IMPACT OF CLEARCUTTING ON INDIGENOUS MAMMALS OF SOUTHWEST VIRGINIA

by

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Thesis submitted to the graduate faculty
of the Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Fisheries and Wildlife
(Wildlife Management)

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February 1976

Blacksburg, Virginia 24061

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to Drs. H. S. Mosby, B. S. McGinnes, and P. F. Scanlon for their patient and helpful assistance as committee members. The suggestions of Drs. Mosby and McGinnes during the initial preparation of this thesis, and Dr. Mosby's bountiful suggestions and extremely constructive criticism are greatly appreciated.

Thanks go to the personnel of the Blacksburg Ranger District, USDA Forest Service in general, and to Mr. Steve Pedigo in particular, for providing the information used in selecting the study areas.

Mr. C. Douglas Goldsmith assisted in the collection of small rodents and insectivores. The assistance of Mr. Samuel Montgomery in the identification of plant specimens, and the preparation of vegetation transects is appreciated.

To the following people who unselfishly gave their time to assist in various parts of this project I give my thanks: Messrs Baumbarger, Ellis, Haufler, Hotvedt, Jones, Ritter, Ruckel, Sanders, Warren, and Woodson; Mesdames Gillikan and Morris; and Mrs. Joyce Sims for her typing of the final manuscript.

A special thanks is given to my parents, Mr. and Mrs. Jerre W. Blymyer, for their encouragement throughout my academic training and for their financial assistance in preparing this manuscript.

Most of all, I would like to thank my wife, Judi, for her loving encouragement, field (and financial) assistance in every aspect of this project, and for the many hours spent typing the rough drafts

of this thesis.

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INTRODUCTION

The timber management plan for the Jefferson National Forest calls for even-aged management that utilizes clearcutting for regeneration (Smith and Woodward 1967). Although clearcutting is a widely used forestry practice its effect on wildlife has had comparatively little study. Since the succession of thousands of acres will be set back to an earlier successional sere by clearcuttings, research is needed to determine what effect this type of environmental disturbance has on the indigenous mammal populations.

Behrend (1972) has pointed out that the literature is filled with generalizations concerning the influence of forestry practices on wildlife, but that most of these generalizations are based on data obtained from plants, not animals. This is especially true in the area of deer habitat. There are dozens of papers on the effects of timber harvest on deer browse, but there are virtually none demonstrating quantitative responses of deer populations to change in the environment produced by cutting (Behrend 1972). Jordan (1967) also noted the lack of quantitative data on the effect of cutting on deer. He felt that the extent to which the habitat is changed has become the means for determining whether deer have benefited from that change.

Even casual observation shows that clearcuts reverse succession. It seems clear that animal populations must change as a result of this habitat manipulation, and that the amount of change that occurs should be related to the extent of the overall change in vegetation.

It is very desirable, therefore, to know what type of successional pattern to expect, and to determine the vegetational and animal components of the various successional seres. Post logging seral history should be studied carefully with regard to its effects upon wildlife habitat factors if silviculturists are to gain information relevant to multiple-use management (Wallmo et al. 1972).

Because of the need for research on silvicultural practices this case-history study was initiated to provide the groundwork for future more intensive studies on the effects of habitat manipulation on the faunal component of the forest resource.

The objectives of the present study were:

1) To assess the impact of clearcutting on the relative abundance of the indigenous mammal populations of the Craig Creek watershed in southwest Virginia.
2) To make an analysis of existing vegetation in selected stages of succession after clearcutting, and to relate these vegetational stages to observed trends in mammal populations.
3) To compare the amount of use by white-tailed deer (Odocoileus virginianus) on the two selected stages of succession after clearcutting, and with an uncut area.
4) To determine the distance into clearcuts which deer travel while utilizing these areas.

Although it is realized that the results of a case-history study pertain only to the areas investigated, it was reasoned that this study would indicate trends, and strengthen previous and future research on the effect of clearcuts on mammalian populations.

LITERATURE REVIEW

In all ecosystems, different species of animals have become adapted to take advantage of various components of the ecosystem (Grinnel 1917, Elton 1936:5). Some species like the grey squirrel (*Sciurus carolinensis*) have adapted to conditions which prevail in the climax forest, while others such as the white-tailed deer (*Odocoileus virginianus*) are more abundant in the earlier successional stages. Apparently, forest-game populations are most numerous under conditions which provide at least some closed canopy, some thick brush, and some grassy open areas (Larson 1967). This relationship between vegetative diversity and wildlife has been referred to as the "law of dispersion" (Leopold 1939:132). It is reasonable to conclude, therefore, that diversity is a desirable objective in managing forest wildlife habitat; and it suggests that where diversity does not exist it should be created by game managers (Larson 1967). Prior to European colonization of North America, ecological disturbances such as fire, floods, disease, and windthrow provided openings in the forest canopy which reversed succession and provided diversity in the vegetation.

In recent years man has not allowed fire (due to economic concerns, safety reasons, and unbased bias) to play its part in setting back succession. Since clearcutting has been shown to reverse succession to a subsere (Kendeigh 1961:22), clearcuts have the potential of replacing fire to maintain diversity and create areas of early successional vegetation.

Vegetation

We know that clearcuts reverse succession. It seems clear that animal populations must change as a result of this habitat disruption, and that the amount of change should be related to the extent of the overall change in the vegetation. It is desirable, therefore, to know what type of general successional pattern to expect.

Succession

The pattern of succession, due to various factors, differs from area to area; however, in general it is roughly similar. On a fresh clearcut before the slash is burned the vegetation resembles that of the forest floor (Thornton 1940). Kendeigh (1961:21) noted that herbaceous plants are stimulated by the lack of competition, and since herbs grow rapidly, they become dominant within a year or two. Shrubs begin to spread, and tree sprouts and seedlings also appear quickly (Kendeigh 1961:21). Approximately 5 or 6 years after cutting, these woody plants gain dominance (Gashwiler 1970). Kimmins (1972) recognized that the change in vegetation after clearcutting depended on a number of factors such as: 1) the ability of the other components of the plant community to respond to reduced competition for light, moisture, nutrients, and rooting space; 2) the degree of disturbance; 3) the size of the cut; 4) whether slash disposal is undertaken; and 5) the successional character of the clearcut site.

Diversity

Nicholson and Monk (1974) noted that comprehensive diversity studies are wanting for terrestrial plant successions, and that most studies to date have considered only changes in richness and have been confined to the old field or forest stages of succession. They further note that recent studies suggest that diversity declines with forest age due to the terminal decline of some plant species caused by monopolistic control by one or more regional climax dominants, or by recurring catastrophic disturbances.

Small Mammals

It has been shown that clearcutting changes the plant yield and composition of an area (Harlow and Palmer 1967, Halls and Alcaniz 1968, Krull 1970, and Wallmo et al. 1972). Since the most abundant mammalian members of the forest wildlife community (and probably the least studied) are the rodents and insectivores (Hamilton 1945, Kendeigh 1961:135), and since these are the least mobile of the terrestrial mammals, they should be the most sensitive to habitat manipulation.

Hooven (1969) noted that forest removal has a profound effect on small mammals. Alteration of the habitat through the removal of cover makes survival difficult for some animal species even when food is available (Lavendor and Engstrom 1956). Smith (1959), studying small mammal populations in conifer plantations in New York, supported the idea that small mammal populations are dependent on cover. Morris (1955) pointed out that cover such as fallen trees, decaying logs and slash from thinning or cutting operations is beneficial to small mammal populations. On the Kaibab Plateau of Arizona, Turkowski and Reynolds (1970) also were of the opinion that uprooted trees provided additional protection to small mammals. In addition, they thought that pinyon-juniper reduction provided a greater variety and abundance of herbacous vegetation resulting in a larger number of microhabitats and a greater abundance of food. Hence, they concluded, a greater number and variety of rodent species could be expected to occupy these treated areas. A study of a clear-cut and forested area in northeast Tennessee by Jones and Nagel (1974) seemed to contradict this conclusion. They found that the species diversity (based on Shannon-Wiener and Simpson indexes) was twice as high on the forested area as in the clearcut. They also reported that the total number of individuals collected was approximately the same in both areas, although white-footed mice (Peromyscus leucopus) were the dominant species on the cut area.

Although cover seems to be an important factor in the observed increase of some small mammal populations, the relationship of food to the size of the observed populations must also be considered. The closed canopy of a mature stand of timber shades out shrubs and weedy annuals that provide an important source of food for rodents, consequently, these mammals are relatively scarce in the uncut forests (Spencer 1956). That food may be a limiting factor in some small mammal populations was supported by Bendell (1959) who reported that the size of white-footed mouse populations is controlled by food. As Hooven (1969) pointed out, however, it is the aggregate of conditions which are important in meeting the food and cover requirements of the species of animals which occupy a particular habitat. It seems apparent, therefore, that when a disruption occurs in a mature forest which changes the floral composition, the vegetational change should benefit some faunal components, but be detrimental to others.

In Oregon, pocket gophers (Thomomys monticola) were reported to increase after clearcutting ponderosa pine (Hooven 1971, Barnes 1973). Although in the Douglas-fir region of Oregon, Hooven (1969, 1973a) observed that an initial reduction in both number of species and number of individuals occurred when the mature forest was cut. He noted that after removal of mature Douglas-fir the cut-over area became inhospitable to species such as the redbacked vole (Clethrionomus spp.) and western grey squirrel (Sciurus griseus) both of which prefer cool timbered areas. Hooven also found that shrew (Sorex spp. populations are initially reduced in numbers, being caught primarily near slash adjacent to the uncut forest, but that by midsummer they became fairly abundant. Chipmunks (Eutamias spp.) were also found to be absent from the freshly cleared areas but were found in older cuts. Hooven (1969, 1973a, 1973b) further noted that populations of deer mice (Peromyscus maniculatus) and Oregon creeping voles (Microtus oregoni) increased after clearcutting. Changes in the faunal composition after clearing operations in the sandhills habitat of Florida were also noted by Beckwith (1964) who reported that Florida mice (Peromyscus floridanus) disappeared on cleared areas while populations of white-footed mice increased dramatically.

Trevis (1956), working in northwestern California, reported that in all areas he studied a greater number of deer mice were trapped on logged areas than in the adjacent virgin forest. From trapping results in 11 cutover areas of different ages in a Douglas-fir forest he generalized that within 3 months after timber had been felled and slash burned, the number of mice is about equal to that of the uncut forest. During the first summer when weedy vegetation covers much of the former bare ground, the population begins to grow; and within 2 or 3 years, as the cutover passes into the weed-brush stages, there is an irruption of mice. From the 4th to 10th year, the animals are 3 to 4 times more numerous than in the uncut forest. After 10 years, with a decrease in variety of ground vegetation, they become less abundant. By the 20th year the population is scarcely larger than in the original forest.

Gashwiler (1959, 1970) also found that the number of deer mice increased soon after prescribed burning of a clearcut area, and that small mammal populations such as the snowshoe hare (Lepus americanus) and Townsend's chipmunk (Eutamias townsendi) increased at different periods after the burn. An increase in the deer mouse population was also reported by Baker and Frischkuecht (1973) in Utah. They found that the number of deer mice and pocket mice (Perognathus parvas) increased greatly 2 years after old juniper stands had been cleared, and that populations remained higher than uncleared areas for 4 years after clearing. In a commercially clearcut area in New York, however, Krull (1970) reported that over a 10-year period more individuals were captured on an uncut area than on a cut area. Surprisingly, he found more Peromyscus spp. as well as redbacked voles in the uncut areas, although he did report more short-tailed shrews (Blarina brevicauda) and woodland jumping mice (Napaeozapus insignus) in the cut areas. In an oak-pine forest in Texas, Murray (1969) also reported a higher density of small mammals in an uncut forest than in two areas that had undergone a 37 percent reduction in basal areas (hardwoods were wholly or partially removed).

That population changes do result from habitat modification was also reported by Sims and Buckner (1973). They found redbacked voles, masked shrews (Sorex cinereus), and meadow voles (Microtus pennsylvanicus) were most prevalent in uncut areas, while deer mice were captured almost exclusively on the burned clearcuts in southeastern Manitoba.

Trousdell (1954) working in the Coastal Plain of Virginia, reported that peak populations of shrews and small rodents occurred 1 year after clearcutting, and although numbers of individuals decreased over the next 3 years, they were still higher than in the uncut forest 4 years after clearcutting. This observation apparently was supported by Morris (1955) who found that the population of small rodents in a thinned conifer stand in Canada was more than double that of a mature stand. Johnson et al. (1974) reported an abundance of small mammals in 1- to 5-year-old clearcuts, but they recorded little use by wildlife in older pine stands in the southeastern United States.

Lovejoy (1971) reported that in New Hampshire there was no increase in the total size of the small mammal population following logging on most areas. Changes in the relative abundance of certain species did occur. He found that the redback vole increased rapidly following logging and remained abundant for at least 4 years. Shrews (*B. brevicauda* and *Sorex* spp., mostly *S. cinereus*) and woodland jumping mice exhibited a 1 to 2 year decrease in numbers, followed by increasing numbers to a population high during the sapling stage of succession. Chipmunks (*Tamias striatus*) and deer mice showed no definite response to logging. Hsia (1958) inferred that the total size of the small mammal population remained about the same after clearcutting. His 3 year study in China indicated that following complete clearcutting 1 species disappeared, 2 decreased, 2 increased, and 1 appeared. However, in North Carolina, Gentry et al. (1968) found that the small mammal population of northern hardwoods on the high ridges was strongly dominated by deer mice, and that the opening up or coppicing of these high forests resulted in increased variety due to invasion of lower altitude species such as the short-tailed shrew, white-footed mouse, and golden mouse (*Ochrotomys nuttalli*).

Deer

Most hunters are not concerned with the effects of clearcutting on small mammals. Their main concern, and therefore the primary concern of game managers, is what effect does clearcutting have on the hunting resource? McGinnes (1969) noted that any disturbance to the forest which alters the vegetative pattern produces an edge-effect, and that edge is a valuable by-product of cutting. The ecological changes as a result of logging and fires are profound, and the shift from climax to disclimax forests, or earlier stages of succession, has favored many animals, including deer (Pengelly 1963). Sweet (1950) theorized that the diverse food habits of deer make clearings of all ages, up to pole stage of tree growth, attractive to them.

Beneficial Aspects of Clearcutting

As early as 1936 Gabrielson observed that wildlife was concentrated around cut-over or burned areas where the forest canopy was broken and wildlife could find the greatest variety of vegetation to provide food requirements, and more abundant and varied cover. More recently, Hooven (1973a) stated that big-game animals benefit from timber removal and slash burning. He noted that staggered logged units create temporary openings of wildlife habitat that provide browse while starting a new plant succession on its course, and openings that provide edges which attract game animals suitable to that habitat. Cowan (1956), referring to Columbian black-tailed deer (*Odocoileus hemionus columbianus*) on the West Coast, stated that block cutting in Douglas-fir and hemlock forests produced a diversified habitat where deer populations can thrive and shift as logged blocks grow up and new ones are created. Goodrum (1969) also commented on the desirability of variety in the vegetation since clearcuts provide open or semiopen fawning areas for deer as well as a place to loaf and play. Goodrum further observed that these areas "green up" a little earlier in the spring, and provide green food in the form of forbs and young grass before browse species begin to grow. Pengelly (1963) concluded that early logging activity at low elevations generally benefited white-tailed deer (Odocoileus virginianus) in the northern Rockies by opening the canopy and producing an abundance and diversity found in the early successional seres. In western Oregon, Horning (1962) noted an irruption of deer, elk, and other animals after clearcutting. Krefting (1962:41) stated that in a study by Donald M. Beal it was reported that cutting benefited deer in three ways: "... first, the cut growth itself provided food when the cutting was done in winter; second, cutting opened up the stands and resulted in an increased tree and shrub growth, as well as sprouts; and third, the openings in the stand created more edge, which, in turn, provided greater variation in the browse supply." Pengelly (1963) also felt that clearcutting had its beneficial aspects since it prepared a seedbed for herbaceous vegetation which was gradually replaced by shrubs and tree reproduction. He further noted that access to isolated hunting areas provided by logging roads, and the burning of slash often favored the early establishment of seral shrubs many of which are preferred browse species.

These general observations were supported by a more quantitative study in western Washington where Brown (1961) found the deer population (sic) to be 63 percent greater in clearcut areas. In Washington's Olympic Peninsula he reported an increase of 58 percent in Columbian black-tailed deer after clearcutting. Wallmo et al. (1972) observed tame mule deer (Odocoileus hemionus) in grazing studies. They found that the mule deer grazed 72 species in the clearcut strips (compared to 44 species in the uncut strips) and obtained 63.3 percent of their forage from these cut strips (compared to 27.4 percent on the uncut strips and 9.3 percent from the logging roads).

Another method that has been used to determine the effect of forest clearings on deer is the amount of use they receive in comparison to uncut areas. Jones (1967) observed that browsing animals were attracted to forest openings. Krull (1964) working in northern New York found that, except during the severe weather of midwinter, deer use was greater on the cut areas than the uncut areas. In the Southeast, Byford (1969) also noted seasonally higher use of clearcuts (during June and July) which he attributed to feeding on sprout growth, herbs, and woody vines. However, Sandt (1969) found no seasonal fluctuation in clearcut use by deer. In addition, he reported that, on the average, there were 3 to 4 times as many deer in clearcut areas as in the grassland or woodland areas of an enclosed area in Virginia.

In Colorado, the use by mule deer doubled in an area that had been logged using the alternate-strip clearcut method (Wallmo 1969). This observation was generally supported by Curtis and Rushmore (1958) who found that deer use of a clearcut and shelterwood cut was higher than on both uncut and selection cut areas in the Adirondack Mountains of New York. Patton (1974) also found that cut areas received more use than uncut areas in Arizona. Beckwith (1964) observed that partially cleared areas (50 to 75 percent) in northcentral and northwestern Florida received significantly more use by deer than uncleared areas.

Studies have generally shown that deer-use of clearcut areas will increase for the first few years and will then decline (Anon. 1948; Crouch 1974). These observations were partially supported by a study on logged areas in New Brunswick (Telfer 1972) which indicated that moose (*Alces alces*) and white-tailed deer fed most heavily in 2-year-old clearcuts. Porter (1959), however, inferred from counts of fecal groups on sample plots that deer use decreased in central Colorado for 2 years after clearcutting. Reduced use by deer during the first 2 years after logging was also reported by Reynolds (1962), but, he noted, that between 3 and 4 years after logging, deer use was several times higher on the cut areas. While a series of studies in the Pisgah National Forest of North Carolina (Morriss 1954, Moore and Downing 1965, Harlow et al. 1966) indicated that use by deer was higher in clearcuts than in uncut areas, but that the usage dropped sharply after 1 or 2 years in the larger cuts. The authors felt that the observed reduction was probably a factor of dense woody regeneration caused by sprouting.

Detrimental Aspects of Clearcutting

Pengelly (1972:258), in writing about the detrimental aspects of clearcutting on the wildlife resource concluded, "Some clearcut logging benefits some species of wildlife in some areas some of the time .... Animals adapt, move, or die if their environment is altered radically." He further noted that many cuts in the western

United States are made at high elevations where they provide no winter range and eliminate fall sanctuary without providing forage. In an earlier paper, Pengelly (1963:739) observed that the adverse effects of logging are both direct and indirect. "Large tangles of unburned slash and other logging debris create fire hazards, impose obstacles to travel by game, and prevent establishment of new vegetation. The logging roads frequently use up valuable acres of game range along valley floors and increase illegal hunting and road hunting." In northern Maine, Gill (1957) pointed out that extensive clearcutting has eliminated deer use of many well established deer yards resulting in deer moving to other, already overcrowded yards. Reynolds (1966a) concluded, on the basis of deer pellet groups, that deer use was greater in an uncut spruce-fir forest of Arizona than in openings. McGinnes and Ripley (1962) reported that, in 4 years of case-history observation on the Broad Run Wildlife Management Area in southwest Virginia, the response of deer to management using supplemental forage clearings, water holes, timber cutting, and timber stand improvement measures, singly and in combination, resulted in no important response in the deer population.

It would seem, then, that if wildlife values and constraints are incorporated into the cutting plan, clearcuts can provide diversity and an abundance of forage which is potentially beneficial to many species of wildlife. Unfortunately, the research necessary to make scientifically based recommendations on the dispersion and size of clearcuts is largely lacking.

Clearcut Size

Before optimum size and distribution of cuts can be determined several factors should be considered such as the average size of a deer's home range (McGinnes 1969), as well as the home range and habitat requirements of other wildlife species. The size of the cut and its relationship to home range must be considered. Cuts large enough to remove all the timber from a deer's home range may be detrimental since deer will be forced into new habitat (McGinnes 1969). Larson (1967) noted that our present knowledge of food and cover requirements of forest game indicates that some diversity in vegetative cover is necessary to sustain huntable populations. He also observed that the lack of a means for determining how much of the forest should be in openings, and where they should be placed is the basic underlying problem today. McGinnes (1969:66) also observed that, "An obvious fact in studying the question of size and distribution of cutting units, is the paucity of literature on the problem. Where research facts are lacking, management practices may be based upon opinions evolved from experience and dictated by economics."

In general, even-aged units should be large enough to be managed economically and small enough to insure habitat variety (Carter and Dow 1969). In Florida, Beckwith (1964) noted that partially cleared areas as large as 1 mile square (259 ha) received substantially less use by white-tailed deer than untreated areas, although treated areas smaller in size had received significantly more use than the uncut areas. He concluded that the large tracts were detrimental to deer. Hosley (1956) observed that the effectiveness of a clearcut varies with the size of the area and the density of the deer population. He found that small deer herds use only the edges of large clearcuttings, while in small clearings large herds eat all the new growth as soon as it starts. A factor in studying deer use of large clearcuts is also the presence or absence of cover within the clearcut. Hosley suggested that if islands of conifers were left in large cuttings, the animals will use the area around these islands, otherwise the deer will tend to use only the edges. This observation is supported by Reynold's (1966a, 1966c, 1969) work in Arizona. He found that the border zone along the forest edge in both opening and forest received the heaviest use by deer, and that use decreased on either side of the border zone with no use recorded beyond 1200 feet (365.8 m) into the opening. He concluded that relative use by deer declined sharply as the size of the opening increased, and suggested that deer use of opening appeared to depend strongly upon distance to cover. Based on these data he suggested that clearcut plots should be restricted to less than 45 acres (18.2 ha) in ponderosa pine and to less than 20 acres (8.1 ha) in spruce-fir forest.

Another paper by Reynolds (1966b) implied that cover is an important factor in the use of and distance traveled into clearcuts by deer. He reported that deer use was greater in cuts where slash was left than where it had been removed. Reynolds theorized that deer may feel more conspicuous in cut areas cleared of slash. This theory was strengthened by a California study by Tabor and Dasmann (1958) who found that black-tailed deer did not feed more than 300 ft (91.4 m) from cover. However, a report by the Arizona Game and Fish Department (1961) stated that they were unable to find statistically significant differences between the number of deer pellet groups in cover and up to 0.5 miles (805 m) into clearings.

In northern Wisconsin, studies failed to show a significant orientation of deer activity toward the edges of clearings 16 to 26 acres (6.5 to 10.5 ha) in size. Although this study did find indications that smaller openings of 0.5 to 5 acres (0.2 to 2.0 ha) were used more intensively than larger openings (McCaffery and Creed 1969). In western North Carolina, Harlow and Palmer (1967) suggested that the best cutting size for deer is between 5 and 20 acres (2.0 and 8.1 ha). The authors pointed out, however, that there are several factors to consider such as the size of the deer herd and the practicality of logging small tracts. Healy (1971) recommended that clearcuts be at least 17 acres (6.9 ha) in northern Pennsylvania to avoid a food-patch effect that could concentrate browsing and prevent tree regeneration. The work of Harlow and Downing (1970) in western North Carolina also suggested that when clearcuts were too small, good browse plants were quickly eliminated through severe browsing and overstory competition. They also noted that when clearcuts were too large, they often became dense and unattractive to deer after 2 years. They suggested that a 21 acre (8.5 ha) clearcut seemed to be a desirable compromise between 1 acre (0.4) and 50 acres (20.2 ha) clearcuts.

DESCRIPTION OF STUDY AREA

Location

The area in which this study was conducted is located along the upper Craig Creek watershed of the James River Basin in Montgomery and Craig Counties, Virginia approximately 13 km (8 miles) northeast of Blacksburg, Virginia (Fig. 1). This area is bounded between 37° 18' and 37° 22' north latitude, and 80° 16' and 80° 25' west longitude.

Climate

Climatic conditions of the general area are typical of the middle east mountain section with winters lasting about 4 months, January and February with an average temperature of $31^{\circ}F$ (-1° C) being the coldest months (Winston and Lee 1908). Annual precipitation in Blacksburg averages about 43 in (105.4 cm) and is usually well distributed throughout the year (Brown 1945).

Geology

The study areas lie within the Ridge and Valley province which is bounded by the Blue Ridge on the east and the Appalachian plateaus on the west (Edmundson 1950). This province is characterized by alternating narrow ridges and valleys with the main ridges generally oriented in a northeast to southwest direction, and secondary ridges running perpendicular to the main ridges in a northwest to southeast direction (McGinnes and Ripley 1962). According to Butts (1933), the 3 areas are underlain by the same parent rock (Brallier shale).

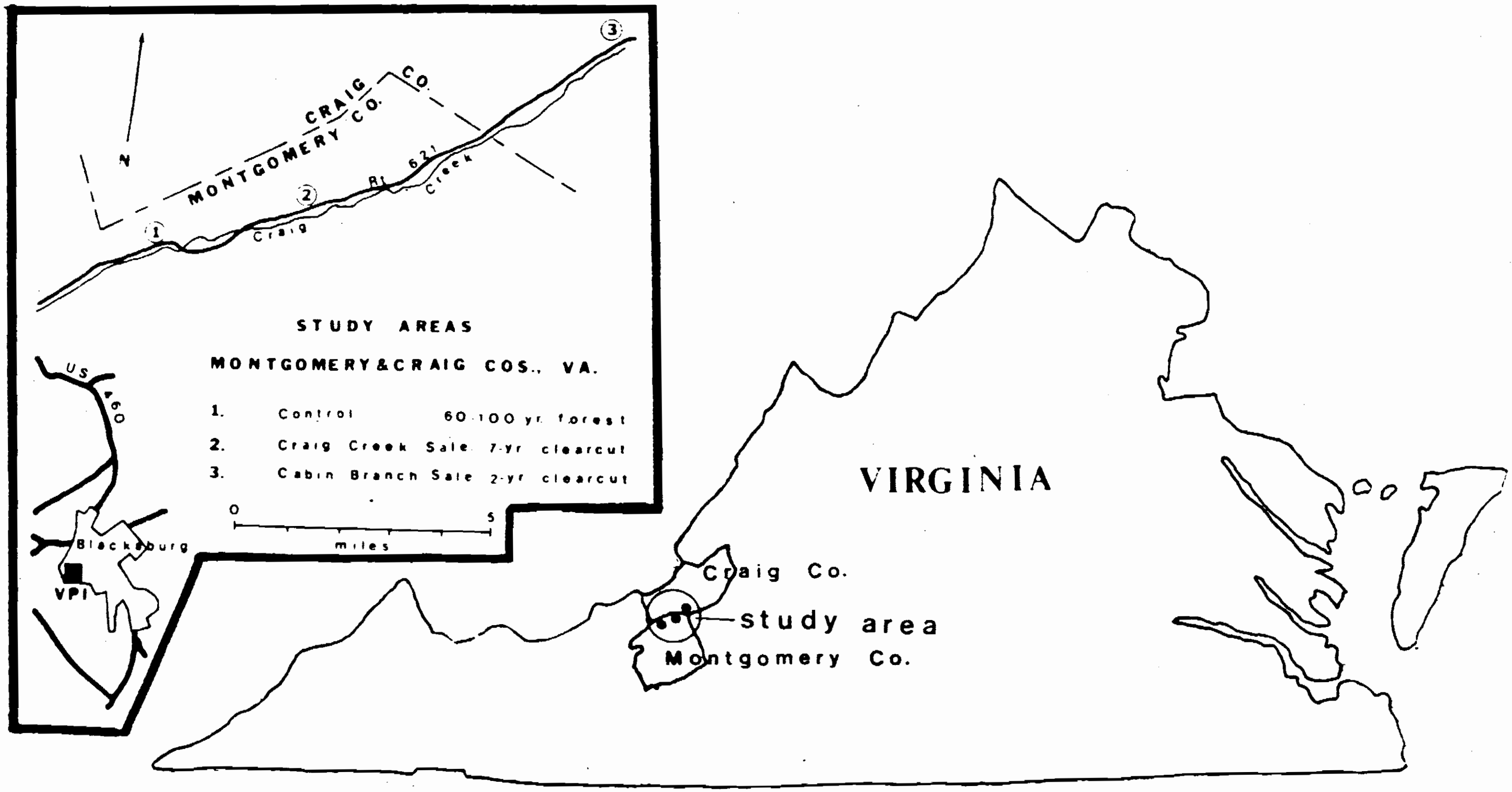


Fig. 1. Generalized map of the state of Virginia showing location of study areas. Upper figure represents a blowup of study area showing location of the three areas investigated; a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut (7-yr. clearcut), and a 2-year-old clearcut (2-yr. clearcut) in Montgomery and Craig Cos., Virginia.

METHODS AND PROCEDURES

Selection of Study Areas

Previous research has indicated that 3 age-types seem to occur after clearcutting: 1) new cut- 1 to 3 years after cutting; 2) young cut- 3 to 15 years old; and 3) old cut- greater than 15 years after cutting. Due to time and personnel constraints, it was determined that the study should be limited to 3 areas. Since the faunal composition in the "old cut" category would probably resemble the uncut forest except for species dependent on mature trees for mast and den sites, it was decided to select clearcuts that would fit the "new" and "young" cut definitions.

Only one clearcut in Montgomery and Craig Counties section of the Blacksburg Ranger District had both natural regeneration and fit the age limitations of a "new" clearcut. Consequently, this particular clearcut was used, and the "young" cut and control areas were chosen on the basis of similar physiographic characteristics.

The 3 areas chosen (a 60- to 100-year-old forest, a 6- to 7-year-old clearcut, and a 2-year-old clearcut) were in the upper Craig Creek watershed of the James River Basin along the east slope of Sinking Creek Mountain in Montgomery and Craig Counties, Virginia. All areas had approximately the same elevation (518 to 713 m), aspect (155 to 161 deg), site index (60 to 70), and parent rock of Brallier shale.

New Cut

The "new" cut selected for this study was a 11.33 ha (28-acre), 2-year-old cut referred to as the Cabin Branch Sale (Unit 1). This clearcut was located in Craig County 5.3 km (3.3 miles) northeast from the Montgomery-Craig County line on Virginia Rt. 621, approximately 17.9 km (11.1 air miles) from the control and 11.6 km (7.2 air miles) from the "young" cut. Prior to cutting this area had an estimated site index of 60 to 70. Maximum and minimum elevations for the new cut were 609 and 518 m (2000 and 1700 ft) respectively with an overall slope of 13 percent, and a general aspect of 160 degrees.

Young Cut

Of the 22 remaining clearcuts only 8 were in the Craig Creek watershed on the east slope of Sinking Creek Mountain. Craig Creek Sale (Unit 1), a 6- to 7-year-old clearcut, was finally chosen to represent the "young" cut. This was accomplished by eliminating clearcuts that either were in the lower age spectrum of this clearcut classification, were too large, or were inaccessible due to private land between the cut and Rt. 621.

Craig Creek Sale (Unit 1) was located in Montgomery County north of Rt. 621 and U.S. Rt. 460. Except for its larger size 34.4 ha (85 acres), the 6- to 7-year-old clearcut was physiographcally similar to the 2-year-old clearcut with a site index of 60, and a general aspect of 155 degrees. The maximum and minimum elevations for the cut were 640 and 548 m (2100 and 1800 ft) respectively with an overall slope of about 13 percent.

Control

Approximately 21.85 ha (54 acres) of a 60- to 100-year-old forest located 4.02 km (2.5 miles) northeast of the junction of U.S. Rt. 460 and Rt. 621 were selected as the control. The site index of this area was estimated to be between 60 and 70 (personal communication with Steve Pedigo, Forester, Blacksburg Ranger District, USDA Forest Service). The general aspect of the control was 161 degrees with an overall slope of about 20 percent. Minimum and maximum elevations for the control were 628 and 713 m (2060 and 2340 ft) respectively.

Vegetation Analysis

Transects

The number of possible transects (with a minimum of 20 m between transects) for each area along the overall gradiant was determined from a large scale map of each of the 3 areas. These maps were reproduced from topographic maps of Newport, McDonalds Mill, and Craig Springs Quadrangles, Virginia (7.5 minute series, USDI Geological Survey). From these possible transects at least 10 percent of the transects were chosen (Fig. 2-4) using a random number table (Rohlf and Sokal 1969).

Starting points for the transects were located in the field using a hand compass and 66-ft Gunter's chain, and marked with a 56 cm (22 in) wire rod with a lettered piece of surveyor's ribbon attached. The stations along each transect were systematically located at 20 m (66 ft) intervals using a Gunter's chain and hand compass, and marked with a 56 cm wire rod with a numbered piece of

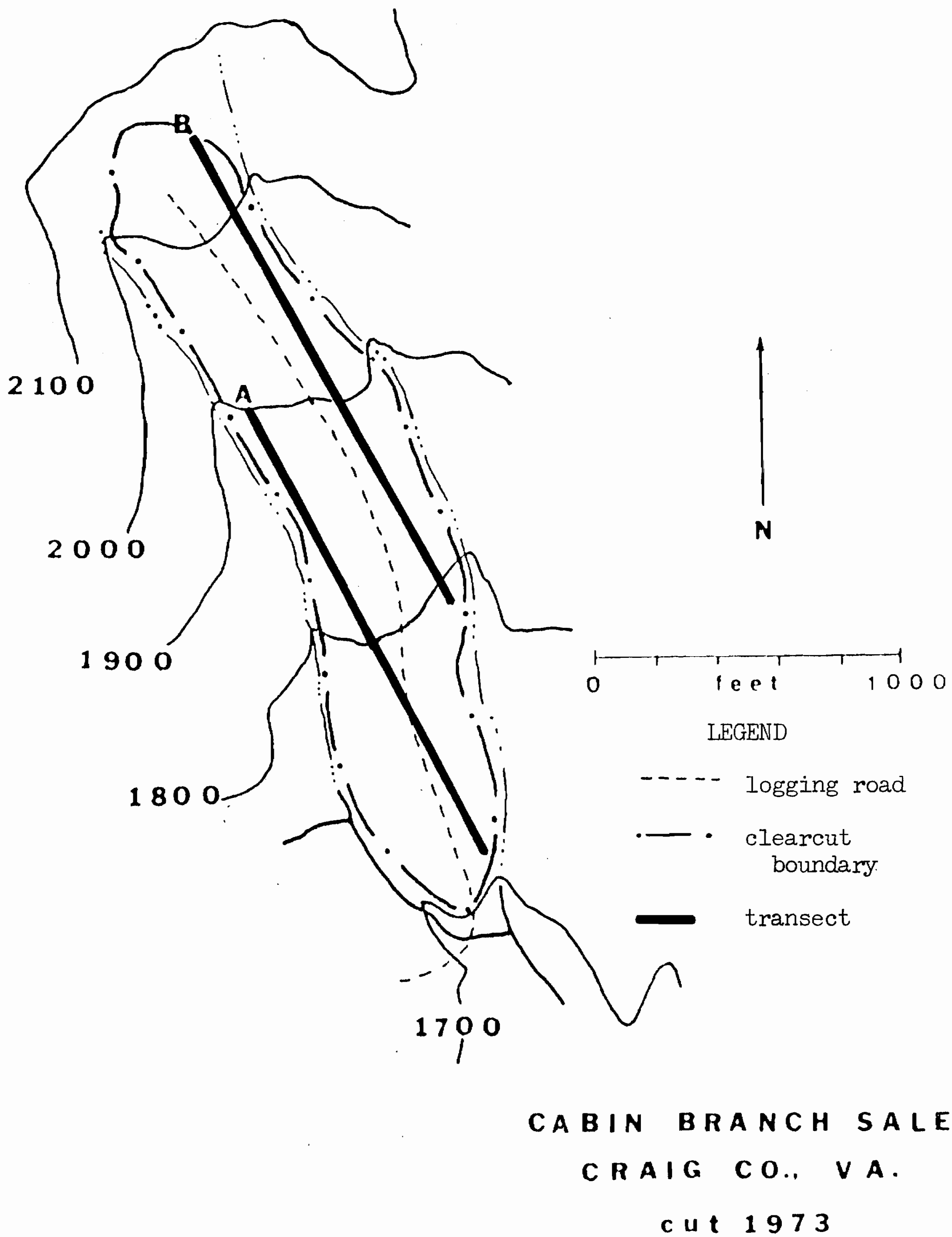
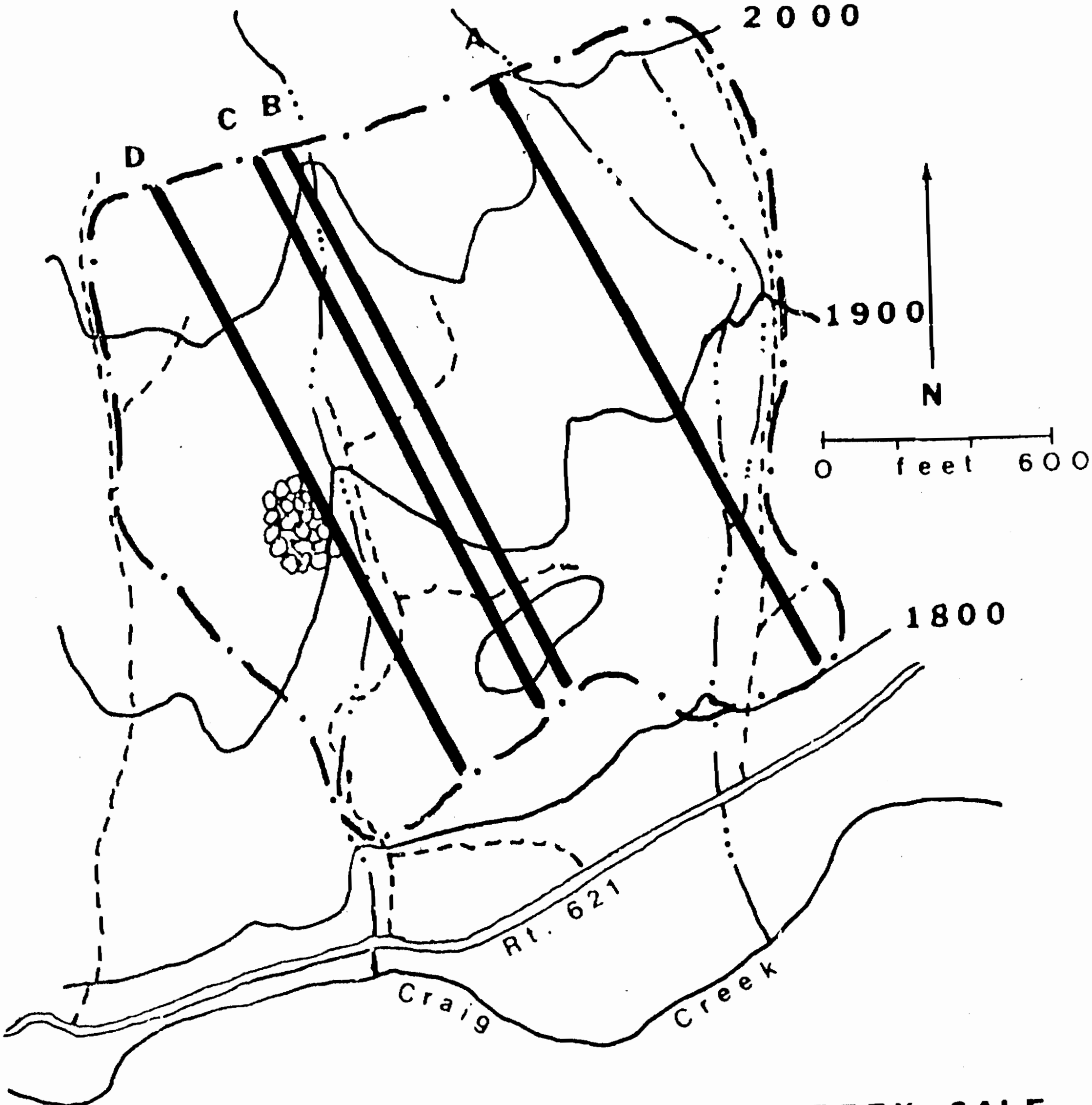


Fig. 2. Location of vegetation transects A and B in the 2-year-old clearcut.



CRAIG CREEK SALE
MONTGOMERY CO., VA.
cut 1968-69

LEGEND

---- logging road

transect

clearcut boundary

uncut trees

Fig. 3. Location of vegetation transects A, B, C, and D in the 6- to 7-year-old clearcut.

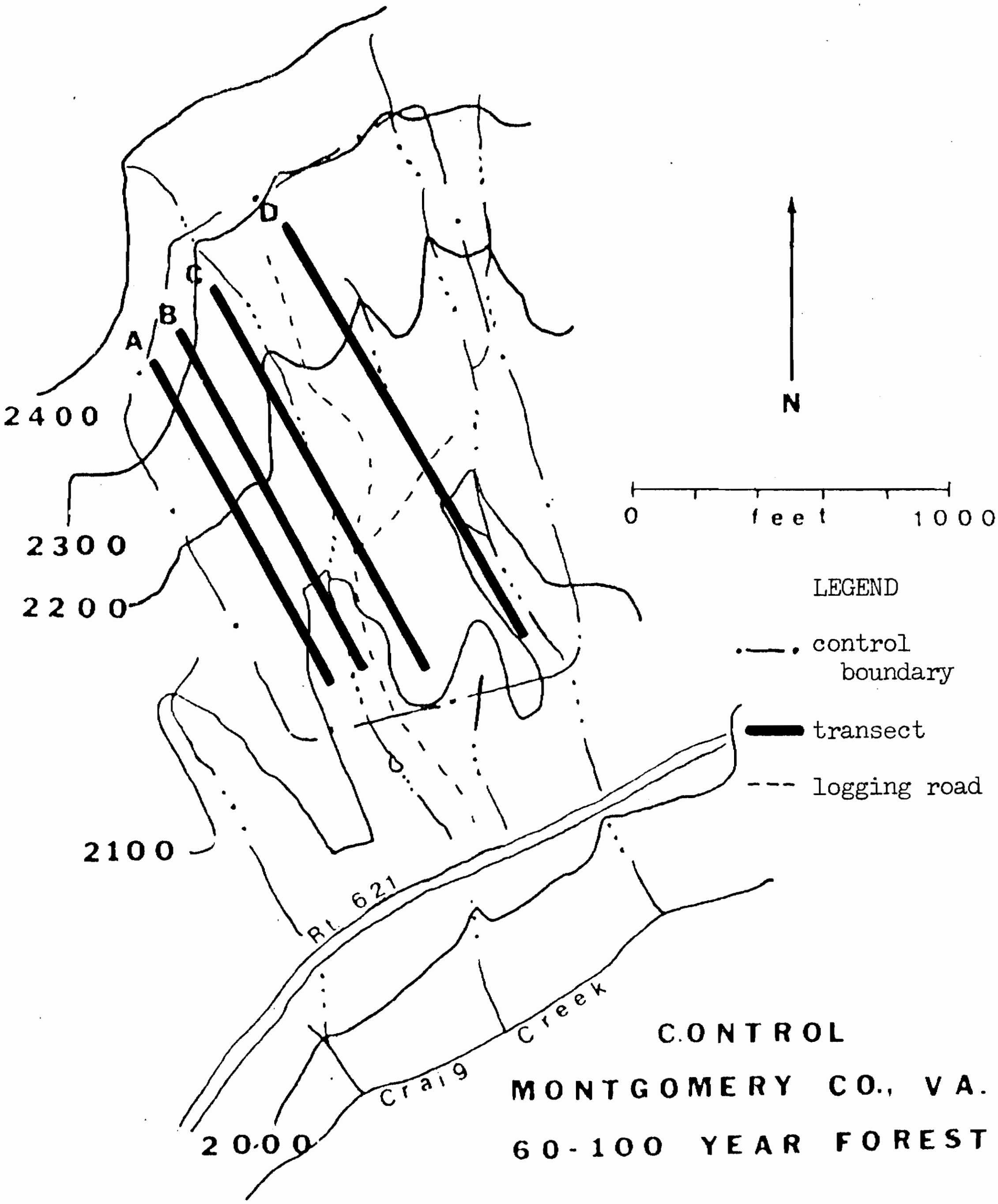


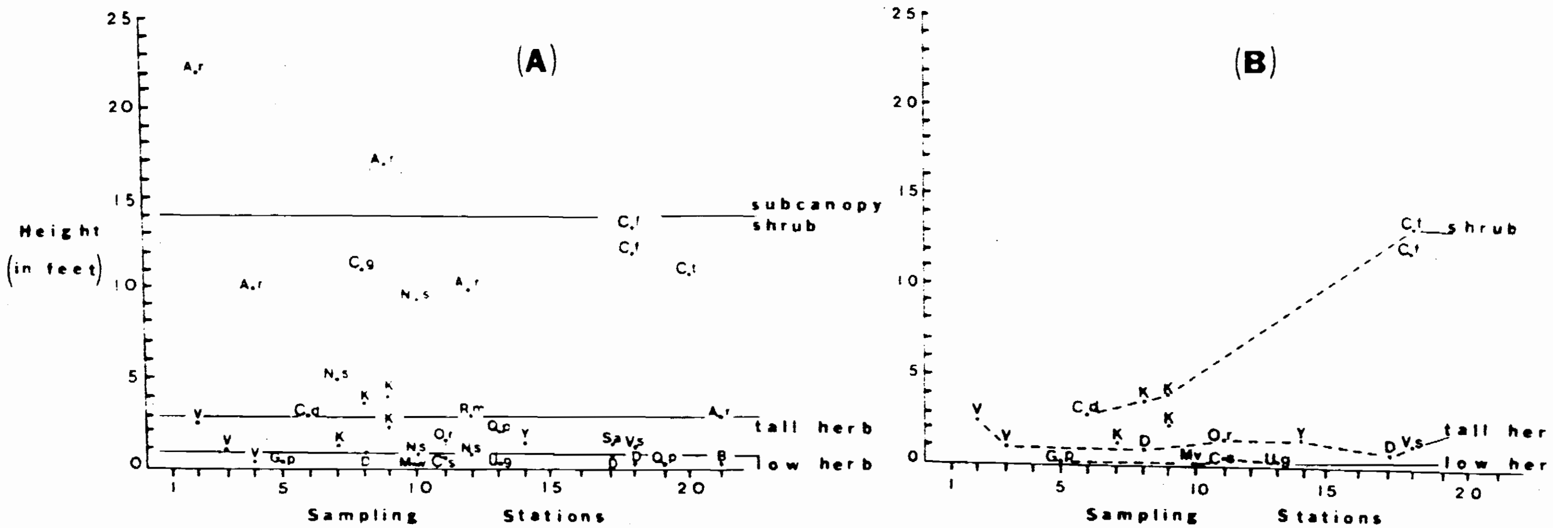
Fig. 4. Location of vegetation transects A, B, C, and D in the control.

surveyor's ribbon.

Stratification

The technique described by Thomas (1974) was used to determine the stratification (actual layers of vegetation present). At each sampling point in the two clearcuts, the species and height were recorded of every plant whose foliage was either touching or was directly over the wire rod. In the uncut forest the procedure was somewhat different. In this area trees (woody plants 10.2 cm or greater dbh) whose foliage was directly over the station marker were identified to species and placed in one of two height categories. If their crowns reached the topmost layer of vegetation they were listed as canopy trees, but if their crowns were overtopped by other trees they were recorded as subcanopy trees (Newman 1954). All other vegetation was recorded in the manner described for clearcuts.

A graph (Fig 5) was constructed for each transect upon which the height of each plant was plotted by sampling point and labeled to species. From the graphs of each transect the various strata were delineated as follows: In the uncut forest the shrub layer was differentiated from the subcanopy stratum by eliminating all immature plants of species that had been categorized as either canopy or subcanopy. The tallest shrub, then, provided both the lower limits of the subcanopy stratum as well as the upper limits of the shrub stratum. In the two clearcuts this step was not necessary since the subcanopy and canopy strata were absent. The herb strata were also segregated from the woody strata on the basis of overall height



L E G E N D : Ar- *Acer rubrum*, B- *Gillium trifoliata*, Cd- *Castanea dentata*, Cf- *Cornus florida*, Cs- *Carex* sp., Ct- *Carya tomentosa*, D- *Desmodium nudiflorium*, Gp- *Gaultheria procumbens*, K- *Kalmia latifolia*, Mv- *Medeola virginiana*. Ns- *Nyssa sylvatica*, Or- *Osmunda regalis*, Qp- *Quercus prinus*, Rm- *Rhododendron maximum*, Sa- *Sassafras albidum*, V- *Vaccinium* sp., Vs- *Vitus aestivalis*, Ug- *Uvularia grandifolia*, Y- *Dioscorea villosa*

Fig. 5. Stratification of plants on each transect was determined by graphic plotting of the height of each species whose foliage either touched or was directly over each sampling point along: (A) transect "C" of the uncut forest (control) in July 1974 and (B) the mature plants present on the same transect.

characteristics. Using this criterion the tallest herbacious plants were used to delineate the upper limit of the herb strata and, therefore, the lower limit of the shrub stratum as well. With the elimination of all woody regeneration the remaining plants occurred in two layers: a tall herb-low shrub layer, and a low herb layer as suggested by Willis (1973) and Thomas (1974). To make these layers more distinct immature plants (as determined by heights cited by Fernald 1950, and Gleason and Cronquist 1963) were eliminated as possible strata delineating points. The remaining herbacious plants and low shrubs such as blueberry (Vaccinium spp.) clearly indicated two strata. The lower limits for the stratum which was designated "tall herb", and the upper limits of the stratum designated "low herb" was determined by using the tallest plants in the low herb stratum.

Vegetation Inventory

The vegetation inventory was conducted using the point-centered quarter method (Curtis 1950) as used by Dix (1961) and Thomas (personal communication with Dr. L. K. Thomas, Jr., Research Biologist, National Capital Parks, National Park Service). This was accomplished by dividing each sampling station into 4 quarters using the transect (at the wire rod) as the other bisecting line. In each quarter the plant closest to the wire rod in each of the predetermined strata was identified and its distance from the wire rod and diameter (dbh for trees and diameter above basal swell for shrubs and herbs) was recorded.

Analysis. The vegetation analysis determined the density (stems per acre), importance value, frequency, and species diversity for each stratum which occurred in the 3 areas investigated.

Density. The density for each strata was determined as follows: The sum of all distances was tallied and divided by the total number of plants measured (some factor of 4). Morista (1954) had shown that, in theory, the mean of the measured distances from the station marker to the nearest individual plant in each quarter of a particular stratum was equal to the square root of the mean area per plant; experimentally Cottam et al. (1953) found this to be true. Therefore, the average distance calculated above was squared to give mean area per plant. The mean area per plant is the reciprocal of the actual density (Greig-Smith 1957, Stearns 1959). In other words, stems per unit of area is determined by dividing the mean area per plant into the unit of area for which density is to be described (i.e. acres, hectares). In this study, the measurements were recorded in meters, however, density was to be described as stems/acre. Therefore, 4046.873 m^2 (1 acre) was divided by the mean area per plant to get the number of stems per acre.

Importance Value. The importance value (Curtis and McIntosh 1951) was used to determine which plant species were dominant in the various strata in the three areas. This index to species dominance was obtained by summing the relative abundance (percent of the total number of stems contributed by a single species), relative frequency (frequency of one species as a percent of the total frequencies of all species), and relative basal area (percent of the total basal contributed by a single species) as described by Curtis and McIntosh (1951).

Frequency. Frequency of occurrence was expressed as the percent of the total number of stations in which the species occurred (Stearns 1959, Spurr 1964).

Species Diversity. Diversity can denote several meanings (Lloyd et al. 1968); however, the use of "diversity" in this study followed Pielou's (1966a) definition. Pielou (1966b, 1966c) used "information content" as a measure of the diversity of many-species biological collections. Diversity in this context means the degree of uncertainty attached to identifying correctly any randomly selected individual. The greater the number of species and the more nearly equal their proportions, the greater the uncertainty, and hence, the diversity (Pielou 1966c). Therefore, a collection has high diversity if it has many species and their abundances are fairly even (Pielou 1966a).

In recent years ecologists have used formulas based on information theory as indices to species diversity. Although several expressions have been proposed, two formulas seem to be the most prevalent in the literature: that of Brillouin (1956) and Shannon (1948). In Brillouin's formula, species diversity (H) is equal to $\frac{1}{N} \log \left(\frac{N!}{n_1!\, n_2! \ldots n_s!}\right)$; where "N" is the total number of individuals, and "n" is the number of individuals in the "s" species. Shannon's formula differs from Brillouin's by estimating the species diversity for a defined population. The Shannon estimate of species diversity (H') is derived by the formula $H' = -\Sigma p_i \log p_i$; where $\frac{n_i}{N}$ is assumed to approximate p_i.

Pielou (1966a:231) pointed out that it must be decided whether a fully censused collection should be treated as a finite population, or as a sample from an infinite parent population. She stated further that only when it is unquestionably legitimate to treat a collection as a sample from a larger population is it justifiable to estimate the population value of H'. Pielou was of the opinion that it was better to treat a collection as an entity to be studied for its own sake rather than something larger, unless the extent of the parent population can be precisely specified and it can be ensured that the collection was a truely random sample. Lloyd et al. (1968) also indicated that (H) should be used when one has measured something which existed on a local scale rather than a sample of size "N" from a larger universe. He also noted, however, that if one was interested in the overall average species diversity as an intrinsic parameter of a whole community it did not seem very important whether H or H' was used as long as the same index was used in making the comparisons.

Pielou (1966c) listed 5 types of collections. The vegetation data were best described by the "Type A" collection, or collections small enough for all members to be identified and counted. Pielou (1966c) suggested that with a "Type A" collection the index to diversity should be calculated using Brillouin's (1956) formula for H. A derivation of Brillouin's formula as described by Lloyd et al. (1968:258) was used to facilitate easier calculation.

The $\log_{10}$ of factorials from 1-1050 were taken from Lloyd et al. (1968), and the $\log_{10}$ of factorials larger than 1050 were approximated using Stirling's factorial approximation (Spiegel 1963).

Pielou (1966a) noted that diversity depends on both the number of species present in a sample and on the evenness individuals are distributed among the species. As a measure of evenness, the ratio of the observed diversity to the maximum possible diversity for the same number of species was determined as suggested by Pielou (1966c). For "Type A" collections, the maximum possible diversity is given by the following formula:

$$H_{max} = \frac{1}{N} \log \frac{N!}{\left\{ \left[\frac{N}{s}\right] ! \right\}^{s-r} \left\{ \left(\left[\frac{N}{s}\right] + 1 \right) ! \right\}^{r}} .$$

A derivation of this formula to a working formula is:

$$H_{max} = \frac{1}{N} \left[\log_{10} N! - \left\{ s-r \left(\log_{10} \left[\frac{N}{s}\right] ! \right) \right\} - \left\{ r \left(\log_{10} \left(\left[\frac{N}{s}\right] - 1 \right) ! \right\} \right]$$

where $\left[\frac{N}{s}\right]$ is the interger part of N/s and $r = N - s\left[\frac{N}{s}\right]$. The population value of the collection's evenness if given by $J = H_{obs}/H_{max}$ (Pielou 1966c).

Logging Residue

The randomly selected vegetation transects were used to determine the percent coverage by logging residue (slash) within the 2 clearcuts. Along each transect sampling stations were set up at 2-chain (about 40 m) intervals. At each station a 20 m (1-chain) diameter circle was marked off, and the size and height of each slash pile (or portion of pile) within the circle determined using a 6-in (15.24 cm) range finder (model no. 50137A by Edmund Scientific Co.) and 1.5 m measuring rod respectively.

From these data it was possible to calculate the percentage of each circle covered by slash, and the average height of the slash piles within each circle. The mean and standard error of the slash coverage and height was then calculated.

Small Mammals

The mammalian segment was broken down into 2 major components (small mammals and white-tailed deer) to facilitate data comparisons due to the differential selectivity of sampling techniques used in this study. The small mammal component was broken down further to "small rodents and insectivores", and "larger mammals" on the basis of their presence or absence during the pitfall and snap trapping phase of the study (i.e. small rodents and insectivores were present in either snap or pitfall traps).

For the purpose of the current study, therefore, "small rodents and insectivores" were defined as rodents (such as the white-footed mouse and woodland jumping mouse) observed during the snap and pitfall trapping phase of the study, and all insectivore species. "Larger mammals" were defined as those species wholly or primarily captured in live traps. This group would include species such as the gray squirrel, spotted skunk, opossum, and raccoon. The term "small mammals" was defined to include all mammals under the "small rodent and insectivore", and "larger mammal" headings.

The relative abundance, use of clearcuts, and species diversity of small mammals in the 3 study areas were determined through the use of sign indices (dropping boards, feeding on antler segments, and snow track-counts) and trapping indices (snap and pitfall traps for small rodents and insectivores, and live traps for larger mammals.

Sign Indices

Dropping boards. Two systematically selected transects were established in each of the 3 study areas and 145 sampling stations placed at 20 m (66 ft) intervals were selected along these transects. Dropping boards, constructed of 10.2-cm square, 3-ply water-proofed .635 cm thick plywood were placed firmly on the ground in an approximately level position at each station on 19 August 1974. The boards were checked for droppings at 24, 72, and 120 hours after initial placement.

Antler segments. On 9 October 1974 segments of deer (*Odocoileus virginianus*) antler were placed at 40 m (132-ft) intervals along systematically selected transects in each area as a possible index of small rodent populations. The antler segments were periodically checked throughout the fall and winter for evidence of small rodent feeding activity; they were removed in May 1975.

Snow track-counts. Initially, 2 procedures were used in conducting snow track-counts of small mammals: 1) track-counts around the periphery of the areas, and 2) track-counts along logging roads within each area.

The snow had often melted before the periphery counts were completed since it normally took from 4 to 6 days to make counts on the 3 areas. Track-counts along logging roads, on the other hand, were completed in 1 day, therefore, rapid snow melt was not as critical to this index.

Periphery counts were conducted in the following manner: After each snowfall with an accumulation of 3 or more inches, the forest edge boundary of each area was walked. At each set of tracks encountered, the species of animal and direction of the tracks (into or out of the study area) was noted, and marked on a map. After all tracks had been recorded each set was followed, and the route through the study area recorded on the map. Unfortunately, it took 1 to 2 days per area to complete this process. Due to the generally short time that the snow normally remained on the ground, and the time lag between counts on each area, this method proved to be unacceptable.

Logging roads which bisected each study area (Fig. 6-8 were selected for the road counts. After each snowfall (1 and 2 December 1974; 20 January, 4 February and 11 March 1975) the roads were walked and the number of track sets for each species recorded.

Trapping Indices

Pitfall traps. Transects (A and C) for the pitfall traps were systematically selected from the vegetation transects, and #5-fruit juice cans (10.48 x 17.8 cm) placed at 40 m (132-ft) intervals. During the

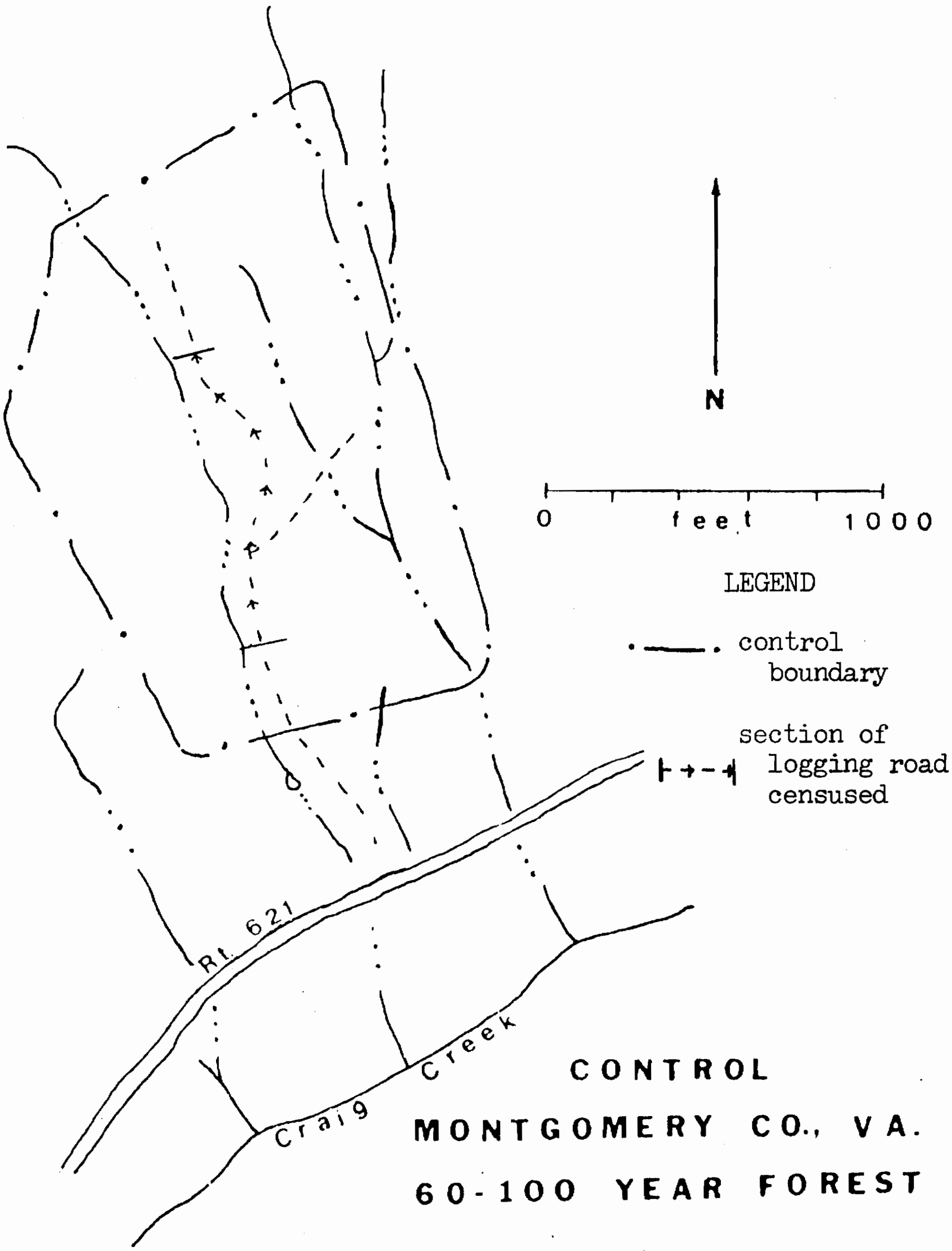
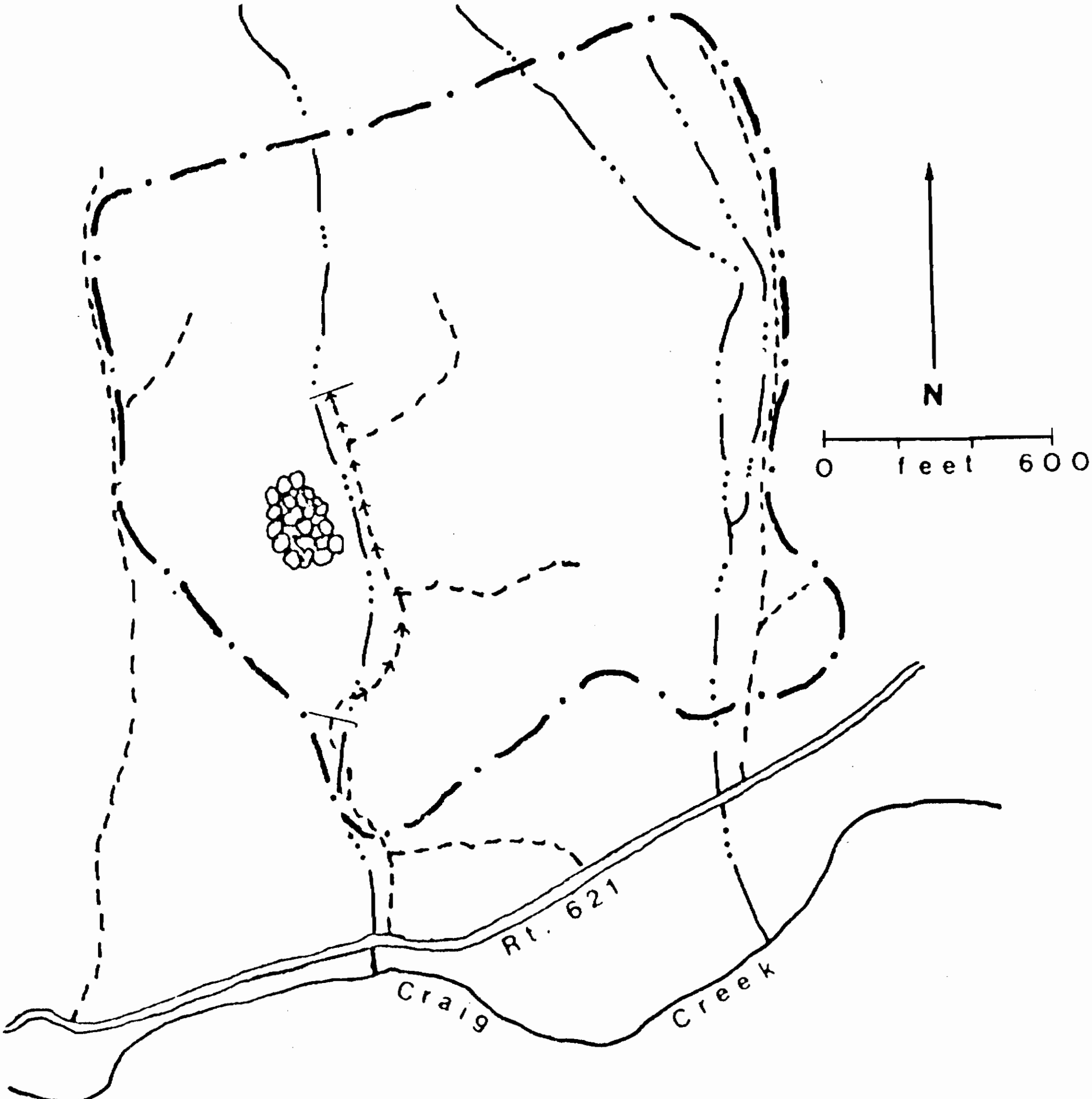


Fig. 6. Location of logging road used for snow track-counts in the 60- to 100-year-old forest (control).



CRAIG CREEK SALE
MONTGOMERY CO., VA.
cut 1968-69

LEGEND

clearcut boundary

section of logging road censused

uncut trees

Fig. 7. Location of logging road used for snow track-counts in the 6- to 7-year-old clearcut.

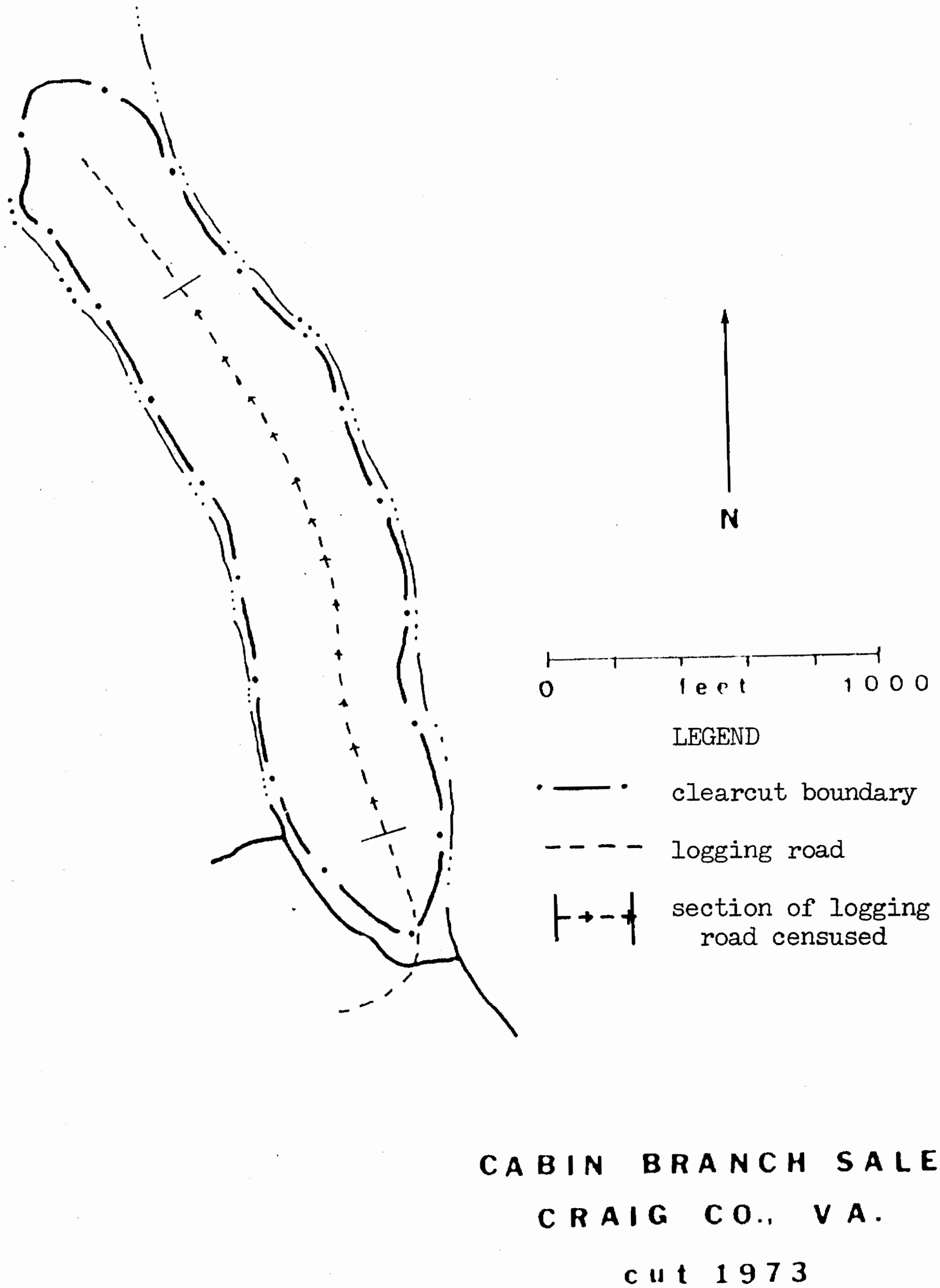


Fig. 8. Location of logging road used for snow track-counts in the 2-year-old clearcut.

period 27 August through 13 September 1974, 59 holes were dug with a post-hole digger and a can placed upside down in each hole. On 16 September 1974, 37 of the cans (one transect in each study area) were uncovered and positioned with the tops flush with ground level. The following day 500 ml of an 8:1 formaldehyde solution and 100 ml of parafin oil (to prevent evaporation of the preservative) were placed in each uncovered can. On 19 September 1974 the remaining 22 cans were uncovered, and the procedure outlined above followed.

Cans were checked weekly for small rodents and insectivores during the period 19 September through 7 November 1974. Captured animals were removed from the pitfalls, labeled with the date and location of capture, placed in individual plastic bags, and taken to the laboratory for identification and measurement.

Due to the small number of insectivores collected during the fall trapping period, the pitfall traps were reopened from 6 May through 16 June 1975. During this period every other pitfall was baited with cracked corn scattered around the edge of the trap, peanut butter smeared on the inside of the can, and fish flavored cat food suspended over the pitfall on a stick. Instead of the formaldehyde and parafin oil mixture, approximately 600 ml of water was placed in each can.

Snap traps. The snap trap method used was a modification of the Calhoun line (Calhoun and Casby 1958). Three traps (2 mouse and 1 rat trap) were placed at 20 m (66-ft) intervals along transects A and C in the control and 6- to 7-year-old clearcut, and transect A in the 2-year-old clearcut on 4 November 1974. The traps were baited with a rolled oats and peanut butter mixture, and placed within a 1.52-m (5-ft) radius of each sampling station at locations most likely to catch animals. Traps were checked daily, and rebaited and reset as necessary for a total of 4 nights. At the end of the trapping period the traps were moved to the remaining transects for the final snap trapping period which commenced on 11 November 1974. The procedure followed for the second period was the same as outlined for the first 4-night segment.

All animals collected were labeled with the date and location of capture, placed in separate plastic bags and transported to the laboratory at the end of the day. In the laboratory, individuals were identified to species; sexed and aged when possible; weighed; and measurements of total length, tail length, and length of the right hind foot recorded.

Live traps. From 17 December 1974 through 28 February 1975 (for a total of 4756 trap-nights) 55 wooden box traps (as described by Mosby 1955) and 27 steel live traps (22.9 x 30.5 x 91.4-cm), single door, wire mesh Tomahawk traps, National Live Trap Co., Tomahawk, Wisc.) were used to determine the relative use and numbers of the larger mammals in the 3 study areas.

The box traps were placed approximately 61 m (200 ft) apart in a rough grid pattern, and the wire mesh traps systematically placed between selected box traps (Fig. 9-11). Traps were checked daily, and reset and rebaited (cracked corn in the box traps and fish

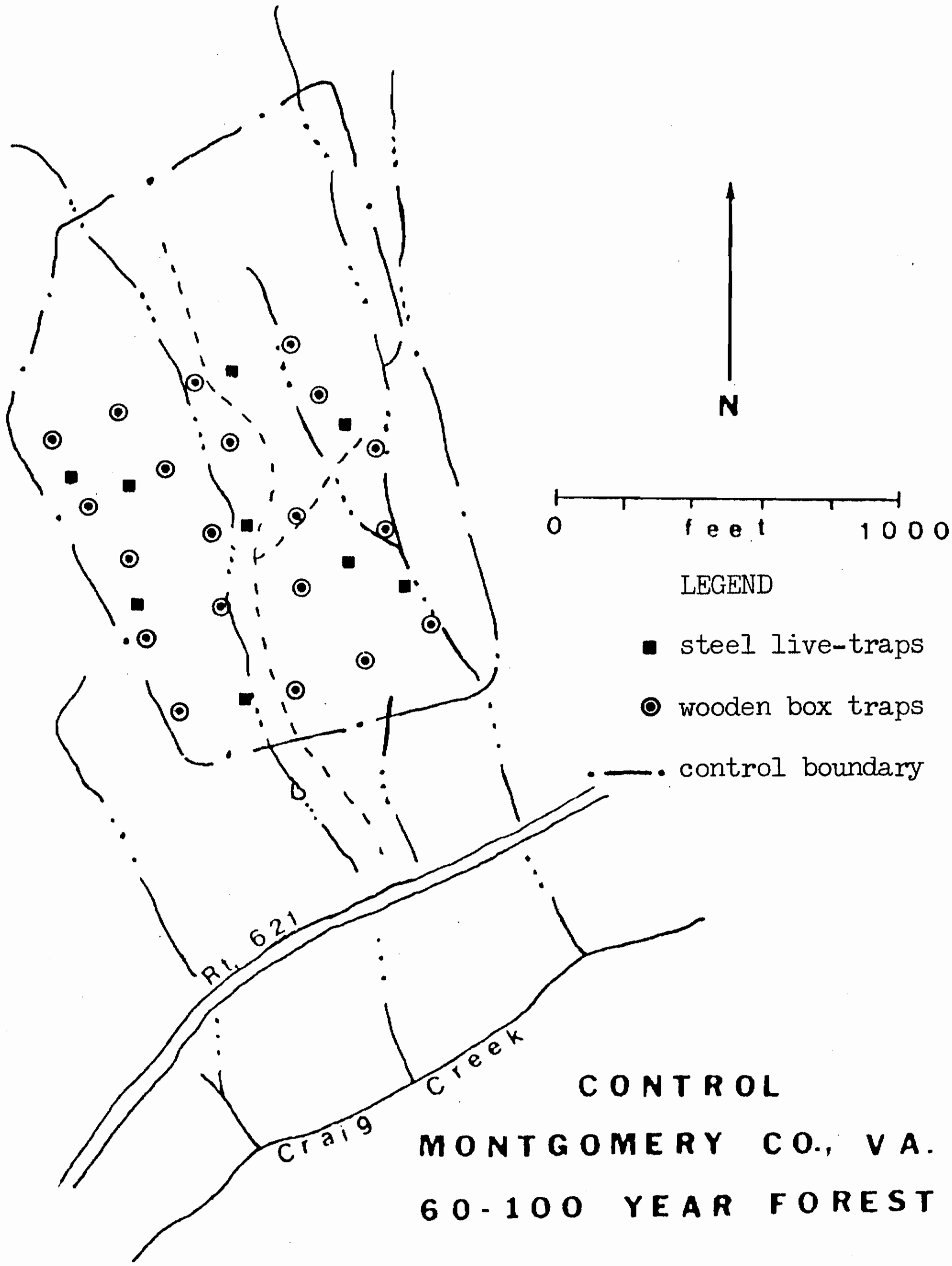


Fig. 9. Location of wooden box and wire mesh (steel) live-traps in the 60- to 100-year-old forest (control).

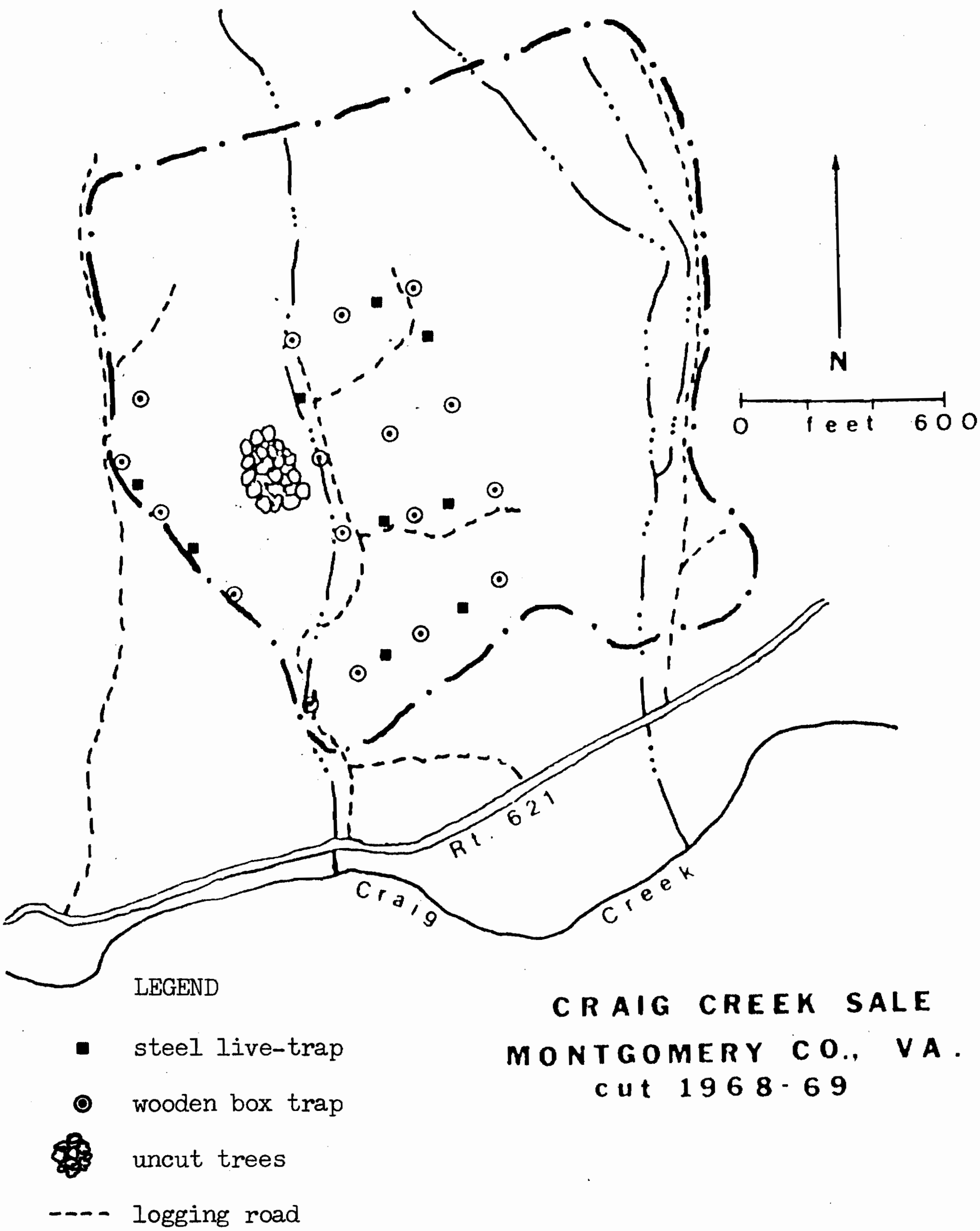


Fig. 10. Location of wooden box and wire mesh (steel) live-traps in the 6- to 7-year-old clearcut.

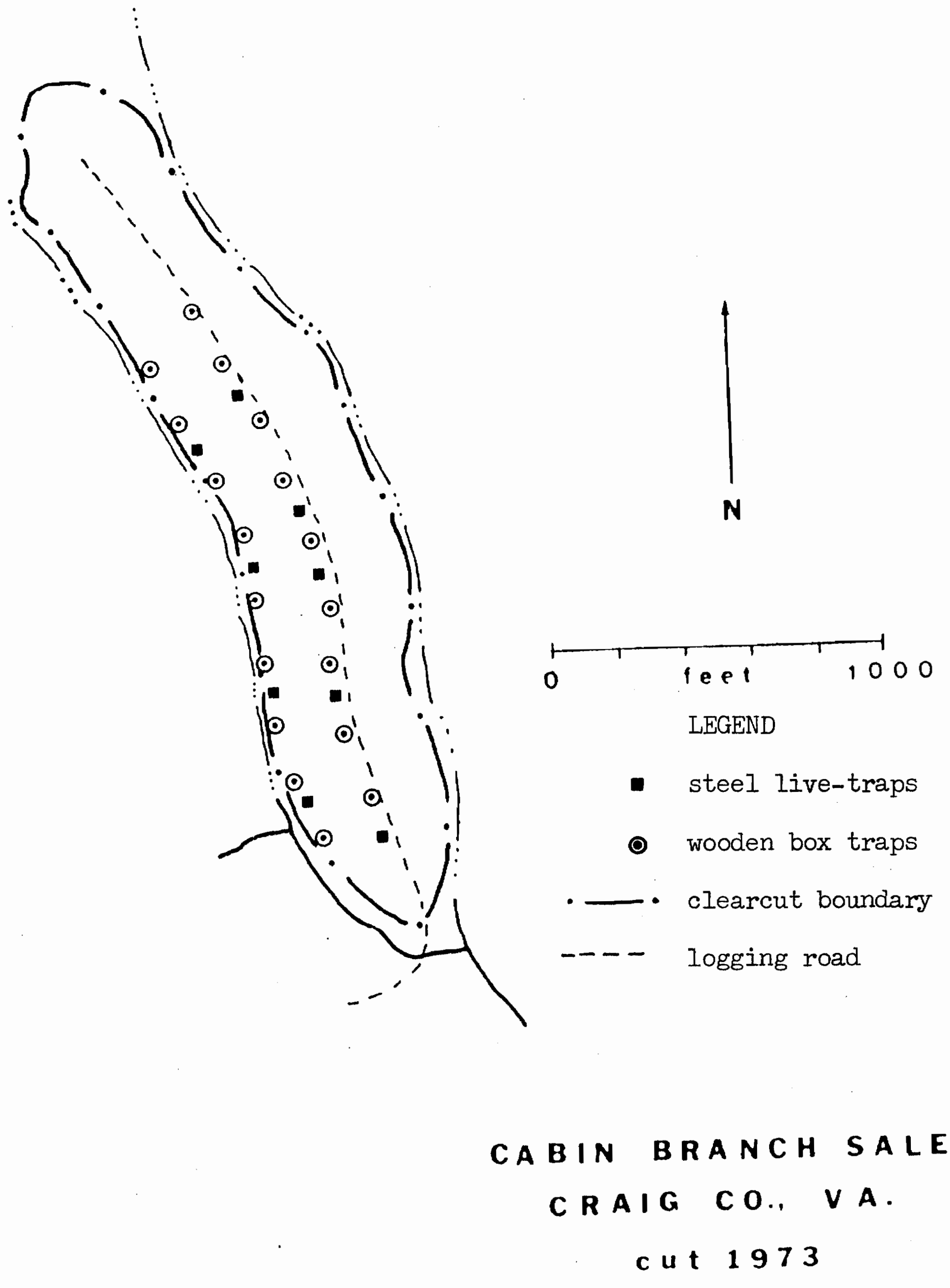


Fig. 11. Location of wooden box and wire mesh (steel) live-traps in the 2-year-old clearcut.

flavored cat food in the wire mesh live traps) as necessary. Captured animals were identified to species, sexed, weighed, and marked using a series of ear notches (Blair 1941). After recording the information the animal was released at the capture site.

Analysis of Small Mammal Data

Relative abundance. Relative abundance was determined for small mammals by comparing corrected catch per unit effort (Nelson and Clark 1973) and catch per unit effort in the 3 selected stages of succession under investigation.

Relative use of clearcuts. To determine the relative use of clearcuts by the larger mammals, the weighted numbers of live trap captures in each clearcut were compared, and trends of increasing or decreasing numbers of captures as a function of the trap's closest distance to the uncut forest noted. Additionally, both catch per unit effort and the estimated number of tracks per 1000 m of snow covered logging road were compared. Due to the small sample size of many of the species captured or observed, statistical tests based on data accumulated during this phase of the study were deemed to be inappropriate.

Species diversity. A brief summary of the theory and application of information theory as an index to species diversity was provided earlier. Lloyd (1968) noted that the formula used as an index to species diversity was relatively unimportant when areas were compared as long as the same formula was used in making the comparisons. Since Shannon's (1948) formula appeared in the literature more than other formulas, it was used to analyze the small mammal data.

To reduce possible bias resulting from unequal sampling intensities, the estimated species diversity for small mammals was computed using a weighted figure based on catch per unit of effort. The resulting trends were then checked against H' figures using unweighted numbers, and with H (Brillion's formula) using both weighted and unweighted numbers.

Use of Clearcuts by Deer

Two sign indices (snow track-counts and pellet counts) were used in determining the relative use of and distance traveled into clearcuts by white-tailed deer (*Odocoileus virginianus*).

Snow Track-counts

The methodology used for this index was identical to the methods described earlier under the small mammal section.

Pellet Group Analysis

A single count of deer pellets was made along systematically placed belt transects in each study area during the period 15 March through 2 May 1975. Belt transects were laid out at 30.5 m (100-ft) intervals with a forester's compass and Jacob's staff along an azimuth approximately perpendicular to the east and west edges, and parallel to the north edge of the study areas. Each transect was run once and all deer pellet groups within 0.76 m (2.5 ft) of the sighted azimuth were counted. No distinction was made between fractions of a pellet group and an entire group. At each deer pellet group the distance from the start of the transect was recorded using a 6-in (15.24 cm) range finder.

Distance traveled into clearcuts. To determine the distance traveled into clearcuts by white-tailed deer, each area was divided into 30.5 m concentric intervals on overlay maps beginning at the edge and extending into the clearings (Fig. 12). Transparent overlays of the transects (Fig. 13-15), and the location of deer pellet groups were prepared. From these overlays it was possible to determine the number of 1.5 x 3-m plots within each distance classification that had one or more pellets in them (positive plots). Since a plot was either positive or negative (multiple groups were not counted) it was thought that using plots would minimize the effect of clumping, and provide a better weighted sample than would the number of pellet groups per acre.

Relative use of clearcuts. The number of deer pellet groups per acre was determined to evaluate the usage by white-tailed deer of the uncut area and the 2 selected stages of succession after clearcutting. From the overlay maps the number of square feet covered along each transect was calculated and converted into acres for each distance class. The number of pellet groups found in each of these classes was then divided by the corresponding number of acres to give pellet groups per acre.

Statistical Analysis of Deer Pellet Group Data

Distance traveled into clearcuts. The plot data (percent of positive

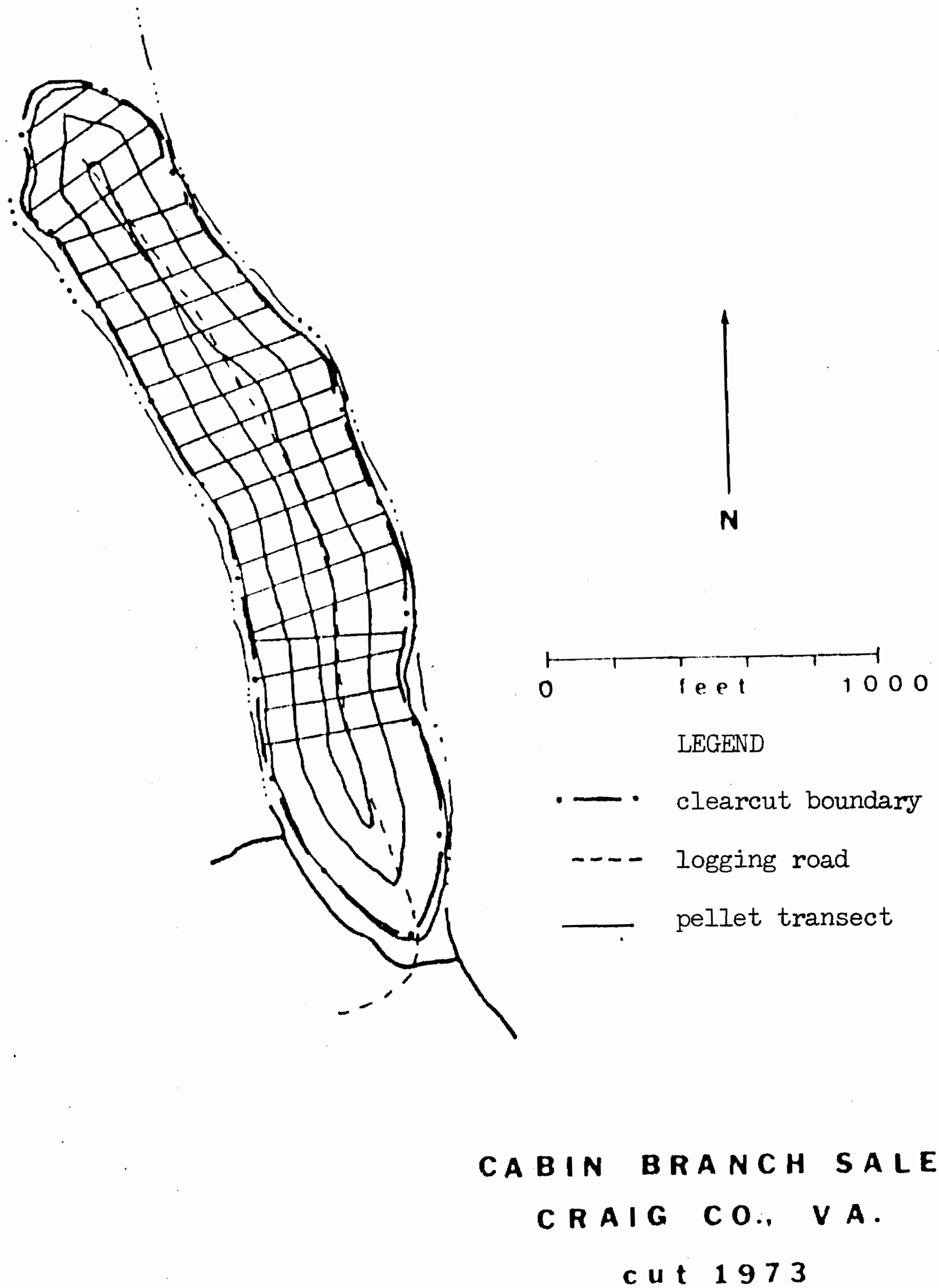


Fig. 12. Example of composite overlays showing concentric 30.5-m (100-ft) rings and belt transects.

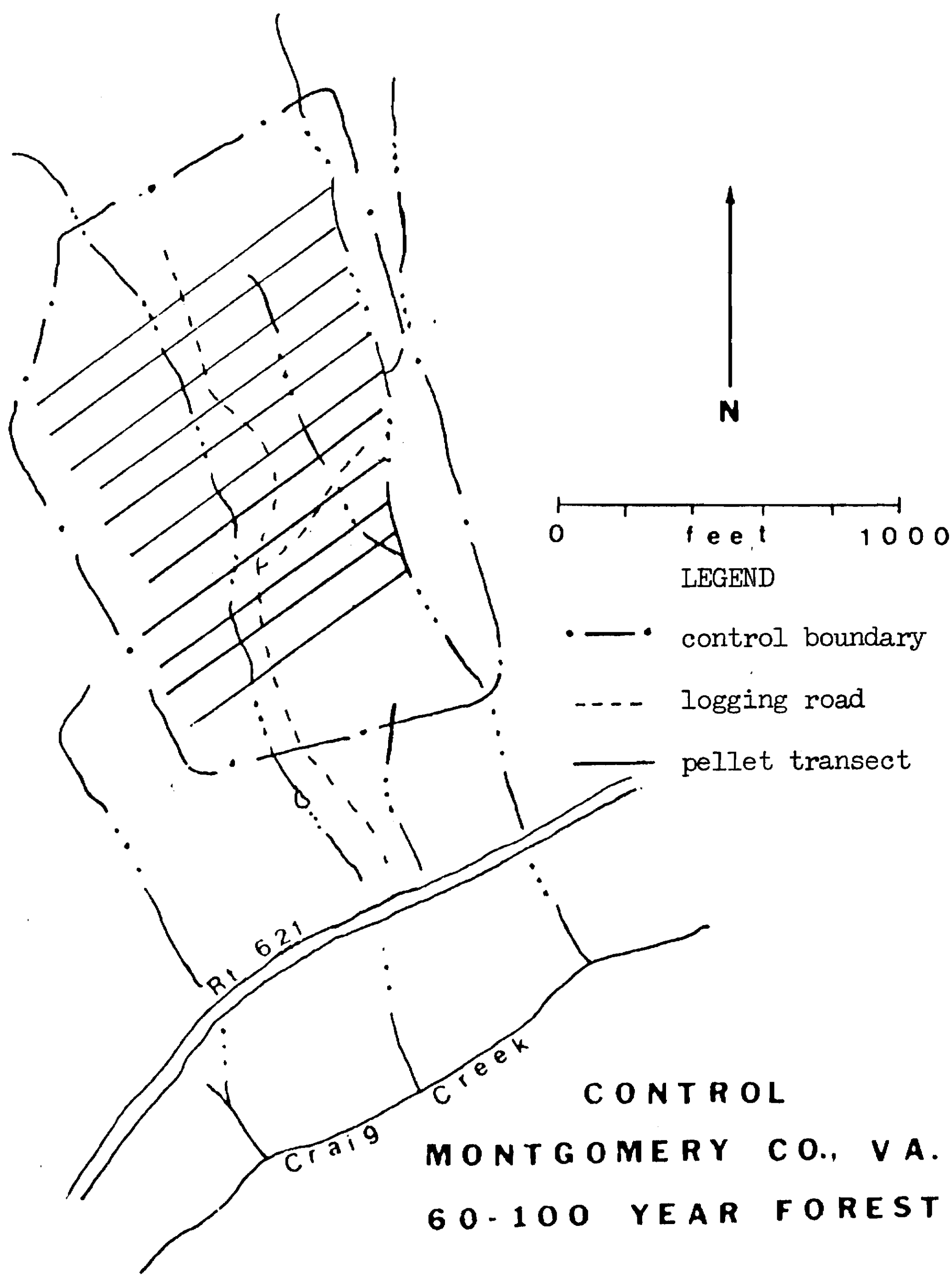


Fig. 13. Location of belt transects used in deer pellet group counts in the 60- to 100-year-old forest (control).

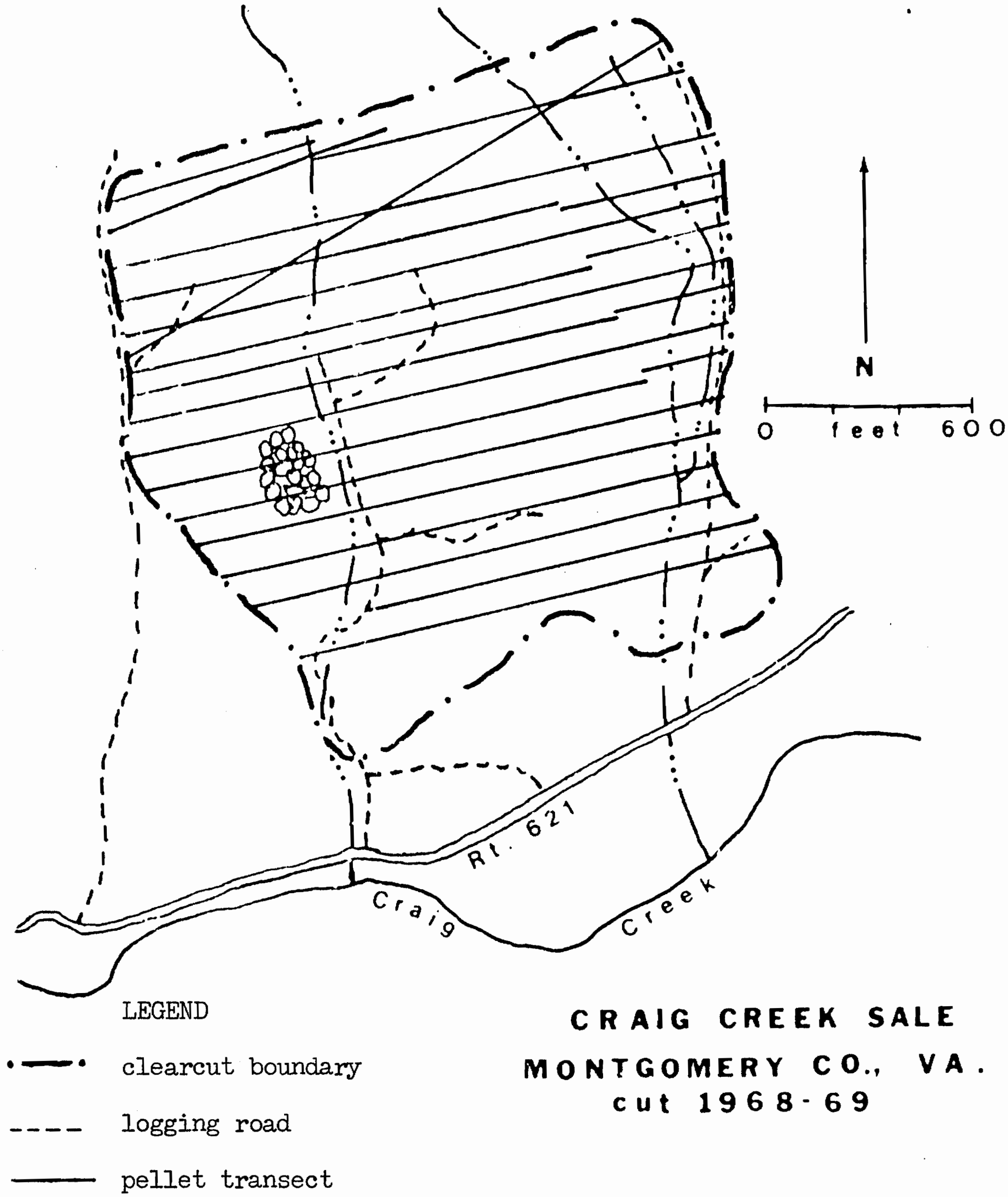


Fig. 14. Location of belt transects used in deer pellet group counts in the 6- to 7-year-old clearcut.

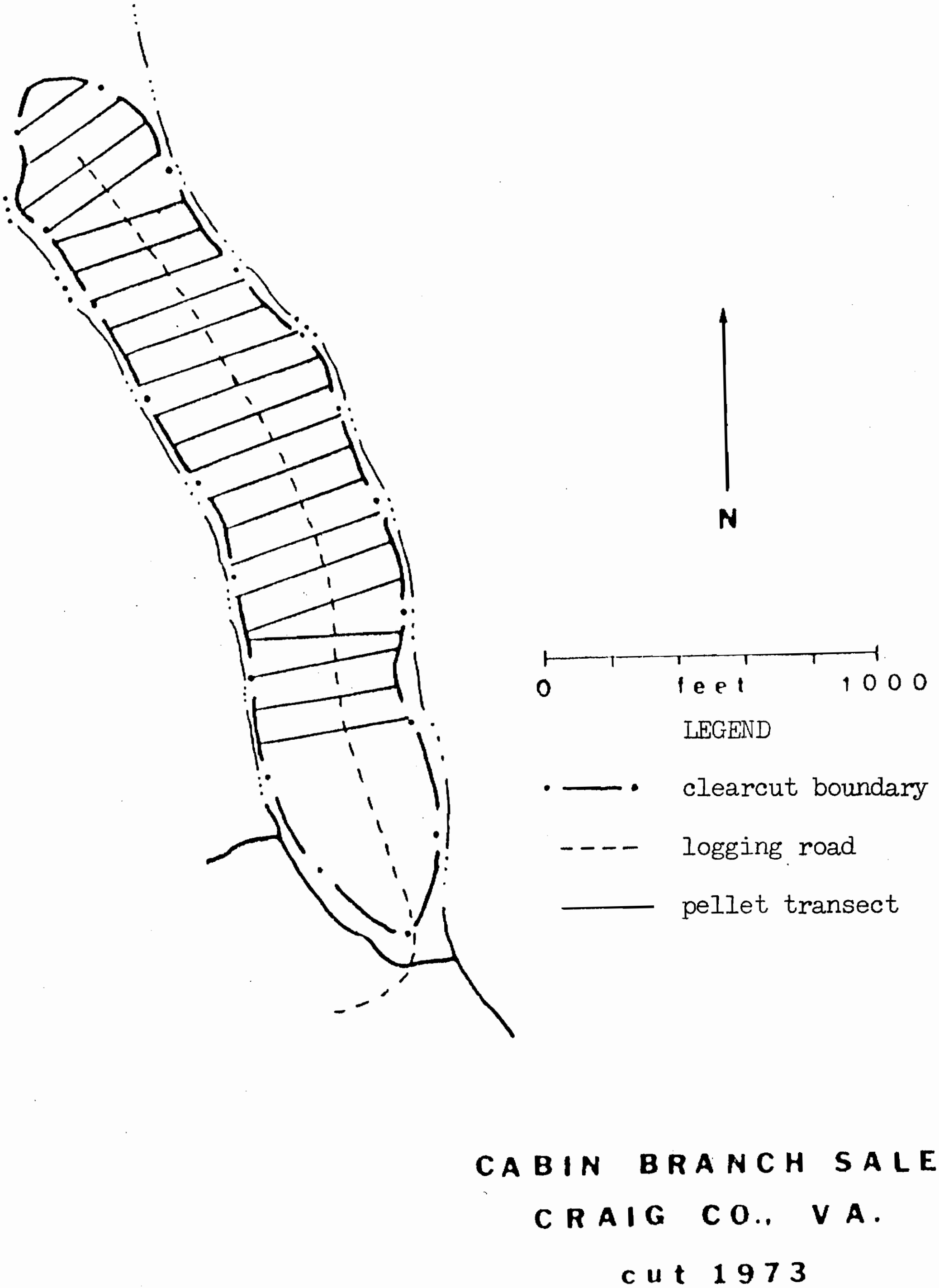


Fig. 15. Location of belt transects used in deer pellet group counts in the 2-year-old clearcut.

1.5 x 3 m plots) were transformed using the arcsin transformation (arcsin P) as suggested by Snedecor (1956:316) for percent data. Bartlett's test for homogeneity of variances was applied to the transformed data.

Distance classifications (distance from the edge by 30.5 m intervals) were compared in each area by analysis of variance and linear regression to determine if significant differences occurred in the number of positive plots, and to determine whether the number of positive plots were related to distance from the clearcut edge. Data were analyzed using the Statistical Analysis System (Barr and Goodnight 1971) implemented on the IBM 370/155 processing system. Analysis of variance was based on the least squares regression principle due to unequal sample sizes encountered in the data.

When a significant difference ($P<0.10$) occurred in the analysis of variance, a modified Duncan's (Kramer 1956) multiple range test was used to determine the location and magnitude of the difference.

Relative use of clearcuts. Bartlett's test for homogeneity of variances on the group data (number of deer pellet groups per acre by distance class) was significant when the 3 areas were compared, indicating that the null hypothesis of heteroscedasticity could not be rejected (variances were not homogeneous). The data were then transformed using a square root transformation ($\sqrt{x + 1}$) as suggested by Snedecor (1956:315) in an effort to make the varnaces homogeneous. Bartlett's test of homogeneity of variances on the transformed data was also significant. Since the hypothesis of heteroscedasticity could not be rejected, an ordinary analysis of variance would not be appropriate. Consequently, the 3 study areas were compared by an approximate test of equality of means (Snedecor 1956:288) to determine if significant differences occurred in the number of pellet groups per acre. Approximate t-tests (Sokal and Rohlf 1969:376) were then used to determine the locations and magnitudes of the differences.

RESULTS

Vegetation Analysis

Stratification

Strata classifications, although descriptive of vegetative forms (i.e. shrubs and herbs), were used solely as a means of describing vertical stratification. Using this criterion, then, the low herb, tall herb and shrub strata contained both woody and herbaceous species. In other words, a very tall herbaceous species, such as fire weed (Erechtites hieracifolia) which may attain a height of 2.5 m (8 ft), would fall within the "shrub layer" classification.

The transectal graphs (Fig. 4) indicated distinct stratification in all areas. From the graphs the following limits for the shrub, tall herb, and low herb strata were derived (Table 1): In the 60- to 100-year-old forest (control) the shrub stratum contained plants 0.9- to 4.6-m (3- to 15-ft) in height, the tall herb stratum represented plants from 0.2- to 0.9-m (8-in to 3-ft) tall, and plants less than 0.2-m (8-in) in height were classed in the low herb stratum. The shrub stratum in the 6- to 7-year-old clearcut was represented by plants greater than 1.5-m (5-ft) tall and the tall and low herb strata were represented by plants 0.3- to 1.4-m (1- to 4.5-ft) and less than 0.3-m (1-ft) tall respectively. In the 2-year-old clearcut, plants greater than 1.2-m (4-ft) in height were designated as shrubs, and plants from 0.15- to 1.2-m (0.5- to 4-ft) and plants less than 0.15-m (0.5-ft) were labeled as tall herbs and low herbs respectively.

Table 1. Height limits of the shrub, tall herb, and low herb strata in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Area	Strata (in meters)		
	Shrub	Tall herb	Low herb
Control	0.91 - 4.57	0.20 - 0.91	< 0.20
6- to 7-yr cut	> 1.52	0.30 - 1.37	< 0.30
2-yr cut	> 1.22	0.15 - 1.22	< 0.15

Density

As shown in Table 2, the 6- to 7-year-old clearcut had the highest density of shrubs per acre and the 2-year-old clearcut the lowest density. For the two herb strata the 60- to 100-year-old forest had the lowest density of stems per acre, the 2-year-old clearcut had the highest density of tall herbs, and the 6- to 7-year-old clearcut the highest density of low herbs.

Dominance

Tree strata. In the 60- to 100-year-old forest, trees in the canopy stratum when ranked according to their importance value (Curtis and McIntosh 1951) indicated that oaks (Quercus alba, Q. prinus, Q. velutina, and Q. coccinea) were the dominant species. Red maple (Acer rubrum), yellow poplar (Liriodendron tulipifera), and hickory (Carya glabra and C. tomentosa) were associated species (Table 3). The subcanopy was dominated by red maple and sourwood (Oxydendrum arboreum) with chestnut oak (Quercus prinus), white oak (Quercus alba), mockernut hickory (Carya tomentosa), black oak (Quercus velutina), and flowering dogwood (Cornus florida) as associated species (Table 4).

When the number of stems in the canopy and subcanopy data were combined and trees 10.2 cm (4 in) and over dbh used (Table 5) the importance values indicated that oaks (Quercus alba, Q. prinus, and Q. velutina) were the dominant species. Red maple, scarlet oak (Quercus coccinea), yellow poplar, sourwood, and hickory (Carya tomentosa and C. glabra) were associated species. For importance values of other recorded tree species see Appendix Tables I-III.

Table 2. Density (number of stems per acre) of vegetation in the canopy, subcanopy, combined canopy and subcanopy (all trees 10.2 cm or greater dbh), shrub, tall herb, and low herb strata in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

	Stems per acre		
Strata	Control (n)	6- to 7-yr cut (n)	2-yr cut (n)
Canopy	115	--	--
Subcanopy	263	--	--
Stems 10.2 cm + dbh	173	--	--
Shrub	895	2,658	594
Tall Herb	9,262	31,226	45,571
Low Herb	40,527	101,172	63,224

Table 3. The 10 most important species of trees (based on importance values) in the canopy stratum of a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Quercus alba	29.01		21.08		28.77		78.86
Quercus prinus	17.59		17.49		14.53		49.61
Quercus velutina	13.89		13.90		18.23		46.02
Quercus coccinea	10.80		11.66		11.70		34.16
Acer rubrum	7.10		8.07		7.51		22.68
Liriodendron tulipifera	6.48		7.17		7.34		20.99
Carya glabra	4.01		5.83		2.94		12.78
Carya tomentosa	3.70		4.93		2.69		11.32
Quercus rubra	1.24		1.79		2.29		5.32
Nyssa sylvatica	1.54		1.79		1.12		4.45

Table 4. The 10 most important species of trees (based on importance values) in the subcanopy stratum of a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Acer rubrum	28.09		21.94		24.52		74.55
Oxydendrum arboreum	13.89		13.50		15.08		42.47
Quercus prinus	11.73		10.13		16.75		38.61
Quercus alba	9.88		10.13		11.30		31.31
Carya tomentosa	5.56		6.75		6.27		18.58
Quercus velutina	5.56		6.33		5.41		17.30
Cornus florida	5.86		7.17		2.09		15.12
Carya glabra	4.01		5.06		3.26		12.33
Nyssa sylvatica	3.09		3.38		1.92		8.39
Liriodendron tulipifera	2.62		2.53		2.56		7.71

Table 5. The 10 most important species of trees 10.2 cm (4 in) or greater dbh (based on importance values) in the combined overstory and understory strata of a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Quercus alba	23.77		17.37		24.44		65.58
Quercus prinus	17.90		16.53		16.01		50.44
Quercus velutina	11.73		13.14		17.14		42.01
Acer rubrum	10.19		9.75		9.43		29.37
Quercus coccinea	8.33		9.32		9.82		27.47
Liriodendron tulipifera	4.94		5.08		6.83		16.85
Oxydendrum arboreum	5.25		6.78		1.69		13.72
Carya tomentosa	4.01		5.51		2.96		12.48
Carya glabra	4.01		4.66		2.99		11.66
Nyssa sylvatica	2.47		2.54		1.84		6.85

Shrub stratum. Based on importance values (Table 6) red maple and flowering dogwood seedlings, mountain laurel (Kalmia latifolia), and sourwood seedlings were the dominant plant species in the shrub stratum of the control area. In the 6- to 7-year-old clearcut this stratum was dominated by sassafras (Sassafras albidum), and black gum (Nyssa sylvatica), scarlet oak, and yellow poplar regeneration. Flowering dogwood, red maple, sassafras, and black gum regeneration appeared to be dominant in the shrub stratum of the 2-year-old clearcut. See Appendix Tables IV-VI for importance values of other plant species found in the shrub stratum of these areas.

Tall herb stratum. Table 7 indicated that naked-flowered tick-trefoil (Desmodium nudiflorum), sassafras regeneration, and blueberries (Vaccinium spp.) were the dominant species of plants in the tall herb layer of the uncut forest (control). This stratum in the 6- to 7-year-old clearcut was dominated (as determined from importance values) by blueberries, mountain laurel regeneration, and huckleberry (Gaylussacia baccata). Blueberries, fireweed (Erechtites hieracifolia), and sassafras regeneration appeared to be the dominant species in the tall herb stratum of the 2-year-old clearcut. Appendix Tables VII-IX lists importance values of all plant species recorded in this stratum in the three study areas.

Low herb stratum. Table 8 shows that naked-flowered tick-trefoil and blueberries appeared to be the dominant low herb species according to their importance values in the uncut forest. In the 6- to 7-year-old clearcut this stratum was apparently dominated by

Table 6. The 10 most important plant species in the shrub stratum (based on importance value) of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-year cut		2-year cut	
Species	I. value*	Species	I. value*	Species	I. value*
Acer rubrum	50.16	_Sassafras albidum_	48.52	_Cornus florida_	49.92
Cornus florida	48.98	_Nyssa sylvatica_	34.36	_Acer rubrum_	40.60
Kalmia latifolia	35.26	_Quercus coccinea_	27.98	_Sassafras albidum_	36.13
Oxydendrum arboreum	33.37	_Liriodendron tulipifera_	23.92	_Nyssa sylvatica_	30.63
Nyssa sylvatica	21.30	_Acer rubrum_	23.08	_Erechtites hieracifolia_	24.99
Sassafras albidum	17.91	_Quercus prinus_	22.11	_Quercus prinus_	15.10
Amelanchier arborea	14.71	_Pinus pungens_	18.83	_Oxydendrum arboreum_	15.02
Castanea dentata	12.81	_Oxydendrum arboreum_	18.69	_Robinia pseudoacacia_	13.21

Table 6. The 10 most important plant species in the shrub stratum (based on importance value) of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974 (continued).

Control		6- to 7-year cut		2-year cut	
Species	I. value*	Species	I. value*	Species	I. value*
Quercus velutina	10.48	*Pinus strobus*	15.95	*Kalmia latifolia*	12.31
Carya tomentosa	9.47	*Cornus florida*	14.16	*Cirsium vulgare*	11.27

*I. value = Importance value

Table 7. The 10 most important plant species in the tall herb stratum (based on importance values) of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-year cut		2-year cut	
Species	I. value*	Species	I. value*	Species	I. value*
Desmodium nudiflorum	30.02	*Vaccinium spp.*	66.77	*Vaccinium spp.*	58.19
Sassafras albidum	25.64	*Kalmia latifolia*	45.19	*Erechtites hieracifolia*	48.68
Vaccinium spp.	24.45	*Gaylussacia baccata*	22.76	*Sassafras albidum*	34.63
Quercus velutina	17.66	*Quercus coccinea*	15.64	*Rhododendron spp.*	15.18
Quercus prinus	15.63	*Cornus florida*	12.92	*Nyssa sylvatica*	13.04
Kalmia latifolia	13.04	*Sassafras albidum*	12.26	*Panicum spp.*	12.47
Cornus florida	12.92	*Quercus prinus*	8.75	*Kalmia latifolia*	10.45
Castanea dentata	12.46	*Vitis aestivalis*	8.44	*Cornus florida*	8.80
Nyssa sylvatica	11.23	*Nyssa sylvatica*	6.72	*Dactylis glomerata*	8.40
Dioscorea villosa	8.88	*Smilax glauca*	5.98	*Smilax glauca*	8.32

*I. value = Importance value

Table 8. The 10 most important plant species in the low herb stratum (based on importance values) of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-year cut		2-year cut	
Species	I. value*	Species	I. value*	Species	I. value*
Desmodium nudiflorum	32.02	Vaccinium spp.	69.09	Vaccinium spp.	71.85
Vaccinium spp.	21.71	Gaultheria procumbens	39.40	Rhododendron spp.	40.37
Gaultheria procumbens	19.16	Potentilla canadensis	27.18	Erechtites hieracifolia	28.70
Quercus alba	18.80	Galax aphylla	14.06	Vitis aestivalis	16.31
Chimaphila maculata	17.17	Kalmia latifolia	13.76	Potentilla canadensis	12.18
Acer rubrum	11.01	Epigaea repens	11.42	Liriodendron tulipifera	12.10
Smilax glauca	10.54	Gaylussacia baccata	10.35	Desmodium nudiflorum	10.11
Quercus prinus	10.52	Parthenocissus quinquefolia	9.80	Panicum spp.	8.09
Rhododendron spp.	9.98	Panicum spp.	7.52	Vaccinium stamineum	7.24
Clintonia borealis	9.70	Acer rubrum	7.48	Cornus florida	6.93

*I. value = Importance value

blueberries, teaberry (Gaultheria procumbens), and dwarf cinquefoil (Potentilla canadensis). Blueberries, azalea (Rhododendron spp.) regeneration, and fireweed seemingly dominated the low herb stratum of the 2-year-old clearcut. Importance values of all plant species recorded as low herbs are listed on Appendix Tables X- XII.

Frequency

Tree strata. As Table 9 shows, oaks (Quercus alba, Q. prinus, Q. velutina, and Q. coccinea) were the most common trees (based on frequency of occurrence) in the canopy stratum of the uncut forest. Red maple regeneration and sourwood were the trees occurring most frequently in the subcanopy stratum.

When the canopy and subcanopy strata were combined using all trees 10.2 cm (4-in) or greater dbh, oaks (Quercus alba, Q. prinus, and Q. velutina) occurred at more sampling stations (51, 48, and 38 percent of the stations respectively) than other tree species.

Shrub stratum. In the control area, Table 10 shows that red maple and flowering dogwood regeneration were present at 47 percent of the sampling stations, and were the plant species encountered most frequently in the shrub stratum. In the 6- to 7-year-old clearcut, however, sassafras and black gum regeneration had the highest frequency of occurrence (53 and 40 percent respectively). Red maple regeneration and sassafras were found to occur more frequently (52 and 39 percent respectively) than other plants in the shrub stratum of the 2-year-old clearcut.

Table 9. The frequency of occurrence of the 10 most common tree species of the canopy, subcanopy, and canopy + subcanopy (all trees 10.2 cm or greater dbh) strata in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; summer 1974.

Canopy		Subcanopy		All trees 10.2 cm or greater	
Species	Frequency (percent)	Species	Frequency (percent)	Species	Frequency (percent)
Quercus alba	58	Acer rubrum	64	Quercus alba	51
Quercus prinus	48	Oxydendrum arboreum	40	Quercus prinus	48
Quercus velutina	38	Quercus alba	30	Quercus velutina	38
Quercus coccinea	32	Quercus prinus	30	Acer rubrum	28
Acer rubrum	22	Cornus florida	21	Quercus coccinea	27
Liriodendron tulipifera	20	Carya tomentosa	20	Oxydendrum arboreum	20
Carya glabra	16	Quercus velutina	19	Carya tomentosa	16
Carya tomentosa	14	Carya glabra	15	Liriodendron tulipifera	15
Nyssa sylvatica	5	Nyssa sylvatica	10	Carya glabra	14
Quercus rubra	5	Liriodendron tulipifera	7	Nyssa sylvatica	7

Table 10. The frequency of occurrence of the 10 most common plant species in the shrub stratum of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-yr cut		2-yr cut	
Species	Frequency (percent)	Species	Frequency (percent)	Species	Frequency (percent)
Acer rubrum	47	*Sassafras albidum*	53	*Acer rubrum*	52
Cornus florida	47	*Nyssa sylvatica*	40	*Sassafras albidum*	39
Oxydendrum arboreum	31	*Quercus coccinea*	29	*Nyssa sylvatica*	33
Sassafras albidum	22	*Acer rubrum*	26	*Cornus florida*	26
Nyssa sylvatica	19	*Liriodendron tulipifera*	24	*Erechtites hieracifolia*	26
Amelanchier arborea	16	*Quercus prinus*	19	*Quercus prinus*	17
Castanea dentata	14	*Pinus strobus*	17	*Robinia pseudoacacia*	17
Quercus velutina	14	*Oxydendrum arboreum*	15	*Oxydendrum arboreum*	15
Carya tomentosa	12	*Cornus florida*	14	*Cirsium vulgare*	11
Acer saccharum	11	*Pinus pungens*	14	*Kalmia latifolia*	11

Tall herb stratum. Naked-flowered tick-trefoil, blueberries, and sassafras regeneration had the highest frequency of occurrence in the tall herb stratum of the uncut forest. In the 6- to 7-year-old and 2-year-old clearcuts blueberries were by far the most common species occurring at 59 percent and 52 percent of the sampling stations, respectively (Table 11).

Low herb stratum. Table 12 shows that naked-flowered tick-trefoil was the most common species in the low herb stratum of the control area since it occurred at nearly twice as many sampling stations as any other plant species. In the 6- to 7-year-old clearcut blueberries (38 percent) and teaberry (32 percent) had the highest frequency of occurrence. Blueberries also seemed to be the most common plant in the low herb stratum of the 2-year-old clearcut where it occurred at 50 percent of all sampling stations.

Species Diversity

Strata. Using Brillouin's (1956) index of species diversity, Table 13 shows that, when all the vegetation data were treated as a single population, the uncut forest (control) had the highest species diversity, and the 2-year-old clearcut had the lowest diversity of plant species in the shrub, tall herb, and low herb strata.

Areas. When all recorded plants in each area were combined regardless of strata (Table 14), the 6- to 7-year-old clearcut showed the highest diversity of plant species, and the 2-year-old clearcut the lowest diversity. Removal of the canopy and subcanopy data,

Table 11. The frequency of occurrence of the 10 most common plant species in the tall herb stratum of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-yr cut		2-yr cut	
Species	Frequency (percent)	Species	Frequency (percent)	Species	Frequency (percent)
Desmodium nudiflorum	33	Vaccinium spp.	59	Vaccinium spp.	52
Vaccinium spp.	27	Kalmia latifolia	27	Erechtites hieracifolia	24
Sassafras albidum	26	Gaylussacia baccata	20	Sassafras albidum	22
Quercus velutina	16	Sassafras albidum	14	Panicum spp.	17
Cornus florida	15	Quercus coccinea	12	Rhododendron spp.	15
Dioscorea villosa	11	Vitis aestivalis	10	Nyssa sylvatica	11
Nyssa sylvatica	10	Smilax glauca	8	Smilax glauca	11
Quercus coccinea	10	Panicum spp.	8	Vaccinium stamineum	9
Vaccinium stamineum	10	Nyssa sylvatica	6	Acer rubrum	7
Rhododendron spp.	9	Quercus prinus	6	Kalmia latifolia	7

Table 12. The frequency of occurrence of the 10 most common plant species in the low herb stratum of a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Control		6- to 7-yr cut		2-yr cut	
Species	Frequency (percent)	Species	Frequency (percent)	Species	Frequency (percent)
Desmodium nudiflorum	33	Vaccinium spp.	38	Vaccinium spp.	50
Gaultheria procumbens	17	Gaultheria procumbens	32	Rhododendron spp.	28
Vaccinium spp.	17	Potentilla canadensis	22	Erechtites hieracifolia	20
Chimaphila maculata	15	Galax aphylla	13	Vitis aestivalis	17
Quercus alba	15	Panicum spp.	10	Liriodendron tulipifera	15
Acer rubrum	14	Epigaea repens	9	Desmodium nudiflorum	11
Smilax glauca	11	Gaylussacia baccata	9	Potentilla canadensis	11
Dioscorea villosa	10	Kalmia latifolia	8	Panicum spp.	9
Quercus prinus	10	Acer rubrum	7	Smilax glauca	7
Quercus velutina	10	Viola spp.	7	Vaccinium stamineum	7

Table 13. Diversity indices (Brillouin 1956) of plants in the canopy, subcanopy, shrub, tall herb, and low herb strata in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Strata	N[a]	s	H_{max}	J	H_{obs}
Canopy					
Control	324	18	1.2032	0.7416	0.8923
6- to 7-yr cut	--	--	--	--	--
2-yr cut	--	--	--	--	--
Subcanopy					
Control	324	21	1.2626	0.7792	0.9837
6- to 7-yr cut	--	--	--	--	--
2-yr cut	--	--	--	--	--
Shrub					
Control	324	32	1.4206	0.8042	1.1424
6- to 7-yr cut	412	36	1.4786	0.7671	1.1343
2-yr cut	216	26	1.3177	0.8209	1.0817
Tall herb					
Control	324	54	1.6580	0.8107	1.3442
6- to 7-yr cut	412	55	1.6312	0.7624	1.2294
2-yr cut	216	39	1.4769	0.7794	1.1510
Low herb					
Control	324	53	1.5983	0.8610	1.3761
6- to 7-yr cut	412	51	1.6057	0.7362	1.1819
2-yr cut	216	34	1.4107	0.8095	1.1420

a/ Designation of the column headings are:

N = total number of individuals observed

s = total number of species observed

H_{obs} = species diversity index

H_{max} = maximum diversity index if individuals were evenly distributed among species

J = H_{obs}/H_{max} = collection's evenness; the evenness with which individuals are distributed among species

Table 14. Diversity indices (Brillouin 1956) of shrub, tall herb, and low herb strata (plus the canopy and subcanopy strata in the control) in three selected stages of succession: a 60- to 100-year-old forest (control) and two clearcuts (a 6- to 7-year-old and 2-year-old cut) in Montgomery and Craig Cos., Virginia; summer 1974.

Area	N[a]	s	H_{max}	J	H_{obs}
Control					
All strata	1620	80	1.8522	0.7847	1.4535
shrub, tall herb, and low herb strata	972	76	1.8078	0.8362	1.5118
6- to 7-yr cut	1236	87	1.8721	0.7879	1.4750
2-yr cut	648	57	1.6765	0.8074	1.3536

a/ Designation of column headings are:

N = total number of individuals observed

s = total number of species observed

H_{obs} = species diversity index

H_{max} = maximum diversity index if individuals were evenly distributed among species

J = H_{obs}/H_{max} = collection's evenness; the evenness with which individuals are distributed among species so that only the strata common to all 3 areas remained (shrub, tall herb, and low herb strata), increased the diversity index value in the uncut forest. A comparison of diversity index values among the 3 areas showed that the uncut forest had the highest index of species diversity as well as the most even distribution of individuals among species observed. In other words, individuals were distributed 84 percent as evenly as possible.

Logging Residue

Analysis of data recorded from 27 sampling stations in the 2-year-old clearcut indicated that 28 (±5) percent of the area was covered an average of 1.07 (± 0.06) m deep by slash.

Unfortunately, spring leaf-out occurred in the 6- to 7-year-old clearcut before measurements could be taken.

Small Mammals

Sign Indices

Dropping boards. Of the 145 pellet boards placed in the study areas only 1 board was positive (*Peromyscus leucopus* droppings in the control area) after 24 hours. At 72 hours no boards were found to be positive for fecal deposits, but 3 boards in the 6- to 7-year-old clearcut showed moderate to severe gnawing from *Peromyscus*. After a total of 120 hours (725 board-nights) no additional evidence of small mammal utilization of the dropping boards was observed.

Antler segments. After 218 days a total of 43 of the original 55 antler segments were located and recovered. None of the recovered segments showed evidence of small rodent feeding activity.

Periphery snow track-counts. The snow storm of 1 and 2 December 1974 was the only storm from which snow covered the ground long enough to perform periphery counts on all study areas. As Table 15 shows, the 2-year-old clearcut evidenced the greatest amount of activity with 3 species of small mammals identified for a total of 11 sets of tracks. The control showed the next highest utilization with 3 species and 5 sets of tracks recorded. The 6- to 7-year-old clearcut showed the least amount of use with only 1 species and 1 set of tracks found.

Logging road snow track-counts. The snow track-counts from logging roads within each area provided a total of 65 sets of small mammal tracks from 8 identified species after snow storms on 1 and 2 December 1974; 20 January, 4 February and 11 March 1975. As Table 16 shows, the 6- to 7-year-old clearcut provided the greatest amount of use with a calculated 103 sets of tracks per 1000 m of logging road. However, 1 genus (*Sylvilagus*) accounted for 94 percent of the tracks. The extrapolated number of track sets per 1000 m of logging road in the uncut forest indicated a total of 66 sets of tracks from 5 species of small mammals. Although the uncut forest showed 36 percent fewer track sets, it had 60 percent more species represented; none of which accounted for more than a 3rd of the tracks. The 2-year-old clearcut appeared to have the least amount of use with 3 small mammal species leaving an estimated total of 10 sets of tracks per 1000 m of logging road.

Table 15. Number of mammalian track sets (excluding white-tailed deer) observed entering a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Counties, Virginia after the snow storm of 1 and 2 December 1974.

Species	Control	6- to 7-yr cut	2-yr cut
Sylvilagus spp.	0	1	9
Glaucomys volans	1	0	0
Sciurus carolinensis	3	0	0
Urocyon cinereoargenteus	0	0	1
Mephitis mephitis	0	0	1
Spilogale putorius	1	0	0
Ursus americanus	0	0	1
Total track sets	5	1	12
Total species	3	1	4

Table 16. Extrapolated and actual number of mammal track sets (excluding white-tailed deer) found on logging roads in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; late fall and winter 1974-75.

Species	Control		6- to 7-yr cut		2-yr cut	
	Actual (350 m)	Weighted (1000 m)	Actual (350 m)	Weighted (1000 m)	Actual (650 m)	Weighted (1000 m)
Didelphis virginianus	2	6	1	3	0	0
Sylvilagus spp.	5	14	34	97	1	2
Sciurus carolinensis	7	20	0	0	0	0
Canis familiaris	0	0	0	0	3	5
Urocyon cinereoargenteus	3	9	1	3	0	0
Mustella frenata	0	0	0	0	1	2
Spilogale putorius	1	3	0	0	0	0
Ursus americanus	0	0	0	0	1	2
Unknowns	5	14	0	0	0	0
Total sets	23	66	36	103	6	11
Total species	5		3		4	

Trapping Indices

<u>Snap and pitfall traps</u>. After 5369 trap-nights utilizing pitfall traps a total of 49 individuals of 7 species were captured. A total of 2841 trap-nights using snap traps accounted for 82 individuals of 6 species.

Comparison of trapping methods (Table 17) revealed that most of the insectivore species were captured in pitfall traps, in fact, only 2 of the 6 insectivore species were represented in the snap trap captures. Snap traps accounted for most of the small rodent captures with the single exception of the woodland jumping mouse (*Napaeozapus insignus*). The absence of *N. insignus* in the snap trapping data is not surprising since it should have been in hibernation during November when this phase of the investigation was undertaken.

When baited versus unbaited pitfall traps (Table 18) were compared, the baited pitfalls accounted for twice as many captures as did the unbaited pitfalls. The success of baited pitfalls was particularly noticeable for the insectivore species which were absent in the snap trapping sample.

<u>Live traps</u>. A total of 4756 trap-nights using wooden box traps and wire mesh live traps provided 82 different individuals of 12 species for a total of 194 captures.

Appendix Tables XVII-XIX show the actual and weighted number (number captured per 1000 trap-nights) of different individuals captured using snap and pitfall traps, and wooden box and wire mesh traps during the 1974-75 fall, winter and spring trapping periods.

Table 17. Catch of small mammals per unit of trapping effort utilizing snap and pitfall traps in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; fall 1974 and spring 1975.

Species	Individuals captured/unit effort*					
	Control		6- to 7-yr cut		2-yr cut	
	snap (N)	pitfall (N)	snap (N)	pitfall (N)	snap (N)	pitfall (N)
Sorex cinereus	0.000	0.160	0.647	0.255	0.000	0.175
Sorex fumeus	0.000	0.106	0.000	0.043	0.000	0.088
Sorex longirostris	0.000	0.053	0.000	0.043	0.000	0.000
Cryptotis parva	0.000	0.000	0.000	0.170	0.000	0.439
Blarina brevicauda	0.313	0.106	0.647	0.043	0.309	0.175
Peromyscus leucopus	0.418	0.106	2.508	0.170	2.469	0.526
Ochrotomys nuttalli	0.000	0.000	0.566	0.000	0.000	0.000
Napaeozapus insignis	0.000	0.160	0.000	0.043	0.000	0.088
Tamias striatus	0.000	0.000	0.081	0.000	0.000	0.000
Glaucomys volans	0.021	0.000	0.000	0.000	0.000	0.000
Totals	0.941	0.691	4.449	0.809	2.778	1.491

*Individuals captured/unit effort = A(100)/TU; where A = number of animals captured of desired species and TU = number of trap nights

Table 18. Comparison of trapping success between baited and unbaited pitfalls in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; spring 1975.

Species	Control		6- to 7-yr cut		2-yr cut		Total	
	baited	unbaited	baited	unbaited	baited	unbaited	baited	unbaited
Sorex fumeus	1	0	0	0	0	0	1	0
S. cinereus	3	0	3	0	C	2	6	2
S. longirostris	1	0	2	0	0	0	3	0
Cryptotis parva	0	0	1	0	0	0	1	0
Blarina brevicauda	0	2	1	0	1	0	2	2
Peromyscus leucopus	0	1	1	2	2	0	3	3
Totals	5	3	8	2	3	2	16	7

Relative Abundance

The 6- to 7-year-old clearcut showed the highest catch per unit of trapping effort with an average of 2.064 individuals captured per 100 trap-nights using snap and pitfall traps, and 7.49 individuals captured per 100 trap-nights utilizing wooden box and wire mesh traps (Tables 19 and 20 respectively). The 2-year-old clearcut had the 2nd highest capture rate (1.679/100 trap-nights) of small rodents and insectivores, but showed the lowest (1.15/100 trap-nights) capture rate of larger small mammals when live traps were used. The 60- to 100-year-old forest with a snap and pitfall trap capture success of 0.777 gave the lowest population of small rodents and insectivores, but the 2nd highest capture rate (3.75 individuals/100 trap-nights) of larger mammals.

When catch per unit of effort for each species (Tables 20 and 21) was compared between areas several trends seemed apparent. Species characteristic of early plant successional stages were found, not surprisingly, to be more prevalent in the 2-year-old clearcut with relative numbers decreasing with successional age. Species classed in this group were the least shrew (*Cryptotis parva*), the eastern cottontail (*Sylvilagus floridanus*), and the stripped skunk (*Mephitis mephitis*). At the other extreme were those species which showed a higher capture success rate in the uncut forest than in the clearcuts. This group included the smoky shrew (*Sorex fumeus*), woodland jumping mouse (*Napaeozapus insignus*), southern flying squirrel (*Glaucomys volans*), eastern gray squirrel

Table 19. Total catch per unit effort of small mammals utilizing snap and pitfall traps in a 60- to 100-year-old forest (control) a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; fall 1974 and spring 1975.

Species	Individuals captured/unit effort*		
	Control (N)	6- to 7-yr cut (N)	2-yr cut (N)
Sorex cinereus	0.106	0.390	0.112
S. fumeus	0.071	0.028	0.056
S. longirostris	0.035	0.056	0.000
Cryptotis parva	0.000	0.112	0.280
Blarina brevicauda	0.176	0.251	0.224
Peromyscus leucopus	0.212	0.976	0.951
Ochrotomys nuttalli	0.000	0.195	0.000
Napaeozapus insignis	0.106	0.028	0.056
Tamias striatus	0.000	0.028	0.000
Glaucomys volans	0.071	0.000	0.000
Totals	0.777	2.064	1.679
No. species	8	10	7

* Individuals captured/unit effort = A(100)/TU;
where A = number of animals captured of desired species
TU = number of trap-nights

Table 20. Total catch of mammals per unit of trapping effort using wire mesh live traps, wooden box traps, and combined wire mesh and box traps (all traps) in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; winter 1974-75.

Area	All traps			Wood box traps			Wire mesh traps		
	CE_1[a] (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)
Control	3.75	3.97	63	2.93	3.09	34	5.56	5.94	29
6- to 7-yr cut	7.49	8.06	113	10.14	11.15	100	2.49	2.57	13
2-yr cut	1.15	1.19	18	1.15	1.20	12	1.15	1.18	6
All areas	4.15	4.39	194	4.58	4.87	146	3.07	3.20	48

a/ Designation of column headings are:

CE_1 = catch/unit effort = A(100)/TU; where A = number of animals captured of desired species
TU = number of trap-nights

CE_2 = corrected catch/unit effort (Nelson and Clark 1973) = A(100)/(TU-IS/2);
where I = length of trapping interval
S = number of traps sprung from all causes

A = number of animals captured

Table 21. Number of individuals captured (A) per unit of trapping effort (CE_1 and CE_2) using wooden box traps and wire mesh live traps in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; winter 1974-75.

Species	Control			6- to 7-yr cut			2-yr cut		
	CE_1[a/] (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)
Spilogale putorius	0.59	0.63	10	0.00	0.00	0	0.13	0.13	2
Mephitis mephitis	0.00	0.00	0	0.20	0.21	3	0.19	0.20	3
Procyon lotor	0.06	0.06	1	0.00	0.00	0	0.06	0.07	1
Canis familiaris	0.18	0.19	3	0.00	0.00	0	0.00	0.00	0
Didelphis virginianus	1.13	1.20	19	0.27	0.29	4	0.06	0.07	1
Sylvilagus transitionalis	0.36	0.38	6	6.43	6.92	97	0.19	0.20	3
Sylvilagus floridanus	0.00	0.00	0	0.13	0.14	2	0.26	0.26	4
Sciurus carolinensis	0.59	0.63	10	0.00	0.00	0	0.06	0.07	1
Glaucomys volans	0.42	0.44	7	0.13	0.14	2	0.00	0.00	0
Tamias striatus	0.30	0.31	5	0.33	0.36	5	0.06	0.07	1

Table 21. Number of individuals captured (A) per unit of trapping effort (CE_1 and CE_2) using wooden box traps and wire mesh live traps in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; winter 1974-75 (continued).

	Control			6- to 7-yr cut			2-yr cut		
Species	CE_1[a/] (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)	CE_1 (percent)	CE_2 (percent)	A (n)
Peromyscus leucopus	0.12	0.13	2	0.00	0.00	0	0.06	0.07	1
Blarina brevicauda	0.00	0.00	0	0.00	0.00	0	0.06	0.07	1
Total									
individuals			63			113			18
species			9			6			10

[a/] Designation of the column headings are:

CE_1 = catch/unit effort = A(100)/TU; where A = number of animals captured of the desired species
TU = number of trap-nights

CE_2 = corrected catch/unit effort (Nelson and Clark 1973) = A(100)/(TU-IS/2);
where I = length of trapping interval
S = number of traps sprung from all causes

A = number of captures of the desired species

(Sciurus carolinensis), spotted skunk (Spilogale putorius), and (from these data) the opossum (Didelphis virginianus). A 3rd category was those species which seemed to prefer, or were very common, in the older secondary successional stage represented by the 6- to 7-year-old clearcut. Listed within this classification were the masked shrew (Sorex cinereus), southeastern shrew (Sorex longirostris), short-tailed shrew (Blarina brevicauda), white-footed mouse (Peromyscus leucopus), golden mouse (Ochrotomya nuttalli), and the New England cottontail (Sylvilagus transitionalis).

Use of Interior of Clearcuts

In the 2-year-old clearcut the capture success of the wooden box and wire mesh live traps was difficult to assess on the basis of the trap's distance from the uncut forest due to the relatively small number of captures (18) in comparison to the relatively large number of species (10). However, Tables 22 and 23 do seem to show some possible trends in the capture success of different species as a function of the trap's distance from the uncut forest in the 2-year-old and 6- to 7-year-old clearcuts.

Capture data indicated that the 2 sympatric species of cottontails were captured irrespective of trap location within the 2 clearcuts. These data, the absence of the eastern cottontail in the uncut forest, and the large number of New England cottontail captures in the 6- to 7-year-old clearcut suggest these species prefer cut areas to uncut forest. This was also suggested for the striped skunk.

Table 22. Number (N) and weighted number (N_w) of small mammal captures using wooden box traps and wire mesh live traps as a function of the trap's closest distance to the uncut forest in a 2-year-old clearcut in Craig Co., Virginia; winter 1974-75.

Species	9.1 m		53.3-68.6 m		Total
	N[a]	N_2	N	N_w	N
Didelphis virginianus	1	2.08	0	0.00	1
Blarina brevicauda	1	2.08	0	0.00	1
Sylvilagus floridanus	1	2.08	3	5.77	4
Sylvilagus transitionalis	0	0.00	3	5.77	3
Peromyscus leucopus	0	0.00	1	1.92	1
Tamias striatus	1	2.08	0	0.00	1
Sciurus carolinensis	0	0.00	1	1.92	1
Procyon lotor	1	2.08	0	0.00	1
Mephitis mephitis	1	2.08	2	3.85	3
Spilogale putorius	1	2.08	1	1.92	2
Totals	7	14.58	11	21.15	18

[a] Designation of the column headings are:

N = number actual captures of desired species

N_w = weighted number of captures at distance D

where $N_w = N/(td/T)$; and N = actual number of captures

T = total number of traps

td = number of traps at distance D

D = 0-9.1 m, or 53.3-68.6 m

Table 23. Number (N) and weighted number (N_w) of captures of small mammals using wooden box traps and wire mesh live traps as a function of the trap's closest distance to the uncut forest in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; winter 1974-75.

Species	0-76.2 m		76.2-152.4 m		152.4 + m		Total
	N[a]	N_w	N	N_w	N	N_w	N
Didelphis virginianus	0	0.00	1	5.26	3	8.57	4
Sylvilagus floridanus	0	0.00	0	0.00	2	5.71	2
Sylvilagus transitionalis	43	93.48	15	78.95	39	111.43	97
Tamias striatus	3	6.52	1	5.26	1	2.86	5
Glaucomys volans	2	4.35	0	0.00	0	0.00	2
Mephitis mephitis	1	2.17	2	10.53	0	0.00	3
Total	49	106.52	19	100.00	45	128.57	113

[a] Designation of the column headings are:

N = number actual captures of desired species

N_w = weighted number of captures at distance D

where $N_w = N/(td/T)$; and N = actual number of captures

T = total number of traps

td = number of traps at distance D

D = 0-76.2 m, 76.2-152.4 m, or 152.4 + m

With the exception of one eastern gray squirrel captured in the middle of the 2-year-old clearcut, this species and the southern flying squirrel were either captured at the clearcut border or were not captured at all in the cut areas.

For other species the trend was not as distinct. The eastern chipmunk seemed to prefer uncut areas since this species was captured most often in the uncut forest, or along the edge of clearcuts. However, 2 captures were made in excess of 76.2 m (250 ft) from the uncut forest in the 6- to 7-year-old clearcut, and individuals were observed in the interior of both clearcuts during this study.

Data on the opossum seems to be contradictory. Captures of this species increased with distance from the uncut forest in the 6- to 7-year-old clearcut (Table 23). This would seem to indicate preference for cut-over to uncut areas. However, more opossums were captured in the control than in both clearcuts combined (Table 21) suggesting the opposite effect of clearcutting on this species. This apparent contradiction may be partially explained by the presence of 2 dead calves dumped in the control during this study (the 1st calf was noticed in November 1974 and the 2nd during the latter part of January 1975). The presence of these calves may have attracted the opossums into the control area, thereby, biasing the capture data for this species.

In general, the snow track-counts supported the trapping data. A possible exception may have been the relatively large number of cottontail tracks found in the control during the logging road counts.

Although more tracks were counted for this genus in the 6- to 7-year-old clearcut, the high number of tracks in the control does not compare favorably with the trapping data.

In addition to species noted in the trapping phase, information was obtained from track counts on 2 other small mammals, the gray fox (Urocyon cinereoargenteus) and the New York weasel (Mustella frenata), and for 1 big game animal (Ursus americanus). Of these 3 species only the gray fox was recorded more than once. The gray fox seemed to avoid the newly cleared areas, and, although it did enter the older clearcut, it seemed to prefer the uncut forest. Again, the apparent preference for the uncut forest may be biased due to the presence of the dead calves.

Species Diversity

The estimated species diversity (Shannon 1948) for small rodents and insectivores, and all trapped mammals increased with the age of the study area (Table 24). The estimated species diversity for larger mammals, however, did not exhibit a successional trend of increasing diversity with increasing age of vegetation. Instead, this category showed the highest estimated species diversity in the 2-year-old clearcut, and the lowest estimated species diversity in the 6- to 7-year-old clearcut.

When these trends were compared against the calculated diversity using unweighted numbers in the Shannon formula, and with weighted and unweighted numbers in the Brillouin (1956) formula the trends remained unchanged with one exception. This particular exception

Table 24. Estimated species diversity (Shannon 1948) of small rodents and insectivores, larger mammals, and all small mammals (total) as derived from the number of different individuals captured per 1000 trap-nights in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; fall, winter, and spring 1974-75.

Area	Small rodents and insectivores			Larger mammals			Total		
	H'_{obs}[a]	H'_{max}	J	H'_{obs}	H'_{max}	J	H'_{obs}	H'_{max}	J
Control	0.812	0.845	0.961	0.784	0.845	0.927	1.030	1.114	0.925
6- to 7-yr cut	0.622	0.954	0.652	0.554	0.778	0.712	0.852	1.146	0.743
2-yr cut	0.452	0.778	0.580	0.880	0.903	0.974	0.733	1.146	0.640

[a] Designation of the column headings are:

H'_{obs} = estimated species diversity (Shannon 1948) = $-\Sigma p_i \log p_i$
where $p_i = n_i/N$; and N = total number of individuals
n_i = number of individuals in each species(s).

H'_{max} = maximum possible species diversity if individuals were distributed equally among the species; $H'_{max} = \log_{10} s$.

J = evenness of the distribution of individuals among rhe species; $J = H'_{obs}/H'_{max}$.

occurred when the species diversity (Brillouin's formula- H) for the larger mammals was calculated. In this instance both the weighted and unweighted data suggested a higher diversity for the control than for the 2-year-old clearcut (the 6- to 7-year-old clearcut still showed the lowest diversity). This may indicate that the sample size of the larger mammals in the 2-year-old clearcut was too small to permit meaningful comparisons.

White-tailed Deer

Distance Traveled Into Clearcuts

2-year-old clearcut. In the 2-year-old clearcut a linear regression analysis of the percent of pellet-positive 1.52 x 3.05 m (5x10-ft) plots, stratified by distance from the edge (Table 25), resulted in a significant ($p<0.0002$) F-value. Although the slope was highly significant, the variance encountered in the data was also high resulting in a r^2 value of only 0.28. In other words, even though there was a highly significant relationship between the number of weighted positive plots and distance into the clearcut, the distance classes accounted for only 28 percent of the variance in the data.

Examination of the means for each distance class showed that the 0-30.5-m (0-100-ft) distance class had twice as many weighted positive plots as the 30.5-61-m (100-200-ft) class, and 5-times as many positive plots as the 61-plus-m (200-plus-ft) distance class. When the data were tested by analysis of variance, the differences were found to be highly significant ($p<0.0002$). Further testing of the distance classes using Duncan's modified (Kramer 1956) multiple

Table 25. Means for percent of positive 1.52 x 3.05-m (5x10-ft) deer pellet plots by distance class from the uncut forest edge in a 2-year-old clearcut located in Craig Co., Virginia; spring 1975.

Distance class (meters)	Total no. of plots	Positive plots (totals)	Positive plots (means)	Transformed means (arcsin)
0 -30.5	450	50	11.11	0.303
30.5-61.0	420	19	4.57	0.148
61.0+	123	2	2.81	0.057

range test (Table 26) supports this observation. The 0-30.5-m (0-100-ft) class was significantly higher than either the 30.5-61-m (100-200-ft) or 61-plus-m (200-plus-ft) classes ($p<0.10$ and and $p<0.01$ respectively). The 30.5-61-m (100-200-ft) class was also significantly ($p<0.01$) greater than the 61-plus-m (200-plus-ft) distance class.

6- to 7-year-old clearcut. In the 6- to 7-year-old clearcut a linear regression analysis of the percent of weighted positive 1.52x3.05-m (5x10-ft) plots by distance from the edge (Table 27) resulted in a significant ($p<0.028$) F-value. Although the slope was significant, the variance encountered in the data was extremely high resulting in a r^2 value of only 0.17. This meant that even though there was a significant relationship between the number of weighted positive plots and distance into the clearcut, the distance classes accounted for only 17 percent of the variance encountered in the data.

The distance classes differed significantly in the number of weighted positive plots as indicated by a significant ($p<0.05$) F-value when tested by analysis of variance. Further testing by Duncan's modified multiple range test to determine where and to what extent these differences occurred (Table 28) showed that the 61-91.4-m (200-300-ft) class had a significantly higher ($p<0.10$) number of positive weighted plots than did the 0-30.5, 121.9-152.4, or 15.4-182.9-m (0-100, 400-500, and 500-600-ft, respectively) classes. The 30.5-61.0 and 91.4-121.9-m (100-200 and 300-400-ft)

Table 26. Duncan's modified (Kramer 1956) multiple range test for the percent of positive 1.52x3.05-m (5x10-ft) deer pellet plots in each distance class of a 2-year-old clearcut in Craig Co., Virginia; spring 1975.

Distance class comparison (meters)	Mean number positive plots (transformed data)	Significance (p)
0 -30.5 x 30.5-61.0	0.303 x 0.148	0.10
0 -30.5 x 61.0+	0.303 x 0.057	0.01
30.5-61.0+	0.148 x 0.057	0.01

Table 27. Means for percent of positive 1.52x3.05 (5x10-ft) deer pellet plots by distance class from the uncut forest edge in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; spring 1975.

Distance class (meters)	Total no. of plots	Positive plots (totals)	Positive plots (means)	Transformed means (arcsin)
0 - 30.5	464	15	2.07	0.067
30.5 - 61.0	528	27	5.46	0.207
61.0 - 91.4	442	25	5.92	0.225
91.4 -121.9	432	20	4.53	0.174
121.9 -152.4	450	17	3.95	0.121
152.4 -182.9	190	7	3.32	0.113
182.9 -213.4	232	10	3.64	0.149
213.4+	84	6	6.75	0.249

Table 28. Duncan's modified (Kramer 1956) multiple range test for the percent of positive 5x10-foot plots in each distance class in a 6- to 7-year-old clearcut located in Montgomery Co., Virginia; spring 1975.

Ranked mean no. of positive plots (transformed data)	Distance classes (meters)	Distance classes (feet)	Significance* ($p<0.10$)
0.249	213.4	700+	
0.225	61.0- 91.4	200-300	A
0.207	30.5- 61.0	100-200	B
0.174	91.4-121.9	300-400	C
0.149	182.9-213.4	600-700	
0.121	121.9-152.4	400-500	a
0.113	152.4-213.4	500-600	a
0.067	0 - 30.5	0-100	a b c

classes both had a significantly ($p<0.10$) greater number of weighted plots than did the 0-30.5-m (0-100-ft) class.

60- to 100-year-old forest. In the 60- to 100-year-old forest no significant differences were detected in the number of positive weighted 1.52x3.05-m (5x10-ft) plots when distance classes were compared (Table 29).

Relative Use of Clearcuts

Pellet group counts. Inspection of the mean values of the number of deer pellet groups per acre in the 2-year-old clearcut, 6- to 7-year-old clearcut, and the 60- to 100-year-old forest (Table 30, Fig. 16-18) shows that the 2-year-old clearcut had nearly twice as many pellet groups per acre as did the 6- to 7-year-old clearcut, and more than 6-times as many pellet groups per acre as did the uncut forest. The 6- to 7-year-old clearcut had nearly 4-times as many deer pellet groups per acre as the uncut forest did. An approximate test of equality of means indicated that the 3 areas did differ significantly ($p<0.001$) in the number of pellet groups per acre. Further testing using a modified Student's t-test (Snedecor 1956:98) to determine how significantly the 3 areas differed showed that both clearcuts had significantly more ($p<0.001$) pellet groups per acre than the uncut forest. The 2-year-old clearcut was significantly different from the 6- to 7-year-old clearcut only at the 0.20 significance level.

Table 29. Means for percent of positive 1.52x3.05 m (5x10-ft) deer pellet plots by distance class from the study area boundary in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; spring 1975.

Distance class (meters)	Total no. of plots	Positive plots (totals)	Positive plots (means)	Transformed means (arcsin)
0 -30.5	161	1	0.57	0.023
30.5-61.0	236	6	2.64	0.081
61.0-91.4	260	3	1.09	0.032
91.4-121.9	204	1	0.56	0.021
121.9+	107	1	1.43	0.046

Table 30. Mean number of deer pellet groups per acre in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; spring 1975.

Area		Sum of pellet groups/acre (Σn_i)	Mean no. of pellet groups/acre ($\bar{X}$)	Transformed means ($\bar{X}$)
Control	52	577	11.10	2.04
6- to 7-yr cut	90	3583	39.81	5.06
2-yr cut	62	4177	67.37	6.34

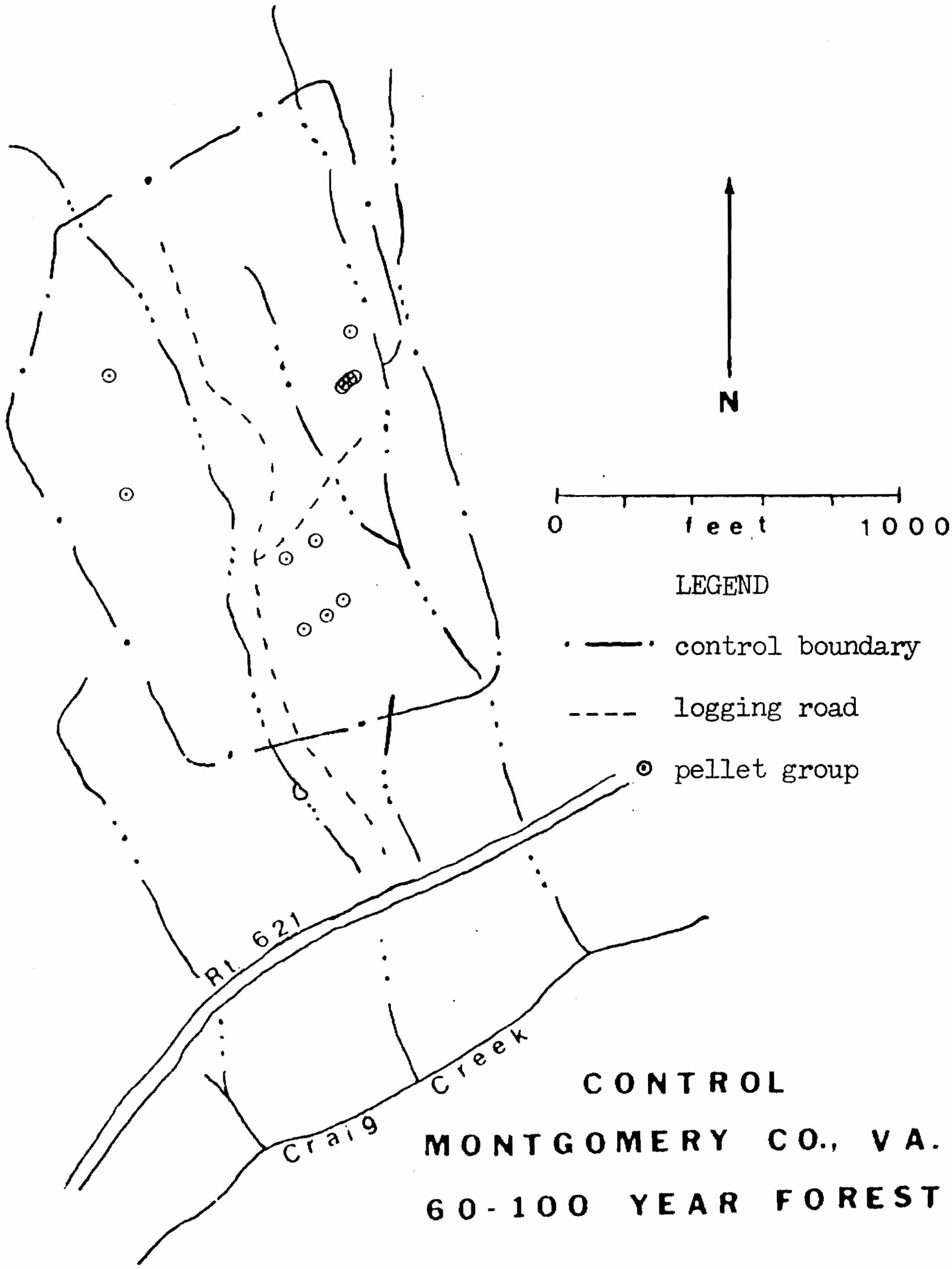


Fig. 16. Location of pellet groups found in a 60- to 100-year-old forest (control); spring 1975.

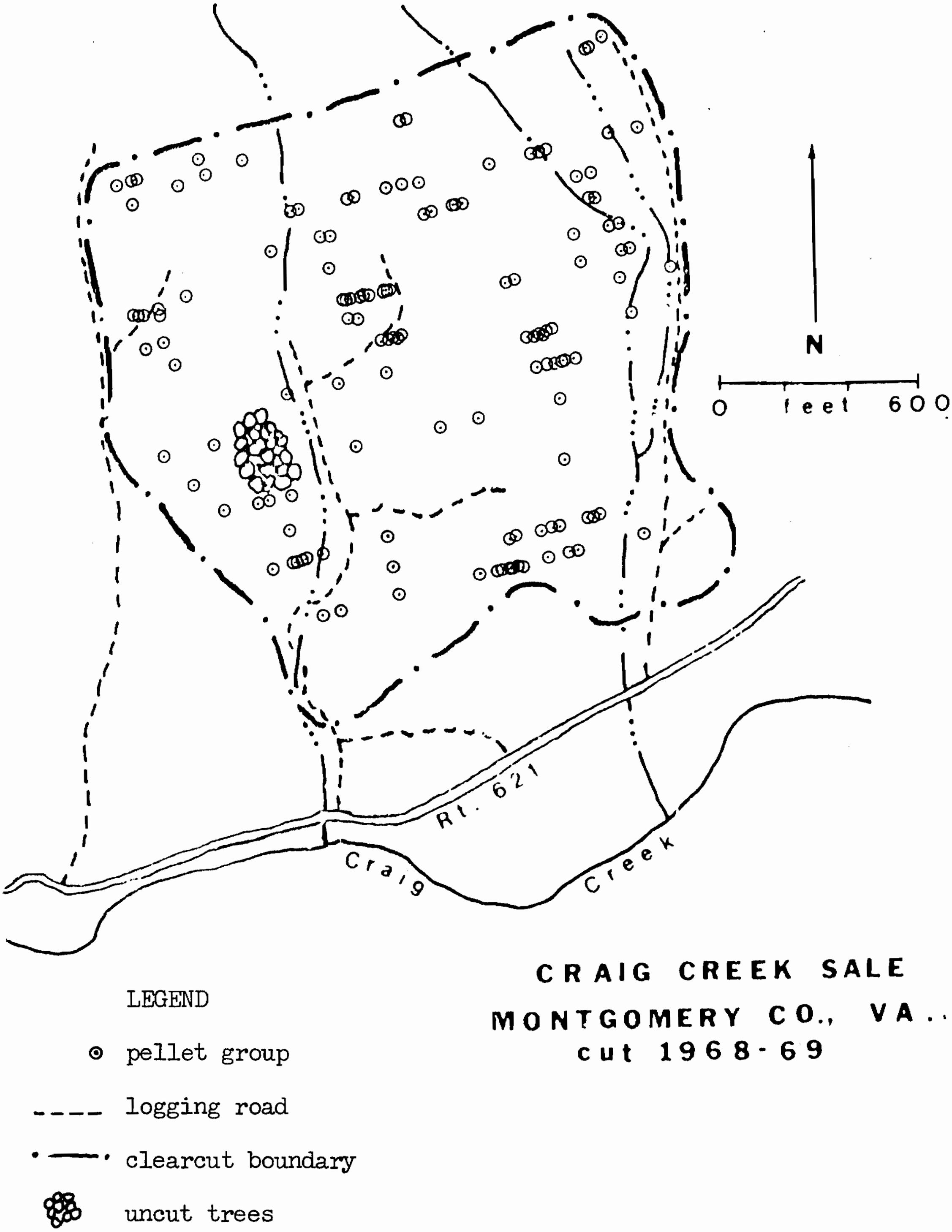


Fig. 17. Location of pellet groups found in a 6- to 7-year-old clearcut; spring 1975.

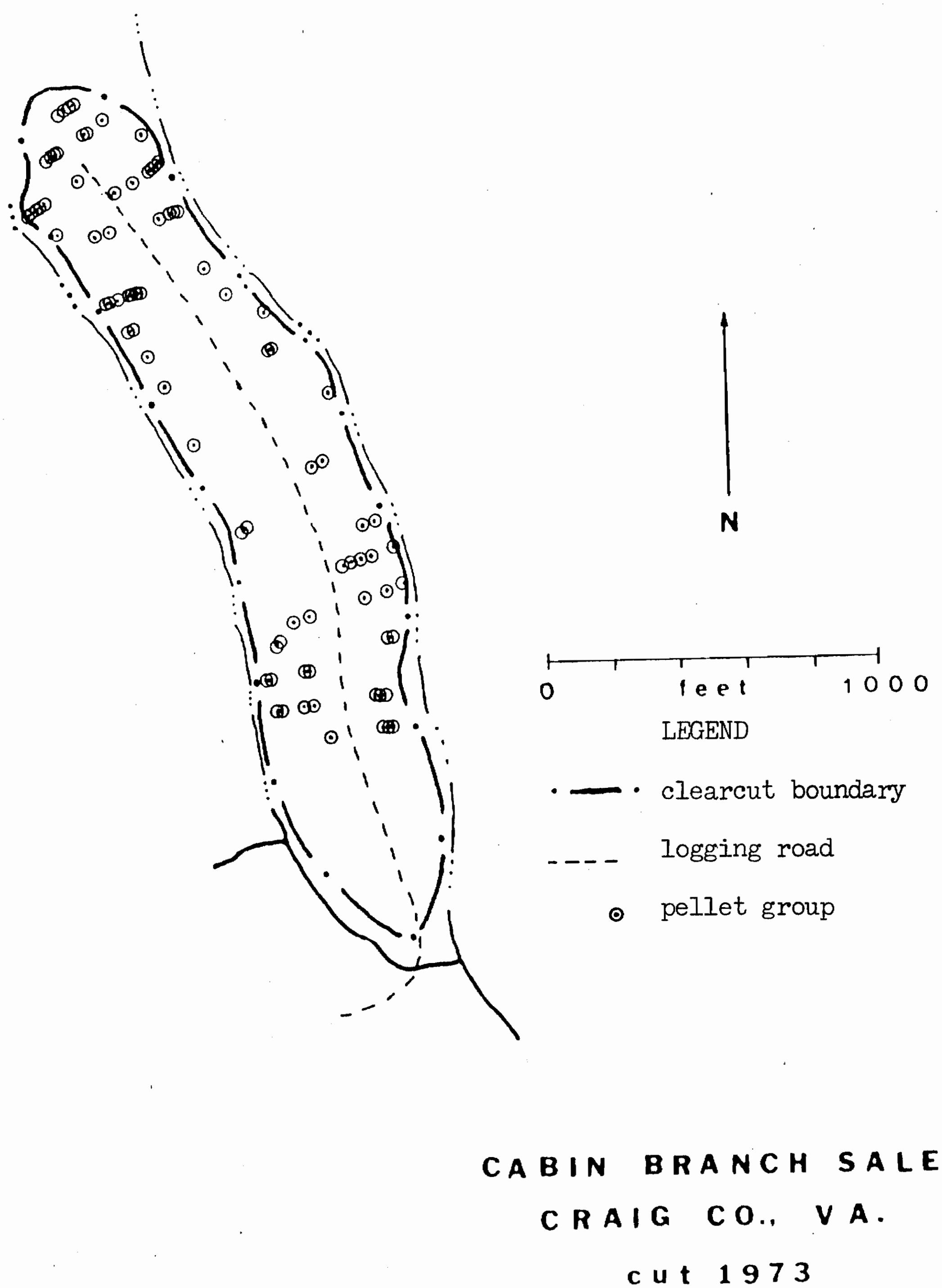


Fig. 18. Location of pellet groups found in a 2-year-old clearcut; spring 1975.

Snow Track-count

Periphery counts. The periphery count of track sets from white-tailed deer after the snow storm of 1 and 2 December 1974 indicated decreasing use of areas as a function of vegetation age. The 2-year-old clearcut showed the most use with a total of 25 sets of deer tracks going into the cut. The 6- to 7-year-old clearcut had the next highest use with 6 sets of deer tracks recorded, and the uncut forest evidenced the least amount of use with no deer tracks found going into the 60- to 100-year-old forest study area.

Mapping of the deer tracks within each clearcut (Fig. 19 and 20) indicated that although deer did utilize the interior of the cuts, most of the use was restricted to the edge of the clearcuts. This observation was particularly true in the 2-year-old clearcut.

Logging road counts. Counts of deer track sets on logging roads within the 3 study areas after snowfalls of 1 and 2 December 1974; 20 January, 4 February, and 11 March 1975 indicated the 2-year-old clearcut had nearly twice as much use as the 6- to 7-year-old clearcut, and that both clearcuts evidenced more utilization than the uncut forest (Table 31).

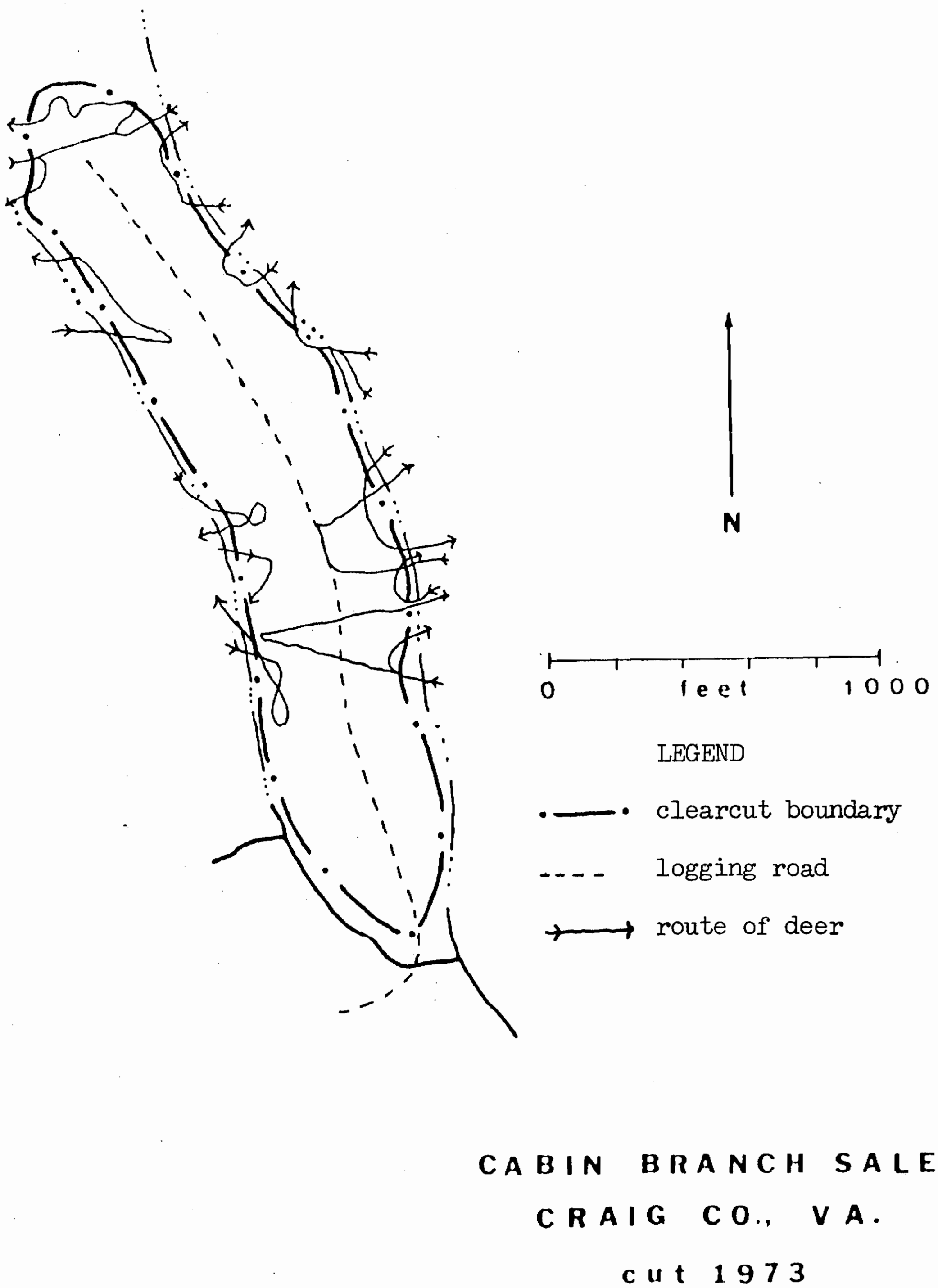
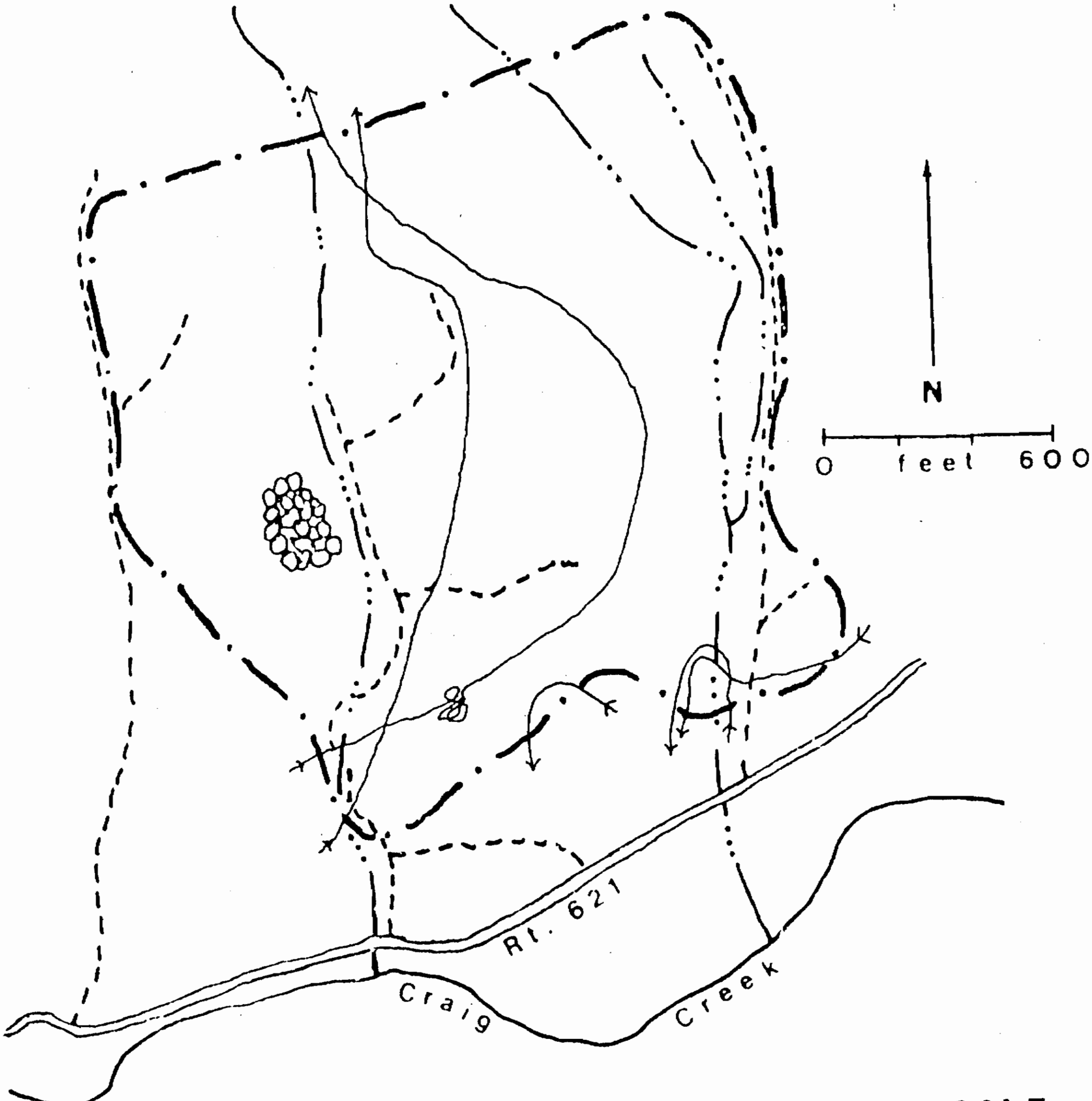


Fig. 19. Route of deer in a 2-year-old clearcut 2 days after the December 1974 snow storm.



CRAIG CREEK SALE
MONTGOMERY CO., VA.
cut 1968-69

LEGEND

uncut trees

clearcut boundary

logging road

route of deer

Fig. 20. Route of deer in a 6- to 7-year-old clearcut during and immediately after the December 1974 snow storm.

Table 31. Extrapolated number of white-tailed deer track sets per 1000 m of logging road as determined from observations made along 350 m of road in a 60- to 100-year-old forest (control), 350 m of road in a 6- to 7-year-old clearcut, and 650 m of road in a 2-year-old clearcut in Montgomery and Craig Cos., Virginia after the snow storms of 1 and 2 Dec. 1974; 20 Jan., 4 Feb., and 11 Mar. 1975.

Date	Control		6- to 7-yr cut		2-yr cut	
	Actual (350 m)	Weighted (1000 m)	Actual (350 m)	Weighted (1000 m)	Actual (650 m)	Weighted (1000 m)
December	0	0	5	14	5	8
January	0	0	0	0	20	31
February	0	0	3	9	7	11
March	0	0	4	11	8	12
Total	0	0	12	34	40	62
Mean	0	0	3	8.5	10	15.5

DISCUSSION AND CONCLUSIONS

Vegetation

Density and Species Abundance

The vegetation data accumulated during this study indicated that immediately after clearcutting reduction in the density of the shrub stratum occurred, while the low herb and tall herb layers increased in density. After 2 growing seasons the shrub strata had not "caught up" to the uncut forest in the number of stems per acre, but, as Table 2 indicated, the "tall herb" stratum showed the greatest density at that time. When the 10 most important plant species in the tall herb stratum were compared for the 3 areas (Table 7) the 2-year-old clearcut showed 3 pioneer herbaceous plants (pilewort, panic grass, and orchard grass), while the 6- to 7-year-old clearcut supported only woody species. Extrapolation of these data indicated that by the end of the 2nd growing season herb species had reached or passed their dominating role. By the 6th or 7th year after clearcutting, the woody regeneration had generally replaced the herbs as dominants. Table 8 showed panic grass as one of the 10 most important species in the low herb stratum of the 6- to 7-year-old clearcut, indicating that even though woody seedlings and sprouts have become dominant, the degree of crown closure had not been significant enough to result in the replacement of all pioneer species. The density and importance values shown in Table 2 and Table 8 indicate that crown closure, although prevalent enough to retard or eliminate most pioneer herbaceous species, had apparently favored the more shade tolerant herb species such as galax, teaberry, and dwarf cinquefoil. These results agree with earlier secondary successional observations described by Thornton (1940), Kendeigh (1961:21), Spurr (1964), Gashwiler (1970), and Perkins (1974).

Diversity

As Ricklefs (1973:759) has pointed out, however, ecologists generally believe that the diversity of communities increases with succession. Nicholson and Monk (1974) contradict this theory. They noted that a large number of early descriptive studies have contributed to the concept that diversity declines with forest age due to the terminal decline of some plant species caused by monopolistic tendencies by 1 or more regional climax dominants or by recurring disturbances. Whittaker (1970) also apparently rejects this theory since he suggests that the intermediate stages of succession may be more diverse in some seres than either newly established communities or the "climax" stage of succession.

The data presented in Table 14 supports the contention that diversity may begin to decrease with forest age. Apparently in this case the decrease is due to the monopolistic tendencies of oaks which, according to Spurr (1964:202), are maintained as an ecologically dominant species by recurring disturbances. Comparison of the species diversity index calcuated from all recorded plants showed that H increased from the 2-year-old clearcut to the 6- to 7-year-old clearcut, but that it was lower in the uncut forest than in the older clearcut. When the tree strata were eliminated, however, species diversity did increase with succession. The apparent cause for the higher diversity index in the uncut forest after data from the tree strata were removed was the preponderance of oaks (Quercus spp.) in these strata. As Appendix Table III shows, oaks comprised nearly 60 percent of the tree species encountered. The high percentage of oaks in the tree strata should decrease the index value of species diversity. Table 14 shows that the diversity value was lower in the uncut forest when data from the tree stratum was included than when these data were not incorporated into the diversity calculations.

Small Mammals

Dropping-board Technique

In 725 observation-nights utilizing the dropping-board technique (Emlen et al. 1957) only 1 board had deposits of fecal material; this was a singular occurrence and could have been due to chance. The presence of small mammals in all 3 areas was confirmed during the period 19 September 1974 through 15 November 1974 when a total of 108 individuals were captured (14 in the control, 40 in the 2-year-old clearcut, and 54 in the 6- to 7-year-old clearcut).

Emlen et al. suggested that pellet boards are used by small mammals since they constitute desirable spots on which to pause during foraging activities, and that they may also be used as "scent posts." In the 3 areas where this technique was used, however, the results indicate negligible use.

The lack of results using this procedure may be partially explained by the abundance of wood chips present from lumbering activities in the 2 clearcuts. This would not explain the absence of droppings in the uncut area. Emlen et al., however, stated that small flat-topped stones were also used to deposit droppings. Such stones were abundant in all 3 study areas, and may help to explain the lack of use of the pellet boards.

Emlen et al. found that there was an increased attractiveness of boards covered or impregnated with excreta. If this observation is valid it would seem that where an abundance of natural sites (such as wood chips or small flat-topped rocks) already occur the animals may prefer to continue using the known "scent posts" when they are as physically attractive as the pellet boards.

Although the technique described by Emlen et al. offers an excellent tool in the study of small mammal populations it would appear that its use may be limited to areas where more favored natural dropping sites are not abundant.

Small Rodent and Insectivore Trapping Results

Comparison of trapping methods (Table 17) indicated that pitfall traps were more effective than were snap traps in taking most species of Insectivora. Conversely, snap traps seemed to be more successful in taking most small rodent species than were pitfall traps. In general, these observations were supported by earlier studies (Clarke 1938, Edwards 1952, Fowle and Edwards 1954, Macheod and Lethoecq 1963, Brown 1967).

In the present study, 3 species of shrew (smokey, least, and southeastern shrews) were captured only in pitfalls. One shrew species (masked shrew) was caught more often in snap traps in the 6- to 7-year-old clearcut, but was taken only by pitfalls in the other study areas. The short-tailed shrew, although taken by both types of traps, was captured more frequently in snap traps. Only 3 species of small rodents were taken consistently during this phase of the study. Of the 3 only the white-footed mouse was captured in both pitfall and snap traps. Woodland jumping mice were trapped only in pitfalls, and golden mice were taken only from snap traps.

The presence or absence of most of the species in the 2 types of traps used (snap and pitfall) was probably due to 3 factors: 1) food preference, 2) size of the species, and 3) behavior. For example, those species taken only in pitfall traps (smokey shrew, southeastern shrew, least shrew, and woodland jumping mouse) were either very light in body weight, and therefore not as likely to set off a snap trap; were primarily carnivores and probably not attracted to the peanut butter-rolled oats bait mixture; or were hibernating in November when snap traps were used. Conversely, those species taken only in snap traps (eastern chipmunk, southern flying squirrel, and golden mouse) were either large enough to climb out of the pitfall traps or were arboreal in nature and, therefore, less likely to encounter pitfalls.

Clark (1938) also found that pitfalls were more effective in taking woodland jumping mice and small shrews, while white-footed mice and short-tailed shrews seemed to avoid them. Brown (1967) reported that pitfalls produced 2- to 4-times as many shrews as snap traps, and Edwards (1952) also found that pitfalls took more woodland jumping mice and shrews (Sorex spp.). He further observed that intensive use of snap traps either failed entirely to secure these genera, or only captured small numbers.

During the present study baited pitfalls accounted for twice as many captures as did unbaited pitfalls (Table 18). Since 3 baiting techniques were used at each baited pitfall (cracked corn scattered around the edge of the pitfall, peanut butter-rolled oats mixture smeared on the inside of the pitfall, and fish flavored cat food suspended over the pitfall on a stick) it was uncertain as to which bait or combination of baits was responsible for the increase of captures.

In an earlier study, Hudson and Solf (1959) reported that pitfalls baited with a peanut butter-rolled oats mixture gave only a slight advantage over unbaited pitfalls (6 percent catch increase). Assuming that Hudson and Solf's results were valid it would appear that the comparatively large number of captures made by baited pitfalls during the present study was not due to the peanut butter-rolled oats mixture. In view of the fact that the majority of captures made in the baited pitfalls were insectivores, one might assume the fish flavored cat food or possibly a combination of baits was the agent responsible for doubling the number of captures. Unfortunately, time did not permit testing this hypothesis further.

When comparing the relative number of species between areas the type of bait and trap used seems unimportant as long as the same bait and type of trap are used in all areas being compared.

When species diversity or species richness is being compared, however, these factors take on a higher significance and potentially can become critical. For example, 1 area has a species-rich insectivore population, but only 1 or 2 species of small rodents. Another area has the same number of species and individuals, but the population is composed mainly of small rodents with very few insectivore species present. In this hypothetical situation the second area would, in all likelihood, show both a greater species richness and diversity if the usual sampling method using snap traps and a peanut butter bait mixture were used.

Diversity

The mammalian segment of this study was stratified into 2 major components (small mammals and white-tailed deer). The small mammal component was divided further into "small rodents and insectivores" and "larger mammals" groupings. These descriptive headings are brought up again to facilitate easier comprehension of the following sections. For a more detailed description of these groups, consult the METHODS AND PROCEDURES - Small Mammals section of this thesis.

The estimated species diversity (H') for small rodents and insectivores, as well as all small mammals, increased with the successional age of the area and with increasing species diversity (H) of the shrub, tall and low herb strata. The estimated species diversity for larger mammals as a separate group, however, did not exhibit these trends. Instead, larger mammals showed the highest estimated species diversity in the 2-year-old clearcut, and the lowest diversity in the 6- to 7-year-old clearcut.

When the trends for the 3 mammal groups (small rodents and insectivores, larger mammals, and all small mammals) were compared with results obtained using unweighted data in the Shannon (1948) formula, and weighted and unweighted data in the Brillouin (1956) formula, the trend for the larger mammal group was the only one to change. Using Brillouin's formula, both the weighted and unweighted data indicated that the estimated species diversity for larger mammals was higher in the uncut forest than either the 2-year-old or 6- to 7-year-old clearcuts. This may indicate that the sample size of larger mammals in the 2-year-old clearcut was too small to permit meaningful comparisons of species diversity to be made of this group. In fact, trapping results, tabulated in Table 21, show that although a greater number of larger mammal species were captured in the 2-year-old clearcut, this area accounted for only 9 percent of the total catch (compared to 32 percent in the control and 59 percent in the 6- to 7-year-old clearcut). In other words, even though the 2-year-old clearcut did show a richer species composition of larger mammals than the uncut forest or 6- to 7-year-old clearcut, many of these species were represented by only 1 individual.

Effect of Vegetation on Small Mammals

Data collected during the present study indicated that the total number of small mammals was associated with the density of the vegetation in the low herb and shrub strata. Figure 21 shows that small rodents and insectivores increased in numbers as the density of vegetation in the low herb stratum increased. The number of larger mammals, on the other hand, increased as the density of vegetation in the shrub stratum increased (Fig. 22).

Estimated species diversity (H'), for both groups of small mammals and the small rodent and insectivore group (Table 24), paralleled the vegetative species diversity (Table 13). As vegetative species diversity (H) increased in the combined strata (shrub, tall and low herb stratum), estimated species diversity of small rodents and insectivores and all small mammals also increased.

No apparent association was noted for the estimated species diversity of larger mammals and vegetative species diversity.

Previous quantitative studies have generally been concerned with the effect of habitat disruption on either the faunal or floral component of a community; rarely both. Several studies have provided possible explanations for observed increases in the total number of small mammals after clearcutting. Some researchers have speculated that the increase in numbers was a result of additional cover provided by logging slash (Morris 1955, Turkowski and Reynolds 1970). Other authors have implied that the increase in numbers was a result of increased food supply (Spencer 1956, Bendell 1959).

In New York, Smith (1959) found the density of small mammals was

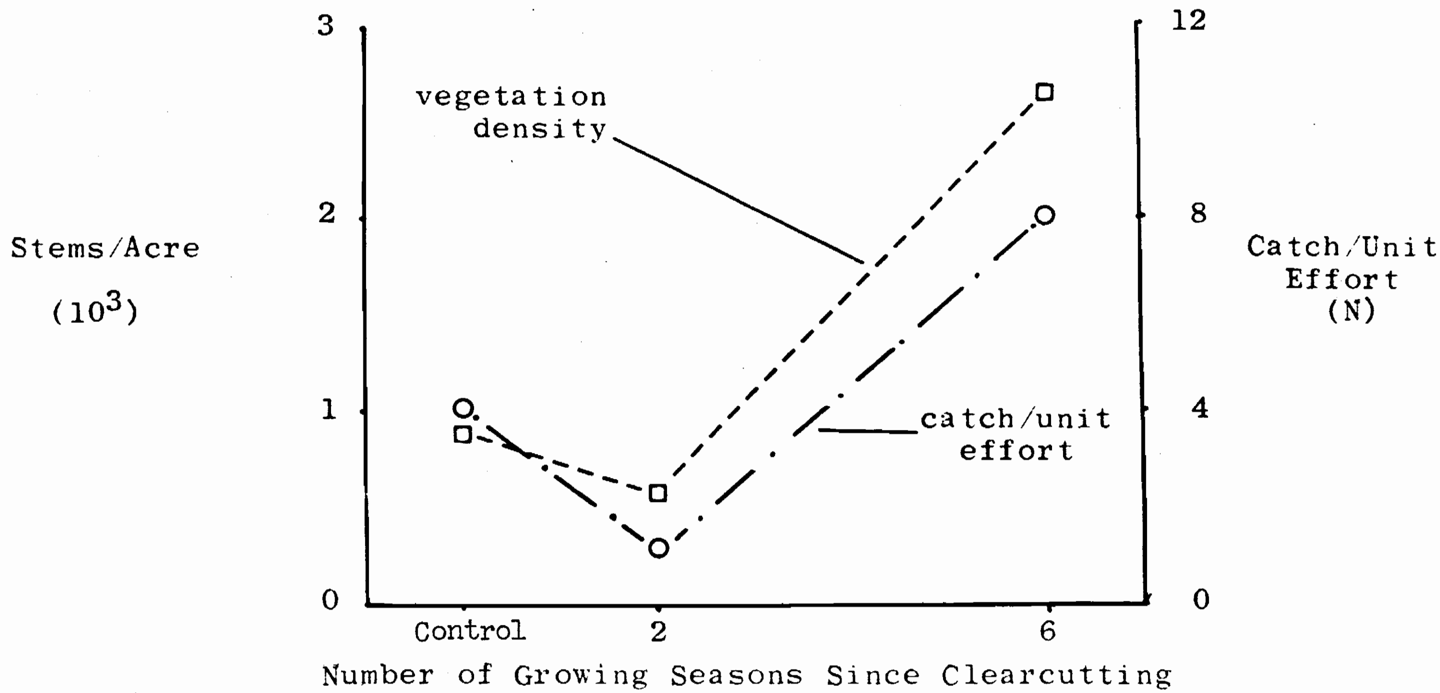


Fig. 21. Graphic relationship of shrub density to capture success of larger mammals as a function of the number of growing seasons since tree removal.

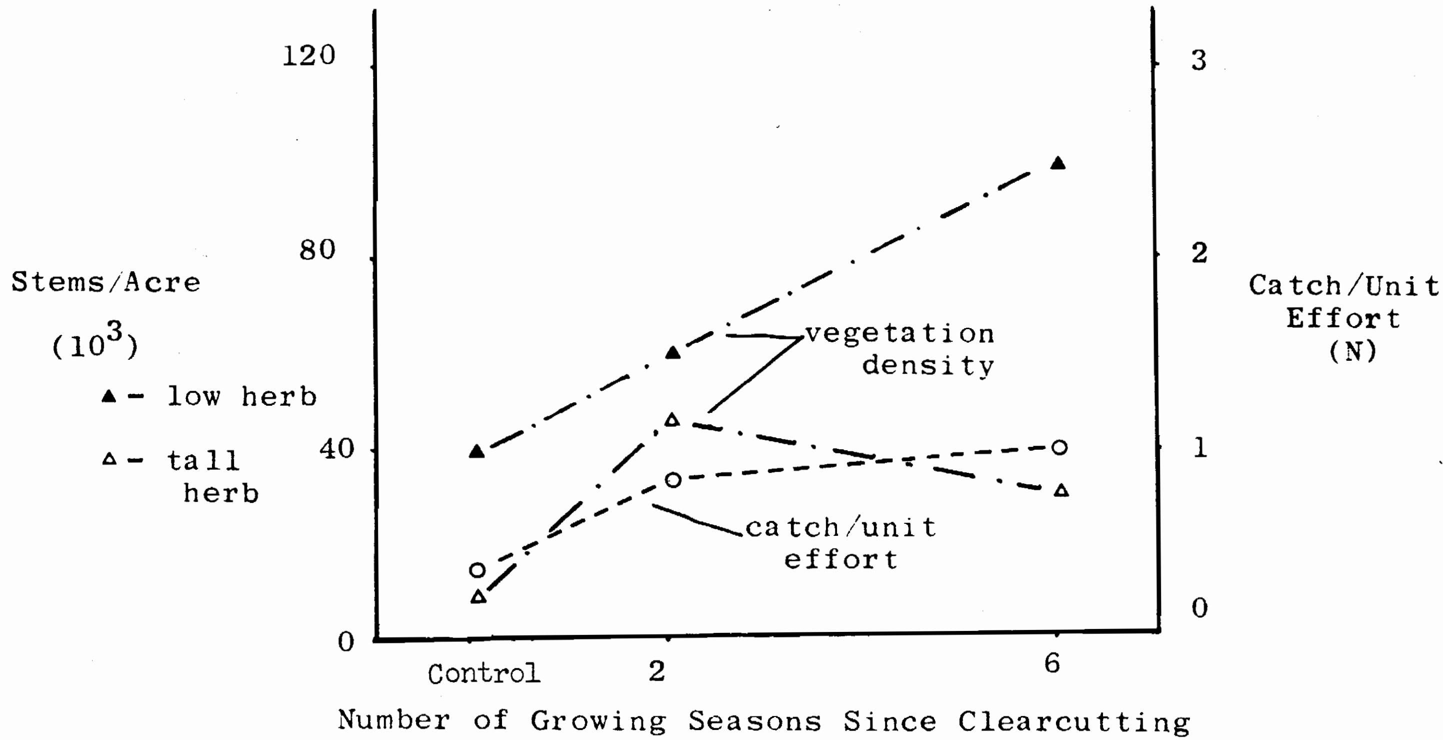


Fig. 22. Graphic relationship between the density of low and tall herbs to capture success of small rodents and insectivores as a function of the number of growing seasons since tree removal.

higher in areas supporting "good" herbaceous and moss cover than in areas with only pine needles. His observations supported the findings reported earlier by Morris (1955). Based on the higher number of small mammals captured in areas with "good" cover, Morris concluded that the existence of small mammals was dependent upon their freedom to forage for food without constantly exposing themselves to predation. On this assumption he believed that since the diet of mice is so omnivorous, the forage possibilities offered by habitat was, perhaps, secondary to cover. Additionally, Hooven (1969, 1973a) showed the importance of cover to insectivores. Hooven noted that immediately after clearcutting shrews (Sorex spp.) were only captured near piles of slash adjacent to the uncut forest.

Trevis (1956) and Gashwiler (1959, 1970) both observed an increase in deer mouse populations after slash from clearcutting had been burned. According to Hooven (1969), after an area is burned-over the weed seeds and numerous insects which feed on the cull logs, wood debris, and recovering vegetation provide food for this species. Additionally, studies have shown that the populations of at least 2 species of Peromyscus (the white-footed mouse and the old field mouse - P. polionotus) are regulated by food (Bendell 1959, Smith 1971, respectively). From these studies one might assume that small rodents were favorably affected by the increasing density of vegetation. Apparently, the increase of vegetative density either directly or indirectly increased the available food supply as well as provided cover after clearcutting.

Whether the observed increases were a factor of increased food, better cover, or both food and cover is not important to the objectivesof this project. What is important, though, is that there was an increase in the small mammal populations of the community and that these increases appeared to be either directly or indirectly associated with the density of various vegetational strata. The density of vegetation was, in turn, a function of successional age following clearcutting.

Effect of Succession

The relative abundance of small rodents and insectivores in cut and uncut areas, as well as the use of these areas by larger mammals, should parallel each area's ability to provide an adequate food supply during the most critical season, and furnish shelter from natural enemies and the elements (Byrd 1956). As a particular site advances through the various successional seres, these factors change and with each change in the type, size, and density of the floral components of the community, different species of mammals are either directly or indirectly benefited or handicapped.

The data accumulated during this study indicated that after clearcutting there was a reduction in the density of the shrub stratum, and an overall reduction in vegetative species diversity (Tables 2 and 13 respectively). After 2 growing seasons, the shrub stratum had not caught up to the uncut forest in the number of stems per acre; however, the 2 herb strata had surpassed the uncut forest in density. These floristic changes apparently influenced the make-up of the faunal segment of the community. Animal species generally associated with the older forested plant communities, such as the smoky shrew, woodland jumping mouse, southern flying squirrel, eastern gray squirrel, and spotted skunk were either absent in the 2-year-old clearcut, or were infrequently captured and rarely observed during the snow track-counts. Ubiquitous species such as the white-footed mouse and short-tailed shrew increased in relative numbers from the uncut forest. Three mammal species characteristic of early plant succession (least shrew, eastern cottontail, and striped skunk) which were not present in the uncut forest reached their highest relative numbers in the 2-year-old clearcut. Along with the change in species composition after clearcutting was the apparent decrease in overall mammalian species diversity.

By the 6th or 7th year after clearcutting, the woody regeneration (including shrubs and tree reproduction) had generally replaced herbs as dominants. The shrub stratum was nearly 4.5-times as dense as in the 2-year-old clearcut and nearly 3-times as dense as in the uncut forest. The partial crown closure of this stratum, although prevalent enough to retard or eliminate most herbaceous pioneer species, had apparently favored the more shade tolerant herb species. This sere also evidenced the largest populations of masked shrew, southeastern shrew, short-tailed shrew, white-footed mouse, golden mouse, and New England cottontail. Additionally, this successional stage showed the highest overall population of small mammals.

Earlier studies in other regions of North America partially confirm the findings of the present study. Hooven (1969, 1973a, 1973b) reported that, in the Douglas-fir region of Oregon, species associated with timbered areas such as the red-backed vole and western gray squirrel were absent from clearcut areas, and that populations of deer mice increased. In northern California, Trevis (1956) reported 3- to 4-times more deer mice in clearcuts 4 to 10 years old than in the adjacent forest. By comparison, the present study showed white-footed mice to be over 4-times more abundant in clearcuts as the uncut forest. The increase of deer mice after clearcutting was also reported by Gashwiler (1959, 1970), Baker and Frischkuecht (1973) and Sims and Buckner (1973).

Lovejoy (1971) reported that in New Hampshire, shrews (short-tailed and Sorex spp., mostly the masked shrew) and woodland jumping mice exhibited a 1- to 2-year decrease in numbers after clearcutting, followed by increasing numbers to a population high during the sapling stage of succession. During the present study it was noted that by the 2nd growing season after clearcutting some shrew species (short-tailed and masked shrews) had increased slightly in relation to the numbers found in the uncut forest. Woodland jumping mice, however, showed a relatively lower population size in the cut areas than in uncut areas. In New York, Krull (1970) also reported an increase in the shrew and woodland jumping mouse populations following clearcutting. The apparent discrepancy in the effect of clearcutting on the woodland jumping mouse populations could be due to the small number of samples collected for this species; during this study only 5 individuals were cpatured.

Other studies on the effect of clearcutting on small rodents and insectivores seem to contradict these findings. In Texas, Murray (1969) found that there was a higher density of small mammals in an uncut oak-pine forest than in areas disturbed by cutting. Jones and Nagel (1974) working in northeastern Tennessee reported that no differences were found in the total number of small mammals in a clear-cut and uncut forest. Lovejoy (1971) also reported that there was no increase in the total size of the small mammal population following logging on most areas he studied in New Hampshire.

One would expect, however, that with the increase in cover due to slash, and an increase in the density of the ground vegetation with its resulting cover and increased potential of available food an increase in the total number of small mammals would occur. This hypothesis was supported by the present study. When the total catch per effort was compared for small rodents and insectivores, it was found that the catch was twice as high in the 2-year-old clearcut and 2.5-times as high in the 6- to 7-year-old clearcut as in the uncut forest. When the catch per unit of effort for larger mammals was compared a decrease was noted for the new cut, but by the 6th or 7th growing season after clearcutting the total catch was twice as high as the catch recorded for the uncut forest.

The observation that an increase of small mammal population occurred after clearcutting was supported in earlier studies by Trousdell (1954) and Morris (1955). Among the studies that infer that small rodents and insectivore populations increase after clearcutting were those by Spencer (1956), Trevis (1956), Gashwiler (1959, 1970), Hooven (1969, 1971, 1973a, 1973b), Baker and Frischkuecht (1973), and Barnes (1973).

Of the 4 papers which contradict the hypothesis that small mammal populations increase after clearcutting, 3 (Jones and Nagel 1974, Krull, 1970, and Murray 1969) may not be applicable to the present discussion. Jones and Nagel (1974) reported that the total number of individuals collected on the cut and uncut areas was approximately the same, however, they also state that the golden mouse was co-dominant with the white-footed mouse in the forested area. It seems unusual to find a species which authorities classify as an early successional type species or a species which prefers thickets (Goodpaster and Hoffmeister 1954, Hall and Kelson 1959, Linzey 1968) to be a co-dominant species in the forested area. The fact the golden mouse was a prevalent species in the uncut forest would seem to indicate that the forested area used in their study was either atypical or was extremely brushy possibly indicating the forest had undergone a disturbance. If the forest had been disturbed the observation that numbers of small mammals in the clearcut and uncut forest were about the same would not be unusual.

Krull's (1970) comparison was based on a commercially clearcut area; in other words, only commercially valuable trees had been removed. This area, therefore, would probable be similar to an area whose basal area had been reduced, rather than a silvicultural clearcut. Additionally, Krull reported more Peromyscus spp. in the cut areas. Most previous studies comparing clearcut and uncut forests contradict this observation (Trevis 1956, Gashwiler 1959, 1970, Baker and Frischkuecht 1973, Sims and Baker 1973). Murray's (1969) work in Texas also compared reduced basal area to uncut areas. Additionally, his comparisons were made on areas cut only 1 or 2 years prior to his study, and therefore, may have included the period of time when small mammal populations were depressed due to cutting activity.

White-tailed Deer

White-tailed deer utilized the entire cut in both the 2-year-old and 6- to 7-year-old clearcuts; however, the distance deer traveled into the cuts was associated with the age of the clearcut (successional stage).

In the 2-year-old clearcut the number of weighted positive plots strongly indicated that deer-use was significantly ($p < 0.01$) greater in the first 61 m (200 ft) from the uncut forest border, and that use decreased with distance into the cut. In the 6- to 7-year-old clearcut, however, the first 31.5 m (100 ft) from the uncut forest had significantly ($p < 0.10$) fewer positive plots than the next 3 distance classes (30.5-61.0, 61.0-91.4, and 91.4-121.9 m from the uncut forest). Further, the 61.0-91.4-m (200-300-ft) class had significantly more positive plots ($p < 0.10$) than did the 121.9-

152.4-m, and 152.4-182.9-m (400-500-, and 500-600-ft, respectively) classes. From analysis of the data in the 6- to 7-year-old clearcut, it was apparent that the expected decrease in deer use as a function of distance into the cut was not as sharply defined as in the 2-year-old clearcut. As Fig. 23 indicates, deer use increased over the first three 30.5-m (100-ft) classes and then (with the exception of the last distance class) generally decreased. The high value observed in the 213.4-m (700-ft) plus class may be due to faulty sampling since only 2 of the 17 transects passed through this class. Statistically, the 213.4-m (700-ft) plus class did not differ significantly in deer usage from the 0-30.5-m (0-100-ft) class which had the fewest number of weighted positive plots.

From these results it appeared that deer were generally reluctant to venture more than 61 m (200 ft) from forest cover in the 2-year-old clearcut. By 6 or 7 years after clearcutting, with an increase in the average height and density of the shrub stratum, the greatest deer activity occurred 61 to 91.4 m (200 to 300 ft) from the uncut forest and then started to decrease with greater distance into the clearcut.

Deer activity around forest openings have been reported by several investigators. Reynolds (1969) noted that the forest edge received the heaviest use by deer, and that use decreased on either side of the border zone. Reynolds concluded that use by deer of the open area declined sharply as the size of the opening increased, suggesting that deer use of openings appeared to depend strongly upon

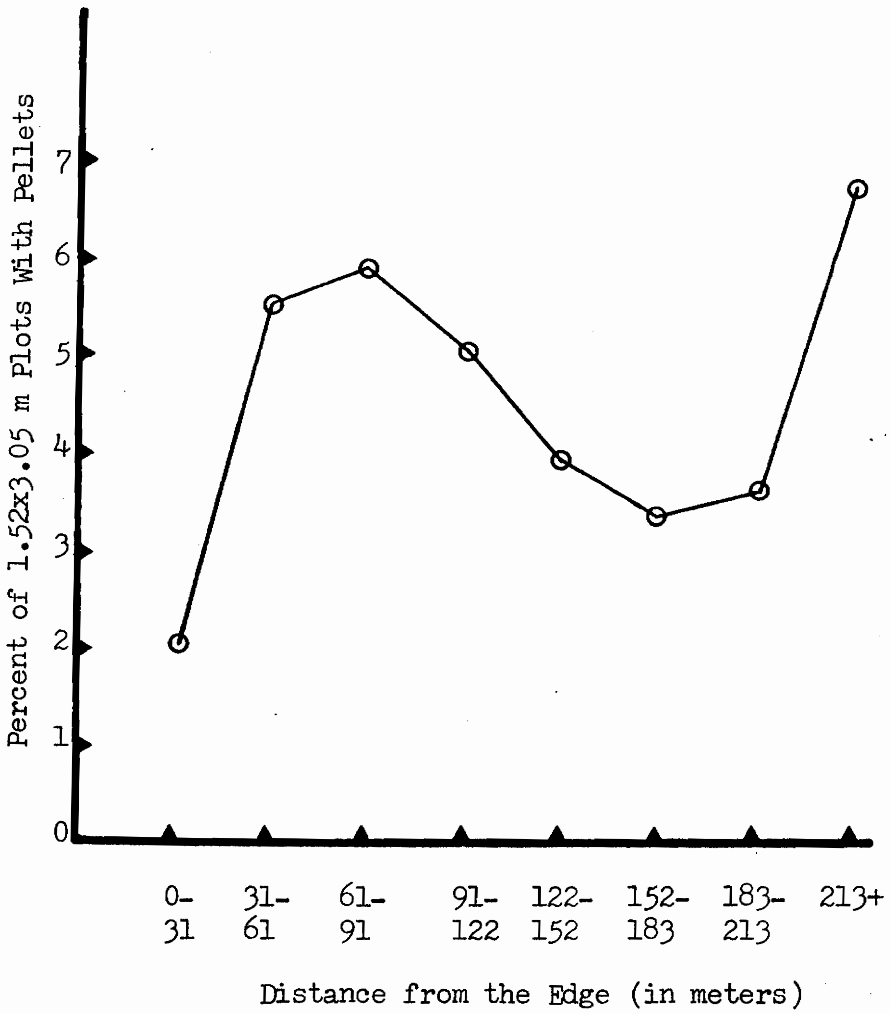


Fig. 23. Distance deer traveled into a 6- to 7-year-old clearcut located in Montgomery Co., Virginia as determined from the percent of positive weighted pellet plots; spring 1975.

distance to cover. In northern Wisconsin, McCaffery and Creed (1969) reported that smaller openings (0.2 to 2 ha) received more use than larger clearings.

Another paper by Reynolds (1966b) also implied that cover was an important factor in the use of and distance traveled into, clearcuts by deer. He reported that deer use was greater in cuts where slash was left than where it had been cleaned up. A California study by Tabor and Dasmann (1958) revealed that black-tailed deer seldom fed more than 300 ft (91.4 m) from cover.

Relative Use of Clearcuts

The findings of the present study support past studies which found clearcuts tend to be more heavily used by deer than uncut forested areas. This deer usage extends from the time of the cut to the pole stage of succession (Brown 1961, Reynolds 1962, Wallmo 1969, 1972, Crouch 1974 in the West; and Morris 1954, Moore and Downing 1965, Harlow et al. 1966, Telfer 1972 in the East).

In the Pisgah National Forest of western North Carolina, Moore and Downing (1965) reported that overall deer-use was 62 percent higher 1 year after clearcutting than what it was in the same area prior to cutting. These increases ranged from a 178 percent increase in a 21-acre (8.5-ha) clearcut to 12 percent in a 105-acre (42.5-ha) cut. During the present study, by comparison, deer use (as determined by pellet-groups) was 6-times higher in the 2-year-old clearcut and nearly 4-times higher in the 6- to 7-year-old clearcut forest (Fig. 24). The greater use by deer of clearcuts as compared

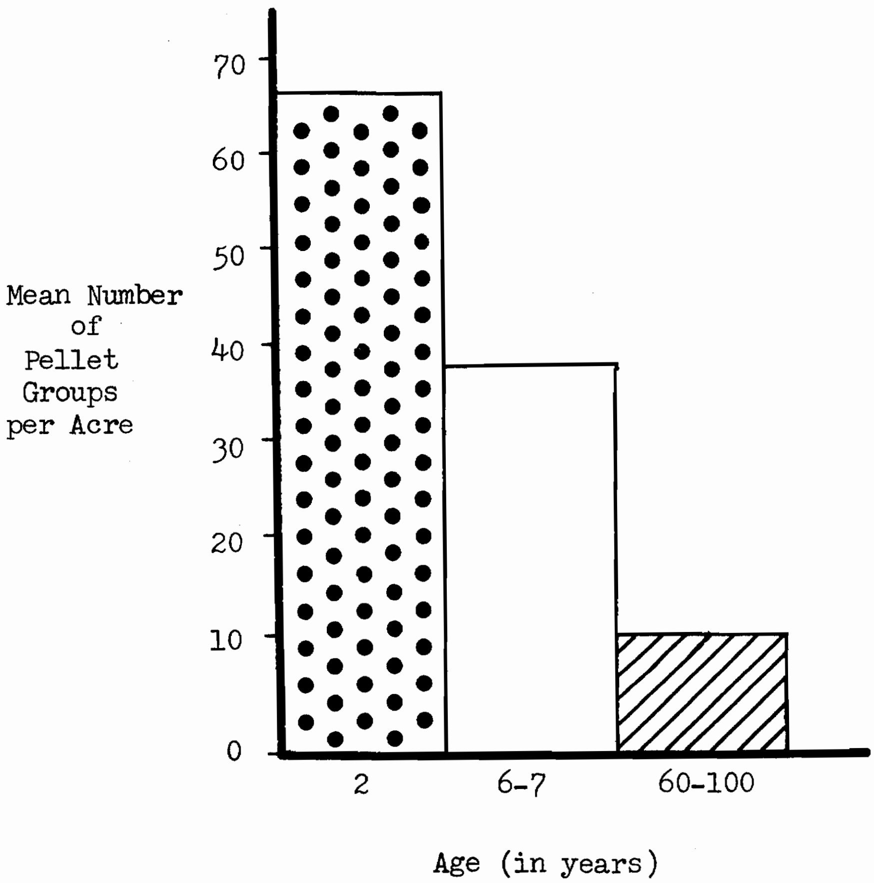


Fig. 24. Mean number of pellet groups per acre in a 2-year-old clearcut, a 6- to 7-year-old clearcut, and a 60- to 100-year-old forest (control) in Montgomery and Craig Cos., Virginia; spring 1975.

with uncut areas during this study was also supported by the results of the snow track-counts. As Table 31 showed, both clearcuts received more use after snowfall than did the uncut forest. The comparatively higher use of clearcuts by deer in western Virginia was also observed by Sandt (1969). He observed 3- to 4- times as many deer in clearcut areas as in grassland or wooden areas in the Radford Arsenal (Pulaski County).

Western studies also have shown higher deer use of clearcut areas as compared with uncut forests. Wallmo (1969) found that, 10 years after alternate-strip clearcutting in Colorado, use by mule deer doubled. He further observed that the increase was due to the higher use of the cut strips where mean pellet-group densities were 3-times those found on uncut strips or on the adjacent virgin forest. Reynolds (1962), working in the ponderosa pine region of Arizona, also reported deer use to be several times higher on 3 to 11 year old clearcut areas than on uncut areas. In the Northwest, Brown (1961, as cited by Resler 1972) credited clearcutting with increasing the deer "population" [usage?] as much as 63 percent, although no time period was given for the increase.

Several Western studies indicate that, for the first 2 years following clearcutting, deer use was lower in clearcuts than in uncut areas (Porter 1961 in Colorado, and Reynolds 1962 in Arizona). Perhaps the limited use of "new" clearcuts is the result of the more arid conditions prevalent in Arizona and Colorado, thereby resulting in slower regeneration.

Studies conducted in more humid climes, however, have shown that deer use of clearcuts will increase for the first few years and then will decline (Anon. 1948, Crouch 1974). These observations were partially supported by Telfer (1972). He reported that in New Brunswick, white-tailed deer fed most heavily in 2-year-old clearcuts. A series of studies in the Pisgah National Forest in western North Carolina (Morriss 1954, Moore and Downing 1965, Harlow et al. 1966) found that deer use decreased sharply 1 or 2 years after clearcutting in cuts greater than 50 acres (20.2 ha). Results from the present study supported these observations. As Figure 24 shows, the 2-year-old clearcut evidenced the greatest amount of use by deer.

The arid conditions in Arizona do not, however, explain the detrimental effect clearcutting may have in the higher elevations of that state (Reynold 1966a), nor does it explain the detrimental effect cutting seemed to have in Florida which is neither arid nor elevated (Beckwith 1964). Reynolds (1966a) reported deer use to be 3- to 7-times higher in uncut spruce-fir forests than in adjacent openings. He noted, however, that the density of pellet-groups was highest between 400 to 500 ft (122 to 152 m) from the edge of the openings, indicating that openings may provide some attraction to deer. Similar studies in Arizona by Reynolds (1962, 1966c) showed deer use to be higher in both clearings and clearcuts in the lower elevations dominated by ponderosa pine. If these studies are characteristic of the effect of clearcutting at higher elevations one would assume, then, that the elevation at which clearcutting occurs is important in assessing its value to deer. This observation is supported by Pengelly's (1972) contention that clearcuts made at high elevations in the western United States are not beneficial to deer.

In Florida, Beckwith (1964) noted that partially cleared areas as large as 1 mile square (259 ha) received substantially less use by deer than uncut areas, although treated areas smaller in size had received significantly more use than the uncut areas. From these results he concluded that large (259 ha) cuts are detrimental to deer.

From these past studies and the results of the present study it appears that the amount of use a clearcut may receive in the Southern Appalachians is related to: 1) the successional stage of the cut, 2) the distance the deer have to go from cover to use the cut (size and shape of the clearcut), and 3) intuitively, the dispersion or juxtaposition of the cuts within the uncut forest. In other words, insuring that the clearcuts are well spaced and not clumped together.

Effect of clearcut age. Studies conducted in the Pacific Northwest, Wisconsin, and the Southern Appalachians (Crouch 1974, Anon. 1948, Morriss 1954, respectively) have shown that use of clearcuts by deer decreased after 1 or 2 years following clearcutting. Morriss (1954) working in the Pisgah National Forest of western North Carolina, concluded that the observed decrease in deer-use was due to the density of the woody regeneration. This observation was supported by other studies conducted in the Pisgah National Forest. Della-Bianca and Johnson (1965) found that deer-use was higher in a cleaned 11-year-old clearcut than in untreated clearcuts of the same age. Apparently, deer reacted favorably to the reduction in vegetation density. Harlow et al. (1966) found that 3 years after clearcutting cuts over 50 acres (20.2 ha) in size showed less deer-use than the uncut forest, but that deer-use was still higher in a 21-acre (8.5 ha) clearcut. They attributed this to the ability of deer to keep the density of sprout growth reduced in the smaller cuts. A reduction in deer use as the density of the vegetation increased was also noted during the present study (Tables 2 and 30).

Effect of clearcut size. Beckwith (1964) noted, in Florida, that extremely large cuts seem to receive little use by deer. Small cuts, on the other hand, appear to increase the amount of deer-use on an area. Apparently, for deer to derive the maximum benefit from clearcutting, both size limitations and distribution of clearcuts must be considered. Due to the various climatic differences whch exist across the United States these constraints will vary somewhat from region to region, and possibly even within regions.

Hosley (1956) observed that the effectiveness of a clearcut varies with the size of the cut and the density of the deer population. He found that small deer herds used only the edges of larger clearcuts, while large herds ate all the new growth in small cuts as soon as it came up. Hosley's findings were supported by studies conducted in the Pisgah National Forest of western North Carolina. Harlow and Downing (1970) also suggested that when clearcuts were too small "good" browse plants were quickly eliminated, however, they also noted that when clearcuts were too large they often became dense and unattractive to deer after 2 years. They suggested that a 21-acre (8.5-ha) clearcut seemed to be a desirable compromise between 1 acre (0.4 ha) and 50 acre (20.2 ha) cuts. In an earlier paper, Harlow and Palmer (1967) suggested that the best cutting size for deer was between 5 and 20 acres (2 and 8.1 ha). The change in the 5-to 20-acre (2- to 8.1-ha) size for clearcuts in the Pisgah area to 21 acres (8.5 ha) apparently was due to the extensive browsing of seedlings and sprouts in the smaller clearcut sizes.

These observations on and recommendations for clearcut size were also supported by Healy (1971) in northwestern Pennsylvania. He recommended that clearcuts be at least 17 acres (6.9 ha) in size to avoid a food-patch effect that could concentrate browsing and prevent tree regeneration.

In the West, Reynolds (1966a, 1966c, 1969) suggested that due to the decline in deer use as the size of openings increased and the apparent relationship of deer-use to cover, clearcut plots should be restricted to less than 45 acres (18.2 ha) in ponderosa pine and to less than 20 acres (8.1 ha) in spruce-fir forests.

The data presented in the current study supports these earlier findings. It was noted that although deer used the entire area of both clearcuts, the use was predominantly in the first 61 m (200 ft) from the forest edge in the new clearcut and from 30.5 (100) to 121.9 m (400 ft) from the forest edge in the 6- to 7-year-old clearcut. In other words, based on these data, to increase deer use in older clearcuts the cut should be no larger than 243.8 m (800 ft) wide. To maximize the use of these areas by deer the cut should be no wider than 183 m (600 ft). In view of the apparent reluctance of deer to travel more than 61 m (200 ft) into new cuts the 183 m (600-ft) projection would probably be the most suitable as a maximum width. Additionally, since deer-use appeared to be very low in the first 30.5 m (100 ft) of the older cut, clearcuts should be greater than 61 m (200 ft) in width.

Previous studies conducted in the East have shown that in small clearcuts deer browsing may prohibit regeneration of desirable timber species (Hosley 1956, Harlow and Downing 1970, Healy 1971). The major problem, therefore, seems to be in determining an optimum size for clearcuts which will allow both maximum use by deer and minimum damage from deer to regenerating timber.

Based on the findings of this and previous studies it is my opinion that as long as the width of the clearcut approximates 183 m (600 ft) the overall acreage of the clearcut is of secondary importance where only the benefit to deer is concerned. It would seem, then, that the main criteria for clearcut size are: 1) that the cuts are small enough to allow even distribution of age-classes in order to provide a continuous supply of successional seres of a desirable stage (2 to 9 years) within a deer's normal home range, and 2) that during this rotation period enough mature forest is left to provide for older successional species.

Roach (1974) has shown that theoretically long-term planning of cutting schedules for small units of land (several hundred to several thousand acres) will allow successful regulation of timber age classes for combined timber and wildlife production with a minimum impact on costs and timber yields.

Roach suggested that 20 to 30 acre (8.1 to 12.1 ha) cuts should be used, and pointed out that there is no way to harvest and grow timber without going through a long pole stage. In order to keep wildlife populations stable, therefore, he advised keeping the pole stands well dispersed among the older and younger stands, and to keep the maximum continuous proportion of non-pole timber as possible. He further states that the only way to effectively keep pole timber to a minimum, and still be able to harvest saw timber, is to balance the timber age-classes, making sure that the cuts are well dispersed. Roach concluded that when wildlife constraints were taken into consideration with what he referred to as "partially delayed, extra rotation" a yield loss of only 3.2 percent would occur.

Previous research has indicated that clearcuts in the Appalachians should be between 17 and 30 acres (6.9 and 12.1 ha) in size (Harlow and Palmer 1967, Harlow and Downing 1970, Healy 1971, Roach 1974). The results of the present study support these observations and suggest that clearcuts should be linear in shape with a width of approximately 183 m (600 ft).

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APPENDIX

Appendix Table I. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the canopy stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Quercus alba	29.01		21.08		28.77		77.86
Quercus prinus	17.59		17.49		14.53		49.61
Quercus velutina	13.89		13.90		18.23		46.02
Quercus coccinea	10.80		11.66		11.70		34.16
Acer rubrum	7.10		8.07		7.51		22.68
Liriodendron tulipifera	6.48		7.17		7.34		20.99
Carya glabra	4.01		5.83		2.94		12.78
Carya tomentosa	3.70		4.93		2.69		11.32
Quercus rubra	1.24		1.79		2.29		5.32
Nyssa sylvatica	1.54		1.79		1.12		4.45
Carya ovalis	0.93		1.35		0.57		2.85
Pinus virginiana	0.93		1.35		0.48		2.76
Robina pseudoacacia	0.62		0.90		0.35		1.87
Acer saccharum	0.62		0.90		0.21		1.73
Pinus pungens	0.62		0.45		0.42		1.49

Appendix Table I. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the canopy stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Magnolia acuminata	0.31		0.45		0.33		1.09
Pinus strobus	0.31		0.45		0.32		1.08
Betula lutea	0.31		0.45		0.21		0.97

Appendix Table II. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the subcanopy stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Acer rubrum	28.09		21.94		24.52		74.55
Oxydendrum arboreum	13.89		13.50		15.08		42.47
Quercus prinus	11.73		10.13		16.75		38.61
Quercus alba	9.88		10.13		11.30		31.31
Carya tomentosa	5.56		6.75		6.27		18.58
Quercus velutina	5.56		6.33		5.41		17.30
Cornus florida	5.86		7.17		2.09		15.12
Carya glabra	4.01		5.06		3.26		12.33
Nyssa sylvatica	3.09		3.38		1.92		8.39
Liriodendron tulipifera	2.62		2.53		2.56		7.71
Quercus coccinea	2.16		2.53		2.17		6.86
Pinus virginiana	1.54		1.69		2.24		5.47
Fraxinus americana	1.24		2.11		1.38		4.73

Appendix Table II. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the subcanopy stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Pinus pungens	0.62		0.84		2.39		3.85
Acer saccharum	1.24		1.69		0.65		3.58
Amelanchier arborea	0.93		1.27		0.29		2.49
Pinus strobus	0.62		0.84		0.41		1.87
Quercus rubra	0.62		0.84		0.34		1.80
Rhododendron maximum	0.62		0.42		0.14		1.18
Betula lenta	0.31		0.42		0.07		0.80
Carya cordiformis	0.31		0.42		0.67		1.40

Appendix Table III. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of trees 4-in (10.2 cm) and over dbh (combined canopy and subcanopy) of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Quercus alba	23.77		17.37		24.44		65.58
Quercus prinus	17.90		16.53		16.01		50.44
Quercus velutina	11.73		13.14		17.14		42.01
Acer rubrum	10.19		9.75		9.43		29.37
Quercus coccinea	8.33		9.32		9.82		27.47
Liriodendron tulipifera	4.94		5.08		6.83		16.85
Oxydendrum arboreum	5.25		6.78		1.69		13.72
Carya tomentosa	4.01		5.51		2.96		12.48
Carya glabra	4.01		4.66		2.99		11.66
Nyssa sylvatica	2.47		2.54		1.84		6.85
Quercus rubra	0.93		1.27		2.56		4.76
Pinus virginiana	1.54		1.69		0.70		3.93

Appendix Table III. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of trees 4-in (10.2 cm) and over dbh (combined canopy and subcanopy) of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Pinus pungens	1.23	1.27	1.02	3.52
Carya ovalis	0.93	1.27	0.85	3.05
Acer saccharum	0.93	1.27	0.06	2.26
Fraxinus americana	0.62	0.85	0.19	1.66
Magnolia acuminata	0.31	0.42	0.48	1.21
Robinia pseudoacacia	0.31	0.42	0.32	1.05
Betula lutea	0.31	0.42	0.30	1.03
Pinus strobus	0.31	0.42	0.06	0.79

Appendix Table IV. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Acer rubrum	16.67		15.51		17.98		50.16
Cornus florida	16.98		15.51		16.49		48.98
Kalmia latifolia	3.70		2.86		28.70		35.26
Oxydendron arboreum	10.49		10.20		12.68		33.37
Nyssa sylvatica	6.48		6.12		8.70		21.30
Sassafras albidum	8.02		7.35		2.54		17.91
Amelanchier arborea	4.94		5.31		4.46		14.71
Castanea dentata	4.01		4.49		4.31		12.81
Quercus velutina	3.70		4.49		2.29		10.48
Carya tomentosa	3.09		4.08		2.30		9.47
Rhododendron spp.	3.09		2.49		3.67		9.25
Acer saccharum	3.09		3.67		2.45		9.21

Appendix Table IV. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area + (percent)	Importance value
Carya glabra	1.54	2.04	4.84	8.42
Liriodendron tulipifera	2.16	2.86	1.91	6.93
Rhododendron maximum	0.93	0.82	4.80	6.55
Fraxinus americana	1.54	2.04	0.77	4.35
Pinus strobus	0.62	0.82	2.54	3.98
Vaccinium stamineum	1.24	1.22	0.81	3.27
Quercus prinus	1.24	0.82	0.53	2.59
Lindera benzoin	0.93	1.22	0.42	2.57
Hamamelis virginiana	0.93	0.82	0.45	2.20
Smilax rotundifolia	0.93	0.82	0.09	1.84
Rhamnus lanceolata	0.93	0.41	0.45	1.79
Pinus virginiana	0.31	0.82	0.47	1.60

Appendix Table IV. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 60- to 100-year old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Alnus serrulata	0.31	0.41	0.54	1.26
Quercus coccinea	0.31	0.41	0.24	0.96
Robinia pseudoacacia	0.31	0.41	0.20	0.92
Magnolia acuminata	0.31	0.41	0.10	0.82
Quercus rubra	0.31	0.41	0.06	0.78
Viburnum acerifolium	0.31	0.41	0.02	0.74
Prenanthes altissima	0.31	0.41	0.02	0.72
Lespedeza hirta	0.31	0.41	0.01	0.71

Appendix Table V. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Sassafras albidum	22.33	17.13	9.06	48.52
Nyssa sylvatica	13.11	12.77	8.48	34.36
Quercus coccinea	8.74	9.35	9.89	27.98
Liriodendron tulipifera	8.25	7.79	7.88	23.92
Acer rubrum	6.80	8.41	7.87	23.08
Quercus prinus	4.85	6.23	11.03	22.11
Pinus pungens	4.85	4.36	9.62	18.83
Oxydendrum arboreum	4.13	4.67	9.89	18.69
Pinus strobus	4.37	5.61	5.97	15.95
Cornus florida	4.85	4.36	4.95	14.16
Quercus alba	1.94	2.49	1.39	5.82
Acer saccharum	0.73	0.93	3.98	5.64
Amelanchier arborea	1.94	2.49	0.68	5.11

Appendix Table V. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Castanea dentata	1.46		1.56		1.91		4.93
Pinus virginiana	0.97		1.25		1.51		3.73
Hamamelis virginiana	1.46		0.93		0.58		2.97
Kalmia latifolia	0.97		1.25		0.57		2.79
Carya glabra	0.97		1.25		0.55		2.77
Pinus rigida	0.48		0.62		1.55		2.65
Quercus ilicifolia	0.97		0.93		0.37		2.27
Rubus spp.	0.73		0.62		0.16		1.51
Quercus velutina	0.48		0.62		0.26		1.36
Viburnum prunifolium	0.73		0.31		0.23		1.27
Carya tomentosa	0.49		0.31		0.45		1.25
Prunus serotina	0.24		0.31		0.69		1.24

Appendix Table V. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Alnus serrulata	0.48		0.31		0.10		0.89
Smilax rotundifolia	0.48		0.31		0.02		0.81
Quercus rubra	0.24		0.31		0.17		0.72
Vaccinium stamineum	0.24		0.31		0.04		0.59
Rhus glabra	0.24		0.31		0.03		0.58
Robinia pseudoacacia	0.24		0.31		0.03		0.58
Crataegus spp.	0.24		0.31		0.02		0.57
Eupatorium perfoliatum	0.24		0.31		0.02		0.57
Lactuca hirsuta	0.24		0.31		0.02		0.57
Rhododendron spp.	0.24		0.31		0.02		0.57
Eupatorium purpureum	0.24		0.31		0.01		0.56

Appendix Table VI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 2-year-old clear-cut in Craig Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Cornus florida	9.72		8.54		31.66		49.92
Acer rubrum	16.20		17.07		7.33		40.60
Sassafras albidum	14.82		12.80		8.51		36.13
Nyssa sylvatica	10.18		10.98		9.47		30.63
Erechtites hieracifolia	10.18		8.54		6.27		24.99
Quercus prinus	6.48		5.49		3.13		15.10
Oxydendron arboreum	4.63		4.88		5.51		15.02
Robinia pseudoacacia	4.63		5.49		3.09		13.21
Kalmia latifolia	3.24		3.66		5.41		12.31
Cirsium vulgare	3.70		3.66		3.91		11.27
Castanea dentata	3.24		4.27		1.72		9.23
Carya tomentosa	0.93		1.22		5.61		7.76
Quercus coccinea	1.85		1.83		1.05		4.73

Appendix Table VI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the shrub stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Hamamelis virginiana	1.85		1.22		0.87		3.94
Quercus alba	0.46		0.61		2.68		3.75
Carya glabra	0.93		1.22		1.44		3.59
Vitis aestivalis	1.39		1.83		0.25		3.47
Quercus velutina	0.93		1.22		0.49		2.64
Spiraea latifolia	0.93		1.22		0.25		2.40
Rhododendron spp.	0.93		0.61		0.17		1.71
Lactuca canadensis	0.46		0.61		0.53		1.60
Liriodendron tulipifera	0.46		0.61		0.28		1.35
Amelanchier arborea	0.46		0.61		0.14		1.21
Rhus vernix	0.46		0.61		0.14		1.21
Erigeron canadensis	0.46		0.61		0.05		1.12
Smilax glauca	0.46		0.61		0.02		1.09

Appendix Table VII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent)	= Importance value
Desmodium nudiflorum	15.43	11.11	3.48	30.02
Sassafras albidum	8.64	8.64	8.36	25.64
Vaccinium spp.	10.80	9.05	4.60	24.45
Quercus velutina	4.32	5.35	7.99	17.66
Quercus prinus	2.47	2.47	10.69	15.63
Kalmia latifolia	3.09	2.06	7.89	13.04
Cornus florida	4.94	4.94	3.04	12.92
Castanea dentata	1.54	2.06	8.86	12.46
Nyssa sylvatica	2.47	3.29	5.47	11.23
Dioscorea villosa	4.01	3.70	1.17	8.88
Quercus coccinea	3.09	3.29	1.91	8.29
Vaccinium stamineum	2.47	3.29	2.35	8.11

Appendix Table VII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Rhododendron spp.	2.78		2.88		2.09		7.75
Gaylussacia baccata	2.78		1.65		2.54		6.97
Acer rubrum	1.85		2.47		2.59		6.91
Solidago spp.	2.47		2.47		0.94		5.88
Carya glabra	1.85		2.47		1.46		5.78
Quercus rubra	1.24		1.65		2.78		5.67
Smilax rotundifolia	2.16		2.06		1.20		5.42
Rhamnus lanceolata	1.24		0.82		3.34		5.40
Clintonia umbellulata	0.93		0.41		3.35		4.69
Amelanchier arborea	1.54		2.06		1.54		5.14
Oxydendrum arboreum	1.24		1.65		1.52		4.41
Quercus alba	1.24		1.65		0.68		3.57

Appendix Table VII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Smilax glauca	1.54		1.65		0.15		3.34
Fraxinus americana	0.31		0.41		2.24		2.96
Vitis aestivalis	0.93		1.23		0.54		2.70
Medeola virginінia	0.93		1.23		0.44		2.60
Galax aphylla	0.93		1.23		0.26		2.42
Gillenia trifoliata	0.93		1.23		0.17		2.33
Lactuca canadensis	0.93		0.82		0.50		2.25
Cimicifuga racemosa	0.93		0.41		0.70		2.04
Carya ovalis	0.31		0.41		1.19		1.91
Aster spp.	0.62		0.82		0.34		1.78
Coreopsis major	0.62		0.82		0.09		1.53
Panicum spp.	0.62		0.82		0.04		1.48

Appendix Table VII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Osmunda regalis	0.62		0.41		0.37		1.40
Viburnum acerifolium	0.62		0.41		0.34		1.37
Rhododendron maximum	0.31		0.41		0.46		1.18
Carya tomentosa	0.31		0.41		0.30		1.02
Magnolia acuminata	0.31		0.41		0.30		1.02
Smilacina racemosa	0.31		0.41		0.30		1.02
Acer saccharum	0.31		0.41		0.17		0.89
Bidens spp.	0.31		0.41		0.17		0.89
Carex spp.	0.31		0.41		0.17		0.89
Eupatorium purpureum	0.31		0.41		0.17		0.89
Goodyera pubescens	0.31		0.41		0.17		0.89
Lespedeza hirta	0.31		0.41		0.17		0.89

Appendix Table VII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Liriodendron tulipifera	0.31		0.41		0.17		0.89
Campanula divaricata	0.31		0.41		0.07		0.79
Unknown herbs	0.31		0.41		0.07		0.79
Viola hirsatula	0.31		0.41		0.07		0.79
Unknown Gramineae	0.31		0.41		0.02		0.74
Uvaluria perfoliata	0.31		0.41		0.02		0.74

Appendix Table VIII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Vaccinium spp.	26.94	22.10	17.73	66.77
Kalmia latifolia	11.16	10.14	23.89	45.19
Gaylussacia baccata	10.92	7.61	4.23	22.76
Quercus coccinea	3.16	4.35	8.13	15.64
Cornus florida	1.94	2.17	8.81	12.92
Sassafras albidum	3.64	5.07	3.55	12.26
Quercus prinus	1.70	2.17	4.88	8.75
Vitis aestivalis	3.64	3.62	1.18	8.44
Nyssa sylvatica	1.70	2.17	2.85	6.72
Smilax glauca	2.67	2.90	0.41	5.98
Quercus velutina	1.21	1.81	2.51	5.53
Liriodendron tulipifera	1.70	1.81	2.01	5.52

Appendix Table VIII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Panicum spp.	2.43	2.90	0.13	5.46
Rubus spp.	1.70	2.17	0.58	4.45
Amelanchier arborea	1.21	1.81	1.31	4.33
Smilax rotundifolia	1.94	1.45	0.83	4.22
Oxydendrum arboreum	0.73	0.72	2.46	3.91
Pinus strobus	0.73	1.09	1.90	3.72
Acer rubrum	1.85	1.09	0.50	3.44
Coreopsis major	1.70	1.45	0.24	3.39
Pinus pungens	0.48	0.72	2.03	3.23
Rosa carolina	1.46	1.09	0.58	3.13
Vaccinium stamineum	0.73	1.09	0.81	2.63
Quercus alba	0.73	0.72	1.13	2.58

Appendix Table VIII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Quercus ilicifolia	0.24		0.36		1.89		2.49
Viburnum acerifolium	0.97		0.72		0.76		2.45
Lysimachia quadifolia	0.97		1.09		0.17		2.23
Unknown Gramineae	1.46		0.72		0.04		2.22
Dioscorea villosa	0.73		1.09		0.13		1.95
Viburnum dentatum	0.48		0.72		0.54		1.74
Eupatorium perfoliatum	0.73		0.72		0.21		1.66
Crateagus spp.	0.48		0.72		0.45		1.65
Hamamelis virginiana	0.48		0.72		0.30		1.50
Viburnum prunifolium	0.48		0.36		0.66		1.50
Carex spp.	0.73		0.72		0.02		1.47
Pteridium aquilinum	0.48		0.72		0.21		1.41

Appendix Table VIII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area = (percent)	Importance value
Lindera benzoin	0.48	0.72	0.15	1.35
Rhus radicans	0.48	0.72	0.15	1.35
Lespedeza hirta	0.48	0.72	0.06	1.26
Ludwigia alternifolia	0.48	0.72	0.06	1.26
Solidago spp.	0.48	0.72	0.06	1.26
Rhododendron spp.	0.24	0.72	0.18	1.14
Baptisia tinctoria	0.24	0.36	0.47	1.07
Pycnanthemum icanum	0.48	0.36	0.13	0.97
Cryptotaenia canadensis	0.48	0.36	0.06	0.90
Robinia pseudoacacia	0.24	0.36	0.18	0.78
Ceanothus americanus	0.24	0.36	0.12	0.72
Lactuca spp.	0.24	0.36	0.07	0.67

Appendix Table VIII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Lyonia liqustrina	0.24		0.36		0.07		0.67
Aster spp.	0.24		0.36		0.03		0.63
Galax aphylla	0.24		0.36		0.03		0.63
Juglans nigra	0.24		0.36		0.03		0.63
Linum virginianum	0.24		0.36		0.03		0.63
Parthenocissus quinquefolia	0.24		0.36		0.03		0.63
Andropogon virginicus	0.24		0.36		0.01		0.61

Appendix Table IX. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Vaccinium spp.	25.46		20.14		12.59		58.19
Erechtites hieracifolia	10.65		9.35		28.68		48.68
Sassafras albidum	9.72		8.63		16.28		34.63
Rhododendron spp.	6.02		5.88		3.28		15.18
Nyssa sylvatica	2.78		4.32		5.94		13.04
Panicum spp.	5.09		6.47		0.91		12.47
Kalmia latifolia	3.24		2.88		4.33		10.45
Cornus florida	2.32		2.88		3.60		8.80
Dactylis glomerata	4.17		2.16		2.07		8.40
Smilax glauca	3.70		4.32		0.30		8.32
Vaccinium stamineum	3.24		3.60		1.29		8.13
Vitis aestivalis	1.85		2.88		1.77		6.50
Acer rubrum	1.85		2.88		1.23		5.96

Appendix Table IX. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Robinia pseudoacacia	1.39		1.44		2.20		5.03
Quercus coccinea	1.39		1.44		1.77		4.60
Quercus alba	0.93		1.44		1.96		4.33
Quercus velutina	0.46		0.72		2.68		3.86
Carex spp.	1.85		1.44		0.48		3.77
Desmodium nudiflorum	1.39		1.44		0.38		3.21
Liriodendron tulipifera	0.93		1.44		0.67		3.04
Smilax rotundifolia	0.93		0.72		1.34		2.99
Lespedeza hirta	0.93		1.44		0.49		2.86
Lindera benzoin	0.93		1.44		0.27		2.64
Angelica atropurpurea	1.39		0.72		0.45		2.56
Castanea dentata	0.46		0.72		1.32		2.50

Appendix Table IX. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Solidago spp.	0.93	0.72	0.67	2.32
Desmodium cuspidatum	0.93	0.72	0.21	1.86
Asclepias spp.	0.46	0.72	0.67	1.85
Coreopsis major	0.46	0.72	0.67	1.85
Carya glabra	0.46	0.72	0.43	1.61
Oxydendrum arboreum	0.46	0.72	0.43	1.61
Lechea racemulosa	0.46	0.72	0.24	1.42
Alnus serrulata	0.46	0.72	0.11	1.29
Dioscorea villosa	0.46	0.72	0.11	1.29
Viola spp.	0.46	0.72	0.11	1.29
Aster spp.	0.46	0.72	0.03	1.21
Smilacina racemosa	0.46	0.72	0.03	1.21

Appendix Table IX. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the tall herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Unknown Graminae	0.46		0.72		0.03		1.21

Appendix Table X. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Desmodium nudiflorum	13.89		11.74		6.39		32.02
Vaccinium spp.	6.17		6.09		9.45		21.71
Gaultheria procumbens	8.02		6.09		5.05		19.16
Quercus alba	5.86		5.22		7.72		18.80
Chimaphila maculata	5.56		5.22		6.39		17.17
Acer rubrum	3.70		4.78		2.53		11.01
Smilax glauca	4.63		3.91		2.00		10.54
Quercus prinus	2.78		3.48		4.26		10.52
Rhododendron spp.	4.01		3.04		2.93		9.98
Clintonia borealis	0.62		0.43		8.65		9.70
Quercus velutina	2.78		3.48		3.19		9.45
Cornus florida	2.16		3.04		3.60		8.80

Appendix Table X. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
<u>Quercus coccinea</u>	2.16		3.04		3.19		8.39
<u>Dioscorea villosa</u>	2.47		3.48		1.46		7.41
Unknown herbs	2.78		3.04		1.59		7.41
<u>Goodyera pubescens</u>	0.93		0.87		5.60		7.40
<u>Amelanchier arborea</u>	2.47		3.04		1.07		6.58
<u>Viola</u> spp.	2.47		3.04		1.07		6.58
<u>Potentilla canadensis</u>	2.47		2.17		1.07		5.71
<u>Galax aphylla</u>	2.16		1.74		0.93		4.83
<u>Viola hirsutula</u>	1.85		1.74		0.80		4.39
<u>Epigaea repens</u>	1.24		0.87		2.14		4.25
<u>Nyssa sylvatica</u>	0.93		1.30		1.87		4.10
<u>Liriodendron tulipifera</u>	1.54		1.30		1.07		3.91
<u>Rhododendron maximum</u>	0.62		0.43		2.39		3.44

Appendix Table X. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Smilax rotundifolia	0.93		0.87		1.20		3.00
Vaccinium stamineum	0.93		0.87		1.20		3.00
Solidago spp.	0.62		0.87		1.34		2.83
Uvularia pudica	1.24		0.87		0.53		2.64
Rhamnus lanceolata	0.93		0.87		0.80		2.60
Gillenia trifoliata	0.93		0.87		0.41		2.21
Medeola virginiana	0.93		0.87		0.41		2.21
Rubus spp.	0.93		0.43		0.80		2.16
Carya glabra	0.62		0.87		0.66		2.15
Sassafras albidum	0.62		0.87		0.66		2.15
Kalmia latifolia	0.31		0.43		1.20		1.94
Lindera benzoin	0.62		0.87		0.27		1.76

Appendix Table X. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Senecio aureus	0.62		0.87		0.27		1.76
Uvularia perfoliata	0.62		0.87		0.27		1.76
Unknown Graminea	0.62		0.43		0.27		1.32
Carya tomentosa	0.31		0.43		0.53		1.27
Lactuca canadensis	0.31		0.43		0.53		1.27
Lillium superbum	0.31		0.43		0.53		1.27
Smilacina racemosa	0.31		0.43		0.53		1.27
Carex spp.	0.31		0.43		0.14		0.88
Hieracium pilosella	0.31		0.43		0.14		0.88
Lespedeza hirta	0.31		0.43		0.14		0.88
Panicum spp.	0.31		0.43		0.14		0.88
Rhus radicans	0.31		0.43		0.14		0.88

Appendix Table X. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 60- to 100-year-old uncut forest in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Streptopus roseus	0.31		0.43		0.14		0.88
Thelypteris noveboracensis	0.31		0.43		0.14		0.88
Viburnum acerifolium	0.31		0.43		0.14		0.88
Vitis aestivalis	0.31		0.43		0.14		0.88

Appendix Table XI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Vaccinium spp.	18.69		16.32		34.08		69.09
Gaultheria procumbens	18.69		13.81		6.90		39.40
Potentilla canadensis	13.59		9.62		3.97		27.18
Galax aphylla	5.58		5.44		3.04		14.06
Kalmia latifolia	2.67		3.35		7.74		13.76
Epigaea repens	4.37		3.77		3.28		11.42
Gaylussacia baccata	2.91		3.77		3.67		10.35
Parthenocissus quinquefolia	3.64		2.09		4.07		9.80
Panicum spp.	2.67		4.18		0.67		7.52
Acer rubrum	1.94		2.93		2.61		7.48
Viola spp.	1.94		2.93		1.52		6.39
Antennaria plantaginifolia	0.24		0.42		5.10		5.76

Appendix Table XI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Solidago spp.	1.94	2.51	0.88	5.33
Unknown Graminae	1.94	2.09	1.24	5.27
Vitis aestivalis	1.21	2.09	1.12	4.42
Erigeron pulchellus	1.46	1.26	1.20	3.92
Lactuca spp.	0.24	0.42	2.88	3.54
Rhus radicans	0.97	1.67	0.80	3.44
Quercus prinus	0.97	1.67	0.56	3.20
Viburnum acerifolium	0.97	0.84	1.20	3.01
Dioscorea villosa	0.97	1.67	0.33	2.97
Quercus coccinea	0.48	1.26	1.04	2.78
Liriodendron tulipifera	0.73	1.26	0.71	2.70
Sassafras albidum	0.97	0.84	0.56	2.37

Appendix Table XI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Coreopsis major	0.73	1.26	0.24	2.23
Hieracium pilosella	0.97	0.42	0.80	2.19
Rubus spp.	0.48	0.84	0.80	2.12
Clintonia borealis	0.24	0.42	1.28	1.94
Cornus florida	0.24	0.42	1.28	1.94
Smilax glauca	0.73	0.84	0.24	1.81
Ascyrum hypericoides	0.97	0.42	0.33	1.72
Unknown herbs	0.48	0.84	0.33	1.65
Carex spp.	0.48	0.42	0.64	1.54
Aster spp.	0.24	0.42	0.72	1.38
Quercus alba	0.24	0.42	0.72	1.38
Rosa carolina	0.24	0.42	0.72	1.38

Appendix Table XI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Uvularia sessilifolia	0.48		0.42		0.32		1.22
Lespedeza procumbens	0.24		0.84		0.08		1.16
Andropogon virginicus	0.48		0.42		0.16		1.06
Cirsium muticum	0.24		0.42		0.32		0.98
Quercus velutina	0.24		0.42		0.32		0.98
Smilacina racemosa	0.24		0.42		0.32		0.98
Amelanchier arborea	0.24		0.42		0.08		0.74
Betula lenta	0.24		0.42		0.08		0.74
Desmodium nudiflorum	0.24		0.42		0.08		0.74
Ludwigia alternifolia	0.24		0.42		0.08		0.74
Rhododendron spp.	0.24		0.42		0.08		0.74
Uvalaria pudica	0.24		0.42		0.08		0.74

Appendix Table XI. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 6- to 7-year-old clearcut in Montgomery Co., Virginia; summer 1974 (continued).

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Viola hirsutula	0.24		0.42		0.08		0.74
Viola pedata	0.24		0.42		0.08		0.74

Appendix Table XII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974.

Species	Relative density (percent)	+	Relative frequency (percent)	+	Relative basal area (percent)	=	Importance value
Vaccinium spp.	23.61		19.71		28.53		71.85
Rhododendron spp.	13.43		10.95		15.99		40.37
Erechtites hieracifolia	7.87		8.03		12.80		28.70
Vitis aestivalis	6.94		6.57		2.80		16.31
Potentilla canadensis	5.56		4.38		2.24		12.18
Liriodendron tulipifera	3.70		5.84		2.56		12.10
Desmodium nudiflorum	3.70		4.38		2.03		10.11
Panicum spp.	2.78		3.65		1.66		8.09
Vaccinium stamineum	2.32		2.92		2.00		7.24
Cornus florida	1.85		2.19		2.89		6.93
Lespedeza procumbens	3.24		2.19		1.31		6.74
Dactylis glomerata	1.85		0.73		3.82		6.40
Carex spp.	2.78		1.46		2.00		6.24

Appendix Table XII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Smilax glauca	2.32	2.92	0.93	6.17
Unknown herbs	1.85	2.92	1.28	6.05
Quercus coccinea	0.93	1.46	2.38	4.77
Galax aphylla	2.32	1.46	0.93	4.71
Acer rubrum	1.39	2.19	1.10	4.68
Viola spp.	1.39	2.19	1.10	4.68
Dioscorea villosa	1.39	2.19	0.56	4.14
Viola hirsutula	1.85	1.46	0.75	4.06
Lespedeza hirta	0.93	1.46	0.91	3.30
Smilacina stellata	0.93	0.73	1.45	3.11
Goodyera pubescens	0.46	0.73	1.66	2.85
Solidago spp.	0.93	0.73	0.91	2.57

Appendix Table XII. Importance values (sum of the relative abundance, relative frequency, and relative basal area) of plants in the low herb stratum of a 2-year-old clearcut in Craig Co., Virginia; summer 1974 (continued).

Species	Relative density (percent) +	Relative frequency (percent) +	Relative basal area (percent) =	Importance value
Desmodium cuspidatum	0.46	0.73	0.72	1.91
Hieracium pilosella	0.46	0.73	0.72	1.91
Kalmia latifolia	0.46	0.73	0.72	1.91
Ludwigia palustris	0.46	0.73	0.72	1.91
Nyssa sylvatica	0.46	0.73	0.72	1.91
Quercus ilicifolia	0.46	0.73	0.72	1.91
Quercus prinus	0.46	0.73	0.72	1.91
Quercus alba	0.46	0.73	0.19	1.38
Smilax rotundifolia	0.46	0.73	0.19	1.38

Appendix Table XIII. Scientific and common names of plants recorded in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974.

Scientific Name	Common Name
Acer rubrum	Red maple
Acer saccharum	Sugar maple
Alnus serrulata	Smooth alder
Andropogon virginicus	Broom sedge
Angelica atropurpurea	Angelica; Alexanders
Anntennaria plantaginifolia	Plantain-leaved pussytoes
Amelanchier arborea	Downy Juneberry
Asclepias spp.	Milkweed
Ascyrum hypericoides	St. Andrew's cross
Aster spp.	Aster
Baptisia tinctoria	Wild indigo
Betula lenta	Black birch
Betula lutea	Yellow birch
Bidens spp.	Tickseed-sunflowers
Campanula divaricata	Southern harebell
Carex spp.	Sedge
Carya cordiformis	Bitternut hickory
Carya glabra	Pignut hickory
Carya ovalis	Sweet pignut
Carya tomentosa	Mockernut hickory
Castanea dentata	Chestnut
Ceanothus americanus	New Jersey tea
Chimaphila maculata	Spotted wintergreen
Cimicifuga racemosa	Black cohosh; Bugbane
Cirsium muticum	Swamp thistle
Cirsium vulgare	Bull thistle
Clintonia borealis	Clintonia; Corn-lily
Clintonia umbellulata	White clintonia
Coreopsis major	
Cornus florida	Flowering dogwood
Crataegus spp.	Hawthorn
Cryptotaenia canadensis	Hornwort
Dactylis glomerata	Orchard grass
Desmodium cuspidatum	Large-bracted tick-trefoil
Desmodium nudiflorum	Naked-flowered tick-trefoil

Appendix Table XIII. Scientific and common names of plants recorded in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974 (continued).

Scientific Name	Common Name
Dioscorea villosa	Wild yam
Epigaea repens	Trailing arbutus
Erechtites hieracifolia	Pilewort; Fireweed
Erigeron canadensis	Horseweed
Erigeron pulchellus	Robin-plantain
Eupatorium perfoliatum	Boneset
Eupatorium purpureum	Sweet Joe-pye-weed
Fraxinus americana	White ash
Galax aphylla	Galax; Beetleweed
Gaultheria procumbens	Wintergreen; Checkerberry; Teaberry
Gaylussacia baccata	Black huckleberry
Gillenia trifoliata	Bowman's-root
Goodyera pubescens	Downy rattlesnake-plantain
Goodyera repens	Dwarf rattlesnake-plantain
Gramineae	Grass, unknown genus
Hamamelis virginiana	Witch-hazel
Hieracium pilosella	Mouse-ear hawkweed
Juglans nigra	Black walnut
Kalmia latifolia	Mountain laurel
Lactuca canadensis	Wild lettuce
Lactuca hirsuta	Hairy lettuce
Lactuca spp.	Wild lettuce, unknown species
Lechea racemulosa	Pinweeds
Lespedeza hirta	Hairy bush-clover
Lespedeza procumbens	Trailing bush-clover
Lilium superbum	Turk's-cap lily
Lindera benzoin	Common spicebush
Linum virginianum	Yellow flax
Liriodendron tulipifera	Yellow poplar
Ludwigia alternifolia	Seedbox
Ludwigia palustris	Water purslane

Appendix Table XIII. Scientific and common names of plants recorded in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974 (continued).

Scientific Name	Common Name
Lyonia liqustrina	Maleberry
Lysimachia quadifolia	Whorled loosestrife
Magnolia acuminata	Cucumber magnolia
Medeola virginiana	Indian cucumber-root
Nyssa sylvatica	Sour-gum; Black-gum
Osmunda regalis	Royal fern
Oxydendrum arboreum	Sourwood
Panicum spp.	Panic grass
Parthenocissus quinquefolia	Virginia creeper
Pinus pungens	Table mountain pine
Punus rigida	Pitch pine
Pinus strobus	White pine
Pinus virginiana	Scrub pine
Potentilla canadensis	Dwarf cinquefoil
Prenanthes altissima	Tall white lettuce
Prunus serotina	Black cherry
Pteridium aquilinum	Bracken fern
Pycnanthemum icanum	Hoary mountain-mint
Quercus alba	White oak
Quercus coccinea	Scarlet oak
Quercus ilicifolia	Scrub oak
Quercus prinus	Chestnut oak
Quercus rubra	Red oak
Quercus velutina	Black oak
Rhamnus lanceolata	Lanceleaf buckthorn
Rhododendron maximum	Great rhododendron; White laurel
Rhododendron spp.	Azelea
Rhus glabra	Smooth sumac
Rhus radicans	Poison-ivy
Rhus vernix	Poison-sumac
Robinia pseudoacacia	Black locust
Rosa carolina	Pasture or Carolina rose

Appendix Table XIII. Scientific and common names of plants recorded in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; summer 1974 (continued).

Scientific Name	Common Name
Rubus spp.	Blackberry
Sassafras albidum	Sassafras
Senecio aureus	Golden ragwort
Smilax glauca	Glaucous greenbrier
Smilax rotundifolia	Common greenbrier
Smilacina racemosa	False solomon's-seal
Smilacina stellata	Starry false solomon's-seal
Solidago spp.	Goldenrod
Spiraea latifolia	Broadleaf spirea, Meadow sweet
Streptopus roseus	Rose twisted-stalk
Thelypteris noveboracensis	New York fern
Uvularia perfoliata	Perfoliate bellwort
Uvularia pudica	Mountain bellwort
Uvularia sessilifolia	Wild oats; Sessile bellwort
Vaccinium spp.	Blueberry
Vaccinium stamineum	Tall deerberry
Viburnum acerifolium	Mapleleaf viburnum
Viburnum dentatum	Southern arrowwood
Viburnum prunifolium	Smooth blackhaw
Viola hirsutula	Southern wood violet
Viola spp.	Violet
Viola pedata	Birdfoot violet
Vitis aestivalis	Summer grape

Appendix Table XIV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; fall 1974, spring 1975.

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
Sorex cinereus	5/20	A	PF	--	--	101	41	13.0
	5/20	A	PF	--	--	108	44	13.5
	5/27	C	PF	--	--	99	39	12.8
Sorex fumeus	10/03	A	PF	--	--	110	45	13
	5/20	C	PF	--	--	119	46	14.5
Sorex longirostris	6/16	C	PF	--	--	76	28	11.0
Blarina brevicauda	11/12	B	MT	F	16.2	109	23	14.8
	11/14	D	MT	F	12.8	107	23	14.1
	11/15	D	MT	--	17.5	119	25	14.5
	5/20	C	PF	--	--	121	25	16.0
	5/27	A	PF	--	--	111	25	15.8
Peromyscus leucopus	9/26	A	PF	M	--	158	74	21
	11/07	C	MT	F(a)	24.5	160	71	20
	11/13	D	MT	F	31.8	177	83	20.6
	11/14	B	MT	M	16.9	149	62	19.6

Appendix Table XIV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; fall 1974, spring 1975 (continued).

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
	11/14	D	MT	M	19.9	155	67	21.6
	5/13	C	PF	M	--	136	62	21.0
Napaeozapus insignis	9/19	C	PF	M	17.6	211	136	30
	10/03	A	PF	F	19.5	215	136	29
	10/17	C	PF	M	16.0	195	125	29
Glaucomys volans	11/07	A	RT	F	55.5	231	97	31
	11/08	A	RT	M	51.2	215	96	31.6

(a) embryos present

Appendix Table XV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall 1974, spring 1975.

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
Sorex cinereus	10/17	A	PF	--	--	106	42	12
	10/17	C	PF	--	--	83	32	10
	11/06	A	MT	--	5.6	106	45	12
	11/07	A	PF	--	--	85	34	12
	11/07	A	MT	--	4.7	102	42	13
	11/07	A	MT	--	5.3	101	45	13
	11/07	A	MT	--	5.2	109	40	12
	11/08	A	MT	--	5.3	102	40	12
	11/08	A	MT	--	5.1	100	40	12
	11/08	A	MT	--	4.8	107	42	13
	5/14	A	PF	--	--	102	47	15
	5/21	C	PF	--	--	100	44	14
	5/21	C	PF	--	--	103	44	13
Sorex fumeus	10/09	A	PF	--	--	111	42	13
Sorex longirostris	5/21	C	PF	--	--	71	29	10
	5/21	C	PF	--	--	72	28	11
Cryptotis parva	10/09	C	PF	--	--	76	16	10

Appendix Table XV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall 1974, spring 1975 (continued).

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
	10/17	A	PF	--	--	76	16	11
	10/17	C	PF	--	--	79	15	10
	5/21	C	PF	--	--	70	16	11
Blarina brevicauda	11/06	A	MT	M	13.3	112	22	14
	11/06	A	MT	F	13.2	112	21	15
	11/08	A	MT	F	13.2	103	20	14.6
	11/12	B	MT	F	14.2	110	24	14.6
	11/13	B	MT	M	16.9	123	23	14.9
	11/13	B	MT	F	15.4	108	21	15.6
	11/13	D	MT	M	13.5	108	20	15.0
	11/14	D	RT	F	13.9	117	24	15.0
	11/15	D	MT	F	12.2	101	18	14.1
	5/14	C	PF	M	--	98	22	16.0
Peromyscus leucopus	9/26	A	PF	M	--	178	87	20
	11/05	A	MT	M	20.0	152	66	21
	11/06	A	MT	M	22.3	170	72	22
	11/06	A	MT	F	15.5	145	61	22
	11/06	C	MT	F(a)	19.5	156	65	21
	11/07	A	MT	F	20.4	165	70	20
	11/07	A	RT	M	24.7	171	74	21

Appendix Table XV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall 1974, spring 1975 (continued).

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
	11/08	C	MT	F(a)	30.1	162	69	19.8
	11/08	C	MT	F(a)	20.6	155	76	19.9
	11/08	C	MT	M	18.7	163	68	20.6
	11/08	A	MT	F	22.2	168	77	20.0
	11/12	D	MT	F	12.6	124	52	19.0
	11/12	D	MT	M	20.1	156	69	20.0
	11/12	D	MT	M	17.5	152	68	19.8
	11/12	D	MT	M	21.2	157	64	20.5
	11/12	D	MT	F	19.6	148	62	20.4
	11/13	B	MT	F	20.1	159	68	20.4
	11/13	B	MT	M	18.4	152	64	19.7
	11/13	B	MT	M	20.7	167	76	21.3
	11/13	B	MT	F	19.9	153	64	19.0
	11/13	B	MT	M	20.7	166	74	20.7
	11/13	B	MT	F	22.2	175	74	21.5
	11/13	D	MT	M	11.6(b)	185	73	20.1
	11/13	D	MT	F	18.4	167	73	20.2
	11/13	D	MT	M	19.2	145	60	20.0
	11/13	D	MT	F	26.3	174	74	22.2
	11/14	D	MT	F	12.7	131	56	20.2
	11/14	D	MT	F	15.9	146	63	20.5
	11/15	D	MT	F	12.0	128	52	20.1
	11/15	D	MT	M	13.1	133	57	19.0
	11/15	D	MT	M	17.0	140	58	19.2

Appendix Table XV. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall 1974, spring 1975 (continued).

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
	5/21	A	PF	M	--	154	65	22
	5/21	C	PF	F	--	154	67	20
	6/16	A	PF	F	--	141	67	20
<u>Ochrotomys nuttalli</u>	11/08	A	MT	M	21.4	160	75	19.3
	11/13	D	MT	F	20.6	163	71	19.2
	11/14	B	RT	F	21.2	170	73	18.1
	11/14	B	MT	F	13.9	142	63	20.4
	11/14	B	MT	F	11.7	138	62	17.8
	11/14	D	MT	F	15.1	153	67	19.1
	11/14	D	MT	M	19.5	173	78	18.3
	11/14	D	MT	M	10.5	131	57	17.7
<u>Napaeozapus insignis</u>	10/09	A	FF	M	--	210	131	30
<u>Tamias striatus</u>	11/15	D	RT	M	89.9	223	74	30.9

(a) embryos present
(b) body partially devoured

Appendix Table XVI. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 2-year-old clearcut in Craig Co., Virginia; fall 1974, spring 1975.

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
Sorex cinereus	5/06	A	PF	--	--	93	41	8
	5/14	A	PF	--	--	94	42	8
Sorex fumeus	10/17	A	PF	--	--	113	45	13
Cryptotis parva	9/26	A	PF	--	--	75	17	10
	10/03	A	PF	--	--	72	16	10
	10/17	A	PF	--	--	68	16	9
	11/07	A	PF	--	--	61	13	10
	11/07	A	PF	--	--	77	16	10
Blarina brevicauda	10/17	A	PF	F	--	122	26	16
	11/13	B	MT	M	17.6	118	25	14.5
	11/14	B	MT	F	15.3	118	25	14.2
	5/27	A	PF	M	--	118	18	13.0
Peromyscus leucopus	9/26	A	PF	M	--	131(c)	42(c)	21
	10/03	A	PF	M	--	176	82	20
	10/09	A	PF	F	--	139	64	20

Appendix Table XVI. Measurements of small mammals captured using pitfall traps (PF), mouse traps (MT), and rat traps (RT) in a 2-year-old clearcut in Craig Co., Virginia; fall 1974, spring 1975 (continued).

Species	Date	Transect	Trap type	Sex	Weight (gms)	Total length (mm)	Tail length (mm)	Hind foot length (mm)
	10/29	A	PF	F	--	130	51	20
	11/06	A	RT	M	22.0	162	73	22
	11/06	A	MT	F(a)	20.2	152	65	20
	11/06	A	MT	M	20.0	157	71	22
	11/07	A	MT	M	22.2	165	73	21
	11/08	A	MT	M	18.4	146	61	19.6
	11/12	B	MT	M	19.7(b)	165	68	20.0
	11/12	B	MT	M	30.9	185	75	20.1
	11/13	B	MT	M	24.8	167	78	20.6
	11/13	B	MT	F(a)	20.8	153	67	20.4
	11/13	B	MT	F	28.0	183	83	20.6
	11/13	B	MT	F	28.3	170	72	19.9
	11/14	B	MT	M	15.7	138	59	18.8
	11/15	B	RT	F	23.1	158	69	21.6
	11/15	B	MT	M	21.8	163	74	20.6
	11/15	B	MT	M	13.1	139	60	21.6
	11/15	B	MT	F(a)	26.7	179	72	19.6
	5/14	A	PF	M	--	137	66	21
	5/14	A	PF	F	--	137	64	21
Napaeozapus insignis	10/03	A	PF	M	--	210	131	30

(a) embryos present (b) body partially devoured (c) tail severed

Appendix Table XVII. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia.

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
MARSUPIALIA						
Didelphis virginianus	0	0	8	5	8	5
INSECTIVORIA						
Sorex cinereus	3	2	0	0	3	2
Sorex fumeus	2	1	0	0	2	1
Sorex longirostris	1	1	0	0	1	1
Blarina brevicauda	5	4	0	0	5	4
LAGOMORPHA						
Sylvilagus transitionalis	0	0	1	1	1	1
RODENTIA						
Peromyscus leucopus	6	5	2	1	8	6
Napaeozapus insignis	3	2	0	0	3	2

Appendix Table XVII. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia (continued).

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
Tamias striatus	0	0	5	3	5	3
Glaucomys volans	2	2	6	4	8	6
Sciurus carolinensis	0	0	6	4	6	4
CARNIVORA						
Spilogale putorius	0	0	4	2	4	2
Procyon lotor	0	0	1	1	1	1
Total species	7	7	8	8	13	13
Total individuals	22	17	33	21	55	38

Appendix Table XVIII. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 6- to 7-year-old clearcut in Montgomery Co., Virginia.

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
MARSUPILIA						
Didelphis virginianus	0	0	4	3	4	3
INSECTIVORIA						
Sorex cinereus	14	9	0	0	14	9
Sorex fumeus	1	0	0	0	1	0
Sorex longirostris	2	1	0	0	2	1
Cryptotis parva	4	2	0	0	4	2
Blarina brevicauda	10	7	0	0	10	7
LAGOMORPHA						
Sylvilagus floridanus	0	0	2	1	2	1
Sylvilagus transitionalis	0	0	20	13	20	13

Appendix Table XVIII. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 6- to 7-year-old clearcut in Montgomery Co., Virginia (continued).

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
RODENTIA						
Peromyscus leucopus	35	27	0	0	35	27
Ochrotomys nuttalli	7	6	0	0	7	6
Napaeozapus insignis	1	0	0	0	1	0
Tamias striatus	1	1	4	3	5	4
Glaucomys volans	0	0	2	1	2	1
CARNIVORA						
Mephitis mephitis	0	0	2	1	2	1
Total species	9	9	6	6	14	14
Total individuals	75	53	34	22	109	75

Appendix Table XIX. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 2-year-old clearcut in Craig Co., Virginia.

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
MARSUPILIA						
Didelphis virginianus	0	0	1	1	1	1
INSECTIVORIA						
Sorex cinereus	2	2	0	0	2	2
Sorex fumeus	1	1	0	0	1	1
Cryptotis parva	5	4	0	0	5	4
Blarina brevicauda	4	5	1	1	5	5*
LAGOMORPHA						
Sylvilagus floridanus	0	0	3	2	3	2
Sylvilagus transitionalis	0	0	1	1	1	1
RODENTIA						
Peromyscus leucopus	22	30	1	1	23	31

Appendix Table XIX. Actual and weighted (number per 1000 trap-nights) number of different individuals captured using snap and pitfall traps, and box and wire mesh traps during the 1974-75 fall, winter, and spring trapping periods in a 2-year-old clearcut in Craig Co., Virginia (continued).

Species	Snap and pitfall traps		Box and wire mesh traps		Total	
	actual	weighted	actual	weighted	actual	weighted
Napaeozapus insignis	1	1	0	0	1	1
Tamias striatus	0	0	1	1	1	1
Sciurus carolinensis	0	0	1	1	1	1
CARNIVORA						
Mephitis mephitis	0	0	3	2	3	2
Spilogale putorius	0	0	2	1	2	1
Procyon lotor	0	0	1	1	1	1
Total species	6	6	10	10	14	14
Total individuals	35	43	15	12	50	54

*The total weighted number of *Blarina brevicauda* was "5" rather than the apparent "6" due to rounding factors.

Appendix Table XX. Number of trap-nights (TU) and traps set off from all causes (S) using wooden box traps, and wire mesh live-traps in a 60- to 100-year-old forest (control), a 6- to 7-year-old clearcut, and a 2-year-old clearcut in Montgomery and Craig Cos., Virginia; winter 1974-75.

Area	Trap-nights (TU)			Traps set off (S)		
	Wire mesh	Wood	Total	Wire mesh	Wood	Total
Control	522	1160	1682	67	121	188
6- to 7-yr. cut	522	986	1508	33	178	211
2-yr. cut	522	1044	1566	28	81	109
All areas	1566	3190	4756	128	380	508

Appendix Table XXI. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; fall and winter 1974-75.

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
Didelphis virginianus	001	F	12/17	WT	--
			12/29	WT	--
			1/10	WT	825
			1/20	WT	--
			1/30	WT	825
			2/01	WT	800
	002	F	12/22	WT	850
			12/30	WT	950
			1/12	WT	--
	003	M	12/31	WT	1300
			1/19	WT	1350
			1/20	WT	--
			2/16	WT	1175
	004	F	1/12	WT	1225
	005	M	2/15	WT	1475
	006	M	2/18	WT	1550
			2/24	BT	1575
	007	F	2/23	WT	1750
	008	M	2/23	WT	2000+
Sylvilagus transitionalis	001	M	1/11	BT	950
			1/16	BT	875
			1/18	BT	--
			1/19	BT	--
			1/25	BT	--
			2/01	BT	950
Peromyscus leucopus	001	--	1/15	BT	--
	002	M	2/18	BT	--

Appendix Table XXI. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; fall and winter 1974-75 (continued).

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
Tamias striatus	001	F	2/15	BT	--
	002	M	2/23	BT	100
	003	M	2/24	BT	80
	004	M	2/25	BT	100
	005	M	2/25	BT	70
Sciurus carolinensis	001(c)	F	1/05	BT	340
	002	F	2/07	BT	450
	003	M	2/14 2/22	BT BT	325 375
	004	M	2/16 2/21	BT BT	400 325
	005	M	2/26	BT	425
	unk	unk	2/04 2/05 2/25	BT BT BT	-- -- --
Glaucomys volans	001	M	12/31 1/18	BT BT	50 --
	002(c)	M	1/05	BT	55
	003(c)	F	1/08	BT	40
	004	M	1/15	BT	50
	005	F	2/17	BT	50

Appendix Table XXI. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 60- to 100-year-old forest (control) in Montgomery Co., Virginia; fall and winter 1974-75 (continued).

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
	ukn	ukn	2/20	BT	--
Spilogale putoreus	001	--	12/18	WT	--
	002	M	12/19	WT	--
			1/01	WT	450
			1/20	WT	--
			2/02	WT	--
			2/19	WT	--
			2/23	WT	650
			2/28	WT	--
	003	M	2/14	WT	700
	unk	M	2/17	WT	650
Procyon lotor	001	M	1/04	WT	2000+
Canis familiaris	001	M	1/15	WT	--
	002	M	2/14	WT	--
	003	M	2/20	WT	--

(c) dead

Appendix Table XXII. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall and winter 1974-75.

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
Didelphis virginianus	001	M	12/22	WT	2000+
	002	M	12/30	WT	1600
	003	F	1/09	WT	2000+
	004	F	2/19	WT	1000
Sylvilagus floridanus	001	M	1/31	BT	1025
	002	F	2/14	BT	925
Sylvilagus transitionalis	001	M	12/17	BT	--
			12/23	BT	--
			1/07	BT	850
			1/08	BT	850
			1/11	BT	1025
			1/12	BT	825
			1/17	BT	825
			1/18	BT	--
			1/19	WT	--
			1/24	WT	--
			1/30	WT	825
			1/31	WT	825
			2/01	WT	--
			2/05	BT	825
			2/06(a)	WT	750
	002	F	12/17	BT	--
			2/17	BT	875
			2/18	BT	875
			2/19	BT	875
			2/20	BT	--
			2/28	BT	--
	003	M	12/18	BT	1100

Appendix Table XXII. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall and winter 1974-75 (continued).

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
			1/05	BT	1000
			1/08	BT	975
			1/19	BT	--
			2/02	BT	1050
	004	M	12/20	BT	775
			12/31	BT	850
			2/20	WT	875
Sylvilagus transitionalis	005	F	12/21	BT	--
			1/03	BT	1100
			1/11	BT	1100
			1/28	BT	--
			2/01	BT	1100
	006	F	12/29	BT	1050
			1/03	BT	1150
			1/05	BT	1075
			1/10	BT	900
			1/16	BT	1050
			1/17	BT	1025
			1/24	BT	--
			2/02	BT	1000
			2/04	BT	1000
	007	M	12/29	BT	800
			1/06	BT	600
			1/11	BT	800
			1/16	BT	800
			1/18(b)	BT	775
	008	M	1/04	BT	975
	009	M	1/04	BT	975
			1/09	BT	1025
			1/10	BT	1025
			1/15	BT	1025
			1/17	BT	1000

Appendix Table XXII. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall and winter 1974-75 (continued).

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
			1/18	BT	--
			1/19	BT	--
			1/25	BT	--
			1/26	BT	925
			1/27	BT	975
			1/28	BT	925
			2/02	BT	--
			2/05	BT	--
			2/18	BT	1025
			2/19	BT	975
			2/20	BT	--
Sylvilagus transitionalis	010	M	1/06	BT	1025
	011	M	1/08	BT	875
			1/28	BT	825
	012	F	1/08	BT	850
			1/11	BT	825
			1/24	BT	--
			1/29	BT	850
	013	F	1/10	BT	1100
			1/15	BT	1075
			1/18	BT	--
			1/27	BT	1075
			1/29	BT	1100
			1/31	BT	1075
			2/01	BT	1075
			2/04	BT	1050
			2/19	BT	1100
			2/23	BT	1100
	014	M	1/19(c)	BT	880
	015	F	1/30(b)	BT	1000
			2/01	BT	--

Appendix Table XXII. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 6- to 7-year-old clearcut in Montgomery Co., Virginia; fall and winter 1974-75 (continued).

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
			2/28	BT	975
	016	M	2/04	BT	1000
	017	F	2/04	BT	950
			2/24	BT	975
			2/26	BT	875
	018	M	2/14	BT	1025
			2/17	BT	1075
			2/19	BT	1000
			2/22	BT	--
			2/23	BT	--
	019	M	2/17	BT	1150
	020	M	2/28	BT	700
Tamias striatus	001	F	2/18	BT	100
			2/22	BT	75
	002	M	2/22	BT	--
	003	M	2/22	BT	75
	unk	unk	2/27	BT	--
Glaucomys volans	001	M	1/19(c)	BT	--
	002	F	2/23	BT	75
Mephitis mephitis	001	M	1/18	WT	1775
	002	M	2/26	WT	1475
			2/27	WT	--

(a) lethargic when released (b) injured (c) dead

Appendix Table XXIII. Small mammal captures using wire mesh (WT) and wooden box traps (BT) in a 2-year-old clearcut in Craig Co., Virginia; fall and winter 1974-75.

Species	I. D. number	Sex	Date	Trap type	Weight (gms)
Didelphis virginianus	001	M	1/12	WT	2000+
Blarina brevicauda	001	ukn	1/19	BT	--
Sylvilagus floridanus	001	M	1/10	BT	1200
	002	M	1/10	BT	1100
			2/03	BT	1225
	003	F	2/23	BT	1250
Sylvilagus transitionalis	001	M	12/17	BT	--
			12/20	BT	850
			12/21	BT	--
Peromyscus leucopus	001	M	12/23	BT	--
Tamias striatus	001	M	2/26	BT	75
Sciurus carolinensis	001	M	1/24	BT	525
Mephitis mephitis	001	F	2/16	WT	1300
	002	M	2/17	WT	1600
	003	M	2/17	WT	1200
Spilogale putoreus	001	M	2/03	WT	550
	002	--	2/19	BT	--
Procyon lotor	001	M	1/24	WT	2000+

VITA

Michael Jerre Blymyer, son of Mr. and Mrs. Jerre W. Blymyer, was born in Washington, D.C. on May 10, 1946. He attended public schools in Prince Georges and Montgomery Counties, Maryland, and was graduated from Richard Montgomery High School in 1965. He matriculated at the University of Maryland in the fall of 1965, and left this institution to enlist in the United States Army in February 1967. Honorably discharged in October 1969 with the rank of Sergeant, he resumed his studies at the University of Maryland, and was graduated with a B. S. degree in Conservation and Resource Development (Wildlife Option) in December 1972. He became a candidate for the Master's Degree in Wildlife Management at Virginia Polytechnic Institute and State University in September 1973, and was awarded a Graduate Research Assistantship in July 1974. He is a member of the American Society of Mammalogists, Virginia Wildlife Federation, The American Forestry Association, The Wildlife Society, the Virginia Tech Student Chapter of The Wildlife Society (president 1974-75), and was elected to membership in the Biological Honor Society of Phi Sigma on May 8, 1975.

Married the former Judith Ann Triebel on December 22, 1973. They have one son; Tad Jeremiah, born September 17, 1975.

Michael Jerre Blymyer

IMPACT OF CLEARCUTTING ON INDIGENOUS
MAMMALS OF SOUTHWEST VIRGINIA

by

Michael J. Blymyer

(ABSTRACT)

Three areas of similar physiographic characteristics were investigated; a control (60 to 100-yr-old forest) and 2 clearcuts (a 2-yr-old and 6- to 7-yr-old cut). These areas were located in the Craig Creek watershed of Montgomery and Craig Cos., Virginia. Two growing seasons after clearcutting it was evident that the shrub stratum had not caught up to the uncut forest in the number of stems per acre, however, the 2 herb strata had surpassed the uncut forest in density. These floristic changes apparently influenced the make-up of the faunal segment of the community. Mammals generally associated with older plant communities were either absent in the 2-yr cut, or were infrequently captured and rarely observed during the snow track-counts. Other species increased in relative numbers over the uncut forest, and 3 mammal species characteristic of early plant succession, which were not present in the uncut forest, reached their highest relative numbers in the 2-yr cut. By the 6th or 7th yr after cutting woody regeneration had generally replaced herbs as dominants. The shrub stratum was denser than either the 2-yr cut or the uncut forest. The partial crown closure of this stratum apparently favored

the more shade tolerant herbs. This sere also evidenced the largest populations of 6 mammal species. Additionally, this successional stage showed the highest overall population of small mammals. White-tailed deer used the entire area of both clearcuts, however, use was predominantly in the first 61 m from the forest edge in the 2-yr cut and from 30.5 to 122 m in the 6- to 7-yr cut. It was recommended that clearcuts be limited to 20 to 30a (8.1 to 12.1 ha) in size and that the cuts should be linear in shape with a width of approximately 183 m.