ECOSYSTEMATIC STUDIES ON ROADSIDE VEGETATION IN SOUTHWESTERN VIRGINIA

by

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under such conditions. To her I can give no less than all my love and devotion forever; and the bittersweet reminder that this part of our life is over.

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INTRODUCTION

General

Heavy construction, chemical advancements in the area of herbicides, all modes of transportation, native vegetation, politics, law, and even the spread of western civilization itself are but a few of the factors that contribute to the shaping of that part of our landscape known as the roadside. This ubiquitous and dynamic element of our environment has always been growing and changing and probably will continue to do so as long as man is on earth. Since in all likelihood roadsides are going to persist, it seems reasonable that everyone should have some interest in them. Pedestrians, motorists, bicyclists, artists, etc., all use, understand, and appreciate some aspect of the roadside's ecology.

No other vegetation type (i. e. roadsides) in the world exists that is more used, abused, modified, or altered by man. Yet in actuality little is known about the ecology of the roadside as a whole in this country, especially when compared to Great Britian (Salisbury, 1961; Mabey, 1974). This seems especially peculiar when considering the use of roads and cars in the United States, coupled with recent arousal for concern and understanding of the environment. The roadside can be a well-managed, safe, and positively aesthetic asset to the environment or it can be a hazard to everyone. Many groups, such as state highway departments, extension agencies, private contractors, horticulturalists, and wildlife managers, to name a few, are working to ensure the former. Understanding and knowing more about the biology of roadside plants can only help further this cause.

The roadside offers an opportunity, too long neglected, to study a unique vegetation type. Roadsides are neither cultivated fields nor pastures where constant and more drastic perturbations of man take place, nor are they successional old fields engaged in a march to climax forest. Some view them as merely edges or incidentals to their adjacent vegetation or community type. But they are in their own right a unique vegetation type, maintained predominently by man rather than nature by a constant and consistant force that attempts to maintain a certain species composition and community structure.

This study attempts to add to the general knowledge about roadside floristics and plant ecology, particularly to the area of southwestern Virginia. Specifically, an examination of the floristic elements and their habitats is performed. Determinations are then made as to mechanisms of dispersal, growth habit, distributional status, origin, and spread for the plant species encountered. These objectives were accomplished by field observations and collections within the study area, examination of herbarium specimens and seed collections, and a review of literature in the fields of taxonomy, ecology, and natural history. Additional background on the status of roadsides was obtained by letters and interviews with highway revegetation contractors and Virginia Department of Highway's environmental and engineering personnel.

Definition of the Vegetation

The unique nature and ecology of the plants considered offer an immediate problem: What shall they be called? Weed is a term used for the last 1100 years, with its origins as far back as ancient Egypt (King, 1966). Generally and benignly stated it is a plant unintentionally grown by man (Anderson, 1939). Other definitions exist and all seem to have very negative and undesirable connotations; they work against man's efforts to modify the environment. King (1966) and Baker (1965) have made lists of certain characteristics they believe weedy plants have in common. Characteristics such as wild rank growth, high reproductive capacities, competitiveness, a great amount of phenotypic variation, efficient dispersal, plasticity, and resistance to control are the most common attributes weeds seem to share. Many of the plants that grow on the roadside have these characteristics, but there are a great many that do not.

Ruderals, a term which best describes roadside vegetation refers to "... weedy and commonly introduced plants growing where the natural vegetation cover has been interrupted, especially a weed other than grass growing where the vegetation has been disturbed by man... plants of roadsides and old fields..." (Merriam, 1971). Similarly the ruderal habitat is defined as "... a sustained disturbance but with no intentional substitution of vegetation where pioneer conditions are created and maintained indefinitely" (Hamel and Dansereau, 1957). This definition comes close to describing roadside vegetation, but falls short on two counts.

First, on modern highways in the United States after the roads are cut, authorities attempt to revegetate the roadsides, usually with monocultures of <u>Festuca elatior</u>, a European grass, or exotic legumes such as <u>Lathyrus latifolia</u> and <u>Coronilla varia</u>. Other commonly planted grasses are <u>Dactylis glomerata</u> and <u>Poa</u> spp. When this situation exists, which is not a pioneer condition, invading species are nothing more than weeds to the plant architects working for the highway department. Species used for revegetation and invading species are not the only members of roadside communities. A fair representation of the natural native vegetation cover may also be present. Native elements are particularly apparent where original construction of the road caused an incomplete disturbance, or where highway maintenence is minimal or lacking.

Second, the conditions of the roadside will probably not be maintained indefinitely. Roadsides of today are quite different from those of fifty years ago and it is probably fair to say they will be different fifty years from now. These are dynamic systems. Certainly, standards of highway maintenance are in effect now that make roadsides look the way they do, but no doubt a change will come.

Ruderal vegetation is quite complex from the standpoint of politics, agriculture, ecology and taxonomy. Politically, ruderals often pose a threat of being harmful. Many species are considered noxious and are eradicated or prohibited. This group broadly overlaps with the concerns of persons in agriculture. Taxonomists are overwhelmed by the constantly changing geographic ranges of these species. Classification for such a problem-ridden group of plants becomes a necessity.

Only a simple classification system is needed for agriculturalists and highway departments. To know whether the plant is a grass, broadleaf herb, woody species, annual or perennial is usually sufficient to determine the proper control measures (Anderson, 1977). This is a result of herbicide specificity to such general groups.

Ecologically, the vegetation is difficult to describe in a successional sense. It is quite easy to look at the roadsides in this study and view them as early seres in old field succession. However, in this case the stage is frozen successionally through the maintenance activities of man. There is stability here but certainly not a climax. For this condition the term ''relative stability'' instead of climax is best used (Niering, 1974). It should be remembered also that these roadsides are dynamic systems with respect to species turnover but, because of their disturbance regime, they do not exhibit normal successional sequences. Similarly, Niering (1974) has proposed the term ''vegetation development'' in lieu of succession. Although these new terms may not pre-empt their counterparts in general use, they do seem more adequate in this instance.

In a taxonomic sense ruderal plants have typically been problems for identification because of variable phenotypic characters as well as often being members of more difficult families or genera. Ranges of such plants are in such a state of flux that determining proper distributional information becomes almost impossible. Once identified there is little problem finding the species' proper place among any one of many accepted taxonomic classification systems. But what considerations do taxonomic and agricultural systems give to such factors concerning ruderals as place of origin, association with man's activities, and nature of areas invaded by such plants? None, but such groups of plants have been noted and classification systems for them have been attempted.

As early as the latter part of the nineteenth century, European railroad yards were investigated in this regard. Adventive plants, those ephemeral plants of exotic origin, were listed as far back as 1895 (Lehmann, 1895). In the United States alien plants introduced in ships' ballast have been recorded in several port cities since the 1860's (Smith, 1867; Brown, 1878). Classification systems for such ruderals and adventives began to appear as early as the mid-nineteenth century (Watson, 1847). They were primarily the work of Europeans around the turn of the century. Systems periodically appeared and disappeared mainly because of cumbersome terminology and the ambiguous nature of the classes (Muhlenbach, 1979). The system of Naegeli and Thellung (1905) was fairly well adopted and stands today as the best classification system for ruderal plants.

This system is also cumbersome and without practical use because of its overburdened terminology, but it remains the best comprehensive system. More recent systems and terms have appeared, e.g. Anderson's (1939) peregrinators and Rikli's (1904) rubric, (both refering to wandering plants which follow activities of man) but they are generally simplistic or developed to cover single cases. The best way to describe ruderal species to a degree that will be useful and meaningful is to have the species examined individually and described with an ecosystematic view considering origins, spread, habitats, life strategies, life histories, and any other pertinent points involved with the species' relationships to their environments. Few attempts have been made to do this in the past; more and better studies are needed.

Roadside Anatomy

The structure, function, and use of roads have changed drastically over the recent past. A half century ago two muddy tread paths across the countryside or through the forest was the rule for a country back road, not a two lane macadum swath with gravel shoulders cutting through small but steep hills to eliminate the most severe part of a rough ride.

The interstate and many state primary highways are constructed with a 24 foot wide pavement in each direction on top of a 12 to 16 inch base of gravel. Added to this width are four shoulders of tar and gravel, two drainage ditches, and vegetation (Figs. 1 - 3). The total right of way can cover a width of 210 feet of complete man-made disturbance. This works out to twenty-six acres per mile; Quite a bit larger than overall estimates of one acre per mile for the average country road (Perring, 1971). Even secondary roads with a 110 foot right of way cover fourteen acres per mile. Of this vast area about 30 - 50% is uninhabitable by plants because it is paved.

A great variety of roads exists today. Such a variety exists because of the multiple uses of roads in our country. The point here is that the varied modes of motorized transportation have specific road types to accomodate them, thus preempting other non-motorized modes of transportation. This has had a profound impact on the roadside community. Walkers, bicycles, horses, and horse-drawn vehicles no longer have an influence on the roadsides, save the occasional urban necessity of a sidewalk or bike path. When the country was not so committed to the automobile, roads were avenues for many types of transportation. This change has had profound effects on the gross physiognomy as well as floristics of the roadside.

One such change that has occurred is in zonation of

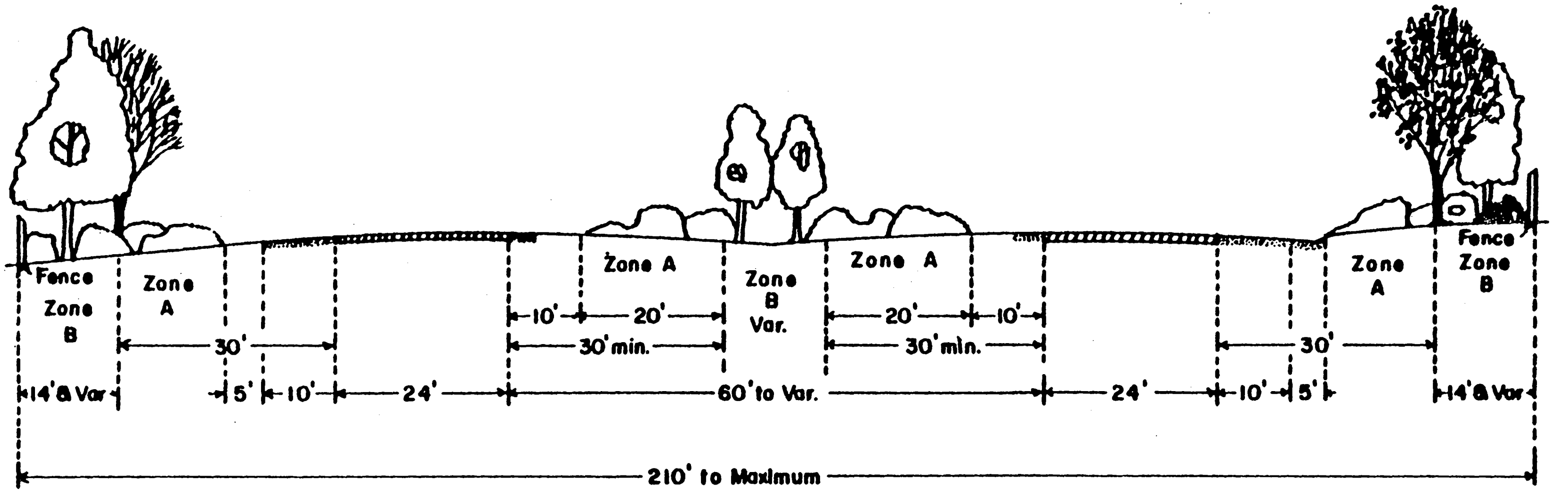

Fig. 1. Cross section of an interstate highway right-of-way with zones and maximum zone widths indicated.

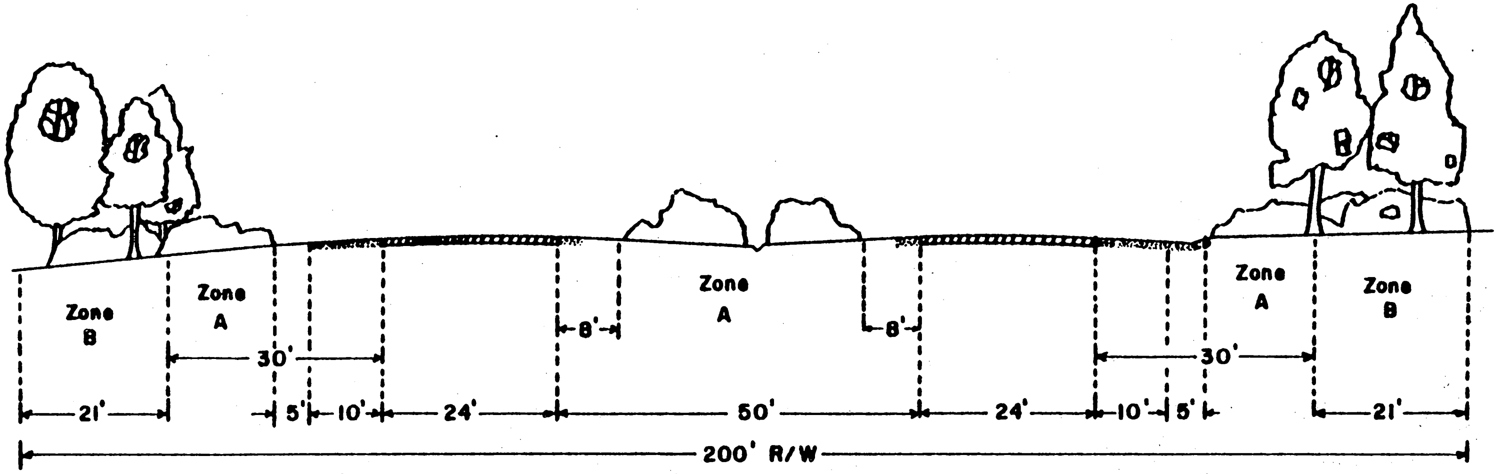

Fig. 2. Cross section of a divided primary highway right-of-way with zones and maximum zone widths indicated.

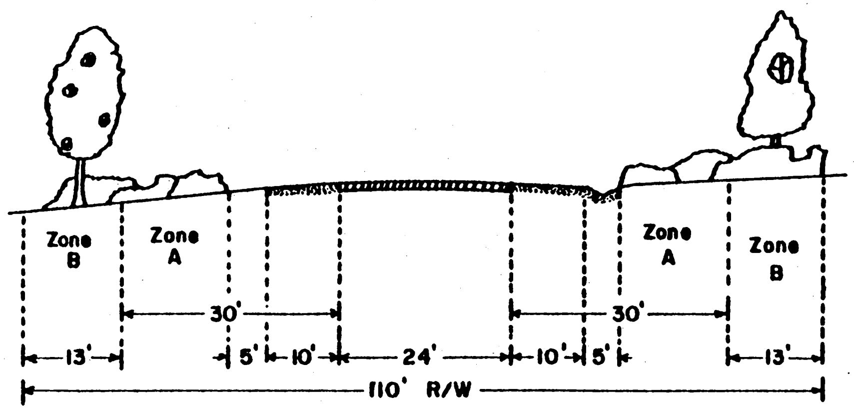

Fig. 3. Cross section of a secondary highway or undivided primary highway right-of-way with zones and maximum zone widths indicated.

roadsides. This is the phenomenon of zones running parallel to the road. Bates (1935, 1937, 1938) and Davies (1938) recognized four such zones. Each zone corresponds to a mean height of vegetation, the height of each zone being inversely proportional to the amount of treading. The effects of treading seem negligible beyond eight feet of the road's edge. Zones are also characterized by certain dominant species, those species more adapted to treading being more dominant as one gets closer to the road. The species found in each zone are as familiar to the roadsides of today as they were in the thirties but gradual zonation is a feature of the past. This is due not only to the fact that treading is reduced but also to modern maintenance procedures.

Today zonation exists but it is much simplified (Figs. 1 - 3). Zone A (the approach) is of variable width to 15 feet. Vegetation height is determined by how frequently it is mowed. In this zone species adapted to treading are usually restricted to irregular intervals along the extreme edge adjacent to or encroaching the pavement. Some treading in this zone does occur and is provided by mowing and spraying machines which make scheduled passes up to three times per year. In addition, motorists may occasionally pull off the road. Species adapted to treading such as _Polygonum aviculare_, _Plantago_ spp., and _Trifolium_ spp. are found in zone A, but not within a consistant band of vegetation.

The A zone is the most highly maintained zone and is of prime importance to the motorist. It is consistantly devoid of woody species, and broadleaf herbs are kept to a minimum with the use of herbicides (Bolt, 1980). Other species that exist in this zone are grasses planted by revegetation crews, contaminants in seed, and naturally invading plants. Those naturally invading and persisting plants must have adaptations to the mowing and spraying to allow for invasion. Rhizomatous and stoloniferous plants do so by having low or below ground parts which resist mowing (eg. *Asclepias* spp. and *Potentilla* spp.). Early flowering or rapidly flowering plants can complete their life cycles before mowing and spraying operations begin in spring (many of the Brassicaceae). Ruderal species may exhibit miniaturization (Salisbury, 1962). This phenomenon allows plants to flower and set seed at abnormally low heights, well below the level of a highway mower. Miniaturization is commonly seen in lawn weeds but I have also observed it during this study in much larger plants such as *Tragopogon dubius*, *Verbascum blattaria*, and *Daucus carota*.

The area of zone B (the slope) is only occasionally maintained by thinning when vegetation becomes too dense. The types of species that occur here are generally those found in old fields. Older roadsides will tend to have more woody species in this zone. Often, ornamental trees are planted here. Therefore, many exotics and non-native species exist here well outside their normal ranges (eg. *Magnolia grandiflora*, *Taxodium distichum*, *Ulmus pumila*).

Disturbance Factors

Treading - As mentioned above treading as a disturbance on today's highways is minimal. On interstate highways all but motorized traffic is prohibited, so treading by man and animals is non-existent. The only significant treading that exists is caused by maintenance equipment or occasional stranded or wrecked vehicles.

Spraying - Regular spraying takes place only on interstate highways and some four-lane divided primary highways. Generally only the first 8 - 12 feet of roadsides are sprayed. This operation takes place one time per year and is specifically done to keep woody species from growing too close to the road. Herbicides used are MH 30 and EMBARK (maliec hydrozide, 1,2-dihydro-3,6- pyridazinedione) and 2-4D (2,4-dichlorophenoxyacetic acid). These chemicals are auxin-like inhibitors specific to broadleaf plants. This type of herbicide tends to simplify a community by reducing the number of species, with a possible increase in the number of grass species. Non-specific herbicides can cause an increase in species complexity of broadleaf plants (Tomkins, 1977). These herbicides are avoided for highway use except for spot eradications. Normally, secondary highways are not sprayed except for local eradication of noxious weeds. Interstates are not sprayed on very steep slopes or on slopes where there is a great deal of rock outcropping.

Blading - Actual scraping of the soil surface can take place in three ways. First, snow plowing can be done to excess; but this is only occasional and sporadic. Second, ditching operations usually performed on secondary roads clear out all vegetation an inch or two below the soil surface. Since this operation is done every second or third year in designated areas, the plants that persist are annual and perennial herbs with deep rhizomes. Third, blading proper involves the scraping of road shoulders to remove and prevent encroachment by vegetation.

Mowing - Mowing operations are generally conducted twice yearly on all interstates and primary highways in late spring and late summer. Mowing on secondary roads if performed takes place once a year. The average height of the vegetation after cutting is three to six inches. The main purpose for mowing is to increase driver visibility and prevent the growth of woody plants near the road. Effort is being made to revegetate approaches with short grasses that have dense fiberous root systems (*Poa* spp.) to reduce the amount of mowing required.

METHODS

The thirty-two roadside sites examined in this study occur within seven southwestern Virginia counties: Giles, Montgomery, Roanoke, Botetourt, Rockbridge, Augusta, and Rockingham. These counties are in the mountain province of Virginia. This region is oriented southwest to northeast paralleling the Blue Ridge Mountains to the east with the Allegheny Mountains to the west. The valley in between is served by two major highways, Interstate Highway 81 and U. S. Primary Highway 11.

Interstate 81 (I-81) is relatively new, with its oldest sections being completed 15 years ago, while its latest completed sections are six years old. It is the major artery for truck and automobile traffic through the area. It is a four lane divided fully controlled (limited access) highway. Six sites are located on this road (13,14,16,23,25,32, on Fig.4).

U. S. Primary Highway 11 (U. S. 11) is a shadow to I-81. U. S. 11 was the former mainline for traffic through the valley before I-81 was built. It still carries much of the commuter traffic in the area and some trucking. Besides local automobile traffic U. S. 11 frequently carries farm vehicles in rural areas. Travel along the present U. S. 11

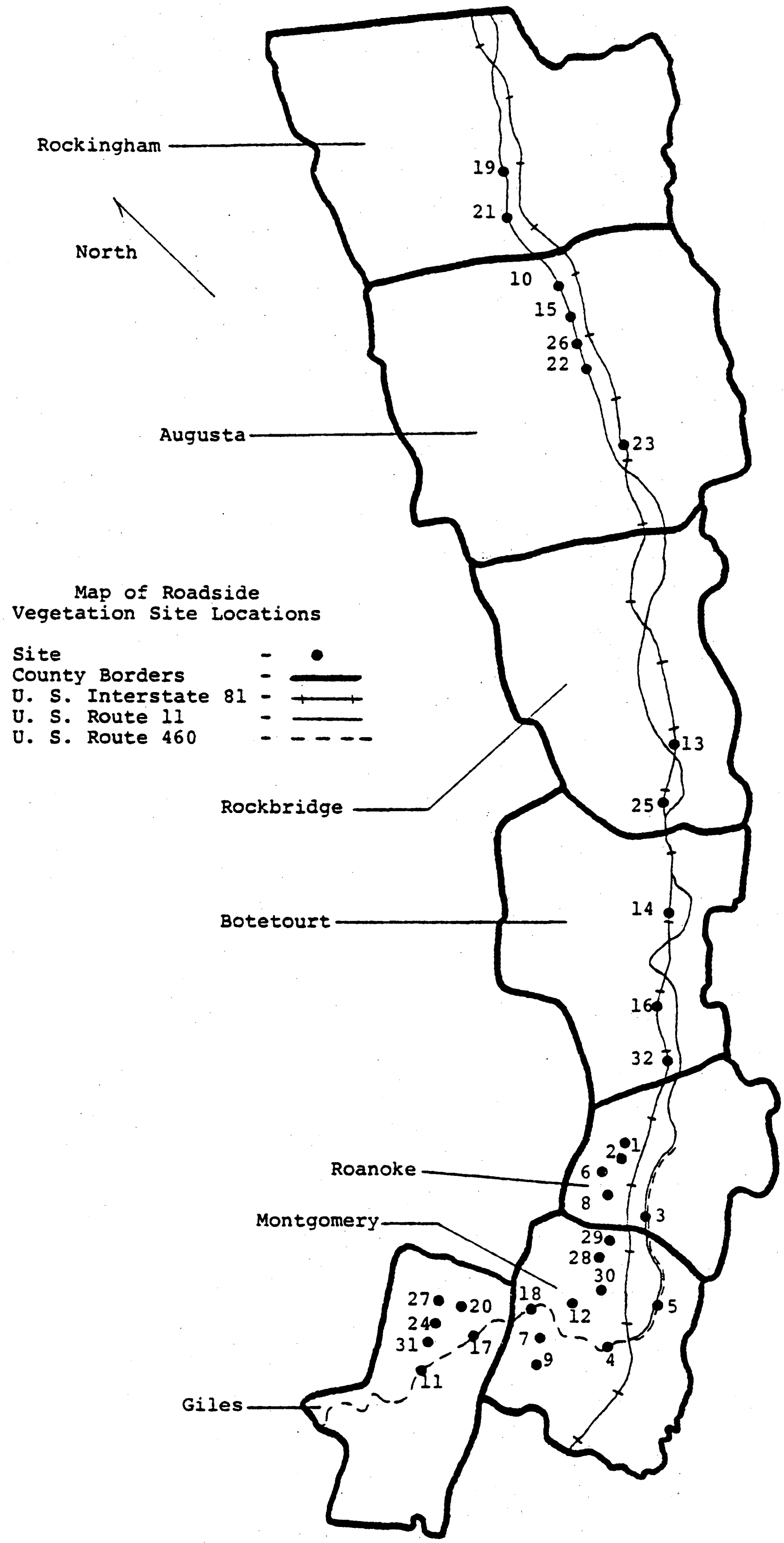

Fig. 4. Map of 32 roadside vegetation site locations in seven counties of Southwestern Virginia.

can be traced back to pre-civil war times. Today it is a two to four lane highway, occasionally divided. Since I-81's construction so much of the traffic has been drawn off U. S. 11 that in some areas along its length maintenance has been reduced to the point that encroachment of ruderals has completely overtaken some shoulder areas. This is an unusual case but points to the dynamic and changing state of the communities. It also may prove to be an unavoidable trend in our highway system. Nine sites are located along this road (3,4,6,10,15,19,21,22,26, on Fig.4).

Both of these major highways traverse the countryside through primarily agricultural lands with occasional forested areas. Agricultural lands are predominantly pasture or in grain production. A significant part of the surrounding vegetation consists of abandoned fields at various stages of succession.

U. S. Primary Highway 460 (U. S. 460) is an east-west running highway. Three sites are located on this road where it runs through western Montgomery and Giles counties (11,17,18, on Fig. 4).

The remaining sites are located on state secondary highways in residential, agricultural and forested areas. All site locations can be seen on the study area map (Fig. 4).

Site selection was designed to sample over a wide range of environmental conditions while meeting the following criteria: 1) vegetation is relatively uniform and homogeneous, i.e. without rock outcroppings or vegetational intrusions; 2) typical maintenance regime for the particular roadtype (see Introduction for explanation); 3) typical A, B zonation (see Introduction for explanation); 4) sample only on paved state primary, secondary, or interstate highways; and 5) segments of road adjacent to the sites are nearly straight and flat.

Species determinations were made using Hitchcock and Chase 1950, Strausbaugh and Chore 1978, Radford et al. 1968. Nomenclature follows Radford et al., (1968). Sequencing is done alphabetically by family, genus, and species.

Sites were chosen and first collected in spring and summer of 1977. During this time 45 sites were marked and collections were made to learn the local weed flora.

During the growing season of 1978 (March - October) 32 sites were sampled and collected to determine the species present at each site. Thirteen of the original 45 sites were either destroyed, failed to meet all of the earlier mentioned criteria, or proved impractical to sample. Each site was sampled at least three times throughout the growing season. A modified nested plot releve' technique was used to sample the sites (Mueller-Dombois and Ellenberg, 1974).

A single one-meter transect was laid perpendicular to the road and sampled; then the left adjacent transect of two meters was sampled. Sampling continued by successive width doubling of the next left adjacent transect until encounters of new species for that transect were diminished to the point where three or fewer new species were encountered.

Each species at every site was assigned a zone presence (A,B, or both based on what zone the species was found in) and a value for cover using the Braun-Blanquet Cover Abundance Scale (Mueller-Dombois and Ellenburg, 1974). This information was later used for zone preference and abundance information found in the species descriptions of the checklist.

Site environmental parameters measured or noted were exposure, slope, elevation, surroundings, and roadtype/maintenance regime. Each site was also assigned to one of four exposure classes corresponding to the nearest of the four cardinal compass points (north, south, east, west).

The slope of the B zone, excluding horizontal areas, was measured with the use of a string paralleling the site's slope and a plumb-bob. Slopes were recorded to the nearest 2.5 degrees. Each site was then assigned to a slope class: flat (0-10 degrees), moderate (10-30 degrees), or steep (greater than 30 degrees).

Surroundings classes were determined to be either open or forested. Open sites were those with adjacent lands being pasture, cultivated, residential, or old field. Forested sites were those sites surrounded by forest.

Roadtype/maintenance classes were assigned as primary, secondary, or interstate highway. The appropriate maintenance and description of these roadtype classes has been discussed in detail in the introduction.

Elevations were determined from U. S. Geological Survey topographic maps. Classes for this factor were: low (less than 2,000 feet) and high (greater than 2,000 feet). These classes were chosen because of a large gap in the elevations of the sites around 2000 feet.

Specimens collected were identified and examined at the Herbarium at VPI & SU. Dispersal type was determined for each species following a modified Dansereau and Lems (1957) classification system. The only modification was the reduction of the sclerochore class to microsclerochore because of the absence of any diaspores in the upper weight limits of the sclerochore class. Life form was determined for each species following Raunkiaer's life form spectrum (Raunkiaer, 1934). Geographic origin of each species was also determined (see Floristic section for explanations of nativity and dispersal types).

Each species record including its life form, dispersal type, and geographic origin, was subjected to the frequency procedure of SAS (Statistical Analysis System) (Barr et al., 1976). This provided overall frequencies for species, life form, dispersal type, and geographic origin among all sites. A second frequency procedure was done on all species data points, combined with life form and dispersal type, by individual site. From this second frequency procedure, proportions (percentages) and absolute numbers of each dispersal type and life form by site were provided.

These by-site proportions (relative numbers) and absolute numbers of dispersal types were subjected to analysis of variance tests, ANOVA, and multivariate analysis of variance tests, MANOVA (Sokal and Rohlf, 1969; Kramer, 1972). Independent variables for these tests were the five environmental factors measured: roadtype, slope, exposure, elevation, and surroundings. Dependent variables were the nine dispersal types. Ten MANOVA tests were performed, one for each dependent variable by proportion and absolute number. Ninety ANOVA tests were done, one for each dispersal type considered under each of the five environmental factors for relative and absolute numbers. ANOVA and MANOVA tests were done by SAS under the GLM (General Linear Model) procedure. The F and Hotelling's T statistic with an F approximation were used to calculate the P>F values for the ANOVA and MANOVA tests respectively.

If significance was found in any of these ANOVA tests (with alpha=.05) a modified Duncan's procedure for unequal sample size was carried out to determine which of the independent variable classes was responsible for the significance (Kramer, 1956).

The same ANOVA and MANOVA procedures were carried out for life forms. Fifty ANOVA tests were done, one for each of the five life forms (dependent variables) under the five environmental factors (independent variables) for both relative and absolute numbers. Ten MANOVA tests were carried out one for each independent variable for both relative and absolute numbers. Duncan's procedures were carried out when significance was found in the same manner as mentioned for dispersal type.

RESULTS AND DISCUSSION

Floristics

Those vascular plants found at the 32 roadside sites in the study area include 274 species, 182 genera, and 57 families. No state or county distributional records were recorded. All species are represented by voucher specimens in the herbarium of VPI & SU. Even though these species are adequately described in floras of adjacent states it is hoped that this examination will add to the ecological and biological understanding of the species.

The format of each species description in the checklist is as follows: 1) scientific name, 2) author's citation, 3) common name, 4) plant habit and height, 5) frequency, 6) habitat 7) notes on the dispersal unit, 8) flowering times (by month), 9) nativity, and 10) dispersal type and optional additional notes. This format will be adhered to except when a family or genus has a consistant set of characters that may preempt the individual species descriptions. The checklist can be found in the appendix.

It should be mentioned that flowering times for these plants can be quite variable, for several reasons. Abnormally high temperatures and maximum light conditions characteristic of the roadside habitat can cause the flowering time of many ruderals to be earlier than normal. This occurs because of increased growth under such conditions and the lack of strong photoperiod mechanisms in such plants. Conversely, the flowering times can be extended later into the season for the same reasons. Mowing may delay vegetative growth and subsequent flowering.

In general, sizes of parts have been omitted except for overall height and fruit or seed size. This was done because of the wide ranges in such measurements due to the great plasticity of phenotypes expressed by such plants.

Notes on dispersal are frequently based on my own observations, in addition to some conservative supposition. Seeds and fruits not observed in the field were examined in the Herbarium of VPI & SU and at the fruit and seed collection of the United States Department of Agriculture, Beltsville, Maryland. Additional aid in determining modes of dispersal was gained from the literature (Ridley, 1930; van der Pijl, 1969). Dispersal types follow the system of Dansereau and Lems (1957) with some modification (Frenkel 1970). Determinations of dispersal type are given by abbreviations at the end of each species description:

1. Cyclo. (Cyclochore) Diaspore very voluminous; usually rolls overland in light breeze (eg. inflorescence of Panicum).

2. Desmo. (Desmochore) Diaspore with appendages that enable it to attach to rough surfaces (eg. loments of Desmodium).

3. Pogon. (Pogonochore) Diaspore with long plumose or hair-like trichomes (eg. achene of Taraxacum).

4. Ptero. (Pterochore) Diaspore with wing-like appendages (eg. samaras of Acer).

5. Sarco. (Sarochore) Diaspore with fleshy covering (eg. drupe of Prunus).

6. Micro. (Microsclerochore) Diaspore unspecialized, too large to be carried by a breeze (eg. achene of Polygonum).

7. Ballo. (Ballochore) Diaspore mechanically expelled by plant (eg. capsule of Impatiens).

8. Baro. (Barochore) Diaspore massive and dense (eg. nut of Quercus).

Frequency and habitat entries are given in relation to the roadside habitat only. The vast majority of these plants are considered to be frequent or common among the local flora. Habitat descriptions for such species usually read ''wasteplaces''. Some idea of the species' moisture, light, and roadside zone preferences is given in the descriptions herein.

Nativity was determined through the use of the floras already mentioned and Flora Europaea (Tutin, 1964). Many sources would indicate that the flora of such disturbed habitats as roadsides are dominated by species of exotic origin. This may or may not be the case depending on how the statistics are viewed (see Table 1).

The native flora, although well represented, is masked by alien species' ubiquity. In addition, alien species tend to be more abundant (i.e. in great numbers within sites). Most alien species encountered in this study are of European. A majority of these entered the United States as contaminants of crop seed and freight or as cultivated species, ornamentals and medicinal herbs now escaped . Other aliens from North Africa, South America, and India generally entered the country as contaminants. Those plants introduced from Japan and China were primarily brought in purposely for use as ornamentals (*Ailanthus altissima*) or ground cover (*Lonicera japonica*, *Pueraria lobata*).

There are also several species not native to the study area itself, but native elsewhere in the United States. These are plants of disturbed habitats from further west and south brought to this area in much the same fashion as European aliens (Dewey, 1897; Anderson, 1960; McNelly, 1978).

The frequency distribution of species among the 32 roadside sites deviates from Raunkiaer's ''Law of

Table 1

Percentages of Native and Alien Species
Under Four Separate Considerations

Consideration	% Alien	% Native
All 274 Species (each species with equal weight)	40	60
All 274 Species (species weighted by frequency among sites)	59	41
The 100 Most Frequent Species	55	45
The 36 Most Frequent Species	67	33

Frequency'' (Oosting, 1956). The major deviation is that no species are present at all 32 sites sampled (Fig. 5). The fact that there is no dominant species, that is always present, may be caused by maintenance procedures which encourage the establishment of a small number of exotic cover species. Such supression of dominant and more widely occurring species may explain the unusually high numbers of species present at eleven to thirteen sites. Another deviation is that those species that are present most infrequently account for a far greter proportion of the total number of species than in Raunkiaer's Normal (43% of all species were present only at one site). In the sense of total numbers of species there is a great deal of diversity of roadsides. The frequency distribution in this study corresponds better with Kenoyer's Normal and is consistent with a previous roadside study in California (Kenoyer, 1927; Frenkel, 1970).

The distribution of families among the 32 sites in relation to roadtype revealed several trends (see Fig. 6). The most frequent families were the Asteraceae and Poaceae, (which are present at all sites) Fabaceae, Rosaceae, Brassicaceae, and Plantaginaceae. The major trend seen among roadtypes is the higher proportion of low frequency families on secondary highway sites. This might be expected, since these roads have less maintenance and tend

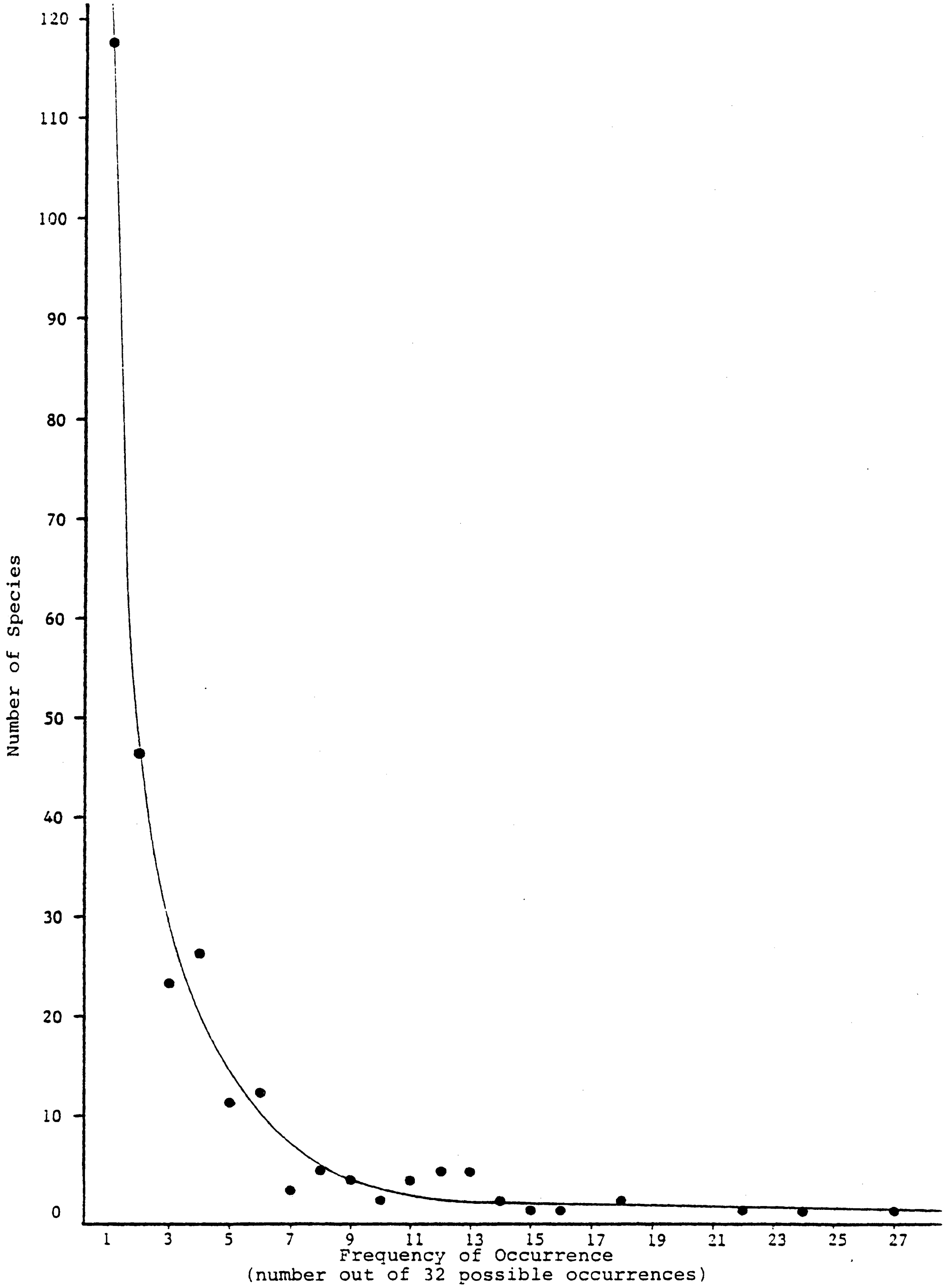

Fig. 5. Frequency at which species occur out of 32 possible roadside vegetation sites in Southwestern Virginia.

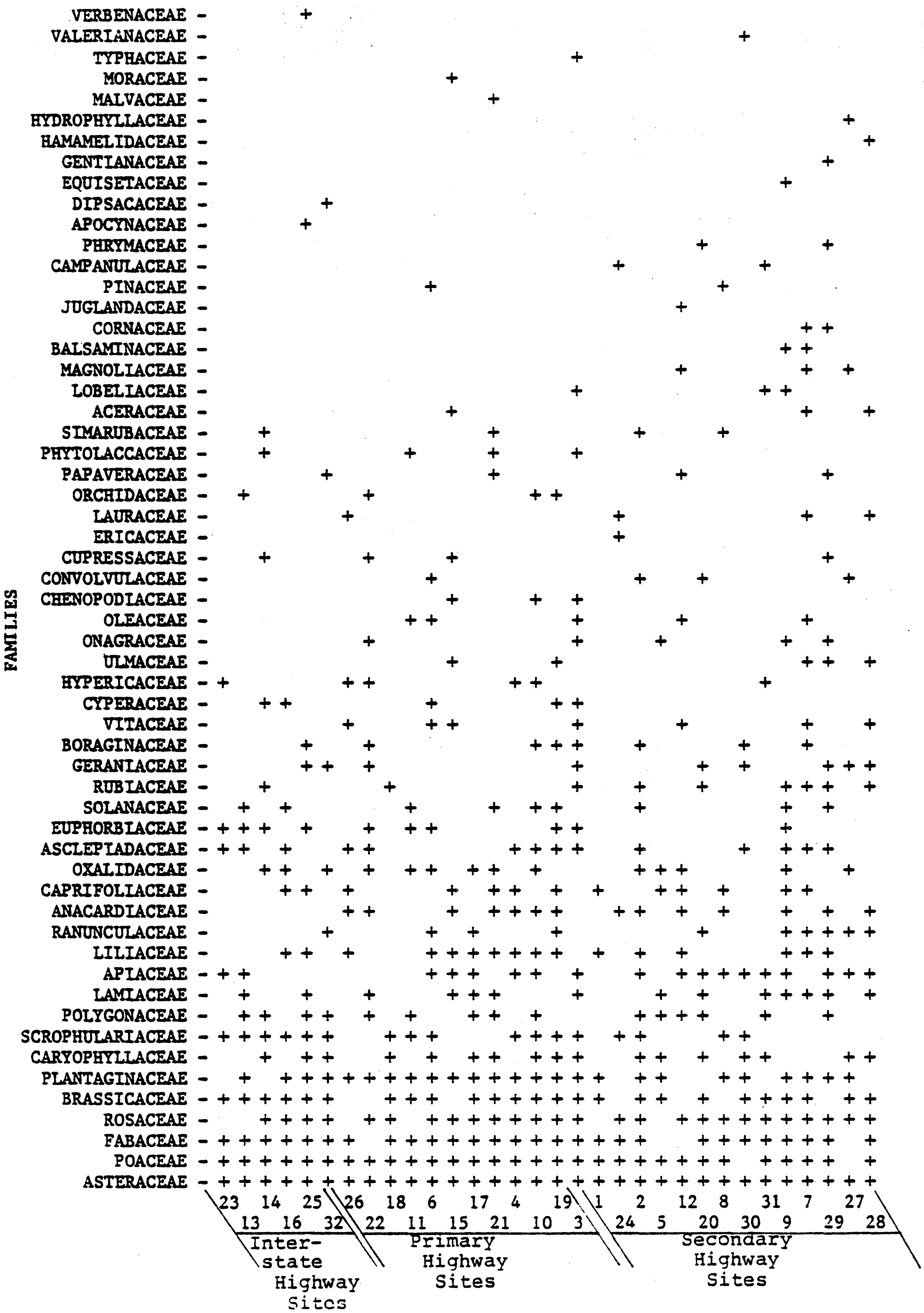

Fig. 6. Presence of plant families among 32 roadside vegetation sites. Sites are grouped by roadtype.

to traverse more heterogeneous environments. Two families of particular interest are the Apiaceae and the Scrophulariaceae. The Apiaceae is generally absent from intersate sites. This family includes *Daucus carota*, a species of high presence, which may be missing from interstate highways because of herbicides used that are selective for dicots. The general absence of the Scrophulariaceae among secondary highway sites is somewhat mysterious. The family contains species suited for both highly disturbed habitats (*Veronica* spp. and *Verbascum* spp.) as well as far more pristine conditions (*Pedicularis canadensis*). Perhaps the species of the Scrophulariaceae are not adapted to the disturbances found on secondary roads. I also advance this hypothesis to explain the similar presence of the Euphorbiaceae among the roadside sites.

Dispersal

As noted in the introduction, there is a great desire to understand the spread of ruderal plants. The problem is so complex that systems designed to describe the nature of man's action soon become cumbersome in terminology and ambiguities. Still, great steps have been made toward understanding the abilities of plants to spread into the ruderal habitat (Ridley, 1930; Salisbury, 1942, 1961). I believe that these works point out very well the continual necessity for descriptive science to be a major part of the process in understanding the activities of ruderal habitats. The ability to relate the spread of ruderals to environmental parameters has many areas yet to be examined. The question this section addresses is, do the environmental factors, including roadtype, elevation, exposure, slope, or surrounding vegetation affect the distribution of dispersal types present on roadsides in Southwestern Virginia?

Attempts to put mode of dispersal into a classification scheme encounter several problems, perhaps the most complicated being created by man's ability to disperse and create new habitats for plants. There seem to be three basic approaches to the problem. First, the mechanistic or agent-oriented system exemplified by van der Pijl (1969). This type of system categorizes the agents of dispersal, i.e. wind, water, gravity, animals, man, or mechanical. The shortcomings of this type of system are the problems of multiple dispersal types. Examples are seen in fruit and seed polymorphisms or diaspores well adapted to disperse by more than one agent (Salisbury, 1962; van der Pijl, 1969). Man and machines are also natural dispersal agents. Even the airplane has been found to transport ruderal species.

Multiplicity of dispersal is recognized by the authors of such systems. To make either broad ambiguous classes or a functionally infinite number of fine classes is not practical, but has been done in the past. Functionally, an infinite number of classes would exist.

The individual descriptions of species dispersal mechanisms might be considered to be a classification system itself. This system is fine from an autecological or natural history point of view (Salisbury, 1961); however, it has no place when trying to relate dispersal to a community type. It simply cannot be used quantitatively.

The third dispersal system used in this study is that of Dansereau and Lems (1957), which lends itself quite well to quantitative analysis. The system is based on physical features of the diaspore. Presence or absence of appendages for attachment, fleshy outer layers, parachuting trichomes, or wings, along with some weight classes, are criteria used to define the dispersal classes (see floristics section for explanation of classes). This system circumvents the problem of multiplicity of dispersal.

Of the species encountered in this study an overwhelming number of them have microsclerochores (Table 2). These are small and non-specialized and spread primarily by general contamination. This group also contains those species with mucilaginous seed coats. They are typified by members of the Brassicaceae and Caryophyllaceae.

The second largest dispersal group based on agents of dispersal is a combination of pogonochore, pterochore, and sporochore. These groups are presumed to be wind dispersed and together account for about 21% of all species.

Species with desmochores as their dispersal type comprise only four to five percent of the total. The dispersal classes, ballochores, barochores, cyclochores, and sporochores, are infrequently represented among the ruderal species encountered.

The overall percentage figures for dispersal types are quite different from those found in California by Frenkel (1970). Cyclochores, barochores, and sporochores in both studies each represented less than one percent of all dispersal types. Dispersal groups in this study that had proportions greater than those of Frenkel (1970) were, microsclerochores (greater by 25%), pogonochores (by 5%), and sarcochores (by 5%). Desmochores accounted for 34% of the species in California; two-thirds of which were aliens. A corresponding importance of desmochores was not found in Southwestern Virginia. Frenkel's study included roadsides through many different native vegetation types (prairie, scrub forest, pine forest, and redwood forest). His percentages may be a better approximation of the geographic proportions of dispersal types in the ruderal situation (Table 2). The two sets of data point out the importance of biome type on proportions of dispersal types.

Several trends for dispersal types found on roadsides were consistent in both Frenkel's and this study (Table 3). First, the importance of those animal dispersed groups (sarcochores and desmochores) are increased with distance away from the road margin.

The proportion of sarcochores relative to the entire flora exhibit a tenfold increase from inslope (zone A) to backslope (zone B). This is an actual increase of only six times because of the greater number of species found in zone B. Dispersal of endozoochorous species in disturbed areas appears to be dependent upon the availability of perching sites for birds (Auclair and Cottam, 1971; Smith, 1975; Howe, 1977).

It is likely that the elimination of habitats conducive to perching from the inslope by normal maintenance is responsible for such differences. In addition, many woody and suffrutescent ruderal species that have sarcochores (e.g. Prunus serotina, Rubus spp. and Crataegus) are also eliminated from the inslope. This permits only herbaceous ruderals, few of which have sarcochores, to persist in zone A.

Desmochores exhibit a relative increase of 70% from

Table 2

Overall Percentages of Dispersal Types

Dispersal Type	% of all 274 species (equal weight to each species)	% of all 274 species (species weighted by frequency among sites)	% of species in California study (Frenkel 1970)
Ballochore	2.2	2.1	10
Barochore	.7	.2	
Cyclochore	1.5	.7	
Desmochore	5.1	4.1	34
Microsclerochore	60.0	60.9	36
Pogonochore	15.3	16.3	11
Pterochore	4.7	4.3	5
Sarcochore	9.5	10.7	3
Sporochore	1.1	.7	

zone A to B. Animal-plant relationships that suggest attractive explanations in these instances are difficult to determine. A previous study by Bullock (1977) indicates that retention of such diaspores is greater as the distance from the road margin is increased. This suggests that the increase in desmochores is caused by something other than the dispersal mechanism itself.

Second, plants with diaspores that are or could be transported in mud i.e. microsclerochores, are most prevalent at the road's edge (Clifford, 1959; Bostich, 1977). There is a relative increase of 50% in microsclerochore species from zone B to zone A. It is also important to note that the vast majority of these species are aliens. This second characteristic is further accentuated when the thirty-seven most frequent species are considered (Table 3). Such exotic ruderals comprise 40% of all species encountered in this study. The dispersal capabilities of microsclerochores aided by man's activities such as walking, motoring, flying, commercial trade, and agriculture have been examined (Ryan, 1929; Ridley, 1930; Clifford, 1958; 1959; Salisbury, 1961; Bostich, 1977). The proportion of alien seeds found in these earlier studies ranged from two-thirds to three-quarters of all contaminant seeds, which compares favorably with alien microsclerochore percentages found in this study.

Table 3

Zonal Distribution of Dispersal Types

	Ballo-chore	Baro-chore	Cyclo-chore	Micro-sclero-chore	Ptero-chore	Pogono-chore	Sarco-chore	Sporo-chore	Desmo-chore	Total
Zone A (inslope)										
Alien	1	0	0	180 (121)	0	33	1	0	8	223
Native	10	0	6	58 (16)	5	14	8	1	3	105
Total	11	0	6	238 (137)	5	47	9	1	11	328
Zone B (backslope)										
Alien	1	0	0	171 (71)	11	36	22	2	13	256
Native	6	2	2	105 (17)	23	68	70	4	19	299
Total	7	2	2	276 (88)	34	104	92	6	32	555
Zone A and B										
Alien	0	0	0	57 (51)	1	4	1	0	6	69
Native	2	0	0	14 (11)	1	1	1	0	0	19
Total	2	0	0	71 (62)	2	5	2	0	6	88

Numbers in parentheses represent counts of 36 most frequent species. Each unit represents a single species found at one of the 32 roadside vegetation sites.

Third, plants dispersed by wind are found at moderate distances from road margins. Wind dispersal includes pterochore, pogonochore and sporochore groups. Pogonochores show only a slight actual increase from inslope to backslope. Most of the diaspores within this group have seeds and fruits that would qualify as microsclerochores if they did not have plumose trichomes. Because such appendages are frequently deciduous and/or hygroscopic they frequently do not aid in wind dispersal and the diaspores may disperse in a fashion more typical if microsclerochores (Salisbury, 1962). Consequently, the expected increases in this class are not as great as might be expected.

Pterochores and sporochores show a relative fourfold increase from inslope to backslope. It has been suggested that such paucity of wind dispersed species near the road margin is due to inhibition of the dispersal process itself (Frenkel, 1970). However, in this instance when pterochores are considered, nine of the thirteen species involved are trees (Table 8). The prevalence of these wind dispersed species on the backslope is more a consequence of their life-form and highway maintenance procedures than dispersal capabilities.

ANOVA tests relating environmental effects to dispersal type were infrequently statistically significant (Tables 4, 5, 6 and 7). Tests relating roadtype to the relative and absolute numbers of desmochores were statistically significant. The Duncan's procedure showed greater number and proportion of this dispersal type on secondary highways than on interstate or primary highways. The most obvious explanation is the physiognomy and maintenance of secondary highways. Interstate and primary highways are wider, more highly maintained by herbicide treatments and mowing, less likely to have shrub or tree cover, and less frequently cut through native deciduous forest than secondary highways. If the agents for deposition of such diaspores carried the same number of desmochores and were equally loaded and frequent on all roadtype right-of-ways one would expect greater deposition of desmochores on the more open interstate and primary highways (Bullock, 1977). Since in reality there are fewer desmochore dispersed plants on such roads, either the agents of dispersion or the environment is operating against the expected trend. It is quite possible that there is greater wildlife activity on secondary roads because of less mowing occurring there (Oetting, 1971). Higher levels of traffic, as found on interstate primary highways, may contribute to the decline of wildlife activity on roadsides, but such a relationship is difficult to determine. This would at least provide more agents for this dispersal class. Additionally, greater wildlife activity is expected on secondary roads because of the forest edge adjacent to the

Table 4

Absolute Number of Dispersal Types for Different Roadtypes and Exposures

Dispersal Type	Roadtype			Exposure			
	I	1°	2°	East	North	West	South
Ballochore	.67	.50	.70	.63	.71	.67	.40
Barochore	0.0	0.0	.14	.25	.13	0.0	0.0
Cyclochore	.16	.25	.21	.13	.47	.17	.20
Desmochore	.83	.75	1.79*	1.50	1.86	.92	.60
Microsclerochore	17.33	20.42	16.86	19.75	21.29	17.17	14.00
Pogonochore	6.33	4.92	4.21	5.13	5.57	5.00	3.20
Pterochore	1.00	1.00	1.64	2.38	1.43	.50	1.20*
Sarcochore	1.83	3.50	3.57	5.63	3.14	2.08	2.20*
Sporochore	.33	.33	.07	.25	.14	.25	.20

Numbers represent mean of the absolute number of dispersal type within independent variable classes.
* - ANOVA test significant at alpha of .o5
1° - primary highway
2° - secondary highway
I - interstate highway

Table 5

Absolute Number of Dispersal Type for Different Elevations, Slopes, and Surroundings

Dispersal Type	Elevation		Slope			Surroundings	
	>2000'	<2000'	<10°	10°-30°	>30°	F	O
Ballochore	.75	.55	1.00	.38	.64*	.63	.63
Barochore	.17	0.0	.13	0.0	.18	0.0	.08
Cyclochore	.42	.10	.25	.31	.09	0.0	.29
Desmochore	1.58	1.00	1.88	1.08	.91	1.75	1.04
Microsclerochore	17.00	19.05	19.25	19.46	16.18	17.37	18.58
Pogonochore	4.33	5.20	5.00	5.00	4.63	4.75	4.91
Pterochore	1.50	1.15	1.13	1.15	1.54	.75	1.46
Sarcochore	3.33	3.15	3.00	3.00	3.63	2.37	3.50
Sporochore	.08	.30	.25	.15	.27	.13	.25

Numbers represent mean proportion of dispersal type within independent variable classes.
* - ANOVA test significant at alpha of .05
F - forested surroundings
O - open surroundings

Table 6

Relative Number of Dispersal Types for Different Roadtypes and Exposures

Dispersal Type	Roadtype			Exposure			
	I	1^o	2^o	East	North	West	South
Ballochore	2.33	1.58	2.21	1.75	1.85	2.42	1.60
Barochore	0.00	0.00	.57	.75	.29	0.00	0.00
Cyclochore	.50	.75	.50	.38	1.00	.50	.60
Desmochore	2.83	2.25	5.50*	4.25	5.00	3.25	2.60
Microsclerochore	61.67	63.92	60.36	54.75	63.46	65.42	63.00
Pogonochore	22.17	16.00	14.14*	14.50	15.86	18.67	14.40
Pterochore	3.50	3.41	6.50	8.63	4.29	2.00	6.00*
Sarcochore	5.83	11.42	11.36	16.13	8.57	7.50	10.40*
Sporochore	1.33	.83	.14	.50	.29	1.00	.75

Numbers represent mean of the relative number of dispersal type within independent variable classes.
* - ANOVA test significant at alpha of .05
1^o - primary highway
2^o - secondary highway
I - interstate highway

Table 7

Relative Number of Dispersal Types for Different Elevations, Slopes, and Surroundings

Dispersal Type	Elevation		Slope			Surroundings	
	>2000'	<2000'	<10°	10°-30°	>30°	F	O
Ballochore	2.33	1.80	3.13	1.15	2.18*	2.13	1.95
Barochore	.67	0.0	.25	0.0	.54	0.0	.33
Cyclochore	1.80	.30	.50	.92	.27	0.0	.79
Desmochore	5.00	3.05	5.13	3.38	3.27	5.75	3.13*
Microsclerochore	60.75	62.65	63.00	63.85	58.91	64.00	61.25
Pogonochore	15.08	17.10	15.38	15.92	17.55	17.63	15.92
Pterochore	4.83	4.75	5.13	4.46	4.91	2.50	5.54
Sarcochore	10.33	10.35	8.88	10.46	11.27	7.87	11.17
Sporochore	.14	.90	.38	.38	.91	.38	.63

Numbers represent mean relative number of dispersal type within independent variable classes.
* - ANOVA test significant at alpha of .05
F - forested surroundings
O - open surroundings

Table 8

Frequency of Species by Dispersal Type and Life Form with Consideration to Geographic Origin

	Ballo-chore	Baro-chore	Cyclo-chore	Desmo-chore	Micro-sclero-chore	Pogono-chore	Ptero-chore	Sarco-chore	Sporo-chore
Chamaephyte									
Alien	0	0	0	0	1	0	0	1	0
Native	0	0	0	0	1	1	0	8	0
Total	0	0	0	0	2	1	0	9	0
Cryptophyte									
Alien	0	0	0	0	6	3	0	0	0
Native	0	0	1	0	13	10	0	2	1
Total	0	0	1	0	19	13	0	2	1
Hemicryptophyte									
Alien	1	0	0	2	40	6	2	2	0
Native	2	0	1	6	41	15	2	4	0
Total	3	0	1	8	81	21	4	6	0
Phanerophyte									
Alien	0	0	0	0	0	0	2	0	0
Native	1	2	0	0	4	0	8	9	0
Total	1	2	0	0	4	0	10	9	0
Therophyte									
Alien	0	0	0	3	39	4	0	0	1
Native	2	0	2	3	18	3	0	0	1
Total	2	0	2	6	57	7	0	0	2

rights-of-way (Karr, 1971). Perhaps the greatest and overriding factor is the increased use of herbicides, especially 2-4,D, on primary and interstate highways. This herbicide is specific to herbaceous dicots. All desmochores found in this study where herbaceous dicots (Table 8). Because mowing and herbicide spraying occur primarily on inslopes they also contribute to the reduction of desmochores from backslope to inslope mentioned earlier.

There is a significantly higher proportion of desmochores on sites surrounded by forested areas (Table 7). Roadsides through wooded areas characteristically set up an ideal ecotone situation with a marked increase in number and diversity of animals (Odum, 1959; Karr, 1971; Mabey, 1974; States, 1976). Because such areas are used by animals as corridors there is at least a larger number of dispersal agents at these sites (Ghiselin, 1977). An increase in agents provides an attractive explanation for increased number of this dispersal type but, positive association requires further investigation.

The relative number of pogonochores was found to be significantly higher statistically on interstate then on other roadtypes. The same trend was expressed by the means of the absolute number for the different roadtypes, however, they were not statistically significant. Two factors concerning interstate highways of the study area that are important to consider here are that they are younger than the other roadtypes (5 - 15 years) and that their intensified maintenance tends to simplify and arrest them at a less developed successional stage (Niering, 1974; Egler, 1975; Tomkins, 1977). Because of these factors and the similar physiognomy and species composition between successional old fields and highway rights-of-way the following comparison is made. Interstate highways, being more like the earlier successional old field, have a greater number of wind dispersed species than primary or secondary highways. This is consistent with the findings of Quarterman (1957), whose study of old fields shows a steady decline in those species that have pogonochores over a twenty-five year period of succession. A similar successional study by Levin (1966) also shows a decline in species with pogonochores over time. The increased disturbance in the form of maintenance on interstate highways may also contribute to an increase in wind dispersed species (Salisbury, 1943). Note in this case that wind dispersed species refers to pogonochores not pterochores, which are predominantly phanerophytes and are generally absent from interstate highways (table 8).

Failure for elevation to be significant is not surprising since the study sites spanned only 2,500 vertical feet. Such a study is ideally performed where all three roadtypes are considered over a larger vertical differential. No such conditions exist in Southwestern Virginia, however, single roadtypes studied over a greater elevation range is possible. Noteworthy is the near significance of desmochore frequency for elevation. Desmochores are more frequent at higher elevations. I believe this to be a side effect of roadtype. No interstates exist above 2,000 feet; while a proportional increase in secondary roads is found at higher elevations.

Tests for exposure differences were statistically signifcant in both relative and absolute numbers for the pterochore and sarcochore dispersal types. However, the Duncan's procedure revealed slightly different trends among exposure classes. Pterochores and sarcochores were in significantly higher proportions on eastern slopes than on western or northern slopes. Absolute number of sarcochores was higher on eastern slopes than any other exposure and, pterochores were in greater numbers on eastern slopes than on western slopes.

The data show that on secondary roads with eastern exposure and an abnormally high proportion of pterochores, a similar complement of species was present. Such high proportions of pterochores were not found on other roadtypes for any exposure. The species common to these eastern exposed secondary roadsides were <u>Ailanthus altissima</u>, <u>Acer</u>

spp., Liriodendron tulipifera and Ulmus rubra. The obvious characteristic among these species is that they are all trees. A great number of trees found in this study are wind dispersed (table 8). The presence of such a high proportion of wind dispersed trees in such a habitat is consistent with the findings of Keay (1957) who found primarily wind dispersed tree species under pioneer conditions in Nigerian forests. The fact that these trees are on secondary roads is not surprising since greater efforts are made to remove them from other roadtypes. These efforts are reflected in the mean number of pterochores by roadtype (Tables 4 and 6) but, without statistical significance ($P>F=.15$). All of these trees have broad moisture requirements with optima found under moist soil conditions. However, no clear moisture trend, with greater numbers of pterochores on northern and eastern slopes than on southern and western slopes, is expressed. Only a weak trend might be shown by the means of the absolute numbers. I believe such a trend if present was obscurred by a few very low or zero values for this dispersal class on some northern exposed sites. The presence of these trees in isolated patches on right-of-ways raises some question as to how they got there since similarly dispersed species deposit most of their seeds near the source (Bakker, 1960; Roe, 1967). In most cases, for native species at least, they are the remnant of previous vegetation (Tramer, 1975). But, the erratic presence of such exotics as _Ailanthus altissima_ suggests the possibility of effective long distance dispersal and invites the study of such a possibility.

To explain the significant effects of exposure on the number of sarcochores reference to the original data is required. Two of the eight eastern exposed sites, which were on secondary roads, had abnormally high proportions of sarcochores. Both sites had a similar composition of species with sarcochores. The species similar to both sites were three species of _Rubus_, _Lonicera japonica_, _Physalis virginiana_ and _Fragaria virginiana_. As was the case with pterochores and exposure, the sarcochore distribution may be linked to moisture preference since most of these species are adapted to broad moisture requirements with optima in moist soil conditions. Such conditions would occur more frequently on north and east facing slopes (Loucks, 1962).

Perhaps the explanation lies within a link between pterochores, which are predominantly tree species, and sarcochores (table 8). The connection being that birds frequently disperse such species while perching in trees (McBride, 1973). The original data seems to bear this out. Those eastern exposed sites with a high number of pterochores were also the ones with high numbers of sarcochores; likewise those northern exposed sites with low and zero readings for pterochores had comparable numbers of sarcochores. Another contributing factor, as with pterochores, is the effect of roadtype/maintenance. Since the vast majority of sarcochores are chamaephytes and phanerophytes (table 8) they are selectively eliminated and frequently not present on the more recently constructed interstate highways. Although sarcochore ANOVA tests were not significant for roadtype (P>F=.2) the means of both the relative and absolute numbers show a strong pattern. Recall that those abnormally high records of sarcochores were found on secondary roads with eastern exposures.

Ballochores were found to be in significantly higher proportion and greater numbers on flat slopes than on moderate slopes (Tables 5 and 7). The significance of ballochore differences on slopes is probably a matter of chance. This group comprises only about 2% of all dispersal types. There are many zero values for this dispersal type at the sites. The major contributor of this group is Oxalis stricta, which is found over wide environmental conditions. Because no flat to steep trend of the means was evident and O. stricta is so widely adapted to ruderal habitats, chance distribution of this poorly represented group on slope seems to be the best explanation for significance.

No MANOVA tests were statistically significant. This could be the result of not having sampled enough sites.

Life Form

Utilization of life form in describing plants has been around since the early Greeks and was probably the second classification system developed by man. Modern use of life form classifications has evolved as a result of man's desire to understand the relationship of climate and formation (biome). The system most widely used today is that of Raunkiaer (1934). This system as well as Koppen's climatic types were developed as a result of de Candolle's thermophylic plant types (Colinvaux, 1973). The basis of Raunkiaer's system is the position of the perennating bud in relation to the ground surface.

Descriptions of the forms are given below:

Therophytes - Perennating bud not present, renewal of growth by seed only; annuals.

Hemicryptophyte - Perennating bud at or near the soil surface; most perennial herbs without rhizomes or bulbs.

Cryptophyte - Perennating bud well below the soil surface; rhizomatous, bulbous, and cormous herbs.

Phanerophyte - Perennating bud more than 25cm above the soil surface; trees and shrubs.

Chamaephytes - Perennating bud less than 25cm above the soil surface; semi-woody herbs and low shrubs.

Unique combinations of these life forms have been shown to be characteristic for particular formations (Cain, 1950). This unique combination for a particular formation is its life form spectrum. The characteristic proportions present in ruderal and disturbed habitats seems to be somewhat in doubt. However, in a California study of roadsides, the dominant form present was the therophyte (Frenkel, 1970). Salisbury (1943) found therophytes to be the major life form present in drastically disturbed sites in England. Allen (1937) and Brun-Hool (1963) also found therophytes dominant in weed communities when the surrounding vegetation was dominated by phanerophytes and hemicryptophytes; their results come from Switzerland and New Zealand respectively. Ellenberg (1963) finds hemicryptophytes dominant in ''man altered'' environments in northwestern Europe. Most of the time, these studies conclude that the majority of plants present in ruderal habitats are therophytes (annuals). Obviously, more studies are needed to determine a life form spectrum for ruderal habitats.

The overall proportions of life form (life form spectrum) for the roadside sites in this study are quite different from deciduous forest, which is the native surrounding vegetation in the study area (Table 9). Deciduous forests typically have higher phanerophyte and cryptophyte components than do the roadside sites (Colinvaux, 1973). The roadside sites have typically higher

Table 9

Overall Percentages of Life Form

Life Form	% of all 274 species (equal weights to each species)	% of all 274 species (species weighted by frequency among sites)
Chamaephytes	5	6
Cryptophytes	13	14
Hemicryptophytes	45	45
Phanerophytes	9	6
Therophytes	28	29

therophyte and hemicryptophyte components. The chamaephyte proportion is comparable on roadside sites and in deciduous forests. By far, the most dominant life form is the hemicryptophyte. Therophytes (annuals), although not dominant, certainly comprise a large part of all species present, a percentage many times higher than found in the deciduous forests. These results coincide best with the findings of Ellenberg (1963).

Perhaps the best explanation for the differing dominant life forms of ruderal habitats is that the life form spectrum for the ruderal vegetation is variable. This variability is influenced not only by climate, but also by surrounding vegetation and the particular disturbance of the ruderal habitat considered.

Surrounding vegetation showed a significant effect on altering the relative number of hemicryptophytes (Table 10). Although the means of the two groups were not far from the overall average of 45% there was a significant influence. There was a significantly greater amount of hemicryptophytes near forested areas. This is, in a way, quite surprising considering the fact that hemicryptophytes are generally in lower proportions in deciduous forests than on roadsides in this study. I suspect that the void in the phanerophyte class created in such areas must be filled with the most likely candidate, hemicryptophytes. Open sites surrounded by pasture and cultivated fields have greater proportions of annuals, thus effectively decreasing the percentage of hemicryptophytes. This higher annual proportion was seen in the data for open sites (Tables 10 and 11). Both influences contribute to the significant findings.

The severity of disturbance also has an influence. I was quite surprised not to find significance in the roadtype test for therophytes. Severity of disturbance has been shown by other investigators to have a direct relationship with the percentage of annuals (Frenkel, 1970). This relationship is present in the means of the relative numbers for roadtype, but is not statistically significant. The distribution of annuals within sites clearly expresses this relationship (Table 12). In zone A, therophytes are the dominant life form. The increased disturbance in this zone is caused by more intense right-of-way maintenance procedures as well as increased blading and treading. Once these disturbances are eliminated or reduced, as in zone B, hemicryptophytes again become dominant along with increases in all other life forms especially phanerophytes and chamaephytes, which are selectively removed from zone A. The proportion of aliens shows a similar trend to that of annuals for distribution within sites except for phanerophytes and chamaephytes, which are poorly represented among the alien species. Only on two sites was there a higher percentage of therophytes than hemicryptophytes. These two sites were on secondary roads near residential areas.

Statistical tests relating exposure to the phanerophyte life form were significant (Tables 10 and 11). The Duncan's procedure for this variable revealed that the rejection was caused by a significantly greater proportion of phanerophytes on southern and eastern slopes than on western slopes. Significance was not expected among exposure classes for phanerophytes since this life form is comprised of groups of species adapted to every environment covered in the study area. Some artificial process must be involved since the means and the Duncan's test reveal such an unnatural trend. Part of the explanation lies in the fact that three eastern exposed sites had abnormally high ratings and one southern exposed site had an extremely high phanerophyte rating of 35%. The means of relative and absolute numbers of phanerophytes for roadtype expressed a clear relationship with greatest numbers of phanerophytes on secondary roads, fewer on primary roads and the least on interstate highways (Tables 10 and 11). However, these differences did not produce statistical significance ($P<.17$). This trend is probably a consequence of the interstate highway's more recent construction as well as having a more intense maintenance regime. (Nicholson, 1974;

Table 10

Relative Number of Life Forms for Different
Roadtypes, Exposures, Elevations,
Slopes, and Surroundings

Life Form	Roadtype			Exposure			
	I	1°	2°	East	North	West	South
Chamaephyte	2.83	6.50	6.86	9.38	5.14	4.25	5.80
Cryptophyte	14.83	13.25	13.50	15.50	12.29	14.67	10.20
Hemicryptophyte	47.33	45.58	46.00	40.63	47.14	47.58	49.80
Phanerophyte	1.50	5.83	9.00	10.13	4.14	2.58	12.80*
Therophyte	33.50	29.00	24.86	24.38	31.29	31.08	22.00

Life Form	Elevation		Slope			Surroundings	
	>2000'	<2000'	10°	10°-30°	>30°	F	O
Chamaephyte	6.42	5.70	4.50	6.00	7.00	3.38	6.83
Cryptophyte	11.25	15.10	17.00	12.38	12.73	11.38	14.42
Hemicryptophyte	49.08	44.30	44.63	44.69	48.82	53.50	43.63*
Phanerophyte	8.92	8.90	3.00	8.15	6.82	7.88	5.92
Therophyte	24.42	30.20	31.00	29.23	24.45	23.88	29.42

Numbers represent mean relative number of life form within independent variable classes.
* - ANOVA significant at alpha of .05
I - interstate highway
1° - primary highway
2° - secondary highway
F - forested surroundings
O - open surroundings

Table 11

Absolute Number of Life Forms for Different Roadtype, Exposures, Elevations, Slopes, and Surroundings

Life Form	Roadtype			Exposure			
	I	1°	2°	East	North	West	South
Chamaephyte	.83	1.83	2.14	3.13	1.86	1.08	1.20
Cryptophyte	4.00	4.17	4.36	5.63	4.71	3.75	2.40
Hemicryptophyte	13.50	14.17	13.00	14.75	15.28	12.75	11.00
Phanerophyte	.50	1.67	2.50	3.37	1.43	.67	2.60*
Therophyte	9.67	9.83	7.21	8.75	11.29	8.50	5.20

Life Form	Elevation		Slope			Surroundings	
	>2000'	<2000'	<10°	10°-30°	>30°	F	O
Chamaephyte	2.08	1.60	1.38	1.69	2.18	1.00	2.04
Cryptophyte	3.67	4.55	5.75	3.69	3.73	3.62	4.42
Hemicryptophyte	13.67	13.45	14.13	13.38	13.27	14.13	13.33
Phanerophyte	2.50	1.40	1.00	2.07	2.09	2.12	1.70
Therophyte	7.25	9.50	9.50	9.69	6.82	6.88	9.25

Numbers represent mean absolute number of life form within independent variable classes.
* - ANOVA significant at alpha of .05
I - interstate highway
1° - primary highway
2° - secondary highway
F - forested surroundings
O - open surroundings

Table 12

Zonal Distribution of Life Forms

	Chamaephyte	Cryptophyte	Hemicryptophyte	Phanerophyte	Therophyte	Total
Zone A (inslope)						
Alien	0	39	79	0	105	223
Native	3	9	42	1	50	105
Total	3	48	121	1	155	328
Zone B (backslope)						
Alien	13	31	136	5	71	256
Native	40	46	123	51	39	299
Total	53	77	259	56	110	555
Zone A and B						
Alien	1	8	50	0	10	69
Native	0	2	13	0	3	19
Total	1	10	63	1	13	88

Each unit represents a single species found at one of the 32 roadside vegetation sites.

Newell, 1978; Smith, 1978).

Perhaps the most significant finding that can be made from this analysis is the great majority of non-significant tests. This points out very well that overall proportions of life forms remain constant under the varying environment influences on the roadsides. Such large numbers may also be due inpart to small sample size. Certainly, more studies will be needed to establish life form spectra of ruderal habitats.

No MANOVA tests were statistically significant. This could again be the result of a small sample size.

SUMMARY

The floristic checklist in this study includes 274 species, 182 genera, and 57 families. A majority of these species are native (60%) but, alien species are more ubiquitous and abundant. The dominant life form is the hemicryptophyte and the dominant dispersal type is the microsclerochore. Species that are most frequent on the inslopes often have the following combination of characteristics: 1. alien; 2. annuals (therophytes); 3. are dispersed by contamination (usually microsclerochores).

The findings from the investigation on the relationship of environmental factors to dispersal types reveal that the roadtype/maintenance regime is by far the most influencial environmental factor both within and between roadside sites. Within sites sarcochores, pogonochores, and microsclerochores are influenced the most by maintenance regime. Sarcochores and pogonochores become more frequent as distances from the road margin are increased while the opposite trend is exhibited by microsclerochores. Desmochores and pterochores show a decrease in number as maintenance on roadsides is increased. Ecotone effects, present at sites with forested surroundings, appear to increase the relative number of desmochores. The relationship of exposure to pterochores and sarcochores is

not clear. It is possible that more pterochores and sarcochores are found on eastern slopes because of a masked roadtype/maintenance regime effect.

The life form spectrum established for Southwestern Virginia roadsides differs from that of the surrounding vegetation. There are relatively more therophytes and hemicryptophytes, but relatively fewer phanerophytes found on roadside sites. The spectrum stayed fairly constant over all environmental conditions tested except for roadtype/maintenance regime. More highly maintained roadsides show a marked decrease in the number of phanerophyrtes. Within sites phanerophytes and chamaeophytes are rarely present on inslopes. Therophytes become the dominant life form on inslopes because of increased maintenance and other physical disturbances.

More knowledge needs to be obtained on the mechanisms for the changes that occur in the roadside habitat in the areas of floristics, dispersal, and life form. Better understanding of such changes will produce more effective management of this large part of our environment. Ultimately, this could produce lower maintenance highway costs as well as safer and more aesthetically pleasing roadsides.

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APPENDIX

Checklist

Aceraceae

1. Acer negundo L. Boxelder. Tree to 20m, but usually much shorter and more shrub-like on roadsides. Infrequent; found on moist slopes or ditches when surrounded by wooded areas. Fruit is a double samara dispersed by wind throughout summer, fall, and winter; April - May. Native. Ptero.

2. Acer saccharum Marsh. Sugar Maple. Tree to 40m, but only saplings found on roadsides. Occasional; an ecotone species of forested areas or an ornamental. Samaras double, dispersed in autumn; April - May. Native. Ptero.

3. Acer platanoides L. Norway Maple. Tree to 20m, An escaped or planted ornamental always found close to residential areas. Samaras double, can be dispersed spring through winter; April - May. Alien, native of Europe. Distribution in our area strictly artificial. Ptero.

Anacardiaceae

1. Rhus glabra L. Smooth sumac. Low tree to 5m. Found on open grassy slopes. Fruit is a drupe, endozoochorously dispersed; June - July. Native. Sarco.

2. Rhus radicans L. Poison Ivy. Vine or low shrub. Common; Found on open or shaded slopes, usually on fence rows or on woody vegetation. Dispersal probably similar to previous species; April - June. Native; An established alien in Europe. Sarco.

3. Rhus typhina L. Staghorn Sumac. Similar to R.glabra, but more common. Both this and species R. glabra are two of the few tree species well adapted to and common in the ruderal habitat. June - July. Native. Sarco.

Apiaceae

1. Cryptotaenia canadensis (L.) DC. Honewort. Perennial herb less than 1m. On moist slopes in wooded areas. Fruits oblong to 5mm, dispersal seemingly haphazard. June - July. Native; naturalized in Europe. Micro.

2. Daucus carota L. Wild carrot; Queen Anne's Lace.

Biennial to 1m. Eubiquitous. One of the most common and abundant plants on the roadside, especially when pasture, urban, residential or abandoned fields are adjacent. Fruits oblong to 4mm with radiating smooth prickels on ribs (might serve to attach to dispersal agent); Dispersal somewhat limited to dry days due to hygroscopic action of inflorescence; May - Oct. Alien, native of Eurasia, throughout North America. Can flower in lawns and cut roadsides at height of 2.5cm. Desmo.

3. *Osmorhiza claytonii* (Michx.) Clarke. Sweet Cicely. Perennial herb less than 1m. Found on roads through moist wooded areas only. Fruits narrow, oblong, 1.5cm, with 2 basal awns with retrorse bristles making up a third of total length. Awns can serve for attachment; May - June. Native. Desmo.

4. *Sanicula canadensis* L. Black Snakeroot. Biennial to short lived perennial to 8 dm. Present only with adjacent wooded areas. Fruits ovoid with many hooked ribs; Much sticky oil between fruits probably enhancing their ability to attach to dispersal agents; June - Aug. Native. Desmo.

5. *Thaspium barbinode* (Michx.) Nutt. Meadow Parsnip.

Perennial herb to 1 m. Although not frequent in roadside communities this species is found over wide environmental ranges, On roads through woods, pastures, and cultivated fields. Fruits ovoid, flattened with winglike ribs, but since they are so minute (5mm) probably not readily wind dispersed; May - July. Native. Micro.

6. Zizia aurea (L.) Koch. Golden Alexanders. Perennial herb to 8dm. Occasional on sunny but moist roadside slopes. Fruits oblong, flattened, 2mm long with short wrinkled ribs; Late April - June. Native.

Asclepiadaceae

1. Asclepias incarnata L. Swamp Milkweed. Rhizomatous perennial herb to 1.5m. In sunny ditches with standing water. Fruit disk-like, oblong with long white plumose trichomes attached apically and which aid in wind dispersal. Hairs removed with little force. Disperses in fall by seed, vegetatively reproduces and disperses by virtue of rhizomes at other times; June - Aug. Native. Pogon.

2. Asclepias syriaca L. Common Milkweed. Perennial herb to 2m with rhizomes frequently forming large clonal colonies. A common and abundant member of the roadside

community on moist to dry sunny slopes. Fruits 7mm in diameter, trichomes 1-3cm long; disperses througout the fall; May - Sept. Flowering often extended by mowing. Native. Most common member of this family in the ruderal habitat. Pogon.

3. Asclepias tuberosa L. Butterfly-Weed. Perennial herb less than 1m high, with stout root stalk. Found on drier sites that are wooded. More frequent at higher elevations; Dispersal similar to that of A. incarnata June - Aug. Native, not widespread. Pogon.

Apocynaceae

1. Apocynum cannabinum L. Indian Hemp. Perennial herb to 1.5 m. Infrequent on open slopes . Seeds numerous, comose, in a follicle; June - Sept. Native. Pogon.

Asteraceae

1. Achillea millefolium L. Yarrow. Perennial herb to 1m with stout rootstock. Common and abundant especially on poor, dry, disturbed soils; found on both approach and slope. Not a 'farm weed' since it will not persist in cultivated soils. Can spread vegetatively by rootstock fragments. Fruits spreading by contamination; May - Nov.

Originally from Europe. Micro.

2. Ambrosia artemisiifolia L. Ragweed. Probably the most common and abundant annual in this study. Present in the most disturbed zone, immediately next to the pavement, usually only reaching a height of a few dm. Fruits to 3.5mm long with a crown of spikes which do not help in attachment to dispersal agents; July - Oct. Native across the continent. Micro.

3. Ambrosia trifida L. Giant Ragweed. Enormous annual to 3m. Not as common as A. artemisiifolia but usually associated with it; found only on moist soils or in ditches, but similar in range and fruits; July - Oct. Native of North America and Europe. Micro.

4. Antennaria plantaginifolia (L.) Richardson. Pussytoes. Stoloniferous perennials to 15 cm with spreading rosette of leaves. On dry open slopes; infrequent. Fruits are minute achenes with a ring of trichomes that allow marginal flotation on air. April - Jun. Native with 2 varieties (var. plantaginifolia and var. ambigens (Greene) Cronq.) found in sympatric populations. Pogon.

5. Arctium minus (Hill) Schk. Bernh. Common Burdock.

Biennial herb to 2m. Specific to roadsides and waste places, where it can be present in the most disturbed zones; infrequent on roadsides, usually a weed of cultivated fields. Head disperses as a unit, subglobose and completely surrounded by apically oriented hooks excellently adapted for surface attachment to animals; June - Oct. This long time alien is well established throughout the U. S. Native of Eurasia. Desmo.

6. _Aster cordifolius_ L. Blue Wood Aster. Rhizomatous perenial herb to 1.5m. Infrequent; an ecotone species in forested areas. Achenes with trichomes have marginal air floatation abilities; Sept - Oct. Native . Pogon.

7. _Aster novae-angliae_ L. New England Aster. Perennial herb to 1.5m. Scattered, but abundant when present; Forming large clones by rhizomes. In open ditches especially with standing water. Pappas of capillary trichomes serves as an effective mechanism for wind dispersal, and the small pubescent achene (2.2mm long) allows for easy contamination; July - Oct. Native; Naturalized in central Europe. Pogon.

8. _Aster pilosus_ Willd. var. _pilosus_ White Heath Aster. Perennial herb to 1.5m. Most common aster of

roadside, also the most prolific seed producer. Mostly on dry open slopes without mowing. Similar dispersal mechanism to A. novae-angliae Aug.-Nov. Native; naturalized in Europe. Pogon.

9. Bidens bipinnata L. Spanish Needles. Annual herb to 1.7m. Infrequent; In moist ditches, open or shaded. Linear achene 2cm long, with short, retrorsely barbed awns that attach well to clothing and are well presented to passing animals; Aug. - Oct. Native of South America, it has spread north as far as southern New England. Desmo.

10. Bidens frondosa L. Beggar Ticks. Annual herb to 1m. Frequent in moist ditches, even where ditching operations are practiced. The flattened ovate achene 1cm long with 2 retrorsely barbed awns attach well to clothing; June - Oct. Native, widespread across the continent. Desmo.

11. Bidens polylepis Blake. Tickseed-Sunflower. Similar to B. frondosa in habit, habitat, and dispersal, but less frequent. Aug. - Oct. Spreading east from mid-west. Native to the U. S. Desmo.

12. Bidens vulgata Greene. Common Beggarticks. Similar to B. frondosa in all respects mentioned and perhaps even

more common and widespread; July - Oct. Native. Desmo.

13. Carduus acanthoides L. Plumless Thistle. Biennial to 2m. Similar to C. nutans but more common; with slightly smaller fruits. June - Oct. Native of Europe. Pogon.

14. Carduus discolor (Willd.) Nutt. Field Thistle. Biennial to 3m. Not uncommon, found on sites with adjacent pasture as well as forest, never on dry soil. Fruit and dispersal similar to other thistles; July - Oct. Native. Pogon.

15. Carduus lanceolatus L. Bull Thistle. Biennial to 2m. Infrequent on roadsides and field borders. Fruits similar to other thistles, with deciduous pappus; June - Oct. Common throughout the U. S. and feared as a weed of farmlands, but it will not persist in regularly cultivated fields. Native to Eurasia. Pogon.

16. Carduus nutans L. Musk Thistle. Biennial to 2m, giant individuals to 4m. Local and scattered on roadsides when adjacent to pasture or cultivated fields. Achene 4mm long with capillary trichomes 2cm long which are easily separated from the achene; it is questionable how well the pappus aids in wind dispersal; May - Oct. Native of Europe;

naturalized in this area, but more common further west. Pogon.

17. Centaurea jacea L. Brown Knapweed. Perennial herb to about 1m. On dry, open slopes of the most disturbed sites. Achene to 3mm long without appendages to aid dispersal; spread by contamination of crop seed. Rare in this area, more common northward, spreading south; native of Europe. Micro.

18. Centaurea maculosa Lam. Spotted Knapweed. Biennial herb to 1m. One of the most frequent and abundant weeds on western Virginia roadsides, especially on secondary roads; Prefers drier open slopes. Achene with or without pappus scales, dispersal by contamination; July - Sept. Often associated with Chrysanthemum leucanthemum and Daucus carota. Native of Europe. Micro.

19. Centaurea nigra L. Black Knapweed. Similar to C. jacea in all respects and hybridizes with it; rare. Micro.

20. Chrysanthemum leucanthemum L. Ox-Eye Daisy. Perennial herb to 5dm. One of the most common and variable species of the roadside.It grows under virtually any environmental regime, but is most common on dry sunny

slopes; it can survive mowing through miniaturization. Fruit less than 3mm long, without trichomes; disperses as a contaminant and probable ornamental introductions; April - Oct. Native to Eurasia; now throughout temperate north America. Micro.

21. Cichorium intybus L. Chicory. Perennial herb to 1m. Perhaps the most abundant plant not purposely introduced by man on the roadside. Common throughout the east and midwest, local further west probably becoming more common in the future. Forms the most common ruderal plant association with Asclepias syrica and Daucus carota. Originating from the mediterannean region, it was cultivated in western Europe and naturalized in this country by cultivation and contamination, for which its fruits are well adapted; May - Nov. Has blue, red, and white color forms. Micro.

22. Coreopsis lanceolata L. Lance-Leaved Tickseed. Perennial herb to 5dm. On dry open slopes; Aesthetically pleasing, this plant is of questionable establishment, perhaps from ornamental plantings. Achene is a 3mm long pterochore with 2 scalelike wings; April - June. Native. Ptero.

23. *Coreopsis major* Walt. var. *stellata* (Nutt) Robins. Wood Tickseed. Perennial herb to 1m. On edges of dry sunny woods. Achene 6mm long, oblong, with 2 wings; June - Aug. Native to the southeastern U. S., but probably spreading elsewhere as an ornamental. Ptero.

24. *Erigeron annuus* (L.) Pers. Daisy Fleabane. Annual herb to 1.5m. Common on open slopes. Achene 1mm long, oblong with only minute pappus scales and trichomes so delicate that they never aid in wind dispersal; May - Oct. Native of eastern U. S. and pacific northwest; Cultivated in Europe. Micro.

25. *Erigeron canadensis* L. var. *canadensis*. Horse Weed. Annual herb to 2m. Common on open dry slopes that are very disturbed but not mowed. Oblong achene 1mm long with many persistant capillary trichomes 2mm long that allow wind to disperse them; July - Nov. Native throughout the U. S. Pogon.

26. *Erigeron philadelphicus* L. Daisy Fleabane. Perennial herb to 2m. Common; An early spring wildflower on moist soils, especially ditches, on shaded or open sites over a wide variety of disturbances except spraying. Achene 1.5mm long, oblong with several pappus trichomes that allow

for wind dispersal; April - June. Native. Pogon.

27. Erigeron strigosus Willd. Daisy Fleabane. Similar to E. annuus. Native. Micro.

28. Eupatorium fistulosum Barratt. Joe-Pye-Weed. Perennial herb to 3m. Infrequent; in ditches of open sites that are periodically flooded by near-by streams. Will not persist in regularly mowed areas, but can survive occasional mowing and ditching operations. Achene oblong and pointed, 3mm long with several capillary trichomes 5mm long effecting wind dispersal. July - Oct. Native. Pogon.

29. Eupatorium perfoliatum L. Boneset. Perennial herb to 1.5m. Scattered; On open sites in ditches where standing water at least periodically occurs, it can survive occasional cuttings. Achene narrowly conic, 2mm long with several capillary trichomes 2mm long; Aug. - Oct. Native. Pogon.

30. Eupatorium rugosum Houttuyn. Perennial herb to 1.5m. Frequent on open and shaded slopes in moist soils. Somewhat of a hazard since it's poisonous and can be transmitted through milk; hard to eradicate, can reproduce by rhizome or seed. Achene similar to E. perfoliatum, but

slightly larger; July - Oct. Native throughout the eastern U. S. Pogon.

31. Galinsoga ciliata (Raf.) Blake. Hairy Galinsoga. Annual herb to 5dm. Infrequent; found on moist slopes where the soil has been greatly disturbed or occasionally in pavement cracks. Triangular achenes 1.4mm long with many short pappus trichomes that allow for wind dispersal; June - Nov. Native of South America invading North America by way of Great Britain, has spread throughout the U. S. Pogon.

32. Gnaphalium obtusifolium L. Everlasting. Annual to 1m. Uncommon on dry open slopes; found outside the most disturbed zones where mowing and spraying are absent. Achene 0.8mm long, oblong with many capillary trichomes; very well dispersed by the wind by virtue of its small size; Aug. - Oct. Native. Pogon.

33. Helenium autumnale L. Yellow Sneezeweed. Perennial herb to 2m. Frequent in the same habitat as Eupatorium fistulosum. Achene without dispersal-aiding appendages; Sept. - Oct. Native. Micro.

34. Helianthus decapetalus L. Thin-Leaved Sunflower. Perennial herb to 2m, with large rhizome. Rare, found on

roadsides only by virtue of their proximity to wooded areas. Achene without persistent appendages; July - Oct. Native. Micro.

35. Helianthus laetiflorus Pers. Showy Sunflower. Perennial herb to 2m, with large rhizome. Infrequent, but becoming more common; on dry slopes especially near old fields and pastures. Achene with awns that do not aid in dispersal; July - Sept. Native to U. S., but introduced into this area from the mid-west; Cultivated in Europe. Micro.

36. Helianthus Tuberosus L. Jerusalem Artichoke. Perennial herb with large tuberous rhizome. Infrequent; on sites with adjacent woodland or pasture. Achene with deciduous awns; Jul - Oct. Native to the mid-west and introduced to the east; Cultivated for food in Europe. Micro.

37. Heliopsis Helianthoides (L.) BSP. Ox-Eye. Perennial herb to 1.5m. Rare; on sites where the road runs through woods. Achene without any special appendages for dispersal; May - Oct. Native. Micro.

38. Hieracium pilosella L. Mouse-Ear Hawkweed. Perennial herb to 25cm, with much vegetative reproduction by

stolons. Frequent on dry open slopes; when clones form basal rosettes they will completely cover area, restricting the growth of any other species within the population. Achene 2mm long, columnar, equipped with pappus of capillary trichomes 6mm long providing excellent wind dispersal; May - Sept. Naturalized from Europe. Pogon.

39. _Hieracium_ _pratense_ Tausch. King Devil. Perennial herb with stolons, but not nearly so vegetatively prolific as _H_. _pilosella_. Common; growing in the most diturbed zone closest to the pavement; Achene and habitat similar to _H_. _pillosella_ May - July. Native of Europe. Pogon.

40. _Lactuca_ _biennis_ (Moench) Fern. Wild Lettuce. Biennial to 4m, usually less than 2m. Rare; only found where there are adjacent wooded areas. Achene eliptic, 4mm long, beakless with capillary trichomes; July - Aug. Native. Pogon.

41. _Lactuca_ _canadensis_ L. Wild Lettuce. Biennial to 3m. Occasional; found in all roadside habitats except the least disturbed. Achene ovoid, 3-4mm long with 2mm beak, capillary trichomes 4-5mm long, well adapted for wind dispersal; June - Nov. Native. Pogon.

42. *Lactuca saligna* L. Willow-Leaved Lettuce. Annual to 15dm. Uncommon indicator of basic soils. Habitat and fruit similar to *L. canadensis*, except that fruits are not as large; Aug. - Nov. Native to Europe. Pogon.

44. *Lapsana communis* L. Nipplewort. Annual to 1m. Uncommon; found only on open sites, but reported to be in wooded areas also. Achene lanceolate, 4mm long, without trichomes or bristles; June - Sept. Native of Europe. Pogon.

45. *Rudbeckia fulgida* Ait. Brilliant Coneflower. Perennial to 1m, often stoloniferous. Not common to the roadside; found on open and wooded sites in moist ditches. Achenes without appendages to aid in dispersal; July - Oct. Native. Micro.

46. *Rudbeckia laciniata* L. Coneflower. Perennial to 2.5m. Common on moist roadsides, especially in areas of periodic flooding. Similar in dispersal and habitat to *R. fulgida* July - Oct. Native; naturalized in Europe.

47. *Senecio aureus* L. Golden Ragwort. Perennial herb to 8dm. Not normally a roadside plant; found on disturbed soil where a road goes through moist woods. Achene cylindric, 3mm long, with pappus trichomes 6mm long, well

adapted to wind dispersal; Mar. - June. Native. Pogon.

48. *Senecio smallii* Britt. Small's Ragwort. Similar to *S. aureus*. Occasional; habitat commonly open or wooded slopes. May - June. Native. Pogon.

49. *Solidago altissima* L. Tall Goldenrod. Perennial herb to 2.5m, usually forming large rhizomatous colonies. The most common species in this genus, found on any open site outside the zone of mowing and spraying operations. Achenes 1.5mm long, with pappus trichomes 3-4mm long; well adapted for wind as well as dispersal through contamination; Aug. - Nov. One of our most lovely native plants; cultivated in Europe as an ornamental. Pogon.

50. *Solidago juncea* Ait. Early Goldenrod. Perennial to 2m. On dry open slopes, uncommon on roadsides. Dispersal and vegetative reproduction similar to those in *S. altissima* July - Nov. Native. Pogon.

51. *Solidago nemoralis* Ait. Oldfield Goldenrod. Perennial to 1m. On dry open slopes, frequent on roadsides; moderately tolerant of mowing. Similar in dispersal and vegetative reproduction to *S. altissima* July - Oct. Native. Pogon.

52. Taraxacum officinale Wiggers. Common Dandelion. Perennial herb to 4dm. One of the most common plants of the roadside, usually occupying zones of maximum purturbation (approach). Well adapted to survive mowing, treading, ditching, and blading due to the tenacity of its taproot and rosette leaves; resistant to herbicides. Achene 3-4m, beak with tuft of pappus trichomes that effect wind dispersal; Jan. - Dec. Native to Eurasia; now cosmopolitan in temperate regions. Pogon.

53. Tragopogon dubius Scop. Goat's Beard. Biennial to 1m, but exhibits miniaturization well; large taproot. Common, usually on dry open sites, especially where soil is poor, but can be found on almost any type of roadside. Achene similar to that of Taraxacum officinale, but much larger, overall length of fruit including pappus and beak is 5-6cm; phyllaries under hygroscopic control opening flowers only in the morning, opened more often when in fruit; April - July. Introduced from Europe. Pogon.

54. Tragopogon porrifolius L. Purple Goat's Beard. Biennial. Similar to T. dubius, except rays purple not yellow, much less frequent, and not on quite such poorsites; April - June. Introduced from Europe, where it is cultivated for food. Pogon.

55. _Tussilago_ _farfara_ L. Coltsfoot. Scapose perennial to 4dm, with long rhizome. A recent invader from the north, it was first found in Virginia in 1968 (Johnson, 1972) and is rapidly becoming a common plant of this area. On open sites in clay soil, usually in zone A. Achene 3mm long, oblong with numerous pappus trichomes 1cm long; this fruit is one of the best wind dispersed over water, being dispersed by virtue of the surface tension properties of its pappus trichomes; Mar. - June. Native to Europe. Pogon.

56. _Verbesina_ _occidentalis_ (L.) Walt. Small Yellow Crownbeard. Perennial herb to 3m, usually less than 2m. An occasional plant where spraying and mowing are lacking, on open or shaded slopes where woodland or pasture are adjacent to roadside. Achene of 6mm, without appendages to aid in dispersal; Aug. - Oct. Native. Micro.

57. _Vernonia_ _noveboracensis_ (L.) Michx. New York Ironweed. Perennial herb to 2.5m. Found on open sites in ditches or low spots that are periodically flooded. Achene 3mm long, with ring of purple pappus trichomes 6mm long; not well dispersed by the wind, dispersal probably more designed to get basal end of achene on soil; July - Sept. Native. Pogon.

58. Xanthium strumarium L. var. strumarium. Cocklebur. Annual herb to 2m. Infrequent on roadsides, usually on open slopes near cultivated fields or newly abandoned fields. Heads form dispersal units of ovoid burrs of up to 2cm long, the burrs being well adapted to attachment on clothes or mammals; July - Nov. Probably native to tropical America, but spread to this area from Europe. Desmo.

Balsaminaceae

1. Impatiens capensis Meerb. Spotted Touch-Me-Not. Annual to 1.5m. In open or shaded moist ditches, occasionally on secondary roads. Capsules explosively dehisce when touched, expelling small seeds with mucilaginous substance presumably intended to aid in attachment to the passing dispersal agent that touched the fruit (Stebbins, 1961); June - Oct. Native; naturalized in Europe, probably as an escaped ornamental. Ballo.

Boraginaceae

1. Echium vulgare L. Viper's Bugloss. Biennial to 1m. Frequent; on dry slopes near old fields, cultivated fields, and dry woods. Nutlets angular, to 4cm long; June - Oct.

Spreading to and throughout this country from Europe as a seed contaminant. Micro.

2. Lithospermum arvense L. Corn Gromwell. Annual to 5dm. Frequent early spring ruderal on all but the most disturbed roadsides; Can be a troublesome crop weed; Mar. - June. Spread as a seed contaminant throughout this country from Europe. Micro.

Brassicaceae

This herbaceous family contains many of the ruderals common to this area. All, except Lepidium virginicum, are aliens originating from Europe. Capsular fruits frequently dehisce and release seeds under the agitating action of rain. This insures that the microsclerochorus seeds, which to greater or lesser extents have mucilaginous coats upon wetting, become wet. Dispersal is accomplished mainly by contamination aided by the adhesive properties of the seeds. These species also express a distinct seasonality; flowering in early spring they give way to the more dominating grass species in the latter part of the growing season. Predominantly annuals, members of this family complete their life cycles in a very short time, usually on the order of two to three weeks.

1. Alliaria petiolata (Bieb.) Cavara & Grande. Garlic Mustard. Plant to 3dm. Scattered localities but abundant where found; on sites where roads go through moist mountainous woods. April - June. Native to Europe. Micro.

2. Alyssum alyssoides L. Alyssum. Plant to 3dm. Infrequent; on open sites without spraying. May - June. Native to Europe. Micro.

3. Arabidopsis thaliana (L.) Heynhold. Mouse-Ear Cress. Annual herb to 3dm. Infrequent; in the most disturbed zones. Mar. - May. Can go from seed to seed in 2 weeks. Native to Europe. Micro.

4. Barbarea verna (Mill.) Anderson. Spring Cress. Annual or biennial to 12dm. Common; in all zones in moist soil. Mar. - June. Native to Europe. Micro.

5. Barbarea vulgaris R. BR. Yellow Rocket. Similar to B. verna. Native to Europe. Micro.

6. Brassica napus L. Turnip. Annual. Similar to B. verna, but not as frequent. April - May. Native to Europe. Micro.

7. <u>Capsella</u> <u>bursa-pastoris</u> (L.) Medic. Shepherd's Purse. Plant to 3dm. Common; found in areas where disturbance is maximal, especially after scraping and ditching or on newly formed roadsides. Mar. - June. Native to Europe. Micro.

8. <u>Draba</u> <u>verna</u> L. Whitlowgrass. Plant to 2dm, but usually much smaller. Found in the most disturbed areas, especially when open and rocky. Feb. - May. Native to Europe. Micro.

9. <u>Lepidium</u> <u>campestre</u> (L.) R. Br. Field Cress. Annual herb to 3dm. Common; found most often in zone A, where there is maximum treading. Mar. - June. Native to Europe. Micro.

10. <u>Lepidium</u> <u>virginicum</u> L. Wild Peppergrass. Similar to <u>L</u>. <u>campestre</u>. Native; naturalized in Europe. Micro.

11. <u>Thlaspi</u> <u>arvense</u> L. Field Pennycress. Similar to <u>L</u>. <u>campestre</u>, but not as common. Native to Europe. Micro.

12. <u>Thlaspi</u> <u>perfoliatum</u> L. Perfoliate Pennycress. Infrequent; habitat and flowering similar to <u>L</u>. <u>campestre</u>. Native to Europe. Micro.

Campanulaceae

1. Campanula divaricata Michx. Southern Bellflower. Perennial herb to 5dm. Occasional on dry slopes where roads have cut through mountain woods; not normally considered a ruderal. Fruit is a microchore; July - Oct. Native. Micro.

Caprifoliaceae

1. Lonicera japonica Thunb. Japanese Honeysuckle. Perennial vine with evergreen leaves. Common on open or shaded slopes, usually found growing on fences and woody vegetation. It seems to dominate in older, more open sites, especially on secondary roads. Fruit is a dark blue berry 0.6mm in diameter; May - July. From Japan and China, originally introduced for cover vegetation and now somewhat out of control; often pernicious in this area. Sarco.

2. Symphorocarpos orbiculatus Moench. Coral Berry. Perennial shrub to 2m, but usually less than 1m. On dry and rocky soil at edges of woods next to roadsides; found only at higher elevations. Fruits are fleshy berries 8mm in diameter; July - Sept. Native. Sarco.

3. Viburnum prunifolium L. Blackhaw. Trees or shrubs

to 8m. Uncommon; in moist ditches or depressions of more established secondary roadsides. Fleshy drupe 1.5cm long; Mar. - May. Native. Sarco.

Caryophyllaceae

As with the Brassicaceae the Caryophyllaceae has a group of common characteristics that unites its members in an ecological sense. They are all herbs, and the majority of them are annuals and aliens from Europe. Seeds are the dispersal unit. Most seeds have the same basic morphology, being spheres or flattened spheres usually on the order of 2mm in diameter or less (microsclerochores). Seeds are contained in a capsule that dehisces apically, creating a pore for the seeds to escape. Seeds are released only when the capsule is forcibly shaken, which is done best by raindrops, in much the same manner as salt is shaken out of a shaker. Seeds in this family characteristically have mucilaginous coats upon wetting which aid in attachment for dispersal, especially by treading. Unless otherwise mentioned these characteristics prevail for all species in this family.

1. Arenaria serpyllifolia L. Thymeleaf. Decumbent to 3dm. Infrequent; open or shaded roadsides with sandy soil.

Mar. - June. Native. Micro.

2. *Cerastium holosteoides* var. *vulgare* (Hartman) Hylander. Mouse-Ear Chickweed. Prostrate to decumbent perennial to 15cm. Common; grows virtually on any roadside, but most frequent on moister sites where mowing is regular. Mar. - June. Native to Europe. Micro.

3. *Dianthus armeria* L. Deptford Pink. Erect biennial to 4dm. Frequent on open dry sites but can be found on almost any roadside. Seeds without mucilaginous coats; April-Sept. Native to Europe. Micro.

4. *Holosteum umbellatum* L. Jagged Chickweed. Erect to 3dm, but usually only a few cm high. Adapted to harsh environments, this species' range extends to the arctic circle; on roadsides it is found in the most disturbed zones where mowing, intense treading, and very poor sandy soils are present. Mar. - May, but can be found flowering year round. Native to Europe. Micro.

5. *Lychnis alba* Mill. White Campion. Dioecious perennial to 1m. Occasional; usually on roadsides next to cultivated fields or pastures where mowing is done after flowering takes place. May - July. Native to Europe. Micro.

6. *Saponaria officinalis* L. Soapwort. Similar to *L. alba*, but monoecious and slightly larger. May - Oct. Native to Europe. Micro.

7. *Silene antirrhina* L. Sleepy Catchfly. Erect to 8dm. Infrequent; occurs on open dry sandy sites solitarily or in populations of only a few individuals. April - July. Native. Micro.

8. *Silene noctiflora* L. Night-Flowering Catchfly. Erect to 1.2m. Frequent; especially common on sites adjacent to farmland or pasture without regular mowing. June - Aug. Native to Europe. Micro.

9. *Stellaria aquatica* (L.) Scop. Giant Chickweed. Decumbent perennial to 8dm. Very rare, especially in mountains; on moist shaded sites in rich woods. June - Oct. Native to Europe. Micro.

10. *Stellaria media* (L.) Cyrillo. Common Chickweed. Annual, similar to *S. aquatica*, but smaller. Well adapted to mowing and treading. Mar. - May; but flowers all year; Native to Europe. Micro.

11. *Stellaria pubera* Michx. Great Chickweed.

Perennial to 4dm. Infrequent; on shaded slopes with moist rich soil. April - June. Native. Micro.

Chenopodiaceae

1. Chenopodium album L. Lamb's quarters. Annual to 1m. Common; found on newly constructed roadsides or those that have had a recent drastic perturbation where soil was mixed. Fruits are 1-seeded utricles 2mm in diameter; spread by contamination; Frequently being carried in pant cuffs; June - Nov. Originally from Europe. Micro.

Convolulaceae

1. Convolvulus sepium L. Hedge Bindweed. Climbing or spreading vine; perennial dying back each winter to a rootstalk. Frequent; on open slopes usually climbing on fences. Capsular fruit releases subspherical seeds of 4-5mm which spread by contamination; May - Sept. Both a native form and European introductions exist in this area. Micro.

Cornaceae

1. Cornus florida L. Flowering Dogwood. Small tree to 15m. Frequent; found on edges of woods adjacent to roads,

on older secondary roads, and planted as an ornamental on roadsides. Fruits are fleshy fusiform drupes to 18mm long, dispersed internally by animals; April - May. Native. Sarco.

Cupressaceae

1. <u>Juniperus</u> <u>virginiana</u> L. Eastern Redcedar. Scale-leaved evergreen, columnar to pyramidal tree to 20m. Common tree of old fields and old roadsides, usually on dry open grassy slopes. Young trees are particularly abundant along fence rows. Cones are glaucous, blue, globose, berry-like structures to 7mm in diameter, internally dispersed by birds; Oct. - Nov. Native; grown in Europe for lumber. Sarco.

Cyperaceae

1. <u>Carex</u> <u>cephalophora</u> Schkuhr. Sedge. Perennial to 6dm. Frequent, but never very abundant; found on dry approaches and slopes of open roadsides. Tolerant of mowing and spraying. Achenes elliptic, to 1.8mm long, without significant appendages; May - July. Native. Micro.

2. <u>Carex</u> <u>hystricina</u> Muhl. Sedge. Cespitose perennial

to 1m. Infrequent; found only in ditches with standing water. Achenes less than 2mm long, without significant appendages; May - July. Native; at southern limit of range. Micro.

3. Cyperus strigosus L. Galingale. Perennial to 8dm, with thick rhizome. infrequent; in wet ditches. Achene to 2mm; July - Oct. Native. Micro.

4. Scirpus atrovirens Willd. Bulrush. Cespitose perennial to 1.5m, with short thick rhizome. Similar in other respects to C. strigosus. Native. Micro.

Dipsacaceae

1. Dipsacus sylvestris Hudson. Teasel. Biennial to 2m. Frequent and becoming increasingly common; on open slopes, seemingly without moisture preference. Achenes oblong, to 4mm long, 4-sided, 8-ribbed without appendages, forms a mucilaginous coat; July - Sept. Introduction from Europe may be linked to the plant's use in the woollen industry, otherwise as a contaminant. Micro.

Ericaceae

All species in this family have similar properties. They are not normally considered ruderals. All are native plants usually present in dry woods, but they do quite well on roadsides. Their roadside presence is by virtue of their proximity to the road. This would indicate that these species might be a wise choice for native revegetation of roadsides.

1. Gaylussacia baccata (Wang.) K. Koch. Black Huckleberry. Fruit is an edible berry, to 8mm in diameter; April - June. Native. Sarco.

2. Rhododendron calendulaceum (Michx.) Torr. Flame Azalea. Shrub to 4m. Fruit is a capsule. Seeds are the dispersal unit; they are fusiform to 4.5mm long, without appendages; May - July. This showy shrub is planted as an ornamental. Native. Micro.

3. Rhododendron nudiflorum (L.) Torr. Wild azalea; Honeysuckle. Similar to R. calendulaceum. April - May. Native. Micro.

4. Vaccinium stamineum L. Squaw-Huckleberry. Shrub to 4m. Fruit is a berry 1.5cm long; April - June. Native. Sarco.

Equisetaceae

1. Equisetum arvense L. Field Horsetail. Annual with dimorpic (sterile/fertile) stems. Infrequent on the roadside, present on moist and flooded soil. Dispersed by spores; Mar. - April. Native. Sporo.

Euphorbiaceae

All members of this family are herbs with capsular friuits which release seeds which are generally pitted spheres of less than 3mm in diameter. Seeds are spread by contamination.

1. Euphorbia corollata L. Flowering Spurge. Rhizomatous perennial to 2dm. Infrequent on roadsides, found on sites adjacent to old fields and pastures; May - Sept. Native. Micro.

2. Euphorbia cyparissias L. Cypress Purge. Rhizomatous perennial to 3dm. Infrequent and scattered; an escape of gardens preferring grassy mowed slopes of secondary highways; Mar. - May. Introduced from Europe; Probably becoming more common in the future. Micro.

3. Euphorbia dentata Michx. Toothed Spurge. Annual to 3dm. Rare, found on dry open slopes with poor, rocky soil. July - Oct. Only recently introduced to this area from further south and west; It's range has spread as recently as 1969 to southern New England. Native. Micro.

4. Euphorbia maculata L. Spotted Spurge. Annual to 6dm, but usually less than 2m on the roadside. One of the most common native species. Present in zone A and other areas where soil is drastically disturbed. May - Oct. Native. Micro.

5. Euphorbia supina Raf. Prostrate Spurge. Almost identical to E. maculata, but prostrate; probably and adaption to treading. Infrequent, occuring in areas where there is frequent treading along with Polygonum aviculare and Plantago major. May - Nov. Native. Micro.

Fabaceae

1. Cassia nicititans L. Wild Sensitive Plant. Shrub-like annual to 5dm. Infrequent, on dry open slopes. Legumes to 4cm long with rapid dehiscence which expels seeds up to a few meters; June - Oct. Native. Ballo.

2. Coronilla varia L. Crown Vetch. Perennial herb with decumbent stems to 5dm. Frequent; planted by highway department on steep roadcuts for erosion control, usually forming large uninterrupted populations. Legumes 1.5-5.5cm long with 3-7 disarticulating 1-seeded segments, spreads very little by its own dispersal; June - Sept. Introduced from Europe. Micro.

3. Desmodium obtusum (Willd.) DC. Tick-Trefoil. Similar to D. perplexum in all respects. July - Sept. Native. Desmo.

4. Desmodium perplexum Schub. Tick-Trefoil. Erect perennial herb to 1.5m. Infrequent, found on dry open slopes or interstates beyond mowed areas. Fruit is a loment of 2-4 sections. Surface of loment is covered with minute hooks which readily attach to clothing; July - Sept. Native. Desmo.

5. Lathyrus latifolius L. Sweet Pea. Climbing or trailing rhizomatous perennial herb. Local and scattered on slopes and fence rows. Legumes cylindrical, 10cm long, 8mm in diameter, explosively dehiscent when jarred, throwing seeds a few to several meters; May - Sept. Native to Europe; Escaped from cultivation in this area, becoming more common.

Ballo.

6. *Lespedeza cuneata* (Dumont) G. Don. Sericea. Perennial herb to 1.5m. Infrequent, planted on steep slopes by highway department for erosion control. Fruit an inconspicuous legume 3mm long. Not readily spread by its own devices; July - Sept. Introduced from Eastern Asia. Micro.

7. *Medicago lupulinia* L. Black Medic. Prostrate annual, usually occurring with *Trifolium campestre*. Common, found on approach and other areas where treading occurs. Fruit is a small curled legume 3mm long that does not readily dehisce but has glandular trichomes; probably dependent on treading action for spread of seed; April - Aug. Introduced from Europe. Micro.

8. *Medicago sativa* L. Alfalfa. Perennial to 1m. Infrequent, existing as a cultivated escape. Fruits and dispersal similar to *M. lupulinia* April - July. Introduced from Europe. Micro.

9. *Melilotus alba* Desr. White Sweet Clover. Annual to 8dm. Frequent; on dry open slopes, Indifferent to mowing because of long flowering time. Tends to be present at

sites with considerable disturbance; almost always occurring with _M_. _officinalis_. Legumes to 4mm long spreading by chance; April - Oct. Native to Europe. Micro.

10. _Melilotus_ _officinalis_ (L.) Lam. Yellow Sweet Clover. Biennial to 2m, but rarely over 1m. Common; similar to _M_. _alba_ in other features; April - Oct. Native to Europe. Micro.

11. _Robinia_ _pseudo-acacia_ L. Black Locust. Large tree, but usually less than 5m on roadsides. The most common native woody species on roadsides, it can be found under any environmental regime. Legume up to 10cm by 1cm, disperses well in wind or can release seeds which qualify as microsclerochore. Seeds reputed to remain dormant and viable close to 100 years in soil; April - June. Native; At one time it was planted as an ornamental, but now that practice is avoided because of its nasty thorns and recent problems with pathogens. Micro.

12. _Trifolium_ _arvense_ L. Rabbit Foot Clover. Annual to 3dm. Occasional; on both approaches and slopes of dry open sites. Dispersal unit includes legume surrounded and exceeded by calyx tube; Calyx lobes are densely villous, but not enough to accomodate wind dispersal or attachment; May -

Sept. Native of Europe and North Africa. Micro.

13. Trifolium campestre Schreber. Low hop clover. Decumbent annual to 2dm. Common; phenotypically similar to and commonly occurring with M. lupulinia. One-seeded legumes to 3mm long, dispersed by contamination; April - Oct. Native to Europe. Micro.

14. Trifolium pratense L. Red Clover. Decumbent perennial herb to 5dm. Frequent; on all but the most shaded roadsides. Often planted for cover and fallowed fields. Legume similar to T. Campestre April - Sept. Introduced from Europe now common throughout (to the point of being adopted as the state flower of Vermont). Micro.

15. Trifolium repens L. White Clover. Perennial herb rarely over 1dm tall, with creeping stems. Common to shoulders and slopes that are frequently mowed. Legumes of 3-4 seeds are 5mm in length, being haphazardly dispersed; April - Oct. Native to Europe. Micro.

16. Vicia americana Muhl. American Vetch. Trailing or climbing perennial to 1m. Uncommon, but probably will become more common with its continued eastward migration. Habitat varies widely from moist woods to railroad beds.

This plant has the potential to exist on any type of roadside if the opportunity arises. Dehiscent legumes explosively release seeds; May - June. Native; this area is presently its eastern most extent. Micro.

Gentianaceae

1. <u>Gentiana</u> <u>quinquefolia</u> L. var. <u>Quinquefolia</u>. Annual to 4dm. Uncommon; found on older road banks of secondary roads through moist woods. Dispersal by microsclerochorous seeds; Aug. - Oct. Native. Micro.

Geraniaceae

1. <u>Geranium</u> <u>carolinianum</u> L. Carolina Cranesbill. Annual to 6dm. Infrequent; found on dry open sterile sites. d Well adapted to the most disturbed sites, which seem to be its only habitat. Fruit is a schizocarp; May - Aug. Native. Micro.

2. <u>Geranium</u> <u>maculatum</u> L. Spotted Cranesbill. Rhizomatous perennial to 5dm. Infrequent; considered a woodland plant, It is found on older secondary road banks through forested areas. Fruit is a small schizocarp; April - June. Native. Micro.

3. *Geranium molle* L. Dovesfoot Cranesbill. Similar to *G. carolinianum*. April - July. Native to Eurasia. Micro.

Hamamelidaceae

1. *Hamamelis virginiana* L. Witch-Hazel. Small tree to 5m. Infrequent; growing on edge of woodlands and on older roadbanks of secondary roads. Capsular fruits explosively dehisce, expelling smooth elliptical seeds 8mm in diameter several meters; Oct. - Nov. Native. Micro.

Hydrophyllaceae

1. *Hydrophyllum virginianum* L. Water-Leaf. Perennial herb to 6dm. Rare on roadsides; on moist soils through rich woods on mountain secondary roads. Not what one would normally consider a ruderal. Capsular fruit releases smooth globose seeds 3mm in diameter. April - June. Native. Micro.

Hypericaceae

1. *Hypericum perforatum* L. St. John's Wort. Perennial herb to 8dm. Occasional; on open slopes near farmland and old fields. Casular fruits dehisce dispersing light seeds

less than 1mm long that can be carried by a breeze; June - Sept. Introduced from Europe, probably as a contaminant. Micro.

2. Hypericum punctatum Lam. St. John's Wort. Almost identical to H. perforatum but more widespread; June - Sept. Native. Micro.

Juglandaceae

1. Carya cordiformis (Wang.) K. Koch. Bitternut Hickory. Large tree, but on roadsides never exceding 10m. Rare on roadsides; only found on older road banks of secondary roads. Fruit is a globose drupe 3cm long; nuts drop in early fall; April. Native. Baro.

Lamiaceae

The representatives of this family have several common characteristics used in their classification as ruderals. Their growth habit is that of perennial herbs. All fruits are schizocarps which contain 4 mericaps (nutlets) that are unspecialized with respect to dispersal and therefore qualify as microsclerochores. None of these species are particularly common on the roadside. Many have the common history of being European garden species that either came to this country by chance or were brought over to be cultivated and subsequently escaped.

1. Glecoma hederacea L. Ground Ivy. Spreading stems to 4dm, rooting at nodes. Most common species of the family. On sites with moist areas that are periodically mowed, but not sprayed. Mar. - June. Native to Europe. Micro.

2. Isanthus brachiatus (L.) BSP. False Pennyroyal. Stems to 4dm. Infrequent; on very dry sparsely vegetated slopes. Aug. - Sept. Native. Micro.

3. Lamium amplexicaule L. Henbit. Annual to 4dm, but usually about 1dm. Infrequent, but abundant when present; in moist disturbed soil; Mar. - Nov. with most flowering early in the season. Native to Europe. Micro.

4. Lycopus americanus Barton. Water Horehound. Usually less than 3dm tall on roadsides. Infrequent; on moist open sites near ditches with standing water; vegetatively reproduces by stolons. June- Sept. Native. Micro.

5. Marrubium vulgare L. Common Horehound. Taprooted perennial to 1m, usually less than 5dm. Infrequent; on dry

soils on roads through old fields or pasture. June - Aug. Naturalized in Europe as a flavoring agent. Micro.

6. _Mentha_ _spicata_ L. Spearmint. Usually less than 3dm on roadsides. Uncommon; on secondary roadsides in moist ditches. June - Nov. Native of Europe, an escape from cultivation as a flavoring agent. Micro.

7. _Monarda_ _fistulosa_ L. Wild Bergamot. Perennial herb to 1.2m. Frequent; on roadside slopes through dry wooded areas. June - Sept. Formerly cultivated, now an escape; Native. Micro.

8. _Nepeta_ _cataria_ L. Catnip. Perennial with stems less than 1m long. Infrequent; on open slopes with severe soil disruption. June - Aug. Garden escape, introduced from Europe. Micro.

9. _Prunella_ _vulgaris_ L. Heal-All. Perennial herb to 5dm. Frequent; can be found anywhere, especially on moist shaded slopes. April - Nov. Origin somewhat in question; may be native, but introductions from Europe have made it much more common. Micro.

10. _Saturega_ _calamintha_ var. _nepta_ (L.) Briquet.

Basil-Thyme. Perennial herb to 6dm. Infrequent; on secondary roads that pass next to pasture and abandoned fields. July - Oct. Native to Europe. Micro.

11. Saturega vulgaris (L.) Fritsch. Field Basil. Perennial herb to 6dm. Uncommon on roadsides; June - Sept. A cultivated herb here and in Europe, consequently its nativity is questionable, but no doubt introductions have taken place. Micro.

12. Scutellaria leonardii Epling. Shale Skullcap. Stems to 2dm. Rare; on dry rocky banks by old fields and pastures. April - May. Native. Micro.

13. Teucrium canadense L. American Germander. Rhizomatous herb to 1m, but usually less than 5dm. Infrequent; on open sites in ditches. June - Aug. Native. Micro.

Lauraceae

1. Sassafras albidum (Nutt.) Nees. Sassafras. Small tree or shrub usually less than 5m. Frequent; usually on roads through moist woodlands or banks of old secondary roads. Fruit is an elliptical drupe that is bird dispersed;

Mar. - April. A native, early successional, and understory tree species. Sarco.

Liliaceae

1. Allium cernuum Roemer. Wild Onion. Bulbous scapose perennial to 6dm. Infrequent; on road cuts through wooded areas that have been thoroughly disturbed without attempts at revegetation. Reproduces by small seeds, without appendages, released from a capsular fruit; July - Sept. Native. Micro.

2. Allium vineale L. Field Garlic. Similar to A. cernuum, but much more common and usually in more open habitats. Reproduction commonly by bulbils; June. Native to Europe. Micro.

3. Asparagus officinalis L. Asparagus. Rhizomatous perennial herb to 2m. Frequent; on roadsides especially by old fields. Fruit is a globose berry 1cm in diameter; April - Aug. Native to Europe; A very successful cultivated escape in this area. Sarco.

4. Trillium grandiflorum (Michx.) Salsb. Large-Flowered Trillium. Rhizomatous perennial herb to 5dm. Rare

on roadsides; present only by virtue of road's proximity to woods without the usual perturbation. Berry is ovoid to 1.5cm in diameter, dispersed by ants, elaiosomes present; April - May. Commonly known as a native spring wildflower of rich woods. Sarco.

Lobeliaceae

1. Lobelia inflata L. Indian Tobacco. Annual to 1m. Rare; on dry high elevation sites. Apically dehiscent capsules release 1mm long seeds. July - Oct; Native. Micro.

2. Lobelia siphilitica L. Great Lobellia. Perebbial herb to 1.8m, but rarely over 1m on roadsides. Infrequent; on opem moist roadsides near ditches. Dispersal similar to L. inflata July - Oct. Native. Micro.

Magnoliaceae

1. Liriodendron Tulipifera L. Tulip Tree. Large rapidly growing deciduous tree to 50m. Frequent; on any type of road bank without spraying or mowing. Usually removed before maturity except along fence rows where older specimens may persist. Fruits are an aggregate of samaras which resemble sled runners and are particularly well

adapted to sliding down roads in the vacuum created by passing cars; April - June. dispersed fall through early spring. Native. Ptero.

2. Magnolia acuminata L. Cucumber Tree. Large deciduous tree to 40m. Rare on roadsides; will invade moist disturbed soil, but will not persist. Fruit is an aggregate of follicles releasing lens-shaped seeds of 1cm in diameter; April - May. Native. Micro.

Malvaceae

1. Abutilon theophrastii Medic. Velvet Leaf. Annual herb to 1.5m. Infrequent; found only in the most disturbed sites with soil mixing, especially on dry open roadsides. Dispersed by seeds which are released from a fruit of united carpels that are dehiscent; June - Oct. Native to India. Micro.

Moraceae

1. Morus Rubra L. Red Mulberry. Small tree of woodlands to 20m rarely over 5m on roadsides. Rare on roadsides; found on steep open slopes in moist soil. Fruit is a spike of nutlets with fleshy persistant calyces. Eaten

and dispersed by birds; May - June. Might be considered a forest escape; Native. Sarco.

Oleaceae

1. Fraxinus pennsylvanica Marsh. Green Ash. Large deciduous tree, but rarely over 5m on roadsides. Frequent; present on roads adjacent to woodlands as well as open, more disturbed sites. Samaras dispersed throughout fall, winter, and early spring. Fairly well adapted to dispersal through air as well as over roads; April. Native. Ptero.

Onagraceae

1. Gaura biennis L. Gaura. Annual to 1.5m. Infrequent; on moist open slopes and in ditches. Resistant to cutting, but not spraying. Capsular fruit releases seeds that are 2mm long; June - Oct. Native. Micro.

2. Oenothera biennis L. Common Evening Primrose. Biennial or perennial herb to 2.5m. Occasional; on moist to dry slopes out of the range of mowing and spraying operations. Capsule releases angular seeds of 2mm upon jarring. Seeds reputedly eaten by birds; June - Oct. Native. Micro.

Orchidaceae

1. Spiranthes gracilis (Bigelow) Beck. Slender Ladies' Tresses. Perennial herb to 5dm. Occasional; on dry open slopes of interstates and primary highways, usually mixed in with a monoculture of Festuca elatior. Seeds borne on air currents; July - Sept. Native. Sporo.

Oxalidaceae

1. Oxalis corniculata L. Creeping Lady's Sorrel. Perennial stoloniferous herb rarely over 1dm. Infrequent; can be found on any roadside, especially those with regular mowing. Capsular fruit explosively dehisces releasing elliptical seed slightly more than 1mm long; April - Oct. flowers year-round. Native to Europe. Ballo.

2. Oxalis stricta L. Yellow Wood Sorrel. Perennial herb to 3dm. Similar to O. Corniculata except not stoloniferous and much more common; April - Oct. Thought to be native, but questionable; cosmopolitan. Ballo.

Papaveraceae

1. Papaver dubium L. Poppy. Annual to 5dm. Occasional;

on slopes of drier open grass sites. Capsule apically dehisces to release minute seeds 0.25mm in diameter, which are carried by wind or become contaminants; April - June. Introduced from Europe as a garden ornamental, now escaped; probably becoming more common in the future. Sporo.

2. Sanguinaria canadensis L. Bloodroot. Rhizomatous perennial herb to 3dm. Infrequent on roadsides; on older wooded moist road banks of secondary roads. Casular fruit disperses ellipsoid seeds of 3mm in diameter; Mar. - April. A native spring wildflower. Micro.

Phrymaceae

1. Phryma leptostachya L. Lopseed. Perennial herb to 1m. Rare; found on slopes of mountain roads through moist woods. Fruit dispersed and enclosed in persistant caylx with hooked lobes, which do not serve as attachment appendages; June - Aug. Native. Micro.

Phytolaccaceae

1. Phytolacca americana L. Pokeweed. Perennial herb to 3m. Frequent; usually on fence rows adjacent to cultivated fields. Berries dispersed by birds; May - Nov. Native.

Sarco.

Pinaceae

1. Pinus virginiana Mill. Virginia Pine. Large evergreen tree usually less than 5m high on roadsides. Frequent; planted for revegetation as well as a natural invader of roadsides. Cones under hygroscopic control, releasing winged seeds in dry weather throughout late summer and fall; April. A native early successional tree species. Ptero.

Plantaginaceae

Several characteristics unite members of this family ecologically. They have a similar growth habit of rosettes with erect spike inflorescences, which makes them particularly well adapted to treading and mowing. Capsular fruits release seeds ranging from 1-3mm long, all in dispersal by treading. All species are found in zone A of roadsides and only occasionally on slopes.

1. Plantago aristata Michx. Bracted Plantain. Annual to 15cm. Infrequent; but widespread. April - July. Native. Micro.

2. Plantago lanceolata L. English Plantain. Annual to 3dm. Common. Mar. - Nov. Native to Europe. Micro.

3. Plantago rugellii DCNE. Common Plantain. Perennial to 15cm. Most common species in this family. April - Nov. Native. Micro.

4. Plantago virginiana L. Dwarf Plantain. Annual to 15cm. Occasional. Mar. - June. Native. Micro.

Poaceae

1. Agropyron repens (L.) Beauv. Quack Grass. Rhizomatous perennial to 1m, but usually less than 5dm. Frequent; on shoulders and other areas where treading or blading may occur, only occasionally on slopes. Grains 7mm long with lemma awns 10mm long. Awn apparently serves no purpose in dispersal; June - Aug. Nativity somewhat confusing; our specimens are introductions from Europe, but it is a possible native of the North Atlantic coast. Micro.

2. Andropogon virginicus L. Broom Sedge. Tufted perennial to 1.5m. Frequent; on sites near old fields or more recently constructed roadsides. An early successional species of old fields. Will persist on older dry open

roadsides in small populations. Spikelet to 8mm with pilose callus beard over 10mm long, very effective as wind dispersal mechanism; Sept. - Oct. Fruits dispering throughout the year. Native. Pogon.

3. Arrhenatherum elatius (L.) Presl. Oat Grass. Tufted perennial to 15dm. Infrequent; on open dry slopes. Spikelet to 9mm long with twisted awn; may serve to help in establishment by drilling action when moistened. May - June. Native to Europe. Micro.

Bromus - Members of this genus are annuals except for B. inermis. All species are introductions from Europe. Fruits are microsclerochores. All are awned except for B. inermus, but awns do not seem to functional in dispersal.

4. Bromus commutatus Schrad. Hairy Chess. Annual to 9dm, but usually less than 6dm. Frequent in zone A of open sites. May - June. Introduced from Europe. Micro.

5. Bromus inermis Leysser. Smooth Brome Grass. Perennial to 1m. Occasional; on open sunny slopes. May - July. Native to Europe. Micro.

6. Bromus japonicus Thunb. Japanese Brome Grass.

Similar to _B_. _commutatus_. Frequent; in more disturbed zones of open or shaded sites. May - June. Native to the Old World. Micro.

7. _Bromus sterilis_ L. Brome Grass. Rare; on open sites. May - June. Native to Europe. Micro.

8. _Bromus tectorum_ L. Downy Chess. Annual to 6dm. Occasional; on open sunny slopes. April - June. Native to Europe. Micro.

9. _Chloris verticillata_ Nutt. Windmill Grass. Tufted perennial to 4 dm. Rare; on dry approaches and shoulders of interstates. Grains to 3mm long with awns of 8mm; June. Native, introduced into this area from further west. Micro.

10. _Cynodon dactylon_ L. Pers. Bermuda Grass. Creeping and rhizomatous perennial to 4dm. Frequent; in areas of treading and maximum maintenance, often invading paved areas. Grains to 2mm long; May - Aug. Native to Europe. Micro.

11. _Dactylis glomerata_ L. Orchard Grass. Tufted perennials to 1.2m. Common; frequently planted for revegetation of roadsides with _Festuca elatior_. Grains to

8mm long with short awn; May - Oct. Native to Europe. Micro.

12. Echinochloa crusgalli (L.) Beauv. Barnyard Grass. Robust annual to 2m. Frequent; in moist ditches. Fruit ovate, to 3mm long; July - Oct. Native to Europe. Micro.

13. Elusine indica (L.) Gaertn. Yard Grass. Prostrate to partially erect annual to 5dm. Frequent; in zone A and treaded areas. Rigid yet springy stems can catapult fruits up to a few feet by rain or treading action; June - Oct. Native to India, pantropical. Micro.

14. Elymus virginicus L. Wild Rye. Tufted perennial to 1.3m. Occasional; on newer roadsides or where soil is mixed. Fruit with awn of variable length; June - Oct. Native. Micro.

15. Eragrostis cilianensis (All.) Lutati. Stink Grass. Cespitose or solitary annual to 6dm. Infrequent; on recently disrupted soil. Fruit less than 2mm long, without appendages; July - Oct. Native to Europe. Micro.

16. Festuca elatior L. Meadow Fescue. Cespitose perennial to 1.5m. The most common plant of roadsides;

planted on all but the steepest slopes for revegetation on interstates, most primary, and some secondary highways. Fruit with short awn; June - Aug. Native to Europe. Micro.

17. Hystrix patula Moench. Bottle-Brush Grass. Perennial to 1.5m. Rare; a forest ecotone species. Fruits with long awns; May - July. Micro.

Panicum - Species of this genus are extremely difficult to identify. Dispersal is accomplished by the entire loose voluminous panicle breaking off. Its light weight and orbicular shape allow for easy overland rolling cyclochores. All species are native.

18. Panicum agrostiodes Spreng. Redtop Panic Grass. Rhizomatous perennial to 1m. Uncommon; in ditches. July - Oct. Native. Cyclo.

19. Panicum capillare L. Old Witch Grass. Annual to 6dm. Occasional; in zones closest to the road surface. Aug. - Oct. Native. Cyclo.

20. Panicum oligosanthes Shultes. Panic Grass. Perennial to 5dm. Uncommon; in moist ditches. April - June. Native. Cyclo.

21. *Panicum philadelphicum* Trin. Wood Witch Grass. Annual to 8dm. Uncommon; on open slopes or on approach. Sept. - Oct. Native. Cyclo.

22. *Paspalum pubiflorum* Rupr. Similar to *P. setaceum*, but found in moist shaded ditches. Sept. - Oct. Native. Micro.

23. *Paspalum setaceum* Michx. Cespitose perennial to 8dm. Infrequent but widespread; on dry open roadsides. Fruits are flattened spheres 2mm in diameter. June - Sept. Native. Micro.

24. *Phleum pratense* L. Timothy. Cespitose perennial to 1m. Frequent in zone A; on dry open slopes. Fruits to 2mm long with short awn; June - Oct. Native to Europe. Micro.

25. *Poa pratensis* L. Kentucky Bluegrass. Cespitose perennial to 1m, but rarely over 5dm. Excellent choice for revegetation of roadsides because of low height and fiberous roots. Often mixed with *Festuca elatior* for revegetation of roadsides. Fruits to 2mm long; April - Aug. Native. Micro.

26. *Setaria faberi* W. Herrmann. Giant Foxtail. Cespitose annual to 1.3m. Frequent; on approaches and

disturbed open slopes. Fruit has bristles that do not aid in dispersal; July - Oct. Native to China. Micro.

27. Setaria glauca (L.) Beauv. Smooth Foxtail. Common; similar to S. faberi, but only grows to height of 1m; July - Oct. Native to Europe. Micro.

28. Setaria viridis (L.) Beauv. Green Foxtail. Similar to S. faberi, but less frequentand only grows to a height of 8dm. July - Oct. Native to Eurasia. Micro.

29. Sorghum halepense (L.) Pers. Johnson Grass. Rhizomatous perennial to 1.5m, forming large tufts. Frequent on open slopes with little mowing. Fruit to 5mm long with or without twisted awn, May - Oct. Native to Mediterranean region, introduced as a forage crop in mid-nineteenth century. Micro.

30. Tridens flavus (L.) Hitchc. Purple Top. Rhizomatous perennial to 1.5m. Similar to Sorghum halepense, but fruits smaller and awnless; July - Oct. Native. Micro.

Polygonaceae

1. Polygonum aviculare L. Knotweed. Prostrate annual spreading to form a thin mat of vegetation over barren ground. Common; found on approach adjacent to pavement on all road types. Extremely resistant to treading, Often the only plant in the most disturbed zones of the roadside. Achenes without appendages, about 2mm long, eaten by birds; Mar. - Nov. Native, but repeated introductions from Europe have increased its frequency. Micro.

2. Polygonum convolulus L. Black Bindweed. Annual vine. Frequent; usually climbing on fences or on woody vegetation, rarely trailing. Achene smooth, about 3mm long, June - Sept. Native to Eurasia. Micro.

3. Polygonum persicaria L. Lady's Thumb. Decumbent annual to 6dm. Frequent; in moist ditches except on primary and secondary highways. Achenes to 2.5mm long without appendages; June - Oct. Native to Europe. Micro.

4. Polygonum pensylvanicum L. Pennsylvania Smartweed. Similar to P. persicaria. May - Oct. Native. Micro.

5. Rumex acetosella L. Sheep Sorrel. Perennial herb to 4dm. Frequent; on recently disrupted soils where treading is minimal. Indicator of acid soils. Achenes to 1.5mm

long; Mar. - Nov. Native to Eurasia. Micro.

6. *Rumex crispus* L. Curly Dock. Biennial or perennial herb to 1.5m. Common; on newer roadsides, recently or constantly disturbed soil. Achenes to 3mm long, with persistant caylx that provides 3 wing-like appendages to enhance wind dispersal, but fruit remains small enough to be an inconspicuous contaminant; Mar. - June. Fruits disperse well into fall. One of the most prolific of all ruderals, a single plant can produce up to 250,000 fruits. Native to Europe. Ptero.

7. *Rumex obtusifolius* L. Broadleaf Dock. Similar to *R. crispus*, but flowering somewhat later; April - June. Native to Europe. Ptero.

Primulaceae

1. *Anagallis arvensis* L. Scarlet Pimpernel. Spreading annual to less than 1dm. Infrequent; on shoulders or semi-barren areas as a solitary plant. Dispersed by seeds 1.5mm long from capsular fruit; April - Nov. Native to Europe. Micro.

Ranunculaceae

1. Anemone virginiana L. Thimble Weed. Rhizomatous perennial herb to 1m, but usually about 5dm. Occasional; on old moist wooded secondary road banks. Achenes to 3mm long, with a dense woolly covering that does not aid in attachment; May - July. Native. Micro.

2. Aquilegia canadensis L. Columbine. Perennial herb to 5dm. Infrequent; on dry rocky road cuts through wooded areas. Fruit is a follicle; dispersed by smooth lusterous black ellipsoidal seeds to 2mm long; April - June. Native. Micro.

3. Clematis virginiana L. Virgin's Bower. Climbing or occasionally trailing perennial herb. Infrequent; on old wooded secondary road banks. Achene 4mm long, develops elongated plumose style to 4cm long, which does not seem to aid in either wind dispersal or attachment. July - Sept. Native. Micro.

4. Hepatica americana (DC.) Ker. Roundlobe Hepatica. Perennial herbs to 3dm. Infrequent; habitat similar to Thalictrum thalictroides. Achenes to 3.5mm long, with villose covering that does not serve to attach; Mar. - May. Native. Micro.

5. Ranunculus abortivus L. Kidneyleaf Crowfoot. Annual herbs to 5dm. Occasional; on moist shaded sites. Achene disk-like, 2mm long, with curved beak almost to the point of being a hook but not serving to attach; April - June. Native. Micro.

6. Ranunculus allegheniensis Britt. Allegheny Crowfoot. Similar to R. abortivus, but rare, April - June. Native. Micro.

7. Ranunculus bulbosus L. Bulbous Buttercut. Bulbous perennial to 5dm. Common; on highly maintained slopes and occasionally on shoulders. Achene ovate, to 3.5mm long, with small beak; April - July. Native to Europe. Micro.

8. Ranunculus recurvatus Poir. Hooked Crowfoot. Perennial herb to 6dm. Rare; habitat similar to Thalictrum thalictroides. Fruit like R. abortivus ; April - June. Native. Micro.

9. Ranunculus repens L. Creeping Buttercup. Creeping perennial herb forming mat-like colonies. Infrequent; in moist ditches in open or shaded habitats. Achene ovate, to 2.5mm long, with non-functional hooked beak; April - July. Native to Europe. Micro.

10. Thalictrum thalictroides (L.) Boivin. Rue-Anemone. Tuberous perennial herb to 2.5dm. Rare; commonly considered a spring wildflower of rich woods, present on roadsides only because of the road's proximity to undisturbed woods. Achenes are smooth, ribbed, ellipsoid, 4mm long; Mar. - June. Native. Micro.

Rosaceae

1. Agrimonia parviflora Ait. Small-Flowered Agrimony. Perennial herb to 1.8m, but rarely over 1m on roadsides. Rare; on sites that are periodically flooded by nearby streams. Achene to 5mm in diameter, covered with several rows of hooks which serve well for attachment to cloth or fur; July - Sept. Native. Desmo.

2. Fragaria virginiana Duchesne. Strawberry. Prostrate to decumbent stoloniferous perennial herbs to 15cm. Occasional; on open slopes near old fields and pastures. Accessory fruit with large fleshy receptacle covered with seeds. Dispersed endozoochorously; Mar. - June. Native. Cultivated in Europe. Many varieties, both cultivated escapes and wild, complicate infraspecific taxonomy. Sarco.

3. Geum canadense Jacq. White Avens. Perennial

rhizomatous herbs to 1m. Infrequent; ecotone species of moist woods. Achenes to 3mm long with long hooked beak marginally adapted for attachment; May - Aug. Native. Desmo.

4. Potentilla recta L. Upright Cinquefoil. Erect perennial herb to 8dm. Frequent; a true ruderal, doing best in dry open regularly disturbed sites, usually on slopes. Achene orbicular, slightly longer than 1mm; Mar. - Aug. Native to Europe. Micro.

5. Potentilla simplex Michx. Common Cinquefoil. Prostrate to decumbent perennial herb to 15cm. Occasional; on open or shaded shoulders of primary and secondary roads; Resistant to treading and mowing if not too severe. Suborbicular achenes slightly longer than 1mm, without appendages; April - June. Native. Micro.

6. Prunus serotina Ehrh. Black Cherry. Moderate sized deciduous tree to 30m. Frequent; on slopes of primary and secondary roads especially along fence rows; occasionally on interstates along fence rows. Drupe to 1cm in diameter, eaten and dispersed by birds; April - May. Native; a forest tree species that is particularly well suited for dispersal to and survival in the roadside habitat. Grown in Europe as a timber species where it has become locally naturalized.

Desmo.

7. Rosa carolina L. Pasture Rose. Erect rhizomatous perennial to 1m. Infrequent; in and about ditches where they are skipped by mowing on primary and secondary roads. Achenes oblong, to 4mm long, contained in hypanthium until it drys and cracks open or is upturned by an outside force; May - July. Native. Micro.

8. Rosa multiflora Thunb. Rambler Rose. Arching or erect shrub to 2m. Infrequent, but overabundant to the point of being a pernicious weed; on dry open slopes especially fence rows. Fruits similar to R. carolina but slightly smaller; May - June. Introduced from the orient as an ornamental that provides habitats for wildlife; Now outlawed in some states. Micro.

Rubus - Blackberries and Raspberries. This genus contains trailing or arching woody perennial shrubs. They are found on all roadsides outside of mowing and spraying, zones usually on fence rows but frequently on the ground, especially next to old fields or pastures. Fruits are an aggregate of drupes ca. 2cm in diameter that are readily edible by mammals and birds. Quite often more than one species of this genus exists at one locality.

9. _Rubus allegheniensis_ Porter. Allegheny Blackberry. Arching to 3m. Frequent; forms large colonies to 3m high. May - June. Native. Sarco.

10. _Rubus betulifolius_ Small. Blackberry. Arching, erect to 2m. Infrequent. May - June. Native. Sarco.

11. _Rubus cuneifolius_ Pursh. Blackberry. Arching or erect to 1.6m. Rare. May - June. Native. Sarco.

12. _Rubus flagellaris_ Willd. Northern Dewberry. Infrequent; Similar to _R. cuneifolius_. May - June. Native. Sarco.

13. _Rubus occidentalis_ L. Black Raspberry. Forms small low colonies. Occasional. May - June. Native. Sarco.

14. _Rubus trivialis_ Michx. Southern Dewberry. Rare. Trailing, forming low colonies. Mar. - April. Native. Sarco.

Rubiaceae

1. _Galium aparine_ L. Spring Bedstraw. Sprawling annual with stems to 8dm long. Common; on moist open or shaded slopes. Spherical fruit 3mm in diameter is covered with

numerous hooked trichomes that serve for attachment very well; April - June. Native; circumpolar in temperate latitudes. Desmo.

2. Galium mollugo L. White Bedstraw. Perennial herb. Infrequent; similar to G. aparine, but fruits without hooks; April - June. Native to Europe. Micro.

3. Galium triflorum Michx. Sweet-Scented Bedstraw. Infrequent; similar to G. aparine, but a perennial; May - Sept. Native. Desmo.

4. Houstonia longifolia Gaerthn. Long-Leaved Summer Bluets. Perennial herb to 2.5dm. Infrequent; on dry open rocky roadcuts with little or no maintenance. Capsular fruits release seeds 2mm in diameter; June - Aug. Native. Micro.

Scrophulariaceae

1. Pedicularis canadensis L. Common Lousewort. Perennial herbs to 4dm. Uncommon; ecotone species of woodlands. Capsule releases seeds 2mm long, when jarred by external force; April - June. Native. Micro.

2. Verbascum blattaria L. Moth Mullein. Perennial herb to 1.5m, exhibits miniaturization to 1.5dm. Frequent; on dry open slopes and shoulders, occasionally growing through cracks in pavement. Globose capsule 8mm in diameter releases seeds as capsule deteriorates or is crushed. Adequate shaking of pedicel by wind is required to shake seeds from capsule. With the wind strength insured seeds will be carried some distance; May - Nov. Native to Eurasia. Micro.

3. Verbascum thapsus L. Common Mullein. Biennial herb with spike rising to over 2m. Frequent; found on dry open slopes. Dispersal mechanism similar to V. blattaria. This mechanism provides a long period of time for seeds to be broadcast (throughout the winter); May - Oct. Native to Eurasia. Micro.

Veronica - Speedwells. Members of this genus are, unless otherwise mentioned, low growing herbs of moist habitats. Fruits are flattened subcordate capsules 4mm long or less, containing seeds of less than 1mm in diameter. Capsules dehisce poorly and are more dependent on deterioration, destruction by treading, or maintenance operations for the release and dispersal of seeds. They are predominantly from Europe and have long periods of flowering.

4. *Veronica arrensis* L. Corn Speedwell. Sprawling annual radiating from taproot. Frequent. April - Sept. Introduced from Europe. Micro.

5. *Veronica anagallis-aquatica* L. Water Speedwell. Short-lived aquatic perennial to 1m, but usually less than 3dm. Rare; present where there is standing water in ditches. May - Aug. Native to Europe. Micro.

6. *Veronica hederaefolia* L. Ivy-Leaved Speedwell. Decumbent annual to 4dm, occasionally rooting at nodes. Infrequent. Mar. - May. Native to Europe. Micro.

7. *Veronica officinalis* L. Common Speedwell. Creeping perennial rooting at nodes, capable of forming mats. Frequent. May - Aug. Native, but also introduced from Europe. Micro.

8. *Veronica peregrina* L. Purslane Speedwell. Erect annual to 3dm. Occasional. April - Oct. Native, spreading westward. Micro.

Simbaroubaceae

1. Ailanthus altissima (Mill.) Swingle. Tree-of-Heaven. Moderate sized deciduous tree to 20m forming large clones by coppice growth. Common tree of roadside; on moist or dry slopes. Dispersed by twisted winged mericarps 4cm by 1cm; well adapted for wind as well as rolling on smooth surfaces; May - June. Naturalized from China, now considered a noxious weed in urban and rural areas. Dispersing seeds throughout summer, fall, and winter. Ptero.

Solanaceae

1. Physalis virginiana Mill. Ground-Cherry. Rhizomatous perennial herb to 3dm. Common; on any site where there is at least a moderate amount of disturbance without spraying. Berry 1cm in diameter, is enclosed in a persistant calyx which does not pose much of an obstacle for voracious browsers. Seeds are dispersed internally; June - Sept. Native. Sarco.

2. Solanum carolinense L. Horse-Nettle. Perennial herb to 6dm with creeping rhizomes, but only occasionally forming clones. Frequent; found in areas of maximum soil disturbance, treading and maintenance. Berries eaten and subsequently dispersed by both birds and mammals. If berries are not eaten they dry, wither, and detoriorate, and

then can spread by contamination; June - Sept. Native. Sarco.

3. Solanum dulcamara L. Bittersweet. Perennial woody climbing vine. Frequent; predominantly growing on fence rows. Red berry 1cm in diameter, endozoochorously dispersed; May - Sept. Native to Europe. Sarco.

Typhaceae

1. Typha latifolia L. Cat-Tail. Rhizomatous perennials to 2m. Occasional; only found in ditches where standing water exists. Achene 1mm long narrowly elliptic, encircled by numerous silky trichomes 1cm long; Extremely effective for wind dispersal; May - July. Native; fruits dispersing throughout the year. Pogon.

Ulmaceae

1. Ulmus pumila Siberian Elm. Similar to U. rubra. Planted by the highway department, a practice now discontinued because of this species' susceptability to ice storm damage. Mar. - April. Native to eastern Asia. Ptero.

2. Ulmus rubra Muhl. Slippery Elm. Moderate-sized

tree, usually immature and less than 5m by the roadside. Occasional; a forest tree that does well on disturbed sites. Only found as an ecotone species or on old moist wooded secondary road banks. Samara 1.5cm in diameter, a wing completely surroundingthe fruit; Dispersing until early summer; Mar. - April. Native. Ptero.

Valerianaceae

1. _Valerianella_ _locusta_ (L.) Betcke. Corn Salad. Annual, to 3dm. Infrequent; on dry rocky open slopes. Dispersal by contamination; April - July. Native to Europe. Micro.

Verbenaceae

1. _Verbena_ _simplex_ Lehm. Vervain. Rhizomatous perennial to 5dm. Uncommon; on slopes with little mowing, no spraying, and rocky soils. Seeds 3mm long, spreading by chance; May - Sept. Native. Micro.

Vitaceae

1. _Parthenocissus_ _quinquefolia_ L. Planchon. Virginia Creeper. Perennial woody vine. Occasional; on roadside

fence rows and on woody vegetation especially on forest edges. Drupes up to 8mm in diameter are probably eaten by birds; May - July. Native. Sarco.

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ECOSYSTEMATIC STUDIES ON ROADSIDE VEGETATION

IN SOUTHWESTERN VIRGINIA

by

Thomas C. Schmaltz

(ABSTRACT)

Thirty-two roadside sites throughout seven counties in Southwestern Virginia were investigated with respect to life form, dispersal type and floristics. A floristic checklist of 274 species, 182 genera and 57 families was compiled. Dispersal mechanism and life form were determined for each species. A statistical analysis was performed (ANOVA and MANOVA) to determine the relationships among life form, dispersal type, and environmental factors (roadtype, elevation, exposure, slope and surrounding vegetation). Frequencies of life form and dispersal type were determined within and among sites. These frequencies were used to establish spectra and zonal distributions of life form and dispersal type.

Natural histories, geographic spread and specific modes of dispersal are discussed in the floristic checklist. Family presence among roadtypes and species presence among sites is examined.

Dispersal type variation was found for the environmental factors of roadtype, surrounding vegetation,

and exposure. Roadtype was the most influential factor. The dispersal types most subject to variation were the wind (pogonochores and pterochores) and animal dispersed (sarcochore and desmochore) groups. Distribution of dispersal types within the site reveals: 1. animal dispersal becomes more important when the distance from the road margin is increased; 2. diaspores that spread by contamination are more frequent near the road margin; 3. wind dispersed species are less frequent near the road margin.

The life form spectrum of roadsides has a greater percentage of therophyte and lesser percentage of phanerophytes than present in the surrounding vegetation. The spectrum shows infrequent variation (statistically significant) due to the environmental factors considered. Life form frequencies within sites show annuals dominating near the road margin with phanerophytes and chamaephytes becoming more frequent and hemicryptophytes becoming dominant as distance from the road margin increases.