *Typha angustifolia*, *T. latifolia*, *Carex elata*, *C. omskiana*, *C. panicea*, *C. pseudo-cyperus*, *C. vesicaria*, *Juncus compressus*, and *J. tenageia*. These usually sit in 50 to 100 cm of water, with plants anchored in a silty bottom.

Soils in transitional bogs are also peaty. Vegetation includes *Carex acutiformis*, *C. appropinquata*, *C. aquatilis*, *C. caespitosa*, *C. canescens*, *C. chordorrhiza*, *C. diandra*, *C. dioica*, *C. disticta*, *C. disperma*, *C. elata*, *C. filiformis*, *C. gracilis*, *C. heleonastes*, *C. juncella*, *C. lasiocarpa*, *C. limosa*, *C. muricata*, *C. omskiana*, *C. pauciflora*, *C. pseudo-cyperus*, *C. riparia*, *C. vesicaria*, *C. vulpina*, *Eriophorum angustifolium*, *E. gracile*, *E. latifolium*, *E. vaginatum*, *Scirpus lacustris*, *Juncus compressus*, *J. effusus*, *J. lampocarpus*, *J. leersii*, *J. squarrosus*, *Alopecurus arundinaceus*, *A. geniculatus*, *Beckmannia eruciformis*, *Calamagrostis neglecta*, *Deschampsia caespitosa*, *Molinia coerulea*, *Equisetum heleocharis*, *E. palustre*, and *E. variegatum*. *Sphagnum apiculatum*, *Sph. compactum*, *Sph. cuspidatum*, *Sph. fuscum*, *Sph. papillosum*, *Sph. recurvum*, *Sph. rubellum*, and *Sph. squarrosum* are common mosses. Transitional bogs are often found in shallowwater (less than 1 m), where *Alnus*

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<sup>15</sup>Community types are general. They are often subdivided into two to many more detailed communities. Not all plants listed for a community will necessarily be found together; rather they are found in one or more of the communities of the type. With nondominants, species order does not necessarily reflect importance.

<sup>16</sup>Common names for individual species can be found in the species list.

<sup>17</sup>Further information about the appearance of vegetation in aerial photographs can be found with the descriptions in the species list.

*glutinosa* has been cut. Transitional bogs often contain shrubs, including *Betula humilis*, *Salix aurita*, *S. cinerea*, *S. lapponum*, *S. myrtilloides*, *S. phylicifolia*, *S. rosmarinifolia*, *Ledum palustre*, and *Chamaedaphne calyculata*. Trees sometimes found in or at the margin of transitional bogs include *Alnus incana*, *Betula pubescens*, *Pinus sylvestris*, and *Populus tremula*. From the air, transitional bogs appear as a patchwork of dark green (wet peat), green (hollow), and yellow (hummock) patches, without sharp boundaries. Water appears as black pools. Tree crowns are visible in aerial photographs.

Most of the bogs in the Chernobyl region are *Sphagnum* peat bogs, with or without trees. The common shrubs in sphagnum bogs include *Andromeda polifolia*, *Betula humilis*, *Calluna vulgaris*, *Chamaedaphne calyculata*, *Empetrum nigrum*, *Ledum palustre*, *Rubus chamaemus*, *Vaccinium oxycoccus*, *V. uliginosum*, and *V. vitis-idaea*. Common herbs include *Carex limosa*, *C. chordorrhiza*, *C. heleonastes*, *Eriophorum vaginatum*, *Juncus bulbosus*, *J. squarrosus*, *Equisetum variegatum*, and the carnivorous plant *Drosera intermedia*. The mosses include *Sphagnum cuspidatum*, *Sph. fuscum*, *Sph. medium*, *Sph. recurvum*, *Sph. rubellum*, *Sph. russovii*, *Pohlia nutans*, *Polytrichum commune*, and *P. strictum*. In aerial photographs, sphagnum bogs have parallel, narrow, dark zigzag lines on a lighter, brownish (sphagnum) background. In black and white photos, they are light to dark gray (with light dominant), or they appear to have sinuous light belts with dark intervals (hummocks and hollows).

Sphagnum-pine bogs are the most common type of wooded sphagnum bog. Trees are not a principal vegetation component of the community. The species are a mixture of those found in sphagnum bogs and pine-sphagnum forests. Pines in bogs only reach 8 m in height. From the air, sphagnum-pine bogs have the same appearance as raised bogs; however, the crowns of trees are visible.

Meadows are usually (1) wet meadows, (2) flood meadows, or (3) fresh meadows. Meadows may be transitional or ecotonal between wetlands and moist forest. In black and white aerial photographs, meadows appear uniformly light colored and usually have very definite boundaries.

(1) Wet meadows are inundated for some time each year, especially late winter and early spring. The groundwater table fluctuates frequently but never drops very low. They often have peaty soils. Wet meadows often are secondary vegetation resulting from drainage of fens or bogs or when moist forest is removed. The vegetation includes *Agrostis alba*, *A. canina*, *A. stolonifera*, *Alopecurus arundinaceus*, *A. geniculatus*, *A. pratensis*, *Beckmannia eruciformis*, *Calamagrostis neglecta*, *C. phragmitoides*, *Catabrosa aquatica*, *Deschampsia caespitosa*, *Festuca arundinacea*, *F. ovina*, *F. pratensis*, *F. rubra*, *Glyceria aquatica*, *G. fruitans*, *G. plicata*, *Hierochloa odorata*, *Molinia coerulea*, *Nardus stricta*, *Phalaris arundinacea*, *Poa palustris*, *Trisetum sibiricum*, *Carex aquatilis*, *C. caespitosa*, *C. canescens*, *C. diandra*, *C. dioica*, *C. disticta*, *C. gracilis*, *C. juncella*,

*C. lasiocarpa*, *C. limosa*, *C. muricata*, *C. panicea*, *C. riparia*, *C. vesicaria*, *C. vulpina*, *Eriophorum angustifolium*, *Scirpus compressus*, *S. eupalustris*, *S. holoschoenus*, *S. ovatus*, *S. pauciflorus*, *S. silvaticus*, *Juncus ambiguus*, *J. compressus*, *J. effusus*, *J. tenageia*, *Equisetum arvense*, *E. heleocharis*, and *E. palustre*.

(2) Flood meadows are usually inundated for at least short periods but are reasonably well drained, have a lower water table than wet meadows during most the year, and have moist soils for the rest of the growing season. Plants include *Agropyron repens*, *Agrostis alba*, *A. canina*, *A. stolonifera*, *Alopecurus arundinaceus*, *A. pratensis*, *A. tenuis*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Beckmannia eruciformis*, *Bromus inermis*, *Calamagrostis epigeios*, *Deschampsia caespitosa*, *Festuca arundinacea*, *F. pratensis*, *Glyceria aquatica*, *G. fruitans*, *G. plicata*, *Hierochloe odorata*, *Koeleria delavignii*, *Phalaris arundinacea*, *Phleum pratense*, *Poa palustris*, *P. pratensis*, *P. trivialis*, *Trifolium hybridum*, *T. pratense*, *T. repens*, *Carex aquatilis*, *C. gracilis*, *C. riparia*, *C. vesicaria*, *Scirpus eupalustris*, *Juncus ambiguus*, *J. compressus*, *J. tenageia*, *Equisetum arvense*, *E. heleocharis*, and *E. palustre*. Species restricted to flood meadows with short periods of inundation include *Festuca ovina*, *Arrhenatherum elatius*, *Medicago falcata*, *Trifolium pratense*, and *T. repens*.

(3) Fresh ("true" or "dry") meadows are often secondary vegetation on cut or burned forest sites. Mowing is often used to prevent forest encroachment. They have a moderate moisture supply that fluctuates widely but generally does not surface. They sometimes become quite dry in summer. These meadows are usually used as pastures or haymeadows and some of the plants, especially the legumes, may have been sown. The vegetation includes *Agropyron repens*, *Alopecurus pratensis*, *A. tenuis*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Briza media*, *Bromus inermis*, *Cynosurus cristatus*, *Dactylis glomerata*, *Festuca rubra*, *F. pratensis*, *Holcus lanatus*, *H. mollis*, *Lolium perenne*, *Nardus stricta*, *Phleum pratense*, *Poa pratensis*, *P. trivialis*, *P. annua*, *Medicago falcata*, *M. lupulina*, *M. sativa*, *Melilotus alba*, *M. officinalis*, *Trifolium repens*, *T. hybridum*, *T. pratense*, *Carex leporina*, and *Equisetum arvense*. *Beckmannia eruciformis*, *Phalaris arundinacea*, and *Poa palustris* are occasionally found there.

Herbaceous plants also commonly dominate forest and woodland margins and openings (glades). Many openings are man-made, the result of burning, felling, or thinning forests or woodlands. Herbs found there include *Agropyron repens*, *Beckmannia pinnatum*, *Briza media*, *Bromus inermis*, *Calamagrostis epigeios*, *Cynosurus cristatus*, *Dactylis glomerata*, *Melica nutans*, *Carex leporina*, and *Equisetum sylvaticum*. *Prunus spinosa*, *Rosa acicularis*, *R. mollis*, *R. tomentosa*, *Rubus chamaemorus*, *Salix caprea*, *S. livida*, *S. nigricans*, *S. phylicifolia*, and *Populus tremula* are often found at the margin of forest openings. Mixed forest-meadow vegetation is divided into three types: (1) scattered, with herbaceous vegetation evenly spread throughout a thinned tree stand (in oak and linden groves there are about 300 to 800 trees

hectare (ha) and in birch woodlands there are about 200 to 600 trees/ha); (2) flower-bed, with alternating openings and dense forests; and (3) windbreak, with forest strips about 25 to 30 m wide alternating with rectangular openings about 70 to 80 m wide.

Relict *Rhododendron luteum* thickets are found at the margins of pine- and spruce-deciduous forests on peaty soils in the Poles'ye. *Ledum palustre*, *Vaccinium uliginosum*, and *V. vitis-idaea* are common dwarf shrubs there.

Heaths (or heathlands) are ericoid shrub fens in poor, acid, podzolized soils, in meadow-type sites, often where pine forest has been cut. *Calluna vulgaris* is the dominant dwarf shrub. Other dwarf shrubs include *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Ledum palustre*, *Vaccinium vitis-idaea*, and *V. uliginosum*. The common herbs include *Nardus stricta* and *Uncus squarrosus*. *Sphagnum fuscum* is a common moss.

More than 60 percent of the forests are dominated by *Pinus sylvestris*. The deciduous forests are dominated by oak, hornbeam, birch, and alder. It is unlikely that any virgin forests remain in eastern Europe (Walter 1979).

There are a number of Russian terms used to describe forests and woodlands. (Woodlands are low density forests.) "Bor" is a pine woodland on poor, sandy soil. Bor woodlands are common on the poor glaciofluvial sands of the Poles'ye. Pine forests can be found in sites that climatically should be deciduous or coniferous-deciduous forest. "Bor oak" is occasionally used for oak growing in sandy soils, and "bor birch" for birch in similar soils. Pine-birch woodlands on poor soils are frequently also called "bor." "Subor" is a mixed deciduous-pine forest, dominated by pine, with a strong lower stratum of deciduous trees, usually oak but also birch or beech. Pine-oak forests are "subor," as are pine-birch forests on better soils. "Ramen" is a more closed stand, usually dominated by spruce. "Suramen" is a mixed "ramen." "Dubrava" is an oak forest or woodland (grove) and includes oak hornbeam forests, and "sudubrava" is a woodland dominated by deciduous trees usually considered subdominant in oak forests, such as birch woodlands and linden and aspen groves.

Carr is an English term for a wooded wetland. There are several types of carrs in the Poles'ye.

Willow (or sallow) carrs occur on either reed or sedge peat. They are usually found in the stream zone of floodplains. Trees may include *Salix alba*, *S. caprea*, *S. rossica*, *Alnus glutinosa*, *A. incana*, and *Betula pubescens*. The shrubs include *Salix acutifolia*, *S. cinerea*, *S. dasyclados*, *S. nigricans*, *S. pentandra*, *S. purpurea*, *S. triandra*, *S. xerophila*, and *Cornus alba*. Dwarf shrubs include *Salix aurita*, *S. livida*, *S. myrtilloides*, *S. rosmarinifolia*, *Rosa mollis*, *R. tomentosa*, and *Ribes nigrum*.

Osier thickets, with osier willows such as *Salix purpurea* and *S. viminalis*, are often found on shore dunes.

Willow-poplar carrs occur on recent alluvial soils in the stream and central zones of floodplains. Soils are saturated during floods but waters flow through, and they can dry out during nonflood periods. The trees include *Populus nigra*, *P. alba*, *Salix alba*, *S. caprea*, and sometimes *Alnus glutinosa* and *Fraxinus excelsior*. Shrubs include *Salix cinerea*, *S. livida*, *S. pentandra*, *S. purpurea*, *S. rosmarinifolia*, *S. triandra*, and *S. viminalis*.

Wet alderwoods occur on reed fen peats. They are usually located in the excessively wet areas in the stream and central zones of floodplains. Trees in alderwoods include *Alnus glutinosa*, *A. incana*, *Fraxinus excelsior*, and *Betula pubescens*. Shrub willows include *Salix cinerea* and dwarf shrub willows include *Salix myrtilloides* and *S. rosmarinifolia* and may also include others found in willow carrs (above). *Ribes nigrum*, *Betula humilis*, *Vaccinium myrtillus*, and *V. vitis-idaea* are also common dwarf shrubs. Herbs include *Agropyron caninum*, *Deschampsia caespitosa*, *Festuca gigantea*, *Glyceria lithuanica*, *Milium effusum*, *Molinia coerulea*, *Phragmites communis*, *Carex argyroglochin*, *C. caespitosa*, *C. elongata*, and *C. inumbrata*.

Alder-ash and elm carrs are small communities with damp to wet, weakly acid to neutral soils.

The plants in elm carrs include *Ulmus laevis*, *U. glabra*, *Quercus robur*, and *Acer platanoides*. Elm carrs are found on sites that are inundated only during major floods.

The dominant trees in alder-ash carrs include *Alnus glutinosa*, *A. incana*, and *Fraxinus excelsior*, mixed with a few *Acer plantinoides* and *Carpinus betulus*. *Ribes nigrum* is a common shrub. *Carex remota* and *Equisetum silvaticum* are important herbs. Alder-ash carrs occur on humic-gley soils.

Aspen groves (dominated by *Populus tremula*), linden groves (dominated by *Tilia cordata*), and birch woodlands (dominated by *Betula pendula* in slightly moist soils and *Betula pubescens* in wetter soils, with a mixture in moderately moist soils) are all "sudubrava." They are all early successional woodlands, and they all have all have strongly herbaceous understories. Occasional *Quercus* trees may be intermixed. *Alopecurus tenuis*, *Calamagrostis arundinacea*, *C. epigeios*, *Melica nutans*, and *Eriophorum vaginatum* are important herbs. Birch woodlands often develop in fire clearings in moist soils, with *Arctostaphylos uva-ursi* as an understory shrub.

The Kiev Poles'ye lies on the ecotone between the mixed coniferous-deciduous forest and the forest steppe. There are two basic mixed coniferous-deciduous forest types: pine-oak forest and spruce-oak forest. The common steppe-forest of the area is oak-hornbeam.

*Quercus robur* is a codominant in each of them and is the dominant tree in forest-steppe in the European USSR. It grows best in the southwestern part of the European USSR and in the Poles'ye. *Quercus robur* will not grow on strongly podzolic soils. It is usually found on floodplains. It usually grows in mixed stands with *Pinus sylvestris*, *Picea abies*, or *Carpinus betulus*.

In addition to *Q. robur* and *C. betulus*, the trees found in oak-hornbeam forests ("dubrava") include *Acer platanoides*, *A. pseudoplatanus*, *Betula pendula*, *Fraxinus excelsior*, *Tilia cordata*, *Ulmus laevis*, and *U. glabra*. On richer soils, *Fagus sylvatica* is sometimes a component on moderately moist soils. *Cornus alba* and *Corylus avellana* are common shrubs. *Agropyron caninum*, *Koeleria delavignii*, *Melica nutans*, and *Millium effusum* are important herbs. *Carex pilosa* is important on drier soils, while *Festuca gigantea* is important on wetter ones. Oak-hornbeam forests are not found in stagnant water. The groundwater depth is usually greater than 1 m. They are most common on older alluvial soils and on frontal and ground moraines. They are often found between wet alderwoods and poorer pine-oak forests. From the air, oak-hornbeam forests appear bright light gray (in black and white photographs). The surface of the canopy appears uneven, and trees appear bunched in groups of three to five.

Acidiphilous pine-oak forests ("subor") are found in poor habitats with weakly to moderately podzolized, sandy or sandy-loam soils. In addition to *Pinus sylvestris* and *Q. robur*, the trees include *Betula pendula* and/or *Betula pubescens*, *Populus tremula*, and *Tilia cordata*. *Corylus avellana* is the dominant shrub, and *Vaccinium myrtillus* is the most important dwarf shrub.

Acidiphilous beechwoods (also "subor") are found on moist, moderately fertile soils. The dominant trees are *Fagus sylvatica* and *Pinus sylvestris*. The nondominant tree species are those found in acidiphilous pine-oak forests.

Most natural pine stands ("bor") are in poor habitats. There are many "bor" woodlands in the Poles'ye, dominated by *Pinus sylvestris*. Pine-dominated stands types include (1) dry to fresh—on well-drained soils with marked podzolization, (2) damp or moist—on poorly drained soils with attenuated podzolization (semi-bog soils), (3) wet—on poorly drained bog soils.

Dry "bor" woodlands are found on the old dunes and morainal hills. The parabolic, west-facing dunes of the Poles'ye are usually covered with *Pinus sylvestris* giving the region a "northern" appearance. These woodlands rarely have understory shrubs. The herbaceous understory vegetation can include *Festuca ovina*, *F. polesica*, *Koeleria glauca*, and *Poa pratensis*. These sites have light, dry sandy soils, and the lichens are common. Lichens include *Cladonia alectoria*, *C. alpestris*, *C. rangiferina*, *C. silvatica*, *C. uncialis*, and *Cetraria islandica*. *C. alpestris* often dominates in late succession. About 100 years is required for pine on dry soil to mature enough to make good timber. Trees are unequal in height, crowns are wide, and branches pendant. *Betula* is not found in dry "bor" woodlands.

Moist "bor" forests are dominated by *Pinus* with either *Polytrichum* mosses or evergreen ericoid shrubs (e.g., *Andromeda polifolia*, *Arctostaphylos uva-ursi*, *Chamaedaphne calyculata*, *Calluna vulgaris*, *Vaccinium myrtillus*, and *V. vitis-idaea*) dominating the understory. *Brachypodium silvaticum*, *Festuca ovina*, *F. rubra*, *Molinia caerulea*, and *Nardus stricta* are

important herbs. Trees are well proportioned, with narrow crowns. Pines in moist habitats are longer lived than in dry or wet habitats and are the best quality timber.

Wet "bor" woodlands can have either flowing or stagnant water. In the former *Phragmites communis* (growing in hollows) is the dominant understory species, with *Nardus stricta* as an important herb. In the latter, *Sphagnum* mosses dominate the understory. Both are dominated by *Pinus*. In "subor" woodlands, *Betula pubescens* is strongly subdominant, but woodlands in which *Betula* is a lesser component are often referred to as "bor." Wet pine-sphagnum woodlands are found in poorly drained depressions on terraces above floodplains. After 100 years, pines on wet soils may be only 6 m tall and reach a total height of only 8 m.

There are several subtypes of pine-sphagnum "bor" woodlands. (1) *Betula pubescens* is an important tree component. *Carex lasiocarpa*, *Equisetum heleocharis*, and *E. vaginatum* are important herbaceous components. The mosses include *Sph. centrale* and *Sph. warnstorffii*, *Sph. girgensohnii*, *Pleurozium schreberi*, and *Aulacomium palustre*. This type is often found in depressions with gentle slopes, with peaty-gley or peaty, intensely boggy soils. (2) *Salix caprea* is an important tree, *Salix pendrandra* is a common shrub, and *Vaccinium vitis-idaea*, *V. myrtillus*, *V. oxycoccus*, *Ledum palustre*, *Empetrum nigrum*, *Chamaedaphne calyculata* are common dwarf shrubs. *Equisetum silvaticum*, *Calamagrostis epigeios*, *Carex lasiocarpa*, *Eriophorum angustifolium*, *E. gracile*, and *E. vaginatum* are important herbaceous species. The mosses include *Sph. magellanicum*, *Sph. compactum*, *Sph. fuscum*, *Sph. russovii*, *Sph. apiculatum*, and *Pleurozium schreberi*. This type occurs in slight depressions with impeded runoff. (3) *Betula* is an important tree component; *Pinus* decreases as *Betula* increases in this type. *Salix aurita*, *Vaccinium myrtillus*, *V. vitis-idaea*, and *Ledum palustre* are the important dwarf shrubs; *V. uliginosum* is unusual. The mosses include *Sph. acutifolium*, *Sph. warnstorffii*, *Polytrichum commune*, *Hylocomium proliferum*, *Pleurozium schreberi*, and *Aulacomium palustre*. This type is transitional between slightly flowing and stagnant wet woodlands and is found in slightly hilly shallow depressions. (4) *Betula pubescens* is an important tree component. There are also infrequent *Alnus*. *Vaccinium vitis-idaea*, *V. myrtillus*, *Andromeda polifolia*, *Calluna vulgaris*, *Chamaedaphne calyculata*, *Ledum palustre*, *Empetrum nigrum*, and *Betula humilis* are important dwarf shrubs. *Carex lasiocarpa* and *Calamagrostis lanceolata* are important herbs. The moss is mostly *Polytrichum commune* with some *Sphagnum* mosses, including *Sph. fuscum*. This type is found in shallow, usually closed depressions between drier pine stands. (5) *Pinus* is sparse. The common subshrubs are *Rubus chamaemorus*, *Vaccinium vitis-idaea*, and *V. uliginosum*; *V. myrtillus* and *V. oxycoccus* are infrequent. *Equisetum variegatum* is a common herb. The mosses are *Sph. angustifolium*, *Sph. acutifolium*, *Sph. fuscum*, *Sph. magellanicum*, and *Sph. russovii*, with *Sph. pulchrum* and *Sph. palustre* in hollows. This type is transitional between woodland and bog.

Soils are highly acidic. (6) *Pinus* is sparse. Shrub and moss species are the same as subtype 5. *Eriophorum vaginatum* is the common herb.

*Picea abies* endures shade well but requires humid, relatively rich soils. Its southern limit runs through Kiev Poles'ye. Spruce-oak forests probably occur mainly on "islands" of richer podzolic soils scattered in the Poles'ye. Understory trees include *Acer platanoides*, *Betula pendula*, *Carpinus betulus*, *Fraxinus excelsior*, *Populus tremula*, *Tilia cordata* and *Ulmus laevis*. Shrubs include *Corylus avellana* and *Rubus chamaemorus*. Herbs include *Carex argyroglochin*, *C. loliacea*, *Scirpus sylvaticus*, *Agropyron caninum*, *Calamagrostis phragmitoides*, *Deschampsia caespitosa*, *Glyceria lithuanica*, *Melica nutans*, and *Millium effusum*. Mosses include *Sphagnum girgensohnii* and *Sph. squarrosum*.

## SECTION 6

### SUCCESSION

In poor sandy soils, peat bogs occupy the low areas, forests the upper ones. Succession can progress from forest to bog or bog to forest.

With increased moisture, succession progresses from *Pinus-Polytrichum* moist forests to *Pinus-Sphagnum* wet forests, then to sphagnum-pine bog.

The first sere in secondary succession after an moderately dry oak-hornbeam "dubrava" has been felled is a pine-birch "bor," followed by a pine-oak-birch "subor," and then finally a return to "dubrava."

When moist pine forests are overly thinned or cleared for meadows, without adequate drainage and with grazing, boggy conditions develop and podzols deteriorate. With time these meadows become sphagnum bogs. Without grazing, meadows that do not become bogged are colonized by birch, aspen, alder. Pine eventually returns under these, and, with time, they return to pine forests.

If birches are left when pines are felled in pine-birch woodlands, birch woodlands with grassy understories often develop within 3 to 5 years. Because *Calamagrostis epigeios* inhibits pine regeneration, it can retard secondary succession.

In deforested dry pine woodlands on sandy hills or dunes, trees and lichens are often replaced by herbaceous dune vegetation, much of which is already found in the understory, including *Festuca ovina*, *F. polesica*, *Koeleria glauca*, *K. gracilis*, and *Poa pratensis*.

Aspen groves, linden groves, and birch woodlands are all early successional woodlands on moderately moist soils. These can become oak-hornbeam forest.

Willow-poplar carrs usually begin as osier thickets. These are replaced with alder-ash carrs, which can become oak-hornbeam forest.

As succession proceeds in a fen, it first becomes a willow carr or wet alderwood, which is replaced by alder-ash carr. If the site dries, this is replaced by an oak-hornbeam forest. Further drying leads to a pine-oak woodland.

If a fen is grazed, the first step is a wet meadow. If the groundwater table drops, it will become a fresh meadow. If grazing is abandoned, the site will become an oak-hornbeam forest. Further drying again results in a pine-oak woodland.

Flood meadows are created when fens are drained. In time these will become forest.

If flowing water decreases in a fen but the site remains wet, peat decomposition will decrease, and pines and sphagnum will increase.

With time, a wet pine-sphagnum woodland will become increasingly bog and eventually will become a sphagnum-pine bog. As the pines become less and less robust, the tree component can be lost, or nearly so.

## **SECTION 7**

### **BOG DRAINAGE AND RECLAMATION**

Most bogs in central Europe are being drained. The replacement vegetation is usually meadow grasses, birch, pine, or spruce.

Many of the wetlands in the Poles'ye have been drained. Between 1872 to 1898, 400,000 ha of wetlands were converted to meadows, 130,000 ha to croplands, and 1,300,000 ha to accessible forests. In 1950, it was estimated that 1.3 million ha in Belorussia and 1 million ha in the Ukraine "needed" reclamation. Between 1950 to 1970, an extensive drainage program was carried out in the Poles'ye in both republics. By 1972, the Poles'ye had ceased to be a primarily waterlogged.

Continuous extensive drainage of the Pripyat wetlands may disturb the groundwater balance both in the Poles'ye and in the drier regions to the south. Drainage can lead to excessive drying of rivers and to destruction of hydrophylic shrubs on berry grounds.

Because the sandy soils of this region are particularly vulnerable to wind erosion when plowed, conversion to croplands has not always been successful. Drainage has made some old farmlands worthless. In some areas, the sandy soils have dried out and become blown sand; some peat soils need irrigation to grow wheat or beets. Since 1968, the formerly excessively wet Poles'ye has experienced dust storms. There is a joke that, in the Poles'ye, those attempting to "reclaim" wetlands "turn all swamps into deserts" (Komarov 1980). Because of the soils beneath the bogs, it might have been better if they had been converted to meadows instead of croplands; however the plans of the agricultural bureaucrats specified plowed croplands.

Pines in some tree farms have died from viral diseases; they needed the acid soils formed from stagnant water to do well. These diseased nursery trees also infected nearby stressed older trees.

## SECTION 8

### CROPS<sup>18</sup>

Only about half of the area around Chernobyl is suitable for agriculture. Much of it is in hay meadows and grazing land (*Trifolium* spp. and grasses),<sup>19</sup> and only about 25 percent of the area is actually in croplands.

*Triticum aestivum*, *Secale cereale*, *Panicum miliaceum*, *Hordeum vulgare*, *Avena sativa*, *Fagopyrum esculentum*, *Beta vulgaris*, *Solanum tuberosum*, *Linum usitatissimum*, *Cannabis sativa*, *Humulus lupulus*, *Daucus carota*, *Brassica oleracea* var. *capitata*, *B. oleracea* var. *acephala*, *B. rapa*, and *Cucumis sativa* are all grown in the southern part of the Belorussian SSR and northern part of the Ukrainian SSR. However, most can not be grown on poorly drained, boggy sites of the Poles'ye. As a result, wheat and other mesic soil crops are less important here than in other parts of Belorussia and the Ukraine. Cereal grains are grown on about half the crop lands, fodder crops on 35 to 40 percent, potatoes on about 8 percent, and flax on up to 5 percent. At any one time, 12 to 17 percent of the land is being fallowed.

On drained bogs with moderate peat beds, crops are often replaced, after a few years, with perennial grasses and legumes, creating an artificial meadow for hay and grazing. Many of the dwarf shrubs growing in bogs produce edible fruits and these are harvested as "crops." In some places, they are cultivated in the bogs.

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<sup>18</sup>Information regarding crops has been synthesized from Lydolph 1964, Skoropanov 1968, Sambur and Kovalenko 1969, Fullard 1972, Symons 1972, Komarov 1980, Dewdney 1982, USSR 1987.

<sup>19</sup>See meadows, under Section 5, Vegetation.

## SECTION 9

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# **APPENDIX A**

## **TREES AND SHRUBS**

### **List of Species<sup>20,21</sup>**

### **Noncultivated<sup>22</sup>**

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<sup>20</sup>Because more than one valid Latin name was sometimes found for species, I chose the conservative name (choosing the name which stresses similarities or "lumper's" name). Latin names of dicotyledons follow the *Flora Europaea*; those of monocotyledons are those used in the current literature. The author of *Flora of the USSR* tended to emphasize differences (i.e., was what is called a splitter, elevating subgeneric names to genera, subspecific epithets to specific); his names often do not reflect those most frequently encountered in the literature.

<sup>21</sup>References include those used for species and habitats in Section 3, Vegetation.

<sup>22</sup>Including species seeded into meadows, excluding species growing as crops in plowed fields.

## GYMNOSPERMS

### *PINUS SYLVESTRIS*<sup>23</sup>

Scots or Scotch pine<sup>24</sup>  
common pine, wild pine  
forest pine

*P. sylvestris* is the dominant tree in the Poles'ye and is the most abundant in much of Europe, where it is often called simply "common pine" (also its common name in the USSR). It can live for up to 400 years. It is an erect evergreen tree and can be 20 to 30 m tall (occasionally up to 40 m). In bogs, trees are quite stunted; after 100 years trees often are only 6 m tall, and they rarely get to be more than 8 m tall. Its crown is round, high, broad, and (in aerial views) appears smooth and dark (although lighter than spruce canopies). Intervals between crowns appear uniform and are not deeply shaded. The trunk is often crooked, with regularly whorled branches, diverging at acute angles. The bark is deeply fissured, thick, and dark brown on the lower trunk but smooth, thin, and red or red-brown on the upper trunk.

There are two types of vegetative apices. Long shoot are elongated stems with scaled leaves in the axils. These produce dwarf shoots, lateral long shoots, and strobili (cones). Short shoot are deciduous shoots, which do not elongate and which produce the leaves. Buds are acute and more or less resinous. Twigs are glabrous and are initially yellow green, becoming gray-brown with age.

Primary leaves are always single and are found only on seedlings. Within 2 to 3 years, they are completely replaced by secondary (permanent) leaves. Secondary leaves (needles) are paired, glaucous, and blue-green in color. Needles are elongate, semicylindrical, tapering toward the apex. The internal surface is flat and either slightly concave or slightly convex. Stomata are found on both sides of the needle distributed in rows along its entire length. The external surface is semicircular. They are twisted, 2 to 7 cm long, and about 2 mm in wide. Needle length varies with year of growth; they may continue to grow for more than one season. Needles on trees from eastern Europe are 5 to 7 cm long; the longest needles found have been on pines from the Poles'ye and Volhynia. Shoots with female cones usually have longer needles than shoots with male cones. Individual leaves can survive 5 or more years.

Degree of stomatal opening decreases from a morning maximum to almost complete closure by evening. Regardless of soil moisture, there are considerably fewer stomata open in the afternoon.

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<sup>23</sup>Sometimes spelled *silvestris*.

<sup>24</sup>Most translators give the English common name for a species. However, American and other European, as well as local, common names were sometimes encountered. I have listed all common names I found for each species.

Reproduction from pollination to mature seed takes 3 years. Seeds form 1 year after pollination. Cones remain small during the first year after pollination. There is rapid growth and a change in color (from gray-brown to rich green) in the second summer. Mature seed cones are 3 to 7 cm long and 2 to 3.5 cm wide. They are yellow-brown when they are mature. Free-standing trees can bear seeds when they are about 15 years old; trees in a closed canopy do not begin to bear seeds until they are about 20 years old. Abundant seed crops are produced only every 3 to 4 years, but at least a few trees yield seeds every year. Self-pollination produces poorer quality seed than does cross pollination.

*P. sylvestris* usually forms mycorrhizal associations in all soil types, although there are qualitative and quantitative differences among soils. Pines in bog soils are very mycorrhizal, probably because of the low nutrient status of the soil. More than 40 species of fungi have been found associated with *P. sylvestris* in Europe. Annual radial growth in *P. sylvestris* is dependent on temperature and nutrient depletion. There can be as many as seven flushes, with more than one growth ring per year. Annual apical growth can be completed as early as mid-June. Maximum needle elongation may occur as early as early May.

There is quite a bit of difference among trees in different habitats. In dry sites, trees are unequal in height, crowns are wide, branches pendant, and needles are quite blue-gray. Growth begins earlier, and the growth increment is more clearly marked than in moister habitats. The size of the increment depends on the amount of summer rainfall. In moist habitats, trees are well proportioned, crowns are narrower, and leaves are greener. Trees live longer (usually more than 200 years). The size of the growth increment depends on the amount of summer rainfall. The best quality timber comes from moist forests. In wet habitats, trees have shorter lives, usually 100 to 200 years. Growth begins late, after the groundwater table subsides. Sphagnum mosses inhibit regeneration from seed. Trees growing in very wet habitats are susceptible to windthrow (or blowdown).

It is codominant with *Quercus robur* in pine-oak mixed forests and with *Fagus silvatica* in acidiphilous beechwoods. It is dominant in "bor" forests. It is found in sphagnum-pine bogs and wooded transitional bogs.

*P. sylvestris* is a light-loving species, not tolerant of shade. It is xerophytic,<sup>25</sup> not very exacting in its moisture requirements and can be found growing under almost any moisture regime from dry to swampy. On wet soils, it is susceptible to windthrow. It is an oligotrophic<sup>26</sup>

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<sup>25</sup>Can tolerate dry soils.

<sup>26</sup>Has broad nutrient tolerances.

acidophyte.<sup>27</sup> It can tolerate relatively poor soils and is often associated with bogs and sandy soils. It has moderate transpiration rates.

***PICEA ABIES*<sup>28</sup>**

Norway spruce  
European spruce  
Common spruce

*P. abies* is an important evergreen tree in much of eastern Europe. Its southern limit runs through Kiev Poles'ye, but it apparently is not common there. It is usually 30 to 50 m tall but occasionally reaches 60 m. It is full grown in 30 to 50 years, but it can live for more than 300 years.

Its crown is pointed, pyramidal, and nearly rests on the ground. In aerial views it appears very uneven and darker than that of *P. sylvestris*.

Its branches are whorled, and it lacks short shoots. Needles are spirally arranged, 1 to 2 cm long, and green. Mature cones are 10 to 14 cm long.

*P. abies* endures shade well but requires humid, relatively rich, loamy soils. Because poor soils predominate in the Poles'ye, *P. abies* is probably limited to widely scattered "islands" of richer podzolic soils.

It is mesotrophic.<sup>29</sup> It grows best on moderately moist soils. On wet soils, it is susceptible to windthrow.

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<sup>27</sup>Tolerates acidic soils.

<sup>28</sup>*P. excelsa* (frequently found in older literature) = *P. abies*.

<sup>29</sup>Requires at least moderate levels of nutrients.

## DICOTYLEDONS

### *QUERCUS ROBUR*

English oak  
British oak  
European oak  
pedunculate oak

*Q. robur* is the most important deciduous tree in the mixed forest of the region. It is found with *Pinus sylvestris* or *Picea abies* in mixed forests and with *Carpinus betulus* in oak-hornbeam forests. It is found in elm carrs and is occasional in linden and aspen groves and birch woodlands.

Its crown appears blunt and is very large. Oak-hornbeam forests appear bright light-gray in aerial photographs (especially in summer). Because of the mixture of other species, the surface of the canopy appears somewhat uneven and trees may appear bunched.

It is mesotrophic, has high transpiration rates, and is a mesoxerophyte.<sup>30</sup> It grows best on moderately moist soils. On wet soils, it is susceptible to windthrow.

It grows to be 30 to 50 m tall and lives up to 800 years.

### *ACER PLATANOIDES*

Norway maple  
sharp-leafed maple

It is a deciduous tree, usually 18 to 20 m (occasionally 30 m) tall. The crown is densely leafed, and it has a spreading canopy. It is eutrophic,<sup>31</sup> has high transpiration rates, and is a xeromesophyte. It grows best in slightly moist soils. It is found in alder-ash carrs, oak-hornbeam forests, and spruce-oak forests.

### *ACER PSEUDOPLATINUS*

sycamore  
sycamore maple  
great maple

It is a deciduous tree, up to 30 m tall. It is eutrophic. It is found in oak-hornbeam forests. Dense, domed crown; spreading canopy.

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<sup>30</sup>Tolerates moderately dry soil.

<sup>31</sup>Requires relatively high nutrient levels.

***ALNUS GLUTINOSA***

European alder, black alder  
common alder

It is a deciduous tree, usually up to 20 m tall (rarely up to 35 m). The crown is pyramidal. Its bark is dark brown and fissured. It is mesotrophic, has moderate transpiration rates, and is a hydrophyte.<sup>32</sup> It always grows in moist soils, especially cleared forest sites and drained bogs. It is unable to grow in dry ones. In boggy soils, grows well only on the peaty layer or on peat, which is at times dry and whose upper layers are strongly decomposed; it is usually found on hummocks. It is codominant in alder-ash carrs and wet alderwoods. It is found in sallow (willow) carrs. It is sometimes found in willow-poplar carrs.

***ALNUS INCANA***

gray alder, white alder  
speckled alder  
European alder

It is a small deciduous tree (sometimes a shrub), 5 to 20 m tall. It grows on moderately well-drained soils. Its bark is smooth. It is mesotrophic and is a mesohydrophyte.<sup>33</sup> In boggy soils, it usually grows on hummocks. It is found in alder-ash carrs, sallow (willow) carrs, wet alderwoods, wooded transitional bogs, and at forest margins. It is an early successional species in cleared moist and wet forest sites. *ALNUS GLUTINOSA* x *A. INCANA* hybrids are not uncommon where parents grow together.

***BETULA PENDULA***<sup>34</sup>

European white birch  
silver birch, common birch

It is a deciduous tree, 10 to 30 m tall. The bark is smooth and white. Its crown is lower, more elongate, lighter colored, and grows closer to the ground than pine. Spaces between crowns are small and uniform. (In a pine-birch mixture, it is difficult to distinguish the two, and the mixture can be difficult to distinguish from pure stands of either.)

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<sup>32</sup>Tolerates extensive flooding (more than 40 days), grows only in damp areas, often in standing water.

<sup>33</sup>Tolerates moderate flooding (20-40 days).

<sup>34</sup>*Betula pendula* = *B. verrucosa* of early literature.

It is oligotrophic, an acidophyte, and a mesophyte.<sup>35</sup> It grows best in slightly moist soils, especially on burns and other clearings. In wet soils, it is susceptible to windthrow. Sphagnum mosses inhibit regeneration from seed. It does not grow well on dry soils. In bog soils, it grows well only on the peaty layer or on peat, which is at times dry and whose upper layers are strongly decomposed; it is usually found on hummocks.

It can be dominant in early successional birch woodlands on moist grounds. It is found in acidiphilous beechwoods, pine-oak woodlands, and spruce-oak forests. It often grows with *B. pubescens*.

**BETULA PUBESCENS**

downy birch, red birch  
pubescent birch

It is a low to medium-height deciduous tree, 10 to 25 m tall. Its crown is lower, more elongate, lighter colored, and grows closer to the ground than pine. Spaces between crowns are small and uniform. (In a pine-birch mixture, it is difficult to distinguish the two, and the mixture can be difficult to distinguish from pure stands of either.)

It is oligotrophic, an acidophyte, and a mesohydrophyte. It grows best on moderately moist soils, especially on burns and other clearings. On wet soils, it is susceptible to windthrow. Sphagnum mosses inhibit regeneration from seed. It does not grow well on dry soils. In bog soils, it grows well only on the peaty layer or on peat, which is at times dry and whose upper layers are strongly decomposed; it is usually found on hummocks.

It is often locally dominant in poor, acid (peaty) woodlands. It can be dominant in early successional birch woodlands on moist grounds. It is found in wet pine-sphagnum forests (subtype 4), sallow (willow) carrs, wet alderwoods, pine-oak woodlands, and wooded transitional bogs. It is often found with *B. pendula*.

**CARPINUS BETULUS**

common hornbeam  
European hornbeam

It is a deciduous tree that is usually 15 to 25 m tall (occasionally up to 30 m). The trunk is fluted. Its bark is smooth and gray. The crown is rounded. It is mesotrophic, an acidophyte, and a mesophyte. It grows best in slightly moist soils and cannot tolerate flooding. It is codominant in oak-hornbeam forests. It is found in alder-ash carrs.

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<sup>35</sup>Requires moderately moist soil.

**FAGUS SILVATICA**European beech  
common beech

It is a deciduous tree that is usually 30 m tall (occasionally up to 50 m in dense beechwoods). The bark is smooth and gray. It is frequently cultivated on well-drained soils. It grows best on slightly moist soils and cannot tolerate flooding. It is codominant in acidiphilous beechwoods (with *Pinus sylvestris*). It is sometimes found in oak-hornbeam forests.

**FRAXINUS EXCELSIOR**European ash  
common ash

It is a deciduous tree, usually up to 30 m tall (occasionally up to 45 m). The bark is gray. It is eutrophic, has high transpiration rates, and is a mesophyte. It grows best in slightly moist soils. In boggy soils, it usually grows on hummocks or intermediate sites.<sup>36</sup> It is found in wet alderwoods, alder-ash carrs, oak-hornbeam, and spruce forests. It is sometimes found in willow-poplar carrs.

**POPULUS ALBA**

white poplar

It is a deciduous tree. It grows in spring-inundated soils. It is found in willow-poplar carrs.

**POPULUS NIGRA**black-barked poplar  
common black poplar  
water poplar

It a deciduous tree, up to 30 m tall. The bark is dark gray. Leaves are deltoid. It grows in spring-inundated soils. It is found in willow-poplar carrs. It usually grows mixed with *Salix* and *Alnus*.

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<sup>36</sup>The slopes between hummocks and hollows in bogs.

***POPULUS TREMULA***

aspen, asp  
European aspen  
trembling aspen  
trembling poplar

It is a deciduous tree that is usually 15 to 20 m tall (occasionally up to 50 m). It is a clonal tree. Individual shoots are shortlived. Bark of young shoots is smooth, greenish-white but is brown and ridged at base of older shoots.

It is mesotrophic. It grows in spring-inundated soils and is a mesohydrophyte. In very wet habitats, it is susceptible to windthrow. In boggy soils, it is usually found on hummocks. Aspen canopies are much lighter than pine or birch and appear flat. When aspen grows mixed with pine or birch, the woodland may have a "flower-bed" appearance because of the clonal growth form of aspen.

It is dominant in early successional aspen groves on moist soils. It is found in acidiphilous beechwoods, pine-oak woodlands, spruce-oak forests, and at the margins of transitional bogs and forest openings.

***SALIX ALBA***

white willow  
European white willow

It is a tree willow, 10 to 25 m tall. The bark is gray. It is a mesohydrophyte and grows best on moderately moist soils. It is found in willow-poplar carrs.

***SALIX CAPREA***

goat willow, pussy willow  
goat sallow, great sallow

It is a tree willow, 6 to 10 m tall. It is mesotrophic and a mesohydrophyte. It grows best on moderately moist soils. In boggy soils, it is usually found on hummocks. It is found in willow-poplar and sallow (willow) carrs, at forest margins, and in wet pine-sphagnum forests (subtype 2).

***SALIX PENTANDRA***

bay willow  
bay-leaf willow  
laurel willow  
laurel-leaf willow

It is a deciduous tree in damp woods, 7 to 10 m tall. Twigs are glabrous and shiny. It is mesotrophic. It is found in sallow (willow) and willow-poplar carrs.

***SALIX ROSSICA***

It is a deciduous tree, 8 to 20 m tall. It is found in sallow (willow) carrs.

***TILIA CORDATA***

small-leaved lime  
small-leaved linden

It is a deciduous tree, up to 35 m tall. The crown appears pale, large, and spreading. It appears almost white in late-spring (flowering) photos. It is mesotrophic and a mesophyte. It is dominant in early successional linden woodlands on moist soils. It is found in oak-hornbeam forests, acidiphilous beechwoods, pine-oak woodlands, and spruce-oak forests.

***ULMUS GLABRA***

Scotch elm, Wych elm  
scabrus elm, mountain elm

It is a deciduous tree, up to 40 m tall. It is eutrophic, has high transpiration rates, and is a mesophyte. It grows best in moderately moist soils. It is codominant in elm carrs. It is found in oak-hornbeam forests on flood-plains and flat interfluvial plains.

***ULMUS LAEVIS*<sup>37</sup>**

European white elm  
European elm, Russian elm  
fluttering elm

It is a deciduous tree, 20 to 35 m tall. It is eutrophic, has high transpiration rates, and is a mesohydrophyte. It grows best in moderately moist soils. It is codominant in elm carrs. It is found in oak-hornbeam forests and spruce-oak forests.

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<sup>37</sup>*Ulmus laevis* = *U. pedunculata* of early literature.

## **SHRUBS (OVER 2 M)**

### ***CORNUS ALBA***

Siberian dogwood

It is a deciduous shrub, up to 3 m tall. Twigs are dark red. It is found in sallow (willow) carrs and oak-hornbeam forests.

### ***CORYLUS AVELLANA***

European filbert, cobnut  
European hazelnut  
common hazelnut  
wild hazelnut

It is 4 to 6 m tall. The bark is smooth and brown. It is eutrophic and a mesophyte. It is found in oak-hornbeam forests and acidiphilous beechwoods, pine-oak woodlands, and spruce-oak forests.

### ***PRUNUS SPINOSA***

blackthorn, sloe berry

It is a deciduous shrub, 4 to 8 m tall. It is found in at the margins of forests.

### ***RHODODENDRON LUTEUM***

pontic azalea

It is an evergreen ericoid shrub, 1 to 6 m tall. It is a mesotrophic acidophyte. In the USSR, this species is principally found in western TransCaucasus. In the Poles'ye, it is assumed to be a Tertiary relict. It is found at the margins of pine- and spruce-deciduous forests on peaty soils.

### ***SALIX ACUTIFOLIA***

sharp-leaved willow

It is a tall deciduous shrub (rarely a tree), 10 to 12 m tall. It is a xerophyte. It is found in sallow (willow) carrs.

***SALIX CINEREA***

gray willow  
gray sallow

It is a deciduous shrub, 5 to 10 m tall. It is a hydrophyte. It is found in sallow (willow) and willow-poplar carrs, wet alderwoods, and shrubby transitional bogs.

***SALIX DASYCLADOS***

It is a deciduous shrub, 5 to 8 m tall. It is found in sallow (willow) carrs.

***SALIX NIGRICANS***

dark-leaved willow  
black-leaved willow

It is a deciduous shrub, 1 to 8 m tall. It is found in sallow (willow) and willow-poplar carrs and at forest margins.

***SALIX PENTANDRA***

bay willow  
bay-leaf willow  
laurel willow  
laurel-leaf willow

It is deciduous and is a shrub (3 to 5 m tall) in peat soils. In boggy soils, it is usually found on intermediate sites. Twigs are glabrous and shiny. It is found in wet pine-sphagnum forests (subtype 2), transitional bogs, and in wet alderwoods.

***SALIX PHYLICIFOLIA***

tea-leaved willow

It is a deciduous shrub, up to 3.5 m tall. It is found in sallow (willow) carrs, transitional bogs, forest openings and at margins.

***SALIX PURPUREA***

purple osier  
purple willow

It is a deciduous shrub, usually 2 to 5 m tall (rarely up to 10 m). It is found in sallow (willow) and willow-poplar carrs.

***SALIX TRIANDRA***

almond-leaved willow  
French willow

It is deciduous and is usually a shrub (sometimes small tree), 4 to 10 m tall. It is found in  
sallow (willow) and willow-poplar carrs.

***SALIX VIMINALIS***

common osier  
osier willow

It is a deciduous shrub, 5 to 10 m tall. It is found in willow-poplar carrs (earlier succession).

***SALIX XEROPHILA***

It is a deciduous shrub, up to 6 m tall. It grows in sallow (willow) carrs.

## DWARF SHRUBS (UNDER 2 METERS)

### *ANDROMEDA POLIFOLIA*

andromeda, bog rosemary  
bog-rosemary andromeda

It is an evergreen ericoid dwarf shrub, 15 to 40 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is found in wet pine-sphagnum forests (subtype 4), sphagnum bogs, and moist pine woodlands.

### *ARCTOSTAPHYLOS UVA-URSI*

bearberry

It is an evergreen, mat-forming, ericoid dwarf shrub, 25 to 130 cm tall, with long, prostrate branches. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks. It is found in heaths, thin birch woodlands, and moist pine woodlands.

### *BETULA NANA*

dwarf birch

It is a deciduous dwarf shrub, 20 to 70 cm tall (rarely more than 2 m), with spreading or procumbant branches. It is oligotrophic. In boggy soils, it is commonly found on hummocks. While this is primarily a tundra-taiga species, it is sometimes found in the forest zone. Its habitats are the same as those of *B. humilus*.

### *BETULA HUMILUS*

low birch  
dwarf birch

It is a small, much-branched deciduous shrub, 1 to 2 m tall. It is oligotrophic. It is characteristic of continuously wet peat. In boggy soils, it is commonly found on hummocks or tree boles. It is found in wet pine-sphagnum forests (subtype 4), shrubby transitional bogs, alderwoods, and sphagnum bogs.

***CHAMAEDAPHNE CALYCVLATA***

leatherleaf  
ground laurel

It is an evergreen ericoid dwarf shrub, 15 to 50 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is found in moist pine forests, in wet pine-sphagnum forests (subtype 1, 2, 4), in shrubby transitional bogs, and in sphagnum bogs.

***CALLUNA VULGARIS***

heather

It is an evergreen ericoid dwarf shrub, 30 to 70 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is the dominant shrub in heaths. It is found in moist pine-sphagnum forests, in wet pine-sphagnum forests (subtype 4), and (in late successional stages) in sphagnum bogs.

***EMPETRUM NIGRUM***

black crowberry

It is an evergreen ericoid dwarf shrub, up to 120 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is found in pine-sphagnum woodlands (subtypes 2, 4, 5, 6), heaths, and sphagnum bogs.

***LEDUM PALUSTRE***

ledum, marshtea  
crystaltea ledum  
wild rosemary

It is an evergreen ericoid dwarf shrub, 12 to 125 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is found in moist pine forests, wet pine-sphagnum forests (subtypes 1, 2, 3, 4), heaths, rhododendron thickets, sphagnum bogs, and shrubby transitional bogs.

***RIBES NIGRUM***

black current

It is a deciduous dwarf shrub, 1 to 2 m tall. In boggy soils, it is usually found on hummocks. It is found in wet alderwoods.

***ROSA ACICULARIS***

dog rose

It is a deciduous dwarf shrub, up to 1 m tall. It is found at forest margins.

***ROSA MOLLIS***

hair rose

It is a deciduous dwarf shrub, 50 to 200 cm tall. It is found in sallow (willow) carrs.

***ROSA TOMENTOSA***

downy rose

It is a deciduous dwarf shrub, 50 to 150 cm tall. It is found in sallow (willow) carrs and at forest margins.

***RUBUS CHAMAEMUS***

raspberry, cloudberry

It is a deciduous dwarf shrub. In boggy soils, it is usually found on hummocks. It is found in wet pine-sphagnum forests (subtypes 5, 6), shrubby sphagnum bogs, and spruce-oak forests.

***SALIX AURITA***

roundear willow  
roundear sallow  
eared sallow

It is a deciduous dwarf shrub, 1 to 2 m (rarely 3 m) tall, with creeping stems. It is oligotrophic and is a hydrophyte. In boggy soils, it is usually found on hummocks or intermediate sites. It is found in wet pine-sphagnum forests (subtype 3), sallow (willow) carrs, wet alderwoods, and shrubby transitional bogs.

***SALIX CINEREA***

gray willow, gray sallow

It is a deciduous shrub, dwarfed in peat-bogs, with creeping stem. It is found in shrubby sphagnum and transitional bogs and in sallow (willow) carrs.

***SALIX LAPPONUM***

burr willow

It is a deciduous dwarf shrub, 1 to 1.5 m tall. It is found in shrubby transitional bogs.

***SALIX LIVIDA***

livid willow

It is a deciduous dwarf shrub, about 50 cm tall. It grows at woodland margins and in sallow (willow) willow-poplar carrs.

***SALIX MYRTILLOIDES***

myrtle willow

It is a deciduous dwarf shrub, 30 to 80 cm tall (rarely up to 2 m), with subterranean creeping stem. It is eutrophic. In boggy soils, it is usually found on intermediate sites. It is found sallow (willow) carrs, wet birch woodlands, and shrubby transitional bogs.

***SALIX ROSMARINIFOLIA***

rosemary willow

It is a deciduous dwarf shrub, 75 to 100 cm tall, with subterranean creeping stem. It is an oligotrophic acidophyte. In boggy soils, it is usually found on intermediate sites. It is found in sallow (willow) and willow-poplar carrs and in transitional bogs.

***VACCINIUM MYRTILLUS***

myrtle whortleberry  
myrtle bilberry

It is a deciduous ericoid dwarf shrub, 15 to 40 cm tall. It is oligotrophic acidophyte. In boggy soils, it is usually found on hummocks or tree boles. It is found in wet pine-sphagnum forests (subtypes 2, 3, 4), wet alderwoods, acidiphilous beechwoods, and pine-oak woodlands. It is infrequent in wet pine-sphagnum forests (subtypes 5, 6).

***VACCINIUM OXYCOCCUS***

small cranberry  
cranberry

It is a evergreen ericoid dwarf shrub, up to 80 cm tall. It is an oligotrophic acidophyte. It is found in wet pine-sphagnum forests (subtypes 1, 2, 5, 6) and sphagnum bogs. Fruit harvested as a "crop."

***VACCINIUM ULIGINOSUM***

bog whortleberry  
bog bilberry

It is a deciduous ericoid dwarf shrub, 50 to 100 cm tall. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks. It is found in moist pine forests, heaths, rhododendron thickets, and (in late successional stages) in sphagnum bogs. It is occasionally found in wet pine-sphagnum forests (subtypes 3, 4). Fruit harvested as a "crop."

***VACCINIUM VITIS-IDAEA***

cowberry  
cranberry  
mountain cranberry  
foxberry

It is a dwarf ericoid shrub, up to 30 cm tall, with persistent leaves. It spreads by creeping rhizomes. It is an oligotrophic acidophyte. In boggy soils, it is usually found on hummocks and tree boles. It is found in wet pine-sphagnum forest (subtypes 1, 2, 3, 5, 6), wet alderwoods, heaths, rhododendron thickets, and (in late successional stages) in sphagnum bogs. Fruit harvested as a "crop."

## **APPENDIX B**

### **HERBS**

#### **Nonvascular and Lower Vascular Plants**

## **MOSSES**

### ***AULACOMIUM PALUSTRE***

green moss

In boggy soils, it is usually found in hollows. It is found in wet pine-sphagnum forests (subtype 1, 3, 4).

### ***HYLOCOMIUM PROLIFORMIS***

green moss

It is found in wet pine-sphagnum forest (subtype 3).

### ***PLEUROZIUM SCHREBERI***

green moss

In boggy soils, it is found on hummocks. It is found in wet pine-sphagnum forests (subtypes 1, 2, 3).

### ***POHLIA NUTANS***

green moss

It is oligotrophic. In boggy soils, it is usually found in intermediate sites. It is found in sphagnum bogs and spruce forests.

### ***POLYTRICHUM COMMUNE***

haircap moss

It is oligotrophic. In boggy soils, it is usually found on hummocks and intermediate sites. It is found in wet pine-sphagnum forests (subtypes 3, 4), sphagnum bogs, and heaths.

### ***POLYTRICHUM STRICTUM***

haircap moss

It is found in sphagnum bogs and heaths.

***SPHAGNUM ACUTIFOLIUM***

It is oligotrophic and an acidophyte. It is found in wet pine-sphagnum forests (subtypes 3, 5, 6).

***SPHAGNUM APICULATUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found in hollows and intermediate sites. It is found in wet pine-sphagnum forests (subtype 2) and transitional bogs.

***SPHAGNUM CENTRALE***

It is oligotrophic and an acidophyte. It is found in wet pine-sphagnum forests (subtype 1).

***SPHAGNUM COMPACTUM***

It is oligotrophic and an acidophyte. It is found in wet pine-sphagnum forests (subtype 2) and transitional bogs.

***SPHAGNUM CUSPIDATUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found in hollows. It is found in sphagnum bogs and transitional bogs.

***SPHAGNUM FUSCUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found on hummocks. It is found in sphagnum transitional bogs, heath, and wet pine-sphagnum forests (subtype 2, 4, 5, 6).

***SPHAGNUM GIRENSOHNII***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found on hummocks and intermediate sites. It is found in wet pine-sphagnum forests (subtype 1).

***SPHAGNUM MAGELLANICUM***

It is oligotrophic and an acidophyte. In boggy soils it is usually found on hummocks. It is found in wet pine-sphagnum forests (subtypes 2, 4, 5, 6).

***SPHAGNUM MEDIUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found on hummocks. It is found in sphagnum bogs.

***SPHAGNUM PAPILLOSUM***

It is found in transitional bogs.

***SPHAGNUM PULCHRUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found in hollows. It is found in wet pine-sphagnum forests (subtype 5, 6).

***SPHAGNUM RECURVUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found in hollows. It is found in sphagnum and transitional bogs.

***SPHAGNUM RUBELLUM***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found on hummocks and intermediate sites. It is found in sphagnum and transitional bogs.

***SPHAGNUM RUSSOVII (RUSSOWII)***

It is oligotrophic and an acidophyte. In boggy soils, it is usually found on hummocks. It is found in wet pine-sphagnum forests (subtypes 2, 5, 6) and sphagnum bogs.

***SPHAGNUM SQUARROSUM***

It is mesotrophic. In boggy soils, it is usually found in hollows and intermediate sites. It is found in transitional bogs and wet spruce forests.

***SPHAGNUM WARNSTORFII***

It is oligotrophic and an acidophyte. It is found in wet pine-sphagnum forests (subtypes 1, 3).

## **LICHENS**

***CLADONIA ALECTORIA***

shrubby lichen

It is found in dry pine woodlands.

***CLADONIA ALPESTRIS***

shrubby lichen

It is found in dry pine woodlands and often dominates in late succession.

***CLADONIA RANGIFERINA***

shrubby lichen

It is found in dry pine woodlands.

***CLADONIA SILVATICA***

forest lichen

It is found in dry pine woodlands.

***CLADONIA UNCIALIS***

It is found in dry pine woodlands.

***CETRARIA ISLANDICA***

It is found in dry pine woodlands.

## **EQUISETACEAE**

### ***EQUISETUM ARVENSE***

field horsetail<sup>38</sup>

It can grow in deep silt deposits. It is found in wet, flood, and fresh meadows and in sedge fens.

### ***EQUISETUM HELEOCHARIS***

swamp horsetail

It can endure prolonged<sup>39</sup> surface flooding and deep deposits of silt. It is found in wet pine-sphagnum forest (subtype 1), transitional bogs, and wet and flood meadows.

### ***EQUISETUM PALUSTRE***

marsh horsetail

It can grow in deep silt deposits. It is found in sedge fens, transitional bogs, and wet and flood meadows.

### ***EQUISETUM PRATENSE***

meadow horsetail

In flood meadows, it is found on ridges. It is found in flood and fresh meadows and sedge fens.

### ***EQUISETUM SILVATICUM***

forest horsetail  
silvan horsetail

It is found in wet pine-sphagnum forests (subtype 2), alder-ash carrs, and forest openings.

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<sup>38</sup>Equisetum is also known as scouring rush.

<sup>39</sup>More than 40 days.

***EQUISETUM VARIEGATUM***

variegated horsetail

It can grow in deep silt deposits. It is found in wet pine-sphagnum forests (subtype 5), sphagnum bogs, transitional bogs, and sedge fens.

## **MONOCOTYLEDONS**

### **Typhaceae**

#### ***TYPHA ANGUSTIFOLIA***

narrow-leafed cattail<sup>40</sup>

It is a hydrophyte. It is found in reed-bulrush fens.

#### ***TYPHA LATIFOLIA***

broad-leafed cattail

It is a hydrophyte. It is found in reed-bulrush fens.

### **Juncaceae**

#### ***JUNCUS AMBIGUUS***

It is found in wet and flood meadows.

#### ***JUNCUS BULBOSA***

bulbous rush  
tuberous rush

It is found in sphagnum and sphagnum-pine bogs.

#### ***JUNCUS COMPRESSUS***

round-fruited rush

It is found in reed-bulrush fens, and sedge fens, transitional bogs, and wet and flood meadows.

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<sup>40</sup>*Typha* is also known as reedmace.

***JUNCUS EFFUSUS***

loose-spreading rush

It is found in transitional bogs and wet meadows.

***JUNCUS INFLEXUS***

It is found in sedge fens.

***JUNCUS LAMPOCARPUS***

It is found in transitional bogs.

***JUNCUS LEERSII***

It is found in transitional bogs.

***JUNCUS SQUARROSUS***

squarrose rush

It is found in heathlands, sphagnum bogs, and transitional bogs.

***JUNCUS TENAGEIA***

It is found in reed-bulrush fens, sedge fens, and wet and flood meadows.

## **Cyperaceae**

### ***CAREX ACUTIFORMIS***

sharp sedge

It is mesotrophic. In boggy soils, it is commonly found in hollows and intermediate sites. It is found in sedge fens and transitional bogs.

### ***CAREX APPROPINQUATA***

It is eutrophic. In boggy soils, it is commonly found on hummocks and intermediate sites. It is found in sedge fens and transitional bogs.

### ***CAREX AQUATILIS***

water sedge  
straight-leafed water sedge

It is oligotrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in wet and flood meadows, sedge fens, and transitional bogs.

### ***CAREX ARGYROGLOCHIN***

silver-arrow sedge

It is found in alderwoods and spruce forest.

### ***CAREX CAESPITOSA***

tufted sedge, turfy sedge

It is mesotrophic and a hydrophyte. In boggy soils, it is usually found in hollows and intermediate sites. It is found in wet and flood meadows, sedge fens, transitional bogs, and wet alderwoods.

### ***CAREX CANESCENS***

gray sedge  
hoary sedge

It is found in wet meadows and transitional bogs.

***CAREX CHORDORRHIZA***

It is oligotrophic. In boggy soils, it is usually found in hollows and intermediate sites. It is found in sphagnum bogs, transitional bogs, and sedge fens.

***CAREX DIANDRA***

diandrous sedge

It is rhizomatous. It is mesotrophic. In boggy soils, it is usually found in hollows and intermediate sites. It is found in sedge fens, transitional bogs, and wet meadows.

***CAREX DIOICA***

dioecious sedge  
creeping separate-headed sedge

It is mesotrophic. In boggy soils, it is usually found on hummocks and in intermediate sites. It is found in sedge fens, transitional bogs, and wet meadows.

***CAREX DISPERMA***

dispermous sedge

It is mesotrophic. In boggy soils, it is usually found on hummocks and in intermediate sites. It is found in transitional bogs.

***CAREX DISTICTA***

distictous sedge

It is rhizomatous. It is found in transitional bogs and wet meadows.

***CAREX FLAVELLA***

little yellow sedge

It is found in wet meadows and willow-poplar carrs.

***CAREX GRACILIS***

sheep sedge, marsi. sedge  
slender sedge

It is mesotrophic and a hydrophyte. It is nonresistant to subsurface flooding but can endure prolonged surface flooding. It can grow in moderate silt deposits. In boggy soils, it is usually found in hollows and intermediate sites. It is found in flood and wet meadows, sedge fens, and transitional bogs.

***CAREX HELEONASTES***

It is mesotrophic. In boggy soils, it is usually found in hollows. It is found in sedge fens, transitional bogs, and sphagnum bogs.

***CAREX INUMBRATA***

It is found in wet alderwoods.

***CAREX JUNCELLA***

little-rush sedge

It is oligotrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in transitional bogs and wet meadows.

***CAREX LASIOCARPA***

hairy fruited sedge

It is oligotrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in wet pine-sphagnum forests (subtypes 1, 2, 4), transitional bogs, sedge fens, and wet meadows.

***CAREX LEPORINA***

hare's-foot sedge

It is found in fresh meadows and at forest margins.

***CAREX LIMOSA***

bog sedge  
mud sedge

It is oligotrophic. In boggy soils, it is usually found in hollows. It is found in sphagnum bogs, transitional bogs, sedge fens, and wet meadows.

***CAREX LOLIACEA***

It is mesotrophic. In boggy soils, it is found on hummocks and intermediate sites. It is found in spruce forests.

***CAREX MURICATA***

muricate sedge  
greater prickly sedge

It is found in transitional bogs and wet meadows.

***CAREX OMSKIANA***

Omskian sedge

It is found in transitional bogs and reed-bulrush fens.

***CAREX PANICEA***

pink-leafed sedge

It is eutrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in wet meadows, and sedge fens.

***CAREX PANICULATA***

paniculate sedge  
great paniced sedge

It is eutrophic. In boggy soils, it is found in hollows. It is found in sedge fens, reed-bulrush fens, and wet meadows.

***CAREX PAUCIFLORA***

few-flowered sedge

It is oligotrophic. In boggy soils, it is found on hummocks and intermediate sites. It is found in transitional bogs and sphagnum bogs.

***CAREX PILOSA***

hairy sedge

It is eutrophic. It is found in drier oak-hornbeam forests.

***CAREX PSUEDO-CYPERUS***

false flatsedge

It is mesotrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in sedge fens and transitional bogs.

***CAREX REMOTA***

distant-spiked sedge

It is found in alder-ash carrs.

***CAREX RIPARIA***

riparian sedge  
great common sedge  
riverine sedge

It is mesotrophic. In boggy soils, it is usually found in hollows. It is found in wet and flood meadows, sedge fens, and transitional bogs.

***CAREX VESICARIA***

bladder sedge  
short-beaked bladder sedge

It is found in transitional bogs, sedge fens, and wet and flood meadows.

***CAREX VULPINA***

fox sedge  
great sedge

It is found in wet meadows, sedge fens, and transitional bogs.

***CYPERUS FLAVESCENS***

yellow flatsedge yellow galingale

It is found in sedge fens.

***CYPERUS PANONICUS***

It is found in sedge fens.

***ERIOPHORUM ANGUSTIFOLIUM***

narrow-leafed  
cottongrass<sup>41</sup>

It is found in sedge fens, transitional bogs, wet meadows, and wet pine-sphagnum forest (subtype 2).

***ERIOPHORUM GRACILE***

slender cottongrass

It is found in sedge fens, transitional bogs, and wet pine-sphagnum forest (subtype 2).

***ERIOPHORUM LATIFOLIUM***

broad-leafed cottongrass

It is found in sedge fens, transitional bogs, and wet meadows.

***ERIOPHORUM VAGINATUM***

sheathed cottongrass  
haretail cottongrass

In boggy soils, it is usually found on hummocks. It is found in wet pine-sphagnum forest (subtype 2), wet birch woodlands, sphagnum bogs, and transitional bogs.

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<sup>41</sup>*Eriophorum* is also called cottonsedge and bogwool.

***SCIRPUS ACICULARIS***

needle bulrush<sup>42</sup>

It is found in reed-bulrush fens.

***SCIRPUS COMPRESSUS***

compressed bulrush

It is found in wet meadows.

***SCIRPUS EUPALUSTRUS***

marsh bulrush, marsh clubrush  
creeping scirpus

It is found in wet and flood meadows and in reed-bulrush fens.

***SCIRPUS HOLOSCHOENUS***

It is found in reed-bulrush fens and wet meadows.

***SCIRPUS LACUSTRIS***

lake bulrush  
lake clubrush

It is mesotrophic and a hydrophyte. In boggy soils, it is found in hollows. It is dominant in reed-bulrush fens. It is found in wet meadows and sedge fens.

***SCIRPUS MAMILLATUS***

It is found in reed-bulrush fens.

***SCIRPUS OVATUS***

ovate bulrush

It is found in reed-bulrush fens and wet meadows.

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<sup>42</sup>Bulrush is also spelled bullrush.

***SCIRPUS PAUCIFLORUS***

few-flowered bulrush  
chocolate-headed clubrush

It is found in reed-bulrush fens and wet meadows.

***SCIRPUS SILVATICUS***

wood scirpus, wood bulrush

It is mesotrophic. In boggy soils, it is found in hollows and intermediate sites. It is found in wet meadows, reed-bulrush fens, and spruce forests.

## **POACEAE<sup>43</sup>**

### ***AGROPYRON CANINUM***

dog wheatgrass  
dog couchgrass  
doggrass

It is mesotrophic. It is found in oak-hornbeam and spruce forests.

### ***AGROPYRON REPENS***

quackgrass  
creeping couchgrass  
creeping wheatgrass  
creeping doggrass  
twitchgrass, quitchgrass  
quickgrass, quakegrass  
squitchgrass

Is a mesohydrophyte. It is nonresistant to subsurface flooding but can endure prolonged surface floods and deep deposits of silt. It is often dominant in flood meadows. It is also found in fresh meadows and at forest margins and in openings.

### ***AGROSTIS ALBA***

redtop bentgrass  
white bentgrass  
marsh bentgrass  
redtop fiorin  
bonnetgrass

It is mesotrophic. It is a mesophyte and can endure prolonged surface flooding. It can adjust to acid soils. It is found in wet and flood meadows. It is recommended for cultivation in flood meadows and drained bogs.

### ***AGROSTIS CANINA***

velvet bentgrass  
dog bentgrass  
brown bentgrass  
finetop bentgrass  
mountain redtop

It is mesotrophic. It is found in wet and flood meadows.

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<sup>43</sup>Gramineae.

***AGROSTIS STOLONIFERA***

carpet bentgrass  
creeping bentgrass  
black twitch

It is mesotrophic and a mesophyte. It can endure moderate<sup>44</sup> subsoil flooding. It is found in wet and flood meadows and on the peripheries of transitional bogs.

***ALOPECURUS ARUNDINACEUS***

creeping foxtail

In flood meadows, it is found in interr ridge depressions. It is found in wet and flood meadows, sedge fens, and transitional bogs.

***ALOPECURUS GENICULATUS***

marsh foxtail, water foxtail  
floating foxtail  
elbowit-grass

It is found in wet meadows, sedge fens, and transitional bogs.

***ALOPECURUS PRATENSIS***

meadow foxtail

It is a mesohydrophyte. It can endure moderate subsoil flooding and prolonged surface flooding. It is found in wet, flood, and fresh meadows. It is recommended for cultivation in fresh and flood meadows and drained bogs.

***ALOPECURUS TENUIS***

slender foxtail

It is found in flood and fresh meadows and birch woodlands.

***ANTHOXANTHUM ORDORATUM***

sweet vernalgrass  
sweet-scented vernalgrass

It is mesotrophic and a mesophyte. It is found in fresh and flood meadows.

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<sup>44</sup>20 to 40 days.

***ARRHENATHERUM ELATIUS***

tall oatgrass  
meadow oatgrass  
false oatgrass  
French ryegrass

It is a mesophyte. It is nonresistant to subsurface flooding but can endure short<sup>45</sup> surface floods. It is found in fresh meadows and flood meadows with short inundation periods.

***BECKMANNIA ERUCIFORMIS***

common sloughgrass

It is a mesohydrophyte. It is able to endure prolonged surface flooding. It is found in wet, flood, fresh meadows, and reed-bulrush fens. It is recommended for cultivation in drained bogs.

***BRACHYPODIUM PINNATUM***

heath falsebrome

It is often dominant at forest and woodland margins and in forest openings.

***BRACHYPODIUM SILVATICUM***

forest falsebrome  
slender falsebrome

It is found in moist pine woodlands.

***BRIZA MEDIA***

common quaking grass  
doddering jockies  
doddering dillies  
earthquakes

It is found in fresh meadows and forest openings.

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<sup>45</sup>Less than 20 days.

***BROMUS INERMIS***

awnless brome  
awnless brome  
smooth brome  
Hungarian brome

It is a mesophyte. It cannot resist subsoil flooding but can endure moderate<sup>46</sup> surface flooding and deep deposits of silt. In flood meadows, it is found in interrill depressions. It is found in flood and fresh meadows and at forest margins and in openings. It is recommended for cultivation in fresh meadows and drained bogs.

***CALAMAGROSTIS ARUNDINACEA***

forest reedgrass  
sand reedgrass  
beachgrass

It is a mesophyte. It inhibits pine regeneration in successional woodlands. Found in linden and aspen groves and birch woodlands.

***CALAMAGROSTIS EPIGEIOS***

chee reedgrass  
small reedgrass  
wood smallreed

It is mesotrophic and a mesophyte. It can grow in deep silt and can endure moderate surface flooding. It inhibits pine regeneration in successional woodlands. It is found in flood meadows, wet pine-sphagnum forest (subtype 2, 4), linden and aspen groves, and birch woodlands.

***CALAMAGROSTIS NEGLECTA***

slim-stem reedgrass

It is mesotrophic. It is found in wet meadows and at the peripheries of transitional bogs.

***CALAMAGROSTIS PHRAGMITOIDES***

tall reedgrass

It is oligotrophic. It is found in wet meadows and damp spruce forests.

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<sup>46</sup>20 to 40 days.

***CATABROSA AQUATICA***

brookgrass  
water whorlgrass

It is found in wet meadows.

***CYNOSURUS CRISTATUS***

crested dogtail  
crested dog's-tail grass

It is a mesophyte. It is found in fresh meadows and moist forest openings.

***DACTYLIS GLOMERATA***

common orchardgrass  
cocksfoot  
rough cocksfoot

It is a mesophyte and can endure moderate surface flooding. It is not able to grow in deep or moderate silt deposits but can grow in thin deposits. It is found in fresh and flood meadows and in forest openings. It is recommended for cultivation in fresh meadows.

***DESCHAMPSIA CAESPITOSA***

tufted hairgrass

It is mesotrophic and a mesohydrophyte. It can endure moderate subsoil flooding. It grows in moist to very wet soils and in thin deposits of silt. It is found in wet and flood meadows, in alderwoods, and spruce forests.

***FESTUCA ARUNDINACEA***

tall fescue, reed fescue  
alta fescue

It is found in wet and flood meadows.

***FESTUCA GIGANTEA***

giant fescue  
tall-bearded fescue

It is found in wetter oak-hornbeam forests.

**FESTUCA OVINA**

sheep fescue  
sheep's fescue

It is mesotrophic. It can grow in thin deposits of silt and can endure short periods of flooding. In flood meadows, it is found on ridges. It is found in fresh meadows and flood meadows with only short floods, as well as dry pine woodlands and on dry sandy hills and dunes.

**FESTUCA POLESICA**

Polish fescue

It is found in dry pine woodlands and on dry sandy hills and dunes.

**FESTUCA PRATENSIS**

meadow fescue

It is mesotrophic. It is a mesophyte but can endure moderate surface flooding. It is not able to grow in deep silt deposits but can grow in moderate deposits. It is found in wet, flood, and fresh meadows and in moist pine-sphagnum forests. It is recommended for cultivation in flood and fresh meadows and drained bogs.

**FESTUCA RUBRA**

red fescue, creeping fescue

It is mesotrophic and a mesohydrophyte. It can endure moderate subsoil and surface flooding. It can grow in poor soils and in thin deposits of silt. It is found in wet, flood, and fresh meadows, as well as moist pine woodlands.

**GLYCERIA AQUATICA**

reed manna grass  
reed sweetgrass  
reed meadowgrass  
reed whitegrass

It is mesotrophic and a hydrophyte. It is found in reed-bulrush fens, sedge fens, and wet and flood meadows.

***GLYCERIA FRUITANS***

floating mannagrass

It is mesotrophic and a hydrophyte. It is found in reed-bulrush fens and wet and flood meadows.

***GLYCERIA HEMORALIS***

It is found in wet alderwoods and reed-bulrush fens.

***GLYCERIA LITHUANICA***

Lithuanian mannagrass

It is eutrophic. It is found in wet alderwoods and spruce forests.

***GLYCERIA PLICATA***

plicate mannagrass

It is found in wet and flood meadows.

***HIEROCHLOE ODORATA***

common sweetgrass  
sweet holygrass  
sweet vanillagrass  
sweet senecagrass

It is mesotrophic. It is found in wet and flood meadows.

***HOLCUS LANATUS***

common velvetgrass  
meadow softgrass  
Yorkshire fog

It is found in fresh meadows.

***HOLCUS MOLLIS***

downy velvetgrass  
creeping softgrass

It is found in fresh meadows.

***KOELERIA DELAVIGNII***

Delavign junegrass

It is found in flood meadows and oak forests.

***KOELERIA GLAUCA***

glaucus junegrass

It is found in dry pine woodlands and on dry sandy hills and dunes.

***LEERSIA ORYZOIDES***

rice cutgrass  
rice whitegrass  
false rice

It is found in sedge and reed-bulrush fens.

***LOLIUM PERENNE***

perennial ryegrass  
English ryegrass  
perennial raygrass

It is a mesophyte and is nonresistant to subsurface flooding. It has only weak resistance to drought. It is found in fresh meadows and is recommended for cultivation there.

***MELICA NUTANS***

mountain melic

It is found in aspen groves, oak-hornbeam forests, and forest openings.

***MILIUM EFFUSSUM***

wood millet  
spreading milletgrass

It is mesotrophic. It is found in alderwoods, oak-hornbeam forests, birch woodlands, aspen and linden groves, and spruce forests.

***MOLINIA COERULIA***

purple heathgrass  
purple moorgrass  
purple molinia

It is mesotrophic and a hydrophyte. In boggy soils, it is usually found on hummocks and intermediate sites. It is found in wet meadows, moist pine forests, wet alderwoods, at the peripheries of transitional bogs, and in spruce forests.

***NARDUS STRICTA***

matgrass

It is oligotrophic and mesophytic. It can grow in poor soils and in thin deposits of silt. In boggy soils, it is usually found in intermediate sites. It is found in wet, flood, and fresh meadows, heathlands, moist pine forests, and wet pine woodlands with flowing water. It grows in moist and very moist "bor" and "subor" sites.

***PHALARIS ARUNDINACEA***

reed canarygrass  
reed swordgrass

It is mesotrophic and a mesohydrophyte. It is able to endure prolonged surface flooding. It can grow in deep silt deposits. In boggy soils, it is usually found in intermediate sites. It is found in reed-bulrush fens and in wet, flood, and fresh meadows. It is recommended for cultivation in fresh and flood meadows and drained bogs.

***PHLEUM PRATENSE***

timothy, common timothy  
meadow timothy  
common cat's-tailgrass  
meadow cat's-tailgrass  
herd's grass

It is mesotrophic and a mesophyte and can endure moderate, but not prolonged, surface flooding. It is found in flood and fresh meadows. It is recommended for cultivation in flood and fresh meadows and drained bogs and is often supplementally sown for forage.

***PHRAGMITES COMMUNIS***

common reed  
giant reed  
ditch reed  
pool reed

It is mesotrophic and a hydrophyte. In boggy soils, it is usually found in hollows and intermediate sites. It is dominant in reed-bulrush fens. It is found in wet pine forests with flowing water, in wet alderwoods, and wet meadows.

***POA ANNUA***

annual meadowgrass  
dwarf meadowgrass  
annual bluegrass  
causeway grass  
Suffolkgrass  
low speargrass

It is found in fresh meadows.

***POA PALUSTRIS***

fowl meadowgrass  
fowl bluegrass  
swamp meadowgrass  
false redtop

It is mesotrophic and a mesohydrophyte. It can endure prolonged surface flooding and can grow in moderate silt deposits. In flood meadows, it is found in interridge depressions. It is found in wet, flood, and fresh meadows and sedge fens.

***POA PRATENSIS***

smooth meadowgrass  
smooth-stalked meadowgrass  
Kentucky bluegrass  
junegrass  
speargrass  
greengrass

It is a mesophyte and can endure moderate surface flooding. It is not able to grow in deep or moderate silt deposits but can grow in thin deposits. It is found in flood and fresh meadows. It is recommended for cultivation in flood and fresh meadows and drained bogs and is often supplementally sown for forage. It is also found in dry pine woodlands and on sandy hills and dunes.

***PAO TRIVIALIS***

rough meadowgrass  
rough-stalked meadowgrass  
rough bluegrass  
rough-stalked bluegrass  
evergreen

It is mesotrophic and a mesophyte. It can endure moderate subsoil flooding. It is found in flood and fresh meadows and is often supplementally sown for forage.

***SETARIA GLAUCA***

glaucus bristlegrass  
glaucus foxtail  
pigeongrass  
bottlegrass

It is found in sedge fens.

***SETARIA VIRIDIS***

green bristlegrass  
green foxtail  
green pigeongrass

It is found in sedge fens.

***TRisetum SIBIRICUM***

Siberian trisetum  
Siberian falseoat  
Siberian oatgrass

It is found in wet meadows.

## DICOTYLEDONS

### *DROSER A ROTUNDIFOLIA*

round-leaf sundew

It is carnivorous, oligotrophic, and an acidophyte. In boggy soils, it is usually found on hummocks. It is found in sphagnum bogs and transitional bogs.

### *MEDICAGO FALCATA*

yellow lucerne  
yellow alfalfa

It is a mesophyte and can endure short surface floods. It is not able to grow in deep silt deposits. In flood meadows, it is found in interr ridge depressions. It grows in fresh meadows, flood meadows with only short inundations periods, and drained bogs. It is often supplementally sown for forage.

### *MEDICAGO LUPULINA*

black medic  
hop medic  
non esuch

It is a mesophyte. It grows in fresh meadows and is often supplementally sown for forage.

### *MEDICAGO SATIVA*

common lucerne  
common alfalfa  
purple medic  
Spanish trefoil

It is a mesophyte and can endure short surface floods. It will not grow in excessively moist soils or soil with even moderately long flooding. It grows in fresh meadows, flood meadows with short inundation periods, and drained bogs and is often supplementally sown for forage.

### *MELILOTUS ALBA*

white sweetclover  
white melilot  
Bokara clover

It is a mesophyte. It is found in fresh meadows and is often supplementally sown for forage.

**MELILOTUS OFFICINALIS**

yellow sweetclover  
yellow melilot

It is a mesophyte. It grows in fresh meadows and is often supplementally sown for forage.

**TRIFOLIUM HYBRIDUM**

alsike clover, pink clover  
Swedish clover

It is a mesophyte. It is not able to grow in deep silt deposits but can grow in moderate deposits. It can endure moderately acid soils. It grows in flood and fresh meadows and pastures. It is recommended for cultivation in fresh and flood meadows and drained bogs and is often supplementally sown for forage.

**TRIFOLIUM PRATENSE**

red clover, meadow clover  
common clover  
broad-leaf clover  
cowgrass clover  
meadow trefoil

It is mesotrophic and a mesophyte. It is not able to grow in deep silt deposits but can grow in moderate deposits. It can withstand short surface floods and soil acidity. It is found in fresh meadows, flood meadows with short inundation periods, and pastures on relatively fertile, moist (but well-drained) soils. It is recommended for cultivation in fresh meadows and drained bogs and is often supplementally sown for forage (see *T. sativum*).

**TRIFOLIUM REPENS**

white clover  
Dutch clover

It is mesotrophic and a mesophyte. It grows best on moderately moist soils and can endure short surface floods. It is not able to grow in deep silt deposits but can grow in moderate deposits. It is found in fresh meadows and flood meadows with short inundation periods, usually on well-drained soils. It is recommended for cultivation in fresh and flood meadows and is often supplementally sown for forage.

**TRIFOLIUM SATIVUM**

field clover

This is a name for the cultivated form of *T. pratense*.

## **APPENDIX C**

### **CROP PLANTS**

**AVENA SATIVA**

oats (spring)

In the Poles'ye, it is cultivated on moderate podzols.

**BETA VULGARIS**

sugar beet, table beet  
forage or fodder beet

It is grown for forage and silage as well as human consumption. In the Poles'ye, it is cultivated on moderate podzols and, with wheat, "dominates" the best soils.

**BRASSICA OLERACEA** var. **ACEPHALA**

kale

**BRASSICA OLERACEA** var. **CAPITATA**

cabbage

**BRASSICA RAPA**

turnips

**CANNABIS SATIVA**

hemp

It is grown for fiber.

**CUCUMIS SATIVA**

cucumbers

**DAUCUS CAROTA**

table carrots  
fodder carrots

In the Poles'ye it is grown in drained bogs.

**FAGOPYRUM ESCULENTUM**

buckwheat

In the Poles'ye, it is cultivated on poor and moderate podzols.

***HORDEUM VULGARE***

barley (winter and spring)

In the Poles'ye, it is cultivated on poor and moderate podzols.

***HUMULUS LUPULUS***

hops

In the Poles'ye, it is cultivated on moderate podzols.

***LINUM USITATISSIMUM***

flax

It is grown for fiber. Fine-quality fiber can be obtained from plants grown on podzolic and gley soils with considerable fertilizing. In the Poles'ye, it is cultivated on poor and moderate podzols.

***PANICUM MILIACEUM***

millet

In the Poles'ye, it is cultivated on poor and moderate podzols.

***SECALE CEREALE***

rye (winter)

In the Poles'ye, it is cultivated on poor and moderate podzols.

***SOLANUM TUBEROSUM***

potato

In the Poles'ye, it is cultivated on poor and moderate podzols.

***TRITICUM AESTIVUM***

wheat (winter and spring)

In the Poles'ye, it is grown only on the best soils and, with beets, "dominates" them.

**ZEA MAYS**

**corn**

**It is usually grown as a forage or silage plant. In the Poles'ye, it is cultivated on moderate podzols.**

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