

A VEGETATIONAL ANALYSIS OF THE FLOODPLAIN FORESTS AND  
A FLORISTIC SURVEY OF VAN LOON WILDLIFE AREA

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## ABSTRACT

The floodplain forest of the Van Loon Wildlife Refuge is located on the bottomlands of the Black River in La Crosse County, Wisconsin. The composition of the tree, shrub and herb strata were surveyed. A total of twelve overstory species were encountered in the study. Acer saccharinum was the dominant species in all stands except one. In that stand, Acer saccharinum was slightly exceeded in importance by Quercus bicolor. Quercus bicolor, Ulmus rubra, Betula nigra and Fraxinus pennsylvanica were secondary dominants and considered important species. Each species was present in all stands. The average tree density in the bottomland forest was 367.8/ha. The average basal area/ha and basal area/tree were 27.1 m<sup>2</sup> and 0.08 m<sup>2</sup>, respectively.

The shrub stratum did not appear to be important in the Van Loon Wildlife Refuge as indicated by low values for frequency and estimated percent cover for all species. Sambucus canadensis, Ilex verticillata and Zanthoxylum americanum were the most prominent shrubs encountered. Shrubs reached greatest importance in openings within the floodplain forest.

Ninety-two herbaceous species were encountered while sampling. Sixty species occurred with a frequency of at least 1%, and Laportea canadensis was the dominant herb. Viola papilionacea, Galium aparine, the family Gramineae and the genus Carex were also important.

A vascular flora of the Van Loon Wildlife Refuge was compiled during the ecological sampling and on reconnaissance trips to the

different communities present in the bottomland habitats and areas adjacent to the Black River. Three hundred sixty-five species, representing 88 families, were collected. Two hundred thirty-eight species from 67 families were found in bottomland communities. The remaining species were found in upland communities adjacent to the Black River.

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## INTRODUCTION

The Van Loon Wildlife Area, McGilvary Bottoms to local residents, provides excellent examples of bottomland forests and other wetland communities in southwestern Wisconsin. It is located along the border between La Crosse and Trempealeau Counties. The Van Loon Wildlife Area originated as a Department of Natural Resources lease project in 1948. Fee acquisition of the area began in 1957 with the purchase of the William Van Loon estate. As of 1978, 3,473 acres of land had been purchased and 740 acres are now being leased by the Department of Natural Resources (Kyro unpublished).

The study area, bounded by the east and west channels of the Black River, is dominated by floodplain forest and is interspersed with old river channels, small lakes, ponds, sloughs, marshlands, shrub-carrs and old field openings (Fig. 1). The objectives of the Department of Natural Resources project are to protect and manage this block of lowland forest with its associated wetlands in a "wild" state and also to permit outdoor recreation and multi-use land activities. The latter objective must be compatible with the maintenance and development of the site as a wildlife area.

In order to develop a management plan for maximum protection and use of the area, the plant species and habitat types must be inventoried. A detailed knowledge of the flora of the bottomland forest would provide both useful baseline data for management and a better understanding of the habitat. Consequently, this study was conducted during September, 1978 through December, 1980 to accomplish the following objectives:

1. Determine the basic composition of the floodplain forests in the Van Loon Wildlife Area.
2. Determine the relative abundance of the floral components of the floodplain forests.
3. Determine the vascular flora of the Van Loon Wildlife Area.
4. Provide information on the vegetation of the Van Loon Wildlife Area that may be useful to plant and wildlife ecologists in future studies.
5. Determine the presence of endangered or threatened species.

## DESCRIPTION OF STUDY AREA

### Location

The Van Loon Wildlife Area, hereafter referred to as Van Loon, is located in the northern part of the Holland Township, T. 18 N., R. 8 W., in La Crosse County, Wisconsin. It lies in parts of sections 2, 10, 11, 14, 15, 16, 21, 22, 27, 28 and 34. Six bottomland forest stands were located in the study area (Fig. 1). The results of this study were based on the vegetational data acquired from these stands. The study sites were located as listed in Table 1.

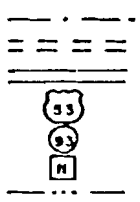
The locations used to gain access to the study sites were as follows: Stand 4, the logging road on the north side of state Highway 93 adjacent to the west channel of the Black River; Stand 5, the logging road adjacent to the east channel of the Black River on the north side of state Highway 93; Stands 1, 2, 3 and 6, the road bed of old county trunk XA or "Seven Bridges Road" just off county trunk XX; Stand 7, the parking lot located on the southeast side of "Hunters Bridge" where Highway 53 crosses the Black River (Fig. 1).

### Climate

The climate in this area is designated as humid-continental (Strahler 1969). Wisconsin is influenced by three types of air masses: Arctic, Subtropical and Continental. The relative duration of these three types of air masses and the frequency of shifts determine the

Figure 1. Map of the Van Loon Wildlife Area showing the locations of the stands.

PROJECT BOUNDARY  
 UNIMPROVED ROAD  
 PAVED ROAD  
 HIGHWAYS - FEDERAL  
                   STATE  
                   COUNTY  
 POWER LINE



N  
 SCALE  
 1" = 31680  
 1" = .5 mi.

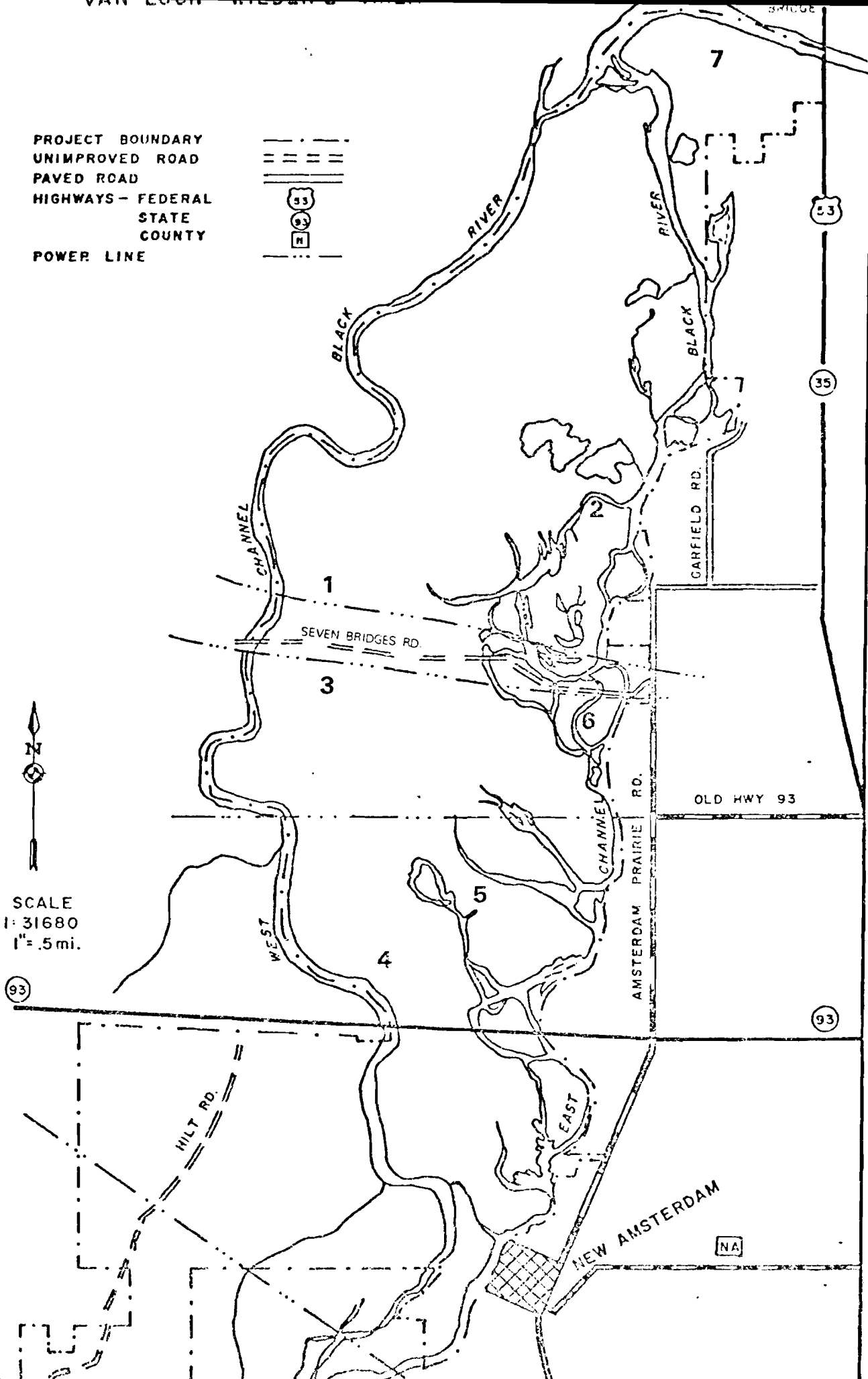


Table 1. Stand locations in the Van Loon Wildlife Area.

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Stand	Section
1	NE $\frac{1}{4}$ , Sec. 21 and SE $\frac{1}{4}$ , Sec. 16
2	SE $\frac{1}{4}$ , Sec. 15 and SW $\frac{1}{4}$ , Sec. 14
3	NE $\frac{1}{4}$ , Sec. 21
4	W $\frac{1}{2}$ , Sec. 27 and E $\frac{1}{2}$ , Sec. 28
5	N $\frac{1}{2}$ , Sec. 27
6	E $\frac{1}{2}$ , Sec. 22
7	S $\frac{1}{4}$ , Sec. 2

---

weather of Wisconsin (Curtis 1959). The weather of La Crosse County is extremely varied from season to season. The average January temperature is  $-8.8^{\circ}\text{C}$  with an extreme low of  $-41^{\circ}\text{C}$ ; on the other hand, the average July temperature is  $22.7^{\circ}\text{C}$  with an extreme high of  $42.2^{\circ}\text{C}$  (USDA 1941). The average length of the growing season in La Crosse is 163 days, with the average spring and fall killing frosts occurring on April 29 and October 9, respectively. The average annual precipitation is approximately 80.5 cm. per year. Nearly 60% of this precipitation occurs between May and September (USDA 1941).

### Geology

The Black River, a major tributary of the Mississippi River, arises in the glaciated portion of central Wisconsin. It flows across the "Western Uplands" of the Driftless Area to the Mississippi Valley. During glacial periods it carried vast floods from melting ice and transported large quantities of sediment across the Driftless Area (Martin 1965).

The uplands of La Crosse County are part of the "Western Uplands" of Wisconsin. Because this region was not glaciated, the type of bedrock is important in determination of landforms and the types of soils that have formed in this area. The bedrock in La Crosse County is of two types, Prairie du Chien Dolomite and Upper Cambrian Sandstone. Both types were originally laid down by ancient seas. In the northern portion of La Crosse County along the Black River, the upper dolomite crust has eroded away and the bedrock is comprised of sandstone. Throughout geologic time, erosion of the sandstone has caused the Black River Valley to become a floodplain covered with deep deposits of



alluvial sand and silt (Beatty 1960).

The elevation of the Black River is 191 m (628 ft) above mean sea level, with a drainage area of 4,879 km<sup>2</sup> (2,270 mi<sup>2</sup>) (Martin 1965). The Black River enters the Mississippi River through Lake Onalaska, which is part of Navigation Pool No. 7.

### Soils

Each year run-off water from uplands deposits alluvium and slope wash into the Black River bottomlands. These deposits represent the alluvial soils which are composed of relatively young sediments that have not been stable long enough to form distinctive subsoil horizons (Hole 1976). Alluvial soils vary widely in texture and are generally stratified due to frequent deposition of alluvial soils during flooding (Beatty 1960). A diagnostic characteristic of alluvial soils is the irregularity of organic content among horizons due to the stratification processes (Hole 1976).

Vegetative growth is vigorous on alluvial soils. Floods primarily damage the herbaceous vegetation, especially the growth adjacent to the stream or river. However, the soils are usually in place long enough for trees and other plants to become established. Regrowth generally occurs with the addition of new soil, which is usually fertile and medium in texture.

Soils mapped in Van Loon fall into three categories. The first type is alluvial, moderately drained soil. It consists of highly variable soil materials that range in texture from sand to silty loam. Alluvial, poorly drained soils, which comprise the second type, are also composed of sandy and silty materials. Alluvial soil areas are

frequently flooded, especially in the spring. Marsh soils, the third category, are made up of mineral and organic soil materials that are generally tangled and wet. The vegetation on marsh soils generally consist of rushes, sedges and other emergent plants. The mapping categories listed above are best used for wildlife and timber management (Beatty 1960).

### Plant Communities

Although Van Loon is restricted to a floodplain, it does support a number of different community types. The communities are similar to those found by Swanson and Sohmer (1978) in Navigation Pool No. 8. Brief descriptions of the plant communities encountered during the study of Van Loon are presented below.

Bottomland Forest: Bottomland forest was the dominant vegetative cover in Van Loon. Acer saccharinum, Ulmus rubra, Fraxinus pennsylvanica, Betula nigra and Quercus bicolor comprised the majority of the canopy. Populus deltoides and Salix spp. dominated stands were also present. Herbs frequently observed in these areas were Laportea canadensis, Viola papilionacea, Galium spp., Ranunculus spp. and members of the Gramineae family. Parthenocissus quinquefolia and Rhus radicans were frequently encountered lianas. Common shrubs were Sambucus canadensis and Ilex verticillata.

Phalaris Meadow: Phalaris arundinacea was a very aggressive grass species which formed dense mats and was found in areas often subject to inundation. This species dominated the vegetation under power lines, along river banks and at drier edges of emergent vegetation.

Sandbars and Shores: Sandbars and shorelines were common in Van Loon. Tolerant species comprised the greatest percentage of vegetation

on these sites due to frequent flooding and xeric conditions which occurred during low water levels. Salix spp. and Populus deltoides were common species, as were Bidens spp., Amaranthus spp., Polygonum spp., Xanthium spp. and members of the family Gramineae.

Old Fields and Grassy Openings: Grassy openings appeared to have been cultivated fields at one time. In dry areas, fields were often overgrown with saplings, grasses, weedy species and pioneer species. Phalaris arundinacea and sedges found in wet areas may have been cut for marsh hay in the past.

Emergent Communities: Emergent communities were found in ponds and backwater areas which were common Van Loon. Sagittaria latifolia, Scirpus fluviatilis, Scirpus validus, Zizania aquatica, Sparganium spp., Polygonum spp., and Carex spp. were commonly found along the margins of ponds and sloughs. Cephalanthus occidentalis was often dispersed within these areas along with dead elms, ash and silver maple.

Floating Leaved Communities: The floating leaved communities were also found in ponds or backwaters. Nymphaea spp., Nuphar spp. and Potamogeton spp. were the dominant floating leaved plants. Free-floating species were present among the emergents and also in the areas protected from the current. The dominant genera of free-floating species were Lemma, Wolfia and Spirodela.

Submergent Communities: Submergent communities were restricted to perennial ponds and sloughs. Potamogeton spp. and Ceratophyllum demersum were common species in these communities and were subject to stress during flooding.

Shrub Communities: Shrub communities were generally found on the borders of emergent vegetation, under power lines or in disturbed areas.

Cornus, Sambucus, Salix and Zanthoxylum were the dominant genera.

Seven Bridges Road: Seven Bridges Road, an old highway road bed, bisects the bottomland area and supports a flora that differs from the typical floodplain forest due to its elevation and substrate type. Species from the adjacent mesic forests and weedy species were present. The families Gramineae, Compositae, and Rosaceae contributed many of the species found on the road. Shrubs such as Juniperis virginianum and Prunus spp. and lianas, including Vitis riparia, Parthenocissus quinquefolia and Celestrus scandens, were also encountered.

## LITERATURE REVIEW

Many ecological studies have been reported on floodplain forest communities. Curtis (1959), in a comprehensive study of Wisconsin vegetation, included the southern lowland forest. Ware (1955) extensively studied the bottomland forests of southern Wisconsin. He noted the dominance of Acer saccharinum and Ulmus americana in combination with Fraxinus pennsylvanica as an important community in floodplain forests.

A transect of alluvial islands in Navigation Pool No. 7 near La Crosse was reported by Claflin (1973). The frequency of trees, shrubs, vines and herbs were noted and listed according to community type. That study area is less than fifteen miles downstream from Van Loon.

Grittenger (1978) examined the loss of Ulmus americana from lowland forests in Sheboygan County, Wisconsin, and he noted a reduced density and basal area/ha. In determining the composition of deciduous swamps, Barnes (1976) found that the loss of all adult Ulmus americana caused a change in overstory; however, the American elm was not eliminated. The understory of the deciduous swamp was made up of 10 to 15% Ulmus americana, an indication that the elm will not be completely lost.

The distribution of herbs on the floodplain of the Chippewa River near Eau Claire, Wisconsin, showed a direct relationship between elevation and soil texture, carbon content and available water capacity (Barnes 1978). There was also a direct relationship between elevation

and frequency of occurrence of herbaceous species. Several soil properties and the frequency of many herbs were closely correlated. Herbs responded either directly to flooding, directly to soil influences or to both. The frequency and magnitude of flooding is either directly or indirectly responsible for the relationships listed above, and thus for the distributional pattern of herbaceous species present on the floodplain (Barnes 1978).

Johnson, Burgess, and Keammerer (1976) determined the composition, structure and dynamics of the overstory on the Missouri River floodplain and related these to environmental variables such as soil texture, available water holding capacity and nutrients. Nelson (1964) characterized the composition and structure of vegetation in the Sheyenne River valley in North Dakota, ascertaining the impact of grazing on the shrubs and herbs.

In east central Illinois, Crites and Ebinger (1969) assessed the composition of the Embarrass River floodplain forest vegetation. Bell (1974), in Piatt County, Illinois, evaluated the distribution of species in a streamside forest. He noted that distribution was related to the percentage of time an area was flooded. Mohlenbrock (1975) surveyed the major plant communities of the Mississippi River floodplain from Cairo, Illinois, to St. Paul, Minnesota, for the U. S. Army Corps of Engineers. His report included the distribution of plant communities, relative location to soil moisture, frequency of inundation and dominant trees, shrubs and herbs. Notes were also included on the possible effects of increased barge traffic and dam construction. Kunshek (1971) studied the composition and possible successional patterns in two floodplain communities in west central Illinois.

A study in the Upper Mississippi River Wildlife and Fish Refuge on mortality and tolerance of various species in the Clinton Pool (now Navigation Pool No. 13) was conducted between 1938 and 1943 by Green (1947). His results showed that trees such as Salix nigra may be tolerant to periods of inundation, but in locations where most of the root crown was permanently covered, mortality of all species was 100%. Green (1947), therefore, concluded that the major tolerance factor to flooding was the relation of the root crown to normal water levels. In a similar study Yeager (1949) determined the mortality rate of various Mississippi River valley tree species that were flooded due to the construction of a dam in Calhoun County, Illinois.

Hosner (1958) tested the effects of submergence on survival of seedlings. The results demonstrated differences in survival at intervals of 32 days, 16 days and less than 16 days. This data suggested that flooding in bottomlands may be selective on species during the growing season. Hosner (1960) again tested the relative tolerance of seedlings to complete inundation; the results were similar to those of the 1958 test with the exception of Acer saccharinum, which had a greater survival rate. It is possible that seed source accounted for the difference in survival of the silver maple seedlings. A list of species from most to least tolerant is as follows: Acer saccharinum, Cephalanthus occidentalis, Acer negundo, Salix nigra, Populus deltoides, Fraxinus pennsylvanica, Ulmus americana, Quercus palustris, Platanus occidentalis, Acer rubrum, Quercus shumardii, Liquidambar styraciflua, Celtis occidentalis and Quercus falcata var. pagodaefolia.

Hosner and Minckler (1960) studied plant reproduction in the river bottomlands of Illinois. It was found that Populus deltoides and

Salix spp. required specific conditions for germination such as direct sunlight and newly formed land with no litter or ground cover. Other major species could not specifically be associated with definite environmental conditions. McDermott (1954) noted that the success of seedlings may be dependent on light tolerance and possibly seed bed conditions.

Forest composition changes along drainage gradients in bottomland areas are apparently due to the tolerance of species to excessive water. Hosner and Boyce (1962) noted that the ability of seedlings to grow under completely saturated soil conditions depends on a combination of three seedling characteristics: (1) the ability of roots to adjust to poorly aerated conditions, (2) the ability to produce adventitious roots to replace poorly functioning root systems and (3) the drought resistance of roots and stems. Additional effects from prolonged flooding, aside from the lack of oxygen needed for respiration, may come from chemical properties of soils. Broadfoot and Williston (1973) stated that sodium ions in high concentration near the surface of the soil or subsoil may become toxic if covered with water. Large amounts of water in acidic soils may dissolve manganese and aluminum ions to cause toxic reactions. If oxygen is excluded from soil, toxic concentrations of ferrous iron, nitrates, sulfides and manganese may accumulate. Large quantities of soluble salts present in low areas, where water is lost through evaporation, may cause moisture stress.

Growth rates in some bottomland tree species have been noted to increase during flood years. Broadfoot and Williston (1973) suggested that an ample water supply during flood years may be the factor. They



observed increased growth during flood years in Fraxinus pennsylvanica and Populus deltoides, 80% and 25-90%, respectively, over non-flood years.

Lateral movement of the river and flooding generally initiate a series of vegetational events. As the river floods or meanders, it deposits alluvium or erodes the established banks. The newly exposed soils and fresh alluvium are prime habitat for new species to become established. Fruits, seeds and roots are deposited over these areas as the flood waters recede, resulting in pioneer vegetation (Hanson 1918). Pioneer herbs are often weedy species from wet habitats or disturbed areas adjacent to the river. Tree species present are generally a result of dispersal from a nearby population. Environmental conditions are harsh on these pioneer sites. Annual destruction by flooding, shifting sands, high evaporation rates, intense heat and desiccation are problems on sand flats (Penfound and Ware 1949). Van Bruggen (1961) observed that wind has effects on sand flat vegetation, e.g. burial by shifting sands or decimation by abrasion due to wind-blown sand.

Populus deltoides and Salix spp. commonly germinate and persist under sand flat conditions (George 1924, McVaugh 1957, Van Bruggen 1961, Hosner and Minckler 1963, Wilson 1970). Salix spp. with rapid growth rates dominate the first phase of vegetation growth, and Populus deltoides also persist during this phase which lasts approximately 10-15 years (Hosner and Minckler 1963 and Wilson 1970). After 20-25 years, Populus deltoides becomes the dominant species, and the soil is changed from xerophytic to mesophytic through the addition of organic matter. Mesophytic trees, shrubs and herbs appear with the cessation

of reproduction in Populus deltoides. After 30-40 years, an increase in importance of mesophytic species is noted. At 50 years, the Populus deltoides stand begins to deteriorate (Wilson 1970). This progression leads to a mixed soft-hardwood subclimax which will reproduce the same species (Hosner and Minckler 1963). In backwater areas where alluvial deposits are finer in texture than sand flats, Cephalanthus occidentalis, Fraxinus pennsylvanica and other species tolerant to poor drainage conditions become established. A slow progression to a mixed hard-hardwood forest dominated by oaks will follow; this subclimax forest will reproduce itself (Hosner and Minckler 1963). The mixed soft-hardwoods and the mixed hard-hardwoods are subclimax forest associations. The progression of either of these associations to a climax forest depends upon long term geologic changes such as erosional deposits or changes in the stream course (Hosner and Minckler 1963).

Keammerer, Johnson and Burgess (1975) analyzed the flora of the Missouri River bottomland forest and noted life form, geographic distribution and relative abundance of vegetation. Ashby and Ozment (1967) studied Beals Woods in Wabash County, Indiana. Attention was given to phenology, vegetation types and species composition. Flowering periods in April and September were observed. Mohlenbrock (1959) discussed the floristic relationships of three bottomland areas in southern Illinois. The "American Bottoms" in Illinois, a bottomland forest area, was inventoried by Ledgerwood (1931). Several floristic studies have been conducted in the lowland communities of La Crosse County, Wisconsin. Swanson (1976) and Swanson and Sohmer (1978) documented the vascular flora and plant communities in Navigation Pool No. 8 of the Upper Mississippi River. Plant communities investigated

and described included alluvial forest, willow forest, sedge meadow, Phalaris meadow, shrub communities, emergent vegetation, spits and shorelines, floating leaved vegetation, submergent vegetation, old fields, levees and dredge spoils. Hartley (1960) outlined the plant communities of the La Crosse area and in 1962 produced The Flora of the Driftless Area which included collections from Van Loon. Nontelle (1973) compiled a flora list of La Crosse County. The Van Loon Wildlife Area Conceptual Master Plan included a vascular plant list (Kyro unpublished). A floristic analysis of dredge spoil material in Navigation Pool No. 8 was completed by Ziegler (1976).

## MATERIALS AND METHODS

### Field Methods

Sampling sites in Van Loon Wildlife Area are designated in Fig. 1. Sampling sites for the community analysis and floral survey of Van Loon were established after reviewing the following maps and photographs: Aerial photographs (SCS 1961), U. S. Dept. of Interior Geological Survey map Galesville Quadrangle, the Van Loon Wildlife Area land classification map (Kyro unpublished), the Department of Natural Resources Van Loon public hunting grounds map and the La Crosse County plat book maps. Forest communities which appeared homogeneous on the aerial photographs were considered as potential sampling areas. Reconnaissance trips were made to determine the condition and accessibility of the stands. If the forest was of natural origin, with no recent disturbances such as cutting, grazing or fire and was reasonably accessible, the site was selected for sampling.

The quarter method of sampling was used to gather data for the tree stratum (Curtis and Cottam 1956 and Curtis 1959). Points of sampling were distributed at intervals of 30 paces along parallel compass lines of traverse. Data recorded in the field included the basal area of each tree species at a height of 1.4 m ( $4\frac{1}{2}$  ft) above the ground and the distance from the center point to the closest tree in each quarter. These distances were obtained by the use of an optical rangefinder. Only woody species having a diameter greater than 10.2 cm (4 in) were recorded as trees. Data were gathered from 40 points in each stand.

Data for shrubs and saplings were gathered using quadrats that measured 4-m<sup>2</sup>. The points of sampling were located along a compass line at intervals of 100 paces. All shrubs and saplings within the quadrat were recorded; fifteen quadrats were recorded in each stand. Data collected in the field included number of stems per quadrat and percent estimated cover for shrub species.

Herbaceous vegetation was sampled with the use of 1-m<sup>2</sup> quadrats. The quadrats were located along compass line transects at intervals of 100 paces. All herbs within the quadrats were recorded for frequency. Herbs within the stand, but not within the quadrat, were recorded separately as being present. Tree seedlings, shrub seedlings and lianas were recorded as herbs. Fifty quadrats were recorded in each stand.

Data for the flora of Van Loon were collected during the period of September 1978 to September 1980. During this period, collections were made by sampling on reconnaissance trips and on flora gathering excursions. Most of the 1,200 specimens were collected between May and November 1979. A preliminary flora compiled on reconnaissance trips to the study areas was identified to aid with sight identification during ecological sampling. Unknown plants encountered in the field were designated with a code name and collected for identification at a later date.

#### Laboratory Methods

Upon returning to the lab, all plants were labeled with a name, numbered and pressed, dried and filed for later identification. These specimens were identified during the winter months of 1979-80 and

were recorded in a field notebook and on note cards. The specimens were then deposited in the University of Wisconsin-La Crosse Herbarium.

Relative frequency, relative dominance, relative density, basal area per tree, basal area per hectare and density per hectare were determined for each species. Relative frequency, relative dominance and relative density were summed to obtain an importance value (IV) (Curtis 1959, Smith 1974). An adaptation number or ecological sequence number for each species was multiplied times the IV to give a weighted IV (Ware 1955, Curtis 1959). The sum of the weighted IV's equals the compositional index number for each stand (Curtis and McIntosh 1951, Curtis 1959). Tree species were separated into six size classes according to basal area: size class I, (.008-.032 m<sup>2</sup>); II, (.032-.064 m<sup>2</sup>); III, (.064-.129 m<sup>2</sup>); IV, (.129-.193 m<sup>2</sup>); V, (.193-.258 m<sup>2</sup>) and VI, (greater than .258 m<sup>2</sup>).

The shrub and sapling data from each stand were condensed to frequency, relative frequency, density, relative density and estimated percent cover for each species. Frequency, presence and a frequency X presence Index were calculated for herb data. A flora from the plant collections was compiled and listed by family (Appendix 1).

Many manuals and keys were used in the identification of the plant specimens collected in the study area. Gleason (1963) was used extensively throughout the identification process. Fascett (1976) was very useful in keying plants collected during the spring and early summer. Fascett's (1951) key of the Gramineae family was used to identify the majority of the grasses. Nomenclature for all plants was taken from Gleason and Cronquist (1963). Fernald (1970), Rosendahl (1975) and Fascett (1960) were keys which also proved quite useful.

The series "Preliminary Reports on the Flora of Wisconsin," published in the Transactions of the Wisconsin Academy of Science, Arts and Letters, was beneficial in identifying members of families. The following reports were utilized: Salicaceae (Costello 1939), Rubiaceae (Urban and Iltis 1957), Primulaceae (Iltis and Shaughnessy 1960), Polygonaceae (Mahony 1932), Labiatae (Koeppen 1957), Cruciferae (Patman and Iltis 1961), Compositae III (Salamun 1963) and Caryophyllaceae (Schlising and Iltis 1961).

Other sources included Courtney and Zimmerman (1972), Peterson and McKenny (1968), Fascett's (unpublished) Plant Ranges of Wisconsin and a key to the genus Salix in Wisconsin by Argus (unpublished). Difficult groups were sent to experts for annotation. Those groups included: the family Gramineae to Dr. Robert W. Freckmann, the genus Carex to Dr. James H. Zimmerman and the genus Botrychium to W. H. Wagner Jr. The Pteridiophyta were annotated by Dr. James Peck at the University of Wisconsin - La Crosse Herbarium.

### Soils

Five composite soil samples were collected from each stand in Van Loon. All vegetable matter not incorporated in the soil was removed and a sample of the first 12 in. was collected using a core sampler (Schulte, Pionke and Walsh 1968). The soils were analyzed for soil texture, using a bouyoucos hydrometer, and available water retaining capacity (Schulte and Olson 1970). Measurement for organic matter content was determined by ignition of soil samples at 550° (American Public Health Association 1976).

## RESULTS

Trees

Twelve tree species were encountered at the six sites sampled in the floodplain forest. Acer saccharinum (silver maple) was the dominant tree, whereas Quercus bicolor (swamp white oak), Ulmus rubra (red elm), Betula nigra (river birch) and Fraxinus pennsylvanica (green ash) were considered to be secondary dominants. The remaining species were Populus deltoides (cottonwood), Carya cordiformis (yellow-bud hickory), Ulmus americana (American elm), Tilia americana (basswood), Acer negundo (box elder), Salix nigra (black willow) and Quercus borealis (red oak).

Tree densities of stands ranged from 254.0 trees/ha to 469.4 trees/ha with an average of 367.8 trees/ha. The average basal area/ha was 27.1 m<sup>2</sup>/ha with a range of 24.6 to 29.7 m<sup>2</sup>/ha. The average basal area/tree was 0.08 m<sup>2</sup> with a range of 0.06 to 0.11 m<sup>2</sup> (Table 2).

Of the aborescent overstory species, the greatest importance values (IV's) were recorded for Acer saccharinum in all stands except Stand 3. Its IV's ranged from 77.8 to 158.9 with an average of 119.0 (Table 3). Acer saccharinum ranked second to Quercus bicolor in Stand 3.

Average IV's for the secondary dominants, Quercus bicolor, Ulmus rubra, Betula nigra and Fraxinus pennsylvanica, were similar with a range of 28.0 to 38.0. These species were considered to be relatively important in Van Loon. Quercus bicolor ranked second in average IV with 38.0 (range 2.0-79.7). It was observed as the dominant overstory species in Stand 3 and ranked second in importance in Stand 5. Swamp



Table 2. Tree density (number/ha), tree basal area ( $m^2/ha$ ) and basal area per hectare ( $m^2/ha$ ) in the floodplain forest of the Van Loon Wildlife Area.

Stand	Trees/ha	BA $m^2$ /tree	BA $m^2$ /ha
1	347.7	.08	27.9
2	469.4	.06	27.0
3	437.1	.07	29.7
4	301.5	.08	24.6
5	254.0	.11	28.5
6	397.1	.06	25.2
Average	367.8	.08	27.1
Range	254.0 - 469.4	.06 - .11	24.6 - 29.7

Table 3. Importance values per stand, average importance values (avg. IV), maximum importance values (max IV), presence (%) and compositional index values (C.I.) of the overstory species in the floodplain forest of the Van Loon Wildlife Area.

Species	Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Stand 6	avg. IV	max. IV	presence
<u>Acer saccharinum</u>	*102.4	*158.9	**77.8	*125.8	*146.4	*103.9	119.0	158.9	100
<u>Quercus bicolor</u>	15.3	2.0	*79.7	37.9	**62.7	30.4	38.0	79.7	100
<u>Ulmus rubra</u>	**56.6	20.9	37.2	23.8	25.3	52.6	36.1	56.6	100
<u>Betula nigra</u>	10.7	42.8	32.6	21.8	35.9	**70.7	35.7	70.7	100
<u>Fraxinus pennsylvanica</u>	44.1	2.1	52.1	**54.5	4.7	15.6	28.8	54.5	100
<u>Populus deltoides</u>		**49.9				16.4	11.0	49.9	33
<u>Carya cordiformis</u>	17.4		17.9	14.4	1.9	4.7	9.4	17.9	83
<u>Ulmus americana</u>	25.9				22.9		8.1	25.9	33
<u>Tilia americana</u>	23.5			20.0			7.2	23.5	33
<u>Acer negundo</u>		15.7		1.8			2.9	15.9	33
<u>Salix nigra</u>		7.6				6.7	2.4	7.6	33
<u>Quercus borealis</u>	3.5		2.6				1.0	3.5	33
C.I.	1,642	1,104	1,429.8	1,429.7	1,321	1,316			

\* Dominant species in stand.

\*\* Secondary dominant in stand.

white oak occurred in all stands sampled. Ulmus rubra and Betula nigra were both present in all stands and ranked third and fourth with average IV's of 36.1 and 35.7, respectively. Red elm ranked second in Stand 1, whereas river birch ranked second in Stand 6. Fraxinus pennsylvanica was fifth in average IV with 28.8 (range 2.1-54.5), but it was the secondary dominant in Stand 4. Green ash was also present in all six stands (Table 3).

Secondary dominants consistently had the second highest IV's and were ubiquitous in the bottomland forest. Populus deltoides was the only other species that assumed the rank of a secondary dominant, this was in Stand 2. It was present in only two stands.

It should be noted that the difference of 81.0 in average IV's between the dominant Acer saccharinum and Quercus bicolor, the closest secondary dominant, is misleading. The average IV's were 119.4 for the dominant tree species and 62.1 for the secondary dominants. Therefore, second dominant tree species had an important role in stand composition.

The remaining species found in the bottomland sites ranged in average IV's from 1.0 to 11.0. These species were inconsistently distributed among stands and were often absent (Table 3).

Acer saccharinum attained greatest average values for relative frequency, relative density and relative dominance. Relative dominance and relative density contributed more to the IV of silver maple than the relative frequency. In contrast, IV's of Ulmus rubra, Betula nigra and Fraxinus pennsylvanica were influenced more by relative frequency and relative density than relative dominance. Importance values of Quercus bicolor were equally influenced by relative frequency, relative density and relative dominance (Table 4).

Table 4. Average relative frequency (%), relative density (%) and relative dominance (%) values in the floodplain forest of the Van Loon Wildlife Area.

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>
<u>Acer saccharinum</u>	29.4	40.4	49.3
<u>Quercus bicolor</u>	12.9	13.1	12.0
<u>Ulmus rubra</u>	15.0	12.5	8.6
<u>Betula nigra</u>	13.9	12.3	9.5
<u>Fraxinus pennsylvanica</u>	11.8	10.2	6.8
<u>Populus deltoides</u>	3.1	2.0	5.9
<u>Carya cordiformis</u>	4.8	3.5	1.0
<u>Ulmus americana</u>	2.4	1.5	4.2
<u>Tilia americana</u>	3.6	2.8	.9
<u>Acer negundo</u>	1.6	.8	.4
<u>Salix nigra</u>	.9	.5	.9
<u>Quercus borealis</u>	.3	.2	.4

Field measurements of all species present in all stands were used to calculate a compositional index number. The compositional index, which is calculated through the use of IV's and an assigned adaptation number to each species, reflects the ecological behavior of each stand (Ware 1955, Curtis 1959). The response of species composition from wet forests (compositional index numbers below 1300) to wet-mesic forests (compositional index numbers above 1300) (Curtis 1959) are presented in Figs. 2, 3, 4 and 5.

The increase of IV's of Acer saccharinum from wet-mesic to wet stands, and the increase in IV's of Ulmus rubra and Fraxinus pennsylvanica from wet to wet-mesic stands are depicted in Fig. 2. Populus deltoides, Betula nigra, Salix nigra and Acer negundo were primarily found in the wet and wet-mesic stands with low compositional index values (Fig. 3). Conversely, Ulmus americana, Tilia americana, Carya cordiformis and Quercus borealis were present in wet-mesic stands with high compositional index values (Fig. 4). Quercus bicolor appeared to have reached its greatest importance in the 1300-1500 range which is in the transition area between wet and wet-mesic stands. Contrarily, swamp white oak exhibited a loss of importance in wet stands and wet-mesic stands with the greatest compositional index values (Fig. 5).

Tree species were separated into six size classes according to basal area. Size class I (.008-.064 m<sup>2</sup>) included 37% of all trees, II (.032-.064 m<sup>2</sup>) included 24.7%, III (.064-.129 m<sup>2</sup>) included 20.7%, IV (.129-.193 m<sup>2</sup>) included 9.0%, V (.193-.258 m<sup>2</sup>) included 4.4%, and VI (greater than .258 m<sup>2</sup>) included 4.3%. Stable population structures (stems/size class) were exhibited by Acer saccharinum, Betula nigra, Quercus bicolor, Ulmus rubra and Fraxinus pennsylvanica. Carya

Fig. 2. Importance values of Acer saccharinum (●), Ulmus rubra (◦) and Fraxinus pennsylvanica (◻) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of species in relation to the gradient.

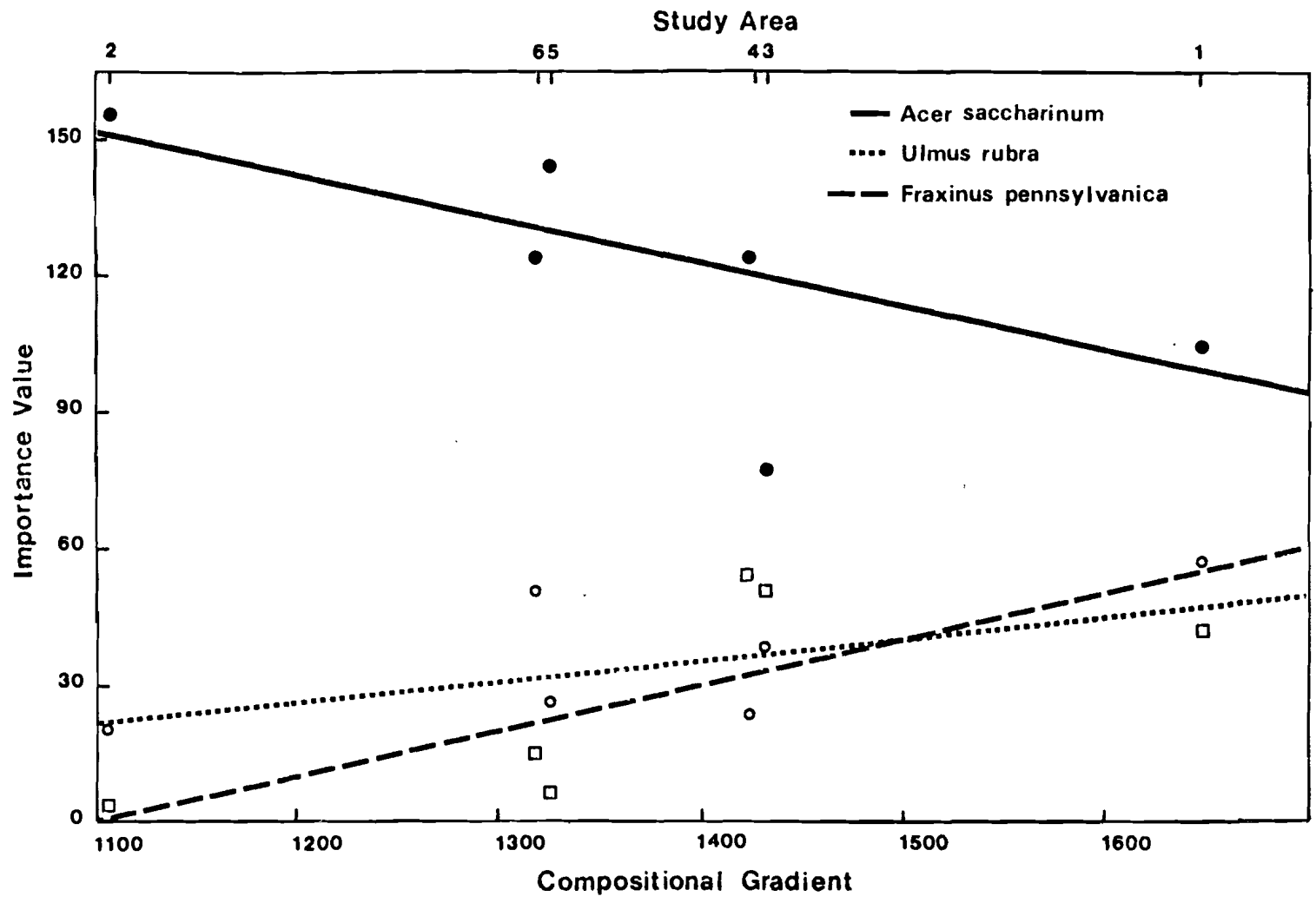


Fig. 3. Importance values of Betula nigra (●), Populus deltoides, (□), Acer negundo (■) and Salix nigra (○) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of species in relation to the gradient.



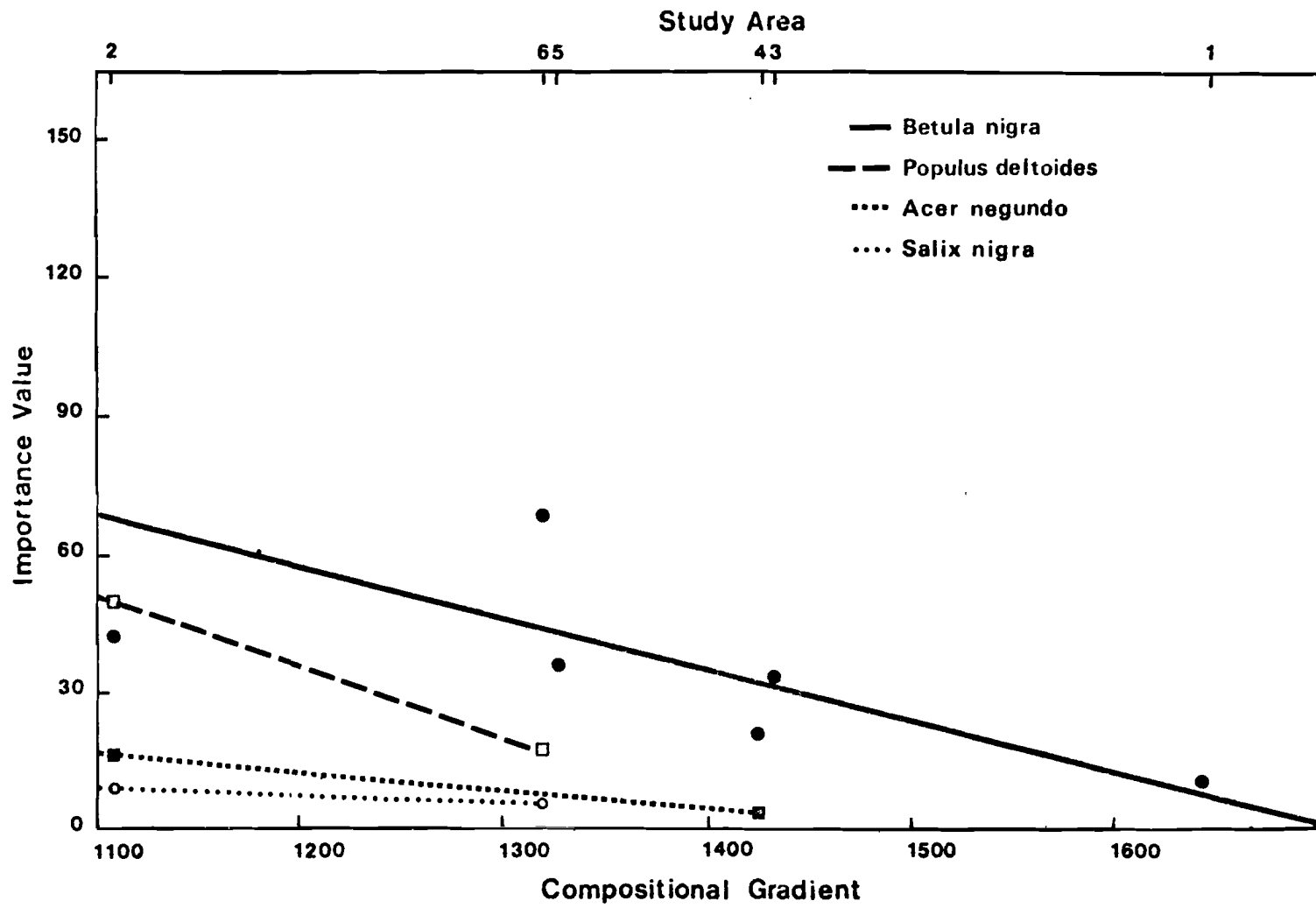


Fig. 4. Importance values of Carya cordiformis (●), Tilia americana (■), Ulmus americana (○), and Quercus borealis (□) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of species in relation to the gradient.

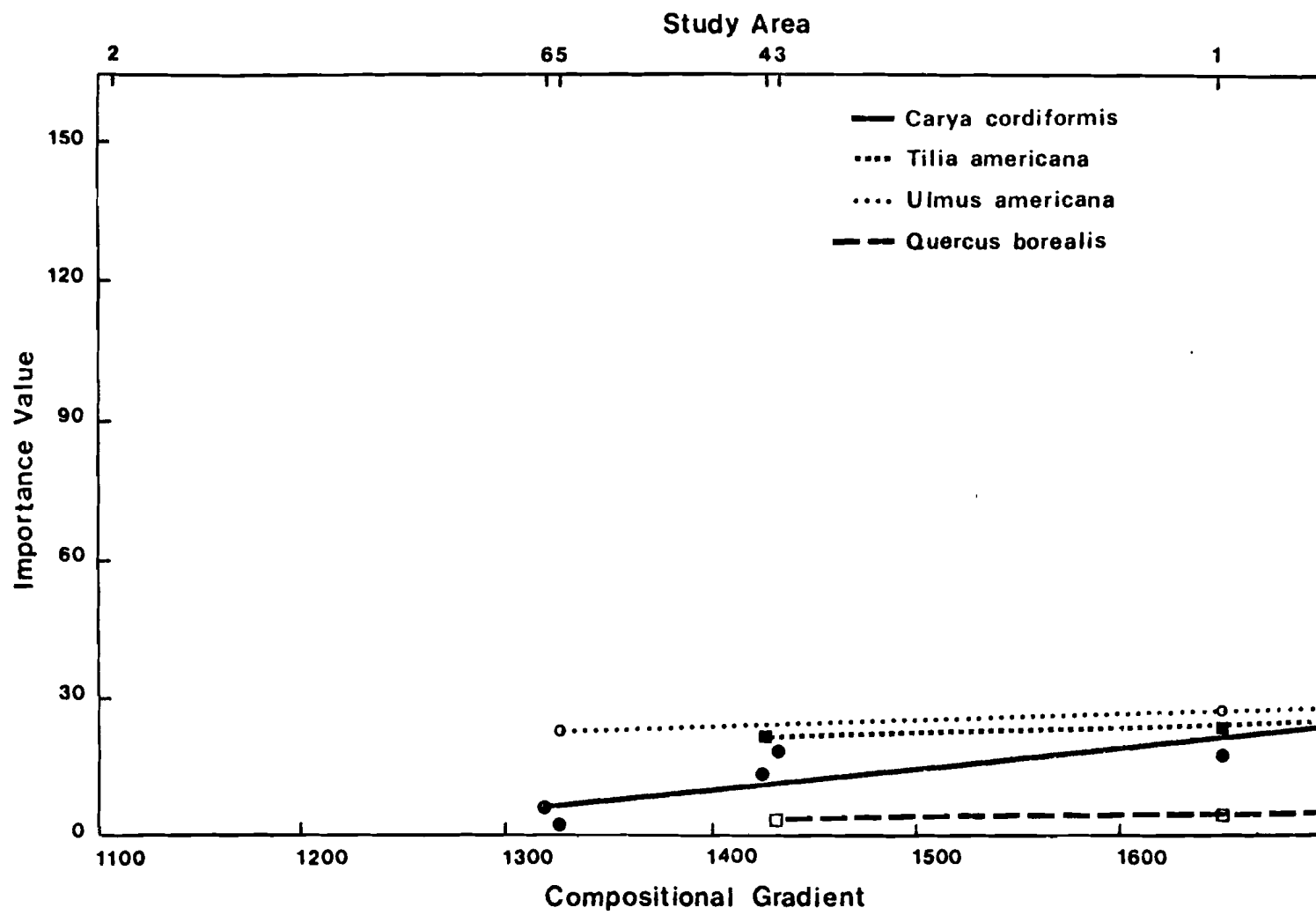
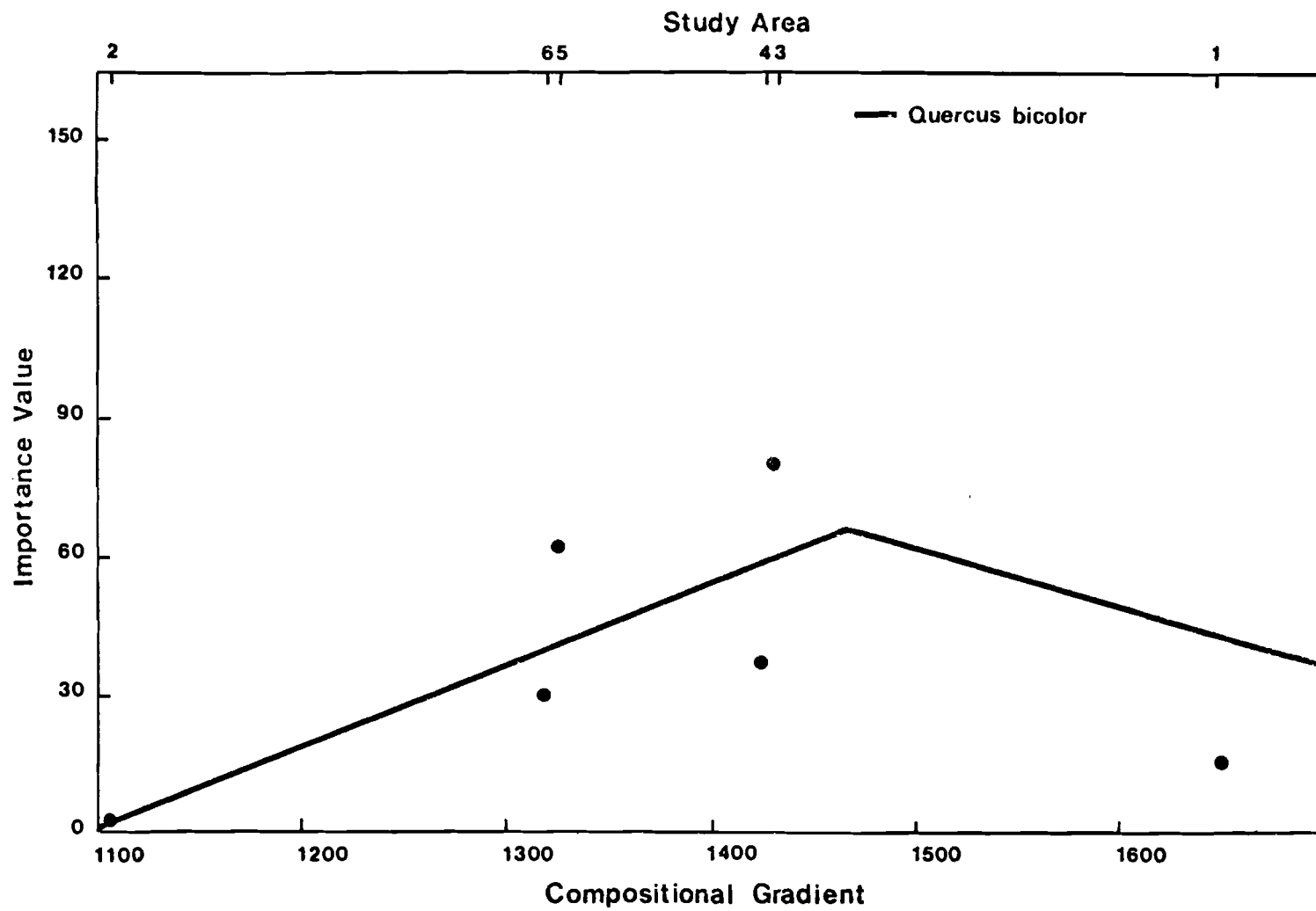


Fig. 5. Importance values of Quercus bicolor (●), plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of species in relation to the gradient.



cordiformis and Tilia americana showed increasing populations with many individuals in the smaller size classes but no representatives in the larger size classes. Populus deltoides, Salix nigra and Ulmus americana were found to have declining populations with the majority of representatives in larger size classes. Stable, increasing and declining populations were represented by Acer saccharinum, Carya cordiformis and Populus deltoides, respectively (Fig. 6).

Acer saccharinum, Ulmus rubra, Fraxinus pennsylvanica, Quercus bicolor, Carya cordiformis and Acer negundo were the sapling species found in Van Loon. Highest average frequencies were observed for Fraxinus pennsylvanica (24.4%), Ulmus rubra (19.5%) and Carya cordiformis (11.1%) (Table 5). With regard to density, the sapling component of the community was dominated by Fraxinus pennsylvanica and Ulmus rubra (Table 5). The average sapling density was 3,507 stems/ha with a range of 832.5 to 7,350 stems/ha (Table 5).

### Shrubs

Ten shrub species were encountered in Van Loon. Sambucus canadensis had the greatest average frequency with a value of 12.2%. It was followed by Ilex verticillata (10.0%), Zanthoxylum americanum (7.2%), Virburnum lentago (3.9%), Ribes sp. (2.2%) and Prunus sp. (2.2%). Other species were Crataegus sp., Amelanchier sp. and Cornus racemosa (Table 6).

Average shrub cover per quadrat was 11.2%. Zanthoxylum americanum had the highest average cover with 3.2%, whereas Ilex verticillata and Sambucus canadensis had values of 3.0% and 2.6%, respectively (Table 7).

Average shrub density was 3,218 stems/ha with a range from 332 to 5,482 among stands. Sambucus canadensis had the highest average density

Fig. 6. Size class structure of Acer saccharinum, Carya cordiformis  
and Populus deltoides in the Van Loon Wildlife Area.

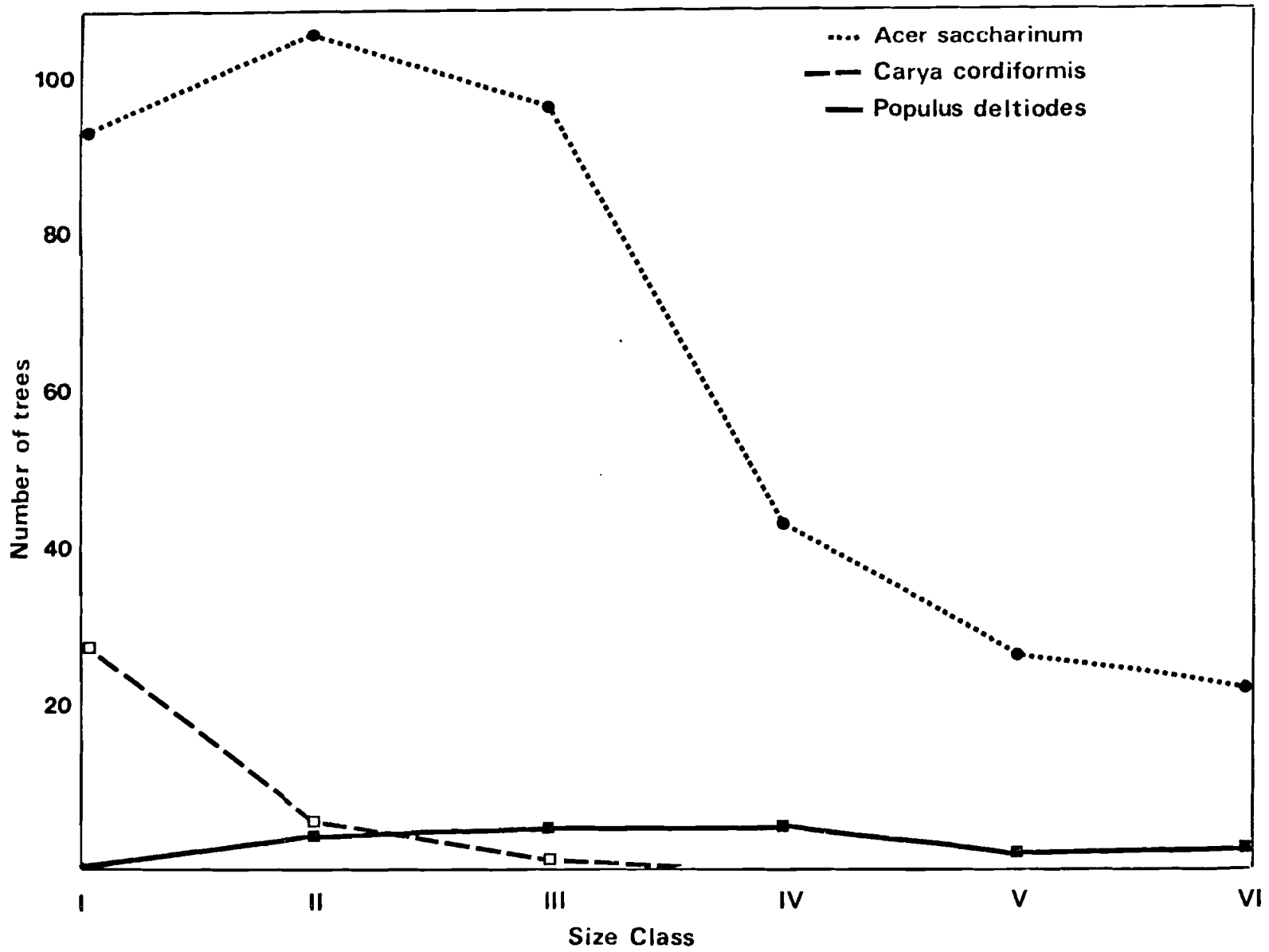




Table 5. Tree sapling density\* (trees/ha) and frequency (%) per stand in the floodplain forest of the Van Loon Wildlife Area.

Species	1	2	3	4	5	6	Average
<u>Fraxinus pennsylvanica</u>	26.7 (667.5)		13.3 (825)	6.7 (332.5)	66.7 (5675)	33.3 (2000)	24.4 (1583.3)
<u>Ulmus rubra</u>	6.7 (167.5)	6.7 (167.5)	40.0 (2825)	6.7 (167.5)	20.0 (675)	36.7 (1500)	19.5 (917.5)
<u>Carya cordiformis</u>	26.7 (1000)		20.0 (825)	13.3 (332.5)		6.7 (150)	11.1 (384.6)
<u>Acer saccharinum</u>		26.6 (1167.5)			6.7 (325)	10.0 (650)	7.2 (357.3)
<u>Quercus bicolor</u>			6.7 (167.5)		20.0 (675)	10.0 (250)	6.1 (182.5)
<u>Acer negundo</u>			6.7 (500)				(82.5)
Total density	1835	1335	5142.5	832.5	7350	4550	3507.7

\*listed in parenthesis

Table 6. Shrub frequency (%) and presence (%) in the floodplain forest of Van Loon Wildlife Area.

Species	1	2	3	4	5	6	Average Frequency	Presence
<u>Sambucus canadensis</u>	6.7	*13.3	6.7	*26.7	*13.3	6.7	12.2	100
<u>Ilex verticillata</u>	6.7		6.7	13.3	*13.3	3.3	10.0	83
<u>Zanthoxylum americanum</u>	*13.3		*20.0		6.7	*10.0	7.2	50
<u>Virburnum lentago</u>	6.7			6.7		3.3	3.9	67
<u>Ribes sp.</u>	6.7					6.7	2.2	33
<u>Prunus sp.</u>			13.3				2.2	17
<u>Cornus racemosa</u>	6.7					6.7	2.2	33
<u>Amelanchier</u>	6.7						1.1	17
<u>Crataegus sp.</u>			6.7				1.1	17

Table 7. Average shrub cover per quadrat (%) in the floodplain forest of the Van Loon Wildlife Area.

Species	1	2	3	4	5	6	Average Cover
<u>Zanthoxylum americanum</u>	9.0		8.5			2.0	3.2
<u>Ilex verticillata</u>	1.0		.3	7.3	6.5	3.0	3.0
<u>Sambucus canadensis</u>	1.3	.3	6.0	5.6	1.9	.5	2.6
<u>Viburnum lentago</u>	.3			2.0	2.0		.7
<u>Crataegus sp.</u>			4.0				.7
<u>Amelanchier interior</u>	2.3						.4
<u>Cornus racemosa</u>	.3					.7	.2
<u>Prunus sp.</u>			1.5				.2
<u>Ribes sp.</u>	.7					.7	.2
Totals	14.8	.3	20.3	14.9	10.4	6.9	11.2

with 930 stems/ha followed by Zanthoxylum americanum (196), Ilex verticillata (717), Virburnum lentago (223) and Ribes sp. (181) (Table 8).

### Herbs

Ninety-two herbaceous species were encountered in the floodplain forest. Of these species, sixty occurred with a frequency of at least 1%; these herbs are listed in Table 9. Twenty-four species were present in all six stands, nine species in five stands and ten species in four stands. In total, fifty-one species were encountered in Stand 4, forty-seven in Stands 2 and 3, forty-six in Stand 1, forty-three species in Stand 6 and forty-one species in Stand 5. The stands were found to have an average of forty-six species.

Commonness and distribution of species were measured by percent frequency. Prevalent herbs with average frequencies of 20% or greater were as follows: Laportea canadensis, 78.3%; Gramineae, 51.0%; Viola papilionacea, 44.7%; Galium aparine, 40.5%; Carex spp., 39.0%; Ranunculus abortivus, 29.5%; Ranunculus septentrionalis, 26.2%; Cryptotaenia canadensis, 25.3%; Parthenocissus quinquefolia, 23.0%; Geum canadense, 21.0%; Lysimachia nummularia, 21.7%; and Unknown species #1, 21.0%. Gramineae were treated as a family and Carex as a genus due to difficulties with making accurate field identifications.

Herb frequency values were plotted against the compositional index. The species responded to the composition of the overstory. Species such as Pilea pumila, Impatiens biflora, Glechoma hederacea, Lysimachia nummularia and the Gramineae increased in frequency with the transition from wet-mesic to wet stands (Figs. 7, 8 and 9). Viola papilionaceae, Ranunculus septentrionalis, Ranunculus abortivus, Hydrophyllum

Table 8. Shrub density (stems/ha) per stand in the floodplain of the Van Loon Wildlife Area.

Species	1	2	3	4	5	6	Average Density
<u>Zanthoxylum americanum</u>	2,000		1,667			1,832	916
<u>Ilex verticillata</u>	325		167	2,150	1,332	332	717
<u>Sambucus canadensis</u>	500	332	167	3,000	832	750	930
<u>Virburnum lentago</u>	175			332	667	167	223
<u>Crataegus sp.</u>			167				27
<u>Amelanchier interior</u>	675						112
<u>Cornus racemosa</u>	175					167	57
<u>Prunus sp.</u>			332				55
<u>Ribes americanum</u>	175					915	181
Total density/ha	4,025	332	2,500	5,482	2,831	4,163	3,218

Table 9. Herb frequency (%), presence (%) and presence X frequency index, in the floodplain forest of the Van Loon Wildlife Area.

Species	Frequency	Presence	Presence X Frequency
<u>Laportea canadensis</u>	78.3	100	7830.0
Graminae	51.0	100	5100.0
<u>Viola papilionacea</u>	44.7	100	4470.0
<u>Galium aparine</u>	40.5	83	3361.5
<u>Carex spp.</u>	39.0	100	3900.0
<u>Ranunculus abortivus</u>	29.5	100	2950.0
<u>Ranunculus septentrionalis</u>	26.2	100	2620.0
<u>Cryptotaenia canadensis</u>	25.3	100	2530.0
<u>Parthenocissus quinquefolia</u>	23.0	100	2300.0
<u>Lysimachia nummularia</u>	21.7	100	2170.0
<u>Geum canadense</u>	21.0	83	1743.0
Unknown #1	21.0	100	2100.0
<u>Rudbeckia laciniata</u>	19.2	100	1920.0
<u>Impatiens biflora</u>	18.8	100	1880.0
Unknown #2	17.2	67	1152.4
<u>Pilea pumila</u>	14.8	83	1228.4
Unknown #3	14.0	83	1162.0
<u>Sanicula gregaria</u>	13.5	100	1350.0
<u>Lysimachia ciliata</u>	12.0	83	996.0
<u>Glechoma hederacea</u>	12.7	67	850.9
Unknown #4	11.3	100	1130.0
<u>Urtica dicca</u>	11.3	100	1130.0
<u>Oncoclea sensibilis</u>	11.0	100	1100.0
<u>Rhus radicans</u>	9.5	100	950.0
<u>Smilax herbacea</u>	9.2	100	920.0

Table 9. continued

<u>Species</u>	<u>Frequency</u>	<u>Presence</u>	<u>Presence X Frequency</u>
<u>Hydrophyllum virginianum</u>	7.8	67	522.6
<u>Polygonum virginianum</u>	7.7	67	515.9
<u>Galium spp.</u>	7.5	100	750.0
<u>Phlox divaricata</u>	7.2	100	720.0
Unknown #5	6.0	33	198.0
Unknown #6	6.0	33	198.0
<u>Senecio aureus</u>	5.8	100	580.0
<u>Smilax hispida</u>	5.0	100	500.0
<u>Thalictrum dasycarpum</u>	5.0	100	500.0
<u>Amphicarpa bracteata</u>	4.7	67	314.9
<u>Arisaema dracontium</u>	4.7	100	470.0
<u>Stellaria aquaticum</u>	4.0	50	200.0
<u>Cardamine pennsylvanica</u>	3.7	83	307.1
<u>Echinocystis lobata</u>	3.7	67	247.9
<u>Asarum canadense</u>	3.7	50	185.0
<u>Oxalis spp.</u>	3.3	50	165.0
<u>Solidago #1</u>	3.3	83	273.9
<u>Ranunculus #1</u>	3.3	33	108.9
<u>Dulichium arundinaceum</u>	2.5	17	42.5
<u>Viola pubescens</u>	2.3	33	75.9
<u>Vitis riparia</u>	2.3	100	230.0
<u>Polygonum arifolium</u>	2.3	100	230.0
<u>Ribes americanum</u>	2.0	50	100.0
<u>Uvularia sessilifolia</u>	2.0	83	166.0
Unknown #7	2.0	33	66.0
<u>Equisetum arvense</u>	1.3	67	113.2

Table 9. continued

<u>Species</u>	<u>Frequency</u>	<u>Presence</u>	<u>Presence X Frequency</u>
<u>Osmorhiza claytonii</u>	1.3	50	65.0
<u>Circaea canadensis</u>	1.3	33	42.9
<u>Rhubus sp.</u>	1.3	17	22.1
<u>Solidago #2</u>	1.3	17	22.1
Unknown #8	1.3	17	22.1
<u>Iris virginica</u>	1.0	67	67.0
<u>Blephilia hirsuta</u>	1.0	17	17.0
<u>Dioscorea villosa</u>	1.0	17	17.0
<u>Chenopodium album</u>	1.0	33	33.0
Tree seedlings			
<u>Acer saccharinum</u>	26.5	100	2650.0
<u>Fraxinus pennsylvanica</u>	6.5	83	539.5
<u>Carya cordiformis</u>	2.3	50	115.0
<u>Quercus bicolor</u>	1.0	33	33.0
<u>Ulmus rubra</u>	1.0	33	33.0



Fig. 7. Frequencies of Pilea pumila (●) and Lysimachia nummularia (○) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.

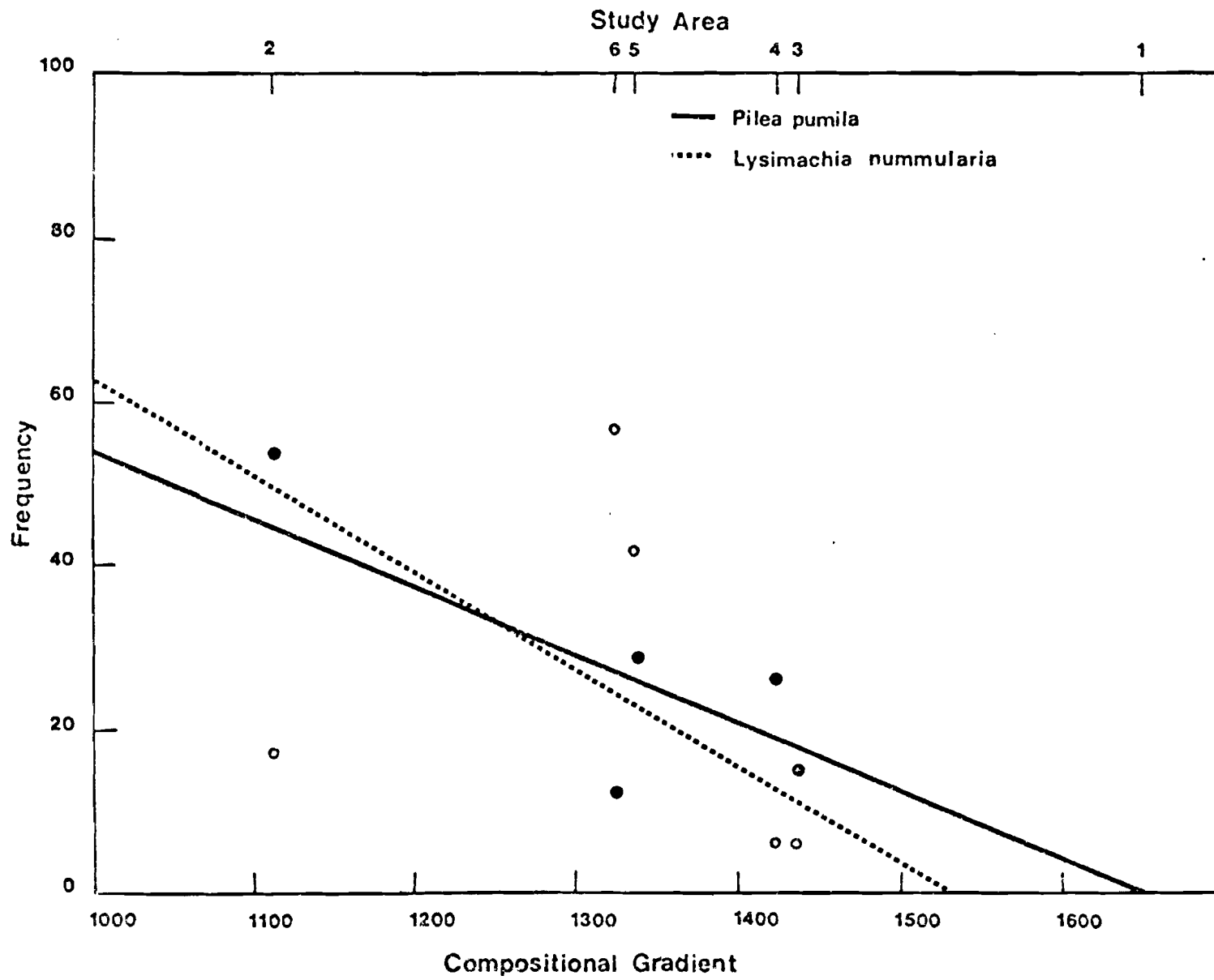


Fig. 8. Frequencies of the Gramineae family (●) and Glechoma hederacea (○) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.

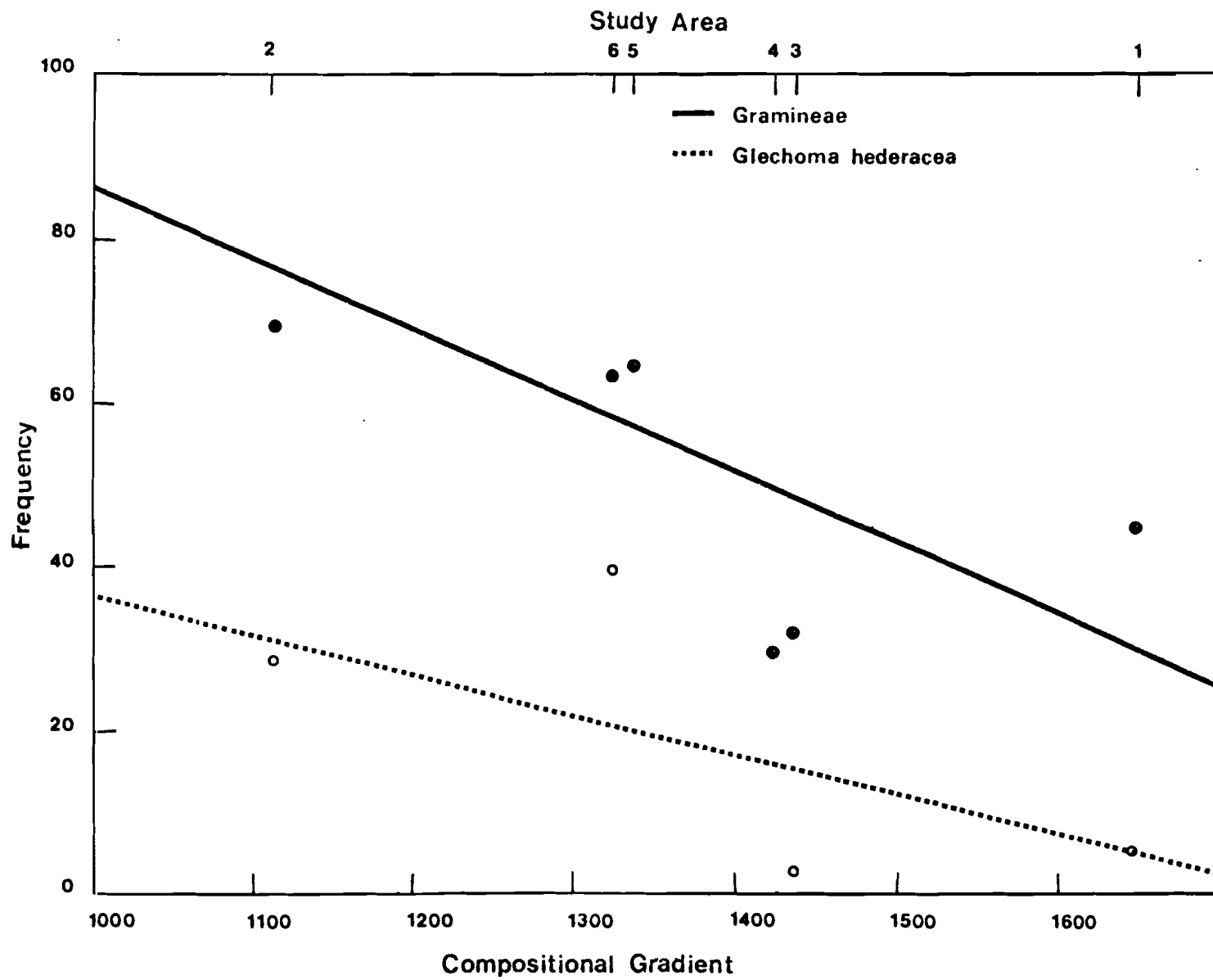
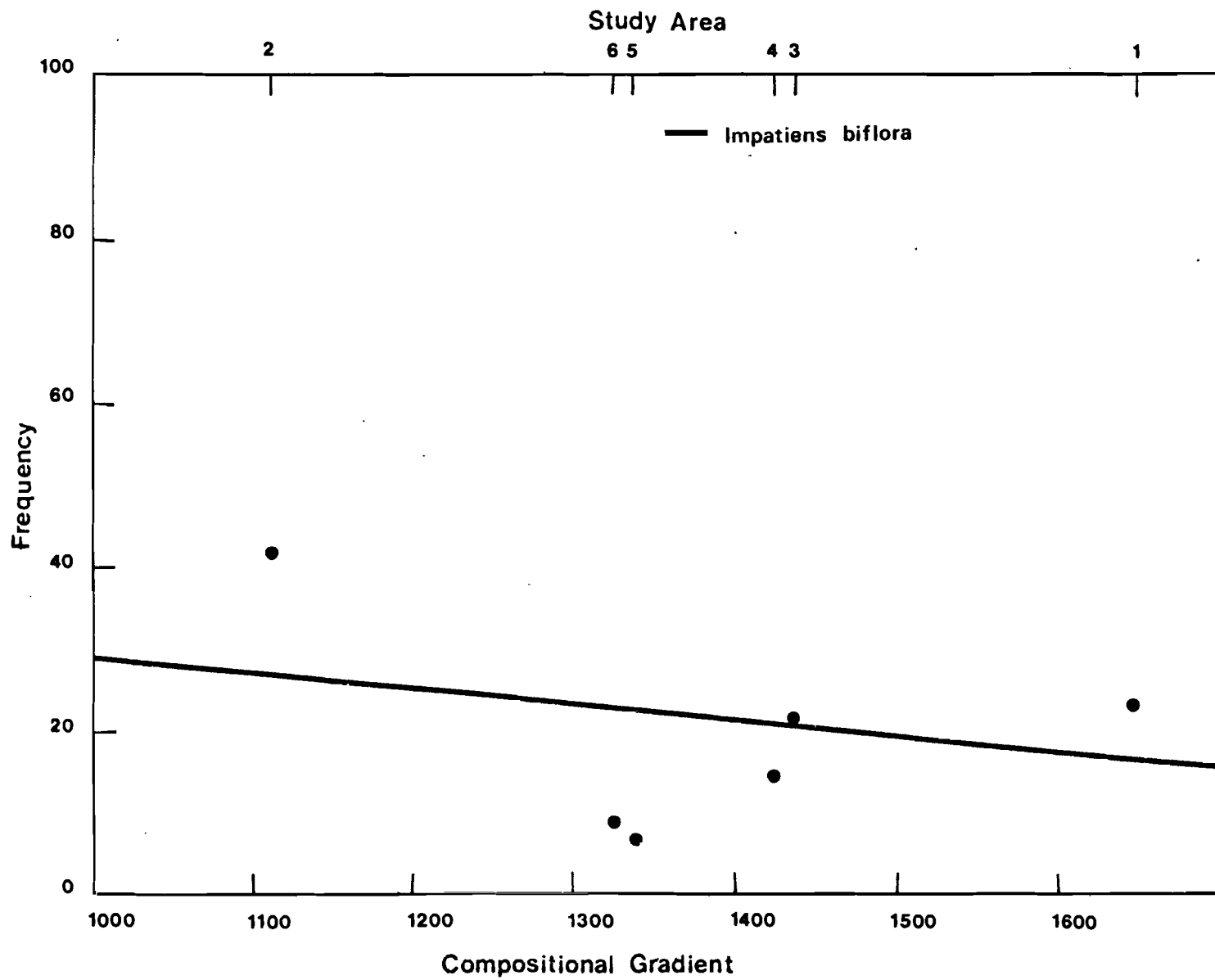


Fig. 9. Frequencies of Impatiens biflora (●) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.



virginianum, Unknown #1 and the genus Carex responded in an opposite manner, i.e. with an increasing frequency in the transition from wet to wet-mesic stands (Figs. 10, 11 and 12). The individual stand composition for species with frequencies greater than 20% are presented in Table 10.

Laportea canadensis had a frequency of 100% in Stand 1; it was the dominant species forming a canopy over other herbs in the stand. Viola papilionacea, Galium aparine, Carex spp., Parthenocissus quinquefolia, the Gramineae family, Ranunculus septentrionalis, Ranunculus abortivus and Cryptotaenia canadensis were distributed evenly throughout the stand. They were, however, secondary species. Highest frequencies of Laportea canadensis, Galium aparine, Carex spp., Parthenocissus quinquefolia, Sanicula gregaria, Smilax hispida, Urtica dioica and Hydrophyllum virginianum were observed in this stand.

In Stand 3 Laportea canadensis was again the dominant herb, having a frequency of 85%. Frequencies greater than 40% were observed for Ranunculus septentrionalis, Cryptotaenia canadensis, Galium aparine, Unknown #1, Viola papilionacea, Carex spp., Geum canadense, Ranunculus abortivus and Unknown #4. Carex spp. were found in thick mats in moist openings. Onoclea sensibilis, Phlox divaricata, Cryptotaenia canadensis, Ranunculus septentrionalis, Unknown #1, Geum canadense, Polygonum virginianum and Unknown #4 were most common in this stand.

In Stand 4, Laportea canadensis again dominated the herb layer; its frequency was 92%. Secondary dominant species were Viola papilionacea, Unknown #2, Ranunculus abortivus and Carex spp., and sporadically distributed in dense patches was Rudbeckia laciniata. Ranunculus abortivus, Rudbeckia laciniata, Unknown #2 and Ranunculus #1 reached

Fig. 10. Frequencies of Viola papilionacea (●) and Ranunculus abortivus (◐) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.



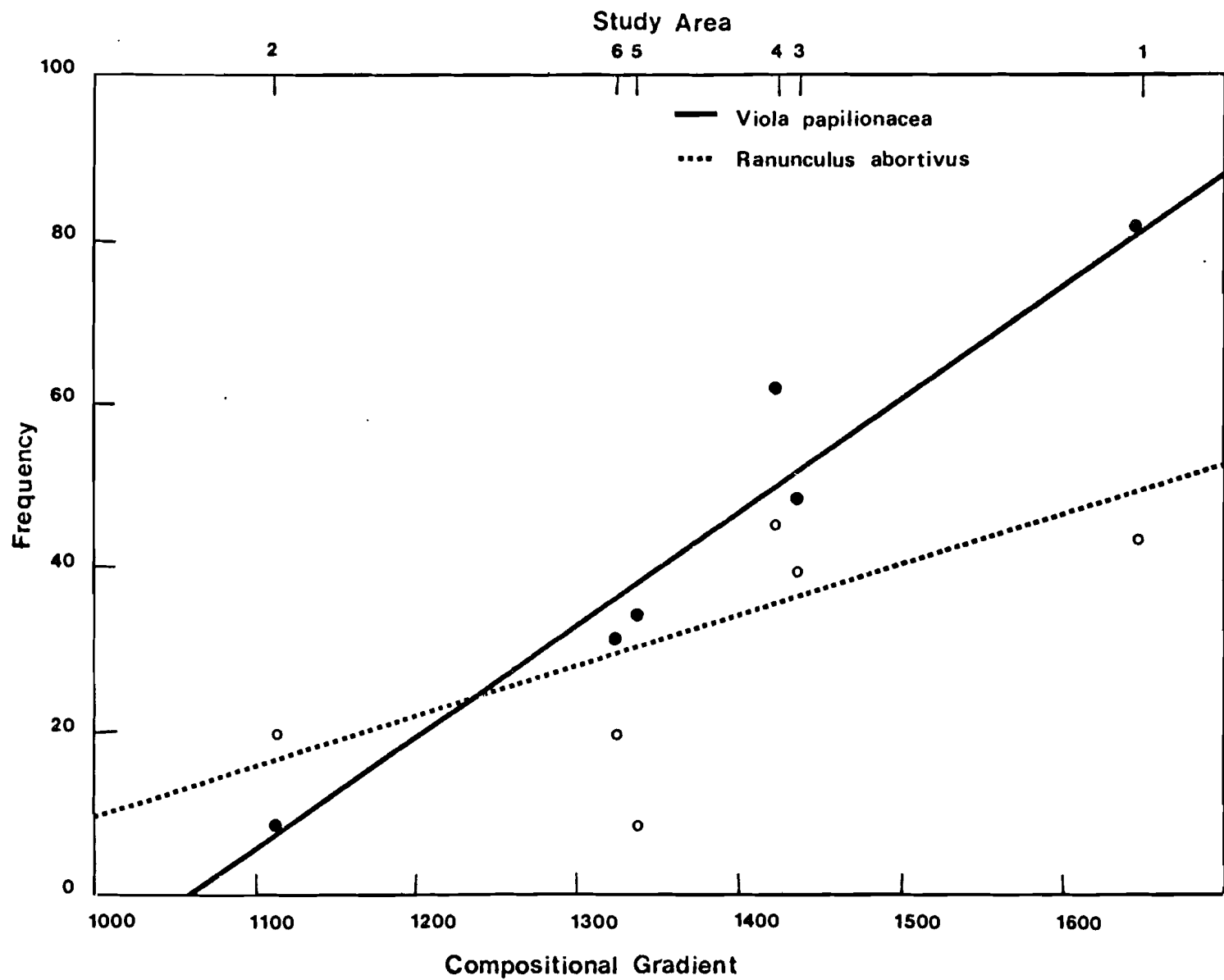


Fig. 11. Frequencies of Hydrophyllum virginianum (○) and Carex spp. (●) plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.

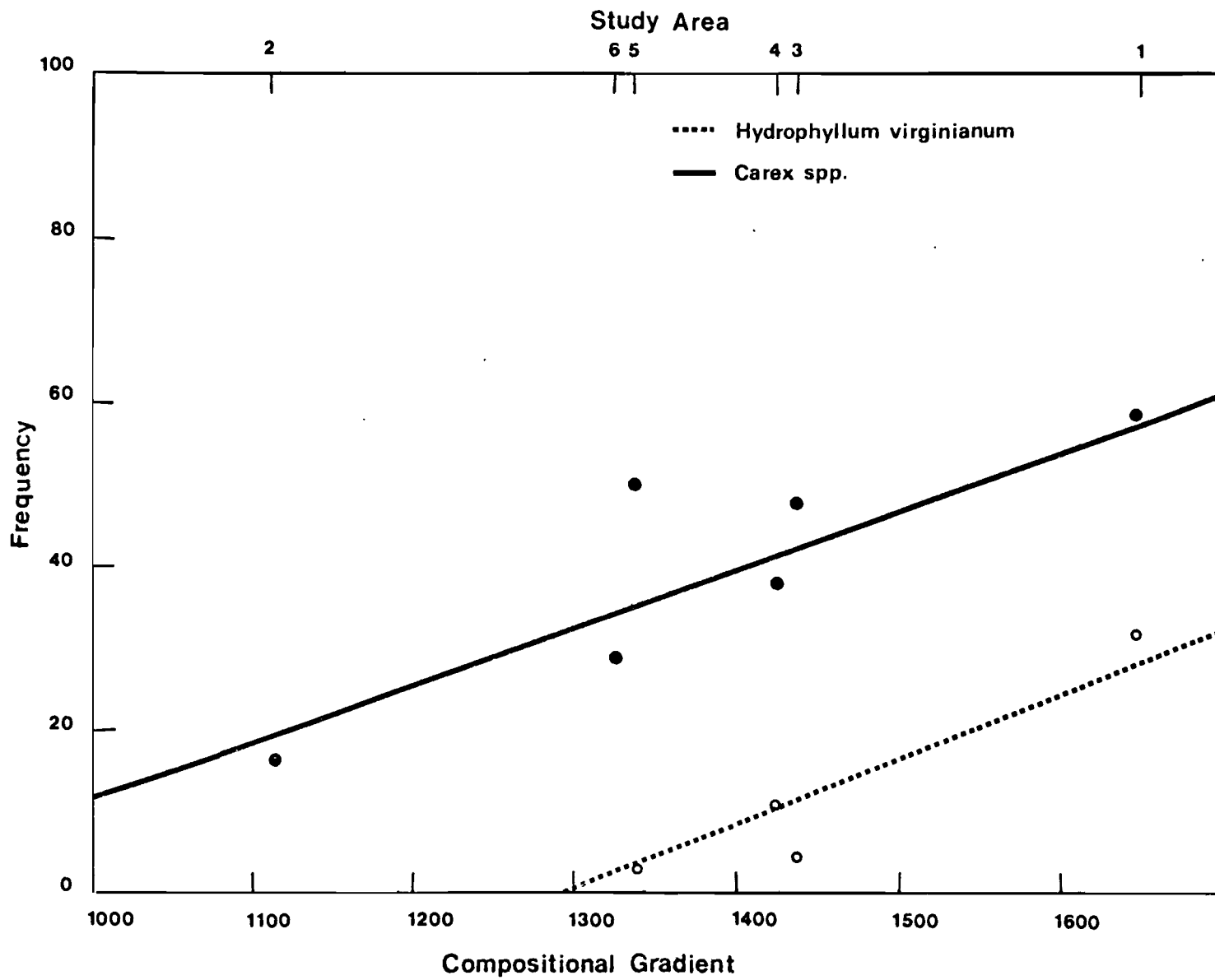


Fig. 12. Frequencies of Ranunculus septentrionalis (○) and Unknown #1 (●), plotted against the compositional gradient as occurred in the Van Loon Wildlife Area. Trend lines depict the behavior of the species in relation to the gradient.

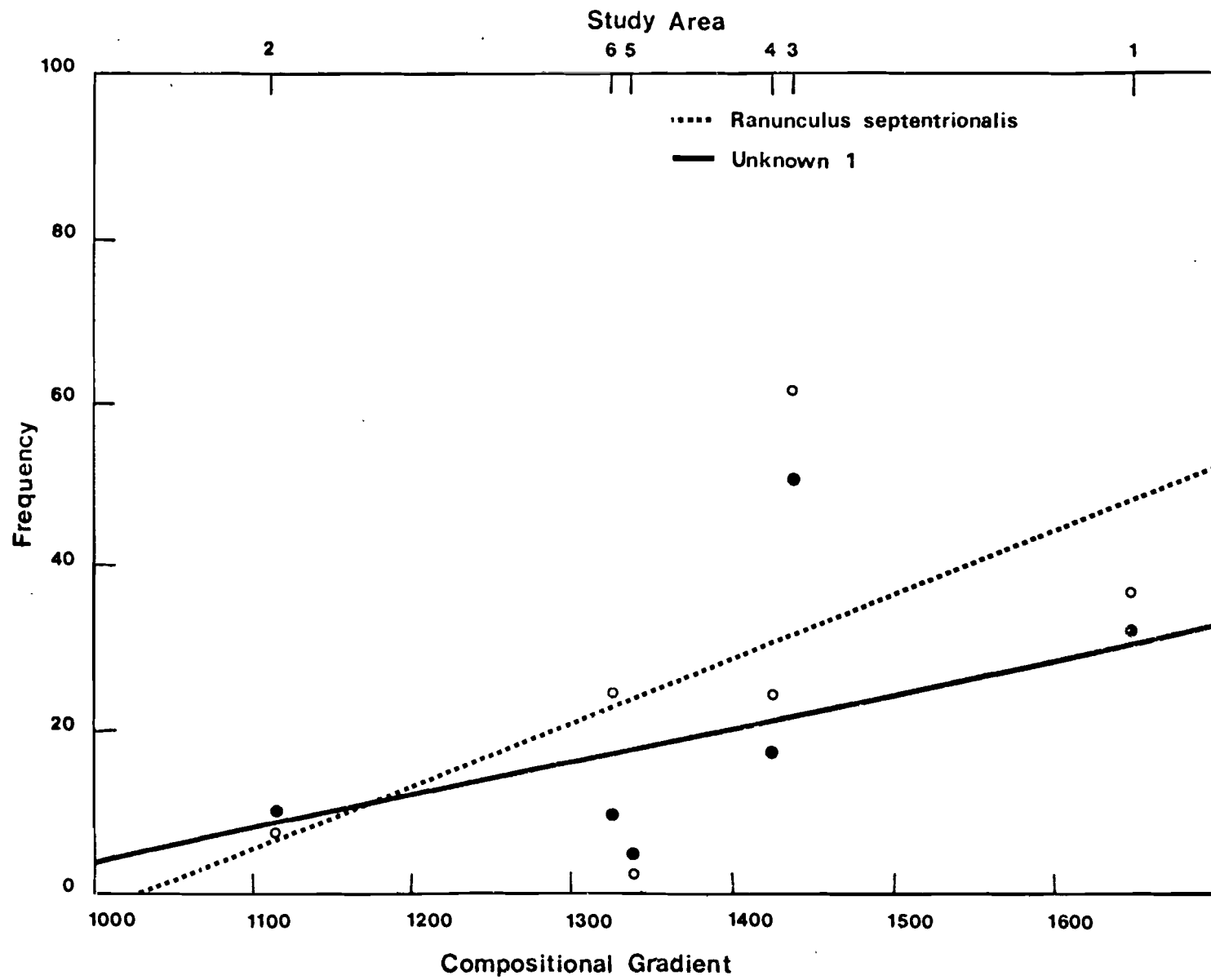


Table 10. A summary of the most common species (frequency greater than 20%) for each stand in the floodplain forest of the Van Loon Wildlife Area.

Stand 1	Frequency	Stand 2	Frequency	Stand 3	Frequency
* <u>Laportea canadensis</u>	100	<u>Laportea canadensis</u>	98	<u>Laportea canadensis</u>	85
* <u>Galium aparine</u>	94	*Gramineae	70	* <u>Ranunculus septentrionalis</u>	62
* <u>Viola papilionacea</u>	82	* <u>Pilea pumila</u>	54	<u>Galium aparine</u>	57
* <u>Carex spp.</u>	57	* <u>Impatiens biflora</u>	42	* <u>Cryptotaenia canadensis</u>	53
* <u>Parthenocissus quinquefolia</u>	51	<u>Glechoma hederacea</u>	28	*Unknown #1	51
<u>Ranunculus abortivus</u>	43	<u>Cryptotaenia canadensis</u>	26	<u>Viola papilionacea</u>	49
Unknown #1	33	<u>Parthenocissus quinquefolia</u>	22	<u>Ranunculus abortivus</u>	40
* <u>Hydrophyllum virginianum</u>	31	Unknown #2	22	*Unknown #4	40
<u>Geum canadense</u>	24	<u>Ranunculus abortivus</u>	20	Gramineae	32
* <u>Sanicula gregaria</u>	24			* <u>Onoclea sensibilis</u>	28
<u>Impatiens biflora</u>	22			<u>Impatiens biflora</u>	21
* <u>Urtica dioica</u>	22			* <u>Phlox divaricata</u>	21
* <u>Smilax hispida</u>	20			* <u>Polygonum virginianum</u>	21

Table 10 continued.

Stand 4	Frequency	Stand 5	Frequency	Stand 6	Frequency
<u>Laportea canadensis</u>	92	Gramineae	65	<u>Laportea canadensis</u>	70
<u>Viola papilionacea</u>	62	<u>Carex spp.</u>	50	Gramineae	64
*Unknown #4	48	* <u>Lysimachia ciliata</u>	50	* <u>Lysimachia nummularia</u>	58
* <u>Ranunculus abortivus</u>	46	<u>Lysimachia nummularia</u>	42	<u>Galium aparine</u>	46
<u>Carex spp.</u>	38	* <u>Rhus radicans</u>	35	* <u>Glechoma hederacea</u>	40
* <u>Rudbeckia laciniata</u>	30	<u>Viola papilionacea</u>	35	<u>Viola papilionacea</u>	32
* <u>Ranunculus #1</u>	28	*Unknown #6	33	<u>Carex spp.</u>	28
<u>Pilea pumila</u>	26	<u>Pilea pumila</u>	29	<u>Rudbeckia laciniata</u>	26
<u>Galium aparine</u>	24	<u>Laportea canadensis</u>	25	<u>Ranunculus septentrionalis</u>	24
<u>Parthenocissus quinquefolia</u>	24	<u>Ranunculus sp.</u>	25	<u>Urtica dioica</u>	22
<u>Ranunculus septentrionalis</u>	24	<u>Geum canadense</u>	21	Unknown #2	22
<u>Onoclea sensibilis</u>	22			<u>Ranunculus abortivus</u>	20
<u>Sanicula gregaria</u>	22				
<u>Cryptotaenia canadensis</u>	20				
<u>Geum canadensis</u>	20				
<u>Polygonum virginianum</u>	20				

\* Species which attain optimum frequency in this stand.

their highest frequencies in this stand.

Stand 5 was the only stand in which Laportea canadensis did not attain the highest frequency value. Gramineae and Lysimachia ciliata, with frequencies of 65% and 50%, respectively, replaced the dominant. Lysimachia nummularia was also a prevalent species. Lysimachia ciliata, Rhus radicans and Unknown #6 reached their highest frequencies in this stand.

Laportea canadensis was the dominant herb in Stand 6 showing a frequency value of 70%. Gramineae was well represented in this stand having a frequency of 64%. Lysimachia nummularia and Glechoma hederacea reached high frequencies in this stand.

In Stand 2, Laportea canadensis attained a frequency of 98%; however, this is a misleading figure as flooding and sand deposition disturbed the herb stratum. Gramineae, Pilea pumila and Impatiens biflora were the important species, and these species also reached their highest frequencies in this stand. Stand 2 had the lowest compositional index value. Phalaris arundinacea dominated dry river channels in this area.

Tree seedling and liana data were included in the 1-m<sup>2</sup> quadrat data. Acer saccharinum (26.5%), Fraxinus pennsylvanica (6.5%), Carya cordiformis (2.3%), Quercus bicolor (1.0%) and Ulmus rubra (1.0%) were the only seedlings reported with frequencies greater than 1.0%. Lianas were well represented in the bottomland forest. Parthenocissus quinquefolia (23.0%) was the most frequently encountered vine; it was followed by Rhus radicans (9.5%) and Smilax herbacea (9.2%).

#### Flora

As a result of the ecological field work and collection trips,



a vascular flora of Van Loon has been compiled. Species collected in the area between the east and west channels of the Black River were generally characteristic of floodplain habitats. Two hundred thirty-eight species from 67 families were collected from this area.

Cyperaceae was the largest family, having 24 species. Carex, the largest genus, had 18 species in the bottomland sites. The upland area, Stand 7, and the Seven Bridges Road site, contained a variety of prairie and upland forest species. Including these areas, the total flora of Van Loon Wildlife Area consisted of 365 species from 88 families (see Appendix 1 for species list).

#### Soils

Soils in Van Loon varied from sand to sandy loam (Table 11), ranging from 66% to 97% sand, 3% to 28% silt and 0% to 6% clay. On the average, the top 12 inches of soils were composed of 82.5% sand, 13.5% silt and 3.3% clay. Soils in Stand 6 contained the most sand (97%), and soils of Stand 4 had the greatest silt content (28%). The highest percentages of clay were found in Stands 1 and 4 (6%).

The average percent organic matter was 2.79%, with a range of 1.09% to 4.20% (Table 11). The greatest amount of organic matter was found in Stand 4 (4.20%); whereas, Stand 6 had the least amount of organic matter (1.09%). Differences in organic matter among stands may be explained by stand age and elevation. Water-retaining capacities of all soils were low due to the high percentage of sand and low organic content. Water-retaining capacities ranged from 28.9% to 51.3% (Table 11).

Table 11. Soil texture, sand (%), silt (%), clay (%), organic matter (%) and water-retaining capacity of the floodplain forest of the Van Loon Wildlife Area.

Stand	Sand	Silt	Clay	Organic Matter	WRC	Texture
6	97%	3%	0%	1.09%	28.9	Sand
2	96%	4%	0%	1.28%	32.6	Sand
5	84%	12%	4%	3.90%	39.1	Sandy loam
3	84%	12%	4%	2.39%	37.8	Sandy loam
1	72%	22%	6%	3.87%	39.9	Loamy sand
4	66%	28%	6%	4.20%	51.3	Loamy sand
average	82.5%	13.5%	3.3%	2.79%	38.3	

## DISCUSSION

Trees

The aborescent overstory of the floodplain forest in Van Loon was composed of tree species characteristic of bottomland habitat. Acer saccharinum was the dominant overstory species, having the highest importance values (IV's) in all stands except one. In Stand 3 Acer saccharinum was exceeded slightly by Quercus bicolor. Quercus bicolor, Ulmus rubra, Betula nigra and Fraxinus pennsylvanica were secondary dominants and were considered important species. All of the preceding species were present in all stands. Populus deltoides, the secondary dominant in Stand 2, was present in only two stands, and was considered a less important species along with Carya cordiformis, Ulmus americana, Tilia americana, Acer negundo, Salix nigra and Quercus borealis. The results obtained in this study were comparable to those of other studies in Wisconsin (Ware 1955, Curtis 1959).

Ware (1955) found Acer saccharinum and Ulmus americana to be leading dominants in 70 stands studied. The association of Acer saccharinum, Ulmus americana and Fraxinus pennsylvanica was repeatedly encountered. The twelve most common species of Ware's study were Salix nigra, Populus deltoides, Betula nigra, Quercus bicolor, Acer saccharinum, Fraxinus pennsylvanica, Fraxinus nigra, Ulmus americana, Tilia americana, Quercus borealis, Celtis occidentalis and Acer saccharum. Nine of these species were encountered in the ecological sampling of Van Loon. Two additional species, Celtis occidentalis and Fraxinus nigra, were encountered in the flora of Van Loon.

The results from Van Loon were similar to those of Curtis (1959), who also noted Acer saccharinum as a dominant, its greatest IV's in the wet forest. Other species that reached optimal importance in the wet forest were Populus deltoides, Salix nigra, Betula nigra, Quercus bicolor and Acer negundo. Acer saccharinum also co-dominated the wet-mesic forest with Ulmus americana. Fraxinus pennsylvanica and Celtis occidentalis reached their maximum importance in these stands. In Van Loon, Fraxinus pennsylvanica was found to be a secondary dominant, Ulmus americana was a less important species, and Celtis occidentalis was not encountered in ecological sampling.

The structure and composition of floodplain forests have been related to factors such as stand age, horizontal and vertical position of the stand in relation to the river, stage of succession, soil development and species range (Ware 1955, Curtis 1959, Lindsey et al. 1961, Johnson et al. 1976, Robertson 1978). Van Loon exhibited frequent intra and inter-stand changes in forest composition. These changes were due to backwaters which reached into almost all sections of the study area. The presence of different associations or successional stages in the same stand of the floodplain forest may be explained by the influence of water levels on different species. Waterways and backwater sloughs provided modified environmental conditions, e.g. greater soil moisture along their edges and an open canopy. These areas were dominated by different species than those occurring on higher ground. Floodplain species generally exhibit the same relative pattern to one another above the average water level (Van Asdall 1958). Quercus bicolor, Betula nigra and Populus deltoides were common along waterways and backwater sloughs. Different associations or stages of succession

may be present in any specific stand; furthermore, average IV's tend to obscure different combinations of species within a given segment of a floodplain forest (Curtis 1959). This effect was evident in Van Loon.

Successional stages or associations found in Van Loon were representative of floodplain forests. Acer saccharinum was the dominant species of both wet and wet-mesic forests studied. As noted above, it was also the dominant species in other Wisconsin studies. Furthermore, it was found to be a major species in studies by Yeager (1949), Lindsey et al. (1961), Ebinger and Crites (1969) and Kunshek (1971). Hosner and Minckler (1963) reported that Acer saccharinum forms a subclimax forest with Acer negundo, Ulmus spp. and Fraxinus spp., an association which reproduces itself. Although Acer saccharinum was the dominant species in five of six stands, it was most abundant in stands with lower compositional index values. Saplings were encountered in Stands 2, 5 and 6. The age structure of Acer saccharinum showed a trend of continued dominance in Stands 2 and 6; however, a decrease in importance occurred with an increase of associated species in Stands 1, 3, 4 and 5.

The Populus-Salix association, recognized as a pioneer association (George 1924, Ware 1955, Curtis 1959, Hosner and Minckler 1963, Wilson 1970), was observed on pioneer sites such as mudflats, sand bars and open sites along the river banks of Van Loon. Populus deltoides and Salix nigra were only encountered in Stands 2 and 6; these two stands had the lowest compositional index values. The presence of these species indicated that pioneer sites were previously present, thus allowing for the establishment of these species. Populus deltoides and Salix nigra

were found in the larger size classes showing a decline in species population. Acer saccharinum was the dominant tree species in these stands. Saplings in Stand 2 were Acer saccharinum and Ulmus rubra; age structures indicate these species will most likely replace Populus deltoides and Salix nigra in the stand. Saplings of Carya cordiformis, Fraxinus pennsylvanica, Acer saccharinum, Quercus bicolor and Ulmus rubra were found in Stand 6. These species will undoubtedly become more important as time progresses. During floods, forest stands near the river are often covered with sandy deposits, whereas stands farther from the river receive finer deposits. Organic matter differences among the stands can be explained by the differences in age and elevation. Newly formed terraces contain very little organic matter, whereas older stands have had more time to accumulate organic matter in the soil (Johnson et al. 1976). Soil texture analyses for Stands 2 and 6 contained a high percentage of sand, a low percentage of silt and clay, low organic matter content and low water-retaining capacity. The presence of Populus deltoides and Salix nigra and soil data indicate that Stands 2 and 6 were on lower terraces than the other stands.

Betula nigra also attained its greatest IV's in Stands 2 and 6, respectively. Its occurrence was noted primarily along river channels, edges of sloughs and in disturbed areas of the stands. These results are similar to those of Ware (1955) who reported that Betula nigra became readily established on pioneer sites. The absence of Betula nigra saplings in these areas indicated that no reproduction was occurring in the stands sampled.

Quercus bicolor was found frequently dominating areas along sloughs, ponds, sedge openings and wet areas of the stands. Swamp

white oak reached its greatest IV's in Stands 3 and 5, being dominant in Stand 3. Ware (1955) suggested that Quercus bicolor and Betula nigra were pioneer species in these habitats. Quercus bicolor saplings were present in Stands 3, 5 and 6; the age structure exhibited a possible increase of importance for this species in stands 3 and 5. This species will continue to persist in the floodplain, but only where proper conditions are available.

Ulmus rubra was represented consistently in all stands with IV's of 20.9 or greater. It exhibited an increase of importance in wet-mesic stands, with its greatest importance in Stand 1. Stand 1 had the greatest compositional index value. Saplings were present in all stands except Stand 3. Crites and Ebinger (1969) reported that Ulmus rubra was a secondary species in an Acer saccharinum, Populus deltoides and Acer negundo forest. Similar to Van Loon, they reported red elm as an invading species in areas of floodplain forest which were becoming drier.

Fraxinus pennsylvanica, a common species in association with Ulmus americana and Acer saccharinum, was found to be important only in stands with high compositional index values, i.e. Stands 1, 3 and 4. A high IV was recorded for Fraxinus pennsylvanica in Stand 4. Ash saplings were recorded in all stands except Stand 2.

Carya cordiformis, Tilia americana, Quercus borealis and Ulmus americana exhibited greater importance in the wet-mesic stands with high compositional index values, i.e. Stand 1, 3, 4 and 5. Only Carya cordiformis occurred in Stand 6. These species were considered of lesser importance in this study, but the presence of these species in Stands 1, 3 and 5 indicate a transition to a more mesic forest.

Soil data from these stands show greater amounts of silts and clays, greater amounts of organic matter and greater water-retaining capacities; therefore, these stands are not significantly affected by direct flooding.

In recent years, the loss of Ulmus americana due to Dutch elm disease has affected the composition of the floodplain forests. Ulmus americana was represented in two stands of the study area. The IV's did not show the same importance as noted by Ware (1955) and Curtis (1959). Dead elms were observed in Stands 1, 3, 4 and 5. This occurrence was apparently the result of Dutch elm disease. Although it is not known if the American elm was ever a dominant species, it has been reduced in numbers. Grittenger (1978) studied lowland stands in southeastern Wisconsin and observed that Ulmus americana lost its dominance as a result of Dutch elm disease. He noted that associated species would replace the dead elms. In Stand 1, where the Ulmus americana achieved its greatest importance value, the saplings of Fraxinus pennsylvanica, Ulmus rubra and Carya cordiformis were present. These species along with Acer saccharinum, the dominant species in the stand, will probably replace Ulmus americana if the population continues to decline.

The basal area of stands in Van Loon ranged from 24.6 to 29.7 m<sup>2</sup>/ha with an average of 27.1 m<sup>2</sup>/ha. This was greater than 22.6 m<sup>2</sup>/ha reported by Curtis (1959). He observed that riverine stands tend to have very high basal areas due to the large size of the trees rather than high density. Grittenger (1978) reported an average basal area of 25.3 m<sup>2</sup>/ha in a lowland forest. This value is also slightly less than the average basal area of Van Loon. Studies in Illinois and Indiana reported basal areas/ha greater than those observed in Van



Loon. Crites and Ebinger (1969), Robertson (1978), Ashby and Ozment (1967) and Schmeltz and Lindsey (1965) documented values of 37.4, 38.8, 45.7 and 29.6 m<sup>2</sup>/ha, respectively. In North Dakota, Wikum and Wali (1974) cited comparable figures to Van Loon in bottomland forests. They reported an average basal area of 24.9 m<sup>2</sup>/ha, while Johnson et al. (1976) documented an average of 28.0 m<sup>2</sup>/ha for stands along the Missouri River in North Dakota. It should be noted that Acer saccharinum was not present in the North Dakota studies. Robertson (1978) suggested favorability of environment, length of growing season and disturbances as possible causes for differences from region to region.

Tree density in Van Loon ranged from 254 to 469 trees/ha with an average of 368 trees/ha. This was greater than the typical Acer saccharinum and Ulmus americana forest in southern Wisconsin in which Curtis (1959) reported 209 trees/ha. In other studies, Robertson (1978), Wikum and Wali (1974) and Johnson et al. (1976) observed 415.5 trees/ha, 801 trees/ha and 573.9 trees/ha, respectively. These densities were all greater than those found in Van Loon. The loss of elm trees in the study area may have lowered the density of Van Loon.

### Shrubs

In general, average frequency data collected from the shrub stratum in Van Loon did not indicate a great importance of shrubs. Average frequencies ranged from 1.1% to 12.1% per species with Sambucus canadensis, Ilex verticillata and Zanthoxylum americanum having the highest values. Average estimated percent cover was low and ranged from 0.1% to 3.2% per species. It appears that on the basis of density, however, shrubs were somewhat important with an average density of

3,225 stems/ha. The frequencies and low percentage of estimated cover in relation to density demonstrate that the shrubs occurred in clumps. High densities of shrubs under dead or wind fallen trees accounted for this phenomenon. Grittenger (1978), in his study of the effects of Dutch elm disease on canopy species, noted an increase in importance of shrubs where the canopy became open.

In a study of the White River in Indiana, Lee (1945) also observed that the small tree and shrub layers were poorly expressed. Cratageus spp. were typical of early succession and Sambucus canadensis was found in open areas. Crites and Ebinger (1969) found Sambucus canadensis and Salix interior to be the most frequently encountered shrub species in a study of east central Illinois. They noted Sambucus canadensis was concentrated in open areas, whereas Salix interior was found only on sandbars near the edge of the river. Mohlenbrock (1975) observed Forestiera acuminata, Cornus obliqua and Cratageus spp. to occur in silver maple-cottonwood communities along the Mississippi River. Sohmer and Swanson (1978) noted that Cephalanthus occidentalis, Amorpha fruticosa, Cornus stolonifera, Cornus obliqua and Cornus racemosa were predominant shrubs in the communities of Navigation Pool No. 8, which includes alluvial forest.

Other research dealing with shrub density yielded data similar to those observed in Van Loon. Grittenger (1978) reported densities in a lowland forest for secondary trees and shrubs ranging from 13,333/ha to 43,250/ha; however, Ribes spp. and Rhubus spp. comprised approximately 53% of these shrubs. An average density of 750 true shrubs/ha in a mature maple-basswood forest was reported by Harper (1963), while Buell and Cantlon (1953) obtained 4,500 and 6,000 stems/ha

in two maple-basswood stands. Shrub-carr densities contrasted strongly with those of mesic and bottomland forests. White (1965) reported shrub-carrs with up to 75,668 stems/ha.

Two species that were common in Van Loon, but were not encountered in samples, also deserve mention. Cephalanthus occidentalis, a water tolerant species, did not occur in the data gathered. It was, however, observed along the edges of ponds, sloughs and in emergent communities. Salix interior was the other species not found within the quadrats, but it was established on river banks and along old river channels disturbed by floods.

#### Herbs

A broad diversity of habitats supporting aquatic, riparian and terrestrial communities were present in Van Loon. Data from herbaceous strata were collected from beneath the canopy of the floodplain forest. Ecotonal areas along openings and large bodies of water were excluded. The herb strata varied among stands. For example, Stand 1 had a relatively homogeneous herb community dominated by Laportea canadensis. In Stand 5, the herb stratum was not homogeneous, rather it consisted of patches of different communities such as Laportea canadensis, Carex spp. and Lysimachia ciliata. This variation of composition among stands was most likely due to flood waters that disturbed the area. Herbaceous layers may be directly influenced by the water or indirectly by the soils deposited by the water, or both (Barnes 1978). The differences in elevation of the bottomland forest may determine how physical factors will affect plants. Species of bottomland forests on the Chippewa River, Eau Claire, Wisconsin, have been characterized

to occur above mean flood level, below mean flood level and both above and below mean flood level.

The herbaceous layers of floodplain forests develop late in the spring as compared to the upland forests. This is because the soil surface usually remains inundated well into the month of May (Curtis 1959). This was true for the greater portion of Van Loon. On May 15, 1979, spring flood waters began to recede. At that time, Claytonia virginica, Viola spp. and Ranunculus spp. were plentiful and were in bloom on higher ground. Conversely, the lower areas were still flooded. By June 13, 1979, flood waters had completely receded and vegetation had changed drastically. The species noted above were insignificant in comparison with the biomass of species such as Laportea canadensis, Cryptotaenia canadensis and Rudbeckia laciniata. It should be noted, however, that the former species started late, and vigorous growth followed.

In the floodplain forest, 92 species were encountered, and 60 species occurred with an average frequency of at least 1%. Laportea canadensis was the most prevalent species observed. It was present in every stand and attained a frequency of 100% in Stand 1. The Gramineae family was second, having an average of 51.0%. It was followed by Viola papilionacea, Galium aparine and Carex spp., which had average frequencies of 44.7%, 40.5% and 39.0% respectively.

The response of the herbaceous layer to the overstory can be illustrated by plotting the importance value of herbs against the compositional index (Figs. 7, 8, 9, 10, 11, and 12). Laportea canadensis occurred abundantly in all stands. Viola papilionacea, Ranunculus abortivus, Ranunculus septentrionalis, Hydrophyllum virginianum, the

genus Carex and Unknown #1 exhibited a tendency to increase frequency with an increase of compositional index values. Conversely, Pilea pumila, Impatiens biflora, Lysimachia nummularia, Glechoma hederacea and the family Gramineae increased in frequency as the compositional index values decreased. These results agreed with results reported by Curtis (1959) and Ware (1955). Although Ware (1955) stated Cryptotaenia canadensis occurred abundantly over the entire range of the compositional index, this pattern was not observed in Van Loon.

Vegetative growth was dense and vigorous in the study area with the exceptions of Stands 2 and 6. These stands had soils which were of high sand content and were disturbed more severely by flooding and sand deposition than Stands 1, 3, 4 and 5. These factors accounted for the sparse vegetational cover in these areas. According to Lindsey (1961), it was common for silver maple-cottonwood-elm bottoms of the Wabash river to have little understory because of severe late spring flooding. In favorable years, a dense herb stratum was comprised predominately of Laportea canadensis, Cryptotaenia canadensis, Aster spp. and Pilea pumila.

In the Raritan River floodplain, Wistendahl (1958) observed Mertensia virginica, Claytonia virginica, and Viola spp. as common spring flowers. In early summer, the cover of the herb stratum was dominated by Laportea canadensis, Hydrophyllum virginianum, Caulophyllum thalictroides, Solidago flexicaulis and Viola spp.. Impatiens biflora, Allaria officinalis and Polygonum spp. were important in wet areas, where Phalaris arundinacea was important on the river banks.

In east central Illinois, Crites and Ebinger (1969) discovered Laportea canadensis to be by far the most abundant herb in all parts

of the floodplain forest. Other frequently encountered species were Impatiens biflora, Viola papilionacea, Cryptotaenia canadensis and Polygonum virginianum.

In describing the plant species of the La Crosse area, Hartley (1960) listed 35 plant species characteristic of alluvial woodlands. All except six of these species were encountered in Van Loon.

Curtis (1959) listed prevalent ground species in southern Wisconsin wet forests. He observed the following five species to have the greatest average frequencies: Leersia virginica, Impatiens biflora, Laportea canadensis, Boehmeria cylindrica and Pilea pumila. The five species with greatest average frequencies in the southern wet-mesic forest were Laportea canadensis, Impatiens biflora, Arisaema triphyllum, Parthenocissus vitacea and Viola cucullata. Laportea canadensis and Cryptotaenia canadensis occurred abundantly in all of the areas studied in southern Wisconsin by Ware (1955).

Laportea canadensis, Cryptotaenia canadensis, Impatiens biflora and Pilea pumila appeared as common species of bottomland forests of the studies reviewed above. These species were all well represented in the herb stratum of Van Loon and attained frequencies of at least 14%. The most important factors affecting the composition of the herb stratum appeared to be canopy cover and position of the stand on the floodplain.

The importance of lianas in bottomland areas contrasts strongly with the relatively insignificant role of true shrubs (Curtis 1959). Parthenocissus quinquefolia was the dominant liana in Van Loon where it attained a frequency of 23.8%. It was followed by Rhus radicans (9.5%), Smilax herbacea (5.0%) and Echinocystis lobata (3.7%). Swan

(1961) studied Parthenocissus vitacea, Vitis riparia and Celestrus scandens. He found these lianas three times more important in lowlands than in uplands. Ware (1955) observed Parthenocissus quinquefolia and Rhus radicans to be abundantly distributed in bottomland forests.

## CONCLUSIONS

Acer saccharinum was the dominant overstory species in the floodplain forest of Van Loon. Quercus bicolor, Ulmus rubra, Betula nigra and Fraxinus pennsylvanica were secondary dominants and varied among stands. Two forest types were found in the study area, i.e. wet forest and wet-mesic forest. Successional status and elevation of the stand in relation to the river determined the composition of the stand. Results of the study were comparable to other reports on bottomland forests with the exception of the relatively low importance values for Ulmus americana. This difference was probably due to Dutch elm disease. It should be noted that Ulmus rubra appeared as an important species in this study.

Although shrubs were important in certain communities such as ecotonal zones, they did not appear to be of great importance in the floodplain forest. Sambucus canadensis, Zanthoxylum americanum, and Ilex verticillata were the most prominent shrub species present. Shrub species reached maximal importance in open areas. Lianas were another important group of plants in the bottomland forests. Parthenocissus quinquefolia, Rhus radicans, Smilax herbacea, Smilax hispida, Echinocystis lobata and Vitis riparia were the most frequent encountered species.

The herb stratum was subject to compositional differences among stands as a result of canopy cover and flooding disturbances. Laportea canadensis was the dominant species encountered in this study. The



development of the herb stratum in Van Loon occurred in late May; flood waters usually occupied the forest floor until that time. Spring ephemerals appeared in elevated areas which were free of flood waters early in the season. Vigorous growth occurred after the water receded. The composition of the wet forest and the wet-mesic forest herb strata differed. Laportea canadensis dominated all stands except for Stand 5. Viola papilionacea, Ranunculus abortivus, Ranunculus septentrionalis, Hydrophyllum virginianum, Carex spp. and Unknown #1 were most frequently encountered in wet-mesic stands with high compositional index values. Conversely, Pilea pumila, Impatiens biflora, Glechoma hederacea, Lysimachia nummularia and the Gramineae family were most frequently encountered in wet forests. Also important in the study area was Cryptotaenia canadensis, a taxon characteristic of floodplain forests.

A flora of Van Loon was compiled. It was comprised of 365 species representing 88 families. Species collected can be related to two major habitat types: (1) bottomland and related habitats found between the east and the west channels of the Black River--238 species representing 67 families were collected in these habitats, (2) upland habitats located at Stand 7 and Seven Bridges Road--an additional 127 species from 21 families were collected in these habitats. Families with the most representatives observed in Van Loon were Compositae, Cyperaceae, Fabaceae and Labiatae, respectively. Cyperaceae, Compositae, Gramineae, Labiatae and Polygonaceae were the most prominent families found in the bottomland habitat in order of abundance.

None of the 365 species observed in Van Loon were listed on the Wisconsin endangered or threatened list. This study should provide

baseline data for further research in Van Loon. A wide variety of plant communities were observed during this study. These communities provide food and cover for the abundant wildlife present in Van Loon. Further studies of the emergent communities, Carex associations, Quercus bicolor and backwater slough communities would provide useful information on floodplain habitats in Wisconsin and for the Department of Natural Resources management plan for Van Loon. Some of the wildlife species observed in the area which deserve further attention are Sistrurus ctenatus (the massasauga, an endangered species in Wisconsin), Lutra canadensis (the river otter), Castor canadensis (the beaver) and Aix sponsa (the wood duck).

Management of Van Loon is best suited for timber and wildlife because of frequent flooding in the area. A timber harvest plan should be initiated to preserve vegetation along the river, ponds and sloughs in the area with emphasis on the preservation of Quercus bicolor. This species provides a significant amount of cover and food for wildlife. Furthermore, Aix sponsa was observed frequently feeding and roosting in backwater areas dominated by swamp white oak.

It appears that little could be accomplished by altering habitats of the area, as it already provides good habitat. Seven Bridges Road should be maintained to provide access to the central section of Van Loon, but other hiking trails would not be practical because of frequent flooding and swarms of mosquitos that inhabit the floodplain forest.

An area which would serve as a representative of a floodplain forest should be preserved in Van Loon. It is also recommended that further studies to locate massasauga populations be conducted. Areas such as these may be of interest to the state of Wisconsin for their Scientific Areas program.

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## APPENDIX I

Vascular flora of the Van Loon Wildlife Area, Black River bottomlands,  
La Crosse County, Wisconsin, during 1979-80.

## Division Pteridiophyta

## Family Equisetaceae

- Equisetum arvense L. Common Horsetail  
Sandy soil alluvial forest. 51,68,76,109,311,330,365,391  
413,434,435,580,639,712
- Equisetum X Ferrissii Clute.  
Sandy soil alluvial forest. 318
- Equisetum hymale L. Scouring-Rush  
Open river bank. 582

## Family Ophioglossaceae

- Botrychium dissectum Spreng. Cut-Leaved Grape Fern  
Alluvial forest 912,958

## Family Osmundaceae

- Osmunda claytoniana L. Interrupted Fern  
Alluvial forest. 555
- Osmunda regalis L. Royal Fern  
Alluvial forest. 1214

## Family Polypodiaceae

- Adiantum pedatum L. Maidenhair Fern  
Mesic forest above floodplain. 578,579
- Athyrium filix-femina (L.) Roth. Lady Fern  
Alluvial forest. 215,216,217,297,358,376,377,378,537,553,  
554,619,759,760,898,1002
- Dryopteris cristata (L.) Gray Crested Fern  
Alluvial forest. 769,770,771,772,790
- Dryopteris spinulosa (Muell.) Watt. Spinulose Woodfern  
Alluvial forest. 249,250
- Matteucia struthiopteris (L.) Todaro. Ostrich Fern  
Alluvial forest. 101,102,203,223,254,270,271,280,405
- Onoclea sensibilis L. Sensitive Fern  
Alluvial forest.
- Pteridium aquilinum (L.) Kuhn. Bracken Fern  
Alluvial forest. 335,560
- Thelypteris palustris Schoh. Marsh Fern  
Alluvial forest. 913,914

## Family Selaginellaceae

- Selaginella rupestris (L.) Spring. Rock Spikemoss  
Dry sandy field. 719,1107

## Division Spermatophyta

## Class Gymnospermae

## Family Alismataceae

- Alisma subcordatum Raf. Water-Plantain  
Wet soil along edges of ponds. 736,756,987

Sagittaria gramineae Michx. Grass-Leaved Arrowhead

Emergent at edge of pond. 1015

Sagittaria latifolia Willd. Broad-Leaved Arrowhead

Emergent in ponds. 1022

Family Amaryllidaceae

Hypoxis hirsuta (L.) Coville Star Grass

Dry sandy old field. 86

Family Araceae

Acorus calamus L. Sweet Flag

Emergent at the edge of pond. 928

Arisaema dracontium (L.) Schott. Green Dragon

Alluvial forest. 83,1204

Arisaema triphyllum (L.) Scott. Jack-in-the-Pulpit

Alluvial forest. 552

Family Commelinaceae

Tradescantia ohiensis Spiderwort

Dry sandy open areas and Seven Bridges Road. 178,179

Family Cyperaceae

Carex annectans (Bickn.) Bickn. Sedge

Var. xanthocarpa (Bickn.) Wieg.

Alluvial forest. 347

Carex bromoides Schk. Sedge

Alluvial forest. 15,30,93,112,200,221,255,256

Carex crinita Lam. Sedge

Alluvial forest. 144,147,485,492

- Carex davisii Schw. and Torr. Davis' Sedge  
Alluvial forest. 117,1173,1174
- Carex gracillima Schw. Sedge  
Alluvial forest. 227,228
- Carex grayii Carey. Sedge  
Alluvial forest. 143,145,274,575,622,742
- Carex grisea Wahl. Sedge  
Alluvial forest. 98,302
- Carex intumescens Rudge. Sedge  
Alluvial forest. 47,49,89,261,262,366,381,479
- Carex lasiocarpa Ehrh. Sedge  
Open area in alluvial forest. 621
- Carex laxiflora Lam. Sedge  
Alluvial forest. 21,385
- Carex lupulina Muhl. Hop Sedge  
Alluvial forest. 367,406,466,469,471
- Carex muhlenbergii Schk. Sand Sedge  
Open area with sandy soil. 697
- Carex muskingumensis Schw. Sedge  
Alluvial forest. 235,449,461,623,998,1189
- Carex rosea Schk. Sedge  
Alluvial forest. 95,269,325,585,586
- Carex stipata Muhl. Awl Sedge  
Alluvial forest. 151
- Carex stricta Lam. Hassock Sedge  
Alluvial forest. 34,1176
- Carex tuckermani Boott. Sedge  
Alluvial forest. 136,239,240,464,496

- Carex tribuloides Wahl Sedge  
Alluvial forest. 483
- Carex typhina Michx. Sedge  
Alluvial forest. 251,257,258,314,331,455,476,481,635,741,1188
- Cyperus odoratus L.  
Alluvial forest. 1198
- Cyperus rivularis Kunth.  
Moist soil on shore of Black River. 1194
- Dulichium arundinaceum (L.) Britt. Three-Way Sedge  
Wet shore of pond. 1117,1118
- Eleocharis acicularis (L.) R.& S. Needle Rush  
Emergent along edge of pond. 757,976,986
- Eleocharis palustris (L.) R.& S. Creeping Spike Rush  
Emergent along the edge of pond. 1034
- Scirpus cyperinus (L.) Kunth. Wool Grass  
Open wet area adjacent to pond. 506,510,840,999
- Scirpus fluviatilis (Torr.) Gray River Bulrush  
Emergent among muddy shore of pond. 404
- Scirpus validus Vahl. Great Bulrush  
Emergent in shallow water of pond. 508,509,1020,1024
- Family Dioscoreaceae
- Dioscorea villosa L. Wild Yam  
Alluvial woods. 343,359,450,587,743
- Family Hydrocharitaceae
- Anacharis canadensis (Michx.) Rich. Elodea  
Submergent in pond. 1105,1112

## Family Gramineae

- Agropyron repens (L.) Beauv. Quackgrass  
Old field. 338
- Agrostis perennans (Walt.) Tuckerm. Bentgrass  
Dry sandy open area. 997,1106
- Andropogon gerardi Vitm. Big Bluestem  
Seven Bridges Road. 916
- Andropogon scoparius Michx. Little Bluestem  
Dry sandy old field. 1037,1045,1050,1078
- Aristida brasiramea Engelm. Triple-Awn Grass  
Dry sandy old field. 1055
- Bromus inermis Leyss. Smooth Brome  
Seven Bridges Road and disturbed areas. 156,157,319,807,  
808,919
- Bromus kalmii Gray. Brome Grass  
Dry sandy old field. 971,1085
- Calamogrostis canadensis Nutt. Bluejoint  
Seven Bridges road. 463,624,848,966,1192
- Cinna arundinacea L. Wood Reed  
Alluvial forest. 826,874,887,934,941,983,991,1124
- Dichanthelium lanuginosum (Ell.) Gould  
var. fasciculatum (Torr.) Spellenb.  
Dry sandy open area. 596,664,1039
- Dichanthelium oligosanthos (Shult.) Gould  
var. schriberianum (Nash)  
Gould  
Dry sandy open area. 701,809

- Dichanthelium perlongum (Nash) Long-Stalked Panic Grass  
Freckm.  
Roadside. 1103
- Echinochloa muricata (Beauv.) Fern. Barnyard Grass  
Moist soil along pond. 938,981,982,1080
- Elymus canadensis L. Wild Rye  
Seven Bridges Road. 798
- Elymus virginica L. Wild Rye  
Alluvial forest. 648,649,739,745,824,890
- Eragrostis hypnoides (Lam.) B.S.P. Lovegrass  
Moist soil along slough. 1071,1114
- Eragrostis pectinacea (Michx.) Nees. Lovegrass  
Wet sandy along river. 1115
- Eragrostis spectabilis (Pursh.) Steud. Purple Lovegrass  
Dry sandy open area. 1094,1095
- Festuca obtusa Biehler. Fescue  
Seven Bridges Road and alluvial forest. 299,431,432,576,577
- Glyceria striata (Lam.) Hitchc. Manna Grass  
Alluvial forest. 780
- Koehleria cristata (L.) Pursh. Junegrass  
Dry sandy open area. 702
- Leersia virginica Willd. White Grass  
Alluvial forest. 935,952
- Muhlenbergia racemosa (Michx.) B.S.P. Muhly  
Open sandy soils. 1056,1061
- Panicum dichotomiflorum Michx. Panic Grass  
Open sandy soils. 1102

- Phalaris arundinacea L. Reed Canary Grass  
 Moist soils along sloughs, ponds and river channels. 135,149,  
 159,202,308,333,387,402,430,470,814
- Phleum pratense L. Timothy  
 Seven Bridges Road. 158,160
- Poa pratensis L. Kentucky Bluegrass  
 Open dry sandy soils. 563,564,666,703.
- Setaria glauca (L.) Beauv. Foxtail  
 Open dry sandy soils. 1173,1179
- Sorghastrum nutans (L.) Nash. Indian Grass  
 Open dry sandy soils. 1047
- Spartina pectinata Link. Slough Grass  
 Moist soil along slough. 964,968
- Zizania aquatica L. Wild Rice  
 Emergent in pond. 921,1021

## Family Iridaceae

- Iris virginica L.  
 Var. Shrevei (Small.) Anders Blue Flag  
 Wet soils along sloughs and ponds. 142,1210

## Family Juncaceae

- Juncus dudleyi Wieg. Rush  
 Moist sandy soils. 663
- Juncus tenuis Willd. Path Rush  
 Moist sandy soils. 1181



## Family Lemnaceae

- Lemna minor L. Lesser Duckweed  
Floating in ponds and sloughs. 1143
- Lemna trisulca L. Star Duckweed  
Floating in the emergent zone. 1004

## Family Liliaceae

- Allium canadense L. Wild Garlic  
Alluvial forest. 452,453,503
- Asparagus officinalis L. Asparagus  
River bank. 727
- Hemerocallis fulva L. Day-Lily  
Alluvial forest. 947
- Lilium michiganense Farw. Turk's-Cap Lily  
Alluvial forest. 324,344,618
- Polygonatum biflorum (Walt.) Ell. Solomon's Seal  
Seven Bridges Road. 186
- Polygonatum caniculatum (Muhl.) Pursh. Great Solomon's Seal  
Alluvial forest. 305,306
- Smilax ecirrhata (Engelm.) Wats. Low Carrion Flower  
Alluvial forest. 81,111
- Smilax herbacea L. Carrion Flower  
Alluvial forest. 140,287,332,362
- Smilax hispida Muhl. Greenbriar  
Alluvial forest. 1193
- Smilacina stellata (L.) Desf. Starry False Solomon's Seal  
Open moist soil. 70,75,106,573

- Smilacina racemosa (L.) Desf. False Solomon's Seal  
Oak forest. 546,691
- Uvularia grandiflora Sm. Large-Flowered Bellwort  
Upland forest. 536
- Uvularia sessiliflora L. Sessile Bellwort; Wild Oats  
Alluvial forest. 11,263,346,353,394,458,574,638

## Family Najadaceae

- Potamogeton crispus L. Curly-Leaved Pondweed  
Submerged in pond. 1119,1120
- Potamogeton zosteriformis Fern. Flat-Stem Pondweed  
Submerged in pond. 748,749

## Family Orchidaceae

- Goodyera Sp. Rattlesnake Plantain  
Dry sandy soil. 533

## Family Pontederiaceae

- Pontederia cordata L. Pickeral-Weed  
Emergent in pond. 516,737,1033

## Family Sparganiaceae

- Sparganium americanum Nutt. Bur-Reed  
Emergent in pond. 775,776,777,888,889,1027
- Sparganium eurycarpum Engelm. Bur-Reed  
Emergent in pond. 901,902,1026

## Subclass Dicotyledoneae

## Family Aceraceae

- Acer negundo L. Box Elder  
 Alluvial forest. 122,774
- Acer saccharinum L. Silver Maple  
 Alluvial forest. 120,123

## Family Aizoaceae

- Mollugo verticillata L. Carpet-Weed  
 Open moist sandy soil. 1013

## Family Anacardiaceae

- Rhus glabra L. Smooth Sumac  
 Sandy hillside. 945
- Rhus radicans L. Poison-Ivy  
 Alluvial forest. 1199
- Rhus typhina L. Staghorn-Sumac  
 Open dry sandy soil. 614

## Family Apocynaceae

- Apocynum androsaemifolium L. Spreading Dogbane  
 Upland woods. 542

## Family Aquifoliaceae

- Ilex verticillata (L.) Gray Winterberry  
 Alluvial forest. 148,292,357,754,768,773,786,816,994,1128,  
 1129,1217

## Family Araliaceae

- Aralia nudicaulis L. Wild Sarsaparilla  
Upland Woods. 547,588

## Family Aristolochiaceae

- Asarum canadense L. Wild Ginger  
Alluvial forest. 26,72

## Family Asclepiadaceae

- Asclepias incarnata L. Swamp-Milkweed  
Open wet areas in alluvial forest. 839,841,895,908  
Asclepias tuberosa L. Butterfly-Weed  
Open sandy soil. 852

## Family Balsaminaceae

- Impatiens biflora Walt. Spotted Touch-Me-Not;  
Alluvial forest. 918,939 Spotted Jewelweed  
Impatiens pallida Nutt. Pale Touch-Me-Not  
Alluvial forest. 922,923

## Family Betulaceae

- Betula nigra L. River Birch  
Alluvial forest. 125,182,187,885  
Corylus americana Walt. American Hazel-Nut  
Upland opening. 595,1052,1054

## Family Bigoniaceae

- Catalpa speciosa Warder. Catalpa  
River Bank. 1195

## Family Boraginaceae

- Lithospermum canescens (Michx.) Lehm. Hoary Pucoon  
Roadside. 19
- Lithospermum caroliniense (Walt.) MacMidl.  
Uplands woods. 598,843
- Myosotis scorpioides L. True Forget-Me-Not  
Alluvial forest. 233

## Family Caesalpiniaceae

- Cassia fasciculata Michx. Partridge-Pea  
Seven Bridges Road. 791,792

## Family Campanulaceae

- Campanula americana L. Tall bellflower  
Alluvial forest. 805,806,956
- Campanula rotundifolia L. Harebell  
Open sandy soils. 603,627
- Triodanis perfoliata (L.) Nieuwl. Venus' Looking-Glass  
Dry sandy open areas. 281,670

## Family Caprifoliaceae

- Lonicera bella Zabel. Honeysuckle  
Along edge of old field. 724,725

Sambucus canadensis L. Common Elder  
Alluvial forest. 342,519,823

Viburnum lentago L. Nannyberry  
Alluvial forest. 116,765

Family Caryophyllaceae

Cerastium nutans Raf. Mouse-ear Chickweed  
Alluvial forest. 129

Cerastium viscosum L. Mouse-Ear Chickweed  
Moist open sandy soils. 699

Lychnis alba Mill. White Champion; Evening Lychnis  
Open areas in alluvial forest. 153,154,830,832

Saponaria officinalis L. Soapwort; Bouncing Bet  
Disturbed areas. 398,723,731,734,810,811,1125

Silene nivea (Nutt.) Otth. White Champion; Snowy Champion  
Alluvial forest. 521,527,626

Stellaria aquatica (L.) Scop. Giant Chickweed  
Alluvial forest. 130,400,880

Stellaria longifolia Muhl. Long-Leaved Chickweed  
Alluvial forest. 411

Family Celastraceae

Celastrus scandens L. Bittersweet  
Seven Bridges Road. 1195

Euonymus atropurpureus Jacq. Burning Bush; Wahoo  
Alluvial forest. 1196

## Family Ceratophyllaceae

- Ceratophyllum demersum L. Coontail  
Submerged in pond. 427,1006

## Family Chenopodiaceae

- Chenopodium album L. Lamb's Quarters; White  
Alluvial forest. 316,424,951,1093 Goosefoot
- Chenopodium leptophyllum Nutt.  
Dry sandy open area. 698

## Family Cistaceae

- Helianthemum bicknellii Fern. Frostweed  
Dry sandy open area. 538,671

## Family Compositae

- Achillea millefolium L. Common Yarrow  
Dry sandy open area. 193,600,1101
- Ambrosia artemisiifolia L. Common Ragweed  
Dry sandy open area. 917,1060,1086,1133
- Ambrosia psilostachya D.C. Sand Ragweed  
Dry sandy open area. 1076
- Ambrosia trifida L. Great Ragweed  
Dry sandy open area. 925,926
- Antennaria neglecta Greene. Pussy-Toes  
Old field. 71,1150,1168,1169
- Artemisia caudata Michx. Wormwood  
Dry open area. 692,1066

<u>Artemisia ludoviciana</u> Nutt.	White Sage
Seven Bridges Road. 295,695	
<u>Aster azureus</u> Lindl.	Sky-Blue Aster
Dry sandy open area. 1057,1164,1165	
<u>Aster drummondii</u> Lindl.	Drummond's Aster
Seven Bridges Road. 1134	
<u>Aster ericoides</u> L.	Aster; White Aster
Dry open area. 1041,1068,1122	
<u>Aster lateriflorus</u> (L.) Britt.	Aster; Calico Aster
Dry open area. 1031,1064,1084,1092,1097,1098	
<u>Aster ontarionis</u> Wieg.	Aster
Alluvial forest. 996	
<u>Aster sagittifolius</u> Willd.	Aster; Arrow-leaved aster
Seven Bridges Road. 1138	
<u>Bidens cernua</u> L.	Nodding Beggar Ticks
Edge of pond. 1011,1032,1081	
<u>Bidens frondosa</u> L.	Beggar Ticks; Sticktight
Moist soil open area. 985	
<u>Cirsium discolor</u> (Muhl.) Spreng.	Field Thistle
Seven Bridges Road. 401	
<u>Cirsium vulgare</u> (Savi.) Tenore	Bull Thistle
Open area sandy soil. 873	
<u>Erigeron annuus</u> (L.) Pers.	Daisy Fleabane; White-Top
Dry open area. 161,165,169,170,282,349,414,661,1111	
<u>Erigeron strigosus</u> Muhl.	Daisy Fleabane
Dry open area. 231,728,729,1099,1089	
<u>Eupatorium maculatum</u> L.	Joe-Pye Weed
Open area moist soil. 532,693	



<u>Eupatorium perfoliatum</u> L.	Boneset
Alluvial forest. 1197	
<u>Eupatorium rugosum</u> Houtt.	White Snakeroot
Alluvial forest. 835,871,1000	
<u>Gnaphalium obtusifolium</u> L.	Sweet Everlasting
Dry open area. 1059,1070	
<u>Gnaphalium uliginosum</u> L.	Low Cudweed
Dry sany soil. 932	
<u>Helianthus tuberosus</u> L.	Jerusalem-Artichoke
Seven Bridges Road. 1009,1010,1077,1136	
<u>Hieracium canadense</u> Michx.	Canada Hawkweed
Seven Bridges Road. 182	
<u>Hieracium longipilum</u> Torr.	
Dry open soil. 1049	
<u>Liatris aspera</u> Michx.	Blazing Star
Dry open areas. 1111	
<u>Krigia biflora</u> (Walt.) Blake	Two-Flowered Cynthia
Dry open area. 195,196,599,672	
<u>Lactuca canadensis</u> L.	Wild Lettuce
Dry open area. 559,711,853,863	
<u>Lactuca serriola</u> L.	Prickly Lettuce
Dry open area. 1194	
<u>Rudbeckia hirta</u> L.	Black-Eyed Susan
Seven Bridges Road. 198,199,337,626	
<u>Rudbeckia laciniata</u> L.	Tall Coneflower
Alluvial forest. 735,825,833,876,897	
<u>Senecio aureus</u> L.	Golden Ragwort
Alluvial forest. 58,73,91,115	

- Solidago canadensis L. Canada Goldenrod  
Seven Bridges Road. 924,1135
- Solidago gigantea Ait. Late Goldenrod  
Dry open area. 957,1099
- Solidago graminifolia (L.) Salisb. Bushy Goldenrod  
Moist open area. 801,802,867,1065
- Solidago nemoralis Ait. Gray Goldenrod  
Dry open area. 1036,1051,1104
- Solidago rigida L. Stiff-Leaved Goldenrod  
Dry open area. 1042
- Tragopogon dubius Scop. Goat's Beard  
Seven Bridges Road. 192,284
- Veronia faciculata Michx. Western Ironweed  
Moist soil along slough. 961,972,984
- Xanthium strumarium L. Cocklebur  
Dry sandy open area. 930,1035

## Family Convolvulaceae

- Cuscuta L. Dodder  
Alluvial forest. 949,967
- Convolvulus sepium L. Hedge-Bindweed  
Open moist soil. 504,522,530

## Family Cornaceae

- Cornus amomum Mill.  
Alluvial forest. 195,408,489,837,988,978,979
- Cornus racemosa Lam. Gray dogwood  
Alluvial forest. 289,290,465,767

## Family Crassulaceae

- Penthorum sedoides L. Stonecrop  
Alluvial forest. 884

## Family Cruciferae

- Arabis laevigata (Muhl.) Poir. Smooth Rock Cress  
Alluvial forest. 57,84,107,382,607,629
- Arabis lyrata L. Lyre-Leaved Rock Cress  
Dry open area. 721
- Berteroa incana (L.) D.C. Hoary Alyssum  
Dry open area. 722
- Rorripa islandica (Oeder.) Bordas. Marsh Cress; Yellow Cress  
Alluvial forest. 520,942,1100
- Barbarea vulgaris R.Br. Yellow Rocket; Winter Cress  
Alluvial forest. 60,63,397
- Cardamine bulbosa (Schreb.) B.S.P. Spring Cress; Bitter Cress  
Alluvial forest. 27,32,38,50
- Cardamine parviflora L. Bitter Cress  
Alluvial forest. 60,63,67,397
- Cardamine pennsylvanica Muhl. Bitter Cress  
Alluvial forest. 39,56,87,428,473
- Erysimum cheiranthoides L. Wormseed-Mustard  
Dry open area. 733,1108
- Hesperis matronalis L. Dames Rocket  
Seven Bridges Road. 301
- Lepidium virginicum L. Pepper-Grass; Poor-Man's  
Seven Bridges Road. 167,1166

Rorippa islandica (Oeder) Borbas.

Moist open area. 520

Family Cucurbitaceae

Echinocystis lobata (Michx.) T. & G. Wild Cucumber

Alluvial forest. 927,929,948,1130

Family Ericaceae

Monotropa uniflora L. Indian Pipe

Uplands forest. 566

Vaccinium angustifolium Ait. Blueberry

Open sandy soil. 591

Family Euphorbiaceae

Euphorbia corollata L. Flowering Spurge

Dry open area. 363,539,650

Euphorbia maculata L. Wartweed; Spotted Spurge

Open disturbed area. 1044

Family Fabaceae

Amorpha canescens Pursh. Lead-Plant

Dry open area. 610,688,855

Amphicarpa bracteata (L.) Fern Hog-Peanut

Alluvial forest. 220

Apios americana Medic. Ground-Nut

Alluvial forest. 410,647

<u>Baptisia leucantha</u> T. & B. Moist open area. 525,526,594	White Wild Indigo; Prairie False Indigo
<u>Desmodium canadense</u> (L.) D.C. Seven Bridges Road. 850,992	Showy Tick-Trefoil
<u>Desmodium illinoense</u> Gray. Dry open area. 864	Illinois Tick-Trefoil
<u>Desmodium glutinosum</u> (Muhl.) Wood. Dry open area. 583,584,633	Tick-Trefoil
<u>Lathyrus venosus</u> Muhl. Moist sandy soil. 196,669	Vetchling
<u>Lespedeza capitata</u> Michx. Dry open area. 886,1083	Bush-Clover
<u>Lupinus perennis</u> L. Moist sandy soil. 608,611,714	Lupine
<u>Medicago lupulina</u> L. Seven Bridges Road. 501	Black Medic
<u>Melilotus officinalis</u> (L.) Lam. Seven Bridges Road. 175,288	Yellow Sweet Clover
<u>Melilotus alba</u> Desr. Seven Bridges Road. 286	White Sweet Clover
<u>Petalostemum candidum</u> (Willd.) Michx. Dry open area. 1157	Prairie Clover
<u>Petalostemum purpureum</u> (Vent.) Rydb. Dry open area. 842	Prairie Clover
<u>Trifolium repens</u> L. Seven Bridges Road. 176,177	White Clover
<u>Trifolium pratense</u> L. Seven Bridges Road. 171,172	Red Clover

## Family Fagaceae

- Quercus bicolor Willd. Swamp White Oak  
Alluvial forest. 128,785,819,847,849,980
- Quercus ellipsoidalis C. J. Hill Jack-Oak  
Upland forest. 616,856,857
- Quercus macrocarpa Michx. Burr Oak  
Upland forest. 124,854,1079
- Quercus velutina Lam. Black Oak  
Upland forest. 859,862,870,872

## Family Fumariaceae

- Dicentra cucullaria (L.) Bernh. Dutchman's Breeches  
Upland forest. 1146

## Family Gentianaceae

- Gentiana andrewsii Griseb. Closed Gentian; Bottle Gentian  
Seven Bridges Road. 1141,1142

## Family Geraniaceae

- Geranium maculatum L. Wild Geranium  
Upland forest. 534

## Family Hydrophyllaceae

- Hydrophyllum virginianum L. Virginia Water Leaf  
Alluvial forest. 9,25,132

## Family Hypericaceae

- Hypericum punctatum Lam. Dotted St. John's-Wort  
Moist sandy soil. 636,681,713,867,1087

## Family Juglandaceae

- Carya cordiformis (Wang.) K. Koch. Bitternut Hickory  
Alluvial forest. 6,836

## Family Labiatae

- Blephilia hirsuta (Pursh.) Benth. Hairy Wood-Mint  
Alluvial forest. 219,371,380,788,789,963
- Dracocephalum formosius (Lunell.) False Dragonhead  
Rydb.  
Alluvial forest. 900,906,907
- Glechoma hederacea L. Creeping Charlie; Ground Ivy  
Alluvial forest. 85
- Hedeoma hispidum Pursh. Grassleaf Pennyroyal  
Dry sandy open area. 174,704
- Leonurus cardiaca L. Motherwort  
Seven Bridges Road. 334,336,438,439,1163
- Lycopus uniflorus Michx. Water-Horehound  
Alluvial forest. 940,944,1030,1074,1186
- Lycopus virginicus L. Water-Horehound; Virginia  
Alluvial forest. 253,480 Bugleweed
- Monarda fistulosa L. Wild Bergamot  
Dry open areas. 793,794

<u>Monarda punctata</u> L.	Horsemint
Dry open areas. 799,800	
<u>Nepeta cataria</u> L.	Catnip
Seven Bridges Road. 340	
<u>Prunella vulgaris</u> L.	Self-Heal; Heal-All
Open distrubed areas. 615,631,988	
<u>Scutellaria lateriflora</u> L.	Mad-dog Skullcap
Alluvial forest. 943,953,990,1008	
<u>Stachys hispida</u> Pursh.	Hedge-Nettle
Alluvial forest. 375,528,881,882,962	
<u>Stachys tenifolia</u> Willd.	Hedge-Nettle
Open area moist soil. 973	
<u>Teucrium canadense</u> L.	Germander; Wood Sage
Alluvial forest. 700,720,730,732,795,879,883,899	

## Family Lobeliaceae

<u>Lobelia cardinalis</u> L.	Cardinal Flower
Alluvial forest. 905	
<u>Lobelia inflata</u> L.	Indian Tobacco
Dry open area. 668,674,689,851,974,1075	
<u>Lobelia spicata</u> Lam.	Spiked Lobelia
Dry open areas. 568	

## Family Nyctaginaceae

<u>Mirabilis nyctaginea</u> (Michx.) MacM.	Four-O'clock
Seven Bridges Road. 173,180,181	



## Family Nymphaeaceae

- Nuphar variegatum Engelm.                      Yellow Water Lily  
     In ponds along the edge of the emergent zone. 514,1007,1019
- Nymphaea tuberosa Paine                      Water Lily  
     In ponds along the edge of the emergent zone. 515,1017

## Family Oleaceae

- Fraxinus americana L.                      White Ash  
     Alluvial forest. 121,820
- Fraxinus nigra Marsh.                      Black Ash  
     Alluvial forest. 716,758,763,781,782,787
- Fraxinus Pennsylvanica                      Green Ash  
     Var. subintegerrima (Vahl.) Fern.  
     Alluvial forest. 189,190,715,738,815,817,818,821,878,1162

## Family Onagraceae

- Oenothera biennis L.                      Evening Primrose  
     Seven Bridges Road. 665,677,915
- Circaea canadensis Hills.                      Enchanter's Nightshade  
     Alluvial forest. 369,370,460,557,651,683,753

## Family Oxalidaceae

- Oxalis europaea Jord.                      Yellow Wood Sorrel; Sove Grass  
     Dry open area. 396,589
- Oxalis stricta L.                      Upright Yellow Wood Sorrel  
     Seven Bridges Road. 162,163

Oxalis violaceae L. Violet Wood Sorrel

Dry open area. 104

Family Phrymaceae

Phryma leptostachya L. Lopseed

Moist open area. 561,632,644

Family Plantaginaceae

Plantago rugelii Decne. Pale Plantain

Seven Bridges Road. 497,1090

Plantago patagonica Jacq.

Seven Bridges Road. 1155, 1156

Family Polemoniaceae

Polemonium reptans L. Jacob's Ladder

Moist open area. 48,640,834

Phlox divaricata L. Wild Blue Phlox

Var. laphamii Wood.

Alluvial forest. 10,13

Phlox divaricata L. Phlox

Alluvial forest. 31,62,103

Family Polygalaceae

Polygala polygama Walt. Racemed Milkwort

Upland woods. 567

## Family Polygonaceae

- Polygonum arifolium L. Halved-Leaved Tearthumb  
Alluvial forest. 146,993,1201
- Polygonum coccineum Muhl. Water Smartweed  
Emergent in pond. 891,894,1028,1209
- Polygonum cilinode Michx. Bindweed  
Alluvial forest. 168,298
- Polygonum hydropiperiodes Michx. Mild Water-Pepper  
Wet soil along edge of pond. 750,751,892,893,1023,1113
- Polygonum pennsylvanicum L. Pinkweed; Pink Knotweed  
Moist open area. 933,1091
- Polygonum sagittatum L. Arrow-Leaved Tearthumb  
Alluvial forest. 472,1208
- Polygonum scandens L. Climbing False Buckwheat  
Alluvial forest. 1127
- Polygonum virginianum L. Jump Seed  
Alluvial forest. 138,273,276,443,444,652,877,911
- Rumex acetosella L. Red Sorrel; Sheep Sorrel  
Dry open area. 94,606,612
- Rumex crispus L. Sour Dock; Curly Dock  
Moist soil along slough. 320
- Rumex obtusifolius L. Bitter Dock  
Moist soil along slough. 304,407
- Rumex verticillatus L. Water-Dock  
Mud along slough. 150,235,1207

## Family Portulacaceae

- Claytonia virginiana L. Spring Beauty  
Alluvial forest. 2,66

## Family Primulaceae

- Lysimachia ciliata L. Fringed Loosestrife  
Alluvial forest. 296,317,475,493,494,523,524,761
- Lysimachia lanceolata Walt. Loosestrife  
Moist sandy soils. 558,656,659,678,845,995,1167
- Lysimachia quadriflora Sims. Whorled Loosestrife  
Moist sandy soils. 543,545,628
- Lysimachia nummularia L. Moneywort  
Alluvial forest. 291,326,412

## Family Ranunculaceae

- Actaea rubra. (Ait.) Willd. Red Baneberry  
Upland forest. 544,617
- Anemone canadensis L. Canada Anemone  
Seven Bridges Road. 166,518
- Anemone cylindrica Gray. Long Headed Thimbleweed  
Dry sandy soil. 844
- Anemone quinquefolia L. Wood Anemone  
Upland forest. 1148
- Anemone virginiana L. Thimbleweed  
Dry open area. 356,540,655,706
- Anemonella thalictroides (L.) Spach. Rue-Anemone  
Upland woods. 1147

- Aquilegia canadensis L. Columbine  
Alluvial forest. 105,694
- Clematis virginiana L. Virgin's Bower  
Alluvial forest. 164,409,718,764
- Isopyrum biternatum (Raf.) T. & G. False Rue Anemone  
Alluvial forest. 77
- Hepatica americana (D.C.) Kerr. Hepatica  
Upland forest. 1149
- Ranunculus abortivus L. Small Flowered Crowfoot  
Alluvial forest. 17,24,37,79,361,388
- Ranunculus rhomboideus Goldie. Dwarf Buttercup  
Upland forest. 1145
- Ranunculus septentrionalis Poir Swamp Buttercup  
Alluvial forest. 4,8,12,16,29,35,36,113,118,201,1144
- Thalictrum dioicum L. Early Meadow Rue  
Alluvial forest. 462,548,551
- Thalictrum dasycarpum Fisch & Meadow Rue  
Avelall.  
Alluvial forest. 134,717

## Family Rhamnaceae

- Ceanthus americanus L. New Jersey Tea  
Open dry area. 572,675

## Family Rosaceae

- Agrimonia gryposepala Wallr. Agrimony  
Seven Bridges Road. 354,355,803,804

<u>Agrimonia striata</u> Michx.	Agrimony
Seven Bridges Road. 1003	
<u>Amelanchier interior</u> Nielson	Juneberry
Seven Bridges Road. 183,184	
<u>Crataegus</u> spp. L.	Hawthorn
Alluvial forest. 784,965,1001,1171	
<u>Fragaria virginiana</u> Duchesne.	Common Strawberry
Dry open areas. 54,686	
<u>Geum canadense</u> Jacq.	White Avens
Alluvial forest. 204,218,246,247,278,468,499,1158	
<u>Physocarpus opulifolius</u> (L.) Maxim:	Ninebark
Alluvial forest. 549,550,1073	
<u>Potentilla arguta</u> Pursh.	Tall Cinquefoil
Open dry area. 860	
<u>Potentilla norvegica</u> L.	Potentilla; Cinquefoil
Seven Bridges Road. 502	
<u>Potentilla simplex</u> Michx.	Old Field Cinquefoil
Moist open area. 155,197,513	
<u>Prunus americana</u> Marsh.	Wild Plum
Seven Bridges Road. 1121	
<u>Prunus pumila</u> L.	Sand Cherry
Dry open areas. 90	
<u>Prunus virginiana</u> L.	Choke-Cherry
Alluvial forest. 61,127,593,778,779	
<u>Rosa acicularis</u> Lindl.	Rose
Seven Bridges Road. 186,487,1140	

Spirea alba DuRoi. Meadowsweet  
Alluvial forest. 827,828,829

## Family Rubiaceae

Cephalathus occidentalis L. Buttonbush  
Wet soils along sloughs. 746

Galium aparine L. Spring Cleavers  
Alluvial forest. 28,152,232

Galium boreale L. Northern Bedstraw  
Moist soil open area. 685,1184

Galium concinnum T. & B. Bedstraw  
Upland forest. 541

Galium obtusum Bigel. Bedstraw  
Alluvial forest. 133,277,345,360,630,1191

Galium triflorum Michx. Bedstraw  
Alluvial forest. 230,321,365,535

Houstonia longifolia Gaertn. Long-Leaved Bluets  
Dry open area. 88,531,660

## Family Rutaceae

Zanthoxylum americanum Mill. Prickly Ash  
Alluvial forest. 1161

## Family Santalaceae

Comandra umbellata (L.) Nutt. Bastard Toadflax  
Dry open areas. 601,709,1182

## Family Saxifragaceae

- Ribes americanum Mill. Wild Black Current  
Alluvial forest. 33
- Heuchera richardsonii R.Br. Alumroot  
Dry open areas. 605,682

## Family Salicaceae

- Populus deltoides Marsh Cottonwood  
Alluvial forest. 1192
- Salix interior Rowlee Sandbar Willow  
Sandbars and river banks. 937
- Salix nigra L. Black Willow  
Alluvial forest. 1109

## Family Schrophulariaceae

- Gratiola neglecta Torr. Hedge Hyssop  
Alluvial forest. 446,498,505
- Mimulus rigens L. Monkey Flower  
Alluvial forest. 766,812,1185
- Pedicularis canadensis L. Lousewort  
Upland forest. 565,667,(662A)
- Penstemon gracilis Nutt. Beardtongue  
Open dry area. 602,662,680,690
- Schrophularia lanceolata Pursh. Firwort  
Open dry area. 590,592,676
- Verbascum thapsus L. Mullein  
Old field. 658



Veronica serpyllifolia L. Thyme-Leaved Speedwell

Moist sandy soil. 1183

Veronicastrum virginicum (L.) Farw. Culvers Root

Alluvial forest. 372,467,646,865

Family Solanaceae

Physalis heterophylla Nees. Ground Cherry

Moist sandy soil. 437,440,441,696,726

Solanum dulcumara Bittersweet Nightshade;

Alluvial forest. 931 Climbing Nightshade

Family Tiliaceae

Tilia americana L. Basswood

Alluvial forest. 327,

Family Ulmaceae

Celtis occidentalis L. Hackberry

Alluvial forest. 126

Ulmus americana L. American Elm

Alluvial forest. 327,1137

Ulmus pumila L. Siberian Elm

Seven Bridges Road. 1139

Ulmus rubra Muhl. Red Elm

Alluvial forest. 119,783,813,838,869,896,969

## Family Umbelliferae

<u>Angelica atropurpurea</u> L.	Angelica
Alluvial forest. 322,323,416,417	
<u>Cicuta bulbifera</u> L.	Water Hemlock
Alluvial forest. 1012	
<u>Cicuta maculata</u> L.	Water Hemlock
Alluvial forest. 223,224,373,374,500,581,653,1159	
<u>Cryptotaenia canadensis</u> (L.) D.C.	Honewort
Alluvial forest. 137,206,260,846	
<u>Heracleum lanatum</u> Michx.	Cow-Parsnip
Alluvial forest. 225,226,386	
<u>Osmorhiza claytoni</u> (Michx.) Clarke	Sweet Cicely
Alluvial forest. 59,310	
<u>Sanicula gregaria</u> Bickn.	Black Snakeroot
Alluvial forest. 82,141,205,207,265,1212	
<u>Sanicula marilandica</u> L.	Black Snakeroot
Alluvial forest. 110,114	
<u>Sium suave</u> Walt.	Water-Parsnip
Alluvial forest. 752,875,989,1025,1160	
<u>Zizia aurea</u> (L.) Koch.	Golden Alexanders
Alluvial forest. 80	

## Family Urticaceae

<u>Boehmeria cylindrica</u> (L.) Sw.	False Nettle
Alluvial forest. 477,740,909,910	
<u>Laportea canadensis</u> (L.) Wedd.	Wood-Nettle
Alluvial forest. 99,100,415	

- Pilea pumila (L.) Gray                      Clearweed  
 Alluvial forest. 279,392,645,954,955,1131,1132
- Urtica dioica L.                              Stinging Nettle  
 Alluvial forest. 108.

## Family Verbenaceae

- Verbena bracteata Lag. & Rodr.              Vervain  
 Dry open area. 285
- Verbena hastata L.                          Blue Vervain  
 Dry open area. 1170,687
- Verbena stricta Vent.                      Hoary Vervain  
 Dry open area. 762

## Family Vitaceae

- Parthenocissus quinquefolia (L.)          Virginia-Creeper  
 Planch.  
 Alluvial forest. 1072
- Vitis riparia Michx.                      River-bank Grape  
 Alluvial forest.

## Family Violaceae

- Viola papilionacea Pursh.                  Blue Violet  
 Alluvial forest. 14,18,22,40,41,42,44,45,46,64,65,1172
- Viola pubescens Ait.                      Downy Yellow Violet  
 var. eriocarpa (Schwein.) Russel.  
 Alluvial forest. 3,20,43
- Viola sagittata Ait.                      Arrow Leaved Violet  
 Old field. 92,708