Order Number 9324210

Effectiveness and other practical considerations of electric transmission line rights-of-way vegetation management in New York State

Nowak, Christopher Anthony, Ph.D.

State University of New York Col. of Environmental Science & Forestry, 1993

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

EFFECTIVENESS AND OTHER PRACTICAL CONSIDERATIONS OF ELECTRIC TRANSMISSION LINE RIGHTS-OF-WAY VEGETATION MANAGEMENT IN NEW YORK STATE

By

Christopher A. Nowak

A thesis
submitted in partial fulfillment
of the requirements for the
Doctor of Philosophy Degree

State University of New York
College of Environmental Science and Forestry
Syracuse, New York

December 1992

Approved:
Faculty of Forestry

Major Professor

Chair, Examining Committee

Faculty Chair

Dean, Instruction and
Graduate Studies

DEDICATION

I dedicate this thesis to my wife, Linda, and to my children, Tristan, Morgan, Rebekah, and Jocelyn. They have sacrificed much during my pursuit of a Ph.D., likely more than they or I appreciate.

ACKNOWLEDGEMENTS

At many points in my past career, I came close to choosing paths that would have led away from a Ph.D. But, with some persistence and work, and much support and presentation of opportunities from others, I have arrived at this point in my career.

This thesis is not the result of my singular efforts, but is the product of much sacrifice from, and cooperation and friendship with, many individuals.

I am appreciative of the funding provided by the Niagara Mohawk Power Corporation (NMPC) and the Empire State Electric Energy Research Corporation (ESEERCO). Specific thanks in this regard are extended to Ed Neuhauser, NMPC, and Kevin McLoughlin, ESEERCO. Thanks are also extended for indirect support in the form of project sponsorship by Dale Freed and Ed Neuhauser, NMPC. At their behest, and with their support, I was involved in all facets of the research process, including proposal writing and pursuit of funding. It was extremely beneficial to be involved in all aspects of these research programs. I owe this extraordinary opportunity to these people, and to others whose acknowledgements follow.

Many people helped execute various field study phases, including measuring 10,000 trees and driving 30,000 miles over one and one-half years. Bob Butts, Matt Delaney, Laura Alban, Amy Van Ord, Don Cameron, and Mike Flynn were integral in these and many other related efforts. Their help is greatly appreciated. Special thanks are extended to Mike Flynn. He persisted from the beginning, and approached all tasks with a smile.

I appreciate the friendship, respect, and encouragement of my colleagues and friends through my years at ESF, especially Don Bickelhaupt, Russ Briggs, Rich Kopp, Vicram Prabhu, Jim Sahm, and Jim Shepard, and including the other people present in this acknowledgement.

My committee members, Drs. Lawrence Abrahamson, Donald Leopold, Edward Neuhauser, Dudley Raynal, Steven Stehman, and Edwin White provided me advice, many challenges, weathered my mistakes, and shared in my accomplishments. I appreciate their perseverance, rigor, and criticism.

I specifically acknowledge the extraordinary efforts in my behalf from Ed Neuhauser, Ed White, and Larry Abrahamson.

Dr. Ed Neuhauser "saved" me from a life without a Ph.D. He offered me the opportunity to pursue a Ph.D. while at the same time providing a means to support my family in a reasonable manner. It was his support that allowed me to begin, and his continued support that has allowed me to carry the effort through to fruition. He opened a myriad of professional opportunities for me. Thanks Ed!

Dr. Ed White was one of the first professors to recognize my potential to be a scientist. It was his confidence and initial support back in 1985 that began this process. It was Ed that supported my move back to Syracuse from Florida in 1988. Thanks Ed! He and Larry (my bosses) have always understood my needs to balance work and family. They always allowed me the flexibility to learn about all facets of science and research, and were strongly supportive of me during those numerous periods when I was bumbling through the program.

Dr. Larry Abrahamson was specifically chosen to be my Major Professor because of his skills outside of research and academia (however, I now fully appreciate that these skills are critical to research and academia). I entered this program lacking strengths in many interpersonal skills. I believe I leave this program with those skills enhanced because of Larry. It is an honor to complete this program with Larry as my friend! Thanks Larry!

Finally, and to quote from my M.S. thesis' acknowledgements:

> Lastly, and certainly not leastly, I acknowledge and appreciate the patience, persistence, love, and late night needle picking by my wife Linda, who has weathered my 10-year progression and development, to this point, in the sciences. She has provided the main, enjoyable sources of distraction from some of my manical (maniacal) pursuits

Things didn't change much over the course of the past 6 years. It has now been 16 years of patience, persistence, and love from Linda. My appreciation for her has increased with the years. There was no "late night needle picking" this time around, but there has been a lot of late nights watching her husband hunched over a lap top computer. The maniacal pursuits did continue. I expect that things will slow done a bit in that regard now, and my enjoyment of those "sources" of distraction, including my children, will increase.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

LIST OF TABLES

TABLE OF CONTENTS

Page

LIST OF TABLES continued.

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

LIST OF FIGURES

TABLE OF CONTENTS

Page

LIST OF APPENDICES

ABSTRACT

Nowak, Christopher, A. Effectiveness and other practical considerations of electric transmission line rights-of-way vegetation management in New York State. Typed and bound thesis, 198 pages, 31 tables, 8 figures, 1992.

A selective approach to managing vegetation on electric transmission line rights-of-way has been demonstrated to be effective in controlling tree populations, but only on small, experimental scales. There is little information on the long-term response of tree populations to selective removal at an operational management scale. We hypothesized that the operational selective removal of trees on rights-of-way can lead to relatively stable, low density populations of trees. Tree densities and species composition were compared on rights-of-way in New York State over a 16-year period across a wide range of management schemes, environmental conditions and plant communities. In 1975, 58 permanent vegetation measurement plots, 0.03 to 0.08 ha in size, were established on 21 rights-of-way across New York. In 1991, trees $\geq$ 1 m height were remeasured on these plots. Tree densities in 1975 and 1991 were expressed as a function of relative distance across each right-of-way plot using a quadratic model. Sequentially estimated regression coefficients were compared between these periods using paired t-tests. Species composition was compared between periods using Morisita-Horn similarity coefficients. On rights-of-way where trees were periodically, selectively removed using herbicides, tree populations were observed at constant low density. There was a spatial redistribution of trees in 1991 compared to 1975, with fewer trees in the centerline area and more in the border areas along right-of-way edges in 1991. An increase in tree density was observed on rights-of-way that did not receive herbicide treatments to control trees, but had only aboveground portions of trees selectively removed using periodic hand cutting. Results of selective tree removal, with or without herbicides, did not vary as a function of site condition or forest region. Species composition generally did not change over the study period. _Acer_, _Betula_, _Fraxinus_, _Populus_, _Prunus_, and _Quercus_ species were commonly present on all sites during 1975 and 1991. Red maple (_Acer rubrum_ L.), white ash (_Fraxinus americana_ L.) and quaking aspen (_Populus tremuloides_ Michx.) were the most important species. Operational, selective removal of trees on rights-of-way, whereby both the above- and belowground portions of the plants are periodically killed and site disturbance minimized, can lead to the creation of relatively stable, compositionally constant, low density tree populations.

Other studies were initiated in 1982 with a goal of examining vegetation management method cost effectiveness during initial clearing and conversion phases. The objectives were to determine which herbicide application mode and method is most cost effective in accomplishing vegetation management objectives during these early right-of-way management phases. Additionally, cost effectiveness of grubbing or brush hogging was compared to that of basal and stem-foliar herbicide schemes during the second conversion cycle. Study duration was 8 years. For the initial clearing phase, clear or selective cutting with no herbicides was the most cost effective approach. For the first and second cycle during the conversion phase, nonselective and selective stem-foliar schemes were most cost effective. Herbicide schemes (stem-foliar and basal) were more cost effective than non-herbicide schemes (grubbing or brush hogging) during the second conversion cycle.

Christopher Anthony Nowak
Candidate for the degree of Doctor of Philosophy,
December 18, 1992
Lawrence P. Abrahamson, Major Professor
Faculty of Forestry
State University of New York College of Environmental
Science and Forestry, Syracuse, New York

Signature of Major Professor Lawrence P. Abrahamson

INTRODUCTION

Electric rights-of-way (ROWs)[1] are essential to the safe and reliable transmission of electricity. Tall trees pose a threat to service reliability and safety by their potential to grow into the conductors. If a tree grows too close to a conductor, a ground-line fault will occur. Electricity will "flash" from the conductors through the trees to the ground. Utilities must periodically remove tree stems growing on transmission ROWs to avoid ground-line faults.

Managers have several methods for removing trees on ROWs. These methods differ in cost and effectiveness. Cost effectiveness is a measure of vegetation management success based on the relative economic production of right-of-way (ROW) values. Safety and reliability are critical values. Wildlife and aesthetics are ancillary values commonly produced with vegetation management on ROWs.

In New York, the selective use of herbicides has been a mandatory approach to vegetation management on ROWs over the last decade (de Waal Malefyt, 1984). This approach is purported to be highly effective (Egler, 1953; Niering, 1958; Egler and Foote, 1975). Researchers and vegetation managers consider the use of herbicides to

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[1] Abbreviations: ROW, right-of-way; ROWs, rights-of-way.

be the most cost effective way to achieve ROW values; however, there is little objective information on the effectiveness and cost of this and other vegetation management schemes (Abrahamson et al., 1992).

Some customers and regulators prefer utilities reduce or eliminate the use of herbicides for ROW management, regardless of cost. In response, a few utilities in the Northeast have established system-wide programs that are restricted to non-herbicide methods such as hand cutting or brush hogging. Other utilities have increased the use of these methods over the past few years (Abrahamson et al., 1992), despite the fact that there is little information on the cost effectiveness of non-herbicide techniques relative to selective herbicide methods.

Five studies of vegetation management on electric transmission line ROWs in New York State were performed with a goal of determining effectiveness and cost of ROW vegetation management methods. Trends in vegetation management methods in New York were investigated using utility management records for 21 ROWs (Study 1), followed by a series of field studies conducted to determine long- and short-term effectiveness and costs for herbicide and non-herbicide ROW vegetation management methods. Study 2 is an examination of long-term effectiveness of operational ROW vegetation management based on 1991 remeasurement of 70 permanent vegetation measurement plots established in 1975 on 21 ROWs across New York State. Studies 3 and 4 were initiated in 1982 with a goal of examining vegetation management method cost effectiveness during initial clearing and conversion phases on a recently cleared ROW in Upstate New York. In Study 5, cost effectiveness of brush hogging and grubbing, both non-herbicide schemes, was examined relative to the herbicide schemes from Study 4.

LITERATURE REVIEW

Definition of Electric Transmission Line Rights-of-way

Electric ROWs are strips of land, generally 30 to 300 m in width, used by the utilities to transmit electricity. They occupy a well-defined, clearly recognizable, and functionally important piece of the landscape (Forman and Godron, 1986).

In the U.S., there are over 1,000,000 km of electric transmission line ROWs (EEI, 1990[2]). New York has 24,000 km of ROWs occupying 61,000 ha of land; about 36,000 ha are under some utility-oriented vegetation management program (J. de Waal Malefyt, 1991, personal communication).

Purpose of Electric Transmission Line Rights-of-way

The purpose of ROWs is to provide a corridor for the safe and reliable transmission of electricity. Tall trees can cause unsafe conditions and disrupt electricity transmission by growing or falling into the transmission wire security zone, which can include up to 7 m surrounding each conductor, depending on voltage. Tall trees are defined as any tree species that can attain a height that will allow it to enter the transmission wire

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2 P. Martin, 1992, personal communication. Refers to the total of all aboveground electric transmission lines greater than 22 kV for investor owned, government owned, municipal system, state project, federal agency, and public power district sources for the U.S. This total excludes REA cooperatives.

security zone. In general, the minimum mature height of a tall growing tree is 6.1 m (ESEERCO, 1984).

Goal of Right-of-way Vegetation Management

In New York, vegetation management on ROWs has been closely regulated since the late 1970s (de Waal Malefyt, 1984). In 1980, a regulatory opinion regarding vegetation management was implemented (NYS Public Service Commission, 1980b, Appendix A, p. 4):

> The principal ROW management objective is (promoting) the growth of low-growing, relatively stable plant communities that are aesthetically appealing, beneficial to wildlife, compatible with electrical system reliability requirements, and need relatively little maintenance over the life of a ROW.

In this definition, ROWs are prescribed as providing a set of broad values -- safety, reliability, wildlife and aesthetics. Safety is not specifically included in the Public Service Commission's regulatory opinion, but is implied along with reliability requirements. Reliability and safety are tantamount. Economic concerns are implied by the statement regarding a "need (for) relatively little maintenance over the life of a ROW". Less maintenance means less management inputs and related costs.

The goal of ROW vegetation management is control of vegetation, which means creating and maintaining a relatively low population of trees. This is similar to the containment policy of weeds in agriculture (Auld et al., 1987), where the weeds for ROWs are tall growing trees. Containment on ROWs means that tree species: 1) are restricted to the area outside of the ROW, 2) can continue to develop and increase in population outside the ROW, and 3) are acceptable in some areas of the ROW at some relatively low density.

Control of vegetation is defined as the suppression of undesirable plants to the point that economic impact is prevented (Ross and Lembi, 1985). The critical economic impact of trees on ROWs is in causing ground-line faults. Vegetation control on ROWs in New York entails creating plant communities that minimize the potential for ground-line faults. Management centers on the cyclic selective removal of trees. Concomitantly, the growth of low stature plant communities, e.g., grasses, forbs, and shrubs, are promoted. Management methods that reduce trees and increase and subsequently maintain desirable plant communities are considered effective methods because they can minimize the potential for ground-line faults and maximize wildlife and aesthetic values (Egler, 1953; Egler and Foote, 1975).

Vegetation Management Methods on Electric Transmission Line Rights-of-way

Methods of vegetation management on ROWs can be grouped into chemical, physical, biological, or ecological classes (adapted from Auld et al., 1987).

The chemical group is solely herbicides; i.e., synthetically produced chemicals that can kill plants. This method has been practiced in New York since the 1950s (Nowak et al., 1993).

Herbicides can be applied in a variety of ways and at different times in the life cycle of a plant. Methods of application vary as a function of entry point into a plant. Cut stump, basal, stem-foliar and foliar methods are common selective treatment methods in New York (Nowak et al., 1993). Cut stump treatment entails completely cutting the stem off near groundline and applying herbicide to the freshly cut cambial area of the stump. Basal is the application of herbicide to the lower bark area of a stem. An oil carrier is commonly used to aid the herbicide in penetrating the bark. Stem-foliar is the treatment of leaves, branches and upper stems. Foliar is the treatment of just foliage. Different herbicide formulations and concentrations are used with each method, matched to maximize the uptake, translocation and activity at the site of action.

Physical methods differ from the other classes in that no chemical or living organism is directly involved in the control of the ROW plant communities. Most of these "non-herbicide" methods do involve the use of synthetic chemicals, such as motor oil, gasoline, bar oil, etc. The most common physical methods operationally used on ROWs are hand cutting and brush hogging (Abrahamson et al., 1992). Hand cutting is the use of chainsaws or hand held brush cutters (small stems) to cut undesirable vegetation at or near groundline.

Brush hogging is the use of a Hydro-Ax™ or similar machine used to cut all vegetation near groundline. Brush hogging equipment is similar to a rotary mower with large hydraulically driven fixed or hinged blades that can cut/shred all vegetation, including woody vegetation up to 10 cm diameter. Machines with flails rather than blades are included in brush hogging. Brush hogging is also commonly referred to as "mowing" (Galvin et al., 1979; Gangstad, 1989), but, since this could be confused with the conventional mowing that is done with a sickle bar or small rotary mower, brush hogging will be the term used in this thesis. There are other machines referred to as brush hogs which are not hydraulically driven, but create the same effect on the plant community.

Grubbing is a physical vegetation management method. It entails the use of a bulldozer with a root rake to "grub" all vegetation, including roots, from a ROW site. Grubbed materials, including physical impediments such as boulders, are generally pushed to the edge of the ROW. The site is leveled, seeded, fertilized, and subsequently mowed or maintained by other methods.

Classically, the biological method is the use of insects or microorganisms to control weeds. The use of vertebrate animals and interference from plants has been referred to as a biological method, but these are ecological control methods. For ROW vegetation management, use of allelochemics, mycoherbicides and bacterial herbicides are potential biological controls (Tillman, 1984).

Ecological methods include the use of plants or the use of animals to control undesirable plants, including the use of competing desirable plants. Methods that increase the relative competitive ability of desirable plants on ROWs are included in ecological control methods.

Physical, chemical, and ecological control methods are commonly integrated. The biological control method is not operationally viable. In New York, the selective use of herbicides is a combination of chemical and at times mechanical (e.g., cut stump) methods with ecological methods. Cut stump treatments integrate mechanical, chemical and ecological control. The selective removal of trees fosters the development of low stature ROW plant communities, which then compete with residual and new trees (Niering and Goodwin, 1974).

Ecological Bases for Vegetation Management on Electric Transmission Line Rights-of-way

Presence of trees on ROWs is a function of two factors: 1) management method, which can be viewed as differing by intensity, timing and frequency of disturbance, and, 2) species on the site now, on the site in the past, or capable of invading from adjacent forest lands. These two factors interact to initiate a particular successional pathway for a site. Herbaceous, shrub or mixed woody pathways are generally recognized results of different ROW vegetation management programs (Galvin et al., 1979; Bramble et al., 1991).

The shrub pathway is most preferred on ROWs because shrubs are generally the most stable low stature plant community (Egler and Foote, 1975). These communities also provide high wildlife (Bramble et al., 1985), aesthetic (Kenfield, 1966, 1991), and general conservation value (Niering, 1958).

Relative stability of ROW shrub communities has been attributed to the occupation of space and utilization of site resources left after the selective removal of trees. The subsequent invasion and establishment of trees is reduced through interference and other processes (Pickett et al., 1987; Pickett and McDonnell, 1989). Herbivory may be an important process in reducing tree presence on ROWs and maintaining stability of ROW plant communities. Deer browsing of trees is prominent on ROWs (Bramble et al., 1985; Kays et al., 1987; Hyman et al., 1991). Small mammals may also have a significant impact on tree dynamics through seed predation and seedling herbivory (Hyman et al., 1991; Luken et al., 1992b).

The shrub pathway approach for ROW vegetation management was first proposed nearly 40 years ago (Egler, 1953), with numerous subsequent repropositions (Niering, 1958; Kenfield, 1966; Egler and Foote, 1975; Egler, 1981; Daar, 1991). It is prevalent in the Northeastern U.S., but has yet to be accepted in other parts of the country (Daar, 1991).

The Shrub Stability Approach and Egler's Initial Floristic Composition

The shrub pathway approach, or shrub stability approach" (*sensu* Niering, 1974, p. xiv in Egler and Foote, 1975), is historically based on Egler's Initial Floristic Composition (IFC) theory (Egler, 1954). The classical pattern of successional stages, where old-fields proceed from abandonment through forb, grassland, shrubland, and forest stages, is described in IFC theory as a function of stochastic processes associated with the arrival of propagules, coupled with the differential expression of plant dominance at various stages due to life history characteristics (Egler 1954; Finegan 1984). A key premise for IFC theory as a basis for the shrub approach as proposed by Egler is that propagules of each successional stage are mostly present, or arrive on the site, soon after abandonment. While propagules continue to arrive on the site during each stage, most of the vegetation present at each stage is a result of an "unfolding of that which was determined at the start" (Egler, 1954). By removing the "unfolded" forest stage, relatively stable residual plant communities are created.

In developing the IFC theory, Egler found that herbicides could be used to selectively kill both above- and belowground tree portions, yet cause relatively little disturbance to the surrounding vegetation (Egler, 1946, 1947, 1948). Subsequently, Egler and others observed relatively stable pre-forest stage plant communities when, through various circumstances, the forest stage was "missing" (Pound and Egler, 1953; Niering and Egler, 1955; Niering et al., 1986). The effects of selective herbicide use, and the observed vegetation dynamics on sites without trees, apparently was the basis for Egler proposing that the selective removal of trees would lead to the creation of relatively stable, desirable ROW plant communities (Egler, 1953).

Further Considerations of Egler's Initial Floristic Composition as a Basis for the Shrub Approach to Right-of-way Vegetation Management

Egler (1954) presented two views of old-field succession, describing Clement's classical theory as Relay Floristic and his own theory as Initial Floristic Composition. The important difference between the two for ROW vegetation management is the timing of the invasion of trees. In Relay Floristics, vegetation development in old-fields progresses from abandonment through time as distinct stages, or waves, of plant communities: first annual weeds, then grasses, large forbs, shrubs, and finally, trees. Each successive stage becomes established only after the preceding stage altered the site in such a way as to prevent its own reestablishment and at the same time, facilitate the establishment of the next stage. Egler proposed that another more important factor existed for old-field development. Abandoned land, having received an initial load of propagules, develops its vegetative cover from this initial load (Egler, 1954). The observed stages of secondary succession simply are a consequence of the different growth rates of the plants involved (life history characteristics) and competition (Shugart, 1984). Drury and Nisbet (1973) supported Egler's IFC theory with an extensive literature search.

Egler restricted IFC to being applicable only in mesic plant communities (this restriction is apparent only after reading Egler, 1977, p. 159-161) that develop in the absence of non-plant biotic influences (e.g., no interaction of animals with plants) and without disturbance subsequent to the initiation of succession (Egler, 1954). Overextension of IFC beyond these restrictions to all ROW situations has been commonplace (Egler, 1953; Niering and Goodwin, 1974; Dreyer and Niering, 1986; Niering et al., 1986; Daar, 1991). This overextension, or misinterpretation, is also prevalent even in the most important oft cited reviews of vegetation development (Drury and Nisbet, 1973; Connell and Slatyer, 1977; Finegan, 1984).

Modern views of vegetation dynamics and plant succession incorporate Egler's restrictions on disturbance, site conditions, and organism interaction as important causal factors of vegetation dynamics (MacMahon, 1980; Shugart, 1984; Pickett et al., 1987, Niering, 1987; Walker and Chapin, 1987; Pickett and McDonnell, 1989). Egler's IFC theory is not rejected with the modern view. It is, however, kept in its original context as a small part of a larger understanding.

Egler's IFC has been used as the sole basis for the shrub stability approach to ROW vegetation management (Egler, and Foote, 1975; Daar, 1991). But, IFC has its limits in this regard. Because ROWs are comprised of wide gradients of site conditions with varied degrees of animal interactions and anthropic disturbance, Egler's restrictions on IFC make it untenable for general use as a theoretical base for understanding vegetation dynamics of ROWs.

Modern vegetation dynamics theory provides a guiding paradigm for understanding ROW vegetation dynamics. This theory is based on a hierarchical organization (O'Neill et al., 1986; Urban et al., 1987) of causes and processes (Pickett and McDonnell, 1989). It describes vegetation dynamics as a function of three main processes: community level site availability, species availability, and species performance. The processes can be decomposed into component causes, some of which are characteristics of the organism of the community, while others are features of the environment (Pickett and McDonnell, 1989). It is these component causes that control vegetation dynamics, and specifically the relative stability, of vegetation on ROWs. Stability will vary as a function of disturbance (size, severity, and dispersion), availability of tree and desirable species propagules, environmental constraints, autecology and interactions between trees and desirable plant, and between biotic and abiotic factors.

STUDY 1: VEGETATION MANAGEMENT TRENDS ON ELECTRIC TRANSMISSION LINE RIGHTS-OF-WAY IN NEW YORK STATE

PREFACE

This study is a prelude to Study 2. It is a summary of the vegetation management trends in New York State using the management history data from Study 2 sites.

INTRODUCTION

General trends of ROW vegetation management methods for the Northeastern U.S. have often been simply cited -- no herbicides before the 1950s, broadcast use of herbicides from the 1950s through the 1970s, and slow integration of the selective use of herbicides into the mainstream of operational practice since the 1950s (Egler, 1953; Niering, 1958; Egler and Foote, 1975; Niering and Goodwin, 1974; Egler, 1981). There have been no objective reviews of vegetation management trends in New York or elsewhere in the Northeast.

The study objective was to examine vegetation management trends on electric transmission line ROWs in New York State over the past 80+ years. Establishing a pattern of selective herbicide use over the past decade was important for Study 2.

MATERIALS AND METHODS

Management histories of 70 permanent vegetation measurement plots on 21 ROWs were constructed in 1975 by the Empire State Electric Energy Research Corporation (ESEERCO, 1977a). These histories were updated in 1991 and 1992 by contacting the seven utilities in New York State (Appendix Table 1).

Trends of vegetation management were based on a decade by decade tally of management schemes and herbicide formulations using the management history data (Appendix Table 1).

Prior to the 1980s, methods of herbicide treatment (e.g., basal vs. stem-foliar vs. helicopter) were commonly reported without documenting a specific herbicide formulation. Therefore, in order to generate meaningful trends in herbicide use, herbicides were grouped within mechanism of action classes (after Warren, 1976; see Table 1). Mechanism of action is the activity of the herbicide within a plant that leads directly to its death (Ashton and Crafts, 1981). Other ROW herbicide formulations not part of the study site histories but used on New York ROWs would be grouped within these classes; therefore, a lack of complete herbicide formulation information does not preclude a general trend analysis of herbicide use.

The trend analysis is divided into two sections: initial clearing and post-clearing. This division is appropriate because there are different plant communities

Table 1. Classification of electric transmission line right-of-way herbicides by primary mechanism of action.[a]

Growth Regulators:

<u>Phenoxy acetic acids</u>

2,4-D
2,4,5-T

<u>Phenoxy propionic acids</u>

dichlorprop
silvex

<u>Picolinic acid and related compounds</u>

picloram
triclopyr

<u>Benzoic acids</u>

dicamba

Inhibitors of Amino Acid Synthesis:

fosamine[b]
glyphosate

<u>Sulfonylureas</u>

metsulfuron methyl

<u>Imidazolinones</u>

imazapyr

Dessication and Plasmolysis:[c]

ammonium sulfamate

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[a] Adapted from Warren (1975) and Aston and Crafts (1981).

[b] Categorized as an amino acid synthesis inhibitor by Newton and Knight (1981).

[c] As defined by Gangstad (1989).

which usually require different management schemes during each phase. Initial clearing is performed prior to or during transmission facilities construction. Mature forests and abandoned agricultural fields at various stages of successional development are common plant communities. Post-clearing is performed the year during or soon after initial clearing, and periodically every one to 15 years thereafter. The plant communities are generally comprised of forbs, shrubs, and short trees in various combinations, depending on past management practice (Bramble et al., 1991).

Each section outlines trends in treatment mode (nonselective or broadcast versus selective), treatment method, and herbicide use. Treatment mode and method, in combination, make up the vegetation management scheme (Nowak et al., 1992).

An important assumption for this study is that the 21 study sites are representative ROWs in New York State. Given that there are over 24,000 km of ROWs in New York, and only 30 km of ROWs included in this evaluation, this assumption appears tenuous. The sites do represent a wide range of site conditions and past management practice. They were originally chosen to represent all of the utilities, forest regions, and physiographic areas of New York State (ESEERCO, 1977a). Additionally, study plots within each site were generally chosen to represent hydric, mesic and xeric conditions (Egler, 1977; ESEERCO, 1977a). Since the purpose of this evaluation is to present generalized trends for management and provide a foundation of information for Study 2, these study sites are adequate and representative of New York State.

Tables 1, 2 and 3 serve as cross-references of groups, classes, common names, trade names, application methods, and decades of use of ROW herbicides referenced in this study.

RESULTS AND DISCUSSION

Initial Clearing Trends of Vegetation Management on Electric Transmission Line Rights-of-way in New York State

Treatment mode. There was no clear pattern for initial clearing treatment mode, although we can speculate that prior to the 1950s a "cut all that is cuttable" (Egler and Foote, 1975) approach was likely used. Since then, a more selective approach has been used whereby only tall growing trees are cut.

Treatment method. From 1900 though the 1950s, hand cutting and bulldozing were prevalent management practices for clearing vegetation on ROWs in New York State. With the advent of the phenoxy herbicides in the 1950s, cut stump treatments gained broad use that has continued to the present. However, a trend may be developing for not using herbicides during initial clearing. Hand cutting or some other scheme of mechanical removal, followed one- or two growing seasons

Table 2. Herbicides used for vegetation management on 21 right-of-way study sites (Studies 1 and 2) over the past four decades.

Trade name(s)	Common name(s)	Application method	Decade(s) of use
2,4,5-T	2,4,5-T	cut stump, stem-foliar (alone or with 2,4-D), conventional bark basal	50s, 60s, 70s
Access	picloram and triclopyr	conventional bark basal (with Garlon 4)	80s
Accord	glyphosate	foliar (alone or with Escort)	90s
Ammate	ammonium sulfamate	stem-foliar	60s, 70s
Arsenal	imazapyr	foliar	90s
Banvel 520	dicamba and 2,4-D	conventional bark basal (alone and with Garlon 4)	70s, 80s
Chopper	imazapyr	low volume basal	90s
Compadre	glyphosate	cut stump	90s
Dacamine 2D/2T	2,4-D and 2,4,5-T	stem-foliar	50s
Escort	metsulfuron methyl	foliar (with Accord)	90s
Esteron		stem-foliar	50s, 60s
Esteron 245	2,4,5-T	cut stump	50s, 60s
Garlon 3A	triclopyr	stem-foliar (with Tordon 101)	80s
Garlon 4	"	conventional bark basal, cut stump (with Weedone CB), stem-foliar (alone or with Tordon 101)	80s
Krenite	fosamine ammonium	stem-foliar	70s, 80s
Krenite S	" "	stem-foliar	80s
Silvex	2,4,5-TP	stem-foliar, cut stump, basal	70s
Tordon 101	2,4-D and picloram	stem-foliar (alone and with Garlon 3A, Garlon 4 or Silvex)	50s, 60s, 70s, 80s
Tordon 155	2,4-D and 2,4,5-T	conventional bark basal, cut stump	60s, 70s
Tordon RTU	2,4-D and picloram	cut stump	90s
Weedone CB	2,4-D and dichlorprop	low volume basal, cut stump	60s, 80s

Table 3. List of herbicides currently commonly used to manage vegetation on electric transmission line rights-of-way in New York State.

Common name	Trade name	Year first registered in New York[a]	Common application method	Manufacturer[b]
2,4-D	Tordon 101, Tordon RTU	1953	cut stump, stem-foliar	DowElanco
fosamine	Krenite	1980	foliar	Dupont
glyphosate	Accord	1982	foliar	Monsanto
imazapyr	Chopper Arsenal	1984	cut stump, basal foliar	American Cyanamid
picloram	Tordon 101, Tordon RTU	1965	cut stump, stem-foliar	DowElanco
triclopyr	Garlon 4	1979	basal, stem-foliar	DowElanco

[a] Source: T.A. Gudlewski (1992, NYS Dept. Env. Conserv., Bureau of Pesticides, pers. comm.) and L.W. Jackson (1991, NYS Public Service Commission, pers. comm.).

[b] Company addresses: E.I. Dupont de Nemours and Company, Wilmington, Delaware 19898; Monsanto Company Agricultural Products, St. Louis, Missouri 63167; American Cyanamid Company, Wayne, New Jersey 07470; DowElanco, Indianapolis, Indiana 46268-1189.

later with a selective stem-foliar or basal herbicide scheme, has gained increased use over the past two decades. This approach is cost effective (Abrahamson et al., 1991a, Nowak et al., 1992). It is similar to operational practice in other areas of the Eastern U.S. (Foreback, 1971).

Herbicide use. From the 1950s through the 1970s, 2,4-D and 2,4,5-T were commonly used in mixtures, or 2,4,5-T was used alone, as a cut stump treatment. In the 1970s, Tordon 101™ (a mixture of 2,4-D and picloram) was a common cut stump treatment. Over the past few years, glyphosate and imazapyr have been used for stump treatment.

Post-Clearing Trends of Vegetation Management on Electric Transmission Line Rights-of-way in New York State

Treatment mode. From the early 1900s through the 1950s, hand cutting and mechanical reclearing were the only management schemes used to maintain ROW vegetation. From the 1950s to the 1970s, broadcast application of herbicides with helicopters was commonly used. The practice of using helicopters to broadcast spray herbicides was essentially discontinued in the early 1980s due to restrictions associated with a series of State regulations on the use of aerial spraying of ROWs (de Waal Malefyt, 1984).

Since the late 1970s-early 1980s, management of vegetation on powerline corridors in New York State has centered around the selective use of herbicides.

Over the past decade there has been an increase in selective and nonselective mechanical treatments. Six of the 21 sites received either brush hogging, grub and seeding, or hand cutting over the total study area during the past 7 years. Three of these sites were treated with brush hogging or brush hogging followed by grub and seeding since 1990.

Treatment method. Basal, cut stump, and selective stem-foliar application of herbicides were used in New York since the 1960s, but these selective techniques did not gain widespread use until 1980, when the selective approach for using herbicides became regulation (de Waal Malefyt, 1984). These selective treatments were predominantly used in the 1980s and early 1990s.

During the late 1980s-early 1990s, there was an increase in the use of hand cutting without herbicides and nonselective mechanical treatment (e.g., brush hogging and grub and seeding) of ROWs. Hand cutting, predominantly used in the buffer areas around wetlands over the past decade (ESEERCO, 1991), was also used on upland areas on three sites.

Herbicide use. Herbicides have been prominently used to maintain ROW vegetation since the 1950s. The phenoxy herbicides have been consistently used for the past four decades. Picolinic and benzoic acids were first used in the 1960s (picloram, dicamba) and were expanded in the

1980s with the introduction of triclopyr. Ammate, the only inorganic ROW herbicide, was used in the 60s and 70s. The phenoxy herbicide 2,4,5-T was not used after 1979 due to federal restrictions on its use for ROW management (Davidson, 1980). Amino acid synthesis inhibitors were first used in the late 1970s-early 1980s (fosamine). During the 1990s, other amino acid synthesis inhibitors (glyphosate, metsulfuron methyl, imazapyr) became commonly used.

Summary

Vegetation has been managed on ROWs in New York since the early 1900s. Prior to the 1940s, when technologies to create and effectively use chemicals to control vegetation were developed, the management of ROWs was largely performed by mechanical means. Repetitive hand cutting, brush hogging, and bull dozing were featured operations. In the 1950s, an alternative approach became available with the advent of phenoxy herbicides (2,4,5-T and 2,4-D). Other herbicides preceded the phenoxies (e.g., ammonium sulfamate), but it was primarily the synthetic organic herbicides that revolutionized ROW vegetation management. Herbicides have been prominently used on New York ROWs since the 1950s. Aerial spraying of ROWs with these herbicides was prevalently used from the 1950s through the early 1980s. In 1980, the selective use of herbicide was mandated by regulation. A majority of ROWs in New York did receive selective herbicide treatment during the 1980s and 1990s using several different herbicides (Table 3). An increase in hand cutting and other non-herbicide methods was observed over the past 5 years.

STUDY 2: SELECTIVE VEGETATION MANAGEMENT ON ELECTRIC TRANSMISSION LINE RIGHTS-OF-WAY IN NEW YORK STATE: TREE DENSITY AND SPECIES COMPOSITION CHANGES FROM 1975 TO 1991

PREFACE

Study 2 is the larger part of the project introduced in Study 1. Study 1 was a review of the management history data from Study 2. Study 2 is an examination of tree density changes between 1975 and 1991 on ROWs across New York.

INTRODUCTION

A selective approach to managing vegetation on electric transmission line ROWs, whereby trees are selectively removed, and low-stature plant communities promoted, has been the mandated approach in New York since 1980 (de Waal Malefyt, 1980). This approach to ROW vegetation management is common throughout the Northeastern U.S. (Abrahamson et al., 1992). It has been demonstrated to be effective in controlling tree populations, but only by using herbicides and only on small experimental scales (e.g., Bramble and Byrnes, 1983; ESEERCO, 1985). There is little information on the long-term response of tree populations on ROWs to selective removal at an operational scale. The objective of this study was to determine whether operational, selective removal of trees can lead to relatively stable, low density populations of trees on electric transmission line ROWs.

MATERIALS AND METHODS

Study Site Descriptions

Twenty-one ROW study sites were chosen in 1975 to represent forest regions across New York (Figure 1 and Table 4; from ESEERCO, 1977a,b). In general, within each site, at least one permanent vegetation measurement plot was established in hydric, mesic and xeric conditions for a total of 70 0.03 to 0.08 ha plots on the 21 ROWs (Table 4). While each plot had varied vegetation management history (Study 1; Appendix Table 1), the use of herbicides to selectively remove trees predominated over the past two decades (Study 1; Nowak et al., 1993). Different methods, e.g., cut stump, basal, stem-foliar, and foliar, were used on the 43 plots that received herbicides to selectively remove trees (Appendix Table 1). These methods were collectively considered representative of the selective approach for using herbicides to control tree populations. All of these methods have been used to selectively remove trees and concomitantly promote low stature desirable plant communities on ROWs (Bramble et al., 1991; ESEERCO, 1985; Nowak et al., 1992). Plots that did not receive herbicides had trees periodically, selectively removed using hand cutting from 1975 to 1991 (Table 4).

Organization of the 1975 Data

The 1975 data were obtained from pencil and ink mylar maps of the sites and plots. These maps were

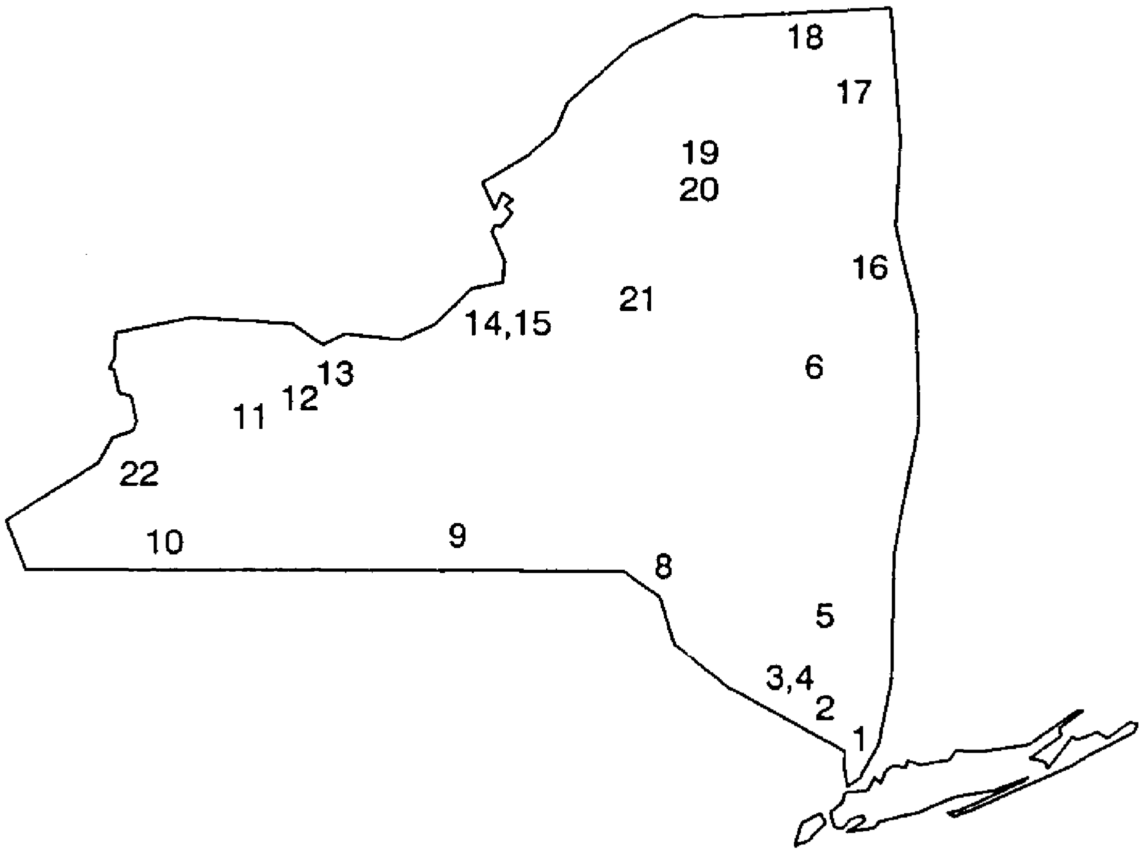

Figure 1. Map of New York State showing the location of the 21 study sites established in 1975 by the Empire State Electric Energy Research Corporation (ESEERCO, 1977a). Site numbers designate the following transmission lines and utilities:

1 -- Sprainbrook to Eastview, Consolidated Edison Company;
2 -- Ramapo to Hudson River (PJM-West), Orange and Rockland Utilities, Inc. (ORU);
3 -- Southern Tier Line 77, ORU;
4 -- Hillburn to Shoemaker, ORU;
5 -- Poughkeepsie to Ohioville, Central Hudson Gas and Electric Company;
6 -- Porter to Rotterdam, Niagara Mohawk Power Corporation (NMPC);
8 -- Hancock to Stilesville, New York State Electric and Gas Corporation (NYSEG);
9 -- Hillside to Oakdale, NYSEG;
10 -- Falconer to Homer Hill, NMPC;
11 -- Station 82 to Station 162, Rochester Gas and Electric Company (RG&E);
12 -- Mortimer to Long Branch (formerly Lockport to Solvay), NMPC;
13 -- Station 121 to Station 13A, RG&E;
14 -- Oswego to Volney, NMPC;
15 -- Oswego to Clay #4, NMPC;
16 -- National Lead Line, NMPC;
17 -- Lyon Mountain to Saranac, NYSEG;
18 -- Moses to Willis (formerly Moses to Plattsburg), NYPA;
19 -- Moses to Adirondack, NYPA;
20 -- Adirondack to Porter, NMPC
21 -- Fitzpatrick to Edic, NYPA;
22 -- Gardenville to Dunkirk, NMPC.

Table 4. Study site and plot descriptions for the comparison of tree density on electric transmission line rights-of-way between 1975 and 1991.

Site	1991 right-of way age	Plot	Moisture regime[a]	Treatment[b]	Forest region[c]
1	36	1	mesic	herbicide	New England
		3	mesic	"	" "
		4	mesic	"	" "
2	20	1	hydric	"	" "
		2	mesic	"	" "
		3	xeric	"	" "
3	18	2	mesic	"	" "
		3	xeric	"	" "
4	66	1	xeric	"	" "
		2	mesic	"	" "
		3	hydric	"	" "
5	75	1	hydric	hand cut	Appalachian
		2	xeric	" "	" "
		3	xeric	" "	" "
		4	hydric	" "	" "
		5	mesic	" "	" "
6	44	1	hydric	" "	" "
		2	mesic	herbicide	" "
		3	xeric	"	" "
		4	xeric	"	" "
		5	mesic	"	" "
8	29	1	hydric	"	" "
		2	mesic	"	" "
		3	mesic	"	" "
		4	xeric	"	" "
		5	xeric	"	" "
9	24	1	mesic	"	" "
		2	mesic	"	" "
		5	mesic	"	" "
10	27	2	hydric	"	" "
11	29	1	mesic	hand cut	Lake Plain
		2	hydric	" "	" "
		3	mesic	" "	" "
13	24	1	hydric	herbicide	" "
		2	mesic	"	" "
14	17	1	hydric	"	" "
		2	mesic	"	" "
15	52	1	xeric	"	" "
		2	mesic	"	" "
16	49	1	mesic	hand cut	Adirondack
		2	hydric	" "	" "
		3	xeric	" "	" "
		5	mesic	" "	" "
		6	xeric	" "	" "

Table 4 continued.

Site	1991 ROW age	Plot	Moisture regime[a]	Treatment[b]	Forest region[c]
17	33	1	hydric	herbicide	Adirondack
		2	mesic	"	" "
		3	mesic	"	" "
		4	hydric	"	" "
18	34	3	xeric	"	" "
19	49	1	mesic	"	" "
		2	hydric	"	" "
20	34	1	hydric	"	" "
		2	mesic	"	" "
21	20	1	hydric	"	" "
		2	mesic	"	" "
		3	mesic	hand cut	" "
22	31	1	mesic	herbicide	Lake Plain
		2	hydric	"	" "

[a] Classification as hydric, mesic, or xeric was done by ESEERCO (1977a) based on soil and plant community characteristics.

[b] Treatment schemes represent those used between 1975 and 1991.

[c] Forest regions were defined after Stout (1958), as presented in ESEERCO (1977a).

presented in the 1975 study final report (ESEERCO, 1977a,b). Location and identification of individual tree stems by species and height are on these maps.

Plot Reestablishment

Plots were reestablished in the field during mid- to late-summer 1991 and late-winter to late-spring 1992 using plot edge to transmission tower distance information from the 1975 maps. Plot edges across a ROW were perpendicular to centerline. A hand compass and tape were used to reestablish plot corners. Steel rebar (1 cm diameter, 1 m length), buried so that only 15 cm was aboveground, was used to remark the corners.

Fifty-eight of the 70 plots were reestablished (Table 5). Plots were not reestablished if they were disturbed by agents not directly related to vegetation management activities or if they were managed using nonselective techniques (e.g., brush hogging, grubbing). One plot was discarded because mapping errors made it impossible to reestablish the plot in the field with sufficient accuracy (± 5-10% of the distance from the referenced right-of-way structure to the plot edge; Table 5). After establishing the corners, each plot was temporarily divided into 3 m wide rectangular subplots with the long axis of the subplot rectangles parallel to centerline (Figure 2).

In 1975, plot corners were marked with wooden stakes. Only 11 of these wooden stakes were found out of a possible 280 (Table 6). Reestablishment of these

Table 5. List of plots excluded from Study 2.

Site	Plot	Reason for exclusion[a]
1	2	Mapping errors on the 1975 site and plot maps
3	1	Plot flooded with water due to beaver activity
9	3	" "
9	4	One-half of plot converted to a horse pasture
10	1	Plot brush hogged in 1991
10	3	" "
12	1	Plot grub and seeded in 1991
12	2	" "
15	3	Plot used for cattle grazing
16	4	Plot flooded with water due to beaver activity
18	1	Plot brush hogged in 1991
18	2	" "

[a] Plots were not reestablished if they were disturbed in a large scale manner by agents not directly related to vegetation management activites or if they were managed nonselectively. Plot 2 on Site 1 was discarded because of mapping errors which made it impossible to reestablish the plot in the field with sufficient accuracy (± 5-10% of the distance from the referenced right-of-way structure to the plot edge).

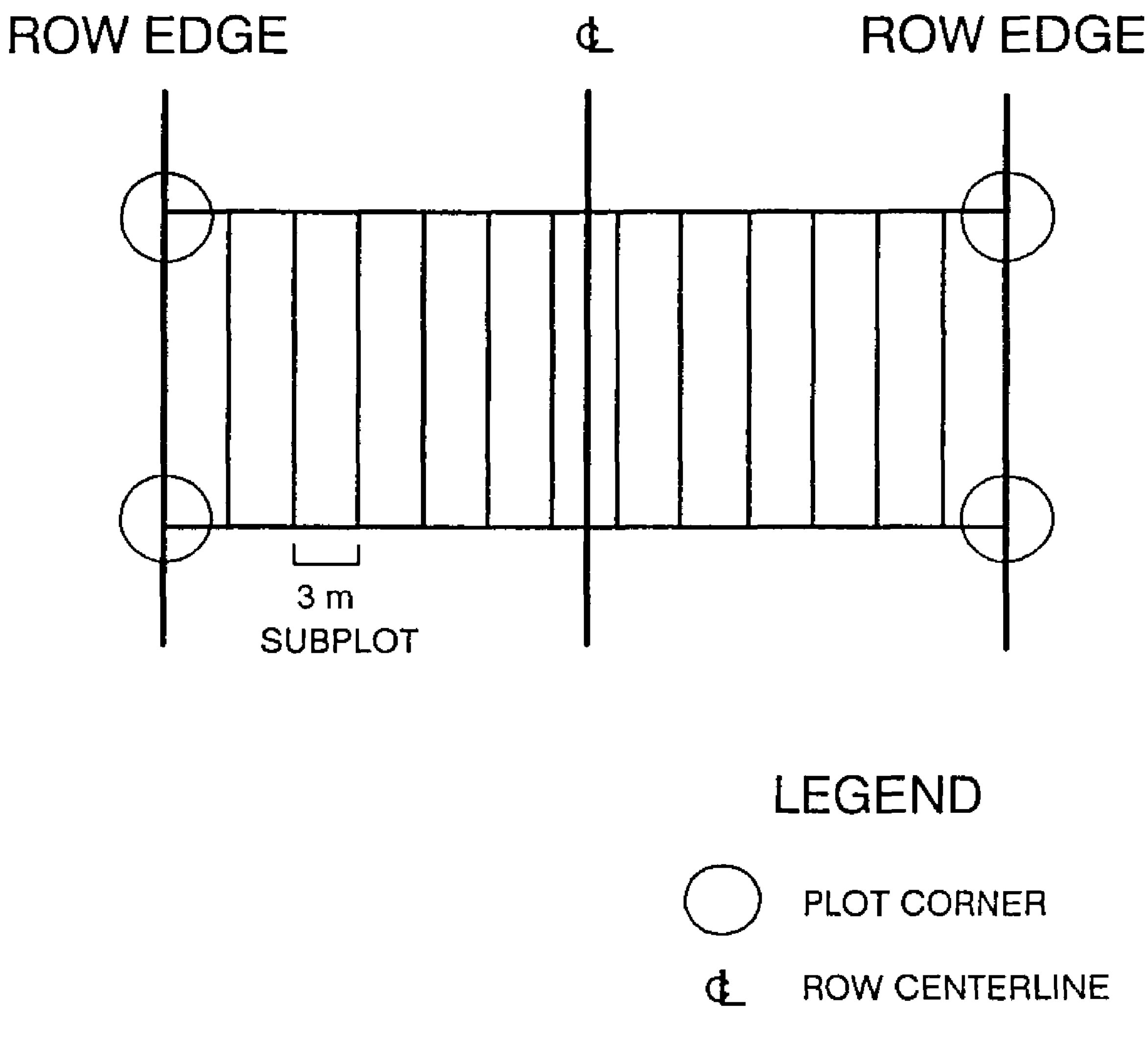

Figure 2. Permanent vegetation measurement plot establishment diagram showing subdivision into 3 m wide rectangular subplots extending from edge to edge of the right-of-way.

Table 6. Distance from original (1975) plot corners to new (1991) plot corners.

Site	Plot	Distance[a] X-axis	Distance[a] Y-axis
		m	m
9	1	0.8	3.7
9	2	4.9	0.9
10	2	1.2	3.0
10	2	0.9	3.4
11	1	2.4	0.5
11	1	1.5	0.6
17	1	1.8	0.0
17	4	3.4	3.4
18	3	0.9	0.6
20	2	3.4	0.2
22	2	0.8	3.5

[a] Distances are expressed as X- and Y-axis values. X-values are the distances between the old and new corners along a line perpendicular to centerline. Y-values are the distance between old and new corners along a line parallel to centerline.

corners in 1991 or 1992 showed that the original location of the plots was not exactly as described on the 1975 maps. Along the axis perpendicular to centerline, the wooden stakes were off, on average, by 2.0 m (Table 6). Along the axis parallel to centerline, the stakes were off 1.8 m from the described location (Table 6). In the field, we observed that the location of the plots was at times too far into the surrounding woods. Given this observation and measured distances to the 1975 wooden stakes, we concluded that the location of plots in 1991 and 1992 may not have been exactly overlain on the 1975 plot locations. In order to control potential confounding effects due to 1975 mapping or field measurement inaccuracies, the comparison of 1975 with 1991 tree density on each plot was done with the end subplots from each plot excluded from the data.

Tree Measurement

A list of tree species that are operationally removed from ROWs during routine management in New York was constructed based on the 1975 plot maps, Niagara Mohawk Power Corporation's "List of trees to be trimmed, removed, or sprayed" (NMPC, 1989), and the 1991 and 1992 field surveys. A total of 49 tree species were found on the study plots (Appendix Table 2).

Amelanchier arborea, *Betula populifolia*, *Carpinus caroliniana*, *Ostrya virginiana*, and *Prunus pensylvanica* are commonly not removed from ROWs under specific site and transmission line conditions, e.g., areas located along the ROW edges, or across the total width of ROWs on high voltage lines (e.g., ≥ 345 kV; NMPC, 1989). In order to control potential confounding effects due to possible inconsistent management of these five species across sites, the comparison of 1975 with 1991 tree density on each plot was done with these five species removed from the data. *Picea mariana* and *Quercus muehlenbergii* were found only in the end subplots of one plot each; hence, these species were also excluded from the analysis.

All tree stems ≥ 1 m height were surveyed within each plot during the summer 1975 (ESEERCO, 1977a,b), late summer 1991 and late winter to late spring 1992, and identified by species and subplot location. A 1991 measurement point was used for comparing tree density differences with 1975.

Tree stems < 1 m height are listed on the 1975 maps; however, these smaller stems were not accurately surveyed in 1975 (H. Dale Freed, Niagara Mohawk Power Corporation, and T. Mayer, Baltimore Gas and Electric, 1991, pers. comm.). Comparisons between 1975 and 1991 were made only for tree stems ≥ 1 m height, as these were accurately surveyed during both periods.

A 1 m minimum height has been commonly used for measurement of trees on ROWs (Bramble and Byrnes 1983; Thibodeau and Nickerson, 1986). Trees of this size are of practical importance, as they may grow into the wire security zone over the course of a treatment cycle.

Hypothesis Testing

The expected pattern of tree density on ROWs is U-shaped, with higher density along ROW edges, tapered to lower density in the centerline area (Niering, 1958; Niering and Goodwin, 1974; Bramble et al., 1985; Figure 3). Tree density over the 16-year study period (1975 to 1991) may have (see Figure 4):

HYP 1) evenly decreased across a ROW;

HYP 2) decreased under centerline and increased in taper along the ROW edges;

HYP 3) been constant across a ROW; or

HYP 4) increased across a ROW.

Except for HYP 2, the responses predicted by these hypotheses could be represented by linear models.

Tree density patterns were separately compared, with reference to these four hypotheses, between 1975 and 1991 within the two treatments groups -- selective removal of trees using herbicides versus selective removal of trees using hand cutting without herbicides. Site condition and forest region effects on tree density changes within each treatment group were examined by retesting hypotheses using data from plots grouped by moisture regime and forest region and contrasting P-values with the total treatment group comparisons.

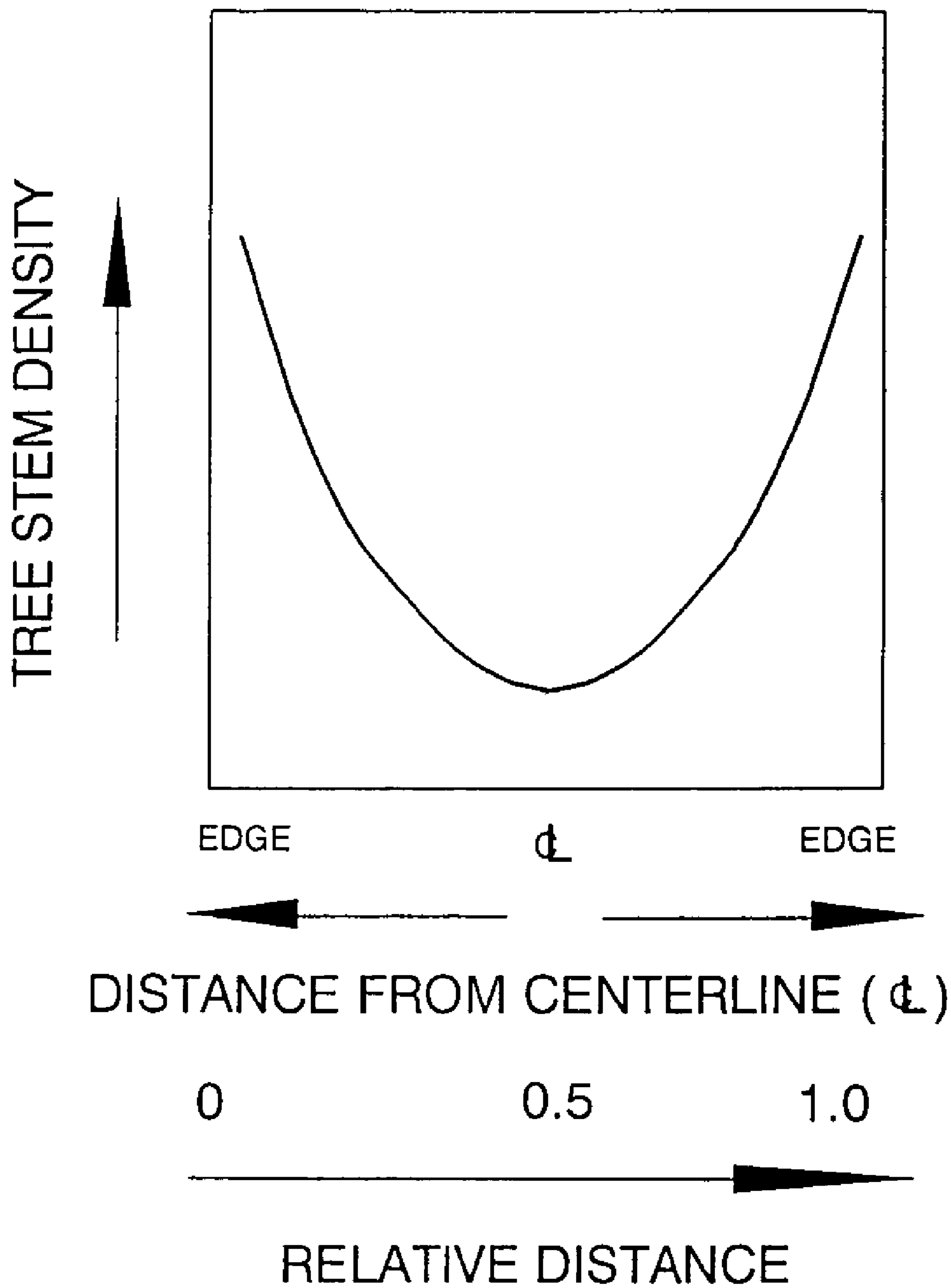

Figure 3. Expected pattern of tree stem density on electric transmission line rights-of-way (Niering, 1958; Niering and Goodwin, 1974; Bramble et al., 1985).

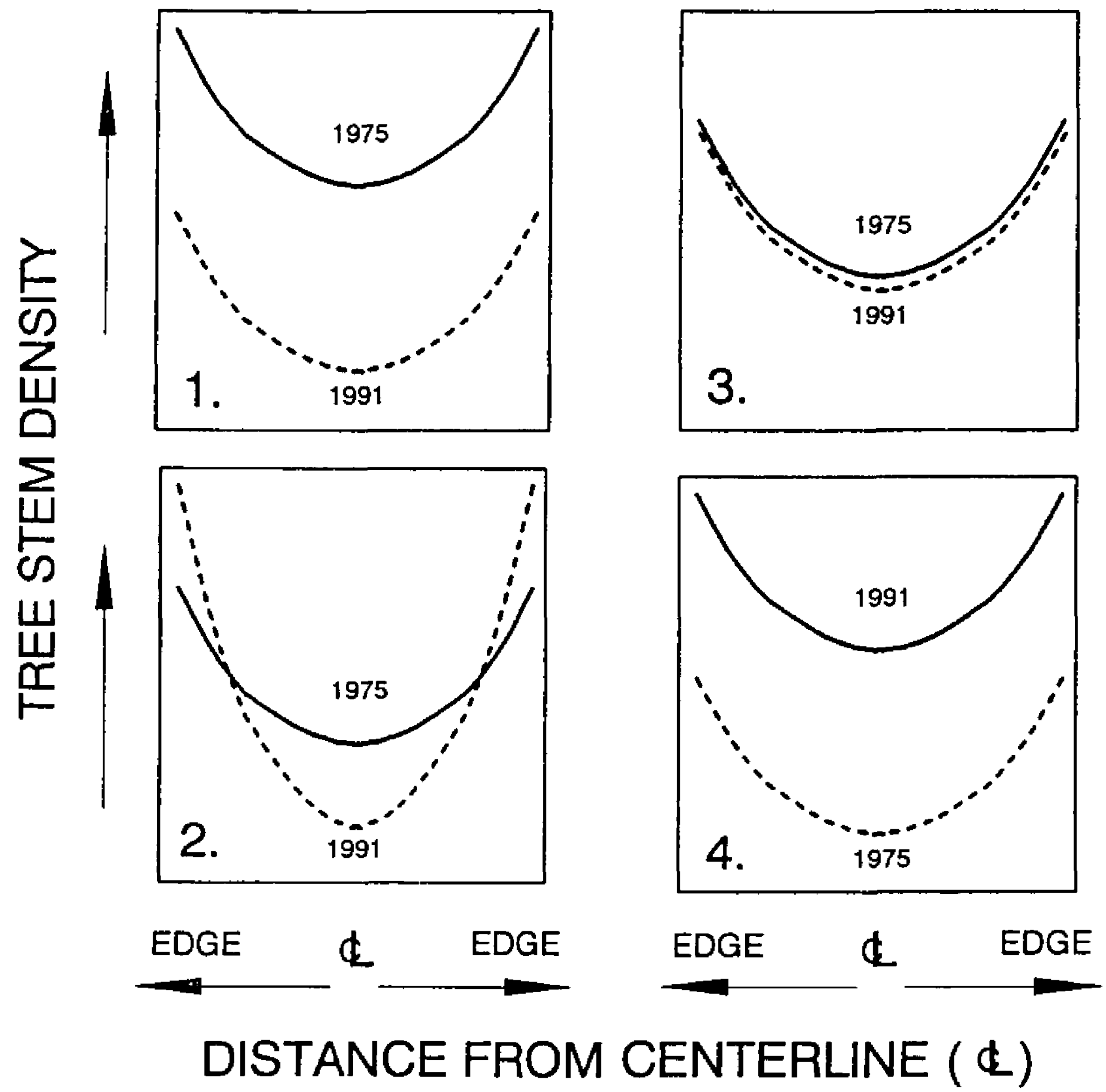

Figure 4. Expected shifts in tree stem density across an electric transmission line rights-of-way between 1975 and 1991. HYP 1 -- decreased tree stem density. HYP 2 -- increased taper and decreased tree stem density along centerline. HYP 3 -- constant tree stem density. HYP 4 -- increased tree stem density.

Statistical Analyses

Regression methods were used to fit a quadratic model to the data from each period (1975 and 1991) for each plot to describe tree density patterns across a ROW:

$$[1] \qquad Y = B_0X_0 + B_1X_1 + B_2X_1^2 + e$$

where Y is tree density (stems ha^{-1}), X_0 is equal to 1, X_1 is the relative distance to the center of a subplot from one ROW edge (edges of the ROW for this study were assigned values of 0 and 1.0, centerline is 0.5), B_0, B_1, and B_2 are the intercept, linear, and quadratic coefficients, and e is random error.

Model [1] was fit to the 1975 and 1991 data for each plot using ordinary least squares. Relative distance, the independent variable, was calculated for each subplot by dividing the distance to the center of a subplot by the total width of the plot (Appendix Tables 2 through 6). Tree density, recorded for each species within each subplot on a per hectare basis, was used as the dependent variable (Appendix Tables 2 through 6).

A repeated measure approach, as proposed by Meredith and Stehman (1991), was used to test equality of coefficients from the tree density regression equations between 1975 and 1991. Estimated regression coefficients from each plot for both 1975 and 1991 were used as secondary data for the analyses. These coefficients were obtained from sequential parameter estimates using PROC REG in SAS (SAS Institute, Inc., 1985). Models that included only (from Model [1]):

[2] $B_0{}^*X_0$;

[3] $B_0{}^*X_0 + B_1{}^*X_1$; and

[4] $B_0{}^*X_0$, $B_1{}^*X_1$, and $B_2{}^*X_1{}^2$

were fit to the data from each plot for both 1975 and 1991. Parameters estimates from Models [2] and [3] are different than from Model [1] because they are sequential parameter estimates. For Models [2] and [3] these estimates are different than the estimates from Model [1]. Model [4] parameter estimates were also obtained using sequential parameter estimates, but the estimates are the same as from Model [1]. Estimated $B_0{}^*$, $B_1{}^*$, and $B_2{}^*$ coefficients from Models [2], [3] and [4], respectively, were used as secondary data for the analysis. The $B_0{}^*$ coefficient is the mean tree density, $B_2{}^*$ is the linear coefficient of a simple linear regression model, and $B_2{}^*$ is the partial regression coefficient for the quadratic term. The advantage of the estimated sequential regression coefficients is that they are independent of each other, thus providing independent measures of the mean, linear, and curvature components of the response. Each coefficient was compared between 1975 and 1991 on a per plot basis using the secondary dataset and paired t-tests. A significance level (alpha) of 0.10 was used to interpret statistical significance of test results. In studies of an exploratory nature, such as

Study 2, a relatively high α-level is appropriate because the consequences of Type I and Type II errors were relatively low and the sample sizes for many of the tests were relatively low (Huberty, 1987).

Species Composition

Importance values were calculated separately for tree stems by species and genera as the sum of relative density and relative frequency.

Species composition on a genera basis was compared between periods by measuring ß diversity between 1975 and 1991 for each plot. Morisita-Horn similarity coefficients were calculated (after Magurran, 1988):

$$C_{MH} = \frac{2\Sigma(an_i x bn_i)}{(da+db)(aNxbN)}$$

where C_{MH} is the similarity coefficient, aN is the number of individuals on a plot (stems ha^{-1}) in 1975, bN is the number of individuals on a plot (stems ha^{-1}) in 1991; an_i is the number of individuals in the ith species on a plot (stems ha^{-1}) in 1975, bn_i is the number of individuals in the ith species on a plot (stems ha^{-1}) in 1991, da is the Σan_i^2 divided by aN^2, and db is the Σbn_i^2 divided by bN^2. C_{MH} varies from 0 to 1.00; a value of 1.00 indicates exactly the same species composition.

Species were grouped by genera to adjust for possible species identification differences between periods. For example, in 1975, all Fraxinus were identified as F. americana (Table 7). In 1991, F. nigra

Table 7. Relative density, relative frequency, importance values and ranking of trees species found on electric transmission line rights-of-way in 1975 and 1991 for both herbicide and hand cut treatment plots.

	Herbicide treated plots								Hand cut treated plots							
	Relative density		Relative frequency		Importance[a] value		Importance value ranking		Relative density		Relative frequency		Importance[a] value		Importance value ranking	
Species	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991
<u>Abies</u> <u>balsamea</u>	0.00	0.30	0.00	0.61	0.00	0.91	36	28	0.00	0.11	0.00	1.09	0.00	1.19	41	25
<u>Acer</u> <u>negundo</u>	0.00	0.17	0.00	0.61	0.00	0.78	40	30	0.00	0.00	0.00	0.00	0.00	0.00	39	31
<u>Acer</u> <u>rubrum</u>	24.50	22.16	15.66	13.41	40.16	35.57	1	1	9.83	16.70	10.26	11.96	20.08	28.66	3	2
<u>Acer</u> <u>saccharinum</u>	0.00	0.51	0.00	0.61	0.00	1.12	38	26	0.00	0.00	0.00	0.00	0.00	0.00	38	37
<u>Acer</u> <u>saccharum</u>	0.19	1.88	1.20	3.05	1.39	4.93	21	12	0.00	7.26	0.00	4.35	0.00	11.61	37	6
<u>Ailanthus</u> <u>altissima</u>	0.25	1.59	0.60	1.83	0.86	3.42	23	15	0.00	0.00	0.00	0.00	0.00	0.00	23	41
<u>Betula</u> <u>alleghaniensis</u>	1.92	4.26	2.41	2.44	4.33	6.70	10	9	5.91	4.29	6.41	3.26	12.32	7.55	8	7
<u>Betula</u> <u>lenta</u>	6.17	7.91	7.23	6.71	13.40	14.61	6	5	0.17	9.98	1.28	3.26	1.46	13.24	18	5
<u>Betula</u> <u>papyrifera</u>	0.19	2.68	1.20	2.44	1.40	5.12	20	11	0.00	0.09	0.00	1.09	0.00	1.18	33	27
<u>Carya</u> <u>cordiformis</u>	0.37	0.24	1.81	1.22	2.18	1.46	14	22	2.33	0.20	3.85	2.17	6.18	2.37	12	21
<u>Carya</u> <u>glabra</u>	0.06	0.00	0.60	0.00	0.66	0.00	29	41	0.00	0.00	0.00	0.00	0.00	0.00	31	40
<u>Carya</u> <u>ovata</u>	0.06	0.55	0.60	2.44	0.66	2.99	26	17	0.16	0.22	1.28	3.26	1.44	3.48	19	15
<u>Fagus</u> <u>grandifolia</u>	0.24	0.82	1.81	3.05	2.05	3.87	15	14	0.00	0.07	0.00	2.17	0.00	2.25	29	23
<u>Fraxinus</u> <u>americana</u>	16.57	8.99	12.65	10.98	29.22	19.97	3	3	19.35	23.23	11.54	10.87	30.88	34.09	1	1
<u>Fraxinus</u> <u>nigra</u>	0.00	0.00	0.00	0.00	0.00	0.00	32	42	0.00	4.43	0.00	1.09	0.00	5.52	27	11
<u>Fraxinus</u> <u>pennsylvanica</u>	0.00	4.78	0.00	2.44	0.00	7.22	31	8	0.00	2.65	0.00	3.26	0.00	5.91	20	8
<u>Juglans</u> <u>cinerea</u>	0.00	0.25	0.00	0.61	0.00	0.86	34	29	0.00	0.00	0.00	0.00	0.00	0.00	36	35
<u>Juglans</u> <u>nigra</u>	0.00	0.00	0.00	0.00	0.00	0.00	41	36	0.18	0.00	1.28	0.00	1.47	0.00	17	36
<u>Juniperus</u> <u>virginiana</u>	0.12	0.00	1.20	0.00	1.33	0.00	22	35	0.00	0.00	0.00	0.00	0.00	0.00	32	42
<u>Liriodendron</u> <u>tulipifera</u>	0.44	0.73	1.81	1.83	2.25	2.56	13	19	0.00	0.00	0.00	0.00	0.00	0.00	30	38
<u>Picea</u> <u>glauca</u>	0.00	0.00	0.00	0.00	0.00	0.00	42	34	0.00	0.11	0.00	1.09	0.00	1.19	28	26

Table 7 continued.

	Herbicide treated plots								Hand cut treated plots							
	Relative density		Relative frequency		Importance value[a]		Importance value ranking		Relative density		Relative frequency		Importance value[a]		Importance value ranking	
Species	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991
Picea rubens	0.24	0.15	1.20	1.22	1.45	1.37	19	23	0.00	0.00	0.00	0.00	0.00	0.00	42	29
Pinus resinosa	0.00	0.08	0.00	0.61	0.00	0.69	37	32	0.00	0.00	0.00	0.00	0.00	0.00	40	39
Pinus strobus	1.62	7.89	2.41	3.66	4.03	11.55	11	6	0.33	0.83	2.56	3.26	2.89	4.09	15	13
Pinus sylvestris	0.77	2.28	1.20	1.83	1.98	4.11	16	13	0.00	0.00	0.00	0.00	0.00	0.00	24	30
Populus deltoides	0.96	0.00	0.60	0.00	1.56	0.00	17	39	0.00	0.04	0.00	1.09	0.00	1.13	35	28
Populus grandidentata	4.11	0.90	3.01	1.83	7.12	2.73	7	18	4.41	0.31	5.13	3.26	9.54	3.57	10	14
Populus tremuloides	18.53	12.56	10.84	8.54	29.37	21.09	2	2	4.30	8.76	7.69	9.78	11.99	18.54	9	4
Prunus serotina	8.07	9.78	9.64	7.93	17.71	17.71	5	4	8.03	11.36	10.26	9.78	18.29	21.15	4	3
Quercus alba	0.32	0.33	1.20	0.61	1.52	0.94	18	27	0.43	0.29	3.85	2.17	4.27	2.47	14	19
Quercus bicolor	0.00	0.08	0.00	0.61	0.00	0.69	30	33	0.00	0.00	0.00	0.00	0.00	0.00	34	32
Quercus coccinea	0.14	0.00	0.60	0.00	0.74	0.00	24	40	0.00	0.00	0.00	0.00	0.00	0.00	25	34
Quercus prinus	0.06	0.82	0.60	1.22	0.66	2.04	27	20	1.22	0.35	5.13	2.17	6.35	2.53	11	18
Quercus rubra	7.71	2.72	10.24	7.32	17.95	10.04	4	7	7.99	1.52	7.69	4.35	15.68	5.87	6	9
Quercus velutina	0.06	2.20	0.60	4.27	0.66	6.47	28	10	0.00	0.66	0.00	2.17	0.00	2.83	21	17
Robinia psuedoacacia	4.39	0.67	1.81	1.22	6.19	1.89	8	21	10.82	2.24	2.56	1.09	13.38	3.33	7	16
Sassafras albidum	0.71	1.22	1.81	1.83	2.52	3.05	12	16	14.64	2.54	6.41	3.26	21.05	5.80	2	10
Thuja occidentalis	0.00	0.00	0.00	0.00	0.00	0.00	39	38	1.86	0.22	2.56	2.17	4.42	2.39	13	20
Tilia americana	0.06	0.00	0.60	0.00	0.66	0.00	25	37	0.38	0.39	1.28	1.09	1.66	1.48	16	24
Tsuga canadensis	0.00	0.15	0.00	1.22	0.00	1.37	35	24	0.00	0.00	0.00	0.00	0.00	0.00	26	33
Ulmus americana	1.16	0.15	4.82	1.22	5.98	1.37	9	25	7.66	1.05	8.97	3.26	16.64	4.31	5	12
Ulmus rubra	0.00	0.17	0.00	0.61	0.00	0.78	33	31	0.00	0.10	0.00	2.17	0.00	2.27	22	22

[a] Importance values were calculated as the sum of relative density and relative frequency.

and F. pennsylvanica were identified in addition to F. americana. Similarly, in 1975 Acer rubrum was the most commonly recorded Acer, whereas in 1991, A. negundo, A. saccharinum, and A. saccharum were identified in addition to A. rubrum.

RESULTS

Tree Density Changes

Differences and similarities in regression equation coefficients were found between 1975 and 1991 for describing patterns of tree density across ROWs. For herbicide treated plots, the B_0^* coefficients were not different between periods (Tables 8 and 9); thus, total tree density was relatively constant between periods at 520 and 420 stems ha^{-1} for 1975 and 1991, respectively (Tables 8 and 9). The B_1^* coefficients were not different between periods for herbicide treated plots (Tables 8 and 9), and were not different from zero for either 1975 or 1991 (α=0.10). This indicates that the distribution of trees was even across the plots. The B_2^* coefficients increased from 1975 to 1991. An increase in B_2^* and equal B_0^*s indicated that a spatial redistribution of trees occurred between 1975 and 1991 for plots that received selective herbicide treatments. Fewer trees were located in the ROW centerline and more trees located along the ROW edges in 1991 compared to 1975. Since the linear coefficient indicated an even

Table 8. Mean estimated regression coefficients and Morisita-Horn similarity coefficients for describing electric transmission line right-of-way tree density pattern and species composition for 1975 and 1991.

		Regression coefficients[a]						
		1975			1991			
Plot groups	Sample size[b]	B_0^*	B_1^*	B_2^*	B_0^*	B_1^*	B_2^*	Morisita-Horn coefficient
Herbicide treated	43(36)	522	60.6	1642.2	421	-164.6	3511.9	0.65
		(84)	(188.3)	(600.0)	(60)	(249.0)	(982.5)	(0.05)
Site condition within the herbicide treated plot group:								
Hydric	12(10)	342	-164.5	1090.4	330	-342.9	1497.1	0.60
		(141)[c]	(311.5)	(493.3)	(131)	(455.6)	(1349.9)	(0.12)
Mesic	22(20)	718	211.7	2356.7	477	-68.2	3469.4	0.65
		(133)	(318.8)	(1075.5)	(82)	(304.2)	(1385.0)	(0.07)
Xeric	9(6)	286	-8.7	631.3	406	-162.6	6302.4	0.74
		(67)	(208.8)	(909.4)	(120)	(757.2)	(2629.3)	(0.06)
Forest region within the herbicide treated plot group:								
Adirondack	11(11)	391	587.1	2867.4	586	672.1	6453.1	0.65
		(112)	(234.2)	(1612.5)	(143)	(740.0)	(2559.2)	(0.09)
Appalachian	13(12)	348	-20.0	935.1	377	-926.6	4173.8	0.64
		(122)	(290.7)	(859.8)	(99)	(417.4)	(1682.8)	(0.10)
Lake Plain	8(5)	885	-864.7	1623.2	226	-96.0	-740.5	0.66
		(209)	(661.6)	(995.1)	(142)	(173.2)	(702.8)	(0.18)
New England	11(8)	595	302.2	1266.3	449	-150.5	2881.3	0.68
		(213)	(297.0)	(1238.6)	(98)	(263.2)	(1661.3)	(0.07)
Hand cut	15(13)	1270	649.9	3304.9	4301	-693.5	1331.9	0.58
		(366)	(976.2)	(2381.6)	(874)	(3078.8)	(9935.5)	(0.07)
Site condition within the hand cut treated plot group:								
Hydric	5(4)	754	1042.4	623.4	2993	-947.2	-11902.1	0.55
		(432)	(660.1)	(3191.4)	(1423)	(1426.2)	(11035.7)	(0.18)
Mesic	6(6)	1713	2416.9	826.4	6658	2746.2	-1104.6	0.60
		(735)	(1918.7)	(3983.5)	(1376)	(7299.8)	(22054.4)	(0.09)

Table 8 continued.

Plot groups	Sample size[b]	1975 B_0^*	1975 B_1^*	1975 B_2^*	1991 B_0^*	1991 B_1^*	1991 B_2^*	Morisita-Horn coefficient
		Regression coefficients[a]						
Site condition within the hand cut treated plot group:								
Xeric	4(3)	1250	-2491.2	10374.5	2399	-5535.9	21529.0	0.57
		(683)	(1353.3)	(4459.7)	(748)	(3939.5)	(9812.0)	(0.10)
Forest region within the hand cut treated plot group:								
Adirondack	6(4)	184	-384.7	2556.9	3014	897.8	-4008.9	0.51
		(93)	(293.5)	(1514.9)	(772)	(3848.7)	(5329.5)	(0.05)
Appalachian	6(6)	1626	-632.4	1091.1	3893	-6935.5	17537.2	0.58
		(484)	(1303.6)	(5685.2)	(1231)	(3055.6)	(21597.6)	(0.12)
Lake Plain	3(3)	2730	5283.8	9228.5	7689	8607.8	-20397.2	0.66
		(1043)	(3312.9)	(1561.4)	(2935)	(11237.3)	(21279.4)	(0.17)
New England	0	-	-	-	-	-	-	-

[a] A quadratic model was fit to the data from each period (1975 and 1991) for each plot to describe patterns of tree density: $Y = B_0X_0 + B_1X_1 + B_2X_1^2 + e$, where Y is tree density (stems ha^{-1}), X_0 is equal to 1, X_1 is the relative distance to the center of a subplot from one ROW edge (edges of the ROW for this study were assigned values of 0 and 1.0, centerline is 0.5), B_0, B_1, and B_2 are parameters to be estimated by regression solution, and e is random error. The coefficients were obtained as the sequential parameter estimates B_0^*, B_1^*, and B_2^* (SAS Institute, Inc., 1985).

[b] Values in parentheses are sample sizes for the Morisita-Horn coefficients; they are lower than the regression equation sample size because Morisita-Horn coefficients could not be calculated if there were no trees on a plot for either period.

[c] Values in parentheses below are the standard errors for each mean coefficient.

Table 9. P-values from paired t-test comparisons of coefficients from regression equations describing tree density across electric transmission line rights-of-way between 1975 and 1991.

Plot groups	Sample size	Regression coefficients[a] B_0^*	B_1^*	B_2^*
<u>Herbicide treated</u>	43	0.31	0.39	0.08
Site condition within the herbicide treated plot group:				
Hydric	12	0.93	0.72	0.81
Mesic	22	0.17	0.42	0.44
Xeric	9	0.39	0.83	0.06
Forest region within the herbicide treated plot group:				
Adirondack	11	0.35	0.90	0.23
Appalachian	13	0.83	0.04	0.08
Lake Plain	8	0.01	0.25	0.12
New England	11	0.50	0.27	0.35
<u>Hand cut</u>	15	<0.01	0.61	0.85
Site condition within the hand cut treated plot group:				
Hydric	5	0.09	0.15	0.20
Mesic	6	<0.01	0.96	0.94
Xeric	4	0.14	0.50	0.31
Forest region within the hand cut treated plot group:				
Adirondack	6	0.01	0.74	0.26
Appalachian	6	0.07	0.13	0.51
Lake plain	3	0.12	0.72	0.27
New England	0	-	-	-

[a] A quadratic model was fit to the data from each period (1975 and 1991) for each plot to describe patterns of tree density: $Y = B_0X_0 + B_1X_1 + B_2X_1^2 + e$, where Y is tree density (stems ha^{-1}), X_0 is equal to 1, X_1 is the relative distance to the center of a subplot from one ROW edge (edges of the ROW for this study were assigned values of 0 and 1.0, centerline is 0.5), B_0, B_1, and B_2 are parameters to be estimated by regression solution, and e is random error. The coefficients tested were the sequential parameter estimates B_0^*, B_1^*, and B_2^* (SAS Institute, Inc., 1985).

distribution of tree stems on the ROW plots, the redistribution of tree stems from 1975 to 1991 can be construed to have been equal on both sides of the ROWs.

The B_0^* coefficient for hand cut plots was higher in 1991 compared to 1975 (Tables 8 and 9). Tree density averaged 1270 and 4300 stems ha^{-1} for 1975 and 1991, respectively (Table 8). There were no differences in B_1^* and B_2^* between 1975 and 1991 (Tables 8 and 9) and these coefficients were not different from zero (α=0.10), indicating uniformly higher tree stem density across hand cut ROW plots in 1991 compared to 1975. The B_0^* coefficients were on average greater chan zero (α=0.10).

P-values from comparing regression coefficients between 1975 and 1991 were relatively constant across site condition and forest region within each treatment group (Table 9). Apparently, the effect of selective tree removal with herbicides or by hand cutting does not vary as a function of site condition or forest region. The few differences in P-values that did exist between the site condition and forest region comparisons, as compared with the treatment group comparisons, were likely unrelated to the comparison groups. The B_0^* coefficient was lower in 1991 compared to 1975 on Lake Plain plots within the herbicide treatment group, but this difference is likely due to a difference in the years since the last herbicide treatment for 1975 and 1991 (Table 10). Average tree density, B_0^*, was positively correlated with the number of years since the

Table 10. Average age, years since the last selective tree removal treatment, and right-of-way width for the plots by treatment group, site condition, and forest region.

Plot group	Sample size[a] 1975	Sample size[a] 1991	1991 age	Years since last treatment 1975	Years since last treatment 1991	Right-of-way width
						- m -
Herbicide treated	43	35	34 (2)	4 (0.5)	4 (0.5)	48.8 (3.0)
Site condition within the herbicide treated plot group:						
Hydric	12	10	32 (4)	5 (0.9)	4 (1.6)	46.0 (4.6)
Mesic	22	19	33 (3)	4 (0.7)	3 (0.5)	52.9 (4.1)
Xeric	9	6	37 (5)	5 (1.3)	5 (1.0)	42.3 (7.9)
Forest region within the herbicide treated plot group:						
Adirondack	11	11	34 (3)	5 (0.3)	4 (0.9)	52.8 (5.7)
Appalachian	13	13	32 (2)	3 (0.6)	6 (0.9)	61.6 (5.2)
Lake Plain	8	8	31 (5)	5 (1.1)	1 (0.3)	40.3 (6.7)
New England	11	3	37 (6)	4 (1.6)	3 (0.0)	35.9 (3.1)
Hand cut	15	9	51 (5)	4 (1.2)	7 (1.1)	27.1 (2.5)
Site condition within the hand cut treated plot group:						
Hydric	5	2	54 (9)	4 (2.3)	6 (0.0)	30.8 (6.1)
Mesic	6	5	42 (8)	6 (2.2)	8 (2.0)	26.7 (3.9)

Table 10 continued.

Plot group	Sample size[a] 1975	Sample size[a] 1991	1991 age	Years since last treatment 1975	Years since last treatment 1991	Right-of-way width
						- m -
Site condition within the hand cut treated plot group:						
Xeric	4	2	62 (7)	2 (0.6)	6 (0.0)	23.2 (1.0)
Forest region within the hand cut treated plot group:						
Adirondack	6	6	44 (5)	3 (0.2)	8 (1.7)	26.2 (3.9)
Appalachian	6	0	70 (5)	1 (0.0)	-	29.0 (5.2)
Lake Plain	3	3	29 (0)	13 (0.0)	6 (0.0)	25.4 (2.0)
New England	0	0	-	-	-	-

last selective tree removal treatment (Table 11). In 1975, there was 880 stem ha^{-1} at 5 years after the previous treatment; in 1991, there was 230 stems ha^{-1} at 1-year after the previous treatment (Tables 8 and 10).

For plots that were hand cut, there were relatively constant, high B_0*s across site conditions and forest regions in 1991 compared to 1975. In contrast with the general hand cut group comparison, B_0^* values for 1975 and 1991 on xeric plots and for the Lake Plain region may be interpreted as not being different between periods, in contrast with the general hand cut comparison; but, since the P-values are near the critical level (α=0.10) and sample size is relatively small, these site condition or regional differences are not clearly interpretable.

Species Composition

Acer, *Betula*, *Fraxinus*, *Populus*, *Prunus*, and *Quercus* were the most important genera during both 1975 and 1991 across herbicide and hand cut treated plots (Table 12). *Acer rubrum*, *F. americana*, and *P. tremuloides* were the most important species on ROWs in New York for both periods (Table 7).

Similarity coefficients averaged 0.65 and 0.58 for herbicide and hand cut treated plots, respectively (Table 8). Mean coefficients were greater than 0.5 for all treatment, site condition, and forest region plot groups, indicating similar species composition between 1975 and 1991.

Table 11. Correlation coefficients between right-of-way age, years since the previous selective tree removal treatment, right-of-way width, and 1975 whole plot tree density (B_0*) with 1991 regression equation coefficients.

Correlate	Sample size	1991 regression equation coefficients		
		B_0*	B_1*	B_2*
Right-of-way age (1991)	58	0.25 (0.06)[a]	-0.39 (<0.01)	0.24 (0.08)
Years since the previous selective tree removal treatment	44[b]	0.33 (0.03)	0.25 (0.10)	-0.06 (0.69)
Right-of-way width	58	-0.35 (0.01)	0.07 (0.60)	0.06 (0.64)
1975 whole plot tree density	58	0.70 (<0.01)	0.21 (0.11)	-0.03 (0.84)

[a] P-values are in parentheses below each correlation.

[b] The samples size is lower than the total of 58 plots because management history information was not provided for sites 2, 3, 4 and 5 from 1975 to 1991.

Table 12. Relative density, relative frequency, importance values and ranking of trees, by genera, found on electric transmission line rights-of-way in 1975 and 1991 for both herbicide and hand cut treatment plots.

	Herbicide treated plots								Hand cut treated plots							
	Relative density		Relative frequency		Importance value[a]		Importance value ranking		Relative density		Relative frequency		Importance value[a]		Importance value ranking	
Genera	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991	1975	1991
Abies	0.00	0.30	0.00	0.61	0.00	0.91	19	17	0.00	0.11	0.00	1.09	0.00	1.19	19	15
Acer	24.68	24.72	16.87	17.68	41.55	42.40	1	1	9.83	23.97	10.26	16.30	20.08	40.27	5	2
Ailanthus	0.25	1.59	0.60	1.83	0.86	3.42	16	10	0.00	0.00	0.00	0.00	0.00	0.00	18	20
Betula	8.29	14.85	10.84	11.59	19.14	26.43	5	3	6.09	14.36	7.69	7.61	13.78	21.97	8	4
Carya	0.50	0.80	3.01	3.66	3.51	4.45	10	8	2.49	0.41	5.13	5.43	7.62	5.85	10	8
Fagus	0.24	0.82	1.81	3.05	2.05	3.87	13	9	0.00	0.07	0.00	2.17	0.00	2.25	20	13
Fraxinus	16.57	13.77	12.65	13.41	29.22	27.19	3	2	19.35	30.31	11.54	15.22	30.88	45.52	1	1
Juglans	0.00	0.25	0.00	0.61	0.00	0.86	20	18	0.18	0.00	1.28	0.00	1.47	0.00	14	19
Juniperus	0.12	0.00	1.20	0.00	1.33	0.00	15	19	0.00	0.00	0.00	0.00	0.00	0.00	17	17
Liriodendron	0.44	0.73	1.81	1.83	2.25	2.56	12	12	0.00	0.00	0.00	0.00	0.00	0.00	16	21
Picea	0.24	0.15	1.20	1.22	1.45	1.37	14	16	0.00	0.11	0.00	1.09	0.00	1.19	21	16
Pinus	2.39	10.25	3.61	6.10	6.01	16.35	8	7	0.33	0.83	2.56	3.26	2.89	4.09	12	10
Populus	23.59	13.46	14.46	10.37	38.05	23.83	2	4	8.71	9.11	12.82	14.13	21.53	23.24	3	3
Prunus	8.07	9.78	9.64	7.93	17.71	17.70	6	6	8.03	11.36	10.26	9.78	18.29	21.15	6	5
Quercus	8.29	6.16	13.25	14.02	21.54	20.18	4	5	9.64	2.83	16.67	10.87	26.30	13.70	2	6
Robinia	4.39	0.67	1.81	1.22	6.19	1.89	7	14	10.82	2.24	2.56	1.09	13.38	3.33	9	11
Sassafras	0.71	1.22	1.81	1.83	2.52	3.05	11	11	14.64	2.54	6.41	3.26	21.05	5.80	4	9
Thuja	0.00	0.00	0.00	0.00	0.00	0.00	21	21	1.86	0.22	2.56	2.17	4.42	2.39	11	12
Tilia	0.06	0.00	0.60	0.00	0.66	0.00	17	20	0.38	0.39	1.28	1.09	1.66	1.48	13	14
Tsuga	0.00	0.15	0.00	1.22	0.00	1.37	18	15	0.00	0.00	0.00	0.00	0.00	0.00	15	18
Ulmus	1.16	0.32	4.82	1.83	5.98	2.15	9	13	7.66	1.15	8.97	5.43	16.64	6.58	7	7

[a] Importance values were calculated as the sum of relative density and relative frequency.

DISCUSSION

Periodic selective removal of trees using herbicides created relatively constant, compositionally similar, low density tree populations on New York ROWs between 1975 and 1991. A decrease in tree density along centerline and increase along the ROW edges are consistent with HYP 2 (Figure 4). The spatial redistribution of trees from 1975 to 1991 is related to vegetation management activities. Trees under centerline, and other woody vegetation that may impede access to and visibility of transmission towers and wires, are commonly, completely removed, and taller vegetation, generally short trees and shrubs, is allowed to grow along the ROW edges during vegetation management (Niering and Goodwin, 1974; Bramble et al., 1985). While tall trees are not purposefully allowed to grow along ROW edges, their increased presence along the edges is a consequence of allowing other vegetation to grow taller. Taller vegetation shields the tall trees from view, and subsequently, from control by vegetation managers.

Creation of low density tree populations with herbicides is directly a result of complete tree removal. Both above- and belowground portions of trees are usually killed using herbicides. Maintenance of low density tree populations can be considered an indirect result of tree removal through the promotion of low-stature, residual, ROW plant communities. Interference effects of the residual plant communities can reduce seed germination and seedling survival and growth (Niering and Goodwin, 1974; Niering et al., 1986). Herbivory may also be an important factor for controlling tree populations on some ROWs (Kays et al., 1987; Luken et al., 1992b).

Trees on the study areas were observed to be less than 16 years old. Age of trees on ROW plots was based on measurement of the two largest tree stems located just outside each plot and within the ROW areas. These stems were cut down at groundline and aged by counting growth rings. Average age for all saplings was found to be 10 years (minimum of 4 years, maximum of 27 years). Only 8 of the 105 tree saplings measured were older than 16 years. Since species composition was generally constant between 1975 and 1991, especially on herbicide treated plots, ecesis from seed must have occurred during the study period in generally the same species proportions as existed in 1975. Buried viable seed was likely not an important mechanism for species persistence on ROWs (Hutnik et al., 1987). Invasion occurred during the study period from large-seeded, wind dispersed species (*Acer* and *Fraxinus*), light-seeded, wind dispersed species (*Betula* and *Populus*), and large-seeded, animal dispersed species (*Prunus* and *Quercus*). All plots were observed to have trees of seed producing size on both sides of all study plots.

Periodic, selective removal of trees by hand cutting, whereby only the aboveground portions of trees are removed, produced tree stem densities 10 times higher in 1991 than on plots where trees were selectively removed with herbicides. This increase is likely due to sprouting and suckering. Failure to kill stumps and root systems of hardwood species can result in a proliferation of new trees stems on ROWs (Brown, 1989; Luken et al., 1991, 1992a; Nowak et al., 1992). Most species on the studied ROWs can sprout when aboveground stems are cut at or near groundline (Johnston, 1975; Mroz et al., 1985; Brown, 1989); some species also produce root suckers after cutting (e.g., Populus, Robinia, and Sassafras). This increase in tree density can eventually lead to uniform, dominant coverage of trees across ROWs. Distribution of tree stems on hand cut plots did not follow the U-shaped pattern as observed on herbicide treated plots, but was linearly distributed across ROWs.

Results of analyses of hand cut data are notably tenuous. Potential confounding effects and a relatively small sample size limit interpretation of results. Hand cut plots were generally older (51 versus 34 years), had more years since the previous treatment from 1991 (7 versus 4 years), had lower ROW width (27.1 versus 48.8 m), and higher 1975 stem density (1270 versus 520 stems ha^{-1}) compared to herbicide plots (Table 10). Correlation analysis of 1991 regression coefficients with these factors for all plots indicated significant associations, especially for $B_0{}^*$ (Table 11). Right-of-way age, years since the last treatment, and 1975 tree density were positively correlated, and ROW width negatively correlated, with 1991 B_0^* (Table 11). Observed increases in tree densities on hand cut plots between 1975 and 1991 may be, in part, due to these peripheral effects.

Sample size also limits interpretation of hand cut treatment effects. Four sites had trees selectively removed by hand cutting between 1975 and 1991, but two of these sites had only one plot each (Table 4).

Results of the operational use of herbicides or hand cutting in selectively removing trees was consistent with experimental evidence. Bramble and Byrnes (1983) compared tree densities between ROW plots that were hand cut or basally treated with herbicides to selectively remove trees over a 14-year period in central Pennsylvania. Density of trees $\geq$ 1 m height was 2.5 times higher on hand cut plots as compared with selective herbicide treated plots. Similar results were found by ESEERCO (1985) in New York State for stems $\geq$ 1 m. Two years after selective tree removal, hand cutting caused an 18% increase in tree density compared to pretreatment densities. In contrast, selective removal of trees using herbicides resulted in a 59 to 78% decrease in tree density compared with pretreatment densities. Results of the current study extend these experimental results to a broader, more practical level. Operational, selective, complete removal of trees using herbicides can lead to relatively stable, low density tree populations on electric transmission line ROWs.

STUDIES 3, 4 AND 5: COST EFFECTIVENESS OF VEGETATION MANAGEMENT METHODS ON A RECENTLY CLEARED ELECTRIC TRANSMISSION LINE RIGHT-OF-WAY

PREFACE

In fall, 1988, the Niagara Mohawk Power Corporation (NMPC) requested technical assistance with their ongoing electric transmission line ROW vegetation management research project -- The Volney-Marcy Vegetation Management Study. In response to this request, a proposal entitled "Principles and practices of vegetation management on electric power transmission line rights-of-way" was written.

Our requested role in the Volney-Marcy Study was to provide analytical and interpretation skills so as to generate objective results and interpretations regarding the cost effectiveness of several herbicide and non-herbicide treatment schemes for managing powerline corridor vegetation, using the Volney-Marcy Study data. Prior to our involvement, there had been no rigorous analysis of the data, only a reporting of treatment means (Foreback and Stevens, 1985; Anonymous, 1987).

Initiation and design of the Volney-Marcy Study was done by Curtis G. Foreback, Senior Environmental Analyst, Environmental Affairs Department, NMPC. Field work, including treatment plot layout and mapping, data collection, application of treatments, and permanent marking of plots in the field with 1 cm rebar, was performed by Tree Preservation Company, Incorporated

(Briarcliff Manor, NY), as directed by Craig H. Stevens, Environmental Manager. Data from Tree Preservation Company was received in Lotus 123™ (Lotus Development Corporation, Cambridge, MA) spreadsheet format. Data cross-checking and other quality control activities were performed with these spreadsheets. In general, though, the data was analyzed as received but in reorganized form (see Appendix Tables 7 to 12 for summary of original data used for Studies 3, 4 and 5).

INTRODUCTION

Several herbicides, by themselves or in mixtures, have been used successfully in management schemes to remove trees and promote desirable plant communities on ROWs (Studies 1 and 2). These herbicides include 2,4-D, picloram and triclopyr. They are commonly used on ROWs in New York State (Table 3; Nowak et al., 1993). In the current study, these herbicides were used in different application schemes and compared for vegetation control and costs during initial clearing and the first and second treatment cycles of the conversion phase on one 765 kV ROW in Upstate New York. The objective was to determine which herbicide application mode (selective or nonselective) and method (basal versus cut stump versus no herbicide for the initial clearing study, and basal versus stem-foliar for the first and second conversion cycle studies) was most cost effective in accomplishing vegetation management objectives during these early ROW management phases. Additionally, cost effectiveness of grubbing or brush hogging was compared with basal and stem-foliar herbicide schemes during the second conversion cycle. The use of non-herbicide schemes is apparently increasing in New York State (Nowak et al., 1993). Cost effectiveness information for these techniques is timely and important as there is relatively little quantitative information on cost effectiveness of non-herbicide treatment schemes relative to herbicide schemes (Abrahamson et al., 1992).

BACKGROUND

Defining Cost Effectiveness

Cost for ROW vegetation management can be viewed as including direct and indirect costs (Abrahamson et al., 1992). Direct costs pertain to the outlay of money made to treat ROW vegetation. Labor, equipment and materials costs are commonly reported as direct costs (ESEERCO, 1984; Abrahamson et al., 1991a,b; Nowak et al., 1992). Indirect costs are the loss or nonproduction of values than can result from treatment. Wildlife and aesthetics are examples of values from ROWs that can be considered indirect costs if they are not effectively produced on ROWs with management (Abrahamson et al., 1992). These values are included as part of the regulatory objective for vegetation management on powerline corridors in New York (de Waal Malefyt, 1984). Realistic dollar amounts are difficult, if not impossible, to ascribe to indirect costs.

Effectiveness is a relative measure of the success of a treatment in producing a desired effect. The desired effect for ROWs is the production of safety, reliability, wildlife and aesthetic values. Initial reduction and subsequent maintenance of tree stem density at relatively low levels and promotion of woody desirables has been viewed as a means of achieving reliable transmission of electricity in a cost effective manner, and at the same time achieving corollary sets of values from ROWs (Study 2).

Cost effectiveness has commonly been examined by dividing it into these two component parts, cost and effectiveness. Some studies have only one of these components (e.g., effectiveness in Bramble and Byrnes, 1983). Other studies have had both components, but have not examined them as a collective measure (e.g., ESEERCO, 1984, 1985). A few studies have considered the terms as one measurement (e.g., Bramble et al., 1985; Nowak et al., 1992). Bramble et al.(1985) defined a Cost-Effectiveness Quotient (CEQ):

$$\text{CEQ} = \frac{\text{Cost per 1000 stems (\$)}}{\text{Tree stem reduction (\%)}} \times 100$$

While this CEQ value effectively combines cost and effectiveness into one measurement, there is no objective reason why it should accurately reflect cost effectiveness. Because CEQ is calculated using percentages, it is highly sensitive to pretreatment tree density values. It is necessary to account for pretreatment density effects in comparing cost effectiveness of management methods (ESEERCO, 1984).

Cost effectiveness of vegetation management schemes in the current study was viewed as a function of vegetation changes (effectiveness) caused by a treatment and the direct costs of equipment, labor and materials. A treatment that would:

1) increase/maintain desirables,
2) decrease tree density, and
3) have relatively low costs

was determined as most cost effective.

Electric Transmission Line Right-of-way Vegetation Management Phases

Right-of-way vegetation management can be divided into a series of phases. In the past, two phases or stages have been considered: initial clearing and maintenance phases (Galvin et al., 1979), conversion and maintenance stages (Egler and Foote, 1975), and initial clearing and post clearing (Study 1). For the current study, these two division approaches were were hybridized into a three phase approach to viewing ROW vegetation management: initial clearing, conversion, and maintenance. The distinction among these phases is the relative importance of tree stems on ROWs; there is a higher proportion of tree stems the closer vegetation management is to the initial clearing phase.

Initial clearing is performed prior to and during electric transmission facilities installation. It entails removing most trees and other tall growing vegetation (e.g., vines). While this phase is referred to as the initial clearing phase, it is not a clearing in an absolute sense as many of the desirable components of the ROW plant communities are left intact. The initial removal of trees from a ROW results in reestablishment of trees from seed, seedlings, stump sprouts, and root sprouts. High numbers of trees and low numbers of desirables are expected during the initial clearing phase.

The conversion phase entails removal of trees, generally using herbicides. During the conversion phase there is a shift in plant community composition from communities with trees as the dominants to communities with desirables as the dominants. Treatment cycle lengths within the conversion phase are a relatively short 3-5 years.

Relatively stable low growing desirable plant communities are furthered and cyclically maintained in the maintenance phase. Treatment cycles are a relatively long 5-10 years.

Tree stems are not completely eradicated from a site during any phase, but can only be contained on ROWs. Containment entails cyclically killing the more readily visible trees. Many trees are not removed during any one treatment cycle, and new invasions of tree stems can occur. Wide seed dispersal and persistence of buried seed leads to a relatively constant tree component on every ROW site. Most of the residual and newly established tree stems will die over the course of the treatment cycle, but some will grow above the desirable plant community canopy and be treated at the end of the following cycle.

Deferred management and unsuccessful treatment schemes can lead to unsuccessful containment of tree stems and reversion of the plant communities to previous phases.

Cost effectiveness varies as a function of tree density, size, and species (ESEERCO, 1984, 1985); therefore, differences are expected in the cost effectiveness of a treatment from one phase to another.

MATERIALS AND METHODS

Study Area Description

Studies took place on the Niagara Mohawk Power Corporation's Volney-Marcy 765 kV electric transmission line ROW in the Towns of Lee, Western and Floyd in Oneida County, New York (43°21'N, 75°32'W to 43°15'N, 75°17'W). The ROW passes through the Interlobal Highland Region, between the Tug Hill Plateau and the Mohawk Valley; it is covered by Northern Hardwood forest with a predominance of red maple (*Acer rubrum* L.) and Eastern hemlock (*Tsuga canadensis* [L.] Carr.), although there was a mixture of both abandoned and active agricultural and forest land on and surrounding the study area.

The Volney-Marcy ROW is 68.6 m wide. The study area is approximately 24 km in length, generally east-west in direction. On the south side of the Volney-Marcy ROW is the 21-yr-old (1992 age) New York Power Authority Fitzpatrick to Edic 345 kV transmission line. Its ROW width is 45.7 m.

Soils of the study area are silt and sandy loams, including a variety of Fragiaquepts, Eutrochrepts and Haplaquepts of varied drainage. The dominant soil series encountered were Camroden, Pickney, Pyrities, Katurah and Malone (J. Kraft, Soil Conservation Service, 1989, personal communication). In general, mesic conditions are dominant throughout the study area.

Experimental Design Selection

Upon initial examination of the Volney-Marcy Study and consultations with study personnel in 1989 (C.G. Foreback and S.B. Shaheen, Niagara Mohawk Power Corporation, and C.H. Stevens, Tree Preservation Co., Inc.), it was apparent that a rigorous experimental approach was not used to analyze the study prior to 1989. However, treatments were replicated and an attempt was made to account for preclearing land use effects through some blocking between woodland and abandoned agricultural land; hence, there was a basis for *a posteriori* derivation of an analysis technique that would allow objective testing of treatment effects.

The analysis approach for each study was selected for simplicity and to represent the intent and field plot layout, and to provide for relatively high statistical power.

Division of Treatment Plots into Three Studies

Treatment plots were divided into three studies: 1) initial clearing herbicide study (Study 3), 2) first and second conversion cycle herbicide studies (Study 4), and 3) second conversion cycle non-herbicide study (Study 5).

Experimental Design and Treatments for the Initial Clearing Study -- Study 3

A completely randomized factorial design (four replications) was used to test initial clearing herbicide treatment mode (clearcut [nonselective] and selective cut [selective]) and method (basal, cut stump or no herbicide treatment) effects on desirable woody stem density, tree stem density, tree sprouting, and treatment costs.

Treatment plots ranged in size from 0.25 to 0.85 ha, extending from edge to edge of the ROW. Treatment plots were systematically assigned within randomly chosen ROW areas (Figure 5).

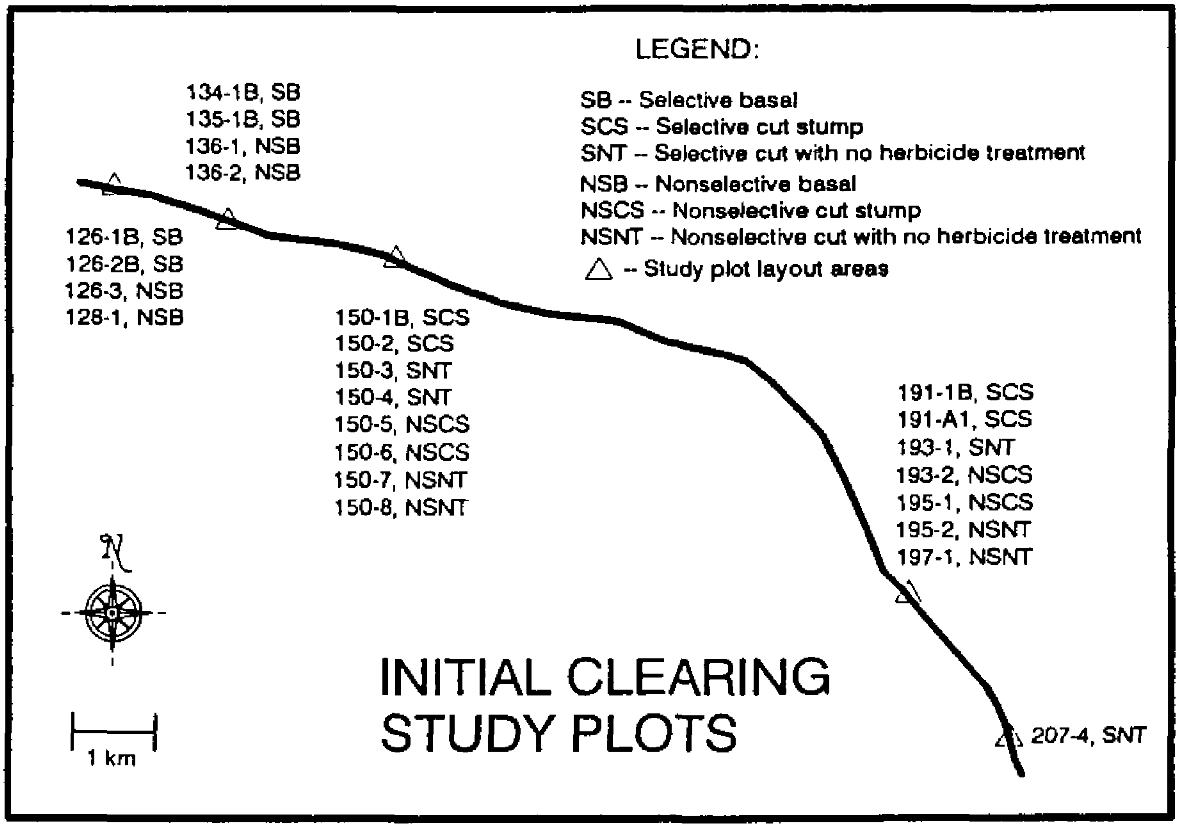

Figure 5. Study plot layout for the initial clearing study (Study 3). The line with triangles represents the Volney-Marcy 765 kV transmission line. Numbers (e.g., 126-1B) along the line are plot designations.

The treatments included stem cutting with basal and cut stump herbicide, and no herbicide, applied selectively and nonselectively at the time of clearing (1983) (Table 13). The six treatments were (mode/method):

Selective/basal -- basal treatment of tree vegetation during late April-early May, 1983, with a herbicide formulation consisting of 7.6 L of triclopyr[4] at 0.480 kg active ingredient (ai) L^{-1} ([(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid) mixed with 371 L of No. 2 fuel oil; it was targeted at the lower 0.3 to 0.6 m of individual stems, saturating the base of the stem and all exposed roots to the point of rundown and puddling around the root collar zone. Treated stems were cut with chainsaws at groundline two to three weeks after herbicide treatment.

Nonselective/basal -- basal treatment of all woody vegetation with a herbicide formulation, application method and stem cutting the same as that for the selective/basal treatment.

Selective/cut stump -- cut stump treatment of tree vegetation during late May-mid July, 1983, with a "ready to use" herbicide formulation of picloram[5] (4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid) at 0.024 kg ai L^{-1} and 2,4-D [(2,4-dichlorophenoxy)acetic

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[4] Garlon 4, DowElanco, Indianapolis, Indiana 46268-1189.

[5] Tordon RTU, DowElanco, Indianapolis, Indiana 46268-1189.

Table 13. Total active ingredient of herbicides applied during initial clearing and first and second conversion cycle studies.

Herbicide application scheme		Total herbicide applied: Initial clearing (1983)	First conversion cycle (1984)	Second conversion cycle (1988)
		kg ai ha^{-1}		
Initial clearing study treatments:				
Clearcut/basal:[a]	triclopyr	9.7	-	-
Clearcut/cut stump:[b]	picloram	1.1	-	-
	2,4-D	4.6	-	-
Selective cut/basal:[a]	triclopyr	9.6	-	-
Selective cut/cut stump:[b]	picloram	0.8	-	-
	2,4-D	2.9	-	-
Conversion cycle study treatments:				
Selective/basal:[a]	triclopyr	-	7.6	2.1
Selective/stem-foliar:[c]	triclopyr	-	2.1	1.2
	picloram	-	0.3	0.2
	2,4-D	-	1.3	0.9
Nonselective/basal:[a]	triclopyr	-	5.7	2.2
Nonselective/stem-foliar:[c]	triclopyr	-	5.7	1.6
	picloram	-	1.0	0.2
	2,4-D	-	3.8	1.0

[a] Basal herbicide formulation consisted of 7.6 L of Garlon 4 and 371 L of No. 2 fuel oil.

[b] Cut stump formulation was Tordon RTU, a "ready to use" formulation.

[c] Stem-foliar herbicide formulation consisted of 1.5 L of Garlon 4, 1.9 L of Amdon 101 (first conversion cycle) or Tordon 101 (second conversion cycle), 1 L of surfactant (Surfel), and 375 L of water.

acid] applied to the freshly cut cambial area of the stump using a hand held squirt bottle. Stems were cut with chainsaws at groundline.

Nonselective/cut stump -- cut stump treatment of all woody vegetation with a herbicide formulation and application method the same as that for the selective/cut stump treatment.

Selective cut/no herbicide treatment -- cutting with chain saws of all tree stems at groundline during early June-early July, 1983. No herbicide treatment was used.

Nonselective cut/no herbicide treatment -- cutting with chain saws of all woody stems during early June-early July, 1983. No herbicide treatment was used.

Experimental Design and Treatments for the First and Second Conversion Cycle Herbicide Studies -- Study 4

A randomized complete block factorial design (six replications) was chosen to test first and second conversion cycle study herbicide mode (nonselective and selective) and method (basal and stem-foliar) effects on desirable woody stem density, tree stem density, number of stems greater than 1.8 m, number of stems greater than 3.7 m, mean height, herbaceous cover, and treatment costs.

Experimental units from all treatments were blocked across preclearing and surrounding land use areas.

Treatment plots ranged in size from 0.16 to 0.85 ha, extending from edge to edge of the ROW.

Treatment plots were systematically assigned to previously used plots from the initial clearing study (Figures 5 and 6).

The four treatments included basal stem-foliar herbicide treatments applied selectively and nonselectively at the beginning of the first conversion cycle study (1984) and repeated at the beginning of the second conversion cycle study (1988) (Table 13). Stem cutting was not included in the first and second conversion cycle studies. The four treatments were (mode/method):

Selective/basal -- basal treatment of tree vegetation during late July-August 1984 and 1988 with a herbicide formulation consisting of 7.6 L of triclopyr[4] at 0.480 kg ai L^{-1} and 371 L of No. 2 fuel oil; it was targeted at the lower 0.3 to 0.6 m of individual stems, saturating the base of the stem and all exposed roots to the point of rundown and puddling around the root collar zone.

Nonselective/basal -- basal treatment of all woody vegetation with a herbicide formulation and application method the same as that for the selective/basal treatment.

Selective/stem-foliar -- stem-foliar treatment of tree vegetation with a herbicide formulation consisting of a mixture of 1.4 L of triclopyr[4] at 0.480 kg ai L^{-1}, 1.9 L

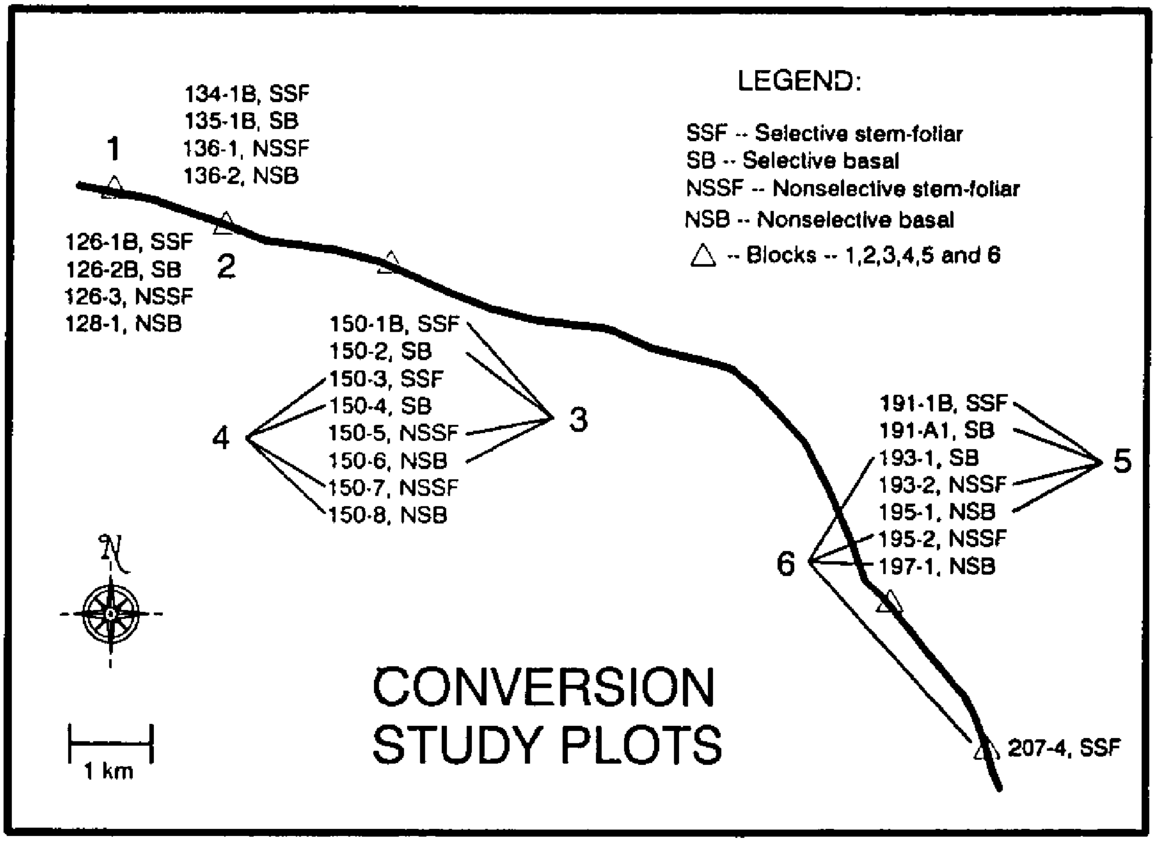

Figure 6. Study plot layout for the first and second conversion cycle herbicide studies (Study 4). The line with triangles represents the Volney-Marcy 765 kV transmission line. Numbers (e.g., 126-1B) along the line are plot designations.

of a formulation of picloram[6] at 0.060 kg ai L^{-1} plus 2,4-D at 0.240 kg ai L^{-1}, 0.95 L of surfactant[7] (crop oil concentrate) and 375 L water, applied to leaves, branches and stems to a point of wetness.

Nonselective/stem-foliar -- stem-foliar treatment of all woody vegetation with a herbicide formulation and application method the same as that for the selective/stem-foliar treatment.

Five of the second conversion cycle study basal treatment plots -- plots 136-2, 150-2, 150-4, 150-6, and 150-8 -- were not treated in 1988; the plots were located within designated wetland areas and could not receive herbicide treatment.

Experimental Design and Treatments for the Second Conversion Cycle Herbicide versus Non-herbicide Treatment Scheme Study -- Study 5

A completely randomized design (7 to 12 replications) was chosen to examine second conversion cycle study herbicide (basal and stem-foliar) and non-herbicide (brush hogging or grubbing) treatment scheme effects on desirable and tree woody stem density, number of stems greater than 1.8 m, number of stems greater than 3.7 m, mean height, relative herbaceous cover, and

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[6] In 1984, Amdon 101, Union Carbide Agricultural Products Company, Inc., P.O. Box 12014, 2 T.W. Alexander Drive, Research Triangle Park, North Carolina, 27709; in 1988, Tordon 101, DowElanco, Indianapolis, Indiana 46268-1189.

[7] Surfel, Union Carbide Agricultural Products Company, Inc., P.O. Box 12014, 2 T.W. Alexander Drive, Research Triangle Park, North Carolina, 27709.

treatment costs. The basal and stem-foliar herbicide treatment scheme data is a combination of nonselective and selective treatment modes used in Study 4.

Treatment plots for brush hogging ranged in size from 0.2 to 0.8 ha; for grubbing, 0.4 to 1.6 ha. Plots extended from edge to edge of the ROW. Treatment plots were randomly assigned to areas used in Studies 3 and 4 (Figure 7).

The two non-herbicide treatments were brush hogging and grubbing:

Brush hogging -- a Hydro-Ax™ or similar machine was used to brush hog all vegetation.

Most treatment plots were brush hogged during September and October, 1988. Plots 8134-4 and 8154-4 were treated during June, 1988, Plot 8156-1 during June and October, 1988, Plots 8199-3 and 8205-1 during September 1988 and 1989, and Plot 8207-1 during May and October 1988, and September, 1989.

Variation associated with plot treatment times may affect treatment comparisons. However, this effect is likely to be an increase in the experimental error, which would make treatment comparisons more conservative.

Grubbing -- a bulldozer with a root rake was used to "grub" all vegetation, including roots, from the site during August-October, 1988. All grubbed materials, including physical impediments such as boulders, were pushed to the edges of the plot. The plot was leveled in the process.

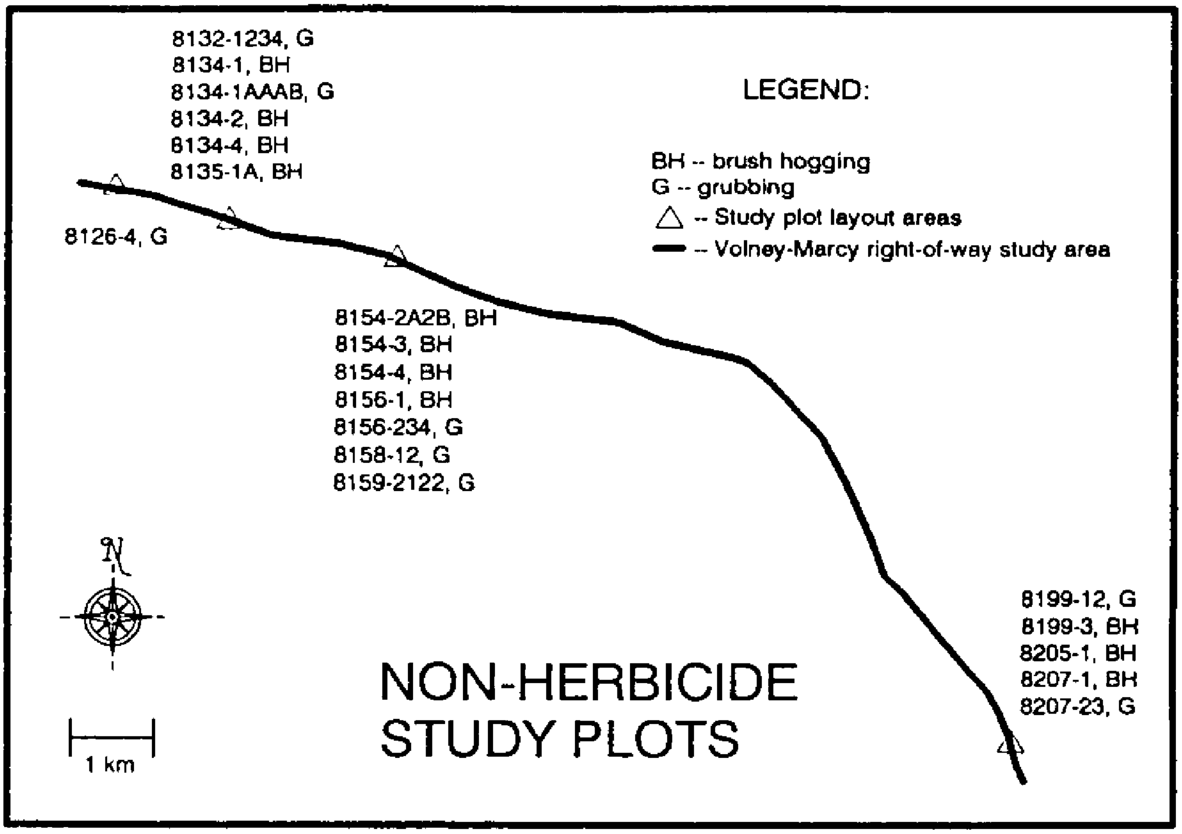

Figure 7. Study plot layout for the second conversion cycle non-herbicide study (Study 5). The line with triangles represents the Volney-Marcy 765 kV transmission line. Numbers (e.g., 126-4) along the line are plot designations.

All grubbed plots were subdivided into 2 to 12 subplots. Seeding (eight different seed mixes), fertilization, tracking, and/or mulching were done on a subplot basis (Appendix Table 12). There was little or no replication of these post-grubbing treatments.

Variation associated with subplot treatments could affect plot level treatment comparisons. However, the effects of post-grubbing treatments on desirable and tree vegetation was likely small due to the low coverage of seeded plants. Total coverage of seeded plants at the end of the treatment cycle (1990) averaged only 18% (Appendix Table 12). Therefore, the subplot effect is likely unimportant.

Data Collection

Treatment costs for all studies were based on current year (1983, 1984 and 1988) contractor billing rates for labor, equipment and materials (Table 14). Labor and equipment use was measured by timing all activities associated with treating a plot. Treatment costs reflect on plot productive time only; it does not include mobilization, demobilization or equipment maintenance costs. Amount of herbicide formulation used to treat each plot was measured using an in-line flow meter. Grubbing treatment cost did not include the cost of seeding, fertilizing, tracking, or mulching. Brush hogging costs were calculated as a per plot average when there was more than one treatment on a plot. Actual

Table 14. Summary of costs associated with the initial clearing and first and second conversion cycle studies.

Category	Initial clearing study (1983)	First conversion cycle study (1984)	Second conversion cycle study[a] (1988)
	dollars h^{-1}		
Labor			
Foreman	27.00	27.00	27.00
Laborers	26.25	26.25	26.25
Equipment			
4X4 spray rig	8.60	8.60	8.60
Tank truck	6.75	6.75	6.80
Brush hog (Hydro-Ax™)	not used	not used	45.00
JD 540 A Skidder	18.80	not used	not used
JD 450 C Dozer with rake	18.50	not used	not used
D-6 bulldozer	not used	not used	46.00
Chainsaw	2.00	not used	2.00
4X4 pickup	6.25	not used	not used
	dollars L^{-1}		
Materials -- herbicide formulation:			
Basal[a]	0.70	0.70	0.76
Cut stump[b]	4.87	not used	not used
Stem-foliar[c]	not used	0.12	0.14

[a] The 4X4 spray rig and tank truck were used only for the basal and stem-foliar herbicide treatments, the brush hog, chainsaw, and 4X4 pickup were used for brush hogging, the chainsaw for cut stump, and the D-6 bulldozer and 4X4 pickup were used for grubbing.

[b] Basal herbicide formulation consisted of 7.6 L of Garlon 4 and 371 L of No. 2 fuel oil.

[c] Cut stump formulation was Tordon RTU, a "ready to use" formulation.

[d] Stem-foliar herbicide formulation consisted of 1.5 L of Garlon 4, 1.9 L of Amdon 101 (first conversion cycle) or Tordon 101 (second conversion cycle), 1 L of surfactant (Surfel), and 375 L of water.

costs for all treatments may be higher or lower than if done on an operational scale, but the cost ratios among treatment would likely not change. Therefore, the cost comparisons presented here should represent results obtained at an operational level.

Vegetation was measured using 4.3 m wide strip transects. These transects extended generally along the plot center, located under the center conductor, and extending along a parallel line located 15.2 m to the north of centerline, nearly under the north conductor. Transects were begun and ended at 6.1 m from the plot edge. Transect lengths were ascribed to cover 7% of the treatment plot.

Shrub and tree stem density (number of stems ha^{-1} as shoot sprouts, root sprouts and seedlings) were measured by species in 1982-83 (initial clearing study), 1985-87 (first conversion cycle study), and 1989-1990 (second conversion cycle study). Plants were categorized as tree or desirable based on Niagara Mohawk Power Corporation's "List of trees to be trimmed, removed or sprayed" (NMPC, 1989; Table 15). In general, desirable stems are defined as those plants that attain maximum heights of less than 6.1 m, tree stems as those that can attain minimum mature height growth greater than 6.1 m (ESEERCO, 1984).

Percent herbaceous cover during the first conversion cycle was tallied separately in 1986 using quadrat samples

Table 15. List of tree (undesirable) and desirable woody plant species present on the Volney-Marcy study area.[a]

Undesirable species:

striped maple (*Acer pensylvanicum* L.)
red maple (*Acer rubrum* L.)
sugar maple (*Acer saccharum* Marsh.)
serviceberry (*Amelanchier* spp.)
yellow birch (*Betula alleghaniensis* Britt. [*Betula lutea* Michx. f.])
paper birch (*Betula papyrifera* Marsh.)
gray birch (*Betula populifolia* Marsh.)
American hornbeam (*Carpinus caroliniana* Walt.)
hickory (*Carya* spp.)
American beech (*Fagus grandifolia* Ehrh.)
white ash (*Fraxinus americana* L.)
walnut (*Juglans* spp.)
eastern hophornbeam (*Ostrya virginiana* [Mill.] K. Koch)
spruce (*Picea* spp.)
red pine (*Pinus resinosa* Ait.)
eastern white pine (*Pinus strobus* L.)
Scotch pine (*Pinus sylvestris* L.)
poplar (*Populus* spp.)
trembling aspen (*Populus tremuloides* Michx.)
pin cherry (*Prunus pensylvanica* L. f.)
black cherry (*Prunus serotina* Ehrh.)
common chokecherry (*Prunus virginiana* L.)
oak (*Quercus* spp.)
sassafras (*Sassafras albidum* [Nutt.] Nees)
American mountain-ash (*Sorbus americana* Marsh.)
American basswood (*Tilia americana* L.)
eastern hemlock (*Tsuga canadensis* [L.] Carr.)
elm (*Ulmus* spp.)

Desirable species:

mountain maple (*Acer spicatum* Lam.)
alder (*Alnus* spp.)
chokeberry (*Aronia* spp.)
dogwood (*Cornus* spp.)
alternate-leaved dogwood (*Cornus alternifolia* L. f.)
hazel (*Corylus* spp.)
hawthorn (*Crataegus* spp.)
witch-hazel (*Hamamelis virginiana* L.)
holly (*Ilex* spp.)
juniper (*Juniperus* spp.)
spicebush (*Lindera benzoin* [L.] Blume)
honeysuckle (*Lonicera* spp.)
apple (*Malus* spp.)
mountain holly (*Nemopanthus mucronata* [L.] Loesener ex Koehne)
buckthorn (*Rhamnus* spp.)
sumac (*Rhus* spp.)
American black currant (*Ribes americanum* Mill.)
rose (*Rosa* spp.)
willow (*Salix* spp.)
elderberry (*Sambucus* spp.)
spiraea (*Spiraea* spp.)
yew (*Taxus* spp.)
low sweet blueberry (*Vaccinium angustifolium* Ait.)
highbush blueberry (*Vaccinium corymbosum* L.)

Table 15 continued.

<u>Desirable species</u>:

maple leaved viburnum (*Viburnum acerifolium* L.)
witch-hobble (*Viburnum alnifolium* Marsh.)
witherod (*Viburnum cassinoides* L.)
nannyberry (*Viburnum lentago* L.)
arrow-wood (*Viburnum recognitum* Fern.)
grape (*Vitis* spp.)

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[a] Designation as undesirable and desirable species was based on Niagara Mohawk Power Corporation's "List of trees to be trimmed, removed, or sprayed" (NMPC, 1989). Nomenclature follows Little (1979).

(0.37 m^2 quadrats) located at 3 m intervals down the center of each strip transect. Relative herbaceous plant cover was measured in 1989 (second conversion cycle study) using 30 1 m^2 quadrats randomly located within 1.8 m of the strip transects.

Hypothesis Testing and Planned Comparisons

The hypothesis for all studies was:

> If an existing land areas is treated during initial clearing or the conversion phase using certain vegetation management schemes, then tree density will be reduced and suitable low-growing, desirable plant communities will be promoted that are compatible with cost effective transmission of electricity.

The accompanying statistical hypothesis is that treatments methods are equal in cost effectiveness.

Measurements made the year before a treatment and at the end of the associated treatment cycle were used in the statistical analyses.

Analysis of variance and analysis of covariance were used to test herbicide treatment mode and method effects on tree and desirable woody stem density, total number of stump sprouts (only 1983), and percent of tree stumps that sprouted (only 1983), number of stems greater than 1.8 m (only 1987 and 1990), number of stems greater than 3.7 m (only 1987 and 1990), and mean stem height (1987 and 1990 only), at the end of each treatment cycle -- 1983 for the initial clearing study, 1987 for first conversion cycle study, and 1990 for second conversion cycle study. Mode and method effects on herbaceous cover were tested for 1986 (first conversion cycle) and on herbaceous density in 1989 (second conversion cycle). Treatment effects on costs were tested for each treatment year -- 1983 for initial clearing study, 1984 for the first conversion cycle study, and 1988 for the second conversion cycle study. An significance level of alpha=0.20 was chosen as the critical value for significance testing. Analysis of covariance was used to adjust for non-homogeneous pretreatment stem densities or percent cover, only if the correlation between the concomitant and dependent variable was greater than r=0.30 (Cochran, 1957). Planned contrasts were performed for the initial clearing study (Study 3) and for the second conversion cycle non-herbicide study (Study 5).

An unbalanced design approach to analysis was taken to examine second conversion cycle mode and method effects on vegetation because all treatments were not represented in all blocks due to five basal plots that did not receive herbicide treatment and unequal replication of the brush hog treatment relative to the herbicide or grub treatments (n=8 instead of 12). In both cases, Type III sums of squares were used to test hypotheses (Milliken and Johnson, 1984). Cost comparisons for the second conversion cycle herbicide study (Study 4) were performed using a balanced design analysis. The five plots that did not receive basal treatment were sprayed with water; costs were calculated as if herbicides had been used.

All statistical analyses were done using the SAS computer software package (SAS Institute, Inc., 1985).

RESULTS AND DISCUSSION

Study 3 -- Initial Clearing Herbicide and Non-herbicide Treatment Methods

Herbicide use reduced desirables as compared to no herbicide treatment, 3990 versus 10570 stems ha^{-1} (Tables 16 and 17). This reduction may be attributed to the killing of desirables in the nonselective mode, and perhaps due to some off-target activity of the herbicides in the selection mode. Trees were in close proximity with desirables, hence, some reduction in desirable stems with herbicides could be expected with selective treatment using basal and cut stump herbicides. Cut stump had less trees than basal schemes, 20670 versus 56290 stems ha^{-1} (Tables 16 and 17). Herbicide treatments reduced the sprouting of trees compared with no herbicide treatment, percentage of stumps that sprouted averaged 22 versus 71 (Tables 16 and 17). Basal treatment plots had a lower sprouting percentage than cut stump in the nonselective mode, but sprouting percentage was not different among methods in the selective mode (Tables 16 and 17). The total number of stump sprouts was also reduced with herbicide use compared to no herbicide treatment, 4100 versus 11860 stems ha^{-1}; however, there

Table 16. P-values from testing initial clearing treatment effects on desirable and undesirable vegetation and costs.

Source of variation	Degrees of free-dom	1983 Stem density		1983 Total tree stump sprouts	1983 Percent of tree stumps that sprouted	1983 Cost			
		Desirable	Tree			Labor	Equipment	Material	Total
Covariate[a]	1	<0.01	-[b]	<0.01	-	0.56	-	-	-
Mode (Mo)	1	0.38	0.97	0.20	0.86	0.61	0.33	0.71	0.23
Method (Me)	2	0.01	0.25	<0.01	<0.01	0.18	0.73	<0.01	0.09
Mo X Me	2	0.73	0.73	0.27	0.10	0.79	0.44	0.94	0.55
Contrasts:[c]									
Herb. vs NT	1	<0.01	0.99	<0.01	<0.01	0.10	0.66	<0.01	0.06
B vs CS	1	0.66	0.10	0.80	0.53	0.41	0.52	<0.01	0.25
INT: Herb. vs NT	1	0.85	0.44	0.20	0.70	0.98	0.77	0.79	0.91
INT: B vs CS	1	0.45	0.92	0.38	0.04	0.50	0.22	0.81	0.29
Herb. vs NT w/NS	1	-	-	0.01	-	-	-	-	-
Herb. vs NT w/S	1	-	-	<0.01	-	-	-	-	-
B vs CS w/NS	1	-	-	-	0.04	-	-	-	-
B vs CS w/S	1	-	-	-	0.30	-	-	-	-

[a] Concomitant variable for desirable stem density was 1982 desirable stem density, for total tree stump sprouts it was 1982 tree stem density, for labor cost it was 1982 tree stem density for selective treatment plots and 1982 desirable plus tree stem densities for nonselective treatment plots.

[b] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model. A hyphen for the contrast means these effects were not tested.

[c] Contrasts: Herb. vs NT -- herbicide treatments versus no herbicide treatments, B vs CS -- basal versus cut stump, INT: Herb. vs NT -- interaction of mode and method for the herbicide treatments versus no herbicide treatments, INT: B vs CS -- interaction of mode and method for basal versus cut stump, w/ -- within.

Table 17. Mean desirable and tree stem density, tree sprout density, and percent of tree stumps that sprouted for initial clearing treatments at the end of the initial clearing cycle.

Treatment[a]		Sample size	1983 Stem density		1983 tree stump sprout density	1983 Percent of tree stumps that sprouted
Mode	Method	(n)	Desirable	Tree		
			stems ha^{-1}			
Unadjusted[b]						
NS	B	4	6130 (3270)[c]	60260 (31560)	1130 (500)	12 (4)
NS	CS	4	3340 (1050)	26740 (8020)	7500 (4940)	33 (9)
NS	NT	4	8480 (3170)	29230 (4030)	13470 (2830)	69 (5)
S	B	4(3)[d]	6110 (4420)	52320 (28980)	5420 (1570)	28 (7)
S	CS	4(3)	1650 (620)	14620 (7930)	1190 (430)	16 (2)
S	NT	4	11460 (2600)	47450 (23190)	11420 (3080)	73 (9)
Adjusted						
NS	B	4	2960 (2350)	-[e]	3240 (1650)	-
NS	CS	4	3630 (2170)	-	4350 (1700)	-
NS	NT	4	9530 (2200)	-	9610 (1730)	-
S	B	4	6050 (2170)	-	5410 (1610)	-
S	CS	4	3330 (2220)	-	3430 (1650)	-
S	NT	4	11630 (2170)	-	14100 (1680)	-

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, CS -- cut stump, NT -- no herbicide treatment.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

[d] Sample sizes in parentheses are for percent tree stumps that sprouted; they are lower because one plot was not measured and one plot did not have stumps.

[e] A hyphen for adjusted means means that analysis of covariance was not used.

was still relatively high densities of trees from stump sprouts, root sprouts, and seedlings one-growing season after initial clearing, an average of nearly 40000 stems ha^{-1} on herbicide treated plots (Tables 16 and 17).

Total treatment cost was higher for herbicide treatments versus no herbicide treatment, \$3290 versus \$2300 ha^{-1}, due primarily to higher costs for labor and materials (Tables 16 and 18). There was no difference in total cost between basal and cut stump treatments, although basal herbicide materials were more expensive than for cut stump (Tables 16 and 18).

Given that the number of desirable stems was reduced with herbicide treatment, tree density was generally the same between herbicide treated and no herbicide treatment plots, and costs were higher for herbicide treatments as compared with no herbicide treatment, the most cost effective method for initial clearing was clear or selective cutting with no herbicide treatment.

Conventional practice for initial clearing of vegetation on powerline corridors in New York is to use a cut stump herbicide scheme (Study 1). Results from the current study show that this is not a cost effective approach. Even with herbicide treatment, there were very high tree stem densities after 1-growing season. Herbicides were effective in reducing tree stump sprouting, but the reduction in stump sprout densities was relatively small compared to the total number of tree stems present on the site. Herbicide use during initial

Table 18. Mean costs for the initial clearing treatments.

Treatment[a] Mode	Method	Sample size (n)	1983 Costs Labor	Equipment	Materials	Total
			dollars ha^{-1}			
Unadjusted[b]						
NS	B	4	1940 (80)[c]	930 (80)	720 (150)	3590 (100)
NS	CS	4	1950 (150)	1420 (160)	170 (20)	3440 (250)
NS	NT	4	1520 (330)	1020 (240)	0 (0)	2540 (550)
S	B	4	1900 (170)	1000 (80)	700 (150)	3600 (390)
S	CS	4	1390 (420)	850 (340)	110 (30)	2350 (780)
S	NT	4	1160 (410)	900 (410)	0 (0)	2060 (820)
Adjusted						
NS	B	4	1900 (300)	-[d]	-	-
NS	CS	4	1880 (320)	-	-	-
NS	NT	4	1430 (350)	-	-	-
S	B	4	1950 (300)	-	-	-
S	CS	4	1480 (320)	-	-	-
S	NT	4	1260 (350)	-	-	-

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, CS -- cut stump, NT -- no herbicide treatment.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

[d] A hyphen for adjusted means means that analysis of covariance was not used.

clearing of powerline corridors is not effective in situations where there is a high potential for invasion and establishment of trees.

Study 4 -- First Conversion Cycle Herbicide Treatment Methods

There were no mode or method effects on desirable and tree stem densities or herbaceous cover (Tables 19 and 20).

Desirable stem height differed by mode, but not by method (Table 19). Plots where stem-foliar herbicides were applied in a nonselective mode had shorter desirable stems compared with plots treated in a selective mode, mean height was 0.8 versus 1.1 m (Tables 19 and 20). The number of desirable stems greater than 1.8 m height was higher for the selective mode versus the nonselective mode, 600 versus 10 stems ha^{-1} (Tables 19 and 20). Tree stem height was affected by both mode and method. There were less tree stems greater than 1.8 m with the nonselective treatment mode compared with the selective, 280 versus 500 stems ha^{-1} (Tables 19 and 20). Mean height of tree stems was lower with the nonselective mode compared with the selective mode, 0.9 versus 1.2 m (Tables 19 and 20). Compared with stem-foliar, basal treatment plots had more tree stems greater than 1.8 m and greater than 3.7 m height (Tables 19 and 20).

There were mode and method related differences in cost. Total treatment cost for the selective mode was generally higher than for the nonselective, $1330 versus

Table 19. P-values from testing the effects of first conversion cycle herbicide treatments on desirable vegetation and tree stems.

Source of variation	Degrees of freedom	1987 Stem density		1987 No. Stems > 1.8 m		1987 No. stems > 3.7 m		1987 Mean height		1986 Percent herbaceous cover
		Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree	
Covariate[a]	1	0.01	-[b]	NA	NA	NA	NA	NA	NA	NA
Block	5	-	-	-	-	-	-	-	-	-
Mode (Mo)	1	0.93	0.34	0.02	0.10	0	0.35	0.09	0.08	0.74
Method (Me)	1	0.31	0.67	0.45	0.15	0	0.19	0.66	0.32	0.55
Mo X Me	1	0.71	0.88	0.52	0.32	0	0.85	0.19	0.54	0.56
Simple effects:[c]										
B vs SF w/NS	1	-	-	-	-	-	-	0.53	-	-
B vs SF w/S	1	-	-	-	-	-	-	0.22	-	-
NS vs S w/B	1	-	-	-	-	-	-	0.75	-	-
NS vs S w/SF	1	-	-	-	-	-	-	0.04	-	-

[a] Concomitant variable for 1987 desirable stem density was 1983 desirable stem density.

[b] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model; a hyphen for the block means this effect was not tested; NA -- not applicable, no concomitant variable was available for use in the analysis of covariance. A hyphen for the contrast means these effects were not tested.

[c] Treatments: NS -- nonselective, S -- selective, B -- basal, SF -- stem-foliar, w/ -- within.

Table 20. Mean desirable and tree stem density, number of stems greater than 1.8 m, number of stems greater than 3.7 m, height, and percent herbaceous cover for basal and stem-foliar herbicide treatment schemes at the end of the first conversion cycle.

Treatment[a]		Sample size	1987 Stem density		1987 No. Stems > 1.8 m		1987 No. stems > 3.7 m		1987 Mean height		1986 Total percent herbaceous cover
Mode	Method	(n)	Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree	
			stems ha^{-1}						m		
Unadjusted[b]											
NS	B	6	5320 (2440)[c]	3990 (470)	7 (5)	300 (200)	0 (0)	10 (10)	0.9 (0.1)	1.0 (0.1)	109 (11)
NS	SF	6	6070 (3220)	4640 (1590)	20 (20)	250 (150)	0 (0)	0 (0)	0.8 (0.1)	0.8 (0.2)	126 (18)
S	B	6	6100 (3780)	5970 (1070)	440 (220)	670 (170)	0 (0)	20 (20)	1.0 (0.1)	1.2 (0.1)	113 (12)
S	SF	6(5)[d]	6500 (2780)	7360 (4380)	770 (420)	320 (100)	0 (0)	0 (0)	1.2 (0.2)	1.2 (0.1)	110 (20)
Adjusted											
NS	B	6	5090 (2300)	-[e]	-	-	-	-	-	-	-
NS	SF	6	6720 (2320)	-	-	-	-	-	-	-	-
S	B	6	4770 (2370)	-	-	-	-	-	-	-	-
S	SF	6(5)	7810 (2350)	-	-	-	-	-	-	-	-

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, SF -- stem-foliar.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

[d] Numbers in parentheses is the sample size for herbaceous cover, it is lower because one plot was not measured.

[e] A hyphen for adjusted means means that analysis of covariance was not used.

\$1160 ha^{-1}, due to higher costs for labor and equipment (Table 21 and 22). Basal herbicide treatments costs were higher than stem-foliar, \$1430 versus \$1090 ha^{-1}, due to differences in labor, equipment and materials (Tables 21 and 22). Material costs varied as a function of treatment mode; basal and stem-foliar material costs were the same in the nonselective mode, basal material costs were higher than stem-foliar in the selective mode (Tables 21 and 22).

Because there was equal reduction of tree stems and maintenance of desirable stem densities, the number of tree stems greater than 1.8 m and greater than 3.7 m was higher with the basal treatment, and basal treatment costs were nearly double that of stem-foliar, the most cost effective herbicide treatment is stem-foliar. The most cost effective mode of application depends on the importance of maintaining tall desirable plants versus reducing tree size. The nonselective mode had both shorter desirable plants and trees.

Study 4 -- Second Conversion Cycle Herbicide Treatment Methods

There were no mode related differences for tree density and herbaceous cover (Table 23). The selective mode had higher desirable density as compared to the nonselective mode, 4270 versus 590 stems ha^{-1} (Tables 23 and 24).

There were no method related differences for desirable stems or herbaceous cover (Table 23). There

Table 21. P-values from testing the effects of first conversion cycle herbicide treatments on costs.

Source of variation[a]	Degrees of freedom	1984 Cost			
		Labor	Equipment	Material	Total
Covariate[b]	1	0.01	0.01	<0.01	<0.01
Block	5	-[c]	-	-	-
Mode (Mo)	1	0.01	0.03	0.71	0.12
Method (Me)	1	0.02	0.02	0.07	0.02
Mo X Me	1	0.67	0.66	0.06	0.22
Simple effects:					
B vs SF w/N	1	-	-	0.96	-
B vs SF w/S	1	-	-	0.02	-
N vs S w/B	1	-	-	0.22	-
N vs S w/SF	1	-	-	0.11	-

[a] Simples effects abbreviations: B -- basal, SF -- stem-foliar, w/ -- within, N -- nonselective, S -- selective.

[b] The concomitant variable was 1987 tree stem density for the selective treatment plots and 1987 tree plus desirable stems for the nonselective treatment plots.

[c] A hyphen for the block effect means this effect was included in the model, but not tested. A hyphen for the contrast effects means this effect was not tested because the main effect interaction was not significant (P>0.20).

Table 22. Mean costs for the first conversion cycle herbicide treatments.

Treatment[a] Mode	Method	Sample size (n)	1984 Costs Labor	Equipment	Materials	Total
			dollars ha^{-1}			
Unadjusted[b]						
NS	B	6	770 (70)[c]	150 (10)	420 (50)	1330 (100)
NS	SF	6	560 (30)	110 (10)	370 (40)	1030 (80)
S	B	6	1020 (130)	200 (30)	560 (130)	1780 (290)
S	SF	6	590 (70)	110 (10)	140 (30)	840 (110)
Adjusted						
NS	B	6	740 (70)	150 (20)	370 (50)	1260 (120)
NS	SF	6	570 (70)	100 (20)	370 (50)	1060 (120)
S	B	6	940 (70)	170 (20)	470 (50)	1610 (120)
S	SF	6	720 (70)	120 (20)	250 (50)	1090 (120)

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, SF -- stem-foliar.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

Table 23. P-values from testing the effects of second conversion cycle herbicide treatments on desirable and undesirable vegetation.

Source of variation[a]	Degrees of freedom	1990 Stem density		1990 No. Stems > 1.8 m		1990 No. stems > 3.7 m		1990 Mean height		1990 Percent herbaceous cover
		Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree	
Covariate[b]	1	0.10	0.52	<0.01	<0.01	-[c]	-	0.31	0.04	0.49
Block	5	-	-	-	-	-	-	-	-	-
Mode (Mo)	1	0.19	0.73	0.75	0.10	0.15	0.34	0.25	0.94	0.35
Method (Me)	1	0.93	<0.01	0.26	0.41	0.56	0.51	0.19	0.27	0.67
Mo X Me	1	0.96	0.74	0.34	0.17	0.93	0.72	0.75	0.40	0.22
Simple effects:										
B vs SF w/NS	1	-	-	-	0.13	-	-	-	-	-
B vs SF w/S	1	-	-	-	0.70	-	-	-	-	-
NS vs S w/B	1	-	-	-	0.08	-	-	-	-	-
NS vs S w/SF	1	-	-	-	0.63	-	-	-	-	-

[a] Simple effects abbreviations: B -- basal, SF -- stem-foliar, w/ -- within, N -- nonselective, S -- selective.

[b] Concomitant variable for desirable stem density was 1987 desirable stem density, for tree stem density it was 1987 tree stem density, for number of desirable stems greater than 1.8 m it was 1987 number of desirable stems greater than 1.8 m, for number of tree stems greater than 1.8 m it was 1987 number of tree stems greater than 1.8 m, for desirable mean height it was 1987 desirable stem mean height, for tree mean height it was 1987 tree stem mean height, and for percent herbaceous cover it was 1986 percent herbaceous cover.

[c] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model. A hyphen for the block effect means this effect was included in the model, but not tested. A hyphen for the simple effect means that this effect was not tested because the interaction was not significant (P>0.20).

Table 24. Mean desirable and tree stem density, number of stems greater than 1.8 m, number of stems greater than 3.7 m, height, and percent herbaceous cover for herbicide treatments at the end of the second conversion cycle.

Treatment[a]		Sample size	1990 Stem density		1990 No. Stems > 1.8 m		1990 No. stems > 3.7 m		1990 Mean height		1989 Percent herbaceous cover
Mode	Method	(n)	Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree	
			stems ha^{-1}						m		
Unadjusted[b]											
NS	B	3[c]	1290 (590)[d]	1900 (840)	0 (0)	20 (20)	0 (0)	0 (0)	0.8 (0.1)	0.8 (0.1)	76 (4)
NS	SF	6	650 (340)	830 (360)	0 (0)	5 (5)	0 (0)	0 (0)	0.5 (0.1)	0.5 (0.1)	70 (4)
S	B	4	6240 (5220)	2320 (530)	960 (890)	300 (270)	20 (20)	20 (20)	1.0 (0.2)	0.9 (0.2)	61 (9)
S	SF	6	4360 (2480)	910 (350)	570 (320)	50 (20)	20 (20)	10 (10)	1.0 (0.3)	0.9 (0.2)	74 (5)
Adjusted											
NS	B	3	400 (3560)	2400 (400)	490 (370)	250 (70)	-[e]	-	1.0 (0.2)	0.9 (0.2)	75 (7)
NS	SF	6	820 (2150)	860 (270)	420 (250)	100 (50)	-	-	0.6 (0.2)	0.7 (0.1)	71 (5)
S	B	4	4200 (2990)	2590 (370)	670 (320)	20 (70)	-	-	1.2 (0.2)	0.8 (0.2)	63 (6)
S	SF	6	4350 (2150)	860 (270)	20 (270)	70 (50)	-	-	0.9 (0.2)	0.8 (0.1)	72 (5)

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, SF -- stem-foliar.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Sample size less than six are due to basal treatment plots not receiving herbicide treatments.

[d] Numbers in parentheses below the means are standard errors.

[e] A hyphen for adjusted means means that analysis of covariance was not used.

were method related differences in tree stem density; basal treatment plots had more tree stems than stem-foliar, 2120 versus 890 stems ha^{-1} (Tables 23 and 24). Higher tree densities with basal herbicide treatments may be attributed to a higher proportion of "misses" during application for basal herbicide treatment versus stem-foliar. Because each stem needs to be individually treated in basal schemes, as compared with the groups of stems that can be treated at one time with stem-foliar sprays, there is a greater chance for misses with basal applications than with stem-foliar.

In a study of cost effectiveness on maintained ROWs, percent of tree misses for basal versus stem-foliar was 6 versus 5 (ESEERCO, 1984). Since the difference in the percentage of misses in this study were relatively low, only 1 %, the higher density of trees in the current study may be attributed to lower herbicide efficacy for the basal treatment versus the stem-foliar.

Density of desirable stems greater than 3.7 m was higher for the selective mode compared with the nonselective mode, 10 versus 0 stems ha^{-1} (Table 23 and 24). Mean desirable height was higher for the basal treatment plots than for stem-foliar, 0.9 versus 0.8 m (Tables 23 and 24). The was no mode or method effects on the number of desirable stems greater than 1.8 m tall. The number of tree stems greater than 1.8 m tall was higher for the nonselective versus the selective mode within the basal treatment only, 300 versus 20 stems ha^{-1}

(Table 23 and 24). Basal treatment plots had more tree stems greater than 1.8 m tall compared with stem-foliar, but only within the nonselective mode. There was no mode or method effect on the number of trees greater than 3.7 m or for mean tree stem height (Table 23).

There was no mode related differences in treatment costs. Costs for basal treatments were higher than for stem-foliar, \$620 versus \$350 ha^{-1}, due to higher cost for labor, equipment and materials (Tables 25 and 26).

Given that there were more desirables with the selective mode, there was a greater reduction in tree stems with stem-foliar schemes, number of desirable stems greater than 3.7 m height was highest for the selective mode, number of tree stems greater than 1.8 m tall was highest with the nonselective mode, and basal costs were nearly double that of stem-foliar, selective stem-foliar is the most cost effective herbicide scheme.

Study 5 -- Second Conversion Cycle Herbicide Versus Non-herbicide Treatment Methods

Results for herbicide treatment comparisons for desirable and tree stem densities in Study 5 were generally the same as reported for Study 4. There was no difference in desirable and tree plants between basal and stem-foliar herbicide treatment schemes (Tables 27 and 28).

Desirable stem densities did not differ among Study 4 treatments (Tables 27 and 28). Desirable stems on

Table 25. P-values from testing the effects of second conversion cycle herbicide treatments on costs.

Source of variation[a]	Degrees of freedom	1988 Cost			
		Labor	Equipment	Material	Total
Covariate[b]	1	-[c]	-	0.05	-
Block	5	-	-	-	-
Mode (Mo)	1	0.35	0.83	0.90	0.60
Method (Me)	1	<0.01	<0.01	0.02	<0.01
Mo X Me	1	0.24	0.14	0.64	0.48
Simple effects:					
B vs SF w/N	1	-	<0.01	-	-
B vs SF w/S	1	-	0.23	-	-
N vs S w/B	1	-	0.23	-	-
N vs S w/SF	1	-	0.36	-	-

[a] Simple effects abbreviations: B -- basal, SF -- stem-foliar, w/ -- within, N -- nonselective, S -- selective.

[b] The concomitant variable was 1987 tree stem density for the selective treatment plots and 1987 tree plus desirable stem density for the nonselective treatment plots.

[c] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model; a hyphen for the block means this effect was not tested. A hyphen for the simple effect means this effect was not tested because the interaction was not significant (P>0.20).

Table 26. Mean costs for the second conversion cycle herbicide treatments.

Treatment[a] Mode	Treatment[a] Method	Sample size (n)	1988 Costs Labor	Equipment	Materials	Total
			dollars ha^{-1}			
Unadjusted[b]						
NS	B	6	400 (50)[c]	80 (10)	180 (30)	660 (90)
NS	SF	6	190 (20)	40 (5)	120 (30)	340 (40)
S	B	6	340 (20)	70 (5)	170 (40)	580 (50)
S	SF	6	200 (20)	50 (10)	100 (20)	350 (30)
Adjusted						
NS	B	6	-[d]	200 (20)	-	-
NS	SF	6	-	100 (20)	-	-
S	B	6	-	170 (20)	-	-
S	SF	6	-	120 (20)	-	-

[a] Treatments: NS -- nonselective, S -- selective, B -- basal, SF -- stem-foliar.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

[d] A hyphen for adjusted means means that analysis of covariance was not used.

Table 27. P-values from testing the effects of second conversion cycle herbicide and non-herbicide treatments on desirable vegetation and tree stems.

Source of variation[a]	Degrees of freedom	1990 Stem density		1990 No. Stems > 1.8 m		1990 No. stems > 3.7 m		1990 Mean height	
		Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree
Covariate[b]	1	SS[c]	-[d]	SS	0.06	NA	-	SS	<0.01
Method	3	0.63	<0.01	0.33	0.03	0.61	0.37	<0.01	<0.01
Contrasts:									
B vs. SF	1	0.66	0.78	0.40	0.87	0.98	0.24	0.39	0.27
Herb. vs. BH	1	0.47	<0.01	0.14	0.04	0.26	0.19	0.14	0.04
Herb. vs. G	1	0.49	0.21	0.15	0.34	0.31	0.23	<0.01	<0.01
G vs. BH	1	0.22	0.02	0.91	0.01	1.00	1.00	<0.01	<0.01

[a] Treatments: B -- basal, SF -- stem-foliar, Herb. -- herbicide, basal combined with stem-foliar, BH -- brush hogging, G -- grubbing.

[b] The concomitant variable for number of tree stems greater than 1.8 m tall was 1987 number of tree stems greater than 1.8 m tall, for tree mean height it was 1987 tree mean height.

[c] SS for the covariate means this effect was originally included in the model, but the slope (interaction effect: covariate*method) was significant ($P \leq 0.20$) and accurate interpretation of analysis of covariance results could not be made.

[d] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model.

Table 28. Mean desirable and tree stem density, number of stems greater than 1.8 m, number of stems greater than 3.7 m, and stem height for the second conversion cycle herbicide and non-herbicide treatments.

Treatment	Sample size (n)	1990 Stem density		1990 No. Stems > 1.8 m		1990 No. stems > 3.7 m		1990 Mean height	
		Desirable	Tree	Desirable	Tree	Desirable	Tree	Desirable	Tree
		stems ha^{-1}						m	
Unadjusted[a]									
Basal	7	4120 (2960)[b]	2150 (440)	540 (520)	170 (150)	10 (10)	10 (10)	0.9 (0.1)	0.9 (0.1)
Stem-foliar	12	2490 (1310)	860 (250)	270 (170)	20 (10)	10 (10)	5 (5)	0.8 (0.2)	0.7 (0.1)
Grubbing	8	1010 (300)	6720 (3930)	0 (0)	0 (0)	0 (0)	0 (0)	0.3 (0.0)	0.3 (0.0)
Brush hogging	11	5510 (3660)	17490 (4500)	20 (20)	2100 (360)	0 (0)	0 (0)	1.1 (0.1)	1.2 (0.1)
Adjusted									
Basal	7	-[c]	-	-	440 (590)	-	-	-	0.9 (0.1)
Stem-foliar	12	-	-	-	320 (470)	-	-	-	0.8 (0.1)
Grubbing	8	-	-	-	-300 (540)	-	-	-	0.2 (0.1)
Brush hogging	11	-	-	-	1800 (470)	-	-	-	1.1 (0.1)

[a] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[b] Numbers in parentheses below the means are standard errors.

[c] A hyphen for adjusted means means that analysis of covariance was not used.

brush hogged plots were, on average, taller than on herbicide treated plots, 1.1 versus 0.8 m, but there were more desirable stems greater than 1.8 m tall on herbicide treated plots as compared with brush hogged plots, 370 versus 20 stems ha^{-1} (Tables 27 and 28). Desirable stems on grubbed plots were shorter, on average, than on plots treated with herbicides, 0.3 versus 0.8 m, or brush hogged, 0.3 versus 1.1 m (Tables 27 and 28). Additionally, there were less desirable stems greater than 1.8 m tall on grubbed plots compared with herbicide treated plots, 0 versus 370 stems ha^{-1} (Tables 27 and 28).

Tree stem densities were higher for the brush hogged plots (17490 stems ha^{-1}) as compared with grubbed plots (6720 stems ha^{-1}) and the herbicide treated plots (1340 stems ha^{-1}, Tables 15 and 16). There was no difference in tree stem densities between grubbing and herbicide treatments (Table 27 and 28).

Number of tree stems greater than 1.8 m tall was greater for brush hogged plots (1800 stems ha^{-1}) than for herbicide treated (360 stems ha^{-1}) or grubbed (0, note that the adjusted mean value is negative) plots (Tables 27 and 28). Herbicide treated plots had more trees stems greater than 3.7 m tall as compared with brush hogged plots, however, there were only 10 and 5 stems per acre for the basal and stem-foliar plots, respectively (Table 27 and 28). Average height of tree stems was greatest for brush hogged plots, followed by herbicide treatment and grubbing (Tables 27 and 28).

Total costs for herbicide treated plots was greatest for basal schemes as compared with stem-foliar, due to higher costs for labor and materials (Tables 29 and 30). These results are the same as reported in Study 4, except in Study 4 equipment differences were also shown to contribute to total treatment cost differences between basal and stem-foliar schemes.

Grubbing was the most costly treatment due to high cost for labor and equipment (Tables 29 and 30). Seeding and fertilization costs, \$300 and \$110 ha^{-1}, respectively (Appendix Table 12), were not added to the cost of grubbing. Addition of these costs would not have changed the cost analysis in terms of interpreting treatment effects -- grubbing would still be the most expensive treatment, however, the magnitude of cost differences would have been different, grubbing costs would increase by 28 %. It is important to recognize that the operational use of grubbing would likely include seeding and fertilization, and would therefore be more costly than reported in this study.

Brush hogging was more costly than herbicide treatments, \$670 versus \$480 ha^{-1} due to higher costs for equipment (Tables 29 and 30).

Since grubbing reduced desirable stem size, increased tree density, and was two to four times more costly than the other treatments, it is not a cost

Table 29. P-values from testing the effects of second conversion cycle herbicide and non-herbicide treatments on costs.

Source of variation	Degrees of freedom	1988 Costs			
		Labor	Equipment	Materials	Total
Covariate[a]	1	-[b]	0.51	-	0.86
Method	3	<0.01	<0.01	<0.01	<0.01
Contrasts:[c]					
B vs. SF	1	<0.01	0.62	<0.01	0.02
Herb. vs. BH	1	0.31	<0.01	<0.01	0.06
Herb. vs. G	1	<0.01	<0.01	<0.01	<0.01
G vs. BH	1	<0.01	<0.01	1.00	<0.01

[a] The concomitant variable was 1987 tree stem density for the selective treatment plots and 1987 tree stem plus desirable stem density for the nonselective treatment plots.

[b] A hyphen for the covariate means that the correlation between the concomitant variable and the dependent variable was <0.30, so the covariate was not included in the model; a hyphen for the block means this effect was not tested.

[c] Treatments: B -- basal, SF -- stem-foliar, Herb. -- herbicide, basal combined with stem-foliar, BH -- brush hogging, G -- grubbing.

Table 30. Mean costs for the second conversion cycle herbicide and non-herbicide treatments.

Treatments[a]	Sample size (n)	1988 Costs			
		Labor	Equipment	Materials	Total
		dollars ha^{-1}			
Unadjusted[b]					
Basal	12	370 (20)[c]	70 (5)	170 (20)	620 (50)
Stem-foliar	12	200 (10)	50 (100)	100 (20)	350 (20)
Grubbing	8	490 (50)	990 (100)	0 (0)	1480 (150)
Brush hogging	12	320 (50)	320 (50)	0 (0)	640 (100)
Adjusted					
Basal	12	-[d]	70 (50)	-	620 (70)
Stem-foliar	12	-	50 (50)	-	350 (70)
Grubbing	8	-	990 (50)	-	1510 (100)
Brush hogging	12	-	320 (50)	-	670 (70)

[a] Treatments: B -- basal, SF -- stem-foliar, Herb. -- herbicide, basal combined with stem-foliar, BH -- brush hogging, G -- grubbing.

[b] Unadjusted means are calculated directly from the plot data, adjusted means are from the analysis of covariance.

[c] Numbers in parentheses below the means are standard errors.

[d] A hyphen for adjusted means means that analysis of covariance was not used.

effective treatment for the second conversion cycle. Brush hogging had higher costs than herbicide treatments, it reduced desirable plant size and increased the number and mean size of trees; therefore, it is not a cost effective treatment. Herbicide treatments were cost effective as compared to grubbing and brush hogging because desirable plants were kept constant in density, tree stem densities were reduced, and costs were relatively low.

Number of tree stems greater than 3.7 m tall was highest on the herbicide treated plots. While the total number of these tall stems was low, they could grow tall enough during the next treatment cycle to cause a ground-line fault on a lower voltage line. Providing safe and reliable transmission of electricity is the most important benefit derived from ROWs. The cost associated with unsafe and unreliable transmission of electricity are not calculated in this study, but can be judged to be very high. If the "escaped" trees associated with the herbicide treatments are important, if they have high potential for affecting safety and reliability, the presence of these trees could alter the interpretation of cost effectiveness. For example, brush hogging had higher costs compared with the herbicide treatments; however, there were no tree stems greater than 3.7 m. In this regard, brush hogging could be considered a more effective treatment.

It should be noted that on an operational basis escaped trees that have the potential to cause a ground-line fault are avoided by contractually mandating that the crews performing vegetation management retreat any missed trees.

Other Cost Effectiveness Studies

Direct costs of ROW vegetation management should be studied in the field using rigorous experimental designs and relatively large treatment plots. There have been four field studies outside the current studies that meet these criteria (Table 31). These studies have included cost, effectiveness, or both components together (Table 31). None of these studies examined cost effectiveness of treatment methods during initial clearing through the conversion phase, as was done in the current studies. Bramble and Byrnes (1983) described a 30-year study in Pennsylvania that followed vegetation development in response to different management methods from initial clearing, but they did not include a cost analysis. In New York, the ESEERCO performed a study to evaluate cost and effectiveness of ROW maintenance treatments (ESEERCO, 1984, 1985). In 1987, Bramble and Byrnes (unpublished reports)[8] initiated two studies in Pennsylvania of cost

[8] Bramble and Byrnes' 1987 results are based on two reports: 1) 1989 annual report to cooperators, Green Lane Research Project on the Elroy to Hosensack 500 kV line of the Philadelphia Electric Company; and 2) 1988 annual report to cooperators (Asplundh Tree Expert Company, DowElanco Chemical Company. Pennsylvania Electric Company, Pennsylvania Game Commission, and Rhône-Poulenc, Inc.) Gamelands 33 research.

Table 31. Summary of studies reporting short-term costs, tree density and shrub cover for various right-of-way vegetation management methods.

				Treatment cost by pretreatment tree stem density class			Tree stem density by pretreatment tree stem density class			
				low	medium	high	low	medium	high	
				stems ha^{-1}			stems ha^{-1}			
Source[a]	Study initiation year	Study duration	Treatment method	2500	5900	11100	2500	5900	11100	Shrub cover
				dollars ha^{-1}			stems ha^{-1}			%
Bramble and Byrnes (1983)	1953	30	hand cut	-[b]	-	-	3750	-	-	-
			basal with stem-foliar	-	-	-	1510	-	-	-
Empire State Electric Energy Research Corporation (ESEERCO 1984, 1985)	1980	6	1.2 m (4 ft) height class:							
			hand cut	-	220	320	990	2720	17780	47
			brush hog	-	250	300	1240	3210	8640	44
			cut stump	-	300	570	490	3460	2720	56
			dormant basal	-	490	690	490	1240	3210	51
			summer basal	-	570	820	740	740	1730	44
			selective stem-foliar	-	270	300	490	740	990	33
			aerial	690	690	690	250	490	1240	13
			2.4 m (8 ft) height class:							
			hand cut	220	300	400	-	-	-	-
			brush hog	400	420	470	-	-	-	-
			cut stump	270	470	770	-	-	-	-
			dormant basal	790	940	1140	-	-	-	-
			summer basal	570	740	990	-	-	-	-
			selective stem-foliar	520	570	570	-	-	-	-
			aerial	690	690	690	-	-	-	-
Bramble, Byrnes, and others (Gamelands 33, unpublished research)	1987	ongoing	hand cut	-	1140	-	6670	-	-	55
			brush hog	-	400	-	220	-	-	50
			brush hog with herbicides	-	570	-	100	-	-	35
			basal (high volume)	-	910	-	370	-	-	70
			basal (low volume)	-	590	-	220	-	-	40
			foliar	-	590	-	150	-	-	25
			stem-foliar	-	250	-	200	-	-	55

Table 31 continued.

Source[a]	Study initiation year	Study duration	Treatment method	Treatment cost by pretreatment tree stem density class: low (stems ha^{-1}) 2500	medium 5900	high 11100	Tree stem density by pretreatment tree stem density class: low (stems ha^{-1}) 2500	medium 5900	high 11100	Shrub cover
				dollars ha^{-1}			stems ha^{-1}			%
Bramble, Byrnes,	1987	ongoing	hand cut	-	-	3830	-	5410	-	-
and others			brush hog	620	-	-	1700	-	-	-
(Green Lane,			brush hog with herbicides	-	1310	-	1980	-	-	-
unpublished research)			foliar	-	1780	-	1240	-	-	-
			stem-foliar	-	2170	-	1310	-	-	-

[a] Bramble and Byrnes' (1983) study had a randomized block design with four replications, treatment plots were 1 ha in size, reported measurements were made 14 years after treatment, and only tree stems greater than 1 m height were measured; for the ESEERCO (1984, 1985) study, the experimental design was randomized block with 18 replications, treament plots were 1 ha in size, 4 ft and 8 ft average tree heights were used for presenting direct costs, reported measurements were made 2 years after treatment, and tree stem density was based on only those stems greater than 1 m height; Bramble and Byrnes' 1987 Gamelands research was overlain on the 1953 study (Bramble and Byrnes 1983), reported measurements were made 2 years after treatment, and tree stem density was based on only those stems greater than 0.3 m height; Bramble and Byrnes' 1987 Greenlane study was a randomized block design with three replications, treatment plots were 1 ha in size, reported measurements were made 1-year after treatment, and tree stem density was based on only those stems greater than 0.3 m height.

[b] A hyphen indicates that these density classes were not studied or that the variable was not measured.

effectiveness during conversion or maintenance phases. The Gamelands 33 research is a continuation of the study initiated in 1953 (Bramble and Byrnes, 1983). The Green Lane research project was similar in scope to Gamelands 33.

Study methods were generally the same for the four studies. Bramble and Byrnes were common researchers to all of these studies. For the ESEERCO (1984, 1985) study, Bramble and Byrnes were among the Principal Investigators. All four studies had rigorous field experiments, but had very limited reporting of statistical analyses and results. Objective comparison of treatment methods within and among studies is limited by this lack of information. None of these four studies report individual costs for labor rates, materials or equipment. This limits the interpretation of their results.

Pretreatment tree stem density has a significant effect on treatment cost and effectiveness (ESEERCO, 1984). ESEERCO (1984) divided pretreatment stem densities into three classes to account for this effect -- low (2500 stems ha^{-1}), medium (5900 stems ha^{-1}), and high (11100 stems ha^{-1}). Cost comparisons made within these density classes are better than cost comparisons made across density classes.

Comparison of direct cost can be made for most of the studies for basal, stem-foliar, brush hogging, and hand cutting methods. The selective stem-foliar treatment method is used as the standard as it was present in all studies. It is used as the denominator in calculating ratios of treatment costs.

The basal treatment used in the current studies was a summer high volume; therefore, basal costs for comparison from ESEERCO (1984) are from the summer basal method, from Gamelands 33 the basal costs are from the high volume basal (Table 31).

Costs. For the current study, basal costs averaged nearly twice that of stem-foliar for both conversion cycles. Basal cost in the ESEERCO (1984) study had similar ratios; basal cost were 1.1 to 1.7 times higher than stem-foliar. The Gamelands 33 Research had a ratio of 3.7 between basal and stem-foliar (Table 31). The consistent high ratio between basal and stem-foliar direct costs among the studies indicates that relative cost comparisons within and among studies are comparably accurate. Although actual costs per treatment may differ among studies, the cost ratios appear to be relatively constant.

Brush hogging costs were variable among the studies. The average ratio of costs for the ESEERCO (1984) and Gamelands 33 research was 1.0, but in some situations brush hogging was less (ratio 0.3) or more (ratio 1.6) costly (Table 31). Brush hogging costs in Study 5 was nearly double that of selective stem-foliar.

Hand cutting costs were variable among studies.

ESEERCO reported hand cutting costs were less than stem-foliar (ratio 0.4 to 0.7). Conversely, Gamelands 33 showed hand cutting costs to be nearly five times that of stem-foliar. Green Lanes had very high hand cutting costs ($3830 ha^{-1}) for the high density class, nearly two times that of stem-foliar.

Hand cutting costs for the current study were done only in the initial clearing phase; therefore, they are not directly comparable with the other studies.

Direct costs were found to vary as a function of treatment method, but also clearly varied as a function of the study. Basal cost were shown to be consistently higher than stem-foliar. Brush hogging costs were variable. In some studies, it was less than stem-foliar, in others, it was equal to or greater than stem-foliar. Hand cutting cost was highly variable.

It is important to note that the literature (and the current study) has presented only short-term costs. The costs reported in Table 31 are the costs of a single treatment. It would be better to compare costs among treatments over the long-term. "The concept of long-term cost ... recognizes that vegetation control is a continuous process, that the type of treatment will influence the cost and timing of the next treatment, and that the most economical method of ROW management is not necessarily the one that results in the lowest cost for a single treatment" (from ESEERCO, 1984, p. 3-1).

Treatment cycle lengths are the critical consideration for measuring long-term costs. Only one study included treatment cycle length measurements (ESEERCO, 1989). Hand cutting was shown to have relatively short cycle lengths compared to selective and nonselective herbicide treatments. Brush hogged plots had cycle lengths comparable to the plots treated with herbicides.

Effectiveness. Effectiveness comparisons are, by definition, based on relative tree stem and desirable stem densities among treatments. A treatment that creates plant communities that persistently have relatively low tree density and high desirable stem density is more effective than a treatment with higher tree density and lower desirable density.

In Study 4, there was no difference between basal and stem-foliar schemes during the first conversion cycle. Ratios were 0.8 and 0.9 for tree and desirable stem density, respectively, between basal and stem-foliar. For the second conversion cycle, tree densities were three times higher for basal compared to stem-foliar. ESEERCO (1985) found that basal tree stem densities were 1.0 to 1.7 times higher than stem-foliar (Table 31). In Gamelands 33, the ratio was 1.9 between basal and stem foliar for tree stems (Table 31). Desirable plant community values from the ESEERCO and Gamelands 33 research were reported as percent cover

(Table 31). Desirable cover was reported to be higher with basal than with stem-foliar, attributed to overspraying with stem-foliar treatment methods.

Tree stem densities for brush hogged plots was found to be higher than stem-foliar in the ESEERCO (ratio 2.5 to 8.7) and Gamelands (ratio 1.1) studies (Table 31). From Study 5, the ratio was 4.2.

Desirable cover was higher with basal treatment in the ESEERCO study (ratio 1.3) and the Gamelands 33 study (ratio 2.8). For Studies 3 and 4, desirable woody stem density was relatively constant through time for the plots treated with herbicides. It was expected that desirable woody stem density would increase after initial clearing until some constant coverage is achieved. Because individual groups of stems (copses) were measured instead of individual stems, increase or decrease in desirable occupancy of the site may not have been adequately expressed in the current study. Reproduction of woody desirable plants on powerline corridors is generally through root and shoot sprouts (Bramble and Byrnes, 1983). Therefore, while the total number of copses may not increase over time, the total number of stems and total coverage can greatly increase.

SUMMARY

Cost effectiveness studies of ROW vegetation management should account for all direct costs, indirect costs, and effectiveness considerations. A relatively simply approach was used in the current studies, whereby direct costs were represented by labor, equipment and materials costs, and indirect direct costs were surrogately accounted for by measures of effectiveness. Effectiveness was viewed as the balancing of tree stem density control with the promotion of woody shrubs and other desirables. A decrease in tree stem density and an increase (or at least maintenance) of woody desirable stems was a positive measure of effectiveness. Right-of-way plant communities dominated by woody desirables are commonly viewed as being the best community for providing safe and reliable transmission of electricity, ancillary wildlife and aesthetics values, with relatively little management inputs. Observations of reduced tree density in all of the studies with the use of herbicides indicates that ROW vegetation management is at least "setting the stage" for the promotion of these desirable communities and the production of these necessary and ancillary values.

In summary, the series of cost effectiveness studies showed that:

- for the initial clearing phase of the Volney-Marcy ROW vegetation management program, extending one-year after clearing, clear or selective cutting with <u>no herbicide</u> was the most cost effective approach, as contrasted with precut basal or cut stump herbicide schemes.

- for the first cycle during the conversion phase of the Volney-Marcy ROW vegetation management program, extending from 1 to 4 years after clearing, <u>selective or nonselective stem-</u>

<u>foliar</u> herbicide schemes were most cost effective, as contrasted with basal herbicide schemes.

- for the second cycle during the conversion phase of the Volney-Marcy ROW vegetation management program, extending from 5 to 7 years after clearing, the <u>selective stem-foliar</u> herbicide scheme was most cost effective, as contrasted with basal herbicide schemes.

In comparing conventional herbicide schemes versus non-herbicide alternatives, it was found that:

- for the second cycle during the conversion phase of the Volney-Marcy ROW vegetation management program, <u>herbicide schemes</u> (stem-foliar and basal) were more cost effective than non-herbicide schemes (grubbing or brush hogging).

Conventional practice for initial clearing of vegetation on powerline corridors in New York is to use a cut stump herbicide scheme (Study 1). Results from the current study show that this is not a cost effective approach. Even when any of the herbicide schemes were used there were very high undesirable stem densities after 1-growing season, over 37000 stems per hectare. Herbicides were effective in reducing undesirable stump sprouting, but the reduction in stump sprout densities was relatively small compared to the total number of undesirable stems present on the site. Herbicide use during initial clearing of powerline corridors is not effective in situations where there is a high potential for invasion and establishment of trees.

During the conversion phase on powerline corridors, when there are high densities of tree stems (5000 to 37000 stems per hectare as encountered during the conversion phase of the current study), stem-foliar herbicide schemes are more cost effective than basal herbicide schemes.

Tree stem densities were observed to have decreased during the conversion phase on plots treated with herbicides. A reduction in herbicide use and concomitant reduction in management costs were also observed. Relatively long treatment cycles may now be expected as the Volney-Marcy ROW enters the maintenance phase of management. Further reductions in herbicide use and management costs will be possible during the maintenance phase as tree stem densities decrease, shrub community develop, and treatment cycles are lengthened.

A shift in application mode from nonselective to selective as being most cost effective during the first and second conversion cycles, respectively, was expected. As the number of tree stems is reduced over time, and stable, desirable plant communities are created, a more selective approach can be implemented.

Non-herbicide alternatives, grubbing or brush hogging, for vegetation management on powerline corridors in New York may become increasingly important in the future. Given current vegetation management objectives, and compared with conventional selective herbicide schemes, these approaches are not cost effective. However, if safe and reliable transmission of electricity is the only concern of ROW vegetation managers, and the importance of wildlife and aesthetic values is reduced, and stable plant communities are considered not necessary, non-herbicide schemes could be viewed as cost effective vegetation management alternatives.

FINAL CONSIDERATIONS

Past vegetation management on ROWs in New York State can be categorized into two eras -- preherbicide and herbicide (Figure 8, from Study 1; Nowak et al., 1993). Apparent beginnings of a third era -- the post-herbicide era -- has been observed these past few years. This despite the fact that these methods are generally not cost effective (Study 5).

In the preherbicide era, from the early 1900s to the 1950s, the objective that guided vegetation management on electric transmission ROWs -- economically create and maintain a corridor for the safe and reliable transmission of electricity -- resulted in two values, safety and reliability.

Since the 1950s, herbicides have provided a cost effective tool for achieving safe and reliable transmission of electricity. Herbicides also provided flexibility in terms of achieving corollary sets of values from ROWs, e.g., wildlife (Bramble and Byrnes, 1972, 1974, 1991; ESEERCO, 1983a; Bramble et al., 1985), aesthetics (Kenfield, 1966, 1991; Richards, 1973), general conservation values (Niering, 1958), and multiple uses (ESEERCO, 1983b).

A steady integration of a broader set of values derived from ROWs began in the 1950s with the selective use of herbicides and increased through the 1980s (Figure 8). In 1980, these multiple values and selective

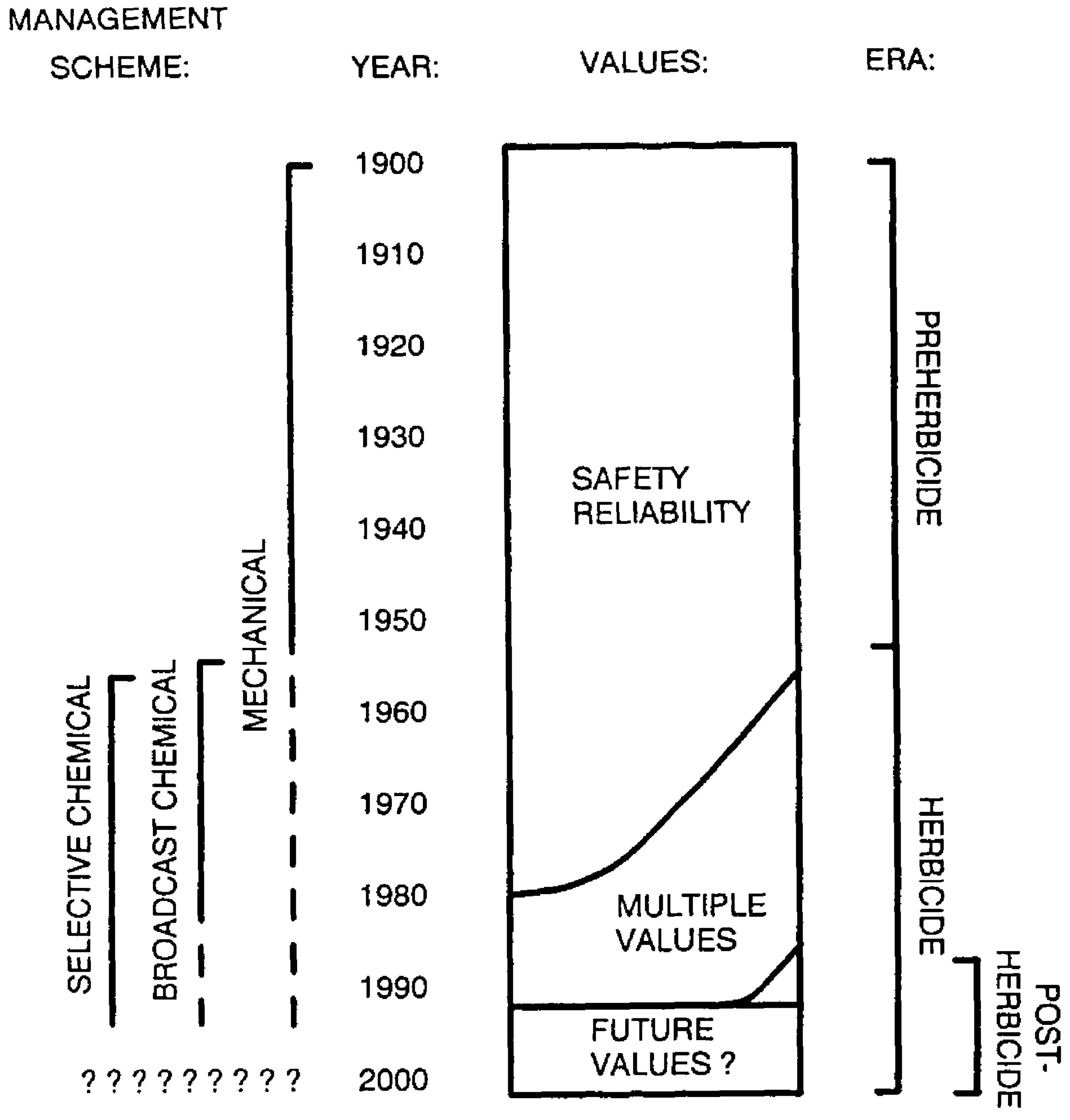

Figure 8. Changes in management schemes, values and eras of powerline corridor vegetation management in New York through the 20th century.

approach to herbicide use were incorporated into New York State regulation (de Waal Malefyt, 1984). These regulations were initiated in response to the broadcast method of applying herbicides, which was viewed by the public as environmentally damaging and cost ineffective (Egler and Foote, 1975; de Waal Malefyt, 1984). Since 1980, the principal ROW vegetation management objective has been to remove undesirable plants and promote "the growth of low-growing, relatively stable plant communities that are aesthetically appealing, beneficial to wildlife, compatible with system reliability requirements, and need relatively little maintenance over the life of the ROW" (p. 4, Appendix A, NYS Public Service Commission, 1980). A selective herbicide approach was recognized as the "best" approach to achieve these values (de Waal Malefyt, 1984). It is an operationally effective (Study 2) and economical approach (Studies 4 and 5; Abrahamson et al., 1991a,b; Nowak et al., 1992).

A majority of ROWs in New York did receive selective herbicide applications during the 1980s and 1990s (Study 1). However, since the late 1980s, a shift away from the multiple use approach to ROW vegetation management back to "safe and reliable" value only approach to ROW vegetation management apparently began in New York State (Figure 8). Increased hand cutting, brush hogging, and grub and seeding of ROWs in New York State may indicate a move into a post-herbicide era (Study 1).

Hand cutting, brush hogging, and grub and seeding are broadcast in nature, similar in effect to the broadcast spraying of herbicides on ROWs during the 50s, 60s and 70s. Broadcast herbicide use resulted in ROWs with low aesthetic and wildlife value (Egler and Foote, 1975). Broadcast non-herbicide treatments could also result in a similar loss of these values. Hand cutting is generally viewed as a selective treatment. However, when viewed over a long time scale, it is more like a broadcast treatment than a selective treatment. Over time, hand cut ROWs become dominated by trees through root and shoot sprouting. This leads to a uniform undesirable coverage across a ROW, similar to brush hogging, and a subsequent need to periodically reclear the total ROW with a concomitant loss of aesthetic and wildlife values.

Public interest for multiple values from ROWs and general concern for herbicides will likely increase in the future. These interests and concerns will create incongruity between vegetation management objectives, as mandated by regulation (de Waal Malefyt, 1984), and the management practices needed to attain those objectives. Selective use of herbicides has been effective at reducing tree stem density over the long-term (Study 2) and is relatively cost effective (Study 5). Non-herbicide alternatives are not effective over the long-term (Study 2) and are not cost effective (Study 5). If desired values from ROWs are reduced to the original tandem of "safe and reliable", then non-herbicide schemes may be considered a viable option. If wildlife and aesthetic values are desired from ROWs, maintenance of tree populations at low densities will be necessary, with herbicides a viable managament alternative.

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APPENDIX

Appendix Table 1. Management histories for the 21 rights-of-way used in Study 1 and Study 2.

Site	Plot	Year(s)	Management activity[a]
1	all	1955	cleared west line, cut stump with Esteron 245 in parts of Plots 1 and 3 (1961 clearing date assumed, see below)
	"	1961	cleared east line, cut stump with Esteron 245 in parts of Plots 1 and 3
	"	1962-76	periodic nonselective and selective chemical maintenance, no record
	"	1977-78	backpack basal with Tordon 155
	"	1978	foliar with Krenite
	"	1978	backpack basal with Banvel 520
	"	1980	foliar with Krenite
	"	1981	foliar with Krenite S
	"	1982	foliar with Krenite S
	"	1983	basal with Banvel 520/Garlon 4 mix
	"	1983	foliar with Krenite S
	1,2,3	1984	hand cut
	1,2	1984	basal with Garlon
	3,4	1986	hand cut
	3,4	1987	hand cut
	3,4	1987	foliar with Krenite
	all	1988	foliar with Krenite
2	all	1970-71	cleared, cut stump with 2,4,5-T (1971 clearing date assumed)
	"	1973-74	cut stump and basal with Tordon 155 and oil
	"	1975	" "
		NOTE: no information provided by utility since 1975	
3	all	1973	selectively cleared, cut stump with Silvex or 2,4-D, midsummer basal with Silvex or 2,4-D
	"	1975	cut stump with 2,4,5-T
		NOTE: no information provided by utility since 1975	
4	all	1920s	cleared (1925 clearing date assumed, see below)
	"	1950	broadcast with herbicides (assumed, see below)
	"	1958-62	basal
		NOTE: broadcast spraying of herbicides during early history, first used in New York in early 1950s	
		NOTE: no information provided by utility since 1975	
5	all	1916	cleared
	"	1917-48	periodically hand cut
	"	1949	recleared
	"	1955	1/3 right-of-way brush hogged, basal treat
	"	1958	recleared
	"	1967	recleared, cut stump with 2,4,5-T
	"	1970	basal spray
	"	1974	cut stump
	"	1988	hand cut (field observation)
		NOTE: no information provided by utility since 1975	

Appendix Table 1 continued.

Site	Plot	Year	Activity
6	all	1932-34	cleared to 30.5 m width (1947 clearing date assumed, see below)
	"	1946	hand cut
	"	1947	right-of-way widened
	"	1950	hand cut and disked
	"	1956	broadcast spray with 2,4-D and 2,4,5-T
	"	1959	broadcast spray with 2,4,5-T
	"	1959-60	ROW widened
	"	1965	broadcast spray with Tordon 101
	"	1966	tall ash cut
	"	1974	helicopter with Tordon 101
	2,3,4,5	1979	foliar spray
	2,3,4,5	1986	foliar spray
		NOTE: 1976-90 data is from pole 712-717; this misses the hydric plot, Plot 1, need from 711	
		NOTE: need herbicide formulations from 1975 to 1992	
7	no plots were established in 1975		
8	all	1962	cleared, cut stump with 2,4,5-T
	"	1963	basal with 2,4,5-T
	"	1970	broadcast with Tordon pellets
	"	1977	stem-foliar with Tordon 101/Kuron (Silvex) mix
	"	1985	cut stump with Weedone CB/Garlon 4 mix
	"	1992	cut stump with Compadre
9	all	1961-62	230 kV line cleared, cut stump with 2,4,5-T (1967 clearing date assumed, see below)
	"	1960-67	345 kV line cleared, cut stump with 2,4,5-T
	"	1962	230 kV line basal with 2,4,5-T
	"	1963-72	records incomplete for 230 kV line
	"	1969	345 kV line basal with 2,4,5-T
	"	1973	aerial with Tordon 101
	1,2,4	1981	stem-foliar with Garlon 3A/Tordon 101 mix
	3	1981	hand cut
	1,2,4,5	1988	stem-foliar with Garlon 4/Tordon 101 mix
	3	1988	hand cut
		NOTE: 1981 data from structures 37-42 only, this misses Plot 5, need to 43	
10	all	1926-27	cleared (1927 clearing date)
	"	1939	recleared
	"	1950	shear dozed
	"	1960	broadcast foliar with 2,4-D and 2,4,5-T
	"	1963-64	new parallel line cleared, cut stump
	"	1968	broadcast foliage with Ammate
	"	1975	foliar spray
	1,3	1991	hydro-ax
		NOTE: no treatment between 1975 and 1990?	
		NOTE: need herbicide formulations from 1975 to 1992	

Appendix Table 1 continued.

Site	Plot	Year	Activity
11	all	1962	cleared, cut stump with Tordon 155
	"	1985	hand cut and mow
		NOTE: line was recut once between 1962 and 1985, but date is unknown	
12	all	1906	cleared
	"	1941	between 1906-41, periodically hand cleared
	"	1952	shear dozed
	"	1957	basal treat brush on right-of-way, frill danger trees with 2,4-D and 2,4,5-T
	"	1962	broadcast foliar Dacamine 2D/2T
	"	1966	ROW widened, cut stump
	"	1968-75	annual brush hog
	1	1985	basal
	2	1985	cut stump
	all	1990	hydro-ax
	"	1991	grub and seed
		NOTE: need herbicide formulations from 1975 to 1992	
13	all	1967	cleared, cut stump with Tordon 155
	"	1968-75	no information on management
	"	1980	cut stump
	"	1985	selective foliar
	"	1990	basal
		NOTE: need herbicide formulations from 1975 to 1992	
14	all	1973-74	cleared (1974 clearing date)
	2	1978	helicopter
	1	1978	basal
	all	1991	spring cut stump with Tordon RTU, summer foliar with Accord
		NOTE: need herbicide formulations from 1975 to 1992	
15	all	1939	cleared
	"	1940-54	hand cut most likely used
	"	1955	broadcast foliar with 2,4-D and 2,4,5-T, or Esteron
	"	1959	broadcast foliar with Esteron
	"	1960	selective foliar with Esteron, danger trees removed by hand/bulldozer
	"	1962	basal and selective foliar
	"	1967	selective foliar Tordon 101
	2	1978	helicopter
	all	1991	cut stump-spring, selective foliar with Accord-summer
		NOTE: missing Plots 1 and 3 information post 1975	
		NOTE: need herbicide formulations from 1975 to 1992	
16	all	1941-42	cleared
	"	1944	hand cut
	"	1950	" "
	"	1954	basal with 2,4-D and 2,4,5-T
	"	1959	access path cut
	"	1960	broadcast foliar with 2,4,5-T

Appendix Table 1 continued.

Site	Plot	Year	Activity
16	all	1962	selective foliar with 2,4,5-T
	1,2,3,6	1964	" "
	4,5	1965	selective foliar with Tordon 101
	all	1971	basal with Tordon 155
	"	1972	basal with Tordon 155
	"	1985	hand cut (in-field tree age measurement)
		NOTE: no history since 1972, records held by the National Lead Line	
17	all	1958	cleared
	1,2	1958	basal with 2,4,5-T
	"	1964	basal
	"	1969	stem-foliar with Tordon 101
	"	1983	hand cut
	1,2	1985	cut stump with Weedone CB/Garlon 4 mix
	3	1985	stem-foliar with Garlon 4
	3	1989	basal Access/Garlon 4 mix
	1,2	1991	cut stump with Compadre
	3,4	1991	selective foliar with Accord/Escort mix
		NOTE: initial clearing date may be prior to 1958	
18	all	1957	cleared, cut stump with 2,4,5-T
	"	1960	stem-foliar with 2,4,5-T
	"	1963	" "
	"	1966	stem-foliar with Tordon 101
	"	1970	" "
	1	1985	hand cut
	2,3	1985	foliar
	2	1988	basal with Garlon 4
	"	1992	spring hydro-ax
		NOTE: need herbicide formulations for 1985	
19	all	1942	cleared
	"	1943-50	periodically hand cut
	"	1951-52	basal with 2,4-D and 2,4,5-T
	"	1953-61	no maintenance record
	"	1962	aerial foliar with 2,4,5-T
	"	1965	broadcast ground foliar with Tordon 101
	"	1969	basal with Tordon 155
	"	1971	broadcast ground foliar with Tordon 101
	"	1984	selective foliar with Krenite
	1	1991	selective foliar with Krenite S
20	all	1957	cleared
	"	1960	broadcast foliar with Esteron
	"	1970	helicopter with Tordon 101
	"	1979	cut stump
	1	1987	cut stump
	2	1987	selective foliar
		NOTE: need herbicide formulations from 1975 to 1992	

Appendix Table 1 continued.

Site	Plot	Year	Activity
21	all	1971	cleared, cut stump with Tordon 155/2,4,5-T mix
	"	1975	cut stump with Tordon 155
	1,2	1985	selective foliar
	3	1985	hand cut
			NOTE: need to confirm hand cut in 1985, need herbicide formulation for 1985
22	all	1958-59	cleared, cut stump with 2,4-D and 2,4,5-T (1959 clearing date)
	"	1961	broadcast foliar with Ammate
	"	1971	selective foliar with Ammate
	"	1981	selective foliar
	"	1989	" "
			NOTE: need herbicide formulation for 1981 and 1989

[a] Herbicide trade name -- common name:

2,4-D -- 2,4-D
2,4,5-T -- 2,4,5-T
Access -- picloram and 2,4-D
Accord -- glyphosate
Ammate -- ammonium sulfamate
Banvel 520 -- dicamba and 2,4-D
Compadre -- glyphosate
Dacamine 2D/2T -- 2,4-D and 2,4,5-T
Escort -- metsulfuron methyl
Esteron 245 -- 2,4,5-T
Esteron -- 2,4-D
Garlon 3A, Garlon 4, and Garlon -- triclopyr
Krenite and Krenite S -- fosamine ammonium
Kuron -- 2,4,5-TP
Silvex -- 2,4,5-TP
Tordon 101 -- 2,4-D and picloram
Tordon 155 -- 2,4,5-T and picloram
Tordon 10K pellets -- picloram
Tordon RTU -- 2,4-D and picloram
Weedone CB -- 2,4-D and dichlorprop

NOTE: Management histories through 1975 were summarized from ESEERCO's 1977 final report "Environmental and Economic Aspects of Contemporaneous Electric Transmission Line Right-of-way Management Techniques, Vol. 2 and 3". Management histories since 1975 were summarized from information provided as personal communications by each utility:

C. Allen, Niagara Mohawk Power Corporation
H. Dale Freed, Niagara Mohawk Power Corporation
A. Higgins, Central Hudson Gas and Electric
D. Hider, New York State Electric and Gas Corporation
B. Slade, New York Power Authority
J. Curly, Consolidated Edison Co., of NY, Inc.
M. Gentile, Consolidated Edison Co., of NY, Inc.
J. Hollahan, Orange and Rockland Utilities, Inc.
J. Pasquini, Rochester Gas and Electric Corporation
P. Woodward, New York State Electric and Gas Corporation

Appendix Table 2. Common and scientific names of tree species found on the electric transmission line right-of-way plots in 1975, 1991, and 1992.[a]

Common name	Scientific name
balsam fir	Abies balsamea (L.) Mill.
boxelder	Acer negundo L.
red maple	Acer rubrum L.
silver maple	Acer saccharinum L.
sugar maple	Acer saccharum Marsh.
ailanthus	Ailanthus altissima (Mill.) Swingle
serviceberry[b]	Amelanchier arborea (Michx. f.) Fern.
yellow birch	Betula alleghaniensis Britton
sweet birch	Betula lenta L.
paper birch	Betula papyrifera Marsh.
gray birch[b]	Betula populifolia Marsh.
American hornbeam[b]	Carpinus caroliniana Walt.
bitternut hickory	Carya cordiformis (Wangenh.) K. Koch
pignut hickory	Carya glabra (Mill.) Sweet
shagbark hickory	Carya ovata (Mill.) K. Koch
American beech	Fagus grandifolia Ehrh.
white ash	Fraxinus americana L.
black ash	Fraxinus nigra Marsh.
green ash	Fraxinus pennsylvanica Marsh.
butternut	Juglans cinerea L.
black walnut	Juglans nigra L.
eastern redcedar	Juniperus virginiana L.
yellow-poplar	Liriodendron tulipifera L.
eastern hophornbeam[b]	Ostrya virginiana (Mill.) K. Koch
white spruce	Picea glauca (Moench) Voss
black spruce	Picea mariana (Mill.) B.S.P.
red spruce	Picea rubens Sarg.
red pine	Pinus resinosa Ait.
eastern white pine	Pinus strobus L.
Scotch pine	Pinus sylvestris L.
eastern cottonwood	Populus deltoides Bartr. ex Marsh.
large-toothed aspen	Populus grandidentata Michx.
quaking aspen	Populus tremuloides Michx.
pin cherry[b]	Prunus pensylvanica L. f.
black cherry	Prunus serotina Ehrh.
white oak	Quercus alba L.
swamp white oak	Quercus bicolor Willd.
scarlet oak	Quercus coccinea Muenchh.
chinkapin oak	Quercus muehlenbergii Engelm.
chestnut oak	Quercus prinus L.
northern red oak	Quercus rubra L.
black oak	Quercus velutina Lam.
black locust	Robinia pseudoacacia L.
sassafras	Sassafras albidum (Nutt.) Nees
northern white-cedar	Thuja occidentalis L.
American basswood	Tilia americana L.

Appendix Table 2 continued.

Common name	Scientific name
eastern hemlock	_Tsuga canadensis_ (L.) Carr.
American elm	_Ulmus americana_ L.
slippery elm	_Ulmus rubra_ Muhl.

[a] Based on plot maps and accompanying list of trees provided with each site map in ESEERCO's 1975 study final report (ESEERCO 1977a), Niagara Mohawk Power Corporation's "List of trees to be trimmed, removed, or sprayed" (NMPC 1989), and the 1991 and 1992 field surveys. Nomenclature follows Little (1979).

[b] These species are conditionally listed as desirable species by the Niagara Mohawk Power Corporation in their "List of small trees and shrubs to be preserved" (NMPC 1989).

Appendix Table 3. Number and height of each tree, by species, tallied from the 1975 study plot maps (ESEERCO, 1977a) by site, plot and subplot.[a]

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	1	10	1	BLL	1.2	5	3	20	1	AME	1.5	10	2	100	1	REM	2.7	17	1	130	2	REM	2.4
1	1	10	1	WHA	1.0	5	3	20	2	BLC	1.0	10	2	110	2	AMH	2.1	17	1	130	1	YEB	1.2
1	1	10	1	BLC	1.2	5	3	20	1	CHO	1.0	10	2	110	1	AMH	1.8	17	1	130	1	REM	1.5
1	1	10	1	WHA	2.4	5	3	20	1	YEB	1.5	10	2	110	1	REM	1.2	17	1	130	1	REM	1.0
1	1	10	1	BLL	1.0	5	3	20	1	SAS	1.5	10	2	120	0	NO	0.0	17	1	140	1	GRB	1.0
1	1	20	1	BLL	2.4	5	3	20	2	GRB	1.2	10	2	130	1	AMH	1.2	17	1	140	1	REM	1.8
1	1	20	1	BLL	1.8	5	3	20	1	WHA	2.1	10	2	140	1	REM	1.8	17	1	140	1	REM	1.5
1	1	20	2	BLL	2.1	5	3	20	1	YEB	1.8	10	2	150	2	AMH	1.0	17	1	150	1	REM	1.8
1	1	20	1	WHA	1.0	5	3	20	1	LAA	1.8	10	2	160	0	NO	0.0	17	1	150	1	GRB	1.0
1	1	20	1	BLL	1.0	5	3	30	1	SWB	1.5	11	1	10	1	WHA	5.2	17	1	150	1	REM	2.1
1	1	20	1	BLL	1.2	5	3	30	1	REO	1.8	11	1	10	1	WHA	3.0	17	1	150	1	REM	1.5
1	1	20	1	YEP	3.7	5	3	30	1	GRB	1.5	11	1	10	3	BLL	1.2	17	1	150	1	GRB	1.2
1	1	20	1	SAS	1.8	5	3	30	3	WHA	1.5	11	1	10	1	BLL	1.5	17	1	150	1	REM	1.2
1	1	30	1	BLL	1.8	5	3	30	1	REM	1.0	11	1	20	2	WHA	1.8	17	1	160	2	REM	1.8
1	1	30	1	BLL	1.2	5	3	30	1	BIH	1.8	11	1	20	1	WHA	2.4	17	1	160	1	REM	1.0
1	1	30	1	WHA	1.0	5	3	30	1	REO	1.2	11	1	20	1	WHA	1.2	17	1	160	1	QUA	1.5
1	1	30	2	BLL	1.0	5	3	30	3	REO	1.5	11	1	20	1	AME	1.5	17	1	165	2	QUA	2.1
1	1	30	1	BLC	1.8	5	3	30	1	YEB	1.5	11	1	20	1	WHA	3.0	17	1	165	1	QUA	1.5
1	1	30	3	BLL	2.1	5	3	40	1	AMH	1.5	11	1	30	1	WHA	2.7	17	1	165	1	BAS	1.2
1	1	40	2	BLL	1.8	5	3	40	1	BLC	1.0	11	1	30	1	BLC	3.7	17	1	165	1	REM	1.5
1	1	40	1	WHA	1.2	5	3	40	1	REO	1.2	11	1	30	1	WHA	1.8	17	1	165	1	REM	1.2
1	1	40	1	REO	1.0	5	3	40	1	BIH	1.0	11	1	30	1	BLC	2.1	17	1	165	1	REM	2.1
1	1	40	4	WHA	1.5	5	3	40	1	WHA	1.5	11	1	30	1	WHA	2.1	17	2	10	2	QUA	1.0
1	1	40	2	BLL	1.2	5	3	40	1	REO	1.5	11	1	30	1	WHA	5.8	17	2	10	1	QUA	1.2
1	1	40	3	SWB	1.2	5	3	50	1	BIH	1.0	11	1	30	1	BLL	1.0	17	2	10	1	QUA	1.8
1	1	40	1	GRB	1.0	5	3	50	1	BIH	1.5	11	1	40	2	BLL	1.5	17	2	10	1	REM	1.5
1	1	40	1	BLL	2.1	5	3	50	1	CHO	1.5	11	1	40	1	REO	1.5	17	2	10	1	WHA	1.8
1	1	40	10	BLL	1.0	5	3	50	1	LAA	1.2	11	1	40	2	AME	1.8	17	2	10	1	WHA	1.2
1	1	40	1	WHA	1.0	5	3	60	2	REO	1.0	11	1	40	2	BLL	3.7	17	2	20	1	WHA	1.5
1	1	40	3	BLL	1.5	5	3	60	1	REO	1.5	11	1	40	1	AME	2.7	17	2	20	1	QUA	1.0
1	1	50	1	BLO	1.0	5	3	60	1	BLC	1.8	11	1	40	1	WHA	2.7	17	2	20	1	QUA	2.1
1	1	50	1	BLL	2.1	5	3	70	1	SAS	1.5	11	1	40	1	BLC	3.4	17	2	20	1	GRB	1.0
1	1	50	3	BLL	1.2	5	3	70	5	REO	1.0	11	1	40	1	WHA	3.0	17	2	20	1	WHA	1.0
1	1	50	1	GRB	1.5	5	3	70	1	BLC	1.2	11	1	40	1	AME	1.5	17	2	20	1	REM	1.8
1	1	50	1	WHA	1.5	5	3	70	2	LAA	1.2	11	1	40	3	BLL	1.0	17	2	30	1	GRB	1.0
1	1	50	6	BLL	1.5	5	3	70	1	CHO	1.0	11	1	40	1	AME	2.1	17	2	40	1	GRB	1.2
1	1	50	1	WHA	1.0	5	3	70	1	SAS	1.0	11	1	40	1	BLC	5.2	17	2	50	1	PIC	1.8
1	1	50	1	BLL	1.0	5	3	70	1	CHO	1.2	11	1	40	1	BLL	1.8	17	2	50	1	WHA	2.1
1	1	60	1	WHA	1.8	5	3	70	2	REO	1.2	11	1	40	2	AME	1.0	17	2	60	1	REM	1.8
1	1	60	1	BLL	1.5	5	3	75	1	SAS	1.5	11	1	40	2	WHA	1.5	17	2	60	1	REM	2.1
1	1	60	1	BLL	1.5	5	3	75	2	REO	1.2	11	1	40	1	BLC	2.7	17	2	60	1	REM	1.8
1	1	70	0	NO	0.0	5	3	75	2	REO	1.0	11	1	50	4	WHA	1.8	17	2	60	1	PIC	1.0
1	1	80	1	GRB	1.0	5	4	10	1	REM	1.8	11	1	50	1	WHA	2.4	17	2	60	1	WHA	1.0
1	1	80	1	SWB	1.5	5	4	10	1	AME	1.5	11	1	50	1	BLL	2.1	17	2	70	1	REM	1.0
1	1	90	0	NO	0.0	5	4	10	1	AME	1.8	11	1	50	1	BLL	3.4	17	2	70	1	REM	1.8
1	1	100	1	BLL	1.5	5	4	20	0	NO	0.0	11	1	50	1	WHA	2.1	17	2	70	1	WHA	2.1
1	1	100	1	QUA	1.2	5	4	30	1	SAS	2.1	11	1	50	1	BLL	1.0	17	2	70	1	GRB	1.8
1	1	100	1	BLL	1.8	5	4	40	2	REM	1.8	11	1	50	1	AME	2.4	17	2	80	1	REM	1.8
1	1	100	1	BLL	2.1	5	4	50	1	WHA	1.5	11	1	50	1	BLC	3.0	17	2	80	1	GRB	1.2
1	1	100	2	BLL	1.2	5	4	50	1	REM	1.8	11	1	50	2	BLL	1.8	17	2	80	1	WHA	1.8
1	1	100	1	BLL	1.0	5	4	60	0	NO	0.0	11	1	50	1	BLL	2.7	17	2	80	1	WHA	6.1
1	1	110	3	BLL	1.5	5	4	70	1	REM	1.5	11	1	60	1	BLL	5.5	17	2	90	1	GRB	1.0

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	1	110	1	BLL	1.0	5	4	70	1	REM	1.8	11	1	60	2	AME	1.2	17	2	90	1	YEB	1.2
1	1	110	1	BLL	2.7	5	4	80	1	REM	1.8	11	1	60	1	BLL	4.3	17	2	100	1	REM	1.8
1	1	120	1	BLC	2.4	5	4	80	1	REM	2.1	11	1	60	1	BLC	2.1	17	2	100	1	QUA	1.2
1	1	120	3	BLL	1.5	5	4	80	1	REM	1.5	11	1	60	1	AME	1.8	17	2	100	1	GRB	1.0
1	1	120	1	BLL	1.2	5	4	80	1	AME	2.1	11	1	60	1	BLL	3.4	17	2	110	1	GRB	1.0
1	1	130	2	BLL	1.5	5	4	80	1	REM	3.0	11	1	60	2	BLL	7.3	17	2	110	1	YEB	1.2
1	1	130	1	GRB	1.8	5	5	10	1	REM	1.5	11	1	60	1	WHA	2.1	17	2	110	1	GRB	1.8
1	1	130	1	BLC	1.5	5	5	10	1	WHO	1.5	11	1	60	1	BLL	5.2	17	2	110	1	WHA	1.5
1	1	130	1	GRB	1.5	5	5	20	3	BIH	1.8	11	1	60	4	BLL	5.2	17	2	110	1	GRB	1.2
1	1	130	1	WHA	1.2	5	5	20	1	GRB	1.0	11	1	60	1	PIC	1.5	17	2	120	1	QUA	6.4
1	1	130	1	BLC	2.4	5	5	20	2	REO	1.8	11	1	60	1	BLL	1.5	17	2	120	1	QUA	1.0
1	1	130	1	SWB	2.4	5	5	20	1	WHA	1.5	11	1	60	1	BLL	3.7	17	2	120	1	SWB	1.2
1	1	140	1	LAA	1.5	5	5	20	1	YEB	1.8	11	1	60	1	BLL	7.9	17	2	120	1	GRB	1.5
1	1	140	1	GRB	1.8	5	5	30	2	LAA	1.2	11	1	60	2	AME	1.5	17	2	120	1	REM	2.7
1	1	140	1	BLC	2.4	5	5	30	1	SAS	1.5	11	1	60	1	BLC	2.7	17	2	120	1	GRB	1.0
1	1	140	2	BLC	1.2	5	5	30	2	SAS	1.0	11	1	60	2	BLL	6.1	17	2	130	2	GRB	1.0
1	1	140	1	BLL	1.0	5	5	30	1	SAS	2.1	11	1	70	2	WHA	1.5	17	2	130	1	BAS	2.1
1	1	140	1	LAA	2.1	5	5	30	1	YEB	1.8	11	1	70	1	BLL	4.3	17	2	130	2	GRB	1.5
1	1	140	1	REO	1.8	5	5	30	1	SAS	1.8	11	1	70	1	WHA	3.4	17	2	130	1	GRB	1.2
1	1	140	2	BLL	1.2	5	5	30	1	REO	1.0	11	1	70	1	BLL	5.2	17	2	130	1	GRB	1.8
1	1	140	2	WHA	1.2	5	5	30	1	YEB	1.5	11	1	70	4	BLL	5.2	17	2	140	1	GRB	1.2
1	1	140	2	WHA	1.0	5	5	40	1	YEB	1.8	11	1	70	1	WHA	1.0	17	2	140	1	REM	2.1
1	1	140	1	GRB	1.2	5	5	40	6	YEB	1.5	11	1	70	5	WHA	2.1	17	2	140	1	REM	3.7
1	1	140	1	GRB	1.5	5	5	40	3	LAA	1.5	11	1	70	1	WHA	3.0	17	2	140	1	GRB	1.0
1	1	150	1	BLC	2.1	5	5	40	1	WHO	1.5	11	1	70	1	BLL	1.8	17	2	140	1	WHA	2.1
1	1	150	1	LAA	1.5	5	5	40	1	GRB	1.2	11	1	70	1	REM	1.8	17	2	140	1	QUA	1.5
1	1	150	1	LAA	1.2	5	5	40	2	BIH	1.8	11	1	70	2	BLC	3.4	17	2	140	1	QUA	1.8
1	1	150	1	LAA	1.0	5	5	40	1	GRB	1.5	11	1	70	1	REO	1.8	17	2	150	1	GRB	1.0
1	1	150	1	BLL	2.1	5	5	40	1	LAA	1.2	11	1	70	1	WHA	2.7	17	2	150	1	QUA	2.1
1	1	150	3	BLL	1.8	5	5	40	1	SAS	1.5	11	1	70	2	BLL	3.4	17	2	150	1	REM	1.8
1	1	150	1	BLC	1.5	5	5	40	1	REM	1.8	11	1	70	2	BLC	1.8	17	2	150	1	REM	2.7
1	1	150	1	BLL	1.2	5	5	40	1	BIH	1.5	11	1	70	1	REO	2.4	17	2	150	1	REM	2.4
1	1	155	1	WHA	1.2	5	5	50	1	YEB	1.0	11	1	70	1	BLL	2.1	17	2	150	1	REM	3.0
1	1	155	1	GRB	1.5	5	5	50	3	SAS	1.5	11	1	70	1	WHA	1.2	17	2	150	2	QUA	1.0
1	1	155	1	SUM	1.5	5	5	50	5	SAS	2.1	11	1	70	1	BLC	2.7	17	2	160	2	QUA	1.8
1	1	155	1	GRB	1.8	5	5	50	1	GRB	1.2	11	1	70	3	BLC	1.5	17	2	160	2	QUA	4.6
1	1	155	2	BLL	1.5	5	5	50	2	YEB	1.5	11	1	70	2	BLL	3.7	17	2	160	1	QUA	7.0
1	3	10	1	SAS	1.8	5	5	50	1	SAS	1.2	11	1	70	1	BLC	1.2	17	2	160	2	QUA	1.2
1	3	10	2	WHA	1.5	5	5	50	1	QUA	1.5	11	1	70	4	WHA	1.8	17	2	160	1	QUA	2.1
1	3	10	1	LAA	1.2	5	5	50	2	LAA	1.0	11	1	70	2	BLC	2.1	17	2	160	1	REM	1.8
1	3	10	1	LAA	1.5	5	5	50	5	SAS	1.8	11	1	80	1	BLL	8.2	17	2	160	1	QUA	1.5
1	3	10	3	REO	1.8	5	5	50	1	YEB	1.8	11	1	80	4	BLC	2.1	17	2	160	1	QUA	6.7
1	3	10	1	LAA	3.0	5	5	50	1	QUA	1.2	11	1	80	1	AME	3.0	17	2	160	1	QUA	5.5
1	3	10	2	SAS	3.4	5	5	50	1	GRB	1.5	11	1	80	1	WHA	4.6	17	2	160	1	QUA	6.1
1	3	10	3	WHA	2.1	5	5	50	1	GRB	1.0	11	1	80	2	BLC	2.4	17	2	160	1	QUA	2.4
1	3	10	1	WHA	1.0	5	5	60	1	BLC	1.0	11	1	80	2	BLC	1.5	17	2	165	2	QUA	5.2
1	3	10	1	SAS	3.0	5	5	60	3	SAS	1.0	11	1	80	1	WHA	3.4	17	2	165	1	WHA	1.2
1	3	10	2	SAS	3.7	5	5	60	1	GRB	1.0	11	1	80	1	BLL	5.5	17	2	165	1	GRB	1.0
1	3	20	1	GRB	2.1	5	5	60	1	SAS	1.8	11	1	80	1	WHA	2.4	17	2	165	1	QUA	1.2
1	3	20	1	SWB	1.2	5	5	60	1	CHO	1.5	11	1	80	5	WHA	2.1	17	2	165	2	QUA	1.8
1	3	20	1	QUA	1.2	5	5	60	1	YEB	1.2	11	1	80	1	AME	2.4	17	2	165	1	WHA	2.4
1	3	20	1	GRB	1.2	5	5	60	5	SAS	1.2	11	1	80	1	BLC	1.8	17	2	165	1	REM	1.8
1	3	20	1	LAA	1.0	5	5	70	1	WHA	1.5	11	1	80	1	BLC	3.4	17	2	165	1	REM	2.4
1	3	20	2	SWB	1.5	5	5	70	4	SAS	1.2	11	1	80	1	BLC	2.7	17	2	165	1	QUA	1.5

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	3	20	1	LAA	1.2	5	5	70	2	BIH	1.5	11	1	80	1	BLL	3.7	17	2	165	1	REM	4.0
1	3	20	1	QUA	1.5	5	5	70	1	LAA	1.5	11	1	80	4	WHA	1.5	17	2	165	1	QUA	5.8
1	3	20	1	QUA	1.0	5	5	70	2	REO	1.5	11	1	80	2	BLL	5.2	17	3	10	1	QUA	1.0
1	3	20	2	REO	2.1	5	5	70	1	YEB	1.0	11	1	80	1	WHA	5.2	17	3	10	1	QUA	1.2
1	3	20	1	GRB	1.0	5	5	70	1	CHO	1.2	11	1	80	1	REM	2.1	17	3	10	1	REM	1.8
1	3	20	1	SAS	1.5	5	5	70	1	WHA	1.0	11	1	80	1	BLC	6.1	17	3	10	2	REM	1.5
1	3	20	1	LAA	1.5	6	1	10	0	NO	0.0	11	1	80	2	BLL	5.2	17	3	10	1	REM	1.5
1	3	20	1	SAS	1.8	6	1	20	0	NO	0.0	11	1	80	3	WHA	1.8	17	3	10	1	WHA	1.0
1	3	20	1	YEP	3.7	6	1	30	1	WHP	1.8	11	1	80	1	BLL	2.1	17	3	10	2	REM	1.0
1	3	30	1	QUA	1.2	6	1	40	0	NO	0.0	11	1	90	2	BLC	1.5	17	3	10	2	QUA	1.8
1	3	30	1	LAA	1.0	6	1	50	0	NO	0.0	11	1	90	1	WHA	4.0	17	3	10	2	REM	1.2
1	3	30	1	GRB	1.0	6	1	60	1	WHP	1.2	11	1	90	1	WHA	1.0	17	3	20	1	REM	1.2
1	3	30	1	LAA	1.2	6	1	70	0	NO	0.0	11	1	90	2	BLC	2.1	17	3	20	1	REM	1.8
1	3	30	1	LAA	1.5	6	1	80	0	NO	0.0	11	1	90	1	BLL	3.7	17	3	20	1	REM	2.1
1	3	40	1	LAA	1.5	6	1	90	0	NO	0.0	11	1	90	3	WHA	1.8	17	3	20	3	REM	1.5
1	3	40	1	QUA	1.5	6	1	100	0	NO	0.0	11	1	90	2	BLL	1.8	17	3	20	1	REM	1.8
1	3	50	3	LAA	1.5	6	1	110	0	NO	0.0	11	1	90	1	WHA	5.2	17	3	20	1	REM	2.1
1	3	50	1	LAA	1.8	6	1	120	0	NO	0.0	11	1	90	2	BLL	2.1	17	3	30	2	REM	1.0
1	3	50	4	LAA	1.0	6	1	130	0	NO	0.0	11	1	90	2	BLC	1.8	17	3	30	1	WHA	2.1
1	3	50	1	GRB	1.5	6	1	140	0	NO	0.0	11	1	90	2	BLL	5.2	17	3	30	1	REM	1.8
1	3	50	5	LAA	1.2	6	1	150	2	WHA	1.5	11	1	90	2	WHA	1.5	17	3	30	2	REM	1.2
1	3	50	1	LAA	2.1	6	1	160	0	NO	0.0	11	1	90	2	BLC	1.8	17	3	30	1	GRB	1.5
1	3	50	1	SWB	1.2	6	1	170	1	AME	1.8	11	1	90	3	WHA	2.4	17	3	30	1	REM	1.5
1	3	60	2	LAA	1.5	6	1	180	0	NO	0.0	11	1	90	6	WHA	2.1	17	3	40	1	REM	1.8
1	3	60	1	LAA	1.8	6	2	10	1	AMH	1.2	11	1	90	2	WHA	3.7	17	3	40	1	PIC	1.8
1	3	60	1	QUA	1.2	6	2	10	1	GRB	1.0	11	2	10	1	NWC	5.2	17	3	50	0	NO	0.0
1	3	60	1	GRB	1.0	6	2	10	2	QUA	1.0	11	2	10	1	NWC	1.8	17	3	60	0	NO	0.0
1	3	60	1	LAA	1.2	6	2	10	1	QUA	1.2	11	2	10	1	NWC	1.0	17	3	70	1	QUA	2.1
1	3	60	1	QUA	1.8	6	2	20	1	QUA	1.5	11	2	10	1	NWC	1.5	17	3	70	3	QUA	1.5
1	3	60	1	QUA	1.0	6	2	20	1	AME	1.0	11	2	10	1	NWC	2.4	17	3	70	2	QUA	1.8
1	3	70	1	WHO	1.2	6	2	20	1	QUA	1.2	11	2	10	1	NWC	2.1	17	3	80	1	QUA	3.0
1	3	70	2	WHA	1.5	6	2	20	2	QUA	1.0	11	2	10	5	NWC	1.2	17	3	80	2	QUA	2.1
1	3	70	1	LAA	1.8	6	2	30	1	WHP	1.8	11	2	20	1	WHA	1.2	17	3	80	3	QUA	1.5
1	3	70	1	LAA	1.2	6	2	30	1	WHP	2.4	11	2	20	2	NWC	1.0	17	3	80	2	QUA	1.8
1	3	70	1	LAA	1.5	6	2	30	3	QUA	1.5	11	2	20	1	NWC	1.5	17	3	80	1	QUA	1.0
1	3	70	1	SAS	1.0	6	2	30	1	REO	6.1	11	2	30	1	NWC	1.5	17	3	80	1	PIC	2.4
1	3	80	1	LAA	1.0	6	2	30	1	QUA	1.8	11	2	30	1	WHA	2.7	17	3	80	3	QUA	1.2
1	3	80	2	LAA	1.8	6	2	30	2	WHP	1.2	11	2	40	1	WHA	1.2	17	3	90	1	REM	1.5
1	3	80	1	BLC	1.8	6	2	30	1	QUA	1.5	11	2	50	1	WHA	1.2	17	3	90	1	PIC	3.0
1	3	80	1	WHA	1.8	6	2	40	0	NO	0.0	11	2	50	1	NWC	3.4	17	3	90	1	REM	1.2
1	3	80	2	SAS	1.0	6	2	50	1	QUA	1.0	11	2	50	1	NWC	1.5	17	3	90	1	PIC	1.8
1	3	80	1	REO	1.0	6	2	50	2	WHP	1.5	11	2	60	4	BLL	1.5	17	3	90	1	PIC	2.1
1	3	80	1	SAS	1.5	6	2	50	1	WHP	1.0	11	2	60	1	WHA	1.8	17	3	90	1	REM	1.5
1	3	80	1	SAS	1.2	6	2	60	0	NO	0.0	11	2	60	1	BLL	1.8	17	3	90	1	REM	1.8
1	3	80	1	REO	1.8	6	2	70	0	NO	0.0	11	2	70	4	BLL	1.8	17	3	90	1	QUA	2.7
1	3	90	1	LAA	1.5	6	2	80	0	NO	0.0	11	2	70	1	NWC	1.8	17	3	90	1	PIC	1.5
1	3	90	1	GRB	1.8	6	2	90	0	NO	0.0	11	2	70	1	BLL	2.1	17	3	90	1	QUA	2.4
1	3	90	1	YEP	1.5	6	2	100	0	NO	0.0	11	2	70	1	REM	2.1	17	3	90	1	QUA	1.8
1	3	90	1	YEP	2.1	6	2	110	0	NO	0.0	11	2	70	1	WHA	4.6	17	3	90	1	QUA	1.0
1	3	90	1	REO	1.5	6	2	120	1	REO	1.5	11	2	70	1	NWC	2.4	17	3	90	1	WHA	2.7
1	3	90	1	LAA	1.2	6	2	130	1	QUA	1.5	11	2	70	1	WHA	2.1	17	3	100	1	QUA	1.8
1	3	90	1	SAS	1.0	6	2	130	1	PIC	1.0	11	2	80	1	WHO	1.8	17	3	100	2	PIC	1.0
1	3	90	1	BIH	1.8	6	2	140	1	WHA	1.8	11	2	80	1	WHA	2.1	17	3	100	1	BLC	1.2
1	3	90	1	WHA	1.8	6	2	150	0	NO	0.0	11	2	80	1	AME	2.4	17	3	100	1	SHB	1.2

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	3	90	1	REO	1.0	6	2	160	0	NO	0.0	11	2	80	1	BLL	1.5	17	3	100	3	REM	1.5
1	3	90	1	BLC	1.5	6	2	170	0	NO	0.0	11	2	80	3	BLL	1.5	17	3	100	1	REM	1.0
1	3	100	2	GRB	1.5	6	2	180	1	WHP	1.0	11	2	80	1	BLL	2.1	17	3	100	1	REM	1.8
1	3	100	1	LAA	2.1	6	2	190	0	NO	0.0	11	2	80	1	WHA	2.4	17	3	100	2	REM	1.2
1	3	100	1	REO	1.5	6	2	200	1	WHA	1.0	11	2	80	2	BLL	1.8	17	3	100	1	REM	3.4
1	3	100	1	REO	1.2	6	2	210	0	NO	0.0	11	2	80	1	AME	2.1	17	4	10	1	AMB	1.8
1	3	100	1	LAA	1.0	6	2	220	1	WHP	1.2	11	2	80	1	AME	3.7	17	4	10	1	AMB	1.5
1	3	100	1	SWB	1.2	6	2	230	0	NO	0.0	11	2	80	1	SHH	2.1	17	4	10	1	REM	1.2
1	3	100	1	BIH	1.0	6	2	240	1	WHA	1.8	11	2	90	1	WHO	3.4	17	4	10	1	WHA	2.4
1	3	100	2	QUA	1.8	6	2	240	1	WHA	1.2	11	2	90	1	REM	3.7	17	4	10	2	WHA	1.2
1	3	110	5	QUA	1.2	6	2	250	1	WHA	1.2	11	2	90	2	BLC	1.0	17	4	20	1	WHA	2.4
1	3	110	1	SWB	1.0	6	2	260	1	WHA	1.2	11	2	90	1	BLL	1.8	17	4	20	1	REM	1.0
1	3	110	2	QUA	1.0	6	2	270	0	NO	0.0	11	2	90	1	WHO	2.1	17	4	30	1	WHA	2.1
1	3	110	2	QUA	1.5	6	3	10	1	WHA	1.2	11	2	90	2	BLL	1.5	17	4	30	1	BLC	1.2
1	3	110	1	REO	1.8	6	3	20	1	WHP	1.2	11	3	10	2	REM	1.5	17	4	40	2	BLC	1.2
1	3	110	1	REO	1.2	6	3	30	2	WHP	1.2	11	3	10	1	REM	2.4	17	4	40	1	PIC	1.5
1	3	110	1	GRB	1.0	6	3	30	1	WHA	1.0	11	3	10	1	AMH	2.1	17	4	40	1	REM	1.5
1	3	120	1	REO	1.2	6	3	30	2	WHP	1.0	11	3	10	1	AME	1.8	17	4	50	1	PIC	1.0
1	3	120	5	QUA	1.2	6	3	40	1	WHA	1.5	11	3	10	2	AMH	1.2	17	4	60	1	PIC	1.2
1	3	120	1	QUA	1.0	6	3	40	1	PIC	1.0	11	3	10	1	NWC	1.5	17	4	70	0	NO	0.0
1	3	120	1	SWB	1.2	6	3	40	1	WHA	1.8	11	3	10	1	WHA	2.1	17	4	80	0	NO	0.0
1	3	120	1	SWB	1.0	6	3	50	1	QUA	2.4	11	3	10	1	REM	2.1	17	4	90	1	REM	1.5
1	3	120	1	SWB	1.8	6	3	50	1	QUA	2.1	11	3	10	5	REM	1.8	17	4	90	1	BLC	1.2
1	3	130	2	REO	1.0	6	3	50	1	QUA	1.5	11	3	10	1	AMH	1.8	17	4	90	1	GRB	1.2
1	3	130	3	SWB	1.2	6	3	50	1	QUA	1.8	11	3	20	1	AME	1.5	17	4	90	1	QUA	1.5
1	3	130	4	REO	1.8	6	3	50	1	REO	1.2	11	3	20	1	WHA	1.2	17	4	90	1	BLC	1.0
1	3	130	1	SWB	1.5	6	3	50	1	QUA	1.0	11	3	20	1	AMH	2.4	18	3	10	0	NO	0.0
1	3	130	3	SWB	1.0	6	3	60	1	WHP	1.2	11	3	20	1	BLC	2.4	18	3	20	0	NO	0.0
1	3	130	2	GRB	1.0	6	3	60	1	ERC	2.1	11	3	20	2	REM	1.8	18	3	30	0	NO	0.0
1	3	130	2	GRB	1.2	6	3	70	2	PIC	1.0	11	3	20	1	WHA	1.8	18	3	40	0	NO	0.0
1	3	130	5	REO	1.5	6	3	80	0	NO	0.0	11	3	20	1	AME	1.8	18	3	50	1	GRB	1.2
1	3	130	1	WHO	1.5	6	3	90	0	NO	0.0	11	3	20	1	AMH	1.2	18	3	60	0	NO	0.0
1	3	130	1	QUA	1.0	6	3	100	0	NO	0.0	11	3	20	1	AMH	1.0	18	3	70	0	NO	0.0
1	3	130	3	REO	1.2	6	3	110	1	WHA	2.4	11	3	20	1	AMH	3.4	18	3	80	1	REM	1.5
1	3	130	1	QUA	1.2	6	3	120	2	WHA	2.1	11	3	20	3	AMH	2.1	18	3	90	1	REM	1.8
1	3	140	1	BIH	1.0	6	3	120	1	WHA	2.4	11	3	20	1	REM	2.1	18	3	90	1	REM	1.5
1	3	140	4	REO	1.2	6	3	120	1	WHA	1.5	11	3	20	1	REM	1.2	18	3	90	2	PAB	1.0
1	3	140	2	REO	1.0	6	3	130	2	WHA	1.5	11	3	20	1	REO	3.4	18	3	90	5	PIC	1.0
1	3	140	1	BLC	1.0	6	3	140	1	PIH	1.5	11	3	20	1	AMH	1.8	18	3	100	2	REM	1.2
1	3	140	1	REO	1.5	6	3	150	1	WHA	1.8	11	3	20	1	WHA	1.5	18	3	100	1	REM	1.0
1	3	140	3	GRB	1.0	6	3	160	1	REO	1.5	11	3	20	3	AMH	1.5	18	3	100	2	PIC	1.0
1	3	140	3	SWB	1.0	6	3	160	1	WHA	1.5	11	3	20	2	WHA	5.2	18	3	100	3	REM	1.5
1	3	140	1	GRB	1.2	6	3	160	1	REO	1.5	11	3	30	4	AMH	2.1	18	3	100	1	REM	2.1
1	3	140	1	LAA	1.2	6	3	170	0	NO	0.0	11	3	30	1	AME	1.5	18	3	110	1	REO	3.4
1	3	140	1	SHH	1.2	6	3	180	1	WHA	2.1	11	3	30	6	AMH	1.8	18	3	110	1	REM	1.0
1	3	140	1	WHO	1.2	6	3	180	1	REO	1.5	11	3	30	1	BAS	1.5	18	3	110	1	EAH	1.5
1	3	140	1	SUM	1.0	6	3	180	1	WHA	1.8	11	3	30	1	WHA	1.8	18	3	110	5	REM	1.2
1	3	150	1	SUM	1.0	6	3	190	1	QUA	1.0	11	3	30	1	AMH	1.0	18	3	110	2	REM	1.8
1	3	150	4	REO	1.0	6	3	190	1	WHA	2.1	11	3	30	1	BAS	2.1	18	3	110	1	REO	2.1
1	3	150	1	REO	1.5	6	3	200	1	QUA	1.8	11	3	30	2	REM	2.1	18	3	110	1	REM	1.5
1	3	150	1	REO	1.8	6	3	200	1	QUA	2.4	11	3	30	2	REM	1.8	18	3	110	1	REM	2.1
1	3	150	1	AMB	1.2	6	3	200	2	QUA	1.2	11	3	30	1	WHA	1.0	19	1	10	1	BLC	5.2
1	3	150	3	SWB	1.0	6	3	200	1	QUA	1.0	11	3	30	2	REM	2.4	19	1	10	1	BLC	5.8
1	3	150	1	LAA	1.0	6	3	210	0	NO	0.0	11	3	30	3	AMH	1.5	19	1	10	2	BLC	1.5

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	3	150	4	REO	1.2	6	3	220	1	REM	1.5	11	3	40	1	AME	2.1	19	1	10	1	BLC	6.4
1	3	150	1	BLC	1.0	6	3	220	1	PIC	1.2	11	3	40	1	AME	1.0	19	1	20	0	NO	0.0
1	3	150	1	YEP	1.5	6	3	220	1	AME	1.8	11	3	40	4	AMH	1.8	19	1	30	0	NO	0.0
1	3	150	1	GRB	1.0	6	3	230	1	WHA	2.4	11	3	40	2	AMH	1.0	19	1	40	0	NO	0.0
1	3	160	1	BLC	1.8	6	3	230	2	PIC	1.5	11	3	40	1	REO	1.2	19	1	50	1	BLC	1.5
1	3	160	2	REO	1.0	6	3	240	0	NO	0.0	11	3	40	3	REM	1.8	19	1	60	0	NO	0.0
1	3	160	1	SUM	1.5	6	3	250	0	NO	0.0	11	3	40	3	REM	2.1	19	1	70	1	BLC	1.2
1	3	160	1	WHA	1.5	6	3	260	1	WHP	1.5	11	3	40	1	AMH	1.2	19	1	70	1	PIC	1.8
1	3	160	1	GRB	1.0	6	3	260	1	WHP	1.0	11	3	40	2	WHA	1.8	19	1	80	1	BLC	2.1
1	3	160	3	REO	1.5	6	3	270	1	PIC	1.2	11	3	40	2	WHA	5.2	19	1	90	0	NO	0.0
1	3	160	1	LAA	1.5	6	3	270	1	REM	6.1	11	3	40	5	AMH	1.5	19	1	100	0	NO	0.0
1	3	160	1	BIH	1.5	6	3	270	1	REM	4.0	11	3	40	1	AMH	2.1	19	1	110	0	NO	0.0
1	3	160	1	BLC	1.5	6	3	270	2	REM	6.4	11	3	50	3	AMH	2.1	19	1	120	0	NO	0.0
1	4	10	1	BLC	1.5	6	3	270	1	REM	3.4	11	3	50	1	REM	1.5	19	1	130	0	NO	0.0
1	4	10	1	BLC	1.0	6	4	10	1	REO	1.5	11	3	50	1	WHA	1.0	19	1	140	0	NO	0.0
1	4	10	1	REO	1.5	6	4	10	1	WHA	1.0	11	3	50	1	AME	1.8	19	1	150	0	NO	0.0
1	4	10	1	REO	1.2	6	4	20	1	REO	1.8	11	3	50	4	AMH	1.8	19	1	160	0	NO	0.0
1	4	10	1	LAA	1.5	6	4	20	1	REO	1.2	11	3	50	1	AMH	1.5	19	1	170	0	NO	0.0
1	4	10	1	REO	1.0	6	4	30	1	WHA	1.2	11	3	50	2	REM	2.4	19	1	180	1	BLC	1.5
1	4	10	2	SWB	1.0	6	4	40	1	REO	1.5	11	3	50	1	NWC	1.5	19	1	190	0	NO	0.0
1	4	10	1	SWB	1.8	6	4	50	0	NO	0.0	11	3	50	2	REM	1.8	19	1	200	0	NO	0.0
1	4	10	1	REO	1.8	6	4	60	1	REO	1.2	11	3	60	1	REM	1.8	19	1	210	1	BLC	1.2
1	4	20	0	NO	0.0	6	4	60	1	REO	1.5	11	3	60	1	WHA	1.5	19	1	220	1	SCP	2.1
1	4	30	1	WHA	1.5	6	4	70	0	NO	0.0	11	3	60	2	AMH	2.1	19	1	220	1	BLC	1.2
1	4	30	1	REO	1.0	6	4	80	0	NO	0.0	11	3	60	2	REM	1.5	19	1	220	1	BLC	5.8
1	4	30	1	QUA	3.7	6	4	90	0	NO	0.0	11	3	60	1	REM	2.1	19	1	230	5	BLC	1.8
1	4	30	1	GRB	1.5	6	4	100	0	NO	0.0	11	3	60	1	WHA	3.7	19	1	230	1	BLC	5.2
1	4	30	2	REO	1.2	6	4	110	1	REO	1.8	11	3	60	1	REM	2.7	19	1	230	2	BLC	1.5
1	4	40	1	BIH	1.2	6	4	110	2	REM	1.5	11	3	60	1	NWC	1.8	19	1	235	2	BLC	2.1
1	4	40	1	WHA	1.5	6	4	120	1	REM	1.5	11	3	60	3	AMH	1.8	19	2	10	1	BAF	3.7
1	4	40	1	REO	1.2	6	4	120	2	REM	1.2	11	3	60	1	NWC	1.0	19	2	10	1	BAF	1.2
1	4	50	1	WHA	1.5	6	4	120	1	REO	1.8	11	3	60	3	AMH	1.5	19	2	20	1	RES	2.1
1	4	50	1	REO	1.2	6	4	120	1	REM	1.0	11	3	60	1	REO	1.0	19	2	20	1	RES	1.2
1	4	50	1	WHA	1.0	6	4	120	1	REO	1.5	11	3	60	1	REM	2.4	19	2	30	1	RES	1.0
1	4	60	1	WHA	1.5	6	4	120	1	REO	1.2	11	3	60	3	WHA	1.0	19	2	40	1	GRB	1.0
1	4	60	1	WHA	1.0	6	4	120	1	WHA	1.5	11	3	60	2	WHA	1.8	19	2	50	2	GRB	1.0
1	4	60	1	YEP	1.0	6	4	130	2	REM	1.5	11	3	60	1	WHA	2.1	19	2	60	0	NO	0.0
1	4	70	2	REO	1.0	6	4	140	1	REO	1.8	11	3	70	1	BIH	5.2	19	2	70	0	NO	0.0
1	4	70	1	WHA	1.2	6	4	140	1	WHA	1.8	11	3	70	1	REM	4.6	19	2	80	0	NO	0.0
1	4	70	1	WHA	1.0	6	4	150	1	REO	1.5	11	3	70	1	NWC	1.5	19	2	90	0	NO	0.0
1	4	80	1	WHA	1.0	6	4	160	1	WHA	2.1	11	3	70	1	AMH	1.8	19	2	100	0	NO	0.0
1	4	80	1	GRB	1.0	6	4	170	0	NO	0.0	13	2	10	1	WHA	1.0	19	2	110	0	NO	0.0
1	4	80	1	YEP	1.8	6	4	180	1	WHA	1.8	13	2	10	1	COT	1.2	19	2	120	0	NO	0.0
1	4	80	1	REO	1.0	6	4	180	1	REO	1.8	13	2	10	1	LAA	2.7	19	2	130	0	NO	0.0
1	4	80	1	QUA	1.2	6	4	190	0	NO	0.0	13	2	10	1	LAA	3.0	19	2	140	0	NO	0.0
1	4	80	2	LAA	1.2	6	4	200	2	WHP	1.0	13	2	10	1	BLC	1.0	19	2	150	0	NO	0.0
1	4	80	1	QUA	1.0	6	4	210	1	ERC	1.2	13	2	10	1	LAA	1.0	19	2	160	0	NO	0.0
1	4	90	1	LAA	1.5	6	4	210	1	WHP	1.0	13	2	20	1	QUA	2.4	19	2	170	0	NO	0.0
1	4	90	1	WHA	1.2	6	4	210	1	REO	1.2	13	2	20	1	AME	1.5	19	2	180	0	NO	0.0
1	4	90	1	REO	1.0	6	4	220	1	REO	1.5	13	2	20	1	REM	1.5	19	2	190	0	NO	0.0
1	4	100	1	REO	1.0	6	4	220	1	WHA	1.5	13	2	20	1	AME	1.0	19	2	200	0	NO	0.0
1	4	100	2	QUA	1.0	6	4	230	1	PIC	1.0	13	2	30	1	LAA	2.1	19	2	210	0	NO	0.0
1	4	100	1	WHA	1.0	6	4	240	1	WHP	2.1	13	2	30	1	LAA	1.5	19	2	220	0	NO	0.0
1	4	110	2	WHA	1.0	6	4	240	1	WHP	1.2	13	2	40	1	LAA	3.0	20	1	10	1	REM	1.0

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
1	4	110	1	REO	1.5	6	4	250	0	NO	0.0	13	2	40	1	LAA	2.4	20	1	10	1	WHP	1.8
1	4	120	3	WHA	1.0	6	4	260	1	AME	1.2	13	2	40	1	AME	2.1	20	1	20	0	NO	0.0
1	4	120	2	QUA	1.2	6	4	270	1	WHP	1.5	13	2	50	1	WHA	1.8	20	1	30	1	REM	1.2
1	4	120	1	GRB	1.0	6	4	270	1	REO	1.0	13	2	50	2	LAA	2.1	20	1	40	0	NO	0.0
1	4	120	1	AIL	1.0	6	5	10	1	WHA	2.1	13	2	60	1	AME	2.4	20	1	50	1	QUA	1.0
1	4	120	1	BLC	1.0	6	5	20	1	PIC	1.2	13	2	60	1	LAA	2.1	20	1	60	0	NO	0.0
1	4	120	1	AIL	1.5	6	5	30	0	NO	0.0	13	2	60	1	LAA	3.7	20	1	70	1	GRB	1.0
1	4	120	1	GRB	1.5	6	5	40	2	BIH	1.5	13	2	70	1	LAA	1.5	20	1	80	1	QUA	1.8
1	4	120	1	REO	1.2	6	5	40	1	REO	1.5	13	2	80	4	LAA	1.0	20	1	80	1	SHB	1.5
1	4	130	3	WHA	1.0	6	5	40	2	WHP	1.0	13	2	80	1	BLL	1.0	20	1	90	2	GRB	1.0
1	4	130	2	QUA	1.2	6	5	50	0	NO	0.0	13	2	90	1	LAA	1.8	20	1	90	1	QUA	1.8
1	4	130	1	AIL	1.0	6	5	60	0	NO	0.0	13	2	90	1	BLC	1.2	20	1	90	1	SHB	1.0
1	4	130	1	AIL	1.5	6	5	70	0	NO	0.0	13	2	90	1	WHA	1.2	20	1	90	1	QUA	1.5
1	4	130	1	WHA	1.5	6	5	80	0	NO	0.0	13	2	90	1	BLC	1.0	20	1	100	1	SHB	1.0
1	4	130	1	GRB	1.2	6	5	90	0	NO	0.0	13	2	100	2	LAA	1.5	20	1	100	1	QUA	1.5
1	4	130	1	BLC	1.0	6	5	100	0	NO	0.0	13	2	100	1	LAA	2.1	20	1	110	0	NO	0.0
1	4	130	2	QUA	1.0	6	5	110	1	REO	1.2	13	2	100	1	LAA	2.7	20	1	120	0	NO	0.0
1	4	130	1	GRB	1.5	6	5	120	0	NO	0.0	13	2	100	1	AME	1.5	20	1	130	0	NO	0.0
1	4	140	1	GRB	1.2	6	5	130	0	NO	0.0	13	2	100	1	BLC	1.8	20	1	140	0	NO	0.0
1	4	140	1	WHA	2.1	6	5	140	2	REO	1.5	13	2	100	1	REM	1.2	20	1	150	0	NO	0.0
1	4	140	1	WHA	1.5	6	5	150	0	NO	0.0	13	1	10	4	WHA	2.1	20	1	160	0	NO	0.0
1	4	150	1	LAA	1.5	6	5	160	0	NO	0.0	13	1	10	1	REM	1.8	20	1	170	0	NO	0.0
1	4	150	1	BLC	1.0	6	5	170	1	REO	1.5	13	1	10	4	REM	1.5	20	1	180	1	REM	1.2
1	4	150	1	LAA	1.8	6	5	180	0	NO	0.0	13	1	10	7	WHA	1.5	20	1	180	1	PIC	1.2
1	4	150	1	LAA	1.2	6	5	190	0	NO	0.0	13	1	10	4	WHA	1.2	20	1	180	1	PIC	1.0
1	4	150	1	WHA	1.0	6	5	200	0	NO	0.0	13	1	10	1	AME	1.8	20	1	190	1	QUA	1.0
1	4	150	1	WHA	1.8	6	5	210	1	WHA	1.2	13	1	10	1	AME	3.4	20	1	200	1	BLC	1.5
1	4	160	1	LAA	1.5	6	5	220	0	NO	0.0	13	1	10	2	BLC	1.8	20	1	210	1	GRB	1.2
1	4	160	1	WHA	2.1	6	5	230	0	NO	0.0	13	1	10	1	REM	1.0	20	1	220	1	REM	1.0
1	4	160	1	WHA	1.5	6	5	240	1	PIC	1.5	13	1	10	2	WHA	1.8	20	1	220	1	RES	1.0
1	4	160	1	REO	1.5	6	5	250	1	WHP	1.0	13	1	10	1	REM	1.2	20	1	220	1	QUA	2.1
1	4	160	1	REO	1.0	6	5	250	1	GRB	1.8	13	1	10	1	WHA	2.4	20	1	230	0	NO	0.0
2	1	10	0	NO	0.0	6	5	250	1	PIC	1.0	13	1	20	1	WHA	3.4	20	1	240	1	BLC	1.0
2	1	20	0	NO	0.0	6	5	250	1	PIC	1.8	13	1	20	2	REM	1.2	20	1	240	1	REM	1.8
2	1	30	0	NO	0.0	6	5	260	1	PIC	1.2	13	1	20	2	REM	1.8	20	1	240	3	REM	1.5
2	1	40	0	NO	0.0	6	5	260	2	WHP	1.0	13	1	20	3	REM	1.5	20	1	240	1	BLC	1.2
2	1	50	0	NO	0.0	6	5	260	1	GRB	1.5	13	1	20	2	WHA	1.2	20	1	240	1	SHB	1.5
2	1	60	0	NO	0.0	6	5	270	1	REM	2.1	13	1	20	3	WHA	1.5	20	1	250	1	QUA	1.2
2	1	70	0	NO	0.0	8	1	10	0	NO	0.0	13	1	20	1	BLL	1.2	20	1	250	2	REM	1.5
2	1	80	0	NO	0.0	8	1	20	0	NO	0.0	13	1	20	1	AME	1.0	20	1	250	1	BLC	1.0
2	1	90	0	NO	0.0	8	1	30	0	NO	0.0	13	1	20	4	WHA	1.8	20	1	250	1	RES	2.1
2	1	100	1	SWB	1.0	8	1	40	1	SWB	1.5	13	1	20	1	REM	3.0	20	2	10	0	NO	0.0
2	1	100	1	AMB	7.3	8	1	40	1	SWB	1.0	13	1	30	1	WHA	3.0	20	2	20	1	PIC	1.0
2	2	10	0	NO	0.0	8	1	50	0	NO	0.0	13	1	30	4	REM	1.8	20	2	20	1	BLC	1.2
2	2	20	0	NO	0.0	8	1	60	0	NO	0.0	13	1	30	3	REM	2.1	20	2	20	1	PIC	1.2
2	2	30	1	SWB	1.8	8	1	70	0	NO	0.0	13	1	30	6	REM	1.5	20	2	30	0	NO	0.0
2	2	30	1	WHA	1.8	8	1	80	0	NO	0.0	13	1	30	5	WHA	1.5	20	2	40	0	NO	0.0
2	2	40	4	SWB	1.5	8	1	90	0	NO	0.0	13	1	30	2	COT	1.2	20	2	50	0	NO	0.0
2	2	40	1	SWB	1.8	8	1	100	0	NO	0.0	13	1	30	1	WHA	1.0	20	2	60	0	NO	0.0
2	2	40	1	SWB	2.1	8	1	110	0	NO	0.0	13	1	30	3	WHA	2.7	20	2	70	0	NO	0.0
2	2	40	4	SWB	2.4	8	1	120	0	NO	0.0	13	1	30	2	WHA	2.4	20	2	80	0	NO	0.0
2	2	40	2	SWB	1.2	8	1	130	0	NO	0.0	13	1	30	1	REM	3.0	20	2	90	0	NO	0.0
2	2	40	1	SWB	1.0	8	1	140	0	NO	0.0	13	1	30	1	COT	1.5	20	2	100	1	BLC	1.5
2	2	50	2	SWB	1.0	8	2	10	1	SWB	1.5	13	1	30	1	WHA	1.8	20	2	100	1	BLC	1.0

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
2	2	50	1	SWB	1.2	8	2	20	0	NO	0.0	13	1	30	1	REM	1.0	20	2	110	1	GRB	1.5
2	2	60	1	SWB	1.0	8	2	30	0	NO	0.0	13	1	30	2	WHA	2.1	20	2	110	1	PIC	1.2
2	2	70	1	SWB	1.0	8	2	40	0	NO	0.0	13	1	40	1	WHA	2.7	20	2	120	0	NO	0.0
2	2	80	2	SWB	1.0	8	2	50	0	NO	0.0	13	1	40	2	WHA	3.0	20	2	130	2	GRB	1.0
2	2	90	0	NO	0.0	8	2	60	0	NO	0.0	13	1	40	1	COT	1.2	20	2	140	0	NO	0.0
2	2	100	0	NO	0.0	8	2	70	0	NO	0.0	13	1	40	1	REM	1.5	20	2	150	1	BLC	1.0
2	2	110	1	SWB	1.8	8	2	80	0	NO	0.0	13	1	40	3	WHA	1.0	20	2	160	1	GRB	1.2
2	2	110	2	SWB	1.5	8	2	90	0	NO	0.0	13	1	40	2	WHA	2.1	20	2	160	1	BLC	1.0
2	2	110	3	SWB	2.1	8	2	100	0	NO	0.0	13	1	40	2	WHA	1.5	20	2	160	2	GRB	1.0
2	2	120	1	REM	3.7	8	2	110	0	NO	0.0	13	1	40	1	REM	2.1	20	2	170	1	GRB	1.2
2	2	120	1	REM	5.5	8	2	120	0	NO	0.0	13	1	40	1	REM	1.0	20	2	170	2	GRB	1.0
2	2	120	1	WHO	2.4	8	2	130	1	REM	3.7	13	1	50	1	COT	1.0	20	2	180	0	NO	0.0
2	2	120	1	SWB	1.5	8	2	130	1	SWB	2.1	13	1	50	1	WHA	2.4	20	2	190	1	BLC	1.5
2	2	120	1	CHO	6.4	8	2	130	1	REO	1.0	13	1	50	1	WHA	5.2	20	2	190	2	BLC	1.0
2	2	120	1	REM	5.8	8	2	130	1	REM	1.8	13	1	50	2	WHA	1.0	20	2	200	1	BLC	1.2
2	2	130	1	REM	2.1	8	2	140	1	SWB	1.5	13	1	50	6	WHA	2.1	20	2	210	0	NO	0.0
2	2	130	2	SWB	1.0	8	2	145	0	NO	0.0	13	1	50	1	WHA	3.0	20	2	220	1	BLC	1.2
2	2	130	1	REM	1.8	8	3	10	3	SWB	1.8	13	1	60	1	COT	1.2	20	2	230	0	NO	0.0
2	2	140	1	WHO	2.4	8	3	10	1	SWB	1.5	13	1	60	1	QUA	2.1	20	2	240	1	PIC	1.2
2	2	140	1	REM	4.6	8	3	10	1	SWB	2.4	13	1	60	1	WHA	2.1	20	2	250	3	PIC	1.5
2	2	150	1	PIH	1.5	8	3	10	1	SWB	2.1	13	1	60	1	WHA	3.0	20	2	250	1	PIC	1.8
2	3	10	2	REM	1.8	8	3	10	1	SWB	1.0	13	1	60	1	REM	1.8	20	2	250	1	PIC	1.0
2	3	20	1	REM	1.8	8	3	20	2	SWB	2.1	13	1	60	1	COT	2.1	20	2	260	3	PIC	1.0
2	3	20	1	REM	2.1	8	3	20	1	SWB	3.4	13	1	60	4	REM	1.0	20	2	260	1	PIC	2.1
2	3	20	1	REM	1.5	8	3	20	1	SWB	1.5	13	1	60	1	WHA	1.5	20	2	260	3	PIC	1.5
2	3	30	1	REO	1.5	8	3	20	1	SWB	1.8	13	1	60	1	COT	1.0	20	2	270	1	PIC	1.5
2	3	30	1	REM	1.8	8	3	30	0	NO	0.0	13	1	70	2	AME	1.8	20	2	270	1	PIC	2.1
2	3	40	1	SWB	1.2	8	3	40	0	NO	0.0	13	1	70	1	REM	1.2	20	2	270	2	PIC	1.0
2	3	40	1	REO	1.8	8	3	50	0	NO	0.0	13	1	70	1	COT	1.2	20	2	270	2	PIC	1.2
2	3	40	1	REM	2.4	8	3	60	0	NO	0.0	13	1	70	1	WHA	2.1	21	1	10	1	QUA	1.5
2	3	40	1	REM	1.5	8	3	70	0	NO	0.0	13	1	70	1	COT	1.0	21	1	10	1	QUA	1.2
2	3	50	1	REM	2.4	8	3	80	0	NO	0.0	13	1	70	1	WHA	1.5	21	1	20	1	QUA	1.2
2	3	50	1	REO	2.4	8	3	90	0	NO	0.0	13	1	70	1	WHA	1.8	21	1	30	0	NO	0.0
2	3	60	1	REM	2.1	8	3	100	0	NO	0.0	13	1	70	1	COT	1.8	21	1	40	0	NO	0.0
2	3	70	1	REO	2.1	8	3	110	0	NO	0.0	13	1	70	1	COT	1.5	21	1	50	0	NO	0.0
2	3	80	0	NO	0.0	8	3	120	2	SWB	2.1	13	1	70	1	BLL	1.2	21	1	60	1	BLC	1.0
3	2	10	1	SWB	1.0	8	3	120	1	SWB	1.8	13	1	70	1	COT	2.1	21	1	70	3	BLC	1.0
3	2	20	1	SWB	1.0	8	3	120	2	SWB	1.5	13	1	80	1	AME	1.2	21	1	70	1	REM	1.0
3	2	30	0	NO	0.0	8	3	130	4	SWB	1.8	13	1	80	1	COT	3.0	21	1	70	1	REM	1.8
3	2	40	0	NO	0.0	8	3	130	2	SWB	2.1	13	1	80	3	WHA	1.5	21	1	70	1	BLC	1.2
3	2	50	1	REM	5.8	8	3	130	1	SWB	1.0	13	1	80	2	QUA	1.2	21	1	70	1	QUA	1.2
3	2	60	0	NO	0.0	8	3	140	1	SWB	1.5	13	1	80	1	WHA	1.0	21	1	80	0	NO	0.0
3	2	70	0	NO	0.0	8	3	140	1	AMB	1.0	13	1	80	1	WHA	1.8	21	1	90	1	PIC	1.2
3	2	80	1	REM	6.4	8	3	140	1	SWB	1.5	13	1	80	1	WHA	2.1	21	1	90	1	GRB	1.0
3	2	90	0	NO	0.0	8	3	140	1	SWB	2.1	13	1	87.5	1	COT	1.8	21	1	100	1	PIC	1.5
3	2	100	0	NO	0.0	8	3	140	2	SWB	1.8	13	1	87.5	3	WHA	1.2	21	1	100	1	PIC	1.0
3	2	110	0	NO	0.0	8	3	140	2	SWB	1.0	13	1	87.5	1	QUA	2.1	21	1	110	1	PIC	1.0
3	2	120	1	AME	2.1	8	4	10	1	SWB	2.1	13	1	87.5	5	WHA	1.0	21	1	120	0	NO	0.0
3	3	10	1	SWB	2.4	8	4	20	1	SWB	1.8	13	1	87.5	1	WHA	2.1	21	1	130	1	GRB	1.0
3	3	20	0	NO	0.0	8	4	30	0	NO	0.0	13	1	87.5	1	WHA	1.5	21	1	130	1	AME	2.1
3	3	30	1	SWB	4.6	8	4	40	0	NO	0.0	14	1	10	1	QUA	1.2	21	1	140	1	BLC	1.0
3	3	40	0	NO	0.0	8	4	50	0	NO	0.0	14	1	10	1	QUA	2.1	21	1	150	0	NO	0.0
3	3	50	0	NO	0.0	8	4	60	0	NO	0.0	14	1	10	1	WHA	2.7	21	2	10	1	BLC	1.0
3	3	60	0	NO	0.0	8	4	70	0	NO	0.0	14	1	10	1	WHA	3.7	21	2	20	1	GRB	1.0

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
3	3	70	0	NO	0.0	8	4	80	1	GRB	3.4	14	1	10	1	BLC	1.0	21	2	20	1	PIC	1.0
3	3	80	0	NO	0.0	8	4	90	0	NO	0.0	14	1	10	3	QUA	1.5	21	2	20	1	BLC	1.0
3	3	90	0	NO	0.0	8	4	100	1	GRB	2.1	14	1	20	3	QUA	1.5	21	2	30	2	PIC	1.2
3	3	100	0	NO	0.0	8	4	110	1	REO	1.8	14	1	30	1	AME	1.2	21	2	30	1	GRB	1.0
3	3	110	1	REM	2.1	8	4	110	1	SWB	1.0	14	1	30	1	QUA	1.0	21	2	30	2	PIC	1.0
3	3	110	1	SWB	1.5	8	4	120	1	SWB	1.5	14	1	30	1	QUA	1.2	21	2	30	2	PIC	1.5
3	3	110	1	REM	1.5	8	4	130	1	GRB	1.0	14	1	30	1	WHA	3.0	21	2	40	1	QUA	1.2
3	3	120	1	CHO	5.2	8	5	10	0	NO	0.0	14	1	40	0	NO	0.0	21	2	40	1	GRB	1.0
4	1	10	1	SHB	1.0	8	5	20	0	NO	0.0	14	1	50	1	QUA	1.0	21	2	40	3	PIC	1.5
4	1	10	1	REM	1.2	8	5	30	0	NO	0.0	14	1	60	1	QUA	1.5	21	2	40	2	BLC	1.0
4	1	10	1	REM	1.0	8	5	40	0	NO	0.0	14	1	70	1	WHA	1.0	21	2	40	1	BLC	1.2
4	1	20	1	AMH	1.0	8	5	50	0	NO	0.0	14	1	70	1	BLC	1.0	21	2	40	1	PIC	1.0
4	1	20	1	BLC	1.2	8	5	60	0	NO	0.0	14	1	80	1	WHA	1.8	21	2	40	2	PIC	1.2
4	1	30	0	NO	0.0	8	5	70	0	NO	0.0	14	1	80	1	BLC	1.2	21	2	40	1	REM	1.2
4	1	40	1	SCO	1.8	8	5	80	0	NO	0.0	14	1	90	1	QUA	1.8	21	2	50	1	BLC	1.2
4	1	40	1	REO	1.8	8	5	90	0	NO	0.0	14	1	90	1	QUA	1.2	21	2	50	2	PIC	1.5
4	1	50	1	REO	1.0	8	5	100	0	NO	0.0	14	1	90	1	BLC	1.0	21	2	50	5	PIC	1.2
4	1	50	1	REM	1.0	8	5	110	0	NO	0.0	14	1	100	1	WHA	1.2	21	2	50	4	PIC	1.0
4	1	50	1	REO	2.1	8	5	120	0	NO	0.0	14	1	110	1	QUA	1.0	21	2	50	1	REM	1.2
4	1	50	2	REM	1.5	8	5	130	0	NO	0.0	14	1	110	1	WHA	1.5	21	2	60	0	NO	0.0
4	1	50	1	WHA	1.2	9	1	10	1	REM	1.0	14	1	120	2	QUA	1.0	21	2	70	1	PIC	1.2
4	1	50	1	GRB	1.5	9	1	10	1	REM	2.1	14	1	120	1	BLC	1.2	21	2	70	1	BLC	1.0
4	1	50	1	WHA	1.0	9	1	20	2	QUA	1.0	14	1	120	1	WHA	4.0	21	2	80	1	PIC	1.5
4	1	60	1	SHB	1.0	9	1	20	1	REO	1.0	14	1	120	2	BLC	1.5	21	2	80	2	GRB	1.0
4	1	70	1	REM	1.2	9	1	20	1	BLC	1.0	14	1	120	2	QUA	1.2	21	2	80	1	REM	1.2
4	1	70	1	SHB	1.2	9	1	30	2	QUA	1.0	14	1	130	1	QUA	1.0	21	2	80	4	BLC	1.0
4	1	70	1	REO	1.0	9	1	30	1	QUA	2.7	14	1	130	1	QUA	6.4	21	2	80	1	BLC	1.2
4	1	75	0	NO	0.0	9	1	30	1	REM	5.2	14	1	130	3	QUA	1.2	21	2	90	1	BLC	1.2
4	2	10	0	NO	0.0	9	1	30	1	QUA	3.0	14	1	130	1	WHA	2.1	21	2	90	5	PIC	1.0
4	2	20	0	NO	0.0	9	1	30	1	QUA	3.7	14	1	130	1	WHA	4.3	21	2	90	1	PIC	1.2
4	2	30	1	YEB	3.0	9	1	30	2	QUA	1.5	14	1	130	1	AME	2.1	21	2	90	2	GRB	1.0
4	2	40	1	YEB	1.5	9	1	30	1	SUM	1.2	14	1	130	2	BLC	1.2	21	2	90	1	BLC	1.5
4	2	40	1	YEB	2.1	9	1	30	3	QUA	1.2	14	1	130	1	WHA	3.7	21	2	100	2	BLC	1.0
4	2	40	1	YEB	1.8	9	1	40	1	QUA	2.7	14	1	140	1	QUA	1.0	21	2	100	1	BLC	1.5
4	2	50	1	YEB	1.8	9	1	40	1	WHA	3.4	14	1	140	1	BLC	1.5	21	2	100	1	GRB	1.0
4	2	60	1	YEB	1.5	9	1	40	1	QUA	1.0	14	1	140	2	QUA	1.5	21	2	100	1	PIC	1.2
4	2	60	2	YEB	1.8	9	1	40	1	QUA	1.5	14	1	140	1	QUA	2.4	21	2	100	1	REM	1.2
4	2	70	1	SWB	2.1	9	1	40	1	QUA	3.0	14	1	140	1	QUA	1.8	21	2	100	5	BLC	1.2
4	2	70	1	SWB	3.7	9	1	50	0	NO	0.0	14	1	150	1	BLC	1.5	21	2	100	3	PIC	1.0
4	2	70	1	SWB	1.5	9	1	60	1	QUA	1.5	14	1	150	1	AME	1.8	21	2	100	1	BLC	1.5
4	2	75	0	NO	0.0	9	1	60	1	REM	1.5	14	1	150	1	BLC	2.4	21	2	110	1	PIC	1.2
4	3	10	0	NO	0.0	9	1	70	2	QUA	1.5	14	1	150	1	WHA	6.7	21	2	110	1	REM	1.0
4	3	20	0	NO	0.0	9	1	70	1	REM	2.7	14	1	150	1	QUA	1.0	21	2	110	3	BLC	1.0
4	3	30	0	NO	0.0	9	1	70	2	QUA	1.8	14	1	150	4	QUA	1.5	21	2	110	1	REM	1.8
4	3	40	0	NO	0.0	9	1	70	1	REM	1.2	14	1	150	1	COT	1.2	21	2	110	1	BLC	1.5
4	3	50	0	NO	0.0	9	1	80	1	QUA	2.1	14	1	150	1	QUA	1.8	21	2	120	1	QUA	1.0
4	3	60	0	NO	0.0	9	1	80	3	QUA	2.7	14	1	150	2	WHA	1.2	21	2	120	1	BLC	1.0
4	3	70	0	NO	0.0	9	1	80	5	QUA	1.5	14	1	150	3	BLC	1.2	21	2	120	1	PIC	1.8
4	3	80	0	NO	0.0	9	1	80	2	QUA	1.0	14	1	150	1	QUA	3.4	21	2	120	1	BLC	1.8
4	3	90	0	NO	0.0	9	1	80	1	QUA	3.0	14	1	150	1	AME	1.5	21	2	120	1	QUA	1.8
4	3	100	0	NO	0.0	9	1	80	1	BLC	3.0	14	1	150	1	WHA	1.0	21	2	120	1	QUA	1.2
5	1	10	1	AME	1.2	9	1	80	2	QUA	1.2	14	1	150	3	BLC	1.0	21	2	130	1	QUA	1.2
5	1	10	1	REM	1.5	9	1	80	1	BLC	2.4	14	1	150	3	QUA	1.2	21	2	130	1	PIC	1.2
5	1	10	1	BLC	1.2	9	1	90	1	QUA	1.5	14	2	10	0	NO	0.0	21	2	130	1	QUA	1.5

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
5	1	10	1	AME	1.8	9	1	90	1	QUA	5.5	14	2	20	0	NO	0.0	21	2	130	1	PIC	1.8
5	1	10	1	REM	1.8	9	1	90	4	QUA	1.0	14	2	30	1	REO	1.0	21	2	140	1	REM	1.0
5	1	10	3	REM	1.0	9	1	90	1	QUA	5.2	14	2	30	2	QUA	1.0	21	2	140	2	REM	1.5
5	1	10	1	WHA	1.5	9	1	90	1	BLC	3.0	14	2	30	2	QUA	1.0	21	2	140	1	BLC	1.2
5	1	10	1	AME	1.5	9	1	90	1	QUA	1.2	14	2	40	0	NO	0.0	21	2	150	1	REM	1.0
5	1	10	1	WHA	1.8	9	1	90	1	QUA	1.8	14	2	50	2	QUA	1.0	21	2	150	1	YEB	1.8
5	1	20	3	AME	1.5	9	1	90	1	REM	2.1	14	2	50	1	QUA	1.2	21	2	150	1	PIC	1.0
5	1	20	1	REM	1.0	9	1	90	2	QUA	2.1	14	2	60	1	QUA	1.2	21	2	150	1	REM	1.0
5	1	20	1	LAA	1.5	9	1	90	3	QUA	1.5	14	2	60	2	QUA	1.0	21	2	150	4	BLC	1.0
5	1	30	1	SAS	1.0	9	1	100	1	QUA	2.4	14	2	70	1	QUA	1.0	21	2	150	1	GRB	1.0
5	1	30	1	SAS	1.5	9	1	100	1	QUA	1.8	14	2	70	1	REO	1.0	21	2	150	2	BLC	1.5
5	1	30	1	AME	1.0	9	1	100	3	QUA	1.8	14	2	70	1	QUA	1.2	21	3	10	3	PIC	1.2
5	1	30	1	REM	1.0	9	1	100	1	QUA	5.5	14	2	70	1	REO	1.5	21	3	10	1	EAH	1.8
5	1	30	1	AME	1.2	9	1	100	1	QUA	1.0	14	2	80	1	QUA	1.2	21	3	10	1	PIC	2.4
5	1	30	1	WHA	1.5	9	1	100	2	QUA	3.4	14	2	80	1	QUA	1.0	21	3	10	6	PIC	3.0
5	1	30	1	WHA	2.1	9	1	100	1	QUA	3.7	14	2	80	3	QUA	1.0	21	3	10	4	PIC	3.4
5	1	30	1	REM	1.5	9	1	100	1	QUA	2.1	14	2	80	1	REO	1.2	21	3	10	6	PIC	1.8
5	1	30	1	AME	1.5	9	1	100	1	QUA	1.2	14	2	90	1	QUA	1.0	21	3	10	3	YEB	1.0
5	1	30	4	REM	1.2	9	1	100	1	QUA	3.0	14	2	100	1	QUA	1.0	21	3	10	6	PIC	1.5
5	1	30	2	SAS	1.8	9	1	110	2	QUA	1.8	14	2	100	2	QUA	1.0	21	3	10	1	BLC	1.0
5	1	30	1	WHA	1.2	9	1	110	1	QUA	2.1	14	2	100	1	QUA	1.2	21	3	10	1	YEB	1.2
5	1	40	1	REM	1.0	9	1	110	2	QUA	1.0	14	2	110	1	BLC	1.0	21	3	10	3	PIC	1.0
5	1	40	1	AME	1.5	9	1	110	1	QUA	4.0	14	2	110	2	QUA	1.2	21	3	20	2	YEB	1.0
5	1	40	2	AME	1.2	9	1	110	1	BLC	1.8	14	2	110	5	QUA	1.0	21	3	20	3	PIC	1.5
5	1	40	1	WHA	1.5	9	1	110	2	QUA	1.2	14	2	110	1	REO	1.0	21	3	20	2	PIC	1.8
5	1	40	1	REM	2.1	9	1	120	2	QUA	1.0	14	2	110	1	QUA	1.0	21	3	20	1	PIC	1.0
5	1	40	1	REM	1.5	9	1	120	1	QUA	2.7	14	2	110	1	REM	1.0	21	3	20	3	PIC	1.2
5	1	40	1	REM	1.2	9	1	120	1	QUA	1.5	14	2	120	1	QUA	1.0	21	3	20	1	GRB	1.0
5	1	40	1	AME	1.0	9	1	120	1	QUA	1.2	14	2	120	1	QUA	1.2	21	3	20	1	PIC	3.4
5	1	40	1	SAS	1.5	9	1	120	3	QUA	2.1	14	2	120	3	QUA	1.0	21	3	20	6	YEB	1.2
5	1	50	1	QUA	2.1	9	1	120	1	QUA	1.8	14	2	120	1	BLC	1.0	21	3	20	1	PIC	2.1
5	1	50	1	CHO	1.8	9	1	130	1	REM	3.4	14	2	120	2	REM	1.0	21	3	20	1	QUA	1.0
5	1	50	2	REM	1.8	9	1	130	1	REM	1.0	14	2	130	0	NO	0.0	21	3	30	3	PIC	2.7
5	1	50	1	AME	1.2	9	1	130	1	SHB	1.2	14	2	140	1	QUA	1.0	21	3	30	2	PIC	3.4
5	1	50	2	WHA	1.0	9	1	130	1	QUA	1.5	14	2	150	1	REM	1.0	21	3	30	4	YEB	1.2
5	1	50	2	WHA	1.2	9	1	140	1	REM	3.4	14	2	150	1	BLC	1.0	21	3	30	1	BLC	1.2
5	1	50	1	WHA	2.1	9	1	140	1	BLC	1.8	14	2	160	1	REM	1.0	21	3	30	3	PIC	1.2
5	1	50	1	AME	1.5	9	1	140	1	REM	1.0	14	2	160	1	REO	1.0	21	3	30	5	PIC	3.0
5	1	60	2	LAA	2.1	9	1	150	1	AMB	1.2	14	2	170	1	BLC	1.0	21	3	30	1	PIC	1.5
5	1	60	3	REM	1.5	9	1	150	1	BLC	1.2	14	2	170	2	REM	1.0	21	3	30	1	QUA	1.5
5	1	60	1	REO	1.0	9	1	160	1	REO	1.2	14	2	170	2	QUA	1.0	21	3	40	3	PIC	3.0
5	1	60	1	REO	1.5	9	1	170	1	REM	1.2	14	2	175	1	QUA	1.2	21	3	40	1	PIC	2.1
5	1	60	1	REO	1.8	9	1	170	1	REM	1.5	15	1	10	3	SAS	1.0	21	3	40	2	PIC	3.7
5	1	60	1	QUA	2.1	9	1	180	1	BLC	2.1	15	1	10	2	QUA	1.0	21	3	40	1	PIC	1.5
5	1	60	1	WHA	2.1	9	1	190	1	BLC	1.0	15	1	10	2	SAS	1.5	21	3	40	1	YEB	1.2
5	1	60	1	LAA	1.8	9	1	190	1	REM	1.2	15	1	10	1	SAS	1.2	21	3	50	0	NO	0.0
5	1	60	1	QUA	1.5	9	1	190	2	QUA	1.2	15	1	10	1	SCP	2.1	21	3	60	0	NO	0.0
5	1	60	1	AME	1.0	9	1	190	1	BLC	1.2	15	1	10	1	REO	1.8	21	3	70	1	YEB	1.5
5	1	60	1	BLC	1.5	9	1	190	1	LAA	1.2	15	1	10	1	QUA	1.5	21	3	80	1	YEB	1.2
5	1	60	1	AME	1.2	9	1	190	1	SHB	1.8	15	1	20	1	SCP	1.0	21	3	80	2	PIC	1.5
5	1	70	2	LAA	1.5	9	1	200	1	LAA	1.0	15	1	20	1	REM	2.1	21	3	90	2	YEB	1.2
5	1	70	1	REO	1.5	9	1	200	1	QUA	1.0	15	1	20	1	REO	1.8	21	3	90	1	WHO	1.0
5	1	70	1	GRB	1.2	9	1	200	1	BLC	1.2	15	1	20	1	SCP	1.8	21	3	90	3	PIC	1.2
5	1	70	3	LAA	1.8	9	1	200	1	REM	1.8	15	1	20	1	REO	1.0	21	3	100	1	QUA	1.2

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
5	1	70	1	BLC	1.0	9	1	200	1	WHA	1.2	15	1	30	1	SAS	1.0	21	3	110	2	QUA	1.5
5	1	70	1	REM	1.5	9	1	210	2	BLC	1.0	15	1	30	1	REO	1.2	21	3	110	1	YEB	1.0
5	1	70	2	WHA	1.2	9	1	220	1	REM	1.8	15	1	30	1	REO	1.5	21	3	110	2	YEB	1.2
5	1	70	1	BLC	1.2	9	1	220	1	AMB	1.2	15	1	30	1	SCP	1.0	21	3	110	1	QUA	1.2
5	1	80	1	QUA	1.2	9	1	230	1	WHA	1.5	15	1	40	1	REO	1.8	21	3	110	2	PIC	1.2
5	1	80	1	SAS	3.0	9	1	230	1	REO	1.5	15	1	50	0	NO	0.0	21	3	110	1	BLC	1.0
5	1	80	1	ERC	3.0	9	1	240	0	NO	0.0	15	1	60	1	SCP	5.2	21	3	110	2	PIC	1.0
5	1	80	1	QUA	1.5	9	1	250	1	SWB	1.5	15	1	60	1	SCP	3.4	21	3	110	1	PIC	1.8
5	1	80	1	WHA	1.0	9	1	250	1	SHB	1.8	15	1	65	1	REO	1.5	21	3	110	1	YEB	1.5
5	1	80	3	REO	1.5	9	1	250	1	SWB	2.4	15	2	10	3	REM	1.2	21	3	110	1	YEB	1.5
5	1	80	2	WHA	1.8	9	1	250	1	SWB	1.8	15	2	10	5	REM	1.0	21	3	120	2	PIC	1.8
5	1	80	1	REO	1.2	9	1	250	1	SWB	1.2	15	2	10	1	QUA	1.0	21	3	120	2	PIC	1.5
5	1	80	1	SAS	3.7	9	2	10	0	NO	0.0	15	2	10	4	REM	1.5	21	3	120	1	QUA	2.1
5	1	80	2	LAA	1.5	9	2	20	0	NO	0.0	15	2	10	1	REM	2.4	21	3	120	1	BLC	1.2
5	1	80	1	WHA	1.2	9	2	30	0	NO	0.0	15	2	10	1	QUA	1.5	21	3	120	1	PIC	1.0
5	1	80	4	REM	1.0	9	2	40	0	NO	0.0	15	2	10	3	PIC	1.0	21	3	120	1	BLC	1.0
5	1	80	2	REM	1.5	9	2	50	1	AMH	3.4	15	2	10	3	QUA	1.2	21	3	130	2	PIC	1.5
5	1	80	4	WHA	1.5	9	2	60	0	NO	0.0	15	2	10	4	REM	1.8	21	3	130	2	PIC	1.2
5	1	80	1	REO	1.8	9	2	70	2	BLC	2.4	15	2	10	1	REO	1.2	21	3	130	1	GRB	1.0
5	1	80	1	SHH	1.2	9	2	80	1	BLC	2.4	15	2	10	2	REM	2.7	21	3	130	1	PIC	2.1
5	2	10	1	WHA	2.1	9	2	90	1	BLC	2.4	15	2	20	7	REM	1.0	21	3	130	1	PIC	1.0
5	2	10	1	BIH	1.8	9	2	90	1	AMH	1.5	15	2	20	3	PIC	1.0	21	3	130	2	PIC	1.8
5	2	10	1	WHA	1.2	9	2	100	1	AMH	2.1	15	2	20	3	REM	1.8	21	3	130	1	REM	3.7
5	2	10	1	BLC	1.2	9	2	100	1	WHA	3.7	15	2	20	4	REM	1.5	21	3	130	1	YEB	1.0
5	2	10	1	WHP	1.8	9	2	100	1	PIC	1.0	15	2	20	6	REM	1.2	21	3	140	5	PIC	1.5
5	2	10	2	BIH	1.2	9	2	100	1	PIC	1.8	15	2	30	5	REM	1.5	21	3	140	1	QUA	1.2
5	2	10	1	YEB	1.8	9	2	100	2	AMH	1.8	15	2	30	1	PIC	1.5	21	3	140	3	YEB	1.0
5	2	10	1	REM	1.2	9	2	100	1	QUA	2.1	15	2	30	5	PIC	1.0	21	3	140	1	GRB	1.5
5	2	10	1	AME	2.4	9	2	110	0	NO	0.0	15	2	30	3	REM	1.0	21	3	140	1	PIC	1.8
5	2	10	1	SAS	1.2	9	2	120	0	NO	0.0	15	2	30	4	REM	1.2	21	3	140	1	YEB	1.2
5	2	10	3	REO	1.5	9	2	130	0	NO	0.0	15	2	40	11	REM	1.0	21	3	150	1	QUA	1.0
5	2	10	1	REM	1.8	9	2	140	2	AMH	1.5	15	2	40	1	REM	1.5	21	3	150	1	AMH	6.4
5	2	20	2	QUA	1.5	9	2	150	1	AMH	2.1	15	2	40	1	REM	1.2	21	3	150	2	YEB	1.2
5	2	20	1	REO	1.5	9	2	150	1	AMH	1.5	15	2	50	1	REM	2.1	21	3	150	1	YEB	1.8
5	2	20	1	REO	1.8	9	2	150	1	AMH	1.0	15	2	50	3	REM	1.0	21	3	150	1	PIC	1.0
5	2	20	1	SAS	1.8	9	2	160	1	AMH	1.8	15	2	60	1	REM	1.2	22	1	10	1	SHB	1.5
5	2	20	3	SAS	1.0	9	2	160	1	AMH	1.5	15	2	60	3	REM	1.0	22	1	10	2	WHA	1.8
5	2	20	1	REO	1.2	9	2	170	0	NO	0.0	15	2	60	1	REM	1.5	22	1	20	1	WHA	1.0
5	2	20	1	BLC	1.2	9	2	180	0	NO	0.0	16	1	10	1	QUA	1.8	22	1	20	1	WHA	1.5
5	2	20	1	BLC	1.0	9	2	190	1	AMH	1.8	16	1	20	0	NO	0.0	22	1	20	1	WHA	1.2
5	2	20	1	SAS	1.5	9	2	200	1	AMH	1.5	16	1	30	0	NO	0.0	22	1	30	1	WHA	1.8
5	2	20	2	SAS	1.2	9	2	200	1	AMH	1.8	16	1	40	0	NO	0.0	22	1	30	1	REM	1.0
5	2	20	1	GRB	1.8	9	2	210	1	BLC	1.8	16	1	50	0	NO	0.0	22	1	40	1	QUA	1.0
5	2	20	1	WHA	1.2	9	2	210	1	QUA	1.5	16	1	60	0	NO	0.0	22	1	40	1	WHA	1.2
5	2	20	1	REO	1.0	9	2	210	1	BLC	1.2	16	1	70	1	BLC	1.0	22	1	40	1	WHA	1.0
5	2	20	1	LAA	1.8	9	2	210	1	AMH	1.5	16	1	75	0	NO	0.0	22	1	50	1	PAB	1.0
5	2	20	3	REO	1.2	9	2	210	1	AMH	2.1	16	2	10	1	BLW	1.5	22	1	50	1	WHA	1.0
5	2	30	1	YEB	1.5	9	2	210	2	BLC	2.1	16	2	10	1	BLW	1.8	22	1	50	1	QUA	1.0
5	2	30	1	BLC	1.2	9	2	210	2	AMH	2.7	16	2	20	0	NO	0.0	22	1	60	3	WHA	1.0
5	2	30	2	REO	1.2	9	2	210	1	AMH	1.0	16	2	30	0	NO	0.0	22	1	60	1	WHA	1.2
5	2	30	1	REO	1.2	9	2	210	2	AMH	1.8	16	2	40	0	NO	0.0	22	1	70	1	WHA	1.0
5	2	30	1	REO	1.5	9	2	220	1	AMH	1.5	16	2	50	0	NO	0.0	22	1	70	1	WHA	1.2
5	2	30	1	AME	1.8	9	2	220	1	REO	1.8	16	2	60	0	NO	0.0	22	1	80	2	WHA	1.0
5	2	30	1	WHA	1.5	9	2	220	1	WHA	1.0	16	2	70	1	SHB	1.0	22	1	80	1	WHA	1.2

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
5	2	30	1	AME	1.5	9	2	220	2	AMH	1.2	16	2	75	2	SHB	3.0	22	1	80	1	QUA	1.0
5	2	30	1	WHA	2.1	9	2	220	1	AMH	1.0	16	2	75	1	WHA	1.8	22	1	90	1	WHA	1.2
5	2	30	5	SAS	1.2	9	2	220	1	AMH	1.8	16	3	10	1	QUA	1.0	22	1	90	1	WHA	1.0
5	2	30	9	SAS	1.5	9	2	220	1	AMH	2.7	16	3	10	1	QUA	1.2	22	1	100	1	REM	1.0
5	2	30	2	SAS	1.8	9	2	225	2	AMH	1.0	16	3	10	1	QUA	1.5	22	1	110	0	NO	0.0
5	2	30	1	SAS	2.1	9	2	225	2	AMH	1.5	16	3	10	1	QUA	1.8	22	1	120	3	WHA	1.0
5	2	30	2	SAS	1.0	9	2	225	1	AMH	1.2	16	3	20	0	NO	0.0	22	1	130	1	PIC	1.2
5	2	30	1	WHA	1.0	9	2	225	1	AMH	2.1	16	3	30	0	NO	0.0	22	1	130	1	WHA	1.0
5	2	30	3	SAS	3.4	9	2	225	1	AMH	1.8	16	3	40	0	NO	0.0	22	1	130	1	WHA	1.2
5	2	40	1	SAS	1.5	9	5	10	1	REM	1.0	16	3	50	0	NO	0.0	22	1	140	2	WHA	1.0
5	2	40	1	SAS	1.0	9	5	20	0	NO	0.0	16	3	60	0	NO	0.0	22	1	150	1	WHA	1.5
5	2	40	2	SAS	1.5	9	5	30	0	NO	0.0	16	3	70	0	NO	0.0	22	1	150	4	WHA	1.0
5	2	40	1	BIH	1.5	9	5	40	0	NO	0.0	16	3	75	0	NO	0.0	22	1	160	1	WHA	1.2
5	2	40	2	SAS	1.8	9	5	50	0	NO	0.0	16	5	10	1	WHP	1.8	22	1	160	1	WHA	1.5
5	2	40	1	AME	1.0	9	5	60	0	NO	0.0	16	5	10	2	QUA	1.0	22	1	160	1	REM	1.0
5	2	40	1	QUA	1.8	9	5	70	0	NO	0.0	16	5	10	1	WHP	2.1	22	1	160	1	REM	1.2
5	2	40	1	AME	1.2	9	5	80	0	NO	0.0	16	5	10	1	QUA	1.2	22	1	170	1	WHA	1.0
5	2	40	2	SAS	2.1	9	5	90	1	BLC	1.2	16	5	20	1	QUA	1.2	22	1	180	1	WHA	1.2
5	2	40	1	REO	1.5	9	5	100	0	NO	0.0	16	5	20	2	QUA	1.0	22	1	180	1	REM	1.2
5	2	40	1	BLC	1.5	9	5	110	0	NO	0.0	16	5	30	1	QUA	1.0	22	1	180	1	QUA	1.0
5	2	40	1	SAS	3.4	9	5	120	1	BLC	2.1	16	5	40	1	YEB	1.8	22	1	190	1	WHA	1.8
5	2	50	1	SAS	2.1	9	5	130	1	REM	3.4	16	5	40	1	QUA	1.8	22	1	190	2	REM	1.2
5	2	50	1	REO	1.5	9	5	140	1	REO	2.1	16	5	50	1	BLW	2.1	22	1	190	1	WHA	1.0
5	2	50	1	LAA	1.2	9	5	140	1	BLC	1.5	16	5	60	1	GRB	1.5	22	1	190	1	PIC	1.0
5	2	50	3	SAS	1.8	9	5	140	1	WHA	1.8	16	5	70	0	NO	0.0	22	1	190	1	REM	1.0
5	2	50	1	SAS	1.2	9	5	150	2	SHB	1.2	16	6	10	2	QUA	1.0	22	1	190	1	WHA	1.5
5	2	50	1	BIH	1.5	9	5	150	1	BLC	1.8	16	6	10	1	QUA	1.2	22	1	200	1	WHA	1.2
5	2	60	1	QUA	2.1	9	5	150	1	WHA	3.4	16	6	10	1	QUA	1.5	22	1	200	1	REM	1.0
5	2	60	1	WHA	1.8	9	5	150	1	BLC	1.2	16	6	10	2	QUA	1.5	22	1	200	2	PIC	1.2
5	2	70	1	REO	1.2	9	5	150	1	BLC	1.5	16	6	20	3	QUA	1.2	22	1	200	1	REM	1.8
5	2	70	1	LAA	2.1	9	5	160	1	BLC	1.2	16	6	20	2	QUA	1.5	22	1	200	1	REM	1.5
5	2	70	2	WHA	1.2	9	5	160	1	WHA	1.8	16	6	20	1	QUA	1.8	22	1	200	1	WHA	1.0
5	2	70	1	QUA	3.4	9	5	160	1	WHA	1.2	16	6	20	1	WHP	1.5	22	1	210	1	REM	1.0
5	2	70	1	WHA	1.0	9	5	160	1	WHA	1.2	16	6	30	0	NO	0.0	22	1	210	1	PIC	1.5
5	2	70	1	REO	1.2	9	5	160	1	REM	1.8	16	6	40	0	NO	0.0	22	1	210	2	REM	1.2
5	2	80	2	WHA	1.5	9	5	160	1	YEB	1.5	16	6	50	0	NO	0.0	22	1	210	1	WHA	1.5
5	2	80	1	CHO	1.5	9	5	160	1	AMB	1.5	16	6	60	0	NO	0.0	22	1	210	1	REM	1.5
5	2	80	1	REO	1.5	9	5	160	3	WHA	1.0	16	6	70	0	NO	0.0	22	1	210	1	PIC	1.0
5	2	80	1	WHA	1.0	9	5	170	4	WHA	1.2	17	1	10	1	QUA	1.2	22	1	220	4	REM	1.5
5	2	80	1	REO	1.8	9	5	170	1	BLC	1.0	17	1	10	1	WHA	1.8	22	2	10	1	WHA	1.2
5	2	80	1	LAA	1.5	9	5	180	2	YEB	1.2	17	1	20	1	GRB	1.8	22	2	10	1	WHA	1.0
5	2	80	1	BLC	1.5	9	5	180	1	REM	1.0	17	1	20	1	WHA	5.8	22	2	10	1	REM	1.0
5	2	80	1	AME	1.5	9	5	180	1	YEB	1.0	17	1	20	1	PIC	1.0	22	2	20	3	WHA	1.2
5	2	85	1	REM	1.0	9	5	180	1	WHA	1.0	17	1	30	1	WHA	1.5	22	2	20	1	WHA	1.0
5	2	85	1	REO	1.5	9	5	180	1	WHA	1.2	17	1	40	0	NO	0.0	22	2	20	1	AME	1.0
5	2	85	1	WHA	1.5	9	5	190	1	REM	1.0	17	1	50	0	NO	0.0	22	2	30	2	REM	1.0
5	2	85	1	BLC	1.5	9	5	200	3	YEB	1.2	17	1	60	0	NO	0.0	22	2	30	2	WHA	1.5
5	2	85	1	REO	1.8	9	5	200	1	WHA	1.0	17	1	70	0	NO	0.0	22	2	30	2	WHA	1.0
5	2	85	1	AMH	1.5	9	5	200	1	WHA	1.2	17	1	80	1	GRB	1.2	22	2	40	3	WHA	1.2
5	3	10	1	GRB	1.2	9	5	200	1	REM	1.2	17	1	80	1	GRB	1.0	22	2	50	1	WHA	1.2
5	3	10	2	WHA	1.2	9	5	200	1	REM	1.8	17	1	80	1	GRB	1.5	22	2	50	2	WHA	1.0
5	3	10	1	GRB	1.5	9	5	200	1	REM	1.0	17	1	90	1	REM	1.5	22	2	50	1	AME	1.2
5	3	10	2	REO	1.5	9	5	200	1	YEB	1.0	17	1	100	1	WHA	1.0	22	2	60	1	WHA	1.0
5	3	10	1	REO	1.2	9	5	210	3	YEB	1.0	17	1	100	1	REM	1.5	22	2	70	1	WHA	1.0

Appendix Table 3 continued.

S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT	S	P	SP	NUM	SPP	HT
					- m -						- m -						- m -						- m -
5	3	10	2	BLC	1.5	9	5	210	2	WHA	1.0	17	1	100	1	WHA	1.8	22	2	70	4	WHA	1.5
5	3	10	1	SAS	1.2	9	5	210	2	REM	1.2	17	1	100	2	GRB	1.2	22	2	70	1	REM	1.5
5	3	10	1	YEP	1.0	9	5	210	1	REM	1.0	17	1	100	1	REM	1.0	22	2	80	3	WHA	1.0
5	3	10	2	REM	1.0	9	5	210	1	WHA	1.2	17	1	110	1	WHA	2.1	22	2	80	1	WHA	1.2
5	3	10	1	SAS	1.8	9	5	220	1	REM	1.2	17	1	110	1	REM	1.5	22	2	80	1	AME	1.0
5	3	10	3	WHA	1.5	9	5	225	1	REM	1.5	17	1	110	1	REM	1.2	22	2	90	0	NO	0.0
5	3	10	2	REO	1.0	10	2	10	0	NO	0.0	17	1	110	1	REM	1.0	22	2	100	2	WHA	1.0
5	3	10	1	AME	1.5	10	2	20	1	REM	1.8	17	1	120	1	REM	2.4	22	2	110	0	NO	0.0
5	3	10	1	AMH	1.2	10	2	20	1	AMH	1.0	17	1	120	1	REM	1.8	22	2	120	1	WHA	1.2
5	3	10	1	BLC	1.0	10	2	30	0	NO	0.0	17	1	120	1	REM	1.2	22	2	120	1	AME	1.0
5	3	20	4	SAS	1.2	10	2	40	0	NO	0.0	17	1	120	1	REM	1.8	22	2	130	1	REM	1.0
5	3	20	1	BIH	1.0	10	2	50	0	NO	0.0	17	1	120	1	REM	1.0	22	2	140	0	NO	0.0
5	3	20	1	YEB	1.2	10	2	60	0	NO	0.0	17	1	120	1	WHA	1.8	22	2	150	0	NO	0.0
5	3	20	1	AMH	1.5	10	2	70	0	NO	0.0	17	1	120	1	REM	1.5	22	2	160	1	WHA	1.0
5	3	20	2	GRB	1.5	10	2	80	0	NO	0.0	17	1	130	1	REM	1.8	22	2	170	1	WHA	1.0
5	3	20	3	WHA	1.0	10	2	90	0	NO	0.0	17	1	130	1	WHA	2.4	22	2	180	1	REO	1.2
																		22	2	190	0	NO	0.0
																		22	2	200	0	NO	0.0

[a] Abbreviations: S -- site, P --- plot, SP -- subplot (distance of furthest subplot edge from the right-of-way edge (ft]), NUM -- number, SPP -- species, and HT -- height. Definitions of abbreviations for species from within the tables are provided in Appendix Table 5.

Individual tree stem data has been archived on the Syracuse University mainframe computer in the WHITE@SUVM account under the file name "ALL75.PRN". This file will remain archived until 11/23/96.

Appendix Table 4. Height of each tree, by species, measured in the field in 1991 by site, plot and subplot.[a]

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
1	1	10	AIL	3.4	6	1	180	NO	0.0	11	2	90	BLA	14.4	17	2	160	PAB	2.5
1	1	10	AIL	3.5	6	2	10	WHA	1.5	11	2	90	NWC	1.5	17	2	160	PAB	2.5
1	1	10	AIL	3.6	6	2	10	REM	1.4	11	2	90	BLA	7.2	17	2	160	PAB	3.7
1	1	10	AIL	2.5	6	2	10	WHP	10.0	11	2	90	BLA	1.3	17	2	160	QUA	7.1
1	1	10	AIL	2.2	6	2	10	WHA	1.2	11	2	90	BLA	1.3	17	2	160	REM	6.8
1	1	10	AIL	3.1	6	2	10	WHP	3.4	11	2	90	NWC	1.1	17	2	160	PAB	2.2
1	1	10	AIL	2.9	6	2	10	WHP	3.9	11	2	90	BLA	1.0	17	2	160	PAB	6.8
1	1	10	AIL	2.2	6	2	10	REM	1.3	11	2	90	AME	2.7	17	2	160	REM	4.8
1	1	10	AIL	1.6	6	2	10	WHP	4.0	11	3	10	SUM	6.1	17	2	160	PAB	4.8
1	1	10	AIL	2.0	6	2	10	WHP	3.4	11	3	10	WHA	1.6	17	2	160	REM	5.8
1	1	10	AIL	3.7	6	2	10	WHP	4.1	11	3	10	SHH	5.9	17	2	160	QUA	6.4
1	1	10	AIL	1.9	6	2	10	REM	2.5	11	3	10	SUM	2.9	17	2	160	QUA	10.3
1	1	10	AIL	3.3	6	2	10	WHP	3.2	11	3	10	REM	4.9	17	2	160	QUA	6.0
1	1	10	AIL	1.3	6	2	10	WHP	1.5	11	3	10	WHA	1.1	17	2	165	PAB	1.8
1	1	10	AIL	3.0	6	2	10	WHP	2.3	11	3	10	REM	6.7	17	2	165	REM	4.9
1	1	10	AIL	3.5	6	2	10	REM	2.4	11	3	10	SHH	1.9	17	2	165	WHA	5.8
1	1	10	AIL	2.9	6	2	10	WHP	2.3	11	3	10	REM	5.2	17	2	165	REM	4.8
1	1	10	AIL	3.0	6	2	10	WHA	1.3	11	3	10	SUM	6.8	17	2	165	REM	7.3
1	1	10	AIL	5.4	6	2	10	WHP	2.3	11	3	10	SUM	6.3	17	2	165	REM	6.4
1	1	20	AIL	3.2	6	2	10	REM	1.5	11	3	10	AMH	2.4	17	2	165	PAB	3.4
1	1	20	AIL	2.6	6	2	10	WHP	3.1	11	3	10	AMH	4.6	17	2	165	YEB	5.3
1	1	20	AIL	3.2	6	2	10	WHP	3.5	11	3	10	AMH	3.6	17	2	165	PAB	9.2
1	1	20	AIL	2.3	6	2	10	WHP	3.0	11	3	10	REM	4.2	17	2	165	PAB	6.3
1	1	20	AIL	2.7	6	2	10	SHH	1.0	11	3	10	SUM	2.7	17	2	165	REM	6.9
1	1	20	AIL	3.0	6	2	10	REO	2.0	11	3	10	SUM	6.7	17	2	165	PAB	6.0
1	1	20	AIL	2.8	6	2	10	WHP	8.7	11	3	10	WHA	3.1	17	2	165	PAB	2.3
1	1	20	AIL	3.3	6	2	10	WHA	1.5	11	3	10	REM	4.7	17	3	10	AMB	1.4
1	1	20	AIL	2.6	6	2	10	WHA	1.1	11	3	10	AMH	3.6	17	3	10	PAB	1.7
1	1	30	BLO	1.1	6	2	10	WHP	2.8	11	3	10	AMH	3.0	17	3	10	AMB	1.4
1	1	30	YEP	3.9	6	2	10	WHA	1.3	11	3	10	SUM	1.7	17	3	10	AMB	1.2
1	1	40	BLC	2.0	6	2	10	WHP	1.5	11	3	10	AMH	3.8	17	3	20	QUA	1.0
1	1	40	BLC	1.2	6	2	10	WHA	1.6	11	3	10	AMH	3.1	17	3	30	NO	0.0
1	1	40	BLC	3.4	6	2	10	WHP	4.0	11	3	10	AMH	2.2	17	3	40	NO	0.0
1	1	50	BLC	1.1	6	2	10	WHA	1.1	11	3	10	AMH	2.9	17	3	50	NO	0.0
1	1	50	SWB	1.8	6	2	10	REM	1.3	11	3	10	AMH	2.5	17	3	60	NO	0.0
1	1	50	BLC	1.4	6	2	10	WHA	1.6	11	3	10	AMH	3.6	17	3	70	NO	0.0
1	1	60	BLC	1.7	6	2	10	REM	1.1	11	3	10	WHA	4.2	17	3	80	NO	0.0
1	1	70	BLC	1.3	6	2	10	WHP	0.0	11	3	10	AMH	3.3	17	3	90	AMB	1.0
1	1	80	BLL	1.4	6	2	10	WHA	1.1	11	3	10	WHA	3.7	17	3	90	QUA	1.0
1	1	80	BLL	1.0	6	2	10	WHA	1.3	11	3	10	AMH	2.3	17	3	100	AMB	1.2
1	1	80	BLL	1.0	6	2	20	WHP	4.4	11	3	10	WHA	1.3	17	3	100	SUM	1.1
1	1	90	BLC	1.4	6	2	20	WHP	2.8	11	3	10	SHH	5.8	17	3	100	SUM	1.5
1	1	100	NO	0.0	6	2	20	REM	1.7	11	3	10	SUM	1.9	17	3	100	SUM	1.0
1	1	110	BLC	1.0	6	2	20	WHP	3.3	11	3	10	AMH	4.4	17	3	100	SUM	1.0
1	1	110	BLC	1.0	6	2	20	WHP	3.4	11	3	10	SUM	1.7	17	4	10	WHA	1.0
1	1	120	BLC	1.5	6	2	20	WHP	1.1	11	3	10	SHH	2.2	17	4	10	QUA	1.1
1	1	130	AIL	1.4	6	2	20	REM	1.2	11	3	10	SUM	5.8	17	4	10	AMB	1.3
1	1	140	AIL	1.5	6	2	20	WHP	3.0	11	3	10	REM	2.3	17	4	10	WHA	1.2
1	1	140	SWB	1.3	6	2	20	REM	2.1	11	3	10	SUM	6.3	17	4	10	REM	1.1
1	1	140	GRB	1.5	6	2	20	WHP	4.1	11	3	10	REM	7.2	17	4	10	REN	1.9
1	1	140	GRB	1.2	6	2	20	WHA	1.2	11	3	10	SUM	5.3	17	4	10	AMB	1.0
1	1	140	GRB	1.4	6	2	20	REM	1.2	11	3	10	SLE	5.8	17	4	10	AMB	1.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
1	1	140	BLC	1.5	6	2	20	WHA	1.5	11	3	10	SUM	4.9	17	4	10	WHA	1.0
1	1	140	GRB	1.6	6	2	20	REM	2.0	11	3	10	AMH	2.1	17	4	10	QUA	1.8
1	1	140	GRB	1.4	6	2	20	WHA	1.7	11	3	10	AMH	2.9	17	4	10	WHA	1.2
1	1	140	SWB	1.0	6	2	20	REM	1.4	11	3	10	SUM	7.0	17	4	10	WHA	1.0
1	1	140	GRB	1.0	6	2	20	WHA	1.3	11	3	10	SUM	4.9	17	4	20	AMB	1.1
1	1	140	AIL	1.1	6	2	20	SHH	1.8	11	3	10	WHA	2.3	17	4	20	AMB	1.1
1	1	150	AIL	1.4	6	2	20	REM	1.8	11	3	10	SUM	5.2	17	4	30	REM	1.2
1	1	150	AIL	1.8	6	2	20	WHP	3.0	11	3	10	SUM	4.2	17	4	30	REM	1.1
1	1	150	BLL	2.0	6	2	30	WHP	1.4	11	3	10	AMH	1.9	17	4	40	BLC	1.3
1	1	150	BLL	1.4	6	2	30	WHP	2.5	11	3	10	SUM	5.6	17	4	50	BLC	1.1
1	1	150	BLL	1.2	6	2	30	WHP	1.3	11	3	10	AMH	2.0	17	4	50	BLC	1.1
1	1	150	AIL	1.1	6	2	30	WHP	1.6	11	3	10	SUM	5.6	17	4	50	BLC	1.0
1	1	150	BLC	1.0	6	2	30	WHP	3.4	11	3	10	WHA	2.3	17	4	60	NO	0.0
1	1	150	AIL	1.0	6	2	30	WHP	3.9	11	3	10	SUM	5.5	17	4	70	NO	0.0
1	1	150	BLL	2.0	6	2	30	REM	1.6	11	3	10	WHA	3.8	17	4	80	NO	0.0
1	1	150	AIL	1.1	6	2	30	REM	1.3	11	3	10	AMH	3.0	17	4	90	NO	0.0
1	1	150	BLL	1.1	6	2	30	WHP	3.0	11	3	10	SUM	6.8	18	3	10	QUA	1.2
1	1	150	AIL	1.1	6	2	30	WHP	2.5	11	3	10	AMH	2.3	18	3	10	QUA	1.2
1	1	155	AIL	2.2	6	2	30	WHP	3.8	11	3	10	WHA	1.1	18	3	10	QUA	1.4
1	1	155	AIL	1.0	6	2	30	WHP	4.5	11	3	10	AMH	2.4	18	3	10	QUA	1.2
1	1	155	AIL	1.0	6	2	30	SHH	1.0	11	3	10	SLE	2.3	18	3	20	QUA	2.0
1	1	155	AIL	1.2	6	2	30	WHP	2.8	11	3	10	SUM	3.2	18	3	20	QUA	1.4
1	1	155	AIL	2.3	6	2	30	WHP	4.0	11	3	10	AMH	4.1	18	3	20	QUA	1.3
1	1	155	AIL	1.3	6	2	30	WHP	3.3	11	3	10	AMH	3.1	18	3	20	QUA	1.5
1	1	155	AIL	1.5	6	2	30	WHP	4.6	11	3	10	SUM	6.3	18	3	20	QUA	1.5
1	1	155	AIL	1.3	6	2	40	QUA	1.0	11	3	10	AMH	3.7	18	3	20	QUA	1.0
1	1	155	AIL	2.4	6	2	40	WHA	1.8	11	3	10	SUM	3.5	18	3	20	QUA	2.2
1	1	155	AIL	1.6	6	2	40	WHA	2.3	11	3	10	WHA	3.1	18	3	30	QUA	1.0
1	1	155	AIL	1.5	6	2	40	WHP	2.2	11	3	10	SUM	3.3	18	3	40	NO	0.0
1	1	155	AIL	2.0	6	2	40	WHP	1.2	11	3	10	AMH	3.8	18	3	50	NO	0.0
1	1	155	AIL	1.7	6	2	40	WHP	2.4	11	3	10	SUM	2.8	18	3	60	NO	0.0
1	1	155	AIL	1.3	6	2	40	GRB	1.2	11	3	10	SUM	6.3	18	3	70	NO	0.0
1	1	155	AIL	1.8	6	2	40	QUA	1.1	11	3	10	AMH	2.1	18	3	80	NO	0.0
1	1	155	AIL	1.4	6	2	50	WHP	4.4	11	3	10	AMH	3.0	18	3	90	REM	2.4
1	1	155	AIL	1.3	6	2	50	WHP	3.6	11	3	10	SUM	2.6	18	3	90	REM	1.0
1	1	155	AIL	1.3	6	2	50	WHP	3.0	11	3	20	AMH	3.9	18	3	90	PIC	5.5
1	1	155	BLL	1.1	6	2	50	WHP	1.6	11	3	20	AMH	4.7	18	3	90	REM	1.2
1	1	155	BLL	1.5	6	2	50	WHP	3.4	11	3	20	WHA	4.8	18	3	90	REM	2.8
1	1	155	AIL	1.3	6	2	50	WHA	3.6	11	3	20	AMH	2.8	18	3	90	PAB	3.0
1	1	155	AIL	1.0	6	2	50	GRB	1.4	11	3	20	REM	3.4	18	3	90	REM	1.6
1	1	155	BLL	2.6	6	2	50	WHP	2.1	11	3	20	AMH	4.8	18	3	90	REM	1.3
1	1	155	AIL	1.3	6	2	60	QUA	1.8	11	3	20	AMH	4.2	18	3	90	REM	3.3
1	1	155	AIL	1.4	6	2	60	WHP	2.3	11	3	20	AMH	4.7	18	3	90	REM	1.4
1	1	155	BLL	2.0	6	2	60	GRB	1.8	11	3	20	WHA	1.8	18	3	90	REM	1.1
1	1	155	BLL	1.3	6	2	60	WHP	5.3	11	3	20	REM	3.0	18	3	90	REM	2.8
1	1	155	AIL	1.1	6	2	60	WHP	4.4	11	3	20	AMH	2.8	18	3	90	PAB	3.0
1	3	10	WHA	4.5	6	2	60	WHP	3.0	11	3	20	SUM	4.2	18	3	90	PAB	3.0
1	3	20	WHA	2.7	6	2	60	GRB	3.1	11	3	20	REM	4.5	18	3	90	REM	2.5
1	3	20	WHA	2.4	6	2	60	PIC	1.7	11	3	20	REO	4.8	18	3	90	REM	1.2
1	3	20	SAS	5.6	6	2	60	WHP	2.1	11	3	20	WHA	1.6	18	3	90	REM	1.8
1	3	30	SAS	3.5	6	2	60	WHP	3.0	11	3	20	WHA	2.9	18	3	90	BLC	2.2
1	3	30	AIL	1.0	6	2	70	QUA	1.1	11	3	20	WHA	2.0	18	3	90	REM	1.0
1	3	30	AIL	3.1	6	2	70	AME	2.4	11	3	20	AMH	2.9	18	3	90	PIC	1.2
1	3	30	SAS	2.6	6	2	70	WHP	3.3	11	3	20	REO	2.9	18	3	90	REM	2.6

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
1	3	40	NO	0.0	6	2	80	NO	0.0	11	3	20	AMH	4.8	18	3	90	PAB	1.9
1	3	50	SWB	2.7	6	2	90	NO	0.0	11	3	20	AMH	4.8	18	3	90	REM	1.0
1	3	60	NO	0.0	6	2	100	WHA	1.3	11	3	20	SUM	3.1	18	3	90	PAB	3.3
1	3	70	REO	3.5	6	2	110	NO	0.0	11	3	20	WHA	2.1	18	3	90	WHA	1.2
1	3	70	BLO	2.4	6	2	120	NO	0.0	11	3	20	AMH	2.1	18	3	90	REM	2.2
1	3	80	NO	0.0	6	2	130	QUA	1.8	11	3	20	REM	4.1	18	3	90	REM	1.6
1	3	90	NO	0.0	6	2	140	NO	0.0	11	3	20	REM	4.2	18	3	90	REM	1.8
1	3	100	LAA	3.5	6	2	150	WHP	1.5	11	3	20	SUM	4.0	18	3	90	WHA	1.9
1	3	110	QUA	1.6	6	2	150	WHP	3.3	11	3	20	WHA	2.5	18	3	100	REM	3.0
1	3	120	QUA	1.6	6	2	160	WHP	1.4	11	3	20	AMH	2.4	18	3	100	REM	4.3
1	3	120	QUA	2.3	6	2	170	WHP	2.3	11	3	20	AMH	1.8	18	3	100	REM	1.1
1	3	130	QUA	1.5	6	2	170	WHA	2.3	11	3	20	SUM	3.0	18	3	100	BLC	1.2
1	3	130	YEP	1.8	6	2	170	WHP	2.0	11	3	20	AMH	3.2	18	3	100	REM	1.5
1	3	130	QUA	1.4	6	2	170	WHP	2.2	11	3	20	WHA	1.8	18	3	100	REO	2.8
1	3	130	YEP	1.8	6	2	170	WHP	2.4	11	3	20	WHO	3.1	18	3	100	REM	1.9
1	3	130	QUA	2.8	6	2	170	QUA	1.5	11	3	20	SUM	2.8	18	3	100	PAB	7.0
1	3	140	QUA	3.1	6	2	180	QUA	2.6	11	3	20	SUM	2.7	18	3	100	WHP	4.5
1	3	140	GRB	1.9	6	2	180	WHP	3.6	11	3	20	AMH	4.0	18	3	100	REM	3.3
1	3	140	QUA	1.6	6	2	180	WHP	1.2	11	3	20	AMH	4.6	18	3	100	REM	1.8
1	3	140	QUA	1.3	6	2	190	QUA	1.1	11	3	20	SUM	1.8	18	3	100	REM	5.5
1	3	140	QUA	1.3	6	2	200	NO	0.0	11	3	20	AMH	2.5	18	3	100	REM	1.0
1	3	140	QUA	3.3	6	2	210	WHA	1.2	11	3	20	AMH	5.3	18	3	100	REM	4.8
1	3	140	GRB	3.8	6	2	210	WHA	1.3	11	3	20	WHA	1.0	18	3	100	REM	1.4
1	3	150	QUA	1.5	6	2	220	WHP	2.0	11	3	20	REM	4.9	18	3	100	REM	1.0
1	3	150	LAA	2.6	6	2	230	WHA	1.0	11	3	20	WHA	2.8	18	3	100	REM	1.6
1	3	150	QUA	1.0	6	2	230	WHA	1.3	11	3	20	AMH	4.1	18	3	100	BLC	4.4
1	3	150	QUA	1.1	6	2	230	WHA	1.0	11	3	20	WHA	3.0	18	3	100	REO	4.3
1	3	150	QUA	1.0	6	2	240	NO	0.0	11	3	20	AMH	4.5	18	3	100	REO	2.2
1	3	150	WHA	1.4	6	2	250	WHA	2.4	11	3	20	WHA	1.6	18	3	100	REM	1.5
1	3	150	QUA	1.7	6	2	250	WHA	2.2	11	3	20	AMH	4.7	18	3	100	REM	2.6
1	3	150	LAA	1.2	6	2	250	WHA	1.4	11	3	20	AMH	3.4	18	3	100	REM	2.2
1	3	150	SWB	1.0	6	2	250	REO	2.2	11	3	20	AMH	3.2	18	3	100	REM	1.0
1	3	150	LAA	4.8	6	2	250	WHA	1.1	11	3	20	WHA	2.6	18	3	100	REM	1.0
1	3	160	QUA	1.8	6	2	250	WHA	1.1	11	3	20	AMH	5.8	18	3	100	REM	1.6
1	3	160	SAS	1.1	6	2	260	WHA	1.1	11	3	20	AMH	4.7	18	3	100	BLC	4.3
1	3	160	QUA	1.2	6	2	260	WHA	1.7	11	3	20	WHA	2.0	18	3	100	REM	2.1
1	3	160	LAA	1.0	6	2	260	WHA	1.2	11	3	20	WHA	1.6	18	3	100	REM	1.0
1	3	160	QUA	1.0	6	2	260	WHA	1.4	11	3	20	AMH	3.4	18	3	100	WHP	2.0
1	3	160	QUA	1.0	6	2	260	WHP	1.6	11	3	20	SUM	3.8	18	3	100	REM	2.8
1	3	160	QUA	1.0	6	2	270	WHA	1.0	11	3	20	REM	4.7	18	3	100	REM	4.0
1	3	160	QUA	1.0	6	2	270	WHA	1.3	11	3	20	WHA	1.9	18	3	100	REM	1.1
1	3	160	QUA	1.1	6	3	10	WHP	3.7	11	3	20	AMH	2.4	18	3	100	REM	2.5
1	4	10	AMB	2.9	6	3	10	WHP	4.8	11	3	20	AMH	4.3	18	3	100	REM	1.7
1	4	10	AMB	1.5	6	3	10	WHP	3.4	11	3	20	AMH	2.8	18	3	110	REM	1.2
1	4	10	SUM	1.7	6	3	10	WHP	5.2	11	3	20	AMH	3.5	18	3	110	REM	1.1
1	4	10	LAA	4.0	6	3	10	WHP	6.7	11	3	20	AMH	2.8	18	3	110	REM	3.5
1	4	10	SUM	2.1	6	3	10	WHP	1.0	11	3	20	AMH	2.6	18	3	110	REM	1.8
1	4	10	AMB	6.0	6	3	10	WHP	1.2	11	3	20	AMH	3.2	18	3	110	BLC	3.5
1	4	10	YEP	1.2	6	3	10	WHP	2.9	11	3	20	AMH	3.2	18	3	110	REM	2.3
1	4	10	SHH	4.3	6	3	10	WHP	3.8	11	3	20	AMH	4.8	18	3	110	REM	3.1
1	4	20	REM	2.2	6	3	10	WHP	4.9	11	3	20	AMH	3.7	18	3	110	BLC	5.1
1	4	20	LAA	2.0	6	3	10	WHP	3.1	11	3	20	AMH	3.3	18	3	110	REM	3.5
1	4	20	REM	1.6	6	3	10	WHP	1.8	11	3	20	AMH	3.6	18	3	110	PIC	3.0
1	4	20	SAS	2.3	6	3	10	WHP	4.6	11	3	20	AMH	5.2	18	3	110	BLC	1.0

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
1	4	20	BIH	1.0	6	3	10	WHP	5.8	11	3	20	AMH	3.9	18	3	110	EAH	7.0
1	4	20	SWB	1.7	6	3	10	WHP	11.0	11	3	20	AMH	3.5	18	3	110	REM	1.6
1	4	20	SHH	2.8	6	3	10	WHP	6.8	11	3	20	REO	4.8	18	3	110	REM	2.2
1	4	20	SWB	1.9	6	3	10	WHP	8.1	11	3	20	AMH	2.7	18	3	110	BLC	4.0
1	4	20	SWB	1.8	6	3	10	WHP	3.4	11	3	20	NWC	1.4	18	3	110	REM	4.5
1	4	20	SWB	1.7	6	3	10	WHP	5.4	11	3	20	AMH	4.4	18	3	110	REM	2.8
1	4	30	SWB	2.4	6	3	20	WHP	3.7	11	3	20	REM	4.5	18	3	110	REM	1.2
1	4	30	SWB	2.1	6	3	20	WHP	5.3	11	3	20	REO	4.1	18	3	110	PAB	3.1
1	4	30	SWB	1.6	6	3	20	WHP	3.5	11	3	20	AMH	2.8	18	3	110	BLC	3.9
1	4	30	SWB	1.8	6	3	20	WHP	2.3	11	3	20	REM	4.7	18	3	110	REM	5.5
1	4	30	SWB	3.0	6	3	20	WHP	3.9	11	3	20	AMH	3.2	18	3	110	REM	2.5
1	4	30	SWB	2.5	6	3	20	WHP	1.2	11	3	20	AMH	5.3	18	3	110	BLC	3.8
1	4	30	SWB	2.7	6	3	20	WHP	3.4	11	3	20	AMH	3.8	18	3	110	REM	1.1
1	4	30	SWB	3.1	6	3	30	WHP	2.7	11	3	20	AMH	4.5	18	3	110	PIC	4.9
1	4	30	SWB	2.5	6	3	30	WHP	1.6	11	3	20	SUM	2.7	18	3	110	PAB	5.0
1	4	30	SWB	2.6	6	3	30	WHP	4.2	11	3	20	REM	4.1	18	3	110	PIC	4.5
1	4	30	SAS	1.8	6	3	30	WHP	2.7	11	3	30	AMH	3.3	18	3	110	PIC	2.6
1	4	40	SWB	2.2	6	3	30	WHP	2.2	11	3	30	AMH	3.5	18	3	110	REM	2.4
1	4	50	AIL	8.2	6	3	30	WHP	4.2	11	3	30	AMH	3.0	18	3	110	REM	1.3
1	4	60	BLO	4.8	6	3	30	WHP	5.8	11	3	30	AMH	4.6	18	3	110	REM	2.1
1	4	60	BLO	2.6	6	3	30	WHP	2.5	11	3	30	AMH	3.7	18	3	110	REM	1.5
1	4	60	WHA	2.8	6	3	30	WHP	4.2	11	3	30	AMH	2.8	18	3	110	PIC	4.5
1	4	60	BLO	3.5	6	3	40	QUA	2.9	11	3	30	AMH	3.5	18	3	110	REM	4.5
1	4	60	BLO	3.0	6	3	40	WHP	2.7	11	3	30	SUM	3.2	18	3	110	PAB	5.0
1	4	70	NO	0.0	6	3	40	WHP	3.4	11	3	30	AMH	3.5	18	3	110	REN	2.1
1	4	80	BLO	1.7	6	3	40	QUA	3.2	11	3	30	SUM	3.9	18	3	110	REM	3.5
1	4	80	BLO	5.0	6	3	40	QUA	1.6	11	3	30	AME	3.4	18	3	110	BLC	6.0
1	4	90	REO	1.3	6	3	40	QUA	1.3	11	3	30	AMH	4.4	18	3	110	REM	2.1
1	4	100	NO	0.0	6	3	40	QUA	2.4	11	3	30	AMH	3.0	18	3	110	REM	3.1
1	4	110	NO	0.0	6	3	50	NO	0.0	11	3	30	SUM	4.0	18	3	110	REM	4.4
1	4	120	NO	0.0	6	3	60	WHP	3.2	11	3	30	AMH	3.4	18	3	110	PAB	5.0
1	4	130	BLO	1.6	6	3	60	REO	1.9	11	3	30	SUM	5.4	18	3	110	BLC	3.5
1	4	130	WHA	1.7	6	3	70	WHP	3.4	11	3	30	SUM	3.7	18	3	110	REM	2.8
1	4	140	WHA	1.2	6	3	70	WHP	3.1	11	3	30	SUM	3.3	18	3	110	PAB	6.0
1	4	140	BLO	1.4	6	3	70	WHP	3.4	11	3	30	AMH	4.0	18	3	110	REM	1.0
1	4	140	WHA	1.5	6	3	70	WHP	4.0	11	3	30	AMH	4.0	18	3	110	BLC	3.4
1	4	150	WHA	2.2	6	3	70	WHP	3.1	11	3	30	AMH	4.0	18	3	110	BLC	5.2
1	4	150	WHA	1.0	6	3	70	WHP	4.2	11	3	30	REO	1.8	18	3	110	REM	4.7
1	4	160	SHH	2.6	6	3	80	QUA	1.7	11	3	30	SUM	3.7	18	3	110	REM	1.6
1	4	160	BLC	1.9	6	3	90	NO	0.0	11	3	30	AMH	3.3	18	3	110	PAB	2.9
1	4	160	REO	4.2	6	3	100	NO	0.0	11	3	30	AMH	3.6	18	3	110	PAB	1.3
2	1	10	NO	0.0	6	3	110	NO	0.0	11	3	30	WHA	1.4	18	3	110	BLC	4.3
2	1	20	NO	0.0	6	3	120	WHA	1.1	11	3	30	AMH	3.2	18	3	110	PAB	5.3
2	1	30	NO	0.0	6	3	120	WHA	1.8	11	3	30	AMH	3.6	18	3	110	BLC	2.0
2	1	40	REM	3.8	6	3	120	WHA	4.8	11	3	30	SUM	4.5	18	3	110	REM	5.5
2	1	50	REM	1.8	6	3	120	WHA	3.4	11	3	30	SUM	3.6	18	3	110	BLC	5.2
2	1	60	SWB	4.0	6	3	130	WHA	1.5	11	3	30	WHA	1.5	19	1	10	BLC	1.0
2	1	60	WHA	2.0	6	3	130	WHA	1.5	11	3	30	WHA	1.3	19	1	10	BLC	1.0
2	1	60	SWB	3.6	6	3	140	WHA	1.0	11	3	30	SUM	4.0	19	1	20	GRB	3.4
2	1	70	SWB	3.3	6	3	150	NO	0.0	11	3	30	SUM	1.5	19	1	20	REM	1.0
2	1	70	SWB	2.8	6	3	160	NO	0.0	11	3	30	AMH	2.7	19	1	30	NO	0.0
2	1	80	REM	2.5	6	3	170	NO	0.0	11	3	30	SUM	4.4	19	1	40	NO	0.0
2	1	90	REM	1.1	6	3	180	NO	0.0	11	3	30	WHA	3.2	19	1	50	REM	1.7
2	1	90	SWB	1.7	6	3	190	WHA	1.0	11	3	30	SUM	4.6	19	1	50	REM	1.0

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
2	1	100	AMB	1.2	6	3	200	NO	0.0	11	3	30	WHA	3.1	19	1	60	REM	1.5
2	1	100	AMB	1.1	6	3	210	NO	0.0	11	3	30	WHA	4.0	19	1	60	REM	1.7
2	1	100	SWB	1.9	6	3	220	REO	1.1	11	3	30	WHA	1.6	19	1	60	REM	1.6
2	1	100	REM	1.6	6	3	230	NO	0.0	11	3	30	SUM	3.6	19	1	60	BLC	1.4
2	2	10	REM	12.0	6	3	240	NO	0.0	11	3	30	AMH	3.5	19	1	60	BLC	1.3
2	2	10	REM	14.0	6	3	250	NO	0.0	11	3	30	SUM	2.7	19	1	60	BLC	1.1
2	2	10	REM	2.8	6	3	260	WHP	1.5	11	3	30	AMH	2.6	19	1	60	BLC	2.6
2	2	10	REM	1.0	6	3	270	WHP	1.9	11	3	30	SUM	4.7	19	1	60	REM	1.0
2	2	10	SWB	2.4	6	4	10	WHP	1.0	11	3	30	WHA	1.4	19	1	60	REM	1.2
2	2	10	SWB	4.7	6	4	10	WHP	1.6	11	3	30	SUM	4.1	19	1	70	BLC	1.1
2	2	10	REM	2.5	6	4	10	WHP	6.0	11	3	30	AMH	3.9	19	1	70	BLC	1.0
2	2	10	WHO	1.0	6	4	10	WHP	4.2	11	3	30	SUM	4.6	19	1	70	BLC	2.7
2	2	20	REM	3.0	6	4	10	WHP	6.0	11	3	30	AMH	3.1	19	1	80	BLC	3.3
2	2	20	SWB	2.1	6	4	10	WHP	5.8	11	3	30	SUM	5.3	19	1	90	BLC	3.3
2	2	20	SWB	7.5	6	4	10	WHP	3.6	11	3	30	AMH	3.7	19	1	100	BLC	1.0
2	2	20	SWB	17.0	6	4	10	WHP	9.4	11	3	30	SUM	3.0	19	1	100	BLC	2.3
2	2	20	YEB	8.0	6	4	10	WHP	5.5	11	3	30	AMH	3.5	19	1	110	NO	0.0
2	2	20	SWB	2.7	6	4	10	WHP	9.8	11	3	30	WHA	3.5	19	1	120	BLC	1.3
2	2	20	REM	1.5	6	4	10	WHP	4.8	11	3	30	AMH	3.2	19	1	120	BLC	1.3
2	2	20	REM	15.5	6	4	10	WHP	1.9	11	3	30	AMH	2.7	19	1	120	BLC	1.1
2	2	20	SWB	1.2	6	4	10	WHP	9.8	11	3	30	AMH	4.1	19	1	120	BLC	1.0
2	2	20	REM	8.5	6	4	10	WHP	3.4	11	3	30	AMH	3.0	19	1	130	BLC	1.0
2	2	20	SWB	3.5	6	4	10	WHP	5.8	11	3	30	AMH	2.6	19	1	140	BLC	1.0
2	2	20	REM	4.7	6	4	10	WHP	5.8	11	3	30	AMH	2.9	19	1	140	BLC	1.0
2	2	20	SWB	2.3	6	4	10	WHP	10.3	11	3	30	WHA	4.9	19	1	140	BLC	2.0
2	2	20	REM	6.4	6	4	10	WHP	6.7	11	3	30	AMH	3.0	19	1	140	BLC	2.0
2	2	20	SWB	2.3	6	4	10	WHP	12.1	11	3	30	SUM	4.1	19	1	150	BLC	1.5
2	2	20	SWB	17.0	6	4	10	WHP	4.8	11	3	30	WHA	1.6	19	1	150	BLC	1.3
2	2	30	SWB	19.0	6	4	10	WHP	1.0	11	3	30	SUM	3.5	19	1	150	GRB	1.3
2	2	30	YEB	18.0	6	4	20	REM	1.6	11	3	30	SUM	3.8	19	1	150	BLC	1.3
2	2	30	SWB	5.6	6	4	20	WHA	1.3	11	3	30	SUM	4.7	19	1	150	BLC	1.3
2	2	40	REM	2.4	6	4	20	QUA	1.0	11	3	30	SUM	5.1	19	1	150	BLC	1.3
2	2	50	NO	0.0	6	4	20	QUA	1.0	11	3	30	SUM	4.8	19	1	160	NO	0.0
2	2	60	SWB	3.1	6	4	20	WHA	1.2	11	3	30	AMH	2.7	19	1	170	NO	0.0
2	2	60	SWB	2.0	6	4	20	WHA	1.2	11	3	30	SUM	5.5	19	1	180	BLC	1.5
2	2	60	YEB	1.2	6	4	20	WHP	6.1	11	3	30	AMH	3.1	19	1	190	BLC	2.3
2	2	60	SWB	1.9	6	4	20	WHP	4.5	11	3	30	AMH	3.9	19	1	200	BLC	2.0
2	2	60	SWB	1.3	6	4	20	QUA	1.2	11	3	30	WHA	3.6	19	1	200	BLC	1.5
2	2	60	SWB	2.1	6	4	20	WHP	3.4	11	3	30	AMH	4.6	19	1	200	BLC	1.1
2	2	60	SWB	2.2	6	4	20	REM	1.4	11	3	30	AMH	3.3	19	1	200	BLC	1.3
2	2	60	YEB	1.5	6	4	20	WHP	7.0	11	3	30	WHA	2.8	19	1	200	BLC	2.0
2	2	70	BLO	1.3	6	4	20	REM	1.8	11	3	30	SUM	4.6	19	1	200	BLC	1.6
2	2	70	BLO	2.1	6	4	20	WHP	4.7	11	3	30	AMH	3.6	19	1	210	BLC	1.7
2	2	80	YEB	1.0	6	4	20	WHP	7.0	11	3	30	AMH	2.9	19	1	210	BLC	2.0
2	2	80	YEB	1.5	6	4	20	WHA	1.1	11	3	30	AMH	3.3	19	1	210	BLC	2.0
2	2	80	YEB	1.3	6	4	20	WHP	6.0	11	3	30	SUM	3.1	19	1	210	BLC	2.8
2	2	80	YEB	1.5	6	4	30	WHP	4.8	11	3	30	AMH	3.8	19	1	210	BLC	3.0
2	2	80	YEB	1.1	6	4	30	WHP	5.4	11	3	30	AMH	2.6	19	1	210	REM	1.3
2	2	80	YEB	1.6	6	4	30	WHA	1.1	11	3	30	AMH	4.3	19	1	210	REM	2.5
2	2	80	BLO	1.6	6	4	30	WHP	4.7	11	3	30	SUM	2.1	19	1	210	BLC	1.1
2	2	80	YEB	1.6	6	4	40	WHP	4.4	11	3	30	AMH	3.0	19	1	210	BLC	2.0
2	2	80	YEB	2.4	6	4	40	WHP	4.8	11	3	30	WHA	2.3	19	1	210	BLC	1.6
2	2	80	YEB	1.1	6	4	40	QUA	1.0	11	3	30	SUM	3.0	19	1	210	BLC	1.8
2	2	80	REM	1.4	6	4	40	REO	1.4	11	3	30	SUM	5.5	19	1	210	REM	2.1

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
2	2	80	YEB	1.2	6	4	40	WHP	1.6	11	3	30	AMH	3.3	19	1	210	BLC	1.0
2	2	80	BLO	1.2	6	4	40	GRB	1.1	11	3	30	SUM	5.8	19	1	210	BLC	1.1
2	2	80	YEB	1.8	6	4	40	REO	2.3	11	3	30	AMH	2.7	19	1	210	BLC	1.8
2	2	80	YEB	1.3	6	4	50	QUA	1.3	11	3	30	SUM	5.2	19	1	220	BLC	1.5
2	2	80	YEB	1.3	6	4	50	WHP	1.5	11	3	30	AMH	4.0	19	1	220	REM	1.3
2	2	80	BLO	1.0	6	4	50	QUA	1.2	11	3	30	AMH	3.9	19	1	220	REM	1.2
2	2	80	YEB	1.6	6	4	50	QUA	2.0	11	3	30	SUM	4.1	19	1	220	BLC	1.7
2	2	90	BLO	1.0	6	4	50	WHA	1.3	11	3	30	AMH	4.2	19	1	220	BLC	1.0
2	2	90	YEB	1.1	6	4	50	QUA	1.0	11	3	30	AMH	1.8	19	1	220	BLC	1.1
2	2	90	YEB	1.1	6	4	50	QUA	2.1	11	3	30	AMH	4.5	19	1	230	BLC	1.7
2	2	100	YEB	1.3	6	4	60	REO	3.1	11	3	30	SUM	3.6	19	1	230	BLC	1.8
2	2	100	REM	1.3	6	4	60	REO	2.9	11	3	30	AMH	2.5	19	1	230	BLC	2.0
2	2	100	WHA	1.4	6	4	60	QUA	1.9	11	3	30	SUM	4.9	19	1	230	BLC	4.1
2	2	100	BLO	1.0	6	4	60	WHA	1.6	11	3	30	SUM	2.8	19	1	230	BLC	1.0
2	2	100	YEB	1.1	6	4	60	REO	3.5	11	3	30	AMH	1.8	19	1	230	REM	2.5
2	2	100	YEB	1.2	6	4	60	WHP	3.9	11	3	30	AMH	4.1	19	1	230	BLC	1.3
2	2	100	BLO	1.5	6	4	60	QUA	5.4	11	3	30	AMH	2.5	19	1	230	BLC	1.8
2	2	100	YEB	1.1	6	4	60	REO	2.4	11	3	30	AMH	2.0	19	1	230	REM	1.6
2	2	100	BLO	1.5	6	4	60	WHP	3.5	11	3	30	AMH	4.0	19	1	230	BLC	2.0
2	2	100	YEB	2.0	6	4	60	WHP	2.8	11	3	30	AMH	2.8	19	1	230	REM	1.1
2	2	100	SHH	1.0	6	4	60	REO	2.0	11	3	30	SUM	3.0	19	1	230	REM	1.0
2	2	100	YEB	1.7	6	4	70	WHP	2.6	11	3	30	AMH	3.0	19	1	230	BLC	1.4
2	2	100	REM	1.5	6	4	70	WHP	2.4	11	3	30	AMH	2.9	19	1	230	BLC	1.0
2	2	100	YEB	1.1	6	4	70	WHA	1.2	11	3	30	AMH	3.0	19	1	230	BLC	1.5
2	2	100	BLO	1.1	6	4	70	WHP	3.5	11	3	30	AMH	2.7	19	1	230	BLC	1.8
2	2	100	BLO	1.0	6	4	70	WHA	1.0	11	3	30	AMH	2.7	19	1	235	BLC	1.8
2	2	100	YEB	1.3	6	4	70	REO	1.2	11	3	40	AMH	1.4	19	1	235	BLC	2.0
2	2	110	NO	0.0	6	4	80	WHP	1.5	11	3	40	SUM	2.4	19	1	235	BLC	1.1
2	2	120	NO	0.0	6	4	90	NO	0.0	11	3	40	AMH	2.5	19	1	235	REM	1.9
2	2	130	SHH	1.0	6	4	100	NO	0.0	11	3	40	SUM	3.5	19	1	235	BLC	3.5
2	2	130	REM	1.6	6	4	110	NO	0.0	11	3	40	SUM	4.7	19	1	235	BLC	1.2
2	2	140	REM	1.0	6	4	120	NO	0.0	11	3	40	SUM	1.6	19	1	235	BLC	2.7
2	2	140	REM	1.5	6	4	130	REO	2.4	11	3	40	SUM	4.6	19	1	235	BLC	1.4
2	2	140	REM	1.5	6	4	130	REO	2.6	11	3	40	SUM	1.2	19	2	10	BAF	2.1
2	2	140	REM	1.0	6	4	140	NO	0.0	11	3	40	SUM	2.2	19	2	10	REM	1.3
2	2	140	REM	1.7	6	4	150	NO	0.0	11	3	40	SUM	4.4	19	2	10	AMB	1.1
2	2	140	YEB	1.1	6	4	160	NO	0.0	11	3	40	SUM	3.2	19	2	10	BLS	4.2
2	2	140	REM	1.6	6	4	170	NO	0.0	11	3	40	AMH	2.5	19	2	10	REM	1.1
2	2	140	REM	1.5	6	4	180	NO	0.0	11	3	40	SUM	3.3	19	2	10	GRB	1.3
2	2	140	YEB	1.0	6	4	190	NO	0.0	11	3	40	SUM	3.4	19	2	10	GRB	3.0
2	2	150	YEB	1.2	6	4	200	NO	0.0	11	3	40	SUM	4.8	19	2	10	BLS	4.2
2	2	150	REO	13.0	6	4	210	NO	0.0	11	3	40	AMH	4.0	19	2	10	GRB	1.2
2	2	150	SWB	17.0	6	4	220	NO	0.0	11	3	40	SUM	1.7	19	2	10	AMB	1.2
2	2	150	REM	2.0	6	4	230	NO	0.0	11	3	40	AMH	3.0	19	2	10	BLS	4.2
2	2	150	REO	19.0	6	4	240	NO	0.0	11	3	40	AMH	3.5	19	2	10	GRB	3.0
2	2	150	REM	17.0	6	4	250	NO	0.0	11	3	40	AMH	2.2	19	2	20	GRB	1.7
2	2	150	SWB	20.0	6	4	260	NO	0.0	11	3	40	SUM	4.4	19	2	20	GRB	1.1
2	2	150	REM	2.0	6	4	270	NO	0.0	11	3	40	AMH	3.4	19	2	20	GRB	1.3
2	2	150	YEB	1.3	6	5	10	QUA	1.4	11	3	40	AMH	3.6	19	2	20	WHP	1.3
2	2	150	REM	1.4	6	5	10	WHA	1.6	11	3	40	AMH	2.6	19	2	20	GRB	1.2
2	3	10	NO	0.0	6	5	10	QUA	1.4	11	3	40	AME	1.6	19	2	20	GRB	2.3
2	3	20	NO	0.0	6	5	10	QUA	1.8	11	3	40	AMH	3.5	19	2	20	GRB	1.0
2	3	30	NO	0.0	6	5	10	WHP	3.0	11	3	40	AMH	2.7	19	2	20	GRB	1.0
2	3	40	NO	0.0	6	5	10	QUA	1.0	11	3	40	WHA	3.4	19	2	30	BAF	1.9

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
2	3	50	NO	0.0	6	5	10	QUA	1.9	11	3	40	AME	1.8	19	2	30	GRB	2.5
2	3	60	NO	0.0	6	5	10	QUA	1.6	11	3	40	AMH	2.5	19	2	30	GRB	2.7
2	3	70	NO	0.0	6	5	10	QUA	1.2	11	3	40	AMH	4.1	19	2	30	GRB	3.1
2	3	80	NO	0.0	6	5	10	WHA	1.0	11	3	40	AME	3.1	19	2	30	GRB	1.6
3	2	10	NO	0.0	6	5	10	QUA	1.3	11	3	40	AMH	2.6	19	2	30	GRB	2.2
3	2	20	NO	0.0	6	5	10	QUA	2.3	11	3	40	AMH	2.3	19	2	30	REM	1.3
3	2	30	REM	4.4	6	5	10	QUA	1.0	11	3	40	AMH	3.5	19	2	30	REM	1.4
3	2	30	BLO	4.1	6	5	10	QUA	2.7	11	3	40	AMH	2.3	19	2	30	GRB	2.4
3	2	30	PIC	4.1	6	5	10	QUA	2.2	11	3	40	AMH	2.5	19	2	40	BAF	2.2
3	2	30	PIC	4.2	6	5	10	QUA	2.2	11	3	40	SUM	1.6	19	2	40	GRB	3.3
3	2	30	PIC	4.0	6	5	10	QUA	2.7	11	3	40	AMH	3.0	19	2	40	GRB	3.4
3	2	30	PIC	4.0	6	5	10	QUA	3.1	11	3	40	WHA	2.2	19	2	40	GRB	3.7
3	2	40	REM	3.6	6	5	10	REM	1.1	11	3	40	AMH	2.7	19	2	40	GRB	2.5
3	2	40	REM	4.6	6	5	10	QUA	2.6	11	3	40	SUM	2.4	19	2	40	GRB	3.4
3	2	40	REM	3.8	6	5	10	QUA	1.4	11	3	40	AMH	3.8	19	2	40	GRB	3.4
3	2	50	HOH	5.8	6	5	10	QUA	4.0	11	3	40	AMH	2.2	19	2	50	NO	0.0
3	2	50	SUM	3.5	6	5	20	QUA	4.6	11	3	40	AMH	2.8	19	2	60	REM	2.4
3	2	50	HOH	6.3	6	5	20	QUA	2.8	11	3	40	SUM	3.1	19	2	70	GRB	6.0
3	2	50	HOH	3.6	6	5	20	QUA	2.3	11	3	40	AMH	2.9	19	2	80	NO	0.0
3	2	60	HOH	4.3	6	5	20	QUA	2.8	11	3	40	AMH	2.7	19	2	90	GRB	1.6
3	2	60	SAS	2.6	6	5	20	QUA	4.2	11	3	40	AMH	2.7	19	2	90	GRB	1.4
3	2	60	WHA	2.5	6	5	20	QUA	3.5	11	3	40	SUM	2.2	19	2	90	GRB	1.8
3	2	60	SAS	5.6	6	5	20	REM	2.4	11	3	40	SUM	4.8	19	2	90	GRB	1.7
3	2	60	WHA	1.5	6	5	20	QUA	2.6	11	3	40	AMH	3.1	19	2	90	REM	1.0
3	2	60	CHO	2.0	6	5	20	REM	1.8	11	3	40	WHA	2.9	19	2	90	REM	1.1
3	2	60	HOH	6.0	6	5	20	QUA	3.1	11	3	40	WHA	1.0	19	2	90	GRB	1.2
3	2	60	HOH	5.2	6	5	20	WHA	1.2	11	3	40	AMH	3.4	19	2	90	REM	1.0
3	2	60	HOH	5.8	6	5	20	QUA	2.4	11	3	40	AMH	4.2	19	2	90	GRB	2.5
3	2	60	WHO	3.5	6	5	20	QUA	3.5	11	3	40	AMH	2.7	19	2	100	GRB	1.6
3	2	60	SUM	2.4	6	5	20	QUA	3.1	11	3	40	SUM	4.2	19	2	110	BLC	1.0
3	2	60	SAS	3.3	6	5	20	QUA	2.9	11	3	40	SUM	2.6	19	2	110	GRB	1.2
3	2	70	HOH	5.2	6	5	20	QUA	2.5	11	3	40	AMH	2.6	19	2	110	GRB	1.3
3	2	70	SHH	2.8	6	5	20	QUA	4.3	11	3	40	AME	2.9	19	2	110	BLC	1.6
3	2	70	SAS	3.0	6	5	20	QUA	2.3	11	3	40	SUM	3.3	19	2	110	REM	1.2
3	2	70	SUM	2.0	6	5	20	QUA	2.7	11	3	40	SUM	2.6	19	2	120	NO	0.0
3	2	70	HOH	2.1	6	5	20	QUA	2.2	11	3	40	AMH	2.4	19	2	130	NO	0.0
3	2	80	WHO	2.5	6	5	20	QUA	3.4	11	3	40	SUM	2.0	19	2	140	NO	0.0
3	2	80	HOH	4.1	6	5	20	QUA	2.9	11	3	40	AMH	2.2	19	2	150	GRB	5.6
3	2	80	SUM	1.6	6	5	20	WHP	2.8	11	3	40	SUM	2.6	19	2	150	GRB	4.1
3	2	80	SAS	2.4	6	5	20	QUA	2.2	11	3	40	AMH	4.4	19	2	150	GRB	4.0
3	2	80	REM	3.3	6	5	20	QUA	3.5	11	3	40	SUM	3.6	19	2	160	GRB	3.4
3	2	90	WHA	1.9	6	5	20	QUA	2.6	11	3	40	AMH	3.5	19	2	160	REM	1.1
3	2	100	REM	2.7	6	5	30	WHP	2.8	11	3	40	SUM	4.7	19	2	160	REM	1.1
3	2	100	HOH	5.1	6	5	30	WHA	1.0	11	3	40	AMH	3.7	19	2	160	REM	1.6
3	2	110	NO	0.0	6	5	30	QUA	2.9	11	3	40	SUM	2.0	19	2	170	NO	0.0
3	2	120	WHA	7.2	6	5	30	WHP	2.3	11	3	40	AMH	3.3	19	2	180	REM	1.4
3	2	120	WHA	1.8	6	5	30	WHP	2.0	11	3	40	AMH	2.2	19	2	190	REM	1.0
3	2	120	WHA	1.8	6	5	30	QUA	3.1	11	3	40	AMH	2.1	19	2	200	GRB	2.0
3	2	120	HOH	4.1	6	5	30	WHA	1.0	11	3	40	AMH	3.3	19	2	210	SHB	2.0
3	3	10	CHO	1.9	6	5	30	WHA	1.0	11	3	40	AMH	3.5	19	2	210	BAF	13.5
3	3	10	CHO	2.3	6	5	40	QUA	1.4	11	3	40	AMH	3.3	19	2	210	RES	1.9
3	3	20	CHO	1.2	6	5	40	QUA	1.1	11	3	40	AMH	3.5	19	2	210	BAF	10.0
3	3	30	CHO	1.3	6	5	50	NO	0.0	11	3	40	AMH	1.7	19	2	210	REM	1.0
3	3	30	CHO	1.3	6	5	60	NO	0.0	11	3	40	AMH	2.5	19	2	220	BAF	5.8

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
3	3	40	NO	0.0	6	5	70	NO	0.0	11	3	40	AMH	1.6	19	2	220	BAF	1.2
3	3	50	YEP	2.2	6	5	80	WHP	3.2	11	3	40	AMH	3.5	19	2	220	REM	4.4
3	3	50	YEP	2.5	6	5	90	WHA	1.5	11	3	40	SUM	4.2	19	2	220	BLA	5.8
3	3	60	BIH	1.5	6	5	90	REO	1.2	11	3	40	AMH	2.7	19	2	220	BLA	7.0
3	3	60	YEP	2.0	6	5	100	NO	0.0	11	3	40	SUM	4.7	19	2	220	BAF	8.5
3	3	70	NO	0.0	6	5	110	NO	0.0	11	3	40	AMH	2.9	19	2	220	BAF	2.2
3	3	80	NO	0.0	6	5	120	NO	0.0	11	3	40	SUM	4.2	19	2	220	BLL	6.9
3	3	90	NO	0.0	6	5	130	REO	1.5	11	3	40	AMH	3.5	19	2	220	REM	1.7
3	3	100	NO	0.0	6	5	130	REO	1.3	11	3	40	SUM	2.0	19	2	220	GRB	9.0
3	3	110	SWB	3.2	6	5	140	WHA	1.2	11	3	40	AMH	3.7	20	1	10	GRB	1.5
3	3	110	CHO	2.8	6	5	140	WHA	1.6	11	3	40	SUM	1.9	20	1	10	GRB	1.8
3	3	110	SWB	3.3	6	5	150	NO	0.0	11	3	40	AMH	3.0	20	1	10	REM	1.7
3	3	110	REM	1.5	6	5	160	NO	0.0	11	3	40	AMH	2.7	20	1	10	REM	1.8
3	3	110	SWB	2.3	6	5	170	NO	0.0	11	3	40	AMH	3.2	20	1	10	BLC	2.5
3	3	110	SWB	3.3	6	5	180	NO	0.0	11	3	40	SUM	4.2	20	1	10	BLC	1.9
3	3	110	SWB	1.4	6	5	190	NO	0.0	11	3	40	AMH	2.6	20	1	10	GRB	1.4
3	3	110	SWB	1.5	6	5	200	PIC	1.0	11	3	40	SUM	2.7	20	1	10	REM	2.1
3	3	110	SWB	1.4	6	5	200	PIC	1.0	11	3	40	AMH	2.2	20	1	20	GRB	1.2
3	3	120	SWB	1.9	6	5	210	WHP	2.1	11	3	40	WHA	1.6	20	1	30	GRB	1.1
3	3	120	SWB	3.0	6	5	220	NO	0.0	11	3	40	AMH	1.2	20	1	40	NO	0.0
3	3	120	SWB	2.5	6	5	230	WHP	1.3	11	3	40	AMH	2.6	20	1	50	NO	0.0
3	3	120	SWB	2.8	6	5	240	GRB	1.2	11	3	40	AMH	1.7	20	1	60	NO	0.0
3	3	120	SWB	3.0	6	5	250	QUA	1.3	11	3	40	SUM	4.6	20	1	70	BLC	1.1
3	3	120	BLO	3.1	6	5	260	GRB	1.1	11	3	40	AMH	2.2	20	1	80	NO	0.0
3	3	120	SWB	2.8	6	5	270	REM	3.6	11	3	40	SUM	4.1	20	1	90	NO	0.0
3	3	120	SWB	2.3	6	5	270	REM	2.3	11	3	40	AMH	2.7	20	1	100	NO	0.0
4	1	10	SWB	1.7	6	5	270	WHP	1.9	11	3	40	SUM	2.7	20	1	110	NO	0.0
4	1	10	SWB	4.4	6	5	270	REM	3.0	11	3	40	AMH	3.1	20	1	120	NO	0.0
4	1	10	REM	1.5	8	1	10	SWB	1.0	11	3	40	WHA	2.3	20	1	130	NO	0.0
4	1	10	SWB	4.4	8	1	20	NO	0.0	11	3	40	AMH	3.1	20	1	140	NO	0.0
4	1	10	CHO	1.2	8	1	30	SWB	1.1	11	3	40	SUM	2.5	20	1	150	NO	0.0
4	1	10	CHO	1.2	8	1	40	NO	0.0	11	3	40	AMH	3.0	20	1	160	NO	0.0
4	1	10	SWB	1.1	8	1	50	NO	0.0	11	3	40	WHA	2.9	20	1	170	NO	0.0
4	1	10	YEB	1.9	8	1	60	NO	0.0	11	3	40	AMH	3.7	20	1	180	NO	0.0
4	1	10	YEB	1.9	8	1	70	NO	0.0	11	3	40	AMH	2.7	20	1	190	NO	0.0
4	1	10	REM	2.8	8	1	80	NO	0.0	11	3	40	AMH	3.5	20	1	200	NO	0.0
4	1	10	REM	3.3	8	1	90	SWB	1.0	11	3	40	SUM	4.3	20	1	210	PIC	1.4
4	1	10	SWB	1.1	8	1	100	SWB	1.0	11	3	40	AMH	3.2	20	1	220	NO	0.0
4	1	10	SWB	1.1	8	1	110	SWB	1.6	11	3	40	SUM	2.9	20	1	230	PIC	1.0
4	1	10	GRB	2.8	8	1	120	NO	0.0	11	3	40	AMH	4.0	20	1	230	PIC	1.3
4	1	10	SWB	3.1	8	1	130	NO	0.0	11	3	50	AMH	2.0	20	1	240	PIC	1.0
4	1	10	CHO	1.2	8	1	140	NO	0.0	11	3	50	AMH	3.3	20	1	240	RES	1.2
4	1	10	GRB	3.5	8	2	10	AMH	1.7	11	3	50	AMH	2.7	20	1	240	PIC	1.3
4	1	10	REM	1.5	8	2	10	AMH	1.3	11	3	50	AMH	2.3	20	1	250	NO	0.0
4	1	10	SWB	3.1	8	2	10	SWB	1.8	11	3	50	AMH	3.0	20	2	10	REM	1.5
4	1	10	SWB	1.8	8	2	10	AMH	1.2	11	3	50	AMH	2.1	20	2	10	REM	1.4
4	1	10	SWB	3.7	8	2	10	SWB	1.3	11	3	50	AMH	2.7	20	2	10	BLC	1.0
4	1	10	YEB	1.9	8	2	10	SWB	1.2	11	3	50	AMH	2.0	20	2	10	BLC	2.5
4	1	20	REM	1.1	8	2	10	SWB	1.0	11	3	50	AMH	3.2	20	2	10	REM	2.6
4	1	20	REO	3.3	8	2	10	HOH	8.4	11	3	50	AMH	2.7	20	2	10	REM	4.1
4	1	20	REM	1.0	8	2	10	SWB	1.0	11	3	50	AMH	2.6	20	2	10	BLC	1.3
4	1	20	BLO	2.0	8	2	10	AMH	7.7	11	3	50	AMH	2.1	20	2	10	REM	1.5
4	1	20	REM	1.5	8	2	10	SWB	1.9	11	3	50	SUM	2.7	20	2	10	REM	2.6
4	1	20	SWB	2.6	8	2	10	AMH	4.8	11	3	50	AMH	1.6	20	2	10	REM	2.3

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
4	1	20	SWB	3.5	8	2	10	SWB	1.7	11	3	50	SUM	4.1	20	2	10	REM	1.0
4	1	30	NO	0.0	8	2	10	AMH	5.4	11	3	50	AMH	3.2	20	2	10	REM	3.7
4	1	40	REM	1.7	8	2	10	AMB	1.2	11	3	50	AMH	1.6	20	2	10	REM	3.1
4	1	40	REM	1.7	8	2	10	HOH	5.8	11	3	50	AMH	2.2	20	2	10	REM	2.2
4	1	40	PIC	1.3	8	2	10	AMH	7.7	11	3	50	AMH	3.2	20	2	10	REM	1.2
4	1	50	NO	0.0	8	2	10	HOH	1.4	11	3	50	AMH	2.0	20	2	10	REM	3.4
4	1	60	REM	1.0	8	2	10	SWB	1.3	11	3	50	AMH	1.7	20	2	10	REM	1.8
4	1	60	REM	1.0	8	2	10	AMH	8.7	11	3	50	AMH	2.4	20	2	10	REM	4.2
4	1	70	REM	1.0	8	2	20	AMH	2.8	11	3	50	AMH	2.5	20	2	10	REM	1.9
4	1	70	REM	1.0	8	2	20	SWB	1.8	11	3	50	AMH	3.7	20	2	10	BLC	1.7
4	1	70	REM	1.1	8	2	20	AMH	2.6	11	3	50	AMH	2.6	20	2	10	REM	6.0
4	1	75	SWB	1.1	8	2	20	AMH	1.7	11	3	50	AMH	3.0	20	2	20	REM	1.0
4	2	10	SWB	1.0	8	2	20	AMH	1.3	11	3	50	AMH	2.7	20	2	30	BLC	1.0
4	2	10	SWB	1.2	8	2	20	AMH	2.3	11	3	50	AMH	2.8	20	2	30	PIC	1.1
4	2	10	SWB	1.0	8	2	20	SWB	1.6	11	3	50	AMH	2.8	20	2	40	NO	0.0
4	2	10	SWB	1.1	8	2	20	AMH	5.8	11	3	50	AMH	2.2	20	2	50	NO	0.0
4	2	10	SWB	1.4	8	2	20	SWB	2.3	11	3	50	AMH	1.8	20	2	60	PIC	1.3
4	2	10	REM	1.1	8	2	20	AMH	2.4	11	3	50	AMH	2.0	20	2	60	PIC	1.5
4	2	10	SWB	1.0	8	2	20	SWB	1.7	11	3	50	AMH	1.7	20	2	60	PIC	1.5
4	2	10	SWB	1.0	8	2	20	AMH	2.2	11	3	50	AMH	2.8	20	2	70	NO	0.0
4	2	20	SWB	1.4	8	2	20	AMH	4.4	11	3	50	AMH	2.8	20	2	80	NO	0.0
4	2	20	SWB	1.0	8	2	20	AMH	1.7	11	3	50	AMH	2.0	20	2	90	PIC	1.2
4	2	20	SWB	1.0	8	2	20	SWB	3.0	11	3	50	WHA	1.0	20	2	90	BLC	1.3
4	2	20	SWB	1.4	8	2	20	AMH	1.4	11	3	50	AMH	2.2	20	2	90	BLC	1.0
4	2	20	SWB	1.0	8	2	20	AMH	1.7	11	3	50	AMH	3.0	20	2	100	NO	0.0
4	2	30	REO	1.8	8	2	20	HOH	6.8	11	3	50	WHA	2.8	20	2	110	BLC	1.5
4	2	30	SWB	1.4	8	2	20	AMH	2.9	11	3	50	AMH	2.2	20	2	110	BLC	1.3
4	2	30	SWB	1.3	8	2	20	AMH	1.3	11	3	50	AMH	2.6	20	2	110	PIC	1.1
4	2	30	SWB	1.4	8	2	20	AMH	2.3	11	3	50	AMH	2.3	20	2	120	PIC	1.5
4	2	30	SUM	1.0	8	2	20	AMH	5.8	11	3	50	AMH	2.2	20	2	130	NO	0.0
4	2	30	SUM	1.0	8	2	20	AMH	1.8	11	3	50	AMH	2.1	20	2	140	NO	0.0
4	2	40	SUM	1.6	8	2	20	AMH	2.2	11	3	50	SUM	4.6	20	2	150	NO	0.0
4	2	50	NO	0.0	8	2	20	AMH	1.7	11	3	50	AMH	2.8	20	2	160	NO	0.0
4	2	60	SUM	4.8	8	2	30	AMH	1.5	11	3	50	AMH	3.0	20	2	170	PIC	1.4
4	2	60	SUM	3.5	8	2	30	AMH	1.4	11	3	50	AMH	2.3	20	2	180	BLC	1.1
4	2	70	NO	0.0	8	2	30	AMH	2.3	11	3	50	AMH	2.1	20	2	190	BLC	1.8
4	2	75	SUM	3.8	8	2	30	AMH	1.4	11	3	50	WHA	1.4	20	2	190	BLC	1.5
4	2	75	SUM	6.3	8	2	30	AMH	1.8	11	3	50	WHA	1.7	20	2	190	BLC	1.8
4	3	10	NO	0.0	8	2	40	AMH	1.0	11	3	50	NWC	3.2	20	2	190	BLC	1.5
4	3	20	NO	0.0	8	2	40	AMH	1.1	11	3	50	AMH	2.1	20	2	200	NO	0.0
4	3	30	NO	0.0	8	2	40	AMH	2.8	11	3	50	WHA	1.6	20	2	210	BLC	2.6
4	3	40	NO	0.0	8	2	40	AMH	1.3	11	3	50	AMH	2.6	20	2	210	BLC	2.7
4	3	50	NO	0.0	8	2	40	AMH	1.2	11	3	50	WHA	1.3	20	2	210	BLC	2.6
4	3	60	NO	0.0	8	2	40	AMH	1.2	11	3	50	AMH	2.3	20	2	210	BLC	1.0
4	3	70	NO	0.0	8	2	40	AMH	1.1	11	3	50	AMH	1.6	20	2	210	BLC	2.5
4	3	80	NO	0.0	8	2	50	SHB	2.3	11	3	50	AMH	3.2	20	2	210	BLC	2.6
4	3	90	NO	0.0	8	2	50	SWB	2.1	11	3	50	AMH	1.6	20	2	210	BLC	1.0
4	3	100	NO	0.0	8	2	50	AMH	1.3	11	3	50	AMH	2.3	20	2	220	NO	0.0
5	1	10	REM	6.4	8	2	50	AMH	1.4	11	3	50	AMH	1.6	20	2	230	NO	0.0
5	1	10	REM	7.1	8	2	50	SWB	2.5	11	3	50	AMH	1.8	20	2	240	BLC	1.0
5	1	10	AME	13.5	8	2	50	SWB	2.1	11	3	50	AMH	2.3	20	2	250	NO	0.0
5	1	10	REM	4.2	8	2	50	SWB	2.5	11	3	50	AME	2.0	20	2	260	NO	0.0
5	1	10	REM	3.2	8	2	50	REO	1.1	11	3	50	AMH	2.7	20	2	270	PIC	2.4
5	1	10	REM	2.7	8	2	50	AMH	1.1	11	3	50	AMH	2.7	21	1	10	REM	3.7

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	10	REM	4.2	8	2	60	SHB	1.4	11	3	50	AMH	2.2	21	1	10	SCP	2.6
5	1	10	REM	3.4	8	2	60	SHB	1.2	11	3	50	AMH	1.6	21	1	10	GRB	6.5
5	1	10	REM	1.7	8	2	70	NO	0.0	11	3	50	AMH	2.1	21	1	10	PIC	3.0
5	1	10	REM	4.6	8	2	80	REM	1.4	11	3	50	AME	1.6	21	1	10	QUA	1.8
5	1	10	REM	2.8	8	2	90	NO	0.0	11	3	50	AMH	1.8	21	1	10	REM	2.3
5	1	10	REM	5.1	8	2	100	NO	0.0	11	3	50	AMH	2.4	21	1	10	REM	2.6
5	1	10	REM	2.8	8	2	110	AMH	2.2	11	3	50	AMH	2.7	21	1	10	PIC	7.3
5	1	10	REM	2.2	8	2	110	AMH	2.2	11	3	50	AMH	1.4	21	1	10	REM	1.8
5	1	10	GRA	3.0	8	2	110	AMH	3.4	11	3	50	AMH	2.7	21	1	10	REM	2.3
5	1	10	REM	5.2	8	2	110	AMH	2.3	11	3	50	AMH	2.3	21	1	10	GRB	3.5
5	1	10	REM	2.9	8	2	110	AMH	2.3	11	3	50	AMH	2.0	21	1	10	PIC	6.3
5	1	10	REM	4.6	8	2	110	AMH	2.3	11	3	50	AMH	2.0	21	1	10	GRB	3.2
5	1	10	REM	3.0	8	2	120	AMH	1.7	11	3	50	AMH	3.2	21	1	10	REM	2.4
5	1	10	REM	5.1	8	2	120	AMH	1.7	11	3	50	AMH	2.6	21	1	10	GRB	3.5
5	1	10	REM	6.0	8	2	120	AMH	2.1	11	3	50	AME	1.8	21	1	10	PIC	5.0
5	1	10	REM	2.1	8	2	120	AMH	2.2	11	3	50	AMH	2.3	21	1	10	GRB	2.8
5	1	10	GRA	6.7	8	2	120	AMH	2.2	11	3	50	REO	6.3	21	1	10	REM	3.3
5	1	10	REM	2.4	8	2	120	AMH	1.9	11	3	50	AMH	3.0	21	1	10	GRB	2.4
5	1	10	REM	2.1	8	2	120	AMH	1.7	11	3	50	AMH	1.7	21	1	10	PIC	5.5
5	1	10	GRA	8.8	8	2	120	AMH	1.5	11	3	50	AMH	2.6	21	1	10	GRB	2.0
5	1	10	REM	2.6	8	2	120	AMH	2.4	11	3	50	AMH	2.1	21	1	10	REM	4.1
5	1	10	REM	2.2	8	2	120	AMH	1.7	11	3	50	AMH	2.5	21	1	10	GRB	1.8
5	1	10	GRA	6.4	8	2	120	AMH	2.3	11	3	50	AMH	1.6	21	1	10	PIC	6.8
5	1	10	REM	3.2	8	2	120	AMH	1.6	11	3	50	WHA	1.7	21	1	10	SCP	1.2
5	1	10	REM	5.4	8	2	120	AMH	2.2	11	3	50	AME	2.8	21	1	10	REM	1.6
5	1	10	REM	3.1	8	2	120	AMH	1.0	11	3	50	AMH	2.3	21	1	10	REM	2.0
5	1	10	GRA	4.0	8	2	120	AMH	2.4	11	3	50	AMH	1.8	21	1	10	GRB	6.3
5	1	10	REM	5.4	8	2	120	AMH	2.5	11	3	50	AMH	1.3	21	1	10	REM	1.5
5	1	10	AME	2.3	8	2	120	AMH	1.9	11	3	50	WHA	1.6	21	1	10	REM	2.6
5	1	10	REM	4.7	8	2	120	AMH	2.0	11	3	50	AMH	2.3	21	1	10	REM	1.8
5	1	10	REM	4.0	8	2	120	AMH	1.6	11	3	50	AMH	3.2	21	1	10	GRB	6.8
5	1	10	REM	2.1	8	2	120	AMH	2.2	11	3	50	AMH	1.7	21	1	10	SHB	3.2
5	1	10	REM	2.8	8	2	120	AMH	1.4	11	3	50	AMH	1.8	21	1	10	SHB	4.0
5	1	10	REM	3.5	8	2	120	AMH	2.5	11	3	50	WHA	1.0	21	1	10	QUA	2.9
5	1	10	REM	4.0	8	2	120	AMH	2.2	11	3	50	AMH	2.8	21	1	10	GRB	7.8
5	1	10	REM	2.4	8	2	120	AMH	1.5	11	3	50	AMH	2.4	21	1	10	REM	1.2
5	1	10	REM	3.3	8	2	120	AMH	2.0	11	3	50	AMH	1.4	21	1	10	REM	3.8
5	1	10	AME	3.5	8	2	120	AMH	[illegible].3	11	3	50	AMH	3.1	21	1	10	GRB	3.2
5	1	10	REM	4.7	8	2	120	AMH	1.0	11	3	50	AMH	2.3	21	1	10	GRB	4.0
5	1	10	REM	3.4	8	2	120	AMH	2.1	11	3	50	AMH	2.8	21	1	10	GRB	2.1
5	1	10	REM	3.5	8	2	120	AMH	2.2	11	3	60	BAS	2.9	21	1	10	REM	3.0
5	1	10	REM	11.6	8	2	120	AMH	1.7	11	3	60	AMH	1.8	21	1	10	GRB	8.8
5	1	10	GRA	7.2	8	2	120	AMH	2.3	11	3	60	AMH	2.3	21	1	10	GRB	6.6
5	1	10	REM	4.9	8	2	120	AMH	2.1	11	3	60	SUM	1.4	21	1	10	SCP	1.6
5	1	10	REM	2.7	8	2	130	AMH	1.1	11	3	60	SUM	2.5	21	1	10	QUA	2.5
5	1	10	REM	4.2	8	2	130	AMH	1.8	11	3	60	BAS	4.2	21	1	10	PIC	2.3
5	1	10	REM	2.0	8	2	130	AMH	2.2	11	3	60	SUM	3.4	21	1	10	GRB	6.1
5	1	10	REM	1.8	8	2	130	AMH	1.3	11	3	60	SUM	2.5	21	1	10	GRB	3.1
5	1	10	AME	1.9	8	2	130	AMH	1.7	11	3	60	AMH	2.4	21	1	10	GRB	5.2
5	1	10	AME	11.5	8	2	130	AMH	1.2	11	3	60	BAS	3.2	21	1	10	GRB	2.6
5	1	20	AME	1.1	8	2	130	AMH	1.1	11	3	60	SUM	4.3	21	1	10	GRB	3.4
5	1	20	REM	4.4	8	2	130	AMH	1.6	11	3	60	WHA	1.2	21	1	10	GRB	4.5
5	1	20	REM	4.3	8	2	130	AMH	1.2	11	3	60	AMH	2.5	21	1	10	GRB	4.2
5	1	20	REM	4.0	8	2	130	AMH	1.0	11	3	60	AMH	2.5	21	1	10	SHB	1.8

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	20	REM	3.7	8	2	140	HOH	2.8	11	3	60	AMH	2.8	21	1	10	GRB	5.4
5	1	20	REM	1.5	8	2	140	HOH	1.8	11	3	60	BAS	1.2	21	1	10	GRB	2.3
5	1	20	AME	4.8	8	2	145	SWB	1.1	11	3	60	BAS	1.3	21	1	10	GRB	1.8
5	1	20	REM	2.6	8	3	10	NO	0.0	11	3	60	AMH	1.8	21	1	10	REM	2.9
5	1	20	REM	5.1	8	3	20	NO	0.0	11	3	60	AMH	3.5	21	1	10	GRB	7.2
5	1	20	REM	4.8	8	3	30	NO	0.0	11	3	60	AMH	2.5	21	1	20	GRB	2.3
5	1	20	REM	4.6	8	3	40	NO	0.0	11	3	60	AMH	1.4	21	1	20	REM	1.1
5	1	20	REM	2.8	8	3	50	NO	0.0	11	3	60	WHA	2.2	21	1	20	GRB	4.9
5	1	20	REM	4.0	8	3	60	NO	0.0	11	3	60	AMH	1.8	21	1	20	QUA	2.0
5	1	20	REM	2.6	8	3	70	YEB	1.4	11	3	60	AMH	2.8	21	1	20	QUA	2.8
5	1	20	REM	1.5	8	3	70	YEB	1.0	11	3	60	AMH	2.5	21	1	20	QUA	2.2
5	1	20	QUA	12.2	8	3	80	NO	0.0	11	3	60	AMH	2.1	21	1	20	GRB	5.0
5	1	20	REM	1.7	8	3	90	NO	0.0	11	3	60	AMH	1.9	21	1	20	QUA	1.9
5	1	20	REM	2.2	8	3	100	NO	0.0	11	3	60	AMH	2.2	21	1	20	QUA	1.7
5	1	20	REM	1.5	8	3	110	NO	0.0	11	3	60	SUM	1.8	21	1	20	QUA	2.2
5	1	20	REM	9.0	8	3	120	YEB	1.0	11	3	60	AMH	2.1	21	1	20	GRB	5.0
5	1	20	REM	1.4	8	3	120	YEB	1.0	11	3	60	AMH	2.3	21	1	20	GRB	2.8
5	1	20	REM	4.7	8	3	120	YEB	1.0	11	3	60	AMH	1.8	21	1	20	REM	1.6
5	1	20	REM	1.4	8	3	120	YEB	1.0	11	3	60	SUM	4.1	21	1	20	GRB	2.8
5	1	20	GRA	3.0	8	3	130	AMB	1.1	11	3	60	AMH	2.6	21	1	20	REM	1.4
5	1	20	REM	1.2	8	3	130	YEB	1.2	11	3	60	AMH	1.1	21	1	20	REM	1.2
5	1	20	REM	2.2	8	3	140	AMB	1.0	11	3	60	SUM	4.8	21	1	20	REM	2.5
5	1	20	REM	1.2	8	3	140	AMB	1.0	11	3	60	AMH	1.8	21	1	20	REM	1.9
5	1	20	REM	2.7	8	3	140	AMB	1.1	11	3	60	AMH	1.4	21	1	20	GRB	2.4
5	1	20	REM	1.1	8	4	10	SWB	1.9	11	3	60	AMH	2.2	21	1	20	REM	1.5
5	1	20	QUA	11.2	8	4	10	PAB	2.6	11	3	60	SHH	1.0	21	1	20	REM	2.2
5	1	20	AME	4.3	8	4	10	SWB	1.3	11	3	60	SUM	3.7	21	1	20	GRB	2.5
5	1	20	GRA	1.6	8	4	10	SWB	1.7	11	3	60	AMH	3.0	21	1	20	GRB	3.5
5	1	20	REM	1.1	8	4	10	SWB	1.5	11	3	60	AMH	2.9	21	1	20	GRB	4.4
5	1	30	REM	1.4	8	4	10	SWB	1.6	11	3	60	SUM	3.5	21	1	20	REM	2.0
5	1	30	AME	1.3	8	4	10	SWB	2.2	11	3	60	AMH	2.7	21	1	20	QUA	4.2
5	1	30	REM	1.7	8	4	10	SWB	3.4	11	3	60	SUM	4.8	21	1	20	GRB	1.8
5	1	30	REM	1.2	8	4	10	SWB	1.2	11	3	60	SUM	2.2	21	1	20	SCP	1.1
5	1	30	AME	1.3	8	4	10	SWB	1.0	11	3	60	SUM	1.4	21	1	20	REM	1.5
5	1	30	REM	1.4	8	4	10	SWB	3.0	11	3	60	SUM	2.0	21	1	20	SCP	1.3
5	1	30	QUA	2.0	8	4	10	SWB	1.2	11	3	60	SUM	4.3	21	1	20	GRB	1.8
5	1	30	REM	1.5	8	4	10	SWB	1.1	11	3	60	AMH	2.8	21	1	20	REM	1.0
5	1	30	QUA	1.7	8	4	10	SWB	2.4	11	3	60	AMH	2.8	21	1	20	SHB	2.4
5	1	30	QUA	1.8	8	4	10	SWB	1.3	11	3	60	BAS	2.8	21	1	20	REM	1.2
5	1	30	QUA	1.5	8	4	10	PAB	1.5	11	3	60	SUM	4.2	21	1	20	GRB	2.5
5	1	30	REM	1.5	8	4	10	SWB	1.8	11	3	60	AMH	2.2	21	1	20	QUA	2.8
5	1	30	GRA	1.3	8	4	10	SWB	1.1	11	3	60	AMH	2.5	21	1	20	REM	2.2
5	1	30	REM	1.6	8	4	10	SWB	1.0	11	3	60	AMH	1.8	21	1	20	SCP	1.3
5	1	30	QUA	2.1	8	4	10	SWB	1.2	11	3	60	SUM	2.8	21	1	20	GRB	2.1
5	1	30	REM	2.4	8	4	10	SWB	1.4	11	3	60	SUM	4.7	21	1	20	REM	1.1
5	1	30	QUA	1.4	8	4	10	SWB	2.2	11	3	60	AMH	2.5	21	1	20	QUA	2.1
5	1	30	WHA	1.1	8	4	10	SWB	1.2	11	3	60	AMH	2.8	21	1	20	SCP	2.1
5	1	30	QUA	2.1	8	4	10	SWB	2.7	11	3	60	AMH	2.4	21	1	20	REM	1.6
5	1	30	AME	1.5	8	4	10	REO	1.1	11	3	60	WHA	1.3	21	1	20	REM	1.2
5	1	30	REM	1.2	8	4	10	SWB	1.7	11	3	60	AMH	2.5	21	1	20	GRB	2.5
5	1	30	WHA	1.4	8	4	10	SWB	1.7	11	3	60	BAS	1.8	21	1	30	GRB	2.0
5	1	30	REM	1.1	8	4	10	PAB	1.6	11	3	60	AMH	2.2	21	1	30	QUA	1.5
5	1	30	AME	1.9	8	4	10	SWB	1.8	11	3	60	AMH	1.6	21	1	30	GRB	2.5
5	1	30	REM	1.9	8	4	10	SWB	1.7	11	3	60	AMH	1.8	21	1	30	REM	1.1

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	30	WHA	2.0	8	4	10	PAB	1.8	11	3	60	AMH	1.6	21	1	30	QUA	2.0
5	1	30	GRA	1.3	8	4	10	SWB	2.0	11	3	60	AMH	1.8	21	1	30	QUA	3.0
5	1	30	AME	1.3	8	4	10	SWB	2.0	11	3	60	REO	2.6	21	1	30	GRB	3.3
5	1	30	REM	1.1	8	4	10	SWB	1.5	11	3	60	AMH	2.8	21	1	30	GRB	2.4
5	1	30	WHA	1.6	8	4	10	SWB	2.5	11	3	60	SUM	2.7	21	1	30	GRB	2.1
5	1	30	REM	1.2	8	4	10	SWB	1.8	11	3	60	SUM	1.3	21	1	30	QUA	2.3
5	1	30	AME	1.1	8	4	10	SWB	1.7	11	3	70	NWC	4.0	21	1	30	QUA	1.6
5	1	30	QUA	3.3	8	4	10	SWB	1.0	11	3	70	AMH	1.2	21	1	30	QUA	1.2
5	1	30	WHA	1.6	8	4	10	SWB	2.5	11	3	70	SUM	1.3	21	1	30	SCP	1.7
5	1	30	REM	1.2	8	4	10	SWB	2.3	11	3	70	AMH	1.3	21	1	30	QUA	2.0
5	1	30	AME	1.1	8	4	10	PAB	1.0	11	3	70	AMH	2.2	21	1	30	GRB	2.0
5	1	30	REM	1.1	8	4	10	SWB	1.7	11	3	70	WHA	2.4	21	1	30	QUA	2.8
5	1	30	REM	1.5	8	4	10	PAB	1.0	11	3	70	SUM	2.8	21	1	30	QUA	2.8
5	1	30	QUA	2.2	8	4	10	SWB	1.2	11	3	70	WHA	1.4	21	1	30	QUA	2.7
5	1	30	REM	1.5	8	4	10	SWB	1.3	11	3	70	AMH	1.9	21	1	30	GRB	2.4
5	1	30	GRA	1.3	8	4	10	SWB	1.6	11	3	70	SUM	1.2	21	1	30	GRB	2.1
5	1	30	WHA	1.4	8	4	10	SWB	1.3	11	3	70	AMH	2.2	21	1	30	REM	1.5
5	1	40	QUA	1.7	8	4	10	SWB	1.8	11	3	70	SUM	1.0	21	1	30	GRB	3.3
5	1	40	WHA	2.3	8	4	10	SWB	1.6	11	3	70	AMH	1.6	21	1	30	QUA	1.2
5	1	40	WHA	1.5	8	4	10	SWB	1.8	11	3	70	SUM	2.2	21	1	30	GRB	2.2
5	1	40	WHA	1.6	8	4	10	SWB	2.6	11	3	70	NWC	1.3	21	1	30	GRB	4.0
5	1	40	REM	1.5	8	4	10	SWB	1.3	11	3	70	SUM	2.1	21	1	30	QUA	1.9
5	1	40	GRA	1.5	8	4	10	SWB	2.7	11	3	70	AMH	1.7	21	1	30	GRB	2.1
5	1	40	WHA	1.4	8	4	10	SWB	2.0	11	3	70	AMH	1.5	21	1	30	QUA	1.9
5	1	40	REM	1.3	8	4	10	SWB	1.1	11	3	70	SUM	1.3	21	1	30	GRB	2.3
5	1	40	WHA	1.7	8	4	10	SWB	1.5	11	3	70	AMH	2.3	21	1	30	GRB	1.7
5	1	40	WHA	1.5	8	4	10	SWB	1.7	11	3	70	WHA	1.8	21	1	30	REM	1.2
5	1	40	WHA	1.1	8	4	10	SWB	1.8	11	3	70	SHH	3.0	21	1	30	GRB	3.1
5	1	40	REM	2.2	8	4	10	SWB	1.2	11	3	70	AMH	1.7	21	1	30	QUA	1.2
5	1	40	WHA	2.1	8	4	10	SWB	1.0	11	3	70	CHI	1.6	21	1	30	GRB	1.6
5	1	40	WHA	1.6	8	4	10	PAB	1.4	11	3	70	AMH	2.3	21	1	30	GRB	1.8
5	1	40	WHA	2.1	8	4	10	SWB	1.5	11	3	70	CHI	2.4	21	1	30	QUA	1.3
5	1	40	REM	1.8	8	4	10	SWB	1.4	11	3	70	AMH	1.7	21	1	30	GRB	3.8
5	1	40	WHA	2.1	8	4	10	SWB	2.7	11	3	70	CHI	4.0	21	1	30	GRB	2.0
5	1	40	WHA	1.6	8	4	20	PAB	1.2	11	3	70	WHA	2.6	21	1	40	QUA	2.6
5	1	40	WHA	2.1	8	4	20	PAB	1.1	11	3	70	WHA	1.8	21	1	40	GRB	3.8
5	1	40	REM	1.2	8	4	20	PAB	1.0	11	3	70	WHA	2.0	21	1	40	QUA	4.0
5	1	40	WHA	1.3	8	4	20	SWB	1.0	11	3	70	CHI	3.0	21	1	40	GRB	3.2
5	1	40	GRA	1.5	8	4	20	PAB	1.0	11	3	70	AMH	1.9	21	1	40	QUA	1.7
5	1	40	REM	1.2	8	4	30	SWB	1.3	11	3	70	AMH	1.7	21	1	40	QUA	2.5
5	1	40	REM	1.7	8	4	30	REO	1.8	11	3	70	CHI	1.6	21	1	40	QUA	3.3
5	1	40	WHA	2.0	8	4	30	REO	1.3	11	3	70	CHI	3.0	21	1	40	BLC	1.6
5	1	40	GRA	1.8	8	4	30	REO	1.1	11	3	70	CHI	3.6	21	1	40	SCP	3.0
5	1	40	QUA	2.9	8	4	30	REM	1.2	11	3	70	AMH	2.3	21	1	40	QUA	1.7
5	1	40	WHA	1.8	8	4	30	REO	1.5	11	3	70	CHI	1.5	21	1	40	QUA	3.0
5	1	40	WHA	1.6	8	4	40	SWB	1.3	11	3	70	AMH	1.7	21	1	40	GRB	6.8
5	1	40	WHA	3.0	8	4	50	SHB	1.2	11	3	70	AMH	3.1	21	1	40	GRB	2.6
5	1	40	QUA	1.2	8	4	50	BLC	1.1	11	3	70	AMH	1.8	21	1	40	QUA	2.3
5	1	40	GRA	1.2	8	4	60	SWB	1.5	11	3	70	CHI	2.3	21	1	40	GRB	2.4
5	1	40	WHA	1.4	8	4	60	REM	1.2	11	3	70	WHA	1.2	21	1	40	QUA	1.7
5	1	40	QUA	2.1	8	4	60	REO	1.1	11	3	70	SUM	1.6	21	1	40	QUA	2.1
5	1	40	WHA	1.8	8	4	60	SWB	1.6	11	3	70	AMH	2.3	21	1	40	QUA	2.6
5	1	40	WHA	1.9	8	4	60	SWB	1.6	11	3	70	AMH	2.3	21	1	40	QUA	5.3
5	1	40	WHA	1.7	8	4	60	SWB	1.8	11	3	70	AMH	2.3	21	1	50	REM	2.2

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	40	WHA	1.3	8	4	60	REO	1.4	11	3	70	SUM	1.6	21	1	50	SCP	2.1
5	1	50	WHA	1.1	8	4	60	SWB	1.7	11	3	70	AMH	1.7	21	1	50	GRB	2.5
5	1	50	WHA	1.3	8	4	60	BLC	1.5	11	3	70	SUM	1.8	21	1	50	REM	3.0
5	1	50	REO	1.8	8	4	70	REO	1.2	11	3	70	AMH	1.8	21	1	50	REM	1.2
5	1	50	REM	1.1	8	4	70	REO	1.1	11	3	70	SUM	3.8	21	1	50	GRB	2.4
5	1	50	REO	1.5	8	4	80	NO	0.0	11	3	70	SUM	1.8	21	1	50	EAH	1.7
5	1	50	REM	1.6	8	4	90	AMB	1.4	11	3	70	AMH	3.0	21	1	50	REM	1.3
5	1	50	BLC	2.4	8	4	100	REM	1.0	11	3	70	AMH	1.6	21	1	50	SCP	1.7
5	1	50	REO	2.5	8	4	100	WHA	1.0	11	3	70	SUM	1.1	21	1	50	GRB	3.6
5	1	50	GRA	1.9	8	4	110	NO	0.0	11	3	70	AMH	1.4	21	1	50	SCP	1.6
5	1	50	REO	3.1	8	4	120	SWB	1.0	11	3	70	AMH	2.2	21	1	50	QUA	3.0
5	1	50	WHA	1.7	8	4	130	SWB	2.0	11	3	70	AMH	2.4	21	1	50	SCP	4.0
5	1	50	WHA	1.7	8	4	130	SWB	2.3	11	3	70	AMH	2.6	21	1	50	SCP	3.0
5	1	50	WHA	1.6	8	4	130	AMB	1.0	11	3	70	AMH	1.6	21	1	50	PIC	2.8
5	1	50	REM	1.0	8	5	10	NO	0.0	11	3	70	WHA	3.3	21	1	60	SCP	1.6
5	1	50	GRA	2.3	8	5	20	NO	0.0	11	3	70	AMH	1.6	21	1	60	BLC	2.2
5	1	50	WHA	1.0	8	5	30	NO	0.0	11	3	70	CHI	2.0	21	1	60	GRB	4.7
5	1	50	WHA	1.6	8	5	40	NO	0.0	11	3	70	AMH	1.5	21	1	60	GRB	4.5
5	1	50	BLC	2.4	8	5	50	NO	0.0	11	3	70	AMH	2.7	21	1	60	REM	2.4
5	1	50	WHA	1.4	8	5	60	NO	0.0	11	3	70	AMH	1.4	21	1	60	SCP	2.3
5	1	50	BLC	1.8	8	5	70	NO	0.0	11	3	70	SUM	1.6	21	1	60	REM	1.7
5	1	50	LAA	1.4	8	5	80	NO	0.0	11	3	70	AMH	1.8	21	1	70	SHB	1.8
5	1	50	REO	2.6	8	5	90	NO	0.0	11	3	70	SUM	2.4	21	1	70	SHB	1.5
5	1	50	GRA	1.9	8	5	100	NO	0.0	11	3	70	SUM	1.8	21	1	70	SHB	1.3
5	1	50	WHA	1.7	8	5	110	NO	0.0	11	3	70	AMH	1.3	21	1	80	NO	0.0
5	1	50	GRA	2.0	8	5	120	NO	0.0	11	3	70	SUM	1.3	21	1	90	REM	2.3
5	1	50	GRA	2.2	8	5	130	EAH	1.5	11	3	70	AMH	2.7	21	1	90	REM	1.9
5	1	50	REM	1.9	8	5	130	EAH	1.4	11	3	70	NWC	1.7	21	1	90	REM	2.3
5	1	50	REM	1.2	9	1	10	QUA	1.3	11	3	70	AMH	1.8	21	1	100	QUA	1.8
5	1	50	QUA	2.0	9	1	20	YEB	1.2	13	1	10	SIM	1.5	21	1	100	REM	1.7
5	1	50	BLC	1.6	9	1	20	YEB	1.3	13	1	10	WHA	1.0	21	1	100	PIC	2.2
5	1	50	QUA	3.2	9	1	20	YEB	1.1	13	1	10	GRA	1.3	21	1	100	REM	1.7
5	1	50	WHA	1.5	9	1	20	YEB	1.2	13	1	10	SIM	1.2	21	1	100	REM	1.2
5	1	50	BLC	2.1	9	1	20	YEB	1.1	13	1	10	SIM	1.4	21	1	100	QUA	2.6
5	1	50	LAA	1.8	9	1	20	YEB	1.0	13	1	20	WHA	1.1	21	1	100	REM	1.0
5	1	50	REO	3.1	9	1	20	YEB	1.0	13	1	20	GRA	1.2	21	1	100	REM	1.6
5	1	50	REM	1.5	9	1	20	YEB	1.5	13	1	20	WHA	1.5	21	1	100	PIC	2.9
5	1	50	REO	1.2	9	1	30	NO	0.0	13	1	20	GRA	2.2	21	1	100	QUA	2.4
5	1	50	REM	1.4	9	1	40	AMH	1.2	13	1	20	GRA	1.7	21	1	100	QUA	2.3
5	1	50	WHA	1.4	9	1	50	NO	0.0	13	1	20	GRA	1.3	21	1	100	REM	2.3
5	1	50	BLC	2.3	9	1	60	REM	1.3	13	1	20	WHA	1.1	21	1	110	PIC	1.2
5	1	50	BLC	2.0	9	1	60	REM	1.7	13	1	30	WHA	1.6	21	1	110	QUA	1.8
5	1	50	REM	2.6	9	1	60	REM	2.4	13	1	30	GRA	3.1	21	1	110	SCP	1.2
5	1	50	REM	1.4	9	1	60	REM	1.9	13	1	30	GRA	2.8	21	1	110	GRB	2.6
5	1	50	REM	1.7	9	1	60	REM	1.4	13	1	30	WHA	4.7	21	1	110	PIC	1.2
5	1	50	WHA	1.5	9	1	70	SUM	2.4	13	1	30	SIM	1.8	21	1	120	GRB	3.5
5	1	50	QUA	1.3	9	1	70	REM	1.8	13	1	30	GRA	3.0	21	1	130	SCP	1.1
5	1	50	REM	1.1	9	1	80	SUM	1.0	13	1	30	GRA	2.6	21	1	130	GRB	1.2
5	1	50	QUA	1.6	9	1	80	YEB	1.1	13	1	30	GRA	1.2	21	1	130	QUA	1.0
5	1	50	REO	3.0	9	1	90	REM	2.1	13	1	30	GRA	3.1	21	1	130	QUA	1.4
5	1	50	WHA	1.8	9	1	90	AMH	1.5	13	1	30	GRA	2.4	21	1	140	NO	0.0
5	1	50	QUA	1.2	9	1	90	AMH	1.5	13	1	30	GRA	2.7	21	1	150	BLC	1.0
5	1	50	REO	1.8	9	1	100	NO	0.0	13	1	30	WHA	4.6	21	1	150	REM	1.8
5	1	50	REM	1.8	9	1	110	YEB	1.1	13	1	30	WHA	4.6	21	1	150	REM	1.4

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	50	WHA	1.1	9	1	120	NO	0.0	13	1	30	GRA	2.8	21	1	150	REM	2.5
5	1	50	REM	2.2	9	1	130	AMH	1.0	13	1	30	WHA	1.4	21	1	150	YEB	1.1
5	1	50	WHA	1.2	9	1	140	AMB	1.5	13	1	30	WHA	2.5	21	1	150	REM	1.3
5	1	50	REO	2.4	9	1	140	AMH	2.1	13	1	30	WHA	2.3	21	1	150	REM	1.2
5	1	50	GRA	1.2	9	1	150	AMH	1.1	13	1	30	WHA	2.4	21	1	150	REM	1.0
5	1	50	WHA	1.3	9	1	150	AMH	1.2	13	1	30	WHA	2.2	21	1	150	REM	1.4
5	1	50	BLC	1.6	9	1	160	AMH	2.0	13	1	30	WHA	4.5	21	1	150	REM	1.0
5	1	50	REM	2.1	9	1	160	AMH	2.4	13	1	40	GRA	2.8	21	1	150	REM	1.3
5	1	50	QUA	1.6	9	1	160	AMH	2.1	13	1	40	GRA	1.2	21	1	150	QUA	6.8
5	1	60	WHA	1.6	9	1	170	WHA	1.5	13	1	40	GRA	3.2	21	1	150	REM	1.5
5	1	60	QUA	1.7	9	1	180	NO	0.0	13	1	40	GRA	2.2	21	1	150	REM	1.0
5	1	60	WHA	1.6	9	1	190	NO	0.0	13	1	40	GRA	2.5	21	1	150	REM	1.2
5	1	60	WHA	1.2	9	1	200	NO	0.0	13	1	40	GRA	2.6	21	1	150	AMB	4.6
5	1	60	QUA	1.9	9	1	210	SUM	1.1	13	1	40	GRA	2.6	21	1	150	REM	1.6
5	1	60	QUA	1.7	9	1	220	AMB	1.7	13	1	40	SIM	1.5	21	1	150	REM	1.1
5	1	60	GRA	1.9	9	1	230	NO	0.0	13	1	40	GRA	3.1	21	1	150	REM	2.3
5	1	60	WHA	2.2	9	1	240	HOH	4.2	13	1	40	GRA	2.5	21	2	10	NO	0.0
5	1	60	WHA	1.8	9	1	250	HOH	2.4	13	1	40	QUA	1.4	21	2	20	SCP	1.0
5	1	60	WHA	2.3	9	1	250	REM	1.2	13	1	40	GRA	2.4	21	2	30	QUA	1.0
5	1	60	WHA	1.9	9	1	250	HOH	3.9	13	1	40	GRA	2.7	21	2	30	SCP	1.0
5	1	60	WHA	2.3	9	1	250	HOH	2.2	13	1	40	GRA	1.9	21	2	30	SCP	1.2
5	1	60	WHA	1.5	9	1	250	REM	1.5	13	1	40	GRA	1.0	21	2	30	SCP	1.1
5	1	60	LAA	1.4	9	1	250	HOH	2.2	13	1	40	GRA	3.4	21	2	30	SCP	1.0
5	1	60	WHA	2.1	9	1	250	HOH	3.9	13	1	40	GRA	2.0	21	2	40	BLC	2.3
5	1	60	REM	2.0	9	1	250	HOH	1.7	13	1	50	ABU	1.3	21	2	40	BLC	2.2
5	1	60	WHA	1.5	9	1	250	HOH	2.0	13	1	50	ABU	1.6	21	2	40	PIC	1.7
5	1	60	WHA	2.0	9	1	250	HOH	4.7	13	1	50	GRA	1.1	21	2	40	SCP	1.0
5	1	60	WHA	1.8	9	1	250	HOH	1.6	13	1	50	GRA	2.1	21	2	40	PIC	1.3
5	1	60	REM	1.5	9	1	250	HOH	2.0	13	1	50	GRA	1.3	21	2	40	BLC	1.2
5	1	60	WHA	2.2	9	1	250	HOH	2.8	13	1	50	GRA	3.4	21	2	40	REP	1.0
5	1	60	BLC	2.5	9	1	250	HOH	3.2	13	1	50	SIM	1.0	21	2	40	SCP	1.4
5	1	60	REM	1.5	9	1	250	HOH	3.8	13	1	50	BOX	2.2	21	2	40	PIC	1.0
5	1	60	BIH	1.2	9	1	250	HOH	1.4	13	1	50	GRA	2.0	21	2	40	SCP	1.5
5	1	60	WHA	1.2	9	1	250	HOH	4.9	13	1	60	WHA	1.3	21	2	50	BLC	1.3
5	1	60	REM	1.4	9	1	250	HOH	2.0	13	1	60	QUA	2.5	21	2	50	BLC	1.3
5	1	60	GRA	2.1	9	1	250	AMB	7.0	13	1	60	GRA	1.4	21	2	50	PIC	1.3
5	1	60	REM	1.8	9	1	250	SUM	3.2	13	1	60	SIM	1.6	21	2	60	GRB	2.3
5	1	60	WHA	1.5	9	1	250	SUM	1.5	13	1	60	QUA	2.8	21	2	60	GRB	2.3
5	1	60	BIH	1.1	9	1	250	REM	1.2	13	1	60	BOX	1.9	21	2	70	BLC	1.0
5	1	60	WHA	1.6	9	1	250	HOH	4.1	13	1	60	SIM	1.8	21	2	70	SCP	2.3
5	1	60	REM	1.5	9	1	250	HOH	2.8	13	1	60	GRA	1.4	21	2	70	SCP	1.5
5	1	60	WHA	1.5	9	1	250	HOH	1.4	13	1	70	GRA	1.8	21	2	80	REM	1.3
5	1	60	WHA	1.4	9	1	250	HOH	2.6	13	1	70	WHA	1.3	21	2	80	REM	1.0
5	1	60	GRA	1.9	9	1	250	SUM	2.4	13	1	70	WHA	2.3	21	2	80	REM	2.4
5	1	60	REM	2.2	9	1	250	REM	1.0	13	1	70	QUA	1.4	21	2	80	REM	2.2
5	1	60	WHA	1.7	9	1	250	HOH	1.7	13	1	70	GRA	1.3	21	2	80	REM	2.2
5	1	60	REM	1.3	9	1	250	HOH	1.5	13	1	70	ABU	1.8	21	2	80	REM	2.0
5	1	60	GRA	2.3	9	1	250	HOH	4.2	13	1	70	WHA	1.5	21	2	80	REM	2.3
5	1	60	REM	1.4	9	1	250	HOH	2.0	13	1	70	SIM	2.6	21	2	80	REM	1.0
5	1	60	WHA	2.1	9	1	250	AMB	5.8	13	1	70	WHA	1.7	21	2	80	REM	1.5
5	1	60	QUA	1.2	9	1	250	BLC	2.3	13	1	70	WHA	2.1	21	2	80	REM	2.3
5	1	60	REM	1.9	9	1	250	HOH	4.7	13	1	80	GRA	1.5	21	2	80	REM	1.0
5	1	60	REM	1.3	9	1	250	HOH	1.1	13	1	80	GRA	1.5	21	2	80	REM	2.0
5	1	60	GRA	2.5	9	1	250	HOH	3.0	13	1	80	GRA	1.5	21	2	80	REM	1.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	60	WHA	1.4	9	1	250	HOH	3.9	13	1	80	GRA	1.3	21	2	80	REM	1.3
5	1	60	WHA	1.3	9	1	250	HOH	1.6	13	1	80	GRA	1.2	21	2	80	REM	1.7
5	1	60	WHA	1.0	9	1	250	HOH	5.8	13	1	87.5	WHA	6.8	21	2	80	REM	1.3
5	1	60	BLC	1.3	9	2	10	AMH	10.5	13	1	87.5	GRA	3.8	21	2	80	REM	1.4
5	1	60	QUA	1.1	9	2	10	AMH	12.5	13	1	87.5	GRA	3.9	21	2	80	REM	2.2
5	1	60	WHA	1.6	9	2	10	SUM	3.2	13	1	87.5	GRA	11.0	21	2	80	REM	2.0
5	1	60	REM	1.7	9	2	10	HOH	10.0	13	1	87.5	GRA	3.3	21	2	80	REM	1.0
5	1	60	REM	1.1	9	2	10	AMH	15.0	13	1	87.5	GRA	3.5	21	2	90	SCP	1.3
5	1	60	BLC	1.5	9	2	10	SUM	2.4	13	1	87.5	GRA	3.3	21	2	90	REM	1.3
5	1	60	REM	1.1	9	2	10	HOH	9.5	13	1	87.5	SLE	1.3	21	2	90	BLC	1.0
5	1	60	WHA	1.6	9	2	10	HOH	9.5	13	1	87.5	GRA	3.0	21	2	90	REM	1.0
5	1	60	WHA	1.8	9	2	10	AMH	10.5	13	1	87.5	GRA	4.2	21	2	90	REM	1.8
5	1	60	REM	1.7	9	2	10	SUM	2.9	13	2	10	WHA	1.0	21	2	90	REM	1.0
5	1	60	REM	1.4	9	2	10	SUM	3.6	13	2	10	PIC	1.5	21	2	90	REM	2.1
5	1	70	REM	1.0	9	2	10	HOH	16.5	13	2	10	WHA	1.5	21	2	100	REM	1.0
5	1	70	WHA	2.4	9	2	10	AMH	12.5	13	2	10	GRA	1.4	21	2	100	REM	1.0
5	1	70	GRA	2.4	9	2	10	AMH	9.0	13	2	10	WHA	1.5	21	2	100	REM	2.3
5	1	70	WHA	1.7	9	2	10	HOH	13.2	13	2	10	GRA	1.4	21	2	110	REM	2.0
5	1	70	REM	1.8	9	2	10	HOH	9.5	13	2	20	PIC	2.5	21	2	110	BLC	1.8
5	1	70	REM	1.1	9	2	10	AMH	8.4	13	2	30	WHA	1.3	21	2	120	REM	2.0
5	1	70	WHA	1.6	9	2	10	AMH	14.5	13	2	30	SLE	1.3	21	2	120	REM	1.5
5	1	70	WHA	2.4	9	2	10	HOH	16.0	13	2	30	WHA	1.2	21	2	120	REM	1.7
5	1	70	REM	1.2	9	2	10	HOH	16.0	13	2	30	WHA	1.2	21	2	120	BLC	1.3
5	1	70	WHA	1.7	9	2	10	HOH	3.2	13	2	30	SLE	1.2	21	2	120	REM	2.2
5	1	70	REM	2.1	9	2	10	SUM	14.5	13	2	40	GRA	1.5	21	2	120	BLC	1.1
5	1	70	REM	1.9	9	2	10	SUM	3.6	13	2	50	WHA	1.3	21	2	120	REM	2.0
5	1	70	WHA	2.0	9	2	10	HOH	10.5	13	2	50	PIC	2.5	21	2	130	REM	1.9
5	1	70	REM	2.5	9	2	10	AMH	2.4	13	2	50	BLC	1.1	21	2	130	BLC	1.2
5	1	70	REM	1.6	9	2	10	HOH	16.0	13	2	50	LAA	1.3	21	2	130	PIC	2.4
5	1	70	WHA	2.0	9	2	20	AMH	1.9	13	2	60	WHA	2.8	21	2	130	REM	1.1
5	1	70	WHA	1.3	9	2	20	SUM	4.1	13	2	60	WHA	3.0	21	2	130	REM	2.0
5	1	70	WHA	2.1	9	2	30	AMH	1.2	13	2	60	LAA	2.5	21	2	130	REM	2.3
5	1	70	WHA	1.6	9	2	30	AMH	1.1	13	2	60	WHA	1.5	21	2	130	REM	2.0
5	1	70	WHA	2.7	9	2	30	AMH	1.5	13	2	70	WHA	2.2	21	2	130	REM	1.7
5	1	70	BLC	1.7	9	2	30	AMH	1.0	13	2	70	WHA	1.2	21	2	130	GRB	3.8
5	1	70	WHA	2.3	9	2	30	AMH	1.0	13	2	70	WHA	1.0	21	2	130	REM	1.6
5	1	80	GRA	1.8	9	2	30	AMH	1.0	13	2	70	LAA	3.1	21	2	130	REM	2.4
5	1	80	WHA	1.7	9	2	30	AMH	1.1	13	2	70	LAA	2.5	21	2	130	BLC	2.0
5	1	80	WHA	2.2	9	2	40	REO	1.6	13	2	70	LAA	1.0	21	2	140	BLC	1.7
5	1	80	WHA	4.6	9	2	40	AMH	1.0	13	2	80	NO	0.0	21	2	140	REM	1.0
5	1	80	REM	2.6	9	2	40	AMH	1.0	13	2	90	WHA	2.3	21	2	140	PIC	2.3
5	1	80	WHA	3.1	9	2	50	NO	0.0	13	2	90	WHA	1.4	21	2	140	GRB	1.5
5	1	80	WHA	3.3	9	2	60	NO	0.0	13	2	90	LAA	2.3	21	2	140	REM	1.5
5	1	80	WHA	6.0	9	2	70	NO	0.0	13	2	100	LAA	1.1	21	2	140	GRB	1.8
5	1	80	SAS	1.7	9	2	80	NO	0.0	13	2	100	LAA	2.6	21	2	140	PIC	2.2
5	1	80	SAS	2.8	9	2	90	NO	0.0	13	2	100	LAA	3.0	21	2	140	SCP	1.3
5	1	80	GRA	4.1	9	2	100	AMH	1.5	14	1	10	NO	0.0	21	2	140	PIC	1.0
5	1	80	WHA	2.1	9	2	100	AMH	2.2	14	1	20	NO	0.0	21	2	140	BLC	1.5
5	1	80	SAS	2.9	9	2	110	QUA	1.2	14	1	30	NO	0.0	21	2	140	GRB	1.6
5	1	80	REM	2.1	9	2	110	AMH	1.8	14	1	40	NO	0.0	21	2	140	PIC	1.1
5	1	80	WHA	4.2	9	2	120	QUA	1.3	14	1	50	NO	0.0	21	2	140	BLC	1.3
5	1	80	GRA	2.6	9	2	120	AMH	1.3	14	1	60	SWO	1.4	21	2	140	SCP	1.4
5	1	80	WHA	3.6	9	2	120	AMH	2.5	14	1	70	NO	0.0	21	2	150	BLC	1.3
5	1	80	WHA	1.6	9	2	120	AMH	1.5	14	1	80	NO	0.0	21	2	150	BLC	1.2

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	1	80	WHA	1.2	9	2	120	AMH	1.1	14	1	90	NO	0.0	21	2	150	REM	1.6
5	1	80	REM	5.8	9	2	120	AMH	1.2	14	1	100	GRA	2.6	21	2	150	BLC	1.3
5	1	80	ERC	1.5	9	2	120	AMH	2.4	14	1	110	NO	0.0	21	2	150	BLC	2.2
5	1	80	WHA	1.5	9	2	120	AMH	1.9	14	1	120	NO	0.0	21	2	150	BLC	1.5
5	1	80	WHA	3.2	9	2	120	AMH	2.4	14	1	130	NO	0.0	21	2	150	BLC	1.8
5	1	80	GRA	2.7	9	2	120	EAH	1.6	14	1	140	NO	0.0	21	2	150	BLC	1.8
5	1	80	REM	1.8	9	2	120	AMH	1.9	14	1	150	NO	0.0	21	2	150	BLC	1.0
5	1	80	SAS	1.8	9	2	120	AMH	1.1	14	2	10	NO	0.0	21	2	150	BLC	2.3
5	1	80	WHA	1.4	9	2	120	AMH	1.1	14	2	20	NO	0.0	21	2	150	REM	1.9
5	1	80	REM	2.7	9	2	120	AMH	1.2	14	2	30	NO	0.0	21	2	150	BLC	1.6
5	1	80	WHA	2.4	9	2	120	QUA	1.1	14	2	40	NO	0.0	21	2	150	GRB	2.0
5	1	80	WHA	2.0	9	2	120	AMH	1.4	14	2	50	NO	0.0	21	2	150	REM	1.0
5	1	80	WHA	3.3	9	2	120	AMH	1.2	14	2	60	NO	0.0	21	2	150	BLC	2.2
5	1	80	GRA	9.6	9	2	130	NO	0.0	14	2	70	NO	0.0	21	2	150	BLC	2.0
5	1	80	REM	1.8	9	2	140	NO	0.0	14	2	80	NO	0.0	21	2	150	BLC	2.5
5	1	80	WHA	1.3	9	2	150	NO	0.0	14	2	90	NO	0.0	21	2	150	BLC	1.8
5	1	80	WHA	1.3	9	2	160	AMH	8.6	14	2	100	NO	0.0	21	2	150	REM	2.0
5	1	80	GRA	3.3	9	2	170	AMH	2.0	14	2	110	NO	0.0	21	2	150	BLC	1.0
5	1	80	WHA	2.7	9	2	170	AMH	1.1	14	2	120	NO	0.0	21	2	150	BLC	1.5
5	1	80	GRA	4.8	9	2	170	AMH	1.1	14	2	130	NO	0.0	21	2	150	BLC	1.3
5	1	80	WHA	2.0	9	2	170	AMH	2.6	14	2	140	NO	0.0	21	2	150	BLC	1.8
5	1	80	GRA	3.3	9	2	170	AMH	2.5	14	2	150	NO	0.0	21	2	150	YEB	2.0
5	1	80	GRA	2.6	9	2	170	AMH	2.8	14	2	160	NO	0.0	21	2	150	REM	1.8
5	1	80	WHA	1.3	9	2	170	AMH	2.4	14	2	170	NO	0.0	21	2	150	BLC	1.0
5	1	80	WHA	2.5	9	2	170	AMH	1.3	14	2	175	NO	0.0	21	2	150	REM	1.4
5	1	80	REM	2.0	9	2	170	AMH	1.2	15	1	10	NO	0.0	21	2	150	YEB	1.3
5	1	80	WHA	2.4	9	2	170	AMH	8.3	15	1	20	NO	0.0	21	2	150	BLC	1.3
5	1	80	ERC	2.6	9	2	180	NO	0.0	15	1	30	NO	0.0	21	2	150	BLC	1.3
5	1	80	WHA	2.2	9	2	190	NO	0.0	15	1	40	NO	0.0	21	2	150	REM	1.3
5	1	80	GRB	11.6	9	2	200	NO	0.0	15	1	50	NO	0.0	21	2	150	BLC	1.0
5	1	80	REM	2.7	9	2	210	NO	0.0	15	1	60	NO	0.0	21	2	150	BLC	1.4
5	1	80	WHA	3.0	9	2	220	NO	0.0	15	1	65	NO	0.0	21	2	150	BLC	1.0
5	1	80	WHA	2.2	9	2	225	AMH	1.3	15	2	10	WHA	1.0	21	2	150	BLC	1.3
5	1	80	ERC	2.1	9	2	225	AMH	1.4	15	2	10	REM	3.5	21	2	150	BLC	2.1
5	1	80	GRA	2.7	9	2	225	AMH	3.0	15	2	10	PIC	1.0	21	2	150	BLC	1.3
5	1	80	WHA	2.1	9	2	225	AMH	1.2	15	2	10	REM	1.7	21	2	150	GRB	2.3
5	1	80	GRA	4.3	9	2	225	AMH	1.0	15	2	10	WHA	1.0	21	2	150	BLC	1.0
5	1	80	ERC	2.5	9	5	10	HOH	1.0	15	2	10	REM	2.7	21	2	150	BLC	1.8
5	1	80	GRA	2.7	9	5	10	AMB	2.1	15	2	10	REM	1.6	21	2	150	BLC	1.0
5	2	10	WHA	1.4	9	5	10	WHP	7.1	15	2	10	BLO	1.6	21	2	150	BLC	2.0
5	2	10	SWB	4.2	9	5	10	YEB	2.9	15	2	10	REM	1.5	21	2	150	GRB	2.0
5	2	10	SAS	4.9	9	5	10	AMH	2.1	15	2	10	BLC	1.5	21	2	150	BLC	2.3
5	2	10	SAS	2.8	9	5	10	HOH	1.0	15	2	10	REM	1.8	21	2	150	GRB	1.3
5	2	10	AMH	1.7	9	5	10	AMB	1.8	15	2	10	REM	3.0	21	2	150	BLC	1.8
5	2	10	WHA	2.1	9	5	10	WHP	3.9	15	2	10	REM	3.2	21	2	150	BLC	1.3
5	2	10	BLC	2.8	9	5	10	AMH	5.1	15	2	10	BLC	2.0	21	2	150	BLC	1.5
5	2	10	HOH	2.2	9	5	10	HOH	2.0	15	2	10	SUM	4.0	21	2	150	BLC	1.9
5	2	10	SAS	3.3	9	5	10	HOH	3.9	15	2	10	REM	2.8	21	2	150	GRB	2.3
5	2	10	SAS	4.4	9	5	10	HOH	1.8	15	2	10	REM	3.7	21	2	150	BLC	1.3
5	2	10	AMH	1.7	9	5	10	AMH	1.4	15	2	10	SUM	2.5	21	2	150	BLC	1.5
5	2	10	GRB	1.9	9	5	10	AMH	5.3	15	2	10	REM	2.6	21	2	150	BLC	2.0
5	2	10	WHA	1.0	9	5	10	WHP	2.9	15	2	10	REM	3.8	21	3	10	REM	3.4
5	2	10	COT	9.4	9	5	10	YEB	1.2	15	2	10	REM	1.3	21	3	10	REM	3.5
5	2	10	BLC	1.8	9	5	10	WHP	4.8	15	2	10	REM	1.8	21	3	10	PIC	4.0

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	2	10	SAS	2.4	9	5	10	AMB	1.6	15	2	10	REM	1.8	21	3	10	REM	1.0
5	2	10	CHO	1.2	9	5	20	NO	0.0	15	2	10	REM	3.4	21	3	10	PIC	6.0
5	2	10	HOH	2.3	9	5	30	NO	0.0	15	2	10	BLC	1.9	21	3	10	BLC	3.2
5	2	10	WHA	1.6	9	5	40	AMH	3.3	15	2	10	REM	1.8	21	3	10	PIC	4.0
5	2	10	HOH	1.7	9	5	40	YEB	1.9	15	2	10	REM	1.5	21	3	10	REM	2.5
5	2	10	GRB	4.4	9	5	40	AMH	2.5	15	2	10	REM	3.2	21	3	10	REM	1.6
5	2	10	HOH	1.9	9	5	50	YEB	1.0	15	2	10	WHA	1.0	21	3	10	BLC	6.0
5	2	10	WHA	5.6	9	5	60	NO	0.0	15	2	10	REM	3.7	21	3	10	REM	3.1
5	2	10	SAS	3.7	9	5	70	NO	0.0	15	2	10	PIC	2.0	21	3	10	REM	6.0
5	2	10	REM	1.6	9	5	80	YEB	1.1	15	2	10	QUA	1.8	21	3	10	PIC	1.5
5	2	10	CHO	2.2	9	5	80	PIC	1.3	15	2	10	REM	1.3	21	3	10	BLC	5.5
5	2	10	BIH	5.1	9	5	90	WHA	1.5	15	2	10	REM	1.7	21	3	10	PIC	2.3
5	2	10	SWB	5.3	9	5	100	YEB	1.0	15	2	10	REM	2.1	21	3	10	REM	2.2
5	2	10	SWB	4.9	9	5	110	YEB	1.0	15	2	20	BLO	1.3	21	3	10	PIC	6.0
5	2	10	GRB	4.5	9	5	120	SUM	1.3	15	2	30	NO	0.0	21	3	10	BLC	6.0
5	2	10	REM	1.4	9	5	120	SHB	1.0	15	2	40	NO	0.0	21	3	10	PIC	4.5
5	2	10	GRB	3.3	9	5	120	REM	1.0	15	2	50	NO	0.0	21	3	10	PIC	4.0
5	2	10	BLC	1.2	9	5	120	SHB	1.0	15	2	60	NO	0.0	21	3	10	BLC	3.5
5	2	10	CHO	1.7	9	5	130	SHB	1.1	16	1	10	LAA	1.3	21	3	10	BLC	6.0
5	2	10	WHA	2.3	9	5	130	SHB	1.5	16	1	10	QUA	1.3	21	3	10	BLC	6.0
5	2	10	GRB	4.8	9	5	130	WHA	1.1	16	1	10	QUA	1.3	21	3	10	BLC	3.3
5	2	20	WHA	1.0	9	5	130	BLC	1.2	16	1	10	QUA	1.4	21	3	10	PIC	6.0
5	2	20	SWB	1.3	9	5	130	SHB	1.0	16	1	10	QUA	1.5	21	3	10	REM	2.3
5	2	20	BLC	1.9	9	5	140	REM	1.1	16	1	10	QUA	1.1	21	3	10	PIC	6.0
5	2	20	REM	1.4	9	5	140	REM	1.0	16	1	10	QUA	1.1	21	3	10	YEB	2.3
5	2	20	SAS	1.3	9	5	150	REM	1.5	16	1	10	QUA	1.5	21	3	10	REM	3.0
5	2	20	GRB	1.9	9	5	150	REM	1.1	16	1	10	QUA	1.0	21	3	10	YEB	5.0
5	2	20	SWB	2.3	9	5	150	WHA	1.1	16	1	10	QUA	3.7	21	3	10	PIC	1.9
5	2	20	LAA	1.7	9	5	150	AMH	1.0	16	1	10	QUA	1.8	21	3	10	BLC	3.2
5	2	20	SWB	2.3	9	5	150	REM	1.2	16	1	10	QUA	1.0	21	3	10	REM	2.8
5	2	20	AMH	2.5	9	5	150	SCP	1.1	16	1	10	AMB	1.0	21	3	10	PIC	1.3
5	2	20	SAS	1.3	9	5	160	REM	1.0	16	1	10	QUA	1.7	21	3	10	YEB	4.0
5	2	20	WHA	1.4	9	5	160	SHB	1.4	16	1	10	QUA	1.2	21	3	20	GRB	1.0
5	2	20	SAS	1.8	9	5	160	BLC	2.7	16	1	10	QUA	1.4	21	3	20	PIC	3.0
5	2	20	AMH	1.6	9	5	160	REM	1.3	16	1	10	QUA	1.9	21	3	20	PIC	3.0
5	2	20	SAS	1.3	9	5	160	REM	1.0	16	1	10	LAA	1.2	21	3	20	PIC	3.5
5	2	20	WHA	1.3	9	5	160	WHA	1.4	16	1	10	QUA	1.4	21	3	20	GRB	1.6
5	2	20	SAS	1.2	9	5	160	YEB	1.1	16	1	10	QUA	1.4	21	3	20	REM	2.5
5	2	20	GRB	1.4	9	5	160	REM	1.4	16	1	20	QUA	2.1	21	3	20	PIC	3.5
5	2	20	GRB	3.5	9	5	170	NO	0.0	16	1	20	QUA	1.0	21	3	20	REM	2.5
5	2	20	SAS	1.6	9	5	180	WHA	1.4	16	1	20	QUA	1.1	21	3	30	NO	0.0
5	2	20	REM	1.0	9	5	180	REM	1.3	16	1	20	QUA	1.0	21	3	40	NO	0.0
5	2	20	GRB	4.4	9	5	180	REM	1.0	16	1	20	QUA	1.6	21	3	50	NO	0.0
5	2	20	GRB	4.8	9	5	180	REM	1.7	16	1	20	QUA	1.5	21	3	60	PIC	3.0
5	2	20	BLC	1.3	9	5	190	REM	1.1	16	1	20	QUA	2.0	21	3	60	COT	2.0
5	2	20	AMH	1.4	9	5	190	REM	1.5	16	1	20	QUA	1.6	21	3	60	COT	1.9
5	2	20	SAS	1.7	9	5	190	REM	1.5	16	1	20	QUA	2.3	21	3	70	PIC	3.8
5	2	20	GRB	3.5	9	5	190	REM	1.3	16	1	20	QUA	1.6	21	3	70	REM	2.0
5	2	20	SAS	1.1	9	5	190	REM	1.4	16	1	20	QUA	1.1	21	3	70	BLC	3.5
5	2	20	SAS	1.1	9	5	200	YEB	2.6	16	1	20	QUA	1.9	21	3	70	PAB	1.8
5	2	20	SAS	1.0	9	5	200	REM	1.5	16	1	20	QUA	1.0	21	3	70	REM	1.5
5	2	20	AMH	2.0	9	5	200	REM	3.0	16	1	30	QUA	1.3	21	3	70	YEB	2.5
5	2	20	GRB	3.6	9	5	200	YEB	2.5	16	1	30	QUA	1.6	21	3	70	BLC	1.3
5	2	20	SAS	2.4	9	5	200	REM	1.3	16	1	30	QUA	2.9	21	3	70	PIC	2.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	2	20	GRB	4.8	9	5	210	BLL	1.1	16	1	30	QUA	2.2	21	3	70	PAB	1.0
5	2	20	BLC	2.2	9	5	220	REM	1.2	16	1	30	QUA	2.4	21	3	70	BLC	1.3
5	2	20	AMH	1.6	9	5	225	NO	0.0	16	1	30	QUA	2.0	21	3	70	BLC	1.7
5	2	20	SAS	2.0	10	2	10	AMH	1.1	16	1	30	QUA	2.0	21	3	70	BLC	3.0
5	2	20	BLC	2.2	10	2	10	AMH	1.0	16	1	30	QUA	1.6	21	3	70	BLC	2.9
5	2	20	SAS	1.4	10	2	10	AMH	1.3	16	1	30	QUA	2.2	21	3	70	REM	2.0
5	2	20	BLC	3.2	10	2	10	AMH	1.3	16	1	30	QUA	1.6	21	3	70	PIC	1.7
5	2	20	AMH	2.3	10	2	10	AMH	1.2	16	1	30	QUA	1.7	21	3	70	BLC	2.5
5	2	20	SAS	1.1	10	2	10	AMH	2.1	16	1	30	QUA	1.7	21	3	70	PIC	2.5
5	2	20	BLC	1.5	10	2	10	AMH	1.2	16	1	30	QUA	1.6	21	3	70	BLC	3.0
5	2	20	SAS	1.5	10	2	20	AMH	1.0	16	1	30	QUA	1.6	21	3	70	BLC	1.7
5	2	20	SWB	2.0	10	2	20	BLC	1.6	16	1	30	QUA	2.9	21	3	70	YEB	3.0
5	2	20	SWB	1.6	10	2	20	AMH	4.5	16	1	30	QUA	1.4	21	3	70	BLC	2.5
5	2	20	BLC	1.6	10	2	30	AMH	2.1	16	1	30	QUA	2.4	21	3	70	PIC	2.0
5	2	20	SAS	1.8	10	2	30	AMH	1.0	16	1	30	QUA	2.6	21	3	70	PAB	2.0
5	2	20	SWB	1.1	10	2	40	NO	0.0	16	1	40	QUA	1.8	21	3	70	PIC	2.5
5	2	20	SAS	2.4	10	2	50	NO	0.0	16	1	40	QUA	2.0	21	3	70	GRB	4.0
5	2	20	SAS	2.2	10	2	60	NO	0.0	16	1	40	QUA	1.4	21	3	70	REM	2.3
5	2	20	AMH	2.1	10	2	70	NO	0.0	16	1	40	QUA	1.3	21	3	70	BLC	1.6
5	2	20	AMH	1.7	10	2	80	NO	0.0	16	1	40	QUA	1.5	21	3	70	YEB	1.5
5	2	20	GRB	1.5	10	2	90	NO	0.0	16	1	40	QUA	1.2	21	3	70	PAB	2.6
5	2	20	SWB	4.4	10	2	100	NO	0.0	16	1	40	QUA	1.1	21	3	70	YEB	2.8
5	2	20	SAS	2.1	10	2	110	NO	0.0	16	1	40	QUA	2.0	21	3	70	YEB	3.7
5	2	20	SAS	1.5	10	2	120	NO	0.0	16	1	40	QUA	2.8	21	3	80	GRB	3.0
5	2	20	SWB	1.8	10	2	130	NO	0.0	16	1	40	QUA	1.7	21	3	80	BLC	3.0
5	2	20	REM	1.3	10	2	140	QUA	1.0	16	1	40	QUA	2.4	21	3	80	YEB	1.8
5	2	20	SWB	2.3	10	2	140	AMH	1.0	16	1	40	QUA	1.5	21	3	80	REM	2.0
5	2	20	AMH	2.2	10	2	140	QUA	1.0	16	1	40	QUA	2.2	21	3	80	REM	2.9
5	2	30	SAS	1.3	10	2	150	QUA	1.0	16	1	40	QUA	2.5	21	3	80	YEB	2.5
5	2	30	REM	1.7	10	2	150	QUA	1.0	16	1	40	QUA	1.3	21	3	80	SUM	1.0
5	2	30	AMH	1.4	10	2	150	QUA	1.0	16	1	40	QUA	1.3	21	3	80	YEB	3.5
5	2	30	GRB	1.4	10	2	150	QUA	1.0	16	1	50	BLC	1.0	21	3	80	GRB	3.8
5	2	30	WHA	1.0	10	2	150	QUA	1.2	16	1	50	BLC	1.5	21	3	80	REM	1.6
5	2	30	QUA	1.3	10	2	150	AMH	3.4	16	1	50	BLC	1.0	21	3	80	BLC	1.7
5	2	30	CHO	1.7	10	2	160	AMH	1.1	16	1	50	QUA	2.3	21	3	80	GRB	3.5
5	2	30	REM	1.2	10	2	160	AMH	1.0	16	1	50	QUA	2.3	21	3	80	YEB	2.3
5	2	30	AMH	1.0	10	2	160	QUA	1.0	16	1	50	BLC	1.5	21	3	80	YEB	3.6
5	2	40	QUA	1.5	10	2	160	AMH	1.0	16	1	50	BLC	1.3	21	3	80	YEB	1.8
5	2	40	QUA	2.4	10	2	160	AMH	1.6	16	1	50	BLC	1.2	21	3	80	AMB	2.8
5	2	40	REM	1.5	11	1	10	WHA	6.0	16	1	50	BLC	1.2	21	3	80	GRB	2.7
5	2	50	REM	1.0	11	1	10	WHA	4.6	16	1	50	BLC	1.1	21	3	80	YEB	3.5
5	2	60	BLC	1.1	11	1	10	WHA	6.0	16	1	50	QUA	2.3	21	3	80	GRB	3.0
5	2	60	BIH	1.4	11	1	10	WHA	3.5	16	1	50	BLC	1.5	21	3	80	GRB	4.0
5	2	60	WHA	1.1	11	1	10	REM	6.0	16	1	50	QUA	2.2	21	3	80	SUM	2.5
5	2	60	BLC	1.5	11	1	10	WHA	5.0	16	1	50	BLC	1.0	21	3	80	YEB	3.8
5	2	60	SHH	1.3	11	1	10	WHA	6.0	16	1	50	BLC	1.3	21	3	80	GRB	4.0
5	2	60	WHA	1.1	11	1	10	WHA	6.0	16	1	50	BLC	1.4	21	3	80	REM	1.5
5	2	60	WHA	1.0	11	1	10	WHA	6.0	16	1	50	QUA	1.4	21	3	80	GRB	4.0
5	2	60	BLC	1.1	11	1	10	WHA	5.1	16	1	50	QUA	1.4	21	3	80	REM	2.0
5	2	70	WHO	1.1	11	1	10	WHA	6.0	16	1	50	BLC	1.0	21	3	80	PIC	2.6
5	2	70	WHA	2.0	11	1	10	WHA	6.0	16	1	50	BLC	1.0	21	3	80	GRB	3.5
5	2	70	SHB	1.1	11	1	10	WHA	6.0	16	1	50	QUA	2.1	21	3	80	REM	1.9
5	2	70	BLC	1.2	11	1	10	WHA	6.0	16	1	50	BLC	1.0	21	3	80	REM	1.5
5	2	70	WHA	2.2	11	1	20	WHA	1.1	16	1	50	BLC	1.1	21	3	80	REM	3.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	2	70	BLC	2.4	11	1	20	WHA	6.0	16	1	50	BLC	1.2	21	3	80	BLC	2.6
5	2	70	GRB	1.5	11	1	20	WHA	1.8	16	1	50	BLC	1.0	21	3	80	SUM	2.4
5	2	70	BLC	2.2	11	1	20	BLL	6.0	16	1	50	BLC	1.0	21	3	80	BLC	1.9
5	2	70	GRB	1.4	11	1	20	BLL	2.0	16	1	50	BLC	1.2	21	3	80	REM	2.5
5	2	70	BLC	1.1	11	1	20	BLL	3.5	16	1	50	BLC	1.7	21	3	80	GRB	2.8
5	2	70	BLC	1.1	11	1	20	BLL	1.3	16	1	50	QUA	1.0	21	3	80	GRB	4.2
5	2	70	BLC	1.5	11	1	30	BLL	1.0	16	1	50	BLC	1.0	21	3	80	GRB	5.0
5	2	70	GRB	1.3	11	1	30	WHA	1.7	16	1	50	BLC	1.2	21	3	80	GRB	4.0
5	2	70	BLC	1.0	11	1	30	BLL	2.3	16	1	50	BLC	1.0	21	3	80	GRB	3.2
5	2	70	GRB	1.2	11	1	30	WHA	1.7	16	1	50	BLC	1.6	21	3	80	GRB	2.8
5	2	70	AMH	1.3	11	1	30	WHA	1.1	16	1	50	BLC	1.3	21	3	80	GRB	3.0
5	2	80	WHO	2.3	11	1	30	WHA	1.0	16	1	60	BLC	1.0	21	3	80	GRB	3.8
5	2	80	WHA	4.9	11	1	30	WHA	1.2	16	1	60	BLC	1.2	21	3	90	REM	2.7
5	2	80	WHA	2.3	11	1	30	SLE	2.3	16	1	60	BLC	1.4	21	3	90	PIC	1.8
5	2	80	WHA	2.7	11	1	40	WHA	1.3	16	1	60	BLC	1.2	21	3	90	PIC	1.6
5	2	80	BLO	5.6	11	1	40	WHA	1.0	16	1	60	BLC	1.1	21	3	90	BLC	2.3
5	2	80	BLC	1.8	11	1	40	WHA	1.0	16	1	60	BLC	1.0	21	3	90	REM	2.7
5	2	80	AMH	3.1	11	1	40	BLC	2.9	16	1	60	BLC	1.3	21	3	90	REM	2.7
5	2	80	WHA	1.9	11	1	40	BLC	1.1	16	1	60	BLC	1.3	21	3	90	PIC	2.5
5	2	80	WHO	6.1	11	1	40	BLL	2.3	16	1	60	BLC	1.4	21	3	90	GRB	2.5
5	2	80	WHA	1.9	11	1	40	WHA	1.5	16	1	60	BLC	1.0	21	3	90	BLC	3.9
5	2	80	WHO	2.1	11	1	40	WHA	1.2	16	1	60	BLC	1.4	21	3	90	REM	1.7
5	2	80	CHO	3.0	11	1	40	WHA	1.5	16	1	60	BLC	1.0	21	3	90	YEB	3.4
5	2	80	BIH	4.1	11	1	40	WHA	1.3	16	1	60	BLC	1.3	21	3	90	GRB	3.5
5	2	80	REM	3.2	11	1	40	WHA	1.3	16	1	60	BLC	1.3	21	3	90	PIC	3.4
5	2	80	WHA	3.2	11	1	40	WHA	1.1	16	1	60	BLC	1.2	21	3	90	REM	2.5
5	2	80	BLO	6.3	11	1	40	WHA	1.1	16	1	60	BLC	1.2	21	3	90	BLC	1.5
5	2	80	REM	1.7	11	1	40	WHA	1.3	16	1	60	BLC	1.4	21	3	90	PIC	2.0
5	2	80	WHO	5.5	11	1	40	WHA	1.2	16	1	60	BLC	1.2	21	3	90	REM	1.8
5	2	85	AME	1.7	11	1	40	WHA	1.1	16	1	60	BLC	1.0	21	3	90	YEB	2.2
5	2	85	BLC	1.2	11	1	40	WHA	1.4	16	1	60	BLC	1.5	21	3	90	PIC	2.0
5	2	85	AMH	1.7	11	1	40	WHA	1.2	16	1	60	BLC	1.1	21	3	90	REM	2.0
5	2	85	AMH	1.4	11	1	40	WHA	1.3	16	1	60	BLC	1.6	21	3	90	YEB	1.8
5	2	85	AME	1.7	11	1	40	BLC	2.2	16	1	60	BLC	1.0	21	3	90	PIC	1.4
5	2	85	BLC	1.1	11	1	40	WHA	1.2	16	1	60	BLC	1.7	21	3	90	GRB	2.5
5	2	85	AMH	1.7	11	1	40	WHA	1.5	16	1	70	BLC	1.0	21	3	90	YEB	3.0
5	2	85	AMH	1.5	11	1	40	WHA	1.0	16	1	70	BLC	1.4	21	3	90	YEB	1.2
5	2	85	SCO	4.1	11	1	40	BLC	2.3	16	1	70	BLC	1.1	21	3	90	REM	2.3
5	2	85	AME	2.0	11	1	40	WHA	2.0	16	1	70	BLC	1.3	21	3	90	REM	1.3
5	3	10	SAS	1.3	11	1	40	WHA	1.3	16	1	70	BLC	1.2	21	3	90	BLC	2.5
5	3	10	AMH	1.2	11	1	40	WHA	1.7	16	1	70	BLC	1.1	21	3	90	YEB	2.3
5	3	10	SAS	1.2	11	1	40	WHA	1.3	16	1	75	WHA	2.1	21	3	90	PIC	2.4
5	3	10	YEB	1.3	11	1	40	WHA	1.4	16	1	75	BLC	1.3	21	3	90	PIC	1.7
5	3	10	AMH	1.1	11	1	40	WHA	1.5	16	1	75	BLC	1.1	21	3	90	REM	2.5
5	3	10	YEB	1.0	11	1	40	WHA	1.1	16	1	75	WHA	1.1	21	3	90	PIC	3.0
5	3	10	AMH	1.0	11	1	40	BLC	1.0	16	2	10	REM	1.2	21	3	90	REM	1.4
5	3	10	YEB	1.0	11	1	40	WHA	1.3	16	2	10	BLC	2.4	21	3	90	YEB	3.0
5	3	10	SAS	1.2	11	1	40	WHA	1.3	16	2	20	BLC	2.1	21	3	90	PIC	1.5
5	3	10	YEB	1.6	11	1	40	WHA	1.2	16	2	20	BLC	2.4	21	3	90	BLC	2.2
5	3	10	SAS	2.2	11	1	40	WHA	2.1	16	2	20	BLC	1.9	21	3	90	PIC	1.5
5	3	10	AMH	1.7	11	1	40	WHA	1.0	16	2	20	BLC	1.9	21	3	90	REM	1.2
5	3	10	SWB	2.5	11	1	40	WHA	1.3	16	2	20	BLC	2.2	21	3	90	PIC	3.0
5	3	10	AMH	1.2	11	1	40	WHA	1.4	16	2	20	BLC	2.2	21	3	90	PIC	1.8
5	3	10	SWB	1.3	11	1	40	BLC	1.9	16	2	20	BLC	2.4	21	3	90	BLC	1.2

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	3	10	BLC	1.3	11	1	40	WHA	1.2	16	2	20	BLC	1.0	21	3	90	REM	3.3
5	3	10	SWB	1.9	11	1	40	WHA	1.0	16	2	20	BLC	1.5	21	3	90	PIC	2.5
5	3	10	BLC	1.2	11	1	40	WHA	1.1	16	2	20	BLC	1.8	21	3	90	REM	2.5
5	3	10	SWB	1.3	11	1	40	WHA	1.2	16	2	20	BLC	1.8	21	3	90	YEB	2.4
5	3	10	SAS	1.0	11	1	40	WHA	1.1	16	2	30	BLC	1.8	21	3	90	REM	2.8
5	3	10	SWB	1.1	11	1	40	WHA	1.1	16	2	30	BLC	1.2	21	3	90	REM	1.5
5	3	10	SAS	1.0	11	1	40	BLL	1.6	16	2	30	BLC	2.3	21	3	90	PIC	4.1
5	3	10	SWB	1.2	11	1	40	WHA	1.2	16	2	30	BLC	1.7	21	3	90	REM	2.9
5	3	10	SAS	1.0	11	1	40	BLC	1.3	16	2	30	BLC	2.5	21	3	90	PIC	3.1
5	3	10	SWB	1.2	11	1	40	GRA	1.8	16	2	30	BLC	2.2	21	3	90	BLC	3.0
5	3	10	SAS	1.6	11	1	40	WHA	1.5	16	2	30	BLC	2.3	21	3	90	PIC	4.2
5	3	10	SWB	1.1	11	1	40	BLC	1.0	16	2	30	BLC	2.1	21	3	90	YEB	3.1
5	3	10	SWB	2.3	11	1	40	WHA	1.2	16	2	30	BLC	1.3	21	3	90	BLC	1.8
5	3	10	SWB	3.1	11	1	40	WHA	1.2	16	2	30	BLC	1.1	21	3	90	PIC	2.3
5	3	10	SWB	1.6	11	1	40	BLC	1.6	16	2	30	BLC	1.5	21	3	90	REM	2.3
5	3	10	SWB	2.7	11	1	40	WHA	1.2	16	2	30	BLC	1.6	21	3	90	REM	2.5
5	3	10	SWB	1.6	11	1	40	WHA	1.0	16	2	40	BLC	1.8	21	3	90	BLC	2.4
5	3	10	SWB	1.4	11	1	40	WHA	1.2	16	2	40	BLC	1.0	21	3	90	BLC	3.0
5	3	10	SAS	1.2	11	1	40	WHA	1.5	16	2	40	WHA	1.3	21	3	90	BLC	1.4
5	3	10	SWB	1.3	11	1	40	WHA	1.4	16	2	40	BLC	1.1	21	3	90	REM	1.3
5	3	10	SAS	1.2	11	1	40	WHA	1.3	16	2	50	BLC	1.4	21	3	90	REM	2.6
5	3	10	SWB	1.0	11	1	40	WHA	1.3	16	2	50	BLC	1.0	21	3	90	REM	2.0
5	3	10	YEB	1.1	11	1	40	WHA	1.6	16	2	50	REM	1.0	21	3	90	REM	4.2
5	3	10	SWB	1.0	11	1	40	WHA	1.2	16	2	50	REM	1.4	21	3	90	BLC	3.7
5	3	10	AMH	1.1	11	1	40	WHA	1.1	16	2	50	BLC	2.0	21	3	90	BLC	2.6
5	3	10	BLO	1.2	11	1	40	WHA	1.3	16	2	50	BLC	1.0	21	3	90	REM	2.5
5	3	10	SWB	1.2	11	1	40	BLL	2.1	16	2	50	BLC	1.3	21	3	90	REM	2.3
5	3	10	AMH	1.3	11	1	40	WHA	1.2	16	2	50	BLC	1.0	21	3	90	BLC	3.0
5	3	10	YEB	1.6	11	1	40	WHA	1.0	16	2	50	BLC	1.0	21	3	90	YEB	3.0
5	3	10	SAS	1.4	11	1	40	WHA	1.3	16	2	50	BLC	1.5	21	3	90	REM	3.0
5	3	10	BLC	1.3	11	1	40	WHA	1.4	16	2	50	BLC	1.2	21	3	90	REM	1.4
5	3	10	SUM	1.7	11	1	40	WHA	1.3	16	2	50	WHA	1.2	21	3	90	GRB	5.5
5	3	20	SAS	1.8	11	1	40	WHA	1.5	16	2	50	BLC	1.2	21	3	90	REM	2.5
5	3	20	SWB	1.2	11	1	40	WHA	1.3	16	2	50	WHA	1.6	21	3	90	PIC	1.8
5	3	20	SWB	1.8	11	1	40	WHA	1.0	16	2	50	BLC	1.3	21	3	100	REM	1.5
5	3	20	SWB	1.2	11	1	40	WHA	1.1	16	2	50	WHA	1.5	21	3	100	REM	2.3
5	3	20	SWB	1.5	11	1	50	BLL	2.7	16	2	50	BLC	1.4	21	3	100	REM	1.8
5	3	20	CHO	1.2	11	1	50	WHA	1.4	16	2	50	BLC	1.2	21	3	100	REM	2.4
5	3	20	SWB	3.5	11	1	50	WHA	1.3	16	2	50	BLC	1.0	21	3	100	REM	2.5
5	3	20	CHO	3.3	11	1	50	WHA	2.3	16	2	50	WHA	1.0	21	3	100	BLC	2.7
5	3	20	SWB	1.5	11	1	50	WHA	1.1	16	2	60	QUA	1.1	21	3	100	PIC	2.5
5	3	20	CHO	1.8	11	1	50	WHA	1.7	16	2	60	AMH	1.1	21	3	100	YEB	3.0
5	3	20	SWB	1.6	11	1	50	WHA	1.3	16	2	60	AMH	1.4	21	3	100	REM	1.5
5	3	20	SWB	1.3	11	1	50	WHA	1.3	16	2	60	AMH	2.9	21	3	100	PIC	1.4
5	3	20	AMH	1.1	11	1	50	WHA	1.4	16	2	60	GRA	1.6	21	3	100	YEB	2.3
5	3	20	SWB	1.3	11	1	50	WHA	1.2	16	2	60	BLC	1.2	21	3	100	REM	2.4
5	3	20	SWB	2.7	11	1	50	WHA	1.2	16	2	60	AMH	1.3	21	3	100	REM	1.3
5	3	20	SWB	1.4	11	1	50	BLL	3.0	16	2	60	REM	2.3	21	3	100	YEB	1.6
5	3	20	SAS	1.0	11	1	50	WHA	1.8	16	2	60	AMH	1.0	21	3	100	REM	2.4
5	3	20	SWB	1.9	11	1	50	WHA	2.2	16	2	60	YEB	2.8	21	3	100	YEB	2.5
5	3	20	SWB	1.8	11	1	50	WHA	1.4	16	2	60	BLC	1.8	21	3	100	PIC	1.5
5	3	20	SWB	2.6	11	1	50	GRA	1.7	16	2	70	WHA	1.1	21	3	100	REM	1.2
5	3	20	AMH	1.7	11	1	50	WHA	1.1	16	2	70	GRA	1.6	21	3	100	YEB	3.0
5	3	20	REM	1.2	11	1	50	WHA	2.5	16	2	70	AMH	2.0	21	3	100	REM	3.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	3	20	SWB	1.5	11	1	50	WHA	1.5	16	2	70	AMH	1.7	21	3	100	BLC	3.7
5	3	20	REM	1.2	11	1	50	WHA	1.2	16	2	70	AMH	1.9	21	3	100	REM	2.4
5	3	20	SAS	1.1	11	1	50	WHA	1.5	16	2	70	AMH	2.1	21	3	100	REM	2.4
5	3	20	SWB	1.6	11	1	50	WHA	1.2	16	2	70	WHA	1.7	21	3	100	YEB	3.0
5	3	20	SWB	1.4	11	1	50	WHA	2.1	16	2	70	AMH	1.1	21	3	100	REM	3.0
5	3	20	SWB	1.5	11	1	50	WHA	1.2	16	2	70	AMH	1.4	21	3	100	REM	2.5
5	3	20	SAS	1.1	11	1	50	WHA	2.5	16	2	75	AMH	1.0	21	3	100	REM	2.3
5	3	20	SWB	1.1	11	1	50	WHA	2.2	16	3	10	QUA	1.6	21	3	100	REM	2.5
5	3	20	SWB	1.3	11	1	50	WHA	1.3	16	3	10	QUA	1.9	21	3	100	BLC	2.4
5	3	20	SWB	1.4	11	1	50	WHA	1.0	16	3	10	QUA	1.7	21	3	100	BLC	3.0
5	3	20	SAS	3.5	11	1	50	WHA	1.6	16	3	10	QUA	1.1	21	3	100	REM	1.5
5	3	20	SAS	1.9	11	1	50	WHA	1.8	16	3	10	QUA	2.0	21	3	100	YEB	2.5
5	3	20	SAS	1.5	11	1	50	WHA	1.6	16	3	10	QUA	2.1	21	3	100	REM	1.3
5	3	20	SWB	1.5	11	1	50	WHA	3.6	16	3	10	REO	2.4	21	3	100	YEB	2.7
5	3	20	SAS	3.5	11	1	50	WHA	1.5	16	3	20	QUA	1.3	21	3	100	REM	2.6
5	3	20	SWB	4.1	11	1	50	WHA	2.0	16	3	30	NO	0.0	21	3	100	REM	2.5
5	3	20	SAS	2.3	11	1	50	WHA	1.2	16	3	40	NO	0.0	21	3	100	REM	2.7
5	3	20	SWB	1.2	11	1	50	WHA	2.0	16	3	50	NO	0.0	21	3	100	YEB	2.2
5	3	20	SAS	4.5	11	1	50	WHA	1.5	16	3	60	QUA	1.4	21	3	100	BLC	3.5
5	3	20	SAS	1.0	11	1	50	WHA	1.4	16	3	60	QUA	2.1	21	3	100	BLC	3.0
5	3	20	SWB	1.7	11	1	50	WHA	2.0	16	3	60	QUA	1.8	21	3	100	REM	1.0
5	3	20	SWB	1.8	11	1	50	WHA	1.2	16	3	60	QUA	1.6	21	3	100	REM	2.0
5	3	20	SWB	4.4	11	1	50	WHA	1.2	16	3	60	QUA	2.2	21	3	100	YEB	2.5
5	3	20	GRB	1.7	11	1	50	WHA	1.3	16	3	60	QUA	1.0	21	3	100	REM	3.0
5	3	20	SWB	2.9	11	1	50	WHA	1.7	16	3	60	QUA	1.3	21	3	100	REM	1.5
5	3	20	SWB	1.0	11	1	50	WHA	2.5	16	3	60	QUA	1.7	21	3	100	REM	1.8
5	3	20	SWB	1.1	11	1	50	WHA	2.4	16	3	70	QUA	1.8	21	3	100	BLC	2.4
5	3	20	SWB	2.0	11	1	50	WHA	1.2	16	3	70	QUA	1.5	21	3	100	REM	2.0
5	3	20	AMB	2.0	11	1	50	WHA	1.1	16	3	70	QUA	1.4	21	3	100	REM	2.0
5	3	20	SWB	1.2	11	1	50	WHA	1.1	16	3	70	QUA	1.4	21	3	100	REM	1.2
5	3	20	SWB	3.5	11	1	50	WHA	2.7	16	3	70	QUA	1.2	21	3	100	YEB	3.0
5	3	20	AMH	1.0	11	1	50	WHA	1.7	16	3	70	REM	1.0	21	3	100	BLC	2.5
5	3	20	AMH	1.7	11	1	60	BLL	3.5	16	3	70	QUA	1.3	21	3	100	REM	2.4
5	3	30	BLC	1.6	11	1	60	WHA	1.5	16	3	70	QUA	1.2	21	3	100	PIC	1.5
5	3	30	SWB	1.4	11	1	60	WHA	1.0	16	3	70	QUA	1.7	21	3	100	BLC	1.5
5	3	30	SAS	1.2	11	1	60	WHA	2.5	16	3	70	QUA	1.4	21	3	100	REM	2.0
5	3	30	GRB	2.0	11	1	60	WHA	2.3	16	3	70	QUA	1.7	21	3	100	REM	2.4
5	3	30	SWB	2.1	11	1	60	WHA	2.5	16	3	70	QUA	2.9	21	3	100	BLC	2.0
5	3	30	SWB	1.0	11	1	60	GRA	1.7	16	3	75	QUA	1.8	21	3	100	REM	2.4
5	3	30	BLC	2.0	11	1	60	WHA	1.8	16	3	75	QUA	3.0	21	3	100	REM	1.0
5	3	30	SAS	1.4	11	1	60	GRA	1.5	16	5	10	WHP	1.8	21	3	100	REM	1.0
5	3	30	SWB	5.2	11	1	60	GRA	2.2	16	5	10	REO	1.6	21	3	100	REM	2.6
5	3	30	SUM	1.4	11	1	60	BLC	1.0	16	5	10	QUA	2.0	21	3	100	REM	2.8
5	3	30	BLC	2.0	11	1	60	WHA	1.6	16	5	10	REM	1.3	21	3	100	REM	2.2
5	3	30	SWB	1.7	11	1	60	WHA	2.0	16	5	10	AMB	1.0	21	3	100	PIC	1.0
5	3	30	SWB	2.5	11	1	60	BLC	2.0	16	5	10	WHP	2.3	21	3	100	REM	2.5
5	3	30	SWB	1.5	11	1	60	BLL	3.5	16	5	10	REM	1.6	21	3	100	REM	2.0
5	3	30	BLC	1.2	11	1	60	BLL	3.5	16	5	10	REM	2.2	21	3	100	REM	2.6
5	3	30	SAS	1.2	11	1	60	BLL	2.9	16	5	10	BAF	1.8	21	3	100	YEB	3.0
5	3	30	REM	1.2	11	1	60	WHA	2.0	16	5	10	REM	1.0	21	3	100	PIC	2.3
5	3	30	GRB	1.6	11	1	60	WHA	2.0	16	5	10	REM	1.8	21	3	100	YEB	1.3
5	3	30	BLO	1.2	11	1	60	BLL	4.1	16	5	10	REM	1.2	21	3	110	YEB	2.5
5	3	30	REM	1.2	11	1	60	WHA	1.2	16	5	10	REM	1.6	21	3	110	REM	2.3
5	3	30	SAS	1.6	11	1	60	WHA	1.0	16	5	10	QUA	1.0	21	3	110	REM	1.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	3	30	SAS	1.2	11	1	60	PIC	1.5	16	5	10	QUA	1.3	21	3	110	SHB	3.0
5	3	30	BLO	1.3	11	1	60	WHA	1.9	16	5	10	REM	2.7	21	3	110	BLC	3.3
5	3	30	SAS	1.8	11	1	60	WHA	1.0	16	5	10	QUA	1.1	21	3	110	YEB	2.3
5	3	30	SWB	1.4	11	1	60	WHA	1.6	16	5	10	REM	1.1	21	3	110	PIC	2.3
5	3	30	WHA	1.6	11	1	60	BLL	3.2	16	5	10	SUM	1.8	21	3	110	REM	3.2
5	3	30	SAS	1.8	11	1	60	WHA	3.0	16	5	10	BAF	1.2	21	3	110	REM	2.4
5	3	30	REM	1.0	11	1	60	WHA	1.0	16	5	10	REM	1.0	21	3	110	GRB	2.5
5	3	30	SWB	1.6	11	1	60	GRA	1.5	16	5	10	REM	1.8	21	3	110	PIC	3.0
5	3	30	SAS	1.0	11	1	60	WHA	1.0	16	5	10	QUA	1.9	21	3	110	REM	2.4
5	3	30	REM	1.2	11	1	60	WHA	1.0	16	5	10	WHS	2.1	21	3	110	GRB	3.0
5	3	30	GRB	2.7	11	1	60	WHA	1.0	16	5	10	REM	2.7	21	3	110	GRB	2.5
5	3	30	REM	1.2	11	1	60	WHA	1.0	16	5	10	QUA	1.4	21	3	110	BLC	2.5
5	3	30	SWB	1.9	11	1	60	BLC	2.5	16	5	10	REM	1.6	21	3	110	BLC	2.3
5	3	30	AMH	2.5	11	1	60	GRA	3.0	16	5	10	QUA	1.6	21	3	110	WHA	2.3
5	3	30	SWB	2.5	11	1	60	GRA	2.5	16	5	10	WHP	2.4	21	3	110	REM	3.0
5	3	30	BLO	1.1	11	1	60	WHA	1.0	16	5	10	REM	1.1	21	3	110	BLC	2.4
5	3	30	CHO	1.2	11	1	60	BLC	2.9	16	5	10	WHP	1.3	21	3	110	REM	2.2
5	3	30	BLO	3.6	11	1	60	PIC	2.0	16	5	10	PAB	2.6	21	3	110	BLC	3.0
5	3	30	SAS	1.5	11	1	60	GRA	1.5	16	5	10	REM	2.1	21	3	110	SHB	2.3
5	3	30	REM	1.5	11	1	60	WHA	2.5	16	5	10	WHP	1.6	21	3	110	YEB	1.0
5	3	30	REM	1.2	11	1	60	WHA	4.5	16	5	10	REM	2.1	21	3	110	BLC	3.0
5	3	30	SWB	3.2	11	1	60	WHA	1.0	16	5	10	BAF	1.4	21	3	110	SHB	3.2
5	3	30	SWB	1.9	11	1	60	GRA	1.5	16	5	10	QUA	1.0	21	3	110	REM	2.4
5	3	30	REM	1.0	11	1	60	BLC	2.5	16	5	10	WHP	1.8	21	3	110	REM	2.3
5	3	30	SWB	4.1	11	1	60	WHA	1.0	16	5	10	YEB	1.7	21	3	110	BLC	2.5
5	3	30	BLO	1.1	11	1	60	WHA	1.3	16	5	10	QUA	1.6	21	3	110	BLC	3.0
5	3	30	REM	1.1	11	1	60	WHA	1.3	16	5	10	BLC	2.5	21	3	110	REM	2.8
5	3	30	BLC	4.4	11	1	60	WHA	1.0	16	5	10	AMB	2.2	21	3	110	GRB	2.5
5	3	30	SAS	1.2	11	1	60	GRA	1.3	16	5	10	QUA	1.1	21	3	110	GRB	2.5
5	3	40	REM	1.3	11	1	60	WHA	1.3	16	5	10	REM	1.2	21	3	110	YEB	1.1
5	3	40	SAS	2.2	11	1	60	BLC	2.0	16	5	10	WHS	1.1	21	3	110	REM	4.0
5	3	40	REM	1.7	11	1	60	BLL	2.1	16	5	10	WHS	1.1	21	3	110	REM	1.8
5	3	40	SAS	2.5	11	1	60	GRA	2.5	16	5	10	REM	2.3	21	3	110	REM	2.0
5	3	40	SAS	2.6	11	1	60	WHA	1.5	16	5	10	WHP	1.5	21	3	110	WHA	2.0
5	3	40	SWB	2.6	11	1	60	WHA	1.5	16	5	10	REM	1.4	21	3	110	GRB	2.3
5	3	40	SAS	2.2	11	1	60	WHA	2.5	16	5	10	REM	1.9	21	3	110	REM	2.1
5	3	40	GRB	3.3	11	1	60	WHA	1.3	16	5	10	WHP	1.1	21	3	110	REM	2.5
5	3	40	SAS	1.6	11	1	60	GRA	2.5	16	5	20	REM	1.4	21	3	110	REM	2.0
5	3	40	SAS	1.4	11	1	60	BLC	2.0	16	5	20	REM	1.1	21	3	110	GRB	2.0
5	3	40	SWB	3.2	11	1	60	WHA	1.0	16	5	20	REM	2.3	21	3	110	BLC	2.0
5	3	40	BLO	1.0	11	1	60	WHA	1.2	16	5	20	SUM	1.1	21	3	110	REM	2.4
5	3	40	GRB	1.2	11	1	60	WHA	1.0	16	5	20	QUA	1.9	21	3	110	GRB	2.5
5	3	40	CHO	1.0	11	1	60	GRA	2.9	16	5	20	REM	2.5	21	3	110	REM	2.1
5	3	40	REM	1.5	11	1	60	WHA	1.3	16	5	20	SUM	1.0	21	3	110	REM	2.4
5	3	40	BLC	1.5	11	1	60	WHA	1.2	16	5	20	REM	2.2	21	3	110	REM	2.4
5	3	40	REM	1.8	11	1	60	GRA	2.4	16	5	20	SUM	2.2	21	3	110	REM	2.1
5	3	40	REM	1.9	11	1	60	GRA	2.0	16	5	20	QUA	1.8	21	3	110	REM	1.8
5	3	40	BLO	1.2	11	1	60	WHA	1.2	16	5	20	REM	4.5	21	3	110	GRB	2.5
5	3	40	SWB	2.1	11	1	60	GRA	1.9	16	5	20	QUA	1.3	21	3	110	BLC	2.5
5	3	40	GRB	1.1	11	1	60	BLC	2.5	16	5	20	REO	1.0	21	3	110	YEB	1.7
5	3	40	BLO	1.9	11	1	60	WHA	1.0	16	5	20	SUM	1.7	21	3	110	REM	2.7
5	3	40	AMH	2.0	11	1	60	WHA	2.4	16	5	20	QUA	1.4	21	3	110	BLC	2.3
5	3	50	SWB	2.9	11	1	60	BLL	2.8	16	5	20	QUA	1.5	21	3	110	YEB	2.5
5	3	50	SWB	1.2	11	1	60	WHA	2.5	16	5	20	BLC	1.2	21	3	110	GRB	2.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	3	50	SWB	2.0	11	1	60	WHA	1.3	16	5	20	REM	2.8	21	3	120	REM	2.6
5	3	50	SWB	1.4	11	1	60	WHA	1.7	16	5	20	REM	1.0	21	3	120	BLC	2.4
5	3	50	SHB	1.0	11	1	60	WHA	1.3	16	5	20	REM	1.4	21	3	120	YEB	2.0
5	3	50	SWB	1.9	11	1	60	WHA	1.6	16	5	20	QUA	1.5	21	3	120	YEB	1.0
5	3	50	SWB	2.7	11	1	60	WHA	1.2	16	5	20	QUA	1.3	21	3	120	YEB	2.0
5	3	50	BLO	1.2	11	1	60	GRA	1.6	16	5	20	QUA	1.3	21	3	120	REM	2.1
5	3	60	BLO	1.1	11	1	60	WHA	1.8	16	5	20	REM	3.3	21	3	120	SHB	3.0
5	3	60	BLO	1.1	11	1	60	BLL	2.0	16	5	20	REM	1.0	21	3	120	REM	2.2
5	3	70	SAS	1.8	11	1	60	WHA	1.0	16	5	20	WHP	1.0	21	3	120	REM	2.5
5	3	70	BLC	1.4	11	1	60	WHA	3.0	16	5	20	REM	1.5	21	3	120	REM	1.5
5	3	70	SAS	1.1	11	1	60	GRA	1.1	16	5	20	QUA	1.3	21	3	120	PIC	1.1
5	3	70	BLC	2.1	11	1	60	PIC	1.9	16	5	20	REM	3.3	21	3	120	YEB	1.8
5	3	75	SAS	1.2	11	1	60	WHA	1.0	16	5	20	REM	1.5	21	3	120	YEB	1.9
5	3	75	CHO	6.4	11	1	60	BLL	3.0	16	5	20	REM	1.8	21	3	120	REM	2.3
5	3	75	BLO	2.9	11	1	60	WHA	1.5	16	5	20	REM	1.8	21	3	120	YEB	2.4
5	4	10	REM	3.6	11	1	60	BLC	2.8	16	5	20	WHS	1.7	21	3	120	REM	1.1
5	4	10	SLE	8.6	11	1	60	WHA	1.3	16	5	20	QUA	1.5	21	3	120	REM	2.5
5	4	10	SLE	9.6	11	1	70	GRA	2.4	16	5	20	BAF	1.9	21	3	120	YEB	5.0
5	4	10	REM	4.8	11	1	70	WHA	2.0	16	5	20	REM	2.3	21	3	120	SHB	3.2
5	4	10	REM	5.5	11	1	70	BLL	3.5	16	5	20	REM	3.8	21	3	120	YEB	3.5
5	4	10	REM	5.3	11	1	70	BLL	3.6	16	5	20	REM	2.5	21	3	120	REM	1.2
5	4	10	SLE	2.5	11	1	70	WHA	1.6	16	5	20	SUM	1.8	21	3	120	REM	2.3
5	4	10	SLE	3.5	11	1	70	WHA	1.8	16	5	20	QUA	1.7	21	3	120	REM	2.3
5	4	10	REM	7.3	11	1	70	WHA	3.0	16	5	20	REM	1.1	21	3	120	REM	1.5
5	4	20	NO	0.0	11	1	70	BLL	3.0	16	5	20	QUA	1.3	21	3	120	REM	3.0
5	4	30	REM	1.7	11	1	70	WHA	1.2	16	5	20	WHP	1.5	21	3	120	YEB	2.0
5	4	30	REM	1.8	11	1	70	WHA	1.5	16	5	20	BAF	2.0	21	3	120	REM	6.0
5	4	30	REM	1.2	11	1	70	WHA	2.0	16	5	30	SUM	1.6	21	3	120	REM	2.0
5	4	30	REM	2.3	11	1	70	WHA	1.1	16	5	30	QUA	2.6	21	3	120	REM	1.0
5	4	30	REM	1.9	11	1	70	WHA	1.3	16	5	30	QUA	1.4	21	3	120	REM	2.3
5	4	30	REM	1.5	11	1	70	WHA	2.0	16	5	30	BLC	1.8	21	3	120	REM	1.0
5	4	30	REM	1.1	11	1	70	BLL	2.0	16	5	30	BLC	2.2	21	3	120	YEB	2.5
5	4	30	REM	1.1	11	1	70	REO	3.5	16	5	30	REM	1.1	21	3	120	YEB	2.3
5	4	30	REM	1.6	11	1	70	PIC	1.0	16	5	30	PIC	5.1	21	3	120	YEB	3.0
5	4	30	REM	1.3	11	1	70	BLL	2.5	16	5	30	REM	1.0	21	3	120	REM	2.5
5	4	30	REM	1.3	11	1	70	WHA	1.0	16	5	30	WHP	1.5	21	3	120	REM	1.8
5	4	30	REM	1.8	11	1	70	WHA	1.0	16	5	30	WHP	1.6	21	3	120	REM	1.8
5	4	30	REM	1.7	11	1	70	WHA	1.0	16	5	30	REM	1.5	21	3	120	REM	3.0
5	4	30	REM	1.9	11	1	70	WHA	3.6	16	5	30	REM	1.3	21	3	120	PIC	2.3
5	4	30	REM	1.5	11	1	70	WHA	2.0	16	5	30	SUM	3.1	21	3	120	REM	2.0
5	4	30	REM	1.5	11	1	70	WHA	1.5	16	5	30	QUA	2.2	21	3	120	YEB	2.1
5	4	30	REM	1.4	11	1	70	WHA	3.5	16	5	30	QUA	1.3	21	3	120	YEB	1.5
5	4	30	REM	2.2	11	1	70	WHA	2.2	16	5	30	REM	1.4	21	3	120	YEB	2.0
5	4	30	REM	1.5	11	1	70	WHA	1.0	16	5	30	QUA	1.8	21	3	120	PIC	2.3
5	4	30	REM	1.1	11	1	70	BLC	1.4	16	5	30	REO	1.9	21	3	120	BLC	1.4
5	4	30	REM	2.2	11	1	70	WHA	2.5	16	5	30	QUA	1.0	21	3	120	YEB	2.1
5	4	30	REM	2.1	11	1	70	BLC	1.0	16	5	30	REM	3.5	21	3	120	GRB	3.4
5	4	30	REM	2.4	11	1	70	WHA	3.0	16	5	30	WHP	1.6	21	3	120	PIC	1.0
5	4	30	REM	1.3	11	1	70	WHA	1.0	16	5	30	BLC	2.2	21	3	120	REM	2.3
5	4	30	REM	2.1	11	1	70	GRA	1.5	16	5	30	REM	2.1	21	3	120	BLC	2.6
5	4	30	REM	1.6	11	1	70	WHA	1.0	16	5	30	QUA	1.0	21	3	120	REM	2.5
5	4	30	REM	2.4	11	1	70	REO	3.5	16	5	30	REO	2.0	21	3	120	REM	1.3
5	4	30	REM	1.2	11	1	70	BLC	1.1	16	5	30	REM	3.2	21	3	120	REM	3.0
5	4	30	REM	2.2	11	1	70	WHA	2.0	16	5	30	REM	3.5	21	3	120	YEB	2.3

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	4	30	REM	2.2	11	1	70	WHA	2.0	16	5	30	QUA	1.3	21	3	120	YEB	2.2
5	4	30	REM	2.4	11	1	70	WHA	1.0	16	5	30	REM	2.5	21	3	120	SHB	3.0
5	4	30	REM	1.3	11	1	70	BLL	2.5	16	5	30	QUA	3.1	21	3	120	YEB	2.7
5	4	30	REM	1.1	11	1	70	BLL	3.0	16	5	30	REM	1.8	21	3	120	SHB	3.0
5	4	30	REM	2.1	11	1	70	WHA	1.5	16	5	40	QUA	2.0	21	3	120	REM	2.5
5	4	30	REM	3.0	11	1	70	WHA	4.8	16	5	40	REO	2.7	21	3	120	PIC	1.5
5	4	30	REM	1.7	11	1	70	WHA	1.5	16	5	40	PIC	6.0	21	3	120	YEB	3.0
5	4	30	REM	1.1	11	1	70	WHA	1.1	16	5	40	REM	1.4	21	3	120	YEB	2.0
5	4	30	REM	1.5	11	1	70	WHA	1.7	16	5	40	REO	1.6	21	3	120	BLC	2.3
5	4	30	REM	1.4	11	1	70	WHA	2.0	16	5	40	QUA	1.9	21	3	120	SHB	2.5
5	4	30	REM	1.1	11	1	70	BLL	3.4	16	5	40	WHS	1.4	21	3	120	REM	1.6
5	4	30	REM	2.2	11	1	70	WHA	1.0	16	5	40	SUM	1.2	21	3	120	BLC	2.6
5	4	30	REM	1.9	11	1	70	WHA	1.7	16	5	40	REO	2.0	21	3	120	REM	1.5
5	4	30	REM	1.6	11	1	70	PIC	1.0	16	5	40	REM	2.9	21	3	120	SHB	3.4
5	4	40	REM	1.3	11	1	70	GRA	1.3	16	5	40	QUA	1.1	21	3	120	REM	2.3
5	4	40	REM	1.4	11	1	70	WHA	1.3	16	5	40	PIC	4.5	21	3	120	REM	2.4
5	4	40	REM	1.6	11	1	70	WHA	1.7	16	5	40	PIC	5.0	21	3	120	YEB	2.3
5	4	40	REM	1.5	11	1	70	BLL	4.0	16	5	40	REM	2.9	21	3	130	BLC	3.5
5	4	40	REM	1.3	11	1	70	WHA	1.5	16	5	40	REM	1.5	21	3	130	YEB	3.0
5	4	50	NO	0.0	11	1	70	WHA	2.0	16	5	40	QUA	1.9	21	3	130	REM	2.4
5	4	60	REM	3.1	11	1	70	WHA	1.3	16	5	40	QUA	1.3	21	3	130	REM	3.0
5	4	70	NO	0.0	11	1	70	WHA	1.0	16	5	40	QUA	1.6	21	3	130	REM	1.3
5	4	80	REM	5.1	11	1	70	WHA	2.5	16	5	40	QUA	2.3	21	3	130	REM	2.8
5	5	10	YEP	1.1	11	1	70	WHA	1.3	16	5	40	PIC	2.9	21	3	130	BLC	2.5
5	5	10	YEB	1.2	11	1	70	WHA	1.3	16	5	40	REM	2.9	21	3	130	REM	4.0
5	5	10	YEB	1.7	11	1	70	GRA	1.0	16	5	40	PIC	2.2	21	3	130	YEB	3.5
5	5	10	SWB	2.6	11	1	70	WHA	1.3	16	5	40	QUA	1.1	21	3	130	REM	2.5
5	5	10	SWB	2.7	11	1	70	BLL	4.0	16	5	40	SUM	1.4	21	3	130	BLC	2.0
5	5	10	YEB	2.3	11	1	70	WHA	1.3	16	5	40	REM	3.1	21	3	130	YEB	2.5
5	5	10	YEB	1.6	11	1	70	WHA	1.3	16	5	40	WHP	1.3	21	3	130	SHB	2.5
5	5	10	SUM	1.8	11	1	70	WHA	1.3	16	5	40	SUM	1.5	21	3	130	REM	3.0
5	5	10	SHH	2.4	11	1	70	WHA	3.5	16	5	40	QUA	1.7	21	3	130	YEB	2.5
5	5	10	SWB	1.9	11	1	70	BLL	2.6	16	5	50	REM	1.5	21	3	130	REM	2.4
5	5	10	HOH	2.6	11	1	70	WHA	1.0	16	5	50	PIC	2.1	21	3	130	YEB	2.0
5	5	10	SWB	1.7	11	1	70	WHA	1.0	16	5	50	PIC	2.8	21	3	130	YEB	3.5
5	5	10	SWB	2.5	11	1	70	WHA	1.0	16	5	50	QUA	2.7	21	3	130	REM	1.0
5	5	10	SWB	1.4	11	1	70	WHA	1.3	16	5	50	SUM	1.7	21	3	130	REM	1.8
5	5	10	SWB	1.7	11	1	70	BLL	1.7	16	5	50	WHP	1.1	21	3	130	REM	1.5
5	5	10	YEB	2.0	11	1	70	WHA	1.3	16	5	50	REM	2.2	21	3	130	REM	1.4
5	5	10	SWB	2.2	11	1	70	WHA	2.1	16	5	50	SUM	1.6	21	3	130	REM	1.5
5	5	10	YEB	1.3	11	1	70	WHA	2.5	16	5	50	REM	1.4	21	3	130	REM	2.0
5	5	10	SWB	2.7	11	1	70	BLL	1.3	16	5	50	QUA	1.7	21	3	130	SHB	2.0
5	5	10	SWB	2.6	11	1	70	WHA	1.3	16	5	50	PIC	3.4	21	3	130	PIC	2.3
5	5	10	SWB	1.5	11	1	70	WHA	2.5	16	5	50	REM	1.4	21	3	130	REM	2.3
5	5	10	SWB	1.2	11	1	70	WHA	1.3	16	5	50	PIC	1.8	21	3	130	REM	3.2
5	5	10	GRB	2.4	11	1	70	WHA	1.3	16	5	50	QUA	2.1	21	3	130	REM	3.0
5	5	10	REM	1.9	11	1	70	GRA	1.5	16	5	50	REM	1.1	21	3	130	YEB	3.0
5	5	10	YEB	1.7	11	1	70	WHA	1.0	16	5	50	PIC	3.5	21	3	130	SHB	2.5
5	5	10	SWB	1.3	11	1	70	WHA	1.0	16	5	50	WHP	1.3	21	3	130	REM	2.0
5	5	10	YEB	3.0	11	1	70	WHA	2.0	16	5	50	REO	1.3	21	3	130	BLC	2.4
5	5	10	SWB	1.1	11	1	70	WHA	1.5	16	5	50	SUM	1.6	21	3	130	SHB	2.3
5	5	10	SWB	2.1	11	1	70	WHA	1.1	16	5	50	QUA	1.4	21	3	130	BLC	2.3
5	5	10	SWB	2.4	11	1	70	WHA	4.0	16	5	50	QUA	1.0	21	3	130	REM	2.5
5	5	10	BLC	1.6	11	1	70	WHA	1.5	16	5	50	REM	1.6	21	3	130	BLC	5.0

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	5	10	ABU	2.5	11	1	70	WHA	1.3	16	5	50	QUA	1.5	21	3	130	GRB	3.5
5	5	10	SWB	1.0	11	1	70	WHA	1.0	16	5	50	REO	1.5	21	3	130	YEB	2.4
5	5	10	SWB	1.5	11	1	70	GRA	2.0	16	5	50	REM	1.2	21	3	130	REM	2.3
5	5	10	YEB	1.1	11	1	70	WHA	1.0	16	5	50	QUA	2.1	21	3	130	YEB	2.6
5	5	10	SWB	3.2	11	1	70	WHA	2.6	16	5	50	PIC	1.7	21	3	130	YEB	2.0
5	5	10	YEB	1.2	11	1	70	WHA	2.0	16	5	50	PIC	1.3	21	3	130	REM	3.1
5	5	10	SUM	2.3	11	1	70	WHA	2.5	16	5	50	PIC	2.7	21	3	130	REM	2.3
5	5	10	YEB	1.0	11	1	70	WHA	1.7	16	5	50	SUM	1.6	21	3	130	SHB	2.5
5	5	20	YEB	1.6	11	1	70	REO	4.5	16	5	50	SUM	1.6	21	3	130	PIC	1.2
5	5	20	YEB	1.8	11	1	70	WHA	1.2	16	5	50	REM	1.6	21	3	130	PIC	2.0
5	5	20	YEB	2.3	11	1	70	WHA	1.0	16	5	50	SUM	2.1	21	3	130	YEB	2.4
5	5	20	SWB	1.7	11	1	70	BLL	2.5	16	5	50	SUM	1.6	21	3	130	GRB	4.0
5	5	20	GRB	2.3	11	1	70	GRA	1.6	16	5	50	PIC	1.3	21	3	130	PIC	3.0
5	5	20	SWB	1.7	11	1	70	WHA	2.8	16	5	50	REM	1.8	21	3	130	REM	1.6
5	5	20	SWB	1.5	11	1	70	WHA	1.3	16	5	50	QUA	1.0	21	3	130	REM	2.4
5	5	20	QUA	1.3	11	1	70	WHA	11.0	16	5	50	PIC	1.9	21	3	130	REM	2.5
5	5	20	YEB	1.9	11	1	70	WHA	2.5	16	5	50	REM	1.2	21	3	130	YEB	2.4
5	5	20	YEB	1.8	11	1	70	GRA	1.8	16	5	60	REM	1.0	21	3	130	BLC	3.0
5	5	20	YEB	1.2	11	1	70	WHA	1.5	16	5	60	PIC	1.3	21	3	130	REM	3.5
5	5	20	SWB	1.3	11	1	70	GRA	1.6	16	5	60	PIC	1.2	21	3	130	REM	3.4
5	5	20	SWB	1.2	11	1	70	WHA	1.3	16	5	60	PIC	1.5	21	3	130	YEB	2.5
5	5	20	SWB	2.5	11	1	70	WHA	2.5	16	5	60	PIC	1.2	21	3	130	SHB	2.5
5	5	20	SWB	1.6	11	1	70	WHA	1.0	16	5	60	REM	1.1	21	3	130	REM	2.4
5	5	20	SWB	2.0	11	1	70	BLC	1.0	16	5	60	PIC	3.1	21	3	130	SHB	4.0
5	5	20	SWB	1.0	11	1	70	WHA	1.0	16	5	60	QUA	1.6	21	3	130	REM	2.5
5	5	20	YEB	1.6	11	1	70	WHA	1.3	16	5	60	PIC	2.6	21	3	130	REM	3.5
5	5	20	SWB	2.2	11	1	70	WHA	1.0	16	5	60	REM	1.1	21	3	130	YEB	3.0
5	5	20	SWB	3.4	11	1	80	BLL	1.8	16	5	60	REM	1.1	21	3	130	YEB	3.5
5	5	20	QUA	1.1	11	1	80	WHA	1.0	16	5	60	REM	1.3	21	3	130	WHA	2.5
5	5	20	SWB	2.0	11	1	80	WHA	2.5	16	5	60	REM	2.6	21	3	130	YEB	2.5
5	5	20	WHA	1.7	11	1	80	WHA	1.3	16	5	60	PIC	1.2	21	3	130	REM	1.5
5	5	20	SWB	2.3	11	1	80	WHA	2.5	16	5	70	BLC	1.8	21	3	130	YEB	3.5
5	5	20	QUA	1.5	11	1	80	WHA	1.3	16	5	70	PIC	1.3	21	3	130	REM	3.5
5	5	20	SWB	2.0	11	1	80	WHA	1.7	16	5	70	PIC	1.0	21	3	130	YEB	1.6
5	5	20	SWB	1.7	11	1	80	WHA	1.0	16	5	70	PIC	1.0	21	3	130	REM	2.4
5	5	20	SWB	2.3	11	1	80	WHA	1.3	16	6	10	QUA	1.5	21	3	130	YEB	3.3
5	5	20	GRB	3.1	11	1	80	REO	1.0	16	6	10	QUA	1.4	21	3	130	YEB	4.0
5	5	20	YEB	1.3	11	1	80	WHA	1.6	16	6	10	QUA	1.5	21	3	130	REM	4.0
5	5	20	GRB	3.0	11	1	80	WHA	2.0	16	6	10	BLC	1.0	21	3	130	YEB	2.5
5	5	20	SWB	1.9	11	1	80	WHA	1.1	16	6	10	BLC	1.5	21	3	130	REM	3.0
5	5	20	GRB	2.3	11	1	80	WHA	1.3	16	6	10	QUA	1.4	21	3	130	SHB	3.5
5	5	20	YEB	1.9	11	1	80	BLC	2.5	16	6	10	BLC	1.4	21	3	130	YEB	2.5
5	5	20	QUA	1.6	11	1	80	WHA	2.1	16	6	10	QUA	1.3	21	3	140	YEB	1.5
5	5	20	YEB	2.3	11	1	80	WHA	3.0	16	6	10	WHA	1.8	21	3	140	BLC	1.0
5	5	20	GRB	2.1	11	1	80	WHA	1.2	16	6	10	QUA	3.1	21	3	140	REM	1.8
5	5	20	GRB	2.6	11	1	80	PIC	2.0	16	6	10	WHA	1.6	21	3	140	BLC	1.7
5	5	20	SWB	1.8	11	1	80	WHA	1.5	16	6	10	QUA	1.2	21	3	140	YEB	1.9
5	5	20	YEB	1.8	11	1	80	BLC	1.5	16	6	10	QUA	1.4	21	3	140	YEB	1.8
5	5	20	YEB	1.3	11	1	80	WHA	3.0	16	6	10	QUA	1.4	21	3	140	REM	1.8
5	5	20	SWB	1.0	11	1	80	BLL	6.0	16	6	10	QUA	1.0	21	3	140	REM	1.8
5	5	20	GRB	2.3	11	1	80	WHA	1.0	16	6	10	BLC	1.0	21	3	140	PIC	6.0
5	5	20	SWB	1.3	11	1	80	BLL	1.7	16	6	10	QUA	1.7	21	3	140	REM	3.0
5	5	20	SWB	1.9	11	1	80	BLL	6.0	16	6	10	QUA	1.2	21	3	140	YEB	3.1
5	5	20	GRB	1.8	11	1	80	BLL	3.0	16	6	10	QUA	1.4	21	3	140	REM	3.4

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	5	20	SWB	2.6	11	1	80	WHA	2.5	16	6	10	QUA	1.0	21	3	140	REM	1.0
5	5	20	SWB	1.2	11	1	80	WHA	5.5	16	6	10	QUA	2.1	21	3	140	REM	1.8
5	5	20	YEB	1.7	11	1	80	WHA	2.5	16	6	10	QUA	1.4	21	3	140	REM	1.3
5	5	20	SWB	1.2	11	1	80	WHA	2.3	16	6	10	QUA	1.5	21	3	140	YEB	2.5
5	5	20	YEB	2.5	11	1	80	WHA	1.3	16	6	10	QUA	1.6	21	3	140	REM	1.7
5	5	20	SWB	1.5	11	1	80	WHA	1.3	16	6	10	QUA	1.0	21	3	140	REM	1.0
5	5	20	SWB	1.6	11	1	80	WHA	1.1	16	6	10	QUA	1.2	21	3	140	REM	1.3
5	5	20	SWB	1.4	11	1	80	BLC	3.0	16	6	10	BLC	1.0	21	3	140	REM	2.3
5	5	20	SWB	1.0	11	1	80	BLL	1.5	16	6	10	QUA	1.0	21	3	140	REM	3.0
5	5	20	YEB	1.4	11	1	80	WHA	1.0	16	6	10	WHA	1.4	21	3	140	YEB	2.2
5	5	20	SWB	1.7	11	1	80	WHA	1.0	16	6	10	QUA	1.2	21	3	140	REM	1.3
5	5	20	YEB	1.8	11	1	80	BLC	2.5	16	6	10	WHA	1.3	21	3	140	REM	1.8
5	5	20	SWB	2.5	11	1	80	WHA	1.0	16	6	10	QUA	1.7	21	3	140	REM	1.6
5	5	20	SWB	2.6	11	1	80	WHA	5.0	16	6	10	QUA	1.8	21	3	140	REM	2.3
5	5	20	YEB	2.2	11	1	80	WHA	2.0	16	6	10	QUA	1.2	21	3	140	REM	1.0
5	5	20	SWB	2.2	11	1	80	WHA	1.3	16	6	10	QUA	1.8	21	3	140	REM	2.0
5	5	20	YEB	1.7	11	1	80	WHA	1.5	16	6	10	QUA	1.5	21	3	140	BLC	2.5
5	5	20	SWB	2.2	11	1	80	WHA	3.5	16	6	10	QUA	1.7	21	3	140	BLC	2.3
5	5	20	YEB	1.2	11	1	80	WHA	2.0	16	6	10	QUA	1.9	21	3	140	REM	1.3
5	5	20	YEB	1.4	11	1	80	WHA	1.0	16	6	10	QUA	1.0	21	3	140	REM	3.2
5	5	20	GRB	2.0	11	1	80	BLC	5.0	16	6	10	QUA	2.0	21	3	140	PIC	3.0
5	5	20	SWB	2.6	11	1	80	WHA	1.1	16	6	10	BLC	1.8	21	3	140	REM	2.5
5	5	20	GRB	1.8	11	1	80	WHA	1.3	16	6	10	QUA	2.0	21	3	140	BLC	1.8
5	5	20	SWB	2.6	11	1	80	WHA	1.5	16	6	10	QUA	1.5	21	3	140	YEB	2.3
5	5	20	SWB	1.8	11	1	80	WHA	2.0	16	6	10	QUA	1.1	21	3	140	YEB	2.3
5	5	20	SWB	1.7	11	1	80	WHA	1.0	16	6	10	QUA	1.2	21	3	140	REM	1.3
5	5	20	SWB	2.5	11	1	80	WHA	1.3	16	6	10	QUA	1.6	21	3	140	REM	1.5
5	5	20	YEB	1.9	11	1	80	BLL	2.0	16	6	10	QUA	1.6	21	3	140	REM	3.3
5	5	20	SWB	1.0	11	1	80	WHA	2.5	16	6	10	QUA	4.4	21	3	140	YEB	2.5
5	5	20	SWB	3.7	11	1	80	BLL	6.0	16	6	10	QUA	1.4	21	3	140	REM	1.8
5	5	20	SWB	1.4	11	1	80	WHA	1.0	16	6	10	QUA	1.1	21	3	140	REM	1.8
5	5	20	SWB	1.2	11	1	80	WHA	1.1	16	6	20	BLC	1.5	21	3	140	YEB	2.3
5	5	20	GRB	2.0	11	1	80	BLL	2.5	16	6	20	QUA	2.0	21	3	140	BLC	2.4
5	5	20	GRB	2.2	11	1	80	GRA	1.0	16	6	20	QUA	1.0	21	3	140	BLC	2.6
5	5	20	QUA	1.1	11	1	80	WHA	1.2	16	6	20	BLC	1.8	21	3	140	REM	2.3
5	5	20	SWB	1.5	11	1	80	BLL	1.5	16	6	20	BLC	1.4	21	3	140	REM	2.5
5	5	20	LAA	1.7	11	1	80	WHA	1.5	16	6	20	BLC	1.9	21	3	140	YEB	1.9
5	5	20	GRB	1.7	11	1	80	BLC	1.5	16	6	20	QUA	1.0	21	3	140	REM	2.3
5	5	20	QUA	1.0	11	1	80	GRA	1.4	16	6	20	BLC	1.1	21	3	140	BLC	2.0
5	5	20	SWB	2.8	11	1	80	WHA	1.0	16	6	20	BLC	1.2	21	3	140	REM	3.0
5	5	20	SWB	1.2	11	1	80	WHA	2.4	16	6	20	QUA	1.7	21	3	140	REM	1.8
5	5	20	SWB	1.7	11	1	80	BLL	1.0	16	6	20	QUA	1.3	21	3	140	REM	1.2
5	5	20	SWB	1.4	11	1	80	WHA	1.0	16	6	20	BLC	1.4	21	3	140	REM	2.7
5	5	20	SWB	1.4	11	1	80	GRA	3.0	16	6	20	BLC	1.8	21	3	140	SHB	1.8
5	5	20	YEB	2.2	11	1	80	WHA	5.0	16	6	20	BLC	1.7	21	3	140	REM	1.9
5	5	20	SWB	2.6	11	1	80	WHA	1.5	16	6	20	QUA	2.0	21	3	140	REM	1.2
5	5	20	GRB	2.4	11	1	80	WHA	1.0	16	6	20	BLC	1.2	21	3	140	REM	2.0
5	5	20	SWB	1.3	11	1	80	BLL	2.5	16	6	20	QUA	1.8	21	3	140	YEB	2.0
5	5	20	SWB	1.9	11	1	80	WHA	1.3	16	6	20	WHA	1.3	21	3	140	REM	2.0
5	5	20	GRB	2.5	11	1	80	WHA	1.8	16	6	20	QUA	1.0	21	3	140	BLC	2.5
5	5	20	YEB	1.0	11	1	80	PIC	5.0	16	6	20	BLC	1.4	21	3	150	REM	2.6
5	5	20	SWB	1.8	11	1	80	WHA	1.7	16	6	30	QUA	1.6	21	3	150	BLC	1.7
5	5	20	YEB	2.6	11	1	90	BLL	6.0	16	6	30	BLC	1.3	21	3	150	REM	1.7
5	5	20	YEB	1.3	11	1	90	WHA	6.0	16	6	30	WHP	1.6	21	3	150	YEB	1.5

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	5	20	YEB	3.2	11	1	90	GRA	6.0	16	6	30	BLC	1.3	21	3	150	REM	1.1
5	5	20	SWB	1.2	11	1	90	BLC	1.0	16	6	30	BLC	1.8	21	3	150	REM	1.8
5	5	20	SWB	1.6	11	1	90	GRA	2.3	16	6	30	BLC	2.0	21	3	150	AMH	6.0
5	5	30	SWB	1.2	11	1	90	BLC	6.0	16	6	30	BLC	2.5	21	3	150	BLC	1.5
5	5	30	YEB	1.5	11	1	90	BLC	1.7	16	6	30	BLC	2.3	21	3	150	BLC	1.5
5	5	30	SWB	1.1	11	1	90	BLL	3.5	16	6	30	QUA	1.3	21	3	150	BLC	2.5
5	5	30	SWB	1.3	11	1	90	GRA	3.0	16	6	30	WHP	1.8	21	3	150	WHA	2.0
5	5	30	SWB	1.8	11	1	90	WHA	6.0	16	6	30	BLC	2.7	21	3	150	REM	1.5
5	5	30	SWB	2.4	11	1	90	BLL	4.8	16	6	30	BLC	1.0	21	3	150	YEB	1.5
5	5	30	GRB	1.5	11	1	90	BLC	5.0	16	6	30	WHP	1.5	21	3	150	REM	1.6
5	5	30	GRB	1.2	11	1	90	WHA	6.0	16	6	30	BLC	1.4	21	3	150	YEB	2.5
5	5	30	GRB	1.2	11	1	90	GRA	3.8	16	6	30	BLC	1.5	21	3	150	YEB	1.3
5	5	30	YEB	1.7	11	1	90	GRA	5.0	16	6	30	QUA	1.3	21	3	150	REM	1.5
5	5	30	SWB	1.1	11	1	90	GRA	2.0	16	6	30	BLC	1.0	21	3	150	REM	1.6
5	5	30	GRB	3.0	11	1	90	GRA	6.0	16	6	40	REM	1.2	21	3	150	BLC	2.1
5	5	30	SWB	2.6	11	1	90	BLC	5.2	16	6	40	WHP	1.1	21	3	150	SUM	1.5
5	5	30	SWB	2.5	11	1	90	BLL	6.0	16	6	40	QUA	1.4	21	3	150	REM	1.0
5	5	30	SWB	1.1	11	1	90	BLL	6.0	16	6	40	BLC	1.2	21	3	150	REM	1.3
5	5	30	SWB	1.0	11	1	90	WHA	6.0	16	6	40	WHP	1.7	21	3	150	REM	2.4
5	5	30	YEB	2.3	11	1	90	BLL	6.0	16	6	40	BLC	1.7	21	3	150	YEB	1.0
5	5	30	SWB	1.1	11	1	90	BLC	2.0	16	6	40	BLC	1.7	21	3	150	REM	2.0
5	5	30	GRB	1.1	11	1	90	GRA	1.6	16	6	40	WHP	1.8	21	3	150	YEB	1.3
5	5	30	SWB	2.6	11	1	90	WHA	6.0	16	6	40	BLC	1.1	21	3	150	YEB	1.7
5	5	30	SWB	1.0	11	1	90	WHA	6.0	16	6	40	BLC	1.2	21	3	150	SUM	1.5
5	5	30	SWB	1.5	11	1	90	BLL	3.5	16	6	40	BLC	1.1	21	3	150	YEB	2.1
5	5	40	SWB	1.1	11	1	90	BLC	6.0	16	6	50	QUA	1.1	21	3	150	BLC	1.2
5	5	40	SWB	1.3	11	1	90	BLC	6.0	16	6	50	QUA	1.0	21	3	150	YEB	2.4
5	5	40	SWB	2.2	11	1	90	WHA	1.3	16	6	50	BLC	1.2	21	3	150	YEB	2.2
5	5	40	SWB	1.0	11	1	90	WHA	4.7	16	6	50	QUA	1.0	21	3	150	GRB	3.8
5	5	40	SWB	1.0	11	1	90	BLC	6.0	16	6	50	QUA	2.0	21	3	150	REM	2.0
5	5	40	SWB	1.9	11	1	90	BLC	6.0	16	6	60	WHP	2.1	21	3	150	BLC	2.4
5	5	40	SWB	1.2	11	1	90	WHA	1.3	16	6	60	BLC	1.2	21	3	150	SUM	1.0
5	5	40	SWB	1.2	11	1	90	BLC	6.0	16	6	60	NWC	2.1	21	3	150	SUM	1.3
5	5	40	YEB	1.0	11	1	90	GRA	3.0	16	6	60	NWC	1.9	21	3	150	YEB	2.4
5	5	40	SWB	1.4	11	1	90	GRA	6.0	16	6	60	BLC	1.1	21	3	150	BLC	2.5
5	5	40	YEB	2.0	11	1	90	BLL	6.0	16	6	70	REM	1.3	21	3	150	REM	2.0
5	5	40	SWB	1.4	11	1	90	WHA	1.7	16	6	70	BLC	1.2	21	3	150	SUM	1.7
5	5	40	YEB	1.0	11	1	90	WHA	6.0	16	6	70	NWC	1.6	21	3	150	REM	2.1
5	5	40	YEB	1.1	11	1	90	BLL	6.0	16	6	70	AMB	1.0	21	3	150	BLC	2.8
5	5	40	SHH	1.3	11	1	90	WHA	6.0	16	6	70	REM	1.0	21	3	150	YEB	2.3
5	5	40	YEB	1.8	11	1	90	BLL	6.0	16	6	70	EAH	1.4	21	3	150	YEB	1.8
5	5	40	YEB	1.6	11	1	90	GRA	5.8	16	6	70	NWC	2.3	21	3	150	YEB	2.5
5	5	40	SWB	2.6	11	1	90	GRA	6.0	16	6	70	REM	2.4	21	3	150	REM	1.7
5	5	40	SHH	2.2	11	2	10	BLA	1.5	16	6	70	NWC	1.2	21	3	150	YEB	2.5
5	5	40	YEB	1.3	11	2	10	BLA	1.3	16	6	70	NWC	1.5	21	3	150	YEB	2.8
5	5	40	YEB	1.0	11	2	10	BLA	1.1	16	6	70	NWC	2.2	21	3	150	REM	2.5
5	5	40	SWB	1.6	11	2	10	NWC	1.1	16	6	70	BLC	1.1	21	3	150	BLC	2.0
5	5	40	SWB	2.5	11	2	10	NWC	14.0	16	6	70	NWC	2.2	21	3	150	YEB	1.5
5	5	40	SWB	2.3	11	2	10	BLA	8.2	16	6	70	NWC	2.4	21	3	150	YEB	1.3
5	5	40	SWB	2.3	11	2	10	BLA	1.2	16	6	70	NWC	1.4	21	3	150	BLC	2.5
5	5	40	SWB	1.1	11	2	10	BLA	2.2	16	6	70	NWC	2.4	21	3	150	BLC	1.3
5	5	40	SWB	2.6	11	2	10	NWC	1.1	16	6	70	REM	1.1	21	3	150	BLC	2.5
5	5	40	SWB	1.2	11	2	10	BLA	1.0	16	6	70	NWC	2.7	21	3	150	BLC	1.0
5	5	40	SWB	2.1	11	2	10	BLA	1.2	16	6	70	BLC	1.2	21	3	150	REM	1.8

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	5	50	SWB	1.2	11	2	10	BLA	1.0	16	6	70	AME	2.3	21	3	150	REM	2.5
5	5	50	SAS	2.4	11	2	10	SWO	11.6	16	6	70	BLC	1.3	21	3	150	REM	2.3
5	5	50	SWB	1.4	11	2	10	NWC	8.2	17	1	10	NO	0.0	21	3	150	YEB	1.3
5	5	50	GRB	3.4	11	2	10	SUM	1.1	17	1	20	NO	0.0	21	3	150	BLC	1.5
5	5	50	SWB	1.0	11	2	10	BLA	1.7	17	1	30	PAB	1.0	21	3	150	REM	2.0
5	5	60	SWB	2.6	11	2	10	NWC	1.6	17	1	30	QUA	1.2	21	3	150	BLC	2.5
5	5	60	SWB	2.1	11	2	10	NWC	1.6	17	1	40	NO	0.0	21	3	150	YEB	1.6
5	5	60	SWB	1.0	11	2	10	NWC	11.0	17	1	50	NO	0.0	21	3	150	REM	1.3
5	5	60	SWB	2.5	11	2	10	BLA	1.3	17	1	60	NO	0.0	21	3	150	SUM	1.5
5	5	60	GRB	2.7	11	2	10	NWC	1.3	17	1	70	NO	0.0	21	3	150	REM	1.4
5	5	60	SWB	2.2	11	2	10	NWC	7.2	17	1	80	NO	0.0	21	3	150	REM	1.4
5	5	60	SWB	1.4	11	2	10	BLA	1.1	17	1	90	NO	0.0	21	3	150	REM	2.3
5	5	60	GRB	4.1	11	2	10	BLA	1.0	17	1	100	NO	0.0	21	3	150	REM	1.3
5	5	60	LAA	1.5	11	2	20	SLE	1.2	17	1	110	WHA	1.2	21	3	150	YEB	1.4
5	5	60	SWB	2.7	11	2	20	BLA	2.0	17	1	110	WHA	1.0	21	3	150	YEB	2.0
5	5	60	SWB	1.0	11	2	20	BLA	1.0	17	1	110	WHA	1.2	21	3	150	SUM	1.1
5	5	60	SWB	2.5	11	2	20	BLA	1.0	17	1	120	NO	0.0	21	3	150	BLC	1.8
5	5	60	GRB	2.0	11	2	20	BLA	1.4	17	1	130	NO	0.0	21	3	150	REM	1.1
5	5	60	SWB	1.5	11	2	20	BLA	1.3	17	1	140	NO	0.0	21	3	150	YEB	2.3
5	5	60	QUA	1.6	11	2	20	BLA	1.0	17	1	150	NO	0.0	21	3	150	REM	1.2
5	5	60	SWB	1.9	11	2	20	BLA	1.2	17	1	160	REM	9.6	21	3	150	YEB	2.5
5	5	60	SWB	1.9	11	2	20	BLA	1.0	17	1	160	REM	8.8	21	3	150	BLC	2.0
5	5	60	SWB	2.0	11	2	20	BLA	1.1	17	1	160	QUA	2.6	21	3	150	YEB	1.8
5	5	60	SWB	1.5	11	2	20	BLA	1.7	17	1	160	REM	10.6	21	3	150	YEB	1.3
5	5	60	SWB	1.3	11	2	20	BLA	1.5	17	1	160	WHA	1.5	21	3	150	REM	1.5
5	5	60	SWB	3.1	11	2	20	BLA	1.0	17	1	160	WHA	1.0	21	3	150	SUM	1.4
5	5	60	SWB	3.1	11	2	30	BLA	1.0	17	1	160	WHA	2.8	21	3	150	REM	1.7
5	5	60	SWB	1.5	11	2	30	BLA	1.8	17	1	160	REM	3.7	21	3	150	REM	2.4
5	5	60	SWB	2.4	11	2	30	BLA	1.2	17	1	160	REM	4.8	22	1	10	NO	0.0
5	5	60	SWB	1.3	11	2	30	BLA	1.2	17	1	160	REM	3.3	22	1	20	NO	0.0
5	5	60	SWB	1.8	11	2	30	BLA	1.3	17	1	160	QUA	6.8	22	1	30	NO	0.0
5	5	60	SWB	1.8	11	2	30	BLA	1.1	17	1	160	REM	2.3	22	1	40	NO	0.0
5	5	60	SWB	1.2	11	2	30	BLA	2.1	17	1	160	QUA	13.8	22	1	50	NO	0.0
5	5	60	SWB	1.3	11	2	30	BLA	1.3	17	1	160	QUA	9.6	22	1	60	NO	0.0
5	5	60	SWB	1.2	11	2	30	BLA	1.2	17	1	160	WHA	6.1	22	1	70	NO	0.0
5	5	60	SWB	1.8	11	2	30	BLA	1.1	17	1	160	REM	5.6	22	1	80	NO	0.0
5	5	60	SWB	1.3	11	2	30	BLA	1.2	17	1	165	YEB	6.3	22	1	90	NO	0.0
5	5	60	SWB	1.4	11	2	30	BLA	1.8	17	1	165	REM	1.5	22	1	100	NO	0.0
5	5	60	SWB	2.2	11	2	30	BLA	2.0	17	1	165	REM	1.2	22	1	110	NO	0.0
5	5	70	SWB	1.7	11	2	30	BLA	1.2	17	1	165	REM	9.8	22	1	120	NO	0.0
5	5	70	YEB	1.3	11	2	40	BLA	1.2	17	1	165	YEB	5.3	22	1	130	NO	0.0
5	5	70	SWB	1.9	11	2	40	BLA	1.5	17	1	165	PAB	3.1	22	1	140	SHB	1.9
5	5	70	SWB	2.6	11	2	40	BLA	1.1	17	1	165	PAB	1.8	22	1	150	SHB	2.3
5	5	70	SWB	1.4	11	2	40	BLA	2.0	17	1	165	PAB	6.8	22	1	150	SHB	1.7
5	5	70	SWB	2.4	11	2	40	BLA	1.3	17	1	165	REM	3.7	22	1	160	SHB	2.5
5	5	70	SWB	2.3	11	2	40	BLA	1.1	17	1	165	WHA	3.3	22	1	160	SHB	2.5
5	5	70	SWB	1.7	11	2	40	BLA	1.2	17	1	165	REM	15.5	22	1	170	SHB	1.3
5	5	70	GRB	1.0	11	2	40	BLA	1.1	17	1	165	QUA	3.5	22	1	180	NO	0.0
5	5	70	GRB	1.6	11	2	40	BLA	1.2	17	1	165	REM	13.5	22	1	190	NO	0.0
5	5	70	GRB	1.1	11	2	40	BLA	2.3	17	1	165	PAB	6.5	22	1	200	SHB	3.1
5	5	70	GRB	1.9	11	2	50	BLA	1.0	17	1	165	REM	3.7	22	1	200	SHB	3.0
5	5	70	GRB	1.7	11	2	50	BLA	1.1	17	1	165	PAB	1.4	22	1	210	SHB	4.2
5	5	70	GRB	2.3	11	2	50	BLA	1.1	17	1	165	REM	10.5	22	1	210	SHB	4.6
5	5	70	GRB	2.6	11	2	50	BLA	2.3	17	1	165	REM	6.2	22	1	220	REM	9.6

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					- m -
5	5	70	SWB	1.0	11	2	50	BLA	1.3	17	1	165	QUA	8.8	22	1	220	REM	3.3
5	5	70	GRB	2.3	11	2	50	BLA	2.0	17	1	165	PAB	10.3	22	1	220	SHB	4.4
5	5	70	GRB	2.7	11	2	50	BLA	1.1	17	1	165	YEB	3.6	22	1	220	REM	4.3
5	5	70	GRB	1.9	11	2	50	BLA	1.2	17	2	10	NO	0.0	22	1	220	BLC	1.3
5	5	70	YEB	1.8	11	2	50	BLA	1.4	17	2	20	QUA	2.1	22	1	220	REM	4.1
5	5	70	GRB	3.8	11	2	50	BLA	1.5	17	2	20	GRB	2.5	22	1	220	REM	5.6
5	5	70	SWB	1.8	11	2	60	BLA	1.0	17	2	20	GRB	2.1	22	1	220	SHB	4.7
5	5	70	SWB	1.6	11	2	60	BLA	1.0	17	2	20	PAB	1.0	22	1	220	WHA	1.9
5	5	70	SWB	2.4	11	2	60	BLA	1.3	17	2	20	PAB	1.1	22	1	220	REM	2.9
5	5	70	SWB	1.1	11	2	60	BLA	1.1	17	2	20	PAB	1.4	22	1	220	SHB	4.8
5	5	70	SWB	1.5	11	2	60	BLA	1.5	17	2	20	GRB	1.4	22	1	220	SHB	4.9
5	5	70	YEB	2.1	11	2	60	BLA	1.5	17	2	30	PAB	1.1	22	1	220	SHB	3.5
5	5	70	REM	1.8	11	2	70	BLA	1.3	17	2	30	PAB	1.0	22	2	10	AME	1.1
5	5	70	GRB	1.2	11	2	70	BLA	1.3	17	2	40	NO	0.0	22	2	20	NO	0.0
5	5	70	SWB	1.7	11	2	70	BLA	1.7	17	2	50	PAB	1.3	22	2	30	NO	0.0
5	5	70	GRB	2.5	11	2	70	BLA	1.5	17	2	50	PIC	1.0	22	2	40	NO	0.0
5	5	70	SWB	2.5	11	2	70	BLA	1.3	17	2	60	PAB	1.3	22	2	50	WHA	1.6
5	5	70	GRB	2.6	11	2	70	BLA	1.6	17	2	70	NO	0.0	22	2	50	AME	3.2
5	5	70	SWB	2.2	11	2	70	BLA	1.7	17	2	80	PAB	1.2	22	2	60	NO	0.0
5	5	70	SWB	2.3	11	2	70	BLA	1.3	17	2	90	QUA	1.0	22	2	70	WHA	1.0
5	5	70	SAS	1.4	11	2	70	BLA	2.3	17	2	100	NO	0.0	22	2	80	NO	0.0
5	5	70	SWB	1.2	11	2	70	BLA	1.6	17	2	110	NO	0.0	22	2	90	NO	0.0
5	5	70	SAS	1.9	11	2	70	BLA	1.6	17	2	120	NO	0.0	22	2	100	GRA	1.1
5	5	70	SWB	1.7	11	2	70	REM	2.8	17	2	130	NO	0.0	22	2	100	GRA	1.2
5	5	70	SAS	2.3	11	2	70	BLA	2.8	17	2	140	NO	0.0	22	2	100	GRA	1.0
5	5	70	SWB	2.3	11	2	70	BLA	1.0	17	2	150	REM	8.8	22	2	110	NO	0.0
5	5	70	GRB	1.7	11	2	70	BLA	2.0	17	2	150	REM	10.4	22	2	120	NO	0.0
5	5	70	GRB	1.9	11	2	70	BLA	2.1	17	2	150	QUA	7.4	22	2	130	NO	0.0
5	5	70	SAS	1.7	11	2	70	BLA	2.2	17	2	150	REM	7.7	22	2	140	GRA	1.1
5	5	70	SAS	1.5	11	2	70	BLA	1.5	17	2	150	PAB	3.5	22	2	150	NO	0.0
6	1	10	BAS	3.0	11	2	70	BLA	1.0	17	2	150	REM	8.1	22	2	160	GRA	1.3
6	1	10	BAS	1.2	11	2	70	BLA	1.0	17	2	150	QUA	9.8	22	2	160	GRA	1.3
6	1	20	AME	14.4	11	2	70	BLA	1.6	17	2	150	QUA	5.3	22	2	160	GRA	1.5
6	1	30	NO	0.0	11	2	70	BLA	2.9	17	2	150	QUA	9.5	22	2	160	GRA	1.4
6	1	40	QUA	1.8	11	2	80	BLA	1.3	17	2	150	PAB	7.4	22	2	160	GRA	1.1
6	1	50	NO	0.0	11	2	80	BLA	1.1	17	2	150	PAB	4.0	22	2	170	GRA	1.0
6	1	60	QUA	1.8	11	2	80	BLA	1.2	17	2	150	QUA	4.8	22	2	170	GRA	2.1
6	1	60	QUA	1.6	11	2	80	BLA	1.2	17	2	150	QUA	7.3	22	2	180	GRA	1.8
6	1	70	QUA	1.7	11	2	80	BLA	1.6	17	2	150	QUA	4.7	22	2	180	GRA	1.1
6	1	70	QUA	1.2	11	2	80	BLA	1.4	17	2	150	PAB	7.0	22	2	180	GRA	1.2
6	1	70	QUA	1.3	11	2	80	BLA	3.4	17	2	150	QUA	11.2	22	2	190	NO	0.0
6	1	80	QUA	1.9	11	2	80	BLA	1.3	17	2	150	PAB	1.6	22	2	200	SHH	6.3
6	1	80	QUA	1.1	11	2	80	BLA	2.8	17	2	150	QUA	10.0	22	2	200	SHH	5.8
6	1	80	QUA	1.0	11	2	80	BLA	1.1	17	2	150	PAB	3.0	22	2	200	REM	2.3
6	1	80	QUA	1.3	11	2	80	BLA	2.1	17	2	160	WHA	7.2					
6	1	80	QUA	1.6	11	2	80	BLA	2.8	17	2	160	REM	9.0					
6	1	90	QUA	1.1	11	2	80	BLA	1.1	17	2	160	REM	7.1					
6	1	90	WHP	2.0	11	2	80	BLA	1.4	17	2	160	REM	7.5					
6	1	100	QUA	1.6	11	2	80	BLA	1.2	17	2	160	QUA	8.8					
6	1	100	QUA	1.8	11	2	80	BLA	1.1	17	2	160	PAB	3.2					
6	1	110	NO	0.0	11	2	80	BLA	1.6	17	2	160	QUA	9.7					
6	1	120	NO	0.0	11	2	80	BLA	2.5	17	2	160	REM	5.3					
6	1	130	NO	0.0	11	2	80	BLA	1.1	17	2	160	QUA	3.7					
6	1	140	NO	0.0	11	2	80	BLA	1.3	17	2	160	PAB	1.4					

Appendix Table 4 continued.

S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT	S	P	SP	SPP	HT
				- m -					- m -					- m -					
6	1	150	NO	0.0	11	2	90	BLA	2.1	17	2	160	QUA	1.0					
6	1	160	NO	0.0	11	2	90	BLA	1.0	17	2	160	PAB	6.1					
6	1	170	AME	3.9	11	2	90	BLA	1.7	17	2	160	WHA	4.6					
6	1	170	WHA	2.8	11	2	90	BLA	1.2	17	2	160	PAB	2.7					

[a] Abbreviations: S -- site, P --- plot, SP -- subplot (distance of furthest subplot edge from the right-of-way edge [ft]), SPP -- species, and HT -- height. Definitions of abbreviations for species from within the tables are provided in Appendix Table 5.

Individual tree stem data has been archived on the Syracuse University mainframe computer in the WHITE@SUVM account under the file name "ALL9192.PRN". This file will remain archived until 11/23/96.

Appendix Table 5. Acronyms and common and scientific names of tree species found on the electric transmission line right-of-way plots in 1975, 1991, and 1992.[a]

Acronym[b]	Common name	Scientific name
BAF	balsam fir	*Abies balsamea* (L.) Mill.
BOX	boxelder	*Acer negundo* L.
REM	red maple	*Acer rubrum* L.
SIM	silver maple	*Acer saccharinum* L.
SUM	sugar maple	*Acer saccharum* Marsh.
AIL	ailanthus	*Ailanthus altissima* (Mill.) Swingle
SHB	serviceberry[c]	*Amelanchier arborea* (Michx. f.) Fern.
YEB	yellow birch	*Betula alleghaniensis* Britton
SWB	sweet birch	*Betula lenta* L.
PAB	paper birch	*Betula papyrifera* Marsh.
GRB	gray birch[c]	*Betula populifolia* Marsh.
AMH	American hornbeam[c]	*Carpinus caroliniana* Walt.
BIH	bitternut hickory	*Carya cordiformis* (Wangenh.) K. Koch
PIH	pignut hickory	*Carya glabra* (Mill.) Sweet
SHH	shagbark hickory	*Carya ovata* (Mill.) K. Koch
AMB	American beech	*Fagus grandifolia* Ehrh.
WHA	white ash	*Fraxinus americana* L.
BLA	black ash	*Fraxinus nigra* Marsh.
GRA	green ash	*Fraxinus pennsylvanica* Marsh.
ABU	butternut	*Juglans cinerea* L.
BLW	black walnut	*Juglans nigra* L.
ERC	eastern redcedar	*Juniperus virginiana* L.
YEP	yellow-poplar	*Liriodendron tulipifera* L.
HOH	eastern hophornbeam[c]	*Ostrya virginiana* (Mill.) K. Koch
WHS	white spruce	*Picea glauca* (Moench) Voss
BLS	black spruce	*Picea mariana* (Mill.) B.S.P.
RES	red spruce	*Picea rubens* Sarg.
REP	red pine	*Pinus resinosa* Ait.
WHP	eastern white pine	*Pinus strobus* L.
SCP	Scotch pine	*Pinus sylvestris* L.
COT	eastern cottonwood	*Populus deltoides* Bartr. ex Marsh.
LAA	large-toothed aspen	*Populus grandidentata* Michx.
QUA	quaking aspen	*Populus tremuloides* Michx.
PIC	pin cherry[c]	*Prunus pensylvanica* L. f.
BLC	black cherry	*Prunus serotina* Ehrh.
WHO	white oak	*Quercus alba* L.
SWO	swamp white oak	*Quercus bicolor* Willd.
SCO	scarlet oak	*Quercus coccinea* Muenchh.
CHI	chinkapin oak	*Quercus muehlenbergii* Engelm.
CHO	chestnut oak	*Quercus prinus* L.
REO	northern red oak	*Quercus rubra* L.
BLO	black oak	*Quercus velutina* Lam.
BLL	black locust	*Robinia pseudoacacia* L.
SAS	sassafras	*Sassafras albidum* (Nutt.) Nees
NWC	northern white-cedar	*Thuja occidentalis* L.
BAS	American basswood	*Tilia americana* L.

Appendix Table 5 continued.

Acronym	Common name	Scientific name
EAH	eastern hemlock	_Tsuga canadensis_ (L.) Carr.
AME	American elm	_Ulmus americana_ L.
SLE	slippery elm	_Ulmus rubra_ Muhl.
NO	no species found in subplot	-

[a] Based on plot maps and accompanying list of trees provided with each site map in ESEERCO's 1975 study final report (ESEERCO, 1977a), Niagara Mohawk Power Corporation's "List of trees to be trimmed, removed, or sprayed" (NMPC, 1989), and the 1991 and 1992 field surveys. Nomenclature follows Little (1979).

[b] Acronyms were adapted from ESEERCO (1977a).

[c] These species are conditionally listed as desirable species by the Niagara Mohawk Power Corporation in their "List of small trees and shrubs to be preserved" (NMPC 1989).

Appendix Table 6. Plot sizes from Study 2.

		Plot size[a]	
Site	Plot	X-axis	Y-axis
		m	
1	1	47.26	17.23
1	3	48.78	16.46
1	4	48.78	16.46
2	1	30.49	27.44
2	2	45.73	17.53
2	3	24.39	17.38
3	2	36.59	10.98
3	3	36.59	10.98
4	1	22.87	17.68
4	2	22.87	17.68
4	3	30.49	13.72
5	1	24.39	16.62
5	2	25.91	15.40
5	3	22.87	16.46
5	4	24.39	16.31
5	5	21.34	18.14
6	1	54.88	15.24
6	2	82.32	9.76
6	3	82.32	9.76
6	4	82.32	9.76
6	5	82.32	9.76
8	1	42.68	18.60
8	2	44.21	18.60
8	3	42.68	18.90
8	4	39.63	20.73
8	5	39.63	19.21
9	1	76.22	10.67
9	2	68.60	11.89
9	5	68.60	11.89
10	2	48.78	16.77
11	1	27.44	15.24
11	2	27.44	15.24
11	3	21.34	18.29
13	1	26.68	30.49
13	2	30.49	26.68
14	1	45.73	17.68
14	2	53.35	15.24
15	1	19.82	20.43
15	2	18.29	21.34
16	1	22.87	17.68
16	2	22.87	17.68
16	3	22.87	17.68
16	5	21.34	18.90
16	6	21.34	18.90

Appendix Table 6 continued.

		Plot size[a]	
Site	Plot	X-axis	Y-axis
		m	
17	1	50.30	16.16
17	2	50.30	16.16
17	3	30.49	13.41
17	4	27.44	14.94
18	3	33.54	24.39
19	1	71.65	11.28
19	2	67.07	12.20
20	1	76.22	10.67
20	2	82.32	10.06
21	1	45.73	17.68
21	2	45.73	17.68
21	3	45.73	17.68
22	1	67.07	12.20
22	2	60.98	13.41

[a] Distances are expressed along X- and Y-axes. The X-axis values are the distances from edge to edge on a right-of-way between. The Y-axis values are the plot lengths along the edges parallel to centerline.

Appendix Table 7. Original vegetation and cost data from the initial clearing study -- Study 3.[a]

AREA	PLOT	MODE[b]	METHOD[c]	D82	D83	UD82	UD83	STMSP83	PERCSPT	LAB83	EQU83	MAT83
				stems ha^{-1}					%	dollars ha^{-1}		
126	2B	SC	B	840	1870	4370	138500	4070	39	1810	990	460
126	3	CC	B	680	520	3660	76120	370	5	2160	1140	530
128	1	CC	B	200	910	2890	142730	2510	24	1890	990	450
134	1B	SC	B	1040	2580	3130	16430	1710	15	1690	880	560
135	1B	SC	B	2770	19310	2650	34290	8730	.	1680	900	640
136	1	CC	B	5680	13900	3000	5320	440	9	1780	780	1080
136	2	CC	B	5270	9200	1960	16870	1210	8	1910	810	840
150	1B	SC	CS	1180	3440	2610	31370	2020	19	1340	780	110
150	2	SC	CS	660	700	2180	24920	1390	17	2410	1710	100
150	3	SC	NT	1160	13000	2400	16240	7070	61	1530	1320	0
150	4	SC	NT	1440	6590	2470	41110	5640	55	2120	1830	0
150	5	CC	CS	1880	1460	3060	47750	1600	18	1880	1620	130
150	6	CC	CS	2510	2490	2860	19180	2570	28	1960	1690	150
150	7	CC	NT	940	7050	5960	29590	11650	64	1680	1450	0
150	8	CC	NT	980	5250	4040	34350	8650	61	1870	1100	0
191	A1	SC	CS	70	1560	3380	2180	1360	11	1460	870	180
191	1B	SC	CS	2270	900	3000	0	0	.	340	50	50
193	1	SC	NT	2390	18100	3470	114880	18690	81	670	400	0
193	2	CC	CS	1790	6330	4010	10440	3530	26	1620	970	230
195	1	CC	CS	190	3070	12350	29580	22280	60	2350	1410	180
195	2	CC	NT	100	3810	10080	35250	21680	66	1980	1180	0
197	1	CC	NT	3190	17790	3710	17730	11910	85	550	330	0
207	4	SC	NT	1590	8130	1940	17580	14300	96	340	50	0

[a] Abbreviations: AREA -- study area, PLOT -- study plot, MODE -- treatment mode, METHOD -- treatment method, D82 -- 1982 desirable stems, D83 -- 1983 desirable stems, UD82 -- 1982 tree stems, UD83 -- 1983 tree stems, STMSP83 -- total number of tree stump sprouts in 1983, PERCSPT -- percentage of tree stumps that sprouted, LAB83 -- 1983 cost for labor, EQU83 -- 1983 cost for equipment, and MAT83 -- 1983 cost for materials.

[b] Abbreviations: CC -- clearcut, nonselective; SC -- selective cut, selective.

[c] Abbreviations: B -- basal, CS -- cut stump, NT -- no treatment.

Appendix Table 8. Original vegetation and cost data from the first conversion cycle study -- Study 4.[a]

AREA	PLOT	BLK	MODE[b]	METHOD[c]	D87	UD87	DG687	UG687	DG1287	UG1287	DHT87	UHT87	HERB86	LAB84	EQU84	MAT84
					stems ha^{-1}						m		%	dollars ha^{-1}		
126	1B	1	S	F	730	8430	0	760	0	0	1.2	1.1	99	680	130	140
126	2B	1	S	B	90	4570	0	730	0	90	0.6	1.3	136	1180	230	770
126	3	1	N	F	300	3270	0	880	0	10	0.8	1.5	194	530	100	330
128	1	1	N	B	1490	3350	30	500	0	0	0.9	1.3	132	910	180	530
134	1B	2	S	F	1860	4670	0	280	0	0	0.9	1.1	95	630	120	120
135	1B	2	S	B	24520	6720	1230	1340	0	0	1.1	1.3	82	780	150	270
136	1	2	N	F	12540	4330	0	0	0	0	0.4	0.4	114	410	80	230
136	2	2	N	B	10780	4610	0	20	0	0	0.8	0.9	89	520	100	450
150	1B	3	S	F	17810	28360	360	280	0	0	0.6	0.8	114	780	150	250
150	2	3	S	B	1390	6480	0	910	0	0	0.9	1.2	112	920	180	490
150	3	4	S	F	9080	1350	2360	420	0	0	1.4	1.5	62	650	130	130
150	4	4	S	B	5650	2790	790	420	0	0	1.2	1.1	88	910	180	480
150	5	3	N	F	2140	6780	0	140	0	0	0.6	0.7	57	600	120	360
150	6	3	N	B	550	4010	0	1160	0	70	1	1.4	86	680	130	260
150	7	4	N	F	19140	11290	190	340	0	0	0.8	0.9	122	560	110	370
150	8	4	N	B	2850	3010	0	90	0	0	0.7	0.9	116	810	160	580
191	A1	5	S	B	1070	4800	20	160	0	0	0.9	1.1	101	730	140	250
191	1B	5	S	F	480	180	60	0	0	0	1.4	0.7	.	290	50	30
193	1	6	S	B	3850	10440	620	420	0	0	1	1	157	1590	310	1090
193	2	5	N	F	1870	1370	0	0	0	0	0.8	0.5	139	620	120	450
195	1	5	N	B	1400	3020	30	30	0	0	1.2	0.8	147	970	190	330
195	2	6	N	F	410	790	0	50	0	0	1.1	1	129	620	120	490
197	1	6	N	B	14820	5950	0	0	0	0	0.8	0.7	84	710	140	360
207	4	6	S	F	9010	1160	1800	240	0	0	1.3	1.3	181	510	100	140

[a] Abbreviations: AREA -- study area, PLOT -- study plot, BLK -- block; MODE -- treatment mode, METHOD -- treatment method, D87 -- 1987 desirable stems, UD87 -- 1987 tree stems, DG687 -- number of 1987 desirables greater than 1.8 m tall, UG687 -- number of 1987 trees greater than 1.8 m tall, DG1287 -- number of 1987 desirables greater than 3.7 m tall, UG1287 -- number of 1987 trees greater than 3.7 m tall, DHT87 -- 1987 desirable average stem height, UHT87 -- 1987 tree average stem height, HERB86 -- 1986 herbaceous cover, LAB84 -- 1984 cost for labor, EQU84 -- 1984 cost for equipment, and MAT84 -- 1984 cost for materials.

[b] Abbreviations: N -- nonselective, S -- selective.

[c] Abbreviations: B -- basal, F -- stem-foliar.

Appendix Table 9. Original vegetation and cost data from the second conversion cycle study -- Study 4.[a]

AREA	PLOT	BLK	MODE[b]	METHOD[c]	WATER[d]	D90	UD90	DG690	UG690	DG1290	UG1290	DMHT90	UMHT90	HERB89	LAB84	EQU84	MAT84
						stems ha^{-1}						m		%	dollars ha^{-1}		
126	1B	1	S	F	NO	0	150	0	0	0	0	0	0.6	73	280	50	130
126	2B	1	S	B	NO	180	1140	0	50	0	0	1	1	54	300	60	160
126	3	1	N	F	NO	110	540	0	0	0	0	0.4	0.7	54	120	20	140
128	1	1	N	B	NO	580	330	0	0	0	0	1	0.9	69	480	90	230
134	1B	2	S	F	NO	3780	1130	0	60	0	0	0.9	0.8	57	170	100	130
135	1B	2	S	B	NO	21860	3200	3610	1140	0	90	1.3	1.6	39	400	80	350
136	1	2	N	F	NO	1780	330	0	0	0	0	0.4	0.4	77	180	30	110
136	2	2	N	B	YES	17220	4900	280	2050	0	90	1.1	2	78	260	50	140
150	1B	3	S	F	NO	2140	2420	140	50	0	0	0.9	0.6	64	180	30	130
150	2	3	S	B	YES	1670	7960	300	5440	0	270	1.4	2.6	73	370	70	120
150	3	4	S	F	NO	3270	530	1530	110	0	0	2	1.6	88	200	40	60
150	4	4	S	B	YES	3070	3130	1540	1100	70	110	2.1	1.8	82	330	60	70
150	5	3	N	F	NO	1650	2560	0	0	0	0	0.4	0.4	77	240	50	140
150	6	3	N	B	YES	650	5800	240	2500	0	1000	1.6	2.1	68	360	70	120
150	7	4	N	F	NO	100	930	0	30	0	0	0.7	0.6	66	250	50	210
150	8	4	N	B	YES	2980	3560	280	890	0	140	1.4	1.6	71	340	70	160
191	A1	5	S	B	NO	780	1720	0	0	0	0	0.7	0.6	79	340	70	190
191	1B	5	S	F	NO	660	120	60	0	0	0	1	0.5	90	180	30	50
193	1	6	S	B	NO	2150	3210	270	0	110	0	1.3	0.6	71	310	60	120
193	2	5	N	F	NO	190	220	0	0	0	0	0.6	0.6	77	150	30	40
195	1	5	N	B	NO	820	2200	0	80	0	0	0.9	0.8	81	360	70	120
195	2	6	N	F	NO	50	410	0	0	0	0	0.8	1	69	210	40	60
197	1	6	N	B	NO	2470	3180	0	0	0	0	0.6	0.7	79	610	120	280
207	4	6	S	F	NO	16280	1090	1660	90	180	40	1.3	0.9	69	210	40	90

[a] Abbreviations: AREA -- study area, PLOT -- study plot, BLK -- block, MODE -- treatment mode, METHOD -- treatment method, D90 -- 1990 desirable stems, UD90 -- 1990 tree stems, DG690 -- number of 1990 desirable stems greater than 1.8 m tall, UG690 -- number of 1990 tree stems greater than 1.8 m tall, DG1290 -- number of 1990 desirable stems greater than 3.7 m tall, UG1290 -- number of 1990 tree stems greater than 3.7 m tall, DHT90 -- 1990 desirable avergae stem height, UHT90 -- 1990 average tree stem height, HERB89 -- 1989 herbaceous cover, LAB88 -- 1988 cost for labor, EQU88 -- 1988 cost for equipment, and MAT83 -- 1988 cost for materials.

[b] Abbreviations: N -- nonselective, S -- selective.

[c] Abbreviations: B -- basal, F -- stem-foliar.

[d] WATER: NO -- received herbicide treatment in 1988; YES -- did not receive herbicide treatment, but was treated with water.

Appendix Table 10. Original 1987 vegetation and cost data from the second conversion cycle non-herbicide study -- Study 5.[a]

AREA	PLOT	METHOD[b]	D87	UD87	DG687	UG687	DG1287	UG1287	DMHT87	UMHT87
			stems ha^{-1}						m	
8126	4	G	0	11250	0	20	0	0.6	0	1.3
8132	1234	G	1730	20560	0.6	25.7	0	2.1	0.9	1.6
8134	1	BH	240	19310	14.3	33.8	0	20	1.1	1.8
8134	1AAAB	G	5400	14240	0	38	0	0.01	0.5	1.8
8134	2	BH	510	15640	0	14.7	0	0.4	1	1.4
8134	4	BH	170	30430	0	45.9	0	4.7	1.1	2
8135	1A	BH	6860	14590	0	12	0	0	1.1	1.4
8154	2A2B	BH	100	14700	0	3	0	0	0.8	0.8
8154	3	BH	1050	3770	0	11	0	0	1.3	1.1
8154	4	BH	890	5040	0	4	0	0	0.7	0.9
8156	1	BH	550	13270	0	28.8	0	0	0.9	1.5
8156	234	G	7610	7950	0.8	14.2	0	0.6	0.8	1.4
8158	12	G	1300	88140	0	12	0	0	0.8	1.1
8159	2122	G	750	17640	0	4	0	0	0.9	1
8199	12	G	1400	7260	1.9	14.5	0	1.2	0.9	1.3
8199	3	BH	900	6330	8.6	39.4	0	3.7	1.2	1.8
8205	1	BH	9740	1130	35	38	0	0	1.2	1.1
8207	1	BH	9360	10980	39	61	0	0	1.6	1.7
8207	23	G	7230	3520	26.9	46.1	0	0	1.3	1.6

[a] Abbreviations: AREA -- study area, PLOT -- study plot, METHOD -- treatment method, D90 -- 1990 desirable stems, UD90 -- 1990 tree stems, DG690 -- number of 1990 desirables greater than 1.8 m tall, UG690 -- number of 1990 trees greater than 1.8 m tall, DG1290 -- number of 1990 desirables greater than 3.7 m tall, UG1290 -- number of 1990 trees greater than 3.7 m tall, DHT90 -- 1990 desirable average stem height, UHT90 -- 1990 tree average stem height, LAB88 -- 1988 cost for labor, EQU88 -- 1988 cost for equipment, and MAT83 -- 1988 cost for materials.

[b] Abbreviations: G -- grub, BH -- brush hog.

Appendix Table 11. Original 1988 and 1990 vegetation and cost data from the second conversion cycle non-herbicide study -- Study 5.[a]

AREA	PLOT	METHOD[b]	D90	UD90	DG690	UG690	DG1290	UG1290	DMHT90	UMHT90	LAB88	EQU88	MAT88
			stems ha^{-1}						m		dollars ha^{-1}		
8126	4	G	1620	11500	0	0	0	0	0.4	0.4	500	960	0
8132	1234	G	310	6190	0	0	0	0	0.3	0.3	810	1570	0
8134	1	BH	690	48820	0	8450	0	0	1	1.5	550	550	0
8134	1AAAB	G	1890	32450	0	0	0	0	0.3	0.3	500	1010	0
8134	2	BH	1170	27100	0	3980	0	0	1.1	1.5	400	410	0
8134	4	BH	70	26140	0	3560	0	0	1.5	1.5	210	210	0
8135	1A	BH	41530	34720	0	5450	0	0	1	1.5	410	410	0
8154	2A2B	BH	2640	15270	110	0	0	0	1	0.9	570	570	0
8154	3	BH	1440	6870	60	540	0	0	1.2	1.2	470	470	0
8154	4	BH	1090	5140	200	0	0	0	1.4	1.2	170	170	0
8156	1	BH	40	12730	0	1120	0	0	0.8	1.2	210	210	0
8156	234	G	630	250	0	0	0	0	0.2	0.2	430	740	0
8158	12	G	360	1420	0	0	0	0	0.4	0.3	420	820	0
8159	2122	G	180	230	0	0	0	0	0.3	0.3	350	680	0
8199	12	G	710	1410	0	0	0	0	0.3	0.3	580	1120	0
8199	3	BH	1340	8410	0	20	0	0	0.8	0.9	210	210	0
8205	1	BH	4970	650	30	0	0	0	0.9	0.8	210	210	0
8207	1	BH	5490	6450	0	0	0	0	0.7	0.9	230	230	0
8207	23	G	2430	250	0	0	0	0	0.4	0.4	480	920	0

[a] Abbreviations: AREA -- study area, PLOT -- study plot, METHOD -- treatment method, D90 -- 1990 desirable stems, UD90 -- 1990 tree stems, DG690 -- number of 1990 desirables greater than 1.8 m tall, UG690 -- number of 1990 trees greater than 1.8 m tall, DG1290 -- number of 1990 desirables greater than 3.7 m tall, UG1290 -- number of 1990 trees greater than 3.7 m tall, DHT90 -- 1990 desirable average stem height, UHT90 -- 1990 tree average stem height, LAB88 -- 1988 cost for labor, EQU88 -- 1988 cost for equipment, and MAT83 -- 1988 cost for materials.

[b] Abbreviations: G -- grub. BH -- brush hog.

Appendix Table 12. Subplot treatment of grubbed plots, including costs and percent cover of seeded and native plants -- Study 5.

			Subplot treatments				Treatment costs					Relative percent herbaceous cover	
Site	Plot	Subplot	Seed mix[a]	Fertil-ization[b]	Track	Mulch[c]	Grub	Seed	Fertil-ization	Track	Mulch	Seed mix	Other
							dollars ha^{-1}						
8126	4	4A	crownvetch	yes	yes	no	1460	550	90	180	-	0.5	64.5
		4B	" (nutricoated)	yes	yes	no	1460	550	90	180	-	0.0	55.0
		4C	none	yes	yes	no	1460	-	90	180	-	0.0	63.0
8132	1234	1A	standard	yes	yes	no	2380	180	100	290	-	32.0	53.0
		1B	"	yes	yes	yes	2380	180	100	290	400	32.0	52.5
		1C	" (nutricoated)	yes	yes	no	2380	180	100	290	-	16.5	62.5
		2A	flat pea	yes	yes	no	2380	250	100	290	-	0.0	95.5
		2B	" "	yes	yes	yes	2380	250	100	290	400	11.0	85.5
		2C	" " (nutricoated)	yes	yes	no	2380	240	100	290	-	1.0	96.5
		3A	crownvetch	yes	yes	no	2380	540	130	290	-	5.0	90.5
		3B	"	yes	yes	yes	2380	540	130	290	380	6.0	85.0
		3C	" (nutricoated)	yes	yes	no	2380	530	130	290	-	3.5	89.5
		4A	triticale	yes	yes	no	2380	470	130	290	-	0.0	98.0
		4B	goldenrod	yes	yes	no	2380	330	130	290	-	4.0	96.0
		4C	Wetsel special	yes	yes	no	2380	500	130	290	-	1.0	99.0
8134	1AAAB	1AA	crownvetch	yes	yes	no	1510	560	110	330	-	40.0	53.5
		1AB	" (nutricoated)	yes	yes	no	1510	530	110	330	-	3.5	89.0

Appendix Table 12. continued.

Site	Plot	Subplot	Subplot treatments: Seed mix[a]	Fertilization	Track	Mulch	Treatment costs: Grub	Seed	Fertilization	Track	Mulch	Relative percent herbaceous cover: Seed mix	Other
							dollars ha^{-1}						
8156	234	2A	wet soils	yes	no	no	1170	220	270	-	-	47.0	29.5
		2B	" " (nutricoated)	yes	no	no	1170	230	110	-	-	44.5	36.5
		3A	sod	yes	no	no	1170	140	120	-	-	14.0	54.0
		3B	" (nutricoated)	yes	no	no	1170	260	120	-	-	7.5	50.0
		4A	none	no	no	no	1170	-	-	-	-	0.0	52.5
		4B	wet soils	yes	no	no	1170	360	100	-	-	43.0	48.5
		4C	" " (nutricoated)	yes	no	no	1170	350	100	-	-	49.5	43.5
8158	12	1A	standard	yes	no	no	1240	200	110	-	-	18.0	63.0
		1B	" (nutricoated)	yes	no	no	1240	200	110	-	-	28.0	57.5
		2A	flat pea	yes	no	no	1240	270	110	-	-	1.0	90.5
		2B	" " (nutricoated)	yes	no	no	1240	250	110	-	-	0.0	100.0
8159	2122	21A	sod	yes	no	no	1030	240	100	-	-	19.0	23.0
		21B	" (nutricoated)	yes	no	no	1030	200	100	-	-	35.5	23.5
		22A	wet soils	yes	no	no	1030	230	100	-	-	35.0	21.0
		22B	" " (nutricoated)	yes	no	no	1030	220	100	-	-	21.0	20.5
8199	12	1A	sod	yes	no	no	1690	180	70	-	-	26.0	72.0
		1B	" (nutricoated)	yes	no	no	1690	170	90	-	-	22.0	68.0
		2A	wet soils	yes	no	no	1690	220	80	-	-	33.0	55.5
		2B	" " (nutricoated)	yes	no	no	1690	220	80	-	-	23.0	66.5
		2C	flat pea	yes	no	no	1690	240	80	-	-	1.0	99.0

Appendix Table 12. continued.

			Subplot treatments				Treatment costs					Relative percent herbaceous cover	
Site	Plot	Subplot	Seed mix[a]	Fertil-ization	Track	Mulch	Grub	Seed	Fertil-ization	Track	Mulch	Seed mix	Other
							dollars ha^{-1}						
8207	23	2A	flat pea	yes	yes	no	1400	280	150	250	-	7.5	92.5
		2B	" " (nutricoated)	yes	yes	no	1400	270	150	250	-	9.5	89.0
		3A	standard	yes	yes	no	1400	200	150	250	-	34.5	64.5
		3B	" (nutricoated)	yes	yes	no	1400	200	150	250	-	44.5	55.5

[a] Standard -- Kentucky 31 64.68%, birdsfoot trefoil 21.78%, redtop 10.17%, inert matter 50%, total 50 kg ha^{-1}. Standard nutricoated -- same mix as previous except one-half of the weight is Fertil-cote (Fertil-Cote -- Lime and fertilizer: nitrogen 1%, phosphoric acid 6.5%, potash 3.5%, iron .35%, zinc .44%, Apron [disease protection]) . Flat pea -- Lathco flat pea 49.0%, Kentucky 31 fescue 38.4%, sorgum Sudan Grass 9.9%, inert matter, total 44 kg ha^{-1}. Flat pea nutricoated -- same mix as previous except one-half of the weight is Fertil-cote. Crownvetch -- crownvetch 43.12%, Kentucky 31 fescue 42.24%: sorghum sudangrass 11.76%, total 38 kg ha^{-1}. Crownvetch nutricoated -- same mix as previous except one-half of the weight is Fertil-cote. Wet soils -- birdsfoot trefoil 37.24%, reeds canary grass 37.14%, alsike clover 15.9%, red top 7.90%, total 44 kg ha^{-1}. Wet soils nutricoated -- same mix as previous except one-half of the weight is Fertil-cote. Sod -- Ruebans bluegrass 33.26%, Saratoga bromegrass 32.20%, Pennlawn red fescue 15.52%, red top 12.88%, total 44 kg ha^{-1}. Sod -- same mix as previous except one-half of the weight is Fertil-cote. Tritical -- Tritical trical 93.00%, Crownvetch 6.89%, total 179 kg ha^{-1}. Goldenrod mix -- goldenrod seed with inert matter to add weight for spreading ease, total 23 kg ha^{-1}. Wetsel Special Seed Mix - Tall fescue 60%, Alsike clover 20%, Canadian Bluegrass 20%, total 44 kg ha^{-1}.

[b] Fertilizer -- 25-3-9, 225 kg ha^{-1}.

[c] Mulch -- straw, 58 bales ha^{-1}.

VITA

NAME: Christopher A. Nowak

DATE AND PLACE OF BIRTH: July 13, 1959
Buffalo, New York

HOME ADDRESS: 413 Nelson Avenue
East Syracuse, New York 13210

MARITAL AND FAMILY STATUS: Married to Linda C. Nowak for 7 years, with four children -- Tristan (age 6), Morgan (age 4½), Rebekah (age 3) and Jocelyn (age 1).

EDUCATION:

	Name and Location	Dates	Degree
High School	St. Mary's High School Lancaster, N.Y.	1973-1977	H.S. Diploma
College	Morrisville ATC Morrisville, New York	1977	
	Erie Community College Buffalo, New York	1978	
	SUNY Coll. Env. Sci. For., Wanakena, New York	1978-1979	A.A.S.
	University of Idaho Moscow, Idaho	1981	
	Erie Community College Buffalo, New York	1982-1983	
	SUNY Coll. Env. Sci. For., Syracuse, New York	1983-1985	B.S.
	SUNY Coll. Env. Sci. For., Syracuse, New York	1985-1986	M.S.
	University of Florida Gainesville, Florida	1987	
	SUNY Coll. Env. Sci. For., Syracuse, New York	1989-1992	Ph.D.

VITA continued.

PROFESSIONAL EXPERIENCE:

Research Forester Starting February 8, 1993. Employer: U.S. Department of Agriculture Forest Service, Northeastern Forest Experiment Station, Forestry Sciences Laboratory, P.O. Box 928, Warren, Pennsylvania.

Visiting Assistant Professor August 1992 to December, 1992. Employer: State University of New York, College of Environmental Science and Forestry, Syracuse, New York.

Doctoral Candidate August 1989 to present. Employer: State University of New York, College of Environmental Science and Forestry, Syracuse, New York.

Principal Research Support Specialist October 1988 to present. Employer: Research Foundation of State University of New York, Syracuse, New York.

Technical Specialist January 1988 to October 1988. Employer: Research Foundation of State University of New York, Syracuse, New York.

Research Analyst January 1987-December 1987. Employer: University of Florida, Gainesville, Florida.

Graduate Research Assistant May 1985-December 1986. Employer: State University of New York, College of Environmental Science and Forestry, Syracuse, New York.

Land Surveyor June 1979-September 1981. Employers: Rene Sauvageau, Statler Building, Buffalo, New York, and McIntosh and McIntosh, PC, 429 Pine Avenue, Lockport, New York.

Additional full- and part-time employment to earn college and living costs from September 1981 to May 1985 included: night manager for a fast-food restaurant, auto parts salesman, crew leader for a silviculture research team, laboratory technician and dispatcher for a Public Safety department.