

AN ABSTRACT OF THE DISSERTATION OF

Jeffrey P. Lemieux for the degree of Doctor of Philosophy in Entomology presented on June 25, 2003. Title: Distribution and Ecological Roles of Arthropods in Dead Woody Materials of Ponderosa Pine Forests, Northern California.

Abstract Approved:

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Darlene D. Judd

This dissertation describes arthropod responses to and effects on decay processes in ponderosa pine, a dominant forest canopy tree in northern California. We used both descriptive and experimental field techniques to establish how arthropod assemblages depend on and are important to the disintegration of woody structures in forests of this type. The first study used pitfall traps placed within and on the outsides of fallen, large old ponderosa pine trees to establish the effects of microenvironments created during tree death. We studied the internal and external structures of fallen trees as well as the forest floor in canopy gaps and in the surrounding undisturbed forest. Five trees were surveyed, representing a decay sequence from newly dead and with distinct canopy gap, to well-decayed with recovering canopy. Arthropod assemblages were distinct among the different microenvironments, but were less so with increasing tree/gap age.

Differences between tree and soil faunae decreased with increasing decay, as did the

differences between gap and non-gap catches from the forest floor. The second study used experimental exclusion techniques to examine how longitudinal (bark beetle) and transverse (woodboring) insect colonists could influence rates of mass loss and carbon respiration from young, dead ponderosa pine. We found that both groups enhanced the prevalence of staining fungi in the sapwood, which in turn was negatively related to the degree of structural failure in the sapwood, associated with decay fungi. Carbon respiration was positively related to sapwood structural failure and we believe that the two insect groups act in concert to suppress wood decomposition in this system. This is contrary to prevailing wisdom among forest practitioners who have suspected that decay and insect activity are positively correlated, but in agreement with laboratory studies showing antagonism between stain and decay fungi. Lastly, we observed that neither forest harvesting nor fire had strong effects on the development of exemplar taxa from decay communities in ponderosa pine two years post-treatment. Though time since treatment did affect all functional groups inside of logs, only undisturbed old-growth treatments showed a reduced variability in composition, leading us to suspect effects to emerge at longer time intervals.

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Distribution and Ecological Roles of Arthropods in Dead Woody Materials of
Ponderosa Pine Forests, Northern California

by
Jeffrey P. Lemieux

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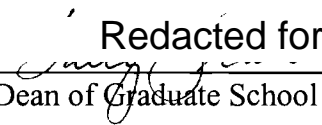
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Jeffrey P. Lemieux, Author

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CONTRIBUTION OF AUTHORS

Nancy Gillette helped in most aspects of every study, including logistical support, design suggestions, analytical suggestions, and general writing guidance.

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DEDICATION

To my Mother, Loretta. Thank you always for helping me to follow my dreams, and for helping me to see when I had met them.

To my Father, Philip. In loving memory; I miss you.

DISTRIBUTION AND ECOLOGICAL ROLES OF ARTHROPODS IN DEAD WOODY MATERIALS
OF PONDEROSA PINE FORESTS, NORTHERN CALIFORNIA.

Chapter 1. Introduction

We cannot cheat on DNA. We cannot get round photosynthesis. We cannot say I am not going to give a damn about phytoplankton. All these tiny mechanisms provide the preconditions of our planetary life. To say we do not care is to say in the most literal sense that "we choose death."

Barbara Ward (1914–81), British author, educator. "Only One Earth," in *Who Speaks for Earth?* (ed. by Maurice F. Strong, 1973).

Over 30 years ago the United Nations convened a discussion that initiated some of the original dialogue about the future of Earth's ecosystems. The 1972 meeting was a novel example of an international discussion that involved not only scientists, but politicians, addressing growing problems of pollution, depletion and overcrowding. The documents produced from those meetings portrayed the Earth as a system that received and output energy, but cycled its material contents internally. Since then there has been an accelerated effort to understand the cycles of water, carbon, nitrogen and other nutrients in biological systems. We recognize that these ecosystem processes both regulate and are regulated by biological communities (Chapin *et al.* 1997) and that human activity is severely altering these interactions. Over 50% of the Earth's surface has been converted to 'alternate' ecological systems, and some authors suggest that many important processes and services inherent to those altered systems have also not been preserved (Vitousek *et al.* 1997). Services include maintenance of atmospheric composition, water cleansing, soil fertility, and erosion control. Implicit in these services are the underlying global cycles of nutrients, water and carbon (Schlesinger 1997).

Efforts to link real-world biological communities with the processes associated with them have emerged in the last decade (Chapin *et al.* 1997; Loreau *et al.* 2002, Tilman *et al.* 1997). Because of their economic roles and ease of sampling, much of our understanding about organism-system interactions comes from forests; trees and other plants have been especially well studied (Perry 1994). While the bulk of resources in terrestrial systems eventually is contained or moved through plants, especially woody plants, other groups have tantamount ecological roles. Arthropods, vertebrates, and microorganisms are being increasingly revealed as important regulators or even bottlenecks in the overall movement of materials and energy (Ausmus 1977).

The particular case for arthropods is interesting because it involves not only the revelation that they are important players, but also that some of the most important roles are played by species that historically have been viewed only as forest pests (Furniss and Carolyn 1977). Primary arthropod colonists are capable of physically penetrating the rough outer bark of live and newly dead trees and belong to four taxonomic groups: the bark and ambrosia beetles (Coleoptera: Scolytidae); the woodborers (Coleoptera: Buprestidae, Cerambycidae); and the horntails (Hymenoptera: Siricidae). Of these the bark and ambrosia beetles are perceived as the most economically threatening, though woodborers also receive much attention. There is a well-established, multifaceted literature of bark beetle and woodborer ecology, well funded because we perceive them to be important competitors for forest products. The fact that those species attack and kill living trees, though, makes them important regulators of a wide array of processes

that are associated with tree death (Franklin *et al.* 1987). Among these is the release of energy and nutrients sequestered by trees.

Cellulose and lignin are complex carbohydrates used to strengthen cellular structures in woody plants, and are composed of molecules that are very difficult for most organisms to digest (Cartwright and Findley 1958; Lambers *et al.* 1998). Cellulose is a repeating matrix of glucose units with alternating stereochemistry in strands and in sheets, and it requires special cellulase systems to convert the matrix to cellobiose and eventually glucose units (Swift 1979). Lignin structure is exceptionally complex, composed largely of ether bonds linking phenyl propanoid precursors, but with random stereo-orientation (Rayner and Boddy 1988). The result is a non-uniform matrix with exceptionally recalcitrant linkages for which very specialized enzyme systems are required for breakdown. Cellulose and lignin typically account for 70-80% of a tree's dry weight, and in temperate forest ecosystems, some of the most productive on Earth, trees can account for 90% of above-ground standing biomass (Rodin and Basilevic 1968). The ubiquitous presence of these compounds in terrestrial ecosystems and the limited occurrence of enzyme systems to metabolize them imply that there is a suite of rate-limiting organisms that control the movement of products contained in trees.

Certain fungi and other microorganisms specializing in the digestion of cellulose and lignin eventually generate gaseous carbon dioxide as a respiration end-product to the atmosphere (Swift *et al.* 1979; Cadisch and Giller 1997). The simple makeup of microorganisms obligates their distribution to passive means or by relationship to other

organisms. The relationship between the stain fungi and bark beetles is a classic example (Leach *et al.* 1934; Solheim 1991), but other groups are likely affected by this kind of activity. Entry to rigorous woody tissues for example may require specialized commensal relationships with insects that physically penetrate wood during colonization, but also guarantees access to tissues rich in nutrients, and to a seemingly buffered and constant environment. The specialized and passive relationships that have been documented between insects and microorganisms during wood decay (Schowalter and Filip 1993) suggest that colonizing insects ultimately control the distribution of wood decaying microorganisms; together these two groups form a 'decomposer subsystem' specific to cellulo-lignified materials, which degrades structures composed during primary productivity and promotes the movement of energy and nutrients in forests. Community composition during log colonization should therefore directly affect spatial and temporal qualities of system processes like carbon, water and nutrient flux. Ultimately these effects should translate to structural and environmental heterogeneity within ecosystems, which in turn affect the very nature of the communities that initiated those changes.

In many ways felled trees make convenient, discrete study units and they have a long history as objects of investigation for natural history and ecological studies. Organisms inside of dead trees are reported from as early as the late 19th century, but real monographic treatments of insects from the insides of logs are reported by Blackman and Stage (1924), Graham (1925) and Savely (1939). Further accounts of within-log insect assemblages were sporadic until the 1990s (but see Howden and Vogt 1951;

Elton 1966), when there was a veritable boom in all manner of literature documenting species richness and 'biodiversity' concepts. Documentation of European, especially Fennoscandian complexes continues into the present day (e.g. Siitonen and Martikainen 1994), and there are important studies from Canada (Hammond 1997) as well as from tropical areas (see Grove 2002). A common theme in many of these studies is that mature, rather than younger forests, are important and threatened habitat for saproxylic insect species (see Grove 2002; Vaisanen *et al.* 1993).

Dead trees eventually inspired a large body of research focused on their patterns of distribution and persistence (Sollins *et al.* 1987) and their overall effects on forest systems (Harmon *et al.* 1986; Franklin *et al.* 1987). Olson (1963) published a benchmark paper in which he measured rates of decay for a wide array of woody species at different latitudes, and clarified confusion over various mathematical models that were being developed to do this. His equations set the stage for the science of sink and source determinations of detritus accumulation in ecosystems. Edmonds and Eglitis (1989) took the first substantial steps to integrate the natural history (Dowding 1973) and systems oriented foci of previous work on dead trees by experimentally manipulating the colonizing insect fauna of trees and examining decomposition qualities as well as rates of decay. Though insect-fungal relationships have long been recognized as important for wood decay (Leach *et al.* 1934), no studies have effectively linked insect *and* fungal colonization dynamics *simultaneously* to decay rates for any woody species. Progar *et al.* (2000) did provide some data for simulated insect penetration in Douglas-fir and its effects on fungal dynamics and respiration, though their results were

inconclusive as to the possible roles that arthropods might have in the development of wood-inhabiting fungi. Further, no studies attempt to uncover relationships in the context of forest management at larger scales than individual log. Studies that synthesize arthropod-microbial dynamics as a complete system inside of dead woody material can be designed to model effects on forest systems at large scales and represent a natural 'next step' for this kind of information.

Today, any discussion of ecology must take place in the context of human-induced disturbance. Perhaps the crowning achievement in ecology will be not only to understand interactions between individuals, communities and processes, but to know how human industry influences those relationships. In forests, harvesting and the intentional and unintentional imposition of fire regimes are common and widespread across the globe. The conversion of old-growth to young forests can have dramatic consequences on carbon dynamics (Harmon *et al.* 1990) and forest structure (Kirby *et al.* 1991), as can fire (Auclair and Carter 1993; Zackrisson *et al.* 1996). This dissertation examines some hypothetical relationships between arthropods, fungi, forest structure, disturbance, and the system process of decomposition. It is not a monograph, but rather an illustration of the circular relationship between communities, ecosystem processes and disturbance. I begin in Chapter 2 describing how forest structures, namely large dead trees and forest canopy gaps created during tree death, can establish patterns of insect composition and activity on the forest floor. This was done using a decay sequence to illustrate the effect of time on arthropod assemblages via the recovery of canopy cover and the dissolution of woody materials.

The third chapter tests the idea that a diversity of life history strategies in colonizing arthropods can affect the rate of decomposition and CO₂ evolution from logs. Because different kinds of insects have very different behaviors and patterns of resource utilization in dead wood, their effects can be tested as discrete entities in isolation or in combination with one another. My experiments focused on varying the relative abundance of two groups: transverse borers in the sapwood and longitudinal borers migrating primarily through the tree phloem.

Lastly, I examined the effects of timber harvesting and prescribed fire on the colonization and decay of timber by the insect-fungal system. Controlled fires are used commonly in many forested areas as a method of clearing debris and reducing 'fuels' that might otherwise contribute to accumulated wildfire hazard. Effects are extremely variable, by system and pattern and intensity of the fire. In Chapter 4 I examine preliminary (first 2 years after disturbance) data from a split-plot design that allowed the presence/absence of fire and two levels of forest harvesting to be examined concurrently.

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Chapter 2

Tree Death in Large, Old Ponderosa Pine and its Effects on the Forest Floor Beetle
Community: Canopy Gaps and Tree Corpses as Insect Habitat Through a Decay
Sequence

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For submission to *Ecography*

Abstract

Tree death creates new species habitat by making tree corpses available to colonization, but also by creating environmental heterogeneity in the forest canopy and on the forest floor. In a reserve of large, old ponderosa pine forest of northern California, I used pitfall traps to survey assemblages of beetles from within and on the surfaces of fallen trees, on the forest floor in the canopy gaps surrounding trees, and in forested area adjacent to gaps. I characterized the physical nature of canopy gaps around trees and related these characters to the decay class of each tree. The beetle community consisted of 235 species from 37 families. Species-area analysis showed that further gains in species numbers could be made in all habitat types, and that the total number of species for the area might be as high as 350. Species richness was highest in gaps>tree surfaces>forest>tree interiors. Most species were caught in low numbers (<10 individuals), and all habitat types shared a portion of species with other habitat types. Indicator species analysis showed that few species were good indicators of any one environment by themselves, suggesting a high degree of mobility between habitat types. Percent canopy cover in gaps was strongly and positively correlated with tree decay class ($r^2=0.78$). A 2-axis ordination using NMS showed that the strongest gradient in the data was between within-tree samples and all others, but also that the state of tree decay was an important factor discriminating among sites, within the same habitat type. Decay and habitat type were not completely independent of one another, and the ordination pattern suggests that with increasing decay and canopy closure, communities from the 4 habitats become more similar. Using current documentation

of family-specific feeding habits from the literature, it appears that with canopy closure and increased log decay, the forest floor community shifts toward predator-detritivore dominance at the expense of herbivorous species.

Introduction

Dead trees and dead tree parts have been well documented as major sources of environmental heterogeneity in forests (Elton 1966). Their roles in various ecological processes have been written about, including the so called 'death cycle' (Franklin *et al.* 1987), as habitat for plants (Rambo and Muir 1998), for vertebrates (Boyland and Bunnell 2002), and for invertebrates (Graham 1925; Hammond 1997; Savely 1939). Tree death can also be responsible for 'canopy gaps' in forests and can form a suite of environmental conditions that influence organisms within and around tree corpses (e.g. Spies *et al.* 1990). More specifically, dead trees and canopy gaps represent horizontally stratified structure in forests that should produce environmental and resource gradients similar to those present through changes in vertical forest structure (e.g. Parker and Brown 2000). For example, the sharp moisture gradients occurring through conifer canopies (McCune 1993) should also be present from the edges to the interiors of canopy gaps. The transition from a tree's internal to external environments as well as changes across the forest floor through the 'canopy gap' represent ecotones to which arthropods and other organisms can be expected to respond. Through time the sharpness of these gradients can be expected to change as wood decays and canopy re-growth through the gap occurs.

Organismal studies have not considered trees and canopy gaps in concert because only invertebrates and microbes abundantly inhabit all of the habitats created during tree death of this fashion. The few studies of canopy gap effects on insects have focused on herbivores that feed on a shrub understorey, and never on the forest floor environment,

or on associated woody debris. It's clear though that dying trees, canopy gaps, and the forest floor form a related complex of environments through which an interacting community of organisms can be expected to live. Because industrial forest practices now extend to the majority of woodlands in North America and Europe, it is important to understand the natural range of variation that is represented by such common processes.

There are long-standing discussions of how important dead wood is to arthropod species. Stubbs (1972) gives some offhand estimates of up to 1000 species that depend on dead or dying wood in British woodlands, and Irmeler *et al.* (1996) tabulated 207 species of midges and beetles from only 1.7 m³ of wood in northern Germany, with little similarity to forest floor species. From a conservation perspective, our knowledge is limited by a paucity of replicated studies from old-growth, non-managed stands. Old-growth forests have larger trees with different physiological and decay properties. Older or 'primeval' forests have been shown in northern Europe to contain wood-dwelling assemblages that are quite different from younger, managed forests (Vaisanen *et al.* 1993), though those studies were limited strictly to saproxylic species. Similarly, Siitonen and Martikainen (1994) estimated that almost all endangered saproxylic species in Finland could be found in greater abundance from neighbouring Russian forest, which had not been managed and had a significant woody debris component absent from Finnish areas.

Here I compare arthropod complexes across a forest floor stratum that contains large, old-growth ponderosa pine trees, from gaps created when those trees died, and from adjacent forest with intact canopy cover. My intent was to implement a replicated study with consistent trapping methods that could compare faunae from within trees to that on the outer surface of trees, while at the same time examining how the effect of gap creation would influence the forest floor species. I have done this specifically in isolated remnants of old-growth forests where I believe the structural roles of individual trees are comparatively greater than in the more widespread, younger forests of the region. I have done this as a case study from a single forest stand, due to the limited amount of old-growth habitat in the region and due to sampling restrictions imposed by the protected status of the area. Further, I have incorporated trees in a wide spectrum of decay stages to understand how changes over time might affect both the internal and external insect communities in and around dead trees. I was explicitly interested in testing the idea that the apparent distinct habitats created during gap creation (subcortical and cortical tree surfaces, forest floor in the gap and forest floor outside of the gap) could influence the species composition of beetle assemblages. Because decay of trees and growth within gaps both proceed after gap creation I also attempted to describe how those two processes could affect the relationship of assemblages from the four different habitats. I predicted that the spatial arrangement of habitats created during gap creation would be reflected as a matching gradient in the similarity of catches from those habitats. Under this scenario, subcortical catches should be most similar to cortical catches, then to forest floor catches near the fallen trees and within gaps. Subcortical catches should be most dissimilar from forest floor

catches in the intact forest surrounding canopy gaps. I also predicted that differences between catches from all groups should decrease with increasing amounts of log decay, and the recovery of the forest canopy around dead trees.

Methods and Materials

In the late summer of 1998 I surveyed a small stand of 'old-growth' ponderosa pine, (*Pinus ponderosae* Dougl.) forest in Lassen National Forest, CA. (Fig. 2.1), and located five large trees in intermediate, varying states of decay on the forest floor. I qualitatively ranked each tree for its state of decay, in a linear fashion from 1 to 5. I based the rank primarily on the strength and degree of fracture in the outer bark (Table 2.1), but also on percent of sapwood moisture. Bark loss and consequent drying of the sapwood are standard features of decay as logs age in this type of forest. Trees in early decay stages had secure and flexible bark, with no visible sapwood. Trees in more advanced states showed considerable sapwood exposure along the bole, had larger percentages of bark that were fractured to the point of being nearly released from the log, and tended to have drier sapwood. I measured exposed sapwood in 5% categories, by visual estimation walking around the circumference of each tree. I estimated fractured bark as the percentage of bark for which I could see more than a single fractured edge, viewed from a fixed location at the middle of each tree. This was done twice, once on each side, and the average taken as the final measure. Sapwood moisture was measured by taking three, 0.5 x 10 cm cores from the midline of each tree directly below trapping locations (see below). One set of cores was taken per side for a total of six cores per tree. Because I sampled trees only with enough



Figure 2.1 Map of California, USA, showing location of the Lassen National Forest. This study was conducted in Black's Mt. Experimental Forest, located in the northern region of the forest, with elevations of 1,700-2100 m.

Table 2.1. Decay characters for trees surveyed in northern California, including remaining cover of outer bark, the fraction that had been fractured, and sapwood moisture.

Decay Rank	Bark cover (%)	Bark fracture (%)	Mean sapwood moisture (%)
1	100	0	66.70
2	95	0	54.41
3	85	20	50.26
4	80	70	47.82
5	75	70	40.36

intact bark to allow a 'subcortical' sample, all trees fell within the decay classes of 1-2, defined by U.S. Forest Service guidelines for conifer species (Parks 1997); outer bark for all trees measured was mostly intact and little integration with the forest floor had occurred.

Forests with ponderosa pine as a leading canopy species occur over a wide geographic range, from northern Baja California to central British Columbia (Oliver and Powers 1998). This stand of trees was part of the larger 'Black's Mountain Experimental Forest', where various questions about harvesting in this system are investigated. Because this facility was established seven decades ago, the few hectares of old-growth trees within its boundaries are a rarity now in the landscape: the majority of land, especially at lower elevations has been converted to second-growth or pasture systems. The forests consist largely of ponderosa pine, but also contained mixes of Jeffrey pine (*P. jeffreyi* Balfour), incense cedar (*Calocedrus decurrens* Torrey) and white fir (*Abies concolor* Gordon & Glendinning), due to the high average elevation of 1700-2100 m. Winters are long with snowfall occurring in October and often lasting into May, and the majority of precipitation occurs as snowfall. Soils are mostly shallow stony loams over lava bedrock.

The particular stand of this study was 45 hectares in size. There has been active fire suppression within the boundaries of the forest for more than 70 years, but forest harvesting has been restricted. I used pitfall traps in a fashion outlined in Fig. 2.2: at each tree I was able to remove bark on the upper surface in 50*50 cm square 'covers',

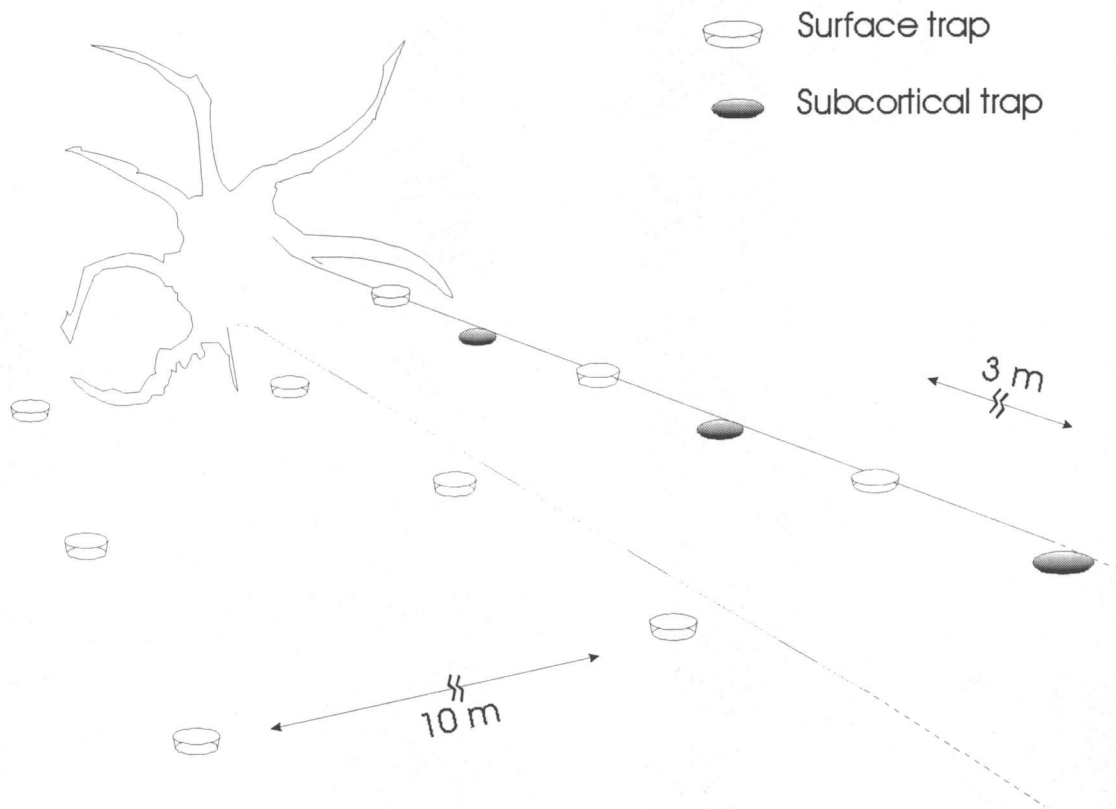


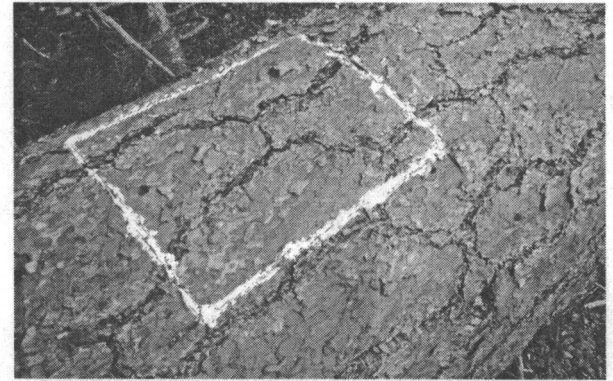
Figure 2.2. Model diagram of pitfall trap placements inside of and around study trees in mature ponderosa pine forests of northern California, USA.

(e.g. see Fig. 2.3) using a handsaw. I used a portable drill with a hole-saw attachment to drill holes 11 cm in diameter, approximately 10 cm deep into which plastic pitfall containers could be installed. I drilled three holes in this fashion on each tree, each 6 m apart, beginning 3 m from the base of the tree; I refer to these types of traps as 'subcortical'. I replaced the bark covers and sealed the incisions with a silicon sealant. Additionally I placed three 'cortical traps', at equal spacing, alternating between each of the subcortical placements (Fig. 2.2). Holes for these traps were drilled directly through the outer bark, so that traps could intercept animals crawling on the tree's outer surface.

At the beginning of the following season I returned to activate the trap structure and at the same time place traps on the forest floor. At right angles to each tree I established three rows of two traps on the forest floor, 1 m (referred to hereafter as 'forest floor 1 m') and 11 m (referred to hereafter as 'forest floor 11 m') from tree edge (Fig. 2.2). The first distance was used to establish a standardized space between trap and tree, whereas the second was the minimum standard distance that ensured all traps were placed within forest with intact canopy surrounding tree gaps. For cortical, gap and forest floor traps I used a 'Nordlander' pitfall design (see Lemieux and Lindgren 1999). This design eliminates aerial catches and most vertebrate entrance to traps and has been shown to produce carabids catches indistinguishable from conventional designs like that used in the subcortical sampling (Lemieux and Lindgren 1999). I used approximately 2.5 cm of propylene glycol in the bottoms of traps to preserve specimens and emptied traps at 3-4 week intervals during the summers of 1999 and 2000. Traps were made of plastic, polyethylene cups 10 cm long x 10 cm in diameter.



A



B



C



D

Figure 2.3. Pitfall traps showing methods used in subcortical (A, B), cortical (C), and forest floor habitats (D). Traps were used in northern California ponderosa pine forests, 1999-2000.

I used a combination of external morphology and genitalia dissection to 'morphotype' all beetles (Insecta: Coleoptera) from the collections into species categories: this approach generates an internally referenced set of species categories, but cannot be compared against other studies, for individuals species. A voucher collection has been deposited at the Oregon State Arthropod Collection, Oregon State University, Corvallis Oregon, USA. At each trap location on the forest floor I measured canopy cover using a gridded, convex, reflection densiometer, averaging over four measures taken facing each of the cardinal directions. Values represent a relative measure of space above the observer that is directly overshadowed by foliage, ranging from 0-100%. I took the average depths of the litter layer 20 cm from each trap by averaging over measures taken at each of the cardinal directions; a ruler was inserted through the litter until it reached bare soil and readings were taken at ground level. In 1 m squares surrounding each trap I visually estimated % cover, in categories of 5%, for litter, fine woody debris, exposed soil, shrubs (predominantly green leaf manzanita, *Arctostaphylos patula* Greene) and *Ceanothus* sp., a common perennial that grows close to the soil surface. Each variable was measured independently, so total covers of all variables within one plot could exceed 100%; this is possible because of the 3-dimensional structure of some variables like shrub, plant and wood cover. I assigned each species to a group based on published records of feeding habits (Borror et al. 1989; Stehr 1987).

Analysis

I used ordination techniques to extract trends from the morphospecies data matrix, and least squares methods to interpret the axes. As a stronger method of identifying which taxa were caught more often in a given habitat type, I used indicator species analysis. Re-sampling curves were generated to estimate how many morphospecies might have been missed in the sampling regime. I used the software program PC ORD to describe samples using non-metric scaling (NMS; Kruskal 1964), an ordination technique appropriate for non-normal, zero-heavy response data, typical of ecological studies (McCune and Grace 2002). Results describe how plots are related to each other in 'species space.' Data were log transformed and morphospecies were standardized to their own maxima. Morphospecies occurring in fewer than 5% of plots were excluded from the analysis. These transformations reduce distortion that can occur in ordination when values between morphospecies range over several orders of magnitude, or when there are a preponderance of zero values in the data (McCune and Grace 2002). I used a 2-dimensional solution in both years, chosen by examining plots of model fit that indicated where subsequent dimensions added little improvement (McCune and Grace 2002). I used 80 iterations to evaluate stability, and plots of iteration vs. model fit to ensure that the final solutions were stable. Within the resulting ordination space, I rotated axes to maximize correspondence of a single axis to treatment groups (Dargie 1984), and used Pearson's r^2 value to relate each morphospecies to the resulting axis (Zar 1999). To describe how well this rotation explained a linear disturbance gradient, I assigned an artificial linear set of numbers to code for treatment groups, based on obvious patterns from the ordination. For lack of better knowledge in this system

about decay processes I have assigned the distance between each rank to be equivalent in the analyses. In reality the time and decay intervals between rankings might be quite unequal. I related those values to the rotated axis values, using Pearson's r^2 , and repeated the entire process for the value of 'tree', to test it as a good explanation for variance along the second axis.

Unless otherwise stated I consider the $\alpha=0.05$ level of confidence to be the measure of statistical rigor for a given result. Occasionally though I have cited levels as high as $\alpha=0.15$ to indicate moderate evidence of a trend (Zar 1999). I used the PC version of S-Plus 2000, invoking least squares regression to empirically model how each of the environmental variables changed around tree perimeters. To do this I used distance from the tree (near and far) and position along the tree axis (0, 6, and 12 m) as independent variables, correcting for spatial autocorrelation where it was necessary. I used Moran's I value (Mathsoft 2002) to test for spatial autocorrelation in the model residuals of each independent variable, finding that only the variable 'canopy density' needed to be corrected. Correction was made using a simultaneous autoregressive procedure (SAR; Mathsoft 2002). Response data needed to be log transformed to improve normality.

I used backward selection for variable elimination in least squares regression to model empirically NMS axis scores as a function of 11 environmental variables. Axis scores were normally distributed and required no transformations. Visual inspection of residuals revealed that the response variables had equal variance among all of the

environmental factors. SAR was used where necessary to correct for spatial dependence in model residuals. Within the forest floor samples I modeled the ecological distance (NMS axis scores) between near and far samples within tree as a function of the tree's decay to test whether decay status can influence the morphospecies gradient away from the tree.

Because the treatments showed strong ordination patterns, a two-way indicator analysis was used in PC-ORD to identify those morphospecies that were strongly associated with regions of the ordination (Dufrene and Legendre 1997). Lastly, I used bootstrap methods to estimate total morphospecies richness by habitat type (Palmer 1990). This procedure is able to estimate a hypothetical asymptote of partial curves generated from rates of species accumulation during sampling (McCune and Grace 2002).

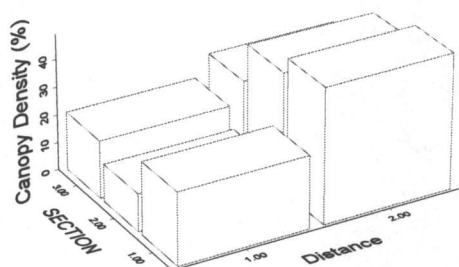
Results

Qualities used in determining tree decay classifications

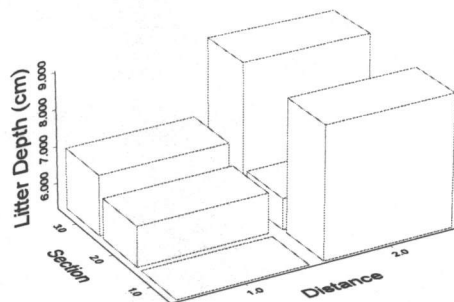
There was good agreement among the three measures I used to rank trees for their decay status. Sapwood exposure and bark fracture were inversely related to sapwood moisture content, and facilitated an intuitive ranking from 1-5 (Table 2.1).

The effect of canopy gaps on forest floor quality

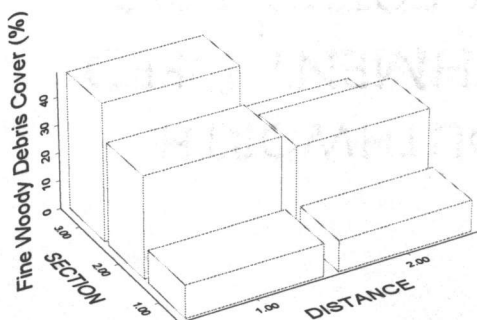
There was good evidence ($\alpha \leq 0.05$) that canopy density shared a negative relationship with distance from tree, and that canopy density tends to be slightly reduced at the mid-length of a tree bole (Fig. 2.4). There was also moderate evidence



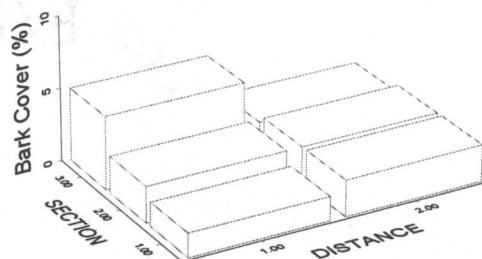
$p(\text{distance}) = 0.00$; $p(\text{section}) = 0.02$



$p(\text{distance}) = 0.14$; $p(\text{section}) = 0.32$

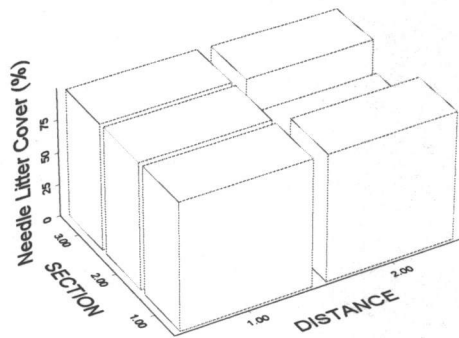


$p(\text{distance}) = 0.08$; $p(\text{section}) = 0.08$

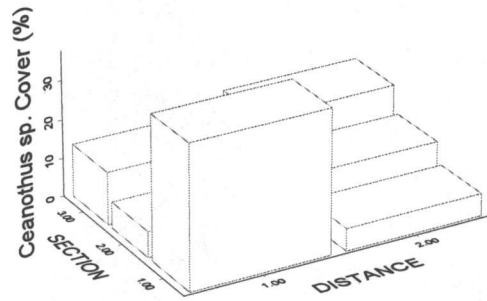


$p(\text{distance}) = 0.69$; $p(\text{section}) = 0.58$

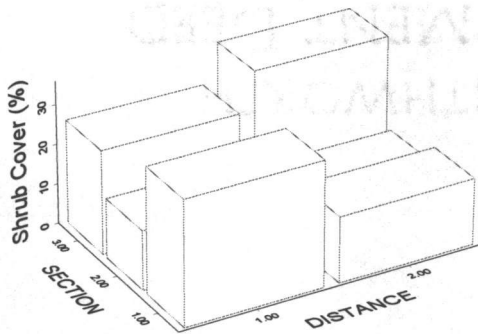
Figure 2.4 (continued on next page). Average values for various structural features measured on the forest floor of ponderosa pine forests, northern California, 1999-2000. Values were measured at 1 and 11 m distances from fallen trees associated with forest canopy gaps (coded as 1 and 2 in the graphs), and at three equally spaced sections along the bole from bottom to top (section 1 through 3). P-values indicate the results of significance tests for least squares estimation of differences within distance and section variables. $n=5$.



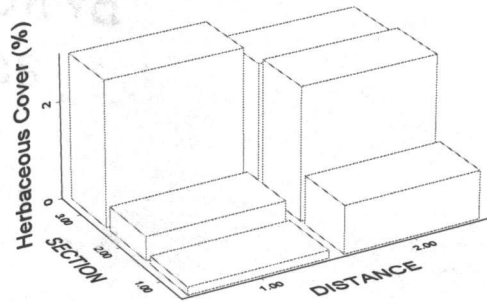
$p(\text{distance}) = 0.34$; $p(\text{section}) = 0.90$



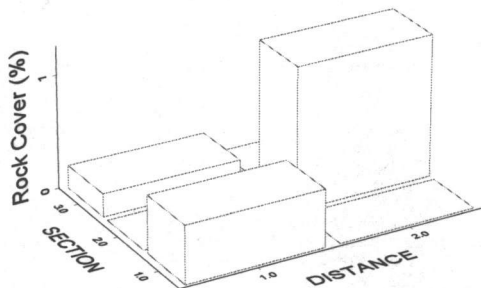
$p(\text{distance}) = 0.19$; $p(\text{section}) = 0.70$



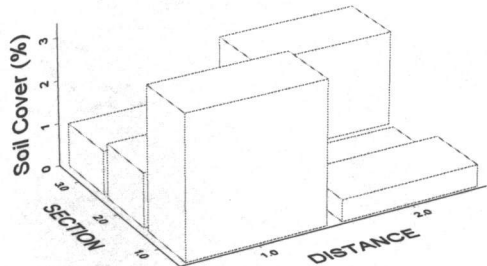
$p(\text{distance}) = 0.45$; $p(\text{section}) = 0.86$



$p(\text{distance}) = 0.31$; $p(\text{section}) = 0.18$



$p(\text{distance}) = 0.77$; $p(\text{section}) = 0.72$



$p(\text{distance}) = 0.29$; $p(\text{section}) = 0.69$

($0.15 > \alpha > 0.05$) that several other factors vary in relation to distance from a fallen tree including litter depth, fine woody debris cover and bark cover. Naturally, the most striking effect around trees was the actual gap formed in the forest canopy, represented by percentage canopy cover. I noted a definitive shape whereby gaps increased in size very slightly, moving from tree bottom to top; the effect size was minor when compared with changes occurring over the tangential distance away from tree axis (Fig. 2.4). These changes are important because they represent the basis for environmental and resource gradients to which arthropods might be expected to respond to.

Trends in richness for families and morphospecies

I collected 9,103 individuals from 37 beetle families, accounting for 235 morphospecies (Fig. 2.5). For a large number of morphospecies, I was able to make taxonomic determinations below the family level (see Appendix 1). Beetles belonged to three general feeding guilds: predators, herbivores, and detritivores, in order of decreasing magnitude (Fig. 2.5). Numbers of individuals and morphospecies were lowest inside of downed trees, increasing dramatically and variously in other treatments (Fig. 2.6). Monte-Carlo re-sampling of the data set by habitat type indicated first and second order jackknife estimates of 342 and 350 species for the area, respectively. Considered by habitat type, it appears that in all of the areas I sampled, there are additional gains to be made in species numbers (Fig. 2.7).

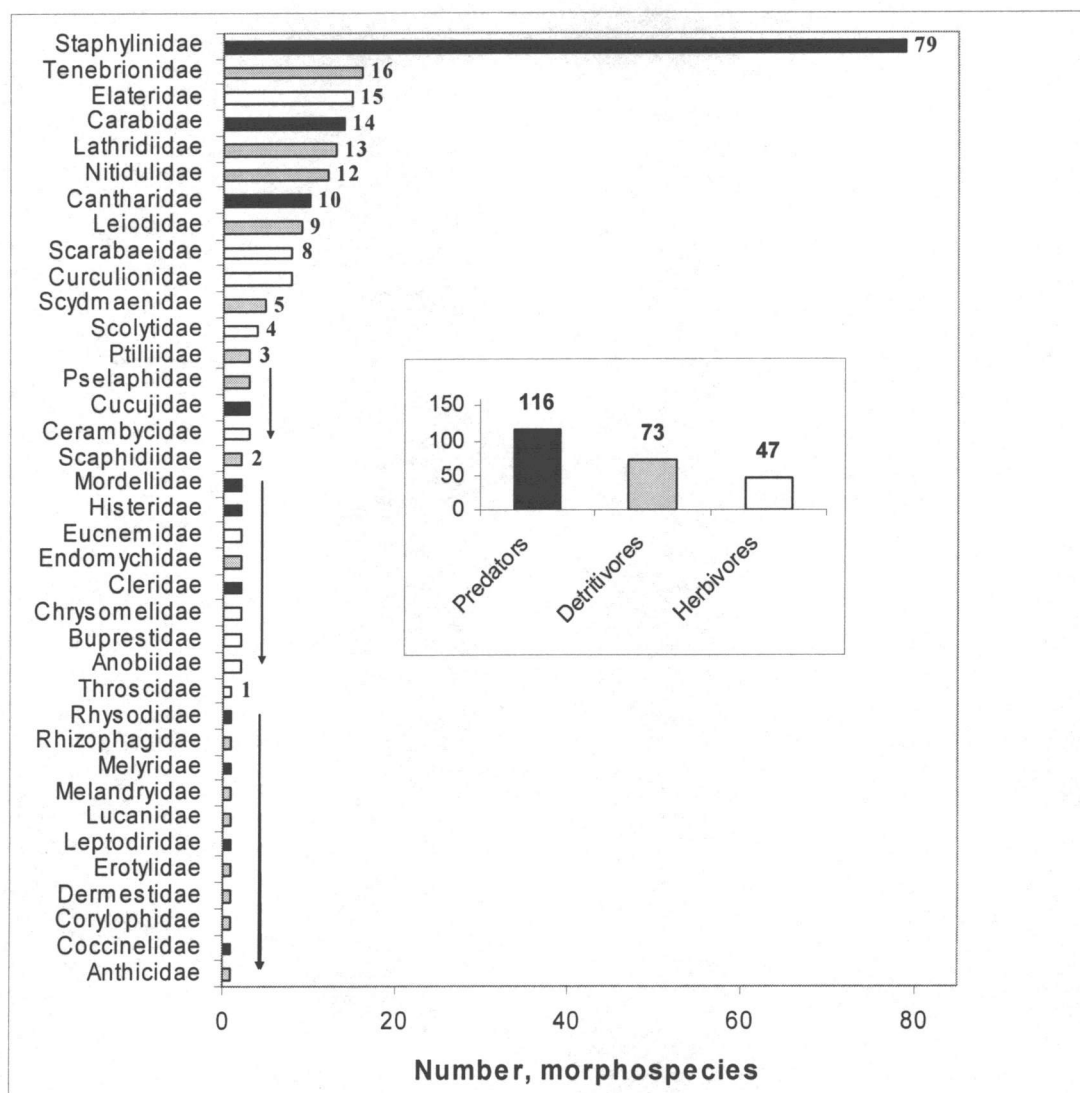


Figure 2.5. Beetle morphospecies allocated by family and coded for their feeding habits. Samples were collected from northern California, USA, 1999-2000 inside and on the cortex of dead trees, on the forest floor in canopy gaps and in nearby forest.

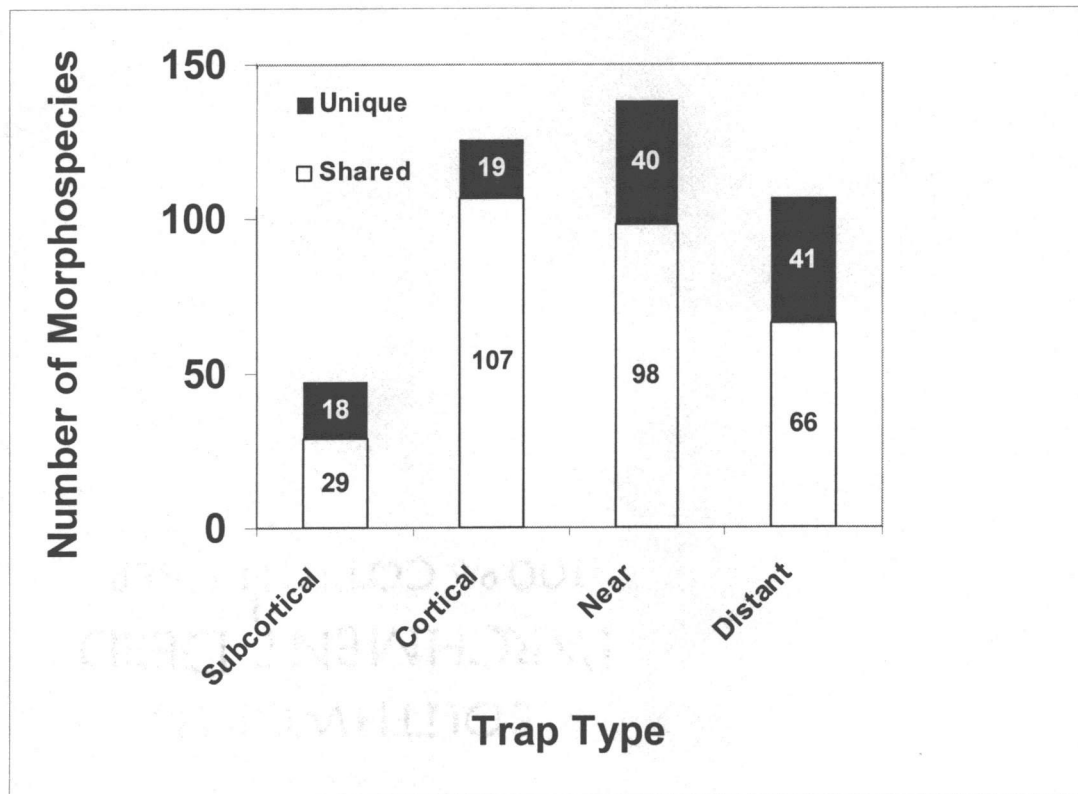


Figure 2.6. Shared and unique numbers of morphospecies caught by habitat type from trees and forest floor beetle catches. 'Unique' refers to species caught only within the indicated habitat type but may be represented by more than one individual specimen. Catches are from ponderosa pine, northern California, 1999-2000.

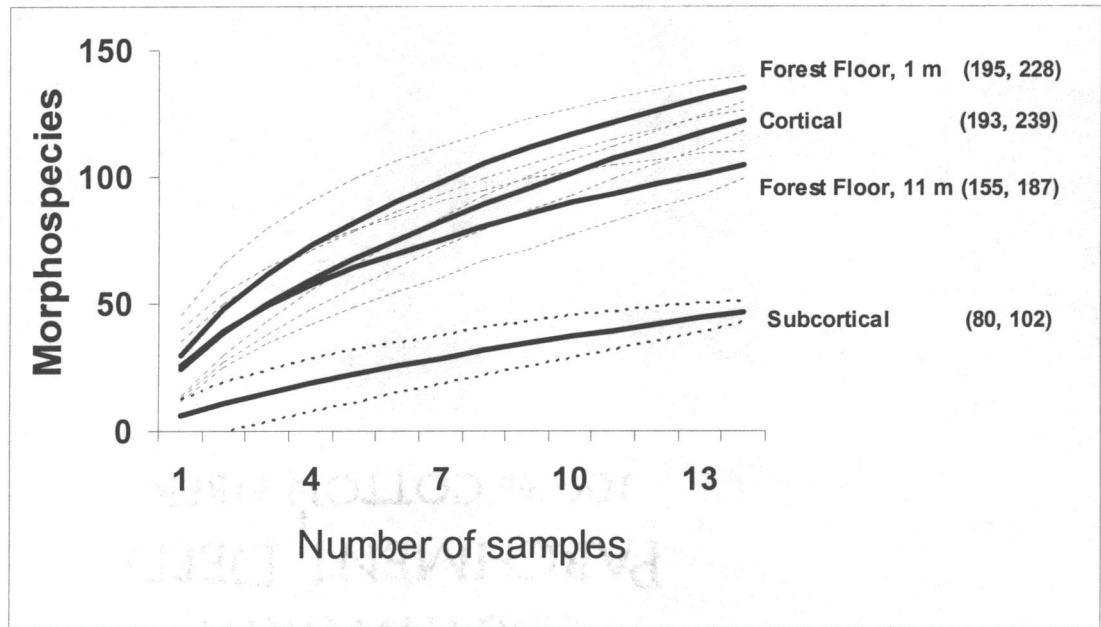


Figure 2.7. Average numbers of beetle morphospecies accumulated by sample size for each of 4 pitfall trapping regimes. Samples were collected from northern California, USA, 1999-2000, inside and on the cortex of dead trees, on the forest floor in canopy gaps, and in nearby forest. Numbers following curves indicate the first and second order bootstrap estimates of morphospecies values at hypothetical curve asymptotes. Dashed lines indicate 95% confidence ellipses.

Beetle patterns revealed by non-metric scaling

The use of NMS with environmental variables failed to resolve any significant patterns in the data, meaning that the variables I chose to measure varied independently of one another (no variable collinearity) within and among habitat types. Because of this, I was unable to reduce the number of environmental variables used to model trap variation among treatments. However, I was able to resolve strong gradients in beetle responses across all measures (Fig. 2.8a), with two axes explaining 83% of the dataset, 66% of which is attributed to an axis that is well correlated with coded values for treatment effects (Pearson's $r^2 = 0.76$). The majority axis differentiates subcortical samples from others, and to a lesser degree separates cortical samples from forest floor samples. Axis 2 represented between-tree values well, especially when linearly coded for their decay rank (Fig 2.8b,c). Pearson's r^2 and p-values from a linear regression of the 2nd axis scores against decay values, by treatment type are (n=15, d.f.=13): 0.80 (subcortical; p=0.00); 0.00 (Cortical; p=0.83); 0.06 (Forest Floor, near; p=0.38); 0.00 (Forest Floor, distant; p=0.94). Though decay rank did not explain axis variation well in forest floor samples, it did adequately account for variation in the ecological distance between average trap values of 1m and 11 m traps along axis 2. The linear equation relating average near- far forest floor trap scores on the 2nd axis to decay rank is:

$$y = 0.17 - 0.03 (\text{Decay})$$

For every increment of decay, difference in distant and near trap scores decreases by a value of 0.04 (n=5, d.f.=3; p=0.05; $r^2 = 0.78$); a decline of 23% of the maximum

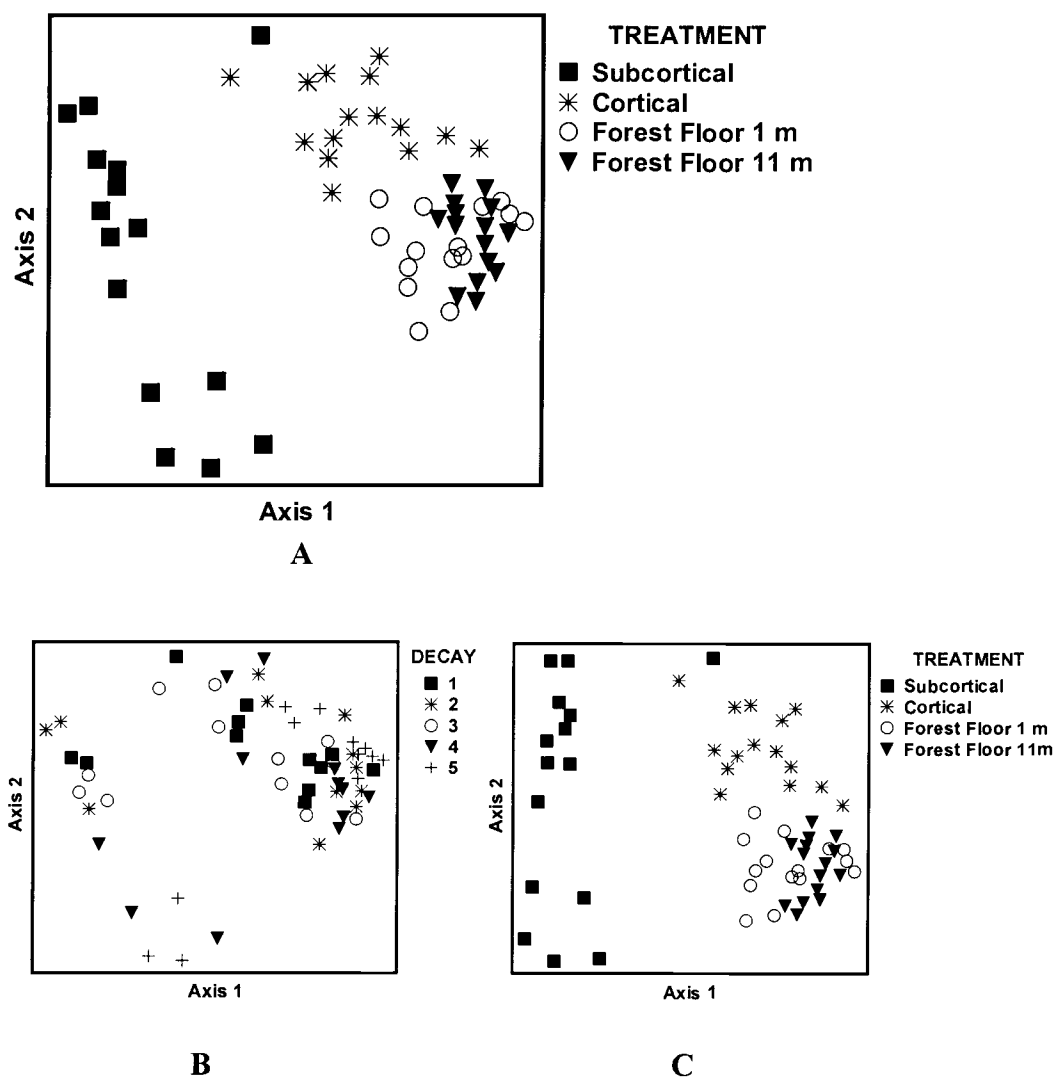


Figure 2.8. Non-metric scaling ordination for beetle morphospecies captured in pitfall traps, northern California, 1999-2000. Overlays show distributions for traps located from insides of trees, through forest canopy gaps to dense forest. Decay rank from 1-5 (least to greatest decay) is also shown. Ordinations have been rotated to discriminate among treatments on Axis 1 (A, B), and for decay along axis 2 (C).

average distance between trap types, per unit decay (Fig. 2.9). Furthermore, the distance between mean cortical score and mean forest floor score did not change as a linear function of decay (Fig. 2.10); $p=0.94$, though the data do seem to fit a quadratic function (Fig. 2.10). There were strong relationships between ordination axes and sample values for morphospecies richness, Shannon-wiener diversity, predator fractions, and detritivore fractions (Fig. 2.11; Table 2.2). Morphospecies that contributed most strongly to these patterns are indicated by the results of indicator species analysis (Table 2.3).

Predicting community score on the forest floor

With the exception of canopy density, none of the environmental variables I measured provided enough predictive power to include in an explanatory model (litter depth, $p=0.33$; bark cover (%), $p=0.37$; fine woody debris cover (%), $p=0.79$; needle litter cover (%), $p=0.55$; shrub cover (%), $p=0.71$; herb cover (%), $p=0.97$; rock cover (%), $p=0.64$; mineral soil cover (%), $p=0.82$). Canopy density predicted values on axis one (habitat treatment axis) significantly, and with a moderate amount of explanatory power ($p=0.00$, $r^2=0.34$). Given that this axis explained 66% of data variance, canopy density can be said to explain about $((0.66*0.34)*100) = 22\%$ of data variance.

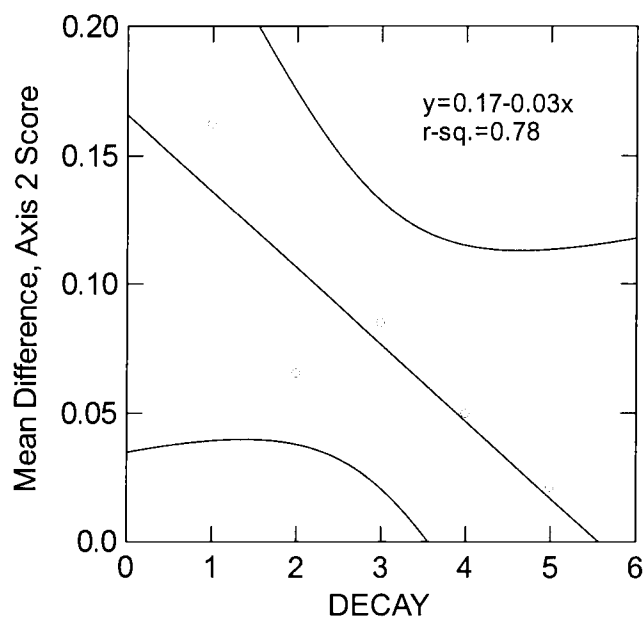


Figure 2.9. Ecological distance between gap and non-gap beetle catches as a function of the decay state of trees at each site. Distances were calculated along a single ordination axis using non-metric scaling. Least squares best fit line and 95% confidence intervals are shown in the graph.

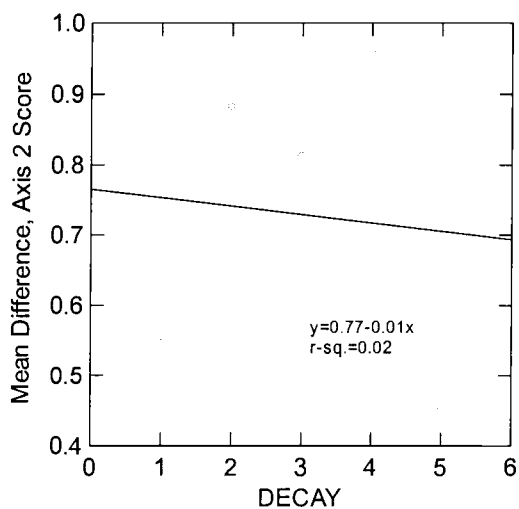
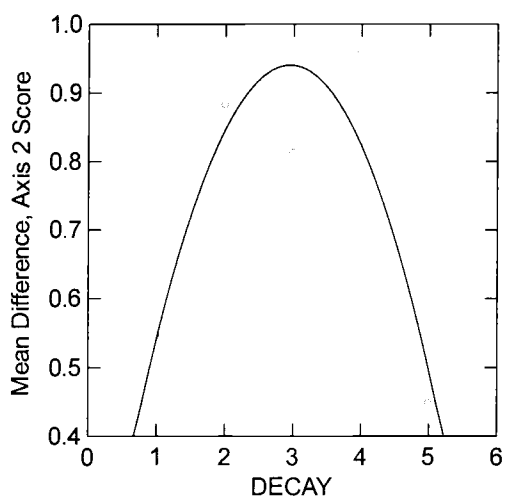


Figure 2.10. Least squares regression showing relationship between decay status of trees and the ecological distance of beetle catches from the outer bark versus those on the forest floor adjacent. Forest floor catches represent averages of traps placed both at 1 m and 11 m distances from trees. The upper figure represents a hypothetical quadratic relationship between axes. Catches were made with pitfall traps in northern California, 1999-2000.

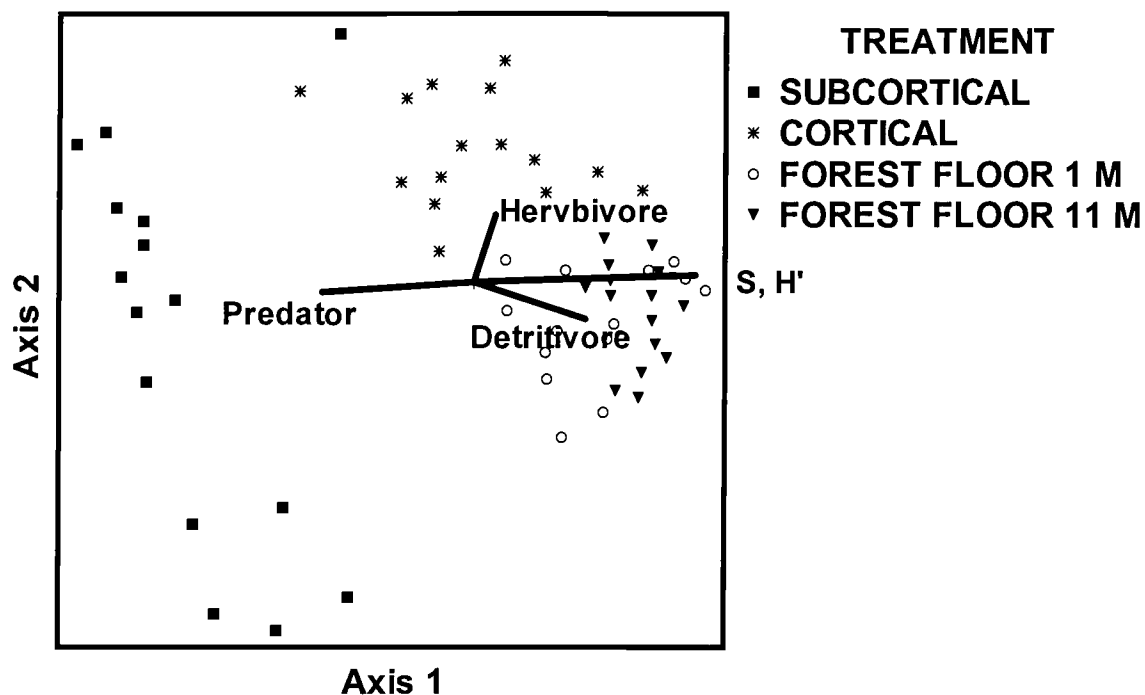


Figure 2.11. Ordination overlay showing vectors for relationships of some community measures with plots in ordination space calculated with non-metric scaling. Data are for beetles collected in trees and canopy gaps on the forest floor in northern California, 1999-2000. Vector directions and strengths are indicated by direction and length of lines. Refer to Table 2.2 for actual correlations with ordination axes.

Table 2.2. Pearson's r -values for various quantities against ordination axes of beetle morphospecies from northern California, 1999-2000. Axes were rotated to maximize correspondence with linearly coded treatment values 1-4. Predator, herbivore, and detritivore categories represent biomass estimates as fractions of trap totals.

Factor	Axis 1	Axis 2
Predator fraction	-0.695	-0.173
Herbivore fraction	0.263	0.46
Detritivore fraction	0.595	-0.34
Morphospecies Richness (S)	0.8	0.147
Shannon-Wiener Index (H')	0.838	0.138

Table 2.3. Morphospecies showing significant monte-carlo p-values for indication of significant presence among treatments, by the method of Legendre and Legendre (1997). Data are for pitfall trap catches, northern California, 1999-2000. Values by treatment type are the percent of perfect indication (fraction of 100%); p-values describe the likelihood of the maximum indicator value from any of the classes occurring by chance.

Morphospecies	Monte-Carlo				
	p-value	Subcortical	Cortical	FF 1 m	FF 11 m
Dermestidae 01	0.00	6	81	4	1
Lathridiidae 02	0.00	4	79	4	0
Nitidulidae 01	0.00	26	0	58	0
<i>Pterostichus</i> 01	0.00	35	0	64	0
Tenebrionidae 04	0.00	0	79	0	8
Aleocharinae 15 (Staphylinidae)	0.00	37	12	49	0
Cerambycidae 01	0.00	3	50	10	0
Buprestis aurulenta (Buprestidae)	0.00	0	41	1	0
Nitidulidae 06	0.00	1	37	0	2
Aleocharinae 27 (Staphylinidae)	0.00	22	4	52	0
Nitidulidae 03	0.00	39	6	54	0
Chrysomelidae 01	0.00	14	15	43	0
Erotylidae 01	0.00	2	34	0	0
Paedaerinae 01 (Staphylinidae)	0.00	23	2	42	0
Tenebrionidae 01	0.00	28	0	2	0
Ptilliidae 01	0.00	51	10	9	0
Tachyporinae 02 (Staphylinidae)	0.00	19	1	37	0
Aleocharinae 30 (Staphylinidae)	0.00	4	5	36	0
Curculionidae 04	0.01	1	14	0	37
Ptilliidae 03	0.01	0	27	0	0

Morphospecies	Monte-Carlo p-value	Subcortical	Cortical	FF 1 m	FF 11 m
Aleocharinae 21 (Staphylinidae)	0.01	22	0	34	0
Elateridae 04	0.01	0	27	0	0
Scydmaenidae 01	0.01	27	0	0	0
Cantharidae 05	0.01	0	27	0	0
Scarabaeidae 01	0.01	1	0	28	0
Aleocharinae 20 (Staphylinidae)	0.01	22	0	34	0
Ptiliidae 02	0.02	25	0	0	0
Aleocharinae 12 (Staphylinidae)	0.03	24	0	1	0
Lathridiidae 01	0.03	3	23	0	1
Scarabaeidae 02	0.04	0	1	22	0
Cossorinae 01 (Curculionidae)	0.05	6	21	0	30
Tachyporinae 01 (Staphylinidae)	0.05	0	1	21	0
Scarabaeidae 03	0.05	19	0	2	0
<i>Pterostichus lama</i> (Carabidae)	0.05	28	1	19	2
Paederinae 08 (Staphylinidae)	0.05	20	0	0	0
Leiodidae 03	0.05	0	20	0	0
Elateridae 05	0.05	20	0	0	0
Curculionidae 02	0.05	12	10	27	0

Table 2.3 (continued).

Discussion

If a tree falls in the forest, it will likely make a terrible ruckus. This is especially true if it is a large, old tree, and its limbs and trunk are still sturdy at the time of descent to the forest floor. Trees in this state are known to be important structural features in tropical forests where broadly developed crowns can create large changes as they remove additional vegetation on their way down (Salvador-Van Eysenrode *et al.* 1999). In temperate forests, where insect and pathogen infection can be common causes of death, trees may often undergo senescence while still standing, and lose much of their foliage and crown structure before the bole collapses. This should create smaller, more symmetrical canopy gaps with distinct floristic and environmental patterns on the forest floor. At my study site I have seen a good mix of both cases, and tried to choose trees that had come to the floor with a reasonable degree of structural integrity; and hence with some uniformity in the type of gap they had created. It is difficult forensically to make any judgement about a tree's decay history, but I consider my results to represent an intermediate range of these extremes, which show tree decay and canopy gaps as an integrated function of the full range of these mortality processes.

The good or moderate evidence that canopy density, litter depth and fine woody debris vary either away from or along a tree's length should be considered as incident functions of modification to forest vegetation during or after gap creation. The significance of length along tree bole as a factor related to canopy density could account for alleged effect of the tree crown, higher along the tree's length, creating wider zones of modification upon falling. Whatever the case beetles do not appear to

respond to this subtle feature in gaps; nor does the use of pitfall traps give any indication that assemblages change as a function of habitat variance on the forest floor as I have measured it at the trap scale. The role that litter structure plays in natural forests is an important guideline because forest harvesting often involves significant scarification to the forest floor. Rappaport *et al.* (2003) found that litter structure changes coincident with fire and harvesting treatments at BMEF could cause dramatic changes in forest floor mite assemblages. These changes were seen to be out of character for the natural, old stands like the one I sampled, in which harvesting never has occurred, and in which fire has been suppressed for 70 years. The recovery of canopy density in gaps coincident with tree decay rank is an important and possibly interrelated feature.

My analyses show clearly that with respect to the beetle fauna, decay is a significant source of variation within downed trees; but perhaps more importantly they show the relationship in certain ranges of decay between insides and outsides of logs. For example, Axis 2 scores for cortical catches are similar to subcortical scores only in the early ranges of log decay (Fig. 2.8). That is to say that cortical catches, regardless of the decay state of the log, share the largest portion of their variation with subcortical catches that are from earlier stages of decay. This perhaps indicates that there is a greater degree of exchange between the 2 environments when sapwood is in earlier decay stages. In all of the trees I measured, primary phloem consumption was nearly or completely accomplished, providing ample space between outer bark and sapwood for mobility and presumably allowing beetles to move in or out of trees as they wished.

Because this region of the ordination also precludes similarity with forest floor communities (Fig. 2.8), it suggests that there is a unique and active fauna in earlier stages of decay that is specifically associated with trees, and not with the forest floor; and that it is supported by characters both on the insides and outsides of trees. Although the ordination spaces can be defined by morphospecies absence as well as presence, there were several morphospecies that contributed positively to this distinction, from all feeding guilds. Further support is gained from morphospecies that were collected on the cortices, but only on trees in the early stages of decay. Among them are several morphospecies of woodborers from the families Buprestidae and Cerambycidae. Morphospecies from these families lay eggs in dead and dying trees by extending an ovipositor through crevices of the outer bark, often directly onto the sapwood. Their capture on the cortices of trees in earlier stages of decay may indicate differential conditions there, which other morphospecies also respond to.

Axes derived in ordination routines are orthogonal, meaning that they do not co-vary with one another. When the first ordination axis is rotated to maximize the separation of linearly coded treatment values, the axis most representative of decay in subcortical samples becomes skewed, loaded partially on both axes; it is impossible to separate these 2 functions completely. This was presumably foreshadowed by my measurements of forest canopy density that indicated gap closure was strongly related to tree decay. This suggests that decay and treatment are not independent factors and that certain portions of the fauna are migrating toward one another, in 'species space', as a function of time-related processes like gap recovery and organic decay.

This is illustrated in the upper regions of the ordination, where cortical and subcortical faunae have stronger relationships on *both* axes early in decay. It also suggests that this will happen between forest floor samples and subcortical samples later in decay (Fig. 2.8). For the range of trees that I measured there is no straightforward relationship between cortical and forest floor sample, as the only non-random pattern appears to be quadratic. In this scenario ecological distance between the treatments actually increases through the intermediate ranges of the ordination, but drops dramatically at the extremes. This would require a decay-oriented mechanism causing similarity early and late in decay, between forest floor and tree cortex. For the trees in this study this is quite unlikely; sites were distinguished fully in their tree quality and by the quality of the forest canopy around them. Eventually one should expect that decay would indeed bring cortical and forest floor catches closer together as a tree disintegrates and becomes less distinguishable from the forest floor substrate. Catches on the forest floor did demonstrate a strong relationship between the decay stage of fallen trees and the ecological distance between gap and forest catches in the forest floor. This assumedly is brought about by the implied environmental consequences of coincident trends in canopy density.

The value of shade to the development of forest floor biota cannot be overstated in this region where summers are very dry and hot; there are no riparian areas on the study site, and moisture must be a shaping factor in biological development. As such, the interiors of fallen trees, early in their decay, as well as any other factors that buffer

temperature extremes like canopy cover should be shaping agents. Graham (1925) had recorded subcortical temperatures in *Pinus strobus* L. exceeding 60 °C in open sunlight, which he claims to be well beyond the lethal limit of subcortical insects. There was onsite evidence of trees that had decayed in open sunlight, having lost their outer bark and 'skeletonized.' The circumstances that cause this are unclear, though the thoroughly competitive shrub 'green-leaf manzanita' was often noted in the vicinity. Whether trees experience bark loss in a shaded or non-shaded environment, subcortical habitat will still disappear. At this stage the role of moisture and shading should be important in determining the quality of sapwood as continuing arthropod habitat.

Based on the percentages of variation that could be assigned to the axes, the largest change occurs across axis one, separating subcortical catches from all others. Because the data indicate that time-dependent processes like decay and other forms of gap recovery cause variance over these axes, their maintenance should maximize the ecological space over which forest floor arthropods occur.

The subcortical and cortical catches together accounted for a significant fraction of unique morphospecies occurrence, evidence for the potential of specialization in over 50% of the fauna (Fig. 2.6). Many of these morphospecies were caught, though, as singletons and indicator analysis shows a more conservative estimate of certain gains in morphospecies richness by preservation of dead wood structures (about 20% of the fauna). Furthermore, no morphospecies were indicated to be perfect indicator of any of

the habitats. Because morphospecies accumulation curves show that there are substantial gains to be made in all habitat types by further sampling, it's impossible even to guess how many of the rare morphospecies actually are specialists for any of the habitats. However, Vaisanen *et al.* (1993) found that when they compared coleopteran samples taken by manual searching in dead Norway spruce and Scots pine, rare species predominated in the larger, older hosts from non-industrialized forests. Samples from managed forests of younger, smaller trees yielded distinct catches that contained significantly fewer rare morphospecies. It's unclear still whether these differences can be ascribed to within tree quality or to differences in exterior environments created by managing for younger stands with different physical structures.

The data also serve to generate interesting hypotheses about how beetles are distributed spatially in the forest floor and their consequential role in the forest floor foodweb; subcortical environments were predator rich, cortical environments were herbivore rich, and forest floor environments, especially those outside of gaps tended to be fungivore rich. The predominance of predator fractions beneath bark is a function partly of reduced numbers of detritivores and herbivores there, but also the consistent catches of large-bodied predators, especially Carabidae. Because numbers of individuals in the subcortical environment were exceptionally sparse, comparatively, it seems that large-bodied predators would either search there specifically for specific prey items or seek shelter of some form. Alternatively, Goulet (1974) has noted that very moist, rotten wood was an important egg-laying feature for the carabid

Pterostichus melanarius Illiger. Nevertheless these morphospecies are readily found in the other study habitats, and it is possible that they require structural habitat diversity on the forest floor to persist.

Apart from the woodborer families Cerambycidae and Buprestidae, herbivore biomass was composed on tree cortices mostly of hard-shelled, larger beetles in the families Curculionidae, and Elateridae, though chrysomelids, scolytids, eucnemids, and scarabs were also caught there. Other than the role of woody debris as an important resting or thermoregulatory feature on the forest floor, a unified explanation for herbivore presence there is questionable. Many herbivorous morphospecies are active fliers, compared with their predator or detritivore counterparts, and may spend less time traversing the forest floor. From an energetics perspective, higher rather than lower resting points should be preferable. Literature discussion for arthropod-related use of woody debris cortices is limited to observations by Buddle (2001) that dead trees in boreal forests were important and distinctive habitat for web building spiders. He found this role was dependent on the spatial relationship of wood with the forest floor, and that elevation of woody debris could affect community composition. The combined observations suggest that woody debris cortices represent an important and distinct trophic feature on the forest floor for a variety of reasons.

Forest floor decomposers have a dominant coleopteran component, whose composition can vary considerably within gaps; much more so than within fully covered forest. This variance was large enough that in some cases catches between

forest floor/gaps were indistinguishable from cortical catches on the first ordination axis. Alternatively, the forest floor within a well developed canopy appears to harbour the most morphospecies rich communities, and in a composition that is much more consistent than in gaps.

The possibility of considerable gains to morphospecies richness in further stages of decay and forest floor development are promising, at the BMEF site. The only comprehensive trapping procedure that has considered wood decay and arthropods found that wood decayed to stages well beyond those I studied continued to contribute to species richness of arthropod catches (Irmiler *et al.* 1996). It is likely that further gains can also be made by studying the other dominant canopy species, and at a wider range of elevations.

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Chapter 3

Experimental Manipulation of Colonization by Bark- and Woodboring Beetles and the
Effects on Wood Decay and CO₂ Efflux in Ponderosa Pine

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For submission to *Oecologia*

Abstract

To study long-term dynamics of insect colonization on wood decay processes, we used metal screens to manipulate the colonization of young ponderosa pine by two insect functional groups, bark beetles (Coleoptera: Scolytidae) and woodborers (Coleoptera: Buprestidae, Cerambycidae). In a randomized complete block design we felled 45 trees near a long-term ecological research forest in northern California, creating three, 1.25 m sections of wood from each tree, 15-25 cm in diameter. After two years there was significant consumption of phloem by both groups (~25% and 10% by area, respectively) and substantial presence of woodboring in the sapwood. Phloem consumption by both groups was positively related to the distribution of stain fungi (Ascomycota) in the sapwood. At low levels of stain and decay (Basidiomycota) fungal presence (<40% and 10%, respectively, by average cross-sectional area) there appeared to be a positive relationship between the two fungal groups, perhaps due to common mechanisms of inoculation. Otherwise, decay and stain fungi shared a strong negative exponential relationship, confirming an antagonistic effect that has been previously suggested by both field and laboratory studies. The presence of woodborers in the sapwood was not strongly related to extent of decay fungi, indicating that initially this group does not serve to promote decay fungi in a proportional fashion. Average dry density of wood samples from centres of logs decreased by almost 10% over the two years, though wood density values were not obviously related to any of the biological characters we measured. Carbon dioxide efflux from logs in the second year was positively correlated with levels of decay fungi in the sapwood, indicating that insect-mediated fungal dynamics can have long-term consequences to decay

processes, atmospheric processes, and to the structural nature of the forest floor in ponderosa pine forests.

Introduction

Elemental flux, especially of carbon, is among the most controversial of modern science topics. Because we believe our health and economies to be affected dramatically by the sequestration and exchange of materials among various reservoirs, the processes by which these are determined become important things to understand (Aron and Patz 2001). In land use policy, where many motives for conservation are dismissed either as unimportant or immeasurable, practical, service-oriented arguments generally gain primacy. Understanding the role of biological communities in regulating system processes is a natural and necessary effort.

Forests are among the hot spots for debate in this regard as they represent substantial proportions of biological diversity (Wilson 1988), potential for material production and wealth (Tollefson 1999), and alleged regulation of planetary processes like carbon, nutrient, and water cycling (Schlesinger 1997). Often, forest insects and fungi that inhabit wood have been viewed as competitors that serve no beneficial ecological role (USDA 1958). This continues (Hughes and Drever 2001), even as we recognize other natural disturbances like fire to be important, natural, and 'good' shaping agents in the landscape (Agee 1994). However, as a number of authors have tried to point out, many of these species, especially bark beetles (Coleoptera: Scolytidae), may have shaped the genetic properties of forest canopy species to begin with; certainly these organisms have interacted with forests for a very long time (Mitton and Sturgeon 1982; Farrell 1998). Further, there is important evidence to suggest that the roles of forest 'pests' and 'pathogens' in shaping the communities of insects in dead and dying trees are

important (Reid 1955; Camors and Payne 1973), and that their activity is an important factor governing tree death (Furniss and Carolyn 1977), and rates of decay post mortem (Edmonds and Eglitis 1989).

Early insect colonists in downed woody material consist primarily of bark beetles and woodborers (Coleoptera: Buprestidae, Cerambycidae; Hymenoptera: Siricidae).

Functionally, these are 2 reasonably separate groups that affect wood quality in different ways. Bark beetles fragment outer bark by boring through it, but the remainder of their life history is restricted to the region of tree phloem where they feed and develop by migrating longitudinally along the length of a tree's bole (Furniss and Carolyn 1977). Their effect on the rest of the tree is by transformation of phloem tissue directly by mastication and digestion, and through the inoculation of microorganisms that can also infect sapwood and heartwood (Furniss and Carolyn 1977). 'Stain' fungi from the genera *Ceratocystis* and *Ophiostoma* are common examples of bark beetle fungal associates (e.g. Leach *et al.* 1934). Edmonds and Eglitis (1989) found that the exclusion of all insects from Douglas-fir logs could markedly inhibit decay over a ten year time period, though they did not assess interactions between wood borers and bark beetles, nor with fungi.

Woodboring insects spend comparatively little time in the tree phloem, and migrate quickly to the sapwood. They excavate and process considerable volumes of sapwood in their development, increasing wood porosity and exposed xylem surface area. Outer bark fragmentation occurs during the emergence of insects as adults. Though adults

oviposit to the wood from the outside, larval galleries are known to contain rich communities of symbiotic microorganisms (Gilbertson 1984); the specific role of this process in decomposition is unknown. 'Decay fungi' that can utilize the lignified components of plant cell walls are responsible for the structural failure in wood (Cartwright and Findley 1958). Some authors have suggested that stain fungi might compete with decay fungi (Progar *et al.* 2000), whereas others have suggested that they may share some successional relationship inside of dead trees, improving carbon quality and detoxifying sapwood prior to the arrival of decay fungi. Because woodborers penetrate into the sapwood, they should affect dynamics of sapwood-living fungi.

In this study we experimentally manipulated the colonization of young ponderosa pine trees (*Pinus ponderosae* Dougl.) by the two functional groups 'bark beetles' and 'woodborers'. We test the relationship between the two groups and their combined effects on the presence and extent of stain fungi and decay fungi in the sapwood. We examine also these relationships to changes in wood density, water content, and to gaseous carbon efflux from the wood. Mass loss data, or wood density change over time, is a standard measure of decay for wood. Because mass is lost largely as the respiration of water and carbon dioxide from wood (Schlessinger 1997), the rate of efflux of CO₂ is also a good measure of decay. The later data type is more expensive to generate, though a much more precise measure when considering small time intervals. We use both as we have made short term measures (two years) but intend to continue this study over a long time interval more appropriate to wood density data.

We were specifically interested in documenting the relationships of colonist arthropods to the two major visible groups of fungi in the sapwood of ponderosa pine, stain and decay fungi, and the resultant effects on wood decay. We wished to demonstrate whether the 2 insect groups could act in concert or against one another to affect fungal dynamics, and whether such trends might have measurable consequences to the disappearance of woody debris and the generation of carbon dioxide from forests of ponderosa pine.

Methods and Materials

In June 1998 we surveyed an 20-hectare area of young ponderosa pine trees near Black's Mt. Experimental Forest, in northern California. The forests consist largely of ponderosa pine, but also contained mixes of Jeffrey pine (*P. jeffreyi* Balfour), incense cedar (*Calocedrus decurrens* Torrey) and white fir (*Abies concolor* Gordon & Glendinning), due to the high average elevation of 1850 m. Forests with ponderosa pine as a leading canopy species occur over a wide geographic range, from northern Baja California to central British Columbia (Oliver and Powers 1998). Winters are long with snowfall occurring in October and often lasting into May, and the majority of precipitation occurs as snowfall. Soils there are mostly shallow, stony loams over lava bedrock.

Because there were heterogeneous conditions through the study area, we used a 100*100 m grid overlay for the study area and randomly selected five 'blocks' of forest

in which to conduct our study. In addition to a variable aspect and slope in the study site, there has been a history of destructive sampling and forest harvesting in the area, making the canopy and forest floor quite variable. In each 1-hectare block we surveyed all ponderosa pine trees with boles exceeding 20 cm in diameter, measured 1.3 m from the ground. Of this sample population we randomly chose six trees in each block and felled them with a chainsaw, at 20 cm from the ground. Measuring from the base of the felled tree, we established three separate pieces of wood, cut from the main bole, each 1.25 m in length (Fig. 3.1). Within each tree three separate treatments were applied by wrapping screen around the boles. To attempt to eliminate all insect activity, we used a double wrap of steel screening, 1 mm mesh size. To allow bark beetle colonization but deter larger woodboring insects, we used a single wrap of steel mesh, 6.5 mm gap, attached to plastic shims nailed to the ends of logs. Shims were lids from five gallon plastic buckets, 30 cm in diameter, creating a hollow screen cage to deter oviposition by woodboring insects landing on screen surfaces. A third, control treatment with no screen was used to allow colonization by both groups. Cut ends of logs were sealed using hot, liquid paraffin wax. Treatments were assigned within block so that each position on the tree received each treatment twice (Fig. 3.1), on two separate trees. Logs were left in situ with the tree remainder to serve as a strong semiochemical attractant for colonizing insects.

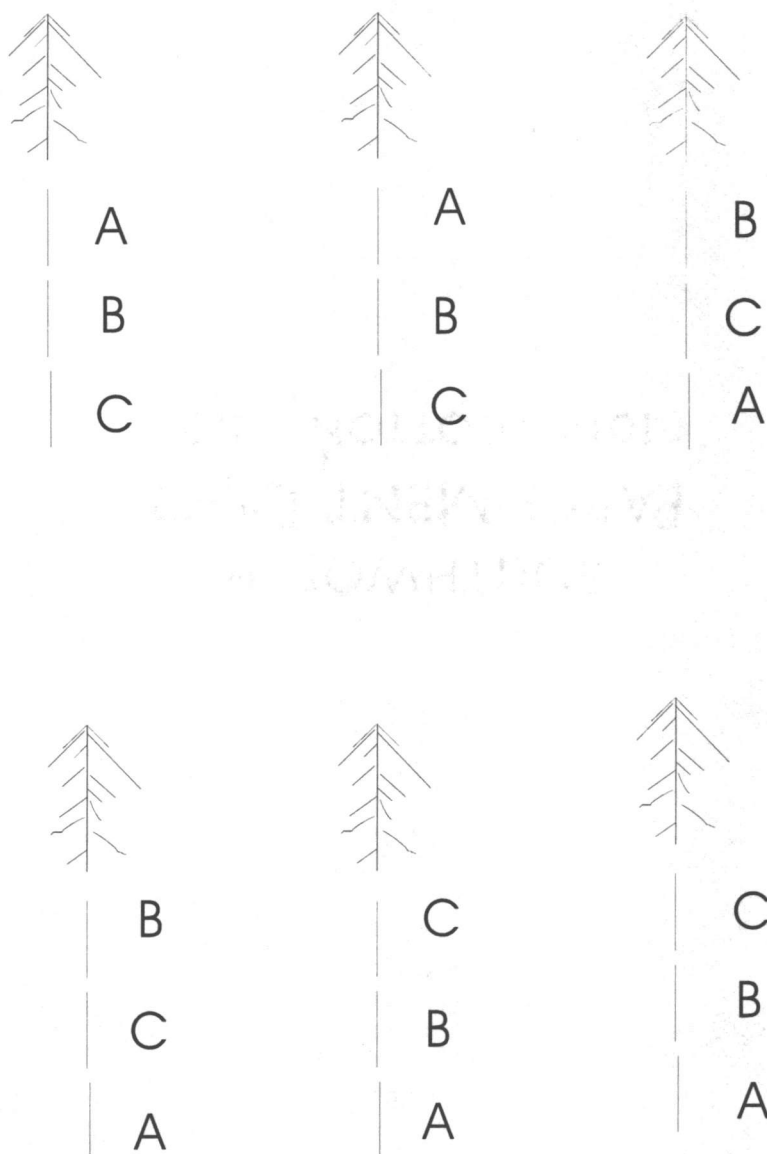


Figure 3.1. Diagrammatic distribution of treatments among logs made by cutting from randomly selected ponderosa pine trees. Trees were chosen from a random sample of the entire population in a stand in Lassen National Forest, northern California. Letters A-C refer to screen treatments of two different kinds, plus a control with no screen applied. Each possibility was represented twice, for equivalent sampling in 1999 and in 2000.

One disc of wood was removed from each tree to serve as a baseline measure of water and density attributes for that tree. In September 1999 and 2000, we removed 50% of the logs, and assessed them for various physical and biological attributes. In 2000 we removed only half samples (approx. 0.675 m in length), and left the other halves for longer term study.

Because of the short term of two years for the initial measures, we anticipated the possibility of indeterminate data from mass loss measures. To augment our measures of decomposition we decided to measure efflux of carbon dioxide from logs, which is one of the primary functions responsible for loss of dry mass in wood (Rayner and Boddy 1988). On the halves to remain under field conditions we established plastic collars constructed from 10*10 cm plastic cylinders, shaped them individually to each log, and sealed them to the center of each log with silicone (Fig. 3.2). We also constructed sealable covers for the collars with rubber nipples imbedded in their centres. In November of 2000, and April of 2001 we sampled 14-day accumulations of gaseous efflux to the containers, using a syringe to withdraw standard volume samples and transfer to sealed vacuum sample containers. Samples were taken to a nearby laboratory where they were analyzed for their CO₂ concentrations, using a Li-cor™ LI-6200 infra-red gas analyzer.

We used gravimetric measures to determine water content and dry density (g wood/volume, after complete desiccation through oven drying). We did this for each of the tissues: bark (including phloem), sapwood, and heartwood. Porosity from decay

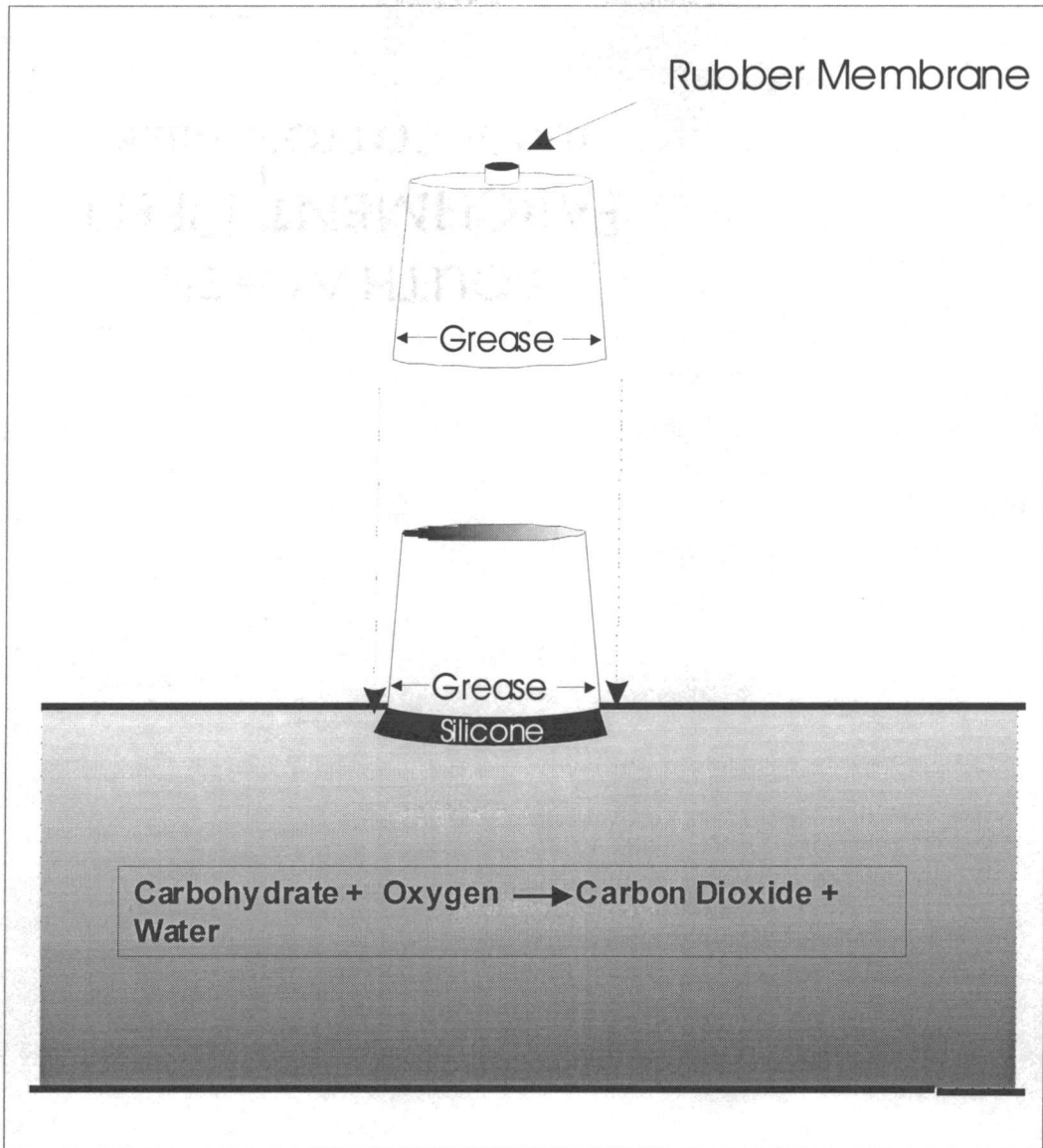


Figure 3.2. Apparatus for measuring CO₂ efflux from ponderosa pine logs in northern California.

processes increasingly skeletonizes the woody structure, reflected as a loss in density. We used dry as opposed to wet density because wood in this region inevitably desiccates long before the majority of decay processes occur, and dry density is therefore a more realistic field standard.

We assessed biological attributes of logs over the lower (thicker) half portion of their area. Logs were assessed for their area-consumption of phloem by bark beetles and woodborers by removing outer bark in longitudinal quarter-segments, and placing a 1-cm * 1-cm square mylar grid over the inner bark surfaces. Stain fungi are apparent by visual inspection because of the dark colour of their hyphae, and by reaction zones in the wood which are discoloured and distinctly softer than unaffected wood (Rayner and Boddy 1988). For each length of sapwood, we used a Mylar overlay and assessed four equally-spaced transverse sections for coverage by stain fungi. Number of sections was determined by the resources available to us to complete sampling. Woodborer galleries in the sapwood were obvious and easily measured with a mylar overlay in transverse sections. Decay fungi were detected by through a combination of visual inspection for mycelial lines and 'reaction zones' in the sapwood, and by a repeated and rapid striking of the sapwood surface in an approximate 0.5-cm * 0.5-cm grid with a pointed, metal dissecting probe. We circled regions of substantial structural change in wood quality with a marker and then used a mylar overlay to tally area affected.

Analysis

In general we viewed $\alpha=0.05$ as the level for which statistically significant results should be considered positive. However occasionally we report values between 0.05 and 0.15 as they too suggest important trends that should not be ignored from field data. We used SYSTAT and SPLUS software to perform least squares techniques (Tabachnik and Fidell 1996) to evaluate a number of models for the data. To demonstrate how screening treatments affected the populations of functional groups, we used the model:

$$\text{Response} = \text{Screen treatment} + \text{Block (tree)} + \text{Year} + \text{error}$$

Responses included bark beetle area of consumption and woodborer area of consumption. Log transformations of the response variables were used to improve normality, and to improve homoscedasticity of the response among treatment levels. Because the method of inoculation for stain fungi is unclear, and because there were many samples that did not contain any evidence of decay fungi, we also performed analysis on a subset of the data with positive decay fungi detection, to illuminate relationships under the condition of positive inoculation. Further, we broke the data set into two pieces based on scatterplot patterns of decay fungi against stain fungi in the sapwood, to illustrate the presence of two distinct and opposing trends in the data. We used the following model to describe stain and decay fungi, wood moisture, wood density, and CO₂ emissions from logs.

Response = Bark beetle + Woodborer in phloem + Woodborer in sapwood + Screen treatment + Block (tree) + Year + error

We also used interaction terms between bark beetles and woodborers to construct our richest models, and then pared down the number of terms in a reverse selection procedure where interactions were not significant. For pair-wise comparisons of insect and fungal groups against one another, we used linear and non-linear regression, developing specific equations in addition to describing the general trend between groups.

Results

Screening treatments did produce significant stratification of groups as per our expectation, though in many cases they failed to eliminate completely the target groups (Fig. 3.3). We found evidence of both bark beetle and wood borer tenacity in their efforts to colonize logs. In some instances bark beetles were able to chew through both layers of screening to enter logs. Elsewhere we found woodborers trapped between mesh layers, or dead inside the screen cages, presumably after entering through a convoluted route, and possibly having laid eggs. Because of this, and because screening treatments may have produced side effects surplus to insect exclusion, we include both the screen treatment and the biological measures of consumption by feeding group as predictors in our models. After accounting for the effects of year-year differences, and for block effects, screen treatments did produce a significant effect on bark beetle consumption ($p=0.03$; $n=89$), and on wood borer consumption of phloem

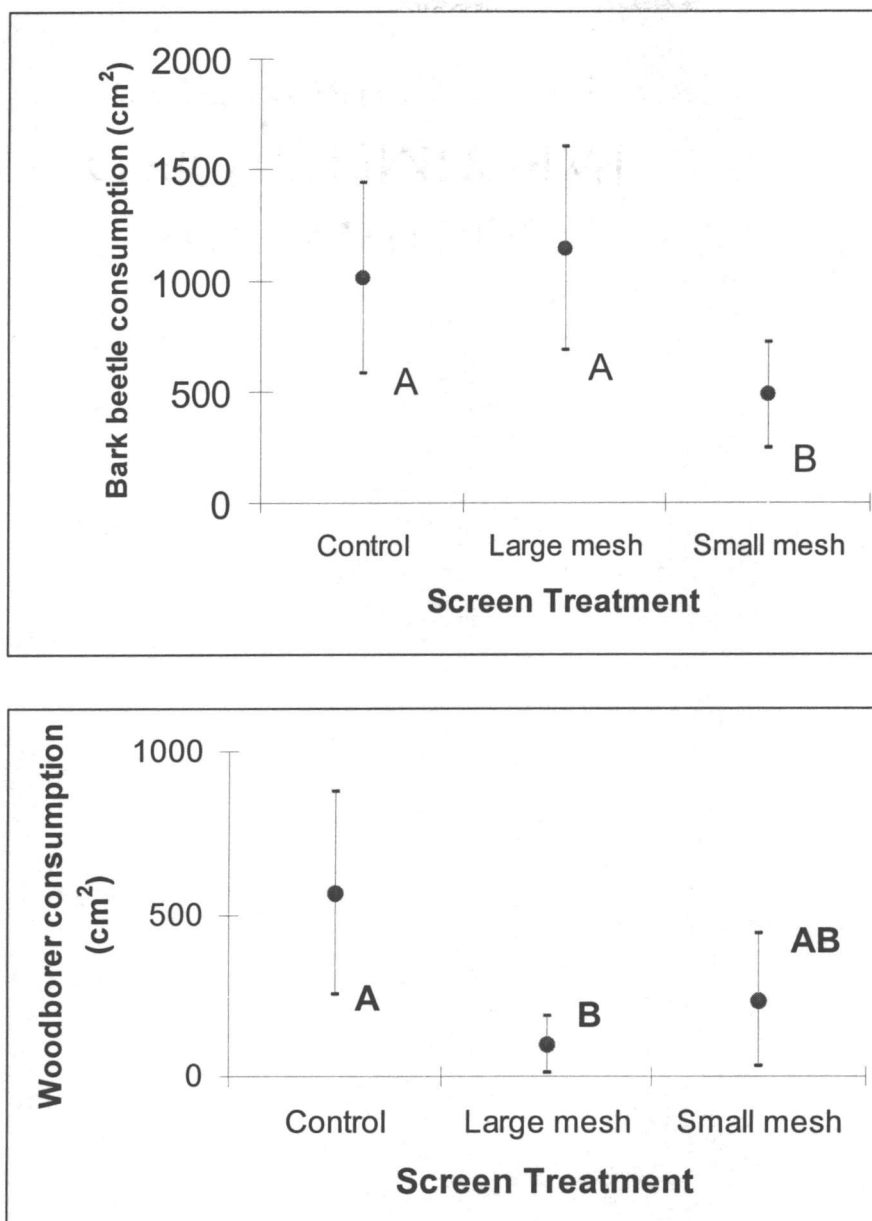
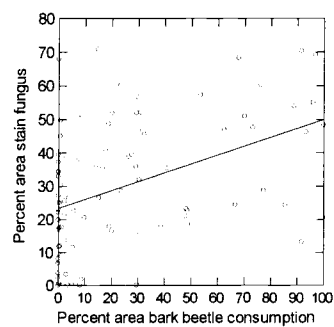


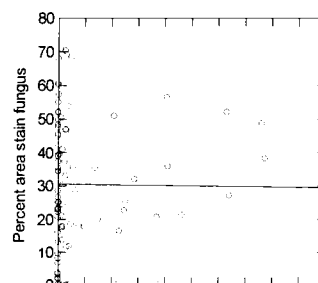
Figure 3.3. Mean and 95% CI for bark beetle and woodborer consumption per 0.675 m length of inner bark, ponderosa pine from northern California, 1998-2000. Screening treatments were designed to restrict axis to various insect colonizers. Letters A, B indicate treatment groups that did not differ (same letter) significantly by Fischer's LSD post-hoc comparison ($\alpha=0.05$), following adjustment by a regression model that accounted also for the effects of removal year, and area 'block'.

($p=0.00$, $n=89$). Bark beetles were the most prevalent consumer of phloem, having consumed an average of 24.5 ± 6.6 %. This is compared against 9.5 ± 4.6 % for larval woodborer activity in the phloem, demonstrating that bark beetles, and not woodborers, should be held responsible for the majority of influence of fungal dynamics originating from the cortex area of the sapwood.

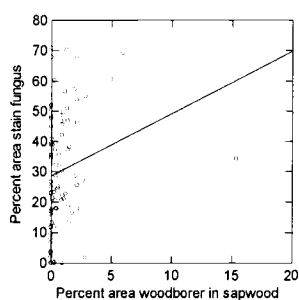
Average cross-sectional area infected by stain fungi was positively correlated with bark beetle consumption in the phloem ($p=0.00$, $r^2=0.19$; Fig. 3.4), confirming previously reported trends for this group. Woodboring in the phloem was not positively related to areal presence of stain fungi in sapwood cross sections ($p=0.953$; Fig. 3.4), but there was a significant interaction between woodborer and bark beetle consumption of phloem, indicating that woodborers do act to further the presence of stain fungi (Table 3.1), though the interaction effect was an order of magnitude smaller than the effect of bark beetles alone. This is relevant because we were interested in the compound effect on decay processes of having the two groups of insects act in concert or antagonistically to one another.



$$y=0.5x+22$$

a

$$y=-0.001x+31$$

b

$$y=2.1x+29.1$$

c

Figure 3.4. Relationships of stain fungi by average cross sectional area to consumption of wood tissues by arthropod groups. Bark beetles in the phloem (a), woodborers in the phloem (b) and woodborer consumption in the sapwood (c) are shown for young ponderosa pine logs from northern California, 1999-2000.

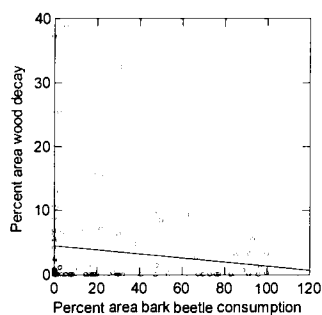
Table 3.1. Least squares model for effects of insect activity on areal extent of stain fungi in young ponderosa pine. Samples were taken from northern California, 1998-2000. Pearson's r-squared value = 0.21.

Source	Coefficient	Sum-of-Squares	df	Mean-Square	F-ratio	P
Bark beetle consumption	0.224	5246.59	1	5246.59	19.509	0.00
Woodborer consumption in phloem	-0.105	180.541	1	180.541	0.671	0.38
Interaction	0.015	1066.681	1	1066.681	3.966	0.03
Error		22858.73	86	268.926		

At the scale of individual log, after two years, there was also a positive relationship between stain fungi and woodboring in the sapwood, although the fit was very poor ($p=0.06$; $r^2=0.04$; Fig. 3.4).

There was an apparent negative relationship between average cross-sectional area of wood decay and bark beetle consumption in the phloem, and between wood decay and woodboring in the sapwood (Fig. 3.5), and between stain fungi (Fig. 3.6). There was no significant relationship between woodborer consumption in the phloem and decay fungi in the sapwood ($p=0.737$), refuting the commonly held notion that these two groups are often positively related.

The full scatterplot of stain against decay fungi (Fig. 3.6a) can be subdivided to more clearly look at interactions when the two are present at relatively high levels inside of logs. A logarithmic relationship becomes most apparent in cases where structurally decayed wood was present at moderate to higher levels: when a subset of cases is considered where the union is: (*average decay area* > 10%) U (*average stain fungi area* > 40%), the outside edge of the original data distribution is described, showing a strong negative exponential relationship where decay fungi cease to be detectable beyond stain fungi levels of 70% average area coverage. Bark beetle consumption and decay fungi were also related in a negative exponential fashion in this subset (Fig. 3.6), and moisture levels showed a rough quadratic relationship with decay fungi, and an inverse quadratic relationship with stain fungi (Fig. 3.7).



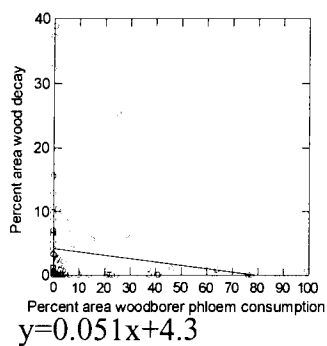
$$y = -0.03x + 4.2$$

A



$$y = -0.15x + 4.0$$

B



$$y = 0.051x + 4.3$$

C

Figure 3.5. Relationships between average cross sectional area of wood decay and bark beetle consumption of phloem (a), woodborer consumption of phloem (b), and woodborer consumption of sapwood (c). Samples are from young ponderosa pine in northern California, 1999-2000.

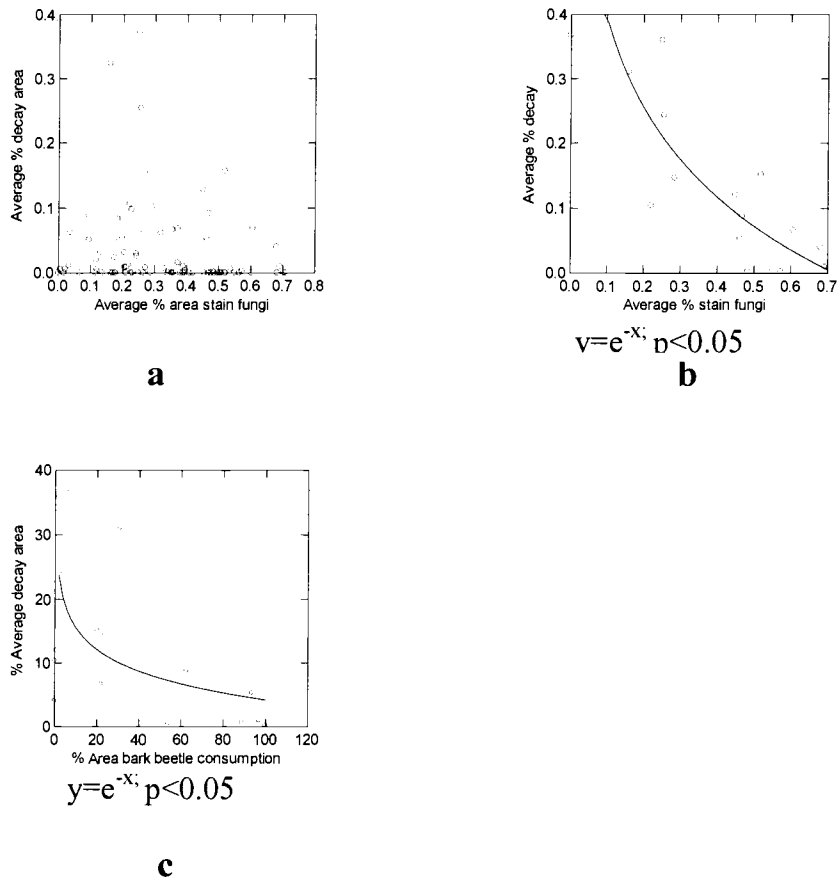


Figure 3.6. Logarithmic relationship between average cross-section area of coverage for decayed wood of ponderosa pine, and average area coverage by stain fungi of the sample (a). (b) represents a subset of all samples where decay coverage > 10%, and stain fungi coverage > 40%. (c) represents the relationship between decay and bark beetle consumption in this same subset of data. Logs were standardized for length and width and exposed to field conditions for 1-2 years in northern California, 1998-2000. Data points represent the average of four equally spaced cross-sections per log.

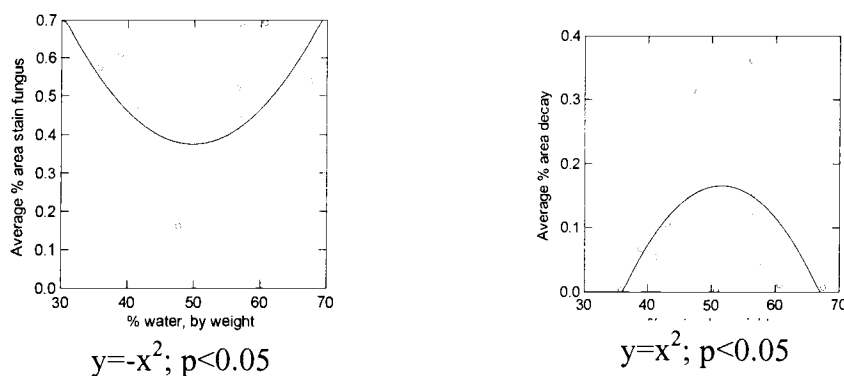


Figure 3.7. Quadratic relationship between average cross-section area of coverage for decayed wood and stain fungi in ponderosa pine, and percent water by weight of the sample. Logs were standardized for length and width and exposed to field conditions for 1-2 years in northern California, 1998-2000. This graph represents a subset of all samples where decay coverage > 10%, and stain fungi coverage > 40%. Data points represent the average of four equally spaced cross-sections per log.

Though wood moisture declined on an annual basis ($15.2 \pm 7.1\%$), further modelling shows these change to be accountable through insect activity, and physical features of individual sites and logs. Table 3.2 shows a general linear model for the percent water from collected samples. Diameter, site, woodborer activity in the phloem, and bark beetle activity all significantly influenced wood moisture content, accounting for the year-year differences.

Dry Density

There was a significant decrease in average sapwood dry density between years; changes in 1999 from the 1998 baseline samples were not significantly different from zero (0.022 ± 0.026 g/ml). Year 2000 samples showed an average change of -0.034 ± 0.029 g/ml, representing an approximate $8.6 \pm 7.3\%$ reduction from the original global sapwood mean of 0.397 ± 0.012 g/ml. When a model that considered the effects of year, block, tree, and screening treatment was applied, only individual trees showed significant effects (Table 3.3).

Dry density in bark was also significantly lower in the second year of sampling, decreasing from 0.014 ± 0.025 g/ml in 1999 to -0.035 ± 0.014 g/ml in 2000. The second year reduction represents an approximate 9.2% decrease from the 0.38 ± 0.011 g/ml mean of initial density for outer bark. That effect should have been due partially to mining of the phloem by insects; though at the whole log scale we were unable to

Table 3.2. Least squares model parameters for determinants of wood moisture in ponderosa pine. Samples were taken from northern California, 1998-2000. Pearson's r-squared value = 0.81.

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Site	0.639	3	0.213	3.597	0.02
Tree	6.091	22	0.277	4.676	0.00
Year	0.106	1	0.106	1.792	0.19
Screening	0.065	2	0.032	0.547	0.59
Sample length	0.011	1	0.011	0.179	0.68
Sample diameter	1.075	1	1.075	18.164	0.00
Bark beetle phloem consumption	0.241	1	0.241	4.062	0.05
Woodborer phloem consumption	0.217	1	0.217	3.664	0.06
Woodboring in sapwood	0.029	1	0.029	0.483	0.49
Error	2.723	46	0.059		

Table 3.3. Least squares model parameters for determinants of sapwood dry density changes in ponderosa pine. Samples were taken from northern California, 1998-2000. Pearson's r-squared value = 0.83.

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Site	0	2	0	0.06	0.94
Tree	0.17	26	0.006	5.74	0.00
Year	0.00	1	0.001	0.73	0.40
Screening	0.00	2	0	0.03	0.97
Sample Length	0.00	1	0	0.01	0.91
Sample Diameter	0.02	1	0.015	13.28	0.00
Bark beetle phloem consumption	0	1	0	0.00	0.96
Woodborer phloem consumption	0	1	0	0.13	0.72
Woodboring in sapwood	0	1	0	0.14	0.72
Error	0.056	51	0.001		

demonstrate this (Table 3.4). Heartwood did not show any annual reduction in dry density (1999, 0.045 ± 0.105 g/ml); 2000, 0.011 ± 0.039 g/ml).

Respiration

CO₂ concentrations were not significantly different between seasons (difference $= 0.0008 \pm 0.0014$ g/ml). There was an apparent negative logarithmic relationship between sample CO₂ concentrations and levels of bark beetles and woodborers (fall and spring samples, Fig. 3.8), and a positive exponential relationships with decay area in the sapwood. Respiration was positively related to sapwood moisture content in both seasons (Fig. 3.8).

Discussion

The growth of stain fungi appears to be a keystone in the development of decay patterns in ponderosa pine. Though the positive relationship with bark beetle activity has been known for some time (Leach *et al.* 1934), relationships with woodboring insect activity are absent from the literature. Because it is the activity in the phloem by woodboring larvae that seemed to promote stain fungi, and because this effect was associated with bark beetle consumption in the phloem, we imagine that they act to vector the fungus across the surface of the sapwood, through incidental contact, and that woodborers have a less specialized relationship than between bark beetles and fungus. At any rate our data indicate that the two groups might act to suppress decay

Table 3.4. Least squares model parameters for bark dry density changes in ponderosa pine. Samples were taken from northern California, 1998-2000. Pearson's r-squared value = 0.67.

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Removal Year	0	1	0	0.06	0.80
Tree	0.20	26	0.01	2.55	0.00
Site	0.01	2	0.01	1.58	0.21
Screening					
Treatment	0.01	2	0.01	2.47	0.09
Sample diameter	0.01	1	0.01	4.10	0.05
Total area mined	0.00	1	0.00	0.23	0.63
Sample length	0.02	1	0.02	6.65	0.01
Error	0.17	55	0.00		

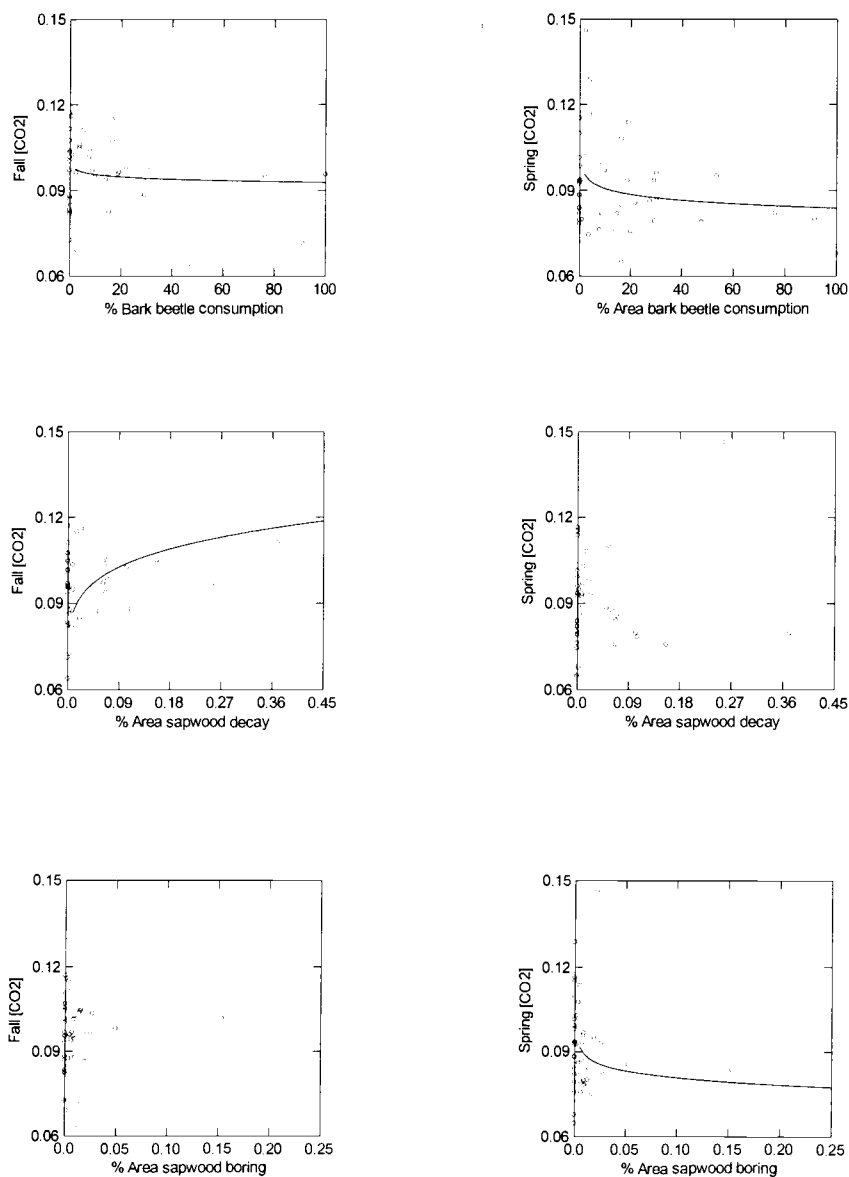


Figure 3.8. Various parameters plotted against fall and spring CO₂ efflux from ponderosa pine logs. Samples were taken from northern California, 1998-2000. Best-fit curves are indicated in cases where obvious patterns emerged.

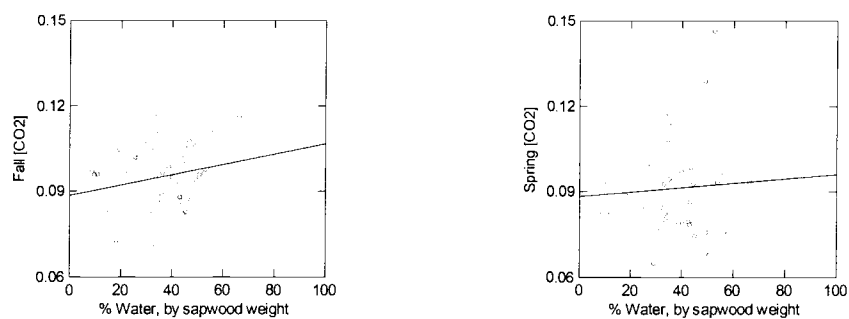


Figure 3.8 (continued).

processes through the promotion of stain fungi and possible roles in adjusting water content in woody debris.

There was good anecdotal evidence to suggest that stain fungi should actively compete against decay fungi. Highley (1997) noted that in laboratory assays, species of the stain fungus from the genus *Trichoderma* could be used to inhibit the growth of basidiomycete wood decay fungus. Using a biofungicide derived from *T. virens*, they effectively eliminated attempted infections in conifer sapwood. There is also nominal evidence from field studies that stain and basidiomycete fungi might be antagonistic in Douglas fir of the northwest United States (Progar *et al.* 2000), based on respiration patterns from inoculated samples. The specific nature of an antagonistic relationship is still not entirely clear. Broad-spectrum biofungicides are a routine mechanism employed by a vast number of microorganisms, and do not necessarily indicate any specific competitive interaction. We can be more certain though, that the two groups do not appear to share a *symbiotic* relationship in the first stages of decay; such a relationship has been repeatedly suggested, perhaps based on the common concurrence of the groups (e.g. Dowding 1973). Their concurrence is likely due to similar inoculation mechanisms (Dowding 1984), perhaps explaining the high population of samples by either fungus in the lower ends of their ranges (Fig. 3.5). Diamond (1992) notes this is a common problem among community data, where potential competitors are 'doomed to associate'. When a subset of the data are considered, eliminating the lower 25% of range for stain and decay fungus, the interaction between them reverses (Fig. 3.5). We suspect that in the case of decay fungi, their presence in the wood is

substantially greater than measured by our structural failure probes, with hyphae extending to areas where decay has not begun (Rayner and Boddy 1988); despite the fact that our measures indicate competitive interactions at decay fungus levels higher than 10% of log area, and stain greater than 40%, the area of colonization for decay fungus is likely much greater, possibly eliciting biochemical defence responses from stain fungi.

A common response pattern in the data is of a Weibull nature. In this pattern, variance and maximum values of the responses are negatively related to values of the opposing variable. Axes appear to share a negative exponential relationship; but because the area underneath the leading edge of the curb is fully populated with data, an attempted linear or even logistic fit to these data will be poor. Several authors have recorded this response, and credit it to be the evidence of competition among two entities (Manly and Patterson 1984; Pinder *et al.* 1978). This response between bark beetles and decay fungi in addition to stain vs. decay fungi suggest that bark beetles are the instigator of the dynamic. Although our experimental manipulations were not designed to assess effects of wood moisture, there are trends indicating that in the range of 45-60% sapwood moisture, decay fungi may gain some advantage. Pechmann *et al.* (1967) found that colonization of woody tissues was inhibited at moisture levels below 15% and above 60%. Again, the population of the response beneath the leading edges of the curves suggests that the relationship between the two groups can be dependent on factors other than moisture, though the maximum values seem constrained by moisture alone. Because these moisture values are in the range of what conifers contain at the

time of death, it may be that desiccant effects commonly observed during stain fungi infections act further to improve their competitive advantage over basidiomycetes and other hydrophilic microorganisms.

From our dissections we noted that at this stage of decay, organism patterns in the logs were still very patchy; while our measures of wood density are registering expected values of reduction, we suggest that mid-point samples from logs are inadequate to reflect the whole-log physiological changes occurring as a result of patchy organism dynamics after only two years. Because wood density changes have been relatively small to this point and because there is evidence that within-log communities are still developing, we expect to see improved resolution of mass-organism relationships at longer time intervals.

Alternatively, mid-point respiration samples were sensitive enough to reflect whole-log processes. The positive relationship to decay fungi activity in the sapwood indicates that eventually gravimetric measures should indicate parallel results when effects are large enough to exceed sampling error. Positive relationships of respiration levels to decay fungus have been suggested (Progar *et al.* 2000), though never confirmed in a direct manner. These measures indicate decay fungi are an important functional group in a systems sense, creating measurably larger degrees of carbon release per unit area than other prominent groups like the stain fungi. Wood moisture relationships to respiration data support the notion that high decay rates are facilitated by moisture within the range of 40-60%. Factors like canopy removal, excessive arthropod mining,

and fire may all act to regulate wood moisture levels, thereby influencing the degree of wood decay and flux of carbon.

Moderate levels of bark beetle activity, on the other hand seem to promote decay, perhaps only by allowing inoculation. Where woodborers mine in the tree phloem, they serve to promote this dynamic. Woodboring in the sapwood however seems to have produced no effect on decay processes, either by promoting decay fungi through vectoring, or by inhibiting it through log desiccation.

Because we observed these respiration patterns after more than two years post-mortem, it may be that initial effects of stain-decay interaction are long-lasting, contradicting results reported by Progar *et al.* (2000), where initial effects disappeared by the second year. The discrepancy is likely due to two factors. Firstly, they used artificial inoculations that did not accurately represent the effects of actual arthropod activity (e.g. sub-cortical phloem mining); nor did they assess the areal extent of stain for decay fungi inside their samples. It's possible that transverse inoculation mechanisms do not promote any substantive presence of either of these groups in logs. It could also be that the moisture regimes in the shaded, mature canopy of their study acted to override any initial arthropod effects by promoting the competitive growth of basidiomycetes. In conditions where fluctuation of wood moisture is more dynamic, arthropod-fungal interactions play a more important role in regulation of carbon flux and decomposition.

So, while evidence for the relationship of biological communities to mass loss data over a two-year period was marginal, relationships with the efflux of carbon dioxide were stronger. Because of this, we believe that mass loss measures at longer time intervals will continue to provide evidence of the antagonistic relationship between decay and stain fungi and the mediation by moisture levels and ultimately by insect colonists. Further research should be focused on experimental work aimed at determining the role of moisture as a central theme for the regulation of decay in this system.

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Chapter 4

Canopy Removal and Low-intensity Fire Effects on Within-log Community Structure
and Decay Processes in Ponderosa Pine

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Abstract

We used a split-plot design with 2 replicates to examine how three types of forest harvest (old-growth, high canopy structural diversity and low canopy structural diversity) interact with the presence of prescribed burns to affect arthropod colonization of dead ponderosa pine. Two years after wood deployment in an experimental forest in northern California, there was no detectable reduction of wood dry density. There also was no significant effect by any treatment toward colonization by bark beetles, woodborers, stain fungi or decay fungi. CO₂ efflux from logs was also indistinguishable among treatments in the second year. NMS ordination of insect-fungal communities within logs showed that year 1 and 2 samples were generally quite similar, though there were higher levels of all functional groups at year 2, and especially of woodborers in the sapwood. Within-log communities from old-growth had less variability along ordination axes, suggesting that increased levels of canopy disturbance create a higher level of variance in community development, at the scale of individual log. We believe that this should translate into more pronounced treatment effects on wood quality when considered over longer time intervals. Low-intensity prescribed burns appear to have very little initial effect on community development in this system, likely a function of the patchy nature of the burns.

Introduction

Several publications have shown variously that invertebrates can be important to the decomposition of soil humus and woody matter (Ausmus 1977; Edmonds and Eglitis 1989; Swift 1979; Seastedt 2000). Through the introduction of microbial populations, or through the pulverization of plant tissues, bark beetles, annelids, and microarthropods have all been shown as players in this process. The contributions to atmospheric processes have been largely unaddressed however. In (Chapter 3; Lemieux and Gillette) we showed that through the adjustment of physical conditions in logs, and through the regulation of fungal patterns, insect colonists could significantly affect fungal dynamics within wood, resulting in changes in decay status and gaseous carbon efflux.

Forests are currently considered one of the major tools for 'sinking' or 'sourcing' carbon from and to the atmosphere on a planetary scale. For instance, it has been suggested that through their increased rates of growth, young forests after disturbance have an enhanced role as carbon sinks by converting atmospheric CO₂ into tree tissues. However, in many cases this effect is offset by increased rates of carbon flux during decomposition on the forest floor after disturbances. Increased temperatures from reduced shading and optimal moisture conditions can lead to heterotrophic activity that literally breathes off mass amounts of gaseous carbon dioxide. The net balance between production and decomposition indicates whether a forest is a source or a sink of carbon to atmospheric pools (Schlesinger 1997).

However, these 'optimal' conditions on the forest floor are a function of prevailing climate and the nature of disturbance regimes that are exercised. In warm and dry environments, complete removal of the forest canopy might desiccate the forest floor, thereby inhibiting the roles of moisture dependent organisms like decay fungi. It is unclear whether woody debris in larger size classes will be affected by increased insolation and other environmental or biological conditions imposed by forest harvesting; or whether debris will still have the moist and cool conditions in its interior and hence act as a biological buffer against such changes. The role of fire is also unclear. Though clearly a frequent occurrence in dry, wooded systems, fire may serve to cause initial efflux of carbon and other elements to the atmosphere; fire can also sterilize the forest floor if too hot and widespread. Alternatively, low intensity fires create charcoal on wood surfaces, creating abundant growth resources including high quality carbon and nutrients as well as significant surface area for microbial growth (Zackrisson *et al.* 1996). Further, the interaction of the two factors may be important, as harvesting and fire are often used together to meet various goals in land management. Harvesting and fire in combination can produce unique biological effects, though, including the exclusion of some organisms that are normally attracted to fire (e.g. Wikars 1995).

There are currently no prospective studies to indicate how within-log communities will react to either of the factors. Here we describe several measures of decay in ponderosa pine after a period of 2 years post-mortem in forests of northern California. A split-plot design was used to examine 2 levels of canopy removal, crossed with

presence/absence of a low-intensity prescribed fire typical of methods used in operational practice for the area. We indicate how the development of within log decomposer communities is influenced by experimental treatments, and whether these treatments influence levels of structural decay in sapwood, whole-log mass loss and carbon efflux from woody debris.

Methods and Materials

The study was conducted on the Black's Mt. Experimental Forest, northern California. The forests consisted largely of ponderosa pine (*Pinus ponderosae* Dougl.), but also contained mixes of Jeffrey pine (*P. jeffreyi* Balfour), incense cedar (*Calocedrus decurrens* Torrey) and white fir (*Abies concolor* Gordon & Glendinning), due to the high average elevation of 1850 m. Forests with ponderosa pine as a leading canopy species occur over a wide geographic range, from northern Baja California to central British Columbia (Oliver and Powers 1998). Winters are long with snowfall occurring in October and often lasting into May, and the majority of precipitation occurs as snowfall. Soils there are mostly shallow stony loams over lava bedrock. Four blocks of 100 hectares each were assigned to either a high or a low diversity canopy removal. Each harvest block was assigned a split plot to include a burned and unburned half, assigned at random. Harvests took place in the spring of 1997, and burns occurred in the fall of 1999. Burns were conducted using large person crews and drip torch methods to regulate a moderate intensity fire, restricted to the forest floor. Additionally we were able to use as reference points from three old growth plots of approximately 50 ha. in size.

In the summer of 1998 we harvested 20 ponderosa pine trees of 20-25 cm diameter from a single small group on the experimental forest. One disc of wood was removed from each tree to serve as a baseline measure of water and density attributes for that tree. From these trees we created 88 wood bolts 1.25 m long and 15-25 cm in diameter. We randomly selected bolts from this population and spread them out over the treatment areas. Cut ends of logs were sealed using hot, liquid paraffin wax. On each block we randomly positioned eight pieces in a selected 1-ha area by using a 1-m square grid overlay and using the centre points of each cell to establish log positions.

As measures of decay we used two methods, mass loss, measured as wood dry density, and evolution of carbon dioxide (CO_2) from wood. The former is a good and inexpensive method for samples observed over long time intervals (longer than five years), whereas the later is a good but more expensive measure for observing changes over a period of days-weeks. We bisected and removed half of the samples in early fall 1999 (prior to the first burn), and again in 2000 (one year post-burn). The remaining half-sections from both years were left for further data collection at longer time intervals. At the time of bisection in 2000 we also attached plastic respiration collars to the center of the log remainders and collected in situ respiration samples from 14-day accumulations in October 2000. To do this we established plastic collars constructed from 10 cm*10 cm plastic cylinders, shaped them individually to each log, and sealed them to the center of each log with silicone. We also constructed sealable covers for the collars with rubber nipples imbedded in their centres. We used a syringe

to withdraw standard volume samples and transfer to sealed vacuum sample containers. Samples were removed to a nearby laboratory where they were analyzed for their CO₂ concentrations, using a Li-Cor 6200 infra-red gas analyzer.

We used gravimetric measures to determine water content and dry density of sapwood (g wood/volume, after complete desiccation through oven drying). Porosity from decay processes increasingly skeletonizes the woody structure, reflected as a loss in density. We used dry as opposed to wet density because wood in this region inevitably desiccates long before the majority of decay processes occur, and this represents a realistic field standard.

We assessed biological attributes of logs over the lower (thicker) half portion of their area. Logs were assessed for their area-consumption of phloem by bark beetles and woodborers by removing outer bark in longitudinal quarter-segments, and placing a 1-cm * 1-cm square mylar grid over the inner bark surfaces. Stain fungi are apparent by visual inspection because of the dark colour of their hyphae, and by characteristic discolouration of the sapwood in the reaction zones surrounding fungal centres (Rayner and Boddy 1988). For each length of sapwood, we used a mylar overlay and assessed four equally-spaced transverse sections for coverage by stain fungi. Wood boring galleries are obvious and easily measured with a mylar overlay. Decay fungi are often detectable by a slight tan colouration and faint black mycelial lines, though we focused on areas of structural effect to the sapwood. To assess this we struck the wood surface with a pointed, metal dissecting probe repeatedly and quickly. We

circled regions of noticeable structural change in wood quality with a marker and then used a mylar overlay to tally area affected in 1 cm² units.

Analysis

We used SYSTAT to produce a general linear model to describe changes of wood density, wood decay, and carbon flux as they were affected by harvest and burn treatments; specifically we used the model:

$$\text{Response} = \text{Harvest} + \text{Burn} + \text{Harvest} * \text{Burn} + \text{error}$$

We used the software program PC ORD to describe patterns of within-log insect and fungal consumption, using non-metric scaling (NMS; Kruskal 1964), an ordination technique appropriate for non-normal data typical in ecological studies (McCune and Grace 2002). Log transformations of abundance data were used and each group was standardized to its own maximum to allow equal weighting to each group in the ordination. These transformations reduce distortion that can occur in ordination when values between species range over several orders of magnitude (McCune and Grace 2002). We used a 2-dimensional solution chosen by examining plots of model fit that indicated where subsequent dimensions added little improvement (McCune and Grace 2002). We used 80 iterations to evaluate stability, and plots of iteration vs. model fit to ensure that our final solutions were stable.

We used multiple response permutation procedure (MRPP; Mccune and Grace 2002) to test for multivariate group differences due to year as well as harvest and burn factors in year two only. Additionally, we used Pearson's r-squared values to evaluate how well individual insect and fungal groups corresponded to the ordination axes.

Results

Bark beetles in our samples were commonly found to be either members of the genus *Ips* DeGeer (Scolytidae), or the species *Dendroctonus valens* LeConte (Scolytidae). Woodboring species were collected sporadically as larvae during wood dissection, and were mostly cerambycid beetles. In collections from old-growth forests in the area and from an experimental trial in a nearby forest, we know that *Monochamus* Megerle (Coleoptera: Cerambycidae) adults and *Anoplodera* Mulsant (Coleoptera: Cerambycidae) adults are common in the area. The golden buprestid, *Buprestis aurulenta* L. (Coleoptera: Buprestidae), was also commonly trapped.

Least squares models indicated that there is no evidence for treatment effects on changes to wood moisture or to CO₂ evolution or wood density in logs (Figs. 4.1-7; Tables 4.1-4). However, there was weak evidence that burning, independent of harvest type, could cause changes in wood dry density (Table 4.4). Generally we consider $\alpha \leq 0.05$ to be a statistically significant result though we do point out values in the region of $\alpha = 0.10$ as being worthy of notice and interpretation.

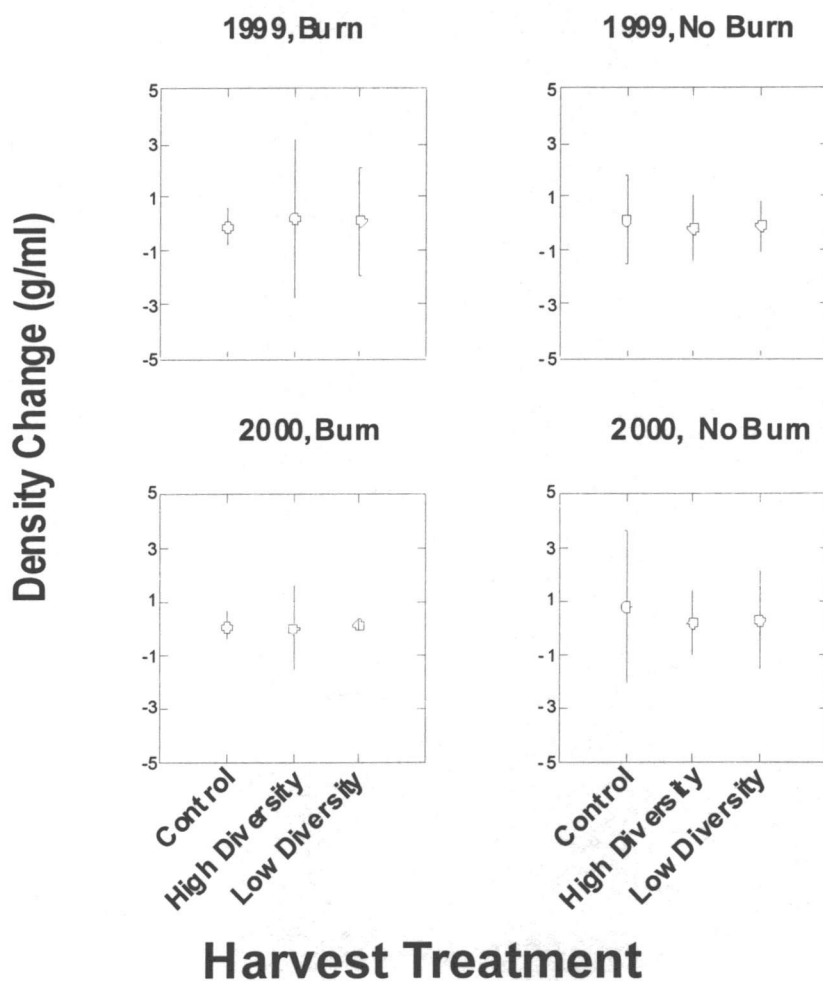


Figure 4.1. Dry density changes as a function of year of sample, harvest, and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

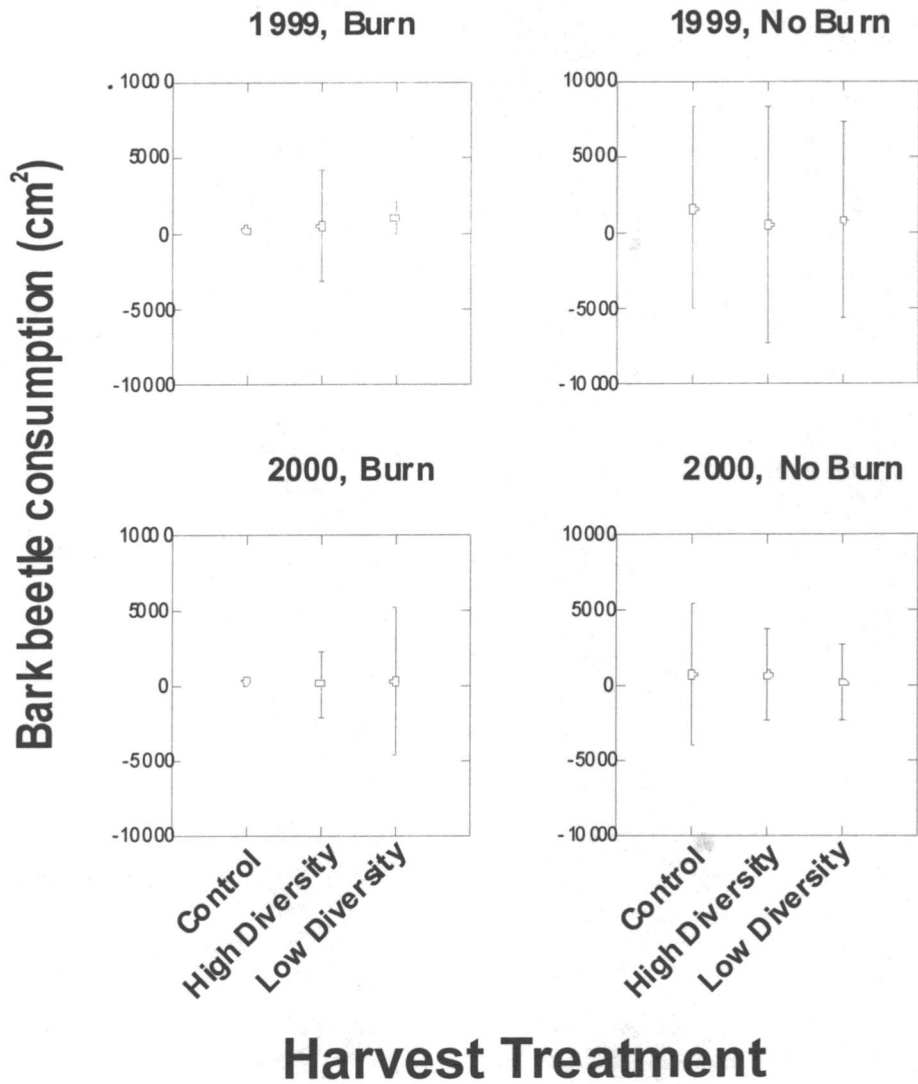


Figure 4.2. Bark beetle consumption in the inner bark as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

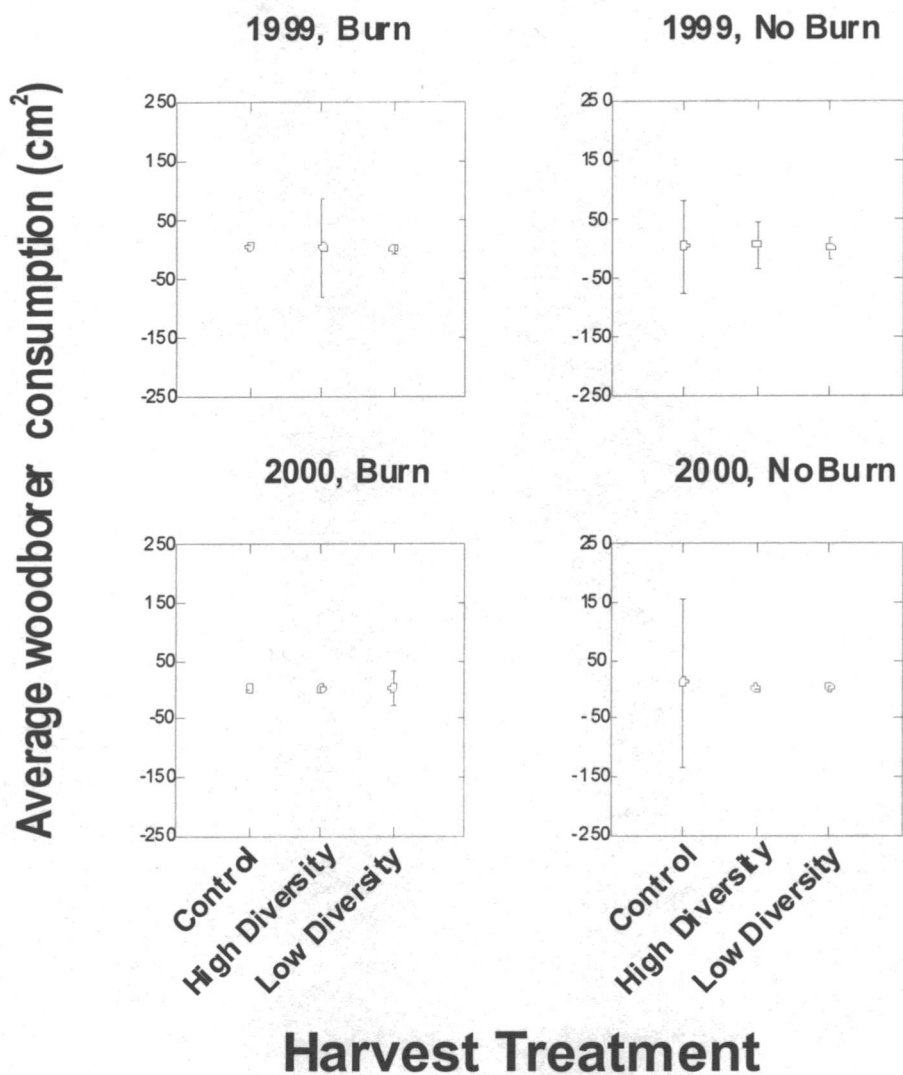


Figure 4.3. Mean consumption of sapwood by woodboring beetles, as an average of four sagittal sections and as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

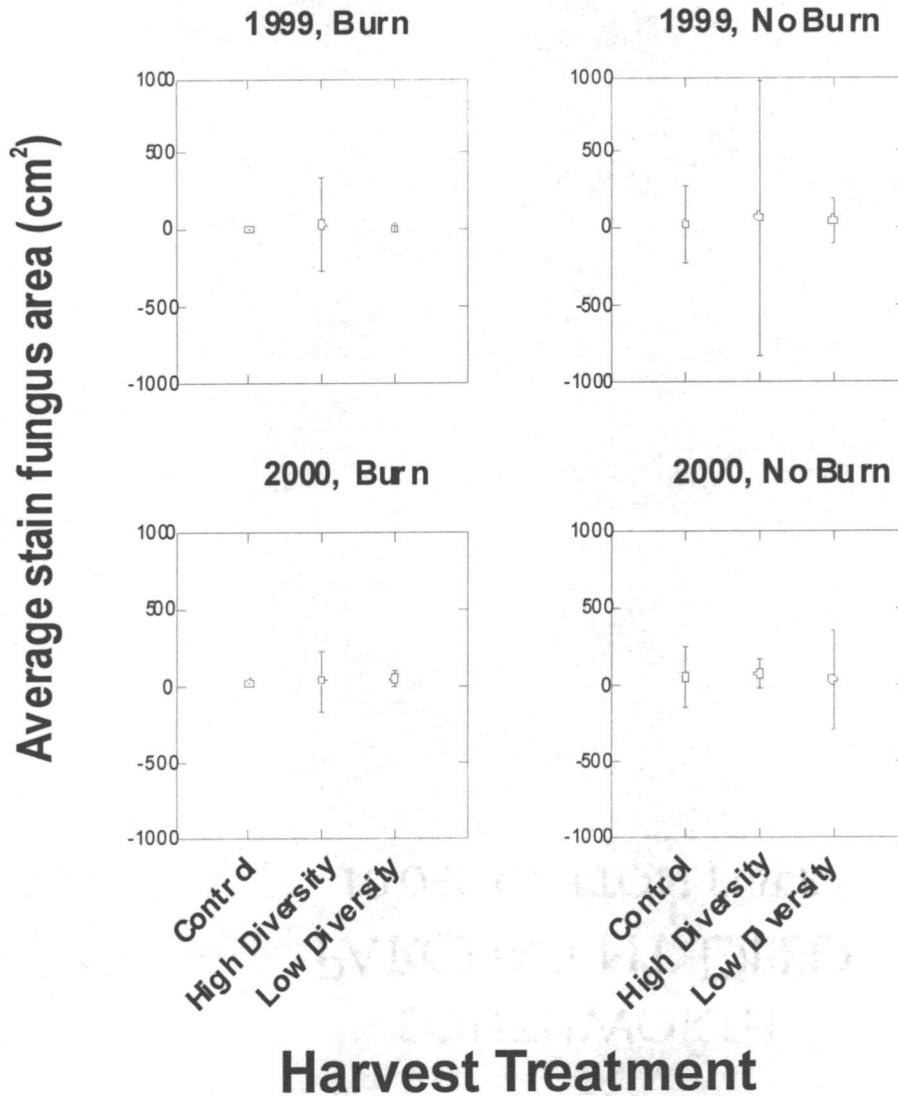


Figure 4.4. Mean area of sapwood stained by stain fungi, as an average of four sagittal sections and as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

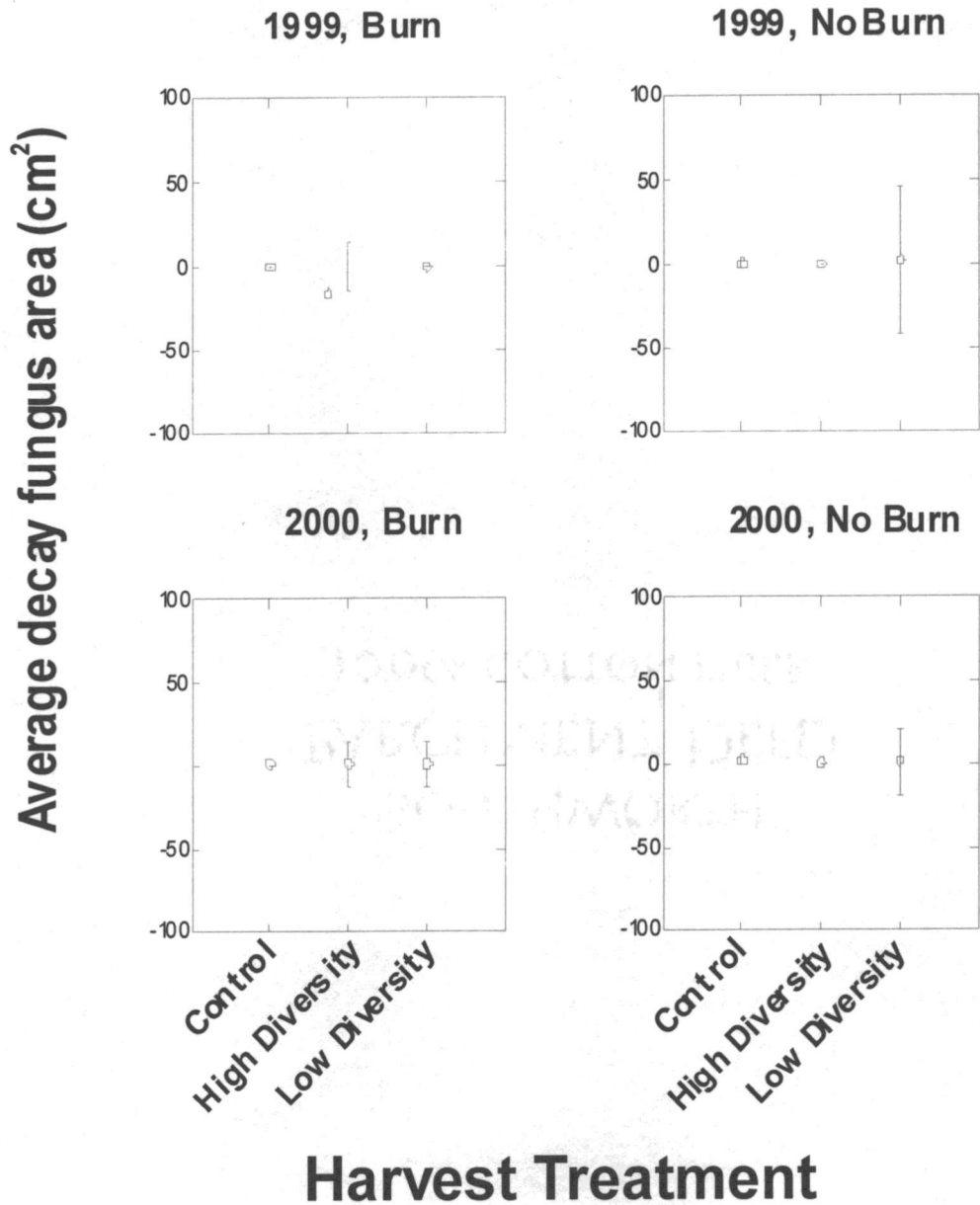


Figure 4.5. Mean area of sapwood occupied by decay fungi, as an average of four sagittal sections and as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

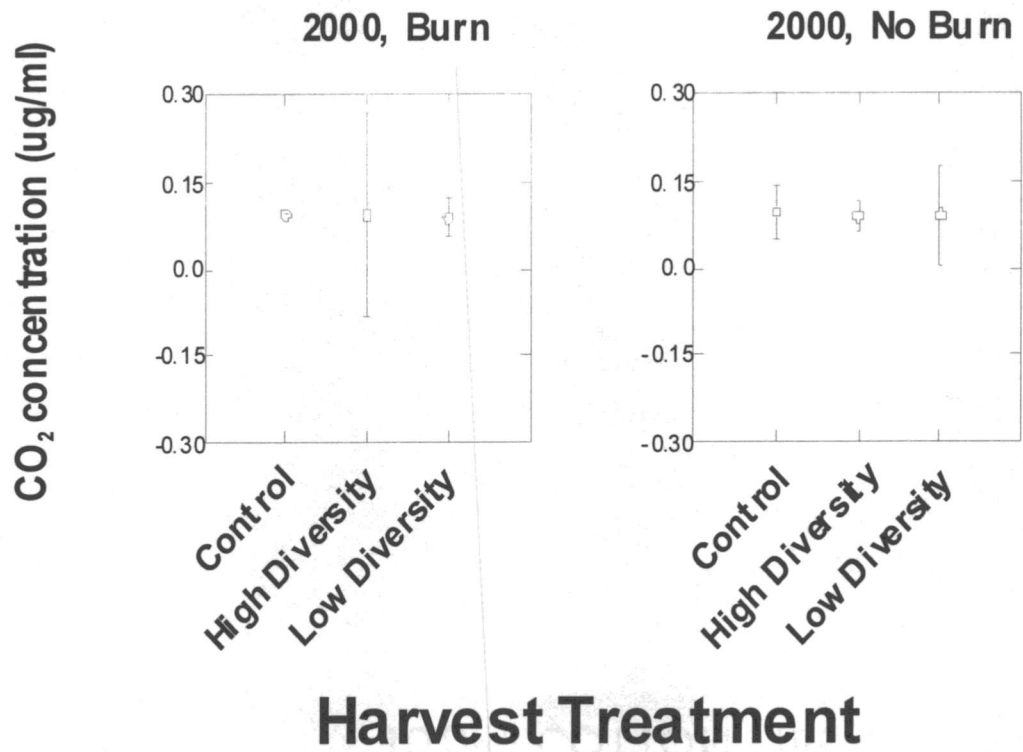


Figure 4.6. Mean carbon dioxide concentrations from individual logs as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

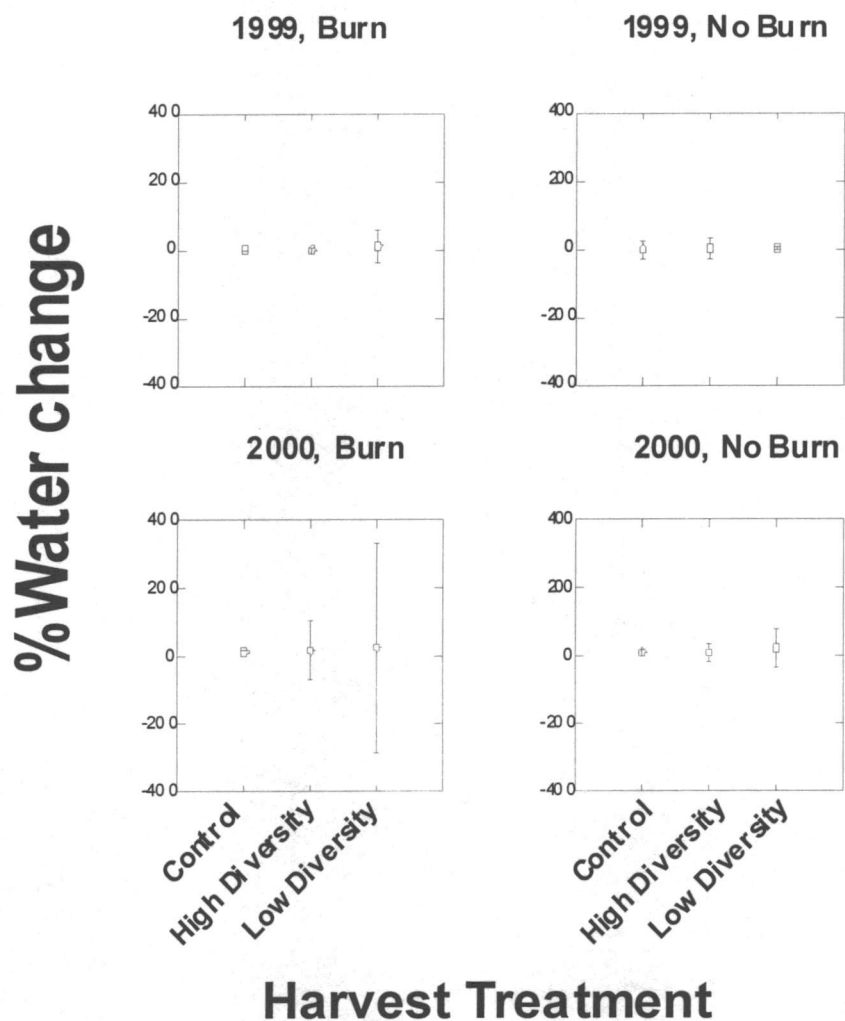


Figure 4.7. Mean change in percent water as a function of original log weights and as a function of year of sample, harvest and burn treatments for ponderosa pine forests near Black's Mt. California. Mean values for a sample size $n=2$ are indicated with circles, flanked by 95% confidence intervals.

Table 4.1. ANOVA model for decay area in the sapwood of ponderosa pine.
 Samples were collected from disturbance treatments in northern California, 1999-2000.

Source Variation	SS	df	MS	F	P
Harvest Treatment	1.29	2	0.64	0.63	0.57
Burn Treatment	0.11	1	0.11	0.11	0.75
Harvest*Burn	1.61	2	0.81	0.79	0.50
Error	5.08	5	1.02		

Table 4.2. ANOVA model for changes in sapwood % water content in ponderosa pine. Samples were collected from disturbance treatments in northern California, 1999-2000.

Source Variation	SS	df	MS	F	P
Harvest Treatment	292.59	2	146.30	1.11	0.40
Burn Treatment	71.80	1	71.80	0.54	0.49
Harvest*Burn	10.27	2	5.14	0.04	0.96
Error	661.60	5	132.32		

Table 4.3. ANOVA model for CO₂ efflux from collection chambers in ponderosa pine. Samples were collected from disturbance treatments in northern California, 1999-2000.

Source Variation	SS	df	MS	F	P
Harvest Treatment	0	2	0	0.63	0.57
Burn Treatment	0	1	0	0.01	0.92
Harvest*Burn	0	2	0	0.35	0.72
Error	0	5	0		

Table 4.4. ANOVA model for changes to sapwood density in ponderosa pine. Samples were collected from disturbance treatments in northern California, 1999-2000.

Source Variation	SS	df	MS	F	P
Harvest Treatment	0	2	0	0.271	0.77
Burn Treatment	0.003	1	0.003	4.276	0.09
Harvest*Burn	0.005	2	0.003	3.526	0.11
Error	0.004	5	0.001		

The 2-dimensional NMS solution for all combined data explained 80% of the variation from the original data set (47 and 33%, respectively: Fig 4.8; Table 4.5). Monte Carlo results of tests for whether axes represent non-random entities are $p=0.01$ and $p=0.11$ respectively. Three of four consumption groups were well isolated in the ordination space (Fig 4.9; Table 4.6).

MRPP provides a Monte Carlo p-value describing the likelihood of an equal or smaller effect size 'A' than that measured by the procedure. The effect size is the value $1 - (\text{within group heterogeneity} / \text{randomly expected heterogeneity})$. When $A=1$, there is perfect within group agreement, and when $A=0$ within group agreement is equal to random expectation. A significant effect size of 0.1 is commonly observed in community data (McCune and Grace 2002). The effect sizes, A, observed in our study between years was $A=0.03$, $p=0.02$. From year 2000 data, effect size for harvest treatment was $A=0.00$, $p=0.47$; and for burn treatments $A=0.00$, $p=0.87$.

Indications from the year-year ordination samples indicated that woodborer development within logs will be the most prominent continued development of community character (Fig. 4.8; Table 4.5). The association of decay with woodboring in the 2000 samples ordination (Fig. 4.10) indicates that decay fungi might develop concurrently with this group. Neither harvest nor burn treatments appeared to influence the development of decay communities after two years' time (Fig. 4.11).

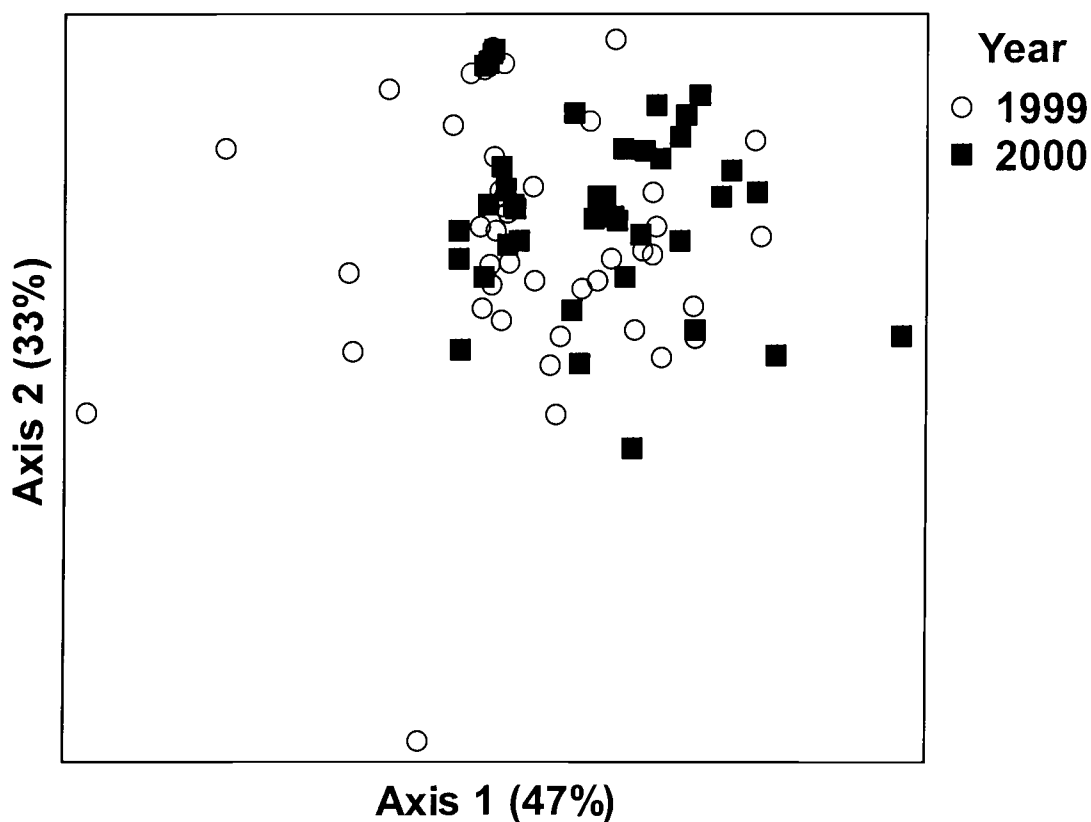


Figure 4.8. Effect of year on NMS ordination of decomposer groups in small-diameter ponderosa pine coarse woody debris. Samples were collected from burn and harvest treatments in northern California, one and two years post-mortem.

Table 4.5. Pearson's r-squared values between organism functional groups and NMS ordination axes. Samples were collected from disturbance treatments in northern California, 1999-2000.

Axis:	Bark beetle consumption	Woodborer consumption	Stained sapwood	Bored sapwood	Decayed Sapwood
1	0.00	0.60	0.00	0.19	0.09
2	0.15	0.00	0.43	0.10	0.02

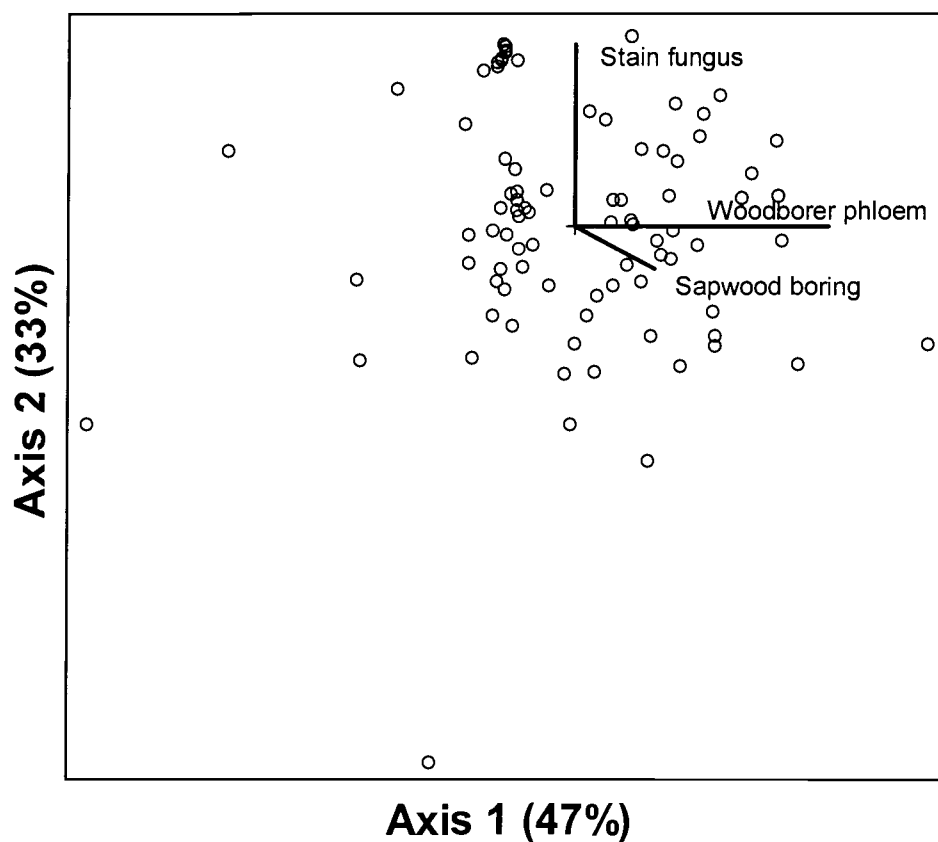


Figure 4.9. Vectors of individual decomposer groups in the NMS ordination of assemblages in small-diameter ponderosa pine coarse woody debris. Samples were collected from burn and harvest treatments in northern California, 1 and 2 years post-mortem, 1999-2000. Vectors with r^2 values >0.15 against either of the ordination axes are indicated.

Table 4.6. Pearson's r-squared values between organism functional groups and NMS ordination axes. Samples were collected from disturbance treatments in northern California, 2000.

Axis	Bark beetle consumption	Woodborer consumption	Stained sapwood	Bored sapwood	Decayed sapwood
1	0.04	0.39	0.17	0.10	0.10
2	0.03	0.07	0.29	0.01	0.09

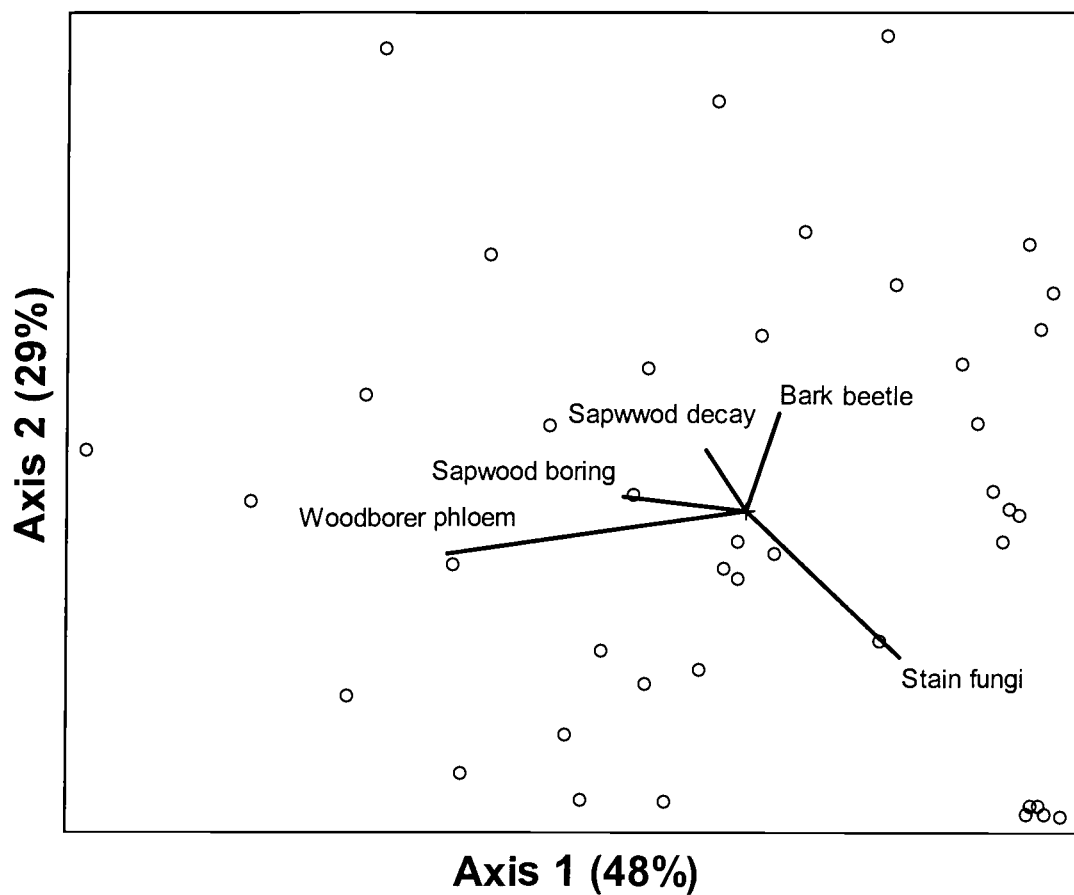


Figure 4.10. Vectors of individual decomposer groups in the NMS ordination of assemblages in small-diameter ponderosa pine coarse woody debris. Samples were collected from burn and harvest treatments in northern California, 2 years post-mortem (year 2000).

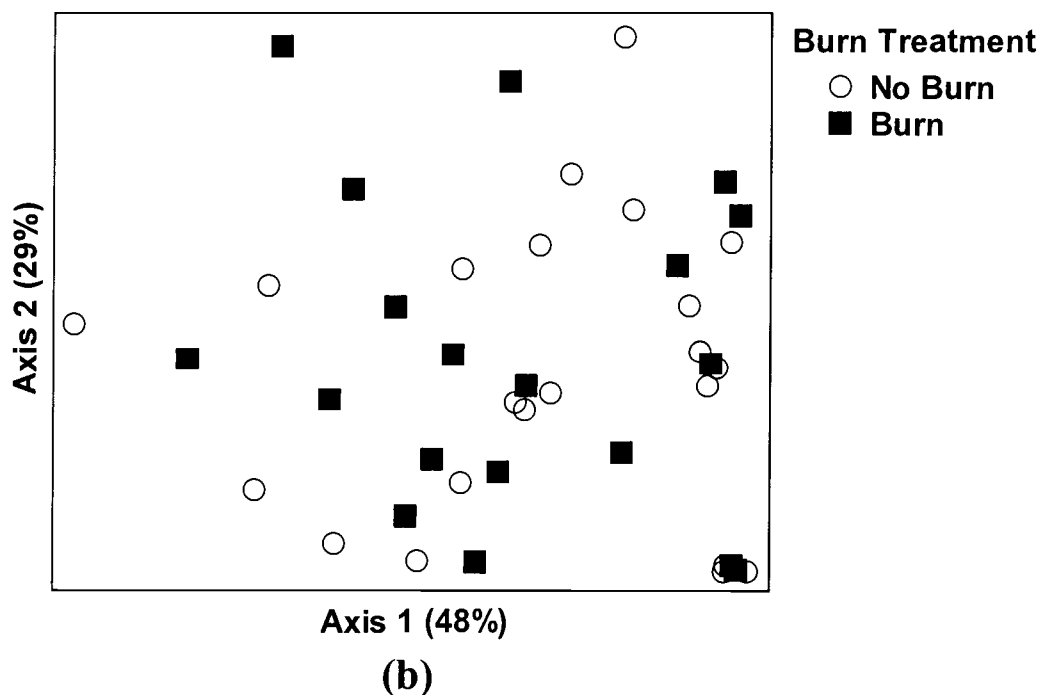
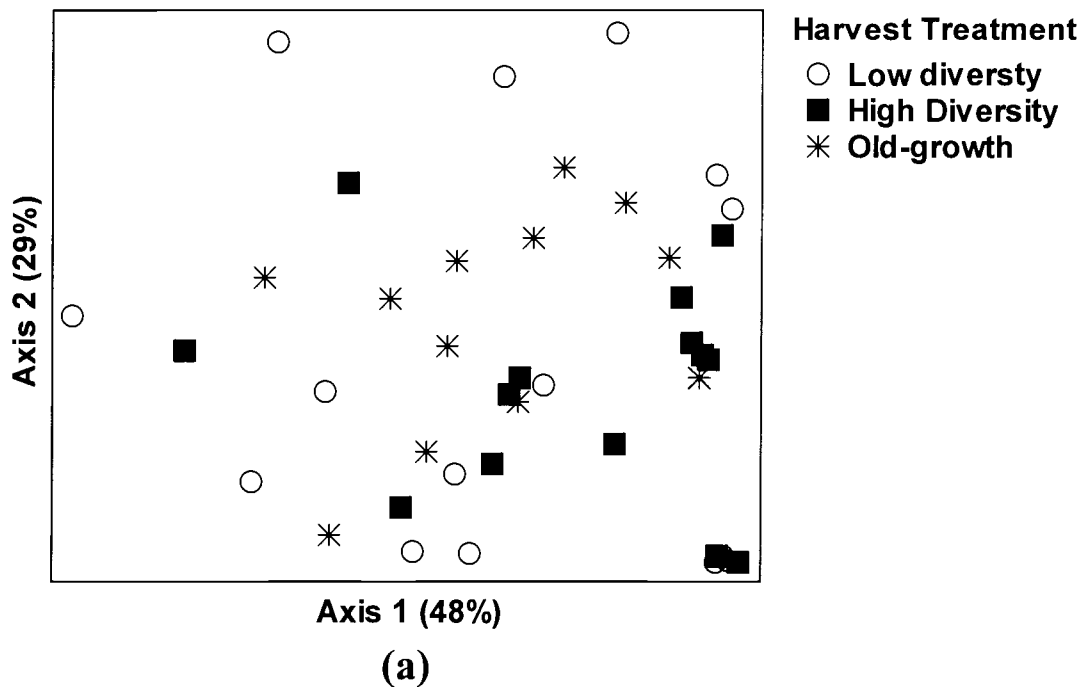


Figure 4.11. Effect of harvest type (a) and burn (b) treatments on NMS ordination of decomposer groups in small-diameter ponderosa pine coarse woody debris. Samples were collected from burn and harvest treatments in northern California, 2 years post-mortem (year 2000).

Discussion

The development of biological communities within dead wood can have consequences for the progression of wood decay and carbon loss (Lemieux and Gillette/ Chapter 3). Specifically, the regulation of decay fungi through inoculation, regulation of wood moisture and competition with stain fungi may have long-term consequences to residence times for woody structures in conifer forests. Insects play an important role in this process, acting as vectors and manually increasing wood porosity through excavation.

Though there was ample variation in the development of communities within logs, only differences between years seemed a significant source of variation from the factors we measured. Year 1999 samples included significantly more variance along both axes of the ordination than year 2000 samples, indicating that with time, variation in community structure is reduced and that there is some predictable increase in the consumption of wood by all groups. However, samples from the year 2000 gave little indication that harvesting and burning regimes at the scale of 50 ha will consistently regulate this development. Perhaps the only distinctive pattern is the reduction of variance on both axes of samples from old-growth forests, when compared with other harvest treatments. This is generally consistent with the notion that the more constant conditions beneath an old-growth canopy tend to promote stability in population and community processes. It implies also that there might be disruption mechanisms in harvested regimes, perhaps due to a greater diversity of conditions, which inhibits some colonization of some logs. Much of the increased variance along the ordination axes associated with harvesting

arises from the position of samples that remained uncolonized. Interruption of semiochemical-mediated colonization of hosts has recently been shown as a function of forest species diversity (Zhang and Schlyter 2003), though other types of variation should produce similar disruption.

Evidence from a nearby , highly manipulated, young ponderosa pine forest indicates also that forest factors beyond the scale of individual tree might not influence decay dynamics; Lemieux and Gillette (Chapter 3) used 1 ha blocks of forests as randomized blocks to account for the effect of forest changes at scales larger than individual tree. In models of biological effects on sapwood these blocks were not significant, though variation at the tree level was quite clear; this may indicate that structural microchanges on the forest floor that affect log colonisation, are unchanged by larger disturbance regimes.

Even so, physical changes between the harvesting regimes were palpable during data collection; changes in forest cover produced dramatic changes in insolation, and in temperature. We were surprised to find that overall, little distinction could be made between old-growth forests, and what essentially are 'clearcuts'. Retrospectively, we believe this underlies the important function of woody debris as a biological buffer. Intact logs, even with large populations of insect colonists, may be resilient to water and temperature changes in the external environment. Several studies have noted that direct sunlight can be used as a mortality agent to regulate bark beetle populations (Buffam and Lucht 1968; Craighead 1920; Negron *et al.* 2001), though with ponderosa pine it

often takes dramatic efforts, including the use of polyethylene wraps. Contrarily, Graham (1925) has shown that in the thin-barked white pine, daytime subcortical temperatures can exceed 60 °C, resulting in 100% mortality of bark beetle larvae. Because we placed our pine bolts in the fall, 1998, there may have been ample time for both woodborer and bark beetle colonisation and consumption prior to the onset of lethal temperatures in the summer of 1999. The development of community structure implied by our ordination indicates that consumption by both insect functional groups may have continued to develop even after a summer season. Given that within-log moisture regimes were unchanged by treatments processes, higher subcortical temperatures can actually act as a boon to the development of decay fungi. Jensen (1967) showed that in some wood decay fungi, temperatures of 15-35 °C were optimum for growth; temperatures which could well be maintained inside of logs in the height of summer at our field site where daytime highs of 30-40 °C are common in the hottest months.

The effect of burns might also have elevated subcortical temperatures, though very few of the logs we collected showed evidence of scorching. We collected no evidence that low-intensity fires are initiating changes in community structure or in the physical quality of coarse woody debris on the forest floor at these sites, further indicating that large pieces of wood are very resilient and may act as important stabilizing features in forest disturbances. Though we did not specifically measure log temperatures, it appears that internal sterilization through temperature increases did not occur, given the abundant signs of fungus and insect activity in our samples. Because a majority of bark

beetle colonization had happened by the first year, the effects of fire (which occurred after the one-yr interval of the study) on colonization would be mitigated for that group. Insects like woodborers seeking to use the sapwood and known to be attracted by fire might be expected to occur at increased levels in future measures, however.

We noted no significant decomposition changes to the bark in our samples, though when the bark eventually sloughs we expect that the desiccant effects of stand canopy alterations may play a more important role in the development of decay processes at this site. Due to eventual recovery of canopies in cleared areas, we expect initial extremes imposed by these treatments to have a moderated impact on within-log decay communities.

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Chapter 5. Conclusions

The processes of carbon fixation (photosynthesis for the most part) and respiration (mainly by glycolysis), represent the ways in which systems gain, store and release carbon and energy. Ultimately these processes are the sum activity of living organisms, organizing in discrete populations and communities. Decomposition represents the physical changes occurring with the progressive respiration of carbon structures that are parts of living organisms; it is facilitated by certain assemblages of organisms and the conditions imposed during decomposition promote a predictable, linear succession of kinds of organisms, not unlike that occurring in plant communities after a disturbance.

The small canopy disturbances formed by the death of large, old trees initiate just such a succession, signalling an abrupt termination to carbon fixation and the imminent release by respiration of microorganisms, vectored by colonizing arthropods. With time the forest canopy around gaps can recover and increase shading, a process that presumably aids in the decomposition of wood by buffering environmental extremes. This is important in forests where air temperatures and insolation have high maximum values, and in which there are daily and seasonal shifts of large magnitude.

Communities of arthropods in the microenvironments created during tree death are initially quite distinct, but tend to lose definition concurrently with the disappearance of disturbance effects. Tree death is an important form of natural variation leading to changes of large magnitude in other forest taxa. Life history strategies within

saprotroph communities reflect the changes in resource types occurring through the decay process.

Diversity of organisms is not only promoted by decay processes; diversity is important in regulation rates of decay. We observed an inverse relationship between the area of structural failure in sapwood of ponderosa pine and the area of coverage for stain fungi associated with bark beetle colonization along the axis of logs. Woodboring in the sapwood was also positively related to the extent of stain fungi in the sapwood, suggesting that both of these groups serve to inhibit the rapid expansion of decay fungi. We provide evidence that this might occur through the regulation of wood moisture content in the sapwood, a factor known to be important for decay fungi. The additive effect of both colonist types was to limit severely decay fungi after two years of development. Because carbon efflux from downed woody material was positively related to the extent of structural failure in the sapwood, we believe that rapid colonization of downed wood by bark beetles and woodborers can serve to limit decay processes; a trend that runs contrary to prevailing thought among forest entomologists and pathologists. The allelopathic effect suggested from laboratory studies of stain fungi toward decay fungi may actually act as a preservative for the lignified portion of dead trees. We recognize that we observed this effect only in the first two years following tree death, and that the results may be limited to the drier forests where the study was conducted. Forests where forest floor moisture is less variable could lead to a reduced competitive ability of stain fungi and a more prevalent regime for decay, largely independent of levels or kinds of arthropod penetration.

Interestingly, in the same time frame we observed little or no effect of land use treatments on the development of decay communities in a nearby experimental forest. Only time since harvest seemed to affect the development of decay communities. Old growth communities experienced less variation along ordination axes, suggesting that they might provide a more constant environment that will eventually translate into distinct decay regimes. Likewise, the effects of forest harvesting and fire on decay dynamics might be indirect, related to the reestablishment phase of on-site vegetation, and hence only visible in the longer term. All of the studies presented here have been established for monitoring over a 20 year period, a time interval more compatible for observing distinct effects.

Aside from longer term monitoring I believe the next steps for understanding this step will be twofold:

1. Scaling to create regional process models. I think this is possible with some additional sampling effort, summarizing regional population dynamics for insect and fungal groups, and the use of spatial records for forest harvesting and burning.
2. Monographic recording of the development of arthropod and microbial communities that is more comprehensive; with datasets that use species-level resolution rather than functional groups.

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APPENDICES

Appendix 1. Morphospecies designations, trap locations, dates and counts for specimens collected near Blacks Mountain, California. Refer to Chapter 1 for collection details. Trap # indicates tree-section-habitat, for 5 trees with 3 sections per tree. Habitats are noted as 's' (subcortical), 'c' (cortical), 'b' (forest floor, 1 m), and 'd' (forest floor, 11 m).

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Aleocharinae 01	1-1-b	03-Aug-99	1	Aleocharinae 08	5-1-d	22-Sep-00	8	Aleocharinae 15	1-2-c	26-Jul-00	1
Aleocharinae 01	1-1-d	03-Aug-99	4	Aleocharinae 08	5-2-b	22-Sep-00	1	Aleocharinae 15	1-2-d	22-Sep-00	14
Aleocharinae 01	1-3-d	03-Aug-99	9	Aleocharinae 08	5-3-c	03-Aug-99	1	Aleocharinae 15	1-2-d	23-Sep-99	3
Aleocharinae 01	1-3-d	23-Sep-99	1	Aleocharinae 08	5-3-c	22-Sep-00	1	Aleocharinae 15	1-2-d	26-Jul-00	3
Aleocharinae 01	2-3-b	23-Sep-99	2	Aleocharinae 09	1-1-b	03-Aug-99	3	Aleocharinae 15	1-3-b	03-Aug-99	45
Aleocharinae 01	2-3-b	26-Jul-00	1	Aleocharinae 09	4-2-d	22-Sep-00	2	Aleocharinae 15	1-3-b	22-Sep-00	35
Aleocharinae 01	2-3-d	03-Aug-99	1	Aleocharinae 10	1-1-b	03-Aug-99	3	Aleocharinae 15	1-3-b	23-Sep-99	8
Aleocharinae 01	2-3-d	22-Sep-00	1	Aleocharinae 10	1-2-d	23-Sep-99	2	Aleocharinae 15	1-3-c	03-Aug-99	1
Aleocharinae 01	3-2-d	03-Aug-99	1	Aleocharinae 10	2-1-d	22-Sep-00	2	Aleocharinae 15	1-3-c	22-Sep-00	4
Aleocharinae 01	3-3-b	03-Aug-99	1	Aleocharinae 10	2-3-b	03-Aug-99	4	Aleocharinae 15	1-3-d	03-Aug-99	57
Aleocharinae 01	3-3-b	22-Sep-00	1	Aleocharinae 10	4-1-c	03-Aug-99	1	Aleocharinae 15	1-3-d	22-Sep-00	34
Aleocharinae 01	3-3-b	23-Sep-99	1	Aleocharinae 10	4-1-d	03-Aug-99	1	Aleocharinae 15	1-3-d	23-Sep-99	22
Aleocharinae 01	4-1-b	23-Sep-99	5	Aleocharinae 11	1-1-b	03-Aug-99	1	Aleocharinae 15	1-3-d	23-Sep-99	1
Aleocharinae 01	4-1-b	23-Sep-99	1	Aleocharinae 11	1-1-d	03-Aug-99	18	Aleocharinae 15	1-3-d	26-Jul-00	11
Aleocharinae 01	4-2-b	26-Jul-00	1	Aleocharinae 11	2-1-d	03-Aug-99	1	Aleocharinae 15	2-1-b	03-Aug-99	11
Aleocharinae 01	4-3-b	03-Aug-99	2	Aleocharinae 11	3-2-c	22-Sep-00	1	Aleocharinae 15	2-1-b	data lost	2
Aleocharinae 01	4-3-b	23-Sep-99	3	Aleocharinae 11	3-2-d	23-Sep-99	3	Aleocharinae 15	2-1-b	data lost	21
Aleocharinae 01	5-3-c	26-Jul-00	1	Aleocharinae 11	5-2-d	03-Aug-99	1	Aleocharinae 15	2-1-b	data lost	16
Aleocharinae 02	1-1-b	03-Aug-99	1	Aleocharinae 11	5-3-b	03-Aug-99	1	Aleocharinae 15	2-1-c	22-Sep-00	3
Aleocharinae 02	3-1-d	03-Aug-99	2	Aleocharinae 12	1-1-b	03-Aug-99	2	Aleocharinae 15	2-1-c	data lost	4
Aleocharinae 02	3-2-d	03-Aug-99	1	Aleocharinae 12	2-2-b	03-Aug-99	5	Aleocharinae 15	2-1-d	03-Aug-99	39
Aleocharinae 03	1-1-b	03-Aug-99	2	Aleocharinae 12	2-3-b	23-Sep-99	1	Aleocharinae 15	2-1-d	22-Sep-00	34
Aleocharinae 03	1-1-d	03-Aug-99	2	Aleocharinae 12	3-1-d	26-Jul-00	1	Aleocharinae 15	2-1-d	26-Jul-00	31
Aleocharinae 03	1-3-b	03-Aug-99	2	Aleocharinae 12	3-2-b	03-Aug-99	1	Aleocharinae 15	2-2-b	03-Aug-99	12
Aleocharinae 03	3-1-b	23-Sep-99	1	Aleocharinae 13	1-1-b	03-Aug-99	2	Aleocharinae 15	2-2-b	22-Sep-00	2
Aleocharinae 04	1-1-b	03-Aug-99	1	Aleocharinae 13	1-2-b	03-Aug-99	5	Aleocharinae 15	2-2-b	23-Sep-99	2
Aleocharinae 04	4-2-d	03-Aug-99	1	Aleocharinae 13	3-2-d	23-Sep-99	1	Aleocharinae 15	2-2-b	26-Jul-00	1
Aleocharinae 05	1-1-b	03-Aug-99	4	Aleocharinae 14	1-1-b	03-Aug-99	1	Aleocharinae 15	2-2-c	26-Jul-00	2
Aleocharinae 05	1-2-b	23-Sep-99	1	Aleocharinae 14	3-1-c	22-Sep-00	1	Aleocharinae 15	2-2-d	03-Aug-99	60
Aleocharinae 05	2-3-b	23-Sep-99	4	Aleocharinae 14	3-1-d	23-Sep-99	1	Aleocharinae 15	2-2-d	22-Sep-00	26
Aleocharinae 05	3-1-b	23-Sep-99	1	Aleocharinae 15	1-1-b	03-Aug-99	1	Aleocharinae 15	2-2-d	23-Sep-99	8
Aleocharinae 05	3-2-d	03-Aug-99	5	Aleocharinae 15	1-1-b	03-Aug-99	21	Aleocharinae 15	2-2-d	26-Jul-00	7
Aleocharinae 05	4-1-b	23-Sep-99	2	Aleocharinae 15	1-1-b	23-Sep-99	8	Aleocharinae 15	2-3-b	03-Aug-99	18
Aleocharinae 05	4-2-c	22-Sep-00	1	Aleocharinae 15	1-1-b	26-Jul-00	2	Aleocharinae 15	2-3-b	22-Sep-00	3
Aleocharinae 05	4-3-b	23-Sep-99	1	Aleocharinae 15	1-1-c	03-Aug-99	1	Aleocharinae 15	2-3-b	23-Sep-99	5
Aleocharinae 05	5-3-d	03-Aug-99	19	Aleocharinae 15	1-1-c	22-Sep-00	10	Aleocharinae 15	2-3-b	26-Jul-00	4
Aleocharinae 06	1-1-b	03-Aug-99	1	Aleocharinae 15	1-1-c	23-Sep-99	1	Aleocharinae 15	2-3-d	03-Aug-99	21
Aleocharinae 06	1-2-d	23-Sep-99	1	Aleocharinae 15	1-1-d	03-Aug-99	52	Aleocharinae 15	2-3-d	22-Sep-00	15
Aleocharinae 07	1-1-b	03-Aug-99	1	Aleocharinae 15	1-1-d	22-Sep-00	20	Aleocharinae 15	2-3-d	23-Sep-99	20
Aleocharinae 07	3-2-d	03-Aug-99	2	Aleocharinae 15	1-1-d	23-Sep-99	14	Aleocharinae 15	2-3-d	26-Jul-00	2
Aleocharinae 08	1-1-b	03-Aug-99	7	Aleocharinae 15	1-1-d	26-Jul-00	8	Aleocharinae 15	3-1-b	03-Aug-99	50
Aleocharinae 08	1-2-b	22-Sep-00	2	Aleocharinae 15	1-2-b	03-Aug-99	65	Aleocharinae 15	3-1-b	22-Sep-00	41
Aleocharinae 08	2-3-d	03-Aug-99	4	Aleocharinae 15	1-2-b	22-Sep-00	4	Aleocharinae 15	3-1-b	23-Sep-99	27
Aleocharinae 08	2-3-d	26-Jul-00	1	Aleocharinae 15	1-2-b	22-Sep-00	15	Aleocharinae 15	3-1-c	03-Aug-99	17
Aleocharinae 08	3-1-c	23-Sep-99	2	Aleocharinae 15	1-2-b	23-Sep-99	6	Aleocharinae 15	3-1-c	22-Sep-00	6
Aleocharinae 08	3-1-d	03-Aug-99	3	Aleocharinae 15	1-2-b	23-Sep-99	1	Aleocharinae 15	3-1-c	23-Sep-99	4
Aleocharinae 08	3-3-b	03-Aug-99	1	Aleocharinae 15	1-2-b	26-Jul-00	1	Aleocharinae 15	3-1-c	26-Jul-00	1
Aleocharinae 08	3-3-d	22-Sep-00	12	Aleocharinae 15	1-2-c	22-Sep-00	20	Aleocharinae 15	3-1-d	03-Aug-99	41
Aleocharinae 08	3-3-d	26-Jul-00	1	Aleocharinae 15	1-2-c	23-Sep-99	1	Aleocharinae 15	3-1-d	22-Sep-00	49
Aleocharinae 15	3-1-d	23-Sep-99	6	Aleocharinae 15	4-3-c	26-Jul-00	11	Aleocharinae 19	1-1-d	23-Sep-99	6
Aleocharinae 15	3-1-d	23-Sep-99	48	Aleocharinae 15	4-3-d	22-Sep-00	38	Aleocharinae 19	1-2-b	03-Aug-99	7
Aleocharinae 15	3-1-d	26-Jul-00	6	Aleocharinae 15	4-3-d	23-Sep-99	10	Aleocharinae 19	1-2-b	22-Sep-00	5
Aleocharinae 15	3-1-d	26-Jul-00	2	Aleocharinae 15	4-3-d	26-Jul-00	3	Aleocharinae 19	1-2-b	26-Jul-00	1
Aleocharinae 15	3-2-b	03-Aug-99	1	Aleocharinae 15	5-1-b	03-Aug-99	31	Aleocharinae 19	1-2-c	03-Aug-99	1
Aleocharinae 15	3-2-b	03-Aug-99	53	Aleocharinae 15	5-1-b	22-Sep-00	6	Aleocharinae 19	1-2-d	22-Sep-00	2
Aleocharinae 15	3-2-b	23-Sep-99	7	Aleocharinae 15	5-1-b	23-Sep-99	2	Aleocharinae 19	1-2-d	26-Jul-00	4
Aleocharinae 15	3-2-c	22-Sep-00	1	Aleocharinae 15	5-1-c	data lost	2	Aleocharinae 19	1-3-b	03-Aug-99	18
Aleocharinae 15	3-2-c	23-Sep-99	2	Aleocharinae 15	5-1-d	03-Aug-99	26	Aleocharinae 19	1-3-b	22-Sep-00	28
Aleocharinae 15	3-2-d	03-Aug-99	47	Aleocharinae 15	5-1-d	22-Sep-00	20	Aleocharinae 19	1-3-b	23-Sep-99	4
Aleocharinae 15	3-2-d	22-Sep-00	51	Aleocharinae 15	5-1-d	23-Sep-99	3	Aleocharinae 19	1-3-b	26-Jul-00	6

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Aleocharinae 15	3-2-d	26-Jul-00	3	Aleocharinae 15	5-1-d	26-Jul-00	10	Aleocharinae 19	1-3-c	22-Sep-00	1
Aleocharinae 15	3-2-d	26-Jul-00	16	Aleocharinae 15	5-2-b	03-Aug-99	8	Aleocharinae 19	1-3-c	26-Jul-00	1
Aleocharinae 15	3-3-b	03-Aug-99	20	Aleocharinae 15	5-2-b	22-Sep-00	4	Aleocharinae 19	1-3-d	03-Aug-99	3
Aleocharinae 15	3-3-b	22-Sep-00	14	Aleocharinae 15	5-2-b	23-Sep-99	2	Aleocharinae 19	1-3-d	22-Sep-00	5
Aleocharinae 15	3-3-b	22-Sep-00	17	Aleocharinae 15	5-2-c	22-Sep-00	10	Aleocharinae 19	1-3-d	23-Sep-99	5
Aleocharinae 15	3-3-b	23-Sep-99	7	Aleocharinae 15	5-2-c	26-Jul-00	1	Aleocharinae 19	2-1-b	data lost	39
Aleocharinae 15	3-3-b	26-Jul-00	2	Aleocharinae 15	5-2-d	03-Aug-99	14	Aleocharinae 19	2-1-b	data lost	2
Aleocharinae 15	3-3-d	03-Aug-99	23	Aleocharinae 15	5-2-d	22-Sep-00	4	Aleocharinae 19	2-1-b	data lost	1
Aleocharinae 15	3-3-d	22-Sep-00	15	Aleocharinae 15	5-2-d	26-Jul-00	1	Aleocharinae 19	2-1-c	22-Sep-00	1
Aleocharinae 15	3-3-d	23-Sep-99	20	Aleocharinae 15	5-3-b	03-Aug-99	33	Aleocharinae 19	2-1-c	data lost	1
Aleocharinae 15	3-3-d	26-Jul-00	6	Aleocharinae 15	5-3-b	22-Sep-00	29	Aleocharinae 19	2-1-d	03-Aug-99	1
Aleocharinae 15	3-3-d	26-Jul-00	1	Aleocharinae 15	5-3-b	23-Sep-99	1	Aleocharinae 19	2-1-d	22-Sep-00	1
Aleocharinae 15	4-1-b	22-Sep-00	10	Aleocharinae 15	5-3-c	03-Aug-99	6	Aleocharinae 19	2-1-d	26-Jul-00	4
Aleocharinae 15	4-1-b	23-Sep-99	1	Aleocharinae 15	5-3-c	22-Sep-00	9	Aleocharinae 19	2-2-c	22-Sep-00	3
Aleocharinae 15	4-1-b	23-Sep-99	2	Aleocharinae 15	5-3-c	26-Jul-00	8	Aleocharinae 19	2-2-c	26-Jul-00	3
Aleocharinae 15	4-1-b	26-Jul-00	9	Aleocharinae 15	5-3-d	23-Sep-99	3	Aleocharinae 19	2-2-d	03-Aug-99	1
Aleocharinae 15	4-1-c	03-Aug-99	3	Aleocharinae 15	5-3-d	26-Jul-00	3	Aleocharinae 19	2-3-b	22-Sep-00	2
Aleocharinae 15	4-1-c	22-Sep-00	95	Aleocharinae 15	5-3-d	data lost	26	Aleocharinae 19	2-3-d	22-Sep-00	7
Aleocharinae 15	4-1-c	23-Sep-99	1	Aleocharinae 16	1-1-b	03-Aug-99	1	Aleocharinae 19	2-3-d	23-Sep-99	1
Aleocharinae 15	4-1-c	26-Jul-00	3	Aleocharinae 16	3-2-b	03-Aug-99	1	Aleocharinae 19	3-1-b	03-Aug-99	1
Aleocharinae 15	4-1-d	03-Aug-99	32	Aleocharinae 16	3-3-s	03-Aug-99	1	Aleocharinae 19	3-1-b	22-Sep-00	1
Aleocharinae 15	4-1-d	22-Sep-00	10	Aleocharinae 16	4-2-s	23-Sep-99	2	Aleocharinae 19	3-1-c	03-Aug-99	3
Aleocharinae 15	4-1-d	26-Jul-00	1	Aleocharinae 16	4-3-b	23-Sep-99	1	Aleocharinae 19	3-1-c	22-Sep-00	2
Aleocharinae 15	4-2-b	22-Sep-00	8	Aleocharinae 16	4-3-d	03-Aug-99	1	Aleocharinae 19	3-1-c	23-Sep-99	1
Aleocharinae 15	4-2-b	23-Sep-99	4	Aleocharinae 18	1-1-b	03-Aug-99	4	Aleocharinae 19	3-1-d	03-Aug-99	6
Aleocharinae 15	4-2-c	03-Aug-99	3	Aleocharinae 18	1-1-b	23-Sep-99	1	Aleocharinae 19	3-1-d	22-Sep-00	6
Aleocharinae 15	4-2-c	22-Sep-00	11	Aleocharinae 18	1-1-d	03-Aug-99	3	Aleocharinae 19	3-1-d	23-Sep-99	6
Aleocharinae 15	4-2-c	23-Sep-99	3	Aleocharinae 18	1-2-b	23-Sep-99	1	Aleocharinae 19	3-1-d	26-Jul-00	1
Aleocharinae 15	4-2-c	26-Jul-00	1	Aleocharinae 18	1-2-d	23-Sep-99	1	Aleocharinae 19	3-2-c	22-Sep-00	1
Aleocharinae 15	4-2-d	03-Aug-99	22	Aleocharinae 18	3-1-d	23-Sep-99	4	Aleocharinae 19	3-2-c	23-Sep-99	1
Aleocharinae 15	4-2-d	22-Sep-00	17	Aleocharinae 18	3-2-d	23-Sep-99	1	Aleocharinae 19	3-2-d	22-Sep-00	4
Aleocharinae 15	4-2-d	23-Sep-99	7	Aleocharinae 18	3-3-b	22-Sep-00	4	Aleocharinae 19	3-2-d	23-Sep-99	3
Aleocharinae 15	4-2-d	26-Jul-00	2	Aleocharinae 18	3-3-c	03-Aug-99	1	Aleocharinae 19	3-3-b	03-Aug-99	1
Aleocharinae 15	4-3-b	03-Aug-99	13	Aleocharinae 18	3-3-d	26-Jul-00	1	Aleocharinae 19	3-3-b	22-Sep-00	3
Aleocharinae 15	4-3-b	22-Sep-00	30	Aleocharinae 18	4-3-d	03-Aug-99	1	Aleocharinae 19	3-3-b	26-Jul-00	1
Aleocharinae 15	4-3-b	23-Sep-99	1	Aleocharinae 19	1-1-b	03-Aug-99	4	Aleocharinae 19	3-3-c	03-Aug-99	1
Aleocharinae 15	4-3-c	03-Aug-99	12	Aleocharinae 19	1-1-b	23-Sep-99	1	Aleocharinae 19	3-3-c	26-Jul-00	4
Aleocharinae 15	4-3-c	22-Sep-00	57	Aleocharinae 19	1-1-d	22-Sep-00	6	Aleocharinae 19	3-3-d	03-Aug-99	1
Aleocharinae 19	3-3-d	22-Sep-00	2	Aleocharinae 20	1-1-b	23-Sep-99	1	Aleocharinae 21	5-3-d	23-Sep-99	1
Aleocharinae 19	3-3-d	23-Sep-99	5	Aleocharinae 20	1-1-d	22-Sep-00	18	Aleocharinae 21	5-3-d	data lost	2
Aleocharinae 19	4-1-b	22-Sep-00	15	Aleocharinae 20	1-1-d	23-Sep-99	3	Aleocharinae 22	1-1-c	03-Aug-99	1
Aleocharinae 19	4-1-b	23-Sep-99	6	Aleocharinae 20	1-2-b	03-Aug-99	5	Aleocharinae 22	4-3-b	23-Sep-99	1
Aleocharinae 19	4-1-b	26-Jul-00	4	Aleocharinae 20	1-2-b	22-Sep-00	6	Aleocharinae 23	1-1-c	03-Aug-99	1
Aleocharinae 19	4-1-c	03-Aug-99	1	Aleocharinae 20	1-2-b	23-Sep-99	3	Aleocharinae 24	1-1-c	03-Aug-99	1
Aleocharinae 19	4-1-c	22-Sep-00	72	Aleocharinae 20	1-2-d	22-Sep-00	21	Aleocharinae 25	1-1-c	03-Aug-99	1
Aleocharinae 19	4-1-c	26-Jul-00	6	Aleocharinae 20	1-2-d	23-Sep-99	7	Aleocharinae 26	2-2-b	23-Sep-99	1
Aleocharinae 19	4-1-d	22-Sep-00	15	Aleocharinae 20	1-3-b	22-Sep-00	16	Aleocharinae 26	3-1-b	03-Aug-99	1
Aleocharinae 19	4-1-d	26-Jul-00	2	Aleocharinae 20	1-3-b	23-Sep-99	5	Aleocharinae 26	3-1-d	22-Sep-00	16
Aleocharinae 19	4-2-b	22-Sep-00	14	Aleocharinae 20	1-3-d	23-Sep-99	1	Aleocharinae 26	3-1-d	23-Sep-99	1
Aleocharinae 19	4-2-c	03-Aug-99	24	Aleocharinae 20	2-1-b	data lost	2	Aleocharinae 26	4-1-c	22-Sep-00	6
Aleocharinae 19	4-2-c	22-Sep-00	99	Aleocharinae 20	2-1-d	22-Sep-00	2	Aleocharinae 26	4-2-c	03-Aug-99	1
Aleocharinae 19	4-2-c	23-Sep-99	17	Aleocharinae 20	2-1-d	26-Jul-00	5	Aleocharinae 26	4-3-c	03-Aug-99	2
Aleocharinae 19	4-2-c	26-Jul-00	2	Aleocharinae 20	2-2-b	22-Sep-00	3	Aleocharinae 26	5-3-b	03-Aug-99	1
Aleocharinae 19	4-2-d	03-Aug-99	20	Aleocharinae 20	2-2-b	23-Sep-99	1	Aleocharinae 26	5-3-c	22-Sep-00	1
Aleocharinae 19	4-2-d	22-Sep-00	3	Aleocharinae 20	2-3-d	22-Sep-00	6	Aleocharinae 27	1-1-d	23-Sep-99	5
Aleocharinae 19	4-2-d	23-Sep-99	1	Aleocharinae 20	3-1-b	23-Sep-99	1	Aleocharinae 27	1-1-d	26-Jul-00	1
Aleocharinae 19	4-2-d	26-Jul-00	3	Aleocharinae 20	3-1-d	23-Sep-99	10	Aleocharinae 27	1-2-d	26-Jul-00	2
Aleocharinae 19	4-2-s	03-Aug-99	1	Aleocharinae 20	3-2-d	23-Sep-99	12	Aleocharinae 27	1-3-c	22-Sep-00	2
Aleocharinae 19	4-3-b	03-Aug-99	21	Aleocharinae 20	3-3-b	22-Sep-00	11	Aleocharinae 27	1-3-d	03-Aug-99	1
Aleocharinae 19	4-3-b	22-Sep-00	37	Aleocharinae 20	3-3-c	23-Sep-99	1	Aleocharinae 27	1-3-d	26-Jul-00	3
Aleocharinae 19	4-3-b	23-Sep-99	9	Aleocharinae 20	3-3-d	23-Sep-99	15	Aleocharinae 27	2-1-b	data lost	1
Aleocharinae 19	4-3-c	03-Aug-99	5	Aleocharinae 20	4-1-b	22-Sep-00	3	Aleocharinae 27	2-1-d	03-Aug-99	7
Aleocharinae 19	4-3-c	22-Sep-00	14	Aleocharinae 20	4-2-b	23-Sep-99	1	Aleocharinae 27	2-1-d	22-Sep-00	8
Aleocharinae 19	4-3-c	26-Jul-00	1	Aleocharinae 21	1-3-b	03-Aug-99	9	Aleocharinae 27	2-1-d	26-Jul-00	2
Aleocharinae 19	4-3-d	03-Aug-99	6	Aleocharinae 21	2-2-d	22-Sep-00	6	Aleocharinae 27	2-2-b	22-Sep-00	1
Aleocharinae 19	4-3-d	22-Sep-00	54	Aleocharinae 21	2-2-d	23-Sep-99	2	Aleocharinae 27	2-2-b	23-Sep-99	1
Aleocharinae 19	4-3-d	23-Sep-99	2	Aleocharinae 21	2-3-b	22-Sep-00	1	Aleocharinae 27	2-2-c	22-Sep-00	1
Aleocharinae 19	4-3-d	26-Jul-00	2	Aleocharinae 21	2-3-d	23-Sep-99	4	Aleocharinae 27	2-3-b	22-Sep-00	4

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Aleocharinae 19	5-1-b	03-Aug-99	14	Aleocharinae 21	3-1-b	22-Sep-00	2	Aleocharinae 27	2-3-c	22-Sep-00	1
Aleocharinae 19	5-1-b	23-Sep-99	2	Aleocharinae 21	3-2-d	22-Sep-00	5	Aleocharinae 27	2-3-d	03-Aug-99	3
Aleocharinae 19	5-1-c	data lost	2	Aleocharinae 21	3-3-b	22-Sep-00	1	Aleocharinae 27	2-3-d	22-Sep-00	17
Aleocharinae 19	5-1-d	03-Aug-99	1	Aleocharinae 21	3-3-b	23-Sep-99	1	Aleocharinae 27	2-3-d	23-Sep-99	1
Aleocharinae 19	5-1-d	22-Sep-00	9	Aleocharinae 21	4-1-b	23-Sep-99	2	Aleocharinae 27	3-1-b	03-Aug-99	1
Aleocharinae 19	5-1-d	26-Jul-00	2	Aleocharinae 21	4-1-b	23-Sep-99	5	Aleocharinae 27	3-1-b	22-Sep-00	7
Aleocharinae 19	5-2-b	23-Sep-99	1	Aleocharinae 21	4-1-d	22-Sep-00	16	Aleocharinae 27	3-1-b	23-Sep-99	5
Aleocharinae 19	5-2-c	22-Sep-00	4	Aleocharinae 21	4-1-d	23-Sep-99	9	Aleocharinae 27	3-1-c	23-Sep-99	1
Aleocharinae 19	5-2-d	03-Aug-99	3	Aleocharinae 21	4-2-b	22-Sep-00	2	Aleocharinae 27	3-1-d	03-Aug-99	2
Aleocharinae 19	5-2-d	22-Sep-00	2	Aleocharinae 21	4-3-b	22-Sep-00	6	Aleocharinae 27	3-1-d	26-Jul-00	1
Aleocharinae 19	5-3-b	03-Aug-99	20	Aleocharinae 21	4-3-d	22-Sep-00	8	Aleocharinae 27	3-2-b	03-Aug-99	1
Aleocharinae 19	5-3-b	22-Sep-00	6	Aleocharinae 21	4-3-d	23-Sep-99	9	Aleocharinae 27	3-2-d	22-Sep-00	11
Aleocharinae 19	5-3-b	23-Sep-99	17	Aleocharinae 21	5-1-b	22-Sep-00	2	Aleocharinae 27	4-1-b	22-Sep-00	24
Aleocharinae 19	5-3-c	03-Aug-99	6	Aleocharinae 21	5-1-b	23-Sep-99	1	Aleocharinae 27	4-1-b	26-Jul-00	1
Aleocharinae 19	5-3-c	22-Sep-00	33	Aleocharinae 21	5-1-d	22-Sep-00	7	Aleocharinae 27	4-1-c	03-Aug-99	1
Aleocharinae 19	5-3-c	26-Jul-00	10	Aleocharinae 21	5-1-d	23-Sep-99	2	Aleocharinae 27	4-1-d	03-Aug-99	8
Aleocharinae 19	5-3-d	03-Aug-99	1	Aleocharinae 21	5-2-d	22-Sep-00	1	Aleocharinae 27	4-1-d	22-Sep-00	1
Aleocharinae 19	5-3-d	23-Sep-99	1	Aleocharinae 21	5-2-d	22-Sep-00	5	Aleocharinae 27	4-1-d	23-Sep-99	1
Aleocharinae 19	5-3-s	03-Aug-99	1	Aleocharinae 21	5-3-b	22-Sep-00	5	Aleocharinae 27	4-2-b	22-Sep-00	3
Aleocharinae 27	4-2-c	03-Aug-99	1	Aleocharinae 32	3-2-c	26-Jul-00	1	Buprestidae 01	3-3-b	26-Jul-00	1
Aleocharinae 27	4-2-c	22-Sep-00	1	Aleocharinae 33	3-3-d	03-Aug-99	1	Buprestis 01	1-1-c	26-Jul-00	1
Aleocharinae 27	4-2-d	03-Aug-99	1	Aleocharinae 34	3-1-d	03-Aug-99	2	Buprestis 01	1-2-c	22-Sep-00	1
Aleocharinae 27	4-2-d	22-Sep-00	6	Aleocharinae 34	3-2-d	22-Sep-00	2	Buprestis 01	2-1-c	03-Aug-99	1
Aleocharinae 27	4-3-b	03-Aug-99	2	Aleocharinae 35	3-1-d	26-Jul-00	1	Buprestis 01	2-1-c	26-Jul-00	1
Aleocharinae 27	4-3-b	22-Sep-00	12	Aleocharinae 35	3-3-b	22-Sep-00	1	Buprestis 01	2-1-d	26-Jul-00	1
Aleocharinae 27	4-3-c	22-Sep-00	5	Aleocharinae 36	2-1-b	data lost	6	Buprestis 01	2-2-c	23-Sep-99	1
Aleocharinae 27	4-3-d	03-Aug-99	2	Aleocharinae 36	3-1-d	23-Sep-99	2	Buprestis 01	2-3-c	26-Jul-00	1
Aleocharinae 27	4-3-d	22-Sep-00	33	Aleocharinae 36	4-2-s	03-Aug-99	2	Buprestis 01	4-1-c	22-Sep-00	1
Aleocharinae 27	4-3-d	26-Jul-00	4	Aleocharinae 37	3-2-d	26-Jul-00	2	Buprestis 01	5-2-c	03-Aug-99	1
Aleocharinae 27	5-1-b	03-Aug-99	3	Aleocharinae 38	2-2-b	23-Sep-99	1	Cantharidae 01	2-2-c	03-Aug-99	1
Aleocharinae 27	5-1-b	22-Sep-00	1	Aleocharinae 38	3-2-d	23-Sep-99	1	Cantharidae 01	4-3-c	03-Aug-99	1
Aleocharinae 27	5-1-d	03-Aug-99	1	Aleocharinae 40	2-2-b	23-Sep-99	1	Cantharidae 02	2-1-b	03-Aug-99	3
Aleocharinae 27	5-1-d	26-Jul-00	1	Aleocharinae 41	2-2-b	23-Sep-99	1	Cantharidae 03	1-1-d	23-Sep-99	1
Aleocharinae 27	5-2-c	22-Sep-00	2	Aleocharinae 42	1-1-d	23-Sep-99	1	Cantharidae 04	4-2-d	23-Sep-99	1
Aleocharinae 27	5-2-d	22-Sep-00	3	Aleocharinae 42	2-1-b	03-Aug-99	1	Cantharidae 05	4-1-c	03-Aug-99	1
Aleocharinae 27	5-3-b	03-Aug-99	1	Aleocharinae 42	4-3-d	03-Aug-99	1	Cantharidae 05	4-1-c	23-Sep-99	2
Aleocharinae 27	5-3-b	22-Sep-00	4	Aleocharinae 42	4-3-d	22-Sep-00	1	Cantharidae 05	4-1-c	26-Jul-00	1
Aleocharinae 27	5-3-d	data lost	4	Aleocharinae 43	1-1-d	26-Jul-00	1	Cantharidae 05	4-2-c	03-Aug-99	1
Aleocharinae 28	2-2-b	22-Sep-00	12	Aleocharinae 43	2-2-b	22-Sep-00	1	Cantharidae 05	4-3-c	26-Jul-00	1
Aleocharinae 28	2-3-b	22-Sep-00	1	Aleocharinae 43	4-1-b	23-Sep-99	2	Cantharidae 05	5-2-c	03-Aug-99	1
Aleocharinae 28	3-1-b	03-Aug-99	1	Aleocharinae 43	4-1-d	23-Sep-99	1	Cantharidae 06	4-3-c	03-Aug-99	1
Aleocharinae 28	3-1-d	26-Jul-00	1	Aleocharinae 43	4-2-b	23-Sep-99	3	Cantharidae 07	4-3-c	03-Aug-99	2
Aleocharinae 29	1-1-d	22-Sep-00	2	Aleocharinae 43	4-2-b	26-Jul-00	1	Cantharidae 08	5-2-b	23-Sep-99	1
Aleocharinae 29	1-2-b	03-Aug-99	5	Aleocharinae 43	5-3-c	26-Jul-00	1	Cantharidae 09	2-2-d	03-Aug-99	1
Aleocharinae 29	1-3-b	03-Aug-99	24	Aleocharinae 44	4-1-b	23-Sep-99	1	Cantharidae 09	2-3-b	03-Aug-99	1
Aleocharinae 29	3-1-b	03-Aug-99	1	Aleocharinae 44	4-3-b	23-Sep-99	1	Cantharidae 09	2-3-c	03-Aug-99	1
Aleocharinae 29	3-3-c	26-Jul-00	1	Aleocharinae 44	5-1-d	03-Aug-99	1	Carabidae 01	2-2-b	03-Aug-99	1
Aleocharinae 30	1-1-d	23-Sep-99	1	Aleocharinae 44	5-3-c	22-Sep-00	1	Carabidae 01	5-2-d	26-Jul-00	1
Aleocharinae 30	1-2-d	26-Jul-00	7	Aleocharinae 45	4-3-b	22-Sep-00	1	Cerambycidae 01	1-1-c	22-Sep-00	1
Aleocharinae 30	1-3-b	03-Aug-99	1	Aleocharinae 46	4-3-c	03-Aug-99	1	Cerambycidae 01	1-1-c	23-Sep-99	5
Aleocharinae 30	1-3-d	03-Aug-99	1	Aleocharinae 47	4-1-d	03-Aug-99	1	Cerambycidae 01	1-2-c	22-Sep-00	8
Aleocharinae 30	2-1-c	data lost	1	Aleocharinae 47	5-1-b	03-Aug-99	2	Cerambycidae 01	1-2-c	23-Sep-99	2
Aleocharinae 30	2-1-d	26-Jul-	1	Aleocharinae 48	4-2-d	03-Aug-99	2	Cerambycidae 01	1-2-d	23-Sep-99	1
Aleocharinae 30	3-1-b	23-Sep-99	1	Aleocharinae 49	5-3-c	26-Jul-00	1	Cerambycidae 01	1-3-b	23-Sep-99	1
Aleocharinae 30	3-1-d	03-Aug-99	5	Aleocharinae 50	5-3-b	03-Aug-99	1	Cerambycidae 01	1-3-c	22-Sep-00	2
Aleocharinae 30	3-2-d	03-Aug-99	1	Aleocharinae 51	5-3-b	03-Aug-99	2	Cerambycidae 01	1-3-d	22-Sep-00	1
Aleocharinae 30	3-2-d	26-Jul-00	1	Aleocharinae 52	5-3-b	03-Aug-99	1	Cerambycidae 01	2-1-b	22-Sep-00	1
Aleocharinae 30	4-1-b	22-Sep-00	1	Aleocharinae 53	2-3-b	26-Jul-00	2	Cerambycidae 01	2-1-b	data lost	1
Aleocharinae 30	4-1-b	23-Sep-99	1	Aleocharinae 54	4-3-s	23-Sep-99	2	Cerambycidae 01	2-1-c	22-Sep-00	2
Aleocharinae 30	4-1-d	23-Sep-99	11	Aleocharinae 55	2-3-b	26-Jul-00	1	Cerambycidae 01	2-2-b	22-Sep-00	2
Aleocharinae 30	4-2-c	03-Aug-99	1	Amara 01	3-1-b	03-Aug-99	1	Cerambycidae 01	2-1-d	23-Sep-99	1
Aleocharinae 30	4-2-c	22-Sep-00	1	Anobiidae 01	4-2-d	23-Sep-99	1	Cerambycidae 01	2-2-b	23-Sep-99	1
Aleocharinae 30	4-3-b	03-Aug-99	1	Anobiidae 02	4-3-d	03-Aug-99	1	Cerambycidae 01	2-2-c	22-Sep-00	2
Aleocharinae 30	4-3-b	23-Sep-99	1	Anthicidae 01	1-2-b	03-Aug-99	1	Cerambycidae 01	2-2-c	23-Sep-99	1
Aleocharinae 30	4-3-c	22-Sep-00	4	Anthicidae 01	4-1-d	03-Aug-99	1	Cerambycidae 01	2-2-c	26-Jul-00	1
Aleocharinae 30	4-3-d	03-Aug-99	1	Anthicidae 01	4-3-d	22-Sep-00	1	Cerambycidae 01	2-3-d	22-Sep-00	1
Aleocharinae 30	5-3-c	03-Aug-99	1	Anthicidae 01	4-3-d	26-Jul-00	2	Cerambycidae 01	2-3-d	23-Sep-99	1
Aleocharinae 31	3-1-b	22-Sep-00	1	Anthicidae 01	5-2-b	23-Sep-99	1	Cerambycidae 01	3-1-c	23-Sep-99	2

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Cerambycidae 01	3-1-d	23-Sep-99	2	Chrysomelidae 01	4-2-d	26-Jul-00	2	Curculionidae 01	2-1-c	22-Sep-00	1
Cerambycidae 01	3-2-c	22-Sep-00	2	Chrysomelidae 01	4-3-b	03-Aug-99	1	Curculionidae 01	2-1-c	26-Jul-00	2
Cerambycidae 01	3-2-c	23-Sep-99	2	Chrysomelidae 01	4-3-b	22-Sep-00	5	Curculionidae 01	2-1-s	03-Aug-99	1
Cerambycidae 01	3-3-b	23-Sep-99	1	Chrysomelidae 01	4-3-b	23-Sep-99	5	Curculionidae 01	2-1-s	26-Jul-00	2
Cerambycidae 01	3-3-c	23-Sep-99	1	Chrysomelidae 01	4-3-c	03-Aug-99	1	Curculionidae 01	2-2-b	03-Aug-99	1
Cerambycidae 01	3-3-d	23-Sep-99	1	Chrysomelidae 01	4-3-d	03-Aug-99	1	Curculionidae 01	2-2-c	22-Sep-00	1
Cerambycidae 01	4-1-c	23-Sep-99	1	Chrysomelidae 01	4-3-d	23-Sep-99	1	Curculionidae 01	2-2-c	26-Jul-00	2
Cerambycidae 01	4-1-d	03-Aug-99	1	Chrysomelidae 01	4-3-d	26-Jul-00	1	Curculionidae 01	2-2-s	03-Aug-99	1
Cerambycidae 01	4-3-c	03-Aug-99	1	Chrysomelidae 01	5-1-c	26-Jul-00	1	Curculionidae 01	2-2-s	26-Jul-00	1
Cerambycidae 01	5-1-c	22-Sep-00	1	Chrysomelidae 01	5-1-d	03-Aug-99	1	Curculionidae 01	2-3-b	03-Aug-99	2
Cerambycidae 02	2-3-b	23-Sep-99	1	Chrysomelidae 01	5-1-d	26-Jul-00	1	Curculionidae 01	2-3-c	03-Aug-99	1
Cerambycidae 03	1-2-s	22-Sep-00	1	Chrysomelidae 01	5-2-c	26-Jul-00	1	Curculionidae 01	2-3-d	22-Sep-00	1
Cerambycidae 04	2-1-c	26-Jul-00	1	Chrysomelidae 01	5-2-d	26-Jul-00	1	Curculionidae 01	2-3-d	03-Aug-99	4
Chrysomelidae 01	1-1-d	03-Aug-99	5	Chrysomelidae 01	5-3-b	22-Sep-00	2	Curculionidae 01	3-1-c	03-Aug-99	1
Chrysomelidae 01	1-1-d	22-Sep-00	1	Chrysomelidae 01	5-3-b	23-Sep-99	1	Curculionidae 01	3-1-s	22-Sep-00	1
Chrysomelidae 01	1-1-d	23-Sep-99	1	Chrysomelidae 01	5-3-c	03-Aug-99	1	Curculionidae 01	4-1-c	03-Aug-99	1
Chrysomelidae 01	1-1-d	26-Jul-00	1	Chrysomelidae 01	5-3-c	26-Jul-00	1	Curculionidae 01	4-1-c	26-Jul-00	2
Chrysomelidae 01	1-2-c	22-Sep-00	1	Chrysomelidae 01	5-3-d	03-Aug-99	1	Curculionidae 01	4-2-c	26-Jul-00	2
Chrysomelidae 01	1-2-d	23-Sep-99	3	Chrysomelidae 03	2-3-c	23-Sep-99	1	Curculionidae 01	5-1-s	23-Sep-99	1
Chrysomelidae 01	1-3-b	22-Sep-00	3	Cleridae 01	1-1-d	03-Aug-99	1	Curculionidae 01	5-2-s	26-Jul-00	2
Chrysomelidae 01	1-3-b	23-Sep-99	3	Cleridae 01	3-2-b	03-Aug-99	1	Curculionidae 01	5-3-s	26-Jul-00	1
Chrysomelidae 01	1-3-c	26-Jul-00	2	Cleridae 02	2-3-b	26-Jul-00	1	Curculionidae 02	1-1-d	03-Aug-99	2
Chrysomelidae 01	1-3-d	03-Aug-99	2	Coccinellidae 01	2-1-d	22-Sep-00	1	Curculionidae 02	1-1-d	26-Jul-00	2
Chrysomelidae 01	1-3-d	23-Sep-99	2	Coccinellidae 01	2-3-c	03-Aug-99	1	Curculionidae 02	1-1-d	26-Jul-00	1
Chrysomelidae 01	2-1-c	22-Sep-00	1	Coccinellidae 01	2-3-d	22-Sep-00	2	Curculionidae 02	1-2-d	26-Jul-00	1
Chrysomelidae 01	2-1-c	22-Sep-00	2	Coccinellidae 01	3-2-c	22-Sep-00	1	Curculionidae 02	1-3-c	26-Jul-00	1
Chrysomelidae 01	2-2-b	03-Aug-99	1	Corylophidae 01	1-1-c	03-Aug-99	1	Curculionidae 02	2-3-d	26-Jul-00	2
Chrysomelidae 01	2-2-d	03-Aug-99	1	Corylophidae 01	1-2-c	03-Aug-99	1	Curculionidae 02	3-2-b	03-Aug-99	1
Chrysomelidae 01	2-2-d	26-Jul-00	2	Corylophidae 01	1-3-b	03-Aug-99	1	Curculionidae 02	3-3-b	03-Aug-99	1
Chrysomelidae 01	2-3-d	03-Aug-99	1	Corylophidae 01	2-3-b	03-Aug-99	1	Curculionidae 02	4-1-c	03-Aug-99	1
Chrysomelidae 01	2-3-d	23-Sep-99	1	Corylophidae 01	4-1-b	26-Jul-00	1	Curculionidae 02	4-1-c	22-Sep-00	1
Chrysomelidae 01	3-1-c	22-Sep-00	1	Corylophidae 01	4-1-c	26-Jul-00	1	Curculionidae 02	4-1-c	23-Sep-99	1
Chrysomelidae 01	3-1-d	03-Aug-99	2	Cucujidae 01	2-2-b	23-Sep-99	1	Curculionidae 02	4-1-c	26-Jul-00	3
Chrysomelidae 01	3-1-d	26-Jul-00	1	Cucujidae 01	4-1-b	26-Jul-00	1	Curculionidae 02	4-1-d	03-Aug-99	1
Chrysomelidae 01	3-1-d	26-Jul-00	1	Cucujidae 02	2-2-b	23-Sep-99	1	Curculionidae 02	4-1-d	03-Aug-99	2
Chrysomelidae 01	3-2-c	22-Sep-00	1	Cucujidae 03	2-3-c	26-Jul-00	1	Curculionidae 02	4-2-b	26-Jul-00	6
Chrysomelidae 01	3-2-c	26-Jul-00	1	Curculionidae 01	1-1-b	03-Aug-99	1	Curculionidae 02	4-2-c	03-Aug-99	2
Chrysomelidae 01	3-2-d	26-Jul-00	1	Curculionidae 01	1-1-c	26-Jul-00	1	Curculionidae 02	4-2-d	03-Aug-99	1
Chrysomelidae 01	3-3-c	26-Jul-00	1	Curculionidae 01	1-1-s	03-Aug-99	4	Curculionidae 02	4-2-d	26-Jul-00	2
Chrysomelidae 01	4-1-b	26-Jul-00	3	Curculionidae 01	1-2-c	03-Aug-99	3	Curculionidae 02	4-3-b	22-Sep-00	1
Chrysomelidae 01	4-1-c	23-Sep-99	1	Curculionidae 01	1-2-d	23-Sep-99	1	Curculionidae 02	4-3-c	03-Aug-99	3
Chrysomelidae 01	4-1-d	22-Sep-00	1	Curculionidae 01	1-2-s	03-Aug-99	5	Curculionidae 02	4-3-d	26-Jul-00	2
Chrysomelidae 01	4-1-d	26-Jul-00	1	Curculionidae 01	1-3-s	26-Jul-00	2	Curculionidae 02	5-1-b	22-Sep-00	1
Chrysomelidae 01	4-2-b	22-Sep-00	1	Curculionidae 01	1-3-b	03-Aug-99	3	Curculionidae 02	5-1-d	03-Aug-99	1
Chrysomelidae 01	4-2-b	23-Sep-99	1	Curculionidae 01	1-3-b	22-Sep-00	1	Curculionidae 02	5-2-b	22-Sep-00	1
Chrysomelidae 01	4-2-b	26-Jul-00	4	Curculionidae 01	1-3-c	22-Sep-00	2	Curculionidae 02	5-2-b	23-Sep-99	1
Chrysomelidae 01	4-2-c	22-Sep-00	1	Curculionidae 01	1-3-c	23-Sep-99	1	Curculionidae 02	5-2-d	03-Aug-99	1
Chrysomelidae 01	4-2-c	26-Jul-00	1	Curculionidae 01	1-3-s	03-Aug-99	1	Curculionidae 02	5-2-d	26-Jul-00	2
Chrysomelidae 01	4-2-d	22-Sep-00	1	Curculionidae 01	2-1-b	data lost	2	Curculionidae 02	5-3-b	22-Sep-00	1
Curculionidae 02	5-3-c	26-Jul-00	2	Curculionidae 06	5-3-b	03-Aug-99	5	Dermostidae sp	2-3-b	26-Jul-00	7
Curculionidae 02	5-3-d	26-Jul-00	1	Curculionidae 06	5-3-b	22-Sep-00	1	Dermostidae sp	2-3-c	03-Aug-99	8
Curculionidae 04	1-1-s	26-Jul-00	1	Curculionidae 06	5-3-b	23-Sep-99	1	Dermostidae sp	2-3-c	22-Sep-00	9
Curculionidae 04	1-2-b	26-Jul-00	1	Curculionidae 06	5-3-c	26-Jul-00	4	Dermostidae sp	2-3-c	23-Sep-99	1
Curculionidae 04	1-2-c	03-Aug-99	1	Curculionidae 06	5-3-d	26-Jul-00	6	Dermostidae sp	2-3-c	26-Jul-00	63
Curculionidae 04	1-3-c	03-Aug-99	2	Curculionidae 06	5-3-d	26-Jul-00	4	Dermostidae sp	2-3-d	03-Aug-99	2
Curculionidae 04	2-1-c	26-Jul-00	1	Curculionidae 06	2-1-s	22-Sep-00	1	Dermostidae sp	2-3-d	22-Sep-00	1
Curculionidae 04	2-1-c	data lost	6	Curculionidae 08	4-2-b	22-Sep-00	1	Dermostidae sp	2-3-d	26-Jul-00	7
Curculionidae 04	2-1-s	03-Aug-99	1	Curculionidae 08	2-2-s	03-Aug-99	1	Dermostidae sp	3-1-b	03-Aug-99	5
Curculionidae 04	2-2-s	03-Aug-99	1	Curculionidae 08	4-1-c	03-Aug-99	1	Dermostidae sp	3-1-c	03-Aug-99	14
Curculionidae 04	2-3-b	26-Jul-00	1	Dermostidae sp	1-1-b	03-Aug-99	1	Dermostidae sp	3-1-c	22-Sep-00	3
Curculionidae 04	2-3-c	23-Sep-99	1	Dermostidae sp	1-1-b	26-Jul-00	1	Dermostidae sp	3-1-c	23-Sep-99	1
Curculionidae 04	2-3-s	03-Aug-99	1	Dermostidae sp	1-1-c	03-Aug-99	11	Dermostidae sp	3-1-c	26-Jul-00	12
Curculionidae 04	3-1-c	03-Aug-99	3	Dermostidae sp	1-1-c	22-Sep-00	2	Dermostidae sp	3-1-d	26-Jul-00	3
Curculionidae 04	3-2-s	23-Sep-99	1	Dermostidae sp	1-1-c	26-Jul-00	20	Dermostidae sp	3-2-c	03-Aug-99	5
Curculionidae 04	3-3-c	26-Jul-00	1	Dermostidae sp	1-1-d	03-Aug-99	1	Dermostidae sp	3-2-c	22-Sep-00	4
Curculionidae 04	3-3-s	22-Sep-00	1	Dermostidae sp	1-2-b	03-Aug-99	2	Dermostidae sp	3-2-c	26-Jul-00	11
Curculionidae 04	3-3-s	26-Jul-00	1	Dermostidae sp	1-2-b	26-Jul-00	3	Dermostidae sp	3-3-c	03-Aug-99	6
				Dermostidae sp	1-2-c	03-Aug-99	28	Dermostidae sp	3-3-c	26-Jul-00	20

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Curculionidae 04	4-1-s	26-Jul-00	11	Dermestidae sp	1-2-c	22-Sep-00	12	Dermestidae sp	3-3-d	03-Aug-99	2
Curculionidae 04	4-2-s	26-Jul-00	1	Dermestidae sp	1-2-c	23-Sep-99	1	Dermestidae sp	4-1-c	03-Aug-99	11
Curculionidae 04	4-3-s	22-Sep-00	3	Dermestidae sp	1-2-c	26-Jul-00	43	Dermestidae sp	4-1-c	22-Sep-00	2
Curculionidae 04	4-3-s	23-Sep-99	5	Dermestidae sp	1-2-d	26-Jul-00	4	Dermestidae sp	4-1-c	26-Jul-00	12
Curculionidae 05	2-3-b	23-Sep-99	1	Dermestidae sp	1-3-b	03-Aug-99	5	Dermestidae sp	4-1-d	03-Aug-99	1
Curculionidae 05	2-3-d	03-Aug-99	1	Dermestidae sp	1-3-b	22-Sep-00	1	Dermestidae sp	4-1-d	26-Jul-00	1
Curculionidae 05	3-1-d	22-Sep-00	1	Dermestidae sp	1-3-c	03-Aug-99	16	Dermestidae sp	4-2-c	03-Aug-99	3
Curculionidae 05	4-1-b	26-Jul-00	4	Dermestidae sp	1-3-c	22-Sep-00	4	Dermestidae sp	4-2-c	26-Jul-00	13
Curculionidae 05	4-2-c	23-Sep-99	1	Dermestidae sp	1-3-c	23-Sep-99	1	Dermestidae sp	4-2-d	03-Aug-99	1
Curculionidae 05	4-3-c	26-Jul-00	1	Dermestidae sp	1-3-c	26-Jul-00	6	Dermestidae sp	4-3-c	03-Aug-99	2
Curculionidae 05	4-3-d	03-Aug-99	1	Dermestidae 01	1-3-d	03-Aug-99	7	Dermestidae 01	4-3-c	22-Sep-00	1
Curculionidae 06	3-2-d	26-Jul-00	1	Dermestidae 01	1-3-d	23-Sep-99	1	Dermestidae 01	4-3-c	26-Jul-00	17
Curculionidae 06	4-1-b	26-Jul-00	4	Dermestidae 01	1-3-d	26-Jul-00	2	Dermestidae 01	4-3-d	03-Aug-99	2
Curculionidae 06	4-1-d	03-Aug-99	2	Dermestidae 01	1-3-s	26-Jul-00	30	Dermestidae 01	5-1-b	03-Aug-99	1
Curculionidae 06	4-1-d	23-Sep-99	1	Dermestidae 01	2-1-b	data lost	6	Dermestidae 01	5-1-b	22-Sep-00	1
Curculionidae 06	4-1-d	26-Jul-00	1	Dermestidae 01	2-1-b	data lost	2	Dermestidae 01	5-1-c	03-Aug-99	1
Curculionidae 06	4-2-d	03-Aug-99	1	Dermestidae 01	2-1-b	data lost	18	Dermestidae 01	5-1-c	26-Jul-00	26
Curculionidae 06	4-3-b	03-Aug-99	5	Dermestidae 01	2-1-c	22-Sep-00	8	Dermestidae 01	5-1-c	data lost	3
Curculionidae 06	4-3-b	22-Sep-00	1	Dermestidae 01	2-1-c	26-Jul-00	53	Dermestidae 01	5-2-b	03-Aug-99	2
Curculionidae 06	4-3-b	23-Sep-99	3	Dermestidae 01	2-1-c	data lost	1	Dermestidae 01	5-2-b	22-Sep-00	1
Curculionidae 06	4-3-c	26-Jul-00	2	Dermestidae 01	2-1-c	data lost	31	Dermestidae 01	5-2-c	03-Aug-99	12
Curculionidae 06	4-3-d	03-Aug-99	1	Dermestidae 01	2-1-d	03-Aug-99	3	Dermestidae 01	5-2-c	22-Sep-00	2
Curculionidae 06	4-3-d	22-Sep-00	1	Dermestidae 01	2-1-d	22-Sep-00	1	Dermestidae 01	5-2-c	26-Jul-00	22
Curculionidae 06	4-3-d	26-Jul-00	1	Dermestidae 01	2-1-d	26-Jul-	8	Dermestidae 01	5-3-b	26-Jul-00	5
Curculionidae 06	5-1-b	22-Sep-00	1	Dermestidae 01	2-1-s	03-Aug-99	1	Dermestidae 01	5-3-c	03-Aug-99	5
Curculionidae 06	5-1-d	03-Aug-99	2	Dermestidae 01	2-2-b	03-Aug-99	1	Elateridae 01	1-1-b	03-Aug-99	1
Curculionidae 06	5-1-d	22-Sep-00	1	Dermestidae 01	2-2-c	03-Aug-99	7	Elateridae 01	1-1-c	03-Aug-99	4
Curculionidae 06	5-2-b	22-Sep-00	2	Dermestidae 01	2-2-c	22-Sep-00	14	Elateridae 01	1-3-d	26-Jul-00	1
Curculionidae 06	5-2-d	03-Aug-99	1	Dermestidae 01	2-2-c	23-Sep-99	1	Elateridae 01	2-2-d	26-Jul-00	1
Curculionidae 06	5-2-d	26-Jul-00	1	Dermestidae 01	2-2-c	26-Jul-00	44	Elateridae 01	3-2-c	22-Sep-00	1
Elateridae 01	4-2-d	26-Jul-00	1	Eleodes 01	3-2-s	26-Jul-00	1	Harpalus 01	5-3-b	03-Aug-99	1
Elateridae 02	1-1-b	03-Aug-99	1	Eleodes 01	3-3-s	03-Aug-99	3	Histeridae 01	2-1-c	data lost	1
Elateridae 02	1-1-d	22-Sep-00	1	Eleodes 01	3-3-s	26-Jul-00	11	Histeridae 02	3-2-c	03-Aug-99	1
Elateridae 02	1-1-d	26-Jul-00	1	Eleodes 01	5-1-c	23-Sep-99	1	Lathridiidae 01	1-1-b	03-Aug-99	1
Elateridae 02	3-2-b	26-Jul-00	1	Eleodes 01	5-1-d	03-Aug-99	1	Lathridiidae 01	1-1-c	22-Sep-00	1
Elateridae 02	3-3-s	03-Aug-99	1	Eleodes 01	5-2-c	26-Jul-00	1	Lathridiidae 01	2-1-c	data lost	2
Elateridae 02	4-2-d	26-Jul-00	1	Eleodes 01	5-2-s	03-Aug-99	2	Lathridiidae 01	2-3-b	22-Sep-00	1
Elateridae 02	4-3-c	26-Jul-00	2	Eleodes 01	5-2-s	26-Jul-00	2	Lathridiidae 01	2-3-c	26-Jul-00	1
Elateridae 02	5-3-b	26-Jul-00	1	Eleodes 01	5-3-d	03-Aug-99	1	Lathridiidae 01	3-1-c	03-Aug-99	1
Elateridae 03	4-2-b	23-Sep-99	1	Eleodes 03	2-2-b	22-Sep-00	1	Lathridiidae 01	3-1-c	22-Sep-00	1
Elateridae 03	4-2-c	23-Sep-99	1	Eleodes 03	2-3-d	22-Sep-00	1	Lathridiidae 01	4-1-c	22-Sep-00	1
Elateridae 04	2-2-c	03-Aug-99	2	Eleodes 03	2-3-d	26-Jul-00	1	Lathridiidae 01	4-1-s	23-Sep-99	1
Elateridae 04	3-2-c	03-Aug-99	1	Eleodes 03	3-1-b	03-Aug-99	1	Lathridiidae 02	1-1-b	26-Jul-00	1
Elateridae 04	3-3-c	26-Jul-00	1	Eleodes 03	3-2-d	26-Jul-00	1	Lathridiidae 02	1-1-c	22-Sep-00	4
Elateridae 04	4-1-c	03-Aug-99	1	Endomychidae 01	4-1-c	03-Aug-99	1	Lathridiidae 02	1-1-c	23-Sep-99	3
Elateridae 05	2-2-b	26-Jul-00	1	Endomychidae 02	1-2-b	26-Jul-00	1	Lathridiidae 02	1-1-c	26-Jul-00	4
Elateridae 05	2-3-b	03-Aug-99	1	Erotylidae 01	1-2-c	23-Sep-99	1	Lathridiidae 02	1-2-c	03-Aug-99	8
Elateridae 05	2-3-b	26-Jul-00	1	Erotylidae 01	2-1-c	22-Sep-00	1	Lathridiidae 02	1-2-c	22-Sep-00	4
Elateridae 05	3-1-b	22-Sep-00	1	Erotylidae 01	2-1-c	data lost	1	Lathridiidae 02	1-2-c	23-Sep-99	2
Elateridae 06	3-2-c	26-Jul-00	1	Erotylidae 01	2-2-c	22-Sep-00	4	Lathridiidae 02	1-2-c	26-Jul-00	8
Elateridae 07	3-1-c	23-Sep-99	1	Erotylidae 01	3-1-c	23-Sep-99	2	Lathridiidae 02	1-2-d	22-Sep-00	1
Elateridae 08	3-1-c	23-Sep-99	1	Erotylidae 01	3-2-b	22-Sep-00	1	Lathridiidae 02	1-3-b	23-Sep-99	1
Elateridae 08b	1-3-b	03-Aug-99	1	Erotylidae 01	5-1-c	data lost	1	Lathridiidae 02	1-3-c	03-Aug-99	3
Elateridae 09a	1-2-b	26-Jul-00	2	Erotylidae 01	5-2-b	23-Sep-99	1	Lathridiidae 02	1-3-c	22-Sep-00	1
Elateridae 09a	1-2-c	22-Sep-00	1	Erotylidae 01	5-2-c	22-Sep-00	1	Lathridiidae 02	1-3-d	03-Aug-99	1
Elateridae 09a	1-3-d	26-Jul-00	1	Eucnemidae 01	2-2-c	23-Sep-99	1	Lathridiidae 02	1-3-d	23-Sep-99	1
Elateridae 09b	4-1-c	03-Aug-99	1	Eucnemidae 01	3-1-s	22-Sep-00	1	Lathridiidae 02	1-3-s	22-Sep-00	1
Elateridae 10	1-3-s	26-Jul-00	1	Eucnemidae 01	3-2-s	26-Jul-00	1	Lathridiidae 02	1-3-s	26-Jul-00	3
Elateridae 9c	5-3-c	26-Jul-00	1	Eucnemidae 01	3-3-c	03-Aug-99	1	Lathridiidae 02	2-1-b	data lost	1
Elateridae 9c	5-2-s	03-Aug-99	1	Eucnemidae 01	3-3-c	26-Jul-00	1	Lathridiidae 02	2-1-c	26-Jul-00	4
Eleodes 01	1-2-b	22-Sep-00	3	Eucnemidae 01	3-3-s	26-Jul-00	11	Lathridiidae 02	2-1-d	03-Aug-99	1
Eleodes 01	1-2-b	23-Sep-99	4	Eucnemidae 01	4-3-d	03-Aug-99	1	Lathridiidae 02	2-2-c	03-Aug-99	1
Eleodes 01	1-2-d	23-Sep-99	11	Eucnemidae 01	5-3-d	26-Jul-00	1	Lathridiidae 02	2-3-b	03-Aug-99	3
Eleodes 01	1-3-b	03-Aug-99	2	Eucnemidae 02	1-1-d	26-Jul-00	1	Lathridiidae 02	2-3-b	22-Sep-00	1
Eleodes 01	1-3-b	23-Sep-99	1	Eucnemidae 02	2-2-c	22-Sep-00	1	Lathridiidae 02	2-3-c	03-Aug-99	1
Eleodes 01	1-3-d	22-Sep-00	2	Eucnemidae 02	4-1-c	23-Sep-99	1	Lathridiidae 02	2-3-c	22-Sep-00	6
Eleodes 01	2-1-d	22-Sep-00	2	Eucnemidae 02	5-1-c	23-Sep-99	1	Lathridiidae 02	3-1-c	23-Sep-99	1
Eleodes 01	2-1-d	23-Sep-99	1	Eyed Click beetle	2-2-b	03-Aug-99	1	Lathridiidae 02	3-1-d	26-Jul-00	1

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
<i>Eleodes</i> 01	2-2-b	22-Sep-00	1	<i>Harpalus</i> 01	1-2-b	03-Aug-99	1	<i>Lathridiidae</i> 02	3-1-d	26-Jul-00	1
<i>Eleodes</i> 01	2-3-b	22-Sep-00	1	<i>Harpalus</i> 01	1-3-b	03-Aug-99	1	<i>Lathridiidae</i> 02	3-2-c	03-Aug-99	8
<i>Eleodes</i> 01	3-1-b	26-Jul-00	1	<i>Harpalus</i> 01	1-3-d	03-Aug-99	2	<i>Lathridiidae</i> 02	3-2-c	22-Sep-00	2
<i>Eleodes</i> 01	3-2-d	22-Sep-00	3	<i>Harpalus</i> 01	1-3-d	03-Aug-99	2	<i>Lathridiidae</i> 02	3-2-c	23-Sep-99	1
<i>Eleodes</i> 01	1-3-b	22-Sep-00	1	<i>Harpalus</i> 01	2-1-b	03-Aug-99	3	<i>Lathridiidae</i> 02	3-2-c	26-Jul-00	1
<i>Eleodes</i> 01	1-3-d	03-Aug-99	1	<i>Harpalus</i> 01	2-1-b	data lost	3	<i>Lathridiidae</i> 02	3-3-b	26-Jul-00	1
<i>Eleodes</i> 01	2-3-b	23-Sep-99	1	<i>Harpalus</i> 01	2-3-b	26-Jul-00	1	<i>Lathridiidae</i> 02	3-3-c	26-Jul-00	2
<i>Eleodes</i> 01	3-1-d	22-Sep-00	1	<i>Harpalus</i> 01	2-3-d	03-Aug-99	2	<i>Lathridiidae</i> 02	4-1-b	26-Jul-00	1
<i>Eleodes</i> 01	3-1-s	26-Jul-00	1	<i>Harpalus</i> 01	2-3-d	22-Sep-00	2	<i>Lathridiidae</i> 02	4-1-c	03-Aug-99	1
<i>Eleodes</i> 01	3-2-s	03-Aug-99	2	<i>Harpalus</i> 01	3-1-d	03-Aug-99	1	<i>Lathridiidae</i> 02	4-1-c	22-Sep-00	3
<i>Eleodes</i> 01	3-2-s	22-Sep-00	1	<i>Harpalus</i> 01	4-3-d	22-Sep-00	1	<i>Lathridiidae</i> 02	4-1-c	23-Sep-99	1
<i>Lathridiidae</i> 02	4-1-c	26-Jul-00	1	<i>Lathridiidae</i> 06	4-1-c	03-Aug-99	1	<i>Leiodidae</i> 07	4-1-b	26-Jul-00	1
<i>Lathridiidae</i> 02	4-1-d	26-Jul-00	1	<i>Lathridiidae</i> 06	4-1-c	22-Sep-00	3	<i>Leiodidae</i> 07	4-1-c	23-Sep-00	1
<i>Lathridiidae</i> 02	4-2-c	03-Aug-99	1	<i>Lathridiidae</i> 06	4-1-c	23-Sep-99	1	<i>Leiodidae</i> 07	4-3-b	03-Aug-99	1
<i>Lathridiidae</i> 02	4-2-c	22-Sep-00	3	<i>Lathridiidae</i> 06	4-2-b	22-Sep-00	5	<i>Leiodidae</i> 09	5-1-b	22-Sep-00	1
<i>Lathridiidae</i> 02	4-2-c	23-Sep-99	2	<i>Lathridiidae</i> 06	4-2-c	03-Aug-99	1	<i>Leiodidae</i> 09	5-3-c	03-Aug-99	1
<i>Lathridiidae</i> 02	4-2-c	26-Jul-00	2	<i>Lathridiidae</i> 06	4-2-d	22-Sep-00	2	<i>Leptodiridae</i> 01	1-2-d	23-Sep-99	1
<i>Lathridiidae</i> 02	4-2-d	03-Aug-99	2	<i>Lathridiidae</i> 06	4-3-b	03-Aug-99	5	<i>Lucanidae</i> 01	3-2-s	26-Jul-00	1
<i>Lathridiidae</i> 02	4-3-c	22-Sep-00	2	<i>Lathridiidae</i> 06	4-3-b	23-Sep-99	8	<i>Melandryidae</i> 01	1-1-d	23-Sep-99	1
<i>Lathridiidae</i> 02	4-3-c	26-Jul-00	4	<i>Lathridiidae</i> 06	4-3-c	22-Sep-00	2	<i>Melandryidae</i> 01	3-1-d	23-Sep-99	1
<i>Lathridiidae</i> 02	5-1-c	03-Aug-99	1	<i>Lathridiidae</i> 06	4-3-c	26-Jul-00	1	<i>Melyridae</i> 01	2-1-d	26-Jul-	2
<i>Lathridiidae</i> 02	5-1-d	03-Aug-99	1	<i>Lathridiidae</i> 06	4-3-d	23-Sep-99	4	<i>Mordellidae</i> 01	1-1-b	03-Aug-99	1
<i>Lathridiidae</i> 02	5-2-c	03-Aug-99	1	<i>Lathridiidae</i> 06	4-3-s	26-Jul-00	1	<i>Mordellidae</i> 01	1-1-b	26-Jul-00	2
<i>Lathridiidae</i> 02	5-2-c	26-Jul-00	1	<i>Lathridiidae</i> 06	5-1-b	22-Sep-00	1	<i>Mordellidae</i> 01	1-1-c	03-Aug-99	1
<i>Lathridiidae</i> 02	5-3-b	03-Aug-99	1	<i>Lathridiidae</i> 06	5-3-c	22-Sep-00	2	<i>Mordellidae</i> 01	1-1-c	26-Jul-00	1
<i>Lathridiidae</i> 02	5-3-c	03-Aug-99	1	<i>Lathridiidae</i> 07	1-3-c	03-Aug-99	1	<i>Mordellidae</i> 01	1-1-d	03-Aug-99	1
<i>Lathridiidae</i> 02	5-3-c	22-Sep-00	1	<i>Lathridiidae</i> 07	1-3-c	22-Sep-00	3	<i>Mordellidae</i> 01	1-2-b	03-Aug-99	1
<i>Lathridiidae</i> 03	1-3-b	03-Aug-99	1	<i>Lathridiidae</i> 08	1-3-c	22-Sep-00	1	<i>Mordellidae</i> 01	1-3-c	03-Aug-99	4
<i>Lathridiidae</i> 03	1-3-s	22-Sep-00	1	<i>Lathridiidae</i> 09	4-1-c	03-Aug-99	2	<i>Mordellidae</i> 01	1-3-c	23-Sep-99	1
<i>Lathridiidae</i> 03	2-2-b	26-Jul-00	1	<i>Lathridiidae</i> 09	4-2-c	26-Jul-00	1	<i>Mordellidae</i> 01	1-3-d	03-Aug-99	2
<i>Lathridiidae</i> 03	3-3-c	03-Aug-99	1	<i>Lathridiidae</i> 09	4-2-d	03-Aug-99	1	<i>Mordellidae</i> 01	1-3-s	26-Jul-00	4
<i>Lathridiidae</i> 03	4-3-b	03-Aug-99	1	<i>Lathridiidae</i> 09	4-2-d	22-Sep-00	1	<i>Mordellidae</i> 01	2-1-c	26-Jul-00	1
<i>Lathridiidae</i> 04	1-1-c	03-Aug-99	1	<i>Lathridiidae</i> 09	4-3-d	26-Jul-00	1	<i>Mordellidae</i> 01	2-1-c	data lost	2
<i>Lathridiidae</i> 04	3-1-c	22-Sep-00	1	<i>Lathridiidae</i> 09	5-1-c	26-Jul-00	1	<i>Mordellidae</i> 01	2-2-c	03-Aug-99	1
<i>Lathridiidae</i> 04	4-3-d	03-Aug-99	2	<i>Lathridiidae</i> 09	5-3-c	03-Aug-99	1	<i>Mordellidae</i> 01	2-3-d	03-Aug-99	1
<i>Lathridiidae</i> 05	1-2-c	03-Aug-99	2	<i>Lathridiidae</i> 10a	4-2-b	22-Sep-00	1	<i>Mordellidae</i> 01	3-2-b	26-Jul-00	1
<i>Lathridiidae</i> 05	1-2-c	22-Sep-00	1	<i>Lathridiidae</i> 10a	4-2-d	22-Sep-00	2	<i>Mordellidae</i> 01	3-3-b	26-Jul-00	1
<i>Lathridiidae</i> 05	1-3-b	03-Aug-99	3	<i>Lathridiidae</i> 10a	4-3-b	22-Sep-00	1	<i>Mordellidae</i> 01	4-2-c	03-Aug-99	1
<i>Lathridiidae</i> 05	3-1-b	03-Aug-99	1	<i>Lathridiidae</i> 10a	4-3-c	03-Aug-99	2	<i>Mordellidae</i> 01	4-3-c	03-Aug-99	1
<i>Lathridiidae</i> 05	3-1-d	03-Aug-99	1	<i>Lathridiidae</i> 10a	4-3-c	22-Sep-00	1	<i>Mordellidae</i> 01	4-3-c	26-Jul-00	1
<i>Lathridiidae</i> 05	3-2-c	03-Aug-99	1	<i>Lathridiidae</i> 10a	5-1-c	26-Jul-00	1	<i>Mordellidae</i> 01	4-3-d	26-Jul-00	1
<i>Lathridiidae</i> 05	3-3-c	03-Aug-99	1	<i>Lathridiidae</i> 10a	5-3-b	22-Sep-00	1	<i>Mordellidae</i> 01	5-1-c	03-Aug-99	1
<i>Lathridiidae</i> 05	4-2-d	26-Jul-00	1	<i>Lathridiidae</i> 10b	4-1-b	26-Jul-00	1	<i>Mordellidae</i> 02	4-2-c	26-Jul-00	1
<i>Lathridiidae</i> 06	1-2-c	03-Aug-99	1	<i>Lathridiidae</i> 10b	4-3-b	22-Sep-00	1	<i>Nebria</i> 01	2-1-c	data lost	1
<i>Lathridiidae</i> 06	1-2-c	22-Sep-00	1	<i>Lathridiidae</i> 12	3-1-s	23-Sep-99	1	<i>Nebria</i> 01	2-2-s	22-Sep-00	1
<i>Lathridiidae</i> 06	1-2-c	23-Sep-99	1	<i>Lathridiidae</i> 13	4-1-s	22-Sep-00	1	<i>Nebria</i> 02	2-2-c	22-Sep-00	1
<i>Lathridiidae</i> 06	1-2-c	26-Jul-00	1	<i>Leiodidae</i> 01	1-1-b	03-Aug-99	1	<i>Nebria</i> 02	2-2-s	03-Aug-99	1
<i>Lathridiidae</i> 06	1-3-b	22-Sep-00	4	<i>Leiodidae</i> 02a	3-3-c	26-Jul-00	1	<i>Nitidulidae</i> 01	1-1-b	03-Aug-99	2
<i>Lathridiidae</i> 06	2-2-b	23-Sep-99	3	<i>Leiodidae</i> 02b	3-3-c	03-Aug-99	1	<i>Nitidulidae</i> 01	1-1-b	26-Jul-00	3
<i>Lathridiidae</i> 06	2-3-b	23-Sep-99	2	<i>Leiodidae</i> 03	2-2-c	23-Sep-99	1	<i>Nitidulidae</i> 01	1-1-c	23-Sep-99	1
<i>Lathridiidae</i> 06	3-1-c	22-Sep-00	1	<i>Leiodidae</i> 03	3-1-c	23-Sep-99	1	<i>Nitidulidae</i> 01	1-1-d	03-Aug-99	1
<i>Lathridiidae</i> 06	3-1-d	03-Aug-99	1	<i>Leiodidae</i> 03	5-2-c	03-Aug-99	1	<i>Nitidulidae</i> 01	1-1-d	26-Jul-00	6
<i>Lathridiidae</i> 06	3-2-b	23-Sep-99	1	<i>Leiodidae</i> 05	1-2-b	03-Aug-99	2	<i>Nitidulidae</i> 01	1-2-b	03-Aug-99	3
<i>Lathridiidae</i> 06	3-2-c	22-Sep-00	9	<i>Leiodidae</i> 05	1-3-c	26-Jul-00	1	<i>Nitidulidae</i> 01	1-2-b	22-Sep-00	1
<i>Lathridiidae</i> 06	3-2-c	26-Jul-00	1	<i>Leiodidae</i> 05	2-1-b	data lost	1	<i>Nitidulidae</i> 01	1-2-d	26-Jul-00	2
<i>Lathridiidae</i> 06	3-3-c	03-Aug-99	1	<i>Leiodidae</i> 05	2-2-b	23-Sep-99	4	<i>Nitidulidae</i> 01	1-3-b	03-Aug-99	2
<i>Lathridiidae</i> 06	3-3-c	23-Sep-99	1	<i>Leiodidae</i> 05	2-2-b	26-Jul-00	1	<i>Nitidulidae</i> 01	1-3-b	26-Jul-00	4
<i>Lathridiidae</i> 06	3-3-s	26-Jul-00	1	<i>Leiodidae</i> 05	5-1-c	03-Aug-99	1	<i>Nitidulidae</i> 01	1-3-d	03-Aug-99	3
<i>Lathridiidae</i> 06	4-1-b	23-Sep-99	3	<i>Leiodidae</i> 06	2-2-b	22-Sep-00	2	<i>Nitidulidae</i> 01	2-1-d	03-Aug-99	1
<i>Lathridiidae</i> 06	4-1-b	26-Jul-00	1	<i>Leiodidae</i> 06	4-3-b	23-Sep-99	1	<i>Nitidulidae</i> 01	2-1-d	22-Sep-00	1
<i>Nitidulidae</i> 01	2-1-d	26-Jul-00	1	<i>Nitidulidae</i> 02/3	2-1-b	data lost	3	<i>Nitidulidae</i> 02/3	4-2-d	03-Aug-99	4
<i>Nitidulidae</i> 01	2-2-b	26-Jul-00	3	<i>Nitidulidae</i> 02/3	2-1-b	data lost	1	<i>Nitidulidae</i> 02/3	4-2-d	22-Sep-00	62
<i>Nitidulidae</i> 01	2-2-d	03-Aug-99	2	<i>Nitidulidae</i> 02/3	2-1-c	data lost	1	<i>Nitidulidae</i> 02/3	4-2-d	23-Sep-99	6
<i>Nitidulidae</i> 01	2-2-d	26-Jul-00	4	<i>Nitidulidae</i> 02/3	2-1-c	data lost	1	<i>Nitidulidae</i> 02/3	4-2-d	26-Jul-00	2
<i>Nitidulidae</i> 01	2-3-b	03-Aug-99	1	<i>Nitidulidae</i> 02/3	2-1-d	03-Aug-99	2	<i>Nitidulidae</i> 02/3	4-3-b	03-Aug-99	58
<i>Nitidulidae</i> 01	2-3-b	26-Jul-00	1	<i>Nitidulidae</i> 02/3	2-1-d	22-Sep-00	9	<i>Nitidulidae</i> 02/3	4-3-b	22-Sep-00	19
<i>Nitidulidae</i> 01	2-3-d	03-Aug-99	1	<i>Nitidulidae</i> 02/3	2-1-d	26-Jul-	9	<i>Nitidulidae</i> 02/3	4-3-b	23-Sep-99	7
<i>Nitidulidae</i> 01	2-3-d	26-Jul-00	4	<i>Nitidulidae</i> 02/3	2-2-b	03-Aug-99	2	<i>Nitidulidae</i> 02/3	4-3-c	22-Sep-00	46

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Nitidulidae 01	3-1-b	03-Aug-99	2	Nitidulidae 02/3	2-2-b	22-Sep-00	2	Nitidulidae 02/3	4-3-d	03-Aug-99	13
Nitidulidae 01	3-1-d	26-Jul-00	3	Nitidulidae 02/3	2-2-b	23-Sep-99	3	Nitidulidae 02/3	4-3-d	22-Sep-00	45
Nitidulidae 01	3-2-b	03-Aug-99	1	Nitidulidae 02/3	2-2-d	03-Aug-99	2	Nitidulidae 02/3	4-3-d	23-Sep-99	8
Nitidulidae 01	3-2-d	03-Aug-99	2	Nitidulidae 02/3	2-2-d	22-Sep-00	8	Nitidulidae 02/3	4-3-d	26-Jul-00	8
Nitidulidae 01	3-2-d	26-Jul-00	2	Nitidulidae 02/3	2-2-d	23-Sep-99	4	Nitidulidae 02/3	5-1-b	03-Aug-99	1
Nitidulidae 01	3-3-b	03-Aug-99	1	Nitidulidae 02/3	2-3-b	22-Sep-00	8	Nitidulidae 02/3	5-1-b	22-Sep-00	31
Nitidulidae 01	3-3-b	03-Aug-99	1	Nitidulidae 02/3	2-3-b	23-Sep-99	14	Nitidulidae 02/3	5-1-b	23-Sep-99	1
Nitidulidae 01	3-3-b	26-Jul-00	2	Nitidulidae 02/3	2-3-d	22-Sep-00	48	Nitidulidae 02/3	5-1-c	data lost	2
Nitidulidae 01	3-3-d	03-Aug-99	5	Nitidulidae 02/3	2-3-d	23-Sep-99	15	Nitidulidae 02/3	5-1-d	03-Aug-99	7
Nitidulidae 01	3-3-d	26-Jul-00	3	Nitidulidae 02/3	3-1-b	22-Sep-00	10	Nitidulidae 02/3	5-1-d	22-Sep-00	17
Nitidulidae 01	4-2-b	23-Sep-99	1	Nitidulidae 02/3	3-1-b	23-Sep-99	7	Nitidulidae 02/3	5-1-d	23-Sep-99	9
Nitidulidae 01	4-3-d	26-Jul-00	1	Nitidulidae 02/3	3-1-c	22-Sep-00	1	Nitidulidae 02/3	5-2-b	22-Sep-00	1
Nitidulidae 01	5-1-b	03-Aug-99	3	Nitidulidae 02/3	3-1-c	23-Sep-99	2	Nitidulidae 02/3	5-2-c	22-Sep-00	4
Nitidulidae 01	5-1-d	03-Aug-99	3	Nitidulidae 02/3	3-1-d	22-Sep-00	42	Nitidulidae 02/3	5-2-d	03-Aug-99	4
Nitidulidae 01	5-1-d	26-Jul-00	6	Nitidulidae 02/3	3-1-d	23-Sep-99	6	Nitidulidae 02/3	5-2-d	22-Sep-00	1
Nitidulidae 01	5-2-b	03-Aug-99	1	Nitidulidae 02/3	3-1-d	26-Jul-00	1	Nitidulidae 02/3	5-2-d	26-Jul-00	1
Nitidulidae 01	5-2-b	22-Sep-00	2	Nitidulidae 02/3	3-2-b	22-Sep-00	5	Nitidulidae 02/3	5-3-b	22-Sep-00	32
Nitidulidae 01	5-2-d	26-Jul-00	2	Nitidulidae 02/3	3-2-b	23-Sep-99	1	Nitidulidae 02/3	5-3-b	23-Sep-99	4
Nitidulidae 01	5-3-b	26-Jul-00	1	Nitidulidae 02/3	3-2-c	22-Sep-00	2	Nitidulidae 02/3	5-3-c	03-Aug-99	1
Nitidulidae 01	5-3-d	03-Aug-99	7	Nitidulidae 02/3	3-2-d	03-Aug-99	2	Nitidulidae 02/3	5-3-c	22-Sep-00	26
Nitidulidae 01	5-3-d	26-Jul-00	11	Nitidulidae 02/3	3-2-d	22-Sep-00	41	Nitidulidae 02/3	5-3-d	03-Aug-99	1
Nitidulidae 02/3	1-1-b	22-Sep-00	27	Nitidulidae 02/3	3-2-d	23-Sep-99	9	Nitidulidae 02/3	5-3-d	23-Sep-99	4
Nitidulidae 02/3	1-1-b	23-Sep-99	3	Nitidulidae 02/3	3-3-b	22-Sep-00	8	Nitidulidae 02/3	5-3-d	data lost	3
Nitidulidae 02/3	1-1-c	22-Sep-00	11	Nitidulidae 02/3	3-3-b	23-Sep-99	1	Nitidulidae 04	1-1-b	22-Sep-00	1
Nitidulidae 02/3	1-1-d	03-Aug-99	7	Nitidulidae 02/3	3-3-b	26-Jul-00	1	Nitidulidae 04	1-1-b	23-Sep-99	1
Nitidulidae 02/3	1-1-d	22-Sep-00	78	Nitidulidae 02/3	3-3-c	23-Sep-99	1	Nitidulidae 04	1-1-c	23-Sep-99	2
Nitidulidae 02/3	1-1-d	23-Sep-99	3	Nitidulidae 02/3	3-3-d	22-Sep-00	16	Nitidulidae 04	1-1-d	03-Aug-99	1
Nitidulidae 02/3	1-2-b	03-Aug-99	3	Nitidulidae 02/3	3-3-d	23-Sep-99	10	Nitidulidae 04	1-1-d	23-Sep-99	2
Nitidulidae 02/3	1-2-b	22-Sep-00	29	Nitidulidae 02/3	4-1-b	22-Sep-00	74	Nitidulidae 04	1-2-b	03-Aug-99	1
Nitidulidae 02/3	1-2-b	23-Sep-99	5	Nitidulidae 02/3	4-1-b	23-Sep-99	12	Nitidulidae 04	1-2-d	23-Sep-99	1
Nitidulidae 02/3	1-2-b	26-Jul-00	2	Nitidulidae 02/3	4-1-b	23-Sep-99	4	Nitidulidae 04	1-3-c	23-Sep-99	1
Nitidulidae 02/3	1-2-c	22-Sep-00	6	Nitidulidae 02/3	4-1-c	03-Aug-99	1	Nitidulidae 04	1-3-d	03-Aug-99	1
Nitidulidae 02/3	1-2-d	22-Sep-00	38	Nitidulidae 02/3	4-1-c	22-Sep-00	4	Nitidulidae 04	2-1-b	data lost	1
Nitidulidae 02/3	1-2-d	23-Sep-99	15	Nitidulidae 02/3	4-1-c	23-Sep-99	3	Nitidulidae 04	2-1-c	data lost	1
Nitidulidae 02/3	1-3-b	22-Sep-00	36	Nitidulidae 02/3	4-1-d	22-Sep-00	49	Nitidulidae 04	2-2-c	03-Aug-99	1
Nitidulidae 02/3	1-3-b	23-Sep-99	5	Nitidulidae 02/3	4-1-d	23-Sep-99	6	Nitidulidae 04	3-2-b	03-Aug-99	3
Nitidulidae 02/3	1-3-c	22-Sep-00	6	Nitidulidae 02/3	4-2-b	22-Sep-00	50	Nitidulidae 04	3-2-d	03-Aug-99	1
Nitidulidae 02/3	1-3-d	03-Aug-99	7	Nitidulidae 02/3	4-2-b	23-Sep-99	11	Nitidulidae 04	3-3-b	22-Sep-00	2
Nitidulidae 02/3	1-3-d	22-Sep-00	25	Nitidulidae 02/3	4-2-c	03-Aug-99	1	Nitidulidae 04	4-1-b	23-Sep-99	3
Nitidulidae 02/3	1-3-d	23-Sep-99	60	Nitidulidae 02/3	4-2-c	23-Sep-99	4	Nitidulidae 04	4-1-c	03-Aug-99	2
Nitidulidae 02/3	2-1-b	data lost	4	Nitidulidae 02/3	4-2-c	26-Jul-00	1	Nitidulidae 04	4-2-b	22-Sep-00	1
Nitidulidae 04	4-2-b	23-Sep-99	1	Nitidulidae 12	4-1-c	03-Aug-99	1	Paederinae 01	5-3-d	03-Aug-99	1
Nitidulidae 04	5-1-b	26-Jul-00	1	Nitidulidae 12	4-1-c	23-Sep-99	4	Paederinae 03	3-1-b	03-Aug-99	1
Nitidulidae 04	5-3-d	23-Sep-99	1	Nitidulidae 12	4-1-d	22-Sep-00	1	Paederinae 03	4-1-d	03-Aug-99	1
Nitidulidae 05	1-1-b	26-Jul-00	1	Nitidulidae 12	4-1-d	23-Sep-99	1	Paederinae 03	5-2-b	03-Aug-99	1
Nitidulidae 05	1-2-b	23-Sep-99	1	Nitidulidae 12	4-1-d	26-Jul-00	2	Paederinae 05	1-1-d	22-Sep-00	3
Nitidulidae 05	1-2-c	22-Sep-00	3	Nitidulidae 12	4-3-b	22-Sep-00	1	Paederinae 05	1-2-b	03-Aug-99	6
Nitidulidae 05	1-2-d	23-Sep-99	1	Nitidulidae 12	4-3-d	22-Sep-00	1	Paederinae 05	1-2-b	22-Sep-00	2
Nitidulidae 05	1-3-c	23-Sep-99	1	Nitidulidae 12	5-2-b	23-Sep-99	1	Paederinae 05	1-2-b	23-Sep-99	1
Nitidulidae 05	1-3-d	23-Sep-99	2	Nitidulidae 12	5-3-c	03-Aug-99	1	Paederinae 05	1-2-c	22-Sep-00	1
Nitidulidae 05	2-1-c	data lost	1	Nitidulidae 13	2-2-b	26-Jul-00	1	Paederinae 05	1-2-d	22-Sep-00	5
Nitidulidae 05	3-1-b	03-Aug-99	1	Nitidulidae 14	2-3-b	22-Sep-00	1	Paederinae 05	1-3-b	22-Sep-00	7
Nitidulidae 05	3-3-b	26-Jul-00	1	Nitidulidae 14	2-3-b	23-Sep-99	1	Paederinae 05	1-3-b	26-Jul-00	1
Nitidulidae 05	4-1-b	22-Sep-00	1	Omaliinae 01	2-2-b	03-Aug-99	1	Paederinae 05	1-3-d	03-Aug-99	1
Nitidulidae 05	4-1-b	23-Sep-99	2	Omaliinae 01	4-3-b	03-Aug-99	1	Paederinae 05	1-3-d	22-Sep-00	5
Nitidulidae 05	4-1-b	23-Sep-99	1	Omaliinae 02	4-1-c	03-Aug-99	1	Paederinae 05	1-3-d	23-Sep-99	1
Nitidulidae 05	4-1-b	26-Jul-00	1	Omaliinae 02	4-3-c	26-Jul-00	1	Paederinae 05	2-1-d	26-Jul-	1
Nitidulidae 05	4-1-c	23-Sep-99	1	Omaliinae 03	4-2-d	03-Aug-99	1	Paederinae 05	2-2-b	22-Sep-00	1
Nitidulidae 05	4-1-d	03-Aug-99	2	Osorinae 01	3-3-s	22-Sep-00	1	Paederinae 05	2-2-b	23-Sep-99	1
Nitidulidae 05	4-1-d	22-Sep-00	1	Paederinae 01	1-1-c	03-Aug-99	1	Paederinae 05	3-1-b	22-Sep-00	1
Nitidulidae 05	4-1-d	23-Sep-99	1	Paederinae 01	1-1-d	22-Sep-00	1	Paederinae 05	3-1-b	23-Sep-99	1
Nitidulidae 05	4-2-b	22-Sep-00	1	Paederinae 01	1-2-d	23-Sep-99	1	Paederinae 05	4-1-b	26-Jul-00	1
Nitidulidae 05	4-2-b	23-Sep-99	1	Paederinae 01	1-3-d	26-Jul-00	2	Paederinae 05	4-1-c	22-Sep-00	1
Nitidulidae 05	4-2-b	26-Jul-00	1	Paederinae 01	2-1-b	data lost	2	Paederinae 05	4-1-c	26-Jul-00	1
Nitidulidae 05	5-1-b	22-Sep-00	1	Paederinae 01	2-2-d	22-Sep-00	2	Paederinae 05	4-2-b	22-Sep-00	2
Nitidulidae 05	5-1-b	23-Sep-99	1	Paederinae 01	2-3-b	22-Sep-00	1	Paederinae 05	4-2-c	22-Sep-00	2
Nitidulidae 05	5-1-c	23-Sep-99	1	Paederinae 01	2-3-b	23-Sep-99	1	Paederinae 05	4-2-d	23-Sep-99	1
Nitidulidae 05	5-1-d	03-Aug-99	1	Paederinae 01	2-3-d	22-Sep-00	3	Paederinae 05	4-3-b	03-Aug-99	2

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Nitidulidae 05	5-2-c	22-Sep-00	1	Paederinae 01	3-1-b	22-Sep-00	1	Paederinae 05	4-3-c	22-Sep-00	5
Nitidulidae 05	5-2-d	03-Aug-99	1	Paederinae 01	3-1-d	22-Sep-00	3	Paederinae 05	5-1-b	22-Sep-00	1
Nitidulidae 05	5-2-d	26-Jul-00	1	Paederinae 01	3-1-d	23-Sep-99	1	Paederinae 05	5-1-d	22-Sep-00	4
Nitidulidae 06	1-2-b	26-Jul-00	1	Paederinae 01	3-2-b	03-Aug-99	1	Paederinae 05	5-2-c	22-Sep-00	1
Nitidulidae 06	1-2-c	22-Sep-00	1	Paederinae 01	3-2-d	03-Aug-99	1	Paederinae 05	5-2-d	22-Sep-00	1
Nitidulidae 06	1-3-c	22-Sep-00	1	Paederinae 01	3-2-d	22-Sep-00	2	Paederinae 05	5-3-b	22-Sep-00	2
Nitidulidae 06	1-3-s	26-Jul-00	3	Paederinae 01	3-3-b	22-Sep-00	1	Paederinae 05	5-3-c	03-Aug-99	1
Nitidulidae 06	2-2-c	22-Sep-00	2	Paederinae 01	4-1-b	22-Sep-00	5	Paederinae 05	5-3-c	22-Sep-00	2
Nitidulidae 06	3-2-c	26-Jul-00	1	Paederinae 01	4-1-b	26-Jul-00	2	Paederinae 07	3-3-c	03-Aug-99	1
Nitidulidae 06	3-3-c	26-Jul-00	1	Paederinae 01	4-2-b	22-Sep-00	3	Paederinae 08a	3-3-b	22-Sep-00	1
Nitidulidae 06	4-3-c	22-Sep-00	1	Paederinae 01	4-2-b	23-Sep-99	1	Paederinae 08a	4-2-d	22-Sep-00	1
Nitidulidae 06	5-2-c	03-Aug-99	1	Paederinae 01	4-2-c	22-Sep-00	5	Paederinae 08a	4-3-b	22-Sep-00	3
Nitidulidae 06	5-3-c	22-Sep-00	1	Paederinae 01	4-2-d	22-Sep-00	4	Paederinae 08b	1-2-b	23-Sep-99	1
Nitidulidae 07	3-2-c	23-Sep-99	1	Paederinae 01	4-3-b	22-Sep-00	9	Paederinae 08b	4-2-b	22-Sep-00	1
Nitidulidae 08b	3-2-b	26-Jul-00	1	Paederinae 01	4-3-d	03-Aug-99	3	Paederinae 08b	4-2-b	23-Sep-99	2
Nitidulidae 09	2-2-b	23-Sep-99	2	Paederinae 01	4-3-d	22-Sep-00	10	Paederinae 08b	4-3-b	03-Aug-99	1
Nitidulidae 09	3-1-b	23-Sep-99	1	Paederinae 01	4-3-d	23-Sep-99	5	Paederinae 09	1-1-d	23-Sep-99	2
Nitidulidae 11	3-1-d	22-Sep-00	1	Paederinae 01	5-1-d	03-Aug-99	1	Paederinae 09	4-1-b	23-Sep-99	1
Nitidulidae 12	3-1-d	22-Sep-00	1	Paederinae 01	5-1-d	22-Sep-00	1	Paederinae 09	4-1-b	23-Sep-99	1
Nitidulidae 12	3-1-d	26-Jul-00	1	Paederinae 01	5-2-d	03-Aug-99	2	Paederinae 09	5-1-c	03-Aug-99	1
Nitidulidae 12	3-2-b	03-Aug-99	1	Paederinae 01	5-3-b	22-Sep-00	4	Paederinae 10a	2-1-s	22-Sep-00	1
Nitidulidae 12	3-3-s	03-Aug-99	1	Paederinae 01	5-3-c	03-Aug-99	1	Paederinae 10b	5-3-s	03-Aug-99	1
Paederinae 11	4-1-b	26-Jul-00	1	Pterostichus 01	2-1-d	22-Sep-00	1	Pterostichus 01	4-3-d	23-Sep-99	1
Paederinae 12	1-2-b	26-Jul-00	1	Pterostichus 01	2-1-d	23-Sep-99	5	Pterostichus 01	5-1-b	23-Sep-99	4
Paederinae 12	5-1-c	03-Aug-99	1	Pterostichus 01	2-1-d	26-Jul-00	1	Pterostichus 01	5-1-d	23-Sep-99	3
Paederinae 12	5-3-b	22-Sep-00	1	Pterostichus 01	2-2-b	23-Sep-99	1	Pterostichus 01	5-2-b	22-Sep-00	1
Paederinae 13a	5-3-d	26-Jul-00	1	Pterostichus 01	2-2-d	03-Aug-99	1	Pterostichus 01	5-2-d	22-Sep-00	2
Paederinae 13b	3-1-s	23-Sep-99	1	Pterostichus 01	2-2-d	23-Sep-99	5	Pterostichus 01	5-2-d	23-Sep-99	1
Pink larva	1-1-d	23-Sep-99	1	Pterostichus 01	2-3-b	03-Aug-99	2	Pterostichus 01	5-2-d	26-Jul-00	2
Pink larva	1-2-d	22-Sep-00	1	Pterostichus 01	2-3-b	23-Sep-99	3	Pterostichus 01	5-2-s	22-Sep-00	1
Pink larva	1-3-b	22-Sep-00	1	Pterostichus 01	2-3-b	26-Jul-00	1	Pterostichus 01	5-3-b	23-Sep-99	1
Pink larva	2-1-d	22-Sep-00	19	Pterostichus 01	2-3-d	22-Sep-00	3	Pterostichus 01	5-3-d	03-Aug-99	1
Pink larva	2-1-d	26-Jul-00	1	Pterostichus 01	2-3-d	23-Sep-99	19	Pterostichus 01	5-3-d	23-Sep-99	3
Pink larva	2-2-b	03-Aug-99	1	Pterostichus 01	2-3-d	26-Jul-00	1	Pterostichus 02	3-2-d	03-Aug-99	1
Pink larva	2-2-d	22-Sep-00	2	Pterostichus 01	3-1-b	03-Aug-99	3	Pterostichus 02	3-2-d	22-Sep-00	1
Pink larva	3-1-b	22-Sep-00	1	Pterostichus 01	3-1-b	23-Sep-99	5	Pterostichus 02	3-3-b	26-Jul-00	2
Pink larva	3-1-d	22-Sep-00	6	Pterostichus 01	3-1-b	26-Jul-00	1	Pterostichus 02	3-3-d	23-Sep-99	1
Pink larva	3-2-b	22-Sep-00	3	Pterostichus 01	3-1-d	03-Aug-99	3	Pterostichus 02	4-1-b	23-Sep-99	1
Pink larva	3-2-b	22-Sep-00	26	Pterostichus 01	3-1-d	22-Sep-00	4	Pterostichus 02	4-1-d	22-Sep-00	2
Pink larva	3-3-b	22-Sep-00	4	Pterostichus 01	3-1-d	23-Sep-99	1	Pterostichus 02	4-1-d	23-Sep-99	1
Pink larva	3-3-d	03-Aug-99	2	Pterostichus 01	3-1-d	26-Jul-00	4	Pterostichus 02	4-2-b	23-Sep-99	1
Pink larva	3-3-d	22-Sep-00	9	Pterostichus 01	3-2-b	03-Aug-99	7	Pterostichus 02	4-2-d	23-Sep-99	2
Pink larva	4-1-d	22-Sep-00	1	Pterostichus 01	3-2-b	22-Sep-00	1	Pterostichus 02	4-2-s	26-Jul-00	1
Pink larva	4-2-d	22-Sep-00	1	Pterostichus 01	3-2-b	23-Sep-99	12	Pterostichus 02	4-3-b	22-Sep-00	1
Pink larva	4-3-s	22-Sep-00	1	Pterostichus 01	3-2-d	03-Aug-99	5	Pterostichus 02	4-3-d	03-Aug-99	1
Pink larva	5-1-b	22-Sep-00	4	Pterostichus 01	3-2-d	22-Sep-00	5	Pterostichus 03	2-3-c	23-Sep-99	1
Pink larva	5-2-c	22-Sep-00	1	Pterostichus 01	3-2-d	23-Sep-99	14	Pterostichus 03	3-3-b	03-Aug-99	1
Pink larva	5-2-d	22-Sep-00	1	Pterostichus 01	3-2-d	26-Jul-00	6	Pterostichus 03	4-1-c	22-Sep-00	1
Pink larva	5-3-b	22-Sep-00	2	Pterostichus 01	3-3-b	03-Aug-99	3	Pterostichus 03	4-2-c	23-Sep-99	1
Pink larva	5-3-d	data lost	3	Pterostichus 01	3-3-b	22-Sep-00	3	Pterostichus 03	4-2-d	23-Sep-99	2
Pselaphidae 01	2-1-c	data lost	1	Pterostichus 01	3-3-b	23-Sep-99	6	Pterostichus 04	3-1-c	03-Aug-99	1
Pselaphidae 02	2-1-s	03-Aug-99	1	Pterostichus 01	3-3-d	03-Aug-99	5	Pterostichus 04	3-3-d	03-Aug-99	1
Pselaphidae 03	2-1-s	26-Jul-00	1	Pterostichus 01	3-3-d	22-Sep-00	6	Pterostichus 05	3-2-d	23-Sep-99	1
Pterostichus 01	1-1-b	03-Aug-99	3	Pterostichus 01	3-3-d	23-Sep-99	5	Pterostichus 06	4-3-d	22-Sep-00	1
Pterostichus 01	1-1-b	22-Sep-00	1	Pterostichus 01	3-3-s	23-Sep-99	1	Pterostichus 07	3-3-s	26-Jul-00	1
Pterostichus 01	1-1-b	23-Sep-99	8	Pterostichus 01	3-3-s	26-Jul-00	1	Pterostichus 07	4-1-s	22-Sep-00	1
Pterostichus 01	1-1-d	03-Aug-99	8	Pterostichus 01	4-1-b	23-Sep-99	6	Pterostichus lama	1-2-c	22-Sep-00	1
Pterostichus 01	1-1-d	26-Jul-00	2	Pterostichus 01	4-1-b	26-Jul-00	2	Pterostichus lama	1-2-d	22-Sep-00	2
Pterostichus 01	1-2-b	03-Aug-99	4	Pterostichus 01	4-1-d	03-Aug-99	6	Pterostichus lama	1-2-d	23-Sep-99	1
Pterostichus 01	1-2-b	22-Sep-00	1	Pterostichus 01	4-1-d	22-Sep-00	3	Pterostichus lama	1-3-b	22-Sep-00	1
Pterostichus 01	1-2-b	23-Sep-99	5	Pterostichus 01	4-1-d	23-Sep-99	3	Pterostichus lama	1-3-d	23-Sep-99	1
Pterostichus 01	1-2-b	26-Jul-00	1	Pterostichus 01	4-2-b	22-Sep-00	1	Pterostichus lama	2-1-b	03-Aug-99	1
Pterostichus 01	1-2-d	22-Sep-00	1	Pterostichus 01	4-2-d	03-Aug-99	1	Pterostichus lama	2-2-b	23-Sep-99	1
Pterostichus 01	1-2-d	23-Sep-99	15	Pterostichus 01	4-2-d	22-Sep-00	1	Pterostichus lama	2-2-d	23-Sep-99	1
Pterostichus 01	1-2-d	26-Jul-00	4	Pterostichus 01	4-2-d	22-Sep-00	2	Pterostichus lama	2-3-b	03-Aug-99	1
Pterostichus 01	1-3-b	23-Sep-99	9	Pterostichus 01	4-2-d	23-Sep-99	10	Pterostichus lama	2-3-b	22-Sep-00	1
Pterostichus 01	1-3-d	03-Aug-99	3	Pterostichus 01	4-2-s	23-Sep-99	2	Pterostichus lama	2-3-b	23-Sep-99	2
Pterostichus 01	1-3-d	22-Sep-00	1	Pterostichus 01	4-3-b	03-Aug-99	1	Pterostichus lama	2-3-s	22-Sep-00	1

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
<i>Pterostichus</i> 01	1-3-d	23-Sep-99	19	<i>Pterostichus</i> 01	4-3-b	23-Sep-99	4	<i>Pterostichus lama</i>	2-3-s	26-Jul-00	1
<i>Pterostichus</i> 01	2-1-b	22-Sep-00	1	<i>Pterostichus</i> 01	4-3-d	22-Sep-00	1	<i>Pterostichus lama</i>	3-1-b	22-Sep-00	1
<i>Pterostichus</i> 01	2-1-b	26-Jul-00	1	<i>Pterostichus</i> 01	4-3-d	23-Sep-99	1	<i>Pterostichus lama</i>	3-1-b	23-Sep-99	1
<i>Pterostichus lama</i>	3-1-b	26-Jul-00	1	<i>Ptilliidae</i> 01	4-1-d	03-Aug-99	1	<i>Scarabaeidae</i> 02	2-1-d	03-Aug-99	1
<i>Pterostichus lama</i>	3-1-c	22-Sep-00	1	<i>Ptilliidae</i> 01	4-1-d	23-Sep-99	1	<i>Scarabaeidae</i> 02	2-2-c	23-Sep-99	1
<i>Pterostichus lama</i>	3-1-c	26-Jul-00	1	<i>Ptilliidae</i> 01	4-2-b	23-Sep-99	2	<i>Scarabaeidae</i> 02	2-3-d	22-Sep-00	1
<i>Pterostichus lama</i>	3-1-d	22-Sep-00	1	<i>Ptilliidae</i> 01	4-2-b	26-Jul-00	1	<i>Scarabaeidae</i> 02	2-3-d	23-Sep-99	1
<i>Pterostichus lama</i>	3-1-d	23-Sep-99	1	<i>Ptilliidae</i> 01	4-2-c	03-Aug-99	2	<i>Scarabaeidae</i> 02	4-3-d	22-Sep-00	1
<i>Pterostichus lama</i>	3-1-s	22-Sep-00	1	<i>Ptilliidae</i> 01	4-2-c	22-Sep-00	2	<i>Scarabaeidae</i> 02	5-2-d	22-Sep-00	1
<i>Pterostichus lama</i>	3-2-b	23-Sep-99	1	<i>Ptilliidae</i> 01	4-2-d	22-Sep-00	1	<i>Scarabaeidae</i> 03	1-2-b	22-Sep-00	1
<i>Pterostichus lama</i>	3-2-d	03-Aug-99	1	<i>Ptilliidae</i> 01	4-3-b	03-Aug-99	9	<i>Scarabaeidae</i> 03	2-2-b	22-Sep-00	2
<i>Pterostichus lama</i>	3-2-s	23-Sep-99	1	<i>Ptilliidae</i> 01	4-3-c	22-Sep-00	1	<i>Scarabaeidae</i> 03	2-3-b	22-Sep-00	1
<i>Pterostichus lama</i>	3-3-b	22-Sep-00	3	<i>Ptilliidae</i> 01	4-3-d	03-Aug-99	2	<i>Scarabaeidae</i> 03	4-1-b	22-Sep-00	1
<i>Pterostichus lama</i>	3-3-b	23-Sep-99	1	<i>Ptilliidae</i> 01	4-3-d	26-Jul-00	2	<i>Scarabaeidae</i> 03	4-3-d	22-Sep-00	2
<i>Pterostichus lama</i>	3-3-d	03-Aug-99	1	<i>Ptilliidae</i> 01	5-1-b	23-Sep-99	1	<i>Scarabaeidae</i> 04	2-1-s	26-Jul-00	1
<i>Pterostichus lama</i>	3-3-d	23-Sep-99	2	<i>Ptilliidae</i> 01	5-1-c	26-Jul-00	1	<i>Scarabaeidae</i> 05	5-2-c	26-Jul-00	2
<i>Pterostichus lama</i>	4-1-b	22-Sep-00	1	<i>Ptilliidae</i> 01	5-2-b	22-Sep-00	1	<i>Scarabaeidae</i> 06	1-2-c	26-Jul-00	1
<i>Pterostichus lama</i>	4-1-b	23-Sep-99	1	<i>Ptilliidae</i> 01	5-3-b	03-Aug-99	5	<i>Scarabaeidae</i> 07	2-3-b	26-Jul-00	1
<i>Pterostichus lama</i>	4-3-d	23-Sep-99	1	<i>Ptilliidae</i> 01	5-3-c	26-Jul-00	10	<i>Scarabaeidae</i> 08	2-2-d	03-Aug-99	1
<i>Pterostichus lama</i>	4-3-d	26-Jul-00	1	<i>Ptilliidae</i> 01	5-3-d	26-Jul-00	1	<i>Scolytidae</i> 01	1-2-b	03-Aug-99	1
<i>Pterostichus lama</i>	5-1-b	23-Sep-99	1	<i>Ptilliidae</i> 02	1-1-b	03-Aug-99	1	<i>Scolytidae</i> 01	1-3-b	03-Aug-99	4
<i>Pterostichus lama</i>	5-2-d	23-Sep-99	1	<i>Ptilliidae</i> 02	1-3-b	03-Aug-99	9	<i>Scolytidae</i> 01	1-3-c	26-Jul-00	1
<i>Ptilliidae</i> 01	1-1-b	03-Aug-99	2	<i>Ptilliidae</i> 02	2-3-b	03-Aug-99	1	<i>Scolytidae</i> 01	2-1-s	03-Aug-99	1
<i>Ptilliidae</i> 01	1-1-b	26-Jul-00	1	<i>Ptilliidae</i> 02	2-3-b	26-Jul-00	1	<i>Scolytidae</i> 01	3-3-s	23-Sep-99	1
<i>Ptilliidae</i> 01	1-1-c	03-Aug-99	1	<i>Ptilliidae</i> 02	2-3-c	26-Jul-00	1	<i>Scolytidae</i> 02a	1-1-c	23-Sep-99	1
<i>Ptilliidae</i> 01	1-1-d	22-Sep-00	5	<i>Ptilliidae</i> 02	4-1-b	26-Jul-00	4	<i>Scolytidae</i> 02b	3-3-b	23-Sep-99	1
<i>Ptilliidae</i> 01	1-1-d	26-Jul-00	9	<i>Ptilliidae</i> 03	1-2-c	03-Aug-99	1	<i>Scolytidae</i> 03	1-1-s	03-Aug-99	1
<i>Ptilliidae</i> 01	1-2-c	03-Aug-99	1	<i>Ptilliidae</i> 03	4-1-c	26-Jul-00	1	<i>Scolytidae</i> 03	1-1-s	26-Jul-00	1
<i>Ptilliidae</i> 01	1-3-b	03-Aug-99	5	<i>Ptilliidae</i> 03	4-3-c	26-Jul-00	1	<i>Scolytidae</i> 03	1-2-c	03-Aug-99	1
<i>Ptilliidae</i> 01	1-3-b	23-Sep-99	1	<i>Ptilliidae</i> 03	5-3-c	26-Jul-00	2	<i>Scolytidae</i> 03	1-3-b	22-Sep-00	1
<i>Ptilliidae</i> 01	1-3-c	03-Aug-99	6	<i>Ptilliidae</i> 04	2-2-s	22-Sep-00	1	<i>Scolytidae</i> 03	1-3-c	03-Aug-99	2
<i>Ptilliidae</i> 01	1-3-c	23-Sep-99	1	<i>Quedius</i> 01	5-3-c	26-Jul-00	1	<i>Scolytidae</i> 03	2-1-s	03-Aug-99	2
<i>Ptilliidae</i> 01	1-3-c	26-Jul-00	2	<i>Rhizophagidae</i> 01	1-2-s	03-Aug-99	1	<i>Scolytidae</i> 03	2-2-c	03-Aug-99	1
<i>Ptilliidae</i> 01	1-3-s	26-Jul-00	1	<i>Rhizophagidae</i> 01	1-3-c	22-Sep-00	1	<i>Scydmaenidae</i> 01	1-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	2-1-d	26-Jul-	1	<i>Rhizophagidae</i> 01	2-2-s	22-Sep-00	1	<i>Scydmaenidae</i> 01	1-3-b	03-Aug-99	1
<i>Ptilliidae</i> 01	2-2-b	23-Sep-99	1	<i>Rhizophagidae</i> 01	3-1-s	22-Sep-00	1	<i>Scydmaenidae</i> 01	4-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	3-1-b	03-Aug-99	3	<i>Rhizophagidae</i> 01	4-1-c	03-Aug-99	1	<i>Scydmaenidae</i> 01	4-3-b	03-Aug-99	2
<i>Ptilliidae</i> 01	3-1-d	03-Aug-99	1	<i>Rhysodidae</i> 01	1-2-c	26-Jul-00	1	<i>Scydmaenidae</i> 02	4-1-b	23-Sep-99	1
<i>Ptilliidae</i> 01	3-1-d	22-Sep-00	2	<i>Rhysodidae</i> 01	3-1-s	03-Aug-99	1	<i>Scydmaenidae</i> 02	4-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	3-1-d	23-Sep-99	1	<i>Rhysodidae</i> 01	3-3-s	26-Jul-00	1	<i>Scydmaenidae</i> 02	4-3-d	23-Sep-99	1
<i>Ptilliidae</i> 01	3-2-b	03-Aug-99	2	<i>Rhysodidae</i> 01	4-1-c	03-Aug-99	1	<i>Scydmaenidae</i> 02	5-3-c	26-Jul-00	1
<i>Ptilliidae</i> 01	3-2-b	23-Sep-99	1	<i>Rhysodidae</i> 01	4-1-c	26-Jul-00	1	<i>Scydmaenidae</i> 03	4-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	3-2-b	26-Jul-00	3	<i>Rhysodidae</i> 01	4-3-c	26-Jul-00	1	<i>Scydmaenidae</i> 04	5-2-b	23-Sep-99	1
<i>Ptilliidae</i> 01	3-3-b	22-Sep-00	2	<i>Scaphidiidae</i> 01	4-1-b	26-Jul-00	2	<i>Scydmaenidae</i> 04	5-3-c	26-Jul-00	1
<i>Ptilliidae</i> 01	3-3-b	26-Jul-00	1	<i>Scaphidiidae</i> 01	5-3-c	03-Aug-99	1	<i>Scydmaenidae</i> 05	1-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	3-3-d	03-Aug-99	1	<i>Scaphidiidae</i> 02	4-3-s	26-Jul-00	1	<i>Scydmaenidae</i> 05	1-3-c	26-Jul-00	1
<i>Ptilliidae</i> 01	3-3-d	23-Sep-99	1	<i>Scarabaeidae</i> 01	1-2-d	22-Sep-00	1	<i>Staphylinidae</i> 01	3-3-s	26-Jul-00	1
<i>Ptilliidae</i> 01	4-1-b	22-Sep-00	3	<i>Scarabaeidae</i> 01	1-3-d	22-Sep-00	1	<i>Staphylinidae</i> 01	4-1-b	22-Sep-00	4
<i>Ptilliidae</i> 01	4-1-b	23-Sep-99	5	<i>Scarabaeidae</i> 01	2-3-d	22-Sep-00	1	<i>Staphylinidae</i> 01	4-1-b	23-Sep-99	1
<i>Ptilliidae</i> 01	4-1-b	23-Sep-99	4	<i>Scarabaeidae</i> 01	3-2-b	26-Jul-00	1	<i>Staphylinidae</i> 01	4-1-b	26-Jul-00	1
<i>Ptilliidae</i> 01	4-1-b	26-Jul-00	55	<i>Scarabaeidae</i> 01	4-3-d	22-Sep-00	1	<i>Staphylinidae</i> 01	4-2-d	03-Aug-99	1
<i>Ptilliidae</i> 01	4-1-c	26-Jul-00	4	<i>Scarabaeidae</i> 01	5-2-d	22-Sep-00	1	<i>Staphylinidae</i> 01	4-3-b	03-Aug-99	1
<i>Staphylinidae</i> 01	4-3-b	22-Sep-00	8	<i>Tachyporinae</i> 02	4-1-d	26-Jul-00	1	<i>Tenebrionidae</i> 04	1-1-s	26-Jul-00	14
<i>Staphylinidae</i> 01	4-3-b	23-Sep-99	3	<i>Tachyporinae</i> 02	4-2-d	03-Aug-99	3	<i>Tenebrionidae</i> 04	1-2-c	03-Aug-99	3
<i>Staphylinidae</i> 01	4-3-c	22-Sep-00	1	<i>Tachyporinae</i> 02	4-2-d	23-Sep-99	1	<i>Tenebrionidae</i> 04	1-2-c	26-Jul-00	2
<i>Staphylinidae</i> 01	5-1-c	03-Aug-99	1	<i>Tachyporinae</i> 02	4-3-b	03-Aug-99	5	<i>Tenebrionidae</i> 04	1-2-s	22-Sep-00	4
<i>Staphylinidae</i> 01	5-3-b	03-Aug-99	1	<i>Tachyporinae</i> 02	4-3-b	22-Sep-00	1	<i>Tenebrionidae</i> 04	1-3-c	03-Aug-99	1
<i>Staphylinidae</i> 02	4-1-d	23-Sep-99	1	<i>Tachyporinae</i> 02	4-3-d	03-Aug-99	3	<i>Tenebrionidae</i> 04	1-3-s	26-Jul-00	2
<i>Staphylinidae</i> 03	2-3-c	03-Aug-99	1	<i>Tachyporinae</i> 02	4-3-d	22-Sep-00	1	<i>Tenebrionidae</i> 04	2-1-c	22-Sep-00	6
<i>Tachyporinae</i> 01	1-1-d	03-Aug-99	1	<i>Tachyporinae</i> 02	4-3-d	23-Sep-99	1	<i>Tenebrionidae</i> 04	2-1-c	26-Jul-00	27
<i>Tachyporinae</i> 01	1-3-d	03-Aug-99	1	<i>Tachyporinae</i> 02	5-3-c	03-Aug-99	1	<i>Tenebrionidae</i> 04	2-1-c	data lost	1
<i>Tachyporinae</i> 01	3-2-d	03-Aug-99	1	<i>Tachyporinae</i> 03	1-1-d	22-Sep-00	2	<i>Tenebrionidae</i> 04	2-1-c	data lost	5
<i>Tachyporinae</i> 01	3-3-d	22-Sep-00	1	<i>Tachyporinae</i> 03	1-2-d	22-Sep-00	1	<i>Tenebrionidae</i> 04	2-1-s	26-Jul-00	1
<i>Tachyporinae</i> 01	4-3-c	03-Aug-99	1	<i>Tachyporinae</i> 03	1-2-d	23-Sep-99	2	<i>Tenebrionidae</i> 04	2-2-c	03-Aug-99	10
<i>Tachyporinae</i> 02	1-1-b	03-Aug-99	2	<i>Tachyporinae</i> 03	1-3-d	22-Sep-00	1	<i>Tenebrionidae</i> 04	2-2-c	26-Jul-00	1
<i>Tachyporinae</i> 02	1-1-d	03-Aug-99	2	<i>Tachyporinae</i> 03	2-2-b	22-Sep-00	2	<i>Tenebrionidae</i> 04	2-2-s	22-Sep-00	1
<i>Tachyporinae</i> 02	1-1-d	22-Sep-00	7	<i>Tachyporinae</i> 03	2-3-d	23-Sep-99	1	<i>Tenebrionidae</i> 04	2-2-s	26-Jul-00	1
<i>Tachyporinae</i> 02	1-1-d	23-Sep-99	2	<i>Tachyporinae</i> 03	3-1-b	22-Sep-00	1	<i>Tenebrionidae</i> 04	2-3-b	22-Sep-00	1

Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count	Morphospecies	Trap #	Date	Count
Tachyporinae 02	1-1-d	26-Jul-00	3	Tachyporinae 03	3-2-b	26-Jul-00	1	Tenebrionidae 04	2-3-c	03-Aug-99	9
Tachyporinae 02	1-2-d	22-Sep-00	1	Tachyporinae 03	3-3-d	03-Aug-99	1	Tenebrionidae 04	2-3-c	22-Sep-00	1
Tachyporinae 02	1-2-d	23-Sep-99	4	Tachyporinae 03	3-3-d	23-Sep-99	1	Tenebrionidae 04	2-3-c	23-Sep-99	6
Tachyporinae 02	1-2-d	26-Jul-00	6	Tachyporinae 03	4-1-b	23-Sep-99	2	Tenebrionidae 04	2-3-c	26-Jul-00	15
Tachyporinae 02	1-3-b	03-Aug-99	1	Tachyporinae 03	4-2-d	26-Jul-00	1	Tenebrionidae 04	2-3-s	22-Sep-00	1
Tachyporinae 02	1-3-b	22-Sep-00	4	Tachyporinae 03	5-2-b	23-Sep-99	1	Tenebrionidae 04	2-3-s	26-Jul-00	3
Tachyporinae 02	1-3-b	26-Jul-00	2	Tachyporinae 03	5-3-b	22-Sep-00	1	Tenebrionidae 04	3-1-c	03-Aug-99	1
Tachyporinae 02	1-3-d	22-Sep-00	1	Tachyporinae 05	1-2-s	03-Aug-99	1	Tenebrionidae 04	3-1-c	22-Sep-00	1
Tachyporinae 02	1-3-d	23-Sep-99	1	Tenebrionidae 01	1-1-b	03-Aug-99	2	Tenebrionidae 04	3-1-c	26-Jul-00	2
Tachyporinae 02	1-3-d	26-Jul-00	1	Tenebrionidae 01	1-1-b	23-Sep-99	1	Tenebrionidae 04	3-2-c	03-Aug-99	1
Tachyporinae 02	2-1-d	03-Aug-99	1	Tenebrionidae 01	1-2-b	22-Sep-00	1	Tenebrionidae 04	3-2-c	26-Jul-00	1
Tachyporinae 02	2-1-d	22-Sep-00	7	Tenebrionidae 01	1-2-b	23-Sep-99	1	Tenebrionidae 04	3-3-c	03-Aug-99	2
Tachyporinae 02	2-1-d	26-Jul-00	1	Tenebrionidae 01	2-1-b	03-Aug-99	2	Tenebrionidae 04	3-3-c	26-Jul-00	2
Tachyporinae 02	2-2-b	03-Aug-99	2	Tenebrionidae 01	2-1-d	03-Aug-99	1	Tenebrionidae 04	4-1-c	26-Jul-00	1
Tachyporinae 02	2-2-b	22-Sep-00	2	Tenebrionidae 01	2-3-b	22-Sep-00	1	Tenebrionidae 04	4-2-c	03-Aug-99	1
Tachyporinae 02	2-2-b	26-Jul-00	9	Tenebrionidae 01	2-3-b	26-Jul-00	1	Tenebrionidae 04	4-2-s	03-Aug-99	3
Tachyporinae 02	2-2-c	03-Aug-99	1	Tenebrionidae 01	4-1-d	23-Sep-99	1	Tenebrionidae 04	4-3-c	03-Aug-99	1
Tachyporinae 02	2-3-b	26-Jul-00	3	Tenebrionidae 01	5-2-b	03-Aug-99	1	Tenebrionidae 04	4-3-c	26-Jul-00	1
Tachyporinae 02	2-3-d	26-Jul-00	2	Tenebrionidae 01	5-2-b	23-Sep-99	1	Tenebrionidae 04	5-1-c	03-Aug-99	9
Tachyporinae 02	3-1-c	22-Sep-00	1	Tenebrionidae 02	1-1-b	03-Aug-99	1	Tenebrionidae 04	5-1-c	23-Sep-99	4
Tachyporinae 02	3-1-d	03-Aug-99	2	Tenebrionidae 02	1-1-d	22-Sep-00	2	Tenebrionidae 04	5-1-c	26-Jul-00	3
Tachyporinae 02	3-1-d	22-Sep-00	1	Tenebrionidae 02	1-3-b	22-Sep-00	3	Tenebrionidae 04	5-2-b	23-Sep-99	1
Tachyporinae 02	3-1-d	26-Jul-00	1	Tenebrionidae 02	1-3-d	26-Jul-00	1	Tenebrionidae 04	5-2-c	03-Aug-99	1
Tachyporinae 02	3-1-d	26-Jul-00	1	Tenebrionidae 02	4-1-b	26-Jul-00	2	Tenebrionidae 04	5-2-c	22-Sep-00	8
Tachyporinae 02	3-2-d	23-Sep-99	1	Tenebrionidae 02	4-3-b	22-Sep-00	1	Tenebrionidae 04	5-2-c	26-Jul-00	3
Tachyporinae 02	3-3-b	03-Aug-99	1	Tenebrionidae 02	5-1-d	03-Aug-99	1	Tenebrionidae 04	5-2-s	22-Sep-00	1
Tachyporinae 02	3-3-b	22-Sep-00	1	Tenebrionidae 02	5-2-d	26-Jul-00	1	Tenebrionidae 05	3-1-c	03-Aug-99	1
Tachyporinae 02	3-3-b	26-Jul-00	6	Tenebrionidae 03	1-1-b	03-Aug-99	1	Tenebrionidae 05	3-1-c	23-Sep-99	1
Tachyporinae 02	4-1-b	22-Sep-00	1	Tenebrionidae 04	1-1-c	03-Aug-99	3	Tenebrionidae 05	4-1-c	22-Sep-00	2
Tachyporinae 02	4-1-b	26-Jul-00	1	Tenebrionidae 04	1-1-c	22-Sep-00	11	Tenebrionidae 06	3-1-c	23-Sep-99	2
Tachyporinae 02	4-1-c	03-Aug-99	1	Tenebrionidae 04	1-1-c	23-Sep-99	8	Tenebrionidae 06	3-2-c	26-Jul-00	1
Tachyporinae 02	4-1-c	26-Jul-00	1	Tenebrionidae 04	1-1-c	26-Jul-00	32	Tenebrionidae 07	2-3-c	22-Sep-00	1
Tachyporinae 02	4-1-d	22-Sep-00	1	Tenebrionidae 04	1-1-s	03-Aug-99	1	Tenebrionidae 07	3-1-d	23-Sep-99	1
Tenebrionidae 08	3-3-b	22-Sep-00	1								
Tenebrionidae 08	1-3-b	22-Sep-00	1								
Tenebrionidae 09	1-2-c	22-Sep-00	1								
Tenebrionidae 10	4-2-c	03-Aug-99	1								
Tenebrionidae 10	4-1-c	03-Aug-99	1								
Tenebrionidae 11	2-3-c	03-Aug-99	1								
Throscidae 01	1-2-b	03-Aug-99	1								
Throscidae 01	1-2-c	03-Aug-99	1								
Throscidae 01	1-3-b	03-Aug-99	1								
Throscidae 01	1-3-b	26-Jul-00	1								
Throscidae 01	2-2-c	03-Aug-99	1								
Throscidae 01	4-1-b	23-Sep-99	1								
Unknown 03	1-2-b	26-Jul-00	1								
Unknown 04	2-3-d	03-Aug-99	1								

Appendix 2. (begins next page). Values for wood density change and saprotroph community values measured at two field locations near Balck's Mt. California. Refer to Chapters ² and 3 for details about the sites 'PEST' and 'BLACKS', respectively. Samples are listed by their plot numbers, which correspond to particular screening or land use treatments (harvest and burn), depending on the study. Three tissue types are listed for each sample, heartwood, sapwood, and outerbark. Sample characters including sample year, tree from which sample came are also given. Data codes are as follows: WWI (wet wieght initial (g)); DWI (Dry weight initial (g)); WWF (Wet weight final (g)); WVI (Wet volume initial (ml)); WVF (Wet volume final (ml)); DVI (Dry volume initial (ml)); DVF (Dry volume final (ml)); TOPDI (Top diameter (cm)); BOTDI (Bottom diameter (cm)); Length (cm); Area (Average area of cross section (cm²)); BB (Area of bark beetle consumption in the phloem (cm²)); WBP (Area of woodborer consumption in the phloem (cm²)); STAIN (Average cross section area of stain fungi in sapwood (cm²)); WBS (Average cross section area of woodborer in sapwood (cm²)); ROT (Average cross section area of decay fungi in sapwood (cm²)).

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	42-	Heartwood	NA	1999	42-3	5	High Diversity	No Burn	2.55	1.86	5.89	4.69	9.38	3.72	2.00	17.60	18.80	60.00	3430.62	0.00	0.00	65.00	74.25	0.00
BLACKS	42-	Heartwood	NA	1999	42-2	15	High Diversity	No Burn	3.43	2.56	11.75	4.69	18.75	4.65	2.75	14.60	15.50	64.00	3025.98	373.00	0.00	153.50	0.00	0.00
BLACKS	42-	Heartwood	NA	1999	42-1	16	High Diversity	No Burn	3.51	2.06	5.23	7.03	5.86	4.65	1.00	18.80	20.40	60.00	3694.51	0.00	0.00	27.00	0.00	0.00
BLACKS	42-	Heartwood	NA	1999	42-7	1	High Diversity	No Burn	8.49	6.01	4.22	14.06	7.03	9.30	1.00	13.00	14.00	58.00	2459.86	256.00	5.00	52.50	0.00	0.00
BLACKS	42-	Outer Bark	NA	1999	42-3	5	High Diversity	No Burn	16.63	9.71	18.12	32.82	42.19	23.25	4.50	17.60	18.80	60.00	3430.62	0.00	0.00	65.00	74.25	0.00
BLACKS	42-	Outer Bark	NA	1999	42-2	15	High Diversity	No Burn	13.51	7.31	23.74	16.41	37.50	13.95		14.60	15.50	64.00	3025.98	373.00	0.00	153.50	0.00	0.00
BLACKS	42-	Outer Bark	NA	1999	42-1	16	High Diversity	No Burn	31.08	11.17	12.99	51.57	23.44	25.58	2.00	18.80	20.40	60.00	3694.51	0.00	0.00	27.00	0.00	0.00
BLACKS	42-	Outer Bark	NA	1999	42-7	1	High Diversity	No Burn	22.75	10.9	10.85	37.50	18.75	30.23	2.50	13.00	14.00	58.00	2459.86	256.00	5.00	52.50	0.00	0.00
BLACKS	42-	Sapwood	NA	1999	42-3	5	High Diversity	No Burn	65.17	27.25	71.44	65.63	117.20	64.17	22.00	17.60	18.80	60.00	3430.62	0.00	0.00	65.00	74.25	0.00
BLACKS	42-	Sapwood	NA	1999	42-2	15	High Diversity	No Burn	44.52	20.45	41.35	65.63	42.19	53.48	8.50	14.60	15.50	64.00	3025.98	373.00	0.00	153.50	0.00	0.00
BLACKS	42-	Sapwood	NA	1999	42-1	16	High Diversity	No Burn	61.25	24.4	100.96	65.63	152.36	60.45	20.00	18.80	20.40	60.00	3694.51	0.00	0.00	27.00	0.00	0.00
BLACKS	42-	Sapwood	NA	1999	42-7	1	High Diversity	No Burn	78.73	35.53	62.49	98.45	84.38	90.68	16.00	13.00	14.00	58.00	2459.86	256.00	5.00	52.50	0.00	0.00
BLACKS	42+	Heartwood	NA	1999	42+4	4	High Diversity	Burn	11.39	8.34	23.79	18.75	30.47	11.63	6.50	22.30	22.30	59.00	4133.39	3454.39	0.00	80.00	130.90	3.00
BLACKS	42+	Heartwood	NA	1999	42+3	7	High Diversity	Burn	5.66	3.01	11.12	11.72	14.06	9.30	3.00	17.20	17.80	59.00	3243.69	24.20	0.00	71.50	0.00	0.00
BLACKS	42+	Heartwood	NA	1999	42+8	14	High Diversity	Burn	2.89	1.98	1.61	5.86	2.34	4.65	0.50	14.10	16.10	58.00	2751.40	0.00	798.00	24.00	56.05	0.00
BLACKS	42+	Heartwood	NA	1999	42+2	15	High Diversity	Burn	3.43	2.56	18.1	4.69	21.10	4.65	4.00	19.40	20.40	62.00	3876.09	0.00	0.00	0.00	0.00	0.00
BLACKS	42+	Heartwood	NA	1999	42+7	18	High Diversity	Burn	3.97	3.09	27.76	7.03	30.47	5.58	6.50	22.60	23.80	54.00	3935.78	505.00	580.00	187.00	3.10	29.00
BLACKS	42+	Outer Bark	NA	1999	42+4	4	High Diversity	Burn	17.13	10.33	13.6	28.13	28.13	23.25	5.50	22.30	22.30	59.00	4133.39	3454.39	0.00	80.00	130.90	3.00
BLACKS	42+	Outer Bark	NA	1999	42+3	7	High Diversity	Burn	23.08	12.56	13.79	37.50	32.82	25.58	6.00	17.20	17.80	59.00	3243.69	24.20	0.00	71.50	0.00	0.00
BLACKS	42+	Outer Bark	NA	1999	42+8	14	High Diversity	Burn	22.02	12.15	11.13	39.85	21.10	26.97	3.00	14.10	16.10	58.00	2751.40	0.00	798.00	24.00	56.05	0.00
BLACKS	42+	Outer Bark	NA	1999	42+2	15	High Diversity	Burn	13.51	7.31	12.17	16.41	23.44	13.95	7.20	19.40	20.40	62.00	3876.09	0.00	0.00	0.00	0.00	0.00
BLACKS	42+	Outer Bark	NA	1999	42+7	18	High Diversity	Burn	19.02	11.08	14.73	37.50	35.16	25.58	6.25	22.60	23.80	54.00	3935.78	505.00	580.00	187.00	3.10	29.00
BLACKS	42+	Sapwood	NA	1999	42+4	4	High Diversity	Burn	79.94	34.55	90.37	91.42	93.76	81.38	17.50	22.30	22.30	59.00	4133.39	3454.39	0.00	80.00	130.90	3.00
BLACKS	42+	Sapwood	NA	1999	42+3	7	High Diversity	Burn	71.8	32.86	93.37	89.07	105.48	83.70	21.50	17.20	17.80	59.00	3243.69	24.20	0.00	71.50	0.00	0.00
BLACKS	42+	Sapwood	NA	1999	42+8	14	High Diversity	Burn	117.7	50.05	82.61	138.30	89.07	116.25	17.50	14.10	16.10	58.00	2751.40	0.00	798.00	24.00	56.05	0.00
BLACKS	42+	Sapwood	NA	1999	42+2	15	High Diversity	Burn	44.52	20.45	85.51	65.63	86.73	53.48	18.00	19.40	20.40	62.00	3876.09	0.00	0.00	0.00	0.00	0.00
BLACKS	42+	Sapwood	NA	1999	42+7	18	High Diversity	Burn	83	36.85	83.3	112.51	103.14	106.95	20.25	22.60	23.80	54.00	3935.78	505.00	580.00	187.00	3.10	29.00
BLACKS	44-	Heartwood	NA	1999	44-7	7	Low Diversity	No Burn	5.66	3.01	4.47	11.72	9.38	9.30	1.25	13.00	14.50	58.00	2505.42	0.00	0.00	412.00	1.97	0.00
BLACKS	44-	Heartwood	NA	1999	44-5	10	Low Diversity	No Burn	2.6	1.61	5.5	4.22	9.38	0.42	1.50	13.50	14.30	61.00	2663.75	1324.00	114.00	22.00	0.00	0.00
BLACKS	44-	Heartwood	NA	1999	44-1	11	Low Diversity	No Burn	17.14	11.63	14.05	21.10	23.44	18.60	3.50	17.30	17.80	60.00	3308.09	0.00	0.00	4.00	0.00	0.00
BLACKS	44-	Heartwood	NA	1999	44-6	18	Low Diversity	No Burn	3.97	3.09	7.07	7.03	18.75	5.58	5.00	21.00	21.00	58.00	3826.46	663.00	36.00	416.00	0.00	0.00
BLACKS	44-	Outer Bark	NA	1999	44-7	7	Low Diversity	No Burn	23.08	12.56	12.44	37.50	23.44	25.58	3.50	13.00	14.50	58.00	2505.42	0.00	0.00	412.00	1.97	0.00
BLACKS	44-	Outer Bark	NA	1999	44-5	10	Low Diversity	No Burn	15.72	8.25	6.72	23.44	14.06	20.93	2.75	13.50	14.30	61.00	2663.75	1324.00	114.00	22.00	0.00	0.00
BLACKS	44-	Outer Bark	NA	1999	44-1	11	Low Diversity	No Burn	25.17	15.87	12.59	51.57	28.13	41.85	5.00	17.30	17.80	60.00	3308.09	0.00	0.00	4.00	0.00	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	44-	Outer Bark	NA	1999	44-6	18	Low Diversity	No Burn	19.02	11.08	11.88	37.50	23.44	25.58	15.00	21.00	21.00	58.00	3826.46	663.00	36.00	416.00	0.00	0.00
BLACKS	44-	Sapwood	NA	1999	44-7	7	Low Diversity	No Burn	71.8	32.86	43.98	89.07	56.26	83.70	11.50	13.00	14.50	58.00	2505.42	0.00	0.00	412.00	1.97	0.00
BLACKS	44-	Sapwood	NA	1999	44-5	10	Low Diversity	No Burn	73.61	31.52	76.63	79.70	84.38	72.08	15.00	13.50	14.30	61.00	2663.75	1324.00	114.00	22.00	0.00	0.00
BLACKS	44-	Sapwood	NA	1999	44-1	11	Low Diversity	No Burn	55.48	24.09	46.49	60.94	60.94	58.13	11.00	17.30	17.80	60.00	3308.09	0.00	0.00	4.00	0.00	0.00
BLACKS	44-	Sapwood	NA	1999	44-6	18	Low Diversity	No Burn	83	36.85	58.95	112.51	79.70	106.9	2.50	21.00	21.00	58.00	3826.46	663.00	36.00	416.00	0.00	0.00
BLACKS	44+	Heartwood	NA	1999	44+7	3	Low Diversity	Burn	1.82	1.25	13.46	4.69	16.41	3.26	3.00	18.10	18.80	62.00	3593.66	1178.00	230.00	24.00	0.25	0.00
BLACKS	44+	Heartwood	NA	1999	44+3	6	Low Diversity	Burn	10.35	6.2	3.52	11.72	23.44	9.30		19.50	21.80	65.00	4216.80	0.00	1841.00	20.00	0.00	0.00
BLACKS	44+	Heartwood	NA	1999	44+4	8	Low Diversity	Burn	7.54	5.41	4.74	11.72	7.03	8.37	2.00	20.50	21.00	58.00	3780.90	330.00	690.00	9.00	24.00	0.00
BLACKS	44+	Heartwood	NA	1999	44+2	14	Low Diversity	Burn	2.89	1.98	2.42	5.86		4.65		16.70	17.50	57.00	3062.11	2669.61	0.00	67.50	0.00	0.00
BLACKS	44+	Outer Bark	NA	1999	44+7	3	Low Diversity	Burn	20.9	11.59	16.78	28.13	32.82	23.25	5.00	18.10	18.80	62.00	3593.66	1178.00	230.00	24.00	0.25	0.00
BLACKS	44+	Outer Bark	NA	1999	44+3	6	Low Diversity	Burn	29.74	17.2	19.21	51.57	46.88	39.53	8.50	19.50	21.80	65.00	4216.80	0.00	1841.00	20.00	0.00	0.00
BLACKS	44+	Outer Bark	NA	1999	44+4	8	Low Diversity	Burn	25.17	13.68	14.05	42.19	28.13	27.90	4.50	20.50	21.00	58.00	3780.90	330.00	690.00	9.00	24.00	0.00
BLACKS	44+	Outer Bark	NA	1999	44+2	14	Low Diversity	Burn	22.02	12.15	9.31	39.85	21.10	26.97	4.00	16.70	17.50	57.00	3062.11	2669.61	0.00	67.50	0.00	0.00
BLACKS	44+	Sapwood	NA	1999	44+7	3	Low Diversity	Burn	105.11	40.86	58.98	112.51	32.82	106.9	7.00	18.10	18.80	62.00	3593.66	1178.00	230.00	24.00	0.25	0.00
BLACKS	44+	Sapwood	NA	1999	44+3	6	Low Diversity	Burn	93.97	36.02	73.57	98.45	65.63	90.68	13.00	19.50	21.80	65.00	4216.80	0.00	1841.00	20.00	0.00	0.00
BLACKS	44+	Sapwood	NA	1999	44+4	8	Low Diversity	Burn	49.55	22.51	30.28	84.38	65.63	60.45	12.75	20.50	21.00	58.00	3780.90	330.00	690.00	9.00	24.00	0.00
BLACKS	44+	Sapwood	NA	1999	44+2	14	Low Diversity	Burn	117.7	50.05	30.77	138.30	46.88	116.2	9.00	16.70	17.50	57.00	3062.11	2669.61	0.00	67.50	0.00	0.00
BLACKS	45-	Heartwood	NA	1999	45-8	3	Low Diversity	No Burn	1.82	1.25	6.18	4.69	9.38	3.26	1.75	17.00	16.50	62.00	3262.54	297.00	489.00	80.00	19.10	0.00
BLACKS	45-	Heartwood	NA	1999	45-7	6	Low Diversity	No Burn	10.35	6.2	8.82	11.72	11.72	9.30	2.25	16.80	17.20	62.00	3311.24	2.00	0.00	224.00	0.00	0.00
BLACKS	45-	Heartwood	NA	1999	45-4	11	Low Diversity	No Burn	17.14	11.63	16.62	21.10	16.41	18.60	3.50	15.80	16.50	56.00	2841.25	1803.00	127.00	58.00	12.50	77.00
BLACKS	45-	Heartwood	NA	1999	45-3	14	Low Diversity	No Burn	2.89	1.98	14.17	5.86	14.06	4.65	3.25	21.20	22.50	61.50	4221.59	2783.00	0.00	237.00	0.00	0.00
BLACKS	45-	Outer Bark	NA	1999	45-8	3	Low Diversity	No Burn	20.9	11.59	11.23	28.13	18.75	23.25	3.00	17.00	16.50	62.00	3262.54	297.00	489.00	80.00	19.10	0.00
BLACKS	45-	Outer Bark	NA	1999	45-7	6	Low Diversity	No Burn	29.74	17.2		51.57		39.53		16.80	17.20	62.00	3311.24	2.00	0.00	224.00	0.00	0.00
BLACKS	45-	Outer Bark	NA	1999	45-4	11	Low Diversity	No Burn	25.17	15.87	17.29	51.57	37.50	41.85	6.50	15.80	16.50	56.00	2841.25	1803.00	127.00	58.00	12.50	77.00
BLACKS	45-	Outer Bark	NA	1999	45-3	14	Low Diversity	No Burn	22.02	12.15	18.66	39.85	44.54	26.97	8.00	21.20	22.50	61.50	4221.59	2783.00	0.00	237.00	0.00	0.00
BLACKS	45-	Sapwood	NA	1999	45-8	3	Low Diversity	No Burn	105.11	40.86	76.96	112.51	89.07	106.9	18.00	17.00	16.50	62.00	3262.54	297.00	489.00	80.00	19.10	0.00
BLACKS	45-	Sapwood	NA	1999	45-7	6	Low Diversity	No Burn	93.97	36.02	85.55	98.45	77.35	90.68	16.50	16.80	17.20	62.00	3311.24	2.00	0.00	224.00	0.00	0.00
BLACKS	45-	Sapwood	NA	1999	45-4	11	Low Diversity	No Burn	55.48	24.09	72.63	60.94	75.01	58.13	14.50	15.80	16.50	56.00	2841.25	1803.00	127.00	58.00	12.50	77.00
BLACKS	45-	Sapwood	NA	1999	45-3	14	Low Diversity	No Burn	117.7	50.05	70.32	138.30	93.76	116.2	17.00	21.20	22.50	61.50	4221.59	2783.00	0.00	237.00	0.00	0.00
BLACKS	45+	Heartwood	NA	1999	45+4	5	Low Diversity	Burn	2.55	1.86	4.72	4.69	4.69	3.72	1.00	12.30	11.00	65.00	2378.97	2269.97	0.00	23.50	4.30	0.00
BLACKS	45+	Heartwood	NA	1999	45+8	10	Low Diversity	Burn	2.6	1.61		4.22		0.42		12.80	13.60	62.00	2571.08	34.70	0.00	7.85	0.25	0.00
BLACKS	45+	Heartwood	NA	1999	45+1	12	Low Diversity	Burn	5.76	3.63	18.55	9.38	18.75	9.30	4.50	20.20	19.70	62.00	3885.83	0.00	0.00	0.50	0.50	0.00
BLACKS	45+	Heartwood	NA	1999	45+3	14	Low Diversity	Burn	2.89	1.98	4.86	5.86	4.69	4.65	0.75	20.00	21.00	56.00	3606.55	2344.25	0.00	41.50	1.90	0.00
BLACKS	45+	Outer Bark	NA	1999	45+4	5	Low Diversity	Burn	16.63	9.71	17.47	32.82	28.13	23.25	4.00	12.30	11.00	65.00	2378.97	2269.97	0.00	23.50	4.30	0.00
BLACKS	45+	Outer Bark	NA	1999	45+8	10	Low Diversity	Burn	15.72	8.25	15.44	23.44	25.78	20.93	4.00	12.80	13.60	62.00	2571.08	34.70	0.00	7.85	0.25	0.00
BLACKS	45+	Outer Bark	NA	1999	45+1	12	Low Diversity	Burn	14.45	8.4		28.13		20.93		20.20	19.70	62.00	3885.83	0.00	0.00	0.50	0.50	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	45+	Outer Bark	NA	1999	45+3	14	Low Diversity	Burn	22.02	12.15	14.17	39.85	79.70	26.97	15.50	20.00	21.00	56.00	3606.55	2344.25	0.00	41.50	1.90	0.00
BLACKS	45+	Sapwood	NA	1999	45+4	5	Low Diversity	Burn	65.17	27.25	38.8	65.63	75.01	64.17	13.50	12.30	11.00	65.00	2378.97	2269.97	0.00	23.50	4.30	0.00
BLACKS	45+	Sapwood	NA	1999	45+8	10	Low Diversity	Burn	73.61	31.52	72.18	79.70	96.10	72.08	20.50	12.80	13.60	62.00	2571.08	34.70	0.00	7.85	0.25	0.00
BLACKS	45+	Sapwood	NA	1999	45+1	12	Low Diversity	Burn	66.16	27.34	81.75	79.70	84.38	69.75	16.50	20.20	19.70	62.00	3885.83	0.00	0.00	0.50	0.50	0.00
BLACKS	45+	Sapwood	NA	1999	45+3	14	Low Diversity	Burn	117.7	50.05	70.41	138.30	75.01	116.25	13.50	20.00	21.00	56.00	3606.55	2344.25	0.00	41.50	1.90	0.00
BLACKS	47-	Heartwood	NA	1999	47-3	4	High Diversity	No Burn	11.39	8.34	22.51	18.75	30.47	11.63	5.00	22.80	24.00	59.00	4337.28	2537.00	247.00	452.00	25.50	0.00
BLACKS	47-	Heartwood	NA	1999	47-4	4	High Diversity	No Burn	11.39	8.34	11.89	18.75	18.75	11.63	3.50	20.90	21.00	56.00	3685.71	0.00	0.00	674.00	0.00	0.00
BLACKS	47-	Heartwood	NA	1999	47-8	1	High Diversity	No Burn	8.49	6.01	4.52	14.06	7.03	9.30	1.25	14.00	15.30	61.00	2807.48	557.00	541.00	296.00	82.00	0.00
BLACKS	47-	Outer Bark	NA	1999	47-3	4	High Diversity	No Burn	17.13	10.33	21.59	28.13	46.88	23.25	9.50	22.80	24.00	59.00	4337.28	2537.00	247.00	452.00	25.50	0.00
BLACKS	47-	Outer Bark	NA	1999	47-4	4	High Diversity	No Burn	17.13	10.33	14.08	28.13	28.13	23.25	5.00	20.90	21.00	56.00	3685.71	0.00	0.00	674.00	0.00	0.00
BLACKS	47-	Outer Bark	NA	1999	47-8	1	High Diversity	No Burn	22.75	10.9	10.58	37.50	14.06	30.23	2.50	14.00	15.30	61.00	2807.48	557.00	541.00	296.00	82.00	0.00
BLACKS	47-	Sapwood	NA	1999	47-3	4	High Diversity	No Burn	79.94	34.55	77.61	91.42	89.07	81.38	18.00	22.80	24.00	59.00	4337.28	2537.00	247.00	452.00	25.50	0.00
BLACKS	47-	Sapwood	NA	1999	47-4	4	High Diversity	No Burn	79.94	34.55	82.32	91.42	93.76	81.38	17.50	20.90	21.00	56.00	3685.71	0.00	0.00	674.00	0.00	0.00
BLACKS	47-	Sapwood	NA	1999	47-8	1	High Diversity	No Burn	78.73	35.53	62.9	98.45	84.38	90.68	17.50	14.00	15.30	61.00	2807.48	557.00	541.00	296.00	82.00	0.00
BLACKS	47+	Heartwood	NA	1999	47+3	13	High Diversity	Burn	2.76	1.95		4.69		3.72		12.60	13.80	62.00	2571.08	0.00	0.00	128.50	0.00	0.00
BLACKS	47+	Heartwood	NA	1999	47+4	16	High Diversity	Burn	3.51	2.06	6.3	7.03	9.38	4.65	2.50	14.20	15.00	55.00	2522.70	588.00	0.00	236.50	0.00	0.00
BLACKS	47+	Heartwood	NA	1999	47+7	17	High Diversity	Burn	1.37	0.95	7.86	4.69	9.38	3.72	1.50	18.30	19.10	57.00	3348.62	0.00	0.00	378.00	0.00	0.00
BLACKS	47+	Heartwood	NA	1999	47+6	17	High Diversity	Burn	1.37	0.95		4.69		3.72		15.80	16.00	64.00	3196.88	985.00	0.00	88.00	0.00	0.00
BLACKS	47+	Outer Bark	NA	1999	47+3	13	High Diversity	Burn	18.3	9.06	12.18	32.82	18.75	18.60	3.50	12.60	13.80	62.00	2571.08	0.00	0.00	128.50	0.00	0.00
BLACKS	47+	Outer Bark	NA	1999	47+4	16	High Diversity	Burn	31.08	11.17	15.89	51.57	23.44	25.58	3.50	14.20	15.00	55.00	2522.70	588.00	0.00	236.50	0.00	0.00
BLACKS	47+	Outer Bark	NA	1999	47+7	17	High Diversity	Burn	18.09	10.26	13.51	37.50	42.19	25.58	6.50	18.30	19.10	57.00	3348.62	0.00	0.00	378.00	0.00	0.00
BLACKS	47+	Outer Bark	NA	1999	47+6	17	High Diversity	Burn	18.09	10.26		37.50		25.58		15.80	16.00	64.00	3196.88	985.00	0.00	88.00	0.00	0.00
BLACKS	47+	Sapwood	NA	1999	47+3	13	High Diversity	Burn	44.73	20.11	60.82	51.57	65.63	46.50	14.00	12.60	13.80	62.00	2571.08	0.00	0.00	128.50	0.00	0.00
BLACKS	47+	Sapwood	NA	1999	47+4	16	High Diversity	Burn	61.25	24.4	91.6	65.63	93.76	60.45	17.50	14.20	15.00	55.00	2522.70	588.00	0.00	236.50	0.00	0.00
BLACKS	47+	Sapwood	NA	1999	47+7	17	High Diversity	Burn	95.51	35.63	80.53	103.14	79.70	93.00	16.00	18.30	19.10	57.00	3348.62	0.00	0.00	378.00	0.00	0.00
BLACKS	47+	Sapwood	NA	1999	47+6	17	High Diversity	Burn	95.51	35.63		103.14		93.00		15.80	16.00	64.00	3196.88	985.00	0.00	88.00	0.00	0.00
BLACKS	RNA A	Heartwood	NA	1999	RNA A-4	2	Control	No Burn	3.15	1.9	7.26	7.03	9.38	5.58	11.50	19.00	18.50	56.00	3298.67	394.00	0.00	56.00	5.60	0.00
BLACKS	RNA A	Heartwood	NA	1999	RNA A-3	8	Control	No Burn	7.54	5.41	5.2	11.72	9.38	8.37	16.50	18.60	19.80	62.00	3739.75	3154.75	0.00	139.00	14.50	0.00
BLACKS	RNA A	Heartwood	NA	1999	RNA A-6	10	Control	No Burn	2.6	1.61	6.13	4.22	7.03	0.42		17.40	18.20	56.00	3131.54	2448.54	0.00	16.00	24.30	4.00
BLACKS	RNA A	Heartwood	NA	1999	RNA A-2	11	Control	No Burn	17.14	11.63	13.59	21.10	14.06	18.60	1.50	18.00	19.50	62.00	3652.10	2242.00	257.50	8.00	100.20	1.00
BLACKS	RNA A	Outer Bark	NA	1999	RNA A-4	2	Control	No Burn	32.69	17.34	11.53	65.63	23.44	44.18	0.00	19.00	18.50	56.00	3298.67	394.00	0.00	56.00	5.60	0.00
BLACKS	RNA A	Outer Bark	NA	1999	RNA A-3	8	Control	No Burn	25.17	13.68	11.42	42.19	18.75	27.90	0.00	18.60	19.80	62.00	3739.75	3154.75	0.00	139.00	14.50	0.00
BLACKS	RNA A	Outer Bark	NA	1999	RNA A-6	10	Control	No Burn	15.72	8.25	10.42	23.44	23.44	20.93	2.00	17.40	18.20	56.00	3131.54	2448.54	0.00	16.00	24.30	4.00
BLACKS	RNA A	Outer Bark	NA	1999	RNA A-2	11	Control	No Burn	25.17	15.87	12.46	51.57	28.13	41.85	1.00	18.00	19.50	62.00	3652.10	2242.00	257.50	8.00	100.20	1.00
BLACKS	RNA A	Sapwood	NA	1999	RNA A-4	2	Control	No Burn	70.85	32.21	33.97	89.07	37.50	83.70	3.00	19.00	18.50	56.00	3298.67	394.00	0.00	56.00	5.60	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	RNA A	Sapwood	NA	1999	RNA A-3	8	Control	No Burn	49.55	22.51	39.92	84.38	56.26	60.45	7.75	18.60	19.80	62.00	3739.75	3154.75	0.00	139.00	14.50	0.00
BLACKS	RNA A	Sapwood	NA	1999	RNA A-6	10	Control	No Burn	73.61	31.52	87.94	79.70	93.76	72.08	11.50	17.40	18.20	56.00	3131.54	2448.54	0.00	16.00	24.30	4.00
BLACKS	RNA A	Sapwood	NA	1999	RNA A-2	11	Control	No Burn	55.48	24.09	37.96	60.94	46.88	58.13	7.00	18.00	19.50	62.00	3652.10	2242.00	257.50	8.00	100.20	1.00
BLACKS	RNA B	Heartwood	NA	1999	RNA B-4	1	Control	Burn	8.49	6.01	4.32	14.06	9.38	9.30	6.00	23.00	23.60	55.00	4025.95	86.00	0.00	3.50	0.00	0.00
BLACKS	RNA B	Heartwood	NA	1999	RNA B-1	3	Control	Burn	1.82	1.25	14.1	4.69	16.41	3.26	12.00	19.20	20.00	56.00	3448.21	1035.00	872.00	4.50	21.95	0.00
BLACKS	RNA B	Heartwood	NA	1999	RNA B-2	4	Control	Burn	11.39	8.34	9.22	18.75	9.38	11.63	3.50	17.80	18.50	62.00	3535.23	31.50	101.00	85.00	0.00	0.00
BLACKS	RNA B	Heartwood	NA	1999	RNA B-7	11	Control	Burn	17.14	11.63	23.64	21.10	32.82	18.60	4.50	23.00	23.60	56.00	4099.15	86.00	0.00	13.00	76.85	0.00
BLACKS	RNA B	Outer Bark	NA	1999	RNA B-4	1	Control	Burn	22.75	10.9	9.63	37.50	18.75	30.23	6.00	23.00	23.60	55.00	4025.95	86.00	0.00	3.50	0.00	0.00
BLACKS	RNA B	Outer Bark	NA	1999	RNA B-1	3	Control	Burn	20.9	11.59	20.57	28.13	42.19	23.25	3.75	19.20	20.00	56.00	3448.21	1035.00	872.00	4.50	21.95	0.00
BLACKS	RNA B	Outer Bark	NA	1999	RNA B-2	4	Control	Burn	17.13	10.33	22.03	28.13	32.82	23.25	20.50	17.80	18.50	62.00	3535.23	31.50	101.00	85.00	0.00	0.00
BLACKS	RNA B	Outer Bark	NA	1999	RNA B-7	11	Control	Burn	25.17	15.87	19.34	51.57	49.22	41.85	21.00	23.00	23.60	56.00	4099.15	86.00	0.00	13.00	76.85	0.00
BLACKS	RNA B	Sapwood	NA	1999	RNA B-4	1	Control	Burn	78.73	35.53	55.72	98.45	79.70	90.68	20.00	23.00	23.60	55.00	4025.95	86.00	0.00	3.50	0.00	0.00
BLACKS	RNA B	Sapwood	NA	1999	RNA B-1	3	Control	Burn	105.11	40.86	80.61	112.51	77.35	106.95	26.50	19.20	20.00	56.00	3448.21	1035.00	872.00	4.50	21.95	0.00
BLACKS	RNA B	Sapwood	NA	1999	RNA B-2	4	Control	Burn	79.94	34.55	30.29	91.42	32.82	81.38	13.75	17.80	18.50	62.00	3535.23	31.50	101.00	85.00	0.00	0.00
BLACKS	RNA B	Sapwood	NA	1999	RNA B-7	11	Control	Burn	55.48	24.09	63.5	60.94	60.94	58.13	12.50	23.00	23.60	56.00	4099.15	86.00	0.00	13.00	76.85	0.00
BLACKS	RNA D	Heartwood	NA	1999	RNA D-7	5	Control	No Burn	2.55	1.86	9.84	4.69	11.72	3.72	14.50	16.30	16.80	61.00	3171.59	232.90	2333.00	92.00	0.00	0.00
BLACKS	RNA D	Heartwood	NA	1999	RNA D-3	12	Control	No Burn	5.76	3.63	22.92	9.38	23.44	9.30	18.00	15.30	16.20	58.00	2869.84	2360.00	0.00	403.00	0.00	0.00
BLACKS	RNA D	Heartwood	NA	1999	RNA D-5	13	Control	No Burn	2.76	1.95	18.42	4.69	23.44	3.72	18.00	19.80	20.80	56.50	3603.25	139.00	0.00	157.00	0.00	0.00
BLACKS	RNA D	Heartwood	NA	1999	RNA D-8	16	Control	No Burn	3.51	2.06	4.42	7.03	7.03	4.65	11.50	17.50	18.20	59.00	3308.57	2529.57	0.00	20.00	1.10	0.00
BLACKS	RNA D	Outer Bark	NA	1999	RNA D-7	5	Control	No Burn	16.63	9.71	23.17	32.82	46.88	23.25	8.00	16.30	16.80	61.00	3171.59	232.90	2333.00	92.00	0.00	0.00
BLACKS	RNA D	Outer Bark	NA	1999	RNA D-3	12	Control	No Burn	14.45	8.4	13.03	28.13	23.44	20.93	9.50	15.30	16.20	58.00	2869.84	2360.00	0.00	403.00	0.00	0.00
BLACKS	RNA D	Outer Bark	NA	1999	RNA D-5	13	Control	No Burn	18.3	9.06	13.86	32.82	30.47	18.60	3.50	19.80	20.80	56.50	3603.25	139.00	0.00	157.00	0.00	0.00
BLACKS	RNA D	Outer Bark	NA	1999	RNA D-8	16	Control	No Burn	31.08	11.17	14.22	51.57	44.54	25.58	8.00	17.50	18.20	59.00	3308.57	2529.57	0.00	20.00	1.10	0.00
BLACKS	RNA D	Sapwood	NA	1999	RNA D-7	5	Control	No Burn	65.17	27.25	57.49	65.63	65.63	64.17	3.25	16.30	16.80	61.00	3171.59	232.90	2333.00	92.00	0.00	0.00
BLACKS	RNA D	Sapwood	NA	1999	RNA D-3	12	Control	No Burn	66.16	27.34	83.44	79.70	84.38	69.75	3.00	15.30	16.20	58.00	2869.84	2360.00	0.00	403.00	0.00	0.00
BLACKS	RNA D	Sapwood	NA	1999	RNA D-5	13	Control	No Burn	44.73	20.11	57.63	51.57	65.63	46.50	1.75	19.80	20.80	56.50	3603.25	139.00	0.00	157.00	0.00	0.00
BLACKS	RNA D	Sapwood	NA	1999	RNA D-8	16	Control	No Burn	61.25	24.4	82.15	65.63	79.70	60.45	0.00	17.50	18.20	59.00	3308.57	2529.57	0.00	20.00	1.10	0.00
BLACKS	42-	Heartwood	NA	2000	42-8	2	High Diversity	No Burn	3.15	1.9	15.5	8.11	21.62	6.49	11.00	19.20	19.50	52.00	3161.07	0.00	0.00	548.00	0.00	0.00
BLACKS	42-	Heartwood	NA	2000	42-5	6	High Diversity	No Burn	10.35	6.2		13.51		10.81	6.50	12.80	14.20	60.00	2544.69	180.00	0.00	40.00	0.23	0.00
BLACKS	42-	Heartwood	NA	2000	42-6	15	High Diversity	No Burn	3.43	2.56	7.97	5.41	10.81	5.41	9.50	15.60	16.20	57.00	2847.22	1236.61	8.00	226.00	0.00	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	42-	Outer Bark	NA	2000	42-8	2	High Diversity	No Burn	32.69	17.34	14.97	75.67	32.43	51.35	6.50	19.20	19.50	52.00	3161.07	0.00	0.00	548.00	0.00	0.00
BLACKS	42-	Outer Bark	NA	2000	42-5	6	High Diversity	No Burn	29.74	17.2	12.44	59.46	18.92	45.94	11.00	12.80	14.20	60.00	2544.69	180.00	0.00	40.00	0.23	0.00
BLACKS	42-	Outer Bark	NA	2000	42-6	15	High Diversity	No Burn	13.51	7.31	4.55	18.92	8.11	16.22	8.00	15.60	16.20	57.00	2847.22	1236.61	8.00	226.00	0.00	0.00
BLACKS	42-	Sapwood	NA	2000	42-8	2	High Diversity	No Burn	70.85	32.21	32.77	102.70	59.46	97.29	7.50	19.20	19.50	52.00	3161.07	0.00	0.00	548.00	0.00	0.00
BLACKS	42-	Sapwood	NA	2000	42-5	6	High Diversity	No Burn	93.97	36.02	38.49	113.51	59.46	105.4	6.50	12.80	14.20	60.00	2544.69	180.00	0.00	40.00	0.23	0.00
BLACKS	42-	Sapwood	NA	2000	42-6	15	High Diversity	No Burn	44.52	20.45	33.19	75.67	54.05	62.16	3.50	15.60	16.20	57.00	2847.22	1236.61	8.00	226.00	0.00	0.00
BLACKS	42+	Heartwood	NA	2000	42+1	4	High Diversity	Burn	11.39	8.34	11.2	21.62	13.51	13.51	24.00	20.00	19.80	60.00	3751.06	60.00	45.00	224.00	0.00	10.00
BLACKS	42+	Heartwood	NA	2000	42+5	7	High Diversity	Burn	5.66	3.01	9.32	13.51	14.86	10.81	16.00	15.30	15.80	55.00	2686.84	10.00	100.00	29.00	0.00	9.50
BLACKS	42+	Heartwood	NA	2000	42+6	10	High Diversity	Burn	2.6	1.61	12.39	4.86	13.51	0.49	26.00	15.00	16.20	60.00	2940.53	10.00	770.00	69.00	0.00	0.00
BLACKS	42+	Outer Bark	NA	2000	42+1	4	High Diversity	Burn	17.13	10.33	7.34	32.43	16.22	27.03	15.00	20.00	19.80	60.00	3751.06	60.00	45.00	224.00	0.00	10.00
BLACKS	42+	Outer Bark	NA	2000	42+5	7	High Diversity	Burn	23.08	12.56	6.82	43.24	13.51	29.73	22.50	15.30	15.80	55.00	2686.84	10.00	100.00	29.00	0.00	9.50
BLACKS	42+	Outer Bark	NA	2000	42+6	10	High Diversity	Burn	15.72	8.25	7.43	27.03	18.92	24.32	18.00	15.00	16.20	60.00	2940.53	10.00	770.00	69.00	0.00	0.00
BLACKS	42+	Sapwood	NA	2000	42+1	4	High Diversity	Burn	79.94	34.55	36.25	105.40	56.75	94.59	14.00	20.00	19.80	60.00	3751.06	60.00	45.00	224.00	0.00	10.00
BLACKS	42+	Sapwood	NA	2000	42+5	7	High Diversity	Burn	71.8	32.86	29.34	102.70	45.94	97.29	16.50	15.30	15.80	55.00	2686.84	10.00	100.00	29.00	0.00	9.50
BLACKS	42+	Sapwood	NA	2000	42+6	10	High Diversity	Burn	73.61	31.52	39.52	91.89	72.97	83.78	14.50	15.00	16.20	60.00	2940.53	10.00	770.00	69.00	0.00	0.00
BLACKS	44-	Heartwood	NA	2000	44-8	1	Low Diversity	No Burn	8.49	6.01	46.5	16.22	56.75	10.81	18.00	20.90	22.00	52.00	3504.13	1.00	299.00	16.00	4.12	0.00
BLACKS	44-	Heartwood	NA	2000	44-2	2	Low Diversity	No Burn	3.15	1.9	7.29	8.11	8.11	6.49	1.50	14.50	14.90	50.00	2309.07	30.00	517.27	145.00	0.40	0.00
BLACKS	44-	Heartwood	NA	2000	44-3	9	Low Diversity	No Burn	5.29	3.85	12.05	13.51	20.27	11.89	0.00	20.50	20.30	64.00	4101.66	90.00	0.00	16.00	8.08	0.00
BLACKS	44-	Outer Bark	NA	2000	44-8	1	Low Diversity	No Burn	22.75	10.9	16.47	43.24	35.13	35.13	12.50	20.90	22.00	52.00	3504.13	1.00	299.00	16.00	4.12	0.00
BLACKS	44-	Outer Bark	NA	2000	44-2	2	Low Diversity	No Burn	32.69	17.34	11.28	75.67	27.03	51.35	11.50	14.50	14.90	50.00	2309.07	30.00	517.27	145.00	0.40	0.00
BLACKS	44-	Outer Bark	NA	2000	44-3	9	Low Diversity	No Burn	35.8	21.39	11.31	81.08	29.73	62.16	17.25	20.50	20.30	64.00	4101.66	90.00	0.00	16.00	8.08	0.00
BLACKS	44-	Sapwood	NA	2000	44-8	1	Low Diversity	No Burn	78.73	35.53	80	113.51	102.7	105.4	4.75	20.90	22.00	52.00	3504.13	1.00	299.00	16.00	4.12	0.00
BLACKS	44-	Sapwood	NA	2000	44-2	2	Low Diversity	No Burn	70.85	32.21	19.41	102.70	43.24	97.29	2.75	14.50	14.90	50.00	2309.07	30.00	517.27	145.00	0.40	0.00
BLACKS	44-	Sapwood	NA	2000	44-3	9	Low Diversity	No Burn	66.61	27.5	30.01	89.18	59.46	81.08	2.75	20.50	20.30	64.00	4101.66	90.00	0.00	16.00	8.08	0.00
BLACKS	44+	Heartwood	NA	2000	44+1	3	Low Diversity	Burn	1.82	1.25	17.35	5.41	21.62	3.78	11.00	20.30	21.20	54.00	3520.15	130.00	0.00	39.25	25.26	15.00
BLACKS	44+	Heartwood	NA	2000	44+6	6	Low Diversity	Burn	10.35	6.2	10.45	13.51	14.86	10.81	9.00	18.00	18.50	57.00	3268.04	0.00	841.00	350.00	0.00	0.00
BLACKS	44+	Heartwood	NA	2000	44+8	8	Low Diversity	Burn	7.54	5.41	16.37	13.51	21.62	9.73	0.00	22.50	23.10	54.00	3867.93	20.00	3067.93	302.00	25.10	11.00
BLACKS	44+	Heartwood	NA	2000	44+5	16	Low Diversity	Burn	3.51	2.06	3.62	8.11	5.41	5.41	11.50	12.20	13.10	55.00	2185.76	29.00	48.00	3.00	0.00	0.00
BLACKS	44+	Outer Bark	NA	2000	44+1	3	Low Diversity	Burn	20.9	11.59	15.2	32.43	37.84	27.03	10.00	20.30	21.20	54.00	3520.15	130.00	0.00	39.25	25.26	15.00
BLACKS	44+	Outer Bark	NA	2000	44+6	6	Low Diversity	Burn	29.74	17.2	11.43	59.46	51.35	45.94	5.75	18.00	18.50	57.00	3268.04	0.00	841.00	350.00	0.00	0.00
BLACKS	44+	Outer Bark	NA	2000	44+8	8	Low Diversity	Burn	25.17	13.68	18.55	48.65	45.94	32.43	7.00	22.50	23.10	54.00	3867.93	20.00	3067.93	302.00	25.10	11.00
BLACKS	44+	Outer Bark	NA	2000	44+5	16	Low Diversity	Burn	31.08	11.17	9.02	59.46	18.92	29.73	5.00	12.20	13.10	55.00	2185.76	29.00	48.00	3.00	0.00	0.00
BLACKS	44+	Sapwood	NA	2000	44+1	3	Low Diversity	Burn	105.11	40.86	40.73	129.72	54.05	124.3	5.50	20.30	21.20	54.00	3520.15	130.00	0.00	39.25	25.26	15.00
BLACKS	44+	Sapwood	NA	2000	44+6	6	Low Diversity	Burn	93.97	36.02	64.84	113.51	81.08	105.4	17.50	18.00	18.50	57.00	3268.04	0.00	841.00	350.00	0.00	0.00
BLACKS	44+	Sapwood	NA	2000	44+8	8	Low Diversity	Burn	49.55	22.51	95.13	97.29	145.9	70.27	13.00	22.50	23.10	54.00	3867.93	20.00	3067.93	302.00	25.10	11.00
BLACKS	44+	Sapwood	NA	2000	44+5	16	Low Diversity	Burn	61.25	24.4	39.69	75.67	75.67	70.27	0.00	12.20	13.10	55.00	2185.76	29.00	48.00	3.00	0.00	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	45-	Heartwood	NA	2000	45-2	5	Low Diversity	No Burn	2.55	1.86	7.31	5.41	12.16	4.32	15.00	14.30	15.00	58.00	2669.41	0.00	0.00	329.00	0.50	0.00
BLACKS	45-	Heartwood	NA	2000	45-1	5	Low Diversity	No Burn	2.55	1.86	3.17	5.41	5.41	4.32	16.50	13.70	14.00	61.00	2654.17	0.00	1547.09	125.50	0.00	0.00
BLACKS	45-	Heartwood	NA	2000	45-6	10	Low Diversity	No Burn	2.6	1.61	32.29	4.86	40.54	0.49	17.00	18.60	19.50	52.00	3112.06	0.00	688.01	0.00	24.81	35.00
BLACKS	45-	Heartwood	NA	2000	45-5	14	Low Diversity	No Burn	2.89	1.98		6.76			12.70	13.20	13.20	59.00	2400.33	1260.17	266.00	352.00	0.51	0.00
BLACKS	45-	Outer Bark	NA	2000	45-2	5	Low Diversity	No Burn	16.63	9.71	10.99	37.84	27.03	27.03	13.00	14.30	15.00	58.00	2669.41	0.00	0.00	329.00	0.50	0.00
BLACKS	45-	Outer Bark	NA	2000	45-1	5	Low Diversity	No Burn	16.63	9.71	10.53	37.84	24.32	27.03	19.75	13.70	14.00	61.00	2654.17	0.00	1547.09	125.50	0.00	0.00
BLACKS	45-	Outer Bark	NA	2000	45-6	10	Low Diversity	No Burn	15.72	8.25	18.77	27.03	52.70	24.32	2.00	18.60	19.50	52.00	3112.06	0.00	688.01	0.00	24.81	35.00
BLACKS	45-	Outer Bark	NA	2000	45-5	14	Low Diversity	No Burn	22.02	12.15	8.09	45.94	16.22	31.35	2.50	12.70	13.20	59.00	2400.33	1260.17	266.00	352.00	0.51	0.00
BLACKS	45-	Sapwood	NA	2000	45-2	5	Low Diversity	No Burn	65.17	27.25	64.13	75.67	91.89	74.59	3.50	14.30	15.00	58.00	2669.41	0.00	0.00	329.00	0.50	0.00
BLACKS	45-	Sapwood	NA	2000	45-1	5	Low Diversity	No Burn	65.17	27.25	34.06	75.67	70.27	74.59	11.50	13.70	14.00	61.00	2654.17	0.00	1547.09	125.50	0.00	0.00
BLACKS	45-	Sapwood	NA	2000	45-6	10	Low Diversity	No Burn	73.61	31.52	64.65	91.89	110.8	83.78	6.00	18.60	19.50	52.00	3112.06	0.00	688.01	0.00	24.81	35.00
BLACKS	45-	Sapwood	NA	2000	45-5	14	Low Diversity	No Burn	117.7	50.05	19.35	159.45	43.24	135.1	2.00	12.70	13.20	59.00	2400.33	1260.17	266.00	352.00	0.51	0.00
BLACKS	45+	Heartwood	NA	2000	45+6	6	Low Diversity	Burn	10.35	6.2	5.14	13.51	9.46	10.81	3.50	15.50	15.60	55.00	2686.84	316.00	0.00	24.75	0.00	0.00
BLACKS	45+	Heartwood	NA	2000	45+2	1	Low Diversity	Burn	8.49	6.01	5.54	16.22	9.46	10.81	3.00	15.40	16.80	63.00	3186.51	0.00	0.00	424.00	0.00	0.00
BLACKS	45+	Heartwood	NA	2000	45+7	12	Low Diversity	Burn	5.76	3.63	5.14	10.81	9.46	10.81	2.50	17.80	18.20	56.00	3166.72	2075.04	0.00	40.00	0.00	0.00
BLACKS	45+	Heartwood	NA	2000	45+5	13	Low Diversity	Burn	2.76	1.95	8.12	5.41	18.92	4.32	7.50	14.70	14.90	55.00	2557.25	0.00	0.00	298.00	0.25	0.00
BLACKS	45+	Outer Bark	NA	2000	45+6	6	Low Diversity	Burn	29.74	17.2	11.95	59.46	29.73	45.94	4.50	15.50	15.60	55.00	2686.84	316.00	0.00	24.75	0.00	0.00
BLACKS	45+	Outer Bark	NA	2000	45+2	1	Low Diversity	Burn	22.75	10.9	17.71	43.24	35.13	35.13	6.00	15.40	16.80	63.00	3186.51	0.00	0.00	424.00	0.00	0.00
BLACKS	45+	Outer Bark	NA	2000	45+7	12	Low Diversity	Burn	14.45	8.4	11.95	32.43	29.73	24.32	6.50	17.80	18.20	56.00	3166.72	2075.04	0.00	40.00	0.00	0.00
BLACKS	45+	Outer Bark	NA	2000	45+5	13	Low Diversity	Burn	18.3	9.06	11.79	37.84	32.43	21.62	5.00	14.70	14.90	55.00	2557.25	0.00	0.00	298.00	0.25	0.00
BLACKS	45+	Sapwood	NA	2000	45+6	6	Low Diversity	Burn	93.97	36.02	32.89	113.51	75.67	105.4	3.50	15.50	15.60	55.00	2686.84	316.00	0.00	24.75	0.00	0.00
BLACKS	45+	Sapwood	NA	2000	45+2	1	Low Diversity	Burn	78.73	35.53	41.82	113.51	108.1	105.4	9.00	15.40	16.80	63.00	3186.51	0.00	0.00	424.00	0.00	0.00
BLACKS	45+	Sapwood	NA	2000	45+7	12	Low Diversity	Burn	66.16	27.34	32.89	91.89	75.67	81.08	5.00	17.80	18.20	56.00	3166.72	2075.04	0.00	40.00	0.00	0.00
BLACKS	45+	Sapwood	NA	2000	45+5	13	Low Diversity	Burn	44.73	20.11	52.96	59.46	118.9	54.05	7.25	14.70	14.90	55.00	2557.25	0.00	0.00	298.00	0.25	0.00
BLACKS	47-	Heartwood	NA	2000	47-7	1	High Diversity	No Burn	8.49	6.01	7.46	16.22	8.11	10.81	19.00	19.50	21.00	60.00	3817.03	0.00	0.00	208.00	0.00	0.00
BLACKS	47-	Heartwood	NA	2000	47-6	12	High Diversity	No Burn	5.76	3.63	4.87	10.81	6.76	10.81	14.50	17.80	16.90	53.00	2888.85	1512.42	4.00	441.00	0.00	0.00
BLACKS	47-	Heartwood	NA	2000	47-2	13	High Diversity	No Burn	2.76	1.95	11.8	5.41	17.57	4.32	16.00	17.40	17.80	57.00	3151.64	1472.82	703.91	540.00	1.80	0.00
BLACKS	47-	Heartwood	NA	2000	47-5	16	High Diversity	No Burn	3.51	2.06	10.2	8.11	13.51	5.41	22.50	15.60	16.50	56.00	2823.66	232.00	9.00	77.00	0.00	0.00
BLACKS	47-	Outer Bark	NA	2000	47-7	1	High Diversity	No Burn	22.75	10.9	10.72	43.24	21.62	35.13	17.00	19.50	21.00	60.00	3817.03	0.00	0.00	208.00	0.00	0.00
BLACKS	47-	Outer Bark	NA	2000	47-6	12	High Diversity	No Burn	14.45	8.4	6.83	32.43	21.62	24.32	16.50	17.80	16.90	53.00	2888.85	1512.42	4.00	441.00	0.00	0.00
BLACKS	47-	Outer Bark	NA	2000	47-2	13	High Diversity	No Burn	18.3	9.06	13.25	37.84	35.13	21.62	16.50	17.40	17.80	57.00	3151.64	1472.82	703.91	540.00	1.80	0.00
BLACKS	47-	Outer Bark	NA	2000	47-5	16	High Diversity	No Burn	31.08	11.17	10.28	59.46	21.62	29.73	17.50	15.60	16.50	56.00	2823.66	232.00	9.00	77.00	0.00	0.00
BLACKS	47-	Sapwood	NA	2000	47-7	1	High Diversity	No Burn	78.73	35.53	69.64	113.51	97.29	105.4	14.50	19.50	21.00	60.00	3817.03	0.00	0.00	208.00	0.00	0.00
BLACKS	47-	Sapwood	NA	2000	47-6	12	High Diversity	No Burn	66.16	27.34	56.46	91.89	75.67	81.08	7.00	17.80	16.90	53.00	2888.85	1512.42	4.00	441.00	0.00	0.00
BLACKS	47-	Sapwood	NA	2000	47-2	13	High Diversity	No Burn	44.73	20.11	34.9	59.46	64.86	54.05	3.50	17.40	17.80	57.00	3151.64	1472.82	703.91	540.00	1.80	0.00
BLACKS	47-	Sapwood	NA	2000	47-5	16	High Diversity	No Burn	61.25	24.4	37.14	75.67	62.16	70.27	1.00	15.60	16.50	56.00	2823.66	232.00	9.00	77.00	0.00	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	47+	Heartwood	NA	2000	47+8	9	High Diversity	Burn	5.29	3.85	10.81	13.51	17.57	11.89	0.75	16.80	17.80	57.00	3097.92	137.00	1093.87	0.00	7.12	0.00
BLACKS	47+	Heartwood	NA	2000	47+2	13	High Diversity	Burn	2.76	1.95	11.91	5.41	17.57	4.32	1.00	18.20	17.80	55.00	3110.17	375.00	398.00	194.00	0.00	0.00
BLACKS	47+	Heartwood	NA	2000	47+5	15	High Diversity	Burn	3.43	2.56		5.41		5.41	0.75	18.10	19.20	60.00	3515.44	60.00	440.00	182.00	0.00	0.00
BLACKS	47+	Heartwood	NA	2000	47+1	11	High Diversity	Burn	17.14	11.63		24.32		21.62	1.50	12.10	13.00	57.00	2247.34	500.00	0.00	404.00	0.00	0.00
BLACKS	47+	Outer Bark	NA	2000	47+8	9	High Diversity	Burn	35.8	21.39	10.05	81.08	21.62	62.16	3.00	16.80	17.80	57.00	3097.92	137.00	1093.87	0.00	7.12	0.00
BLACKS	47+	Outer Bark	NA	2000	47+2	13	High Diversity	Burn	18.3	9.06		37.84		21.62	2.50	18.20	17.80	55.00	3110.17	375.00	398.00	194.00	0.00	0.00
BLACKS	47+	Outer Bark	NA	2000	47+5	15	High Diversity	Burn	13.51	7.31	13.49	18.92	32.43	16.22	7.50	18.10	19.20	60.00	3515.44	60.00	440.00	182.00	0.00	0.00
BLACKS	47+	Outer Bark	NA	2000	47+1	11	High Diversity	Burn	25.17	15.87	9.29	59.46	29.73	48.65	7.00	12.10	13.00	57.00	2247.34	500.00	0.00	404.00	0.00	0.00
BLACKS	47+	Sapwood	NA	2000	47+8	9	High Diversity	Burn	66.61	27.5	37.78	89.18	81.08	81.08	5.00	16.80	17.80	57.00	3097.92	137.00	1093.87	0.00	7.12	0.00
BLACKS	47+	Sapwood	NA	2000	47+2	13	High Diversity	Burn	44.73	20.11	45.97	59.46	62.16	54.05	6.50	18.20	17.80	55.00	3110.17	375.00	398.00	194.00	0.00	0.00
BLACKS	47+	Sapwood	NA	2000	47+5	15	High Diversity	Burn	44.52	20.45	29.38	75.67	54.05	62.16	6.50	18.10	19.20	60.00	3515.44	60.00	440.00	182.00	0.00	0.00
BLACKS	47+	Sapwood	NA	2000	47+1	11	High Diversity	Burn	55.48	24.09	23.11	70.27	59.46	67.56	3.00	12.10	13.00	57.00	2247.34	500.00	0.00	404.00	0.00	0.00
BLACKS	RNA A	Heartwood	NA	2000	RNA A-1	3	Control	No Burn	1.82	1.25	5.3	5.41	5.41	3.78	5.00	13.80	15.20	51.00	2323.21	1025.00	1370.80	9.50	57.00	0.00
BLACKS	RNA A	Heartwood	NA	2000	RNA A-7	12	Control	No Burn	5.76	3.63	8.41	10.81	8.11	10.81	8.50	19.90	20.50	55.00	3490.31	285.00	0.00	350.00	0.00	0.00
BLACKS	RNA A	Heartwood	NA	2000	RNA A-8	15	Control	No Burn	3.43	2.56	12.51	5.41	13.51	5.41	5.00	17.40	18.90	53.00	3022.05	2186.54	705.51	497.00	0.00	0.00
BLACKS	RNA A	Heartwood	NA	2000	RNA A-5	17	Control	No Burn	1.37	0.95	15.82	5.41	16.22	4.32	11.50	17.30	17.20	53.00	2872.20	350.00	80.00	152.00	0.00	32.10
BLACKS	RNA A	Outer Bark	NA	2000	RNA A-1	3	Control	No Burn	20.9	11.59	15.23	32.43	24.32	27.03	17.00	13.80	15.20	51.00	2323.21	1025.00	1370.80	9.50	57.00	0.00
BLACKS	RNA A	Outer Bark	NA	2000	RNA A-7	12	Control	No Burn	14.45	8.4	20.13	32.43	43.24	24.32	10.00	19.90	20.50	55.00	3490.31	285.00	0.00	350.00	0.00	0.00
BLACKS	RNA A	Outer Bark	NA	2000	RNA A-8	15	Control	No Burn	13.51	7.31	20.56	18.92	21.62	16.22	19.50	17.40	18.90	53.00	3022.05	2186.54	705.51	497.00	0.00	0.00
BLACKS	RNA A	Outer Bark	NA	2000	RNA A-5	17	Control	No Burn	18.09	10.26	11.2	43.24	24.32	29.73	18.00	17.30	17.20	53.00	2872.20	350.00	80.00	152.00	0.00	32.10
BLACKS	RNA A	Sapwood	NA	2000	RNA A-1	3	Control	No Burn	105.11	40.86	41.02	129.72	72.97	124.32	10.00	13.80	15.20	51.00	2323.21	1025.00	1370.80	9.50	57.00	0.00
BLACKS	RNA A	Sapwood	NA	2000	RNA A-7	12	Control	No Burn	66.16	27.34	53.37	91.89	64.86	81.08	14.50	19.90	20.50	55.00	3490.31	285.00	0.00	350.00	0.00	0.00
BLACKS	RNA A	Sapwood	NA	2000	RNA A-8	15	Control	No Burn	44.52	20.45	81.28	75.67	127.02	62.16	17.00	17.40	18.90	53.00	3022.05	2186.54	705.51	497.00	0.00	0.00
BLACKS	RNA A	Sapwood	NA	2000	RNA A-5	17	Control	No Burn	95.51	35.63	57.06	118.91	78.37	108.10	17.50	17.30	17.20	53.00	2872.20	350.00	80.00	152.00	0.00	32.10
BLACKS	RNA B	Heartwood	NA	2000	RNA B-6	1	Control	Burn	8.49	6.01	14.35	16.22	18.92	10.81	1.75	17.20	18.00	52.00	2875.18	478.80	768.80	42.00	0.00	0.00
BLACKS	RNA B	Heartwood	NA	2000	RNA B-3	8	Control	Burn	7.54	5.41	5.68	13.51	12.16	9.73	1.00	16.20	17.40	58.00	3061.17	52.00	1190.58	99.00	0.00	0.00
BLACKS	RNA B	Heartwood	NA	2000	RNA B-5	8	Control	Burn	7.54	5.41	6.9	13.51	10.81	9.73	1.00	12.80	14.10	54.00	2281.74	465.00	12.00	52.00	0.00	0.00
BLACKS	RNA B	Heartwood	NA	2000	RNA B-8	11	Control	Burn	17.14	11.63	25.41	24.32	21.62	21.62	2.50	19.00	19.90	58.00	3544.03	160.00	374.00	172.00	42.11	11.00
BLACKS	RNA B	Outer Bark	NA	2000	RNA B-6	1	Control	Burn	22.75	10.9	8.5	43.24	18.92	35.13	3.25	17.20	18.00	52.00	2875.18	478.80	768.80	42.00	0.00	0.00
BLACKS	RNA B	Outer Bark	NA	2000	RNA B-3	8	Control	Burn	25.17	13.68	11.29	48.65	27.03	32.43	3.00	16.20	17.40	58.00	3061.17	52.00	1190.58	99.00	0.00	0.00
BLACKS	RNA B	Outer Bark	NA	2000	RNA B-5	8	Control	Burn	25.17	13.68	9.23	48.65	16.22	32.43	4.50	12.80	14.10	54.00	2281.74	465.00	12.00	52.00	0.00	0.00
BLACKS	RNA B	Outer Bark	NA	2000	RNA B-8	11	Control	Burn	25.17	15.87	8.83	59.46	27.03	48.65	4.00	19.00	19.90	58.00	3544.03	160.00	374.00	172.00	42.11	11.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
BLACKS	RNA B	Sapwood	NA	2000	RNA B-6	1	Control	Burn	78.73	35.53	49.41	113.51	86.48	105.40	8.00	17.20	18.00	52.00	2875.18	478.80	768.80	42.00	0.00	0.00
BLACKS	RNA B	Sapwood	NA	2000	RNA B-3	8	Control	Burn	49.55	22.51	34.5	97.29	90.53	70.27	10.50	16.20	17.40	58.00	3061.17	52.00	1190.58	99.00	0.00	0.00
BLACKS	RNA B	Sapwood	NA	2000	RNA B-5	8	Control	Burn	49.55	22.51	42.81	97.29	62.16	70.27	16.00	12.80	14.10	54.00	2281.74	465.00	12.00	52.00	0.00	0.00
BLACKS	RNA B	Sapwood	NA	2000	RNA B-8	11	Control	Burn	55.48	24.09	53.56	70.27	72.97	67.56	7.50	19.00	19.90	58.00	3544.03	160.00	374.00	172.00	42.11	11.00
BLACKS	RNA D	Heartwood	NA	2000	RNA D-4	1	Control	No Burn	8.49	6.01	23.77	16.22	29.73	10.81	1.50	18.50	19.50	61.00	3641.10	434.00	0.00	92.00	0.00	12.00
BLACKS	RNA D	Heartwood	NA	2000	RNA D-2	9	Control	No Burn	5.29	3.85	13.76	13.51	13.51	11.89	3.50	23.10	25.20	59.00	4476.29	660.00	0.00	209.00	38.25	15.00
BLACKS	RNA D	Heartwood	NA	2000	RNA D-1	9	Control	No Burn	5.29	3.85	8.13	13.51	10.81	11.89	2.00	20.80	21.80	55.00	3680.37	0.00	1049.09	270.50	240.00	0.00
BLACKS	RNA D	Heartwood	NA	2000	RNA D-6	9	Control	No Burn	5.29	3.85	15.52	13.51	24.32	11.89	6.00	18.20	19.20	60.00	3524.86	632.22	212.00	69.00	35.94	0.00
BLACKS	RNA D	Outer Bark	NA	2000	RNA D-4	1	Control	No Burn	22.75	10.9	5.83	43.24	10.81	35.13	2.50	18.50	19.50	61.00	3641.10	434.00	0.00	92.00	0.00	12.00
BLACKS	RNA D	Outer Bark	NA	2000	RNA D-2	9	Control	No Burn	35.8	21.39	21.38	81.08	48.65	62.16	7.00	23.10	25.20	59.00	4476.29	660.00	0.00	209.00	38.25	15.00
BLACKS	RNA D	Outer Bark	NA	2000	RNA D-1	9	Control	No Burn	35.8	21.39	15.65	81.08	27.03	62.16	5.50	20.80	21.80	55.00	3680.37	0.00	1049.09	270.50	240.00	0.00
BLACKS	RNA D	Outer Bark	NA	2000	RNA D-6	9	Control	No Burn	35.8	21.39	12.25	81.08	18.92	62.16	8.50	18.20	19.20	60.00	3524.86	632.22	212.00	69.00	35.94	0.00
BLACKS	RNA D	Sapwood	NA	2000	RNA D-4	1	Control	No Burn	78.73	35.53	37.28	113.51	67.56	105.40	15.50	18.50	19.50	61.00	3641.10	434.00	0.00	92.00	0.00	12.00
BLACKS	RNA D	Sapwood	NA	2000	RNA D-2	9	Control	No Burn	66.61	27.5	43.76	89.18	54.05	81.08	15.00	23.10	25.20	59.00	4476.29	660.00	0.00	209.00	38.25	15.00
BLACKS	RNA D	Sapwood	NA	2000	RNA D-1	9	Control	No Burn	66.61	27.5	53.08	89.18	89.18	81.08	5.50	20.80	21.80	55.00	3680.37	0.00	1049.09	270.50	240.00	0.00
BLACKS	RNA D	Sapwood	NA	2000	RNA D-6	9	Control	No Burn	66.61	27.5	48.77	89.18	64.86	81.08	11.00	18.20	19.20	60.00	3524.86	632.22	212.00	69.00	35.94	0.00
BLACKS	47-	Heartwood	NA	1999 destroyed	47-1	18	High Diversity	No Burn							2.25	0.00	0.00	0.00	0.00	0.00	0.00			
BLACKS	47-	Outer Bark	NA	1999 destroyed	47-1	18	High Diversity	No Burn	19.02	11.08		43.24		29.73	4.50	0.00	0.00	0.00	0.00	0.00	0.00			
BLACKS	47-	Sapwood	NA	1999 destroyed	47-1	18	High Diversity	No Burn	3.97	3.09		8.11		6.49	4.50	0.00	0.00	0.00	0.00	0.00	0.00			
BLACKS	42-	Heartwood	NA	2000 destroyed	42-4	2	High Diversity	No Burn	3.15	1.9	0	8.11	0.00	6.49	1.00	20.90	21.00	56.00	3685.71	0.00	0.00	217.00	90.25	0.00
BLACKS	42-	Outer Bark	NA	2000 destroyed	42-4	2	High Diversity	No Burn	32.69	17.34	0	75.67	0.00	51.35	8.50	20.90	21.00	56.00	3685.71	0.00	0.00	217.00	90.25	0.00
BLACKS	42-	Sapwood	NA	2000 destroyed	42-4	2	High Diversity	No Burn	70.85	32.21	0	102.70	0.00	97.29	3.50	20.90	21.00	56.00	3685.71	0.00	0.00	217.00	90.25	0.00
BLACKS	44-	Heartwood	NA	2000 missing	44-4	2	Low Diversity	No Burn	3.15	1.9		8.11		6.49	6.00	0.00	0.00	0.00	0.00	0.00	0.00			
BLACKS	44-	Outer Bark	NA	2000 missing	44-4	2	Low Diversity	No Burn	32.69	17.34	7.01	75.67	16.22	51.35	9.00	0.00	0.00	0.00	0.00	0.00	0.00			
BLACKS	44-	Sapwood	NA	2000 missing	44-4	2	Low Diversity	No Burn	70.85	32.21	25.44	102.70	64.86	97.29	12.50	0.00	0.00	0.00	0.00	0.00	0.00			

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 1	Heartwood	Large Mesh	1999	4	20	NA	NA	0	50.8	14	0.00	42.19	189.1	17.00	21.10	21.20	62.00	4119.57	0.00	0.00	955.00	0.00	57.00
PEST	Pest 1	Heartwood	Small Mesh	1999	5	20	NA	NA	0	50.8	51.45	0.00	82.04	90.68	14.00	20.20	21.00	63.00	4077.16	1080.21	0.00	518.00	0.00	0.00
PEST	Pest 1	Heartwood	Control	1999	6	20	NA	NA	0	50.8	20.57	0.00	35.16	90.68	15.50	19.00	19.60	58.00	3516.70	625.00	57.00	478.00	0.40	0.00
PEST	Pest 1	Heartwood	Small Mesh	1999	7	21	NA	NA	0	35.82	5.36	0.00	32.82	51.15	4.00	19.80	21.10	47.00	3019.54	20.00	0.00	591.00	0.00	158.00
PEST	Pest 1	Heartwood	Large Mesh	1999	8	21	NA	NA	0	35.82	0	0.00	0.00	51.15		17.00	17.80	50.00	2733.18	100.00	50.00	0.00	0.00	0.00
PEST	Pest 1	Heartwood	Control	1999	9	21	NA	NA	0	35.82	0	0.00	0.00	51.15	2.00	15.50	16.30	59.00	2947.13	2828.13	0.00	436.00	21.50	0.00
PEST	Pest 1	Heartwood	Small Mesh	1999	16	24	NA	NA	0	7.96	9.11	0.00	9.38	12.56	5.00	20.80	21.00	60.00	3939.55	1180.78	1604.89	775.00	15.40	0.00
PEST	Pest 1	Heartwood	Large Mesh	1999	17	24	NA	NA	0	7.96	4.62	0.00	9.38	12.56	3.00	19.50	20.60	66.00	4157.27	983.32	0.00	360.00	24.00	184.80
PEST	Pest 1	Heartwood	Control	1999	18	24	NA	NA	0	7.96	10.55	0.00	14.06	12.56	1.75	18.70	19.80	61.00	3689.01	3066.76	5.00	489.00	9.85	0.00
PEST	Pest 1	Outer Bark	Large Mesh	1999	4	20	NA	NA	0	20	22.18	0.00	42.19	48.83	10.00	21.10	21.20	62.00	4119.57	0.00	0.00	955.00	0.00	57.00
PEST	Pest 1	Outer Bark	Small Mesh	1999	5	20	NA	NA	0	20	34.35	0.00	70.32	48.83	10.00	20.20	21.00	63.00	4077.16	1080.21	0.00	518.00	0.00	0.00
PEST	Pest 1	Outer Bark	Control	1999	6	20	NA	NA	0	20	25.43	0.00	39.85	48.83	9.00	19.00	19.60	58.00	3516.70	625.00	57.00	478.00	0.40	0.00
PEST	Pest 1	Outer Bark	Small Mesh	1999	7	21	NA	NA	0	16.75	18.98	0.00	37.50	44.64	2.75	19.80	21.10	47.00	3019.54	20.00	0.00	591.00	0.00	158.00
PEST	Pest 1	Outer Bark	Large Mesh	1999	8	21	NA	NA	0	16.75	45.65	0.00	79.70	44.64	1.25	17.00	17.80	50.00	2733.18	100.00	50.00	0.00	0.00	0.00
PEST	Pest 1	Outer Bark	Control	1999	9	21	NA	NA	0	16.75	6.93	0.00	11.72	44.64	2.00	15.50	16.30	59.00	2947.13	2828.13	0.00	436.00	21.50	0.00
PEST	Pest 1	Outer Bark	Small Mesh	1999	16	24	NA	NA	0	24.97	11.41	0.00	23.44	55.80	2.25	20.80	21.00	60.00	3939.55	1180.78	1604.89	775.00	15.40	0.00
PEST	Pest 1	Outer Bark	Large Mesh	1999	17	24	NA	NA	0	24.97	20.47	0.00	37.50	55.80	2.00	19.50	20.60	66.00	4157.27	983.32	0.00	360.00	24.00	184.80
PEST	Pest 1	Outer Bark	Control	1999	18	24	NA	NA	0	24.97	9.7	0.00	21.10	55.80	3.00	18.70	19.80	61.00	3689.01	3066.76	5.00	489.00	9.85	0.00
PEST	Pest 1	Sapwood	Large Mesh	1999	4	20	NA	NA	0	56.3	92.07	0.00	103.1	125.5	10.00	21.10	21.20	62.00	4119.57	0.00	0.00	955.00	0.00	57.00
PEST	Pest 1	Sapwood	Small Mesh	1999	5	20	NA	NA	0	56.3	85.49	0.00	100.7	125.5	7.50	20.20	21.00	63.00	4077.16	1080.21	0.00	518.00	0.00	0.00
PEST	Pest 1	Sapwood	Control	1999	6	20	NA	NA	0	56.3	59.9	0.00	98.45	125.5	12.00	19.00	19.60	58.00	3516.70	625.00	57.00	478.00	0.40	0.00
PEST	Pest 1	Sapwood	Small Mesh	1999	7	21	NA	NA	0	80.63	135.6	0.00	147.6	158.1	8.50	19.80	21.10	47.00	3019.54	20.00	0.00	591.00	0.00	158.00
PEST	Pest 1	Sapwood	Large Mesh	1999	8	21	NA	NA	0	80.63	61.83	0.00	72.66	158.1	1.50	17.00	17.80	50.00	2733.18	100.00	50.00	0.00	0.00	0.00
PEST	Pest 1	Sapwood	Control	1999	9	21	NA	NA	0	80.63	30.5	0.00	65.63	158.1	3.25	15.50	16.30	59.00	2947.13	2828.13	0.00	436.00	21.50	0.00
PEST	Pest 1	Sapwood	Small Mesh	1999	16	24	NA	NA	0	36.52	65.95	0.00	70.32	83.70	6.00	20.80	21.00	60.00	3939.55	1180.78	1604.89	775.00	15.40	0.00
PEST	Pest 1	Sapwood	Large Mesh	1999	17	24	NA	NA	0	36.52	86.91	0.00	42.19	83.70	4.50	19.50	20.60	66.00	4157.27	983.32	0.00	360.00	24.00	184.80
PEST	Pest 1	Sapwood	Control	1999	18	24	NA	NA	0	36.52	86.75	0.00	98.45	83.70	4.50	18.70	19.80	61.00	3689.01	3066.76	5.00	489.00	9.85	0.00
PEST	Pest 2	Heartwood	Large Mesh	1999	22	26	NA	NA	0	16.67	37.63	0.00	58.60	32.55	17.50	21.80	22.10	53.00	3054.88	2850.78	147.60	699.00	32.15	81.00
PEST	Pest 2	Heartwood	Control	1999	23	26	NA	NA	0	16.67	27.85	0.00	37.50	32.55	7.50	20.00	20.50	63.00	4007.88	90.00	1858.00	274.00	1.54	12.00
PEST	Pest 2	Heartwood	Small Mesh	1999	24	26	NA	NA	0	16.67	33.79	0.00	51.57	32.55	10.00	19.00	19.70	56.00	3404.23	16.40	8.00	294.00	0.00	0.00
PEST	Pest 2	Heartwood	Small Mesh	1999	25	27	NA	NA	0	24.32	18.56	0.00	23.44	41.85	3.75	20.80	21.80	58.00	3881.12	2423.84	113.00	668.00	18.50	125.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 2	Heartwood	Large Mesh	1999	26	27	NA	NA	0	24.32	30.32	0.00	42.19	41.85	2.25	18.70	19.50	60.00	3600.26	724.07	828.07	188.00	19.30	0.00
PEST	Pest 2	Heartwood	Control	1999	27	27	NA	NA	0	24.32	10.4	0.00	16.41	41.85	3.75	17.90	18.50	69.00	3945.21	231.00	981.30	235.00	12.10	0.00
PEST	Pest 2	Heartwood	Control	1999	28	28	NA	NA	0	7.65	12.98	0.00	14.06	13.95	0.75	20.80	21.80	58.00	3881.12	1505.56	308.00	256.00	5.50	64.00
PEST	Pest 2	Heartwood	Small Mesh	1999	29	28	NA	NA	0	7.65	7.95	0.00	9.38	13.95	6.00	18.70	19.50	54.00	3240.24	995.06	0.00	183.00	0.00	356.00
PEST	Pest 2	Heartwood	Large Mesh	1999	30	28	NA	NA	0	7.65	0	0.00	0.00	13.95	4.50	15.70	16.40	57.00	2874.08	888.52	0.00	421.00	0.00	0.00
PEST	Pest 2	Outer Bark	Large Mesh	1999	22	26	NA	NA	0	15.07	21.95	0.00	51.57	37.20	7.50	21.80	22.10	53.00	3054.88	2850.78	147.60	699.00	32.15	81.00
PEST	Pest 2	Outer Bark	Control	1999	23	26	NA	NA	0	15.07	18.99	0.00	37.50	37.20	3.50	20.00	20.50	63.00	4007.88	90.00	1858.00	274.00	1.54	12.00
PEST	Pest 2	Outer Bark	Small Mesh	1999	24	26	NA	NA	0	15.07	29.55	0.00	56.26	37.20	9.00	19.00	19.70	56.00	3404.23	16.40	8.00	294.00	0.00	0.00
PEST	Pest 2	Outer Bark	Small Mesh	1999	25	27	NA	NA	0	16.32	20.84	0.00	42.19	41.85	13.00	20.80	21.80	58.00	3881.12	2423.84	113.00	668.00	18.50	125.00
PEST	Pest 2	Outer Bark	Large Mesh	1999	26	27	NA	NA	0	16.32	33.22	0.00	65.63	41.85	24.50	18.70	19.50	60.00	3600.26	724.07	828.07	188.00	19.30	0.00
PEST	Pest 2	Outer Bark	Control	1999	27	27	NA	NA	0	16.32	22.99	0.00	46.88	41.85	12.50	17.90	18.50	69.00	3945.21	231.00	981.30	235.00	12.10	0.00
PEST	Pest 2	Outer Bark	Control	1999	28	28	NA	NA	0	20.42	21.53	0.00	46.88	34.88	1.25	20.80	21.80	58.00	3881.12	1505.56	308.00	256.00	5.50	64.00
PEST	Pest 2	Outer Bark	Small Mesh	1999	29	28	NA	NA	0	20.42	24.3	0.00	42.19	34.88	0.75	18.70	19.50	54.00	3240.24	995.06	0.00	183.00	0.00	356.00
PEST	Pest 2	Outer Bark	Large Mesh	1999	30	28	NA	NA	0	20.42	16.15	0.00	25.78	34.88	8.00	15.70	16.40	57.00	2874.08	888.52	0.00	421.00	0.00	0.00
PEST	Pest 2	Sapwood	Large Mesh	1999	22	26	NA	NA	0	46.52	77.37	0.00	63.29	110.2		21.80	22.10	53.00	3054.88	2850.78	147.60	699.00	32.15	81.00
PEST	Pest 2	Sapwood	Control	1999	23	26	NA	NA	0	46.52	66.2	0.00	98.45	110.2	4.50	20.00	20.50	63.00	4007.88	90.00	1858.00	274.00	1.54	12.00
PEST	Pest 2	Sapwood	Small Mesh	1999	24	26	NA	NA	0	46.52	89.87	0.00	126.5	110.2	4.50	19.00	19.70	56.00	3404.23	16.40	8.00	294.00	0.00	0.00
PEST	Pest 2	Sapwood	Small Mesh	1999	25	27	NA	NA	0	33.28	69.98	0.00	79.70	65.10	9.25	20.80	21.80	58.00	3881.12	2423.84	113.00	668.00	18.50	125.00
PEST	Pest 2	Sapwood	Large Mesh	1999	26	27	NA	NA	0	33.28	72.45	0.00	119.5	65.10	3.25	18.70	19.50	60.00	3600.26	724.07	828.07	188.00	19.30	0.00
PEST	Pest 2	Sapwood	Control	1999	27	27	NA	NA	0	33.28	57.57	0.00	96.10	65.10	16.50	17.90	18.50	69.00	3945.21	231.00	981.30	235.00	12.10	0.00
PEST	Pest 2	Sapwood	Control	1999	28	28	NA	NA	0	43.5	66.24	0.00	75.01	118.5	13.00	20.80	21.80	58.00	3881.12	1505.56	308.00	256.00	5.50	64.00
PEST	Pest 2	Sapwood	Small Mesh	1999	29	28	NA	NA	0	43.5	58.32	0.00	84.38	118.5	18.00	18.70	19.50	54.00	3240.24	995.06	0.00	183.00	0.00	356.00
PEST	Pest 2	Sapwood	Large Mesh	1999	30	28	NA	NA	0	43.5	48.99	0.00	79.70	118.5	9.00	15.70	16.40	57.00	2874.08	888.52	0.00	421.00	0.00	0.00
PEST	Pest 3	Heartwood	Control	1999	37	31	NA	NA	0	46.19	65.06	0.00	93.76	74.40	1.50	22.00	22.50	57.00	3984.32	75.00	1495.00	0.00	0.00	0.00
PEST	Pest 3	Heartwood	Small Mesh	1999	38	31	NA	NA	0	46.19	22.14	0.00	9.38	74.40	2.00	19.90	20.50	50.00	3173.01	939.25	99.00	0.00	0.50	0.00
PEST	Pest 3	Heartwood	Large Mesh	1999	39	31	NA	NA	0	46.19	0	0.00	0.00	74.40	1.50	18.20	19.20	64.00	3759.85	201.40	20.00	0.00	2.95	404.00
PEST	Pest 3	Heartwood	Small Mesh	1999	43	33	NA	NA	0	32.75	41.24	0.00	67.98	67.43	3.25	18.20	19.00	55.00	3213.85	1.50	0.00	23.00	0.00	6.00
PEST	Pest 3	Heartwood	Large Mesh	1999	44	33	NA	NA	0	32.75	36.35	0.00	65.63	67.43	5.50	16.70	17.50	62.00	3330.71	8.10	9.00	5.00	1.75	5.00
PEST	Pest 3	Heartwood	Control	1999	45	33	NA	NA	0	32.75	51.18	0.00	82.04	67.43	6.75	15.30	15.90	61.00	2989.54	20.00	2969.54	91.50	2.20	4.00
PEST	Pest 3	Heartwood	Large Mesh	1999	46	34	NA	NA	0	9.72	23.08	0.00	28.13	16.28	5.50	18.80	19.70	57.00	3447.11	2298.83	61.00	284.00	6.35	29.00
PEST	Pest 3	Heartwood	Control	1999	47	34	NA	NA	0	9.72	2.16	0.00	16.41	16.28	6.50	16.50	16.60	67.00	3483.55	3373.55	110.00	595.00	50.60	8.50

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 3	Heartwood	Small Mesh	1999	48	34	NA	NA	0	9.72	8.23	0.00	14.06	16.28	14.00	15.30	15.90	61.00	2989.54	965.16	0.00	348.00	6.85	0.00
PEST	Pest 3	Outer Bark	Control	1999	37	31	NA	NA	0	17.63	22	0.00	51.57	47.66	19.50	22.00	22.50	57.00	3984.32	75.00	1495.00	0.00	0.00	0.00
PEST	Pest 3	Outer Bark	Small Mesh	1999	38	31	NA	NA	0	17.63	26.76	0.00	49.22	47.66	14.50	19.90	20.50	50.00	3173.01	939.25	99.00	0.00	0.50	0.00
PEST	Pest 3	Outer Bark	Large Mesh	1999	39	31	NA	NA	0	17.63	0	0.00	0.00	47.66	22.00	18.20	19.20	64.00	3759.85	201.40	20.00	0.00	2.95	404.00
PEST	Pest 3	Outer Bark	Small Mesh	1999	43	33	NA	NA	0	12.48	25.33	0.00	63.29	34.88	2.00	18.20	19.00	55.00	3213.85	1.50	0.00	23.00	0.00	6.00
PEST	Pest 3	Outer Bark	Large Mesh	1999	44	33	NA	NA	0	12.48	24.99	0.00	53.91	34.88	1.25	16.70	17.50	62.00	3330.71	8.10	9.00	5.00	1.75	5.00
PEST	Pest 3	Outer Bark	Control	1999	45	33	NA	NA	0	12.48	17.05	0.00	37.50	34.88	2.75	15.30	15.90	61.00	2989.54	20.00	2969.54	91.50	2.20	4.00
PEST	Pest 3	Outer Bark	Large Mesh	1999	46	34	NA	NA	0	19.04	16.95	0.00	32.82	53.48	1.75	18.80	19.70	57.00	3447.11	2298.83	61.00	284.00	6.35	29.00
PEST	Pest 3	Outer Bark	Control	1999	47	34	NA	NA	0	19.04	14.45	0.00	32.82	53.48	4.50	16.50	16.60	67.00	3483.55	3373.55	110.00	595.00	50.60	8.50
PEST	Pest 3	Outer Bark	Small Mesh	1999	48	34	NA	NA	0	19.04	17.63	0.00	32.82	53.48	2.50	15.30	15.90	61.00	2989.54	965.16	0.00	348.00	6.85	0.00
PEST	Pest 3	Sapwood	Control	1999	37	31	NA	NA	0	40.47	71.01	0.00	91.42	90.68	5.25	22.00	22.50	57.00	3984.32	75.00	1495.00	0.00	0.00	0.00
PEST	Pest 3	Sapwood	Small Mesh	1999	38	31	NA	NA	0	40.47	55.55	0.00	65.63	90.68	3.50	19.90	20.50	50.00	3173.01	939.25	99.00	0.00	0.50	0.00
PEST	Pest 3	Sapwood	Large Mesh	1999	39	31	NA	NA	0	40.47	0	0.00	0.00	90.68	17.25	18.20	19.20	64.00	3759.85	201.40	20.00	0.00	2.95	404.00
PEST	Pest 3	Sapwood	Small Mesh	1999	43	33	NA	NA	0	69.31	72.59	0.00	79.70	160.43	12.25	18.20	19.00	55.00	3213.85	1.50	0.00	23.00	0.00	6.00
PEST	Pest 3	Sapwood	Large Mesh	1999	44	33	NA	NA	0	69.31	76.37	0.00	84.38	160.43	10.25	16.70	17.50	62.00	3330.71	8.10	9.00	5.00	1.75	5.00
PEST	Pest 3	Sapwood	Control	1999	45	33	NA	NA	0	69.31	65.98	0.00	93.76	160.43	10.25	15.30	15.90	61.00	2989.54	20.00	2969.54	91.50	2.20	4.00
PEST	Pest 3	Sapwood	Large Mesh	1999	46	34	NA	NA	0	26.56	73.86	0.00	84.38	62.78	3.50	18.80	19.70	57.00	3447.11	2298.83	61.00	284.00	6.35	29.00
PEST	Pest 3	Sapwood	Control	1999	47	34	NA	NA	0	26.56	53.49	0.00	63.29	62.78	3.00	16.50	16.60	67.00	3483.55	3373.55	110.00	595.00	50.60	8.50
PEST	Pest 3	Sapwood	Small Mesh	1999	48	34	NA	NA	0	26.56	74.81	0.00	103.14	62.78		15.30	15.90	61.00	2989.54	965.16	0.00	348.00	6.85	0.00
PEST	Pest 4	Heartwood	Large Mesh	1999	58	38	NA	NA	0	13.79	10.83	0.00	11.72	23.25		20.00	21.60	61.00	3986.05	1631.51	0.00	480.00	0.00	0.00
PEST	Pest 4	Heartwood	Control	1999	59	38	NA	NA	0	13.79	9.74	0.00	11.72	23.25	3.25	19.00	19.50	57.00	3447.11	0.80	0.00	93.50	0.00	98.50
PEST	Pest 4	Heartwood	Small Mesh	1999	60	38	NA	NA	0	13.79	11.69	0.00	14.06	23.25		17.20	17.50	63.00	3433.91	1654.44	0.00	220.00	2.50	13.00
PEST	Pest 4	Heartwood	Large Mesh	1999	67	41	NA	NA	0	15.31	47.56	0.00	53.91	32.55	5.50	21.60	22.00	67.00	4588.61	3548.61	295.00	428.00	5.75	0.00
PEST	Pest 4	Heartwood	Control	1999	68	41	NA	NA	0	15.31	21.28	0.00	32.82	32.55	4.75	20.10	20.80	61.00	3918.98	31.00	0.00	653.00	12.50	0.00
PEST	Pest 4	Heartwood	Small Mesh	1999	69	41	NA	NA	0	15.31	10.41	0.00	16.41	32.55	14.00	19.10	20.10	62.00	3817.66	314.00	151.00	0.00	10.50	0.00
PEST	Pest 4	Heartwood	Small Mesh	1999	70	42	NA	NA	0	10.64	12.62	0.00	14.06	18.60	10.25	20.40	20.80	59.00	3818.29	114.00	0.00	44.00	0.00	15.00
PEST	Pest 4	Heartwood	Large Mesh	1999	71	42	NA	NA	0	10.64	11.03	0.00	16.41	18.60	10.25	19.70	20.30	60.00	3769.91	1832.95	0.00	286.00	0.00	119.00
PEST	Pest 4	Heartwood	Control	1999	72	42	NA	NA	0	10.64	6.06	0.00	14.06	18.60	10.50	19.00	19.50	60.00	3628.54	2656.40	0.00	554.00	0.00	0.00
PEST	Pest 4	Outer Bark	Large Mesh	1999	58	38	NA	NA	0	15	20.77	0.00	42.19	39.53	8.25	20.00	21.60	61.00	3986.05	1631.51	0.00	480.00	0.00	0.00
PEST	Pest 4	Outer Bark	Control	1999	59	38	NA	NA	0	15	14.23	0.00	28.13	39.53	3.50	19.00	19.50	57.00	3447.11	0.80	0.00	93.50	0.00	98.50
PEST	Pest 4	Outer Bark	Small Mesh	1999	60	38	NA	NA	0	15	19.88	0.00	42.19	39.53	11.25	17.20	17.50	63.00	3433.91	1654.44	0.00	220.00	2.50	13.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 4	Outer Bark	Large Mesh	1999	67	41	NA	NA	0	12.38	17.63	0.00	32.82	29.30	5.00	21.60	22.00	67.00	4588.61	3548.61	295.00	428.00	5.75	0.00
PEST	Pest 4	Outer Bark	Control	1999	68	41	NA	NA	0	12.38	16.36	0.00	28.13	29.30	6.25	20.10	20.80	61.00	3918.98	31.00	0.00	653.00	12.50	0.00
PEST	Pest 4	Outer Bark	Small Mesh	1999	69	41	NA	NA	0	12.38	9.88	0.00	21.10	29.30	4.50	19.10	20.10	62.00	3817.66	314.00	151.00	0.00	10.50	0.00
PEST	Pest 4	Outer Bark	Small Mesh	1999	70	42	NA	NA	0	26.01	20.9	0.00	49.22	69.75	5.50	20.40	20.80	59.00	3818.29	114.00	0.00	44.00	0.00	15.00
PEST	Pest 4	Outer Bark	Large Mesh	1999	71	42	NA	NA	0	26.01	14.79	0.00	28.13	69.75	19.00	19.70	20.30	60.00	3769.91	1832.95	0.00	286.00	0.00	119.0
PEST	Pest 4	Outer Bark	Control	1999	72	42	NA	NA	0	26.01	20.13	0.00	42.19	69.75	5.25	19.00	19.50	60.00	3628.54	2656.40	0.00	554.00	0.00	0.00
PEST	Pest 4	Sapwood	Large Mesh	1999	58	38	NA	NA	0	46.13	104.54	0.00	100.7	106.9	7.25	20.00	21.60	61.00	3986.05	1631.51	0.00	480.00	0.00	0.00
PEST	Pest 4	Sapwood	Control	1999	59	38	NA	NA	0	46.13	70.41	0.00	70.32	106.9	6.50	19.00	19.50	57.00	3447.11	0.80	0.00	93.50	0.00	98.50
PEST	Pest 4	Sapwood	Small Mesh	1999	60	38	NA	NA	0	46.13	47.5	0.00	93.76	106.9	7.00	17.20	17.50	63.00	3433.91	1654.44	0.00	220.00	2.50	13.00
PEST	Pest 4	Sapwood	Large Mesh	1999	67	41	NA	NA	0	44.29	87.28	0.00	110.1	102.3	11.50	21.60	22.00	67.00	4588.61	3548.61	295.00	428.00	5.75	0.00
PEST	Pest 4	Sapwood	Control	1999	68	41	NA	NA	0	44.29	86.16	0.00	89.07	102.3	5.25	20.10	20.80	61.00	3918.98	31.00	0.00	653.00	12.50	0.00
PEST	Pest 4	Sapwood	Small Mesh	1999	69	41	NA	NA	0	44.29	60.15	0.00	89.07	102.3	4.00	19.10	20.10	62.00	3817.66	314.00	151.00	0.00	10.50	0.00
PEST	Pest 4	Sapwood	Small Mesh	1999	70	42	NA	NA	0	46.39	82.26	0.00	89.07	153.4	6.50	20.40	20.80	59.00	3818.29	114.00	0.00	44.00	0.00	15.00
PEST	Pest 4	Sapwood	Large Mesh	1999	71	42	NA	NA	0	46.39	69.19	0.00	89.07	153.4	2.00	19.70	20.30	60.00	3769.91	1832.95	0.00	286.00	0.00	119.0
PEST	Pest 4	Sapwood	Control	1999	72	42	NA	NA	0	46.39	76.49	0.00	75.01	153.4	3.50	19.00	19.50	60.00	3628.54	2656.40	0.00	554.00	0.00	0.00
PEST	Pest 5	Heartwood	Large Mesh	1999	76	44	NA	NA	0	17.21	34.84	0.00	44.54	32.55	24.00	18.90	20.50	60.00	3713.36	3409.96	3.40	160.00	0.75	35.50
PEST	Pest 5	Heartwood	Control	1999	77	44	NA	NA	0	17.21	12.7	0.00	18.75	32.55	15.00	17.20	18.40	60.00	3355.22	1688.47	163.00	184.00	13.50	77.50
PEST	Pest 5	Heartwood	Small Mesh	1999	78	44	NA	NA	0	17.21	3.2	0.00	4.69	32.55	10.50	15.80	16.50	61.00	3094.94	0.00	0.00	30.00	0.00	49.00
PEST	Pest 5	Heartwood	Small Mesh	1999	79	45	NA	NA	0	4.46	2.75	0.00	18.75	7.91	22.00	19.80	21.80	60.00	3920.70	50.00	387.00	240.00	29.85	0.00
PEST	Pest 5	Heartwood	Large Mesh	1999	80	45	NA	NA	0	4.46	6.62	0.00	4.69	7.91	11.50	17.30	17.80	60.00	3015.93	2578.93	22.00	235.00	1.95	28.00
PEST	Pest 5	Heartwood	Control	1999	81	45	NA	NA	0	4.46	2.51	0.00	4.69	7.91	14.25	16.30	15.70	60.00	3015.93	2114.94	634.98	409.00	11.00	0.00
PEST	Pest 5	Heartwood	Control	1999	82	46	NA	NA	0	8.65	7.24	0.00	7.03	17.21	22.00	20.30	21.70	54.00	3562.56	2416.42	175.00	945.00	27.25	0.00
PEST	Pest 5	Heartwood	Small Mesh	1999	83	46	NA	NA	0	8.65	10.13	0.00	14.06	17.21	12.25	18.60	19.00	57.00	3366.53	2990.53	130.00	597.00	23.20	7.00
PEST	Pest 5	Heartwood	Large Mesh	1999	84	46	NA	NA	0	8.65	9.12	0.00	14.06	17.21	13.25	17.30	18.50	62.00	3486.54	3486.54	0.00	206.00	3.35	30.00
PEST	Pest 5	Outer Bark	Large Mesh	1999	76	44	NA	NA	0	16.47	17.44	0.00	46.88	44.18	2.00	18.90	20.50	60.00	3713.36	3409.96	3.40	160.00	0.75	35.50
PEST	Pest 5	Outer Bark	Control	1999	77	44	NA	NA	0	16.47	16.66	0.00	37.50	44.18	1.50	17.20	18.40	60.00	3355.22	1688.47	163.00	184.00	13.50	77.50
PEST	Pest 5	Outer Bark	Small Mesh	1999	78	44	NA	NA	0	16.47	16.32	0.00	32.82	44.18	1.00	15.80	16.50	61.00	3094.94	0.00	0.00	30.00	0.00	49.00
PEST	Pest 5	Outer Bark	Small Mesh	1999	79	45	NA	NA	0	17.74	20.55	0.00	32.82	40.46	2.00	19.80	21.80	60.00	3920.70	50.00	387.00	240.00	29.85	0.00
PEST	Pest 5	Outer Bark	Large Mesh	1999	80	45	NA	NA	0	17.74	17.32	0.00	35.16	40.46	3.25	17.30	17.80	60.00	3015.93	2578.93	22.00	235.00	1.95	28.00
PEST	Pest 5	Outer Bark	Control	1999	81	45	NA	NA	0	17.74	10.12	0.00	18.75	40.46	2.50	16.30	15.70	60.00	3015.93	2114.94	634.98	409.00	11.00	0.00
PEST	Pest 5	Outer Bark	Control	1999	82	46	NA	NA	0	19.85	15.8	0.00	28.13	53.48	2.50	20.30	21.70	54.00	3562.56	2416.42	175.00	945.00	27.25	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 5	Outer Bark	Small Mesh	1999	83	46	NA	NA	0	19.85	21.13	0.00	46.88	53.48	3.50	18.60	19.00	57.00	3366.53	2990.53	130.00	597.00	23.20	7.00
PEST	Pest 5	Outer Bark	Large Mesh	1999	84	46	NA	NA	0	19.85	18.47	0.00	32.82	53.48	1.00	17.30	18.50	62.00	3486.54	3486.54	0.00	206.00	3.35	30.00
PEST	Pest 5	Sapwood	Large Mesh	1999	76	44	NA	NA	0	39.33	62.58	0.00	56.26	97.65	6.50	18.90	20.50	60.00	3713.36	3409.96	3.40	160.00	0.75	35.50
PEST	Pest 5	Sapwood	Control	1999	77	44	NA	NA	0	39.33	78.23	0.00	91.42	97.65	4.00	17.20	18.40	60.00	3355.22	1688.47	163.00	184.00	13.50	77.50
PEST	Pest 5	Sapwood	Small Mesh	1999	78	44	NA	NA	0	39.33	41.78	0.00	51.57	97.65	3.50	15.80	16.50	61.00	3094.94	0.00	0.00	30.00	0.00	49.00
PEST	Pest 5	Sapwood	Small Mesh	1999	79	45	NA	NA	0	50.19	103.77	0.00	103.1	116.2	4.25	19.80	21.80	60.00	3920.70	50.00	387.00	240.00	29.85	0.00
PEST	Pest 5	Sapwood	Large Mesh	1999	80	45	NA	NA	0	50.19	83.44	0.00	86.73	116.2	7.50	17.30	17.80	60.00	3015.93	2578.93	22.00	235.00	1.95	28.00
PEST	Pest 5	Sapwood	Control	1999	81	45	NA	NA	0	50.19	35.78	0.00	53.91	116.2	4.75	16.30	15.70	60.00	3015.93	2114.94	634.98	409.00	11.00	0.00
PEST	Pest 5	Sapwood	Control	1999	82	46	NA	NA	0	38.45	64.25	0.00	75.01	97.65	7.50	20.30	21.70	54.00	3562.56	2416.42	175.00	945.00	27.25	0.00
PEST	Pest 5	Sapwood	Small Mesh	1999	83	46	NA	NA	0	38.45	84.39	0.00	84.38	97.65	6.00	18.60	19.00	57.00	3366.53	2990.53	130.00	597.00	23.20	7.00
PEST	Pest 5	Sapwood	Large Mesh	1999	84	46	NA	NA	0	38.45	82.97	0.00	89.07	97.65	6.25	17.30	18.50	62.00	3486.54	3486.54	0.00	206.00	3.35	30.00
PEST	Pest 1	Heartwood	Control	2000	1	19	NA	NA	0	24.85	40.52	0.00	48.65	45.94	15.00	20.50	21.30	54.00	3545.60	590.00	495.00	485.00	0.00	0.00
PEST	Pest 1	Heartwood	Small Mesh	2000	2	19	NA	NA	0	24.85	13.5	0.00	18.92	45.94	7.50	19.40	19.80	50.00	3078.76	240.00	2385.07	460.00	17.70	0.00
PEST	Pest 1	Heartwood	Large Mesh	2000	3	19	NA	NA	0	24.85	47.33	0.00	64.86	45.94	10.00	18.20	19.00	53.00	3096.98	594.24	52.00	193.00	5.00	0.00
PEST	Pest 1	Heartwood	Control	2000	10	22	NA	NA	0	17.03	21.23	0.00	29.73	37.84	16.00	19.80	21.10	47.00	3019.54	0.00	0.00	453.00	0.00	4.00
PEST	Pest 1	Heartwood	Small Mesh	2000	11	22	NA	NA	0	17.03	24.04	0.00	37.84	37.84	17.25	19.20	19.50	51.00	3100.28	4.00	0.00	112.00	0.00	59.50
PEST	Pest 1	Heartwood	Large Mesh	2000	12	22	NA	NA	0	17.03	17	0.00	24.32	37.84	11.50	18.00	18.50	52.00	2981.37	7.00	123.00	123.00	0.00	21.00
PEST	Pest 1	Heartwood	Large Mesh	2000	13	23	NA	NA	0	53.15	25.9	0.00	32.43	113.5	22.25	23.20	23.80	53.00	3912.85	0.00	0.00	400.00	0.00	0.00
PEST	Pest 1	Heartwood	Control	2000	14	23	NA	NA	0	53.15	71.9	0.00	118.9	113.5	16.00	22.20	22.60	54.00	3800.07	0.00	50.00	267.00	0.00	0.00
PEST	Pest 1	Heartwood	Small Mesh	2000	15	23	NA	NA	0	53.15	21.18	0.00	32.43	113.5	13.00	22.00	22.00	55.00	3801.32	205.00	120.00	176.00	0.00	0.00
PEST	Pest 1	Outer Bark	Control	2000	1	19	NA	NA	0	7.45	16.73	0.00	45.94	24.32	18.00	20.50	21.30	54.00	3545.60	590.00	495.00	485.00	0.00	0.00
PEST	Pest 1	Outer Bark	Small Mesh	2000	2	19	NA	NA	0	7.45	16.6	0.00	37.84	24.32	4.75	19.40	19.80	50.00	3078.76	240.00	2385.07	460.00	17.70	0.00
PEST	Pest 1	Outer Bark	Large Mesh	2000	3	19	NA	NA	0	7.45	19.36	0.00	43.24	24.32	9.00	18.20	19.00	53.00	3096.98	594.24	52.00	193.00	5.00	0.00
PEST	Pest 1	Outer Bark	Control	2000	10	22	NA	NA	0	10.7	25.1	0.00	64.86	29.73	8.50	19.80	21.10	47.00	3019.54	0.00	0.00	453.00	0.00	4.00
PEST	Pest 1	Outer Bark	Small Mesh	2000	11	22	NA	NA	0	10.7	12.38	0.00	29.73	29.73	3.25	19.20	19.50	51.00	3100.28	4.00	0.00	112.00	0.00	59.50
PEST	Pest 1	Outer Bark	Large Mesh	2000	12	22	NA	NA	0	10.7	11.7	0.00	24.32	29.73	3.00	18.00	18.50	52.00	2981.37	7.00	123.00	123.00	0.00	21.00
PEST	Pest 1	Outer Bark	Large Mesh	2000	13	23	NA	NA	0	17.74	18.89	0.00	37.84	43.24	2.50	23.20	23.80	53.00	3912.85	0.00	0.00	400.00	0.00	0.00
PEST	Pest 1	Outer Bark	Control	2000	14	23	NA	NA	0	17.74	6.8	0.00	10.81	43.24	1.75	22.20	22.60	54.00	3800.07	0.00	50.00	267.00	0.00	0.00
PEST	Pest 1	Outer Bark	Small Mesh	2000	15	23	NA	NA	0	17.74	10.08	0.00	21.62	43.24		22.00	22.00	55.00	3801.32	205.00	120.00	176.00	0.00	0.00
PEST	Pest 1	Sapwood	Control	2000	1	19	NA	NA	0	44.21	69.58	0.00	140.5	110.8	3.75	20.50	21.30	54.00	3545.60	590.00	495.00	485.00	0.00	0.00
PEST	Pest 1	Sapwood	Small Mesh	2000	2	19	NA	NA	0	44.21	46.46	0.00	91.89	110.8	5.50	19.40	19.80	50.00	3078.76	240.00	2385.07	460.00	17.70	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 1	Sapwood	Large Mesh	2000	3	19	NA	NA	0	44.21	43.7	0.00	78.37	110.8	6.25	18.20	19.00	53.00	3096.98	594.24	52.00	193.00	5.00	0.00
PEST	Pest 1	Sapwood	Control	2000	10	22	NA	NA	0	53.2	59.5	0.00	132.4	143.2	5.00	19.80	21.10	47.00	3019.54	0.00	0.00	453.00	0.00	4.00
PEST	Pest 1	Sapwood	Small Mesh	2000	11	22	NA	NA	0	53.2	37.24	0.00	67.56	143.2	8.00	19.20	19.50	51.00	3100.28	4.00	0.00	112.00	0.00	59.50
PEST	Pest 1	Sapwood	Large Mesh	2000	12	22	NA	NA	0	53.2	42.49	0.00	83.78	143.2	6.00	18.00	18.50	52.00	2981.37	7.00	123.00	123.00	0.00	21.00
PEST	Pest 1	Sapwood	Large Mesh	2000	13	23	NA	NA	0	40.42	76.67	0.00	129.7	102.7	3.75	23.20	23.80	53.00	3912.85	0.00	0.00	400.00	0.00	0.00
PEST	Pest 1	Sapwood	Control	2000	14	23	NA	NA	0	40.42	45.62	0.00	75.67	102.7	5.50	22.20	22.60	54.00	3800.07	0.00	50.00	267.00	0.00	0.00
PEST	Pest 1	Sapwood	Small Mesh	2000	15	23	NA	NA	0	40.42	45.3	0.00	83.78	102.7	6.50	22.00	22.00	55.00	3801.32	205.00	120.00	176.00	0.00	0.00
PEST	Pest 2	Heartwood	Control	2000	19	25	NA	NA	0	11.45	13.29	0.00	10.81	18.92	9.00	19.00	19.90	57.00	3482.92	764.73	0.00	720.00	56.00	79.00
PEST	Pest 2	Heartwood	Small Mesh	2000	20	25	NA	NA	0	11.45	5.72	0.00	9.46	18.92	13.50	18.80	18.60	52.00	3054.88	928.72	880.00	351.00	7.50	69.00
PEST	Pest 2	Heartwood	Large Mesh	2000	21	25	NA	NA	0	11.45	3.62	0.00	5.41	18.92	9.00	15.00	15.30	53.00	2522.54	355.63	140.00	256.00	4.60	47.00
PEST	Pest 2	Heartwood	Large Mesh	2000	31	29	NA	NA	0	4.44	11.53	0.00	14.86	8.11	11.50	20.50	22.00	53.00	3538.22	1067.55	97.00	663.00	10.99	0.00
PEST	Pest 2	Heartwood	Control	2000	32	29	NA	NA	0	4.44	11.55	0.00	16.22	8.11	16.25	16.50	17.90	57.00	3080.01	900.01	1270.00	333.00	0.00	0.00
PEST	Pest 2	Heartwood	Small Mesh	2000	33	29	NA	NA	0	4.44	11.8	0.00	16.22	8.11	18.75	15.20	16.70	57.00	2856.18	25.00	50.00	242.00	6.50	75.00
PEST	Pest 2	Heartwood	Small Mesh	2000	34	30	NA	NA	0	10.15	12.98	0.00	18.92	23.24	8.50	21.70	23.40	52.00	3683.83	0.00	2362.87	433.00	39.20	12.00
PEST	Pest 2	Heartwood	Large Mesh	2000	35	30	NA	NA	0	10.15	13.57	0.00	18.92	23.24	14.25	20.50	21.40	61.00	4014.79	95.00	1017.40	352.00	28.50	335.4
PEST	Pest 2	Heartwood	Control	2000	36	30	NA	NA	0	10.15	5.23	0.00	6.76	23.24	19.25	19.00	19.50	56.50	3416.87	335.00	1268.44	240.00	10.10	10.10
PEST	Pest 2	Outer Bark	Control	2000	19	25	NA	NA	0	12.6	16.67	0.00	35.13	35.13	3.50	19.00	19.90	57.00	3482.92	764.73	0.00	720.00	56.00	79.00
PEST	Pest 2	Outer Bark	Small Mesh	2000	20	25	NA	NA	0	12.6	12.38	0.00	21.62	35.13	2.50	18.80	18.60	52.00	3054.88	928.72	880.00	351.00	7.50	69.00
PEST	Pest 2	Outer Bark	Large Mesh	2000	21	25	NA	NA	0	12.6	11.82	0.00	24.32	35.13	4.25	15.00	15.30	53.00	2522.54	355.63	140.00	256.00	4.60	47.00
PEST	Pest 2	Outer Bark	Large Mesh	2000	31	29	NA	NA	0	10.28	10.91	0.00	27.03	28.38	2.50	20.50	22.00	53.00	3538.22	1067.55	97.00	663.00	10.99	0.00
PEST	Pest 2	Outer Bark	Control	2000	32	29	NA	NA	0	10.28	19.96	0.00	18.92	28.38	2.25	16.50	17.90	57.00	3080.01	900.01	1270.00	333.00	0.00	0.00
PEST	Pest 2	Outer Bark	Small Mesh	2000	33	29	NA	NA	0	10.28	13.45	0.00	27.03	28.38	2.75	15.20	16.70	57.00	2856.18	25.00	50.00	242.00	6.50	75.00
PEST	Pest 2	Outer Bark	Small Mesh	2000	34	30	NA	NA	0	16.17	16.42	0.00	40.54	47.02	7.25	21.70	23.40	52.00	3683.83	0.00	2362.87	433.00	39.20	12.00
PEST	Pest 2	Outer Bark	Large Mesh	2000	35	30	NA	NA	0	16.17	15.44	0.00	35.13	47.02	4.50	20.50	21.40	61.00	4014.79	95.00	1017.40	352.00	28.50	335.4
PEST	Pest 2	Outer Bark	Control	2000	36	30	NA	NA	0	16.17	17.55	0.00	37.84	47.02	4.00	19.00	19.50	56.50	3416.87	335.00	1268.44	240.00	10.10	10.10
PEST	Pest 2	Sapwood	Control	2000	19	25	NA	NA	0	51.44	58.55	0.00	89.18	132.4	4.00	19.00	19.90	57.00	3482.92	764.73	0.00	720.00	56.00	79.00
PEST	Pest 2	Sapwood	Small Mesh	2000	20	25	NA	NA	0	51.44	35.12	0.00	43.24	132.4	5.75	18.80	18.60	52.00	3054.88	928.72	880.00	351.00	7.50	69.00
PEST	Pest 2	Sapwood	Large Mesh	2000	21	25	NA	NA	0	51.44	43.16	0.00	59.46	132.4	3.00	15.00	15.30	53.00	2522.54	355.63	140.00	256.00	4.60	47.00
PEST	Pest 2	Sapwood	Large Mesh	2000	31	29	NA	NA	0	66.37	96.07	0.00	99.99	202.6	4.00	20.50	22.00	53.00	3538.22	1067.55	97.00	663.00	10.99	0.00
PEST	Pest 2	Sapwood	Control	2000	32	29	NA	NA	0	66.37	60.73	0.00	102.7	202.6	7.00	16.50	17.90	57.00	3080.01	900.01	1270.00	333.00	0.00	0.00
PEST	Pest 2	Sapwood	Small	2000	33	29	NA	NA	0	66.37	43.05	0.00	67.56	202.6	9.75	15.20	16.70	57.00	2856.18	25.00	50.00	242.00	6.50	75.00

Mesh

9

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 2	Sapwood	Small Mesh	2000	34	30	NA	NA	0	37.98	113.49	0.00	132.4	99.99	10.75	21.70	23.40	52.00	3683.83	0.00	2362.87	433.00	39.20	12.00
PEST	Pest 2	Sapwood	Large Mesh	2000	35	30	NA	NA	0	37.98	67.32	0.00	91.89	99.99	6.00	20.50	21.40	61.00	4014.79	95.00	1017.40	352.00	28.50	335.40
PEST	Pest 2	Sapwood	Control	2000	36	30	NA	NA	0	37.98	38.82	0.00	75.67	99.99	5.75	19.00	19.50	56.50	3416.87	335.00	1268.44	240.00	10.10	10.10
PEST	Pest 3	Heartwood	Large Mesh	2000	40	32	NA	NA	0	39.8	68.55	0.00	105.4	94.59	18.50	19.70	20.80	55.00	3498.95	580.00	85.00	480.00	4.00	19.00
PEST	Pest 3	Heartwood	Control	2000	41	32	NA	NA	0	39.8	17.6	0.00	29.73	94.59	21.00	18.30	18.80	59.00	3438.31	0.00	519.00	215.00	0.00	58.00
PEST	Pest 3	Heartwood	Small Mesh	2000	42	32	NA	NA	0	39.8	36.29	0.00	54.05	94.59	11.50	15.30	16.60	56.00	2806.07	0.00	0.00	53.00	0.00	0.00
PEST	Pest 3	Heartwood	Large Mesh	2000	49	35	NA	NA	0	8.42	33.22	0.00	54.05	18.92	12.75	21.60	22.30	55.00	3792.68	0.00	0.00	379.00	8.75	545.00
PEST	Pest 3	Heartwood	Control	2000	50	35	NA	NA	0	8.42	12.31	0.00	18.92	18.92	17.50	18.00	20.80	57.00	3473.97	1018.49	2195.48	614.00	0.00	0.00
PEST	Pest 3	Heartwood	Small Mesh	2000	51	35	NA	NA	0	8.42	10.55	0.00	16.22	18.92	9.75	18.00	19.00	57.00	3312.81	0.00	731.20	0.00	0.00	0.00
PEST	Pest 3	Heartwood	Small Mesh	2000	52	36	NA	NA	0	2.55	10.13	0.00	16.22	5.41	16.50	19.70	21.00	61.00	3899.81	15.00	57.00	227.00	0.75	29.00
PEST	Pest 3	Heartwood	Large Mesh	2000	53	36	NA	NA	0	2.55	8.65	0.00	10.81	5.41	16.25	17.80	18.50	53.00	3022.05	120.00	0.00	275.00	0.00	65.00
PEST	Pest 3	Heartwood	Control	2000	54	36	NA	NA	0	2.55		0.00		5.41	15.50	15.80	16.30	57.00	2874.08	540.00	2193.08	393.00	5.95	0.00
PEST	Pest 3	Outer Bark	Large Mesh	2000	40	32	NA	NA	0	22.24	11.02	0.00	24.32	62.16	3.00	19.70	20.80	55.00	3498.95	580.00	85.00	480.00	4.00	19.00
PEST	Pest 3	Outer Bark	Control	2000	41	32	NA	NA	0	22.24	17.67	0.00	37.84	62.16	1.50	18.30	18.80	59.00	3438.31	0.00	519.00	215.00	0.00	58.00
PEST	Pest 3	Outer Bark	Small Mesh	2000	42	32	NA	NA	0	22.24	17.08	0.00	37.84	62.16		15.30	16.60	56.00	2806.07	0.00	0.00	53.00	0.00	0.00
PEST	Pest 3	Outer Bark	Large Mesh	2000	49	35	NA	NA	0	15.49	12.99	0.00	32.43	37.84	7.75	21.60	22.30	55.00	3792.68	0.00	0.00	379.00	8.75	545.00
PEST	Pest 3	Outer Bark	Control	2000	50	35	NA	NA	0	15.49	19.72	0.00	45.94	37.84	8.00	18.00	20.80	57.00	3473.97	1018.49	2195.48	614.00	0.00	0.00
PEST	Pest 3	Outer Bark	Small Mesh	2000	51	35	NA	NA	0	15.49	15.07	0.00	35.13	37.84	2.00	18.00	19.00	57.00	3312.81	0.00	731.20	0.00	0.00	0.00
PEST	Pest 3	Outer Bark	Small Mesh	2000	52	36	NA	NA	0	14.04	10.17	0.00	24.32	48.65	7.25	19.70	21.00	61.00	3899.81	15.00	57.00	227.00	0.75	29.00
PEST	Pest 3	Outer Bark	Large Mesh	2000	53	36	NA	NA	0	14.04	12.75	0.00	32.43	48.65	7.50	17.80	18.50	53.00	3022.05	120.00	0.00	275.00	0.00	65.00
PEST	Pest 3	Outer Bark	Control	2000	54	36	NA	NA	0	14.04	15.69	0.00	37.84	48.65	13.25	15.80	16.30	57.00	2874.08	540.00	2193.08	393.00	5.95	0.00
PEST	Pest 3	Sapwood	Large Mesh	2000	40	32	NA	NA	0	45.54	30.03	0.00	54.05	154.0	5.75	19.70	20.80	55.00	3498.95	580.00	85.00	480.00	4.00	19.00
PEST	Pest 3	Sapwood	Control	2000	41	32	NA	NA	0	45.54	41.2	0.00	78.37	154.0	5.00	18.30	18.80	59.00	3438.31	0.00	519.00	215.00	0.00	58.00
PEST	Pest 3	Sapwood	Small Mesh	2000	42	32	NA	NA	0	45.54	22.38	0.00	54.05	154.0	5.50	15.30	16.60	56.00	2806.07	0.00	0.00	53.00	0.00	0.00
PEST	Pest 3	Sapwood	Large Mesh	2000	49	35	NA	NA	0	53.91	56.98	0.00	70.27	151.3	7.00	21.60	22.30	55.00	3792.68	0.00	0.00	379.00	8.75	545.00
PEST	Pest 3	Sapwood	Control	2000	50	35	NA	NA	0	53.91	54.47	0.00	91.89	151.3	5.00	18.00	20.80	57.00	3473.97	1018.49	2195.48	614.00	0.00	0.00
PEST	Pest 3	Sapwood	Small Mesh	2000	51	35	NA	NA	0	53.91	69.95	0.00	113.5	151.3	4.50	18.00	19.00	57.00	3312.81	0.00	731.20	0.00	0.00	0.00
PEST	Pest 3	Sapwood	Small Mesh	2000	52	36	NA	NA	0	55.55	55.21	0.00	54.05	156.7	7.50	19.70	21.00	61.00	3899.81	15.00	57.00	227.00	0.75	29.00
PEST	Pest 3	Sapwood	Large Mesh	2000	53	36	NA	NA	0	55.55	47.04	0.00	81.08	156.7	6.25	17.80	18.50	53.00	3022.05	120.00	0.00	275.00	0.00	65.00
PEST	Pest 3	Sapwood	Control	2000	54	36	NA	NA	0	55.55	38.54	0.00	109.4	156.7	6.00	15.80	16.30	57.00	2874.08	540.00	2193.08	393.00	5.95	0.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 4	Heartwood	Control	2000	55	37	NA	NA	0	16.76	19.1	0.00	21.62	33.51	10.50	20.90	22.20	53.00	3588.17	3285.17	95.00	1025.00	17.35	0.00
PEST	Pest 4	Heartwood	Small Mesh	2000	56	37	NA	NA	0	16.76	10.48	0.00	13.51	33.51	11.50	18.90	19.30	53.00	3180.23	1519.17	44.00	241.00	11.97	0.00
PEST	Pest 4	Heartwood	Large Mesh	2000	57	37	NA	NA	0	16.76	16.48	0.00	25.67	33.51	25.50	17.50	18.00	53.00	2955.45	84.00	0.00	385.00	1.26	10.00
PEST	Pest 4	Heartwood	Small Mesh	2000	61	39	NA	NA	0	24.24	10.2	0.00	13.51	51.35	13.00	20.10	20.80	56.00	3597.75	724.00	0.00	681.00	0.00	199.00
PEST	Pest 4	Heartwood	Large Mesh	2000	62	39	NA	NA	0	24.24	11.78	0.00	12.16	51.35	10.00	19.10	19.90	57.00	3491.88	2661.88	0.00	719.00	2.92	0.00
PEST	Pest 4	Heartwood	Control	2000	63	39	NA	NA	0	24.24	13.83	0.00	17.57	51.35	13.50	18.00	18.50	54.00	3096.04	1657.03	5.00	599.00	19.50	2.50
PEST	Pest 4	Heartwood	Control	2000	64	40	NA	NA	0	16.04	31.98	0.00	41.89	29.73	15.00	18.90	19.50	52.00	3136.56	0.00	88.00	382.00	2.00	8.00
PEST	Pest 4	Heartwood	Small Mesh	2000	65	40	NA	NA	0	16.04	23.7	0.00	32.43	29.73	7.75	18.10	18.90	57.00	3312.81	121.00	51.00	147.00	15.77	0.00
PEST	Pest 4	Heartwood	Large Mesh	2000	66	40	NA	NA	0	16.04	14.31	0.00	22.97	29.73	19.25	16.80	17.50	52.00	2801.67	2801.67	0.00	446.00	0.00	2.00
PEST	Pest 4	Outer Bark	Control	2000	55	37	NA	NA	0	13.42	10.93	0.00	24.32	37.84	1.50	20.90	22.20	53.00	3588.17	3285.17	95.00	1025.00	17.35	0.00
PEST	Pest 4	Outer Bark	Small Mesh	2000	56	37	NA	NA	0	13.42	15.68	0.00	32.43	37.84	1.50	18.90	19.30	53.00	3180.23	1519.17	44.00	241.00	11.97	0.00
PEST	Pest 4	Outer Bark	Large Mesh	2000	57	37	NA	NA	0	13.42	7.58	0.00	20.27	37.84	3.00	17.50	18.00	53.00	2955.45	84.00	0.00	385.00	1.26	10.00
PEST	Pest 4	Outer Bark	Small Mesh	2000	61	39	NA	NA	0	17.44	12.32	0.00	24.32	48.65	3.50	20.10	20.80	56.00	3597.75	724.00	0.00	681.00	0.00	199.00
PEST	Pest 4	Outer Bark	Large Mesh	2000	62	39	NA	NA	0	17.44	17.38	0.00	40.54	48.65	5.00	19.10	19.90	57.00	3491.88	2661.88	0.00	719.00	2.92	0.00
PEST	Pest 4	Outer Bark	Control	2000	63	39	NA	NA	0	17.44	26.1	0.00	59.46	48.65	8.00	18.00	18.50	54.00	3096.04	1657.03	5.00	599.00	19.50	2.50
PEST	Pest 4	Outer Bark	Control	2000	64	40	NA	NA	0	19.06	24.94	0.00	70.27	62.16	6.00	18.90	19.50	52.00	3136.56	0.00	88.00	382.00	2.00	8.00
PEST	Pest 4	Outer Bark	Small Mesh	2000	65	40	NA	NA	0	19.06	18.01	0.00	40.54	62.16	3.75	18.10	18.90	57.00	3312.81	121.00	51.00	147.00	15.77	0.00
PEST	Pest 4	Outer Bark	Large Mesh	2000	66	40	NA	NA	0	19.06	18.88	0.00	43.24	62.16	13.50	16.80	17.50	52.00	2801.67	2801.67	0.00	446.00	0.00	2.00
PEST	Pest 4	Sapwood	Control	2000	55	37	NA	NA	0	64.3	67.5	0.00	108.10	265.39	11.50	20.90	22.20	53.00	3588.17	3285.17	95.00	1025.00	17.35	0.00
PEST	Pest 4	Sapwood	Small Mesh	2000	56	37	NA	NA	0	64.3	66.1	0.00	124.32	265.39	12.75	18.90	19.30	53.00	3180.23	1519.17	44.00	241.00	11.97	0.00
PEST	Pest 4	Sapwood	Large Mesh	2000	57	37	NA	NA	0	64.3	32.25	0.00	67.56	265.39	13.00	17.50	18.00	53.00	2955.45	84.00	0.00	385.00	1.26	10.00
PEST	Pest 4	Sapwood	Small Mesh	2000	61	39	NA	NA	0	40.54	68.98	0.00	75.67	97.29	3.50	20.10	20.80	56.00	3597.75	724.00	0.00	681.00	0.00	199.00
PEST	Pest 4	Sapwood	Large Mesh	2000	62	39	NA	NA	0	40.54	58.92	0.00	102.70	97.29	2.25	19.10	19.90	57.00	3491.88	2661.88	0.00	719.00	2.92	0.00
PEST	Pest 4	Sapwood	Control	2000	63	39	NA	NA	0	40.54	36.77	0.00	62.16	97.29	3.00	18.00	18.50	54.00	3096.04	1657.03	5.00	599.00	19.50	2.50
PEST	Pest 4	Sapwood	Control	2000	64	40	NA	NA	0	46.55	63.54	0.00	94.59	124.32	4.25	18.90	19.50	52.00	3136.56	0.00	88.00	382.00	2.00	8.00
PEST	Pest 4	Sapwood	Small Mesh	2000	65	40	NA	NA	0	46.55	57.37	0.00	94.59	124.32	3.00	18.10	18.90	57.00	3312.81	121.00	51.00	147.00	15.77	0.00
PEST	Pest 4	Sapwood	Large Mesh	2000	66	40	NA	NA	0	46.55	66.11	0.00	97.29	124.32	4.25	16.80	17.50	52.00	2801.67	2801.67	0.00	446.00	0.00	2.00
PEST	Pest 5	Heartwood	Control	2000	73	43	NA	NA	0	9.12	10.37	0.00	18.92	16.22	2.75	18.30	19.80	49.00	2932.52	0.00	0.00	390.00	161.43	0.00
PEST	Pest 5	Heartwood	Small Mesh	2000	74	43	NA	NA	0	9.12	5.39	0.00	9.46	16.22	4.00	15.60	16.90	50.00	2552.54	193.00	25.00	418.00	0.00	0.00
PEST	Pest 5	Heartwood	Large Mesh	2000	75	43	NA	NA	0	2.37		0.00		8.11	15.00	13.50	14.50	58.00	2550.97	378.00	25.00	436.00	0.00	0.00
PEST	Pest 5	Heartwood	Large Mesh	2000	85	47	NA	NA	0	9.12	30.14	0.00	44.59	16.22	15.00	19.80	21.00	48.00	3076.24	0.00	0.00	487.00	16.95	84.00

STUDY	SITE	TISSUE	SCREEN	YR	PLOT	TREE	HARVEST	BURN	WWI	DWI	WWF	WVI	WVF	DVI	DVF	TOPDI	BOTDI	LENGTH	AREA	BB	WBP	STAIN	WBS	ROT
PEST	Pest 5	Heartwood	Control	2000	86	47	NA	NA	0	9.12	23.38	0.00	43.24	16.22	20.00	18.20	18.80	53.00	3080.33	0.00	0.00	424.00	0.00	0.00
PEST	Pest 5	Heartwood	Small Mesh	2000	87	47	NA	NA	0	9.12	5.03	0.00	10.81	16.22	13.50	16.80	17.50	51.00	2747.79	242.00	0.00	16.00	25.00	0.00
PEST	Pest 5	Heartwood	Small Mesh	2000	88	48	NA	NA	0	52.26	27.2	0.00	43.24	89.18	5.75	22.00	22.40	51.00	3556.91	0.00	0.00	343.00	14.39	161.00
PEST	Pest 5	Heartwood	Large Mesh	2000	89	48	NA	NA	0	52.26	29.57	0.00	43.24	89.18	2.50	20.70	21.40	52.00	3438.78	949.70	20.00	550.00	4.75	5.00
PEST	Pest 5	Heartwood	Control	2000	90	48	NA	NA	0	52.26	59.33	0.00	78.37	89.18	1.75	20.40	20.70	54.00	3486.22	532.56	0.00	352.00	0.00	0.00
PEST	Pest 5	Outer Bark	Control	2000	73	43	NA	NA	0	14.49	12.41	0.00	35.13	37.84	4.25	18.30	19.80	49.00	2932.52	0.00	0.00	390.00	161.43	0.00
PEST	Pest 5	Outer Bark	Small Mesh	2000	74	43	NA	NA	0	14.49	10.42	0.00	29.73	37.84	2.00	15.60	16.90	50.00	2552.54	193.00	25.00	418.00	0.00	0.00
PEST	Pest 5	Outer Bark	Large Mesh	2000	75	43	NA	NA	0	14.49	10.72	0.00	29.73	37.84	8.00	13.50	14.50	58.00	2550.97	378.00	25.00	436.00	0.00	0.00
PEST	Pest 5	Outer Bark	Large Mesh	2000	85	47	NA	NA	0	14.49	16.95	0.00	44.59	37.84	5.00	19.80	21.00	48.00	3076.24	0.00	0.00	487.00	16.95	84.00
PEST	Pest 5	Outer Bark	Control	2000	86	47	NA	NA	0	14.49	11.13	0.00	27.03	37.84	3.50	18.20	18.80	53.00	3080.33	0.00	0.00	424.00	0.00	0.00
PEST	Pest 5	Outer Bark	Small Mesh	2000	87	47	NA	NA	0	14.49	10.61	0.00	25.67	37.84	11.00	16.80	17.50	51.00	2747.79	242.00	0.00	16.00	25.00	0.00
PEST	Pest 5	Outer Bark	Small Mesh	2000	88	48	NA	NA	0	22.45	20.97	0.00	48.65	64.86	10.25	22.00	22.40	51.00	3556.91	0.00	0.00	343.00	14.39	161.00
PEST	Pest 5	Outer Bark	Large Mesh	2000	89	48	NA	NA	0	22.45	18.61	0.00	40.54	64.86	13.50	20.70	21.40	52.00	3438.78	949.70	20.00	550.00	4.75	5.00
PEST	Pest 5	Outer Bark	Control	2000	90	48	NA	NA	0	22.45	14.37	0.00	32.43	64.86	12.25	20.40	20.70	54.00	3486.22	532.56	0.00	352.00	0.00	0.00
PEST	Pest 5	Sapwood	Control	2000	73	43	NA	NA	0	72.51	31.23	0.00	67.56	172.96		18.30	19.80	49.00	2932.52	0.00	0.00	390.00	161.43	0.00
PEST	Pest 5	Sapwood	Small Mesh	2000	74	43	NA	NA	0	72.51	35.62	0.00	70.27	172.96		15.60	16.90	50.00	2552.54	193.00	25.00	418.00	0.00	0.00
PEST	Pest 5	Sapwood	Large Mesh	2000	75	43	NA	NA	0	72.51	58.87	0.00	145.94	172.96		13.50	14.50	58.00	2550.97	378.00	25.00	436.00	0.00	0.00
PEST	Pest 5	Sapwood	Large Mesh	2000	85	47	NA	NA	0	72.51	32.54	0.00	72.97	172.96	0.00	19.80	21.00	48.00	3076.24	0.00	0.00	487.00	16.95	84.00
PEST	Pest 5	Sapwood	Control	2000	86	47	NA	NA	0	72.51	22.76	0.00	59.46	172.96	0.00	18.20	18.80	53.00	3080.33	0.00	0.00	424.00	0.00	0.00
PEST	Pest 5	Sapwood	Small Mesh	2000	87	47	NA	NA	0	72.51	29.38	0.00	74.32	172.96	0.00	16.80	17.50	51.00	2747.79	242.00	0.00	16.00	25.00	0.00
PEST	Pest 5	Sapwood	Small Mesh	2000	88	48	NA	NA	0	50.62	61.55	0.00	91.89	132.42		22.00	22.40	51.00	3556.91	0.00	0.00	343.00	14.39	161.00
PEST	Pest 5	Sapwood	Large Mesh	2000	89	48	NA	NA	0	50.62	67.19	0.00	50.00	132.42	2.50	20.70	21.40	52.00	3438.78	949.70	20.00	550.00	4.75	5.00
PEST	Pest 5	Sapwood	Control	2000	90	48	NA	NA	0	50.62	61.84	0.00	116.21	132.42	11.25	20.40	20.70	54.00	3486.22	532.56	0.00	352.00	0.00	0.00

Appendix 3. CO₂ values (ug/ml) for 14 day accumulations from Black's Mt. Experimental Forest, California. Two sites are indicated, the experimental forest proper, noted as 'BLACKS' (Chapter 4) and a nearby adjacent site noted as 'PEST' (Chapter 3). Plot numbers for PEST are given as block-tree-section. SCREEN refers to screening treatments used for experimental treatments. Two sampling periods, Fall and Spring were used at this site, corresponding to November 1999, and April 2000. BLACKS plots are indicated by tree from which sample units were cut, and the harvest/burn plot, which is a unique combination of harvest and burn treatments. See appropriate chapters for further details.

SITE	PLOT	SCREEN	FALL [CO ₂]	SPRING [CO ₂]	SITE	TREE	PLOT	Harvest	Burn	FALL [CO ₂]
Pest	1-1a	Control	0.1072	0.0647	BLACKS	2	42-	High Diversity	No Burn	0.0874
Pest	1-1b	Small Mesh	0.1044	0.0761	BLACKS	6	42-	High Diversity	No Burn	0.0917
Pest	1-1c	Large Mesh	0.0961	0.1137	BLACKS	15	42-	High Diversity	No Burn	0.0855
Pest	1-4a	Control	0.0725	0.0883	BLACKS	4	42+	High Diversity	Burn	0.0853
Pest	1-4b	Small Mesh	0.0825	0.0881	BLACKS	7	42+	High Diversity	Burn	0.1001
Pest	1-4c	Large Mesh	0.0847	0.0982	BLACKS	10	42+	High Diversity	Burn	0.1203
Pest	1-5a	Large Mesh	0.117	0.0924	BLACKS	1	44-	Low Diversity	No Burn	0.0909
Pest	1-5b	Control	0.1002	0.1013	BLACKS	2	44-	Low Diversity	No Burn	0.092
Pest	1-5c	Small Mesh	0.111	0.1164	BLACKS	9	44-	Low Diversity	No Burn	0.0737
Pest	2-1a	Control	0.0981	0.0855	BLACKS	3	44+	Low Diversity	Burn	0.0904
Pest	2-1b	Small Mesh	0.0969	0.0872	BLACKS	6	44+	Low Diversity	Burn	0.0825
Pest	2-1c	Large Mesh	0.0937	0.0755	BLACKS	8	44+	Low Diversity	Burn	0.0866
Pest	2-5a	Large Mesh	0.1013	0.0959	BLACKS	16	44+	Low Diversity	Burn	0.0985
Pest	2-5b	Control	0.0884	0.0932	BLACKS	5	45-	Low Diversity	No Burn	0.0865
Pest	2-5c	Small Mesh	0.1023	0.0797	BLACKS	5	45-	Low Diversity	No Burn	0.0916
Pest	2-6a	Small Mesh	0.1033	0.0931	BLACKS	10	45-	Low Diversity	No Burn	0.1038
Pest	2-6b	Large Mesh	0.0961	0.1462	BLACKS	14	45-	Low Diversity	No Burn	0.0992
Pest	2-6c	Control	0.0946	0.0968	BLACKS	6	45+	Low Diversity	Burn	0.0819
Pest	3-2a	Large Mesh	0.1148	0.108	BLACKS	1	45+	Low Diversity	Burn	0.0786
Pest	3-2b	Control	0.087	0.1098	BLACKS	12	45+	Low Diversity	Burn	0.0969
Pest	3-2c	Small Mesh	0.0968	0.1152	BLACKS	13	45+	Low Diversity	Burn	0.0858
Pest	3-5a	Large Mesh	0.1115	0.0795	BLACKS	1	47-	High Diversity	No Burn	0.0933
Pest	3-5b	Control	0.093	0.0792	BLACKS	12	47-	High Diversity	No Burn	0.0873
Pest	3-5c	Small Mesh	0.1074	0.0819	BLACKS	13	47-	High Diversity	No Burn	0.0721
Pest	3-6a	Small Mesh	0.1159	0.0933	BLACKS	16	47-	High Diversity	No Burn	0.0887
Pest	3-6b	Large Mesh	0.1056	0.1287	BLACKS	9	47+	High Diversity	Burn	0.1028
Pest	3-6c	Control	0.0955	0.0932	BLACKS	13	47+	High Diversity	Burn	0.0859
Pest	4-1a	Control	0.071	0.08	BLACKS	15	47+	High Diversity	Burn	0.0715
Pest	4-1b	Small Mesh	0.0637	0.0788	BLACKS	11	47+	High Diversity	Burn	0.0694
Pest	4-1c	Large Mesh	0.069	0.1027	BLACKS	3	RNA A	Control	No Burn	0.0963

SITE	PLOT	SCREEN	FALL [CO2]	SPRING [CO2]	SITE	TREE	PLOT	Harvest	Burn	FALL [CO2]
Pest	4-3a	Small Mesh	0.1048	0.0756	BLACKS	12	RNA A	Control	No Burn	0.0989
Pest	4-3b	Large Mesh	0.095	0.082	BLACKS	15	RNA A	Control	No Burn	0.0874
Pest	4-3c	Control	0.0865	0.0948	BLACKS	17	RNA A	Control	No Burn	0.0893
Pest	4-4a	Control	0.0817	0.0924	BLACKS	1	RNA B	Control	Burn	0.0844
Pest	4-4b	Small Mesh	0.1049	0.0743	BLACKS	8	RNA B	Control	Burn	0.0906
Pest	4-4c	Large Mesh	0.0955	0.0677	BLACKS	8	RNA B	Control	Burn	0.102
Pest	5-1a	Control	0.1016	0.0835	BLACKS	11	RNA B	Control	Burn	0.1002
Pest	5-1b	Small Mesh	0.1014	0.0991	BLACKS	1	RNA D	Control	No Burn	0.1177
Pest	5-1c	Large Mesh	0.0957	0.0819	BLACKS	9	RNA D	Control	No Burn	
Pest	5-5a	Large Mesh	0.1038	0.084	BLACKS	9	RNA D	Control	No Burn	0.0917
Pest	5-5b	Control	0.0831	0.0934	BLACKS	9	RNA D	Control	No Burn	0.0854
Pest	5-5c	Small Mesh	0.0967	0.0817						
Pest	5-6a	Small Mesh	0.0878	0.0782						
Pest	5-6b	Large Mesh	0.0875	0.086						
Pest	5-6c	Control	0.0823	0.084						