DISSERTATION

CHARACTERIZE SOUTHWESTERN U.S. PIÑON-JUNIPER WOODLANDS:

SEEING THE "OLD" TREES FOR THE "YOUNG" FOREST

Submitted By:

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY *BRIAN FRANCIS JACOBS* ENTITLED *CHARACTERIZE SOUTHWESTERN U.S. PIÑON-JUNIPER WOODLANDS: SEEING THE 'OLD' TREES FOR THE 'YOUNG' FOREST* BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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ABSTRACT OF DISSERTATION

CHARACTERIZE SOUTHWESTERN U.S. PIÑON-JUNIPER WOODLANDS: SEEING THE "OLD" TREES FOR THE "YOUNG" FOREST

Southwestern U.S. piñon pine and juniper woodlands are often represented as an expanding and even invasive vegetation type, a legacy of historic grazing and culpable in the degradation of western rangelands. Yet the extent and dynamics of piñon-juniper communities pre-dating intensive Euro-American settlement activities are poorly known or understood, while the intrinsic ecological, aesthetic, and economic values of old-growth woodlands are often overlooked. Historical changes in piñon-juniper include two related, but poorly differentiated, processes: recent tree expansion into grass or shrub dominated (i.e., non-woodland) vegetation and thickening or infilling of savanna or mosaic woodlands pre-dating settlement. My work addresses the expansion pattern, modeling the occurrence of "older" savanna and woodland stands extant prior to 1850, in contrast to "younger" piñon-juniper growth of more recent, post-settlement origin. I present criteria in the form of a diagnostic key for distinguishing "older", pre-Euro-American settlement woodlands from "younger" (post-1850) stands, and report results of predictive modeling and mapping efforts within the Four Corners states (i.e., Arizona, Colorado, New Mexico, and Utah) of the American southwest in piñon-juniper types characterized by *Pinus edulis* and three associated junipers (*Juniperus osteosperma, J. monosperma, J. scopulorum*). Selected models suggest a primary role for soil moisture in the current distribution of "old" versus "young" piñon-juniper stands. Pre-settlement era woodlands are shown to occupy a discrete ecological space, defined by the interaction of effective (seasonal) moisture with landform setting and fine-scale (soil-water) depositional patterns. “Older” stands are generally found at higher elevations or on skeletal soils in upland settings, while “younger” stands (often dominated by one-seed juniper, *Juniperus monosperma*) are most common at lower elevations or in productive, depositional settings. Areas of the southwestern U.S. with strong monsoonal (summer moisture) patterns appear to have been the most susceptible to historical woodland expansion, but even here the great majority of extant piñon-juniper has pre-settlement origins (although widely thickened and infilled historically) and old-growth structure is not uncommon in appropriate upland settings. Modeling at broad regional scales can enhance a general understanding of piñon-juniper ecology, while predictive mapping of local areas has potential to provide products useful for land management.

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Chapter I

Environmental controls of "old" or persistent woodland:

A study proposal

Abstract

Piñon-juniper woodlands are widely distributed on millions of acres across the southwestern U.S. Recent, historical changes in woodland occurrence and stand density have been variously interpreted as continued adjustment to Holocene climate, recovery from harvest (historic and pre-historic), succession after fire, drought, insect, and/ or disease induced mortality events, or response to grazing practices, altered fire regimes, elevated temperatures and CO_2 levels. The broad ecological amplitude of southwestern piñon-juniper woodland tree species is demonstrated by the wide range of sites on which these trees can grow. Conversely, these species are extremely sensitive to fire disturbance and easily killed; drought, insect, and disease mortality can also have large effects on woodland stand dynamics, structure, and local distribution patterns. I suggest that while ecological amplitude and regional climate set broad limits on potential woodland species distribution, environmental factors and associated disturbance regimes formerly constrained the local extent and expression of woodland species occurrence on the landscape. If competitive interactions with understory, and disturbances like periodic surface fire, formerly restricted woodlands to a more limited range of sites (i.e., through competition with grasses and shrubs or fire avoidance) one could expect to detect meaningful relationships between "old" or persistent woodland stands (i.e., pre-dating Euro-American settlement) and suites of environmental site parameters. Field delineation of "old" or persistent stands could be accomplished using a set of semi-quantitative and qualitative characters found to be diagnostic for assignment of a pre- versus post-settlement stand-age. Relating the occurrence of sampled pre- versus post-settlement stands to potential environmental controls through spatial modeling could

provide a viable approach for predictive mapping and of "old" versus "young" woodlands that would in turn facilitate appropriate and targeted management actions.

Introduction

Piñon and juniper dominated woodlands occupy millions of acres throughout the western United States (West, 1999), and are thought to have expanded several fold since 1850 (Miller and Wigand, 1994; Swetnam et. al., 1999; Tausch, 1999a ; Miller and Tausch, 2001;). Research and management efforts have primarily addressed this recent, post-Euro-American settlement expansion pattern of woodlands into degraded rangelands and upland forests understories. Often ignored, or poorly recognized however, are the "old" or persistent pre-settlement stands (in various stages of successional development), which in some areas are thought to account for only a few percent of the total acreage (Waicher et. al, 2001), but which in other locations may be much more common than previously thought (Eisenhart, 2004.). These pre-settlement status piñon and juniper woodlands, typically exceeding 150 years in age, are often thought to be restricted to low productivity sites where shallow soils and natural topographic barriers may combine to provide fire-safe conditions (Miller and Tausch, 2001). Old growth woodlands often create structurally complex and biologically diverse habitat supporting many unique organisms; individual trees can live several hundred to more than a thousand years, with juniper snags and logs often persisting for several hundred years (Floyd et. al., 2003). Yet, because these "old" or persistent growth communities are poorly understood, undervalued, and not easily distinguished from stands of more recent origin, they are increasingly at risk of being "restored" or burned over. Unrecognized, these old growth woodlands can be inadvertently harmed by management actions (i.e., restoration, rangeland improvement, and fuel mitigation efforts) designed for post- Euro-American settlement woodlands (Eisenhart, 2004); conversely, crown fire is much more likely to occur in old growth stands contiguous with post-Euro-American settlement woodlands occupying more productive sites (Waicher et. al., 2001; Romme et. al. 2003).

Much of the confusion about the nature of woodlands can be attributed to overly simplistic classification methods utilizing extant tree overstory as the primary determinate of community type, regardless of age-structure, understory composition, or site history. Thus often lumped together with woodland, are former pine savanna, grass- and shrub- land communities only recently (i.e. <150 years) characterized by a significant piñon and/or juniper overstory component (Tausch, 1999a). Key to discerning “old” or persistent woodland types from former pine savanna, grass- and shrublands, may be the soils and corresponding understory communities, inherent site productivity, topographic setting, and fire history (Tausch, 1999a). Shallow soils and broken topography are often thought to support “old” or persistent woodland where fire disturbance is infrequent owing to low site productivity and discontinuous fine fuels (Miller and Tausch, 2001). Conversely, deeper, more productive soils, and unbroken topography are thought to favor fire dependent pine savanna, grass- and shrub- land communities where fine fuel continuity allows more regular fire disturbance and culling of fire sensitive woodland species (Brackley, 1987). Romme et. al. (2003) presented general criteria for discerning three putative types of woodland in western North America in order to stimulate critical review of woodland system dynamics and classification.

Southwestern piñon-juniper woodlands are dynamic systems, some very "old", although in various stages of development or recovery, and many others of apparently recent origin. Individuals and stands can often persist hundreds and thousands of years respectively, yet be consumed by crown fire in a single afternoon and require 50 to 100 years or more to re-establish dominance. In other settings, where piñon and/or juniper have recently colonized more productive sites, the woodland type is best characterized as invasive. Paleo-vegetation reconstructions, based largely on pollen and macro-fossil evidence (Betancourt, 1987), document changing patterns of woodland distribution (i.e., northward and to higher elevations) and composition in response to prevailing regional climate (Neilson, 1987) and episodic weather events which facilitate pulsed establishment and mortality (Miller and Wigand, 1994; Swetnam et. al., 1999; Tausch, 1999a). Long-term records document a tidal advance and retreat of woodlands, coming and going repeatedly as climatic conditions fluctuate; the current dynamics of southwestern woodlands could be viewed as merely the latest response of this system to prevailing climate (Betancourt, 1987; Neilson, 1987; Swetnam et. al., 1999). Woodland species distributions, landscape patterns, and stand structures can be interpreted as the cumulative result of episodic establishment and mortality events under prevailing climatic conditions (Mitchell, 1976; Betancourt, 1987; Eisenhart, 2004). Although many morphological and ecophysiological traits represented within conifer species and populations are assumed to be conservative over Holocene time periods, their relative expression and representation in extant populations is likely a unique outcome influenced by factors such as sorting to meet changing conditions, shifting ranges, founder effects, and stochastic processes (Neilson, 1987). Across much of the southwest a relative expansion of woodlands was likely ongoing prior to European settlement (Miller and Wigand, 1994; Swetnam et. al, 1999; Tausch, 1999a); intensive historic land-use activities (e.g., grazing), beginning in the mid-late 1800's, are thought to have altered natural dynamics (e.g., loss of fire regime) in grass and shrub dominated systems and opened up additional sites for woodland colonization essentially unavailable during previous prehistoric expansions (Brackley, 1987). With sustained grazing pressure and in the absence of fire disturbance, these tree species have wide ecological amplitudes and can aggressively colonize adjacent communities (Brackley, 1987; Tausch, 1999a; Miller and Tausch, 2001). Southwestern woodlands thus include "old" or persistent stands of considerable age, structural and biological diversity, as well as stands of more recent origin which have often displaced or suppressed the community formerly occupying the site.

Colorado piñon is typically shorter lived, and less drought/ insect and disease tolerant than either juniper species, but is more productive with faster growth rates during wet periods and in more mesic (e.g., higher elevation) settings (Chambers et. al., 1999; Nowak et. al, 1999; Martens et. al., 2001). One-seed and Utah juniper in contrast, are longer lived and relatively resistant to drought, insect, and disease, but less productive than piñon during wet periods or in more mesic settings. One-seed juniper, with extensive shallow roots which harvest water from canopy interspaces, may compete more directly with herbaceous cover for available moisture than either Utah juniper or piñon; reported foliar uptake of moisture by one-seed juniper (Breshears et. al., 2008) may also enhance this species apparent resistance to drought. Alternatively, some woodland trees may be able to reallocate harvested surface water to deep root storage where transpirational losses would be reduced (West, personal communication.).

Current distributional patterns of the three woodland species appear to be constrained in part by the relative positions of summer and winter potential air mass temperature boundaries related to seasonal migration of the Bermuda High (Neilson, 1987, 2003; Castro et. al., 2001) which strongly influences regional precipitation patterns and which Mitchell (1976) uses to define broad western climatic regions. For example, *J. monosperma* appears to be more dependent on a summer dominated moisture pattern (i.e., climate region VI, south and east of the summer monsoonal boundary) and less cold tolerant than *J. osteosperma*, which occurs mostly in areas north and west of the summer monsoonal boundary (i.e., climate region V). *Pinus edulis* and *J. osteosperma* are both distributed south of the winter polar front, but *J. osteosperma* is reported to occur elevationally above, as well as below, piñon (Neilson, 1987). Presumed differences in root system architecture between the two junipers, and relative dependence on deep versus shallow sources of water, may be reflected by their distributional patterns (and differential establishment and mortality) relative to seasonality of moisture.

Establishment patterns for woodland species are often episodic and associated with favorable climatic patterns (e.g., for establishment) and suitable microsites (e.g., shrub nurse plants) assuming seed availability; piñon masts infrequently at intervals of several years and seed are heavily predated and short lived in the soil seed bank, while juniper produces a more consistent seed crop with longer viability (Chambers et. al., 1999). Mature individuals of either tree species can serve as nurse plants for seedlings of one or both species, forming distinct multi-aged patches. Persistence patterns for woodland species may be related, in part, to site conditions that promote deep infiltration and enhance subsoil water availability. While shallow soil sites may not provide sufficient water storage to support well developed herbaceous cover, fractured substrates underlying these soils may provide deep water storage accessible only by woody plants (McAuliffe, 2003). Piñon can attain dominance at higher, more mesic sites or during prolonged wet periods (except for localized fungal disease outbreaks), but juniper is usually favored at lower and drier sites and through drought periods which make piñon susceptible to insect mortality (Pieper and Lymbery, 1987). I suggest establishment of woodland onto deep soil sites during relatively moist periods, and in absence of fire disturbance, may proceed to closed canopy woodland (and eventual suppression of the understory community) given adequate subsoil water availability; however, sustained drought which limits deep soil water recharge at earlier stages of woodland establishment, and competitive interactions with herbaceous understory for growing season moisture, could result in widespread tree mortality.

Prolonged and severe drought episodes, insect and disease outbreaks, and fire, appear to be the primary disturbances thought to limit maximum age. My observations of burned woodlands suggest both piñon and juniper are extremely susceptible to fire and heat damage, and are usually killed outright, as opposed to merely scarred, by even moderate fire behavior. Given this fire intolerance and the several hundred years required for trees to attain site dominance, it seems unlikely woodland would normally persist on sites where extant understory vegetation could potentially support fire return intervals of less than 50 to 100 years (in absence of grazing or fire suppression). Long-term avoidance of lethal fire effects can be afforded by fire-safe settings (i.e., on sites which generally support only sparse or patchy surface fuels and/ or in topographic settings limiting fire spread from adjacent areas); protection from ground fire also may be afforded to individuals or woodland patches by compact litter mats and competitive suppression of adjacent understory cover. I suggest that sites with shallow, rocky soils and which are often labeled unproductive because insufficient and/ or irregular water availability (within rooting depths of herbaceous plants) support only sparse understory cover, may sometimes be relatively productive from a deep rooted tree perspective where the underlying, fractured rock substrate captures and stores a source of ground water accessible only to woody plants. Similarly, deep, but coarse and well drained, soils may be unproductive for understory cover (where water drains or perches below effective understory rooting depths), but may support good tree growth if water is perched and available within effective tree rooting depths). Soils or substrates that effectively inhibit deep water filtration and storage, through soil texture, presence of argillic horizons or impermeable layers at shallow depths, may favor herbaceous cover and show increased resistance to woody plant establishment even under sustained grazing pressure (McAuliffe, 2003). Alternatively, Walker et. al., (1981) describe overgrazed savanna systems where dispersed infiltration into grass dominated sites becomes progressively more focused, as decreasing herbaceous cover allows rain drop splash to seal surface soil pores and enhance runoff from intercanopy spaces; this runoff is then captured by canopy patches whose litter mounds and root profiles may facilitate rapid infiltration to depth. I suggest canopy interception may also focus water inputs around the dripline of trees and thus potentially enhance deep infiltration of even relatively small precipitation events.

Seasonality of moisture (and temperature) regime patterns across an apparent southeast to northwest moisture gradient in the southwestern U.S. (mediated by climatic zone boundaries and locally amplified by elevational and orographic effects) can also influence site and corresponding vegetative cover potential (Neilson, 1987, 2003). Portions of the southwestern U.S. experience a summer monsoonal pattern that is driven by seasonal shifts of atmospheric pressure and wind patterns, a consequence of the annual westward migration of the Bermuda High, whose clockwise circulation acts to draw moisture into parts of Arizona and New Mexico off the Gulf of Mexico and from the Gulf of California (Castro et. al., 2001). In arid and semi-arid portions of the southwestern U.S. the variability of monsoonal precipitation can sometimes exceed the summer mean, and this variance can drive episodic patterns of plant establishment and mortality (Castro et. al., 2001). Neilson (2003) speculates that the mid-Holocene (i.e. thermal maximum) monsoonal pattern likely extended further northward and may have supported rapid northward expansion of some plant species dependent on summer moisture for establishment. However, there is little evidence to suggest that either monsoonal intensity or extent have changed enough during the last several hundred years to account for observed changes in woodland systems since settlement.

Sites within Mitchells' (1976) climate zone V (Figure 1.1) are often dominated by cool season moisture patterns (i.e., with extended late summer to spring elevated plateau moisture patterns which may favor deeper rooted, perennial or woody species, whose dominance could promote longer fire return intervals), while other locations have somewhat more uniform distributions; with either pattern there is often a relative trough in the late May-June time period. Sites within Mitchells' (1976) climate zone VI (Figure 1.1), by contrast, are often strongly dominated by a warm season dominated moisture pattern (i.e., with a distinct summer peak and a depressed plateau moisture pattern the rest of the year) which may favor shallow rooted herbaceous cover and shorter fire return intervals; at locations near the summer monsoon boundary, precipitation patterns may be bimodal with elements of both the cool season moisture and summer peak patterns and a notable, but narrow trough from late May to June. In zone V locations, increasing moisture patterns after the late-May-June trough is best interpreted as a return to normal cooler season moisture levels. Thus, while sites within Mitchells' (1976) climate zones V and VI (Figure 1.1) may both experience low moisture conditions during the late May to June period when temperatures are rising (creating relative moisture deficits at most locations), areas within zone V may be buffered by recent cool season moisture inputs, while in zone VI, the same period may culminate an extended low moisture pattern beginning the previous fall. In addition, most of the summer peak moisture in Mitchells' (1976) climate zone VI (Figure 1.1) arrives in the form of convective thunderstorms with significant levels of lightning strikes (and potential for ignitions), while cool season moisture patterns have both lower levels of summer lightning (and perhaps lower potentials for ignition of fuels with residual winter moisture).

Finally, one might expect interactions between topographic position (and effects on soil properties such as texture and infiltration depth) and the dominant precipitation pattern to influence woody plant distribution (Walker et. al., 1981). For example, in areas dominated by a winter precipitation pattern, infiltration to depth may be sufficient across a wide range of topographic positions and promote woody plant dominance across a variety of landscape settings; conversely, as summer dominated precipitation patterns become increasingly important, associated losses due to evapo-transpiration would increase, and topographic effects (which mediate deeper infiltration and retention of deep soil moisture) would become increasingly influential in determining where woody plants could occur. These same interactions, and effects on soil moisture, could promote the occurrence of grass dominated communities (and increased surface fire potential) across a broader range of landscape positions in areas with summer dominated precipitation patterns.

My observations of a scarcity of fire evidence in many "younger" woodlands of apparently recent, post-settlement origin suggests they may have developed since the last fire disturbance in formerly non-woodland vegetation types, perhaps mediated by the indirect effects of historic grazing. Conversely, recovery of a woodland stand after harvest, or from a crown fire, drought/ insect mortality event would usually provide some evidence of the previous stand. In addition, infrequent observations of fire scarred piñon or juniper in many "older" or persistent growth woodlands suggests surface fire may be an uncommon disturbance event in these systems (Baker and Shinneman, 2004), particularly in light of the often sparse herbaceous fuels and compact needle litter; when scars can be found they often appear to be associated with crown fire patch margins or interfaces with high fire frequency (i.e., grassland or ponderosa pine) communities. Where fire evidence (i.e., charred wood, stumps and snags) is present, it usually suggests an infrequent, high severity, crown fire of variable pattern and patch size as the predominant regime (Fuchs, 2002; Romme et. al., 2003; Baker and Shimmeman, 2004). With reduced herbaceous competition and in the absence of fire disturbance (i.e., direct and indirect effects of historic grazing pressure), piñon and juniper can successfully colonize a wide range of sites as illustrated by establishment patterns during the last century (Tausch, 1999a; Miller and Tausch, 2001).

Fire, drought, insect, and disease disturbances, and competitive interactions with grass and shrub understories (as mediated by one or more environmental site factors) are thought to have formerly limited potential woodland occurrence within the distributional bounds imposed by regional climate. These same processes control stand dynamics, including episodic establishment and mortality, and thus influence stand structure, as well as persistence of woodland on a particular site. While drought, insect, and disease disturbance processes continue to operate, as evidenced by recent widespread piñon mortality (Breshears et. al., 2005), surface fire disturbance and / or competitive interactions with grass and shrub understories (in areas formerly dominated by grass- and shrub-land systems) were likely interrupted by historic grazing practices. The latter direct and indirect effects of historic grazing are thought to been important drivers of recent woodland expansion into adjacent non-woodland communities (and thickening of formerly more open stands) within the context of favorable regional climate patterns for tree establishment. General vegetation patterns developed during the historic period should reflect a combination of climatic and historic influences, while patterns established earlier may be attributed primarily to climatic effects (with assumption that pre-historic landuse effects were more localized). If "old" or persistent growth woodland, and the range of environmental site factors which support this old growth, can be adequately circumscribed, then delineation of "younger" woodlands of more recent origin (i.e., post-Euro-American settlement) which occupy a range of site conditions previously unavailable for woodland colonization, may also be possible.

Study Overview and Objectives

The regional scope of the study was defined by the ranges of Colorado piñon pine (*Pinus edulis*), and several associated species of non-sprouting juniper (One-seed, *Juniperus monosperma*; Utah, *J. osteosperma*, and Rocky Mountain, *J. scopulorum*) representing Southern Rocky Mountain and Colorado Plateau savanna and woodland types as recently mapped by the Southwest Regional Gap Analysis Project (SWReGAP; Lowry et. al., 2005) within the Four Corners states (i.e., Arizona, Colorado, New Mexico, and Utah) of the southwestern U.S. Intensive sampling was conducted within three National Park Service units (Bandelier National Monument, Mesa Verde National Park, and Colorado National Monument) along an apparent southeast to northwest moisture seasonality gradient. The intensive plot data were used to inform identification of qualitative and semi-quantitative criteria and development of a diagnostic key for distinguishing "old" or persistent piñon-juniper individuals and stands from "younger" woodlands of more recent origin.

Subsequently I extensively sampled across the Four Corners states to provide adequate data for regional scale predictive modeling efforts. Extensive sampling was initially focused within the north-central New Mexico area and then expanded across the entire regional area. Field samples were assigned a pre- versus post-settlement status using the diagnostic key and individual points were associated with environmental metrics within a GIS. The compiled dataset was exported to statistical software for model development using both global, parametric and local, non-parametric procedures. Predictive modeling and mapping was first conducted within the north-central New Mexico area using a simple logistic model to predict a binary ("old" versus "young") response. I then validated a more sophisticated piece-wise linear regression approach in the north-central New Mexico area before using this approach to model the larger regional dataset.

The specific objectives of this study were to: 1) identify meaningful and consistent qualitative and semi-quantitative criteria for recognition and delineation of "old" or persistent (>150 years age) piñon and juniper individuals and stands from "younger" woodlands of more recent, post-settlement origin and develop a diagnostic key; 2) assess the relative importance of (and availability of spatial coverage for) potential environmental (i.e., topographic, climatic, edaphic) factors relevant to woodland distribution and stand-age; and 3) predictively model and map the distribution of "old" versus "young" stands across the range of *Pinus edulis* and associated junipers (*Juniperus monosperma, J. osteosperma, J. scopulorum*) within the Four Corners states (i.e., Arizona, Colorado, New Mexico, and Utah) of the southwestern U.S. An overview of southwestern U.S. woodland ecological history and natural range of variation is presented in Chapter 2 (Jacobs, 2008) along with maps showing the distribution of component piñon and juniper species.

An initial task was to identify and validate qualitative and semi-quantitative criteria for recognition of "old" or persistent woodlands, distinguishing these from "younger" woodlands of more recent origin which have only established in the last one-hundred and fifty years (i.e., or since initiation of historic landuse activities) and use these criteria in development of a diagnostic key. Development of a diagnostic key was primarily in support of planned regional scale modeling efforts. I report on this effort in Chapter 3 (Jacobs et. al., 2008) including presentation of a diagnostic key for delineating "older" pre-settlement woodlands from "younger" stands of post-settlement origin. Stand densities in many woodlands are dominated by younger age-classes; this can be variously interpreted as either a response to historic landuse, or normal demographic and successional dynamics reflective of episodic patterns of establishment and mortality. More intensive evaluations (i.e., outside the scope of the present study) of individual woodlands with "old" or persistent growth components would be required to assess whether these stands have also been influenced by post-Euro-American settlement (e.g., thickened), or if they represent natural woodland structures largely unaffected by historic changes.

The second task was to relate the occurrence of "old" or persistent (i.e., pre-dating the effects of Euro-American settlement) woodland stands to one or more environmental site factors (e.g., climate, landform, elevation, slope, aspect, soils, etc.) for which regional spatial data were available. My initial work on this task was at the scale of a north-central New Mexico study area and is reported in Chapter 3 and I expanded this effort to encompass the regional extent of the Four Corners states in Chapter 4. A large component of this task involves the development and evaluation of secondary metrics with potential ecological relevance. For example indices of effective moisture were derived from seasonal measures of precipitation and potential evaporation, and categorical variables were created from continuous parameters to highlight potential ecological relevant thresholds in measures such as depositional environment.

The final task was to predictively model and map pre- versus post-settlement aged woodland stands within the Four Corners state study area. First I needed to create a dataset for predictive modeling by associating the GPS location of each sampled stand (assigned an "old" versus "young" status using the diagnostic key) with the spatial coverage of potential explanatory variables developed within a GIS. The compiled dataset was exported to statistical software and used for model development (using both global, parametric and local, non-parametric procedures). Selected model parameters were implemented within a GIS (using SWReGAP woodland coverage as an analysis mask) and used to realize map products showing probability of "old" versus "young" woodland. Predictive modeling and mapping efforts were initially conducted within a north-central New Mexico study area (Chapter 3, Jacobs et al, 2008) and then expanded to the larger Four Corners states regional extent (Chapter 4).

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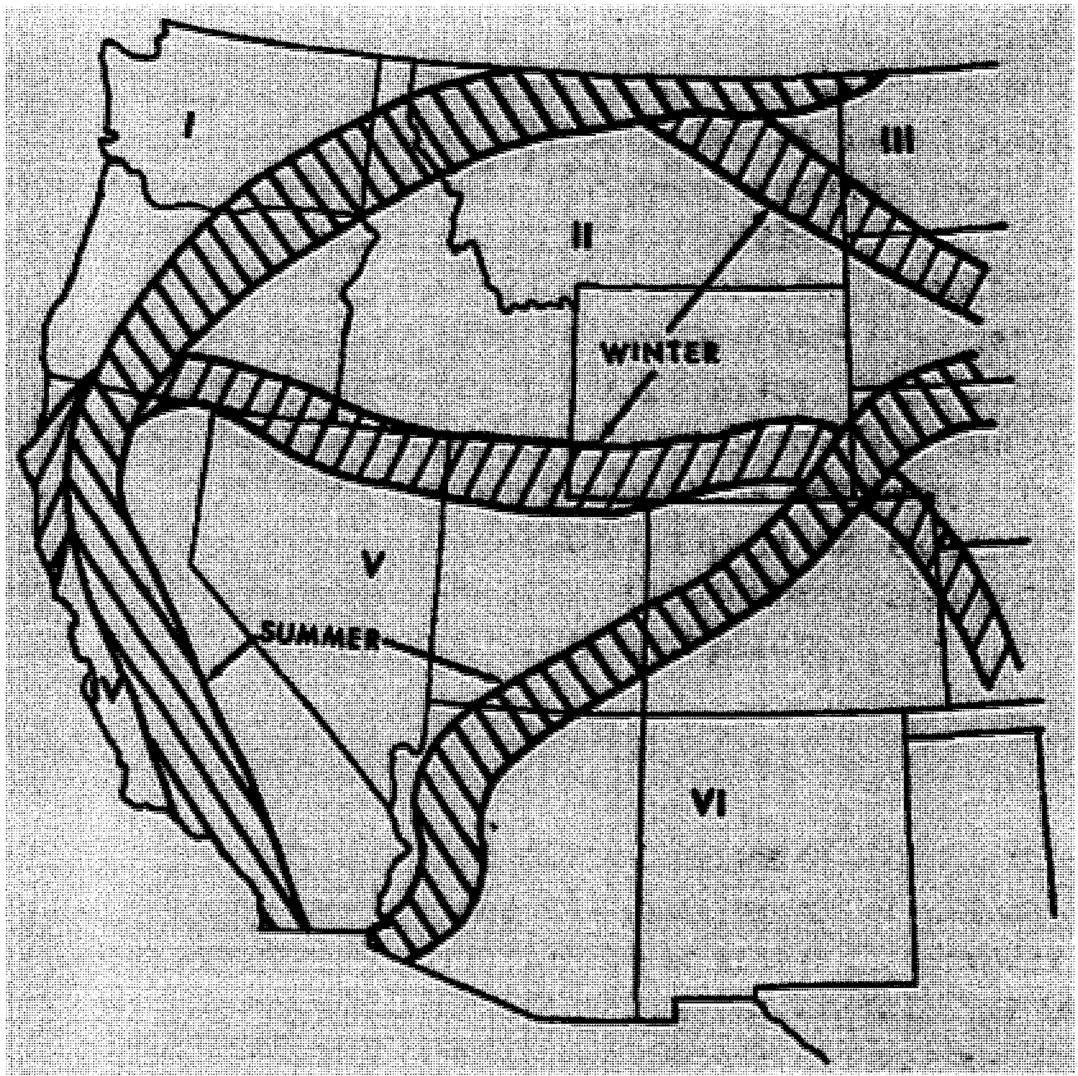
Figures

Figure 1.1 Mitchells (1976) climate zones for the western U.S. with each zone representing distinct seasonal precipitation and temperature patterns that can strongly influence potential vegetation and species distributions.



Chapter II

Southwestern U.S. Juniper and Piñon-Juniper Savanna and Woodland Communities: Ecological History and Natural Range of Variability

Abstract

Juniper and piñon-juniper savanna and woodland communities collectively represent a widespread and diverse vegetation type that occupies foothill and mesa landforms at middle elevations in semi-arid portions of the American Southwest. Ecological understanding and proper management of these juniper and piñon types requires local knowledge of component species, site history and potential, set within a regional floristic and climatic context. The wide distribution and broad ecological amplitude of this vegetation type across a six-state area of the southwestern U.S. is best appreciated as the sum of the individual ranges of the component piñon and juniper species, and their environmental tolerances. Key environmental controls of juniper and piñon occurrence, stand age-structure, and composition, include the interaction of climate, topography, soils, and disturbance processes, in combination with biotic interactions, and over various spatial and temporal scales.

Introduction

Juniper and piñon-juniper (piñon-juniper) savanna and woodland in the American Southwest have often been viewed by researchers and land managers as an ecological unit which can be understood and managed as a single, if variable, entity. The consequences of this approach include confusing and contradictory research findings, ongoing controversy, inappropriate management, and potentially undesirable outcomes. In reality, the piñon-juniper type is a simplistic grouping of many different species distributed across diverse climatic and topographic settings, each species with a unique history and range of environmental tolerances. While ecological amplitude of the component species and regional climate set broad limits on potential woodland distributional limits, smaller scale competitive and disturbance factors may ultimately constrain the extent and expression of species occurrence on local landscapes. Recent, historical changes in woodland occurrence and stand density have been variously interpreted as continued adjustment to Holocene climate, recovery from harvest (historic and pre-historic), succession after fire, drought, insect, and/ or disease induced mortality events, or response to grazing practices, altered fire regimes, elevated temperatures and CO_2 levels (Betancourt, 1987; Neilson, 1987; Betancourt et. al., 1993; Tausch, 1999b; Miller and Tausch, 2001; Baker and Shinneman, 2004; Eisenhart 2004; Floyd et. al., 2004; Shinneman, 2006). The following sections provide an overview of the distribution, ecology, environmental controls, disturbance regimes, and historical land use impacts relevant to an understanding of extant southwestern U.S. woodlands.

Distribution

Juniper and piñon-juniper savanna and woodlands collectively constitute one of the most widespread vegetation types in the American Southwest (Lowry et. al., 2005). These plant communities typically occupy foothill, mesa, and mountain slope positions, at middle elevations within a semi-arid climatic zone and between desert grass- and shrub-lands and upland coniferous forests. Within the American Southwest, defined here by New Mexico (NM), Arizona (AZ), Utah (UT), Colorado (CO), Nevada (NV), and eastern California (e. CA), there are five common species of juniper, Utah (*Juniperus osteosperma*), one-seed (*J. monosperma*), Rocky Mountain (*J. scopulorum*), alligator-bark (*J. deppeana*), and western juniper, (*J. occidentalis*), and two of piñon, Colorado

(*Pinus edulis*), and single-leaf (*P. monophylla*), which alone and in various assemblages, account for the majority of extant piñon-juniper types. An overview of component piñon and juniper species and their respective distributions was obtained by referencing distribution maps originally prepared by Little (1971), subsequently digitized by the USGS, with taxonomy and nomenclature following Flora North America (Flora of North America Editorial Committee, eds., 1993+). See Appendix 2.1: Supplemental Figures.

Colorado piñon has a distribution centered on the four-corner state area of UT, CO, NM and AZ, while the closely related single-leaf piñon is found to the west in NV, se. CA and sw. UT (Little, 1971). Piñon typically dominates the upper, or more mesic, end of the woodland zone (although Utah and Rocky Mountain junipers may exhibit greater cold tolerance), while Utah and one-seed junipers gain importance at the lower, or more xeric end. Of the common junipers, Rocky Mountain is the most mesophytic species with a range extending north to BC, Canada, while Alligator-bark juniper, also more mesic than Utah or one-seed junipers, gains importance in warmer areas to the south with a range extending into Mexico (Chambers et. al., 1999; Nowak et. al, 1999; Martens et. al., 2001). Western juniper is both drought and cold tolerant, and its range, unlike the other four junipers considered, is not closely associated with any of the piñon species (Miller et. al., 2005). Within the four-corner state area, one-seed and alligator-bark junipers pre-dominate in locations under the seasonal influence of the Arizona summer monsoon, as defined by Mitchell's climate zone VI (Figure 1.1, Mitchell, 1976), with alligator-bark juniper more common in s. NM and east-central AZ, while one-seed juniper dominates woodlands in the rest of NM. Utah juniper, conversely, is more common in winter moisture areas, defined by Mitchell's climate zone V, (Figure 1.1, Mitchell, 1976) north and west of the monsoon boundary, and is the most widespread juniper in the American Southwest, forming associations with both Colorado and Single-leaf piñon. The ranges of Colorado piñon and Rocky Mountain juniper both span the monsoonal boundary, although piñon distribution is bounded to the north by the position of the winter polar front as defined by the northern boundary of Mitchell's climate zone V (Figure 1.1,); the distributional pattern of these two species may be less influenced by seasonal monsoonal influences because my analysis of climate data suggests annual moisture patterns often become more uniform with increasing elevation in the southwestern U.S.

Looking around a six-state area representing the American Southwest , and noting piñon and juniper species whose ranges bound the American Southwest (Little, 1971), one finds California piñon (*Pinus quadrifolia*), Mexican piñon (*P. cembroides*) and rose-berry juniper (*Juniperus coahuilensis*, sensu ~*J. erythrocarpa*) just entering the Four Corners States area, but with ranges mostly to the south in Mexico, western juniper, (*J. occidentalis*) occurring in e. CA and n NV, but with a range extending northwest to OR (WA) and ID, and red-berry juniper (*J. pinchotii*), Ashe juniper (*J. ashei*) and eastern red-cedar, (*J. virginiana*) to the east in TX and OK.

While each of these piñon-juniper species is distinctive enough to be afforded specific taxonomic status, and even retain integrity as a distinct taxon in the paleo-record, modern distributions are relatively recent (Betancourt, 1987) and extant populations representing recognized taxa likely represent or express only a portion of the underlying genetic diversity present; further, many or most of the piñon and juniper species are reported to have some level of gene flow between related species (Flora of North America Editorial Committee, 1993+), which presents additional opportunities from both ecological and evolutionary perspectives. For example, western juniper reportedly hybridizes with Utah juniper, Utah with one-seed, one-seed with Alligator, red-berry with rose-berry, and Rocky Mountain with eastern red-cedar (*J. scopulorum* is sometimes classified as a variety of *J. virginiana*); the sprouting ability of red-berry and rose-berry junipers, and small, single-seeded cone features, may suggest relationships between these taxa and *J. deppeana* and *J. monosperma*. *Pinus edulis* can reportedly hybridize with *P. monophylla* (~*P. edulis var. fallax*) and *P. cembroides* (~*P. remota*), while *P. quadrifolia* was formerly recognized as a variety of *P. cembroides*.

From an evolutionary perspective, closely related piñon taxa which maintain capacity for genetic exchange, and whose shifting ranges both maintain intermittent contact while promoting expression of discrete entities, might be more productively viewed as components of larger meta-populations. Long-lived perennials like piñon and juniper, which have potential maximum lifespans easily exceeding 500 years (Betancourt, 1987) are potentially buffered against shorter-term fluctuations in climate, requiring only occasional favorable windows for successful establishment. In contrast, climatic requirements for persistence of mature piñon-juniper individuals are often minimal. Long-lived, wind pollinated, out-crossing, perennials might be expected to maintain high levels of genetic diversity in a population, while also being a conservative force mitigating rapid shifts in allele frequency.

Ecology

Southwestern piñon-juniper types viewed collectively span an impressive range of environmental settings and present challenges to traditional ways of categorizing vegetation assemblages and interpreting ecological processes. Piñon dominated stands with multi-layered and nearly closed canopies, can occur at the moist, upper elevation end of the woodland zone, while at the interface with desert grasslands, it is common to observe open stands of juniper interspersed with grasses, forbs, and shrubs. In between these extremes, and depending on a variety of local site conditions and histories, and within the context of regional biogeography, one can delineate a great variety of juniper and piñon-juniper types in association with various shrub, grass, and forb understories. Recent vegetation mapping efforts as part of the Southwest Regional Gap Analysis Project, SWReGAP (Lowry et. al., 2005) with a five-state area (four-corner state area plus NV) of the American Southwest, and following community classifications prepared by NatureServe (Comer et. al., 2004), circumscribe four major piñon-juniper categories, primarily as groupings of the major piñon and/or juniper species: Great Basin (*P. monophylla* and *J. osteosperma*), Colorado Plateau (*P. edulis* and *J. osteosperma*) , Southern Rocky Mountain (*P. edulis* and *J. monosperma*), and Madrean (*P. edulis, P. cembroides*, *J. deppeana*, *J. monosperma*, *J. coahuilensis*, and *J. pinchotii*). These four major groupings are further sub-divided on basis of structure and composition (i.e., piñon-juniper woodland versus juniper savanna) with additional community assemblages noted as having a juniper and/ or piñon component. Finer grained community and habitat typing in juniper and piñon-juniper types have typically subdivided major tree overstory groupings by dominant shrub-grass-forb understory. Understory composition can be an important indicator of site history and site potential, particularly when the tree overstory is of relatively recent origin; Tausch (1999) suggests understory composition can be key to understanding the potential of particular piñon-juniper sites, providing insight on available soil and water resources, and presumably this information would be critical to management at local scales.

Climate, modified by local topographic and soil factors, provides fundamental control over potential woodland species distributions (; while disturbance regimes and stochastic (establishment and mortality) events can help to shape actual occurrence patterns (Betancourt et. al., 1993). A range of potential vegetation types is possible for most locations, and extant woodland vegetation may or may not represent a balanced or optimal state from natural or human perspectives. Extant woodland communities then should be viewed as the cumulative outcome of multiple interacting factors, and over shorter temporal and smaller spatial scales there appear to be repeating patterns and a sense of dynamic stasis; however, paleo-vegetation reconstructions reinforce the idea that species assemblages are neither prescribed nor static at longer or larger scales (Betancourt et. al., 1993). Still, ecological concepts such as succession and restoration are still meaningful and useful within the limited spatial and temporal scales that land managers (and researchers) typically operate. More problematic is how to integrate rare, episodic, and/ or extreme events into an ecological understanding and short term, local management of vegetation systems, especially when these low frequency events have large and long term consequences on community structure, composition and function.

Disturbance

Spatial pattern and structure of woodland vegetation are generally thought to be controlled by disturbance processes and episodic events, like fire (Baker and Shinneman, 2004), wet and dry climatic patterns (Betancourt et. al., 1993), and insect or disease outbreaks (Breshears et. al., 2005), however, interpreting the relative importance of these potential factors in a particular woodland setting can be challenging. This is especially the case when the extant woodland vegetation, reflects influences of earlier disturbances or events which occurred within the context of a former non-woodland vegetation assemblage. For example, fire disturbance is possible or likely given suitable fuel structures within the context of a particular vegetation assemblage. The vegetation assemblage and fuel structure present on a site is in turn depend on climate, topographic, and soil factors. Fire disturbance may be strongly associated with a particular vegetation assemblage to the extent one can recognize recurring burn patterns (intensity and frequency) and/ or infer meaningful relationships between vegetation composition, structure, and life history. For example, southwestern ponderosa pine, tall grass prairie, or northern Rocky Mountain lodgepole pine communities can be somewhat easily assigned to fire regime categories, and there are often meaningful synergies which exist between these vegetation types, life history attributes of dominant species, and recurring fire disturbance.

In contrast, Baker and Shinneman (2004) review a number of fire history studies and note that evidence to substantiate spreading surface fire behavior in piñon-juniper woodlands is generally lacking; fire scars on living trees are usually infrequent, and often found at what could be interpreted as ecotonal boundaries (such as rocky outcrops, or an interface with Ponderosa Pine savanna) or woodland burn patch edges. Thus, although fire histories have been reconstructed for selected piñon-juniper sites where abundant fire evidence is available, this fire evidence may be reflective of historic upper and lower ecotonal boundaries where woodlands abutted high fire frequency forest and grassland systems, or locations where fine scale woodland mosaics (superimposed on topo-edaphic patterns) formerly intermingled with fire prone, non-woodland types, than of the general piñon-juniper type in a larger sense. The historical role of surface fire disturbance in maintaining stand structure and composition in pre-settlement piñon-juniper types then, is problematic; for example, most of the piñon and juniper species are fire sensitive and easily killed by even moderate fire intensity and the species as a group generally lack life history attributes that can be easily associated with recurrent fire disturbance (although several juniper species can resprout after burning, and one can infer possible mechanisms, such as dense litter mats or suppressed herbaceous, for mitigating fire mortality and scarring).

Observations by the author at numerous field locations in the Four Corners States area, in connection with an effort to model occurrence of pre-settlement woodlands relative to topo-climatic factors, suggest fire disturbance in pre-settlement Colorado Plateau and Southern Rocky Mountain piñon-juniper types was at best uneven, perhaps more opportunistic than inevitable, largely dependent on local site conditions, and not obviously essential to maintenance of "normal" system structure and function; rather historic evidence of fire, when present, often suggests a patchy crown fire behavior, with charred stumps, logs, and snags, as might be expected with the discontinuous fuel structure (surface and crown) associated with this vegetation type (Muldavin et. al., 2003).

Water

Water is a major limiting resource in semi-arid systems, and it is reasonable to infer that extant piñon-juniper types are largely responsive to and shaped by (spatial and temporal) variability in available soil moisture. For example, Johnsen (1960) provides data to support the widely observed inverse relationship between increasing density of overstory in piñon-juniper types and decreasing understory cover (interpreted as a response to limited soil water); conversely, I have observed that mechanical thinning, fire treatment, and drought-insect induced mortality of overstory, will often yield increases in understory cover. Available soil moisture then is an important, perhaps central, environmental control in piñon-juniper systems (McAuliffe, 2003) affecting where they can occur, which species can be present, influencing stand structure by mediating episodic establishment and mortality (Martens et. al., 2001), and potential for fire or drought-insect disturbance. Light in contrast probably is limiting only to understory plants with the development and closure of mature tree canopy; however, it is unclear to what extent light rather than moisture or soil properties associated with litter mounds is really limiting and notable that I have observed mesic grasses (e.g. *Oryzopsis micrantha*, littleseed rice grass) to occur primarily on litter mounds under the shade of live tree canopies in the piñon-juniper woodlands of north-central New Mexico. Eisenhart (2004) proposes density dependent regulation of stand density in *P. edulis – J. osteosperma* types (i.e., self-thinning) and periodic drought-insect mortality as viable mechanisms for maintenance of stand structure in piñon-juniper types, particularly in the absence of any fire evidence. Savanna structure in low end juniper dominated types could also be interpreted as a density dependent response to limited soil moisture, particularly on shallow substrates where trees are primarily accessing deeper water stored in fractured bedrock. Site productivity and potential in semi-arid settings is largely a function of (spatial and temporal availability of) soil moisture (McAuliffe, 2003) which is controlled by the interactions of climate, topography, and soil.

Different growth forms and species employ a variety of strategies for extracting available soil moisture. A site may be productive for deep rooted trees, if available water is mostly at depth, either due to a deep, well drained soil or a shallow soil with fractured bedrock; conversely, a site may be productive for shallow rooted, herbaceous species, if available water is primarily in upper 0-30cm due to fine textured soils, high clay or organic content, or presence of shallow argillic (i.e., water perching) horizons (McAuliffe, 2003). Some, or most, sites can support a mixture of both shallow and deeper rooted species, and many species (including piñon and juniper) have dimorphic root morphologies and flexible strategies which allow them to opportunistically (and temporally) harvest water from both shallow and deep sources, as well as from wide horizontal extents encompassing adjacent intercanopy locations (McAuliffe, 2003). Thus, even with a uniform climate context, extant vegetation and site potential can be strongly influenced by local topographic setting and soil properties.

For example, at Bandelier National Monument, NM, pumice soils can strongly influence local vegetation patterns and associated disturbance processes though enhanced water capture and storage. Julius (1999) documented differences in piñon-juniper age-class and density, as well as in composition and cover of associated understory, across three soil types within a 100 acre study area at Bandelier. Woodlands on pumice soils, with an argillic horizon, had both the lowest tree densities and youngest age-class, relative to pumice and non-pumice soils, without an argillic horizon; non-pumice, non-argillic soils had the highest densities and oldest age-class, while pumice, non-argillic soils were intermediate for both density and age-class. In addition, pumice argillic soils supported the highest understory cover, with a composition dominated by grasses, (such as *Schizachyrium scoparium*), while non-argillic, pumice soils had forb dominated understories, and non-pumice, non-argillic soils were characterized by only sparse understory cover (Julius, 1999).

Germination and successful establishment are critical life stages for all plants, but in semi-arid woodlands, proper timing is especially important. Successful establishment of piñon and juniper individuals is enhanced by sufficient moisture during the time period between germination and establishment of a secondary root system, below the average depth of the herbaceous rooting zone (Chambers et. al., 1999); Johnsen (1960, 1962) reported that seedlings of *J. monosperma* were very vulnerable while in direct competition for water with shallow and fibrous rooted herbaceous species, and could only successfully establish during years when soil water was effectively not a limiting resource. As noted by Neilson (2003), the effective window for successful tree establishment may have been enhanced by the reduction of herbaceous competition through sustained grazing.

Grazing

Considerable attention has been focused on the presumed effects of historic grazing, both in altering the structure and composition of pre-settlement piñon-juniper types (i.e., infill and thickening), as well as in promoting tree encroachment into formerly non-woodland (including forest, shrub- and grass- land) communities. Schlesinger and Pilmanis (1998) report the effects of long-term, sustained grazing in semi-arid systems, particularly during drought episodes, can include reduced herbaceous cover, vigor, and (above and below ground) biomass, increased runoff and sediment transport, and initiation and facilitation of "desertification" processes (i.e. the re-allocation of limited nutrient and water resources to shrub and tree "islands"). Alternatively, simultaneous reduction of understory competition and associated interruption of surface fire regimes, during favorable climatic intervals, would appear to be plausible effects of historic grazing in facilitating piñon-juniper encroachment into non-woodland areas (Johnsen, 1960, 1962; Tausch, 1999). Both of these mechanisms, acting in concert, are likely important factors mediating recent "invasion" of western rangelands (cool and warm season respectively), by western juniper in OR (Miller et. al., 2005) and one-seed juniper in AZ and NM (Johnsen, 1960, 1962). However, within extant, pre-settlement, savanna and woodland communities (where evidence to support a role for recurrent surface fire in maintaining stand structure is absent), it may be reasonable to conclude that historic grazing effects alone would have been sufficient to alter the competitive environment and facilitate establishment of tree seedlings, by reducing herbaceous competition for water, focusing runoff and enhancing deeper infiltration through reduction of effective ground cover. Recent attention has also been given to the idea of CO_2 facilitated enhancement of tree growth presumably through increased water use efficiency, but this proposed effect could might be largely offset by increased evaporative demand and thermal stress from warmer temperatures associated with increased levels of CO_2 (Breshears et. al., 2005).

It has also been noted that grazing effects can be extremely variable across different soil types within the same climatic zone, suggesting some sites and soils are more tolerant of grazing, while conversely, other sites and soils are more susceptible to desertification (i.e., shrub and tree encroachment). McAuliffe (2003) notes grazed soil types, with shallow argillic horizons, are much more resistant to woody plant encroachment than sites which promote deeper infiltration. As Nielson (2003) suggests, recent and widespread encroachment of woody plants into many western rangelands (and thickening of savanna types) is probably best interpreted as a synergistic interaction of climate and grazing, on susceptible soil sites, and where woody plant populations are proximate.

In some areas of the American Southwest, particularly on portions of the Colorado Plateau characterized by winter moisture patterns, the paradigm of a pervasive and ongoing, grazing induced, western woodland invasion is overstated, or at best mis-applied. For example, Floyd et al (2003) report extant stand densities at Mesa Verde National Park, CO are generally within the range of historical variability, while Eisenhart

(2004) suggests that reports of "thickened" woodlands in west-central CO woodlands may actually be normal stages in stand development prior to onset of density dependent thinning as trees mature.

Summary

Interpreting regional patterns of pre- versus post- settlement woodland occurrence in relation to climatic, topographic, and edaphic variables, can be complicated by associated changes in both woodland species assemblages and geomorphic settings. Seasonality of moisture however, appears to be a central determinant of woodland pattern in both areas, but perhaps for different reasons. In winter moisture dominated areas, woodlands might be expected to occupy a wider range of landform settings, since moisture is available both at greater depth and during the early spring season, promoting woody dominance, while limiting herbaceous competition, production of fine fuels, and potential for surface fire. Conversely, in summer moisture dominated areas, shallow moisture could be expected to enhance herbaceous cover, fine fuel production, and the potential for surface fire, effectively restricting woody vegetation to coarser textured soil settings where moisture can infiltrate to depth (on steep slopes, and fractured rocky substrates) or locations where grass production is otherwise limited (thus reducing potential for surface fire). In areas with especially strong monsoonal patterns, even discontinuous topographic settings with adequate soils might be expected to have relatively high potentials for surface fire (in absence of grazing) given both enhanced herbaceous cover and an increased incidence of lightning ignition.

Whatever the mechanisms (such as, favorable climatic patterns, grazing effects on herbaceous competition and fire disturbance) responsible for the initial establishment of woodland species onto a new site, persistence of the tree component can be enhanced by positive feedback on local environmental conditions; for example, suppression of herbaceous vegetation by maturing piñon and juniper overstory, and associated reductions in intercanopy cover, changes in soil texture and runoff which promote deeper infiltration, and reduced potential for surface fire, tend to reinforce conditions favorable to woody plant establishment and persistence. One can think of these woodland influences on local site conditions in terms of moisture and fire shadow effects, which in the absence of a disturbance, allow woodland to establish into, persist on, and eventually dominate a wide range of settings.

From a landscape perspective, infilling and thickening of patchy, pre-settlement woodland mosaic patterns by post-settlement woodland, was likely facilitated by regional, synchronous and/ or synergistic, effects of climate and grazing. Some reports of woodland thickening may also be a function of the relative spatial and temporal perspective in sampling or observation. As woodland patches expand and merge, ground fuels become limiting while canopy fuel structure becomes more continuous across larger areas; under this scenario, the probability of fire spread from a point ignition can be expected to change, along with the potential frequency, nature, and extent of fire events. Discerning patterns of recent woodland expansion from longer term migrational dynamics, may be possible by comparing the range of environmental settings associated with pre- versus post- settlement stands. For example, while relatively few new northerly locations appear to have been successfully colonized in response to migrational dynamics of piñon pine during the last 1000 years (Jackson et al, 2005), the extent of woodland occurrence across its range has apparently increased several fold since 1850 (West, 1999). Management of the piñon-juniper type then should be informed by an ecological knowledge of site potential and vegetation dynamics, and consistent with sustainable and appropriate management practices which attempt to balance our understanding of the system with stated societal needs and desires.

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Appendices

Appendix 2.1: Supplemental Figures

Figure 2.1. Distribution of southwestern U.S. piñon-juniper woodland communities in a five state area (i.e., Arizona, Colorado, New Mexico, Utah, and Nevada) delineated and mapped by Southwest Regional Gap Analysis Project (SWReGAP); Lowry et. al., 2005

Figure 2.2a. Distribution of four common piñon species in the southwestern U.S. and adjacent Mexico using species distribution maps developed by Little (1971), digitized by the USGS and posted online (http://esp.cr.usgs.gov/data/atlas/little/)

Figure 2.2b. Distribution of four common piñon species in the southwestern U.S.

Figure 2.3a. Range of *Pinus edulis* (Colorado piñon) in the southwestern U.S. overlay on SWReGAP woodland community coverage

Figure 2.3b. Range of *Pinus monophylla* (single-leaf piñon) in the southwestern U.S. overlay on SWReGAP woodland community coverage

Figure 2.4a. Distribution of nine common juniper species in the southwestern U.S. and adjacent Mexico using species distribution maps developed by Little (1971), digitized by the USGS and posted online (http://esp.cr.usgs.gov/data/atlas/little/)

Figure 2.4b. Distribution of four common juniper species in the southwestern U.S.

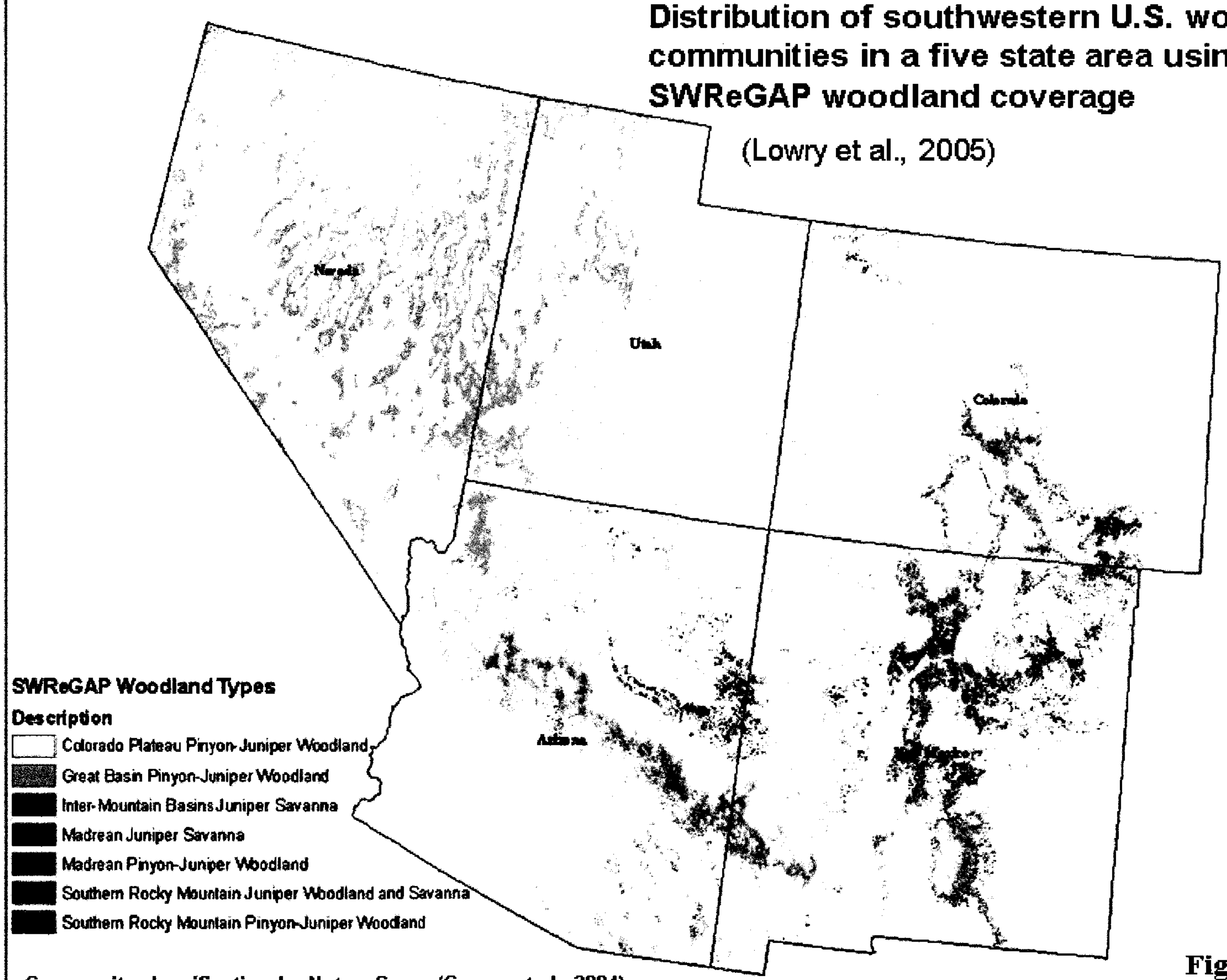
Figure 2.5a. Range of *Juniperus monosperma* (one-seed juniper) in the southwestern U.S. overlay on SWReGAP woodland community coverage

Figure 2.5b. Range of *Juniperus deppeana* (alligator-bark juniper) in the southwestern U.S. overlay on SWReGAP woodland community coverage

Figure 2.5c. Range of *Juniperus osteosperma* (Utah juniper) in the southwestern U.S. overlay on SWReGAP woodland community coverage

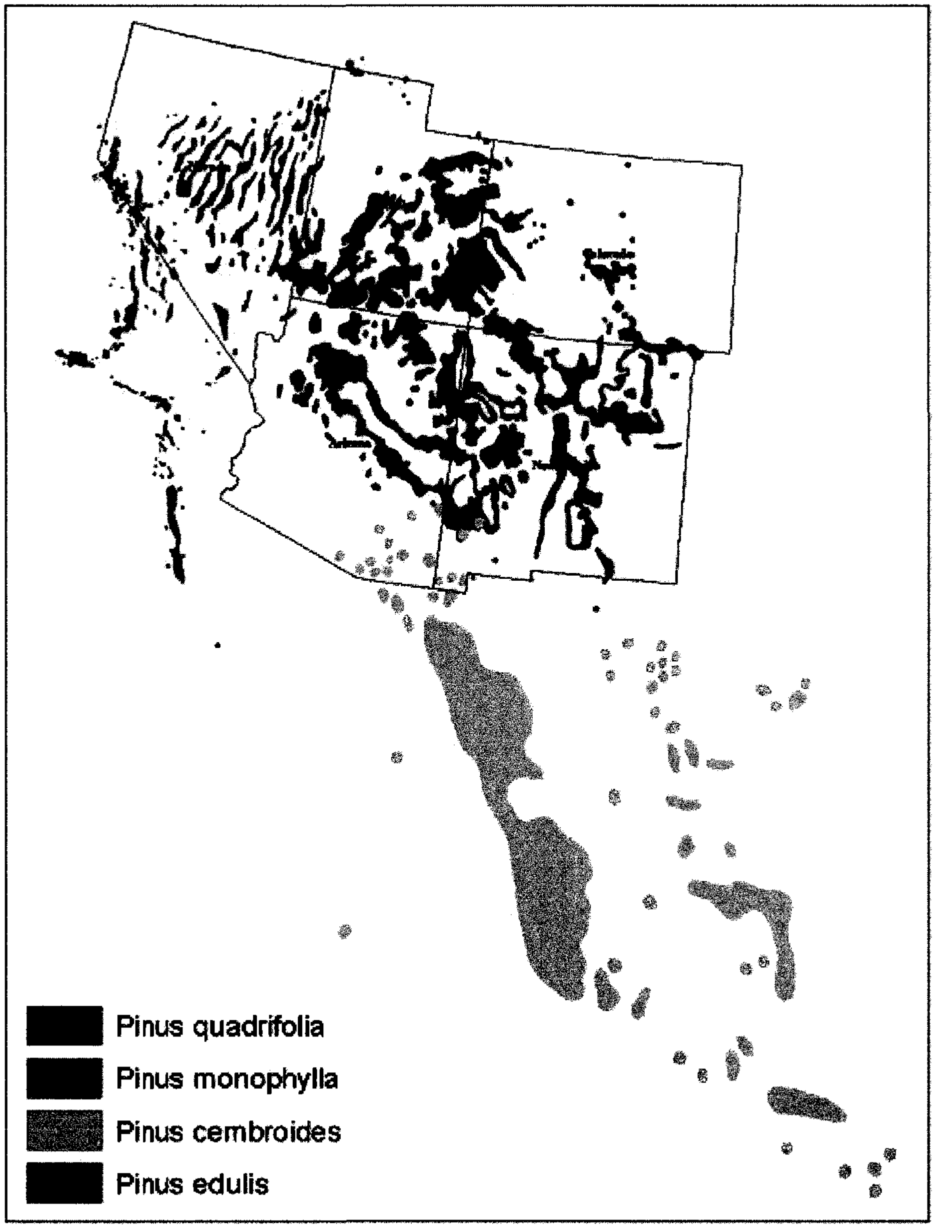
Distribution of southwestern U.S. woodland communities in a five state area using SWReGAP woodland coverage

(Lowry et al., 2005)



Community classification by NatureServe (Comer et al., 2004)

Figure 2.1



Distribution of four common piñon species in the southwestern US and adjacent Mexico

from Little (1971)

Many of the piñon species can reportedly hybridize with related species at areas of contact

Figure 2.2a

Distribution of four common piñon species in the southwestern US

from Little (1971)

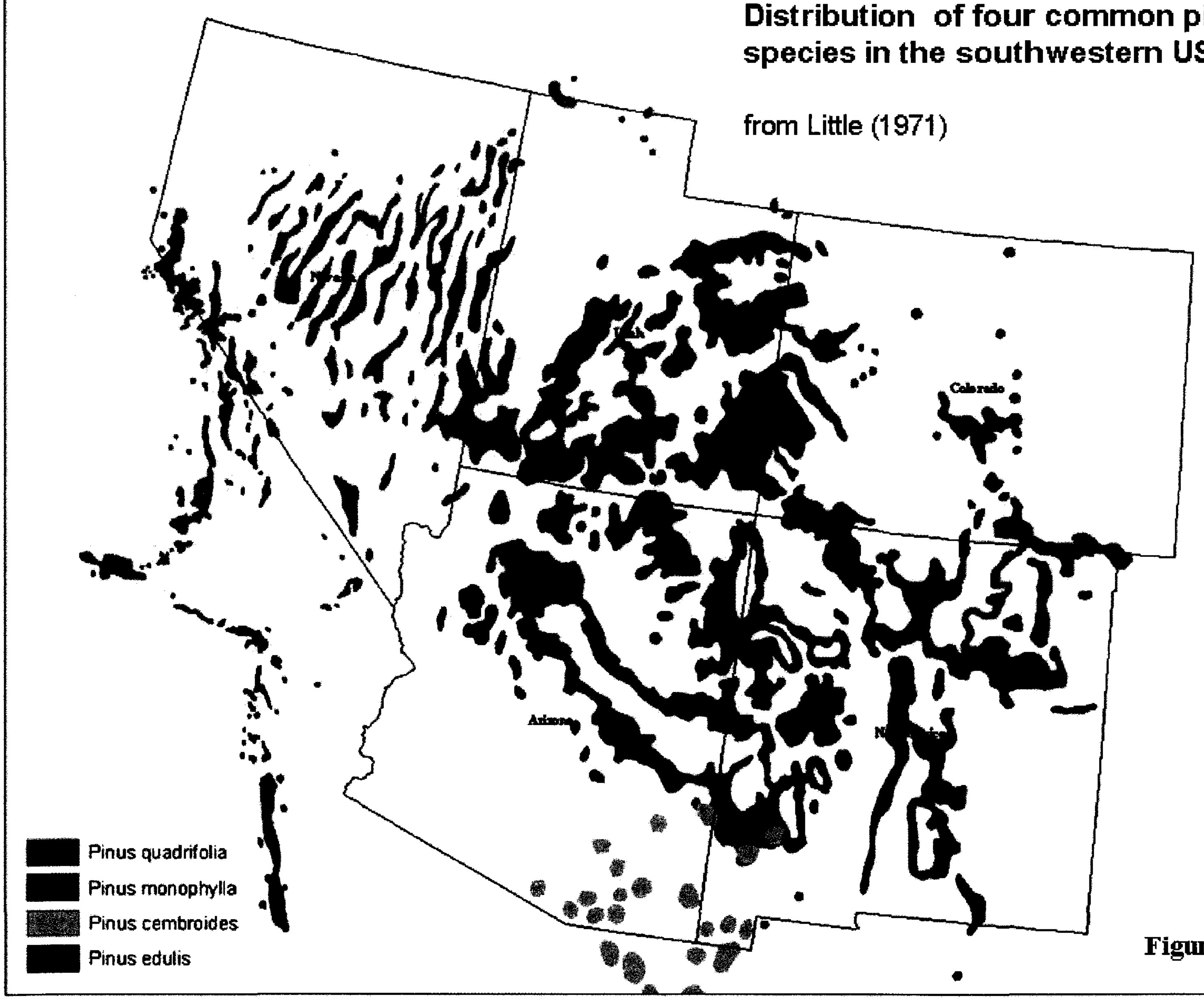


Figure 2.2b

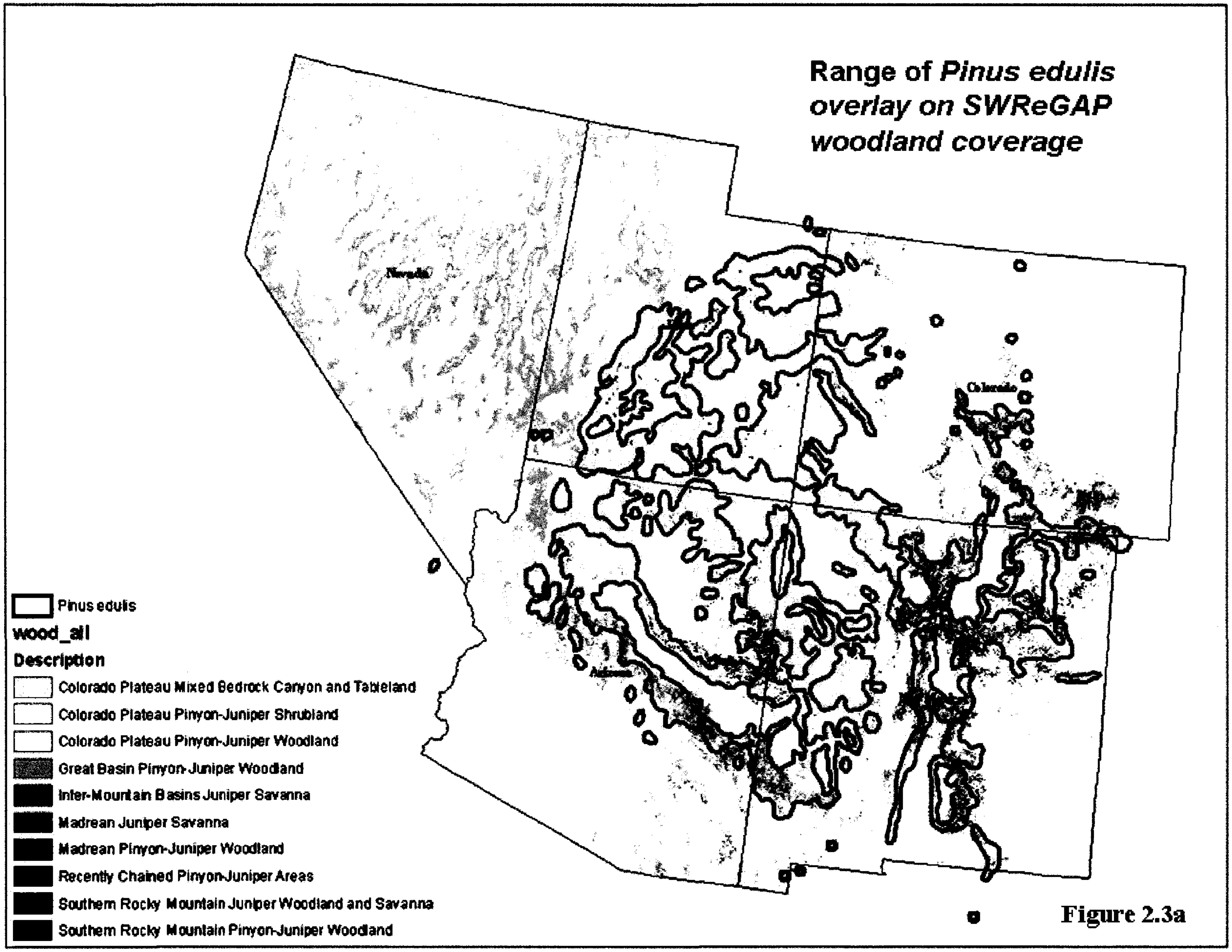
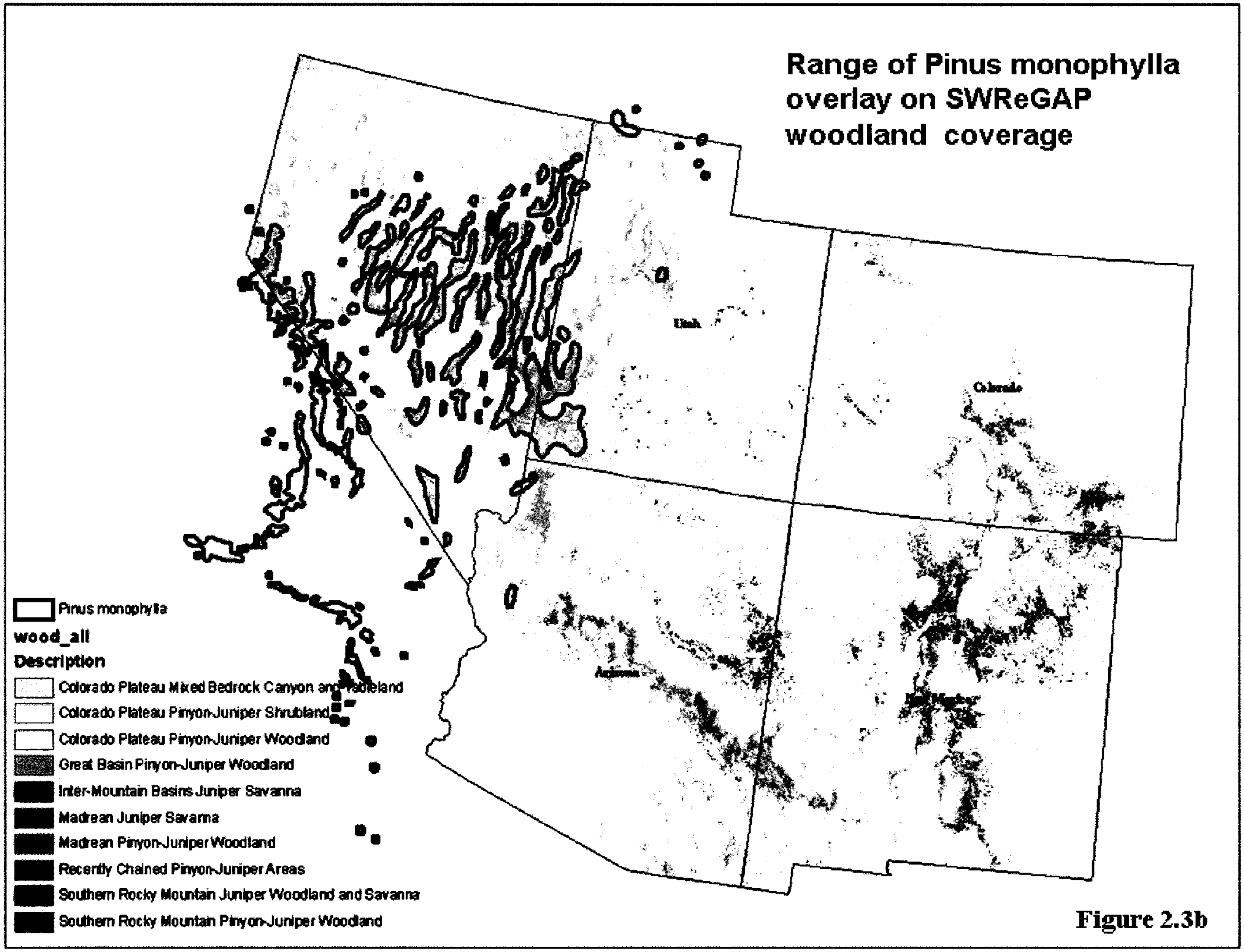

Range of *Pinus edulis* overlay on SWReGAP woodland coverage
Nevada
Colorado
Arizona
Pinus edulis
wood_all
Description
Colorado Plateau Mixed Bedrock Canyon and Tableland
Colorado Plateau Pinyon-Juniper Shrubland
Colorado Plateau Pinyon-Juniper Woodland
Great Basin Pinyon-Juniper Woodland
Inter-Mountain Basins Juniper Savanna
Madrean Juniper Savanna
Madrean Pinyon-Juniper Woodland
Recently Chained Pinyon-Juniper Areas
Southern Rocky Mountain Juniper Woodland and Savanna
Southern Rocky Mountain Pinyon-Juniper Woodland

Figure 2.3a

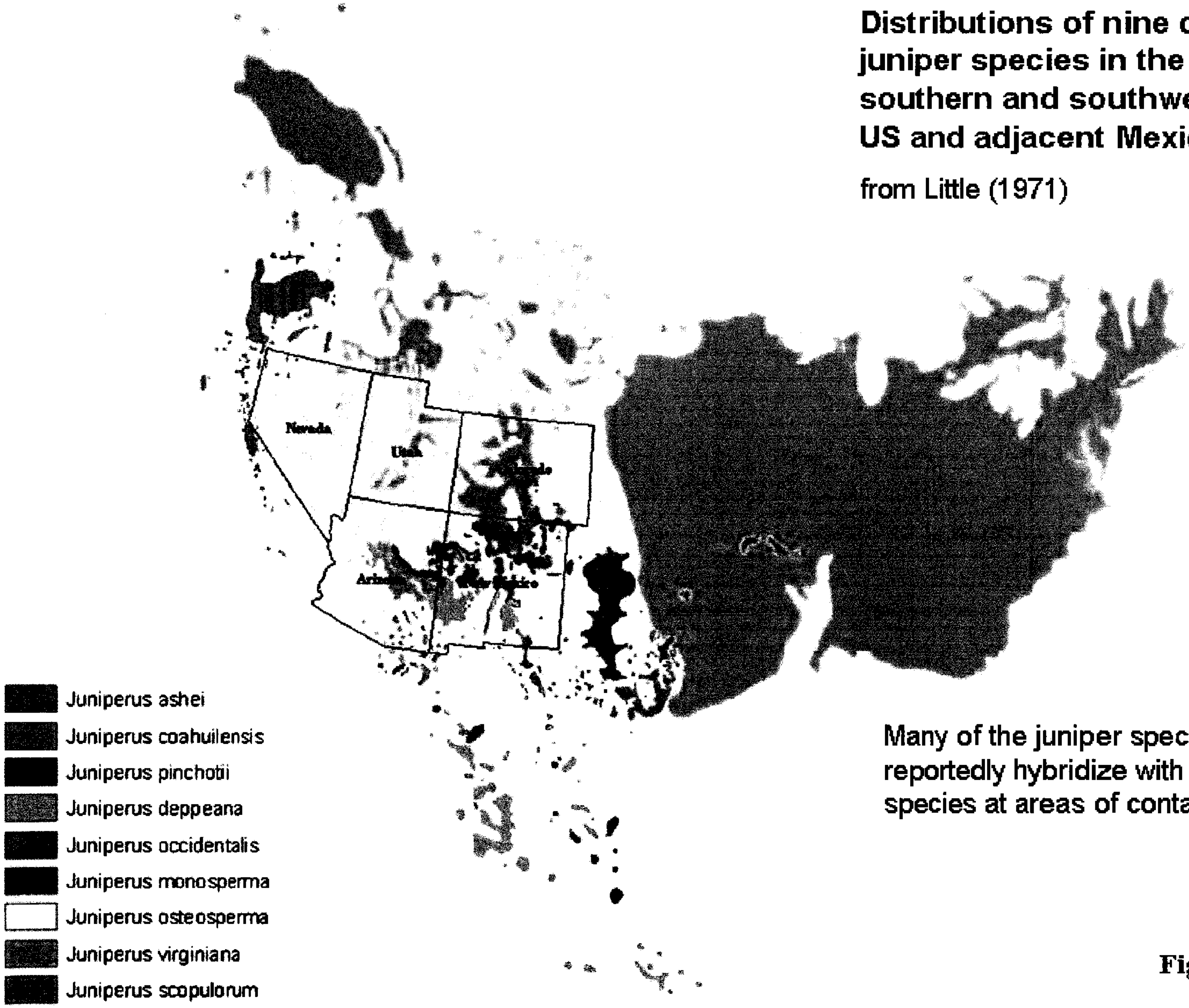


Range of Pinus monophylla overlay on SWReGAP woodland coverage

Figure 2.3b

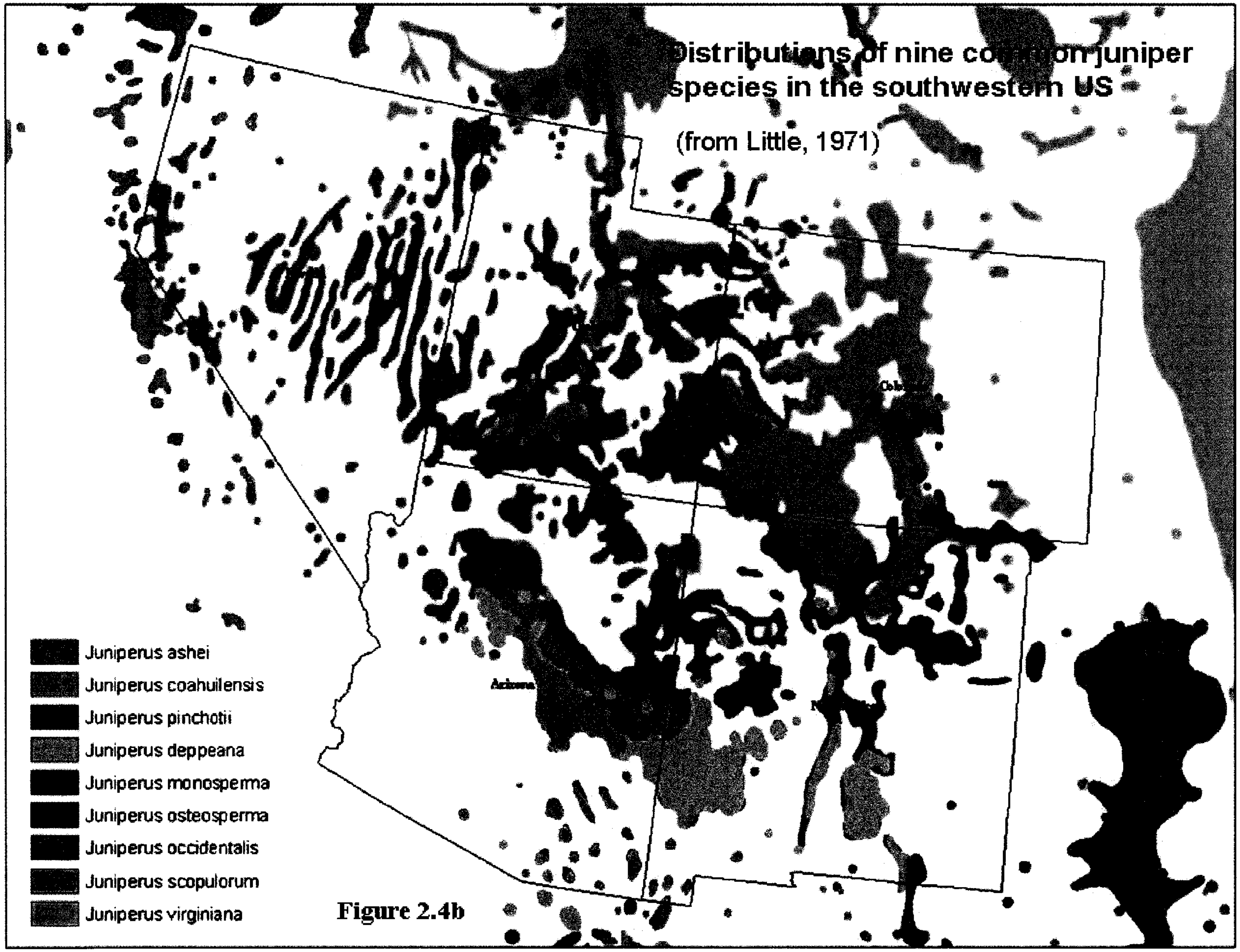
Distributions of nine common juniper species in the southern and southwestern US and adjacent Mexico

from Little (1971)



Many of the juniper species can reportedly hybridize with related species at areas of contact

Figure 2.4a



Distributions of nine common juniper species in the southwestern US

(from Little, 1971)

Figure 2.4b

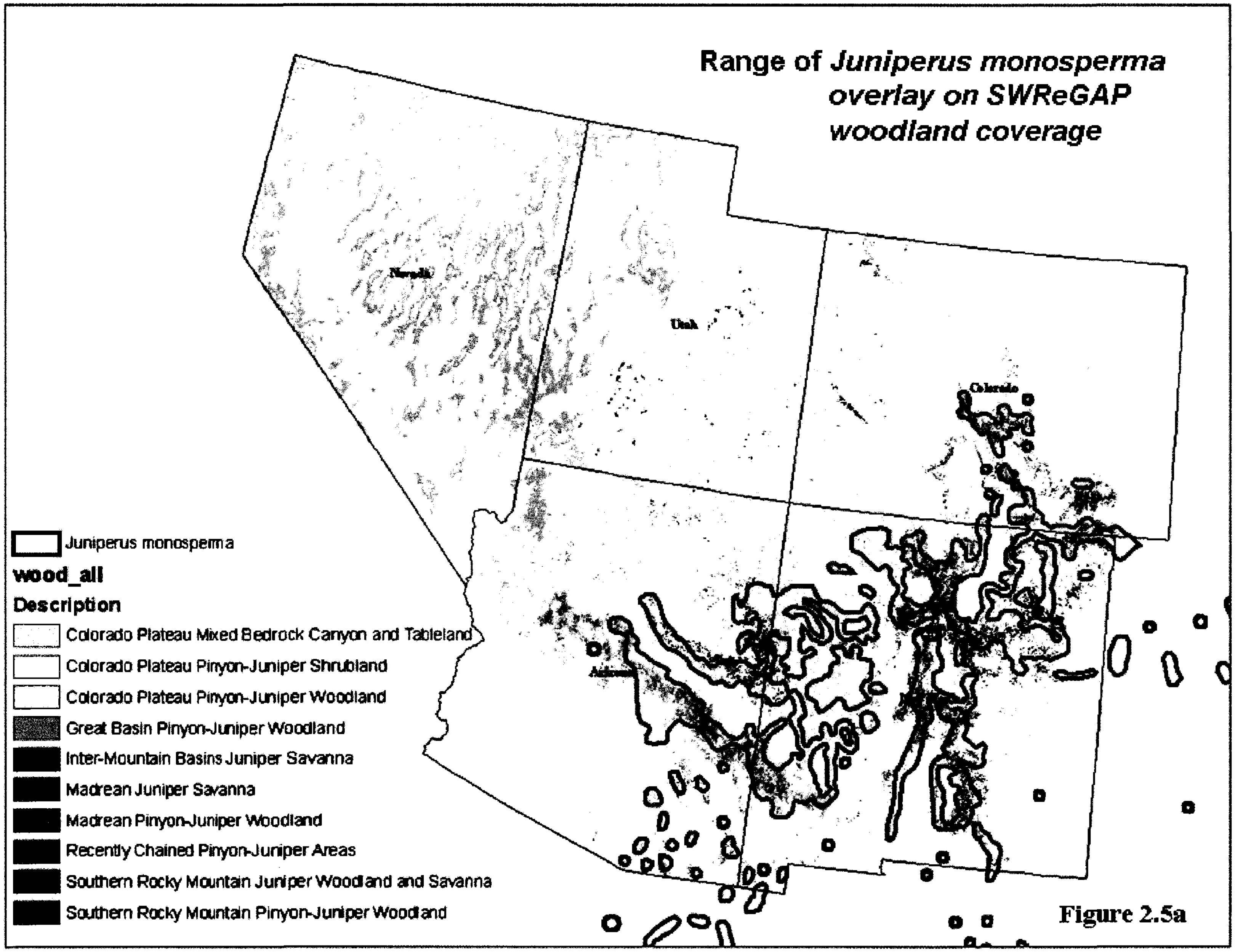
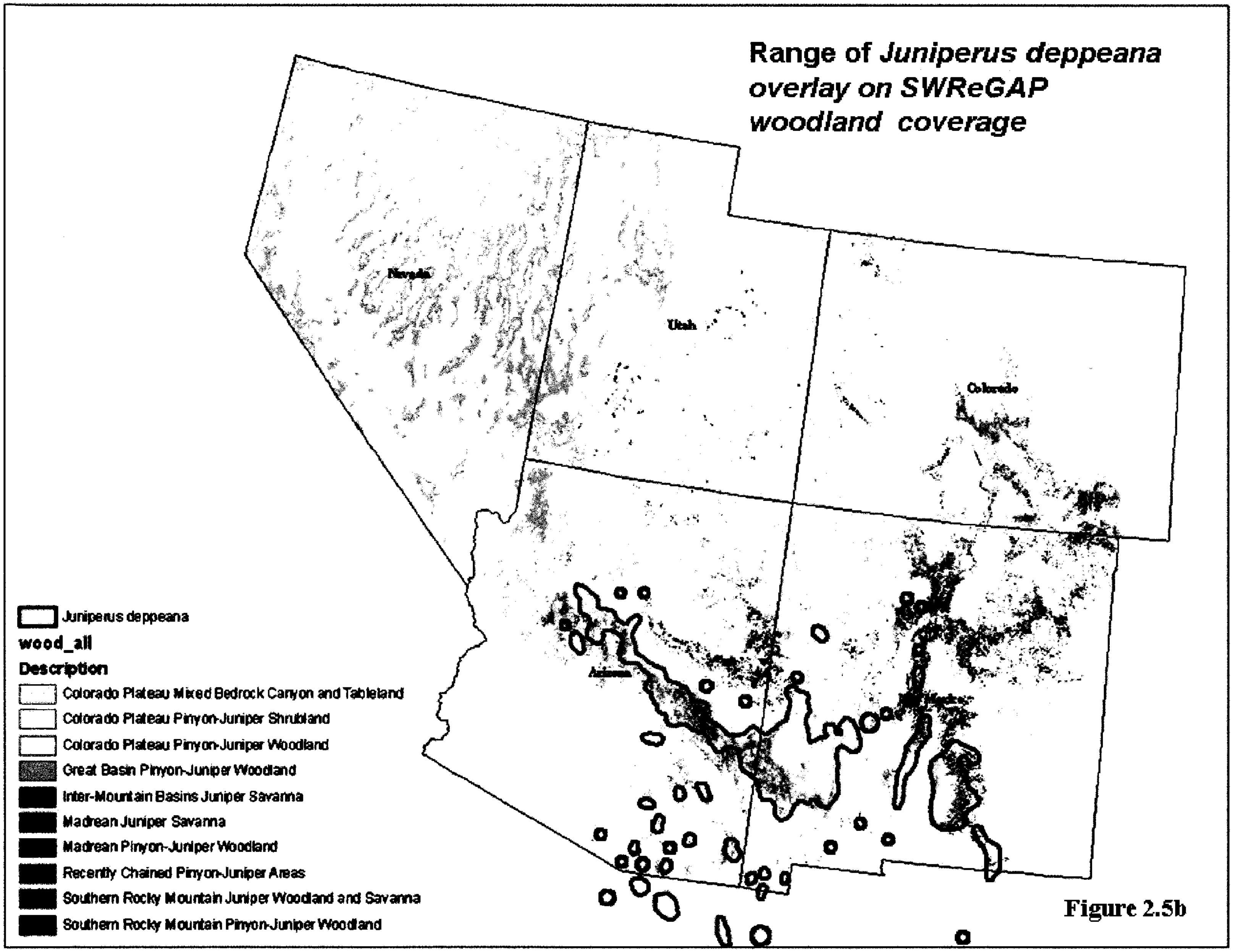

Range of *Juniperus monosperma* overlay on SWReGAP woodland coverage

Figure 2.5a



Range of *Juniperus deppeana* overlay on *SWReGAP woodland coverage*

Figure 2.5b

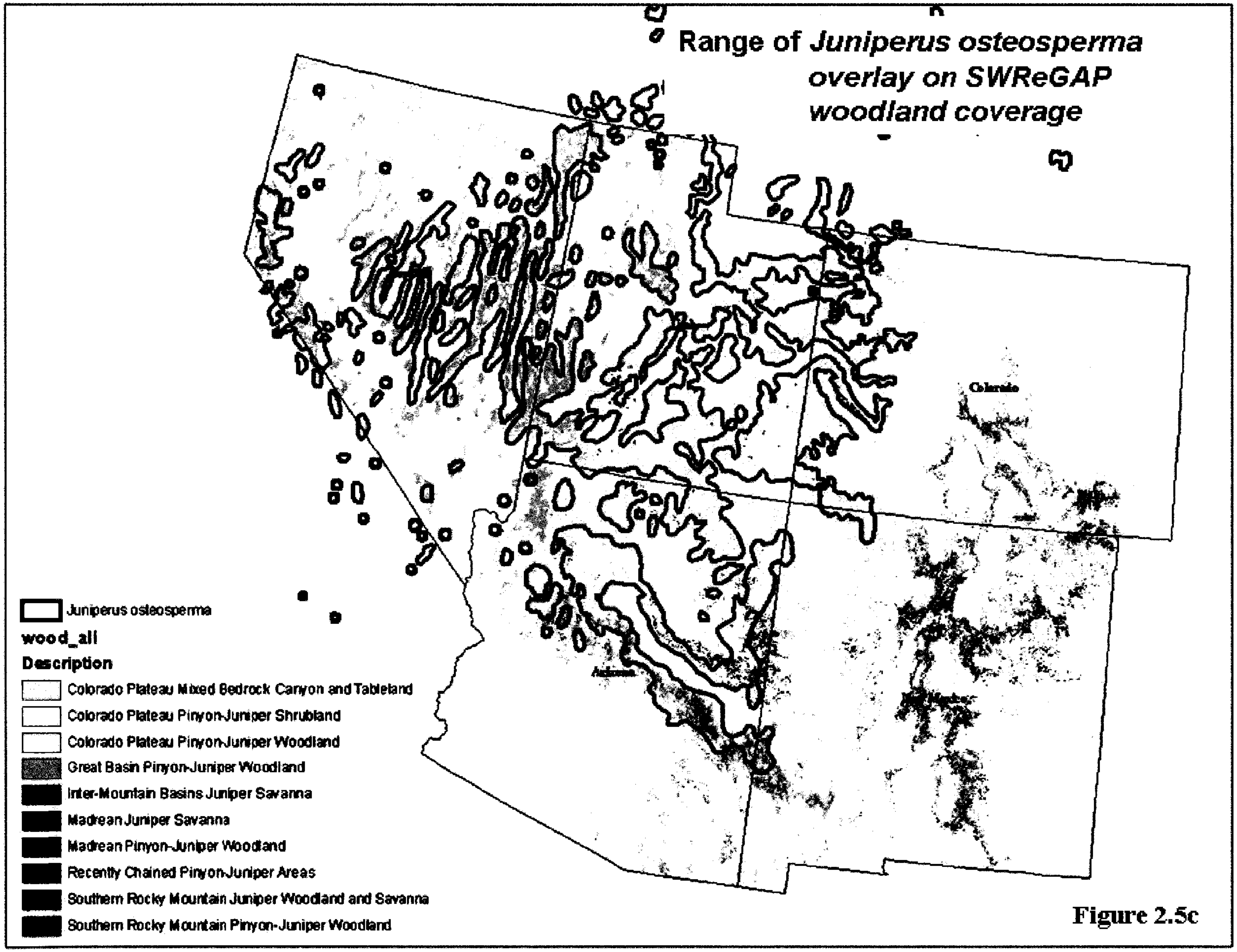

Range of *Juniperus osteosperma* overlay on SWReGAP woodland coverage
Juniperus osteosperma
wood_all
Description
Colorado Plateau Mixed Bedrock Canyon and Tableland
Colorado Plateau Pinyon-Juniper Shrubland
Colorado Plateau Pinyon-Juniper Woodland
Great Basin Pinyon-Juniper Woodland
Inter-Mountain Basins Juniper Savanna
Madrean Juniper Savanna
Madrean Pinyon-Juniper Woodland
Recently Chained Pinyon-Juniper Areas
Southern Rocky Mountain Juniper Woodland and Savanna
Southern Rocky Mountain Pinyon-Juniper Woodland
Colorado
Arizona
New Mexico

Figure 2.5c

Chapter III

Mapping “old” versus “young” piñon-juniper stands with a predictive topo-climatic model

in north-central New Mexico, USA

Abstract

Southwestern U.S. piñon pine and juniper woodlands are often represented as an expanding and even invasive vegetation type, a legacy of historic grazing and culpable in the degradation of western rangelands. A long standing emphasis on forage production, in combination with recent hazard fuel concerns, has prompted a new era of woodland management with stated restoration objectives. Yet, the extent and dynamics of piñon-juniper communities pre-dating intensive Euro-American settlement activities are poorly known or understood, while the intrinsic ecological, aesthetic, and economic values of old-growth woodlands are often overlooked. Historical changes in piñon-juniper include two related, but poorly differentiated, processes: recent tree expansion into grass or shrub dominated (i.e., non-woodland) vegetation and thickening or infilling of savanna or mosaic woodlands pre-dating settlement. My work addresses the expansion pattern, modeling the occurrence of "older" savanna and woodland stands extant prior to 1850, in contrast to "younger" piñon-juniper growth of more recent, post-settlement origin. I present qualitative criteria in the form of a diagnostic key for distinguishing "older", pre-Euro-American settlement piñon-juniper from "younger" (post-1850) stands, and report results of predictive modeling and mapping efforts within a north-central New Mexico study area. Selected models suggest a primary role for soil moisture in the current distribution of "old" versus "young" piñon-juniper stands. Pre-settlement era woodlands are shown to occupy a discrete ecological space, defined by the interaction of effective (seasonal) moisture with landform setting and fine-scale (soil-water) depositional patterns. "Older" stands are generally found at higher elevations or on skeletal soils in upland settings, while "younger" stands (often dominated by one-seed juniper, *Juniperus*

monosperma) are most common at lower elevations or in productive, depositional settings. Modeling at broad regional scales can enhance a general understanding of piñon-juniper ecology, while predictive mapping of local areas has potential to provide products useful for land management. Areas of the southwestern U.S. with strong monsoonal (summer moisture) patterns appear to have been the most susceptible to historical woodland expansion, but even here the great majority of extant piñon-juniper has pre-settlement origins (although widely thickened and infilled historically) and old-growth structure is not uncommon in appropriate upland settings.

Introduction

Piñon-juniper savanna and woodland communities collectively constitute one of the most widespread vegetation types within the Four Corners states of Arizona, Colorado, New Mexico, and Utah in the American Southwest (Figure 3.1). Within this four-state region piñon-juniper types represented by Colorado piñon (*Pinus edulis*) and one of the three commonly associated non-sprouting juniper species (one-seed, *Juniperus monosperma*, Utah, *J. osteosperma,* and Rocky Mountain, *J. scopulorum*) cover ca. 14.5 million ha (Lowry et. al., 2005). Recent attention has focused on presumed historical changes in piñon-juniper distribution and dynamics, particularly tree invasion of former grass and shrub communities, and associated effects on habitat, forage, soil, water resources (Everett, 1987; Miller and Wigand, 1994; Monsen and Stevens, 1999; Miller and Tausch, 2001). There is widespread interest in restoring degraded western rangelands, often through removal of the tree or shrub components, but managers proposing large-scale woodland restoration often face serious challenges, in part because field distinction between piñon-juniper stands of relatively recent origin and those with older trees that pre-date intensive Euro-American settlement activities (ca. 1850) can be problematic (Romme et. al., 2003). Selected qualitative features of individual trees and stands can be reliably associated with general categories of stand age or development, such as old-growth (Kaufmann et. al., 1992; Miller et. al., 1999; Waichler et. al., 2001; Floyd et. al., 2003) or successional status (Miller et. al., 2005), allowing these features to be used as a proxy to infer a pre- versus post-Euro-American settlement stand age. Using this general approach, I present criteria in the form of a diagnostic key for consistent field recognition of "older", pre-settlement piñon-juniper types, as distinguished from "younger" stands (i.e., post-1850 origin) and demonstrate a predictive approach for modeling and mapping of pre- versus post-settlement aged woodlands (*P. edulis* and *J. monosperma / J. scopulorum*) in a north-central New Mexico study area.

Southwestern piñon-juniper types span an impressive range of environmental settings, occurring on foothill, mesa, and mountain slope positions at middle elevations within a semi-arid climatic zone, between lower elevation desert grass and shrub communities and higher elevation ponderosa pine and mixed coniferous forests (Pieper and Lymbery, 1987; West, 1999). However, despite the apparently broad ecological amplitude and wide distribution of piñon-juniper types across diverse climatic and topographic settings, each component species has a unique life history and range of environmental tolerances (Neilson, 1987; Ronco, 1987; Chambers et. al., 1999). Colorado piñon and Rocky Mountain juniper are often dominant within the more mesic, or upper elevation (and northerly) portions of the woodland zone (Pieper and Lymbery, 1987; Martens et. al.,

2001) sometimes forming multi-layered stands with nearly closed canopies. At lower elevations or more xeric interfaces of woodlands with grass and shrub dominated communities, it is common to observe open savanna-like stands of one-seed or Utah junipers (and even piñon in some locations) with grass, forb, and / or shrub understories (Pieper and Lymbery, 1987; West, 1999). Utah juniper however, being both cold and drought tolerant also occurs at both higher elevations and latitudes than piñon (Neilson, 1987). The elevation limits (upper and lower) of woodland distribution are likely reinforced by disturbance regimes (e.g., fire) and competitive interactions associated with ponderosa pine and grass- or shrub-land systems (Neilson, 1987; Gottfried et. al., 1995). Between these extremes a great variety of juniper and piñon-juniper types can be recognized as associations with various understories (Ronco, 1987; Gottfried et. al., 1995), depending on local site conditions and histories, and within the regional biogeography of individual species distributions (West and Van Pelt, 1987). While discrete piñon-juniper types can be delineated, savanna and woodland structures may alternatively be viewed as points along a continuum from open, non-woodland to closed canopy forest, with observed structure and individual species composition strongly influenced by the temporal and spatial scale of measurement, underlying topo-edaphic controls, species pool, and site history (Neilson, 1987; Martens et. al., 2001).

Drought, insects, disease, and fire are commonly recognized natural disturbances in piñon-juniper types, but interpreting the relative importance of these in controlling the spatial pattern of vegetation can be challenging (Baker and Shinneman, 2004; Breshears et. al., 2005). Competitive interactions, both between and among growth forms, are also thought to have been important mechanisms historically in maintaining grass-tree ecotones and internal stand structure (Johnsen, 1960, 1962; Eisenhart, 2004). The role of infrequent or extreme events can be especially difficult to integrate into local and typically short-term land management contexts. Establishment and mortality of woodland may result from pulsed disturbance or climatic events (Betancourt et. al., 1993; Chambers et. al., 1999; Swetnam et. al., 1999; Breshears et. al., 2005; Shinneman, 2006), while long-term persistence on newly colonized sites can be enhanced by positive feedbacks (i.e., desertification) of established vegetation on soil moisture and nutrient patterns (Walker et. al., 1981; West and Van Pelt, 1987; Schlesinger and Pilmanis, 1998; Breshears and Barnes, 1999) or through suppression of understory vegetation and associated potential for surface fire (Brackley, 1987; Miller and Tausch, 2001). Observed patterns in the occurrence and composition of woodlands are related to both local topo-edaphic conditions (Chambers et. al., 1999) as well as the regional climatic context. For example, coarse, shallow soils may lack sufficient soil moisture to support well-developed herbaceous cover, yet the fractured substrates underlying these sites can allow rapid infiltration and provide abundant deep water accessible primarily to woody plants (McAuliffe, 2003). At regional scales, seasonality of precipitation (i.e., summer versus winter dominance) can strongly influence water availability at depth and thus potential vegetation, given the large intra-annual differences in evaporative demand (Mitchell, 1976; Neilson, 1987).

Reconstructed stand age structures, paleoecological evidence, and visual comparisons of current conditions with historic photos suggest piñon-juniper has become more abundant at many locations since Euro-American settlement, ca. 1850 (e.g., Miller and Wigand, 1994; Tausch, 1999a; Miller and Tausch, 2001; Fuchs, 2002). Observed or reconstructed changes in southwestern piñon-juniper since settlement have been variously interpreted as (1) ongoing migrational adjustment to Holocene climate (2) natural demographic response (i.e., pulsed establishment) to fluctuating weather patterns (3) stages in normal stand development (4) recovery from harvest (historic or pre-historic) (5) succession after fire, drought, insect or disease induced mortality events (6) response to grazing practices including altered competitive interactions, soil properties, hydrologic patterns, and fire regimes (7) or accelerated growth as a result of elevated temperatures and CO_2 levels associated with recent anthropogenic climate changes (Betancourt, 1987; Neilson, 1987; Betancourt et. al., 1993; Tausch, 1999b; Miller and Tausch, 2001; Baker and Shinneman, 2004; Eisenhart 2004; Floyd et. al., 2004; Shinneman, 2006). The relative importance of these mechanisms and processes likely differs from place to place, with both synchronous and synergistic interactions across multiple spatial and temporal scales (Neilson, 1987, 2003; Wagner and Fortin, 2005).

Historical changes in piñon-juniper include two distinct, but often poorly differentiated, processes: tree expansion into non-woodland areas (e.g., shrublands and grasslands) and thickening or infilling of piñon-juniper savanna and mosaic woodland communities extant prior to intensive Euro-American settlement (ca.1850). While expansion and infilling both involve new tree establishment, they often occur in different, albeit sometimes adjacent, edaphic and landform settings. The scale of observation or sampling approach, therefore, can determine whether results from different studies are comparable, particularly in regard to how fine-scale topographic patterns and associated vegetation mosaics are interpreted (Johnsen, 1960; Pieper and Lymbery, 1987; Wilcox and Breshears, 1994; Weisberg et. al., 2007). Although the underlying mechanisms driving expansion versus infilling may differ in some basic ways, both processes are thought to have been enhanced historically by intensive landuse and relaxation of competitive and disturbance constraints (Chambers et. al., 1999).

Predictive vegetation modeling has recently gained attention both as a practical tool for land managers and for its potential to inform ecological research through an integrated method of inquiry. A variety of statistical and geospatial methods have been used successfully to predict and map discrete vegetation patterns from spatially explicit environmental variables (Franklin, 1995; Jensen et. al., 2001; Wagner and Fortin, 2005) with a recent emphasis on modeling species bio-climatic envelopes to infer potential for climate induced range shifts (Araujo and Guisan, 2006; Latimer et. al., 2006). I applied these predictive modeling methods to model and map "older", pre-settlement versus "younger", post-settlement piñon-juniper in a monsoonal, north-central New Mexico study area. My approach implicitly tests the idea that "older", pre-settlement age piñon-juniper woodlands occupy an ecological space distinct from "younger", post-settlement stands. I sampled across "old" versus "young" stands, associate these sites with relevant topo-climatic metrics, and developed predictive relationships between woodland stand-age and environmental variables.

Methods

Overview

I used an intensive, plot-based sampling approach to characterize southwestern U.S. piñon-juniper types, represented by Colorado piñon pine and several associated species of non-sprouting juniper (one-seed, Utah, and Rocky Mountain) in three National Park Service units (Bandelier National Monument, Mesa Verde National Park, and Colorado National Monument) representing a southeast to northwest, moisture seasonality gradient across the Four Corners states (Figures 3.1, 3.2). The intensive plot data (Appendix 4.3a) were used to inform development of a diagnostic key (Table 2.1) distinguishing "older", pre-settlement woodlands (>150 years) from "younger", post-settlement stands of more recent origin. Intensive plot data (Appendix 4.3a) were also used for exploratory analysis to provide insight into regional-scale woodland patterns. Subsequently, I identified a focal study area in north-central New Mexico representing the southeastern (monsoonal) end of the regional moisture gradient initially sampled, where summer seasonal precipitation averages half or more of the annual total (Figure 3.2) and woodlands are mapped as southern Rocky Mountain types (*P. edulis* and *J. monosperma / J. scopulorum*) by the Southwest Regional Gap Analysis Project (SWReGAP); Lowry et. al., 2005, (Figure 3.1). The study area was centered on Bandelier, a well researched landscape and protected from wood harvest and livestock grazing since 1932. Within the focal study area I then conducted extensive sampling in support of planned modeling efforts. Each point was assigned a pre- versus post-settlement stand age (i.e., "young" or "old") using the diagnostic key. Subsequently, all sample points were associated with potentially relevant topo-climatic metrics and the compiled dataset used for modeling.

Models were fit using stepwise logistic regression and evaluated using several standard measures of accuracy. Selected models for the north-central New Mexico study area were mapped within a geographic information system (GIS).

Intensive Field Sampling and Development of Diagnostic Key

Intensively sampled plots were circular, 50 m in diameter (0.2 ha) and with a single 25 m radial transect. Plots were established within homogeneous settings in which piñon-juniper was the dominant overstory and exceeded 5% canopy cover. Plot centers were anchored to the upslope drip-line of the oldest piñon and / or juniper individuals apparent within a local search area. A radial transect was established down slope from the plot center and aligned with site aspect. Within a designated quarter-plot section, a complete tree census (including dead individuals) was conducted: diameters were taken approximately 30 cm above ground surface (i.e., at core height); for multi-stemmed individuals (e.g., one-seed juniper) I measured the basal diameter of the largest primary stem. Qualitative features (e.g., crown shape, amount of dead wood in living canopy, lichen growth on dead wood or axe-cut limbs, trunk cavities, large exposed roots, burned wood) were noted for each sampled tree. At the full plot (i.e., stand) level I also noted additional qualitative features, including presence of stumps, down-wood, or snags, and other evidence of historic cutting or fire disturbance. At 5-m intervals along the radial line transect I recorded overstory canopy cover by species, and understory vegetation and ground cover by form, within a 0.5-m quadrat; soil depths (<50 cm) were also sampled at each 5-m interval. Intersections of large down-wood (>6 cm) were tabulated along the entire transect. Maximum soil depth was obtained at plot center using a (2 ¼-inch) auger;

a representative soil sample was obtained at a depth of 0 to 10 cm. Cores (and associated diameters) were obtained (at 30 cm above base) from the largest 5 to 10 piñon trees within the full plot. Cores were mounted, sanded, ring-counted, and subsequently cross-dated to validate ring-count estimates. Although juniper may represent the oldest trees in some stands (Shinneman, 2006), they are problematic to core and many species (e.g., one-seed and Utah junipers) cannot be dated precisely (Peter M. Brown, pers. comm.).

Quantitative stand age estimates were calculated as the average (ring-count) age of the three largest piñon (and three largest juniper when these data were available). In constructing the diagnostic key I selected qualitative characters that were easily recognizable and consistently present in trees and stands with quantitative age estimates of 150 years or more. Diameter thresholds (for distinguishing stands of pre- versus post-settlement age) were developed as an additional component of the diagnostic key, using regressions of ring-count on diameter from *Pinus edulis* and *Juniperus monosperma.* Sample data for regression analysis were obtained from nine woodland plots (stratified across three topo-edaphic settings representing shallow to deep soils) established as part of an earlier study within Bandelier National Monument (Julius, 1999) and supplemented with six intensive plots sampled as part of the current project. Piñon tree diameters were measured near core height (i.e., 30 cm) and juniper stem diameters were measured near their base. Since diameter was being associated with ring-count at sample height, no standard adjustment (in ring-count for sample height above ground) was deemed necessary for developing regressions. I used a no-intercept linear regression model for predicting ring-count from diameter since both parameters can be expected to equal zero at time zero (Eisenhauer, 2003).

Reliability of the diagnostic key for use in north-central New Mexico was assessed using data from the fifteen plots sampled within Bandelier National Monument (Appendix 3.1). The plots at Bandelier provided a suitable test of the qualitative diagnostic criteria approach because the park supports a mosaic of "older" and "younger" stands that span the settlement threshold period (ca. 1850), and visual distinction between pre- versus post-settlement age stands sometimes can be difficult. In addition, nine of the fifteen plots at Bandelier had ring-count data available for one-seed juniper from an earlier study (Julius, 1999), and this allowed for a more robust estimate of quantitative stand age. For each plot, I compared the stand age assigned using the qualitative diagnostic criteria, with a quantitative stand age based on the average ring-counts of the three largest trees.

Extensive Field Sampling for Predictive Modeling

Extensive field sampling was focused initially within Bandelier and subsequently extended onto the surrounding Carson and Santa Fe National Forests, as well as along accessible public right-of-ways, to acquire a more wide-ranging sample of woodlands from the north-central New Mexico study area. Using existing trails and roads as transects, I selected routes which sampled across the range of topographic and elevation settings where woodland occurred. Sampling was stratified across four general landforms: (1) valleys, including swales and drainage bottoms, (2) mesas and ridges, (3) upland terraces, and (4) steeper slopes and cliffs. These landform categories were readily discernible in the field, provided an ecologically relevant approach for dispersion of points across local landscapes, and were available as spatial coverage within a GIS (Lowry et. al., 2005). Along each transect, I sampled successive landform strata as they were encountered; this approach distributed sampling effort across the different strata in proportion to their availability.

For each sample point I established a 50-m circular plot within which I collected the following information: geographic coordinates and elevation; apparent landform and (soil-water) depositional context; diameter near base of trunk or largest stem of the three largest individuals per species (including snags, stumps, and logs), qualitative old-growth characteristics of sampled trees; and qualitative features of the stand including successional status or signs of obvious landuse or historical disturbance. Assignment of piñon-juniper type, pre- versus post-settlement stand age, landform, and depositional setting initially were made onsite. Field assignments were subsequently reviewed to ensure consistent application of diagnostic key criteria and correspondence of sampled field points with GIS landform coverage.

Development of GIS Datasets for Modeling

A variety of geospatial datasets, including elevation, climate (temperature and precipitation), vegetation cover, landform, geology, and soils, were acquired to provide baseline GIS data for the Four Corners states. Geospatial climate variables were procured from Climate Source Inc., a vendor of 2-km resolution climate products developed by the Parameter-elevation Regressions on Independent Slopes Model (PRISM) group at Oregon State University, and seamless 30-m resolution digital elevation model (DEM) coverage was purchased from USGS-EROS. Vegetation and landform coverages (30-m resolution) were obtained from SWReGAP (Comer et. al., 2003; Comer et. al., 2004; Lowry et. al., 2005). Different spatial references and resolutions necessitated some standardization to create compatible datasets for analysis (Latimer et. al., 2006); all data were projected to Albers Equal Area Conic, NAD83.

Surface analysis of 30-m DEM's was used to create slope (in degrees), hillshade (an index of slope-aspect relative to a fixed sun position), and flow accumulation (cumulative number of cells flowing into a reference cell) datasets using standard utilities in ArcGIS 9.1 (ESRI, 2005). Precipitation and temperature values were available as 30-year (1961-1990) monthly means from PRISM at 2-km resolution; these data were then used to calculate annual and seasonal means. Mean annual precipitation (MAP) was calculated by averaging the 30-year monthly means. Seasonal (summer and winter) precipitation represents growing or dormant season moisture (mean monthly values) summed for the June-September and October-May periods respectively. A seasonal moisture index (MONSOON) represents growing season (June-September) precipitation as a percentage of MAP. Metrics of effective (summer and winter) moisture (ESP and EWP) were developed by adjusting (i.e. dividing) seasonal precipitation values with seasonal estimates of potential evapo-transpiration (PET). Seasonal indices of PET (winter and summer) were calculated as the product of $\log_n$(hillshade) for summer or winter solstice solar parameters (1300 hours) and mean maximum or minimum monthly temperatures respectively (method adapted from Penman, 1948). Landform coverage originally developed by SWReGAP (Lowry et. al., 2005) was generalized to four categories (from ten) delineated using slope and flow accumulation thresholds. This yielded a class variable (LANDFORM) with four levels: 1 = alluvial slope positions, swales, and valley bottoms, 2 = upland mesas and ridges, 3 = upland terraces, 4 = steeper slope positions, shoulders, and cliffs (Table 3.2). Relative runoff accumulation and soil depositional patterns were compiled using LANDFORM specific, flow accumulation thresholds, to generate a class variable (FLOW) with two levels: 0 = *losing* soil-water settings; 1 = *gaining* soil-water settings (Table 3.2). Computational details and code for development of metrics within a GIS are presented in Appendix B.

Predictive Modeling and Map Realization

Statistical modeling was performed in SAS 9.1 (SAS, 2005) using a binary logistic procedure (where "old" = event and "young" = nonevent) and stepwise model selection with default thresholds (P-values) for entry ($P < 0.2$) and retention ($P < 0.1$) of individual explanatory variables. Topographic and climate data, including secondarily derived metrics, were used as potential explanatory variables of stand age. Secondary metrics were developed (as detailed above) by combining precipitation and temperature with DEM derived surfaces (e.g., hillshade) to create variables with potential ecological relevance (e.g., ESP, EWP, PET). Topo-climatic data associated with each sample point ($n = 210$) were extracted using the spatial analyst sample utility in ArcGIS 9.1 (ESRI, 2005) and the data imported to SAS for model development (Appendix 4.3b). A potential set of some twenty topo-climatic predictors, including both discrete and continuous data versions of some variables, were provided to the logistic program for initial selection. Prior probabilities were not specified and defaulted to the observed ratio of "old:young" in each dataset. Table 3.2 presents a frequency distribution (%) of samples across the two class variables used in modeling: LANDFORM (four levels) and FLOW (two levels), for the full (*n* = 210) and split training (*n* = 146) / test (*n* = 64) datasets.

Modeling runs were conducted using both the full dataset (*n* = 210 sample points) and a split training / test dataset (*n* = 146 / *n* = 64) partitioned using a simple rule. Alternative models developed using the full and training datasets were evaluated using several standard measures of accuracy, including leave-one-out (LOO), cross-validated probability (XP), classification table outputs (i.e., total correct, sensitivity, specificity, false positive / negative) across a limited range (i.e., 0.40 to 0.60) of probability cutoffs (Table 3.3). Comparable models with fewer and / or more easily interpretable predictors were given preference. For the split dataset modeling effort, the test dataset was scored using the model independently fit with the training data. LOO XP, receiver operating characteristic (ROC), area under curve (AUC) values (LOO XP ROC AUC) also were calculated for full, training, and test models. ROC AUC values represent a plot of LOO XP sensitivity * specificity measures across all probability levels, providing a single integrated measure of model predictive accuracy.

Spatial analysis of logistic model outputs in ArcGIS (throughout the north-central New Mexico study area) involved calculation of predicted probabilities using SWReGAP woodland coverage as an analysis mask to represent occurrence of southern Rocky Mountain piñon-juniper. Intercept and partial slope regression parameters were used to calculate individual cell probabilities of class membership (i.e., “young” or “old”) using the raster calculator utility. Cell probabilities were then grouped into two or more response classes (e.g., "young" < 0.5 or "old" ≥ 0.5) and color coded for map visualization.

Results

Diagnostic Key

A diagnostic key (Table 3.1) was developed to facilitate rapid field assignment of piñon-juniper type, and is used here to distinguish "older", pre-Euro-American settlement woodlands (>150 years) from "younger" stands of more recent (post-1850) origin. Tree diameter thresholds presented in the key (Table 3.1) are based on diameter to age (ring-count) regressions, using a zero-intercept model and developed with samples from Bandelier National Monument: Colorado piñon age = 5.49 * diameter ($P < 0.0001$, n = 204) and one-seed juniper age = 6.65 * diameter ($P < 0.0001$, n = 398); Appendix 3.1. P-values are provided in lieu of r-square values which cannot be used to evaluate zero-intercept models (Eisenhauer, 2003). Diameter thresholds are intended to provide a pre- versus post-settlement (ca. 1850) approximation of stand age for Colorado piñon (30 cm) and one-seed juniper (25 cm) in upland settings of north-central New Mexico with moderate soil depths (15 to 35 cm). My diameter-age estimates are comparable to those in published reports of piñon and juniper growth rates in New Mexico (Howell, 1940). The key provides minimum densities of old trees below which detection of individuals >150 years could be considered incidental to the site under consideration. Although the key delineates woodland and savanna types, my experience in the field tells us that these stand structures can intergrade or occur in mosaic patterns reflecting variable site histories along complex environmental gradients.

Reliability of the diagnostic key for delineating pre- versus post-settlement stands in the north-central New Mexico study area was assessed using data from fifteen (0.1 ha) intensively sampled plots within Bandelier National Monument. Using the key, 13 of 15 of stands were correctly assigned to a pre- versus post-settlement age, based on stand age computed from average ring-counts of the three largest sampled piñon (and juniper in nine plots) trees in each stand (Appendix 3.1). The key performed well when used to delineate "older" (>175 years) from "younger" (<125 years) stands. Stands of median age (i.e., 150 years ± 25 years) were sometimes problematic given the nature of criteria used, particularly when assessing "young" stands (with large diameter trees) in productive settings or "old" stands (with small diameter trees) on poor sites. Plot *BAND12* was misclassified as "young", but ring-counts of the three largest piñon averaged 150 years, suggesting a marginally "old" stand with slower-growing piñon. Plot *BAND15* was misclassified as being "old", although the ring-count data suggested a marginally "young" stand with several large (>30-cm stems), fast-growing junipers averaging <135 ring years.

Predictive Modeling and Mapping

The full model correctly classified 89.5% of observations (0.45 probability cutoff) using four predictors: effective winter moisture (EWP, $P < 0.0001$), flow accumulation (FLOW, $P < 0.0001$), landform (LANDFORM, $P < 0.0015$) and elevation (DEM, $P < 0.0014$); 93.2% of pre-settlement stands (136 of 146) and 81.3% of post-settlement stands

(52 of 64) were correctly classified (Tables 3.2, 3.3). The leave-one-out, cross-validated probability, receiver operator characteristic, area under curve (LOO XP ROC AUC) value for the full model was $c = 0.932$. Comparable classification results were obtained for the split, training ($n = 146$) / test ($n = 64$) dataset (0.60 probability cutoff) using the same four predictors; total correct for the training dataset was 89.0%, with an LOO XP ROC AUC value of $c = 0.938$. The test data scored using the model fit independently with the training dataset correctly classified 90.6% of all observations: 93.3% of pre-settlement stands (42 of 45) and 84.2% of post-settlement stands (16 of 19). LOO XP ROC AUC value for the scored test data was $c = 0.913$.

Map realizations of the full model were generated in ArcGIS at various spatial extents, including the north-central New Mexico study area (Figure 3.3a) and the Tsankawi subunit of Bandelier National Monument (Figure 3.3b). Within the north-central New Mexico study area, SWReGAP coverage indicates that *P. edulis* / *J. monosperma* types occupy 28% (820,955 ha) of land area. My model results suggest that less than a third (29%) of this extant piñon-juniper cover is post-settlement in origin. I noted during field work, however, that SWReGAP coverage often classified sites with scattered "young" piñon-juniper stands (<50 years) as non-woodland types, so using this coverage as an analysis mask for map realization likely underestimates total acreage of post-settlement woodland in the north-central New Mexico area. The majority of these "younger", post-settlement stands occur either below critical EWP thresholds in lower elevation valley and terrace landform settings or in strongly depositional areas within an upland landform context. An equally important result is the corollary finding that >70% of extant piñon-juniper was savanna or woodland prior to 1850. Although widely thickened or infilled, these "older" stands should not be misinterpreted as part of the post-settlement expansion of piñon-juniper into non-woodland (e.g., grass and shrub) vegetation types.

Discussion

A diagnostic key (Table 3.1), using a combination of semi-quantitative and qualitative features, was developed to facilitate rapid field distinction of piñon-juniper type and pre- versus post-settlement stand age. I used the key only to assign sampled stands to "old" versus "young" categories in preparation for logistic modeling within the north-central New Mexico study area, although the key provides for finer classification of piñon-juniper types. Notably the key does not distinguish historically thickened or infilled savanna and mosaic woodland structures, where tree cover was sparse or patchy prior to 1850, from woodlands where tree density and cover has been relatively high or continuous since before settlement. For my purposes, both of these structures would be classified as pre-settlement if they contained old or persistent piñon-juniper features.

Use of the diagnostic key outside of the north-central New Mexico area, or within selected landform and climatic settings, may require local calibration of the semi-quantitative (e.g., diameter thresholds) criteria. Piñon cores collected from intensively sampled plots across the Four Corners states (data not presented) indicate that differences in seasonal moisture patterns and landform setting may strongly influence relative growth rates. For example, growth rates of one-seed juniper at Bandelier are nearly twice those reported for Wupatki National Monument, Arizona (Hassler, 2006), where MAP is about half of that reported for Bandelier and summer moisture averages only 45-50% of MAP. Across areas having comparable ranges of MAP, a 30-cm diameter piñon in the Bandelier area (where summer precipitation averages 50 to 55% of the annual total) might be expected to range between 150-180 years old, whereas in winter moisture dominated portions of the Colorado Plateau (MONSOON < 0.5) a similar piñon would generally exceed 200 years, and in strongly monsoonal portions of southern New Mexico (MONSOON > 0.55) the same diameter trees would often be less than 150 years old (Figure 3.2). Within local areas, growth rates were observed to be greater on depositional versus immediately adjacent non-depositional settings (Appendix 3.1), whereas nearby upland settings with exposed bedrock and little capacity for subsurface water storage often supported surprisingly old, but relatively small diameter, trees.

I predictively modeled and mapped the occurrence of pre- versus post-settlement woodlands within a 2.9-million ha study area comprising a north-central New Mexico extent. Sampled stands were classified as "old" versus "young" using the diagnostic key and each sample point was associated with potential topo-climatic predictors in a GIS. The resulting dataset was used for logistic modeling, and the selected models were implemented within a GIS to realize predictive map products. This approach allowed us to evaluate the relative importance of individual explanatory variables, and generate map outputs for use by land managers. The topo-climatic metrics selected (i.e., FLOW, LANDFORM, EWP, DEM) were both spatially explicit and ecologically relevant. My model and map realizations highlight environmental settings inherently favorable to the growth and long-term persistence of piñon-juniper savanna and woodland versus locations that would have formerly supported non-woodland (e.g., grass and shrub) vegetation types (Figure 3.3b). Nonetheless, woodland vegetation is dynamic and positive feedbacks can effectively mitigate environmental or disturbance constraints on potential distribution. Once established, woodland can persist even in strongly depositional settings if tree cover effectively usurps resources, suppresses understory cover and potential for surface fire, or alters hydrologic and soil properties (West and Van Pelt, 1987; Schlesinger and Pilmanis, 1998; Breshears and Barnes, 1999).

Within the north-central New Mexico study area, woodland expansion appears largely attributable to establishment of one-seed juniper into historically degraded grasslands in depositional valley and terrace settings under monsoonal influence. Although many valley locations in north-central New Mexico experienced domestic grazing pressures as early as the 1600s, the influence of intensive Euro-American settlement beginning ca.1850 was likely the overriding historic influence on age-structure of extant woodland vegetation. Across the Four Corners states my intensive plot work suggests that seasonal patterns of moisture and occurrence of different juniper species (Figures 3.1, 3.2) may influence the relative susceptibility of southwestern U.S. landscapes to historic woodland expansion. For example, one-seed juniper (Little, 1971) is associated with a summer monsoonal influence (Mitchell, 1976; Neilson, 1987, 2003; Figure 3.2) and this species has life history attributes that relate successful seedling establishment to adequate growing season moisture (Johnsen 1960, 1962; Chambers et. al., 1999). In contrast, Utah juniper (Little, 1971) occurs primarily in weakly bimodal and winter moisture dominated areas to the northwest (Figure 3.2). Rocky Mountain juniper gains importance northward and eventually replaces one-seed juniper as the common associate of piñon in portions of south-central Colorado where early spring moisture becomes an important component of the annual total (Woodin and Lindsey, 1954). Among closely related piñon species there is also an apparent relationship between needle number and seasonality of moisture. The range of Colorado piñon with two-needles encompasses areas influenced by both summer and winter moisture. Its one-needle relative, *Pinus monophylla,* located to the west is exclusively under the influence of winter moisture, and its three-needle relative, *Pinus cembroides,* found to the south is under the influence of strong summer monsoon moisture patterns (Neilson, 1987).

Along a northwest-to-southeast moisture seasonality gradient (within woodlands of the Four Corners states) I casually observed a dramatic increase in the frequency of "younger", post-settlement stands in locations roughly corresponding to the distributional limits of one-seed juniper (Little, 1971) and a shift to summer monsoonal moisture patterns (Figure 3.2). These "younger", usually one-seed juniper dominated, stands are typically found in low gradient valley and terrace landform settings (including gentle slopes and rolling hills). Chambers et al (1999) suggest that tree establishment into grasslands may be facilitated by adequate growing season moisture, which can mitigate the need for favorable micro-sites otherwise provided by woody nurse plants in winter moisture areas. Although arid grasslands are susceptible to desertification processes (Walker et. al., 1981; Schlesinger and Pilmanis, 1998), McAuliffe (2003) found that sites with shallow argillic horizons (which inhibit infiltration and deep water storage) can apparently resist woody plant establishment even under sustained grazing pressure.

Colorado piñon, along with Rocky Mountain and Utah juniper, while present in many post-settlement stands, are more commonly observed as components of expansive woodlands colonizing higher elevation, depositional settings occupied by grass and sage types (Weisberg et. al., 2007), as well as infilling ponderosa pine understories on adjacent toeslopes.

On the Colorado Plateau (northwest of north-central New Mexico), where seasonal moisture patterns are weakly bimodal or winter-dominated, the occurrence of "young", post-settlement woodlands becomes correspondingly less frequent. In this bio-climatic zone, landform and (soil-water) depositional patterns increasingly delineate woodland from non-woodland areas across relatively sharp ecotonal boundaries. Notably, woodland expansion into grassland vegetation appears much less extensive outside the range of one-seed juniper (for example in the areas where Utah juniper is dominant). However, environmental constraints of woodland distribution and age structure can also be variously reinforced, amplified, or muted by associated disturbance processes (e.g., fire) and competitive interactions (Neilson, 1987). My intensively sampled plot data from the Colorado Plateau (not presented here) suggest that this area supports an abundance of "older", pre-settlement aged woodlands, and these observations are consistent with recent findings by Eisenhart (2004), Floyd et. al., (2004; 2008), Hassler (2006), and Shinneman (2006). Although I found a relationship between summer monsoonal patterns, one-seed juniper distribution, and susceptibility of landscapes in the Four Corners states to historic woodland expansion, further west in the winter-spring moisture influenced Great Basin region, western juniper (*Juniperus occidentalis*) also has expanded dramatically since

1860 into sagebrush steppe communities (Miller et. al., 2007).

In summary, I developed a diagnostic key to distinguish between “older”, pre-settlement and “younger” post-settlement piñon-juniper woodlands in the southwestern U.S. I assigned a pre- versus post-settlement age (ca. 1850) to sampled stands using this key. Topo-climatic metrics associated with sampled points were extracted and compiled within a GIS, and the resulting dataset was used for predictive modeling and mapping of pre- versus post-settlement (“old” versus “young”) stands of piñon-juniper within a north-central New Mexico study area. My modeling results suggest that “older” stands occupy an ecological space largely distinct from the settings where “younger” woodlands are commonly found, allowing us to use the associated environmental parameters to predict these occurrence patterns. Map realization of selected models highlights that landscape patterns of “older” pre- versus “younger” post-settlement woodland are likely structured by gradients of effective moisture and (soil-water) depositional environment (Pieper and Lymbery, 1987; Wilcox and Breshears, 1994). My field observations reinforce the idea that woodlands growing under winter-dominated or weakly bimodal moisture regimes have a fundamentally different character than those strongly influenced by summer monsoonal patterns. These findings contribute to a basic understanding of piñon-juniper ecosystems and can help inform appropriate management. Historic woodland expansion in north-central New Mexico is largely attributable to establishment of one-seed juniper into degraded rangeland settings under a summer monsoonal influence, and ecological restoration of grasslands and savanna structures in these locations appears generally warranted. In contrast, proposals for restoration of woodland sites on the Colorado Plateau should be reviewed more cautiously given my findings and reported prevalence of “older” pre-settlement woodlands in locations with bimodal or winter moisture patterns (Romme et. al., 2003).

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Table 3.1. Diagnostic criteria and artificial key for delineation of southwestern U.S. piñon-juniper, savanna and woodland communities (*Pinus edulis*, *Juniperus osteosperma*, *J. monosperma*, and *J. scopulorum)*, in the Four Corners states (Arizona, Colorado, New Mexico, and Utah)

KEY TO GROUPS

1a. *Mature piñon (live or dead) well represented*	**2**
1b. *Mature piñon few or absent*	**3**
2a. *Mature juniper few or absent* (Piñon Dominated)	**Group I**
2b. *Mature juniper (live or dead) well represented* (Piñon-Juniper Co-Dominant)	**Group II**
3a. *Mature juniper (live or dead) well represented* (Juniper-Dominated)	**Group III**
3b. *Mature juniper few or absent* (Successional Piñon and / or Juniper)	**Group IV**

INDIVIDUAL GROUP KEYS

GROUP I: PIÑON DOMINATED, WOODLAND OR SAVANNA

Canopy closure usually ≥25% (20 to 80+%); juniper, if present, mostly younger

A. *Old-growth trees present* ***Old-growth Piñon Dominated, Woodland or Savanna***

Individual old trees (≥5 trees / ha on average), live or dead, average diameter (of largest 3 trees) for piñon near base ≥30 cm*; AND with two or more of following old-growth characteristics: truncate crown formed by terminals with short, often gnarled, internodes; attached dead wood in canopy, often polished and with well developed lichen growth; basal trunks with exposed polished wood or well developed cavities; individual old tree(s) form the center of an established patch of mature and / or suppressed trees; large girth roots with exposed polished wood, and widely trailing on shallow substrates; stands with large diameter down-wood (comparable in girth to standing old trees), polished, bleached, and with well developed lichen growth; signs of historic woodcutting evidenced by large girth, axe-cut, limbs and trunks, with cuts covered by lichen growth; historic fire evidence, when present, suggestive of patchy crown fire (fire sculpted snags, burned out stumps, and down-wood from which the charcoal may have worn off) and / or surface fire with occasional scarring at grass and forest ecotones

B. *Old-growth trees absent* **Group IV**
Old trees generally absent, peripheral (in different topographic settings along margins of site under consideration) or present only as large diameter, remnant (sometimes burnt) snags, stumps, or down-wood (evidence of past disturbance)

GROUP II*:* PIÑON AND JUNIPER WOODLAND
Canopy closure usually ≥20% (15 to 60+%); mature piñon and juniper present

A. *Old-growth trees of both species present* ***Old-growth Piñon-Juniper Woodland***
Individual old trees (≥3 old trees / ha on average, piñon and / or juniper), live or dead, average diameter (of largest 3 trees) near base for piñon ≥30 cm* and / or juniper ≥25 cm* ; AND with two or more of following old-growth characteristics: truncate crown formed by terminals with short, often gnarled, internodes; attached dead wood in canopy, often polished and with well developed lichen growth; basal trunks with exposed polished wood or well developed cavities; individual old tree(s) form the center of an established patch of mature and / or suppressed trees; large girth roots with exposed polished wood, and widely trailing on shallow substrates; stands with large diameter down-wood (comparable in girth to standing old trees), polished, bleached, and with well developed lichen growth; signs of historic woodcutting evidenced by large girth, axe-cut, limbs and trunks, with cuts covered by lichen growth; historic fire evidence, when present, suggestive of patchy crown fire (fire sculpted snags, burned out stumps, and down-wood from which the charcoal may have worn off)

B. *Old-growth trees absent* **Group IV**
Old trees generally absent, peripheral (in different topographic settings along margins of site under consideration) or present only as large diameter, remnant (sometimes burnt) snags, stumps, or down-wood (evidence of past disturbance)

GROUP III: JUNIPER SAVANNA
Canopy closure usually ≤15% (5 to 30+%); piñon, if present, mostly younger

A. *Old-growth trees present* ***Old-growth Juniper Savanna***
Individual old trees (≥1 old tree / ha on average), live or dead, average diameter (of largest 3 trees) for juniper near base ≥25 cm*; AND with two or more of following old-growth characteristics: truncate crown formed by terminals with short, often gnarled, internodes; attached dead wood in canopy, often polished and with well developed lichen growth; basal trunks with exposed polished wood or well developed cavities; individual old tree(s) form the center of an established patch of mature and / or suppressed trees; large girth roots with exposed polished wood, and widely trailing on shallow substrates; stands with large diameter down-wood (comparable in girth to standing old trees), polished, bleached, and with well developed lichen growth; signs of historic woodcutting evidenced by large girth, axe-cut, limbs and trunks, with cuts covered by lichen growth; historic fire

evidence, when present, suggestive of surface fire (occasional scarring) with torching of individual trees (fire sculpted snags, burned out stumps, and down-wood from which the charcoal may have worn off)

B. *Old-growth trees absent* **Group IV**
Old trees generally absent, peripheral (in different topographic settings along margins of site under consideration) or present only as large diameter, remnant (sometimes burnt) snags, stumps, or down-wood (evidence of past disturbance)

GROUP IV: SUCCESSIONAL PIÑON / JUNIPER WOODLAND OR SAVANNA
Canopy closure ≥5%** (5 to 80+%); average diameter (of largest 3 living trees) near base for piñon ≤30 cm* and / or juniper ≤25 cm*

A. *Evidence of prior woodland community apparent* ***Recovering Woodland***

Sites with evidence of long-term woodland occupation, but subjected to prior disturbance, e.g., fire, drought, harvest, and / or insect / disease induced mortality and lacking extant old-growth. Evidence of disturbance to former old-growth woodland is based on remnant (e.g., fire, drought, insect, or disease killed, cut, chained, burned, or mechanically harvested) large girth, (piñon and / or juniper) snags, stumps, trunks, or down-wood (average diameter of 3 largest down-wood remnants of piñon ≥30 cm* and / or juniper ≥25 cm*); large diameter down-wood (piñon or juniper) is often bleached, polished, or decomposed, and with well developed lichen growth

B. *Lacking above evidence of prior woodland community* ***Expanding Woodland***

Sites without evidence of a prior woodland community and apparently expanding into non-woodland vegetation, usually onto deeper soils or productive settings capable of supporting robust understory growth, as indicated by presence of suppressed or remnant understory components typical of adjacent grass-land, shrub-land, and / or pine savanna communities. These expanding woodland sites may include scattered living or dead -standing or fallen- ponderosa pine and other non-woodland conifer tree species, but are lacking large diameter (piñon and / or juniper) snags, stumps, or down-wood

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* diameter thresholds for Pinus edulis and Juniperus monosperma in upland settings with moderate soil depth (i.e., 15 to 35-cm deep) in north-central New Mexico; (add 2 to 5 cm for mesic, depositional soil sites (i.e., >35 cm deep) and subtract 2 to 5 cm for dry sites with shallow, skeletal soils (i.e., <15 cm deep) with exposed bedrock). For single stem trunks, measure diameter just above base (ca. 30 cm or core height), and for multi-branched trees (e.g., one-seed juniper), measure diameter of largest stem just above junction

**minimum tree canopy cover ≥5% to be considered here as a piñon-juniper type

Table 3.2. Number of samples across landform (LANDFORM) strata and depositional environment (FLOW), and by stand age (pre- versus post-settlement stand age) for full (n = 210), training (n = 146), and test (n = 64) datasets within a north-central New Mexico study area. Relative percent of “young” versus “old” samples in each dataset, and of total samples in the split training and test datasets are noted. See *Development of GIS Datasets for Modeling* in Methods section for additional explanation of LANDFORM and FLOW parameters.

Dataset	**Stand age**		**LANDFORM (#)**			**FLOW**	
sample size (%)		**Valley (1)**	**Mesa (2)**	**Terrace (3)**	**Slope (4)**	**0 (Losing)**	**1 (Gaining)**
Full			Number of samples			Number of samples	
64 (30.5)	**Young**	7	23	30	4	30	34
146 (69.5)	**Old**	2	67	25	52	137	9
N = *210*	Sub-totals	9	90	55	56	167	43
Training							
45 (30.8)	**Young**	6	17	19	3	22	23
101 (69.2)	**Old**	1	45	18	37	94	7
N = *146* (69.5)	Sub-totals	7	62	37	40	116	30
Test							
19 (29.7)	**Young**	1	6	11	1	8	11
45 (70.3)	**Old**	1	22	7	15	43	2
N = *64* (30.5)	Sub-totals	2	28	18	16	51	13

Table 3.3. Leave-one-out (LOO), cross-validated probability (XP), classification results ("old" = event) for the full dataset model, $n = 210$, (with results itemized by class level for variable LANDFORM) using four explanatory parameters (EWP, FLOW, LANDFORM, DEM) and a probability prediction threshold (prob. cutoff) of 0.45. I report a LOO XP receiver operator characteristic (ROC), area under curve (AUC) value (LOO XP ROC AUC) for the full model of $c = 0.932$. Comparable results were obtained for the split, training ($n = 146$) and test ($n = 64$) dataset, with a 0.60 prob. cutoff. The test data were scored using the model fit independently with the training dataset. I report LOO XP ROC AUC values for the training data of $c = 0.938$, and scored test data of $c = 0.913$. Prior probabilities for the full and training models reflect the sampled ratios of "old" to "young" in each dataset (see Table 3.2).

Model (prob. cutoff) *ROC c = value*	Sample size (*n*)	**Observed**		**Correct**		**Incorrect**			**Percentages**			
		Old	**Young**	**Old**	**Young**	**Old**	**Young**	**Total**	**Sensitivity (Old)**	**Specificity (Young)**	**False positive**	**False negative**
Full (0.45) *c* = ***0.932***	**210**	**146**	**64**	**136**	**52**	**12**	**10**	**89.5**	**93.2**	**81.3**	**8.1**	**16.1**
LANDFORM1 (Valley)	9	2	7	1	6	1	1	77.8	50.0	85.7	50.0	14.3
LANDFORM2 (Mesa)	90	67	23	62	18	5	5	88.9	92.5	78.3	7.5	21.7
LANDFORM3 (Terrace)	55	25	30	21	27	3	4	87.3	84.0	90.0	12.5	12.9
LANDFORM4 (Slope)	56	52	4	52	1	3	0	94.6	100.0	25.0	5.5	0.0
Training (0.60) *c* = 0.938	146	101	45	92	38	7	9	89.0	91.1	84.4	7.1	19.1
Test (0.60) *c* = ***0.913***	**64**	**45**	**19**	**42**	**16**	**3**	**3**	**90.6**	**93.3**	**84.2**	**6.7**	**15.8**

Figures

Figure 3.1. Generalized distribution of Colorado Plateau and southern Rocky Mountain piñon-juniper savanna and woodland types within the Four Corners states: piñon-juniper covers ca. 14.5 million ha or ~13% of the total land area (modified from data provided by SWReGAP). Three National Park Service units (Bandelier National Monument, Mesa Verde National Park, and Colorado National Monument) were sampled intensively to inform selection of qualitative criteria and development of the diagnostic key, and to provide data for exploratory modeling. Extensive sampling and modeling efforts were conducted within the north-central New Mexico study area where SWReGAP-mapped piñon-juniper represents southern Rocky Mountain (PIED-JUMO-JUSC) savanna and woodland types. *Pinus edulis* = PIED; *Juniperus monosperma* = JUMO; *Juniperus scopulorum* = JUSC; *Juniperus osteosperma* = JUOS

Figure 3.2. Index of growing season moisture (MONSOON) is calculated as the June-September percent of mean annual precipitation (MAP) across the Four Corners states. I highlight the casual association of one-seed (JUMO) and Utah (JUOS) juniper ranges (Little, 1971) with MONSOON. Extensive sampling (and predictive modeling and mapping efforts) were conducted within (and for) the north-central New Mexico study area where one-seed juniper woodlands (as delineated by Little, 1971) occur primarily within areas receiving half or more of MAP during the (June-September) growing season (MONSOON $\geq$ 50%); the range of Colorado piñon (not shown) within the north-central New Mexico study area coincides with the mapped distribution for one-seed juniper (Little, 1971). *Pinus edulis* = PIED; *Juniperus monosperma* = JUMO; *Juniperus osteosperma* = JUOS

Figure 3.3a. Predictive map of "old" versus "young" (percent probability "old") piñon-juniper stands within the 2.9 million-ha north-central New Mexico study area. Figure 3.3b is a close-up of the Tsankawi Unit (see inset), a disjunct part of Bandelier National Monument

Figure 3.3b. Predictive map of "old" versus "young" (percent probability "old") piñon-juniper stands within the (336 ha) Tsankawi Unit, Bandelier National Monument, New Mexico. Green with scattered tree overlay -delineated using high resolution soil coverage- highlights inferred areas of historically thickened savanna structure in marginal depositional settings, and indicates where mechanical thinning of the younger tree component might be considered an appropriate restoration treatment. Light gray denotes areas mapped as non-woodland vegetation. Map resolution of predicted pre- versus post-settlement woodland cover is 30 m, but an appropriate scale (e.g., minimum map unit) for field application in this location would be ~1 ha

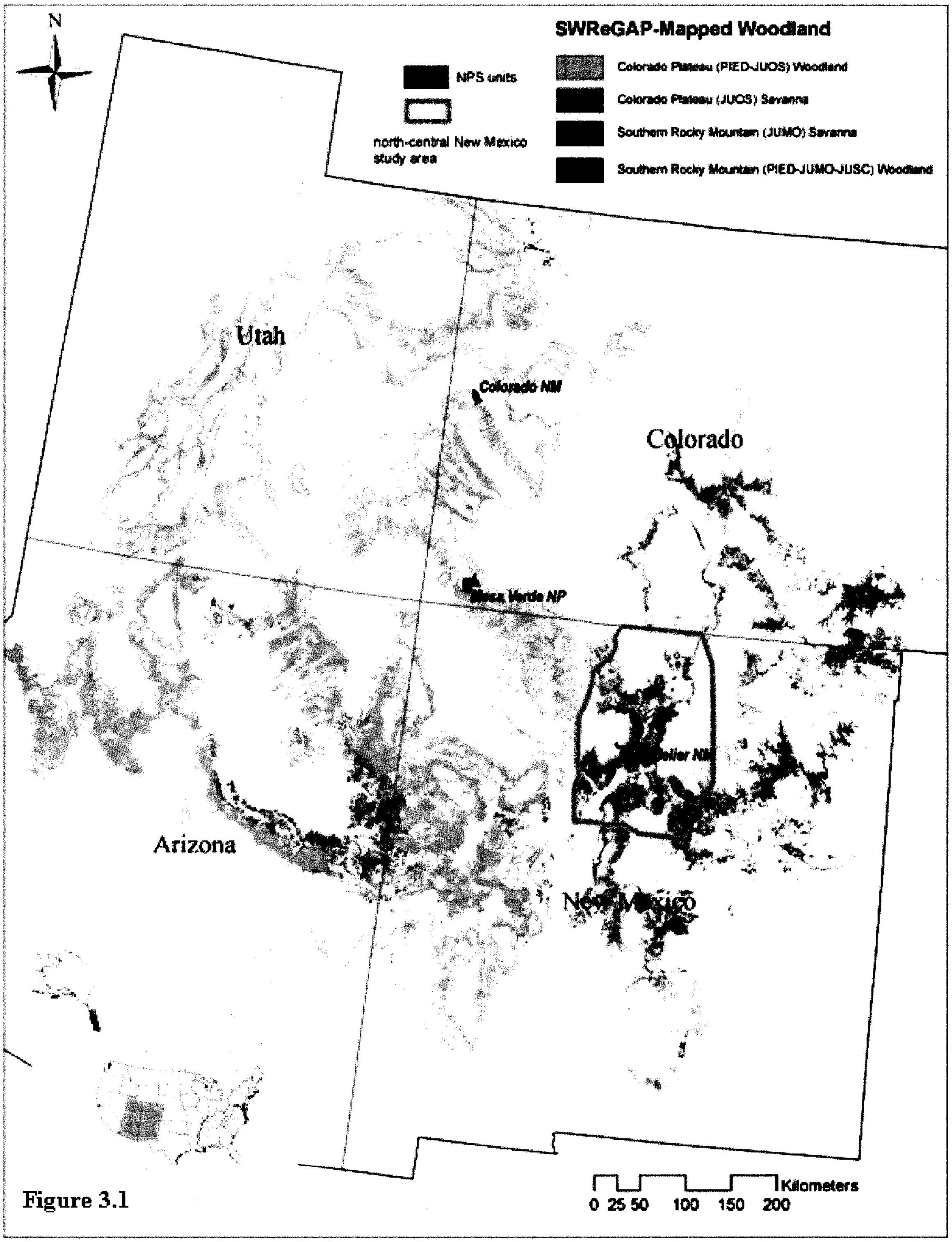
N
SWReGAP-Mapped Woodland
NPS units
north-central New Mexico study area
Colorado Plateau (PIED-JUOS) Woodland
Colorado Plateau (JUOS) Savanna
Southern Rocky Mountain (JUMO) Savanna
Southern Rocky Mountain (PIED-JUMO-JUSC) Woodland
Utah
Colorado NM
Colorado
Mesa Verde NP
elier NM
Arizona
New Mexico
Kilometers
0 25 50 100 150 200

Figure 3.1

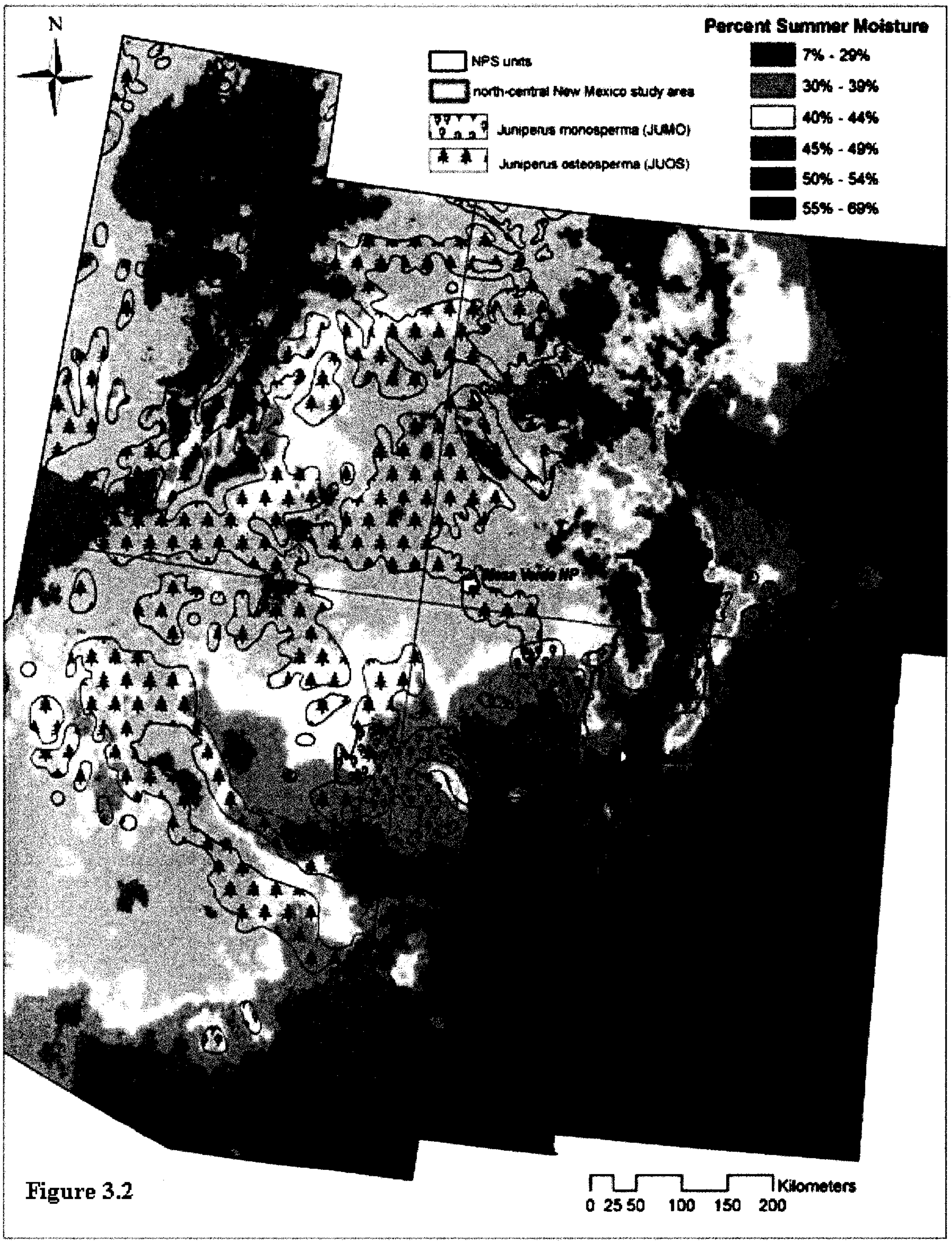
N
NPS units
north-central New Mexico study area
Juniperus monosperma (JUMO)
Juniperus osteosperma (JUOS)
Percent Summer Moisture
7% - 29%
30% - 39%
40% - 44%
45% - 49%
50% - 54%
55% - 69%
Mesa Verde NP
0 25 50 100 150 200
Kilometers

Figure 3.2

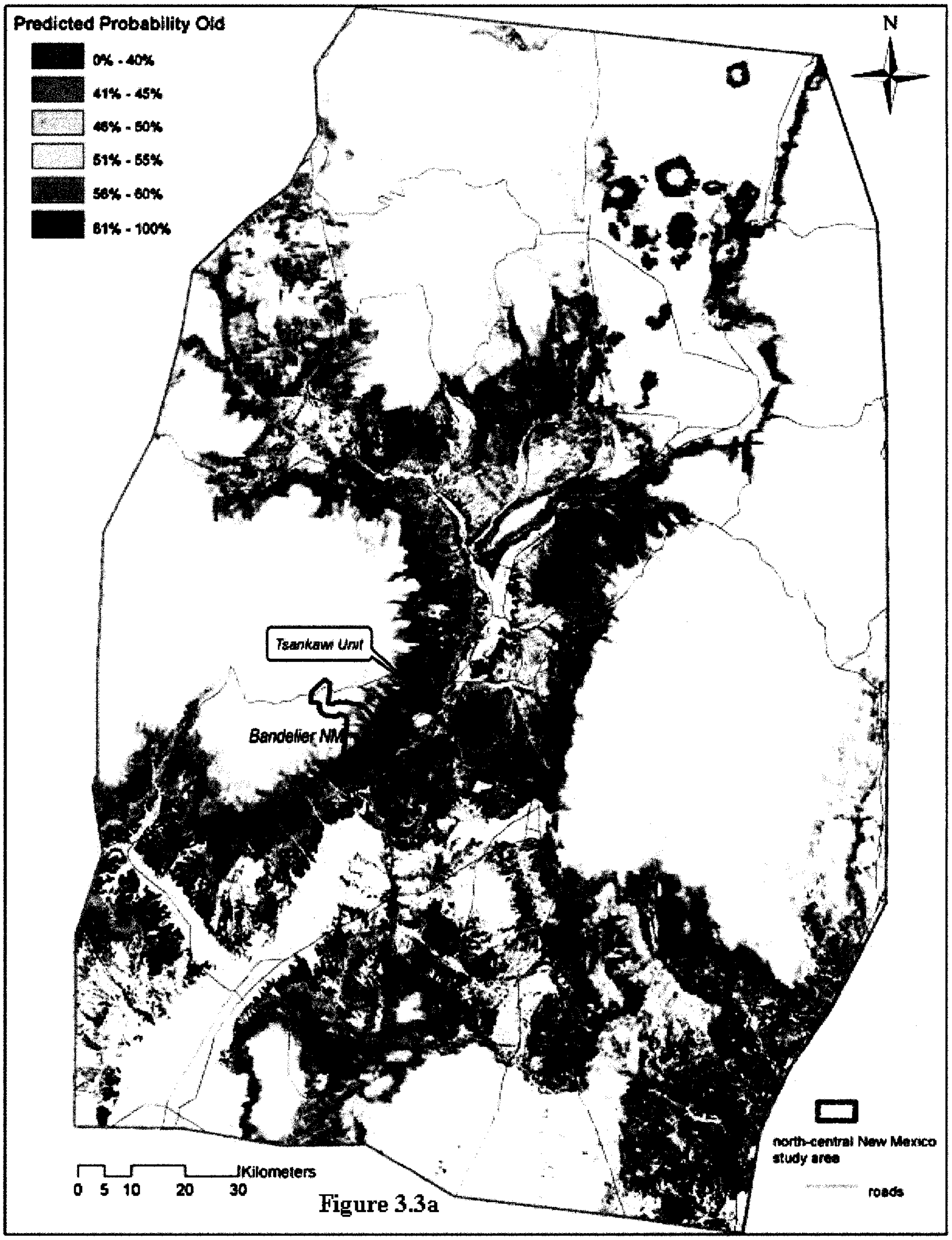
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
Tsankaw Unit
Bandelier NM
Kilometers
0 5 10 20 30
north-central New Mexico study area
roads

Figure 3.3a

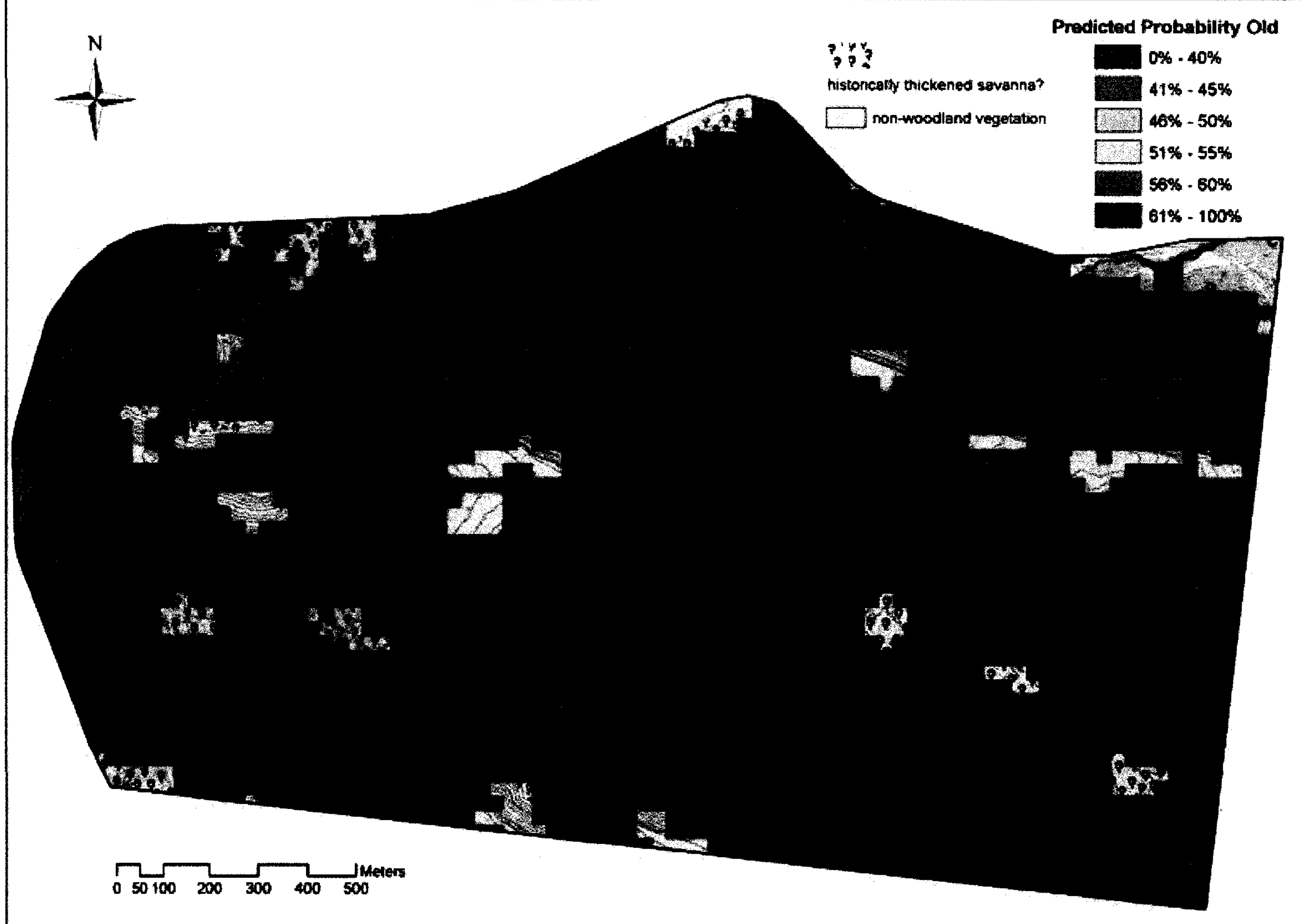
N
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
historically thickened savanna?
non-woodland vegetation
0 50 100 200 300 400 500
Meters

Figure 3.3b

Appendices

Appendix 3.1. A table presenting stand level data for fifteen intensive plots sampled within Bandelier National Monument, New Mexico, USA. This table represents an excel spreadsheet with embedded formula which assign a woodland type and pre- vs. post-settlement stand age by applying the diagnostic key criteria to stand level data.

Appendix 3.1

SITE	p1	ring_p1	p2	ring_p2	p3	ring_p3	pinyon-3	R_Age-P	Ring_P-3	OGC-P	j1	ring_j1	j2	ring_j2	j3	ring_j3	juniper-3	R_Age-J	Ring_J-3	OGC_J
Conservative pre-settlement thresholds:							*30.0*	*165.8*									*25.0*	*167.3*		
BAND1	39.5	210.0	28.5	210.0	28.0	174.0	32.0	176.8	198.0	y	48.0		28.5		23.0		31.8	212.7		y
BAND2	27.5	162.0	27.5	154.0	28.0	168.0	27.7	153.0	161.3	n	30.0		27.0		23.5		26.8	179.5		y
BAND3	39.0	185.0	40.0	180.0	42.5	210.0	40.5	223.5	191.7	y	45.0		22.5		20.5		29.3	196.1		y
BAND4	38.5	173.0	37.5	196.0	34.0	160.0	36.7	202.5	176.3	y	54.0		28.5		28.0		36.8	246.0		y
BAND5	35.5	220.0	32.0	210.0	32.0	220.0	33.2	183.2	216.7	y	30.0		22.0		19.0		23.7	158.4		y
BAND6	38.0	150.0	30.0	180.0	36.0	160.0	34.7	191.5	163.3	y	38.0		35.0		32.0		35.0	233.8		y
BAND7	27.5	154.0	28.0	168.0	44.5	153.0	33.3	184.2	158.3	y	29.5	201.0	35.0	169.0	38.5	241.0	34.3	229.3	203.7	y
BAND8	35.0	200.0	33.0	174.0	30.5	157.0	32.8	181.4	177.0	y	29.0	240.0	29.0	173.0	32.0	242.0	30.0	200.5	218.3	y
BAND9	37.0	207.0	32.0	202.0	32.0	200.0	33.7	186.0	203.0	y	27.0	145.0	25.0	184.0	23.0	153.0	25.0	167.3	160.7	n
BAND10	28.0	185.0	22.0	113.0	18.0	68.0	22.7	125.5	122.0	n	31.0	223.0	29.0	125.0	25.0		28.3	189.4	174.0	y
BAND11	35.0	164.0	31.5	135.0	29.0	142.0	31.8	175.9	147.0	y	33.0	167.0	27.5	213.0	25.0	124.0	28.5	190.5	168.0	y
BAND12	30.0	164.0	27.0	111.0	26.0	175.0	27.7	153.0	150.0	n	29.0	157.0	27.0	156.0	25.0	104.0	27.0	180.6	139.0	n
BAND13	25.0	41.0	12.0	42.0	9.0	52.0	15.3	85.3	45.0	n	25.0	86.0	25.0	90.0	24.0	89.0	24.7	165.1	88.3	n
BAND14	23.0	77.0	20.5	77.0	18.5	76.0	20.7	114.6	76.7	n	23.0	91.0	23.0	93.0	24.5	125.0	23.5	157.3	103.0	n
BAND15	35.0	107.0	19.0	83.0	24.0	78.0	26.0	143.9	89.3	n	39.0	161.0	38.0	108.0	33.0	133.0	36.7	244.9	134.0	y

DATA HEADER NOTES

p1, p2, p3= 3 largest sampled pinon
ring_p1, 2, 3=ring-count age of p1, p2, p3
pinon-3=average diameter largest three sampled pinon
Ring_P-3=actual average ring count of three largest diameter pinon
R_Age-P=regression age pinon-3

j1, j2, j3= 3 largest sampled juniper stems
ring_j1, 2, 3=ring-count age of j1, p2, p3
juniper-3=average diameter largest three sampled juniper stems
Ring_J-3=actual average ring count of three largest diameter juniper stems
R_Age-J=regression age juniper-3

OGC-J=old growth characteristics juniper
OGC-P=old growth characteristics pinyon

Fire=historic fire evidence
Debris=large woody debris
Harvest=historic cutting evidence

Diameter-Age Regressions

Colorado Piñon Age = 5.49 * Diameter (n=204) p<.0001
One-seed juniper Age = 6.85 * Diameter (n=398) p<.0001

Note: r-squared values cannot be used to evaluate performance of no-intercept models

APPENDIX (sheet 1 of 2)

excel spreadsheet with embedded formulas

Appendix 3.1 (continued)

SITE	HARVEST	FIRE	DEBRIS	STATUS-P	STATUS-J	STATUS	PERSIST	KEY	TYPE
BAND1	N	N	Y	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND2	N	N	Y	POST	PRE	PRE	PRE	6a	Old Growth Juniper Woodland Savanna
BAND3	Y	Y	N	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND4	Y	N	Y	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND5	N	N	N	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND6	N	Y	N	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND7	N	N	Y	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND8	Y	Y	N	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND9	N	N	Y	PRE	POST	PRE	PRE	4a	Old Growth Piñon Dominated Woodland
BAND10	N	N	N	POST	PRE	PRE	PRE	6a	Old Growth Juniper Woodland Savanna
BAND11	N	N	N	PRE	PRE	PRE	PRE	5a	Old Growth Piñon-Juniper Woodland
BAND12	**N**	**N**	**N**	**POST**	**POST**	**POST**	**POST**	**7b**	**Expanding Woodland Types**
BAND13	N	N	N	POST	POST	POST	POST	7b	Expanding Woodland Types
BAND14	N	N	N	POST	POST	POST	POST	7b	Expanding Woodland Types
BAND15	**N**	**N**	**N**	**POST**	**PRE**	**PRE**	**PRE**	**6a**	**Old Growth Juniper Woodland Savanna**

Classification Header Notes
Status-P=pre- vs. post-settlement status based on age and OGC-P
Status-J=pre- vs. post-settlement status based on age and OGC-J
Status=pre- vs. post-settlement stand status based on older of Status-P or Status-J components
Persist=updates stand status on basis of fire or historic harvest disturbance evidence
Key=number/letter of assigned PJ type in diagnostic key
Type=PJ type name in diagnostic key

Classification Results
13 of 15 plots were corrected classifed
(BAND12 was misclassified as POST 'young')
(BAND15 was misclassifed as PRE 'old')

Note: see text for additional discussion of classification results

APPENDIX (sheet 2 of 2)

excel spreadsheet with embedded formulas

Chapter IV

Regional scale modeling of southwestern U.S. piñon-juniper woodlands: predictive mapping of “old” versus “young” stands in the Four-Corner states

Abstract

Differing interpretations of post-Euro-American settlement dynamics in southwestern U.S piñon-juniper woodlands have generated considerable controversy, particularly in regards to the appropriateness of management efforts intended to improve watershed, wildlife, and range conditions, or mitigate impending wildfire hazards. I employ a modeling approach to inform this debate, by associating (pre- versus post-settlement) piñon-juniper stand-age with topographic, edaphic, and climatic factors relevant to woodland occurrence. Predictive modeling and mapping of "old" versus "young" piñon-juniper stand-age was conducted in southwestern U.S woodlands characterized by *Pinus edulis* and three associated junipers (*Juniperus osteosperma, J. monosperma, J. scopulorum*) within the Four Corners states (i.e., Arizona, Colorado, New Mexico, and Utah). Extensive samples collected across the four state region provided inputs for spatial modeling with each field point assigned an "old" versus "young" stand-age using a diagnostic field key previously developed (Table 3.1, Chapter 3). Sample points were associated with a suite of relevant topographic, edaphic, and climatic variables within a GIS, and the compiled regional dataset was used for model development. Selected models were implemented within a GIS and probabilities of "old" (versus "young") stands calculated for extant, Southern Rocky Mountain (SRM) and Colorado Plateau (CP), woodland communities recently mapped by the Southwest Regional Gap Analysis Project (SWReGAP). Map products depict color coded probabilities of stand-age and provide a visual means for assessing the relative magnitude and extent of woodland

expansion patterns across the Four Corners states. Models and map realizations developed using piece-wise linear regression procedures and the regional dataset were generally consistent with the results of previous modeling efforts using logistic regression and a more localized dataset (Chapter 3), when compared within the same north-central New Mexico extent. The regional models continue to predict a prevalence of "young", post-settlement expansion stands in productive, depositional settings, but also highlight an apparent relationship of expansion stands with summer seasonal (i.e. monsoonal) moisture patterns and the range of one-seed juniper. Modeling at more heterogeneous regional scales, with a greater variety of woodland types, and topographic, edaphic, and climatic settings, required the use of non-parametric procedures and more complicated, somewhat less interpretable, models in order to obtain acceptable levels of predictive accuracy. My model and map products can inform an understanding of woodland system dynamics by highlighting potential environmental controls of historic expansion (versus old or persistent) stands, while focusing management efforts on appropriate sites where treatments are most likely to achieve desired objectives.

Introduction

Southwestern US piñon-juniper woodlands are poorly understood and often under-appreciated ecological systems which present significant challenges to both researchers and managers (Gottfried et. al., 1995; Tausch, 1999). Colorado piñon pine (*Pinus edulis*) and several associated species of non-sprouting juniper (One-seed, *Juniperus* *monosperma*; Utah, *J. osteosperma*, and Rocky Mountain, *J. scopulorum*) are broadly distributed across the Four Corners states (i.e., Arizona, Colorado, New Mexico, and Utah) of the American southwest. The distributions of individual piñon and juniper species were mapped by Little (1971) and community level coverage of woodland types in the Four Corners states was developed by the Southwest Regional Gap Analysis Project (SWReGAP; Comer et. al., 2003, 2004; Lowry et. al., 2005). Differing interpretations of post-Euro-American settlement dynamics in these woodlands, particularly in the aftermath of widespread and sometimes indiscriminate type conversion of woodlands for forage production during the last century, has sparked considerable controversy and sometimes limited even appropriate management efforts designed to improve watershed, wildlife, and range conditions, or mitigate impending wildfire hazards. Old growth stands now embedded within homogenized woodland landscapes composed mostly of "younger" post-settlement stands are increasingly vulnerable to both crown fire and indiscriminate "restoration" (Romme et. al., 2003). A more complete discussion of woodland distribution, ecology, and disturbance dynamics within southwestern U.S. is provided in Chapters 2 and 3. Here I employ a modeling approach to characterize the relationship of woodland stand age with environmental setting by associating (pre- versus post-settlement) piñon-juniper stand-age with topographic, edaphic, and climatic factors considered relevant to woodland occurrence. Selected models can be used to generate predictive maps of presumed stand-age (i.e. young versus old) based on these relationships. The model and map products can increase an understanding of woodland systems by highlighting potential environmental controls of historic expansion stand dynamics while focusing management efforts on appropriate sites where treatments are most likely to achieve desired objectives.

Increasing application of geospatial analysis, including predictive modeling techniques, to address ecological questions has been facilitated by enhancement of PC based (statistical and GIS) software, and availability of high resolution spatial datasets, allowing even field oriented biologists with little prior modeling experience to utilize these powerful tools (Franklin, 1995; Guisan and Zimmermann, 2000). However the complex interactions of (biotic and physical) process and structure, across different spatial and temporal scales, may not always be amenable to standard linear (i.e. parametric) models (Wagner and Fortin, 2005). This chapter represents an extension of earlier modeling efforts (Chapter 3) where I employed logistic regression procedures and which were conducted within a more localized and homogeneous north-central New Mexico extent. For regional scale efforts I elected to use a piece-wise linear (i.e. non-parametric) approach, Multivariate Adaptive Regression Splines (MARS) developed by Friedman (1991), to predictively model relationships between environmental factors and distribution of "old" (i.e., pre-settlement) woodlands versus "younger" stands of more recent (i.e., post-settlement origin) in a large and diverse regional study area defined by the range of *Pinus edulis* and associated juniper species within the Four Corners states of the southwestern U.S. Predictive models were developed using a regional database where sampled stands are assigned a pre- versus post-settlement age using a diagnostic key previously developed (Table 3.1, Chapter 3) and associated with a suite of environmental parameters within a GIS. Map realizations of selected models present the predicted probability of “old” woodland using the SWReGAP woodland coverage as an analysis mask.

Several authors note that a sound ecological understanding of the system being modeled is as critical to credible model outputs as the particular statistical approach employed (Austin et. al., 2000; Wagner and Fortin, 2005), however, there are often real limitations to traditional parametric techniques in modeling natural systems across large spatial extents where threshold effects are likely. The logistic regression method previously used for modeling within a north-central New Mexico extent in Chapter 3 was easily implemented, parameters were interpretable ecologically, and predictive accuracy was high even with a relatively small training dataset. However, logistic procedures and global models could be expected to have less utility at larger regional extents where there is greater range and variability in environmental controls and even changes in the dominant woodland tree species. One approach would be to model a series of smaller, homogenous extents defined by woodland type and/ or ranges of important environmental parameters. For example, model extents could be constrained by the range of Southern Rocky Mountain (SRM) versus Colorado Plateau (CP) woodlands (as mapped by SWReGAP, or limited to areas having summer (versus winter) dominated moisture patterns. However, there are only a limited number of discrete extents which could be defined in this way, and while these may increase accuracy (by reducing variability) they can also limit the scope and applications of the resulting models. In addition, there will likely always be additional confounding (known and measured, or unknown and/ or unmeasured) factors present within these smaller extents. In addition, interactions between explanatory variables may exhibit threshold or non-linear relationships and these effects may occur at any spatial scale. Given my previous experience with logistic modeling within the north-central New Mexico extent, and the apparent relationship of seasonal precipitation patterns to the ranges of one-seed and Utah juniper, I anticipated that global parametric modeling approaches would be insufficient to adequately model woodland patterns at regional scales. However the logistic approach is a still a useful starting point even for regional scale modeling because it can provide a useful baseline for subsequent modeling efforts as well as highlighting potentially important predictor variables. After a review of non-parametric modeling options, I elected to employ a piece-wise linear regression approach (i.e., MARS) that could accommodate local or asymmetric relationships among and between predictor and response variables (Muñoz, and Felicísimo, 2004). In particular, Leatherwick et al (2005) report that since MARS allows interactions between variables to be fit locally within specified sub-ranges of the variables, this method can effectively capture complex, non-linear patterns while preserving model interpretability. Finally MARS model outputs can be easily implemented within a GIS for map realization.

Methods

I follow general methods detailed in Chapter 3 and only highlight notable additions or changes to those procedures. In particular, given the large geographic extent of my study area, extensive sampling was necessarily more dispersed and sampling was predominantly conducted along public right-of-ways across a variety of public and private, state, federal, and tribal ownerships. In addition, at selected locations (where accessibility was constrained by either landownership or slope position) I had to evaluate stands remotely, assigning stand-age and topographic setting to projected geographic points where I was confident of both stand-age status and could readily identify the associated landform. I calibrated my diagnostic key (Table 3.1, Chapter 3) for use in different climatic zones, primarily by adjusting estimates for pre- versus post-settlement aged tree diameter thresholds on the basis of regional core data from piñon (Appendix A); some qualitative criteria such as lichen growth on dead wood were not reliable old growth indicators in strongly monsoonal areas. Additional potential environmental predictors were identified, developed and / or evaluated, while others previously used were modified or dropped. I also added variables for which I had only coarse scale coverage not suitable for modeling within smaller extents. Perhaps the most significant change in my regional scale efforts was the use of a non-parametric modeling technique which allowed for inclusion of more local and non-linear effects. In addition I elected to use the entire regional dataset for model development, using leave-one-out (n-1) cross-validation (LOOCV), since my previous experience (Chapter 3) suggested LOOCV evaluation procedures can provide results comparable to the traditional split training / test dataset approach and allows all sample points to inform the final model. The outputs from the non-parametric model were subsequently refit using a logistic procedure and implemented within a GIS to realize map products as before.

To support modeling efforts I developed a regional dataset with 1129 observations (Appendix C) representing individual woodland stands (represented by *Pinus edulis* and three associated junipers (*Juniperus osteosperma, J. monosperma, J. scopulorum*) and mapped by SWReGAP as Southern Rocky Mountain (SRM) and Colorado Plateau (CP) savanna and woodland types) from across the Four Corners States (Figure 4.1) and assigned an "old" or "young" stand-age using the diagnostic key criteria. The distribution of "old" vs. "young" stands relative to potentially important environmental factors such as landform, depositional setting, and soil-geologic substrate are provided in Tables 4.1a,b. Intensive plot samples from three National Park Service units and extensive samples collected previously for modeling within the north-central New Mexico extent are included in the regional dataset.

The compiled regional dataset (Appendix C) samples a geographic extent encompassing the range of *Pinus edulis* within the Four Corners states (Figure 4.1) and includes the extensive dataset (n=210) developed for the north-central New Mexico study area. Fieldwork was conducted over the course of four field seasons from 2004 to 2007, but the majority of extensive samples for regional modeling were collected during the final two field seasons (2006-2007). Fieldwork during the initial two seasons (2004-2005) emphasized collection of intensive samples from woodlands within three southwestern U.S. national park units (Colorado National Monument, Mesa Verde National Park, and Bandelier National Monument) along a presumed seasonal moisture gradient. These intensive data were used to facilitate development of a diagnostic key for assignment of pre- versus post-settlement stand-ages to extensive regional sample points collected subsequently. My use of the diagnostic key and qualitative criteria was calibrated for different climatic regions primarily through collection and dating of piñon tree cores from selected intensive and extensive sample locations. While the regional core data (Appendix A) were too limited to support development of diameter to age regressions for any specific locale, they were adequate to inform calibration of my diagnostic key at a sub-regional scale. For example, cores from the strongly monsoonal Lincoln County, NM area suggested extremely rapid rates of tree growth, while trees sampled in winter moisture dominated areas of northwestern CO, central AZ, and southeastern UT often displayed relatively slow growth. The effects of depositional environment on apparent tree age were most pronounced in areas with median monsoonal patterns such as north-central NM. In bimodal and winter moisture areas depositional environments increasingly supported non-woodland (shrub and grass dominated) vegetation across abrupt ecotonal boundaries at lower elevations; however depositional settings in winter moisture areas can also support old growth woodland in some higher elevation, mesic settings.

General procedures for development of the explanatory variable spatial coverage are detailed in Chapter 3 and I discuss only notable differences in methods used for modeling at the regional extent. For regional scale modeling I developed a potential set of 25 explanatory variables for which I was able to procure or develop suitable spatial datasets. I used higher resolution PRISM climate data (400m grid resolution) which recently became available for modeling the regional extent, as compared with the 2-km grid resolution PRISM climate data originally used for the north-central New Mexico study area in Chapter 3. In addition, a geologic-soils substrate coverage (SWSUBS) compiled from NRCS data by SWReGAP which was too coarse for use with the north-central New Mexico extent was found to be a useful explanatory variable at larger regional scales. I continued to use HILLSHADE (an index of slope-aspect relative to a fixed sun position) as a proxy for solar radiation in my current modeling efforts, although the most recent version of ArcGIS 9.2 (ESRI, 2005) now includes a utility for calculating insolation. However, I found development of an insolation dataset for the regional extent to be too computationally and time intensive, although it would be potentially useful to evaluate the statistical relationship of HILLSHADE to solar radiation. I added metrics of aspect, (ASPECT), curvature (CURVATURE) and plan profile (PRO_FILE) to the potential suite of predictors, including a categorical version of profile (PROFILE) where 1 = concave profiles with values <0, and 0 = convex profiles with values ≥0. ASPECT was a categorical metric (with 9 classes) condensed from a continuous (0 to 360 degree) aspect coverage. I also developed and evaluated various metrics of surface roughness or topographic breaks (calculated as the standard deviation and / or maximum range of elevation, slope, and/ or aspect values within the surrounding eight cell neighborhood) to be used a proxy for fine fuel continuity and fire propagation potential and therefore delineate fire safe sites. However, relatively poor performance of the surface roughness metrics during model selection (i.e. in their ability to explain a significant portion of variance) led me to drop these parameters during the evaluation stage. To facilitate computational development of spatial coverage (and subsequent spatial analysis) within A GIS, the Four Corners state (regional) extent was functionally broken down into ten sub-extents as defined by the base DEM 30-m resolution digital elevation data (each sub-extent spans two degrees of latitude and six degrees longitude). For calculation of HILLSHADE I used the center point of each DEM area to estimate solar parameters, and the summer or winter solstice (@ 1300 hours) to represent HILLSHADE $_{(\text{maximum})}$ and HILLSHADE $_{(\text{minimum}),}$ respectively.

Inherent positional error associated with GIS coverage and GPS locations required some post-processing of sample points. Prior to modeling, I verified that landform (FORM) and depositional environment (FLOW) coverage associated with each sample's GPS location corresponded to what had been observed in the field. To account for positional discrepancy an individual sample point was moved into the appropriate landform and/ or flow settings when it was immediately adjacent (i.e. <100m linear distance) to the recorded GPS location. Stand-age assignments made in the field were subsequently reviewed for consistent application of diagnostic criteria on basis of field data, associated notes, and photos. Values from each of the 25 data layers were extracted with the sample utility in ArcGIS 9.1 (ESRI, 2005) using the coordinates of 1129 sample points and subsequently exported to a excel spreadsheet.

A standard logistic program (SAS, 2005) was initially used to model the regional dataset using the same basic approach as detailed in Chapter 3 and a comparable set of potential predictor variables. Logistic modeling and development of a global parametric model provided useful benchmarks for both predictive model accuracy and relative importance of explanatory variables at regional extents. Subsequently I employed a local, non-parametric approach to develop a regional model using a piece-wise linear regression procedure (i.e., MARS). I used the version of MARS developed and licensed by Salford Systems, San Diego, CA. When modeling a binomial response, MARS outputs need to be refit using a generalized linear model in order to constrain the range of values to those appropriate for a binomial response (Friedman, 1991); MARS outputs were refit using the SAS 9.1 (SAS, 2005) logistic procedure to impose a 0 to 1 probability range.

In order to gain confidence and expertise with the piece-wise linear approach and MARS software, I initially developed MARS models within the north-central New Mexico extent using the same dataset developed for logistic modeling in Chapter 3. My earlier logistic modeling efforts provided a sound foundation for understanding how MARS handled the same data and whether MARS outputs were equivalent or superior at detecting and predicting relevant landscape patterns with the available data. An untransformed MARS model is nearly equivalent to a linear model since each predictor can have only a single (global) slope. Allowing transformation of variables effectively enables MARS to partition individual variables into two or more segments or base functions (encompassing a discrete range of values for that variable), and assign each a different (local) slope. With the addition of interactions between and among variables (and variable segments or base functions) MARS can essentially model local effects between discrete ranges of one or more variables. This is a very powerful and intuitive approach to modeling ecological systems where non-linear and threshold interactions between important environment factors are likely the norm and one could expect a flexible non-parametric model to be somewhat better at capturing these underlying complexities. Leatherwick et al (2005; 2006) provide an excellent overview of the piece-wise linear modeling approach including a tangible regional scale application of MARS using an R-code version of the software. The creation of base functions by MARS extends the development of potential explanatory metrics by partitioning out local effects and interactions while a subsequent pruning phase allows the final model to retain only the most important base function predictors.

Within MARS one can set various modeling parameters including: pool of available predictors (and whether continuous or categorical in nature), allowance for transformation of variables, permitting interactions between variables (and setting maximum levels), specification of allowable numbers of base functions, minimum number of observations between knots, speed and accuracy of modeling, and degrees of freedom charged per base function. In my modeling efforts I started with default program settings and those most comparable to a general linear model, then successively altered one or model parameters to assess its effect on the model building process. I initially built simple models directly comparable to logistic models using the smaller dataset from the north-central New Mexico extent and then progressed to more complex models by first allowing transformations and then successively higher orders of interaction. Allowing higher levels of interaction required increasingly higher numbers of base functions, although final model selection involves a pruning process (best-models option) or the modeler can also manually select a lower performance model from a full range of model outputs (all-models option). I generally used the all-models option and selected models that combined the lowest number of base functions with the highest performance; this selection was facilitated by a line graph plotting number of base functions by model performance which highlighted the relative cost-benefit relationship.

Within SAS, MARS base functions are calculated from the raw predictor variables using the code output from the MARS modeling run and the logistic procedure implements the MARS model. In addition to having the individual probabilities adjusted for a binary response, the SAS logistic procedure also allows for the easy computation of leave-one-out, cross-validated (LOOCV) individual probabilities, and cross-validated area-under-the-curve (AUC) receiver operator characteristics (ROC) values for robust evaluation of model performance as described in Chapter 3.

MARS model outputs were refit using the logistic procedure in SAS 9.1 (SAS, 2005) which provided options for generating a range of model diagnostics including classification tables, and supports calculation of LOOCV individual probabilities and AUC ROC values for robust model evaluation. Given my prior experience (Chapter 3) showing comparable model performance based on LOOCV probabilities and LOO AUC ROC values for the full versus a split training / test dataset, I elected to use the entire regional dataset (minus one point at a time) using the LOOCV approach to conduct and evaluate my regional modeling efforts. Logistic model parameter outputs (intercept and partial slopes for each basis function) were then used to implement the MARS model within ArcGIS 9.1 (ESRI, 2005) using the raster calculator utility. When implementing a MARS model in a GIS, a new raster corresponding to each basis function needs to be calculated; since some basis functions may represent second or third order interactions of explanatory variables and there is no requirement that all of interacting variables be retained as primary effects in the final model, the number of new rasters which need to be generated can exceed the number of basis functions. Degrees of freedom (*df*) reported for MARS models refit using the logistic procedure are equivalent to the number of base functions included in the final model; the number of explanatory variables used (not including classes of categorical variables) is typically the same or fewer. Models with higher order interactions generally have a number of component base functions (i.e., which contributed to the development of the retained base functions) excluded from the final model. Computationally, implementation of complex MARS models within a GIS can be very intensive using a standard windows based computer platform, especially with large numbers of predictors and across broad spatial extents. Given limitations in computational resources, I elected to constrain implementation and map realization to MARS models with 16 or fewer base functions, although the basic procedure would be the same for implementing models of any complexity. Implementation of the final model including development of map products was accomplished at the sub-extent (i.e., individual DEM areas) scale with the final map products for the entire region subsequently stitched together. The display of regional scale map products within a GIS (using nearest neighbor re-sampling) with component outputs compiled from the individual DEM sub-extents can result in a systematic shift of ca. 15-30m which is enough to bump individual points sitting close to edges, across mapped probability boundaries. A comparable issue addressed earlier is the inherent error in both the GPS locations (of sampled points) and or mismatch with associated environmental coverage in a GIS, both which can create problems for the correct classification of individual points. While these effects do not impact the mapped probability patterns, they make it appear that the mapped probability for selected points differs from the actual values calculated during modeling. Another potential source of predictive model error is the mismatch between the scale of field observations (i.e., of stand-age relative to local topo-edaphic patterns) and the resolution of available coverage for environmental variables within a GIS. For example, using coarse resolution DEM coverage, a fine scale rocky mosaic interspersed with depositional settings (which could in turn support a mosaic of "old" and "young") would not incorporate fine scale topographic influences or predict a mosaic of "old" and "young". However, higher resolution coverage is not always better since the most appropriate scales for modeling can vary by predictor or for interactions among different predictors.

Results

A series of MARS models of increasing accuracy and complexity were generated using the dataset (*n* = 210) previously prepared for logistic modeling in Chapter 3 within the north-central New Mexico extent in (Table 4.2). A baseline MARS model was developed for direct comparison to the full logistic model by initially restricting model development to the same four predictor variables (FLOW, FORM, EWP, DEM) used previously and not allowing explanatory variables to be transformed (i.e., maintaining a global model) or interact. This baseline, untransformed MARS model (BASE MARS) provided comparable results to the full logistic model, using all 4 explanatory variables and with a LOO AUC ROC value of $c = 0.938$ ($df = 4$); at a probability cutoff of 0.50 the model correctly assigned 90.0% of samples with a sensitivity of 93.8% and a specificity of 81.3%. The full logistic model (Full) had a LOO AUC ROC value of $c = 0.932$ ($df = 6$) and correctly assigned 89.5% of samples at a 0.45 probability cutoff with a sensitivity of 93.2% and a specificity of 81.3%. A low-range MARS model (MARS LR) was developed by limiting potential explanatory variables to the same four used by the full logistic model, but now allowing both transformations and interactions. The MARS LR model showed a slightly improved performance over the BASE MARS model with a LOO AUC ROC value of $c = 0.948$ ($df = 3$); at a probability cutoff of 0.44 the model correctly assigned 90.5% of samples with a sensitivity of 92.5% and a specificity of 85.9%. Additional MARS modeling was conducted using a dataset with 12 potential predictors, representing the core set of explanatory variables previously used for logistic modeling of the north-central New Mexico extent in Chapter 3. A mid-range MARS model (MARS MR) using 9 explanatory variables provided a LOO AUC ROC value of $c = 0.976$ ($df = 8$); at a probability cutoff of 0.62 the model correctly assigned 93.8% of samples with a sensitivity of 93.8% and specificity of 93.8%. A high-range MARS model

(MARS HR) generated to explore the upper limits of measured predictive success using the available explanatory variables, although likely at the expense of being over fit. The MARS HR model used 10 explanatory variables and provided a LOO AUC ROC values of $c = 0.984$ ($df = 12$); at a probability cutoff of 0.50 the model correctly assigned 96.2% of samples with a sensitivity of 97.9% and a specificity of 92.2%.

A range of alternative regional models was developed using the entire regional dataset ($n = 1129$) and beginning with a baseline (global parametric) logistic model and followed by a series of piece-wise linear (local, non-parametric) models with increasing accuracy, but typically at the expense of additional variables and complexity (Table 4.3a). The baseline logistic model (BASE LOGISTIC) used 13 explanatory variables and provided a LOO AUC ROC value of $c = 0.876$ ($df = 24$); at a probability cutoff of 0.64 the model correctly assigned 80.8% of samples with a sensitivity of 81.0% and specificity of 80.3%. Similar to the logistic model developed for the north-central New Mexico area, the regional model selected metrics of landform (FORM), depositional environment (FLOW and PROFILE), elevation (DEM), seasonal precipitation (MONSOON, MAPS, MAPW), and seasonal temperature / sun exposure (TMEANS, TMEANW, HILLSHADE) as important explanatory variables for predicting "old" versus "young" stands, but also included soil-geologic substrate (a coarse resolution predictor which was not suitable for use within the smaller north-central New Mexico extent). A logistic (global) model was developed to provide a baseline for subsequent development of MARS (local) models (Table 4.3a) using the piece-wise linear regression procedure; the logistic model used 13 explanatory variables and provided a LOO AUC ROC of $c = 0.876$ ($df = 24$); at a probability cutoff of 0.64 the model correctly assigned 80.8% of samples with a sensitivity of 81.0% and a specificity of 80.3%.

A low-end MARS model (MARS 001) using 5 explanatory variables provided a LOO AUC ROC value of $c = 0.870$ ($df = 5$); at a probability cutoff of 0.66 the model correctly assigned 80.2% of samples with a sensitivity of 79.9% and specificity of 80.8% (Table 4.3a). An enhanced low-end MARS model (MARS 002) using 8 explanatory variables provided a LOO AUC ROC value of $c = 0.886$ ($df = 8$); at a probability cutoff of 0.58 the model correctly assigned 84.2% of samples with a sensitivity of 86.4% and specificity of 80.3%. A slightly more complex MARS model (MARS 003) using 8 explanatory variables and one additional base function provided a LOO AUC ROC value of $c = 0.894$ ($df = 9$); at a probability cutoff of 0.64 the model correctly assigned 84.2% of samples with a sensitivity of 86.4% and specificity of 80.3%. A mid-range MARS model (MARS 004) using 11 explanatory variables provided a LOO AUC ROC value of $c = 0.903$ ($df = 12$); at a probability cutoff of 0.58 the model correctly assigned 85.7% of samples with a sensitivity of 88.6% and specificity of 80.3%. An alternative mid-range MARS model (MARS REGION) selected for subsequent map realization used 12 explanatory variables provided a LOO AUC ROC value of $c = 0.900$ ($df = 13$); at a probability cutoff of 0.60 the model correctly assigned 84.9% of samples with a sensitivity of 86.7% and specificity of 81.6%. A high-end MARS model (MARS 005) using 13 explanatory variables provided a LOO AUC ROC value of $c = 0.919$ ($df = 16$); at a probability cutoff of 0.60

the model correctly assigned 85.9% of samples with a sensitivity of 88.1% and specificity of 82.1%. A max-end MARS model (MARS 006) generated primarily to illustrate the practical upper limits of measured predictive success using the available explanatory variables for this extent used 17 explanatory variables and provided a LOO AUC ROC of $c = 0.932$ ($df = 29$); at a probability cutoff of 0.60 the model correctly assigned 86.7% of samples with a sensitivity of 88.2% and specificity of 84.0%.

Additional indicators of model performance were provided by comparison of P-values for individual model parameters (i.e., base functions) in the SAS logistic output (i.e., maximum likelihood estimates). Individual parameters for the selected regional model ($df = 13$) and models with fewer degrees of freedom had P-values within the range of $P < 0.0001$, while individual parameters of all higher end regional models ($df = 14$ and higher) began to exceed that range and indicated inclusion of less significant terms in final models. Although more complex models often have higher measures of accuracy, implementation of these models in a GIS may sometimes produce uneven results when mapped across regional landscapes, and this is one of the rationales for giving preference to models with fewer and only highly significant terms. In addition, where models had generally comparable performance, I preferred those which were more either easily interpreted or that included the range of explanatory variables thought to be most influential (and ecologically relevant) based on prior logistic modeling efforts.

After a review of alternative regional models, including relative complexity and performance, and consistency of map realizations with previous logistic model outputs for the north-central New Mexico extent, I selected one of the mid-range models (MARS REGION) for implementation within a GIS to produce map products for the Four Corner states (Figure 4.2). In addition to standard measures of model performance, visual map inspections along with evaluations of how individual sample points were scored by alternative models, proved to be an intuitive approach for interpreting model outcomes for known areas at local scales. I visually reviewed the regional distribution of misclassified points for the mid-range model relative to geographic location and woodland types. Subsequently, I calculated measures of spatial autocorrelation and spatial clustering for misclassified points within a GIS.

Misclassified points (including both false positive "young" misclassified as "old" and false negative "old" classified as "young") were found to be uniformly distributed across the entire region based on both visual examination (Figure 4.4) and spatial autocorrelation (Moran Value) / clustering diagnostics (General G value) where the z values are a measure of each measures significance. A Moran value near zero (Moran I value = 0.04, z=1.0 standard deviations) suggests that misclassified points are not spatially correlated (i.e. neither clustered nor dispersed). A general G index close to zero (General G index = 0, z=0.9 standard deviations) indicates no apparent clustering of misclassified points. From the perspective of woodland types, I found the false positive rate to be slightly higher (and specificity lower) for CP (versus SRM) woodland areas (Table 4.3b, Figure 4.1).

MARS REGION model map realizations for the north-central New Mexico (Figure 4.3a) and Bandelier National Monument, Tsankawi Unit (Figure 4.3b) extents are provided for higher resolution of detail. Comparison of the MARS REGION map output with several alternative MARS models for the same extents (BASE MARS and MARS 002) are presented in Figures 4.3b,c and 4.4b,c (Appendix 4.1), respectively, as well as to the full logistic model (FULL) developed in Chapter 3 (Figure 3.3a,b). I also present MARS REGION model map realizations for selected NPS units within the Four Corners states to provide examples of how a single regional model is implemented across a variety of topographic-edaphic-climatic settings (Figures 4.5a-h, Appendix 4.1).

Although woodland type (CP versus SRM) was a potential predictor, it was only included in a few of the more complicated MARS models. My point by point evaluation of the selected mid-range model (MARS REGION) suggested I might be able to improve predictive performance by splitting the regional dataset using woodland type and modeling each area separately. As noted earlier, this approach can improve accuracy but at the expense of limiting a model's scope and applicability. This effort yielded a slightly improved model (MARS SRM) for the SRM woodland area dataset ($n = 552$). The MARS SRM model used 11 explanatory variables and provided a LOO AUC ROC value of $c = 0.931$ ($df = 14$); at a probability cutoff of 0.65 the model correctly assigned 87.1% of samples with a sensitivity of 87.1% and specificity of 87.6%. In contrast, the regional model (MARS REGION) continued to provide the best predictive outcomes for the CP woodland area dataset ($n = 577$); a specificity of 81.6% suggests misclassification of "young" stands in CP woodland areas was a weak spot for the regional model. Results of SRM versus CP woodland area modeling, with SRM woodland area outcomes shown for both the MARS REGION-SRM and MARS SRM models, and estimated performance for a hybrid model (MARS HYBRID) that combines MARS SRM model outcomes with regional model results for CP area (MARS REGION-CP) in comparison to MARS REGION are presented in Table 4.3b. Map implementation of the MARS SRM model for the north-central New Mexico and Tsankawi Unit extents are presented in Figures 4.3d and 4.4d, respectively.

My results suggest areas of the southwestern U.S. with strong monsoonal (summer moisture) patterns were the most susceptible to historical woodland expansion. However, even in these locations many stands have pre-settlement origins and old-growth structure is not uncommon in appropriate upland settings. Observed woodland expansion is largely attributable to establishment of one-seed juniper into historically degraded grasslands in depositional valley and terrace settings. These results need to be interpreted in light of how I delineate "old" from "young" stands because although thickening and infill processes are apparently widespread most of these woodlands would necessarily have pre-settlement origins and be classified as "old". Where seasonal moisture patterns are weakly bimodal or winter-dominated, the occurrence of "young", post-settlement woodlands becomes correspondingly less frequent. In this bio-climatic zone, landform and (soil-water) depositional patterns increasingly delineate "old" or persistent woodland from non-woodland vegetation across relatively sharp ecotonal boundaries. “Younger”, post-settlement woodlands appear to occupy a distinct ecological space from “older” or persistent woodlands and this result suggests historic grazing and associated effects (e.g. reduced herbaceous competition and fire effects) played a major role in facilitating historic woodland changes (i.e. expansion), as opposed to a natural demographic or migrational interpretation.

Discussion

Explanatory Predictors

A core group of explanatory predictors was selected by all of the alternative models, with simple, low-range models composed primarily of the core predictors, and more complex, mid-range models distinguished by the addition of one or more predictors to the core group. There was also a core group of base functions that was largely analogous to the core predictor group with the base functions representing discrete ranges of (and/ or interactions between) core variables. The methods section provides a more complete description of how explanatory variables used in regional modeling were developed. The core group of predictors and in general order of importance included: (1) FLOW (a categorical metric representing soil-water accumulation with two levels: 0 = non-depositional or losing, and 1 = depositional or gaining; (2) EPW (an index of effective winter moisture); (3) FORM (a categorical metric representing general landforms with six classes: 1 = valley, 2 = swale, 3 = mesa, 4 = terrace, 5 = slope, and 6 = cliff; and (4)

EPS (an index of effective summer moisture). Predictors selected to enhance the core group included: (5) DEM (30-m digital elevation model); (6) SWSUBS (a categorical metric representing general soil-geology types with 10 classes, not including water and unknown; (7) $\mathrm{HILLSHADE}_{(x\ \mathrm{and}\ m)}$ (a surface metric calculated from DEM to represent relative insolation for $\mathrm{summer}_{(x)}$ and $\mathrm{winter}_{(m)}$ seasons); (8) $\mathrm{TMEAN}_{(x\ \mathrm{and}\ m)}$ (mean monthly temperatures for the June to September $_{(x)}$ and October to $\mathrm{May}_{(m)}$ time periods; (9) $\mathrm{SLOPE}_{(30m\ \mathrm{and}\ 180m)}$ (a surface metric calculated from DEM representing slope perpendicular to contour in degrees was calculated at two scales using 30m and 180m DEM's); and (10) MAP (mean annual precipitation), MAPS (mean summer precipitation), MAPW (mean winter precipitation). Two additional metrics: (10) ASPECT (a categorical version of aspect in degrees calculated from DEM with 9 classes); and (11) MONSOON (a relative index of growing season moisture) were only included in the more complicated regional models (as well as by a model developed for the SRM woodland extent) because they were likely collinear with other effects like HILLSHADE, MAPS, and MAPW.

Jensen et al. (2001) suggest environmental variables considered for inclusion in a predictive vegetation model should be tested at various spatial scales, with the resolution of the mapped response ideally several times coarser than the variables used to predict it. The relative importance of individual explanatory variables, and the respective resolution of these data, can influence the minimum scale at which predicted responses can be meaningfully interpreted. Thus, minimum map units of predicted vegetation response may need to be determined post-modeling, in combination with the resolution or scale of important predictors. Predictive modeling efforts are often limited by the available data and its resolution; however a sound ecological understanding of the system being modeled and appropriate matching of data and resolutions to the process or pattern of interest will generally enhance model performance and interpretability. Initial evaluation of available datasets and resolutions for representation and predictive modeling of ecosystem patterns and processes is best accomplished within small spatial extents within the larger area of interest. This approach also allows for construction and evaluation of potential proxies to represent poorly delineated spatial features and / or unmeasured parameters which might be important predictors, for example where these parameters influence soil-water accumulation or constrain propagation of a disturbance process.

Map Implementation

Implementation of selected MARS models in a GIS and generation of map products provided for visual inspection of model predictions at landscape scales. In addition to measures of model performance, it is instructive to evaluate map realizations to assess how the model predictions are implemented at landscape scales both in known or well sampled areas and in less known or poorly sampled settings. I initially evaluated my alternative regional model map outputs for the well sampled and previously modeled north-central New Mexico extent, and compared predicted patterns to those generated using the smaller north-central New Mexico dataset (using both logistic and MARS models). This provided us with a well known landscape context within which I could critique and interpret alternative regional scale map predictions, ultimately selecting a few to implement across the entire regional extent. Each model attempts to provide a best fit of the training points to a predictive relationship given the various constraints imposed during model development, and each can be expected have varying levels of success as measured by model performance and inferred from visual map assessments. However, quantitative measures of model performance are not always a reliable indicator of how well map predictions will track actual landscape patterns, and I attribute this discrepancy to a combination of factors. Over fitting or increasing local model performance at the expense of global relationships can reduce the accuracy of map outputs when models are extrapolated beyond the range of conditions used to train the model (amplifying poorly characterized effects through the modeling and mapping process) or where the training dataset does not adequately represent the spatial extent and variability of modeled landscape settings. While even the best models can only represent a partial truth, even relatively simple and low performance models may provide useful insights. My low end models highlight the selection of core explanatory variables by all models, which are enhanced by additional variables and interactions in the increasingly complex and more accurate higher end models. However my mid to low-end models appear to provide the most realistic landscape scale patterns, to the degree that they correspond with my knowledge of woodland age structures within selected map areas.

While field validation of map products was beyond the scope of this study, visualization of map products color coded response class (i.e. "old versus "young") groupings to match probability cutoffs found to maximize model performance and thus allowed for cursory assessment of map predictions across various extents. As MARS models become more complex in an attempt to fit a model to the data, they can degrade or swamp signals from the more basic environment controls important in the distribution of "old" versus "young" woodland. At some point then the models are over-fit and the idiosyncratic signals generated by fitting rare outliers or poorly sampled settings generate a model which has higher predictive performance, but produces map products which appear to deviate in notable ways from observed patterns. For example a mid- to high-range (df = 16) regional MARS model appears to erroneously over predict "young" woodland on north facing aspects with the north-central New Mexico area, an effect which is contrary to observed patterns (usually north aspects will support "older" woodland relative to south aspects) and given the complexity of the model, it is hard to interpret the source of this mapping artifact. In another instance, the model developed for the SRM woodland area (df = 14) combines aspect with selected substrates, and predicts an increased probability of "young" woodland on east facing aspects with the likelihood increasing below slopes$_{(180)}$ of 3.5 degrees; whether this is a real effect or artifact of the model would require field validation of predicted points. Preliminary efforts to split the regional dataset into training and test components as an alternative modeling approach to address some of these issues did not produce materially better results, and to the degree that sample size was a limiting factor in constructing a fully adequate model, supported my decision to employ the entire dataset in model development. Given this experience I have tended to be conservative in my selection of the best or optimal model, preferring the lower end models with fewer and more basic explanatory variables despite lower measures of accuracy, and to place a greater reliance on visual inspection of map outputs in evaluating actual model performance. Given that the MARS outputs generated for the north-central New Mexico extent (using the smaller dataset originally created for logistic modeling of that extent) was comparable or better than the logistic model, my experience at the regional scale may be largely a sampling problem that could be remedied by enhanced sample numbers or targeted at under sampled environmental settings. However, I was able to improve results somewhat by modeling separately within the SRM woodland extent, while retaining the regional model outputs for CP woodland areas; this hybrid model provides a somewhat improved version of the final map product.

As noted in Chapter 3, the SWReGAP coverage generally mapped lower density, and often "younger" (<50 years) woodland, as non-woodland types. For example, in one portion of Wupaki National Monument shown (by SWReGAP) to have only a light scattering of woodland, I observed an expansive distribution of "younger" one-seed juniper, with scattered "older" stands, although this difference in part reflects my use of a lower threshold (i.e., 5% canopy cover) for delineating woodland from grass or shrub dominated types. SWReGAP also incorrectly mapped some lower elevation ponderosa pine or mixed conifer as woodland, and vice versa, while I observed some non-tree (i.e., grass and shrub) vegetation classified as woodland. Therefore, in some locations my estimated acreage of "younger", post-settlement aged woodland (using SWReGAP coverage as an analysis mask) may be under represented and conversely the acreage of "older" woodland may be sometimes be over represented. Alternatively, in some locations (i.e., Colorado National Monument and Mesa Verde National Park in Colorado) the predictive maps show young woodland along secondary drainages in upland settings; in my experience these settings are mostly narrow non-woodland (shrub dominated) drainages or swales embedded in older growth woodlands and thus in this instance the analysis mask is highlighting settings with a potential (although often unrealized) to support young woodland. One option available for National Park Service units is to use the vegetation maps being developed for these units as a higher resolution analysis mask. In spite of these limitations, I found the SWReGAP vegetation coverage, along with the ancillary landform and soil-geologic substrate layers developed the same group, to be extremely valuable geospatial datasets and essential tools for conducting regional scale research within the southwestern U.S.

Conclusion

Regional scale modeling and predictive mapping results suggests there is an abundance of pre-settlement status woodland on the Colorado Plateau, where precipitation patterns are either winter dominated or lack strong seasonality. Conversely, occurrence of post-settlement status woodland is predicted to become increasingly frequent in rangeland areas of New Mexico and east-central Arizona, where they occupy lower gradient basin and valley landform settings, adjacent slopes and rolling hills, in locations characterized by summer precipitation patterns. The great majority of locations predicted to have "young" expansion stands occur in areas under monsoonal influence and within distributional limits of one-seed juniper. Pre-settlement woodland within the monsoonal one-seed juniper area becomes increasingly restricted to a narrower range of upland settings, including steeper gradient landforms, with shallow rocky substrate, and/ or isolated or broken topographic settings, presumably reflecting locations which promote deeper water infiltration and/ or limit fire effects.

I utilize predictive modeling and mapping techniques to improve understanding and enhance management of southwestern U.S. piñon-juniper systems. In particular, the development of predictive maps depicting the probability of "old" or persistent woodland occurrence versus those locations more likely to support "younger" post-settlement stands could benefit land management efforts to restore former grass and shrub communities historically displaced by expanding tree cover. My regional scale models highlight environmental factors that were likely important controls of pre-settlement piñon-juniper woodland distribution and map products express these relationships as landscape patterns. Standard measures of model performance however need to be balanced with field reviews of how well mapped stand-age probabilities reproduce observed patterns. In well sampled areas map realizations can be used to visually evaluate model assumptions at landscape scales, including choice and weighting of individual predictors, adequacy of the training sample, and whether standard measures of predictive model accuracy are consistently reliable indicators of real world performance. Additional sampling of problematic locations, combined with the identification or acquisition of additional (and higher resolution) environmental control coverage, will likely improve future model and map outputs. Regional models might also be improved by incorporating additional environmental factors of enhanced resolution, or factors currently unmeasured and otherwise unavailable in geospatial format. Even so, dynamic and diverse systems like piñon-juniper will defy modeling and mapping efforts beyond a certain level of accuracy and pushing predictive approaches beyond intrinsic limits could be self defeating. Regional map products should be used primarily to infer landscape patterns and environmental controls of woodland stand-age that can inform local perspectives and interpretations rather than as an absolute predictor for any particular hectare. My work highlights the potential of predictive modeling methods for researchers and land managers of piñon-juniper systems, but also suggests there are practical limits to this approach and its predictive products.

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Table 4.1a. Frequency of sampled “old” versus “young” piñon-juniper woodland stands by landform (LANDFORM) strata and depositional (FLOW) environment (losing versus gaining soil-water) within the Four Corners states.

Dataset /	**Stand Age**		**LANDFORM (#)**			**FLOW**	
sample totals (%)		**Valley (1)**	**Mesa (2)**	**Terrace (3)**	**Slope (4)**	**0 (Losing)**	**1 (Gaining)**
sample size							
Regional			Number of samples			Number of samples	
407 (36.0%)	**Young**	47	114	214	32	216	191
722 (64.0%)	**Old**	8	316	160	238	673	49
n=1129	Sub-Totals	55	430	374	270	889	240

Table 4.1b. Frequency of sampled “old” versus “young” piñon-juniper woodland stands by soil-geologic substrate.

Dataset / sample totals (%) *sample size*	**Stand Age**	**Soil-Geologic Substrate (Unit #)**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Regional											
407 (36.0%)	**Young**	30	27	1	10	28	10	90	59	46	106
722 (64.0%)	**Old**	44	54	6	11	143	17	95	78	80	194
n=1129		74	81	7	21	171	27	185	137	126	300

Key to Soil-Geologic Units

1	Metamorphic or igneous units with dominantly mafic composition all ages
2	Carbonate dominated formations either limestone or dolomites of all ages
3	Unconsolidated Aeolian sand deposits both active and stabilized
4	Evaporite units either halite, gypsum, or other saline mineral dominated formations of all ages
5	Metamorphic or igneous units with a dominantly silicic composition all ages
6	Quaternary age older alluvium and surficial deposits
7	Quaternary age younger alluvium and surficial deposits
8	Shale dominated formations of all ages
9	Siltstone and/or mudstone dominated formations of all ages
10	Sandstone dominated formations of all ages

Table 4.2. Comparative performance of regional models developed for the north-central New Mexico extent; reported values are leave-one-out (LOO), cross-validated probability (XP), classification results ("old" = event) and LOO XP receiver operator characteristic (ROC), area under curve (AUC) values (*c*).

Model		**Observed**		**Correct**		**Incorrect**				**Percentages**		
(prob. cutoff) *ROC c=value* *(df=degrees freedom)*	Sample Size (*n*)	**Old**	**Young**	**Old**	**Young**	**Old**	**Young**	**Total**	**Sensitivity (Old)**	**Specificity (Young)**	**False Positive**	**False Negative**
FULL (0.45) *c=0.932 (df=6)*	210	146	64	136	52	12	10	89.5	93.2	81.3	8.1	16.1
BASE MARS (0.50) ***c=0.938 (df=4)***	**210**	**146**	**64**	**137**	**52**	**12**	**9**	**90.0**	**93.8**	**81.3**	**8.1**	**14.8**
MARS LR (0.44) *c=0.948 (df=3)*	210	146	64	135	55	9	11	90.5	92.5	85.9	6.3	16.7
MARS MR (0.62) *c=0.976 (df=8)*	210	146	64	137	60	4	9	93.8	93.8	93.8	2.8	13.0
MARS HR (0.50) *c=0.984 (df=12)*	210	146	64	143	59	5	3	96.2	97.9	92.2	3.4	4.8

Table 4.3a. Comparative performance of regional models developed for the regional extent; reported values are leave-one-out (LOO), cross-validated probability (XP), classification results ("old" = event) and LOO XP receiver operator characteristic (ROC), area under curve (AUC) values (*c*).

Model		**Observed**		**Correct**		**Incorrect**		**Percentages**				
(prob. cutoff) *ROC **c=value*** *(df=degrees freedom)*	Sample Size (n)	**Old**	**Young**	**Old**	**Young**	**Old**	**Young**	**Total**	**Sensitivity (Old)**	**Specificity (Young)**	**False Positive**	**False Negative**
BASE LOGISTIC (0.64) *c=0.876 (df=24)*	1129	722	407	585	327	80	137	80.8	81.0	80.3	12.0	29.5
MARS 001 (0.66) *c=0.870 (df=5)*	1129	722	407	577	329	78	145	80.2	79.9	80.8	11.9	30.6
MARS 002 (0.58) *c=0.886 (df=8)*	1129	722	407	624	327	80	98	84.2	86.4	80.3	11.4	23.1
MARS 003 (0.64) *c=0.894 (df=9)*	1129	722	407	605	326	81	117	82.5	83.8	80.1	11.8	26.4
MARS 004 (0.58) *c=0.903 (df=12)*	1129	722	407	640	327	80	82	85.7	88.6	80.3	11.1	20.0
MARS REGION (0.60) ***c=0.900 (df=13)***	**1129**	**722**	**407**	**626**	**332**	**75**	**96**	**84.9**	**86.7**	**81.6**	**10.7**	**22.4**
MARS 005 (0.60) *c=0.919 (df=16)*	1129	722	407	636	334	73	86	85.9	88.1	82.1	10.3	20.5
MARS 006 (0.60) *c=0.932 (df=29)*	1129	722	407	637	342	65	85	86.7	88.2	84.0	9.3	19.9

Table 4.3b. Comparative performance of sub-regional models developed for Southern Rocky Mountain and Colorado Plateau woodland extents; reported values are leave-one-out (LOO), cross-validated probability (XP), classification results ("old" = event) and LOO XP receiver operator characteristic (ROC), area under curve (AUC) values (*c*).

Model (prob. cutoff) *ROC **c=value*** *(df=degrees freedom)*	Sample Size (*n*)	**Observed**		**Correct**		**Incorrect**		**Percentages**				
		Old	**Young**	**Old**	**Young**	**Old**	**Young**	**Total**	**Sensitivity (Old)**	**Specificity (Young)**	**False Positive**	**False Negative**
BASE LOGISTIC (0.64) *c=0.876 (df=24)*	1129	722	407	585	327	80	137	80.8	81.0	80.3	12.0	29.5
MARS REGION (0.60) ***c=0.900 (df=13)***	**1129**	**722**	**407**	**626**	**332**	**75**	**96**	**84.9**	**86.7**	**81.6**	**10.7**	**22.4**
MARS REGION-SRM (0.60)	552	334	217	289	182	35	46	85.3	86.5	83.9	10.8	20.2
MARS SRM (0.65) ***c=0.931 (df=14)***	**552**	**334**	**217**	**291**	**190**	**27**	**44**	**87.1**	**87.1**	**87.6**	**8.5**	**18.8**
MARS REGION-CP (0.65)	***577***	***387***	***190***	***334***	***155***	***35***	***53***	***84.7***	***86.3***	***81.6***	***9.5***	***25.5***
MARS HYBRID	**1129**	**722**	**407**	**625**	**345**	**62**	**97**	**85.9**	**86.6**	**84.8**	**9.0**	**21.9**

Figures

Figure 4.1. Regional sample locations in relation to a generalized distribution of Colorado Plateau and southern Rocky Mountain piñon-juniper savanna and woodland communities recently mapped by SWReGAP within the Four Corners states.

Figure 4.2. Predictive map of "old" versus "young" (percent probability "old") piñon-juniper stands using the MARS REGION model for the Four Corners states.

Figure 4.3a. Predictive map of "old" versus "young" (percent probability "old") piñon-juniper stands using the MARS REGION model for the 2.9 million-ha north-central New Mexico study area. Figure 4.3b is a close-up of Tsankawi Unit (see inset), Bandelier National Monument.

Figure 4.3b. Predictive map of "old" versus "young" (percent probability "old") piñon-juniper stands using the MARS REGION model for the (336 ha) Tsankawi Unit, Bandelier National Monument, New Mexico.

Figure 4.4. Misclassified points (including both false positive "young" misclassified as "old" and false negative "old" classified as "young") were found to be uniformly distributed on the basis of both visual examination (Figure 4.4) and spatial autocorrelation (Moran Value) / clustering diagnostics (General G value) where the z values are a measure of each measure's significance. A Moran value near zero (Moran I value = 0.04, z=1.0 standard deviations) suggests that misclassified points are not spatially correlated (i.e. neither clustered nor dispersed). A general G index close to zero (General G index = 0, z=0.9 standard deviations) indicates no apparent clustering of misclassified points.

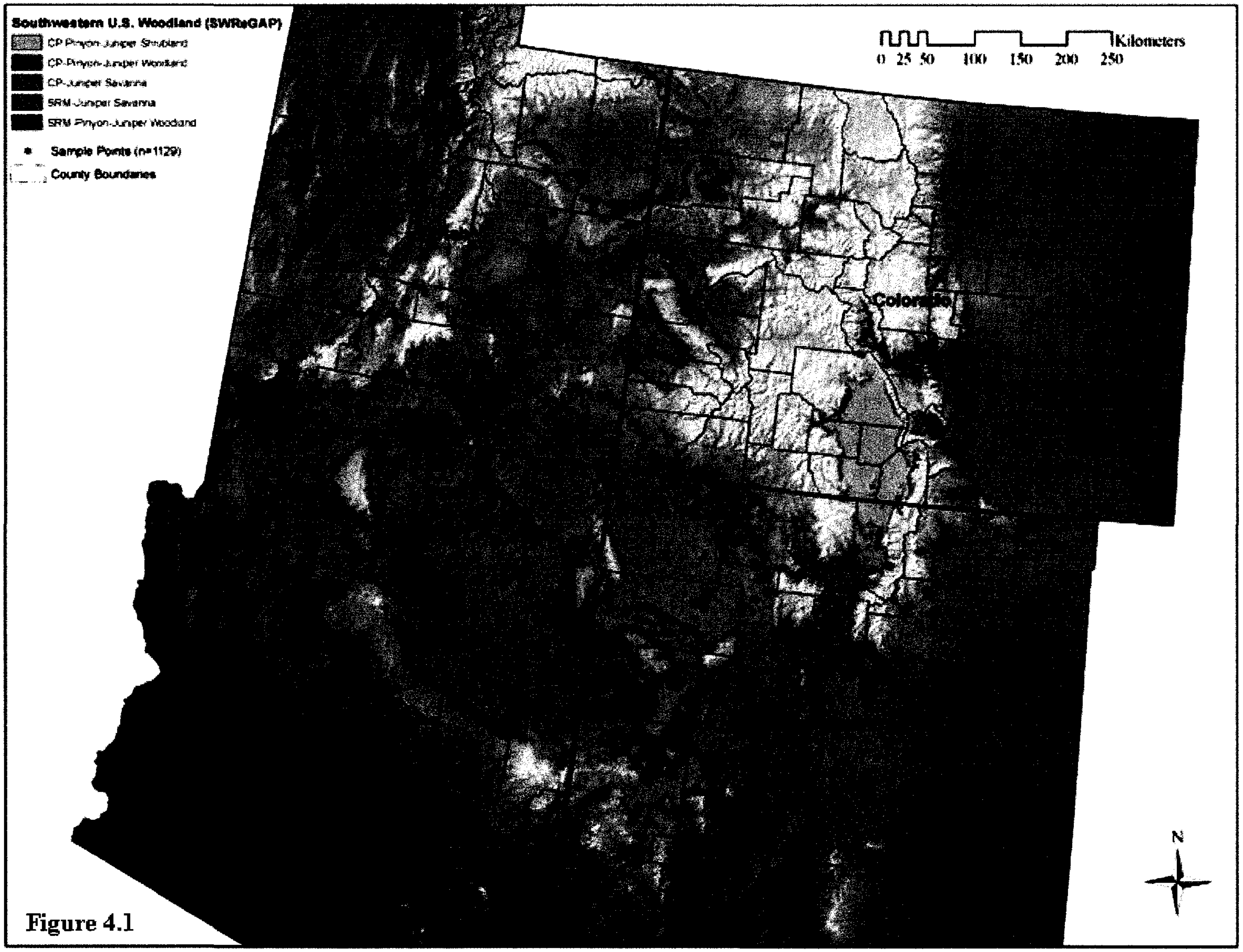
Southwestern U.S. Woodland (SWReGAP)
CP Pinyon-Juniper Shrubland
CP-Pinyon-Juniper Woodland
CP-Juniper Savanna
SRM-Juniper Savanna
SRM Pinyon-Juniper Woodland
● Sample Points (n=1129)
County Boundaries
0 25 50 100 150 200 250
Kilometers
Colorado
N

Figure 4.1

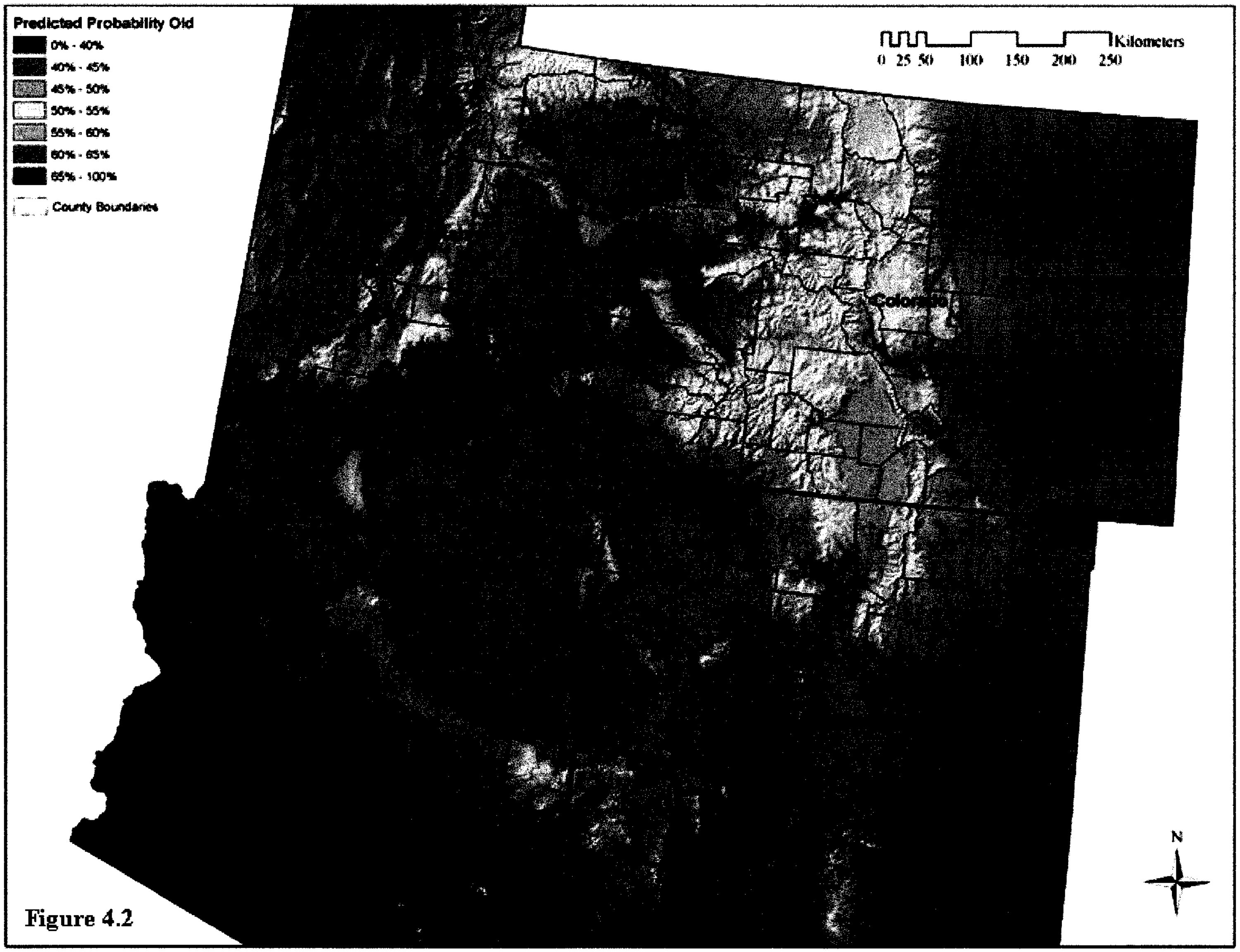
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
County Boundaries
0 25 50 100 150 200 250 Kilometers
Colorado
N

Figure 4.2

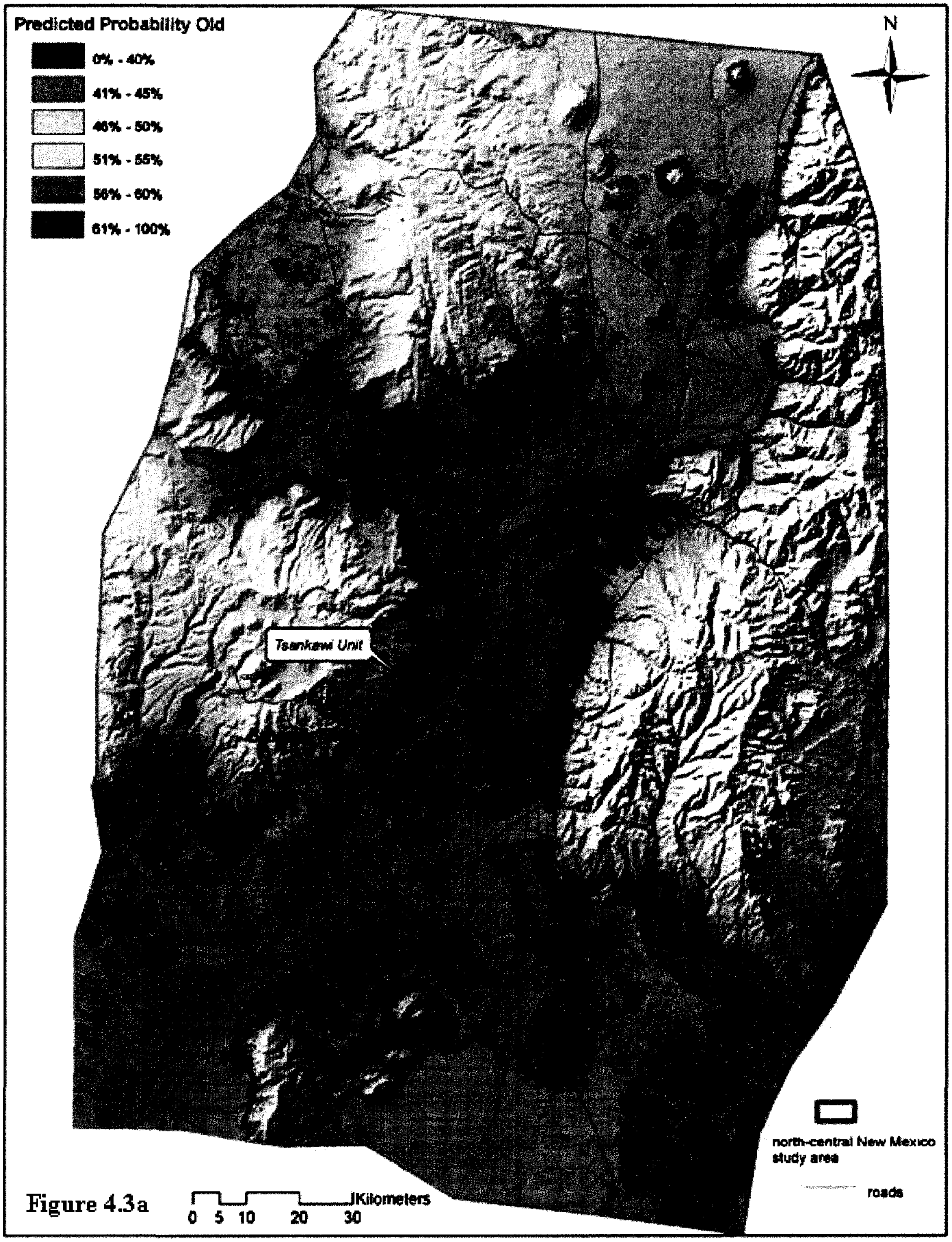
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
Tsankawi Unit
north-central New Mexico study area
roads
0 5 10 20 30
Kilometers

Figure 4.3a

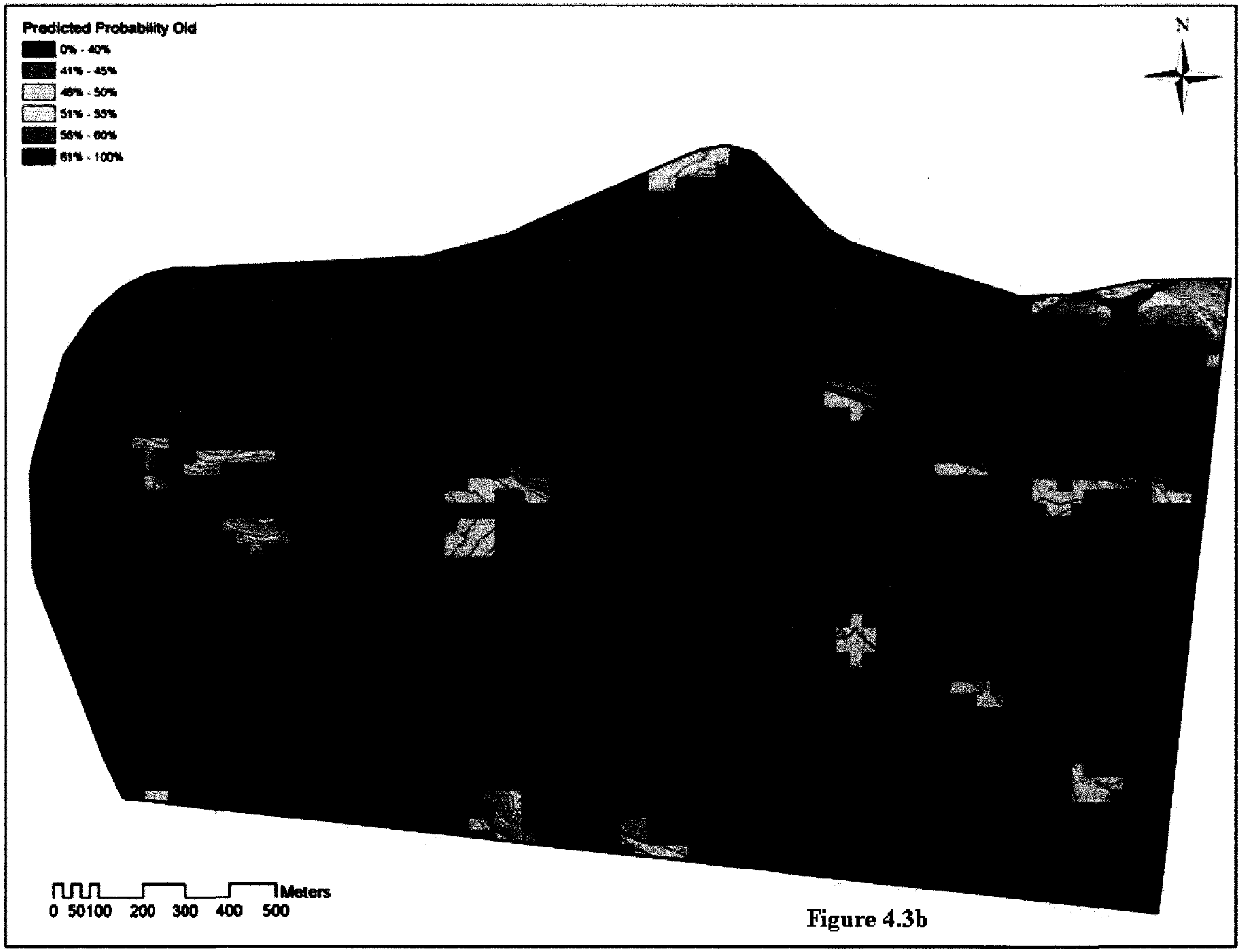
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
0 50100 200 300 400 500
Meters

Figure 4.3b

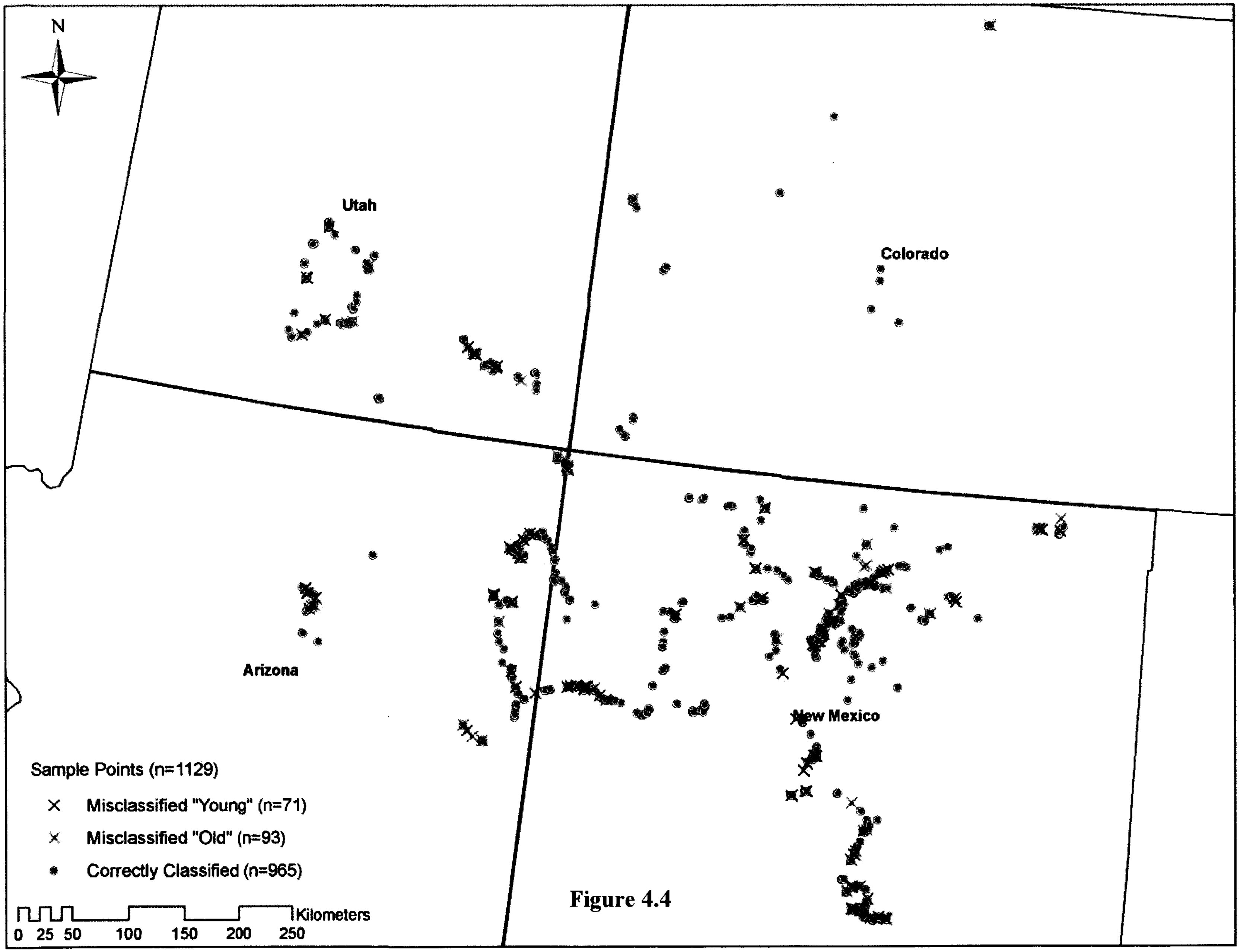
N
Utah
Colorado
Arizona
New Mexico
Sample Points (n=1129)
× Misclassified "Young" (n=71)
× Misclassified "Old" (n=93)
● Correctly Classified (n=965)
0 25 50 100 150 200 250
Kilometers

Figure 4.4

Appendices

Appendix 4.1: Supplemental Figures (map realizations for selected NPS areas)

Figure 4.3b. Implementation of the BASE MARS model for a north-central New Mexico extent

Figure 4.3c. Implementation of the MARS 002 model for a north-central New Mexico extent

Figure 4.3d. Implementation of the MARS SRM model for a north-central New Mexico extent

Figure 4.4b. Implementation of the BASE MARS model for the Tsankawi Unit, Bandelier National Monument, New Mexico

Figure 4.4c. Implementation of the MARS 002 model for the Tsankawi Unit, Bandelier National Monument, New Mexico

Figure 4.4d. Implementation of the MARS SRM model for the Tsankawi Unit, Bandelier National Monument, New Mexico

Figure 4.5a. Implementation of the MARS REGION model for Colorado National Monument, Colorado and vicinity

Figure 4.5b. Implementation of the MARS REGION model for Mesa Verde National Park, Colorado and vicinity

Figure 4.5c. Implementation of the MARS REGION model for Canyon de Chelly National Monument, Arizona and vicinity

Figure 4.5d. Implementation of the MARS REGION model for Flagstaff, Arizona area parks (Wupaki, Sunset Crater, and Walnut Canyon National Monuments) and vicinity

Figure 4.5e. Implementation of the MARS REGION model for Natural Bridges National Monument, Utah and vicinity

Figure 4.5f. Implementation of the MARS REGION model for El Morro National Monument, New Mexico and vicinity

Figure 4.5g. Implementation of the MARS REGION model for Capulin Volcano National Monument, New Mexico and vicinity

Figure 4.5h. Implementation of the MARS REGION model for Salinas Pueblo Mission National Monument, New Mexico and vicinity

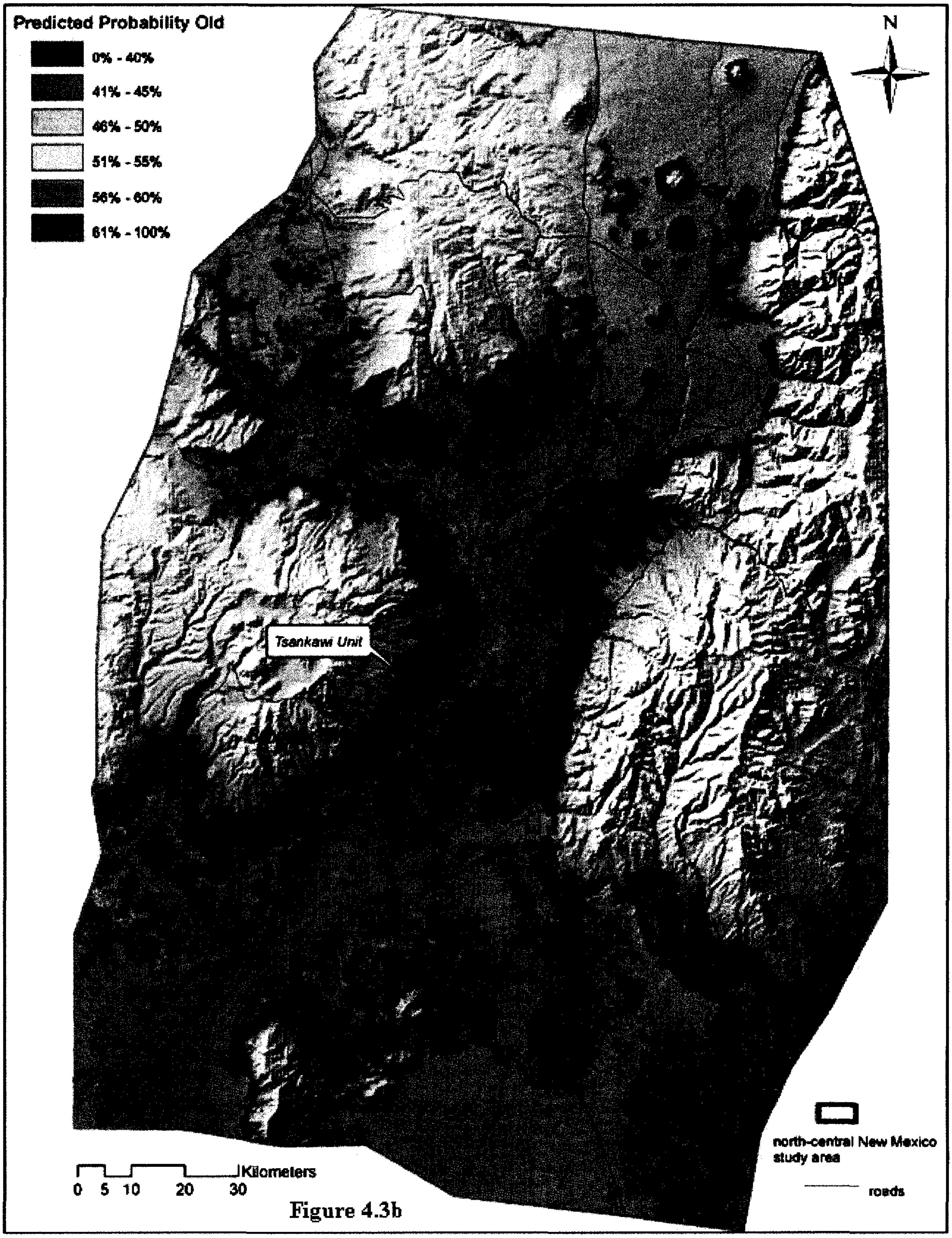
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
Tsankawi Unit
0 5 10 20 30
Kilometers
north-central New Mexico study area
roads

Figure 4.3b

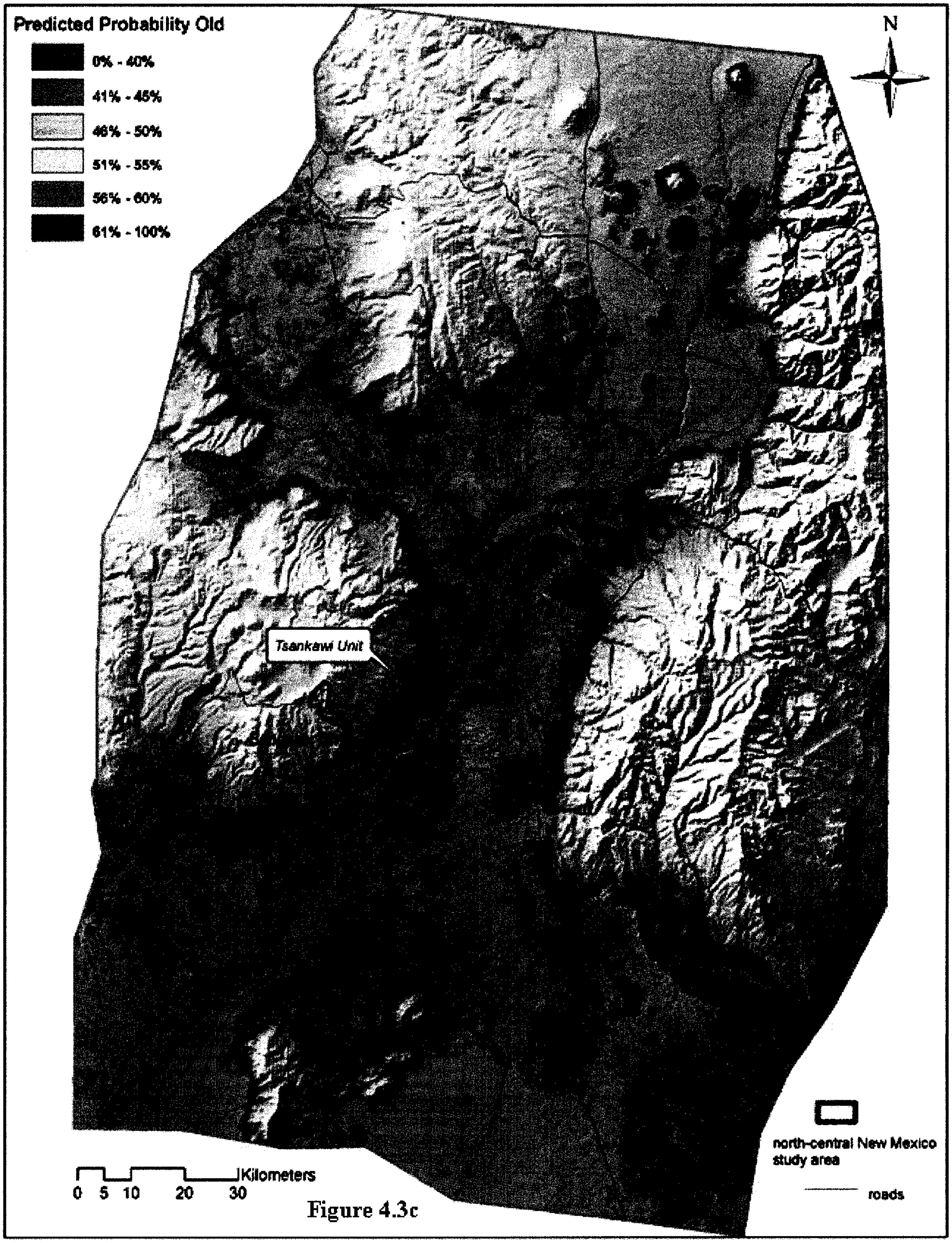
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
Tsankawi Unit
north-central New Mexico study area
roads
0 5 10 20 30
Kilometers

Figure 4.3c

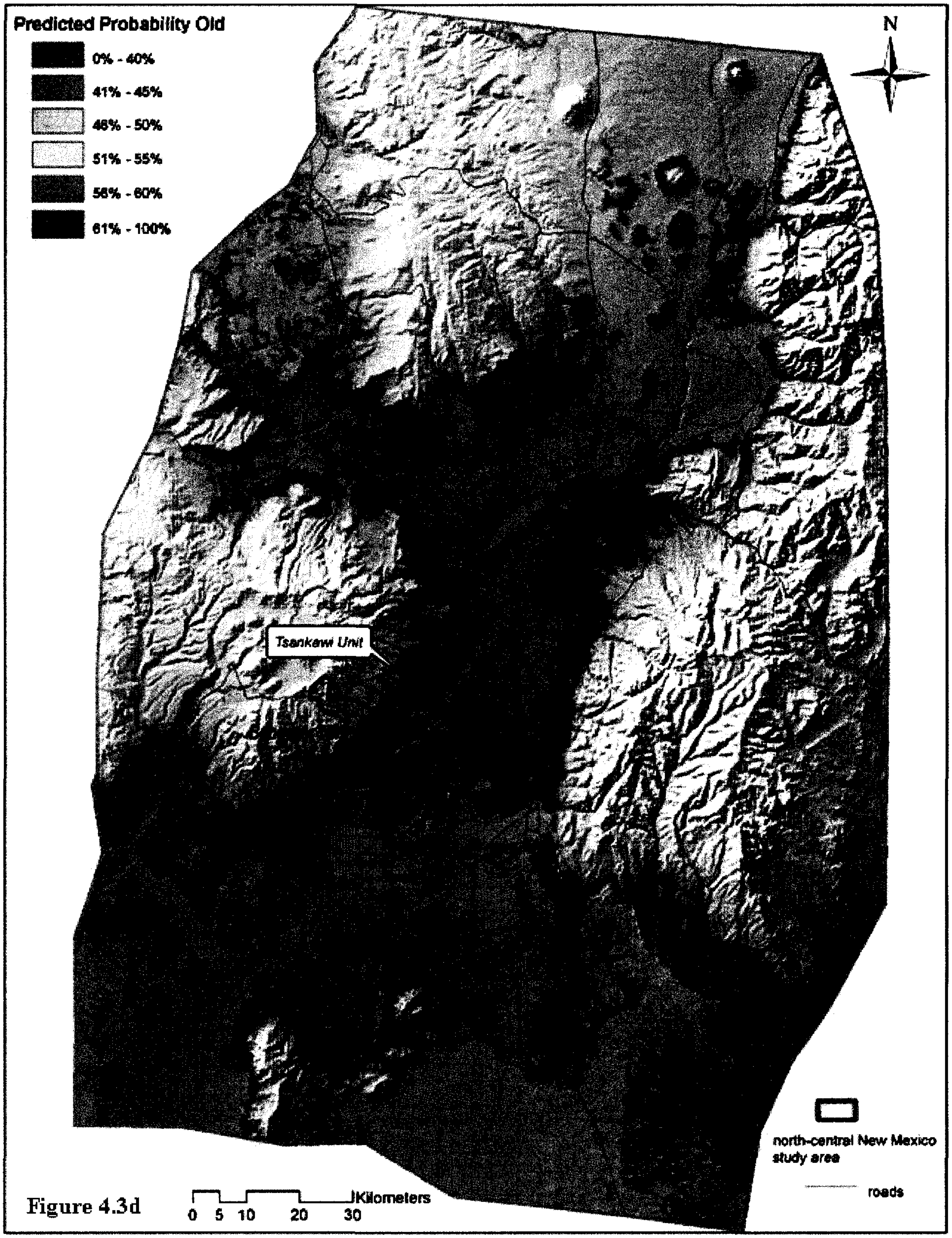
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
Tsankawi Unit
north-central New Mexico study area
roads
Kilometers
0 5 10 20 30

Figure 4.3d

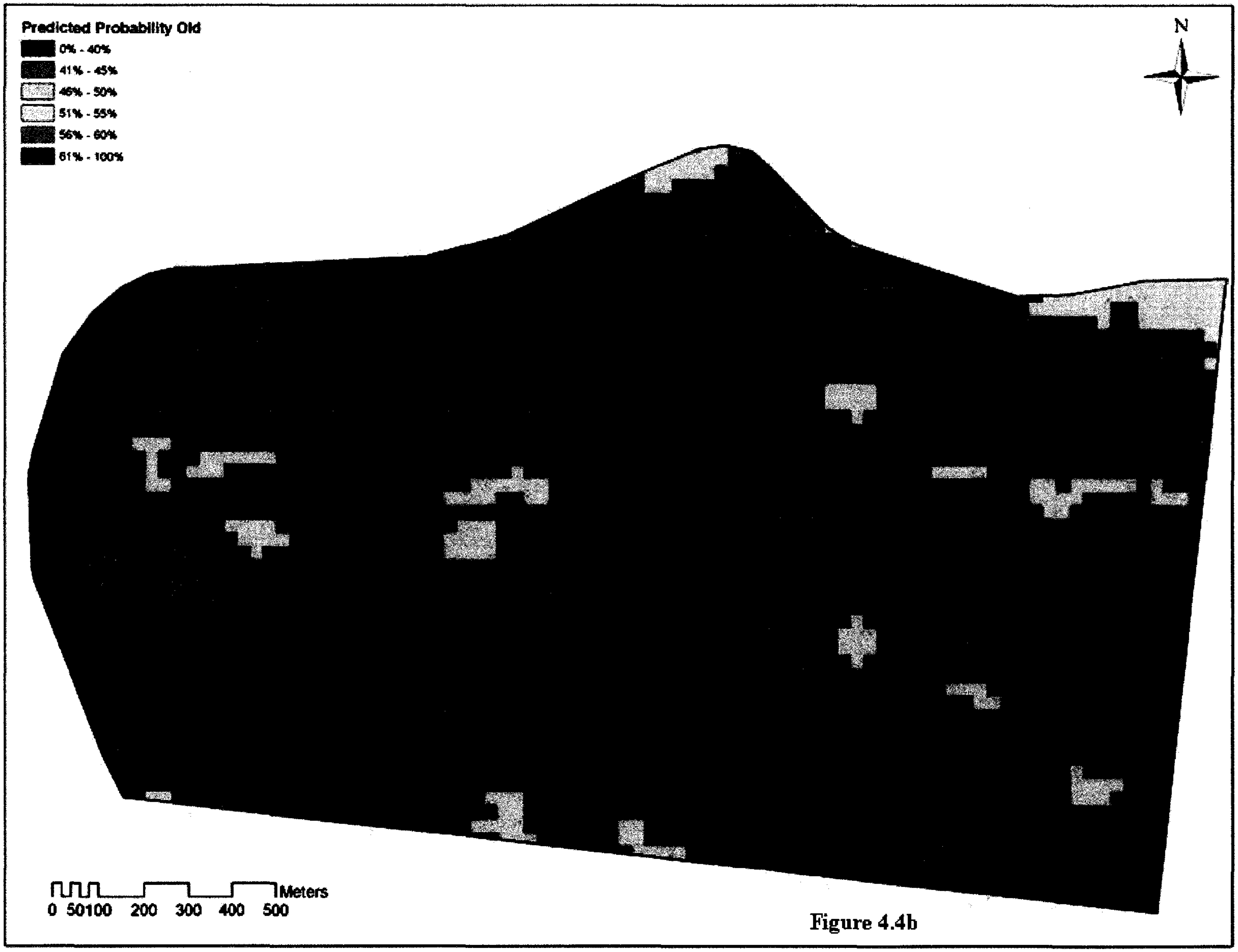
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
0 50100 200 300 400 500
Meters

Figure 4.4b

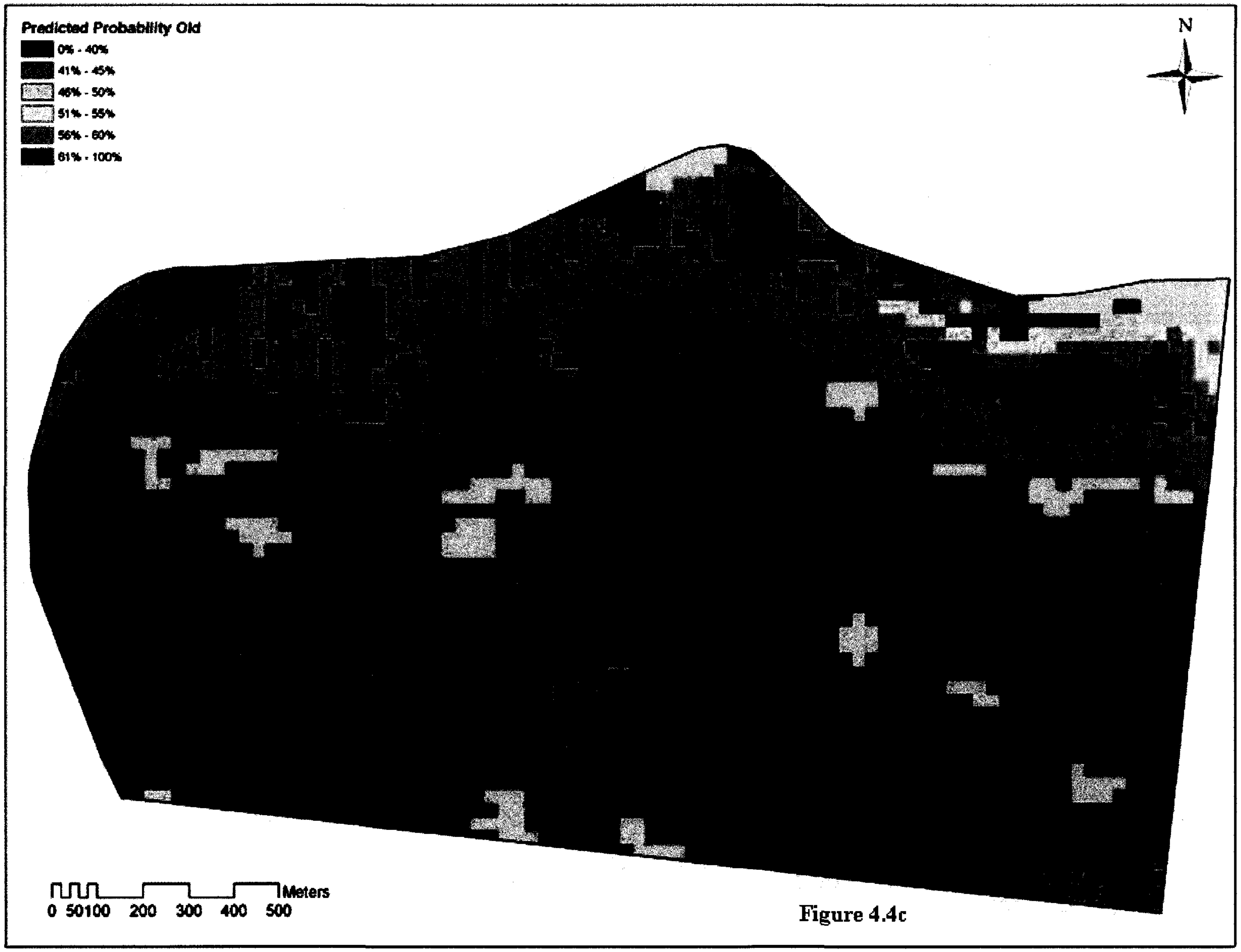
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
0 50100 200 300 400 500
Meters

Figure 4.4c

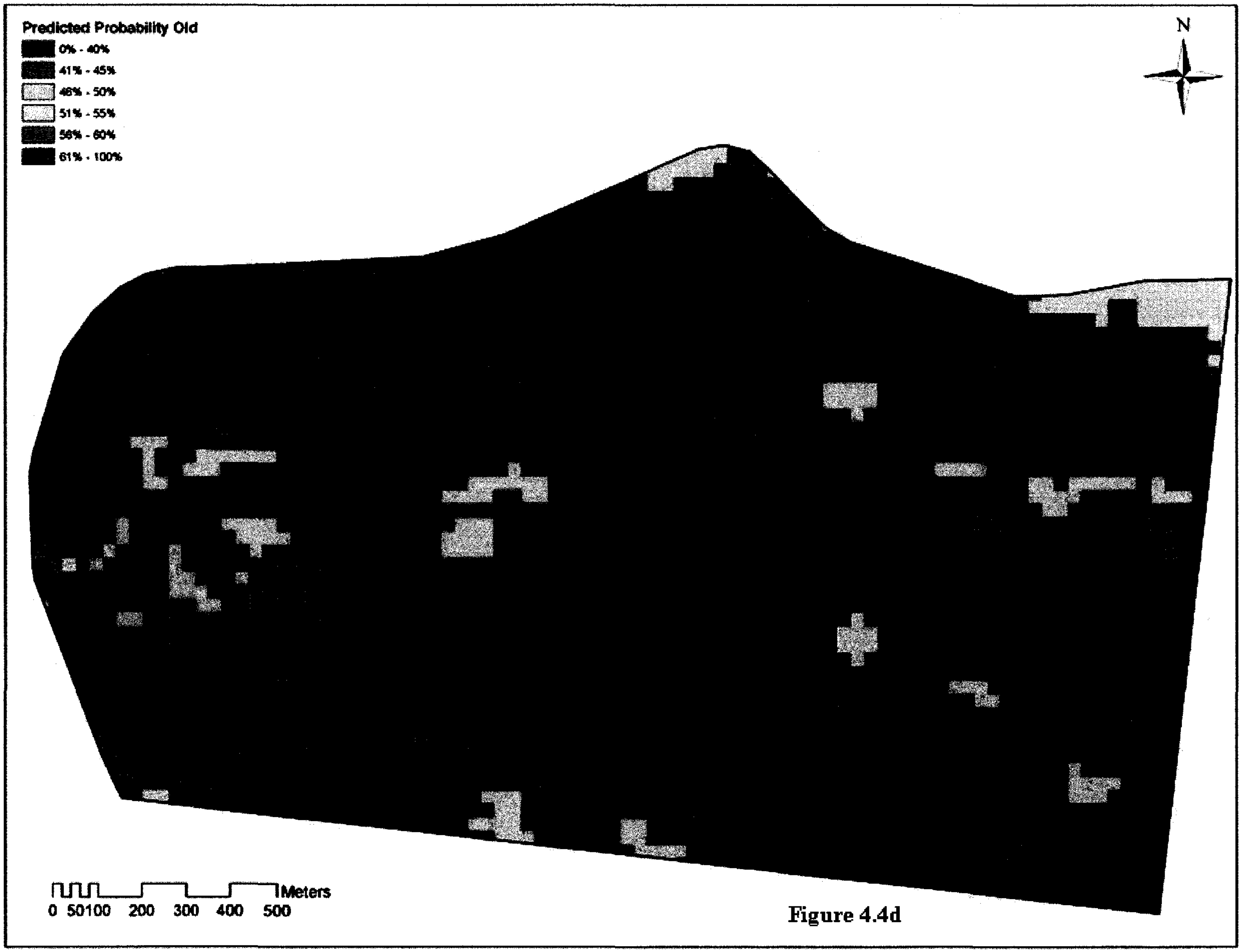
Predicted Probability Old
0% - 40%
41% - 45%
46% - 50%
51% - 55%
56% - 60%
61% - 100%
N
0 50100 200 300 400 500
Meters

Figure 4.4d

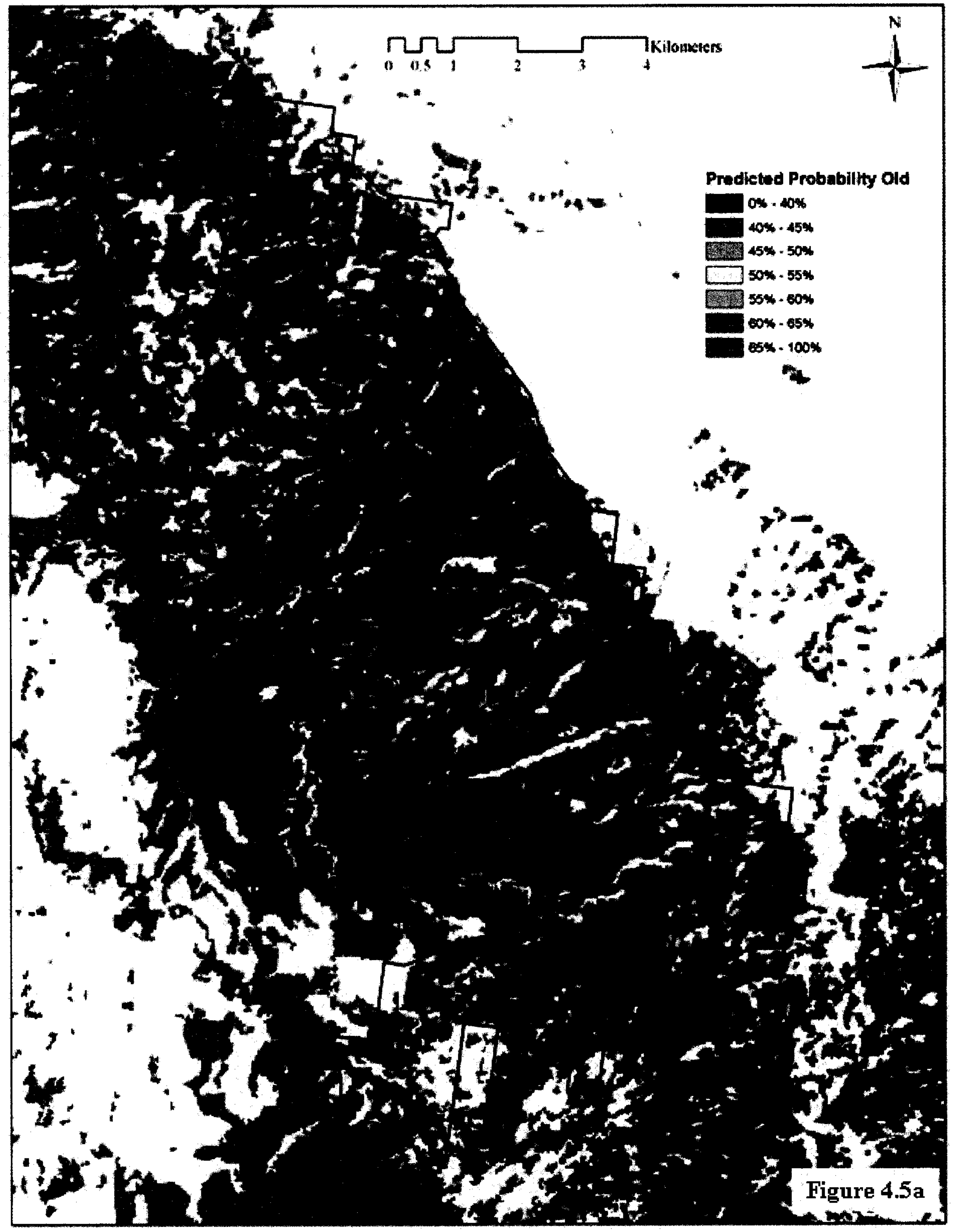
Kilometers
0
0.5
1
2
3
4
N
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%

Figure 4.5a


Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
0 0.5 1 2 3 4 Kilometers
N
esa Verde

Figure 4.5b

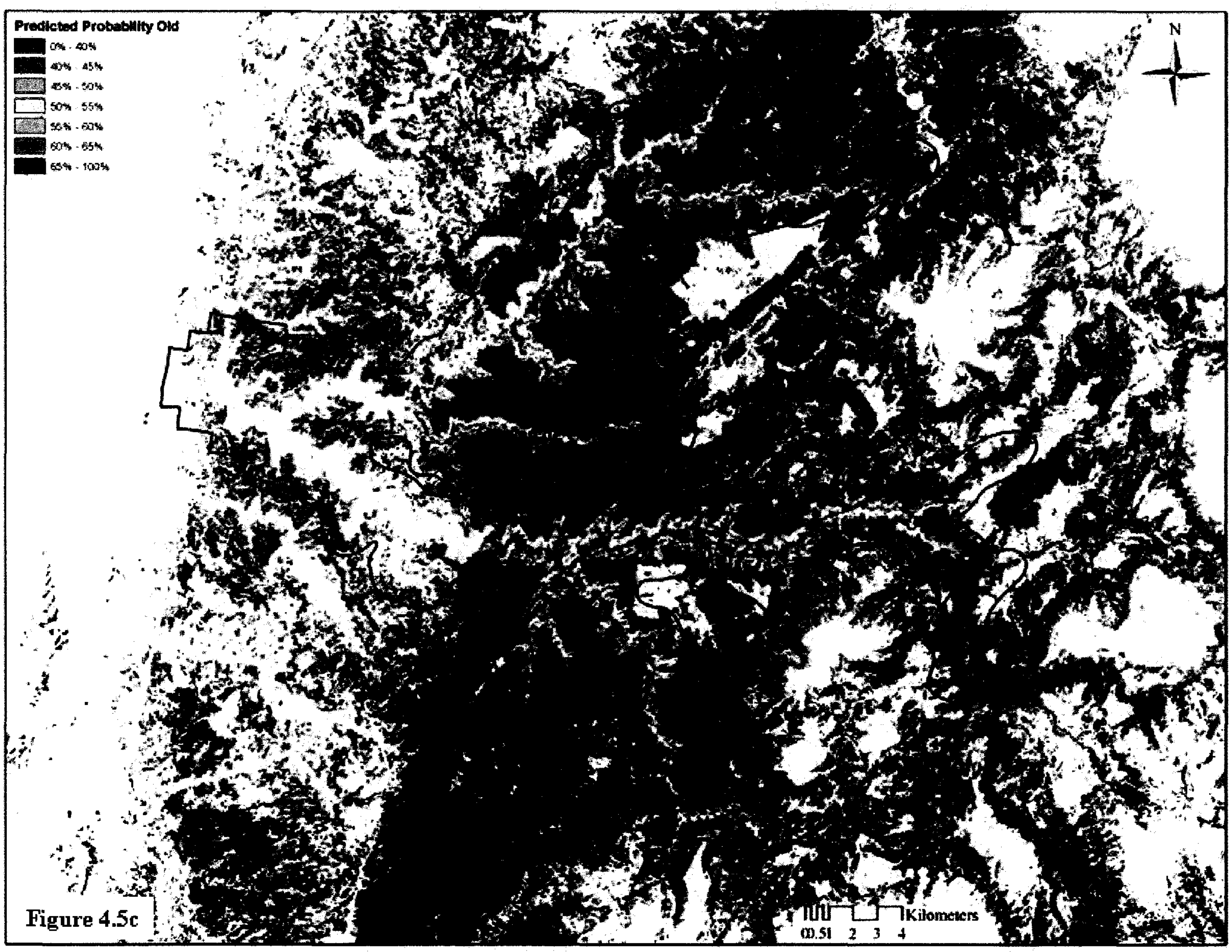
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
N
0 0.5 1 2 3 4
Kilometers

Figure 4.5c

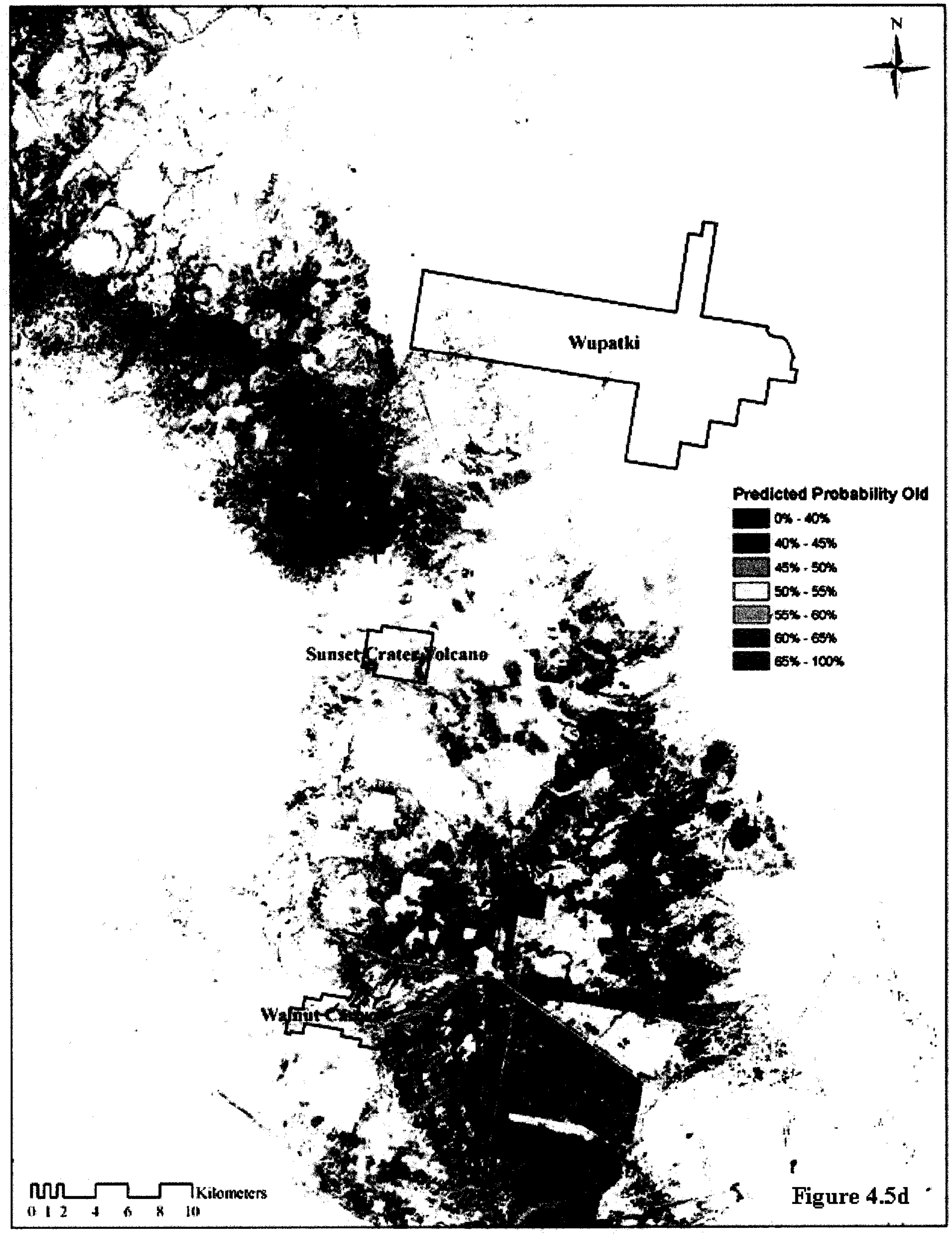
N
Wupatki
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
Sunset Crater Volcano
Walnut Canyon
Kilometers
0 1 2 4 6 8 10

Figure 4.5d

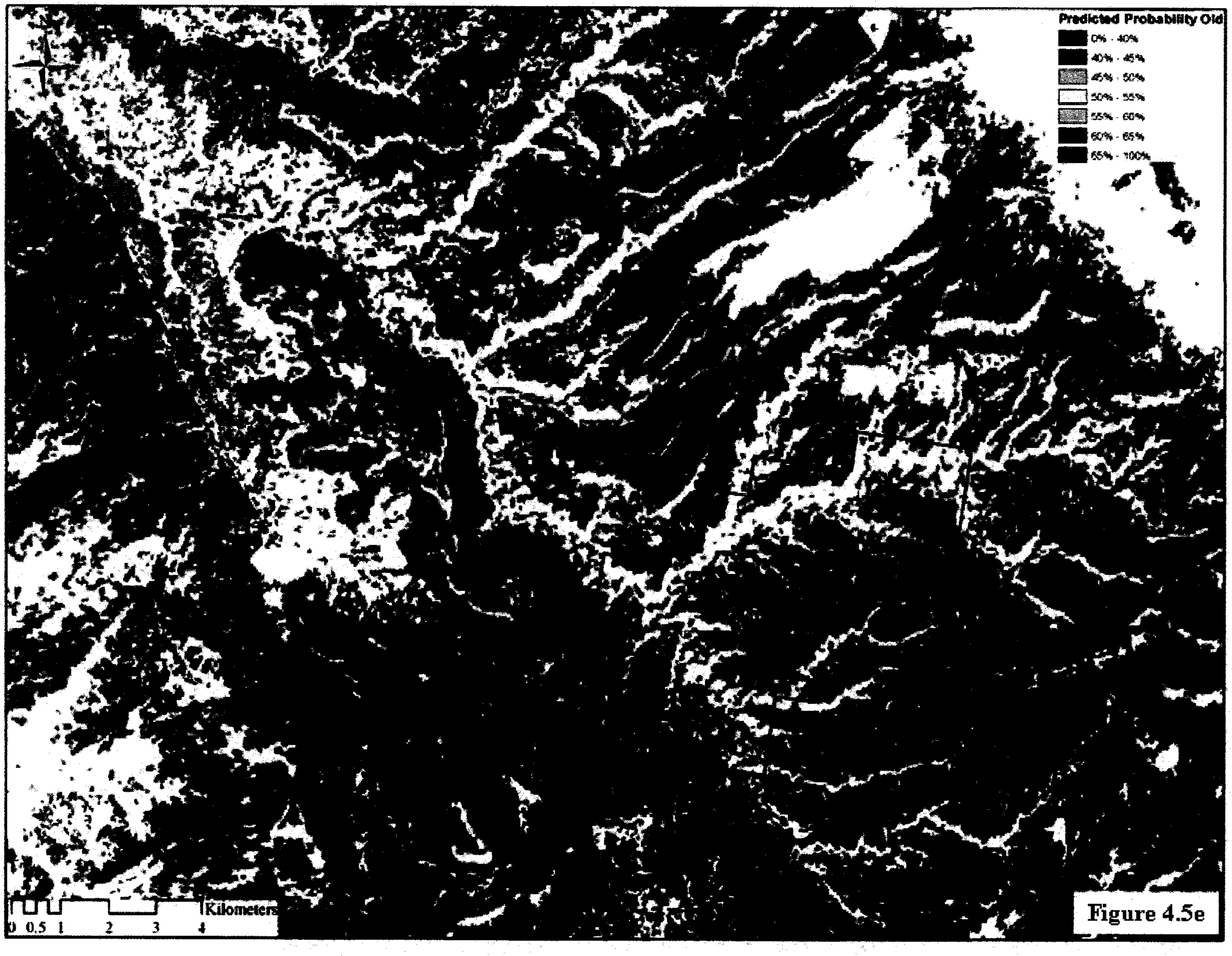
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
0 0.5 1 2 3 4
Kilometers

Figure 4.5e


Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
N
Morro
0 0.5 1 2 3 4
Kilometers

Figure 4.5f

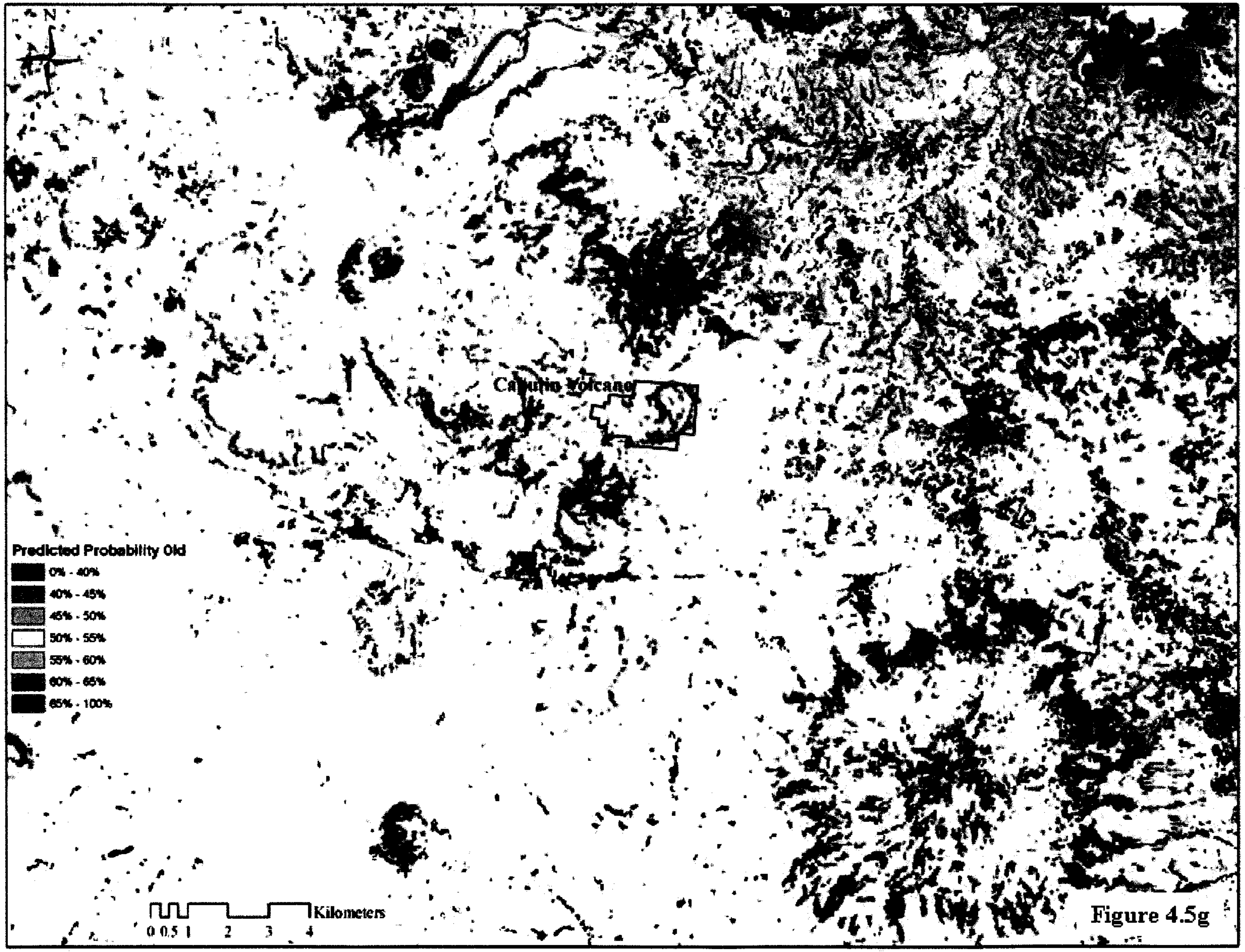
N
Capulin Volcano
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
0 0.5 1 2 3 4
Kilometers

Figure 4.5g

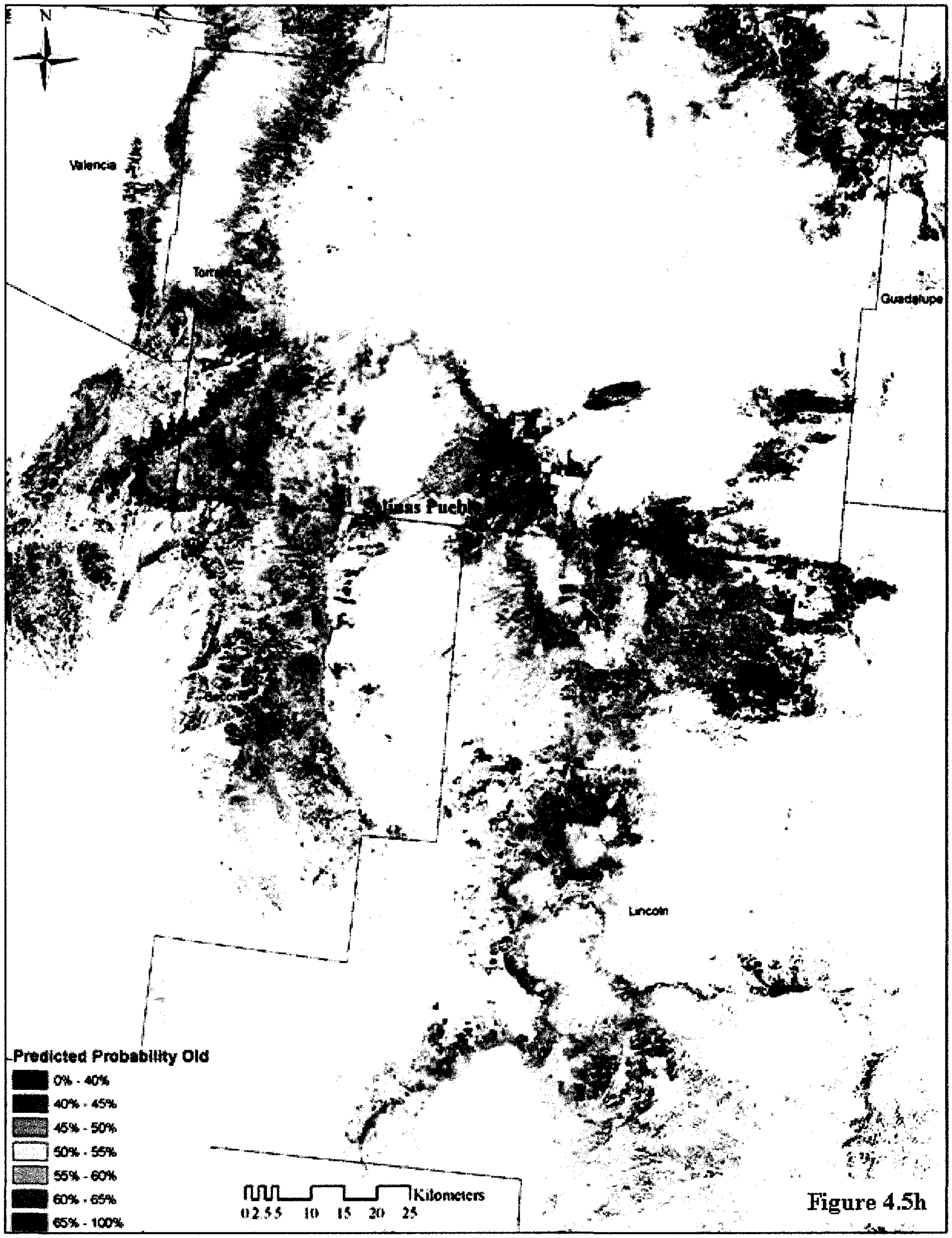
N
Valencia
Torrance
Guadalupe
Salinas Pueblo
Lincoln
Predicted Probability Old
0% - 40%
40% - 45%
45% - 50%
50% - 55%
55% - 60%
60% - 65%
65% - 100%
0 2.5 5 10 15 20 25
Kilometers

Figure 4.5h

Chapter V

Synopsis of Dissertation Research and Ecological Implications of Regional Scale Models: Interpreting Patterns and Process in Southwestern U.S. Piñon-Juniper Systems

Synopsis of Work

A prospectus of the current study is outlined in Chapter One and was based largely on the original proposal for doctoral research developed in 2004. In Chapter Two, I present an overview of the current distribution of southwestern U.S. (i.e. *Pinus edulis-Juniperus osteosperma/ J. monosperma/ J. scopulorum*) woodland types and component species along with a discussion of landscape patterns, stand structures, and disturbance regimes commonly observed in extant communities. This chapter was developed initially for an invited presentation to the Society of American Foresters who conducted a workshop on piñon-juniper in 2006; subsequently I submitted a revised version for publication in the workshop proceedings (Jacobs, 2008). Chapter Two also discusses important ecological controls of current and past woodland distribution, in particular seasonal precipitation patterns, soil moisture, drought, insect, and fire induced mortality, as well as the potential direct and indirect effects of historic landuse (e.g. harvest and grazing). Extant woodland distributions and assumed environmental controls are used as a basis for interpreting observed and perceived changes in southwestern U.S. woodlands since Euro-American settlement (ca. 1850).

Historic changes in woodlands can be alternatively viewed as 1) natural stand demographics/ dynamics including: recovery from fire/ drought/ insect disturbances and ongoing Holocene climate induced migration versus 2) an anthropogenic facilitated response to historic grazing including: reductions in understory competition and/ or fire disturbance, and recovery from (pre-) historic harvest. The central question addressed by my study is whether pre- and post- settlement woodlands occupy the same ecological space (supporting a natural demographic or climatic migration interpretation). Alternatively, do "younger" post-settlement stands tend to occur in a discrete and separate range of habitats (i.e. from "older" woodlands), suggesting a relaxation of pre-settlement competitive and disturbance constraints which allowed woodland to colonize previously unavailable locations.

My research program first evaluated whether "older" pre-settlement woodlands could be reliably distinguished from "younger" post-settlement woodlands (ca. 1850) using a set of semi-quantitative and qualitative criteria as a prerequisite for planned modeling efforts. Using the intensive plot dataset I developed a diagnostic key to facilitate assignment of an "old" versus "young" stand-age to sampled stands. The key was tested using intensive plot data from Bandelier National Monument and then used to assign stand-age to sampled extensive stands within a north-central New Mexico study area. Subsequently, tree-age data collected from selected regional extensive plots was used to calibrate the key for use across the larger Four Corners states study area.

Sampling and modeling efforts were conducted initially within the north-central New Mexico study area and then extended across the larger regional extent. Sampled plots were assigned a pre- versus post-settlement stand-age and each sample point was associated with a suite of potential topographic, climatic, and edaphic parameters with a GIS. Modeling employed both parametric (i.e. logistic regression) and non-parametric (i.e. multivariate adaptive regression splines) techniques and was implemented at several extents ranging from north-central New Mexico to the entire Four Corners states. Chapter

Three (Jacobs et. al., 2008) presents the results of modeling efforts at the north-central New Mexico extent and using parametric methods only and was published in the October 2008 issue of Ecological Applications. Chapter Four includes results of modeling across multiple extents including north-central New Mexico, the respective ranges of one-seed versus Utah Juniper, and the entire Four Corners states region, and using both parametric and non-parametric techniques.

Key Findings

My findings suggest portions of the southwestern U.S. with strong monsoonal (summer moisture) patterns have been the most susceptible to historical woodland expansion. However, even here many stands still have pre-settlement origins and old-growth structure is not uncommon in appropriate upland settings. Observed patterns of woodland expansion can be largely attributed to establishment of one-seed juniper into historically degraded grasslands in depositional valley and terrace settings. Where seasonal moisture patterns are weakly bimodal or winter-dominated, the occurrence of "young", post-settlement woodlands becomes correspondingly less frequent. "Younger", post-settlement woodlands appear to occupy a distinct ecological space from "older" or persistent woodlands and this result suggests historic grazing practices and associated effects (e.g. reduced herbaceous competition and fire effects) likely played a major role in facilitating observed historic woodland changes (e.g.. expansion).

System Dynamics and Ecological Patterns

The current study is relevant to an understanding of how savanna-like structures (including ecotonal boundaries between tree and grass-shrub dominated patches) are created and maintained. In the case of southwestern U.S. woodland systems there appear to be several important factors regulating both internal stand structure and ecotonal boundaries. These include precipitation (both amount and seasonality) which in our area is strongly correlated with elevation such that structurally woodlands are commonly observed to range from open savanna-like structures at lower and more xeric settings to closed forest at the upper, mesic end. Soils are closely associated with topographic setting and often define the potential productivity of a site, as well influencing the possible vegetation types and structures which can occur. The available species pool and the unique morphologies and life histories of component species will create dynamic feedbacks that influence potential disturbance patterns. From a mechanistic standpoint, a one-seed juniper expansion into grasslands was likely facilitated by grazing which reduced herbaceous competition and disturbed soils, while potentially mitigating lethal fire effects. A comparable Utah juniper expansion pattern in contrast would have had to occur primarily into surrounding shrublands where grazing effects may have acted to increase shrub cover and enhance understory competitive interactions (i.e. with tree seedlings), while also increasing fire return intervals. Finally there is the temporal and spatial scale of vegetation and disturbance dynamics, which at any particular reference point may suggest stability while longer term or larger scale patterns often reveal the opposite; that is an ecotone or savanna structure may exist more as an intermediate phase in an ongoing dynamic process than as a static reality.

Woodland vegetation is dynamic and positive feedbacks can sometimes mitigate environmental or disturbance constraints. For example, once established woodland vegetation can persist even in strongly depositional settings, if trees effectively suppress understory cover and potential for surface fire or alter hydrologic and soil properties (Schlesinger and Pilmanis, 1998; West and Van Pelt, 1987). I suggest that if woodland can successfully establish onto deep soil sites during relatively moist periods, it may (in the absence of subsequent drought, insect, or fire related mortality) proceed to a closed canopy woodland and suppression of understory vegetation. Alternatively, prolonged droughts which limit deep water recharge during early stages of woodland establishment, or where woodlands have colonized settings with argillic horizons that inhibit infiltration and development of deep root systems, may intensify competitive interactions with established shrub and herbaceous cover (and result in tree mortality). Enhanced growing season moisture may also affect the qualitative appearance (of individual trees and stands), effectively shortening average lifespan, while enhancing decomposition rates and growth of lichens; cumulatively this can present a misleading picture of advanced age in some strongly monsoonal areas. My regional core samples (Appendix A) suggest rapid growth rates during early years in monsoonal climates (perhaps corresponding to favorable establishment windows) versus more uniform growth rates throughout the life of a tree in winter moisture areas. However, suppressed individuals growing under mature nurse trees can be expected to exhibit slow growth rates until released, even under monsoonal influence.

Within their distributional ranges, the local occurrence of piñon and juniper species is commonly interpreted to be a function of favorable edaphic and topographic settings, which provide both sufficient moisture (for establishment and long-term persistence), and protection from surface fire or competitive effects (mediated by understory components). Relaxation of these local controls on occurrence (e.g., fire disturbance and understory competition) through historic grazing practices during the last 150 years is thought to have facilitated expansion of piñon-juniper woodland elements into former grass and shrub dominated communities (Miller and Tausch, 2001). Many piñon-juniper woodlands have also become denser, but the proximal causes (e.g., interruption of surface fire and/ or reduction of understory competitive effects by domestic grazing pressure) typically offered for changes in stand structure are generally unsubstantiated. Moreover, convincing evidence for surface fire disturbance in many piñon-juniper woodlands is often lacking or anecdotal (Baker and Shinneman, 2004). However, surface fire was an important disturbance process in many adjacent grass, shrub, and pine savanna communities, and in this role effectively reinforced woodland boundaries. While some shrub communities likely had longer fire return intervals, these still would have been too short, and the associated fires too severe, for persistence of woodland (Baker, personal communication).

Properly interpreting the ecological role of fire as a disturbance process in southwestern woodlands then is a potentially important component of our understanding and management of these systems. Fire evidence is generally in the form of burned juniper (and occasionally piñon) stumps, logs, and snags (Gottfried et. al., 1995; Baker and

Shinneman, 2004; Floyd et. al., 2004, 2008). Piñon pine, Utah, one-seed, and Rocky Mountain juniper are extremely sensitive to fire effects, seldom scarring, and often killed by even moderate fire behavior. There are a number of possible factors (i.e., from thin bark, or susceptibility to disease after injury, flammability of the foliage, and inability to recover from loss of canopy) that might account for the sensitivity of these species to fire, but the net result of fire disturbance in most instances appears to be high mortality of all age and size classes within burned areas. Individuals that survive fire events may often have simply avoided lethal fire effects (by some combination of chance, discontinuous or insufficient fuels). Juniper remains (charred or not) can persist on most sites for hundreds of years, while piñon usually degrades much more rapidly (Kearns et. al., 2005). Fire scars, recorded by piñon and/ or juniper trees that survived a fire event are infrequent, and woodland trees recording multiple fire events are apparently rare (Baker and Shinneman, 2004). Even when present, scarred trees may sometimes be incidental to the predominant fire pattern, for example located at ecotones with high fire frequency systems like Ponderosa savanna, or reflective an extremely fine grained and patchy crown fire type behavior (Floyd et. al., 2008). However, the physical record available to interpret past fire events in woodlands might be misleading; low intensity surface fire might not scar or kill larger individuals and thus would leave little or no evidence, while more intense fires which scar surviving trees, or create patches and openings with burnt snags and stumps, and initiate pulsed recruitment of recognizable post-fire cohorts, would appear to be the only mode of fire disturbance.

Successional patterns following crown fire in woodland systems, where herbaceous and / or shrub stages are progressively re-colonized by woodland tree species can vary greatly depending on the nature of the fire (size and intensity which affect survivorship and seed source), climatic patterns, and understory response. Re-establishment of woodland onto burned sites can range from several decades to several hundred years or more, with type conversion to non-woodland in extreme cases (Floyd et. al., 2004). An extended grass-forb-shrub successional phase may be typical of some productive sites where a robust understory effectively limits woodland recruitment through some combination of competitive exclusion and frequent fire. Given this general pattern of lethal fire effects, climatic extremes (wet and dry) and associated bark beetle or disease induced mortality events, along with inter- and intra-specific competitive effects, thus may be more important than previously thought in controlling woodland stand structure (Eisenhart, 2004) through the combined effects of pulsed recruitment, self-thinning, and differential mortality.

Many pre-settlement aged woodland communities, lacking any apparent fire disturbance or for which the return intervals are so long that evidence of the last fire is not discernable, are then apparently structured by the cumulative effects of differential establishment and mortality patterns related to site conditions, time since last disturbance, drought, insect, disease and intra-/inter- competition. An absence of fire is relative to the time period a site has been occupied by woodland; for example, many expansive post-settlement aged woodlands are thought to have developed as a consequence of historic grazing practices, which simultaneously reduced herbaceous competition and surface fuels (across a range of grass, shrub, and pine savanna types), promoting tree establishment while minimizing potential for fire effects lethal to woody plants. There are also many examples of "older", pre-settlement aged woodlands, with little to no fire evidence, that apparently do not require periodic fire disturbance to maintain structural or compositional integrity. Fire disturbance then occurred in some pre-settlement woodland systems, affecting structural and compositional attributes of these communities by creating a matrix of fine scale patches or larger openings and associated successional patterns. In many other pre-settlement status woodlands however, the apparent absence of, or long time interval between, fire disturbance events appears to pose no particular ecological crisis.

Management Implications

Woodland communities and their associated disturbance regimes, successional patterns, and suites of linked biotic organisms are a tangible ecological entity that researchers can study, the public can appreciate, and agencies can manage. My research highlights the underlying environmental controls which tend to promote occurrence and persistence of one or more woodland tree species in particular topo-edaphic-climatic settings, but climatic conditions and associated vegetation assemblages are, have been, and always will be a dynamic and (albeit slowly) moving target. Recent paleo-vegetation findings have highlighted the transient and even unique nature of modern plant assemblages relative to those recorded during prior interglacial periods (Betancourt, 1987). The dilemma for land managers is setting appropriate desired future conditions or target communities given this context and the overlay of historic and recent landuse effects. I believe a flexible ecological framework is an essential perspective today given the problematic nature of reconstructing vegetation structure or system process at sufficient levels of resolution or determining whether these would in any event are still relevant for current or future management. Certainly a full understanding of a plant community can only benefit management, but I increasingly believe this information is most useful not for recreating past conditions, but for appreciating the alternative potentials of individual species and sites. A renewed emphasis should be placed on maintaining functionality of ecological systems (and services), within the general context of historical (structural and compositional) reference conditions. Moreover, I believe many disturbance patterns often associated with woodland systems should be strictly viewed as intrinsic or recurring properties linked to particular sites or plant communities, but as emergent phenomenon with a dynamic nature that are opportunistic in occurrence. What this means for management of woodland communities is the application of a more flexible approach, incorporating the ideas of site potential and potential natural vegetation, to enhance desired future condition targets based initially on historical reference conditions and thus facilitate appropriate treatments and successful outcomes.

Conclusion

This study provides a much needed regional context for interpreting pattern and process in southwestern U.S. piñon-juniper systems. The broad diversity of woodlands systems within the southwestern U.S. is highlighted while differentiating among the unique component species, ecological controls, woodland types, stand structures, landscape patterns, and disturbance regimes across a range of climate settings. I outline a clear distinction between "young" expansion stands (i.e. those invading formerly non-woodland vegetation types) versus infill or thickening processes within pre-existing woodland stands. My model and predictive map results illustrate that the majority of woodland expansion in the southwestern U.S. is spatially correlated with both the distribution of one-seed juniper and the summer monsoonal pattern. Conversely, my work predicts a predominance of "older" woodland in winter moisture dominated areas and by inference suggests that historic changes reported for those areas are perhaps driven more by thickening/ infill of pre-existing woodland-shrub mosaics as well as by natural demographics of stand development following recovery from (harvest, drought, insect, and/ or fire) disturbances. Ecotonal boundaries between "older" woodland, "younger" expansion stands, and grass or shrub-lands often appear blurred within monsoonal areas highlighting recent establishment dynamics. In contrast, winter moisture locations typically have well defined woodland ecotones (typically with shrublands) and "young" expansion stands are not commonly observed in productive valley and terrace settings.

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Appendices

Regional Datasets and Computation Details of Metric Development

Appendix A. Regional core data used to calibrate diagnostic key

Key to Row Headers:
p#_ = piñon core # (sequential for each named site)
p#_dia = measured piñon tree diameter at core height (~30cm above base)
p#_ring = ring count of piñon core
p#_xdate = cross-dated pith date (unadjusted for height above ground)
p#_age = cross-dated tree age (calculated as sample date minus pith date)
na = unable to cross-date

Spreadsheet Notes: An excel spreadsheet with the cross-dates for regional piñon samples (including the 3+ oldest trees cored from the intensive plot stands) which were ring-counted and cross-dated. Ring counts were generally conservative and underestimated actual age, with the discrepancy increasing with tree age. At Bandelier, ring-counts underestimated cross-dated ages by an average 34 years (and regression developed using ring counts similarly under estimate cross-dated age by an average of 35 years). However, ring-counts for younger trees (<150 years) are generally within 15 years or less of the cross-dated age. Cross-dating was an attempt to validate correlations of ring-count with diameter and used to provide an estimate of a pre- versus post-settlement stand age (in combination with the qualitative criteria). Based on these data, trees classified as "old" on the basis of ring-counts were almost never found to be younger on the basis of cross-dating. As noted the discrepancy with younger, post-settlement trees (i.e. such as in Lincoln County and at Mesa Verde) was incrementally smaller, and was generally insufficient to warrant switching stand age assignments based on ring-counts (i.e. most stands assigned "young" on basis of ring-counts were still young using cross-dated ages).

SITE	p1_dia	p1_ring	p1_xdate	p1_age	p2_dia	p2_ring	p2_xdate	p2_age	p3_dia	p3_ring	p3_xdate	p3_age	p4_dia	p4_ring	p4_xdate	p4_age
BAND1	28	174	1785	220	39.5	210	1750	255	28.5	210	1785	220				na
BAND2	27.5	154	1798	207	27.5	162	1809	196	28	168	1795	210	27.5	154	1790	215
BAND3	39	185	1788	217	42.5	210	1738	267	40	180	1786	219	18.5	65		na
BAND4	28	175	1786	219	34	160	1806	199	37.5	196	1799	206	38.5	173	1797	208
BAND5	32	210	1748	257	35.5	220	1747	258	32	220	1740	265				na
BAND6	38	150	1844	161	30	180	1821	184	36	160	1823	182				na
Carson1	28.5	250	1730	275	28	216	1713	292	37	270	1726	279	31	220	1730	275
Carson2	36	283	1692	313	29.5	295	1688	317	34.5	190	1793	212	35	295	1651	354
COLM2	33.5	280	1680	325				na				na				na
COLM3	24	225		na	29	345	1633	372				na				na
COLM4	48	290	1695	310	28	320	1633	372	29	316	1665	340	38	310	1663	342
COLM5	37.5	375	1510	495	26	280	1700	305	27	276	1715	290	38	490	1498	507
COLM6	46.5	580	1396	609	33.5	483		na	32	315	1683	322	38	375	1618	387
ELMA	41.5	170	1832	173				na				na				na
ELMO	68	401	1749	256	65	305	1685	320	42	123	1884	121	33	284	1708	297
Hayden	35	175	1823	182	39.5	232	1763	242	34.5	236	1758	247	36.5	162	1838	167
Lincoln308	35.5	250	1715	290				na				na				na
Lincoln329	27.5	213		na				na				na				na
Lincoln330	27	103	1903	102	30.5	138	1852	153	24.5	80	1903	102	31.5	142	1850	155
Lincoln331	34	156		na	31	174	1818	187	22.5	150	1827	178				na
Lincoln333	42	105	1902	103				na				na				na
Lincoln337	48	155	1850	155				na				na				na
Manzano217	17.5	110	1870	135				na				na				na
Manzano221	36	152	1854	151				na				na				na
McCoy	44.5	350		na	44	460		na	43.5	285	1719	286	32.5	305	1680	325
MEVE1	28	270	1690	315	41	260	1720	285				na				na
MEVE2	33	295		na	40	280	1685	320	29	210	1740	265	32.5	345	1578	427
MEVE3	57	435	1550	455	48	330	1640	365	50	395	1550	455	39	363	1606	399
MEVE4	33	215	1769	236	25.5	233	1762	243	36.5	274	1706	299	29	176	1822	183
MEVE5	24	217	1776	229	33.5	193	1795	210	27.5	254	1718	287				na
MEVE6	25	80	1920	85	37	97	1908	97	24.5	60	1940	65	31	90	1915	90
MEVE7	42	175	1796	209	37.5	208	1790	215	36	180	1815	190	36.5	135	1868	137
MEVE8	20.5	94	1912	93	29	90	1905	100	20	45	1959	46				na
NMFISH	53.5	250	1818	187	40	430	1551	454	46	470		na	40	300	1733	272
Owl47	71	424		na	59.5	480	1518	487				na				na
Pecos	47	400		na	37.5	245	1735	270	46	355		na	54	480	1460	545

SITE	p1_dia	p1_ring	p1_xdate	p1_age	p2_dia	p2_ring	p2_xdate	p2_age	p3_dia	p3_ring	p3_xdate	p3_age	p4_dia	p4_ring	p4_xdate	p4_age
Perham	41	310	1680	325	48	380		na	53.5	460		na	46	380	1602	403
Poncho1	38.5	255	1734	271	40	200	1785	220	47	520		na	30	170	1810	195
Poncho2	28	170	1820	185	23	280		na	29	300	1660	345	33	250		na
Ruby	37	315		na	52	390	1580	425	29	170	1825	180	29.5	165	1825	180
Tablas	50	270	1710	295	43	285	1698	307	48	360	1645	360	49	235	1762	243
UP	71.5	368	1610	395				na				na				na
Utah12	31.5	295		na	40	380		na	24.5	190	1780	225				na
Utah34	47	300	1693	312				na				na				na
Utah56	43	250	1743	262	40	350	1620	385	56	252	1715	290				na

SITE	p5_dia	p5_ring	p5_xdate	p5_age	p6_dia	p6_ring	p6_xdate	p6_age	p7_dia	p7_ring	p7_xdate	p7_age	p8_dia	p8_ring	p8_xdate	p8_age
BAND1				na				na				na				na
BAND2	58	254	1723	282				na				na				na
BAND3	42.5	210	1738	267				na				na				na
BAND4				na				na				na				na
BAND5				na				na				na				na
BAND6				na				na				na				na
Carson1	38	260	1713	292				na				na				na
Carson2	30	305	1678	327	35	350	1615	390	42.5	316	1656	349				na
COLM2				na				na				na				na
COLM3				na				na				na				na
COLM4	28	260	1706	299	44	510	1420	585	35	270	1733	272	35.5	335	1620	385
COLM5	27	345	1595	410	41	490	1470	535				na				na
COLM6	45.5	405	1550	455	42.5	463	1481	524				na				na
ELMA				na				na				na				na
ELMO	35	270	1702	303	30.5	240	1743	262				na				na
Hayden	28.5	103	1899	106				na				na				na
Lincoln308				na				na				na				na
Lincoln329				na				na				na				na
Lincoln330				na				na				na				na
Lincoln331				na				na				na				na
Lincoln333				na				na				na				na
Lincoln337				na				na				na				na
Manzano217				na				na				na				na
Manzano221				na				na				na				na
McCoy	41.5	275	1716	289	60.5	rotten		na	62	628		na				na
MEVE1				na				na				na				na
MEVE2	41.5	360	1598	407				na				na				na
MEVE3				na				na				na				na
MEVE4	32.5	192	1796	209				na				na				na
MEVE5				na				na				na				na
MEVE6				na				na				na				na
MEVE7	52	220	1781	224	29.5	103	1895	110				na				na
MEVE8				na				na				na				na
NMFISH	59	390		na				na				na				na
Owl47				na				na				na				na
Pecos	50.5	405	1540	465	52	372	1630	375				na				na

SITE	p5_dia	p5_ring	p5_xdate	p5_age	p6_dia	p6_ring	p6_xdate	p6_age	p7_dia	p7_ring	p7_xdate	p7_age	p8_dia	p8_ring	p8_xdate	p8_age
Perham	66	360	1600	405	68	470		na				na				na
Poncho1	39	190	1795	210	37	285	1695	310				na				na
Poncho2	43	215		na	35	210	1762	243				na				na
Ruby	52.5	530		na				na				na				na
Tablas	43	382	1609	396				na				na				na
UP				na				na				na				na
Utah12				na				na				na				na
Utah34				na				na				na				na
Utah56				na				na				na				na

Appendix B. Computation details of metric development including selected raster calculator code for implementation within a GIS

Computational Overview of Metric Development

Topographic Metrics

1) procure gridded Digital Elevation Model (DEM) for study area from USGS-EROS
2) project to Albers Equal Area Conic, NAD 83
3) calculate [slope] (in degrees) using standard ArcGIS utility
4) calculate seasonal (summer and winter) hillshade values using standard ArcGIS utility
(using sun altitude-angle parameters for June 21 and December 21 at 1300 hours at specified locations)
5) calculate flow direction and flow accumulation using standard ArcGIS utility

Climate Metrics

1) procure gridded climate data study area from PRISM (or Climate Source)
2) project to Albers Equal Area Conic, NAD 83
3) calculate index of seasonal moisture
(June to September and October to May totals as percent of annual)
4) calculate absolute index of seasonal temperature (adding a constant to ensure only positive values)
(June to September and October to May averages divided by annual mean)
5) calculate summer precipitation (June to September total)
6) calculate winter precipitation: (October to May total)

SWReGAP Metrics

1) procure land cover, land form, soil-geology, and ancillary datasets from SWReGAP
2) reclass land cover and retain woodland coverage
3) reclass woodland coverage to create a generic woodland analysis mask
4) convert soil-geology coverage from shape file to raster

Topo-climatic Metrics

1) calculate seasonal indices of potential evapo-transpiration (pet) where: natural log of (summer or winter) seasonal hillshade (plus a small constant to reduce influence of low values) is multiplied times corresponding (winter or summer) absolute seasonal temperature
2) reclass flow accumulation to [*FLOW*] (using flow accumulation thresholds by land form)
3) calculate index of effective summer moisture (summer precipitation / summer pet)
4) calculate index of effective winter moisture (winter precipitation / winter pet)
5) reclass land form to [*FORM*] using slope and flow accumulation thresholds

Selected Raster Calculator Code

Metric Development

Code for calculating Form and Flow Metrics

```
[FORM##]=con(([form_6] == 1) & ([slope##] <= 1), 1, con(([form_6] == 1 | 2 | 5) & ([slope##] < 3) &
([flowacc##] < 4), 4, con(([form_6] == 1 | 2 | 5) & ([slope##] >= 3) & ([slope##] < 10) & ([flowacc##] <
4), 3, con(([slope##] < 3) & ([form_6] == 2 | [form_6] == 5), 1, con(([slope##] < 3) & ([form_6] == 3 |
[form_6] > 5), 4, con(([slope##] >= 3) & ([slope##] < 10) & ([form_6] == 1 | [form_6] == 5), 2,
con(([slope##] >= 3) & ([slope##] < 10) & ([form_6] == 4 | [form_6] > 5), 3, con(([slope##] >= 10) &
([slope##] < 35), 5, con([slope##] >= 35, 6, [form_6])))))))))
```

```
[FLOW##]=con([form##] == 1, 1, con([form##] == 2, 1, con(([form##] == 3) & ([flowacc##] >= 6), 1,
con(([form##] == 4) & ([flowacc##] >= 4), 1, con(([form##] == 5) & ([flowacc##] > 25), 1, con(([form##]
== 6) & ([flowacc##] > 50), 1, 0))))))
```

Implementing Logistic Model

Code for Implementing Logistic Procedure for north-central New Mexico Model

```
[PROB##]= con([form##] == 3, (-29.4817 + 0.0681 + (63.0920 * [ewp##]) + (0.00891 * [dem##]) +
con([flow##] == 1, -2.9618, 2.9618)), con([form##] == 4, (-29.4817 + (-1.2266) + (63.0920 * [ewp##]) +
(0.00891 * [dem##]) + con([flow##] == 1, -2.9618, 2.9618)), con([form##] == 1, (-29.4817 + (-0.9161) +
(63.0920 * [ewp##])  + (0.00891 * [dem##]) + con([flow##] == 1, -2.9618, 2.9618)), con([form##] == 5, (-
29.4817 + 2.0746 + (63.0920 * [ewp##]) + (0.00891 * [dem##]) + con([flow##] == 1, -2.9618, 2.9618)))))

[PRED##]= exp([prob##]) / (1 + exp([prob##]))
```

Implementing MARS Model

Code for Calculating Base Functions [BF##] from discrete ranges of metrics

```
[BF1] = con([flow61] == 0, 1, 0)
[BF4] = max(((2.30374 - [ep61w]) * [BF1]), 0)
[BF5] = con([form61] == 1 | 2 | 4, 1, 0)
[BF7] = max(([ep61s] - 0.95113), 0)
[BF8] = max((0.95113 - [ep61s]), 0)
[BF11] = max(([hillsh61x] - 241.00000), 0)
[BF20] = max((([slope_180] - 1.78770) * [BF4]), 0)
[BF24] = max((([dem61] - 1837.89502) * [BF4]), 0)
[BF26] = max((([tmean_w] - 67.68750) * [BF11]), 0)
[BF31] = max(((9.71694 - [slope61]) * [BF1]), 0)
[BF32] = con([swsubs] == 2 | 3 | 5, 1, 0) * [BF31]
[BF36] = max((([ppt14_400] - 373.00000) * [BF31]), 0)
[BF38] = max((([ep61s] - 0.78044) * [BF31]), 0)
[BF73] = max(((2075.54004 - [dem61]) * [BF7]), 0)
[BF74] = max((([tmean_s] - 197.37500) * [BF73]), 0)
[BF75] = max(((197.37500 - [tmean_s]) * [BF73]), 0)
[BF77] = max(((6.63575 - [ppt14_400]) * [BF73]), 0)
```

Code Implementing MARS Procedure for Regional Model

```
[PROB_Region##] = (-1.1658) + (3.5408 * [BF1]) + (-7.1398 * [BF4]) + (-1.5029 * [BF5]) + (4.4180 *
[BF8]) + (0.4113 * [BF20]) + (0.0269 * [BF24]) + (0.0509 * [BF26]) + (0.2574 * [BF32]) + (0.00638 *
[BF36]) + (-0.8111 * [BF38]) + (-0.00492 * [BF74]) + (-0.00284 * [BF75]) + (0.000505 * [BF77])

[PRED_Region##]= exp([prob_region##]]) / (1 + exp([prob_region##]]))
```

Appendix C: Extensive plot dataset for regional study area (n=1129)

Key to Row Headers:
AGE = field assigned stand age using diagnostic key
PROB = leave-one-out, cross-validated, predicted individual probability of "old"
X = x coordinate (Albers Equal Area Conic, NAD83)
Y = y coordinate (Albers Equal Area Conic, NAD83)
DEM = 30m cell value from digital elevation model
WOOD = SWReGAP woodland type (1=SRM; 2=CP)
FLOW = categorized flow accumulation (0 = non-depositional, 1=depositional)
TMEANS = mean summer temperature (June-September monthly mean)
TMEANW = mean winter temperature (October-May monthly mean)
SWSUBS = soil-geology type (see Table 4.1b for details)
SLOPE180 = slope in degrees calculated from a 180m DEM
SLOPE = slope in degrees calculated from a 30m DEM
HILLM = winter hillshade (calculated for 1300 hours on December 21)
HILLX = summer hillshade (calculated for 1300 hours on June 21)
ASPECT = aspect represented by 9 classes including 0=flat (i.e. no aspect)
MONSOON = June-September precipitation/ mean annual total
EPS = effective summer moisture
EPW = effective winter moisture
MAP = mean annual precipitation
MAPS = mean summer precipitation (June-September)
MAPW = mean winter precipitation (October-May)
PETS = summer index of potential evapo-transpiration
PETW = winter index of potential evapo-transpiration
FLOWACC = flow accumulation
CURVE = curvature (based on 30m DEM)
PROFILE = plan profile (based on 30m DEM)
PROCAT = categorized profile (0= profile<0; 1= profile≥0)

See: Chapter 3 methods and Appendix B for metric computational details

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Abiquil	Old	0.91	-923474.84	1518384.54	2051.34	1	0	3	192.25	49.13	10	4.45	5.00
Abiquil41	Young	0.11	-922408.04	1514921.07	1845.47	1	0	3	201.38	54.69	8	3.31	3.43
Abiquil41a	Young	0.18	-922278.97	1515194.25	1859.81	1	0	3	202.50	55.50	11	3.71	7.09
Abiquil41b	Young	0.27	-922362.93	1515375.32	1877.86	1	0	5	202.50	55.50	11	5.16	13.96
Abiquil42	Old	0.36	-926891.38	1518520.36	1915.23	1	0	3	197.88	52.38	8	3.74	3.61
Abiquil43	Young	0.10	-926392.56	1517998.91	1921.75	1	0	4	197.25	52.00	10	2.11	2.13
Abiquil44	Young	0.20	-926556.69	1517159.49	1970.65	1	0	4	198.25	52.56	10	1.47	3.99
Abiquil44a	Young	0.22	-926487.81	1517244.76	1973.03	1	0	4	198.25	52.56	10	1.47	1.10
Abiquil45	Young	0.27	-925030.36	1517858.00	1980.64	1	0	4	195.25	50.94	10	1.52	2.11
Abiquil46	Young	0.11	-924660.41	1516839.28	1962.94	1	1	4	196.75	52.06	10	3.09	1.41
Abiquil47	Old	0.59	-924902.01	1517697.40	1973.24	1	0	3	195.25	50.94	10	1.19	3.96
Abiquil48	Young	0.11	-924418.08	1515865.04	1913.50	1	0	4	201.63	55.81	10	3.12	1.56
Abiquil49	Young	0.39	-915116.94	1511756.84	1822.95	1	1	3	199.00	53.63	8	12.42	3.34
Abiquil49a	Young	0.12	-915099.25	1511755.91	1823.13	1	1	4	199.00	53.63	8	12.42	2.91
Abiquil49b	Old	0.65	-915157.99	1511665.53	1828.06	1	0	3	199.00	53.63	8	9.27	5.39
Abiquil49c	Old	0.81	-915001.37	1511605.41	1840.91	1	0	5	200.88	54.31	11	9.67	15.24
Abiquil50	Young	0.44	-911126.66	1510579.34	1807.99	1	0	3	199.50	54.13	11	3.19	8.27
Abiquil51	Young	0.10	-909584.03	1508615.76	1791.52	1	0	4	200.13	55.19	8	2.53	2.19
Abiquil52	Young	0.12	-908125.97	1507864.73	1787.26	1	0	4	199.25	54.75	8	0.92	0.59
Abiquil53	Young	0.37	-901155.08	1496139.93	1746.02	1	0	3	198.75	55.94	8	4.77	4.05
Abiquil54	Young	0.82	-902152.35	1497036.09	1751.40	1	0	5	199.75	56.38	8	9.91	16.27
Abiquil55	Young	0.11	-899695.56	1488910.29	1750.89	1	1	4	203.00	57.38	8	2.14	2.25
BAND1	Old	0.95	-918834.09	1463390.54	1983.47	1	0	4	199.25	54.94	5	2.09	1.73
BAND101	Old	0.91	-918667.46	1463630.36	1896.00	1	0	5	199.38	55.38	5	14.33	39.66
BAND102	Old	0.91	-918664.73	1463464.51	1955.87	1	0	5	199.38	55.38	5	7.44	21.70
BAND103	Young	0.23	-918708.75	1463399.46	1974.34	1	1	5	199.38	55.38	5	7.44	17.14
BAND104	Old	0.98	-918731.59	1463346.76	1984.61	1	0	3	199.38	55.38	5	7.44	3.04
BAND105	Old	0.92	-918763.16	1463064.13	1976.85	1	0	4	199.25	54.94	5	2.25	3.14
BAND106	Young	0.07	-918895.75	1463096.54	1959.89	1	1	1	199.00	54.75	5	2.35	8.49
BAND107	Young	0.24	-918988.65	1463129.14	1976.25	1	1	3	199.00	54.75	5	1.80	7.81
BAND108	Old	0.94	-919062.30	1463131.51	1982.69	1	0	4	199.00	54.75	5	1.41	2.23
BAND109	Old	0.97	-919112.94	1463179.80	1982.29	1	0	3	199.00	54.75	5	1.41	4.78
BAND110	Old	0.96	-919213.98	1463212.17	1971.43	1	0	3	199.00	54.75	5	1.13	6.02
BAND111	Young	0.23	-919126.43	1463337.81	1968.87	1	1	3	199.25	54.94	5	2.45	4.03
BAND112	Old	0.95	-919101.51	1463517.55	1982.16	1	0	3	199.25	54.94	5	3.19	7.08
BAND113	Old	0.95	-919096.20	1463657.75	1988.60	1	0	4	199.25	54.94	5	2.95	1.67

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
BAND114	Old	0.95	-919009.98	1463613.48	1988.59	1	0	4	199.25	54.94	5	3.19	1.58
BAND115	Old	0.97	-918861.67	1463609.77	1981.08	1	0	3	199.25	54.94	5	0.25	5.70
BAND116a	Young	0.26	-918531.03	1463805.40	1855.24	1	1	3	198.38	54.00	5	11.74	6.22
BAND117	Old	0.97	-921247.01	1468108.30	2173.22	1	0	4	193.50	52.00	5	6.03	2.15
BAND118	Old	0.94	-921146.17	1467909.24	2156.16	1	0	3	194.38	52.88	5	4.23	8.55
BAND119	Old	0.94	-921046.28	1467842.05	2147.65	1	0	3	194.38	52.88	5	4.23	8.62
BAND120	Old	0.06	-919471.62	1466291.12	2081.80	1	1	4	197.25	54.56	5	2.44	2.75
BAND121	Old	0.95	-919494.18	1465959.08	2070.55	1	0	3	197.88	54.56	5	5.73	7.93
BAND122	Old	0.94	-918284.46	1463945.81	1993.55	1	0	3	198.38	53.69	5	13.93	8.58
BAND123	Old	0.96	-918243.67	1464039.37	2001.97	1	0	4	198.38	53.69	5	14.30	0.90
BAND124	Old	0.93	-917708.69	1462997.06	1961.06	1	0	5	197.88	51.88	5	7.17	16.95
BAND125	Old	0.96	-917724.61	1463066.35	1959.66	1	0	3	197.88	51.88	5	7.17	6.54
BAND126	Old	0.93	-918312.17	1463590.68	1867.14	1	0	5	198.50	53.69	5	10.38	23.03
BAND127	Old	0.94	-917788.32	1461871.61	1848.78	1	0	5	199.25	53.63	5	15.30	10.87
BAND128	Old	0.95	-917732.58	1461845.30	1817.77	1	0	5	199.25	53.63	5	4.25	48.26
BAND129	Old	0.30	-917809.39	1461777.05	1847.01	1	1	3	199.25	53.63	5	14.52	9.05
BAND130	Old	0.94	-917873.86	1461731.10	1872.33	1	0	5	199.25	53.63	5	14.52	37.14
BAND131	Old	0.93	-917950.45	1461689.86	1940.59	1	0	5	199.25	53.63	5	15.20	11.53
BAND132	Old	0.97	-917982.59	1461509.77	1944.01	1	0	3	198.75	54.38	5	13.85	3.18
BAND133	Old	0.92	-917948.02	1461038.66	1945.00	1	0	5	202.75	56.50	5	12.48	10.28
BAND134	Old	0.92	-917932.36	1460883.80	1920.86	1	0	5	202.75	56.50	5	22.26	38.92
BAND135	Old	0.95	-918041.90	1460605.12	1857.37	1	0	5	198.63	53.25	5	32.06	35.26
BAND136	Old	0.92	-917764.64	1460875.76	1838.63	1	0	5	202.75	56.50	1	24.51	25.79
BAND137	Old	0.92	-917767.89	1461145.27	1852.32	1	0	5	202.75	56.50	5	12.71	20.22
BAND138	Old	0.91	-918230.10	1461787.75	1951.65	1	0	4	198.50	53.75	5	1.00	2.89
BAND139	Young	0.28	-918485.78	1461898.82	1940.67	1	1	3	198.63	53.81	5	1.83	7.13
BAND140	Old	0.97	-918526.02	1462059.72	1934.41	1	0	3	199.25	54.75	5	1.07	5.82
BAND141	Young	0.23	-918766.75	1463446.30	1980.07	1	1	3	199.38	55.38	5	7.44	7.58
BAND142	Old	0.22	-919304.47	1465457.56	2027.78	1	1	3	197.88	54.56	5	2.53	4.03
BAND143	Old	0.97	-919483.73	1465225.88	2038.14	1	0	4	198.25	54.75	5	12.67	0.88
BAND144	Old	0.94	-917890.12	1462770.09	1891.62	1	0	5	197.88	52.38	5	12.08	13.85
BAND145	Old	0.87	-917522.01	1460677.16	1659.34	1	0	5	211.63	63.56	1	11.35	10.55
BAND146	Young	0.04	-917357.00	1460569.19	1638.01	1	1	1	211.63	63.56	8	24.07	1.88
BAND147	Old	0.93	-918256.03	1462878.47	1859.43	1	0	5	198.63	53.81	5	16.78	33.82
BAND148	Old	0.95	-918214.37	1463196.04	1855.65	1	0	3	198.63	53.81	5	10.89	8.01
BAND149	Old	0.92	-918891.30	1464034.19	1878.26	1	0	5	198.25	53.94	5	17.23	27.66

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
BAND150	Old	0.92	-919081.69	1464148.34	1903.74	1	0	5	197.88	53.38	5	6.17	28.97
BAND151	Old	0.90	-919763.52	1464550.13	1999.40	1	0	5	199.75	56.56	5	4.74	14.51
BAND152	Old	0.98	-919936.94	1464637.68	2012.15	1	0	3	198.63	55.00	5	1.90	3.46
BAND153	Old	0.97	-919909.75	1464664.00	2010.41	1	0	3	198.63	55.00	5	1.90	5.57
BAND154	Old	0.97	-920035.19	1464811.66	2017.24	1	0	4	198.63	55.00	5	1.73	0.57
BAND155	Old	0.93	-912828.54	1472396.67	2025.19	1	0	5	197.38	54.19	5	1.34	13.15
BAND156	Young	0.29	-913020.62	1472251.85	1990.59	1	1	3	197.50	54.38	5	3.79	6.67
BAND157	Old	0.96	-913126.22	1472257.62	1992.30	1	0	3	197.50	54.38	5	2.63	6.34
BAND158	Old	0.96	-913220.95	1472105.67	1987.93	1	0	3	197.50	54.38	5	1.81	7.18
BAND159	Old	0.96	-913240.81	1471946.77	1978.89	1	0	3	197.50	54.38	5	0.82	6.71
BAND160	Old	0.08	-913117.20	1471740.84	1969.09	1	1	1	197.50	54.38	5	3.99	1.71
BAND161	Old	0.96	-912755.25	1471741.18	1965.31	1	0	3	197.88	54.75	5	1.26	6.41
BAND162	Old	0.95	-912558.94	1471758.29	1995.66	1	0	3	197.88	54.75	5	2.42	7.50
BAND163	Old	0.93	-912420.01	1471685.86	2014.10	1	0	5	198.50	55.25	5	4.20	14.10
BAND164	Young	0.29	-912413.90	1471867.65	1966.88	1	1	3	198.38	55.31	5	1.68	5.67
BAND165	Old	0.97	-912384.38	1471941.05	1961.23	1	0	3	198.38	55.31	5	2.15	4.40
BAND166	Old	0.28	-912144.40	1472104.36	1953.04	1	1	3	198.38	55.31	5	2.65	4.14
BAND167	Old	0.95	-911874.15	1472239.64	1949.92	1	0	3	197.63	54.06	5	2.03	7.94
BAND168	Old	0.09	-911876.58	1472525.96	1945.02	1	1	4	197.63	54.06	5	4.17	2.90
BAND169	Old	0.97	-912092.25	1472521.07	1952.63	1	0	3	197.50	54.13	5	5.80	5.54
BAND170	Old	0.94	-912279.52	1472504.10	1981.32	1	0	5	197.50	54.13	5	7.40	27.43
BAND171	Old	0.94	-912892.98	1472525.25	1973.58	1	0	3	197.38	54.19	5	2.01	9.72
BAND172	Old	0.93	-913340.61	1472456.46	1986.09	1	0	5	197.63	54.69	5	0.91	17.41
BAND173	Old	0.98	-917618.92	1462611.18	1963.55	1	0	3	197.88	52.38	5	10.52	3.91
BAND174	Old	0.97	-917564.61	1462546.73	1956.36	1	0	3	197.88	52.38	5	14.86	6.51
BAND175	Old	0.95	-912179.18	1472933.62	1942.55	1	0	3	196.88	53.06	5	7.27	10.37
BAND176	Old	0.95	-912109.45	1472895.70	1945.76	1	0	5	196.88	53.06	5	4.80	16.42
BAND177	Old	0.94	-912094.70	1472790.49	1977.33	1	0	5	196.88	53.06	5	2.63	10.26
BAND178	Old	0.94	-912015.38	1472783.06	1989.59	1	0	5	197.13	53.31	5	2.63	16.11
BAND179	Old	0.89	-911972.78	1473019.48	1929.27	1	0	3	196.88	53.44	1	5.32	3.58
BAND180	Young	0.13	-904728.28	1473111.78	1692.09	1	1	4	207.00	60.63	8	2.54	1.77
BAND180a	Young	0.15	-904699.57	1473110.68	1692.60	1	0	4	207.00	60.63	8	2.54	1.78
BAND181	Young	0.46	-906322.88	1473910.93	1710.16	1	0	5	207.75	61.38	8	4.17	17.57
BAND182	Young	0.41	-906112.34	1475077.58	1707.36	1	0	3	207.88	61.50	11	1.86	3.99
BAND183	Young	0.09	-901365.28	1487666.05	1795.23	1	0	4	204.38	59.19	8	1.01	0.89
BAND184	Young	0.73	-903090.10	1488347.07	1855.37	1	0	3	201.13	57.38	8	4.45	4.79

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
BAND185	Old	0.45	-904713.01	1488233.67	1966.70	1	0	4	197.38	54.63	11	10.26	3.03
BAND186	Old	0.91	-904056.22	1488326.61	1919.47	1	0	5	197.88	54.63	11	9.63	18.91
BAND187	Young	0.13	-902344.09	1488149.03	1833.78	1	0	4	203.88	59.44	8	3.66	2.85
BAND188	Young	0.09	-902349.59	1481571.54	1724.13	1	0	4	205.00	59.13	8	2.46	2.94
BAND189	Young	0.11	-905753.18	1475347.66	1699.98	1	1	4	208.13	61.38	8	2.51	2.15
BAND190	Old	0.91	-914568.13	1473750.29	2081.68	1	0	5	195.75	53.31	5	7.44	20.67
BAND191	Old	0.94	-916505.50	1474561.51	2158.45	1	0	4	191.25	50.13	5	7.79	1.71
BAND192	Young	0.20	-917582.79	1460116.16	1697.11	1	1	5	205.88	58.94	8	10.85	26.61
BAND193	Old	0.90	-917586.01	1460186.33	1670.03	1	0	5	205.88	58.94	8	10.85	21.73
BAND194	Old	0.90	-917552.62	1460070.09	1720.87	1	0	5	205.88	58.94	8	27.68	30.83
BAND195	Old	0.82	-917522.38	1459991.37	1762.19	1	0	5	212.13	63.88	8	32.39	26.48
BAND196	Old	0.85	-917454.04	1459881.48	1813.08	1	0	5	211.75	63.81	8	32.39	27.31
BAND197	Old	0.83	-917292.38	1459442.79	1942.42	1	0	3	206.75	60.06	1	15.49	5.83
BAND198	Old	0.89	-917420.14	1459445.36	1932.33	1	0	3	206.75	60.06	1	29.92	8.76
BAND199	Old	0.94	-919998.38	1464594.80	2007.40	1	0	3	198.63	55.00	5	1.90	8.24
BAND2	Old	0.95	-918918.51	1462496.48	1959.26	1	0	4	198.88	54.44	5	1.08	1.28
BAND200	Old	0.98	-920201.45	1464616.87	2007.70	1	0	3	199.13	56.13	5	3.29	3.53
BAND200a	Young	0.21	-920304.14	1464644.92	2011.92	1	1	3	199.13	56.13	5	3.37	3.01
BAND201	Old	0.94	-920497.36	1464663.69	2032.83	1	0	4	199.13	56.13	5	1.01	2.87
BAND202	Old	0.91	-920609.07	1464813.24	2044.33	1	0	5	199.88	57.13	5	2.84	10.05
BAND203	Old	0.96	-920698.41	1464919.82	2050.23	1	0	3	199.88	57.13	5	4.13	7.06
BAND204	Young	0.06	-920802.40	1465032.49	2063.56	1	1	4	199.88	56.94	5	5.72	2.98
BAND205	Young	0.06	-920450.21	1465039.24	2018.24	1	1	4	199.13	56.13	5	3.32	0.43
BAND209	Old	0.83	-919245.08	1460152.28	1922.65	1	0	4	200.88	55.00	5	1.50	2.51
BAND210	Old	0.95	-919290.94	1459987.20	1921.40	1	0	3	200.88	55.00	5	2.23	4.23
BAND211	Old	0.94	-919392.58	1458328.11	1887.99	1	0	3	206.75	60.31	5	11.88	5.14
BAND212	Old	0.91	-919404.56	1458001.69	1854.84	1	0	5	209.00	62.50	1	16.19	14.36
BAND213	Old	0.82	-919555.15	1457877.27	1809.30	1	0	5	209.00	62.50	1	8.87	27.41
BAND214	Old	0.87	-919709.28	1457969.45	1768.47	1	0	5	208.75	62.06	1	8.43	12.17
BAND215	Old	0.91	-920023.04	1457937.08	1709.92	1	0	5	208.75	62.06	1	1.38	22.42
BAND216	Old	0.95	-920397.91	1458130.96	1874.64	1	0	3	209.38	63.00	5	13.80	5.56
BAND217	Old	0.94	-920735.35	1459822.02	1902.67	1	0	3	203.25	56.13	5	3.24	5.16
BAND218	Old	0.90	-920648.29	1461410.65	1930.45	1	0	4	200.63	53.94	5	13.99	2.68
BAND220	Young	0.28	-928052.39	1454890.17	1786.87	1	0	4	211.75	66.69	7	4.27	2.89
BAND221	Young	0.14	-927040.65	1451566.31	1703.13	1	1	1	217.00	72.00	5	2.81	2.33
BAND222	Young	0.34	-924767.50	1448894.53	1659.89	1	0	4	220.38	74.81	7	1.65	2.15

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
BAND223	Young	0.49	-925974.50	1447383.18	1615.28	1	1	3	219.38	73.25	8	2.32	7.74
BAND224	Young	0.26	-925863.14	1442990.37	1603.35	1	1	4	219.38	73.06	7	1.16	2.02
BAND225	Young	0.25	-924908.23	1441090.14	1663.58	1	1	4	217.75	72.81	7	1.20	1.83
BAND226	Young	0.84	-926732.49	1451206.02	1713.07	1	0	3	217.50	72.88	5	1.34	3.76
BAND227	Young	0.73	-928397.43	1452827.51	1752.51	1	0	4	213.88	68.81	5	1.71	1.01
BAND228	Young	0.06	-928234.80	1454518.22	1755.49	1	1	1	212.38	67.13	5	4.05	1.65
BAND229	Old	0.89	-928245.10	1455799.90	1847.89	1	0	5	205.00	60.00	5	6.57	23.05
BAND230	Old	0.91	-929940.38	1457527.70	2092.56	1	0	5	200.00	58.94	1	14.77	27.95
BAND231	Old	0.91	-929900.97	1457566.17	2115.77	1	0	5	200.00	58.94	1	14.77	24.29
BAND288	Old	0.78	-922002.34	1454425.73	1629.49	1	0	5	216.75	69.31	1	4.84	13.46
BAND288a	Old	0.76	-922210.21	1454464.11	1686.75	1	0	5	215.50	69.69	1	5.52	23.69
BAND289	Old	0.38	-922680.37	1455225.91	1685.86	1	1	3	215.00	69.00	5	3.77	4.44
BAND289a	Old	0.83	-922537.47	1455266.30	1696.39	1	0	3	215.50	69.69	5	8.51	7.94
BAND289b	Old	0.83	-922246.27	1455823.96	1724.15	1	0	5	215.00	68.94	5	10.54	12.80
BAND289c	Old	0.84	-922064.51	1456010.27	1757.26	1	0	3	214.00	68.00	5	7.42	6.53
BAND290	Old	0.84	-921606.68	1457523.60	1861.67	1	0	4	206.13	60.00	5	12.90	1.70
BAND290a	Old	0.58	-921944.21	1456353.05	1748.05	1	0	6	212.75	67.00	5	4.27	39.48
BAND290b	Old	0.67	-921950.80	1456333.71	1738.88	1	0	5	212.75	67.00	5	4.27	28.39
BAND291	Old	0.94	-921553.58	1457862.44	1859.20	1	0	3	205.75	59.44	5	7.21	5.64
BAND292	Old	0.96	-922581.18	1462015.21	1983.51	1	0	3	200.63	57.00	5	2.97	5.94
BAND3	Old	0.98	-918561.28	1462416.05	1947.73	1	0	3	199.25	54.75	5	1.03	4.17
BAND303	Young	0.11	-905939.54	1473263.99	1679.40	1	1	4	207.50	61.13	8	2.87	1.44
BAND4	Old	0.98	-918851.48	1462208.79	1951.64	1	0	3	198.38	53.94	5	2.00	3.34
BAND5	Old	0.92	-918763.16	1463064.13	1976.85	1	0	4	199.25	54.94	5	2.25	3.14
BAND6	Old	0.96	-918754.40	1463377.39	1982.47	1	0	3	199.38	55.38	5	7.44	5.95
CACH_ELMA223	Old	0.91	-971687.06	1493070.58	2261.19	2	0	5	166.00	23.13	10	5.07	27.15
CACH_ELMA224	Old	0.83	-973131.36	1492526.90	2180.88	2	0	5	172.38	26.88	11	2.54	6.14
CACH_ELMA225	Old	0.88	-973404.78	1492745.57	2187.98	2	0	3	172.88	27.19	11	3.45	8.09
CACH_ELMA225a	Young	0.07	-973412.91	1492912.97	2187.49	2	1	4	171.75	26.13	9	3.32	1.52
CACH_ELMA225b	Old	0.91	-973308.50	1492747.15	2204.18	2	0	5	172.88	27.19	11	5.11	26.47
CACH_ELMA226	Young	0.70	-974220.50	1494678.30	2175.28	2	0	3	174.25	27.94	11	3.27	3.34
CACH_ELMA226a	Young	0.31	-974241.45	1494640.79	2177.77	2	0	4	174.25	27.94	11	3.27	2.81
CACH_ELMA227a	Young	0.37	-978833.32	1496648.24	2090.99	2	0	4	179.50	31.81	9	2.67	2.71
CACH_ELMA227b	Old	0.84	-978940.98	1496745.88	2115.26	2	0	3	179.50	31.81	9	2.03	6.37
CACH_ELMA228	Young	0.40	-980376.98	1492759.32	2067.31	2	0	4	181.25	33.75	9	0.81	0.95
CACH_ELMA228a	Old	0.80	-980296.02	1492993.75	2089.63	2	0	3	181.25	33.75	9	1.60	3.11

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
CACH_ELMA229	Old	0.81	-983060.15	1492742.37	2089.05	2	0	3	181.63	34.13	9	1.74	2.70
CACH_ELMA230	Old	0.51	-993640.81	1486489.71	2079.60	2	0	4	185.38	37.63	10	0.88	0.93
CACH_ELMA230a	Old	0.89	-993755.22	1486677.07	2081.95	2	0	3	185.38	37.63	10	2.35	5.16
CACH_ELMA231	Old	0.67	-1009416.00	1477134.19	2062.46	2	0	4	199.50	50.50	9	1.79	0.93
CACH_ELMA231a	Old	0.92	-1009342.23	1477105.85	2059.87	2	0	3	199.50	50.50	9	0.39	7.86
CACH_ELMA232	Old	0.69	-1054778.85	1482572.84	2054.68	2	0	4	193.00	45.44	9	2.92	1.97
CACH_ELMA232a	Old	0.92	-1054779.40	1482533.77	2059.58	2	0	3	193.00	45.44	9	2.77	5.79
CACH_ELMA233	Old	0.69	-1060800.42	1482828.21	2070.37	2	0	4	194.38	47.69	9	0.84	2.35
CACH_ELMA233a	Old	0.94	-1060779.12	1482923.85	2074.22	2	0	3	194.38	47.69	9	2.62	3.57
CACH_ELMA234	Young	0.11	-1148813.33	1475722.34	2036.09	2	1	4	190.38	45.50	9	1.13	1.21
CACH_ELMA234a	Old	0.76	-1148833.32	1475742.15	2036.66	2	0	4	190.38	45.50	9	1.13	1.86
CACH_ELMA234b	Old	0.94	-1148803.21	1475767.64	2034.32	2	0	3	190.38	45.50	9	1.13	3.32
CACH_ELMA235a	Young	0.70	-1201632.72	1540854.54	1741.22	2	0	3	216.63	64.75	10	4.45	3.06
CACH_ELMA235b	Old	0.65	-1201621.85	1540991.70	1739.45	2	0	3	216.63	64.69	10	3.90	3.51
CACH_ELMA236	Old	0.97	-1197993.68	1538458.81	1889.63	2	0	3	211.88	61.44	11	13.72	4.68
CACH_ELMA236a	Old	0.89	-1198031.94	1538452.07	1889.50	2	0	4	212.25	61.63	11	13.44	1.31
CACH_ELMA237	Old	0.87	-1198122.85	1538077.91	1892.46	2	0	4	209.13	59.94	10	11.77	2.87
CACH_ELMA237a	Old	0.97	-1198089.99	1538069.95	1892.20	2	0	3	209.13	59.94	10	11.77	5.15
CACH_ELMA238	Young	0.24	-1197215.52	1537036.60	1910.23	2	1	4	207.13	59.00	10	1.96	1.84
CACH_ELMA238a	Old	0.94	-1197348.48	1536905.45	1912.96	2	0	3	207.13	59.00	10	1.81	3.43
CACH_ELMA238b	Old	0.75	-1197260.67	1536972.96	1911.66	2	0	4	207.13	59.00	10	1.96	2.10
CACH_ELMA239a	Young	0.23	-1194311.78	1535417.79	1974.87	2	1	1	204.25	56.88	11	1.57	1.07
CACH_ELMA239b	Old	0.83	-1194308.40	1535449.92	1974.46	2	0	4	204.25	56.88	11	1.57	1.05
CACH_ELMA239c	Old	0.22	-1194289.80	1535478.66	1974.55	2	1	4	204.25	56.88	11	1.52	0.96
CACH_ELMA239d	Old	0.96	-1194156.22	1535240.25	1982.40	2	0	3	205.50	57.44	11	0.68	3.00
CACH_ELMA240	Old	0.94	-1193980.81	1534916.30	1994.81	2	0	4	204.88	57.06	11	15.93	2.11
CACH_ELMA240a	Old	0.99	-1193943.17	1534910.53	1993.57	2	0	3	204.88	57.06	11	15.93	4.53
CACH_ELMA241	Young	0.89	-1191108.49	1531476.85	2053.33	2	0	4	196.13	51.81	10	2.35	2.56
CACH_ELMA241a	Old	0.17	-1191068.88	1531522.67	2052.88	2	1	1	196.13	51.81	10	2.14	2.77
CACH_ELMA241b	Old	0.49	-1191008.76	1531484.96	2055.90	2	1	3	196.13	51.81	10	2.35	3.84
CACH_ELMA241c	Old	0.97	-1190924.59	1531436.32	2063.29	2	0	3	196.13	51.81	10	2.56	3.22
CACH_ELMA241d	Old	0.88	-1191233.94	1531387.13	2053.32	2	0	4	196.13	51.81	10	1.07	2.71
CACH_ELMA242	Old	0.97	-1187835.42	1533975.47	2093.89	2	0	5	201.00	54.06	11	6.37	12.37
CACH_ELMA242a	Old	0.91	-1187797.86	1533953.39	2097.09	2	0	4	201.00	54.06	11	6.37	2.98
CACH_ELMA242b	Old	0.98	-1187829.86	1533953.39	2097.23	2	0	3	201.00	54.06	11	6.37	4.13
CACH_ELMA243	Young	0.18	-1188328.37	1533510.24	2097.06	2	1	4	193.00	49.81	11	1.51	0.52

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
CACH_ELMA243a	Old	0.88	-1188301.79	1533499.35	2097.35	2	0	4	194.00	50.44	11	1.51	1.03
CACH_ELMA243b	Old	0.97	-1188212.92	1533464.34	2100.47	2	0	3	194.00	50.44	11	0.96	3.11
CACH_ELMA244	Old	0.88	-1189822.86	1532992.35	2081.89	2	0	4	194.50	50.81	10	0.91	1.05
CACH_ELMA245a	Young	0.19	-1193016.89	1531281.14	2032.23	2	1	4	198.50	53.25	10	1.13	1.63
CACH_ELMA245b	Old	0.18	-1192934.90	1531279.40	2032.33	2	1	4	198.50	53.13	10	1.17	2.52
CACH_ELMA245c	Old	0.88	-1192900.88	1531279.40	2032.86	2	0	4	198.50	53.13	10	1.17	2.95
CACH_ELMA245d	Old	0.97	-1192899.14	1531249.74	2034.44	2	0	3	198.50	53.13	10	1.17	3.21
CACH_ELMA246	Young	0.80	-1199665.84	1539504.37	1837.41	2	0	3	213.63	62.81	11	1.71	6.89
CACH_ELMA246a	Young	0.46	-1199565.28	1539457.33	1845.49	2	0	4	213.63	62.81	11	2.33	1.48
CACH_ELMA246b	Old	0.82	-1199556.38	1539595.29	1840.45	2	0	3	213.63	62.81	11	2.33	5.78
CACH_ELMA247	Old	0.36	-1200385.39	1539121.95	1825.04	2	0	4	212.25	62.13	10	2.62	2.37
CACH_ELMA247a	Old	0.26	-1200344.45	1539028.51	1824.85	2	1	1	212.25	62.13	10	2.86	2.61
CACH_ELMA247b	Old	0.79	-1200205.42	1538943.55	1832.59	2	0	3	212.25	62.13	10	2.45	4.03
CACH_ELMA247c	Old	0.26	-1200340.59	1539121.20	1824.40	2	1	4	212.25	62.13	10	2.62	2.60
CACH_ELMA248a	Old	0.19	-1216782.56	1498607.12	1953.61	2	1	4	196.88	49.44	10	3.38	2.99
CACH_ELMA248b	Old	0.87	-1216751.39	1498633.62	1953.61	2	0	4	196.88	49.44	10	3.38	2.93
CACH_ELMA248c	Old	0.97	-1216614.22	1498440.34	1972.68	2	0	3	196.88	49.44	10	2.94	6.98
CACH_ELMA248d	Old	0.97	-1216229.23	1498538.54	1982.86	2	0	5	196.63	49.56	10	4.16	11.87
CACH_ELMA248e	Old	0.97	-1216179.35	1498512.04	1999.95	2	0	3	196.63	49.56	10	4.16	5.96
CACH_ELMA249	Old	0.19	-1216713.23	1497663.92	1973.45	2	1	4	196.38	49.44	10	1.72	2.08
CACH_ELMA249a	Old	0.85	-1216765.61	1497667.08	1972.30	2	0	4	196.38	49.44	10	2.54	2.39
CACH_ELMA249b	Old	0.97	-1216671.44	1497557.95	1976.28	2	0	3	196.38	49.44	10	1.72	3.91
CACH_ELMA250	Old	0.86	-1216200.57	1496835.45	1976.19	2	0	4	195.88	49.81	10	0.96	0.99
CACH_ELMA250a	Old	0.18	-1216127.98	1496837.96	1976.17	2	1	4	195.63	49.50	10	1.99	0.60
CACH_ELMA250b	Old	0.96	-1216371.13	1497082.45	1979.94	2	0	3	196.00	49.88	10	1.31	4.87
CACH_ELMA250c	Old	0.96	-1216402.08	1497141.66	1987.41	2	0	5	196.00	49.88	10	0.13	11.03
CACH_ELMA251a	Young	0.17	-1205539.69	1492233.50	2007.22	2	1	2	192.75	47.06	10	2.34	3.65
CACH_ELMA251b	Old	0.97	-1205496.57	1492185.46	2017.00	2	0	3	192.75	47.06	10	2.34	8.06
CACH_ELMA252	Old	0.85	-1200081.32	1491887.91	2086.26	2	0	4	190.00	46.31	11	0.34	0.62
CACH_ELMA252a	Old	0.96	-1199360.51	1490378.69	2115.46	2	0	3	189.00	45.88	11	1.94	4.29
CACH_ELMA252b	Young	0.14	-1200064.73	1491396.98	2090.00	2	1	4	189.88	46.19	11	0.68	1.19
CACH_ELMA252c	Young	0.86	-1200099.20	1491334.50	2091.51	2	0	4	189.88	46.19	11	0.69	1.09
CACH_ELMA252d	Young	0.14	-1199909.77	1491604.94	2085.91	2	1	2	190.00	46.31	11	0.92	0.72
CACH_ELMA253a	Young	0.14	-1198543.95	1491585.51	2104.45	2	1	2	189.13	46.31	11	0.62	1.36
CACH_ELMA253b	Old	0.84	-1198453.90	1491557.81	2108.54	2	0	4	189.13	46.31	11	1.13	1.73
CACH_ELMA253c	Old	0.13	-1198457.70	1491525.78	2108.77	2	1	4	188.88	46.19	11	1.15	1.60

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
CACH_ELMA254	Old	0.97	-1211633.63	1488777.46	2059.08	2	0	3	193.75	48.63	11	1.51	4.60
CACH_ELMA254a	Old	0.87	-1211480.80	1488706.69	2070.05	2	0	4	193.38	48.56	11	0.88	1.59
CACH_ELMA255	Old	0.12	-1211737.11	1473565.33	1995.70	2	1	4	189.25	43.06	11	1.97	2.53
CACH_ELMA255a	Old	0.82	-1211717.49	1473479.35	1992.66	2	0	4	189.25	43.06	11	1.07	2.66
CACH_ELMA255b	Old	0.95	-1211716.48	1473625.86	1998.27	2	0	3	189.25	43.06	11	1.97	3.90
CACH_ELMA255c	Young	0.12	-1212133.56	1474359.02	2015.24	2	1	2	190.00	44.56	11	1.91	1.35
CACH_ELMA256	Old	0.86	-1212742.48	1463327.45	1987.32	2	0	4	193.63	48.50	11	1.00	1.28
CACH_ELMA256a	Old	0.97	-1212735.37	1463342.26	1985.92	2	0	3	193.63	48.50	11	1.00	3.25
CACH_ELMA257	Old	0.97	-1211425.05	1455769.00	1886.96	2	0	3	200.13	54.00	11	0.32	4.98
CACH_ELMA257a	Old	0.89	-1211453.90	1455728.68	1892.03	2	0	4	200.13	54.00	11	0.32	2.32
CACH_ELMA258	Old	0.87	-1207141.92	1449122.98	1933.93	2	0	4	198.00	53.44	11	1.49	0.75
CACH_ELMA259	Old	0.83	-1209008.52	1437189.03	1812.10	2	0	4	205.63	60.13	11	1.86	1.90
CACH_ELMA259a	Old	0.95	-1208975.27	1437197.64	1812.71	2	0	3	205.63	60.13	11	1.76	3.06
CACH_ELMA260	Old	0.82	-1200211.59	1432134.73	1805.39	2	0	4	206.13	61.13	11	2.92	0.90
CACH_ELMA260a	Old	0.96	-1200174.32	1432144.10	1804.58	2	0	3	206.13	61.13	11	2.92	3.41
CACH_ELMA260b	Young	0.19	-1199367.19	1431523.04	1790.95	2	1	4	206.13	60.94	11	1.69	2.74
CACH_ELMA261	Young	0.19	-1200729.37	1429166.62	1834.70	2	1	2	204.00	59.38	8	1.52	0.75
CACH_ELMA261a	Young	0.88	-1200667.52	1429155.60	1835.24	2	0	4	204.00	59.38	8	1.52	0.32
CACH_ELMA261b	Young	0.19	-1200604.74	1429112.00	1835.03	2	1	4	203.88	59.13	8	1.52	0.04
CACH_ELMA262	Old	0.88	-1199800.49	1423095.71	1879.00	2	0	4	201.63	57.19	8	1.07	1.66
CACH_ELMA262a	Old	0.97	-1199596.51	1423024.26	1883.04	2	0	3	201.38	56.88	8	1.70	3.16
CACH_ELMA263	Old	0.96	-1196247.99	1414467.73	1931.82	2	0	3	196.50	51.69	11	2.17	4.34
CACH_ELMA263a	Old	0.96	-1195890.49	1414419.89	1959.38	2	0	5	195.75	51.31	8	4.07	17.24
CACH_ELMA263b	Old	0.86	-1195621.73	1414435.47	1968.07	2	0	4	195.75	51.31	8	0.56	2.09
CACH_ELMA263c	Young	0.86	-1196513.72	1414813.29	1910.86	2	0	4	197.00	52.31	11	2.03	2.35
CACH_ELMA263d	Young	0.15	-1196463.08	1414848.35	1911.41	2	1	4	197.00	52.31	11	2.03	2.45
CACH_ELMA264a	Old	0.85	-1193980.56	1408813.11	1939.24	2	0	4	194.88	50.56	8	1.98	2.87
CACH_ELMA264b	Old	0.96	-1193959.90	1408817.70	1936.99	2	0	3	194.88	50.56	8	1.98	4.10
CACH_ELMA265	Young	0.15	-1195894.82	1399543.38	1890.90	2	1	4	199.13	55.50	8	2.17	1.31
CACH_ELMA265a	Old	0.96	-1195622.77	1399382.44	1904.66	2	0	3	199.13	55.50	8	0.72	3.07
CACH_ELMA265b	Old	0.85	-1195641.53	1399428.28	1903.33	2	0	4	199.13	55.50	8	0.56	2.95
CACH_ELMA266	Old	0.80	-1188417.38	1404069.44	1980.93	2	0	4	193.38	50.38	8	0.70	1.35
CACH_ELMA266a	Old	0.95	-1188313.06	1403980.50	1980.17	2	0	3	193.38	50.38	8	1.21	3.06
CACH_ELMA267	Old	0.71	-1166467.58	1412389.95	1920.70	2	0	4	196.88	54.69	10	1.43	1.08
CACH_ELMA268	Young	0.07	-1113013.13	1403225.13	2194.94	2	1	4	177.75	39.00	1	0.94	2.41
CACH_ELMA268a	Old	0.85	-1113013.01	1403277.40	2197.40	2	0	3	177.75	39.00	1	0.94	5.30

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CACH_ELMA268b	Old	0.43	-1112838.29	1403222.21	2200.90	2	0	4	177.75	39.00	11	0.89	1.72
CACH_ELMA269	Young	0.24	-1112818.61	1403380.28	2198.74	2	1	3	177.75	39.00	1	0.68	3.45
CACH_ELMA269a	Old	0.50	-1112805.19	1403379.19	2199.79	2	0	4	177.75	38.81	1	0.68	2.95
CACH_ELMA269b	Old	0.82	-1112814.17	1403403.46	2198.38	2	0	3	177.75	39.00	1	0.68	3.59
CACH_ELMA270	Young	0.07	-1113148.89	1403023.94	2193.40	2	1	4	177.75	39.00	11	1.87	1.23
CACH_ELMA270a	Old	0.41	-1113146.99	1403023.79	2193.87	2	0	4	177.75	39.00	11	1.87	1.27
CACH_ELMA271	Young	0.07	-1113544.07	1403400.53	2187.08	2	1	1	177.75	38.94	1	0.28	0.11
CACH_ELMA271a	Young	0.07	-1113847.70	1403455.84	2188.97	2	1	4	177.38	38.31	11	1.42	0.41
CACH_ELMA272	Young	0.07	-1108603.79	1403399.86	2231.34	2	1	4	175.63	37.13	1	0.38	0.73
CACH_ELMA272a	Young	0.45	-1108635.32	1403384.59	2232.08	2	0	4	175.63	37.13	1	0.38	0.66
CACH_ELMA272b	Young	0.07	-1108541.90	1403437.35	2231.20	2	1	1	175.75	37.25	1	0.38	0.55
CACH_ELMA273	Young	0.07	-1104695.45	1402754.91	2252.54	2	1	1	174.38	36.44	1	1.34	0.02
CACH_ELMA274a	Young	0.07	-1098741.02	1400650.86	2326.64	2	1	1	167.88	31.63	2	1.64	1.07
CACH_ELMA275a	Young	0.07	-1084237.19	1391452.27	2228.21	2	1	4	170.00	34.00	1	2.29	1.87
CACH_ELMA275b	Young	0.50	-1084237.19	1391464.37	2228.72	2	0	4	170.00	34.00	1	2.29	2.34
CACH_ELMA276a	Old	0.86	-1084144.92	1391347.14	2224.94	2	0	3	170.00	34.00	1	2.29	3.83
CACH_ELMA277	Young	0.07	-1080237.74	1389577.69	2135.45	2	1	4	172.75	35.94	5	1.51	1.77
CACH_ELMA277a	Old	0.94	-1080113.07	1389794.03	2137.83	2	0	3	172.75	35.94	5	1.03	6.21
CACH_ELMA278	Young	0.07	-1078926.66	1389831.45	2112.79	2	1	4	175.00	37.94	5	0.45	0.45
CACH_ELMA278a	Old	0.93	-1078770.10	1389878.71	2113.09	2	0	3	175.00	37.94	5	0.30	3.03
CACH_ELMA279	Young	0.07	-1075751.75	1391461.81	2065.41	2	1	4	176.63	39.69	2	1.69	2.13
CACH_ELMA279a	Old	0.95	-1075890.43	1391432.82	2073.02	2	0	3	176.63	39.69	2	5.82	7.58
CACH_ELMA280	Young	0.15	-1073423.04	1394935.08	2008.20	2	0	4	186.38	48.00	8	1.23	1.87
CACH_ELMA280a	Old	0.87	-1073766.96	1395242.73	2029.64	2	0	3	179.13	41.25	8	6.14	7.51
CACH_ELMA280b	Old	0.98	-1074039.23	1395242.73	2065.55	2	0	5	175.63	39.38	11	11.88	13.51
CACH_ELMA281	Young	0.01	-1048906.46	1399534.86	1890.02	2	0	4	201.50	61.06	11	0.69	0.96
CACH_ELMA282	Young	0.00	-1035439.62	1393279.63	1805.19	2	0	4	210.25	67.69	11	1.42	1.47
CACH_ELMA282a	Young	0.29	-1034477.55	1391831.77	1833.14	2	0	3	207.25	65.56	11	5.47	16.63
CACH_ELMA282b	Young	0.04	-1034849.78	1391935.87	1817.59	2	0	5	209.00	67.13	11	2.55	5.72
CACH_ELMA283	Young	0.13	-1025999.67	1392446.32	1796.06	2	1	4	212.63	70.56	11	3.27	2.71
CACH_ELMA283a	Young	0.03	-1025954.09	1392425.19	1797.06	2	0	3	212.38	70.44	11	3.27	3.03
CACH_ELMA284	Young	0.00	-1028342.93	1393804.56	1783.73	2	0	4	212.00	69.63	11	1.41	1.58
CACH_ELMA284a	Young	0.01	-1028244.96	1394073.63	1808.64	2	0	3	212.00	69.63	9	2.12	14.02
CACH_ELMA284b	Young	0.03	-1028062.06	1394066.86	1804.04	2	0	5	212.00	69.63	9	1.17	4.77
CACH_ELMA285	Young	0.01	-1024002.64	1397203.42	1762.82	2	0	4	213.00	70.50	8	2.01	1.89
CACH_ELMA285a	Young	0.21	-1024806.74	1397453.95	1794.06	2	0	3	210.13	68.31	9	8.08	5.53

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
CACH_ELMA286	Young	0.49	-1024923.88	1398472.59	1839.18	2	0	5	201.25	60.50	9	10.45	11.84
CACH_ELMA287	Young	0.05	-1024765.88	1399833.07	1876.36	2	0	4	202.50	61.56	11	6.33	2.12
CACH_ELMA287a	Young	0.37	-1024817.12	1399815.35	1879.64	2	0	3	202.50	61.56	11	6.33	8.85
Carson1	Old	0.06	-881075.40	1522389.47	2116.54	1	1	4	181.63	41.00	11	1.39	1.44
Carson106	Old	0.91	-880813.73	1575702.30	2596.56	1	0	3	139.88	0.13	1	3.42	9.34
Carson106a	Old	0.91	-880824.22	1575774.05	2594.41	1	0	5	139.88	0.13	1	3.42	10.94
Carson107	Young	0.07	-878532.20	1543003.15	2353.90	1	1	1	163.25	21.13	1	0.73	0.28
Carson107a	Young	0.07	-878504.26	1543062.09	2354.57	1	1	4	163.25	21.13	1	0.57	1.54
Carson108	Old	0.12	-878459.52	1543032.70	2355.00	1	0	4	163.25	21.13	1	0.45	1.91
Carson2	Old	0.06	-878780.73	1524176.44	2243.22	1	1	1	175.13	34.00	3	0.79	1.01
Chupaderos130	Old	0.53	-913128.85	1480570.81	2075.48	1	0	4	196.25	53.31	7	3.04	1.60
Chupaderos130a	Old	0.90	-912949.73	1480516.68	2085.98	1	0	3	196.25	53.31	7	2.36	8.29
Chupaderos131	Old	0.91	-912953.88	1480492.21	2086.50	1	0	5	196.25	53.31	7	2.36	12.04
Chupaderos131A	Old	0.88	-913745.93	1479488.71	2088.99	1	0	3	195.75	53.06	7	4.01	5.27
Chupaderos132	Old	0.91	-914753.71	1478089.63	2018.94	1	0	5	193.63	51.69	7	5.10	29.99
colm1	Old	1.00	-1086640.27	1856176.88	1659.00	2	0	3	223.75	55.50	5	5.31	3.33
colm2	Old	0.29	-1087498.35	1856830.76	1897.54	2	1	1	209.63	45.56	11	13.49	6.49
colm3	Old	0.98	-1088005.56	1856448.99	1937.98	2	0	5	202.00	39.06	11	16.84	16.83
colm4	Old	0.98	-1087996.42	1854700.45	1963.92	2	0	3	203.50	40.13	11	8.48	5.20
colm5	Old	0.98	-1088131.88	1854369.25	1988.71	2	0	5	203.50	40.13	11	4.49	22.13
colm6	Old	0.65	-1084114.30	1848363.38	2030.38	2	1	3	200.50	38.81	5	6.82	3.45
GLCA1	Old	0.93	-1317281.75	1676747.86	2257.64	2	0	4	197.00	56.00	9	1.34	1.98
GLCA2	Old	0.98	-1317126.32	1676723.05	2264.54	2	0	3	197.00	56.00	9	2.94	3.36
GLCA3	Old	0.94	-1316359.52	1674858.87	2257.60	2	0	4	201.63	53.56	9	1.82	0.76
GLOR	Old	0.81	-873942.91	1432323.09	2407.67	1	0	3	163.50	32.00	11	2.87	5.41
Hayden26	Old	0.94	-848155.33	1743990.78	2315.74	1	0	5	158.50	21.06	11	17.04	21.64
Jemez132	Old	0.33	-961142.72	1457309.70	1745.92	1	0	3	210.00	64.31	10	6.14	4.51
Jemez133	Young	0.07	-962495.98	1462236.37	1807.59	1	1	1	205.00	59.94	10	0.23	3.66
Jemez134	Old	0.96	-962796.06	1462224.29	1848.35	1	0	5	199.75	56.25	10	19.01	22.65
Jemez135	Young	0.25	-961793.26	1455436.54	1750.20	1	0	3	212.13	65.19	8	3.98	6.64
Jemez136	Young	0.05	-961652.68	1447141.74	1706.64	1	0	4	215.13	68.88	7	1.58	2.64
Jemez137	Young	0.23	-967462.88	1442162.25	1664.06	1	1	1	216.50	70.25	8	0.41	0.51
Jemez138	Young	0.74	-955966.51	1426704.97	1641.05	1	0	3	222.25	77.13	8	1.94	3.35
Jemez139	Young	0.11	-957928.51	1430558.43	1634.53	1	0	4	221.50	76.13	8	1.79	0.88
Jemez156	Young	0.18	-907695.68	1474326.23	1731.97	1	0	4	207.38	60.81	8	2.55	1.93
Jemez157	Young	0.90	-909689.24	1473211.59	1795.62	1	0	3	202.50	57.13	7	3.27	8.64

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Jemez158	Young	0.30	-902810.94	1473849.40	1732.10	1	0	3	205.50	60.00	11	2.86	3.03
Lincoln306a	Old	0.93	-877506.02	1285679.12	2071.12	1	0	4	187.50	59.00	2	0.82	0.88
Lincoln307	Old	0.05	-879083.50	1285264.25	2060.34	1	1	4	187.00	58.31	2	2.09	1.15
Lincoln307a	Old	0.90	-879105.91	1285264.55	2060.93	1	0	4	187.00	58.31	2	2.09	1.19
Lincoln308a	Old	0.85	-880699.06	1284434.85	2098.13	1	0	4	185.50	57.25	2	0.50	2.95
Lincoln308b	Old	0.95	-880687.47	1284461.89	2095.18	1	0	3	185.50	57.25	2	0.50	5.99
Lincoln309a	Young	0.07	-881060.88	1284373.04	2086.72	1	1	4	184.88	56.75	2	1.58	2.27
Lincoln309b	Old	0.87	-881028.69	1284384.63	2086.77	1	0	4	184.88	56.75	2	1.58	1.65
Lincoln309c	Old	0.85	-881116.25	1284398.79	2089.96	1	0	4	184.88	56.75	2	1.58	3.17
Lincoln310	Young	0.07	-882745.88	1284281.19	2111.10	1	1	4	182.88	55.31	11	2.00	2.71
Lincoln310a	Old	0.84	-882856.89	1284291.87	2112.65	1	0	3	182.88	55.31	11	2.34	3.61
Lincoln310b	Old	0.46	-882648.97	1284166.65	2108.67	1	0	4	182.88	55.31	11	0.80	1.30
Lincoln311	Young	0.06	-880765.99	1283380.32	2064.49	1	1	4	185.63	57.56	2	1.53	1.75
Lincoln311a	Old	0.84	-880849.56	1283347.71	2067.01	1	0	4	185.63	57.56	2	1.13	2.49
Lincoln311b	Old	0.96	-880882.39	1283359.38	2068.69	1	0	3	185.13	57.00	2	1.13	3.72
Lincoln312	Young	0.20	-884978.33	1274602.14	2045.34	1	0	4	186.00	56.75	8	1.41	1.26
Lincoln312a	Young	0.06	-884964.86	1274598.73	2044.73	1	1	4	186.00	56.75	8	0.86	1.21
Lincoln312b	Young	0.06	-884963.93	1274623.38	2044.88	1	1	1	186.00	56.75	8	0.86	1.33
Lincoln312c	Old	0.69	-884808.15	1274688.94	2044.62	1	0	3	186.00	56.75	8	0.85	4.21
Lincoln313	Young	0.06	-887883.52	1270141.27	1993.95	1	1	4	187.88	58.31	2	4.77	1.70
Lincoln313a	Young	0.55	-887861.80	1270115.96	1994.43	1	0	4	188.50	58.81	2	4.77	3.54
Lincoln313b	Old	0.74	-887910.22	1270163.00	1993.94	1	0	3	187.88	58.31	2	2.55	0.98
Lincoln314	Old	0.91	-888451.15	1268763.58	1954.61	1	0	5	190.88	60.75	2	2.97	20.11
Lincoln315	Young	0.11	-888899.75	1268089.41	1932.57	1	1	1	193.13	62.69	2	2.54	2.41
Lincoln315a	Old	0.94	-888831.11	1267964.56	1948.46	1	0	5	192.50	61.94	10	5.89	11.37
Lincoln315b	Old	0.86	-888798.59	1268000.59	1942.75	1	0	3	192.50	61.94	10	2.54	7.56
Lincoln316	Young	0.15	-889631.62	1266424.19	1914.86	1	1	4	195.75	64.75	10	1.34	1.44
Lincoln316a	Old	0.74	-889487.08	1266162.44	1919.60	1	0	3	195.75	64.75	10	1.87	3.95
Lincoln316b	Old	0.15	-889610.86	1266260.33	1914.69	1	0	4	195.75	64.75	10	1.64	0.80
Lincoln317	Young	0.67	-890678.02	1263153.27	1867.72	1	0	4	200.88	69.13	2	1.09	2.94
Lincoln317a	Old	0.88	-890539.53	1263349.22	1877.03	1	0	3	200.25	68.88	2	0.97	4.63
Lincoln317b	Young	0.08	-890570.63	1263256.80	1871.10	1	1	4	200.88	69.13	2	1.09	1.97
Lincoln317c	Young	0.90	-890664.83	1263153.71	1869.86	1	0	3	200.88	69.13	2	1.09	3.52
Lincoln318	Old	0.26	-893782.87	1258278.98	1857.18	1	0	4	205.88	74.19	4	2.20	1.36
Lincoln318a	Old	0.44	-893445.58	1258180.62	1850.22	1	0	3	206.25	74.31	4	1.57	4.93
Lincoln318b	Young	0.06	-893747.68	1258300.92	1856.17	1	1	4	205.88	74.19	4	2.20	1.36

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Lincoln319	Young	0.01	-902115.86	1240965.67	1759.58	1	1	4	214.88	82.25	9	2.19	1.37
Lincoln319a	Young	0.01	-902202.93	1240922.35	1758.81	1	0	4	214.88	82.25	9	2.19	0.86
Lincoln319b	Young	0.07	-900259.04	1240842.01	1808.62	1	0	3	211.25	79.38	11	5.10	6.29
Lincoln320a	Old	0.80	-893351.84	1214770.74	1932.40	1	0	5	197.38	72.75	11	3.11	10.52
Lincoln320b	Old	0.85	-893351.10	1214745.39	1928.02	1	0	3	197.38	72.75	11	3.11	9.12
Lincoln320c	Young	0.26	-893298.16	1214504.59	1921.71	1	0	4	197.38	72.75	11	2.10	2.45
Lincoln320d	Young	0.68	-893301.14	1214533.66	1920.75	1	0	3	197.38	72.75	11	1.86	4.46
Lincoln321	Old	0.61	-891876.13	1213654.12	1976.35	1	0	3	191.63	70.13	11	4.10	9.71
Lincoln321a	Old	0.86	-891647.94	1213845.16	2006.42	1	0	5	190.25	69.25	11	5.39	10.72
Lincoln321b	Young	0.02	-891889.76	1213508.01	1963.61	1	1	2	191.63	70.00	11	5.14	4.23
Lincoln321c	Old	0.77	-891892.09	1213421.98	1987.83	1	0	5	191.63	70.00	11	3.57	24.34
Lincoln321d	Young	0.75	-891645.62	1213782.38	2001.10	1	0	3	190.25	69.25	11	2.21	8.22
Lincoln322	Old	0.92	-888714.32	1214400.01	2117.99	1	0	5	180.75	63.44	11	1.41	10.07
Lincoln322a	Old	0.88	-888714.38	1214395.76	2114.88	1	0	3	180.75	63.44	11	1.41	4.10
Lincoln323a	Old	0.87	-885498.34	1212240.21	2063.27	1	0	5	184.75	65.81	9	2.87	13.26
Lincoln323b	Old	0.83	-885503.33	1212142.96	2060.07	1	0	3	184.75	65.81	9	2.03	9.03
Lincoln324	Young	0.69	-885457.90	1212674.12	2037.32	1	0	3	184.63	65.81	9	3.86	7.33
Lincoln324a	Old	0.79	-885461.57	1212608.30	2044.32	1	0	5	184.63	65.81	9	3.86	11.90
Lincoln324b	Young	0.02	-885203.96	1212618.54	2032.14	1	1	4	184.63	65.81	9	2.97	1.15
Lincoln324c	Young	0.02	-885227.90	1212582.64	2031.27	1	1	2	184.63	65.81	9	2.97	1.95
Lincoln324d	Young	0.15	-885193.32	1212583.97	2031.59	1	0	4	184.63	65.81	9	2.97	1.79
Lincoln325	Old	0.90	-886882.12	1213366.81	2073.64	1	0	3	183.63	65.75	5	1.31	9.75
Lincoln325a	Old	0.96	-886984.48	1213248.85	2077.53	1	0	3	183.63	65.75	5	4.05	5.40
Lincoln325b	Old	0.91	-886908.04	1213401.72	2077.31	1	0	5	183.63	65.75	5	1.31	10.30
Lincoln326a	Old	0.87	-882492.21	1207389.97	1999.46	1	0	5	188.75	70.31	9	7.25	24.24
Lincoln326b	Old	0.74	-880320.19	1208784.22	1965.36	1	0	3	191.38	72.00	11	6.51	8.20
Lincoln326c	Young	0.32	-880507.01	1208628.54	1924.00	1	0	5	192.50	72.75	9	2.07	11.79
Lincoln326d	Young	0.02	-882215.91	1207357.95	1954.97	1	1	4	188.75	70.31	9	9.45	2.40
Lincoln326e	Young	0.22	-880125.51	1207648.98	1954.74	1	0	3	191.38	71.94	9	2.46	6.54
Lincoln326f	Young	0.18	-880096.17	1208579.69	1947.15	1	0	5	191.38	72.00	11	1.28	26.28
Lincoln326g	Young	0.04	-879966.96	1208382.62	1912.07	1	1	4	191.88	72.25	11	2.14	2.56
Lincoln327a	Old	0.97	-873925.95	1204917.10	1845.63	1	0	5	197.25	75.56	4	1.97	10.58
Lincoln327b	Old	0.97	-873921.25	1204964.11	1857.35	1	0	3	197.25	75.56	4	1.97	9.81
Lincoln327c	Young	0.11	-873864.85	1204458.80	1850.06	1	0	4	197.88	76.25	2	3.61	2.83
Lincoln327d	Old	0.62	-873853.09	1204383.59	1852.53	1	0	3	197.88	76.25	2	7.16	4.03
Lincoln327e	Old	0.89	-873813.14	1204348.34	1857.55	1	0	5	197.88	76.25	2	6.75	12.75

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Lincoln327f	Young	0.57	-873425.35	1205100.42	1858.71	1	0	5	197.25	75.56	2	3.04	15.50
Lincoln328	Young	0.20	-868390.97	1206613.33	1834.88	1	1	1	197.75	75.63	4	4.42	3.34
Lincoln328a	Young	0.69	-868301.01	1206589.00	1839.77	1	0	4	197.75	75.63	4	17.34	5.31
Lincoln328b	Young	0.13	-868322.31	1206684.83	1834.80	1	0	3	197.75	75.63	4	4.42	2.85
Lincoln329	Old	0.96	-868297.52	1206397.50	1894.30	1	0	5	198.63	76.56	4	19.54	27.71
Lincoln330	Old	0.98	-868447.89	1206972.56	1909.86	1	0	5	196.75	74.81	2	4.60	16.11
Lincoln330a	Old	0.71	-868457.92	1207032.39	1920.67	1	0	3	196.75	74.81	2	4.60	4.87
Lincoln330b	Young	0.98	-868414.16	1206896.75	1874.91	1	0	5	196.75	74.81	2	3.82	22.35
Lincoln331	Old	0.95	-868109.63	1206515.73	1884.06	1	0	5	195.38	73.94	4	20.38	24.62
Lincoln332	Young	0.48	-861284.28	1205530.49	1942.88	1	0	3	194.38	74.88	8	0.73	4.82
Lincoln332a	Old	0.14	-861161.67	1205472.78	1942.40	1	0	4	194.38	74.88	8	1.09	2.98
Lincoln332b	Old	0.69	-861101.82	1205315.52	1938.22	1	0	3	194.38	74.88	4	1.59	3.06
Lincoln332c	Old	0.08	-861017.49	1204774.61	1918.66	1	1	4	193.63	73.88	2	10.52	1.47
Lincoln332d	Old	0.69	-861018.98	1204639.08	1944.77	1	0	5	191.75	72.56	2	10.52	28.22
Lincoln333	Old	0.05	-862919.28	1206083.77	1966.81	1	1	4	192.25	72.63	8	1.38	2.42
Lincoln333a	Old	0.05	-863248.16	1206195.05	1974.85	1	0	4	191.75	72.56	8	2.24	0.92
Lincoln333b	Old	0.70	-863381.28	1205946.54	1987.82	1	0	3	192.13	72.75	4	8.19	5.01
Lincoln333c	Old	0.90	-863381.28	1205769.04	2009.12	1	0	5	192.13	72.75	4	12.51	17.30
Lincoln334	Young	0.42	-873532.50	1204237.52	1861.40	1	1	2	197.00	75.44	2	2.20	4.85
Lincoln334a	Young	0.43	-873551.70	1204205.88	1862.44	1	0	3	197.00	75.44	2	2.20	3.51
Lincoln334b	Old	0.99	-873633.28	1204241.62	1879.06	1	0	5	197.00	75.44	2	2.20	14.59
Lincoln334c	Old	0.99	-873673.67	1204268.03	1886.15	1	0	3	197.00	75.44	2	6.75	6.74
Lincoln335	Old	0.86	-873404.47	1204164.10	1889.36	1	0	5	197.00	75.44	2	5.25	12.97
Lincoln336	Old	0.64	-873474.71	1203990.41	1901.46	1	0	3	197.00	75.44	2	1.52	8.99
Lincoln337	Old	0.75	-873480.22	1204065.05	1889.11	1	0	3	197.00	75.44	2	1.52	10.70
Lincoln337a	Young	0.37	-873468.46	1204137.00	1879.77	1	1	2	197.00	75.44	2	2.20	9.17
Lincoln337b	Old	0.69	-873468.06	1204080.87	1886.17	1	0	3	197.00	75.44	2	1.52	9.14
Lincoln338	Young	0.24	-875507.35	1205875.62	1896.24	1	0	3	195.13	73.56	10	2.31	3.21
Lincoln338a	Old	0.73	-875204.65	1205944.46	1901.72	1	0	3	195.63	74.00	10	1.52	5.70
Lincoln338b	Old	0.02	-876241.67	1206068.65	1921.97	1	0	4	193.13	72.25	10	1.51	1.94
Lincoln339	Old	0.10	-880854.78	1213414.58	2028.07	1	0	4	186.13	66.88	11	1.27	2.59
Lincoln339a	Old	0.80	-880988.64	1213870.00	2051.02	1	0	5	183.88	65.44	11	3.35	10.70
Lincoln339b	Young	0.02	-880758.72	1213489.95	2024.74	1	1	4	186.13	66.88	11	0.66	1.30
Lincoln339c	Old	0.52	-880577.04	1213439.45	2035.76	1	0	3	186.13	66.88	9	2.31	4.29
Lincoln340	Young	0.07	-879440.80	1218665.18	2078.99	1	1	2	181.50	63.63	2	3.29	5.14
Lincoln340a	Old	0.91	-879273.43	1218747.97	2075.22	1	0	5	182.25	64.25	2	2.59	12.02

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Lincoln340b	Old	0.93	-879670.23	1218960.28	2112.76	1	0	5	181.88	63.81	10	5.89	10.63
Lincoln340c	Old	0.93	-879661.99	1218899.47	2099.20	1	0	3	181.88	63.81	10	5.89	9.56
Lincoln341a	Old	0.83	-879307.03	1219649.96	2052.83	1	0	3	185.13	65.75	10	7.33	8.21
Lincoln341b	Young	0.51	-879173.36	1220354.56	2013.60	1	0	3	187.25	66.56	10	3.74	5.52
Lincoln342	Young	0.02	-878645.38	1220611.43	2007.92	1	1	2	189.00	67.69	10	2.63	2.77
Lincoln342a	Young	0.09	-878567.47	1220595.94	2013.01	1	1	3	189.00	67.69	10	2.63	3.33
Lincoln342b	Young	0.43	-878529.95	1220579.40	2014.47	1	0	3	189.00	67.69	10	2.63	3.24
Lincoln342c	Young	0.02	-878739.79	1220667.79	2003.99	1	1	4	189.00	67.69	10	1.24	2.59
Lincoln342d	Young	0.09	-878870.82	1220791.82	1997.06	1	0	4	190.63	68.56	10	1.24	2.48
Lincoln343	Young	0.47	-878359.83	1221166.45	1997.08	1	0	3	190.50	68.56	10	4.57	4.89
Lincoln343a	Young	0.03	-879014.04	1221680.38	1973.44	1	1	4	192.38	69.25	10	2.01	1.55
Lincoln343b	Young	0.08	-878876.92	1221675.81	1972.08	1	0	4	192.38	69.25	10	2.01	1.60
Lincoln344a	Young	0.08	-879545.95	1231857.89	1960.52	1	0	4	194.50	69.56	9	0.84	1.01
Lincoln344b	Young	0.59	-879362.69	1231857.89	1971.92	1	0	3	194.50	69.56	9	3.03	6.40
Lincoln344c	Young	0.67	-878342.37	1223197.51	1970.77	1	0	5	191.38	68.75	9	3.54	13.68
Lincoln344d	Young	0.28	-878596.72	1222977.31	1967.34	1	0	3	191.38	68.75	9	3.85	3.24
Lincoln345	Old	0.19	-885569.70	1234457.93	2066.90	1	1	3	186.63	65.25	9	3.57	3.06
Lincoln345a	Old	0.80	-885568.94	1234494.62	2066.07	1	0	3	186.63	65.25	9	3.57	2.86
Lincoln345b	Old	0.05	-885566.44	1234356.10	2069.70	1	1	4	186.63	65.25	9	3.57	3.96
Lincoln345c	Old	0.51	-885793.61	1234463.74	2075.54	1	0	4	186.63	65.25	9	3.21	2.66
Lincoln346	Young	0.05	-886305.51	1234666.55	2067.92	1	1	1	186.38	65.31	9	4.86	3.01
Lincoln346a	Young	0.23	-886254.61	1234583.24	2073.12	1	1	3	186.38	65.31	9	4.86	3.53
Lincoln346b	Young	0.05	-886413.30	1234835.41	2063.40	1	1	2	188.00	66.94	9	3.87	2.16
Lincoln346c	Young	0.05	-886532.86	1234946.27	2062.57	1	1	4	188.00	66.94	9	2.36	2.58
Lincoln347	Young	0.04	-892962.30	1234217.86	1955.49	1	1	4	192.38	69.31	9	2.22	2.38
Lincoln347a	Young	0.89	-892980.70	1234263.07	1960.75	1	0	3	192.38	69.31	9	2.22	5.31
Lincoln347b	Young	0.88	-892787.22	1234077.65	2012.23	1	0	5	192.38	69.31	9	14.18	23.77
Lincoln347c	Old	0.87	-892730.79	1233972.85	2064.75	1	0	3	192.38	69.31	9	14.18	4.48
Lincoln347d	Old	0.93	-889892.40	1234777.47	2083.21	1	0	3	189.88	68.13	9	3.05	8.94
Lincoln347e	Old	0.93	-889902.78	1234757.79	2082.19	1	0	5	189.88	68.13	9	3.05	10.34
Lincoln348a	Young	0.56	-898121.50	1229588.96	1835.56	1	0	5	207.38	77.56	5	13.59	12.78
Lincoln348b	Old	0.09	-897388.45	1230149.16	1829.57	1	0	5	207.88	78.00	8	3.02	10.11
Lincoln348c	Young	0.26	-897132.36	1229809.84	1832.05	1	0	3	205.25	76.25	8	5.69	7.20
Lincoln348d	Young	0.05	-897350.03	1229953.89	1811.47	1	1	4	207.88	78.00	8	2.53	1.62
Lincoln348e	Young	0.05	-897423.27	1230048.88	1814.73	1	0	3	207.88	78.00	8	1.00	5.00
Lincoln348f	Young	0.58	-897134.86	1229884.26	1825.98	1	0	5	205.25	76.25	8	4.55	10.80

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Lincoln348g	Young	0.21	-897727.15	1230210.70	1806.53	1	0	4	208.50	78.38	5	0.96	0.95
Manzano198	Young	0.84	-943893.76	1385562.77	1777.53	1	0	5	211.38	67.50	5	6.59	15.46
Manzano199	Old	0.93	-937162.99	1385989.11	1933.41	1	0	5	193.38	52.63	11	3.11	5.72
Manzano200	Old	0.91	-937653.08	1382566.93	2082.52	1	0	5	186.63	49.94	11	2.45	13.51
Manzano201	Old	0.89	-937607.65	1382773.56	2052.64	1	0	5	188.38	51.56	11	2.77	26.38
Manzano202	Old	1.00	-930010.56	1372059.79	2221.03	1	0	3	179.00	45.50	11	2.42	3.39
Manzano203	Young	0.03	-925311.84	1358237.63	2012.19	1	1	4	188.00	51.88	11	1.58	2.31
Manzano203a	Old	0.91	-925343.10	1358263.66	2013.88	1	0	3	188.00	51.88	11	1.58	3.76
Manzano204	Young	0.03	-927386.42	1352535.63	2015.35	1	1	4	187.63	53.31	8	1.69	0.93
Manzano204a	Old	0.89	-927169.63	1352606.64	2007.91	1	0	3	188.50	53.50	8	1.19	3.87
Manzano204b	Young	0.77	-927386.69	1352495.55	2015.45	1	0	4	187.63	53.31	8	1.69	0.99
Manzano205	Young	0.03	-925089.13	1352275.16	1969.66	1	1	1	190.75	53.44	8	0.71	1.59
Manzano205a	Young	0.48	-925042.21	1352354.01	1969.22	1	0	4	190.75	53.44	8	0.71	1.03
Manzano205b	Young	0.83	-925313.52	1351977.55	1974.53	1	0	3	190.38	53.56	8	1.60	4.71
Manzano205c	Young	0.03	-925011.62	1352352.23	1968.88	1	1	4	190.75	53.44	8	0.71	1.21
Manzano206	Old	0.15	-928075.29	1352598.90	2039.56	1	1	3	186.25	52.56	11	5.86	6.61
Manzano206a	Old	0.92	-928116.63	1352640.63	2047.78	1	0	3	185.25	52.06	11	5.86	5.45
Manzano206b	Old	0.91	-928297.98	1352776.65	2078.13	1	0	5	185.25	52.06	11	2.14	15.19
Manzano207	Young	0.57	-927787.09	1349311.65	1985.38	1	0	4	190.38	53.75	11	2.12	1.52
Manzano208	Old	0.88	-933203.67	1347472.16	2051.19	1	0	4	184.75	51.06	8	0.89	2.55
Manzano209	Young	0.27	-905427.01	1319034.05	1864.08	1	1	1	199.00	60.44	4	0.80	0.49
Manzano209a	Young	0.13	-906008.55	1318628.48	1879.90	1	0	4	198.25	60.50	4	3.31	2.36
Manzano210	Old	0.26	-892957.43	1310151.31	1907.72	1	0	4	196.88	60.31	3	0.23	0.13
Manzano211	Young	0.12	-884375.19	1302521.31	1942.92	1	0	4	194.63	61.00	8	0.88	1.01
Manzano212	Young	0.05	-878867.14	1294459.05	1972.79	1	1	4	193.25	62.00	8	0.96	0.79
Manzano213	Old	0.84	-877311.37	1290661.03	2036.77	1	0	3	187.50	58.81	11	1.47	4.31
Manzano214	Old	0.95	-876479.35	1289167.45	2100.85	1	0	4	185.50	56.88	2	1.84	0.56
Manzano215	Young	0.31	-869125.35	1294452.86	1954.71	1	0	4	195.00	64.06	8	1.24	0.50
Manzano216	Old	0.94	-937535.22	1383151.70	2015.32	1	0	3	188.38	51.56	11	5.96	7.09
Manzano217	Old	0.87	-937518.18	1382933.71	2038.10	1	0	5	188.38	51.56	11	6.86	22.75
Manzano218	Young	0.03	-924974.84	1360336.83	2013.67	1	1	4	187.50	52.06	11	1.13	2.81
Manzano218a	Old	0.91	-924993.34	1360619.47	2017.15	1	0	3	187.50	52.06	11	0.80	3.85
Manzano219	Young	0.84	-933894.28	1345457.92	2046.44	1	0	4	186.63	51.69	8	1.92	2.31
Manzano220	Young	0.92	-937189.49	1339003.31	2087.08	1	0	4	186.75	53.25	8	1.67	1.10
Manzano221	Young	0.07	-935832.11	1320765.00	1946.15	1	0	4	202.50	63.56	4	0.84	0.95
Manzano221a	Old	0.37	-935770.38	1320767.24	1944.29	1	0	3	202.50	63.56	4	0.84	3.20

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Manzano221b	Young	0.05	-935242.23	1320653.03	1928.20	1	0	4	203.13	63.50	4	0.86	0.45
Manzano221c	Young	0.71	-934324.85	1320399.29	1940.36	1	0	3	202.63	63.31	4	3.00	6.81
Manzano221d	Old	0.90	-934142.68	1320334.23	1969.82	1	0	5	202.63	63.31	4	4.01	21.42
Manzano221e	Young	0.35	-935579.81	1320713.10	1929.05	1	0	3	202.50	63.44	4	1.89	3.19
Manzano222	Young	0.07	-948649.01	1317634.33	1782.56	1	1	4	214.00	71.50	9	1.66	1.35
Manzano222a	Old	0.57	-947377.90	1316977.63	1836.36	1	0	5	212.38	70.25	10	8.16	15.57
Manzano222b	Old	0.23	-948538.96	1316696.16	1782.97	1	0	5	214.00	71.94	9	3.06	11.37
Manzano222c	Young	0.01	-948110.34	1317858.80	1779.99	1	0	4	213.13	71.00	9	0.77	1.17
Manzano222d	Young	0.08	-947759.34	1317352.40	1779.70	1	0	3	213.75	71.31	9	3.42	5.61
McCoy	Old	0.94	-908015.53	1930891.24	2164.52	2	0	5	155.00	2.31	11	5.11	10.56
McCoy1a	Old	0.94	-908000.42	1930891.26	2164.52	2	0	3	155.00	2.31	11	5.11	9.36
meve1	Old	0.98	-1095282.62	1642117.63	2111.47	2	0	4	199.13	49.38	11	3.51	1.02
meve2	Old	0.97	-1093830.32	1641270.24	2086.92	2	0	4	198.13	49.44	11	8.44	2.37
meve3	Old	1.00	-1099639.10	1647945.37	2276.57	2	0	3	191.75	43.19	11	10.70	3.91
meve4	Old	0.94	-1095484.99	1642841.79	1994.24	2	0	5	198.50	48.75	11	9.76	27.72
meve5	Old	0.98	-1095323.20	1642092.48	2110.51	2	0	4	199.50	50.13	11	3.51	1.16
meve6	Young	0.24	-1086751.90	1658213.43	2196.08	2	1	3	176.88	33.25	9	4.76	8.69
meve7	Old	0.91	-1087104.42	1656137.12	2458.77	2	0	5	180.63	39.13	9	11.49	31.95
meve8	Young	0.26	-1087091.38	1659160.01	2129.69	2	1	3	176.38	32.00	9	3.83	5.78
neNM01	Young	0.08	-891133.88	1499630.33	1774.02	1	0	4	195.88	53.69	8	1.86	3.05
neNM01a	Old	0.94	-895192.64	1501806.78	2056.44	1	0	3	193.38	56.44	1	9.25	9.00
neNM01b	Old	0.88	-895040.86	1501697.61	2009.75	1	0	3	193.38	56.44	1	7.76	6.89
neNM01c	Young	0.25	-894785.24	1501543.17	1988.18	1	0	4	193.38	56.44	1	1.46	1.97
neNM01d	Old	0.76	-894207.71	1500873.31	1914.62	1	0	3	193.13	52.31	8	8.11	7.65
neNM01e	Old	0.63	-894107.58	1500762.04	1873.06	1	0	5	193.75	52.50	8	7.63	20.01
neNM01f	Young	0.07	-891079.69	1499514.18	1776.59	1	0	4	195.38	53.38	8	1.84	1.42
neNM01g	Young	0.49	-890331.06	1499176.76	1809.84	1	0	5	194.88	52.81	11	2.02	14.98
neNM01h	Young	0.38	-890254.78	1498958.01	1809.62	1	0	3	194.25	52.63	11	2.69	7.23
neNM02	Young	0.09	-889229.50	1501197.27	1776.98	1	0	4	195.88	53.06	8	3.56	1.83
neNM02a	Young	0.39	-888923.30	1501084.10	1801.82	1	0	3	195.88	53.06	11	2.60	5.43
neNM02b	Young	0.59	-888991.84	1501052.16	1794.95	1	0	5	195.88	53.06	11	2.47	12.21
neNM03	Young	0.31	-887373.43	1502465.62	1789.12	1	1	3	195.63	52.50	11	10.15	7.19
neNM03a	Old	0.92	-886988.34	1502423.72	1858.63	1	0	5	196.13	53.50	11	15.24	17.20
neNM03b	Young	0.26	-888036.65	1503482.30	1761.39	1	0	3	196.63	53.88	8	1.56	5.51
neNM03c	Old	0.61	-888423.37	1503869.02	1816.17	1	0	5	196.63	53.88	8	9.27	15.46
neNM03d	Old	0.52	-888612.53	1504058.19	1827.42	1	0	3	196.38	54.25	8	7.61	9.15

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
neNM03e	Old	0.91	-890025.38	1505412.26	2051.76	1	0	3	191.88	53.81	1	4.90	9.31
neNM04a	Old	0.86	-887740.33	1505287.74	1838.53	1	0	5	196.75	55.38	8	12.76	27.44
neNM04b	Old	0.65	-888053.47	1505397.77	1894.85	1	0	3	194.75	53.50	8	8.38	6.78
neNM04c	Old	0.90	-888908.28	1506252.58	2074.74	1	0	3	191.25	53.88	1	10.81	4.12
neNM04d	Old	0.83	-887097.10	1505677.06	1856.62	1	0	5	195.75	53.19	8	13.64	12.33
neNM05	Old	0.97	-887003.95	1507352.54	1778.10	1	0	5	196.13	53.25	8	20.90	24.90
neNM05a	Old	0.93	-887323.59	1507533.66	1878.45	1	0	5	194.88	52.44	8	17.34	21.01
neNM05b	Old	0.97	-886812.09	1507250.99	1901.73	1	0	5	196.13	53.25	8	18.87	34.86
neNM06a	Young	0.49	-881178.15	1508060.77	1799.76	1	0	3	195.25	51.06	11	6.04	5.96
neNM06b	Old	0.72	-881432.09	1508055.74	1822.06	1	0	5	195.25	51.31	8	9.29	18.45
neNM06c	Old	0.45	-881578.61	1508047.43	1839.07	1	0	3	195.25	51.31	8	6.16	3.45
neNM06d	Old	0.94	-880934.10	1508065.84	1829.38	1	0	5	195.25	51.06	11	9.31	25.07
neNM07	Young	0.61	-877135.24	1506918.02	1885.22	1	0	3	193.88	50.81	8	4.19	8.56
neNM07a	Old	0.86	-877038.97	1506874.77	1902.37	1	0	5	192.13	50.69	8	11.21	16.33
neNM07b	Old	0.81	-877628.54	1506966.02	1930.69	1	0	3	194.25	50.31	11	9.38	5.88
neNM07c	Young	0.54	-877540.05	1506707.95	1883.54	1	0	3	194.00	50.50	11	4.93	6.19
neNM07d	Young	0.58	-877491.12	1506709.70	1870.65	1	0	5	194.00	50.50	11	4.93	15.57
neNM07e	Young	0.49	-877442.20	1506828.52	1873.19	1	0	3	193.88	50.81	8	4.93	7.87
neNM07f	Young	0.05	-877466.66	1506442.36	1858.04	1	0	4	193.88	50.56	8	0.86	1.89
neNM07g	Young	0.07	-877277.95	1506592.63	1863.92	1	1	4	193.88	50.56	8	2.02	2.07
neNM07h	Old	0.76	-877570.55	1506945.68	1913.94	1	0	5	194.25	50.31	11	6.34	25.53
neNM08	Young	0.14	-876486.71	1507244.61	1902.68	1	0	4	190.38	50.94	11	3.54	2.37
neNM08a	Old	0.92	-876484.40	1506740.85	2044.20	1	0	5	190.13	51.00	5	14.41	22.66
neNM08b	Young	0.51	-876720.27	1507394.42	1916.53	1	0	5	191.25	50.81	11	2.89	14.95
neNM08c	Young	0.49	-876528.62	1507409.16	1912.31	1	0	3	190.38	50.94	11	3.10	4.69
neNM08d	Old	0.79	-876376.29	1507600.81	1950.52	1	0	3	191.00	50.88	11	4.18	9.65
neNM09	Young	0.88	-874751.17	1507628.30	1992.09	1	0	5	187.63	48.38	5	4.40	18.86
neNM09a	Old	0.92	-874779.76	1507803.20	2022.98	1	0	5	187.63	48.38	5	6.17	34.32
neNM09b	Old	0.95	-874911.33	1507402.22	1986.25	1	0	5	187.88	48.69	11	13.62	22.74
neNM09c	Young	0.85	-875393.76	1507608.97	1960.78	1	0	5	189.13	50.25	5	7.03	22.48
neNM09d	Young	0.93	-875140.02	1507483.67	1976.91	1	0	5	188.00	49.63	5	9.41	12.38
neNM10a	Old	0.92	-873700.18	1507213.64	2105.99	1	0	5	186.50	47.88	5	5.71	33.18
neNM10b	Old	0.91	-873780.61	1507133.22	2136.03	1	0	5	183.13	46.69	5	4.05	32.03
neNM11a	Old	0.92	-872961.60	1506737.66	2160.32	1	0	5	181.50	45.56	5	1.86	29.92
neNM11b	Old	0.91	-873032.20	1506672.68	2166.90	1	0	5	180.88	45.19	5	1.86	22.95
neNM12a	Old	0.91	-872248.44	1506660.64	2210.41	1	0	5	180.88	44.75	5	1.18	15.26

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
neNM12b	Old	0.91	-872281.89	1506505.42	2188.80	1	0	5	180.88	44.75	5	1.18	19.99
neNM13	Old	0.93	-870721.79	1505815.67	2242.59	1	0	3	175.88	41.19	5	3.37	3.80
neNM13a	Old	0.91	-870276.50	1506331.30	2265.87	1	0	5	173.88	39.50	5	4.45	14.55
neNM13b	Old	0.91	-870853.29	1505289.03	2259.79	1	0	5	175.63	41.06	5	6.39	17.70
neNM14	Young	0.24	-863427.25	1503331.00	2280.45	1	1	3	163.50	31.31	8	3.75	4.81
neNM14a	Old	0.91	-863367.75	1503319.36	2291.18	1	0	5	163.50	31.31	7	5.03	12.75
neNM15	Old	0.53	-861038.82	1502927.84	2343.46	1	0	4	158.50	26.38	11	0.92	1.89
neNM16	Old	0.91	-859292.49	1503580.40	2294.92	1	0	5	156.00	23.94	8	2.38	12.42
neNM17	Old	0.91	-837459.59	1485672.39	2406.31	1	0	5	145.50	24.31	2	12.83	11.73
neNM17a	Young	0.24	-837278.26	1485611.59	2370.40	1	1	3	146.50	23.56	2	14.20	8.38
neNM17b	Old	0.95	-837181.86	1485779.01	2391.17	1	0	3	145.88	23.69	2	4.92	8.19
neNM18a	Old	0.91	-828490.94	1474943.28	2183.08	1	0	5	165.00	38.06	2	2.64	18.37
neNM19	Young	0.24	-825021.20	1474087.48	2179.14	1	1	3	164.13	37.63	8	1.24	4.25
neNM19a	Old	0.91	-825348.82	1474241.66	2217.61	1	0	5	162.63	36.38	8	12.39	23.62
neNM20	Old	0.83	-820797.91	1480017.41	2218.16	1	0	3	162.88	35.94	10	2.47	4.41
neNM20a	Old	0.41	-820690.33	1480017.38	2221.71	1	0	4	162.88	35.94	10	2.16	2.20
neNM21	Old	0.91	-820787.47	1480725.22	2246.57	1	0	5	161.00	34.50	10	6.51	11.63
neNM21a	Old	0.91	-820804.07	1480725.48	2241.45	1	0	3	161.00	34.50	10	6.51	9.69
neNM22a	Old	0.72	-803887.04	1495578.91	2288.23	1	0	3	163.88	37.81	1	6.89	5.18
neNM23a	Old	0.91	-801638.37	1495889.18	2199.29	1	0	5	166.63	39.06	8	7.98	19.22
neNM24	Old	0.71	-800654.99	1495786.67	2162.48	1	0	3	168.13	40.31	8	4.78	3.88
neNM24a	Old	0.91	-800436.52	1496042.25	2175.34	1	0	5	168.13	40.31	8	2.06	23.49
neNM24b	Old	0.91	-801018.39	1495872.78	2194.50	1	0	5	167.00	39.75	8	8.66	17.07
neNM25	Young	0.07	-799040.59	1494010.21	2168.38	1	1	4	168.75	41.25	8	1.83	1.34
neNM25a	Young	0.92	-798769.43	1494078.06	2168.46	1	0	5	169.88	41.81	8	0.88	10.32
neNM25b	Old	0.73	-799703.95	1493182.64	2230.07	1	0	3	166.88	40.31	8	2.69	3.43
neNM25c	Old	0.91	-799838.40	1493068.11	2229.23	1	0	5	166.88	40.31	8	4.25	14.59
neNM25d	Young	0.79	-797913.62	1490655.55	2218.69	1	0	3	167.38	40.81	1	1.54	3.63
neNM26a	Young	0.11	-778383.96	1476032.74	1959.77	1	0	3	182.13	49.25	8	6.58	5.50
neNM26b	Young	0.25	-778495.07	1475855.79	1983.17	1	0	5	181.13	49.81	8	9.92	13.81
neNM27a	Old	0.85	-727409.37	1557120.72	2053.22	1	0	5	182.13	47.81	9	6.02	12.38
neNM27b	Young	0.21	-727339.39	1557361.36	2010.47	1	0	3	181.88	47.56	9	5.67	3.45
neNM28a	Old	0.91	-723743.69	1558546.72	2164.42	1	0	5	179.38	46.69	8	14.32	15.45
neNM28b	Old	0.91	-724758.69	1556653.89	2078.75	1	0	5	179.75	47.38	9	12.89	23.72
neNM28c	Young	0.80	-724729.33	1556949.55	2049.78	1	0	5	180.25	47.00	9	1.73	10.31
neNM29a	Old	0.91	-723055.80	1556174.98	2080.62	1	0	5	178.88	46.63	9	2.36	12.26

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
neNM29b	Old	0.91	-723211.83	1555938.09	2091.66	1	0	5	178.25	47.00	9	10.45	25.00
neNM29c	Young	0.92	-722130.54	1555759.49	2097.24	1	0	5	179.00	46.50	9	7.59	12.14
neNM29e	Old	0.91	-722682.02	1557739.60	2170.15	1	0	5	177.00	45.13	8	7.41	16.68
neNM30	Young	0.17	-706418.92	1552167.74	2076.28	1	0	4	180.75	46.25	8	0.71	0.49
neNM30a	Old	0.76	-706101.64	1552540.70	2092.32	1	0	3	181.38	46.50	8	1.97	4.89
neNM31	Young	0.23	-706337.20	1553631.48	2101.33	1	0	4	181.50	47.00	1	1.81	1.08
neNM31a	Old	0.84	-706024.48	1553637.48	2105.46	1	0	3	182.00	47.13	1	0.88	6.59
neNM32	Young	0.42	-705680.32	1555264.86	2158.88	1	0	4	182.00	48.69	1	4.32	2.92
neNM32a	Young	0.79	-705665.54	1555299.54	2159.72	1	0	3	182.00	48.69	1	2.38	3.47
neNM32b	Old	0.91	-705148.26	1555408.65	2185.94	1	0	5	181.50	48.81	1	4.46	12.72
neNM33	Young	0.24	-704957.46	1556546.43	2206.16	1	1	3	179.88	47.50	1	5.03	3.21
neNM33a	Old	0.91	-704732.38	1556435.37	2221.05	1	0	5	179.00	46.75	1	6.82	13.13
neNM34	Young	0.07	-702718.37	1558297.65	2104.59	1	1	4	184.13	49.44	1	2.74	2.96
neNM34a	Young	0.24	-702704.83	1558286.34	2103.72	1	1	3	184.13	49.44	1	2.74	3.49
neNM34b	Old	0.91	-702559.41	1558204.05	2109.05	1	0	5	184.13	49.44	1	5.07	11.82
neNM35	Old	0.55	-704816.37	1565916.27	2012.39	1	0	3	185.25	48.38	8	5.46	5.55
neNM36a	Old	0.86	-804485.86	1540473.72	2256.32	1	0	3	166.63	35.56	8	2.74	5.23
neNM37a	Old	0.91	-811594.85	1538046.57	2393.44	1	0	5	150.00	20.50	5	13.15	31.44
neNM38	Old	0.91	-841328.10	1522177.44	2361.64	1	0	5	155.50	21.13	2	6.86	10.25
neNM39a	Old	0.91	-843510.50	1523607.27	2328.94	1	0	5	161.63	25.63	2	6.77	32.26
neNM40a	Old	0.91	-844703.42	1523985.77	2301.27	1	0	5	163.88	27.31	2	5.45	26.98
neNM41	Young	0.24	-848040.84	1523572.46	2194.40	1	1	3	173.00	31.63	8	8.26	5.39
neNM41a	Young	0.07	-848227.10	1523811.32	2178.92	1	1	4	174.88	33.69	8	2.35	2.68
neNM41b	Old	0.91	-848114.67	1523352.22	2220.71	1	0	5	173.00	31.63	8	9.05	12.23
neNM42	Old	0.81	-858821.68	1519890.96	2149.91	1	0	3	178.63	37.44	8	3.13	3.64
neNM42a	Young	0.83	-858847.69	1520163.09	2137.08	1	0	3	178.63	37.44	8	1.84	4.19
neNM42b	Young	0.42	-858872.87	1520224.74	2135.58	1	0	4	178.63	37.44	8	1.26	1.22
neNM42c	Old	0.43	-858665.34	1519763.84	2160.13	1	0	4	178.13	36.56	8	3.18	2.02
neNM43	Young	0.47	-862379.49	1518651.72	2128.17	1	0	4	182.38	40.63	8	2.11	2.35
neNM43a	Young	0.85	-862273.22	1519100.73	2117.57	1	0	3	181.88	40.69	8	3.06	4.32
neNM43b	Old	0.81	-862037.49	1518265.16	2160.34	1	0	3	180.38	38.13	8	5.00	3.81
neNM44	Old	0.79	-864349.26	1517428.45	2156.48	1	0	3	182.75	41.00	8	6.56	3.20
neNM44a	Young	0.76	-864621.65	1517479.75	2144.64	1	0	3	182.13	41.19	8	4.39	2.31
neNM44b	Young	0.71	-864297.28	1517242.74	2164.02	1	0	4	182.25	41.00	8	7.05	22.91
neNM44c	Young	0.07	-865153.61	1517398.48	2078.03	1	1	4	182.50	41.38	8	5.91	24.78
neNM44d	Old	0.75	-864646.02	1517726.77	2137.03	1	0	5	182.75	41.25	8	6.18	2.49

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
neNM44e	Old	0.78	-864637.00	1517585.47	2141.01	1	0	5	182.13	41.19	8	4.39	3.27
neNM45	Old	0.94	-871216.42	1513057.38	1842.20	1	0	5	191.00	48.81	5	21.88	20.26
neNM45a	Old	0.84	-871280.14	1513211.07	1852.95	1	0	5	191.00	48.81	8	11.81	18.26
neNM45b	Old	0.92	-867898.80	1516556.69	1951.00	1	0	5	192.38	48.19	7	17.67	27.70
NM_AZ355a	Old	0.93	-1001671.14	1477757.76	2003.02	2	0	5	203.88	53.88	9	3.43	16.13
NM_AZ356a	Old	0.97	-1044397.26	1490930.09	2114.29	2	0	3	188.75	40.88	9	4.77	5.10
NM_AZ357a	Young	0.10	-1043896.90	1491676.00	2084.72	2	1	4	189.63	41.25	9	5.61	2.05
NM_AZ357b	Old	0.95	-1043799.60	1491676.00	2087.95	2	0	3	189.63	41.25	9	5.61	6.97
NM_AZ358	Young	0.76	-1050237.10	1479748.10	2093.28	2	0	4	191.50	44.50	9	0.79	1.26
NM_AZ358a	Old	0.93	-1050074.83	1479917.39	2089.78	2	0	3	191.50	44.50	9	0.48	4.04
NM_AZ358b	Old	0.94	-1049703.70	1478966.19	2159.55	2	0	5	191.13	44.69	9	7.74	26.07
NM_AZ359a	Old	0.96	-1050455.04	1476275.02	2160.82	2	0	3	190.88	45.06	9	1.74	3.63
NM_AZ359b	Old	0.80	-1050378.63	1476342.94	2164.66	2	0	4	190.88	45.38	9	1.14	1.08
NM_AZ360	Old	0.93	-1059870.06	1464657.82	2158.84	2	0	3	188.75	45.88	9	2.34	3.08
NM_AZ360a	Old	0.70	-1059898.04	1464641.01	2159.62	2	0	4	188.75	45.88	9	2.34	2.09
NM_AZ361a	Old	0.96	-1061052.75	1455205.09	2187.86	2	0	5	184.00	43.31	9	2.85	15.46
NM_AZ361b	Old	0.97	-1061065.86	1455129.39	2195.61	2	0	3	184.00	43.31	9	4.14	8.77
NM_AZ362a	Old	0.98	-1061732.74	1451352.56	2270.42	2	0	3	178.88	38.56	11	5.78	7.31
NM_AZ362b	Old	0.99	-1061704.33	1451303.86	2254.16	2	0	5	178.88	38.56	11	5.78	16.73
NM_AZ362c	Old	0.99	-1061688.10	1451660.99	2295.80	2	0	3	178.75	38.25	11	3.17	9.33
NM_AZ363a	Old	0.91	-1061736.42	1450859.24	2243.27	2	0	3	178.88	39.00	9	2.03	3.40
NM_AZ364	Young	0.39	-1059051.25	1431869.51	2087.02	2	0	4	190.75	48.75	11	1.38	1.04
NM_AZ365a	Young	0.07	-1061491.59	1429923.09	2073.25	2	1	4	190.00	48.38	8	3.07	2.75
NM_AZ365b	Old	0.79	-1061447.75	1430010.76	2078.61	2	0	3	188.75	47.69	9	2.25	4.27
NM_AZ365c	Old	0.99	-1061419.05	1430218.92	2106.02	2	0	5	188.75	47.69	9	9.65	29.69
NM_AZ366a	Old	0.92	-1070304.70	1416025.17	2024.97	2	0	5	198.25	54.56	8	6.06	12.05
NM_AZ367	Young	0.29	-1114164.41	1404190.22	2189.65	2	0	4	177.13	38.00	1	4.85	0.87
NM_AZ368	Young	0.15	-1117139.53	1405291.66	2174.54	2	0	4	176.88	37.38	1	0.13	0.40
NM_AZ369	Young	0.20	-1118752.08	1406886.72	2209.38	2	0	4	175.63	36.44	11	0.77	1.87
NM_AZ369a	Young	0.68	-1118674.44	1406908.78	2206.06	2	0	3	175.75	36.50	11	0.77	4.17
NM_AZ370	Young	0.07	-1122515.38	1411723.39	2160.46	2	1	4	178.38	38.25	11	0.98	0.76
NM_AZ370a	Young	0.16	-1122743.35	1411911.73	2161.19	2	0	4	178.63	38.38	11	0.45	0.37
NM_AZ370b	Old	0.91	-1123593.95	1412006.79	2217.02	2	0	5	177.88	37.88	11	4.90	20.07
NM_AZ370c	Old	0.81	-1123633.34	1412107.06	2213.86	2	0	3	177.88	37.88	11	4.90	6.39
NM_AZ371	Young	0.07	-1123768.77	1413253.24	2130.62	2	1	1	180.00	39.63	11	0.25	1.70
NM_AZ371a	Old	0.71	-1123756.87	1413356.60	2132.72	2	0	3	180.00	39.63	11	0.25	4.06

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
NM_AZ371b	Old	0.20	-1123708.20	1413403.64	2135.70	2	0	4	180.00	39.63	11	0.25	1.45
NM_AZ371c	Old	0.91	-1123816.90	1412414.02	2178.54	2	0	5	178.75	38.63	11	9.66	14.42
NM_AZ372	Young	0.24	-1127642.64	1416069.16	2108.55	2	1	3	181.25	40.94	9	2.28	3.26
NM_AZ372a	Old	0.91	-1127681.39	1416098.44	2112.08	2	0	3	181.25	40.94	9	2.28	9.83
NM_AZ372b	Old	0.91	-1128208.32	1415537.79	2112.25	2	0	5	182.88	42.31	11	5.17	17.39
NM_AZ373	Young	0.36	-1130059.17	1415114.05	2103.65	2	0	4	183.25	42.31	9	1.76	2.82
NM_AZ373a	Young	0.84	-1129928.92	1415315.37	2116.35	2	0	3	183.38	42.38	9	1.47	6.15
NM_AZ373b	Young	0.88	-1131205.08	1415210.27	2104.60	2	0	3	183.88	43.13	9	2.19	7.79
NM_AZ373c	Old	0.91	-1130101.58	1414921.26	2121.31	2	0	5	183.25	42.31	9	0.91	17.08
NM_AZ373d	Old	0.83	-1130096.50	1415027.02	2107.52	2	0	3	183.25	42.31	9	0.91	6.15
NM_AZ374	Young	0.32	-1132925.80	1413666.31	2074.56	2	0	4	184.63	43.88	1	0.23	0.69
NM_AZ374a	Young	0.81	-1132926.22	1412489.26	2094.62	2	0	3	184.13	43.94	9	6.14	4.61
NM_AZ374b	Young	0.88	-1132949.54	1413996.84	2069.55	2	0	3	184.50	43.81	1	8.53	7.41
NM_AZ374c	Old	0.91	-1133048.17	1412251.78	2113.69	2	0	5	183.75	43.50	9	3.00	18.75
NM_AZ374d	Old	0.87	-1133141.87	1412150.68	2125.37	2	0	3	184.63	44.31	9	3.37	6.95
NM_AZ375	Young	0.24	-1138054.61	1416095.58	2048.13	2	1	3	186.50	46.00	11	5.29	4.49
NM_AZ375a	Old	0.91	-1138155.34	1415924.74	2077.31	2	0	5	184.63	44.69	11	6.54	13.98
NM_AZ375b	Young	0.07	-1136837.80	1415426.58	2065.31	2	1	2	185.00	44.38	9	11.98	3.22
NM_AZ376	Young	0.50	-1140192.99	1416223.67	2035.39	2	0	4	188.00	47.50	9	2.39	2.59
NM_AZ376a	Young	0.83	-1140203.67	1415853.75	2049.34	2	0	3	187.63	46.94	11	3.57	3.58
NM_AZ376b	Old	0.91	-1140108.91	1415738.68	2076.03	2	0	5	187.63	46.94	11	6.46	21.93
NM_AZ377	Young	0.88	-1145708.96	1415737.00	2001.97	2	0	3	189.63	49.00	11	5.91	3.45
NM_AZ377a	Young	0.58	-1145660.76	1415822.54	2001.49	2	0	4	189.63	49.00	1	2.81	2.52
NM_AZ377b	Old	0.92	-1145591.24	1415481.52	2033.61	2	0	5	186.88	46.56	11	16.40	17.66
NM_AZ378	Old	0.89	-1148985.74	1414820.31	1997.25	2	0	3	189.75	49.69	10	3.69	3.83
NM_AZ378a	Young	0.63	-1148945.53	1414874.30	1993.37	2	0	4	189.75	49.69	10	1.53	2.36
NM_AZ378b	Old	0.28	-1149090.94	1414471.78	2009.12	2	1	3	189.63	49.63	10	6.82	3.93
NM_AZ379	Young	0.10	-1164341.01	1412906.42	1910.91	2	1	4	197.25	55.06	10	1.26	0.72
NM_AZ379a	Old	0.68	-1164523.93	1413056.19	1914.82	2	0	4	197.25	55.06	10	0.94	0.66
NM_AZ379b	Old	0.92	-1164716.28	1413236.52	1918.38	2	0	3	196.63	54.31	10	1.42	3.88
NM_AZ379c	Young	0.09	-1164049.06	1412863.83	1908.59	2	1	1	197.38	55.25	10	0.11	0.36
NM_AZ380	Old	0.76	-1169483.51	1411696.75	1928.11	2	0	4	197.13	54.38	8	2.42	1.95
NM_AZ380a	Young	0.11	-1169026.55	1411662.12	1911.61	2	1	2	197.38	54.50	8	2.65	3.47
NM_AZ381	Old	0.10	-1178337.59	1409444.95	1947.30	2	1	1	194.50	51.63	8	1.00	0.58
NM_AZ381a	Old	0.10	-1178320.42	1409509.25	1947.88	2	1	4	194.50	51.63	8	0.69	0.55
NM_AZ382	Old	0.83	-1196069.71	1398211.16	1892.46	2	0	4	200.13	56.63	8	1.03	2.22

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
NM_AZ383	Old	0.70	-1196827.02	1392555.02	1920.45	2	0	4	201.13	58.56	8	1.64	1.41
NM_AZ384	Old	0.85	-1197203.96	1389840.34	1858.49	2	0	3	203.88	60.31	11	1.52	3.19
NM_AZ385	Young	0.49	-1197549.26	1387678.18	1803.28	2	0	4	205.00	61.06	8	1.55	1.02
NM_AZ386	Young	0.15	-1226519.30	1366175.64	1745.46	2	0	3	208.63	67.69	10	2.14	3.45
NM_AZ386a	Young	0.55	-1226396.12	1365960.03	1766.76	2	0	5	208.63	67.69	10	5.75	11.47
NM_AZ387	Old	0.23	-1227431.90	1367000.09	1716.66	2	0	3	211.38	69.38	9	1.65	3.41
NM_AZ387a	Young	0.37	-1227038.32	1367136.38	1738.78	2	0	5	211.75	69.69	9	6.38	14.56
NM_AZ388	Old	0.10	-1236104.52	1370579.00	1672.77	2	0	4	214.88	71.00	10	1.01	2.42
NM_AZ389	Old	0.18	-1240762.56	1375971.25	1682.64	2	0	4	215.25	69.06	9	2.31	2.60
NM_AZ389a	Old	0.52	-1240811.42	1376012.84	1683.39	2	0	3	216.00	69.50	9	1.98	3.44
NM_AZ390	Young	0.34	-1244087.22	1381264.49	1668.04	2	1	1	216.00	69.75	10	0.80	0.22
NM_AZ390a	Old	0.45	-1244021.32	1381259.16	1668.92	2	0	3	216.00	69.75	10	0.66	3.13
NM_AZ390b	Old	0.16	-1244119.43	1381237.55	1667.57	2	0	4	216.00	69.75	10	0.80	1.79
NM_AZ391	Young	0.11	-1372588.41	1455795.46	1777.16	2	1	4	203.50	62.88	2	1.13	0.87
NM_AZ391a	Old	0.96	-1372741.28	1455721.90	1779.77	2	0	4	203.00	62.75	2	0.68	0.70
NM_AZ392a	Old	0.99	-1386454.42	1463482.06	1897.74	2	0	4	192.13	53.94	2	1.24	1.68
NM_AZ392b	Old	0.99	-1386499.72	1463516.70	1900.69	2	0	3	192.13	53.94	2	1.77	5.21
NM_AZ393	Old	0.91	-1387253.01	1464049.00	1927.11	2	0	4	191.13	53.38	1	0.80	0.88
NM_AZ394	Old	0.89	-1383426.86	1483241.76	1862.22	2	0	3	193.00	53.56	1	3.70	4.14
NM_AZ395	Old	0.76	-1381762.08	1484855.35	1792.28	2	0	4	203.00	61.31	1	2.47	1.60
NM_AZ395a	Young	0.11	-1381753.60	1484888.22	1791.96	2	1	4	203.00	61.31	1	1.87	1.52
NM_AZ395b	Old	0.94	-1381802.06	1484985.30	1791.27	2	0	3	203.00	61.31	1	1.34	3.41
NM_AZ396	Old	0.36	-1380976.59	1485212.27	1754.88	2	1	3	204.38	62.50	1	4.04	3.79
NM_AZ396a	Old	0.93	-1380975.23	1485188.64	1756.15	2	0	3	204.38	62.50	1	4.04	4.06
NM_AZ397	Old	0.13	-1380550.88	1485600.86	1734.07	2	1	4	208.38	65.44	1	1.44	1.42
NM_AZ398	Old	0.23	-1378505.14	1487771.92	1667.72	2	0	4	215.88	71.94	1	1.30	2.70
NM_AZ399	Old	0.38	-1376221.46	1488691.04	1606.72	2	0	4	220.88	75.69	1	1.18	1.47
NM_AZ399a	Old	0.72	-1376221.46	1488691.04	1606.72	2	1	4	220.88	75.69	1	1.18	1.47
NM_AZ400	Young	0.25	-1375773.99	1491049.64	1575.80	2	0	4	222.63	77.81	1	1.67	1.09
NM_AZ400a	Young	0.34	-1375963.61	1490829.33	1582.35	2	0	3	222.63	77.81	1	2.74	4.48
NM_AZ401	Young	0.79	-1374568.35	1495097.08	1476.57	2	0	4	233.38	86.31	9	1.95	1.06
NM_AZ402	Young	0.49	-1375770.49	1498243.16	1475.74	2	0	4	234.38	87.19	9	1.05	1.45
NM_AZ403	Old	0.66	-1378421.80	1499140.17	1608.48	2	0	4	222.50	78.06	2	4.09	1.79
NM_AZ404	Old	0.58	-1381718.18	1499105.87	1653.11	2	1	4	217.38	73.44	9	0.66	0.47
NM_AZ404a	Old	0.21	-1381718.18	1499105.87	1653.11	2	0	4	217.38	73.44	9	0.66	0.47
NM_AZ405	Old	0.53	-1382894.33	1499632.24	1658.90	2	1	4	217.25	72.81	9	0.23	0.34

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
NM_AZ405a	Old	0.17	-1382894.33	1499632.24	1658.90	2	0	4	217.25	72.81	9	0.23	0.34
NM_AZ406	Young	0.60	-1383909.38	1502054.05	1652.41	2	1	4	218.25	72.94	1	0.71	0.68
NM_AZ406a	Young	0.17	-1383909.38	1502054.05	1652.41	2	0	4	218.25	72.94	1	0.71	0.68
NM_AZ407	Young	0.69	-1383956.05	1503671.49	1632.49	2	1	1	219.50	73.75	2	1.20	0.92
NM_AZ407a	Young	0.61	-1383959.14	1503597.83	1634.39	2	0	4	219.50	73.75	2	0.57	1.41
NM_AZ407b	Young	0.20	-1383953.33	1503394.60	1639.40	2	0	3	219.50	73.75	2	1.49	8.38
NM_AZ408	Young	0.42	-1387232.63	1505095.29	1659.10	2	1	4	215.75	70.31	2	0.92	0.38
NM_AZ409a	Old	0.94	-1322671.68	1534159.15	1901.19	2	0	4	209.50	61.75	11	15.62	2.09
NM_AZ410	Old	0.97	-1194186.06	1541120.82	1957.19	2	0	3	207.25	59.13	10	8.07	6.92
NM_AZ411	Old	0.83	-1193775.17	1542678.89	1969.40	2	0	4	203.75	56.50	10	2.76	1.48
NM_AZ412	Young	0.21	-1192079.44	1544929.79	1994.41	2	1	4	201.38	54.88	10	1.76	0.70
NM_AZ413a	Young	0.19	-1189844.37	1546641.58	2054.84	2	1	4	196.00	50.56	10	1.16	1.27
NM_AZ413b	Old	0.97	-1189825.13	1546550.52	2056.36	2	0	3	196.00	50.56	10	1.24	3.43
NM_AZ414	Young	0.89	-1188858.32	1547416.94	2091.33	2	0	4	194.88	49.88	10	1.67	0.63
NM_AZ415	Old	0.97	-1188421.16	1547809.69	2083.54	2	0	3	194.38	49.63	10	2.88	3.82
NM_AZ415a	Young	0.19	-1188459.29	1547797.41	2081.14	2	1	2	194.38	49.63	10	2.33	3.39
NM_AZ416	Young	0.19	-1187807.98	1548663.92	2076.70	2	1	4	194.75	49.88	10	1.30	2.30
NM_AZ416a	Old	0.88	-1187768.50	1548649.85	2077.69	2	0	4	194.75	49.88	10	1.30	1.81
NM_AZ417a	Old	0.97	-1185429.44	1552220.09	2076.14	2	0	3	195.63	50.44	10	2.12	3.19
NM_AZ418a	Old	0.97	-1183279.84	1553645.21	2095.78	2	0	3	194.25	49.69	10	1.98	4.39
NM_AZ418b	Young	0.89	-1183277.22	1553592.92	2097.43	2	0	4	194.25	49.69	10	1.98	2.10
NM_AZ419	Young	0.90	-1178731.23	1552274.23	2175.18	2	0	4	186.75	43.75	10	1.21	2.60
NM_AZ420	Old	0.97	-1176482.97	1552045.26	2213.09	2	0	3	185.75	43.81	10	2.92	5.88
NM_AZ421	Old	0.97	-1177074.58	1551756.26	2180.19	2	0	3	186.13	43.81	10	1.04	3.25
NM_AZ422	Young	0.17	-1171128.66	1554720.68	2165.08	2	1	4	188.00	44.94	10	1.02	1.60
NM_AZ422a	Old	0.98	-1171080.58	1554991.22	2162.57	2	0	3	187.75	44.69	10	0.96	3.94
NM_AZ423	Young	0.15	-1169468.91	1549812.40	2205.10	2	1	1	185.25	42.88	10	2.31	1.81
NM_AZ423a	Old	0.96	-1169406.95	1549602.54	2212.72	2	0	3	184.75	42.69	10	2.85	4.24
NM_AZ424	Young	0.11	-1166389.87	1547103.50	2243.89	2	1	4	178.75	39.38	10	3.63	2.85
NM_AZ425	Young	0.39	-1163536.77	1541462.61	2228.46	2	1	3	183.50	43.19	10	3.29	4.64
NM_AZ425a	Young	0.11	-1162901.19	1541304.51	2235.90	2	1	4	181.88	42.31	10	3.35	2.38
NM_AZ426a	Old	0.89	-1161687.27	1537812.63	2270.91	2	0	3	180.25	41.44	11	2.52	3.01
NM_AZ427	Young	0.30	-1161584.57	1537025.56	2259.14	2	1	3	180.88	41.38	11	5.05	4.25
NM_AZ427a	Old	0.93	-1161397.18	1537099.39	2277.92	2	0	3	180.88	41.38	11	11.06	8.87
NM_AZ428	Young	0.08	-1159221.99	1530762.28	2267.18	2	1	4	174.00	35.38	10	1.91	1.65
NM_AZ428a	Old	0.87	-1159518.52	1530798.11	2273.58	2	0	3	173.63	35.38	10	2.46	3.37

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
NM_AZ428b	Young	0.08	-1159431.15	1530787.19	2271.11	2	1	1	173.63	35.38	10	3.17	1.86
NM_AZ429	Young	0.09	-1159960.36	1528630.29	2245.45	2	1	4	178.50	39.00	10	1.39	1.73
NM_AZ429a	Old	0.91	-1159859.46	1528544.33	2244.47	2	0	3	178.50	39.00	10	0.90	4.66
NM_AZ430	Old	0.93	-1159380.65	1517668.40	2259.62	2	0	3	180.25	41.56	10	1.43	4.32
NM_AZ431a	Young	0.33	-1159787.51	1514378.08	2230.03	2	1	3	182.63	42.81	11	10.40	8.92
NM_AZ431b	Old	0.94	-1159756.12	1514381.77	2233.59	2	0	3	182.63	42.81	11	10.40	9.63
NM_AZ431c	Old	0.94	-1159724.74	1514409.46	2232.59	2	0	5	182.63	42.81	11	3.82	12.19
NM_AZ432	Young	0.35	-1161487.30	1511774.51	2168.87	2	1	3	183.38	42.38	10	4.43	4.40
NM_AZ432a	Old	0.95	-1161354.70	1511787.74	2185.09	2	0	3	183.38	42.38	10	5.49	8.46
NM_AZ432b	Old	0.94	-1161290.36	1511809.86	2196.39	2	0	5	183.25	43.13	10	5.49	16.29
NM_AZ433	Old	0.92	-1160299.11	1509642.68	2191.74	2	0	3	181.75	42.56	11	6.85	7.82
NM_AZ433a	Old	0.93	-1160254.14	1509641.38	2196.15	2	0	5	181.75	42.56	11	6.85	14.94
NM_AZ434	Old	0.84	-1153508.03	1510679.56	2244.93	2	0	3	177.38	39.50	11	9.58	3.42
NM_AZ435	Young	0.07	-1149669.57	1505222.53	2341.74	2	1	4	164.50	33.00	9	0.86	2.52
NM_AZ435a	Old	0.92	-1149763.10	1505163.23	2349.13	2	0	3	164.50	33.00	9	6.16	9.51
NM_AZ436a	Young	0.24	-1150401.48	1501876.02	2268.56	2	1	3	171.63	35.38	9	2.32	4.62
NM_AZ436b	Old	0.89	-1150283.95	1501880.46	2283.36	2	0	3	173.50	36.31	9	0.55	8.19
NM_AZ436c	Old	0.91	-1150235.16	1501882.67	2288.14	2	0	5	173.50	36.31	9	0.55	13.30
NM_AZ437a	Old	0.89	-1151024.67	1500667.96	2244.91	2	0	3	174.25	36.69	11	6.04	7.47
NM_AZ437b	Old	0.91	-1150809.54	1500698.59	2236.86	2	0	5	174.25	36.69	11	6.37	11.40
NM_AZ438	Old	0.88	-1150601.86	1500245.09	2173.41	2	0	3	179.13	40.56	11	8.57	6.44
NM_AZ438a	Old	0.92	-1150574.33	1500218.81	2175.00	2	0	5	179.13	40.56	11	8.57	12.09
NM_AZ439a	Old	0.93	-1150357.78	1499071.27	2104.39	2	0	5	185.25	45.19	9	5.56	16.20
NM_AZ440	Young	0.23	-1146116.69	1492897.15	1962.28	2	0	4	197.38	52.31	9	1.53	3.84
NM_AZ440a	Old	0.84	-1145410.05	1493289.07	1987.01	2	0	5	197.50	52.63	9	5.10	12.64
NM_AZ441	Old	0.83	-1122429.06	1489117.56	1936.98	2	0	3	199.13	52.38	11	4.45	3.93
NMFISH1	Old	0.91	-852547.17	1558304.55	2219.56	1	0	5	171.00	26.88	1	5.53	20.69
nw_NM175	Old	0.72	-950654.28	1511247.74	2245.68	1	0	4	173.00	31.00	10	4.27	2.90
nw_NM176	Old	0.98	-954725.53	1515073.09	2333.10	1	0	3	167.13	26.63	8	1.71	3.10
nw_NM176a	Young	0.07	-954726.81	1515098.38	2331.57	1	1	4	167.13	26.63	8	1.71	2.81
nw_NM177	Old	0.96	-960547.80	1520176.15	2294.67	2	0	3	162.13	20.13	10	2.08	3.30
nw_NM177a	Young	0.07	-960217.61	1520071.21	2300.11	2	1	4	162.13	20.13	10	1.00	1.33
nw_NM178	Young	0.07	-968993.13	1521345.85	2240.60	2	1	1	169.63	24.63	9	1.15	2.63
nw_NM178a	Old	0.90	-969035.93	1521450.95	2255.83	2	0	3	170.00	25.06	9	1.37	8.23
nw_NM178b	Old	0.91	-969078.24	1521485.57	2262.22	2	0	5	170.00	25.06	11	3.40	19.16
nw_NM179	Young	0.90	-979693.59	1521440.37	2218.00	2	0	3	174.00	27.06	11	3.05	8.49

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
nw_NM179a	Old	0.06	-980046.79	1521152.72	2212.91	2	1	4	174.38	27.50	11	4.67	1.49
nw_NM179b	Old	0.91	-979667.33	1521471.99	2227.18	2	0	5	174.00	27.06	11	3.05	12.97
nw_NM180	Young	0.36	-979257.76	1521094.17	2214.17	2	0	4	172.75	26.19	11	2.14	0.70
nw_NM180a	Old	0.81	-979199.07	1521227.02	2217.69	2	0	3	172.75	26.19	11	2.14	4.15
nw_NM181	Old	0.77	-983715.18	1535706.35	2151.60	2	0	3	177.13	29.06	11	0.45	2.05
nw_NM182	Young	0.07	-983232.61	1539724.46	2190.81	2	1	1	173.75	26.06	11	1.27	1.91
nw_NM182a	Young	0.07	-983319.85	1539732.34	2194.26	2	1	4	173.75	26.06	11	1.13	1.82
nw_NM182b	Old	0.80	-983408.22	1539748.41	2198.89	2	0	3	174.38	26.75	11	1.13	4.91
nw_NM183	Old	0.91	-989625.79	1543391.85	2191.60	2	0	3	177.25	29.44	11	2.79	9.42
nw_NM184	Young	0.78	-990263.77	1547245.77	2191.54	2	0	3	176.75	29.00	11	3.02	3.84
nw_NM184a	Old	0.91	-990353.90	1547167.47	2203.35	2	0	5	176.00	28.69	11	4.50	10.20
nw_NM185	Old	0.77	-990317.90	1548588.80	2160.91	2	0	3	177.38	29.56	11	2.08	3.68
nw_NM185a	Young	0.38	-990318.20	1548598.64	2160.11	2	0	4	177.38	29.56	11	2.08	2.42
nw_NM186	Young	0.38	-989648.84	1556011.99	2157.16	2	0	4	177.75	29.38	11	1.83	1.82
nw_NM186a	Old	0.82	-989568.05	1556005.48	2159.74	2	0	3	177.75	29.38	11	1.83	5.03
nw_NM187	Old	0.85	-975025.08	1565217.19	2250.49	2	0	3	166.63	20.13	11	1.69	3.04
nw_NM188	Young	0.24	-971684.70	1575927.66	2212.21	2	1	3	162.50	17.56	11	1.81	5.74
nw_NM188a	Young	0.74	-971715.82	1575878.33	2208.48	2	0	4	162.88	17.44	11	1.81	2.90
nw_NM188b	Old	0.91	-971617.85	1575974.41	2222.05	2	0	5	162.50	17.56	11	2.95	10.64
nw_NM189	Young	0.07	-970261.99	1577108.97	2231.31	2	1	4	161.63	16.25	11	1.72	1.92
nw_NM189a	Old	0.97	-970013.84	1577018.68	2245.31	2	0	3	161.63	16.25	11	6.64	3.44
nw_NM190	Young	0.07	-975580.33	1583924.56	2251.95	2	1	4	161.00	15.81	11	1.96	1.87
nw_NM190a	Old	0.99	-975673.35	1584019.06	2256.28	2	0	3	161.00	15.81	11	1.96	4.21
nw_NM191	Old	0.95	-999852.82	1578109.54	2055.03	2	0	3	181.13	32.00	11	10.25	6.91
nw_NM192	Old	0.84	-1002906.46	1578088.68	2043.96	2	0	4	183.88	34.13	11	1.29	1.78
nw_NM192a	Old	0.96	-1002836.00	1578068.23	2046.12	2	0	3	183.88	34.13	11	1.05	3.70
nw_NM193	Old	0.96	-1024552.39	1585704.71	1915.40	2	0	3	196.38	44.06	11	2.92	3.65
nw_NM194	Old	0.83	-1026698.49	1583820.43	1936.25	2	0	4	194.38	43.44	11	5.31	2.42
nw_NM194a	Old	0.96	-1026772.56	1583631.41	1945.71	2	0	3	194.38	43.44	11	6.97	5.19
nw_NM195	Young	0.24	-1037978.16	1585243.00	1786.52	2	1	4	207.25	53.44	9	4.61	2.70
nw_NM196	Old	0.92	-1037846.84	1585732.45	1796.68	2	0	3	206.13	52.38	9	2.39	3.78
nw_NM196a	Old	0.95	-1037647.66	1585988.59	1827.31	2	0	5	205.50	51.88	9	7.28	13.06
Owl47	Old	0.06	-767218.34	2013106.40	1870.46	1	0	5	168.00	23.81	2	6.21	10.06
Owl47a	Young	0.33	-767523.93	2013114.04	1879.86	1	0	3	169.50	25.00	2	4.34	6.87
Owl47b	Young	0.21	-767763.37	2013407.93	1861.80	1	0	4	170.88	26.44	2	3.09	1.76
Pecos1	Old	0.91	-863389.33	1437670.31	2381.23	1	0	5	163.88	33.06	2	12.00	14.78

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Pecos2	Young	0.30	-849814.12	1413976.20	1921.00	1	0	4	191.25	56.31	2	1.75	2.09
Perham_OG	Old	0.91	-957706.64	1861914.54	2126.17	2	0	5	155.00	7.38	10	22.96	27.95
Perham_SE	Old	0.91	-957993.91	1861887.70	2172.22	2	0	5	155.00	7.38	10	12.03	28.96
Perham1	Old	0.91	-957743.92	1861926.87	2140.38	2	0	5	155.00	7.38	10	22.96	27.37
Poncho1	Old	0.99	-865865.81	1782046.10	2319.19	1	0	5	160.88	19.00	5	5.98	11.85
Poncho2	Old	0.91	-873941.06	1756345.22	2785.01	1	0	5	137.00	1.13	5	16.98	22.04
Ruby24	Old	0.95	-865077.38	1792739.21	2405.29	1	0	5	155.88	10.44	8	5.40	26.07
Ruby24a	Old	0.94	-865129.07	1792740.86	2433.12	1	0	3	155.88	10.44	8	5.40	3.99
Tablas1	Old	0.91	-887766.80	1532781.24	2154.55	1	0	5	178.25	36.31	1	2.73	10.09
Tablas1a	Old	0.85	-887766.97	1532786.55	2151.26	1	0	3	178.25	36.31	1	2.73	6.78
Tablas1b	Young	0.07	-887679.43	1532769.63	2138.65	1	1	1	178.25	36.31	1	2.73	3.09
Tablas1c	Old	0.89	-887645.49	1532748.14	2138.84	1	0	3	178.25	36.31	1	1.95	8.57
Tablas1d	Old	0.91	-887625.13	1532751.53	2147.57	1	0	5	178.25	36.31	1	1.95	13.65
Tesque159	Young	0.28	-892196.22	1466765.48	1909.19	1	0	4	202.13	57.69	11	2.71	1.55
Tesque159a	Old	0.73	-892140.85	1466765.48	1915.05	1	0	3	202.13	57.69	11	3.46	8.21
Tesque160	Old	0.31	-888153.12	1460283.33	2076.88	1	0	4	189.75	51.38	11	2.18	2.86
Tesque160a	Old	0.83	-888192.00	1460208.63	2083.20	1	0	3	189.75	51.38	11	2.11	6.28
Tesque161	Old	0.81	-888487.17	1461195.36	2069.62	1	0	3	192.38	52.81	11	5.06	4.48
Tesque161a	Old	0.91	-888293.19	1461299.62	2077.26	1	0	5	191.00	52.38	11	2.90	10.61
Tesque162	Old	0.92	-885396.80	1462992.60	2220.45	1	0	3	179.63	44.00	5	1.51	4.18
Tesque163	Old	0.92	-885292.58	1462757.68	2233.40	1	0	3	178.63	43.25	5	2.27	3.81
Tesque164	Old	0.89	-884601.33	1461184.80	2328.57	1	0	3	172.38	39.19	11	0.88	4.43
Tesque165	Old	0.65	-889814.14	1458485.31	2114.21	1	0	3	189.75	50.44	11	2.87	2.80
Tesque166	Young	0.24	-889380.73	1457686.65	2106.70	1	1	3	187.75	49.31	11	2.62	4.03
Tesque167	Young	0.24	-889001.84	1454511.66	2207.31	1	1	3	181.25	44.63	11	3.05	5.09
Tesque168	Young	0.24	-890328.83	1453946.25	2212.18	1	1	3	183.38	45.88	11	2.73	4.64
Tesque169	Old	0.76	-891350.47	1453499.77	2186.91	1	0	3	185.13	47.38	11	2.10	5.40
Tesque170	Young	0.25	-899241.49	1448061.33	1996.59	1	0	4	198.25	55.06	7	1.54	0.64
Tesque171	Young	0.08	-901970.76	1453088.82	1975.77	1	1	4	199.63	55.75	7	1.24	1.54
Tesque172	Young	0.07	-901036.45	1455835.70	1998.07	1	1	4	198.63	55.00	11	0.77	2.48
Tesque173	Old	0.96	-886196.15	1435791.60	2191.40	1	0	3	185.38	46.75	5	2.29	3.34
Tesque174	Old	0.92	-888836.51	1442464.22	2201.27	1	0	3	183.00	45.88	5	2.63	7.44
Tesque174a	Young	0.28	-890796.59	1444454.62	2133.91	1	0	4	190.13	50.38	7	1.63	2.93
Tesque174b	Old	0.91	-888797.47	1442476.68	2205.30	1	0	5	183.00	45.88	5	2.63	11.03
Tesque304	Young	0.19	-892806.59	1421012.40	1892.35	1	0	4	202.38	57.94	9	0.46	1.09
Tesque305	Old	0.94	-895907.86	1402747.98	1989.37	1	0	5	195.25	53.88	9	2.54	10.57

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
UP FIRE	Old	0.95	-1057914.48	1794764.00	2160.52	2	0	5	191.13	37.50	9	11.87	15.91
UP OGPIE	Old	0.91	-1060511.82	1791779.00	2267.04	2	0	3	181.50	31.00	9	4.76	6.24
Utah001a	Young	0.16	-1147028.14	1610931.67	1723.42	2	0	4	218.75	61.31	11	2.00	1.94
Utah001b	Old	0.44	-1147855.32	1611021.45	1765.56	2	0	5	217.50	60.56	11	3.52	10.63
Utah001c	Old	0.47	-1147827.78	1610985.53	1756.34	2	0	3	217.50	60.56	11	3.52	8.13
Utah001d	Young	0.73	-1147759.55	1610888.57	1745.59	2	1	3	217.50	60.38	11	2.88	3.36
Utah002a	Old	0.60	-1147663.99	1612587.00	1759.15	2	0	3	220.00	62.00	11	2.47	5.79
Utah002b	Old	0.45	-1148147.22	1613468.63	1769.72	2	0	5	218.13	60.69	11	4.00	13.68
Utah002c	Young	0.36	-1148247.46	1613185.89	1755.76	2	1	4	217.25	60.19	11	1.06	1.71
Utah002d	Old	0.13	-1147794.55	1612884.97	1746.30	2	0	4	219.75	61.69	11	1.25	0.02
Utah003	Young	0.39	-1149407.76	1617572.83	1712.98	2	1	4	221.13	63.31	11	1.80	2.63
Utah003a	Young	0.17	-1149348.24	1617741.48	1708.52	2	0	4	222.25	64.31	11	3.13	2.31
Utah003b	Old	0.80	-1149744.99	1617040.87	1751.16	2	0	5	218.13	60.94	11	4.32	14.44
Utah003c	Old	0.67	-1149823.60	1616937.24	1774.41	2	0	3	218.13	60.94	11	4.97	8.48
Utah004	Old	0.99	-1176651.15	1683354.84	1610.87	2	0	4	225.88	64.69	3	1.26	0.34
Utah005	Old	0.99	-1176320.82	1688862.64	1633.10	2	0	3	222.75	63.13	11	1.62	3.03
Utah006	Old	0.98	-1178056.04	1699430.95	1713.24	2	0	5	214.50	56.81	9	6.28	14.29
Utah006a	Old	0.98	-1177868.82	1699339.59	1705.50	2	0	3	214.50	56.81	9	5.60	3.65
Utah006b	Old	0.98	-1177506.22	1699186.54	1720.83	2	0	3	215.88	57.06	9	4.09	9.99
Utah007a	Old	0.51	-1190841.65	1691927.00	1639.91	2	0	5	235.13	74.06	11	2.93	28.67
Utah008	Old	0.96	-1193300.93	1695736.74	1679.55	2	0	3	225.00	64.13	11	6.59	5.82
Utah008a	Old	0.85	-1193399.72	1695648.34	1683.78	2	0	4	224.00	63.25	11	5.64	0.61
Utah009	Young	0.88	-1212781.16	1705104.27	2094.12	2	0	4	195.75	39.94	11	1.39	0.80
Utah009a	Young	0.17	-1212755.26	1705102.42	2093.94	2	1	4	194.88	39.50	11	1.69	1.09
Utah010	Old	0.97	-1213040.78	1705885.71	2099.61	2	0	3	194.63	39.31	11	1.15	1.43
Utah011	Old	0.92	-1218440.11	1708829.87	1971.13	2	0	4	206.50	50.38	11	0.61	1.55
Utah011a	Old	0.98	-1218427.87	1708792.49	1969.95	2	0	3	206.50	50.38	11	1.09	3.22
Utah012	Old	0.92	-1218298.04	1708667.19	1969.77	2	0	4	206.88	50.63	11	2.06	2.82
Utah012a	Old	0.98	-1218363.12	1708665.02	1964.94	2	0	3	206.88	50.63	11	1.09	4.63
Utah013a	Old	0.97	-1215038.93	1706747.64	2062.90	2	0	3	198.63	43.00	11	1.96	3.13
Utah013b	Old	0.89	-1215066.20	1706718.10	2061.26	2	0	4	198.63	43.00	11	1.96	1.96
Utah014	Young	0.18	-1213755.40	1703882.90	2069.46	2	1	4	197.13	41.19	11	0.82	1.19
Utah014a	Young	0.88	-1213829.53	1703937.39	2069.07	2	0	4	197.13	41.19	11	0.82	0.80
Utah014a	Old	0.88	-1213829.53	1703937.39	2069.07	2	0	4	197.13	41.19	11	0.82	0.80
Utah014b	Old	0.97	-1213867.32	1704021.37	2067.73	2	0	3	197.13	41.19	11	2.32	3.65
Utah015	Young	0.20	-1216213.81	1701257.46	2025.72	2	1	4	200.75	44.38	11	1.43	1.05

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Utah015a	Old	0.89	-1216239.36	1701320.52	2025.26	2	0	4	200.75	44.38	11	1.43	0.67
Utah016	Old	0.90	-1216727.88	1701053.64	2012.66	2	0	4	201.50	44.88	11	1.91	1.03
Utah016a	Old	0.97	-1216827.13	1701092.65	2008.70	2	0	3	201.50	44.88	11	1.89	3.58
Utah017	Old	0.58	-1223621.91	1706177.73	1844.58	2	1	3	207.63	50.00	11	6.41	8.30
Utah017a	Old	0.92	-1223183.59	1706155.82	1853.57	2	0	4	214.25	55.75	11	0.45	1.98
Utah017b	Old	0.98	-1223859.96	1706055.16	1926.18	2	0	5	202.75	46.00	2	17.71	31.14
Utah017c	Old	0.98	-1224419.57	1705886.07	2082.06	2	0	3	198.00	42.13	9	6.22	5.72
Utah018a	Young	0.41	-1231316.08	1717082.82	1673.05	2	1	4	228.13	66.75	8	1.64	1.63
Utah018b	Young	0.56	-1231469.92	1717086.32	1671.76	2	0	4	228.38	67.00	8	1.64	1.37
Utah018c	Young	0.43	-1231931.46	1715757.66	1651.57	2	1	4	229.38	68.06	11	3.43	2.55
Utah018d	Young	0.63	-1231802.09	1715866.05	1657.44	2	0	4	229.38	68.06	11	4.13	2.05
Utah018e	Old	0.99	-1231176.22	1716159.75	1639.39	2	0	5	227.88	66.38	11	7.61	32.91
Utah018f	Old	0.97	-1231242.65	1716065.35	1665.28	2	0	3	227.88	66.38	11	7.61	9.21
Utah018g	Old	0.74	-1231330.06	1716019.89	1667.03	2	1	3	228.38	67.19	11	5.79	5.41
Utah019	Old	0.72	-1234407.13	1716533.83	1627.60	2	1	3	225.13	63.31	8	16.25	7.85
Utah019a	Old	0.98	-1234309.99	1716474.06	1636.25	2	0	3	225.13	63.31	8	11.25	8.01
Utah019b	Old	0.99	-1234466.91	1716384.39	1665.50	2	0	5	225.13	63.31	8	16.25	26.23
Utah019c	Young	0.73	-1233899.02	1716645.92	1623.65	2	0	4	226.75	65.25	11	3.20	1.58
Utah019d	Young	0.40	-1233981.22	1716593.61	1625.99	2	1	4	226.75	65.25	11	3.20	1.87
Utah019e	Young	0.46	-1233293.78	1717916.19	1636.57	2	1	4	231.13	69.38	8	2.27	2.19
Utah019f	Young	0.47	-1233435.75	1717856.41	1635.14	2	0	4	231.50	69.81	8	2.27	0.86
Utah019g	Old	0.89	-1234377.24	1716959.75	1604.85	2	0	3	231.63	69.44	11	1.53	4.96
Utah019h	Old	0.75	-1234474.38	1716870.08	1602.97	2	1	3	231.63	69.44	11	2.26	7.43
Utah019i	Old	0.88	-1233630.03	1717348.30	1617.89	2	0	3	231.50	69.81	8	5.96	4.24
Utah019j	Old	0.76	-1233786.94	1717318.41	1605.77	2	1	3	231.50	69.81	8	6.99	7.75
Utah020	Young	0.92	-1238757.37	1722604.07	1488.32	2	0	3	236.88	74.19	11	3.73	3.34
Utah020a	Old	0.96	-1238787.91	1722447.84	1505.90	2	0	5	236.88	74.19	11	3.24	14.01
Utah020b	Young	0.53	-1238763.68	1722676.35	1485.47	2	0	4	238.00	75.56	11	2.08	2.70
Utah020c	Young	0.49	-1238870.14	1722668.90	1487.08	2	1	4	238.00	75.56	11	2.22	2.26
Utah020d	Young	0.81	-1238864.64	1722610.17	1490.06	2	1	3	236.88	74.19	11	4.03	3.25
Utah021a	Old	0.64	-1242337.73	1729785.68	1453.49	2	1	4	236.75	73.19	8	2.26	2.26
Utah021b	Old	0.96	-1242116.85	1729845.92	1448.62	2	0	3	238.63	73.94	8	3.92	3.30
Utah022a	Old	0.70	-1320814.04	1805227.31	1868.83	2	0	4	197.38	41.88	2	0.93	1.94
Utah022b	Old	0.73	-1320850.93	1805166.71	1869.75	2	0	3	197.38	41.88	2	0.93	6.52
Utah022c	Old	0.91	-1320484.69	1805480.25	1891.01	2	0	5	192.50	38.81	9	8.50	15.22
Utah023a	Old	0.98	-1327460.20	1798773.54	2109.30	2	0	3	178.88	26.31	2	2.92	8.78

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Utah023b	Old	0.98	-1327548.57	1798715.47	2128.68	2	0	5	178.38	26.00	2	2.92	19.99
Utah023c	Old	0.99	-1327641.99	1798661.19	2157.07	2	0	3	178.38	26.00	2	3.82	5.73
Utah024	Young	0.17	-1327046.04	1797024.80	2176.64	2	1	1	173.13	21.69	8	3.66	3.84
Utah024a	Young	0.17	-1326917.92	1797208.97	2169.74	2	1	2	173.13	21.69	8	2.62	1.01
Utah024b	Young	0.19	-1326835.22	1797349.88	2168.57	2	1	4	175.00	23.19	8	2.67	1.52
Utah024c	Old	0.97	-1327383.54	1796896.52	2190.19	2	0	3	173.75	22.00	8	2.13	4.31
Utah024d	Old	0.88	-1327328.40	1796724.98	2196.65	2	0	4	172.00	20.69	8	4.18	2.23
Utah024e	Old	0.97	-1327310.02	1796547.32	2225.54	2	0	5	172.00	20.69	8	8.41	23.32
Utah025	Young	0.17	-1326739.19	1796703.30	2195.42	2	1	2	171.13	19.94	8	1.96	2.00
Utah025a	Old	0.97	-1326783.36	1796626.91	2200.06	2	0	3	171.13	19.94	8	4.70	5.72
Utah025b	Old	0.88	-1326703.18	1796783.30	2195.34	2	0	4	171.13	19.94	8	1.96	0.71
Utah026a	Young	0.16	-1326046.26	1795703.36	2205.23	2	1	4	168.25	16.81	8	3.36	1.81
Utah026b	Old	0.97	-1325966.05	1795498.57	2211.16	2	0	3	168.25	16.81	8	3.43	7.11
Utah026c	Old	0.97	-1326169.13	1795522.46	2225.90	2	0	5	168.25	16.81	8	3.76	11.87
Utah026d	Old	0.46	-1325901.20	1795768.21	2198.72	2	1	3	168.25	16.81	8	1.95	3.22
Utah026e	Old	0.87	-1325976.29	1795855.24	2203.91	2	0	4	168.25	16.81	8	1.95	2.80
Utah027a	Old	0.72	-1325879.33	1792232.94	2345.02	2	0	4	158.88	7.88	7	3.06	1.64
Utah027b	Old	0.94	-1325883.10	1792183.95	2343.51	2	0	3	158.88	7.88	7	3.06	6.54
Utah027c	Old	0.95	-1325830.34	1792183.95	2341.80	2	0	5	158.88	7.88	7	3.06	10.33
Utah027d	Young	0.10	-1326054.29	1792192.73	2340.36	2	1	2	158.88	7.88	7	3.78	2.21
Utah028	Old	0.68	-1336662.78	1769372.70	2318.42	2	0	4	165.00	18.31	8	1.88	2.64
Utah028b	Old	0.97	-1337121.22	1763078.23	2105.42	2	0	5	182.88	35.31	2	14.00	12.42
Utah029	Old	0.91	-1340712.94	1759274.12	2062.07	2	0	4	186.00	38.25	11	5.16	1.34
Utah030a	Old	0.91	-1340013.89	1757690.33	2008.10	2	0	4	194.00	45.31	11	5.59	2.40
Utah030b	Old	0.98	-1340017.80	1757659.75	2006.40	2	0	5	194.00	45.31	11	12.50	10.27
Utah030c	Old	0.98	-1339980.36	1757658.33	2009.18	2	0	3	194.00	45.31	11	5.59	6.54
Utah031	Old	0.60	-1339520.97	1756544.71	1992.76	2	1	3	196.63	46.75	11	2.25	5.56
Utah031a	Old	0.98	-1339590.41	1756510.44	1999.14	2	0	3	196.63	46.75	11	2.25	3.30
Utah031b	Old	0.93	-1339686.69	1756489.59	2001.30	2	0	4	196.63	46.75	11	12.02	2.38
Utah031c	Old	0.98	-1339737.58	1756474.26	1989.59	2	0	5	196.63	47.25	7	12.02	19.72
Utah032	Old	0.40	-1340279.69	1745679.66	1747.06	2	0	4	206.25	53.31	11	1.28	2.02
Utah033	Old	0.95	-1341266.92	1744425.16	1762.07	2	0	3	205.38	53.44	3	2.14	3.67
Utah034	Old	0.97	-1342282.40	1743355.95	1819.08	2	0	3	203.13	50.63	11	12.17	5.11
Utah035	Old	0.96	-1345808.42	1744608.48	1828.40	2	0	4	201.63	50.06	2	1.95	1.20
Utah035a	Old	0.28	-1345668.35	1744598.75	1831.85	2	1	4	201.63	50.06	2	2.59	1.62
Utah035b	Old	0.63	-1345508.40	1744621.59	1837.91	2	1	3	201.50	49.81	2	1.84	3.53

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Utah035c	Old	0.98	-1345518.68	1744503.92	1837.90	2	0	3	202.00	50.13	2	1.84	3.43
Utah036	Old	0.87	-1349529.06	1742613.13	1752.76	2	0	4	201.13	50.06	2	3.10	4.66
Utah036a	Old	0.98	-1349596.21	1742529.65	1748.12	2	0	3	201.13	50.06	2	2.77	2.43
Utah036b	Old	0.94	-1349447.40	1742870.82	1766.12	2	0	5	201.13	50.06	2	2.03	11.95
Utah037	Old	0.97	-1351150.89	1744257.41	1762.86	2	0	3	199.00	48.88	2	1.84	4.32
Utah038a	Old	0.97	-1364957.86	1746868.38	1923.61	2	0	3	181.63	36.75	8	15.20	5.20
Utah038b	Old	0.96	-1364892.61	1746832.13	1937.17	2	0	5	181.63	36.75	8	15.20	31.76
Utah038c	Old	0.97	-1364763.79	1746729.28	2045.19	2	0	5	181.63	36.75	9	19.93	16.93
Utah038d	Young	0.97	-1365338.50	1747253.87	1982.78	2	0	5	182.13	35.69	9	14.03	23.01
Utah038e	Old	0.97	-1365425.03	1747460.27	2109.18	2	0	3	182.13	35.69	9	20.49	9.17
Utah039a	Young	0.38	-1372750.03	1743893.81	2126.24	2	1	3	167.63	25.50	8	2.53	3.43
Utah039b	Old	0.95	-1372870.65	1743739.64	2139.71	2	0	5	167.25	25.19	8	2.99	11.92
Utah040a	Old	0.96	-1381501.34	1735796.28	2149.38	2	0	3	169.63	26.94	7	2.10	2.24
Utah040b	Old	0.85	-1381544.83	1735796.28	2148.12	2	0	4	169.63	26.94	7	2.10	3.12
Utah041	Young	0.97	-1386912.02	1733664.51	1955.00	2	0	3	178.75	37.25	9	4.45	4.37
Utah041a	Young	0.89	-1386983.19	1733660.89	1951.38	2	0	4	179.00	37.63	9	4.45	2.65
Utah041b	Old	0.97	-1386793.27	1733674.87	1978.58	2	0	5	178.75	37.25	9	6.45	22.75
Utah041c	Old	0.97	-1387170.78	1733319.50	1961.39	2	0	5	179.00	36.88	8	5.39	16.03
Utah041d	Young	0.50	-1386936.58	1733658.56	1953.16	2	1	3	178.75	37.25	9	4.45	3.58
Utah041e	Young	0.51	-1386968.04	1733630.60	1950.92	2	1	3	179.00	37.63	9	2.01	2.76
Utah042	Old	0.98	-1395969.24	1731744.09	1803.46	2	0	3	190.75	46.94	8	5.73	3.99
Utah043a	Young	0.17	-1398844.93	1738160.29	1907.94	2	1	4	175.50	37.31	8	4.92	2.90
Utah043b	Young	0.49	-1398844.93	1738131.14	1908.75	2	1	3	175.50	37.31	8	7.28	3.67
Utah043c	Old	0.97	-1398941.59	1738099.68	1924.69	2	0	5	175.50	37.31	8	7.80	13.19
Utah044a	Old	0.93	-1393824.42	1754001.72	2302.44	2	0	5	153.75	13.25	11	2.57	10.78
Utah044b	Old	0.93	-1393831.16	1754030.34	2307.47	2	0	3	153.75	13.25	11	2.57	9.15
Utah044c	Young	0.08	-1393793.00	1753910.27	2297.75	2	1	4	153.75	13.25	11	2.17	2.25
Utah045a	Young	0.99	-1382426.43	1785150.37	2008.22	2	0	5	165.00	23.94	5	10.69	21.83
Utah045b	Old	0.97	-1382300.88	1784971.59	2015.18	2	0	5	165.13	23.88	5	9.40	29.70
Utah045c	Old	0.98	-1382126.19	1784901.99	2080.62	2	0	3	165.13	23.88	5	9.42	8.75
Utah046	Young	0.98	-1383015.41	1785692.56	1995.82	2	0	5	164.75	23.50	5	8.55	16.34
Utah046a	Young	0.52	-1383115.13	1785501.08	2000.37	2	1	3	165.25	23.75	5	9.02	6.47
Utah046b	Old	0.99	-1383084.18	1785468.58	1999.70	2	0	3	165.25	23.75	5	13.26	7.70
Utah046c	Old	0.97	-1383221.93	1785375.71	2055.47	2	0	5	165.50	23.88	8	13.78	26.52
Utah046d	Old	0.98	-1383310.15	1785253.44	2106.50	2	0	3	165.50	23.88	8	10.68	7.32
Utah047a	Old	0.97	-1381808.69	1786586.17	2022.55	2	0	5	165.38	24.19	5	5.82	13.69

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Utah047b	Old	0.93	-1382142.61	1786803.99	1997.16	2	0	5	166.00	24.75	8	3.31	12.57
Utah048a	Old	0.96	-1384432.54	1799214.21	1985.84	2	0	5	167.25	24.63	5	8.63	10.84
Utah048b	Old	0.97	-1384562.65	1798019.13	1971.62	2	0	5	166.00	24.44	7	13.75	23.60
Utah049a	Old	0.88	-1376638.53	1815845.41	2099.58	2	0	4	166.00	23.25	7	4.12	2.03
Utah049b	Old	0.97	-1376882.79	1815822.51	2102.95	2	0	3	167.00	24.06	7	4.16	8.24
Utah049c	Old	0.96	-1377348.41	1816776.65	2177.90	2	0	5	167.75	25.81	5	7.52	12.93
Utah049d	Old	0.96	-1375012.68	1816463.69	2041.76	2	0	5	164.75	21.75	7	3.17	10.42
Utah050a	Old	0.99	-1362401.54	1835909.14	2152.56	2	0	3	156.88	14.75	5	5.56	6.37
Utah050b	Old	0.97	-1362246.64	1835937.31	2166.96	2	0	5	156.88	14.75	5	4.63	11.20
Utah050c	Old	0.99	-1362105.82	1835993.64	2173.27	2	0	4	156.88	14.75	5	1.87	0.85
Utah051	Old	0.99	-1361663.52	1835948.50	2196.42	2	0	3	155.63	13.69	5	5.00	3.46
Utah051a	Old	0.97	-1361612.94	1835957.02	2199.32	2	0	4	153.88	12.25	5	6.59	2.99
Utah051b	Old	0.96	-1361520.00	1835799.30	2206.46	2	0	5	153.88	12.25	5	7.98	12.27
Utah052a	Old	0.95	-1360964.75	1835346.45	2265.23	2	0	5	152.38	9.56	5	7.82	14.63
Utah052b	Old	0.95	-1361122.52	1835326.90	2279.49	2	0	5	152.38	9.56	5	6.07	24.31
Utah052c	Old	0.95	-1361003.91	1834371.46	2330.34	2	0	3	149.25	5.81	5	5.20	9.35
Utah053a	Old	0.95	-1361277.98	1833191.42	2400.87	2	0	5	148.25	5.13	5	2.52	12.30
Utah053b	Old	0.95	-1361527.34	1833189.21	2398.72	2	0	5	148.25	5.13	5	2.65	19.14
Utah054a	Old	0.92	-1361319.75	1831448.61	2451.32	2	0	5	144.50	2.88	5	10.68	25.60
Utah054b	Old	0.96	-1362035.45	1831631.31	2381.45	2	0	3	147.25	4.50	5	4.95	7.75
Utah054c	Young	0.96	-1361937.51	1831292.29	2396.25	2	0	4	146.75	4.19	5	0.86	0.87
Utah054d	Old	0.94	-1362210.61	1831478.75	2366.76	2	0	5	148.75	5.63	5	4.96	11.34
Utah056a	Old	0.99	-1338539.36	1810340.18	2203.92	2	0	3	167.13	21.13	11	6.29	6.63
Utah056b	Old	0.97	-1338472.85	1810413.95	2209.75	2	0	5	167.25	20.44	11	6.29	14.65
Utah057a	Old	0.98	-1337963.94	1810673.08	2204.20	2	0	5	167.75	19.88	11	4.44	11.09
Utah057b	Old	0.98	-1337934.76	1810672.22	2207.03	2	0	3	167.75	19.88	11	4.44	9.91
Utah057c	Old	0.97	-1337784.55	1810493.69	2211.99	2	0	5	167.75	19.88	9	5.73	11.97
Utah058a	Young	0.08	-1156599.36	1623593.74	1584.87	2	0	4	230.63	69.44	11	1.48	1.33
Utah058b	Young	0.42	-1157479.92	1620493.02	1643.69	2	1	4	226.25	66.81	11	3.60	2.29
Utah058c	Old	0.41	-1157143.38	1623886.63	1635.00	2	0	3	228.75	68.75	11	3.15	6.31
Utah058d	Old	0.65	-1157144.14	1623939.75	1620.60	2	0	5	228.75	68.75	11	3.15	13.54
Utah059a	Young	0.39	-1150359.71	1619648.03	1664.30	2	0	3	226.38	67.88	11	1.78	4.53
Utah059b	Old	0.41	-1149642.39	1619632.96	1658.84	2	1	1	225.25	67.38	11	1.15	1.41
Utah059c	Young	0.11	-1149674.00	1619723.58	1658.48	2	0	4	225.25	67.38	11	2.16	1.64
Utah060a	Young	0.18	-1148527.40	1615274.24	1694.88	2	0	4	221.50	63.44	11	2.70	1.82
Utah060b	Young	0.46	-1148461.13	1615212.39	1692.53	2	0	3	221.50	63.44	11	1.92	1.58

SITE	AGE	PROB	X	Y	DEM	WOOD	FLOW	FORM	TMEANS	TMEANW	SWSUBS	SLOPE180	SLOPE
Utah060c	Old	0.36	-1148955.97	1615101.93	1709.73	2	1	1	219.88	62.19	11	1.67	3.61
Utah060d	Old	0.69	-1149323.24	1615008.36	1743.78	2	0	5	218.13	60.75	11	6.97	16.10
Utah20e	Old	0.93	-1238497.27	1722762.74	1469.79	2	0	5	238.00	75.56	11	2.74	11.45
Utah28a	Old	0.91	-1336662.62	1769384.81	2319.61	2	0	3	165.00	18.31	8	1.88	3.05
Utah29a	Young	0.22	-1340919.79	1759124.01	2063.66	2	1	4	186.00	38.25	11	2.46	1.22
Utah32a	Old	0.72	-1340427.27	1745746.17	1754.52	2	0	3	206.25	53.31	11	1.82	4.53
Utah33a	Old	0.87	-1341327.49	1744357.68	1761.65	2	0	4	205.38	53.44	3	2.75	2.55
Utah34a	Old	0.87	-1342295.48	1743379.94	1817.38	2	0	4	203.13	50.63	11	12.03	2.83
Utah37a	Young	0.30	-1351314.39	1744420.55	1765.82	2	1	2	199.00	48.88	2	2.28	3.32
Utah42a	Young	0.61	-1396050.43	1731751.51	1800.23	2	1	3	190.75	46.94	8	4.37	3.13
Utah55a	Old	0.98	-1356155.35	1824223.16	2425.82	2	0	3	145.25	4.19	5	2.35	4.90
Utah61a	Old	0.99	-1176376.11	1697962.74	1751.40	2	0	4	213.13	56.75	3	1.33	0.72
Utah61b	Young	0.28	-1176375.69	1697934.11	1751.08	2	1	4	213.13	56.75	3	1.33	0.75

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Abiqui1	178	122	238	6	0.50	0.86	1.84	283	142	141	165.78	76.83	0.00	-0.03	0.05	1
Abiqui141	178	123	240	6	0.53	0.77	1.47	248	131	117	171.04	79.65	6.78	-0.39	0.32	1
Abiqui141a	182	116	234	7	0.53	0.77	1.49	251	131	117	170.26	78.71	0.69	-0.04	0.09	1
Abiqui141b	173	167	253	4	0.53	0.76	1.40	251	132	119	173.29	85.00	0.00	1.34	-0.57	0
Abiqui142	183	131	246	4	0.53	0.78	1.46	249	133	116	169.87	79.53	0.00	0.25	-0.21	0
Abiqui143	185	111	238	8	0.53	0.81	1.56	256	136	120	168.52	76.73	0.00	0.21	-0.05	0
Abiqui144	179	133	245	5	0.53	0.80	1.50	256	136	120	169.95	79.86	1.10	0.03	-0.03	0
Abiqui144a	179	115	241	1	0.53	0.80	1.55	256	136	120	169.45	77.55	0.00	0.10	-0.06	0
Abiqui145	179	124	244	3	0.52	0.82	1.63	265	138	127	168.17	77.96	0.00	0.19	-0.18	0
Abiqui146	171	123	243	4	0.53	0.82	1.58	263	139	124	168.88	78.38	2.08	-0.04	0.01	1
Abiqui147	180	111	236	7	0.52	0.82	1.64	265	138	125	167.37	76.34	0.69	0.02	0.00	1
Abiqui148	184	125	243	5	0.53	0.80	1.53	260	137	123	171.56	80.45	0.00	0.08	-0.05	0
Abiqui149	203	106	238	1	0.51	0.79	1.69	264	134	130	169.48	76.76	2.77	0.11	-0.17	0
Abiqui149a	203	107	237	1	0.51	0.79	1.69	264	134	130	169.35	76.91	5.37	-0.03	-0.03	0
Abiqui149b	197	99	236	1	0.51	0.79	1.72	264	134	130	169.22	75.68	1.10	-0.16	0.02	1
Abiqui149c	203	56	213	8	0.52	0.81	1.90	262	135	127	167.10	67.00	0.00	-0.23	0.31	1
Abiqui150	181	95	236	2	0.50	0.80	1.80	270	136	136	169.50	75.37	0.69	-0.30	0.36	1
Abiqui151	175	117	242	2	0.49	0.80	1.78	278	137	141	170.61	79.08	0.69	0.00	0.00	0
Abiqui152	178	116	241	1	0.49	0.80	1.83	280	136	144	170.00	78.74	1.39	-0.07	0.04	1
Abiqui153	169	134	246	5	0.50	0.85	1.79	291	145	146	170.35	81.64	0.00	0.21	-0.08	0
Abiqui154	196	84	212	7	0.50	0.88	1.98	294	146	147	166.29	74.36	0.69	-0.63	0.73	1
Abiqui155	182	117	242	2	0.49	0.81	1.82	286	140	146	172.19	80.13	0.00	-0.04	0.03	1
BAND1	183	133	245	5	0.47	1.17	2.75	423	200	223	170.50	81.03	0.00	0.15	0.01	1
BAND101	157	62	204	2	0.47	1.21	3.22	422	200	222	164.98	69.03	3.85	-0.11	-0.16	0
BAND102	166	91	234	2	0.47	1.18	2.95	422	200	222	169.17	75.13	1.39	0.98	-0.70	0
BAND103	166	110	242	2	0.47	1.18	2.84	422	200	222	170.20	78.18	0.69	0.76	-0.57	0
BAND104	166	117	242	2	0.47	1.18	2.80	422	200	222	170.20	79.17	0.00	0.59	-0.30	0
BAND105	173	134	247	4	0.47	1.17	2.71	419	199	220	170.75	81.15	0.00	0.30	-0.35	0
BAND106	175	142	240	6	0.47	1.17	2.70	420	199	221	169.74	81.99	4.51	-1.88	0.74	1
BAND107	180	133	249	3	0.47	1.16	2.73	420	199	221	170.86	80.94	1.10	0.23	-0.13	0
BAND108	184	128	242	6	0.47	1.17	2.75	420	199	221	169.99	80.32	0.00	0.15	-0.22	0
BAND109	184	132	241	6	0.47	1.17	2.73	420	199	221	169.86	80.81	0.00	0.18	-0.17	0
BAND110	183	122	236	7	0.47	1.18	2.78	420	199	221	169.22	79.55	0.00	0.17	0.01	1
BAND111	184	119	238	7	0.47	1.18	2.81	423	200	223	169.62	79.24	3.47	-0.39	0.01	1
BAND112	181	128	237	7	0.47	1.18	2.77	423	200	223	169.49	80.41	1.10	-0.02	0.04	1
BAND113	177	127	242	6	0.47	1.18	2.78	423	200	223	170.13	80.28	0.00	0.21	-0.17	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
BAND114	181	120	242	1	0.47	1.18	2.81	423	200	223	170.13	79.37	1.10	-0.32	0.23	1
BAND115	180	138	249	3	0.47	1.17	2.73	423	200	223	171.00	81.62	0.00	0.22	-0.10	0
BAND116a	166	139	242	6	0.48	1.20	2.72	424	203	221	169.65	81.28	2.30	-0.15	0.18	1
BAND117	167	133	244	5	0.50	1.38	2.89	461	231	230	167.21	79.59	0.00	0.12	-0.08	0
BAND118	175	151	244	5	0.50	1.37	2.79	458	229	229	167.69	82.04	1.10	0.10	-0.03	0
BAND119	175	158	249	5	0.50	1.36	2.77	458	229	229	168.30	82.76	0.69	0.17	-0.08	0
BAND120	172	135	246	4	0.48	1.27	2.82	444	215	229	169.52	81.08	1.95	-0.13	0.03	1
BAND121	161	150	244	5	0.48	1.26	2.75	441	213	228	169.62	82.78	1.61	0.16	-0.19	0
BAND122	190	141	239	6	0.47	1.18	2.74	423	200	223	169.27	81.35	1.10	0.21	-0.26	0
BAND123	192	129	244	4	0.47	1.18	2.79	423	200	223	169.90	79.93	0.00	0.31	-0.11	0
BAND124	176	92	213	7	0.47	1.20	2.98	419	199	220	165.49	73.72	0.69	0.87	-0.68	0
BAND125	176	145	244	5	0.47	1.17	2.72	419	199	220	169.62	80.89	3.30	-1.33	0.06	1
BAND126	185	154	219	6	0.48	1.20	2.67	421	200	221	166.67	82.76	1.61	0.19	0.27	1
BAND127	144	88	233	1	0.47	1.11	2.86	399	188	211	168.97	73.81	0.00	1.37	-1.07	0
BAND128	166	154	210	3	0.47	1.13	2.55	399	188	211	165.80	82.73	1.10	1.89	-1.70	0
BAND129	142	123	246	3	0.47	1.10	2.67	399	188	211	170.63	79.13	0.69	-1.20	1.25	1
BAND130	142	108	222	3	0.47	1.12	2.74	399	188	211	167.49	77.06	0.69	-1.60	2.15	1
BAND131	139	108	242	2	0.47	1.11	2.74	399	188	211	170.13	77.06	0.69	0.83	-0.34	0
BAND132	143	120	243	2	0.47	1.11	2.65	398	188	210	169.98	79.10	0.00	0.45	-0.53	0
BAND133	140	146	252	3	0.47	1.04	2.44	383	180	203	173.30	83.32	0.69	0.47	-0.54	0
BAND134	99	194	235	4	0.47	1.05	2.31	383	180	203	171.15	87.97	1.10	3.48	-2.22	0
BAND135	57	161	237	3	0.47	1.05	2.39	377	178	199	169.15	83.26	1.39	-0.73	0.67	1
BAND136	89	204	250	4	0.47	1.04	2.29	383	180	203	173.06	88.79	1.10	1.24	-1.24	0
BAND137	149	122	244	3	0.47	1.04	2.53	383	180	203	172.31	80.39	1.95	2.24	-2.12	0
BAND138	178	121	240	7	0.47	1.13	2.71	405	191	214	169.46	78.93	0.00	0.10	-0.13	0
BAND139	184	103	232	8	0.47	1.15	2.85	411	193	218	168.50	76.39	0.69	0.00	-0.03	0
BAND140	180	148	248	5	0.47	1.14	2.66	415	195	220	170.87	82.66	1.79	-0.26	0.24	1
BAND141	166	110	242	2	0.47	1.18	2.84	422	200	222	170.20	78.18	0.69	0.26	-0.27	0
BAND142	172	133	247	3	0.48	1.25	2.82	441	213	228	169.99	80.84	1.95	0.00	0.00	0
BAND143	172	127	244	3	0.48	1.24	2.83	437	210	227	169.83	80.19	0.00	0.23	-0.15	0
BAND144	181	123	226	7	0.47	1.17	2.80	415	195	220	167.29	78.53	2.64	-0.08	0.08	1
BAND145	142	130	249	3	0.47	0.98	2.32	372	175	197	177.84	84.88	0.00	0.56	-0.18	0
BAND146	233	133	245	4	0.47	0.99	2.31	372	175	197	177.33	85.27	1.95	-0.21	0.14	1
BAND147	144	140	235	3	0.47	1.16	2.72	417	196	221	168.89	81.30	1.79	-1.54	1.42	1
BAND148	157	126	235	7	0.47	1.16	2.78	417	196	221	168.89	79.61	0.00	0.32	-0.25	0
BAND149	151	88	228	2	0.48	1.21	3.02	426	203	223	167.76	73.95	1.79	-0.58	0.60	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
BAND150	179	51	214	2	0.47	1.23	3.45	428	203	225	165.63	65.17	1.79	0.01	-0.01	0
BAND151	168	103	240	2	0.48	1.22	2.90	432	207	225	170.15	77.68	0.00	0.71	-0.76	0
BAND152	174	137	247	4	0.48	1.23	2.77	436	210	226	170.41	81.54	0.00	0.22	-0.06	0
BAND153	174	131	248	3	0.48	1.23	2.80	436	210	226	170.53	80.81	0.69	0.15	-0.08	0
BAND154	181	127	244	3	0.48	1.24	2.81	436	210	226	170.03	80.31	0.00	0.20	-0.17	0
BAND155	176	173	250	5	0.49	1.17	2.45	407	199	208	170.08	84.89	0.00	0.94	-1.20	0
BAND156	169	149	246	5	0.48	1.18	2.58	413	200	213	169.66	82.58	1.61	-0.13	0.12	1
BAND157	174	146	245	5	0.48	1.18	2.59	413	200	213	169.54	82.25	0.00	0.13	0.10	1
BAND158	174	100	236	1	0.48	1.19	2.80	413	200	213	168.40	76.18	0.69	-0.36	0.52	1
BAND159	177	145	244	5	0.48	1.18	2.59	413	200	213	169.41	82.14	1.61	-0.21	0.09	1
BAND160	180	123	243	2	0.48	1.18	2.68	413	202	213	169.29	79.50	2.83	-0.01	0.01	1
BAND161	178	145	244	5	0.49	1.18	2.55	410	200	212	169.62	82.33	1.61	-0.12	0.12	1
BAND162	178	104	231	8	0.49	1.19	2.73	410	200	212	167.96	76.98	0.00	1.21	-0.36	0
BAND163	182	86	234	2	0.49	1.17	2.82	406	197	209	168.69	74.17	0.00	1.28	-0.98	0
BAND164	184	109	240	2	0.48	1.16	2.69	407	197	210	169.39	78.00	2.56	-0.06	0.05	1
BAND165	182	112	241	1	0.48	1.16	2.68	407	197	210	169.52	78.44	0.69	0.00	0.02	1
BAND166	184	142	247	5	0.48	1.16	2.55	407	197	210	170.27	82.27	1.95	-0.03	0.02	1
BAND167	174	144	251	3	0.48	1.14	2.53	401	194	207	170.34	81.87	0.00	0.18	0.04	1
BAND168	183	136	244	5	0.48	1.14	2.56	401	194	207	169.48	80.96	2.08	-0.19	0.15	1
BAND169	181	113	242	2	0.48	1.15	2.68	404	195	209	169.16	78.02	1.39	-0.07	0.07	1
BAND170	173	32	206	2	0.48	1.19	3.58	404	195	209	164.28	58.35	1.39	-1.21	1.11	1
BAND171	183	89	232	1	0.49	1.19	2.80	407	199	208	167.81	74.24	1.61	-0.05	0.14	1
BAND172	182	124	220	7	0.49	1.22	2.67	416	203	213	166.34	79.78	1.10	-0.50	0.55	1
BAND173	187	130	241	6	0.47	1.15	2.77	415	195	220	169.24	79.41	0.00	0.45	-0.33	0
BAND174	172	143	250	4	0.47	1.14	2.72	415	195	220	170.36	80.92	0.00	-0.06	0.06	1
BAND175	193	85	230	1	0.49	1.17	2.82	401	195	206	167.28	73.01	0.69	0.33	-0.01	0
BAND176	190	66	224	1	0.49	1.17	2.98	401	195	206	166.48	69.04	1.10	-0.88	0.75	1
BAND177	174	128	233	6	0.49	1.16	2.59	401	195	206	167.67	79.50	0.00	1.60	-0.60	0
BAND178	174	162	236	6	0.48	1.15	2.46	398	193	205	168.20	83.39	0.00	2.55	-1.74	0
BAND179	191	112	240	1	0.48	1.14	2.63	396	193	205	168.57	77.55	2.08	0.14	0.00	0
BAND180	187	119	241	8	0.48	0.78	1.81	284	136	148	174.26	81.97	1.79	-0.01	-0.01	0
BAND180a	187	119	241	8	0.48	0.78	1.81	284	136	148	174.26	81.97	1.39	0.02	-0.02	0
BAND181	178	142	225	6	0.48	0.83	1.81	297	145	156	172.52	85.29	1.10	0.12	0.18	1
BAND182	175	124	245	2	0.48	0.82	1.85	297	143	154	175.26	83.08	0.69	-0.32	0.27	1
BAND183	179	116	241	1	0.49	0.85	1.87	298	147	151	172.82	80.86	0.00	0.18	-0.06	0
BAND184	165	100	236	1	0.49	0.95	2.18	331	162	169	170.39	77.57	0.00	0.19	0.05	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
BAND185	149	130	245	4	0.49	1.04	2.25	357	176	181	169.47	80.51	0.00	0.04	0.04	1
BAND186	149	185	251	5	0.49	1.00	2.08	350	171	179	170.48	86.20	1.10	0.05	0.18	1
BAND187	169	130	245	5	0.49	0.89	1.92	313	154	159	173.05	82.86	0.69	0.18	-0.08	0
BAND188	172	134	247	4	0.49	0.80	1.75	285	139	146	173.93	83.21	1.39	0.08	-0.07	0
BAND189	173	133	246	4	0.48	0.81	1.82	296	143	153	175.52	84.19	1.61	0.00	0.01	1
BAND190	165	189	241	5	0.49	1.23	2.48	420	207	213	168.08	85.86	0.69	0.93	-1.11	0
BAND191	157	127	245	3	0.50	1.32	2.80	438	220	218	166.09	77.94	0.00	0.07	0.00	1
BAND192	210	26	184	8	0.47	1.05	3.39	367	174	193	165.24	56.89	2.64	-0.28	0.32	1
BAND193	210	51	198	8	0.47	1.04	2.86	367	174	193	167.52	67.39	1.95	0.23	0.03	1
BAND194	241	11	170	8	0.47	1.04	4.23	367	174	194	166.00	45.89	2.56	-0.49	0.19	1
BAND195	241	45	185	8	0.47	1.03	2.88	367	173	194	168.68	67.31	3.00	0.68	-0.25	0
BAND196	241	41	182	8	0.48	1.02	2.89	362	172	190	167.97	65.77	3.26	0.01	-0.03	0
BAND197	203	128	238	6	0.48	1.01	2.30	366	175	191	173.73	82.91	0.00	0.39	-0.13	0
BAND198	226	114	231	7	0.48	1.01	2.36	366	175	191	172.80	80.99	0.00	0.62	-0.22	0
BAND199	174	143	241	6	0.48	1.24	2.75	436	210	226	169.66	82.23	0.00	0.59	-0.37	0
BAND2	178	126	242	7	0.47	1.15	2.77	417	196	221	169.92	79.91	0.00	0.14	-0.08	0
BAND200	171	129	246	3	0.48	1.24	2.80	439	212	227	170.56	81.12	0.69	0.18	-0.10	0
BAND200a	171	133	247	4	0.48	1.24	2.78	439	212	227	170.68	81.61	3.00	-0.14	0.07	1
BAND201	177	137	246	4	0.48	1.24	2.74	439	212	226	170.97	82.59	0.00	0.26	0.08	1
BAND202	171	155	244	5	0.48	1.24	2.67	438	212	226	170.72	84.61	0.00	0.23	-0.12	0
BAND203	167	150	246	5	0.48	1.24	2.69	438	212	226	170.97	84.07	1.61	-0.26	0.08	1
BAND204	165	134	247	4	0.48	1.24	2.78	441	213	228	171.10	82.13	0.00	0.07	-0.03	0
BAND205	169	127	244	4	0.48	1.24	2.81	439	212	227	170.31	80.86	5.61	-0.57	0.42	1
BAND209	181	126	245	3	0.47	1.04	2.49	378	178	200	171.40	80.19	0.00	0.14	-0.11	0
BAND210	174	140	248	4	0.47	1.04	2.44	378	178	200	171.77	81.89	0.69	0.15	-0.11	0
BAND211	202	139	249	4	0.48	0.93	2.13	343	163	180	175.14	84.40	0.00	0.33	-0.41	0
BAND212	125	165	254	4	0.47	0.91	2.03	340	161	179	177.02	88.39	0.00	1.62	-1.62	0
BAND213	150	136	203	6	0.47	0.95	2.10	340	161	179	169.96	85.12	0.00	0.71	0.22	1
BAND214	198	116	227	7	0.47	0.93	2.18	340	161	179	173.34	82.23	1.95	-0.75	0.85	1
BAND215	179	54	196	8	0.47	0.95	2.57	340	161	179	168.72	69.57	1.95	0.20	0.09	1
BAND216	133	146	249	4	0.47	0.92	2.10	344	162	182	176.60	86.57	0.00	0.59	-0.37	0
BAND217	184	145	248	5	0.47	1.03	2.42	380	179	201	173.08	83.02	0.69	0.21	-0.25	0
BAND218	188	131	246	3	0.47	1.11	2.65	403	190	213	171.39	80.29	0.00	1.03	-0.94	0
BAND220	172	133	246	3	0.47	0.97	2.20	363	172	191	177.52	86.80	0.00	0.14	-0.06	0
BAND221	185	121	243	2	0.47	0.86	1.96	327	155	172	180.02	87.73	4.58	-0.22	0.11	1
BAND222	175	129	245	3	0.46	0.74	1.75	293	135	158	182.15	90.24	1.10	-0.07	0.00	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
BAND223	181	123	235	7	0.46	0.70	1.69	277	127	150	180.24	88.62	2.56	-0.46	0.21	1
BAND224	181	120	242	2	0.47	0.65	1.51	250	117	133	181.20	88.09	5.07	-0.10	0.09	1
BAND225	182	120	242	1	0.46	0.65	1.57	256	118	138	180.30	87.97	2.30	0.00	0.00	0
BAND226	183	114	241	1	0.47	0.84	1.95	322	152	170	180.03	87.09	0.00	0.34	-0.21	0
BAND227	176	129	244	5	0.48	0.92	2.08	347	165	182	178.44	87.31	0.00	0.00	0.01	1
BAND228	174	131	244	6	0.47	0.96	2.18	359	170	189	177.61	86.75	2.64	-0.19	0.13	1
BAND229	158	86	231	2	0.48	1.07	2.59	382	184	198	171.84	76.31	1.39	-1.06	0.73	1
BAND230	165	188	222	6	0.49	1.25	2.50	432	210	222	167.90	88.73	2.08	-0.82	0.04	1
BAND231	165	167	222	6	0.49	1.25	2.56	432	210	222	167.90	86.76	1.10	0.51	-0.51	0
BAND288	194	165	254	4	0.48	0.85	1.86	326	155	171	181.32	91.88	0.69	-1.04	0.98	1
BAND288a	162	145	247	3	0.47	0.86	1.90	325	154	171	179.72	89.79	1.39	0.54	-0.27	0
BAND289	171	127	246	3	0.48	0.87	1.97	328	156	172	179.32	87.13	3.33	-0.41	0.15	1
BAND289a	160	126	235	7	0.47	0.86	1.96	325	154	171	178.12	87.32	0.00	0.46	-0.53	0
BAND289b	190	171	248	5	0.48	0.89	1.88	333	159	174	179.58	92.31	0.00	0.75	0.02	1
BAND289c	187	136	240	6	0.47	0.88	1.98	331	157	174	177.98	87.83	0.69	-0.12	-0.16	0
BAND290	145	132	244	5	0.47	0.95	2.21	349	165	184	174.17	83.39	0.00	0.09	-0.03	0
BAND290a	166	153	178	6	0.47	0.95	1.97	335	159	176	167.78	89.38	1.61	-3.37	2.30	1
BAND290b	166	135	201	6	0.47	0.93	2.02	335	159	176	171.64	87.21	1.10	-1.56	1.38	1
BAND291	163	112	235	7	0.47	0.98	2.34	357	169	188	172.79	80.40	0.00	0.11	-0.12	0
BAND292	171	145	250	4	0.48	1.17	2.62	420	201	219	171.88	83.45	1.39	-0.25	0.04	1
BAND3	177	142	246	5	0.47	1.14	2.68	415	195	220	170.63	81.99	0.00	0.16	-0.01	0
BAND303	173	128	243	6	0.48	0.81	1.87	298	142	156	174.79	83.43	1.95	-0.23	0.10	1
BAND4	176	138	247	4	0.47	1.15	2.67	412	195	217	170.27	81.13	0.00	0.02	-0.01	0
BAND5	173	134	247	4	0.47	1.17	2.71	419	199	220	170.75	81.15	0.00	0.30	-0.35	0
BAND6	166	114	242	2	0.47	1.18	2.82	422	200	222	170.20	78.75	0.00	0.41	-0.39	0
CACH_ELMA223	195	213	243	5	0.44	1.29	3.52	448	196	252	151.95	71.56	1.39	0.06	0.13	1
CACH_ELMA224	176	149	248	5	0.46	1.14	3.01	385	178	207	156.03	68.76	2.71	-0.03	-0.02	0
CACH_ELMA225	181	106	231	7	0.46	1.13	3.19	380	175	205	154.32	64.36	0.00	0.29	0.22	1
CACH_ELMA225a	180	131	244	5	0.46	1.13	3.13	384	175	209	155.23	66.67	5.30	-0.14	-0.03	0
CACH_ELMA225b	180	50	185	8	0.46	1.18	3.76	380	175	205	148.13	54.47	1.10	-0.37	0.59	1
CACH_ELMA226	187	116	242	2	0.46	1.08	3.06	371	169	202	156.37	65.92	0.00	0.05	-0.01	0
CACH_ELMA226a	187	119	243	2	0.46	1.08	3.05	371	169	202	156.49	66.27	0.00	0.22	-0.09	0
CACH_ELMA227a	172	129	245	4	0.48	1.04	2.55	349	167	182	160.30	69.70	1.10	-0.05	0.02	1
CACH_ELMA227b	175	143	247	5	0.48	1.04	2.58	349	167	182	159.85	70.67	0.00	2.37	-0.64	0
CACH_ELMA228	178	130	244	5	0.49	0.96	2.28	319	155	164	160.53	70.33	0.00	0.06	-0.05	0
CACH_ELMA228a	176	132	242	6	0.49	0.97	2.33	319	155	164	160.22	70.51	0.00	1.17	-0.57	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
CACH_ELMA229	175	122	244	2	0.49	0.95	2.30	312	152	160	160.67	69.59	1.39	-0.03	0.00	1
CACH_ELMA230	178	129	244	4	0.49	0.91	2.15	305	148	156	163.15	72.48	0.00	0.11	-0.05	0
CACH_ELMA230a	174	144	249	4	0.49	0.91	2.13	305	148	157	163.33	73.67	1.10	-0.05	0.09	1
CACH_ELMA231	182	126	243	6	0.49	0.81	1.82	280	138	142	170.39	78.00	0.00	0.25	-0.21	0
CACH_ELMA231a	181	111	242	2	0.49	0.81	1.87	280	138	142	170.26	76.02	0.69	0.29	-0.34	0
CACH_ELMA232	187	119	241	8	0.51	0.80	1.71	262	134	128	166.56	74.67	1.10	-0.13	0.11	1
CACH_ELMA232a	187	103	235	1	0.51	0.81	1.77	262	134	128	165.81	72.49	0.00	0.24	-0.10	0
CACH_ELMA233	178	135	246	5	0.52	0.79	1.61	258	133	125	167.94	77.70	0.69	0.00	0.02	1
CACH_ELMA233a	175	139	247	4	0.52	0.79	1.60	258	133	125	168.06	78.15	0.00	0.01	0.03	1
CACH_ELMA234	180	129	247	2	0.44	0.81	2.23	304	135	169	165.85	75.93	4.38	0.01	-0.02	0
CACH_ELMA234a	180	126	246	2	0.44	0.81	2.24	304	135	169	165.73	75.57	0.00	0.18	-0.11	0
CACH_ELMA234b	180	122	246	2	0.44	0.81	2.25	304	135	169	165.73	75.08	0.69	0.00	-0.01	0
CACH_ELMA235a	190	117	238	7	0.40	0.55	1.75	244	98	146	179.15	83.66	1.10	0.02	-0.01	0
CACH_ELMA235b	188	113	237	7	0.40	0.55	1.75	243	98	145	179.01	83.04	2.89	-0.18	0.08	1
CACH_ELMA236	160	123	245	3	0.40	0.59	1.93	265	105	160	177.46	82.91	0.00	0.75	-0.43	0
CACH_ELMA236a	159	123	242	6	0.40	0.59	1.93	265	105	160	177.28	83.00	0.00	0.27	-0.21	0
CACH_ELMA237	153	109	239	1	0.40	0.60	2.00	265	105	160	175.17	80.18	0.00	0.45	-0.20	0
CACH_ELMA237a	153	120	244	3	0.40	0.60	1.96	265	105	160	175.82	81.78	0.00	0.45	-0.34	0
CACH_ELMA238	185	112	239	8	0.39	0.61	2.05	270	106	164	174.07	80.19	5.29	-0.01	0.00	0
CACH_ELMA238a	185	106	236	8	0.39	0.61	2.07	270	106	164	173.67	79.28	1.10	0.00	-0.03	0
CACH_ELMA238b	185	111	238	1	0.39	0.61	2.05	270	106	164	173.94	80.04	1.39	-0.01	0.02	1
CACH_ELMA239a	184	115	240	8	0.39	0.63	2.11	276	108	168	172.62	79.61	1.95	-0.01	0.00	0
CACH_ELMA239b	184	116	240	8	0.39	0.63	2.11	276	108	168	172.62	79.75	1.10	-0.01	0.00	0
CACH_ELMA239c	185	117	240	8	0.39	0.63	2.10	276	108	168	172.62	79.89	3.43	-0.02	0.00	0
CACH_ELMA239d	181	108	237	8	0.40	0.64	2.13	278	110	168	172.91	78.86	1.61	-0.11	0.08	1
CACH_ELMA240	128	114	241	2	0.40	0.64	2.11	279	111	168	173.09	79.56	0.00	0.24	-0.21	0
CACH_ELMA240a	128	111	241	2	0.40	0.64	2.12	279	111	168	173.09	79.12	0.69	0.18	-0.14	0
CACH_ELMA241	187	110	238	8	0.39	0.69	2.34	295	116	179	167.90	76.50	2.20	0.02	0.00	1
CACH_ELMA241a	186	108	237	8	0.39	0.69	2.35	295	116	179	167.78	76.21	2.20	0.01	-0.01	0
CACH_ELMA241b	187	105	235	8	0.39	0.69	2.36	295	116	179	167.52	75.76	2.08	-0.09	0.07	1
CACH_ELMA241c	187	107	236	8	0.39	0.69	2.35	295	116	179	167.65	76.06	1.61	0.02	0.01	1
CACH_ELMA241d	183	108	238	1	0.39	0.69	2.35	295	116	179	167.90	76.21	0.69	0.00	-0.01	0
CACH_ELMA242	196	69	222	1	0.40	0.67	2.39	281	113	168	168.44	70.16	1.10	0.75	-0.81	0
CACH_ELMA242a	196	109	239	1	0.40	0.66	2.17	281	113	168	170.71	77.41	0.00	0.26	-0.12	0
CACH_ELMA242b	196	103	236	1	0.40	0.66	2.20	281	113	168	170.32	76.51	0.00	0.32	-0.23	0
CACH_ELMA243	183	117	241	1	0.40	0.68	2.26	287	114	173	166.56	76.51	5.18	-0.07	0.01	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
CACH_ELMA243a	183	116	240	8	0.40	0.68	2.27	284	114	173	166.44	76.38	1.10	-0.02	0.02	1
CACH_ELMA243b	179	109	237	8	0.40	0.68	2.26	284	113	171	166.61	75.70	0.69	-0.01	0.02	1
CACH_ELMA244	182	115	240	8	0.40	0.69	2.29	291	115	176	167.26	76.72	0.00	-0.01	0.03	1
CACH_ELMA245a	183	114	240	2	0.40	0.68	2.25	290	115	175	169.46	77.74	1.79	-0.01	-0.01	0
CACH_ELMA245b	183	109	238	8	0.40	0.68	2.29	291	115	176	169.21	76.97	2.30	-0.03	0.04	1
CACH_ELMA245c	183	108	237	1	0.40	0.68	2.29	291	115	176	169.08	76.82	1.39	-0.04	0.06	1
CACH_ELMA245d	183	107	237	8	0.40	0.68	2.30	291	115	176	169.08	76.68	1.10	0.00	0.00	1
CACH_ELMA246	185	106	231	7	0.40	0.58	1.92	258	102	156	176.55	81.07	0.69	-0.12	0.15	1
CACH_ELMA246a	181	114	239	8	0.40	0.57	1.90	258	102	156	177.64	82.30	0.69	-0.01	0.03	1
CACH_ELMA246b	181	103	238	2	0.40	0.57	1.94	258	102	156	177.50	80.59	0.00	-0.01	-0.17	0
CACH_ELMA247	185	128	244	4	0.39	0.57	1.85	256	101	155	177.54	83.91	1.10	0.03	-0.02	0
CACH_ELMA247a	186	112	238	8	0.39	0.57	1.90	256	101	155	176.75	81.67	3.14	-0.02	0.01	1
CACH_ELMA247b	186	108	235	8	0.39	0.57	1.91	256	101	155	176.34	81.06	1.10	-0.02	0.02	1
CACH_ELMA247c	185	125	241	6	0.39	0.57	1.86	256	101	155	177.15	83.52	5.38	-0.26	0.10	1
CACH_ELMA248a	189	122	244	8	0.40	0.67	2.25	287	114	173	169.07	76.98	1.79	0.04	-0.02	0
CACH_ELMA248b	189	120	243	8	0.40	0.67	2.25	287	114	173	168.94	76.72	0.00	0.02	0.03	1
CACH_ELMA248c	189	105	238	8	0.40	0.68	2.32	287	114	173	168.31	74.65	0.00	0.51	-0.05	0
CACH_ELMA248d	192	105	231	7	0.40	0.68	2.33	288	114	174	167.27	74.71	1.61	-0.77	0.31	1
CACH_ELMA248e	192	109	239	8	0.40	0.68	2.31	288	114	174	168.30	75.29	0.00	1.15	-0.90	0
CACH_ELMA249	184	134	247	6	0.40	0.67	2.21	287	114	173	169.16	78.44	2.08	0.09	-0.08	0
CACH_ELMA249a	185	134	247	6	0.40	0.67	2.21	287	114	173	169.16	78.44	0.69	-0.02	0.02	1
CACH_ELMA249b	184	123	243	7	0.40	0.68	2.24	287	114	173	168.67	77.11	0.00	0.34	-0.25	0
CACH_ELMA250	180	134	248	5	0.40	0.67	2.21	288	114	174	169.01	78.63	0.00	0.12	-0.06	0
CACH_ELMA250a	184	131	247	7	0.39	0.68	2.25	290	114	176	168.75	78.12	4.51	-0.03	0.03	1
CACH_ELMA250b	176	146	251	4	0.39	0.67	2.19	289	114	175	169.44	80.00	1.39	-0.02	0.06	1
CACH_ELMA250c	179	158	253	4	0.39	0.67	2.15	289	114	175	169.68	81.24	0.00	-0.18	0.33	1
CACH_ELMA251a	186	139	247	6	0.39	0.71	2.36	303	119	184	167.16	77.84	5.74	-0.78	0.31	1
CACH_ELMA251b	186	100	236	8	0.39	0.72	2.53	303	119	184	165.80	72.79	0.69	0.41	-0.36	0
CACH_ELMA252	181	133	247	6	0.40	0.75	2.49	316	125	191	165.64	76.79	0.69	0.00	0.00	1
CACH_ELMA252a	186	114	242	1	0.39	0.77	2.61	320	126	194	164.49	74.23	1.10	0.01	-0.01	0
CACH_ELMA252b	182	129	247	2	0.39	0.75	2.52	317	125	192	165.57	76.26	1.79	-0.10	0.04	1
CACH_ELMA252c	182	129	247	2	0.39	0.75	2.52	317	125	192	165.57	76.26	0.69	0.03	-0.04	0
CACH_ELMA252d	182	128	246	1	0.40	0.76	2.51	316	125	191	165.52	76.21	0.69	0.03	0.00	0
CACH_ELMA253a	182	129	246	7	0.39	0.76	2.54	320	126	194	165.04	76.32	3.33	-0.19	0.10	1
CACH_ELMA253b	183	127	245	8	0.39	0.76	2.55	320	126	194	164.92	76.09	0.00	0.11	-0.07	0
CACH_ELMA253c	183	127	245	8	0.39	0.76	2.56	321	126	195	164.78	76.02	2.71	-0.01	-0.01	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
CACH_ELMA254	182	120	242	8	0.39	0.71	2.41	303	119	184	167.10	76.33	0.00	0.02	0.01	1
CACH_ELMA254a	179	136	248	6	0.39	0.72	2.35	304	120	184	167.63	78.24	0.00	0.06	0.01	1
CACH_ELMA255	174	140	249	4	0.39	0.79	2.67	334	131	203	165.47	75.96	1.79	-0.05	0.03	1
CACH_ELMA255a	176	136	249	4	0.39	0.79	2.69	334	131	203	165.47	75.53	0.00	0.04	-0.03	0
CACH_ELMA255b	174	145	250	4	0.39	0.79	2.65	334	131	203	165.59	76.49	0.00	0.05	0.00	0
CACH_ELMA255c	175	136	248	5	0.39	0.79	2.69	336	131	205	165.76	76.27	2.20	-0.01	0.00	1
CACH_ELMA256	182	126	246	1	0.39	0.73	2.52	317	123	194	167.52	77.03	0.00	-0.02	-0.13	0
CACH_ELMA256a	182	120	245	2	0.39	0.73	2.54	317	123	194	167.40	76.27	1.10	-0.16	-0.06	0
CACH_ELMA257	179	112	242	1	0.39	0.68	2.35	299	116	183	170.61	77.82	1.10	-0.65	-0.03	0
CACH_ELMA257a	179	124	246	2	0.39	0.68	2.30	299	116	183	171.11	79.44	0.00	0.80	-0.46	0
CACH_ELMA258	177	129	246	8	0.38	0.71	2.43	315	121	194	169.94	79.80	0.00	0.06	-0.03	0
CACH_ELMA259	181	134	247	6	0.38	0.64	2.21	297	112	185	174.27	83.70	0.00	0.08	0.02	1
CACH_ELMA259a	177	142	250	5	0.38	0.64	2.19	297	112	185	174.65	84.67	0.00	0.19	-0.05	0
CACH_ELMA260	177	131	247	3	0.39	0.66	2.21	301	116	185	174.55	83.81	1.39	-0.12	0.10	1
CACH_ELMA260a	177	128	247	3	0.39	0.66	2.22	301	116	185	174.55	83.43	0.00	0.30	-0.20	0
CACH_ELMA260b	185	124	244	8	0.39	0.67	2.25	303	117	186	174.17	82.81	2.30	0.03	-0.01	0
CACH_ELMA261	183	128	246	1	0.38	0.68	2.29	307	118	189	173.25	82.57	6.63	-0.05	-0.01	0
CACH_ELMA261a	183	130	247	1	0.38	0.68	2.28	307	118	189	173.37	82.83	0.00	-0.07	0.08	1
CACH_ELMA261b	183	131	247	4	0.38	0.68	2.29	308	118	190	173.30	82.83	3.22	-0.08	0.04	1
CACH_ELMA262	179	126	245	8	0.38	0.69	2.36	311	119	192	171.81	81.25	0.69	-0.10	0.04	1
CACH_ELMA262a	180	136	247	6	0.38	0.69	2.37	314	119	195	171.92	82.34	0.69	0.14	-0.06	0
CACH_ELMA263	186	119	242	8	0.39	0.75	2.59	327	126	201	168.61	77.68	0.69	0.02	0.00	1
CACH_ELMA263a	191	62	218	8	0.38	0.76	2.98	328	126	201	165.45	67.49	1.10	-0.58	0.57	1
CACH_ELMA263b	178	137	249	4	0.38	0.75	2.53	328	126	202	169.06	79.71	0.00	0.01	0.00	0
CACH_ELMA263c	186	125	244	8	0.39	0.74	2.53	325	126	199	169.14	78.75	1.10	-0.07	0.04	1
CACH_ELMA263d	186	125	244	8	0.39	0.74	2.53	325	126	199	169.14	78.75	3.58	-0.03	0.01	1
CACH_ELMA264a	174	125	246	2	0.39	0.76	2.53	325	128	197	168.21	77.91	0.00	0.67	-0.32	0
CACH_ELMA264b	174	128	248	3	0.39	0.76	2.52	325	128	197	168.46	78.28	0.00	0.31	-0.04	0
CACH_ELMA265	186	127	245	8	0.41	0.75	2.34	318	128	189	170.78	80.83	3.66	-0.14	0.10	1
CACH_ELMA265a	178	120	243	8	0.41	0.76	2.37	318	129	189	170.18	79.64	1.10	0.00	0.03	1
CACH_ELMA265b	182	120	243	8	0.41	0.76	2.37	318	129	189	170.18	79.64	0.00	0.03	0.01	1
CACH_ELMA266	180	129	246	7	0.40	0.80	2.54	333	134	199	167.39	78.31	1.10	0.03	-0.01	0
CACH_ELMA266a	178	142	250	5	0.40	0.80	2.49	333	134	199	167.87	79.81	1.10	0.03	-0.02	0
CACH_ELMA267	182	135	248	5	0.43	0.84	2.34	333	143	190	169.56	81.15	1.10	-0.04	0.01	1
CACH_ELMA268	183	134	247	6	0.46	1.16	2.93	399	184	215	158.88	73.31	1.61	0.00	0.01	1
CACH_ELMA268a	183	138	246	6	0.46	1.16	2.92	399	184	215	158.76	73.74	0.69	0.05	0.05	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
CACH_ELMA268b	182	136	248	6	0.46	1.16	2.92	399	184	215	158.99	73.52	0.00	0.06	-0.02	0
CACH_ELMA269	181	118	243	8	0.46	1.16	3.01	399	184	215	158.42	71.46	2.20	-0.04	-0.05	0
CACH_ELMA269a	181	121	243	8	0.46	1.16	3.04	401	183	218	158.42	71.73	1.10	0.07	-0.09	0
CACH_ELMA269b	181	120	243	8	0.46	1.15	3.01	398	182	216	158.42	71.70	1.10	-0.04	-0.01	0
CACH_ELMA270	186	127	246	8	0.46	1.16	2.96	399	184	215	158.76	72.53	2.40	0.00	0.00	1
CACH_ELMA270a	186	127	246	8	0.46	1.16	2.96	399	184	215	158.76	72.53	1.39	0.01	0.00	0
CACH_ELMA271	181	131	247	3	0.46	1.14	2.89	393	181	211	158.88	72.92	7.01	-0.15	0.05	1
CACH_ELMA271a	176	131	247	3	0.46	1.14	2.88	390	181	209	158.67	72.64	2.40	-0.01	0.00	1
CACH_ELMA272	181	129	247	2	0.45	1.14	3.09	401	180	222	157.78	71.84	1.95	-0.06	0.04	1
CACH_ELMA272a	181	130	247	3	0.45	1.15	3.06	401	181	220	157.71	71.95	0.00	0.05	-0.04	0
CACH_ELMA272b	181	129	246	8	0.45	1.14	3.05	399	180	219	157.66	71.90	0.69	-0.01	0.01	1
CACH_ELMA273	177	131	247	7	0.45	1.16	3.07	402	182	220	157.02	71.72	2.40	0.00	0.00	0
CACH_ELMA274a	179	130	246	7	0.44	1.21	3.38	420	186	234	153.32	69.26	1.61	-0.01	0.00	1
CACH_ELMA275a	173	135	249	4	0.54	1.11	2.03	316	172	144	154.82	70.95	1.95	-0.01	0.01	1
CACH_ELMA275b	173	137	249	4	0.54	1.11	2.02	316	172	144	154.82	71.16	1.10	-0.04	0.01	1
CACH_ELMA276a	173	144	250	4	0.54	1.11	2.00	316	172	144	154.93	71.86	0.69	0.21	-0.13	0
CACH_ELMA277	176	128	245	3	0.55	1.08	1.97	308	168	140	155.89	71.15	1.95	-0.05	0.04	1
CACH_ELMA277a	177	142	243	6	0.55	1.08	1.93	308	168	140	155.66	72.63	1.39	-0.45	0.44	1
CACH_ELMA278	179	128	244	4	0.55	1.06	1.93	306	167	139	157.02	72.12	0.00	0.01	-0.01	0
CACH_ELMA278a	179	118	242	2	0.55	1.07	1.96	306	167	139	156.79	70.95	0.00	-0.05	0.11	1
CACH_ELMA279	175	128	245	3	0.54	1.04	1.89	303	165	138	158.03	72.98	1.61	0.01	-0.01	0
CACH_ELMA279a	163	151	251	4	0.54	1.04	1.83	303	165	138	158.71	75.40	0.69	0.09	0.07	1
CACH_ELMA280	178	124	244	2	0.54	0.96	1.71	287	156	131	163.28	76.54	0.00	0.03	0.03	1
CACH_ELMA280a	162	151	251	4	0.54	0.99	1.80	296	159	137	160.10	76.18	1.10	-0.14	0.13	1
CACH_ELMA280b	140	149	252	3	0.54	1.02	1.85	300	161	139	158.27	75.04	1.10	0.19	-0.05	0
CACH_ELMA281	179	128	244	3	0.55	0.92	1.52	285	158	127	171.62	83.40	0.00	0.01	0.00	1
CACH_ELMA282	176	132	245	4	0.55	0.82	1.34	262	145	117	176.57	87.16	1.39	-0.01	0.00	1
CACH_ELMA282a	195	58	217	1	0.55	0.86	1.65	266	147	119	171.11	72.17	0.69	0.08	-0.10	0
CACH_ELMA282b	188	108	240	1	0.55	0.83	1.43	265	146	119	175.23	83.42	0.00	0.40	-0.13	0
CACH_ELMA283	190	116	239	8	0.55	0.78	1.28	247	138	110	176.95	86.23	1.79	0.00	0.02	1
CACH_ELMA283a	190	115	239	8	0.56	0.78	1.28	248	138	110	176.95	86.08	1.79	0.02	0.00	1
CACH_ELMA284	180	130	243	6	0.55	0.78	1.28	250	138	112	177.27	87.84	0.69	0.01	0.02	1
CACH_ELMA284a	177	159	239	6	0.55	0.78	1.23	250	138	112	176.74	91.39	0.69	-0.04	0.03	1
CACH_ELMA284b	176	136	248	3	0.55	0.78	1.26	250	138	112	177.92	88.64	1.10	-0.11	0.12	1
CACH_ELMA285	175	125	244	2	0.56	0.79	1.29	254	141	113	177.95	87.58	0.69	0.04	-0.02	0
CACH_ELMA285a	158	143	249	4	0.55	0.81	1.31	259	143	116	177.01	88.86	1.39	-0.15	0.21	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
CACH_ELMA286	148	135	250	3	0.55	0.91	1.50	282	156	126	172.23	84.01	2.30	0.32	-0.17	0
CACH_ELMA287	172	122	243	2	0.55	0.91	1.56	286	157	129	172.04	82.84	2.77	-0.01	-0.03	0
CACH_ELMA287a	172	114	244	2	0.55	0.91	1.58	286	157	129	172.17	81.70	2.64	-0.75	0.56	1
Carson1	181	115	239	8	0.48	1.04	2.50	345	167	180	160.00	71.86	2.71	-0.04	0.00	0
Carson106	187	104	228	7	0.50	1.65	4.43	453	225	228	135.99	51.46	1.79	0.49	-0.45	0
Carson106a	187	97	224	7	0.50	1.66	4.50	453	225	228	135.56	50.71	1.10	0.47	-0.45	0
Carson107	177	119	241	6	0.51	1.20	2.80	357	181	177	150.35	63.11	4.17	-0.04	0.01	1
Carson107a	178	121	241	6	0.51	1.20	2.80	357	181	177	150.35	63.33	2.77	-0.13	0.08	1
Carson108	180	119	240	7	0.51	1.20	2.80	357	181	177	150.24	63.11	1.39	-0.07	0.05	1
Carson2	177	122	243	4	0.47	1.08	2.73	360	170	190	156.97	69.53	2.20	-0.02	0.01	1
Chupaderos130	170	131	245	4	0.50	1.22	2.61	415	206	209	168.85	79.99	0.00	-0.05	0.02	1
Chupaderos130a	180	106	230	7	0.50	1.23	2.73	415	206	209	166.94	76.62	0.00	0.51	-0.11	0
Chupaderos131	180	139	234	6	0.50	1.23	2.58	415	206	209	167.46	80.93	0.00	1.49	-0.66	0
Chupaderos131A	182	138	243	6	0.50	1.24	2.62	416	209	211	168.12	80.60	0.69	-0.07	0.03	1
Chupaderos132	187	0	192	1	0.50	1.33	11.93	425	213	212	160.10	17.76	1.61	-1.10	1.02	1
colm1	188	115	244	3	0.32	0.50	2.53	292	92	200	183.88	78.95	2.40	-0.21	-0.01	0
colm2	135	121	246	3	0.32	0.54	2.69	298	96	202	176.35	74.99	3.00	0.27	-0.26	0
colm3	146	104	237	3	0.32	0.57	2.94	303	98	205	171.00	69.65	0.69	0.22	0.27	1
colm4	182	94	236	1	0.33	0.56	2.93	298	97	201	171.69	68.68	0.00	0.32	-0.31	0
colm5	177	88	228	3	0.33	0.57	2.97	298	97	201	170.62	67.72	0.69	-0.48	0.50	1
colm6	163	110	242	2	0.34	0.54	2.52	269	92	177	170.81	70.35	1.95	0.06	-0.02	0
GLCA1	184	115	239	7	0.37	0.95	3.40	429	160	269	168.51	79.19	0.00	0.03	0.00	0
GLCA2	186	117	238	7	0.37	0.95	3.38	429	160	269	168.38	79.47	1.10	0.02	0.01	1
GLCA3	185	119	241	7	0.37	0.92	3.37	422	157	265	171.31	78.58	0.00	0.08	-0.03	0
GLOR	172	146	247	5	0.55	1.65	2.81	449	249	200	151.01	71.06	1.39	-0.03	0.11	1
Hayden26	125	180	254	4	0.47	0.92	2.28	293	137	156	148.99	68.28	0.69	0.86	-0.20	0
Jemez132	196	108	238	1	0.52	0.85	1.71	289	149	140	175.51	82.09	2.30	-0.13	0.17	1
Jemez133	180	121	239	7	0.51	1.06	2.16	361	184	177	172.90	81.91	1.95	-0.02	0.00	0
Jemez134	127	118	241	3	0.50	1.08	2.28	366	184	182	170.27	79.73	1.39	-0.38	0.42	1
Jemez135	177	125	237	7	0.50	0.78	1.62	276	138	138	176.55	85.00	0.69	0.03	0.04	1
Jemez136	184	118	242	1	0.48	0.73	1.63	270	130	140	178.86	85.78	1.10	0.02	0.00	0
Jemez137	179	127	244	4	0.50	0.72	1.47	258	129	129	179.88	87.74	0.69	0.02	-0.01	0
Jemez138	181	129	246	3	0.48	0.75	1.63	286	137	149	183.32	91.37	0.00	0.46	-0.25	0
Jemez139	182	123	243	1	0.48	0.74	1.63	282	135	147	182.50	90.02	0.00	0.13	-0.06	0
Jemez156	177	132	246	4	0.48	0.90	2.03	327	158	173	175.11	83.79	0.69	-0.06	0.02	1
Jemez157	169	157	251	4	0.48	1.02	2.28	370	177	193	173.04	84.82	0.00	0.31	-0.08	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Jemez158	188	128	241	6	0.48	0.75	1.69	269	131	140	173.57	82.79	0.00	0.25	-0.14	0
Lincoln306a	181	127	243	6	0.53	1.45	2.56	449	238	211	163.78	82.26	0.69	0.04	-0.02	0
Lincoln307	179	129	245	4	0.53	1.44	2.54	444	235	209	163.75	82.18	1.79	-0.04	0.03	1
Lincoln307a	179	130	245	4	0.53	1.44	2.54	444	235	209	163.75	82.31	1.10	0.00	0.00	1
Lincoln308a	179	115	239	8	0.53	1.41	2.57	433	228	205	162.20	79.79	0.00	0.49	-0.34	0
Lincoln308b	179	102	235	1	0.53	1.41	2.63	433	228	205	161.71	77.84	0.00	0.18	-0.01	0
Lincoln309a	175	135	245	5	0.53	1.40	2.48	432	228	204	162.58	82.16	2.08	-0.09	0.04	1
Lincoln309b	175	132	244	5	0.53	1.40	2.49	432	228	204	162.46	81.80	1.39	-0.04	0.00	0
Lincoln309c	175	137	247	4	0.53	1.40	2.48	432	228	204	162.81	82.40	1.39	0.07	-0.05	0
Lincoln310	175	136	245	5	0.52	1.38	2.55	431	223	208	161.47	81.57	3.40	-0.09	0.06	1
Lincoln310a	174	140	246	5	0.52	1.38	2.54	431	223	208	161.59	82.04	1.61	0.01	0.00	1
Lincoln310b	178	130	244	5	0.52	1.38	2.57	431	223	208	161.36	80.84	0.69	0.00	0.01	1
Lincoln311	175	129	245	3	0.53	1.39	2.49	430	226	204	162.99	81.82	2.20	0.00	0.00	0
Lincoln311a	176	129	246	3	0.53	1.39	2.49	430	226	204	163.11	81.82	1.39	-0.09	0.08	1
Lincoln311b	176	131	247	3	0.52	1.37	2.52	430	224	206	162.95	81.79	1.10	-0.07	0.07	1
Lincoln312	176	129	245	3	0.53	1.30	2.30	399	212	187	163.20	81.42	1.10	-0.01	0.01	1
Lincoln312a	177	128	245	3	0.53	1.30	2.30	399	212	187	163.20	81.29	1.39	0.00	0.00	0
Lincoln312b	177	128	245	3	0.53	1.30	2.30	399	212	187	163.20	81.29	1.79	0.00	0.00	0
Lincoln312c	177	130	241	6	0.53	1.30	2.29	399	212	187	162.72	81.55	1.61	-0.02	0.07	1
Lincoln313	175	124	241	7	0.56	1.32	2.12	389	216	173	163.75	81.53	5.00	-0.24	0.18	1
Lincoln313a	175	115	238	8	0.56	1.32	2.15	389	216	173	163.72	80.54	1.61	-0.29	0.22	1
Lincoln313b	181	130	244	5	0.56	1.32	2.10	389	216	173	164.11	82.31	1.39	-0.04	0.03	1
Lincoln314	177	98	208	7	0.55	1.34	2.22	390	216	174	160.69	78.54	1.10	-0.56	0.66	1
Lincoln315	188	121	240	7	0.55	1.29	2.11	391	215	176	166.51	83.24	2.20	-0.11	0.05	1
Lincoln315a	197	81	228	1	0.55	1.31	2.31	391	215	176	164.63	76.18	0.69	0.16	0.07	1
Lincoln315b	188	98	236	1	0.55	1.30	2.22	391	215	176	165.66	79.35	1.10	-0.18	0.25	1
Lincoln316	183	123	241	7	0.54	1.27	2.12	392	213	179	168.08	84.51	1.79	-0.01	0.01	1
Lincoln316a	182	111	238	8	0.54	1.26	2.17	392	212	180	167.70	82.77	1.61	-0.04	0.00	0
Lincoln316b	182	129	244	5	0.54	1.26	2.11	392	212	180	168.45	85.33	0.00	-0.02	0.02	1
Lincoln317	183	121	240	7	0.53	1.24	2.18	400	212	188	170.77	86.34	0.69	-0.12	0.11	1
Lincoln317a	182	134	242	6	0.53	1.24	2.14	400	212	188	170.68	88.01	1.10	0.14	-0.10	0
Lincoln317b	183	128	242	6	0.53	1.24	2.15	400	212	188	171.02	87.33	1.61	-0.01	0.03	1
Lincoln317c	183	119	238	7	0.53	1.24	2.18	400	212	188	170.51	86.05	0.00	0.12	-0.02	0
Lincoln318	181	130	245	2	0.51	1.20	2.21	408	209	199	174.16	90.07	1.39	0.03	0.00	0
Lincoln318a	181	114	239	1	0.51	1.20	2.27	408	209	199	173.59	87.77	1.10	-0.11	0.09	1
Lincoln318b	181	131	245	2	0.51	1.20	2.21	408	209	199	174.16	90.21	1.61	0.03	-0.01	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Lincoln319	183	128	243	8	0.52	1.12	1.95	383	200	183	178.85	93.73	1.79	0.01	-0.01	0
Lincoln319a	183	132	244	7	0.52	1.12	1.94	383	200	183	178.99	94.30	0.00	0.04	0.00	0
Lincoln319b	191	132	238	7	0.52	1.16	2.00	391	205	186	176.20	92.89	0.00	0.17	0.03	1
Lincoln320a	181	158	241	6	0.57	1.45	1.97	428	245	183	168.97	92.86	0.00	-0.05	0.13	1
Lincoln320b	181	156	243	6	0.57	1.45	1.98	428	245	183	169.22	92.63	0.00	0.06	0.03	1
Lincoln320c	186	129	242	7	0.57	1.45	2.05	428	245	183	169.09	89.23	0.00	0.34	-0.13	0
Lincoln320d	180	117	239	8	0.57	1.45	2.09	428	245	183	168.72	87.49	0.69	0.36	-0.25	0
Lincoln321	191	142	237	6	0.61	1.69	2.02	461	280	181	165.31	89.64	0.00	0.62	-0.24	0
Lincoln321a	178	166	253	4	0.62	1.75	1.97	473	292	181	166.49	91.95	0.69	-0.29	0.13	1
Lincoln321b	194	141	243	6	0.61	1.69	2.02	462	281	181	166.05	89.46	1.61	-0.13	0.10	1
Lincoln321c	190	33	204	1	0.61	1.75	2.81	462	281	181	160.85	64.50	0.69	0.75	-0.48	0
Lincoln321d	186	157	252	4	0.62	1.76	1.99	473	292	181	166.38	90.97	1.10	0.19	-0.01	0
Lincoln322	180	156	241	6	0.61	1.97	2.25	513	315	198	159.83	87.91	2.20	-0.60	0.52	1
Lincoln322a	180	145	245	5	0.61	1.97	2.28	513	315	198	160.30	86.67	8.24	-0.47	0.40	1
Lincoln323a	171	140	251	3	0.61	1.83	2.17	488	299	189	163.21	87.25	1.10	-0.09	0.05	1
Lincoln323b	174	159	253	4	0.61	1.83	2.11	488	299	189	163.44	89.45	1.10	0.09	0.07	1
Lincoln324	178	119	245	2	0.61	1.83	2.23	486	298	188	162.44	84.46	1.10	0.14	-0.02	0
Lincoln324a	178	110	243	2	0.61	1.84	2.26	486	298	188	162.20	83.11	0.69	0.27	-0.09	0
Lincoln324b	181	136	245	5	0.61	1.83	2.17	486	298	188	162.44	86.75	3.14	0.00	-0.01	0
Lincoln324c	181	139	245	5	0.61	1.83	2.16	486	298	188	162.44	87.13	3.83	0.12	-0.13	0
Lincoln324d	181	137	245	6	0.61	1.83	2.16	486	298	188	162.44	86.88	0.69	0.05	-0.07	0
Lincoln325	180	165	247	5	0.61	1.91	2.20	508	310	198	162.12	90.05	1.10	0.27	-0.08	0
Lincoln325a	180	117	242	2	0.61	1.92	2.35	508	310	198	161.53	84.14	0.00	0.15	-0.03	0
Lincoln325b	180	163	244	5	0.61	1.92	2.20	508	310	198	161.77	89.84	0.69	-0.05	0.09	1
Lincoln326a	156	166	250	3	0.62	1.70	1.85	452	281	171	165.31	92.50	1.61	-0.15	0.23	1
Lincoln326b	172	161	247	5	0.62	1.65	1.80	442	275	167	166.40	92.82	1.10	-0.12	-0.05	0
Lincoln326c	177	167	244	5	0.62	1.65	1.78	442	275	167	166.66	93.86	2.71	-0.23	0.28	1
Lincoln326d	153	134	247	3	0.62	1.70	1.93	452	281	171	164.95	88.71	2.64	-0.01	0.00	1
Lincoln326e	187	108	239	1	0.62	1.66	1.95	442	275	167	165.42	85.68	1.39	0.10	0.05	1
Lincoln326f	182	185	221	6	0.62	1.69	1.75	442	275	167	163.09	95.30	1.79	-0.73	0.58	1
Lincoln326g	186	130	246	2	0.62	1.65	1.86	441	275	166	166.56	89.13	4.84	-0.70	0.25	1
Lincoln327a	174	170	251	4	0.63	1.46	1.53	394	248	146	170.13	95.63	3.09	-0.25	0.16	1
Lincoln327b	174	168	250	5	0.63	1.46	1.53	394	248	146	170.01	95.41	1.10	0.19	-0.12	0
Lincoln327c	188	122	241	8	0.63	1.47	1.62	395	249	146	169.24	89.93	0.69	-0.01	0.01	1
Lincoln327d	198	118	239	8	0.63	1.47	1.63	395	249	146	168.99	89.32	1.79	-0.10	0.13	1
Lincoln327e	195	83	224	8	0.63	1.49	1.76	395	249	146	167.02	82.96	1.79	-0.55	0.50	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Lincoln327f	172	177	241	5	0.63	1.47	1.53	395	248	147	168.90	96.36	0.00	0.46	-0.02	0
Lincoln328	192	121	240	8	0.62	1.53	1.77	417	259	158	169.05	89.48	2.48	-0.02	0.04	1
Lincoln328a	225	113	238	8	0.62	1.53	1.79	417	259	158	168.79	88.24	0.00	-0.06	0.14	1
Lincoln328b	192	122	241	8	0.62	1.53	1.76	417	259	158	169.18	89.63	0.69	-0.03	0.04	1
Lincoln329	223	39	184	8	0.62	1.60	2.24	414	258	156	161.45	69.73	1.95	-0.07	0.20	1
Lincoln330	173	187	251	4	0.62	1.54	1.63	419	261	158	169.86	96.97	0.69	0.18	-0.31	0
Lincoln330a	173	139	242	6	0.62	1.55	1.73	419	261	158	168.75	91.59	0.00	0.52	0.12	1
Lincoln330b	170	201	251	4	0.62	1.54	1.61	419	261	158	169.86	98.29	1.39	-0.11	0.10	1
Lincoln331	228	32	204	1	0.62	1.59	2.43	418	259	159	162.85	65.40	1.79	0.03	0.14	1
Lincoln332	178	144	244	6	0.61	1.65	1.89	450	276	174	167.69	92.26	1.39	0.05	0.00	0
Lincoln332a	179	142	245	5	0.61	1.64	1.89	450	276	174	167.82	92.01	1.10	-0.07	0.10	1
Lincoln332b	175	144	248	4	0.61	1.64	1.89	450	276	174	168.18	92.26	0.69	0.06	-0.06	0
Lincoln332c	190	138	246	4	0.61	1.63	1.92	448	273	175	167.52	91.00	1.79	0.03	-0.02	0
Lincoln332d	190	29	205	1	0.61	1.68	2.75	445	271	174	161.06	63.27	1.61	-0.52	0.38	1
Lincoln333	181	128	245	2	0.62	1.66	1.93	449	277	172	166.64	89.03	2.89	0.00	0.01	1
Lincoln333a	181	132	245	3	0.62	1.66	1.91	447	276	171	166.37	89.55	0.69	0.00	0.00	0
Lincoln333b	195	122	244	2	0.62	1.65	1.93	445	275	170	166.45	88.24	1.10	-0.22	0.11	1
Lincoln333c	184	100	239	2	0.62	1.66	2.01	445	275	170	165.83	84.70	0.69	-0.14	0.13	1
Lincoln334	184	114	239	8	0.63	1.48	1.68	398	250	148	168.51	88.31	3.18	-0.21	0.08	1
Lincoln334a	184	120	240	8	0.63	1.48	1.66	398	250	148	168.64	89.24	1.10	-0.27	0.31	1
Lincoln334b	184	162	254	3	0.63	1.47	1.56	398	250	148	170.36	94.68	0.69	0.40	-0.35	0
Lincoln334c	195	134	249	3	0.63	1.47	1.62	398	250	148	169.75	91.23	0.00	0.56	-0.14	0
Lincoln335	195	96	223	8	0.63	1.50	1.74	398	250	148	166.41	85.21	1.61	0.06	-0.12	0
Lincoln336	179	114	231	7	0.63	1.49	1.68	398	250	148	167.48	88.31	0.00	1.17	-0.32	0
Lincoln337	179	91	229	8	0.63	1.50	1.76	398	250	148	167.21	84.25	1.61	-0.84	0.50	1
Lincoln337a	184	98	231	8	0.63	1.49	1.73	398	250	148	167.48	85.58	2.08	-1.27	0.50	1
Lincoln337b	179	98	231	8	0.63	1.49	1.73	398	250	148	167.48	85.58	1.39	0.16	-0.23	0
Lincoln338	173	144	246	5	0.63	1.50	1.62	401	253	148	168.35	91.61	1.61	-0.13	0.05	1
Lincoln338a	175	151	250	4	0.63	1.48	1.59	398	251	147	169.11	92.68	0.69	-0.07	0.09	1
Lincoln338b	175	140	247	4	0.63	1.54	1.68	410	258	152	167.37	90.45	0.69	0.01	-0.01	0
Lincoln339	177	136	247	3	0.61	1.79	2.10	475	292	183	163.50	87.28	0.69	0.03	0.02	1
Lincoln339a	169	155	253	3	0.62	1.82	2.08	482	297	185	162.96	88.82	1.95	0.26	-0.25	0
Lincoln339b	178	129	244	1	0.61	1.79	2.12	475	292	183	163.15	86.36	2.20	-0.10	0.02	1
Lincoln339c	180	119	239	8	0.61	1.80	2.15	475	292	183	162.54	84.97	0.69	0.26	-0.13	0
Lincoln340	176	134	248	3	0.61	1.95	2.32	512	314	198	161.07	85.42	1.61	-0.02	-0.05	0
Lincoln340a	180	91	225	8	0.61	1.93	2.48	503	307	196	158.67	79.17	1.39	0.11	-0.04	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Lincoln340b	161	170	251	4	0.61	1.91	2.19	505	309	196	161.62	89.57	1.10	0.05	-0.03	0
Lincoln340c	161	166	252	4	0.61	1.91	2.20	505	309	196	161.74	89.16	1.39	-0.27	0.24	1
Lincoln341a	179	135	249	3	0.61	1.83	2.16	485	298	187	163.19	86.60	0.00	0.46	-0.15	0
Lincoln341b	182	127	246	2	0.61	1.79	2.14	476	293	184	164.14	86.03	0.00	0.04	0.01	1
Lincoln342	187	124	241	8	0.61	1.75	2.10	469	288	181	164.37	86.08	2.56	0.01	0.01	1
Lincoln342a	187	123	240	8	0.61	1.75	2.11	469	288	181	164.24	85.93	1.95	0.01	0.00	0
Lincoln342b	187	123	240	8	0.61	1.75	2.11	469	288	181	164.24	85.93	1.79	0.02	-0.01	0
Lincoln342c	184	125	241	8	0.61	1.75	2.10	469	288	181	164.30	86.12	2.08	0.01	0.00	1
Lincoln342d	180	124	241	8	0.61	1.72	2.06	462	284	178	165.26	86.50	1.39	-0.03	0.04	1
Lincoln343	194	115	238	8	0.62	1.72	2.08	461	284	177	164.82	85.19	2.08	-0.05	0.04	1
Lincoln343a	183	127	244	1	0.61	1.67	2.02	454	278	176	166.59	87.25	2.30	0.00	0.00	0
Lincoln343b	183	130	245	2	0.61	1.67	2.01	454	278	176	166.71	87.66	0.69	-0.02	0.03	1
Lincoln344a	182	129	243	8	0.60	1.56	2.02	439	262	177	167.64	87.68	0.00	0.09	-0.05	0
Lincoln344b	187	119	236	7	0.60	1.57	2.05	439	262	177	166.76	86.26	1.79	0.02	0.00	1
Lincoln344c	169	176	254	4	0.61	1.65	1.88	450	276	174	167.24	92.72	1.10	-0.15	0.24	1
Lincoln344d	172	131	246	2	0.61	1.66	1.99	450	276	174	166.28	87.55	0.00	0.04	0.02	1
Lincoln345	176	130	246	2	0.59	1.73	2.26	477	283	194	163.66	85.70	2.30	0.01	0.00	1
Lincoln345a	176	130	246	2	0.59	1.73	2.26	477	283	194	163.66	85.70	3.56	-0.02	0.02	1
Lincoln345b	176	129	246	2	0.59	1.73	2.27	477	283	194	163.66	85.57	1.39	0.02	0.00	1
Lincoln345c	179	125	244	1	0.59	1.73	2.28	477	283	194	163.42	85.03	0.00	0.03	0.00	1
Lincoln346	188	122	242	1	0.59	1.74	2.30	478	283	195	163.04	84.65	3.09	-0.02	0.01	1
Lincoln346a	188	119	242	1	0.59	1.74	2.32	478	283	195	163.04	84.22	3.22	0.02	0.01	1
Lincoln346b	184	128	245	2	0.57	1.61	2.27	461	265	196	164.30	86.26	2.40	0.02	-0.01	0
Lincoln346c	179	127	245	2	0.57	1.61	2.28	461	265	196	164.30	86.12	2.30	-0.02	0.01	1
Lincoln347	177	140	245	5	0.53	1.40	2.34	441	233	208	166.71	88.99	5.74	-0.36	0.20	1
Lincoln347a	177	152	249	4	0.53	1.39	2.30	441	233	208	167.20	90.43	0.00	0.07	-0.03	0
Lincoln347b	218	54	196	8	0.53	1.46	2.87	441	233	208	160.06	72.50	1.79	-0.70	0.37	1
Lincoln347c	218	119	238	8	0.53	1.40	2.41	441	233	208	165.85	86.14	0.00	1.12	-1.03	0
Lincoln347d	179	161	252	4	0.53	1.43	2.31	448	238	210	166.17	90.84	0.69	0.66	-0.50	0
Lincoln347e	179	168	252	4	0.53	1.43	2.29	448	238	210	166.17	91.59	0.69	0.55	-0.41	0
Lincoln348a	201	89	234	1	0.54	1.24	2.19	402	216	186	173.54	84.81	1.39	-0.25	0.18	1
Lincoln348b	183	130	233	7	0.53	1.24	2.04	403	215	188	173.68	91.94	3.22	-0.45	0.24	1
Lincoln348c	197	134	238	6	0.53	1.27	2.10	412	220	192	172.91	91.63	0.69	-0.10	0.10	1
Lincoln348d	188	138	245	5	0.53	1.23	2.02	403	215	188	175.26	93.04	5.48	-0.37	0.25	1
Lincoln348e	182	137	241	6	0.53	1.23	2.02	403	215	188	174.74	92.90	0.00	-0.08	0.09	1
Lincoln348f	193	91	228	8	0.53	1.28	2.27	412	220	192	171.57	84.62	1.10	-0.41	0.37	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Lincoln348g	182	131	244	7	0.54	1.23	2.02	401	215	186	175.47	92.26	0.00	0.02	-0.01	0
Manzano198	199	63	217	8	0.46	1.02	2.81	385	176	209	173.34	74.37	1.10	-0.14	0.29	1
Manzano199	182	128	247	3	0.45	1.24	3.19	460	207	253	167.51	79.28	7.84	-1.20	0.98	1
Manzano200	184	89	219	8	0.44	1.43	3.98	517	229	288	160.26	72.32	1.10	0.29	-0.26	0
Manzano201	183	15	189	8	0.44	1.45	6.12	513	227	286	156.87	46.70	1.95	-1.09	0.55	1
Manzano202	184	113	240	1	0.44	1.57	4.29	566	249	317	158.75	73.92	1.39	-0.09	0.18	1
Manzano203	175	130	246	3	0.49	1.39	3.03	468	228	240	164.42	79.16	2.20	-0.05	0.06	1
Manzano203a	175	132	247	3	0.49	1.39	3.02	468	228	240	164.54	79.40	1.39	-0.08	0.06	1
Manzano204	177	127	244	3	0.49	1.38	2.99	464	226	238	163.97	79.49	5.17	0.00	0.00	0
Manzano204a	179	136	248	4	0.49	1.36	2.91	460	225	235	164.93	80.68	1.10	-0.03	0.03	1
Manzano204b	177	126	244	3	0.49	1.38	3.00	464	226	238	163.97	79.37	1.10	0.01	-0.01	0
Manzano205	179	121	243	2	0.50	1.33	2.77	438	220	218	165.57	78.78	1.95	-0.01	0.01	1
Manzano205a	179	130	244	4	0.50	1.33	2.73	438	220	218	165.69	79.93	0.00	0.01	0.01	1
Manzano205b	178	142	248	4	0.50	1.32	2.70	442	220	220	166.11	81.43	1.39	0.11	-0.09	0
Manzano205c	179	130	245	4	0.50	1.33	2.73	438	220	218	165.82	79.93	1.79	-0.01	-0.01	0
Manzano206	161	138	249	3	0.48	1.38	3.01	468	226	242	163.81	80.45	3.76	-0.23	0.09	1
Manzano206a	161	139	249	4	0.48	1.40	3.04	472	228	244	163.26	80.32	0.00	-0.01	0.08	1
Manzano206b	174	178	253	4	0.48	1.39	2.90	472	228	244	163.72	84.25	0.69	0.03	0.08	1
Manzano207	175	132	245	5	0.50	1.34	2.78	445	222	223	165.61	80.32	1.39	-0.02	0.00	1
Manzano208	178	122	244	2	0.47	1.43	3.33	491	232	259	162.39	77.77	1.39	0.03	0.00	1
Manzano209	181	125	243	2	0.57	1.22	1.92	367	208	159	170.11	82.70	0.00	0.02	-0.01	0
Manzano209a	178	118	242	1	0.57	1.25	1.98	374	212	162	169.58	81.77	0.00	0.08	-0.02	0
Manzano210	181	126	243	8	0.57	1.25	1.92	370	211	159	168.94	82.77	1.95	-0.01	0.01	1
Manzano211	178	126	244	3	0.56	1.29	2.08	390	217	173	167.83	83.10	0.00	0.00	0.03	1
Manzano212	182	123	242	8	0.54	1.37	2.36	425	229	196	166.83	83.18	2.08	0.03	-0.01	0
Manzano213	177	121	244	2	0.53	1.47	2.64	456	241	215	163.90	81.37	5.34	-0.03	-0.03	0
Manzano214	176	124	242	8	0.53	1.49	2.68	459	242	217	162.56	80.84	1.79	-0.01	-0.04	0
Manzano215	182	124	243	8	0.54	1.35	2.25	416	226	190	167.91	84.32	0.69	-0.03	0.03	1
Manzano216	177	126	247	3	0.44	1.38	3.64	513	227	286	164.75	78.52	0.00	0.49	-0.15	0
Manzano217	185	51	195	8	0.44	1.44	4.44	513	227	286	157.79	64.45	0.69	0.56	-0.52	0
Manzano218	180	117	241	1	0.49	1.40	3.09	469	229	240	163.54	77.59	1.79	-0.10	0.09	1
Manzano218a	178	138	244	5	0.49	1.40	2.99	469	229	240	163.90	80.20	0.69	0.01	-0.01	0
Manzano219	174	128	245	3	0.49	1.41	3.08	474	231	243	163.54	78.83	1.10	-0.02	0.03	1
Manzano220	175	128	244	3	0.49	1.44	3.05	478	235	243	163.49	79.59	0.00	0.03	0.00	0
Manzano221	177	128	244	4	0.56	1.27	2.06	393	219	174	172.17	84.62	0.00	0.08	-0.02	0
Manzano221a	177	121	244	2	0.56	1.27	2.08	393	219	174	172.17	83.66	0.00	0.14	-0.17	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Manzano221b	177	128	244	5	0.56	1.27	2.06	393	219	174	172.51	84.58	0.00	0.13	-0.03	0
Manzano221c	189	101	233	8	0.56	1.29	2.16	394	220	174	170.81	80.49	1.39	0.05	-0.03	0
Manzano221d	190	42	200	8	0.56	1.32	2.64	394	220	174	166.10	65.97	1.10	-0.51	0.42	1
Manzano221e	174	130	246	3	0.56	1.27	2.05	393	219	174	172.42	84.82	1.61	-0.15	0.11	1
Manzano222	175	131	245	4	0.54	1.03	1.77	341	184	157	178.64	88.90	1.61	0.01	0.00	1
Manzano222a	204	68	214	8	0.54	1.10	2.10	351	190	161	173.43	76.83	1.61	0.44	-0.28	0
Manzano222b	189	87	224	8	0.54	1.04	1.92	340	183	157	175.77	81.87	0.69	0.54	-0.34	0
Manzano222c	178	128	243	6	0.54	1.05	1.79	344	186	158	177.89	88.24	1.39	-0.04	0.02	1
Manzano222d	190	107	235	8	0.54	1.06	1.85	345	187	158	177.16	85.23	0.00	-0.19	0.22	1
McCoy	184	145	243	5	0.41	0.87	3.24	309	127	182	145.89	56.12	0.69	-0.26	0.34	1
McCoy1a	184	145	247	5	0.41	0.87	3.24	309	127	182	146.32	56.12	0.69	-0.04	0.24	1
meve1	189	121	241	6	0.32	0.79	3.71	420	135	285	169.93	76.82	0.69	0.05	-0.04	0
meve2	188	117	239	7	0.32	0.79	3.71	416	133	281	169.06	75.82	1.39	-0.04	-0.01	0
meve3	197	134	245	5	0.31	0.93	4.52	496	155	341	166.37	75.37	0.00	0.21	-0.04	0
meve4	176	0	178	8	0.32	0.85	16.51	424	136	288	160.37	17.44	1.61	-0.39	0.33	1
meve5	189	121	241	6	0.32	0.78	3.68	417	133	284	170.14	77.18	1.10	-0.02	0.00	0
meve6	182	84	228	1	0.32	0.96	5.05	473	150	323	156.13	63.97	3.66	-0.37	0.16	1
meve7	185	86	178	7	0.31	1.13	5.56	542	170	372	151.08	66.94	1.39	0.19	0.18	1
meve8	191	104	232	8	0.32	0.93	4.67	460	145	310	156.21	66.44	4.30	-0.07	-0.01	0
neNM01	185	109	240	2	0.50	0.86	1.86	286	145	143	167.74	77.09	0.00	0.28	-0.18	0
neNM01a	149	147	251	4	0.51	1.04	2.04	344	174	170	167.99	83.40	1.39	0.58	-0.57	0
neNM01b	154	126	247	3	0.51	1.04	2.10	344	174	170	167.51	80.89	0.00	0.94	-0.30	0
neNM01c	176	126	244	4	0.51	1.04	2.10	344	174	170	167.14	80.89	1.10	-0.26	0.26	1
neNM01d	153	145	246	5	0.51	0.95	1.92	326	166	160	167.59	81.20	0.00	0.98	-0.40	0
neNM01e	156	188	252	4	0.51	0.95	1.83	316	160	156	168.32	85.35	2.08	-0.31	0.20	1
neNM01f	185	114	241	1	0.50	0.86	1.84	288	145	143	167.87	77.80	0.00	0.08	-0.03	0
neNM01g	186	99	218	7	0.50	0.90	1.93	291	148	145	164.24	75.21	0.69	0.41	-0.14	0
neNM01h	188	115	234	7	0.51	0.89	1.87	293	148	145	166.37	77.58	1.39	-0.20	0.07	1
neNM02	190	115	239	7	0.50	0.86	1.83	286	144	142	167.89	77.79	1.61	0.02	0.01	1
neNM02a	187	103	239	2	0.50	0.86	1.87	286	144	142	167.89	76.04	0.00	1.30	-0.58	0
neNM02b	186	83	220	8	0.50	0.87	1.96	286	144	142	165.39	72.63	0.00	0.13	0.07	1
neNM03	207	89	231	1	0.50	0.88	1.96	290	146	144	166.73	73.48	3.26	-0.08	0.01	1
neNM03a	219	60	207	8	0.51	0.91	2.14	294	149	145	163.69	67.74	2.08	-0.90	0.39	1
neNM03b	175	134	248	4	0.50	0.87	1.81	293	147	146	169.42	80.63	1.79	0.26	-0.21	0
neNM03c	151	156	238	6	0.50	0.87	1.76	293	147	146	168.18	83.07	1.10	-0.20	0.07	1
neNM03d	154	140	240	6	0.51	0.91	1.80	300	153	147	168.29	81.51	0.69	0.21	-0.25	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
neNM03e	164	153	250	4	0.51	0.99	1.96	328	166	162	167.04	82.72	0.00	0.95	-0.77	0
neNM04a	148	76	224	2	0.51	0.94	2.08	306	156	150	166.41	72.26	1.39	-0.65	0.12	1
neNM04b	155	144	248	5	0.51	0.95	1.85	311	160	151	168.39	81.59	0.69	-0.05	-0.09	0
neNM04c	143	121	244	3	0.50	0.99	2.05	326	164	162	165.97	78.99	0.00	0.53	-0.52	0
neNM04d	179	162	247	5	0.51	0.92	1.81	306	155	151	168.82	83.32	4.71	-1.04	0.08	1
neNM05	228	0	185	8	0.51	1.01	8.70	318	162	156	160.30	17.93	1.39	-1.01	0.96	1
neNM05a	121	191	251	5	0.51	0.96	1.85	320	162	158	168.82	85.57	2.94	0.89	-0.71	0
neNM05b	228	0	152	8	0.51	1.05	8.70	318	162	156	154.39	17.93	2.30	-0.48	0.44	1
neNM06a	197	112	234	7	0.51	0.94	1.93	300	156	148	166.43	76.75	1.10	-0.62	0.37	1
neNM06b	159	116	243	3	0.51	0.94	1.95	304	158	150	167.22	76.88	1.10	0.59	-0.28	0
neNM06c	176	109	240	2	0.51	0.95	1.98	304	158	150	166.85	75.91	0.00	0.09	0.02	1
neNM06d	205	0	184	8	0.51	0.98	8.33	300	156	148	159.22	17.77	1.10	-1.51	1.06	1
neNM07	188	111	231	7	0.52	0.95	1.93	305	158	147	165.77	76.16	0.00	0.38	-0.14	0
neNM07a	210	142	230	6	0.52	0.97	1.86	308	159	149	164.69	79.97	0.69	0.50	-0.26	0
neNM07b	154	95	233	1	0.52	0.94	2.00	304	157	147	166.24	73.50	0.00	1.97	-0.42	0
neNM07c	169	118	235	7	0.52	0.95	1.92	306	158	148	166.36	76.97	0.00	1.01	-0.69	0
neNM07d	169	132	248	3	0.52	0.95	1.88	306	159	148	167.90	78.76	0.69	-1.00	0.79	1
neNM07e	169	138	250	4	0.52	0.94	1.85	305	158	147	168.15	79.58	1.61	-0.45	0.27	1
neNM07f	181	124	242	6	0.52	0.95	1.90	307	159	148	167.17	77.78	0.00	0.02	0.01	1
neNM07g	177	122	241	6	0.52	0.95	1.91	307	159	148	167.05	77.52	1.61	-0.07	0.03	1
neNM07h	160	120	239	3	0.52	0.94	1.91	304	157	147	167.00	77.15	0.69	0.48	-0.16	0
neNM08	186	124	242	6	0.51	0.96	1.94	309	158	151	165.24	77.96	3.71	-0.18	0.10	1
neNM08a	195	35	192	8	0.51	1.00	2.57	310	159	150	159.18	58.41	0.00	0.91	-0.37	0
neNM08b	175	172	249	5	0.52	0.95	1.78	307	159	148	166.57	83.06	0.00	0.39	-0.02	0
neNM08c	177	130	242	6	0.51	0.96	1.92	309	158	151	165.24	78.70	1.10	-0.02	0.09	1
neNM08d	184	122	233	6	0.51	0.96	1.94	309	158	151	164.12	77.71	0.00	1.57	-0.18	0
neNM09	186	183	253	4	0.49	0.99	2.04	332	163	169	165.18	82.93	0.00	-0.40	-0.03	0
neNM09a	176	109	179	7	0.49	1.05	2.26	332	163	169	154.88	74.73	1.10	0.15	0.27	1
neNM09b	216	189	240	5	0.49	1.00	2.03	332	163	169	163.62	83.43	0.00	2.59	0.02	1
neNM09c	166	195	247	5	0.50	0.96	1.86	317	159	157	164.95	84.22	0.69	0.15	0.12	1
neNM09d	206	68	220	8	0.50	1.01	2.42	327	162	165	161.13	68.04	0.00	1.31	-0.59	0
neNM10a	189	143	194	6	0.48	1.08	2.29	347	167	179	154.86	78.09	1.10	-0.02	0.69	1
neNM10b	179	47	208	2	0.48	1.06	2.92	346	167	179	156.88	61.30	1.10	-0.56	0.04	1
neNM11a	180	185	220	6	0.48	1.09	2.29	359	172	186	157.28	81.26	1.61	-1.67	1.23	1
neNM11b	180	32	206	1	0.48	1.11	3.37	358	172	186	155.40	55.17	1.61	0.54	-0.35	0
neNM12a	180	168	245	5	0.47	1.08	2.46	370	174	196	160.37	79.57	0.00	1.49	-1.15	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
neNM12b	180	36	207	1	0.47	1.12	3.46	370	174	196	155.53	56.69	1.10	0.06	-0.01	0
neNM13	188	104	237	1	0.46	1.11	2.90	379	174	205	156.68	70.65	0.00	0.18	0.01	1
neNM13a	178	159	241	5	0.45	1.10	2.73	386	173	210	157.08	76.79	0.00	0.42	-0.09	0
neNM13b	159	72	228	2	0.46	1.11	3.11	375	172	203	155.45	65.22	0.69	0.28	-0.07	0
neNM14	188	110	235	7	0.43	1.15	3.40	399	172	227	149.67	66.80	2.77	-0.24	0.21	1
neNM14a	185	98	221	7	0.43	1.16	3.48	399	172	227	148.01	65.22	1.10	-0.06	0.13	1
neNM15	183	122	243	3	0.43	1.18	3.57	409	174	235	147.82	65.85	0.00	0.01	0.02	1
neNM16	187	132	232	6	0.41	1.23	3.84	430	178	252	145.23	65.70	1.61	-0.09	0.19	1
neNM17	142	126	248	3	0.52	2.12	4.22	578	299	279	141.18	64.88	2.48	0.02	-0.11	0
neNM17a	140	122	246	3	0.53	2.11	4.16	566	298	268	141.52	64.49	2.08	-0.08	0.07	1
neNM17b	165	149	250	4	0.52	2.11	4.05	571	299	272	141.59	67.16	0.00	0.28	0.00	1
neNM18a	176	117	216	7	0.56	1.94	3.15	510	287	223	148.20	70.88	1.39	-0.19	0.29	1
neNM19	176	135	248	3	0.58	1.89	2.90	498	287	211	151.47	72.74	3.64	-0.07	0.09	1
neNM19a	142	180	253	4	0.57	1.89	2.81	500	286	214	151.18	76.25	1.61	-0.38	0.50	1
neNM20	179	131	243	6	0.58	1.92	2.90	496	289	207	150.23	71.48	0.00	0.33	-0.03	0
neNM20a	175	127	244	5	0.58	1.92	2.91	496	289	207	150.34	71.04	0.00	0.22	0.01	1
neNM21	183	127	232	6	0.58	1.95	3.00	499	288	211	147.95	70.34	2.30	-0.22	0.13	1
neNM21a	183	130	235	6	0.58	1.94	2.99	499	288	211	148.30	70.67	0.69	-0.37	0.17	1
neNM22a	163	99	236	1	0.63	2.02	2.63	483	303	180	149.99	68.36	1.10	-0.02	0.02	1
neNM23a	203	50	201	8	0.62	2.06	3.08	485	303	182	147.11	59.18	1.61	-0.32	0.43	1
neNM24	170	117	243	3	0.62	1.97	2.55	484	301	184	153.05	72.02	0.00	-0.01	0.03	1
neNM24a	174	182	235	5	0.62	1.98	2.33	484	301	183	152.20	78.47	3.61	-0.53	0.47	1
neNM24b	187	60	222	1	0.62	2.01	2.95	485	302	183	150.03	62.04	0.00	0.46	-0.32	0
neNM25	183	116	241	2	0.62	1.95	2.55	485	299	186	153.65	72.52	3.47	-0.07	0.02	1
neNM25a	181	95	225	7	0.62	1.97	2.66	483	299	185	151.75	69.58	0.00	0.33	-0.13	0
neNM25b	172	130	246	4	0.61	1.97	2.58	491	301	190	152.76	73.51	0.00	0.62	-0.18	0
neNM25c	167	139	251	3	0.61	1.96	2.55	491	301	190	153.31	74.49	0.69	0.09	-0.05	0
neNM25d	184	104	237	1	0.61	1.97	2.75	493	299	194	152.02	70.47	0.69	0.06	0.01	1
neNM26a	171	100	237	1	0.58	1.79	2.75	489	286	203	160.10	73.81	1.10	-0.05	0.03	1
neNM26b	164	88	234	2	0.59	1.80	2.79	488	287	201	159.19	72.09	1.10	0.23	-0.08	0
neNM27a	193	78	229	1	0.60	1.65	2.49	436	263	173	159.11	69.35	0.00	0.20	0.02	1
neNM27b	191	129	243	5	0.60	1.64	2.26	436	263	174	160.69	76.97	0.00	0.06	-0.02	0
neNM28a	175	163	241	5	0.59	1.69	2.33	456	269	187	159.07	80.10	0.00	0.35	-0.06	0
neNM28b	209	27	189	8	0.60	1.76	3.29	444	268	176	152.34	53.53	1.79	0.25	0.10	1
neNM28c	178	156	248	5	0.60	1.67	2.21	444	268	176	160.10	79.77	0.00	0.60	-0.42	0
neNM29a	180	145	238	6	0.60	1.70	2.26	447	270	177	158.44	78.27	1.10	-0.34	0.37	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
neNM29b	191	45	213	2	0.61	1.74	2.88	445	270	175	154.94	60.78	1.95	-0.11	0.24	1
neNM29c	199	85	220	8	0.61	1.73	2.48	445	271	174	156.27	70.07	0.00	-0.12	0.12	1
neNM29e	188	140	229	6	0.59	1.75	2.47	463	273	190	156.32	76.99	1.10	0.36	-0.22	0
neNM30	182	117	241	1	0.59	1.63	2.38	439	261	178	159.83	74.80	1.95	0.00	0.01	1
neNM30a	180	133	243	6	0.59	1.63	2.34	442	262	180	160.41	76.88	2.20	-0.51	0.18	1
neNM31	183	119	241	6	0.59	1.63	2.42	445	261	182	159.97	75.21	2.20	0.00	-0.01	0
neNM31a	182	121	245	3	0.59	1.63	2.42	446	263	183	160.99	75.74	0.00	0.42	-0.19	0
neNM32	176	119	239	7	0.58	1.65	2.50	458	265	190	160.28	75.99	0.69	-0.22	0.11	1
neNM32a	179	124	240	6	0.58	1.65	2.48	458	265	190	160.40	76.63	2.30	-0.22	0.09	1
neNM32b	182	119	227	7	0.58	1.68	2.50	458	267	191	158.52	76.29	0.69	-0.39	0.36	1
neNM33	195	107	237	8	0.58	1.69	2.63	462	268	194	158.39	73.68	0.00	0.20	-0.05	0
neNM33a	198	65	221	1	0.58	1.71	2.93	462	268	194	156.40	66.14	1.10	-0.37	0.33	1
neNM34	186	112	241	2	0.58	1.62	2.50	451	262	189	161.69	75.65	3.85	-0.06	0.01	1
neNM34a	186	111	241	2	0.58	1.62	2.50	451	262	189	161.69	75.51	2.20	0.02	-0.02	0
neNM34b	193	74	227	1	0.58	1.65	2.73	451	264	189	159.54	69.12	0.00	0.29	-0.02	0
neNM35	163	140	247	5	0.58	1.59	2.40	449	260	189	163.02	78.60	0.69	0.09	-0.09	0
neNM36a	171	138	246	5	0.55	1.66	2.94	468	254	211	152.97	71.82	1.39	0.12	-0.16	0
neNM37a	135	207	248	4	0.51	1.89	3.70	529	271	258	143.66	69.78	1.10	1.43	-0.30	0
neNM38	198	127	234	6	0.41	1.47	4.79	519	213	306	145.18	63.83	1.95	-0.87	0.90	1
neNM39a	164	220	238	5	0.41	1.32	3.84	474	196	282	148.98	73.44	1.61	-0.48	0.18	1
neNM40a	168	201	237	5	0.42	1.28	3.57	453	192	261	150.10	73.02	0.00	1.09	-0.17	0
neNM41	198	98	235	1	0.44	1.00	3.03	353	155	198	154.87	65.36	2.20	-0.02	0.03	1
neNM41a	185	109	239	1	0.44	0.96	2.80	340	150	190	156.37	67.80	2.56	0.04	-0.03	0
neNM41b	206	80	231	2	0.44	1.00	3.16	353	155	198	154.39	62.58	0.00	0.09	0.23	1
neNM42	188	107	236	8	0.46	0.96	2.58	331	152	179	158.06	69.30	0.00	-0.09	0.17	1
neNM42a	185	102	237	1	0.46	0.96	2.61	331	152	179	158.18	68.62	0.69	-0.08	0.17	1
neNM42b	183	117	242	2	0.46	0.96	2.54	331	152	179	158.78	70.59	0.00	0.19	-0.16	0
neNM42c	188	111	240	1	0.45	0.96	2.67	337	152	185	158.27	69.41	0.69	0.05	-0.03	0
neNM43	186	111	240	2	0.47	0.95	2.45	328	153	175	160.60	71.34	0.00	0.10	-0.07	0
neNM43a	189	108	235	7	0.47	0.95	2.44	324	151	173	159.72	70.97	0.00	0.07	-0.02	0
neNM43b	195	104	236	8	0.46	0.97	2.66	339	155	184	159.02	69.22	0.69	-0.01	-0.02	0
neNM44	185	106	237	1	0.46	0.97	2.56	337	156	181	160.45	70.84	1.61	-0.01	-0.01	0
neNM44a	176	113	238	7	0.47	0.99	2.52	340	159	181	160.22	71.87	2.08	-0.03	0.00	0
neNM44b	194	91	201	7	0.46	1.02	2.73	345	158	187	155.42	68.60	1.10	0.18	-0.17	0
neNM44c	183	74	225	2	0.47	0.99	2.72	336	157	179	158.81	65.75	1.39	-0.18	0.14	1
neNM44d	194	111	238	8	0.47	0.99	2.53	333	159	181	160.22	71.61	1.79	0.04	-0.02	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
neNM44e	176	109	237	8	0.47	0.99	2.54	340	159	181	160.10	71.34	1.10	0.01	0.01	1
neNM45	234	0	200	8	0.49	1.00	9.82	327	160	171	160.19	17.42	2.20	-0.97	0.63	1
neNM45a	209	182	249	5	0.49	0.96	2.03	327	159	168	166.44	82.91	2.20	-0.20	-0.04	0
neNM45b	225	0	192	1	0.49	0.96	9.15	312	153	159	159.44	17.38	1.10	0.66	-0.31	0
NM_AZ355a	190	64	223	1	0.49	0.80	2.06	278	136	142	170.14	68.90	0.00	0.58	-0.18	0
NM_AZ356a	168	136	248	3	0.50	0.83	1.87	276	137	139	165.07	74.45	1.10	0.12	-0.17	0
NM_AZ357a	196	128	245	3	0.50	0.84	1.89	278	139	139	165.20	73.74	1.61	-0.08	0.08	1
NM_AZ357b	196	104	232	8	0.50	0.85	1.97	278	139	139	163.58	70.68	0.69	0.09	-0.01	0
NM_AZ358	182	127	242	6	0.51	0.83	1.79	270	137	135	165.79	75.33	0.00	0.04	-0.04	0
NM_AZ358a	181	111	240	1	0.51	0.83	1.82	270	137	133	165.62	73.17	1.10	-0.18	0.07	1
NM_AZ358b	202	28	204	1	0.51	0.87	2.52	274	140	136	160.58	53.12	1.39	0.29	-0.04	0
NM_AZ359a	180	137	244	6	0.51	0.86	1.81	282	143	139	165.76	76.63	1.61	-0.02	0.02	1
NM_AZ359b	179	129	245	4	0.51	0.86	1.83	282	143	139	165.89	75.87	0.00	0.09	-0.02	0
NM_AZ360	176	121	244	2	0.52	0.92	1.86	291	151	140	164.59	75.14	0.69	0.18	-0.11	0
NM_AZ360a	176	120	243	2	0.52	0.92	1.87	291	152	141	164.47	75.01	0.00	0.11	-0.05	0
NM_AZ361a	187	101	239	2	0.53	0.98	1.99	300	158	142	161.37	71.20	0.00	1.37	-1.16	0
NM_AZ361b	188	106	241	2	0.53	0.98	1.97	300	158	142	161.62	71.92	0.00	0.50	-0.31	0
NM_AZ362a	162	147	251	4	0.53	1.03	1.96	310	164	146	159.96	74.44	0.00	0.31	-0.21	0
NM_AZ362b	162	181	254	4	0.53	1.02	1.88	310	164	146	160.30	77.47	1.79	-0.79	0.18	1
NM_AZ362c	170	160	249	5	0.53	1.02	1.93	309	163	146	159.66	75.51	0.69	0.23	-0.35	0
NM_AZ363a	173	137	247	4	0.53	1.03	2.00	311	164	147	159.50	73.63	1.10	0.06	-0.03	0
NM_AZ364	176	130	244	5	0.56	0.95	1.56	278	157	121	165.69	77.63	0.00	0.01	0.00	0
NM_AZ365a	170	136	246	5	0.56	0.94	1.57	278	155	123	165.52	78.15	1.95	-0.04	0.04	1
NM_AZ365b	173	142	247	5	0.56	0.94	1.58	279	155	124	164.95	78.48	0.69	0.03	0.01	1
NM_AZ365c	154	219	241	5	0.56	0.94	1.46	279	155	124	164.23	85.19	1.10	-0.89	1.02	1
NM_AZ366a	197	81	222	8	0.53	0.89	1.78	278	148	130	166.95	72.91	1.10	0.27	-0.13	0
NM_AZ367	186	132	248	3	0.47	1.14	2.84	387	181	206	158.65	72.60	1.39	-0.10	0.06	1
NM_AZ368	179	132	247	4	0.49	1.13	2.63	369	179	190	158.40	72.29	0.69	0.01	0.00	1
NM_AZ369	181	125	246	1	0.49	1.14	2.63	367	180	187	157.59	71.05	0.00	0.13	-0.13	0
NM_AZ369a	181	116	243	1	0.49	1.15	2.69	369	181	188	157.31	70.01	2.08	-0.07	-0.01	0
NM_AZ370	179	132	247	6	0.49	1.12	2.60	367	178	189	159.23	72.69	2.77	0.00	0.01	1
NM_AZ370a	178	132	247	5	0.48	1.12	2.61	368	178	190	159.36	72.78	0.69	0.00	-0.01	0
NM_AZ370b	169	133	243	3	0.49	1.12	2.60	367	178	189	158.48	72.65	0.69	0.56	-0.17	0
NM_AZ370c	169	107	240	1	0.49	1.13	2.72	367	178	189	158.13	69.51	0.00	0.10	-0.07	0
NM_AZ371	181	125	245	8	0.48	1.09	2.63	367	175	191	159.96	72.69	6.13	0.00	-0.03	0
NM_AZ371a	181	135	246	6	0.48	1.10	2.59	367	176	191	160.01	73.72	0.69	0.15	-0.06	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
NM_AZ371b	181	131	246	7	0.48	1.10	2.61	367	176	191	160.01	73.28	0.00	0.13	-0.02	0
NM_AZ371c	198	80	230	1	0.48	1.12	2.89	366	176	190	157.40	65.68	0.00	1.49	-0.45	0
NM_AZ372	174	143	250	5	0.46	1.05	2.61	365	169	196	161.16	75.22	1.95	-0.06	0.06	1
NM_AZ372a	174	165	254	4	0.46	1.05	2.53	365	169	196	161.62	77.34	1.39	-0.25	0.44	1
NM_AZ372b	164	173	253	4	0.47	1.04	2.46	363	169	194	162.40	78.75	1.10	-0.27	0.34	1
NM_AZ373	184	124	244	8	0.47	1.04	2.62	361	168	193	161.56	73.78	1.39	0.01	-0.05	0
NM_AZ373a	179	139	245	6	0.46	1.04	2.57	362	168	194	161.75	75.51	0.00	0.32	-0.11	0
NM_AZ373b	173	153	253	4	0.46	1.02	2.52	361	166	195	162.96	77.33	0.00	0.41	-0.06	0
NM_AZ373c	177	63	218	8	0.47	1.06	3.01	361	168	193	158.44	64.02	0.00	-0.35	0.32	1
NM_AZ373d	177	107	239	8	0.47	1.04	2.70	361	168	193	160.96	71.59	1.39	-0.08	0.10	1
NM_AZ374	181	128	246	8	0.45	1.01	2.64	362	164	198	162.56	75.02	0.69	0.04	-0.02	0
NM_AZ374a	196	118	241	8	0.45	1.01	2.72	365	164	201	161.69	73.83	0.69	-0.01	0.05	1
NM_AZ374b	159	156	250	5	0.45	1.01	2.54	362	164	198	162.96	77.97	1.10	-0.41	0.38	1
NM_AZ374c	189	55	214	8	0.45	1.04	3.22	367	164	201	158.24	62.51	0.00	-0.16	0.25	1
NM_AZ374d	180	151	248	6	0.45	1.01	2.62	368	164	204	162.79	77.73	0.00	0.61	-0.33	0
NM_AZ375	182	116	244	2	0.43	0.97	2.80	368	159	209	163.35	74.55	1.95	0.01	0.00	1
NM_AZ375a	169	107	240	2	0.43	0.98	2.92	370	158	212	161.84	72.71	1.10	0.37	-0.13	0
NM_AZ375b	182	120	245	1	0.44	0.98	2.79	367	160	207	162.65	74.29	2.40	-0.11	-0.01	0
NM_AZ376	185	126	247	2	0.42	0.94	2.84	372	155	217	164.54	76.54	1.10	-0.02	0.02	1
NM_AZ376a	189	117	243	1	0.42	0.95	2.89	372	155	217	163.85	75.13	1.10	0.09	-0.03	0
NM_AZ376b	195	40	208	1	0.42	0.97	3.68	372	155	217	159.28	59.03	0.00	0.92	-0.40	0
NM_AZ377	197	121	243	8	0.40	0.91	2.91	373	150	224	165.30	76.91	1.10	-0.05	0.05	1
NM_AZ377a	188	121	244	1	0.40	0.91	2.91	373	150	223	165.08	76.64	0.00	0.18	-0.10	0
NM_AZ377b	223	71	217	8	0.40	0.94	3.32	374	150	224	160.12	67.39	1.61	0.00	0.24	1
NM_AZ378	189	117	243	1	0.39	0.89	2.96	373	147	226	165.02	76.45	0.69	0.08	-0.02	0
NM_AZ378a	184	122	245	1	0.39	0.89	2.93	373	147	226	165.27	77.10	1.10	-0.04	0.04	1
NM_AZ378b	195	116	242	8	0.40	0.89	2.95	372	147	225	164.83	76.29	2.56	0.03	0.00	1
NM_AZ379	176	133	248	4	0.44	0.85	2.32	333	145	188	169.77	81.09	1.95	-0.01	0.01	1
NM_AZ379a	177	133	248	4	0.44	0.85	2.32	333	145	188	169.77	81.09	0.69	0.04	-0.03	0
NM_AZ379b	176	133	249	3	0.43	0.86	2.34	334	145	189	169.55	80.72	0.69	0.06	0.04	1
NM_AZ379c	179	132	247	4	0.44	0.87	2.29	334	148	186	169.72	81.06	0.69	0.02	-0.01	0
NM_AZ380	173	137	249	4	0.43	0.82	2.33	329	140	189	169.82	81.23	0.69	0.05	-0.02	0
NM_AZ380a	171	142	250	4	0.43	0.82	2.31	329	140	189	170.08	81.87	2.40	-0.06	0.00	0
NM_AZ381	182	133	247	5	0.42	0.83	2.48	337	140	197	168.13	79.40	3.47	0.00	0.00	1
NM_AZ381a	181	133	247	5	0.42	0.83	2.48	337	140	197	168.13	79.40	3.40	0.00	0.00	0
NM_AZ382	182	127	247	2	0.41	0.75	2.28	314	129	185	171.23	81.11	0.00	0.04	0.02	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
NM_AZ383	183	131	246	7	0.43	0.77	2.14	310	133	177	171.66	82.56	0.00	0.07	-0.02	0
NM_AZ384	180	136	247	6	0.42	0.74	2.07	302	128	174	173.30	84.04	0.69	0.00	-0.02	0
NM_AZ385	176	135	248	4	0.42	0.72	2.03	296	125	171	174.05	84.29	1.39	0.00	0.00	1
NM_AZ386	186	139	247	6	0.50	0.83	1.67	293	146	147	175.93	88.06	1.61	-0.21	0.19	1
NM_AZ386a	196	92	230	8	0.50	0.84	1.82	293	146	147	173.68	80.92	0.69	-0.11	0.08	1
NM_AZ387	180	125	247	2	0.50	0.81	1.67	288	143	145	177.45	87.03	1.39	-0.09	-0.01	0
NM_AZ387a	195	126	232	7	0.50	0.80	1.61	282	144	143	175.66	87.32	1.95	0.21	-0.01	0
NM_AZ388	180	125	246	2	0.48	0.74	1.63	275	132	143	179.25	87.82	0.69	0.03	0.02	1
NM_AZ389	178	129	247	3	0.44	0.65	1.72	266	116	150	179.59	87.43	1.79	0.05	-0.11	0
NM_AZ389a	178	124	246	2	0.43	0.64	1.73	265	115	150	179.87	86.95	1.39	0.01	-0.02	0
NM_AZ390	177	130	247	2	0.44	0.64	1.70	265	116	149	180.00	87.90	0.00	0.04	-0.06	0
NM_AZ390a	179	123	244	8	0.44	0.65	1.71	265	116	149	179.61	86.93	0.69	-0.08	0.09	1
NM_AZ390b	177	135	247	6	0.44	0.64	1.68	265	116	149	180.00	88.57	0.69	0.11	-0.09	0
NM_AZ391	178	131	247	3	0.40	0.83	2.55	359	143	216	173.10	84.67	2.71	-0.01	0.01	1
NM_AZ391a	180	130	247	2	0.40	0.84	2.57	362	145	217	172.82	84.48	0.00	0.00	0.00	1
NM_AZ392a	176	131	248	3	0.39	1.02	3.26	433	171	262	166.94	80.29	1.79	-0.01	0.02	1
NM_AZ392b	174	148	252	4	0.39	1.02	3.19	433	171	262	167.42	82.25	1.61	-0.17	0.04	1
NM_AZ393	177	133	248	4	0.40	1.05	3.26	436	174	262	166.39	80.26	0.00	0.15	-0.07	0
NM_AZ394	177	132	249	3	0.41	0.94	2.82	384	158	226	167.54	80.23	2.71	0.04	0.03	1
NM_AZ395	176	125	246	1	0.42	0.82	2.32	335	142	193	172.70	83.12	1.10	-0.12	0.09	1
NM_AZ395a	178	130	247	3	0.42	0.82	2.30	335	142	193	172.82	83.78	4.43	-0.01	-0.05	0
NM_AZ395b	181	118	243	1	0.42	0.82	2.35	335	142	193	172.32	82.16	0.69	0.11	-0.04	0
NM_AZ396	176	127	247	2	0.43	0.81	2.24	329	141	188	173.58	83.96	4.79	-0.07	-0.04	0
NM_AZ396a	176	121	245	2	0.43	0.81	2.26	329	141	188	173.33	83.15	1.10	-0.05	0.01	1
NM_AZ397	178	131	247	3	0.43	0.77	2.06	313	136	177	175.79	85.93	2.48	0.00	0.01	1
NM_AZ398	179	124	246	2	0.45	0.70	1.71	276	125	151	179.80	88.13	1.10	-0.05	0.05	1
NM_AZ399	180	128	247	2	0.46	0.67	1.61	268	122	146	182.69	90.53	1.39	0.00	0.00	1
NM_AZ399a	180	128	247	2	0.46	0.67	1.61	268	122	146	182.69	90.53	1.39	0.00	0.00	1
NM_AZ400	182	127	246	1	0.47	0.64	1.47	252	118	134	183.52	91.42	0.00	0.04	-0.02	0
NM_AZ400a	181	116	243	1	0.47	0.64	1.49	252	118	134	183.12	89.76	1.10	-0.05	0.06	1
NM_AZ401	175	129	247	2	0.48	0.58	1.22	227	110	117	189.59	95.86	1.61	0.00	0.00	0
NM_AZ402	182	125	246	1	0.49	0.58	1.20	225	110	115	190.01	95.68	1.10	0.02	0.00	0
NM_AZ403	192	124	245	1	0.47	0.62	1.38	239	113	126	183.32	91.10	5.23	-0.44	0.03	1
NM_AZ404	179	131	247	3	0.46	0.66	1.58	261	119	142	180.76	89.84	3.40	0.00	0.00	0
NM_AZ404a	179	131	247	3	0.46	0.66	1.58	261	119	142	180.76	89.84	3.40	0.00	0.00	0
NM_AZ405	180	130	247	2	0.46	0.66	1.58	261	120	141	180.69	89.40	1.10	0.00	0.00	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
NM_AZ405a	180	130	247	2	0.46	0.66	1.58	261	120	141	180.69	89.40	1.10	0.00	0.00	0
NM_AZ406	179	130	247	3	0.46	0.63	1.53	252	115	137	181.24	89.46	3.40	-0.03	0.01	1
NM_AZ406a	179	130	247	3	0.46	0.63	1.53	252	115	137	181.24	89.46	3.40	-0.03	0.01	1
NM_AZ407	177	129	247	2	0.46	0.62	1.45	242	112	130	181.93	89.72	1.61	-0.09	0.08	1
NM_AZ407a	180	129	247	2	0.46	0.62	1.45	242	112	130	181.93	89.72	0.00	0.06	-0.04	0
NM_AZ407b	184	103	235	8	0.46	0.62	1.52	242	112	130	180.31	85.69	1.39	0.08	0.06	1
NM_AZ408	178	131	247	3	0.45	0.61	1.48	240	109	131	179.86	88.31	0.00	0.03	0.02	1
NM_AZ409a	126	126	245	8	0.36	0.53	1.94	255	93	162	176.15	83.47	0.00	-0.03	0.01	1
NM_AZ410	153	144	249	4	0.39	0.62	1.98	275	108	167	175.42	84.40	0.00	0.60	-0.42	0
NM_AZ411	188	115	241	2	0.40	0.64	2.10	277	110	167	172.47	79.43	0.69	-0.03	-0.01	0
NM_AZ412	176	119	241	7	0.40	0.65	2.12	280	112	168	171.17	79.21	0.00	0.14	-0.07	0
NM_AZ413a	177	124	243	4	0.40	0.68	2.16	282	114	168	168.46	77.78	6.96	-0.15	0.11	1
NM_AZ413b	180	108	236	8	0.40	0.68	2.22	282	114	168	167.58	75.62	0.69	-0.01	0.07	1
NM_AZ414	184	121	241	6	0.40	0.67	2.18	281	113	168	167.59	77.06	0.00	0.00	0.00	0
NM_AZ415	188	111	236	7	0.40	0.68	2.22	281	113	168	166.69	75.60	0.00	0.11	-0.06	0
NM_AZ415a	184	110	236	8	0.40	0.68	2.23	281	113	168	166.69	75.46	5.55	-0.28	0.11	1
NM_AZ416	184	114	238	7	0.41	0.68	2.15	278	114	164	167.15	76.14	1.95	0.02	-0.03	0
NM_AZ416a	184	114	239	8	0.41	0.68	2.15	278	114	164	167.28	76.14	1.39	0.02	-0.03	0
NM_AZ417a	185	107	237	1	0.42	0.68	2.10	272	114	158	167.50	75.41	1.79	-0.01	0.01	1
NM_AZ418a	186	104	238	1	0.43	0.69	2.08	270	115	155	166.88	74.62	0.00	0.32	-0.11	0
NM_AZ418b	186	115	241	2	0.43	0.69	2.03	270	115	155	167.25	76.18	0.00	0.39	-0.19	0
NM_AZ419	181	109	238	1	0.42	0.72	2.20	278	118	160	162.90	72.66	0.69	-0.04	0.03	1
NM_AZ420	185	106	233	7	0.43	0.74	2.23	280	119	161	161.59	72.16	1.10	-0.18	0.16	1
NM_AZ421	182	109	240	2	0.43	0.74	2.22	281	120	161	162.66	72.58	1.61	-0.07	0.00	0
NM_AZ422	183	113	239	8	0.42	0.72	2.17	277	117	160	163.57	73.65	1.79	0.00	0.00	1
NM_AZ422a	182	128	241	6	0.42	0.71	2.12	277	117	160	163.68	75.41	1.10	-0.07	0.05	1
NM_AZ423	187	113	239	8	0.42	0.75	2.30	288	121	167	162.06	72.67	4.41	-0.02	0.01	1
NM_AZ423a	188	105	235	8	0.42	0.76	2.38	292	122	170	161.30	71.49	1.39	-0.03	0.04	1
NM_AZ424	183	110	239	1	0.42	0.81	2.53	308	129	179	158.49	70.62	1.61	-0.01	0.02	1
NM_AZ425	171	128	246	3	0.42	0.79	2.38	306	128	178	161.94	74.68	2.08	-0.01	0.01	1
NM_AZ425a	190	110	238	8	0.42	0.82	2.54	314	131	183	160.09	72.00	3.40	-0.02	0.02	1
NM_AZ426a	183	115	238	7	0.42	0.89	2.74	339	141	198	159.20	72.25	1.10	0.09	0.03	1
NM_AZ427	187	119	238	7	0.42	0.88	2.68	335	140	195	159.54	72.72	2.40	-0.01	0.00	1
NM_AZ427a	186	129	236	6	0.42	0.88	2.64	335	140	195	159.30	73.91	0.69	-0.09	0.17	1
NM_AZ428	174	123	243	3	0.40	0.91	3.13	363	144	220	156.15	70.31	0.69	-0.01	0.01	1
NM_AZ428a	172	129	246	4	0.39	0.91	3.10	362	142	220	156.49	70.98	1.10	-0.04	0.02	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
NM_AZ428b	171	126	243	5	0.39	0.91	3.11	362	142	220	156.15	70.65	3.99	-0.01	-0.01	0
NM_AZ429	177	122	243	3	0.41	0.88	2.79	340	139	201	158.83	71.94	1.39	-0.02	0.02	1
NM_AZ429a	177	102	234	8	0.41	0.88	2.90	340	139	201	157.75	69.34	1.10	-0.27	0.31	1
NM_AZ430	183	141	250	4	0.40	0.84	2.68	337	135	202	160.61	75.32	0.69	0.03	0.02	1
NM_AZ431a	208	97	234	8	0.40	0.85	2.87	338	136	202	160.01	70.37	2.71	-0.35	0.14	1
NM_AZ431b	208	98	233	8	0.40	0.85	2.86	338	136	202	159.89	70.52	1.10	0.03	-0.02	0
NM_AZ431c	191	84	228	8	0.40	0.85	2.96	338	136	202	159.26	68.24	0.00	0.18	0.03	1
NM_AZ432	190	127	243	7	0.40	0.83	2.67	332	134	198	161.51	74.17	2.20	-0.02	0.03	1
NM_AZ432a	192	120	238	7	0.40	0.83	2.72	332	134	199	160.77	73.27	1.39	-0.03	0.06	1
NM_AZ432b	192	111	226	7	0.40	0.85	2.79	337	135	202	159.34	72.52	0.69	-0.42	0.46	1
NM_AZ433	198	107	237	8	0.40	0.89	2.96	355	143	212	159.90	71.71	0.00	0.13	0.22	1
NM_AZ433a	198	94	225	8	0.40	0.90	3.04	355	143	212	158.40	69.79	0.00	-0.16	0.29	1
NM_AZ434	198	140	250	4	0.41	0.93	2.91	364	148	216	159.02	74.19	1.10	-0.26	0.24	1
NM_AZ435	177	130	245	7	0.39	1.08	3.72	423	163	260	151.34	69.93	5.25	-1.25	0.92	1
NM_AZ435a	161	152	253	4	0.39	1.07	3.61	423	163	260	152.22	72.12	0.00	0.16	0.01	1
NM_AZ436a	185	132	244	7	0.40	1.00	3.21	384	155	229	155.16	71.31	3.50	-0.42	0.22	1
NM_AZ436b	178	121	239	7	0.41	0.98	3.06	369	153	216	155.61	70.53	1.10	-0.19	0.15	1
NM_AZ436c	178	108	230	7	0.41	0.99	3.13	369	153	216	154.54	68.91	0.69	-0.63	0.54	1
NM_AZ437a	161	150	252	4	0.41	0.96	2.98	371	151	220	157.51	73.79	0.69	0.40	-0.15	0
NM_AZ437b	160	150	252	3	0.41	0.96	2.98	371	151	220	157.51	73.79	0.69	0.13	-0.12	0
NM_AZ438	151	140	245	6	0.42	0.93	2.72	352	149	203	159.41	74.72	1.39	-0.11	0.16	1
NM_AZ438a	151	153	243	6	0.42	0.94	2.67	352	149	203	159.17	76.03	0.69	0.52	-0.27	0
NM_AZ439a	165	76	229	2	0.44	0.90	2.68	326	144	182	160.81	67.81	0.69	-0.30	0.21	1
NM_AZ440	178	132	245	7	0.52	0.76	1.52	250	129	121	169.47	79.62	0.69	0.03	0.00	0
NM_AZ440a	166	173	254	4	0.51	0.76	1.45	251	129	122	170.63	84.09	0.00	0.84	-0.19	0
NM_AZ441	170	127	247	2	0.47	0.70	1.75	258	120	138	170.68	79.04	2.30	-0.01	-0.06	0
NMFISH1	192	118	214	7	0.47	1.02	2.61	325	154	171	151.18	65.64	0.00	0.53	0.01	1
nw_NM175	171	120	244	3	0.48	1.40	3.48	455	219	236	155.92	67.85	1.39	-0.01	0.01	1
nw_NM176	184	106	237	8	0.47	1.57	4.21	509	239	270	151.88	64.10	0.00	0.03	0.00	0
nw_NM176a	184	107	238	1	0.47	1.57	4.20	509	239	270	152.00	64.22	0.69	-0.01	0.03	1
nw_NM177	176	106	238	1	0.42	1.29	4.36	459	193	266	149.26	61.05	0.00	0.09	0.15	1
nw_NM177a	182	114	239	8	0.42	1.29	4.29	459	193	266	149.37	61.97	0.69	0.01	-0.03	0
nw_NM178	182	126	242	6	0.44	1.16	3.45	405	179	226	153.83	65.43	4.16	-0.30	0.11	1
nw_NM178a	176	150	249	5	0.45	1.16	3.28	402	179	223	154.82	67.94	0.00	0.58	-0.20	0
nw_NM178b	183	181	254	4	0.45	1.15	3.17	402	179	223	155.37	70.43	1.39	-0.85	0.84	1
nw_NM179	181	129	237	6	0.44	1.08	3.24	385	168	217	155.65	66.92	1.10	-0.28	0.33	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
nw_NM179a	184	113	240	1	0.44	1.08	3.30	384	168	216	156.21	65.36	2.83	0.03	-0.03	0
nw_NM179b	181	141	235	6	0.44	1.08	3.19	385	168	217	155.41	68.12	0.69	0.10	0.01	1
nw_NM180	180	116	240	8	0.44	1.10	3.32	387	171	217	155.73	65.38	0.69	-0.01	0.03	1
nw_NM180a	180	133	244	5	0.44	1.10	3.23	387	171	216	155.78	66.90	1.10	0.05	-0.03	0
nw_NM181	180	126	243	5	0.44	0.97	2.91	350	153	197	158.07	67.58	2.08	-0.03	0.03	1
nw_NM182	177	123	244	4	0.44	1.03	3.15	368	161	207	156.33	65.80	3.18	-0.11	0.05	1
nw_NM182a	178	120	243	3	0.44	1.03	3.16	368	161	207	156.21	65.48	1.79	0.00	0.01	1
nw_NM182b	178	121	245	3	0.44	1.04	3.13	369	163	206	156.79	65.92	1.10	-0.04	0.01	1
nw_NM183	176	152	246	5	0.44	1.03	3.00	374	163	211	158.49	70.32	0.00	0.69	-0.25	0
nw_NM184	186	108	240	2	0.43	1.03	3.25	373	162	212	157.10	65.32	1.39	0.03	0.02	1
nw_NM184a	188	91	235	2	0.43	1.04	3.36	374	162	212	156.51	63.01	0.00	-0.10	0.29	1
nw_NM185	180	117	243	3	0.43	1.01	3.14	370	160	210	158.21	66.82	0.00	-0.04	0.13	1
nw_NM185a	180	116	242	2	0.43	1.01	3.15	370	160	210	158.09	66.70	0.00	-0.02	0.07	1
nw_NM186	185	112	239	8	0.43	0.99	3.18	367	157	210	157.94	66.13	0.69	0.00	-0.01	0
nw_NM186a	185	101	233	8	0.43	1.00	3.24	367	157	210	157.22	64.73	1.39	-0.29	0.23	1
nw_NM187	175	121	240	6	0.43	1.14	3.68	404	173	231	151.95	62.72	1.79	-0.10	0.07	1
nw_NM188	185	117	236	7	0.41	1.19	4.08	431	178	249	149.44	61.01	1.10	-0.09	0.14	1
nw_NM188a	185	121	240	6	0.42	1.19	4.05	427	178	249	149.89	61.43	0.00	-0.09	0.11	1
nw_NM188b	182	99	225	7	0.41	1.20	4.22	431	178	249	148.15	58.94	0.69	0.28	-0.16	0
nw_NM189	184	119	240	7	0.40	1.22	4.42	453	182	268	149.07	60.62	6.64	-0.07	-0.02	0
nw_NM189a	199	106	236	8	0.40	1.22	4.59	453	181	272	148.75	59.23	0.00	0.27	-0.10	0
nw_NM190	177	124	242	6	0.38	1.28	5.02	497	191	306	149.08	60.95	3.14	-0.03	0.02	1
nw_NM190a	177	134	246	4	0.38	1.28	4.94	497	191	306	149.52	61.90	1.79	-0.18	0.12	1
nw_NM191	180	124	246	3	0.39	0.80	2.91	329	129	200	160.63	68.79	1.39	0.19	-0.23	0
nw_NM192	176	125	243	5	0.39	0.77	2.76	317	124	193	161.79	69.93	2.77	-0.19	0.04	1
nw_NM192a	179	113	237	7	0.39	0.76	2.82	317	123	193	160.99	68.42	1.39	-0.07	0.01	1
nw_NM193	183	107	239	2	0.39	0.74	2.72	322	125	197	168.17	72.42	0.00	0.01	0.01	1
nw_NM194	185	109	238	1	0.40	0.78	2.76	331	131	200	166.94	72.40	1.79	-0.01	-0.01	0
nw_NM194a	173	99	236	1	0.40	0.79	2.82	331	131	200	166.69	70.96	1.39	-0.09	0.15	1
nw_NM195	190	108	238	1	0.39	0.61	2.23	271	106	169	172.70	75.94	1.79	-0.05	0.05	1
nw_NM196	174	131	243	5	0.39	0.60	2.09	271	105	166	174.04	79.53	0.00	0.08	0.06	1
nw_NM196a	170	148	238	6	0.38	0.61	2.09	275	105	170	173.05	81.22	0.00	1.20	-0.19	0
Owl47	163	111	243	3	0.45	1.22	3.68	420	187	233	153.05	63.38	1.10	0.18	0.18	1
Owl47a	188	110	234	6	0.45	1.24	3.62	420	189	231	152.83	63.82	0.00	-0.26	0.23	1
Owl47b	189	105	236	6	0.45	1.23	3.62	420	189	231	153.82	63.88	1.10	-0.04	-0.01	0
Pecos1	196	85	217	8	0.53	1.76	3.65	494	260	234	147.72	64.05	0.00	-0.02	0.07	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Pecos2	179	134	245	5	0.59	1.49	2.10	419	247	172	166.09	81.83	1.10	-0.11	-0.10	0
Perham_OG	98	173	250	4	0.33	1.03	5.16	464	151	313	146.63	60.69	1.61	0.22	-0.11	0
Perham_SE	138	206	249	4	0.33	1.03	4.99	464	151	313	146.53	62.71	0.00	0.71	-0.38	0
Perham1	98	175	251	4	0.33	1.03	5.15	464	151	313	146.74	60.82	0.00	0.49	-0.04	0
Poncho1	181	145	252	4	0.46	0.77	2.06	248	115	133	150.10	64.46	0.69	-0.34	0.08	1
Poncho2	172	184	245	5	0.40	0.96	3.35	326	131	195	136.18	58.13	1.79	0.54	0.03	1
Ruby24	196	132	242	3	0.47	0.82	2.30	256	120	136	146.26	59.08	0.69	0.21	0.31	1
Ruby24a	196	115	238	6	0.47	0.82	2.37	256	120	136	145.83	57.46	0.00	3.84	-0.89	0
Tablas1	174	106	241	2	0.49	1.03	2.48	334	164	170	158.46	68.64	1.39	0.42	-0.11	0
Tablas1a	174	108	241	2	0.49	1.03	2.47	334	164	170	158.46	68.91	0.00	0.04	0.18	1
Tablas1b	174	126	245	3	0.49	1.03	2.39	334	164	170	158.92	71.11	4.23	-0.57	0.44	1
Tablas1c	176	112	231	7	0.49	1.04	2.45	334	164	170	157.25	69.42	1.10	-0.78	0.75	1
Tablas1d	176	96	220	7	0.49	1.05	2.53	334	164	170	155.86	67.23	0.69	0.55	-0.27	0
Tesque159	186	125	242	7	0.48	0.83	1.89	297	143	154	171.71	81.36	1.10	-0.08	0.12	1
Tesque159a	187	126	235	7	0.48	0.84	1.89	297	143	154	170.80	81.49	0.00	0.40	0.02	1
Tesque160	186	115	239	8	0.50	1.07	2.30	353	176	177	164.53	76.99	0.69	0.02	0.00	1
Tesque160a	186	102	234	8	0.50	1.07	2.36	353	176	177	163.91	75.10	0.00	0.42	-0.07	0
Tesque161	188	139	244	6	0.49	1.01	2.17	342	168	175	166.59	80.78	0.00	0.76	-0.32	0
Tesque161a	184	124	231	7	0.49	1.04	2.22	346	171	175	164.21	78.66	0.00	0.45	-0.36	0
Tesque162	184	130	241	6	0.49	1.19	2.64	388	189	199	159.21	75.31	0.00	1.07	-0.57	0
Tesque163	186	115	238	8	0.49	1.21	2.71	390	192	198	158.30	73.11	0.00	0.08	-0.04	0
Tesque164	182	134	248	3	0.49	1.36	3.11	435	211	227	155.06	72.91	0.00	1.12	-1.19	0
Tesque165	182	129	246	3	0.50	1.09	2.28	359	180	179	165.39	78.34	0.00	0.48	-0.26	0
Tesque166	178	121	244	2	0.50	1.12	2.38	366	183	183	164.04	76.79	2.56	-0.40	0.21	1
Tesque167	181	123	245	2	0.51	1.20	2.50	380	193	187	160.58	74.78	3.00	-0.51	0.37	1
Tesque168	171	138	248	4	0.51	1.18	2.42	379	192	187	162.10	77.14	2.64	-0.45	0.12	1
Tesque169	182	146	248	4	0.51	1.17	2.37	378	191	187	163.07	78.75	1.39	-0.05	0.01	1
Tesque170	182	127	243	6	0.50	1.04	2.19	353	177	176	169.70	80.34	0.00	0.00	0.01	1
Tesque171	184	123	243	2	0.50	1.01	2.17	346	172	174	170.46	80.16	2.08	-0.11	0.00	1
Tesque172	181	132	243	6	0.49	0.99	2.14	342	169	173	169.91	80.94	0.00	0.00	0.04	1
Tesque173	181	131	242	6	0.48	1.19	2.74	404	194	210	162.49	76.77	3.58	0.09	-0.05	0
Tesque174	187	122	235	7	0.50	1.24	2.60	395	199	196	160.34	75.26	1.61	-0.15	0.11	1
Tesque174a	185	120	239	7	0.51	1.17	2.42	379	192	187	164.74	77.18	0.69	0.03	-0.03	0
Tesque174b	187	122	230	7	0.50	1.25	2.60	395	199	196	159.72	75.26	1.39	-0.54	0.33	1
Tesque304	180	123	243	1	0.49	0.96	2.11	336	165	171	171.97	81.22	1.10	-0.01	0.00	1
Tesque305	180	88	225	8	0.51	1.21	2.57	391	201	190	165.73	73.92	0.69	0.27	0.03	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
UP FIRE	211	0	214	8	0.44	0.80	10.31	297	130	167	162.00	16.20	1.79	-1.25	1.07	1
UP OGPIE	168	135	250	4	0.40	0.90	3.20	358	145	222	160.95	69.38	0.00	-0.11	0.18	1
Utah001a	179	118	242	3	0.39	0.47	1.64	220	85	135	180.85	82.16	0.00	0.00	0.02	1
Utah001b	170	158	251	4	0.39	0.48	1.58	224	87	137	181.35	86.67	0.69	0.53	-0.34	0
Utah001c	170	149	250	4	0.39	0.48	1.60	224	87	137	181.22	85.69	1.10	-0.52	0.45	1
Utah001d	173	128	245	4	0.39	0.48	1.65	223	86	137	180.56	83.06	3.50	-0.42	0.21	1
Utah002a	176	97	235	1	0.38	0.46	1.70	218	83	135	180.58	79.21	1.10	0.13	0.06	1
Utah002b	167	157	253	4	0.39	0.47	1.56	220	85	135	181.95	86.63	0.00	0.53	-0.05	0
Utah002c	177	125	244	4	0.39	0.48	1.66	224	87	137	180.29	82.58	2.56	-0.01	0.02	1
Utah002d	177	119	241	5	0.38	0.46	1.62	217	83	134	181.27	82.48	0.00	0.03	-0.02	0
Utah003	178	119	243	3	0.39	0.46	1.59	215	83	132	182.30	83.26	1.61	-0.04	0.04	1
Utah003a	176	119	243	3	0.38	0.44	1.59	213	80	133	182.91	83.74	0.00	0.05	-0.01	0
Utah003b	176	75	228	2	0.39	0.47	1.80	218	84	134	178.58	74.47	1.61	0.18	-0.03	0
Utah003c	168	111	243	2	0.39	0.47	1.66	218	84	134	180.64	80.96	0.00	0.04	-0.01	0
Utah004	176	120	242	4	0.30	0.42	2.21	264	78	186	184.77	84.06	0.00	0.07	0.02	1
Utah005	181	116	238	7	0.31	0.46	2.31	275	84	191	182.51	82.74	0.69	0.17	-0.10	0
Utah006	160	160	242	5	0.31	0.56	2.57	318	100	218	178.52	84.97	1.61	-0.67	0.45	1
Utah006a	162	130	246	4	0.31	0.56	2.67	318	100	218	179.04	81.58	0.69	-0.05	0.02	1
Utah006b	192	78	226	1	0.31	0.56	2.97	318	100	218	177.07	73.41	0.00	0.43	-0.07	0
Utah007a	170	193	228	5	0.32	0.39	1.59	223	72	152	186.20	95.80	0.00	3.24	-1.85	0
Utah008	165	124	246	3	0.33	0.45	2.03	254	83	171	184.83	84.35	0.69	0.11	-0.04	0
Utah008a	167	118	241	2	0.33	0.46	2.07	256	84	172	183.61	83.09	0.00	0.13	-0.12	0
Utah009	177	122	242	5	0.37	0.71	2.78	321	120	201	168.20	72.39	0.00	0.02	0.00	1
Utah009a	178	123	243	4	0.37	0.71	2.78	321	120	201	167.84	72.30	1.79	0.02	-0.02	0
Utah010	182	114	239	8	0.37	0.73	2.90	328	122	206	167.21	71.11	0.69	0.03	-0.01	0
Utah011	181	124	242	5	0.35	0.60	2.54	302	105	197	174.11	77.69	0.69	0.11	-0.10	0
Utah011a	178	130	243	5	0.35	0.60	2.51	302	105	197	174.24	78.43	1.10	0.12	-0.11	0
Utah012	178	124	241	6	0.35	0.60	2.53	302	105	197	174.19	77.81	0.00	0.29	-0.09	0
Utah012a	178	113	236	7	0.35	0.61	2.58	302	105	197	173.54	76.35	0.69	0.00	0.12	1
Utah013a	181	127	242	6	0.36	0.68	2.78	322	115	207	169.78	74.47	0.69	-0.09	0.06	1
Utah013b	181	124	242	6	0.36	0.68	2.79	322	115	207	169.78	74.12	0.00	0.01	-0.01	0
Utah014	179	121	241	6	0.38	0.70	2.66	312	118	194	168.83	72.88	1.79	0.00	-0.01	0
Utah014a	179	121	241	6	0.38	0.70	2.66	312	118	194	168.83	72.88	0.00	0.03	-0.01	0
Utah014a	179	121	241	6	0.38	0.70	2.66	312	118	194	168.83	72.88	0.00	0.03	-0.01	0
Utah014b	187	106	236	8	0.38	0.70	2.74	312	118	194	168.20	70.93	0.69	0.14	-0.18	0
Utah015	183	117	240	7	0.38	0.67	2.52	300	114	186	170.70	73.91	2.20	0.00	0.00	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Utah015a	183	119	241	7	0.38	0.67	2.51	300	114	186	170.82	74.16	0.00	0.02	-0.02	0
Utah016	185	117	240	7	0.38	0.66	2.51	299	113	186	171.11	74.15	0.69	-0.02	0.02	1
Utah016a	183	129	242	6	0.38	0.66	2.46	299	113	186	171.36	75.62	3.00	-0.22	0.09	1
Utah017	167	121	246	3	0.36	0.60	2.49	298	106	192	175.25	77.12	5.06	0.13	-0.15	0
Utah017a	180	115	239	7	0.35	0.58	2.39	292	103	189	177.98	79.07	1.39	0.00	-0.01	0
Utah017b	130	152	241	3	0.35	0.62	2.48	302	107	195	171.92	78.68	1.10	0.52	-0.02	0
Utah017c	160	138	248	4	0.36	0.65	2.59	305	110	195	170.18	75.28	0.69	0.07	-0.03	0
Utah018a	181	124	242	6	0.33	0.44	1.87	244	81	160	186.15	85.74	2.83	-0.02	0.00	0
Utah018b	181	117	240	7	0.34	0.44	1.89	241	81	160	185.87	84.74	0.00	0.11	-0.04	0
Utah018c	187	119	239	7	0.33	0.42	1.87	238	78	160	186.28	85.54	2.08	-0.03	0.00	1
Utah018d	190	123	241	6	0.33	0.42	1.86	238	78	160	186.56	86.12	1.10	0.01	0.00	1
Utah018e	202	0	161	8	0.33	0.47	8.41	244	81	163	172.31	19.38	1.61	1.40	-1.33	0
Utah018f	202	82	228	1	0.33	0.44	2.08	244	81	163	183.89	78.36	1.39	0.16	-0.18	0
Utah018g	194	98	233	8	0.34	0.44	1.96	241	81	160	184.88	81.77	2.30	0.07	-0.03	0
Utah019	204	88	231	1	0.34	0.47	2.12	252	86	166	182.82	78.18	2.30	-0.10	0.11	1
Utah019a	186	93	235	1	0.34	0.47	2.10	252	86	166	183.39	79.11	0.00	0.08	0.13	1
Utah019b	204	0	186	1	0.34	0.49	8.72	252	86	166	175.66	19.04	1.10	0.20	0.32	1
Utah019c	186	114	240	1	0.33	0.45	1.98	248	83	165	184.98	83.46	0.00	0.02	0.01	1
Utah019d	186	113	240	1	0.33	0.45	1.98	248	83	165	184.98	83.31	2.20	0.01	0.00	1
Utah019e	181	126	242	5	0.33	0.42	1.79	234	78	156	187.66	87.17	3.26	-0.01	0.01	1
Utah019f	181	123	242	5	0.33	0.42	1.80	233	78	156	187.66	86.75	0.00	0.11	-0.06	0
Utah019g	184	103	233	8	0.33	0.43	1.95	244	81	163	186.66	83.68	1.10	0.06	-0.01	0
Utah019h	186	90	229	8	0.33	0.44	2.00	244	81	163	186.07	81.33	2.20	-0.14	0.03	1
Utah019i	180	122	239	6	0.33	0.42	1.81	235	78	157	187.45	86.82	1.10	0.03	-0.05	0
Utah019j	171	138	241	6	0.33	0.42	1.76	235	78	157	187.73	88.98	2.71	-0.21	-0.05	0
Utah020	181	115	242	2	0.31	0.38	1.84	234	72	162	190.82	87.87	1.10	-0.03	0.04	1
Utah020a	175	73	227	1	0.31	0.38	2.03	234	72	162	188.63	79.77	0.00	0.15	0.13	1
Utah020b	179	113	241	2	0.31	0.37	1.83	232	71	161	191.30	88.21	0.69	0.05	-0.02	0
Utah020c	177	112	240	1	0.31	0.37	1.83	232	71	161	191.16	88.05	2.30	-0.03	0.03	1
Utah020d	184	108	239	1	0.31	0.38	1.87	234	72	162	190.40	86.74	2.08	0.03	-0.01	0
Utah021a	179	124	244	3	0.31	0.39	1.86	240	75	165	191.04	88.74	2.56	-0.09	0.06	1
Utah021b	174	124	245	3	0.31	0.38	1.83	237	74	163	192.21	89.10	1.10	0.01	0.00	1
Utah022a	177	122	245	5	0.43	0.56	1.72	221	95	126	169.47	73.33	0.00	0.05	0.01	1
Utah022b	177	136	250	4	0.43	0.56	1.68	221	95	126	170.08	74.94	0.00	0.02	0.26	1
Utah022c	156	170	254	5	0.42	0.57	1.73	229	96	133	167.86	76.69	0.00	0.73	-0.08	0
Utah023a	184	117	245	3	0.42	0.67	2.28	255	106	149	159.27	65.26	1.79	-0.19	0.22	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Utah023b	184	129	243	3	0.41	0.67	2.26	256	106	150	158.76	66.41	1.10	-0.52	0.32	1
Utah023c	190	137	249	5	0.41	0.66	2.23	256	106	150	159.45	67.21	0.00	1.33	-0.19	0
Utah024	189	101	239	1	0.41	0.70	2.60	268	109	159	155.41	61.16	2.08	-0.02	-0.02	0
Utah024a	186	112	242	2	0.41	0.70	2.54	268	109	159	155.75	62.48	6.42	-0.04	0.00	1
Utah024b	187	113	242	7	0.41	0.68	2.45	261	106	155	156.79	63.31	1.61	-0.02	0.00	1
Utah024c	181	101	239	2	0.40	0.69	2.59	267	108	159	155.75	61.31	0.69	0.04	-0.02	0
Utah024d	187	116	244	3	0.40	0.70	2.61	272	109	163	155.36	62.46	0.00	0.19	-0.08	0
Utah024e	197	16	196	1	0.40	0.73	4.24	272	109	163	149.27	38.48	1.39	0.42	-0.18	0
Utah025	183	110	242	2	0.40	0.70	2.67	273	109	164	154.65	61.43	2.48	-0.14	0.13	1
Utah025a	186	100	239	2	0.40	0.71	2.72	273	109	164	154.31	60.22	1.61	-0.06	0.07	1
Utah025b	183	118	244	5	0.40	0.70	2.63	273	109	164	154.88	62.32	1.10	0.01	0.01	1
Utah026a	178	114	244	3	0.40	0.72	2.77	277	110	167	153.30	60.39	3.93	-0.01	-0.02	0
Utah026b	176	102	240	2	0.40	0.72	2.83	277	110	167	152.84	59.02	1.10	0.04	0.11	1
Utah026c	173	84	233	2	0.40	0.72	2.95	277	110	167	152.03	56.63	0.69	-0.09	0.02	1
Utah026d	175	120	246	3	0.40	0.72	2.74	277	110	167	153.52	61.02	4.01	-0.01	-0.01	0
Utah026e	175	123	246	4	0.40	0.72	2.72	277	110	167	153.52	61.33	1.39	0.03	-0.02	0
Utah027a	178	121	245	4	0.36	0.84	3.98	351	125	226	148.24	56.82	0.00	0.32	-0.18	0
Utah027b	178	140	250	5	0.36	0.84	3.86	351	125	226	148.78	58.50	0.00	0.58	-0.44	0
Utah027c	178	149	252	4	0.36	0.84	3.82	351	125	226	148.99	59.22	0.69	0.91	-0.54	0
Utah027d	182	117	244	3	0.36	0.84	4.00	351	125	226	148.13	56.43	4.44	-0.11	0.00	1
Utah028	176	129	245	4	0.36	0.86	3.69	362	131	231	151.62	62.65	0.00	0.06	0.00	0
Utah028b	201	104	223	7	0.37	0.67	2.65	287	107	180	158.75	67.90	2.20	-0.11	0.07	1
Utah029	168	124	242	5	0.37	0.63	2.42	277	103	174	162.84	71.82	0.00	0.07	-0.02	0
Utah030a	181	118	239	7	0.38	0.61	2.27	271	102	169	166.86	74.48	0.00	0.33	0.00	0
Utah030b	172	143	240	6	0.38	0.61	2.18	271	102	169	166.99	77.40	0.69	0.65	-0.62	0
Utah030c	181	133	240	6	0.38	0.61	2.21	271	102	169	166.99	76.30	0.00	0.82	-0.64	0
Utah031	174	133	248	4	0.37	0.59	2.18	268	100	168	169.42	77.01	2.71	-0.07	-0.05	0
Utah031a	174	128	245	4	0.37	0.59	2.20	268	100	168	169.06	76.42	1.39	0.07	-0.06	0
Utah031b	189	123	241	6	0.37	0.59	2.22	268	100	168	168.56	75.81	0.00	0.28	-0.31	0
Utah031c	189	121	216	6	0.37	0.61	2.22	268	100	168	165.24	75.80	1.61	-0.09	-0.20	0
Utah032	177	126	244	4	0.38	0.52	1.86	239	91	148	174.23	79.37	1.10	0.00	0.02	1
Utah033	173	132	246	4	0.37	0.52	1.90	243	91	152	174.01	80.17	1.10	-0.02	0.03	1
Utah034	165	119	244	3	0.38	0.54	2.02	250	94	156	172.51	77.16	0.00	0.26	-0.03	0
Utah035	181	120	241	7	0.37	0.55	2.06	254	95	159	171.31	77.03	0.69	-0.01	0.02	1
Utah035a	183	120	240	6	0.37	0.55	2.06	254	95	159	171.18	77.03	4.34	-0.01	0.01	1
Utah035b	181	117	238	7	0.37	0.56	2.08	254	95	159	170.85	76.51	3.18	-0.05	0.01	1

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Utah035c	181	117	238	7	0.37	0.56	2.07	254	95	159	171.13	76.66	1.39	0.02	0.00	1
Utah036	179	119	237	7	0.38	0.55	1.99	246	93	153	170.52	76.89	0.00	0.07	-0.01	0
Utah036a	176	117	239	7	0.38	0.54	2.00	246	93	153	170.77	76.63	0.69	0.00	0.05	1
Utah036b	180	88	220	7	0.38	0.55	2.12	246	93	153	168.23	72.20	0.00	1.17	-0.71	0
Utah037	177	130	242	6	0.37	0.55	2.01	249	93	156	169.99	77.70	2.64	-0.01	0.00	1
Utah038a	214	0	233	8	0.37	0.69	11.66	298	110	188	159.34	16.12	0.00	0.00	0.08	1
Utah038b	214	0	163	8	0.37	0.74	11.66	298	110	188	149.08	16.12	1.39	-1.98	1.72	1
Utah038c	226	49	210	1	0.37	0.70	3.24	298	110	188	156.35	57.98	0.69	-0.08	0.20	1
Utah038d	131	190	253	4	0.38	0.69	2.43	298	112	186	161.99	76.67	1.39	-0.81	0.87	1
Utah038e	115	149	251	4	0.38	0.69	2.54	298	112	186	161.76	73.19	0.00	1.05	-0.15	0
Utah039a	172	116	242	2	0.36	0.81	3.37	341	123	218	152.73	64.76	3.00	-0.10	-0.01	0
Utah039b	170	78	229	1	0.36	0.81	3.67	341	123	218	151.01	59.41	1.10	-0.48	0.25	1
Utah040a	181	114	238	7	0.35	0.75	3.22	325	115	210	153.37	65.21	0.00	0.04	-0.03	0
Utah040b	181	113	237	7	0.35	0.75	3.23	325	115	210	153.25	65.09	0.69	0.07	-0.07	0
Utah041	178	124	239	6	0.36	0.69	2.76	307	110	197	158.49	71.33	1.61	-0.06	0.06	1
Utah041a	178	126	242	6	0.36	0.69	2.72	304	109	195	158.99	71.74	0.69	0.00	0.01	1
Utah041b	175	155	222	6	0.36	0.70	2.64	307	110	197	156.39	74.55	0.69	0.82	0.04	1
Utah041c	189	77	230	2	0.36	0.69	3.05	305	109	196	157.54	64.36	0.69	-0.16	0.24	1
Utah041d	178	124	240	6	0.36	0.69	2.76	307	110	197	158.61	71.33	1.95	-0.14	0.07	1
Utah041e	181	124	241	6	0.36	0.69	2.73	304	109	195	158.87	71.51	2.08	-0.11	0.05	1
Utah042	167	132	243	5	0.35	0.60	2.34	279	99	180	165.57	76.98	1.10	-0.03	0.04	1
Utah043a	175	115	242	2	0.36	0.70	2.73	302	110	192	157.06	70.28	1.61	-0.03	0.03	1
Utah043b	179	113	241	2	0.36	0.70	2.74	302	110	192	156.94	70.03	3.81	-0.19	0.14	1
Utah043c	171	119	245	3	0.36	0.70	2.71	302	110	192	157.41	70.77	0.00	0.47	0.04	1
Utah044a	183	141	238	6	0.35	0.89	3.92	369	129	240	144.66	61.25	0.69	-0.08	0.11	1
Utah044b	183	133	237	6	0.35	0.89	3.96	369	129	240	144.55	60.55	0.69	0.56	-0.29	0
Utah044c	185	118	239	7	0.35	0.89	4.06	369	129	240	144.77	59.11	7.17	-0.07	-0.03	0
Utah045a	143	189	254	4	0.44	0.67	1.86	233	102	131	152.60	70.42	2.20	-0.64	0.71	1
Utah045b	199	0	174	1	0.44	0.72	8.97	234	102	132	142.41	14.71	1.39	-0.99	0.97	1
Utah045c	196	81	229	8	0.44	0.68	2.23	234	102	132	149.85	59.32	1.61	0.10	-0.20	0
Utah046	194	128	233	6	0.44	0.67	1.95	228	101	127	150.12	65.08	2.20	-0.90	0.92	1
Utah046a	166	110	243	3	0.44	0.67	2.07	233	102	131	151.53	63.23	6.74	-0.27	0.03	1
Utah046b	152	105	241	2	0.44	0.67	2.09	233	102	131	151.31	62.62	0.00	-0.01	0.14	1
Utah046c	149	0	187	1	0.44	0.71	8.84	232	102	130	144.56	14.71	1.39	0.13	-0.04	0
Utah046d	161	85	232	1	0.44	0.68	2.17	232	102	130	150.41	59.94	0.00	0.15	-0.01	0
Utah047a	196	90	224	7	0.44	0.65	2.06	222	97	125	149.39	60.82	0.00	0.35	-0.11	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Utah047b	172	135	249	3	0.45	0.65	1.82	220	99	121	152.61	66.39	0.00	0.81	-0.35	0
Utah048a	151	151	253	4	0.50	0.69	1.55	211	106	105	153.74	67.81	0.00	0.79	-0.15	0
Utah048b	195	23	201	1	0.51	0.72	2.31	207	106	101	146.78	43.80	1.95	-0.30	0.13	1
Utah049a	167	121	245	4	0.44	0.72	2.15	247	109	138	152.17	64.23	0.00	0.14	-0.09	0
Utah049b	166	115	244	3	0.43	0.72	2.24	253	110	143	152.61	63.96	1.10	-0.11	0.10	1
Utah049c	155	151	253	4	0.42	0.76	2.34	277	117	160	154.02	68.41	0.69	-0.01	0.02	1
Utah049d	170	148	252	4	0.44	0.68	2.01	237	104	133	152.25	66.10	0.69	-0.25	0.24	1
Utah050a	194	122	242	6	0.41	0.70	2.46	251	103	148	146.81	60.23	0.00	0.17	0.14	1
Utah050b	191	151	248	5	0.41	0.70	2.36	251	103	148	147.46	62.84	0.69	0.15	-0.16	0
Utah050c	184	117	243	6	0.41	0.70	2.48	251	103	148	146.92	59.72	0.00	0.05	0.00	1
Utah051	192	113	241	7	0.40	0.73	2.69	264	106	158	146.02	58.80	1.10	0.09	-0.06	0
Utah051a	198	117	242	7	0.38	0.74	2.92	278	107	171	145.16	58.53	0.00	0.03	0.05	1
Utah051b	200	68	222	8	0.38	0.75	3.28	278	107	171	142.92	52.11	0.69	0.17	0.00	1
Utah052a	199	64	217	8	0.37	0.81	3.92	312	115	197	141.52	50.27	0.69	0.34	-0.17	0
Utah052b	189	127	238	3	0.37	0.80	3.39	312	115	197	143.91	58.20	1.10	0.37	-0.33	0
Utah052c	195	80	228	8	0.36	0.83	4.08	326	117	209	141.09	51.18	0.69	-0.46	0.45	1
Utah053a	173	95	227	7	0.36	0.83	3.90	323	117	206	140.44	52.78	2.08	0.10	-0.07	0
Utah053b	171	153	250	4	0.36	0.82	3.54	323	117	206	142.90	58.14	1.39	-0.27	0.26	1
Utah054a	208	46	193	8	0.34	0.94	5.60	372	126	246	134.33	43.93	2.64	-0.38	0.28	1
Utah054b	195	91	232	8	0.35	0.87	4.29	345	122	223	140.45	52.02	1.10	-0.19	0.17	1
Utah054c	182	115	243	3	0.35	0.87	4.19	351	123	228	141.35	54.48	0.69	-0.03	0.03	1
Utah054d	190	88	227	8	0.36	0.85	4.06	331	119	212	140.71	52.16	2.48	-0.17	0.07	1
Utah056a	197	109	237	7	0.42	0.65	2.17	233	99	134	151.88	61.87	1.61	0.07	-0.03	0
Utah056b	197	56	216	8	0.43	0.67	2.46	231	100	131	149.41	53.19	0.69	0.68	-0.30	0
Utah057a	193	148	247	6	0.42	0.68	2.21	248	104	144	153.36	65.16	0.69	0.54	-0.32	0
Utah057b	193	150	249	5	0.42	0.68	2.20	248	104	144	153.58	65.33	0.00	1.03	-0.63	0
Utah057c	194	78	230	2	0.42	0.69	2.52	248	104	144	151.40	57.07	1.10	-0.51	0.52	1
Utah058a	175	124	243	4	0.36	0.38	1.46	199	72	127	187.53	86.92	1.39	-0.05	-0.01	0
Utah058b	185	113	240	2	0.37	0.43	1.58	212	79	133	184.70	84.05	1.61	0.01	-0.02	0
Utah058c	180	101	238	2	0.37	0.40	1.53	202	75	127	185.80	83.02	0.00	0.96	-0.57	0
Utah058d	180	66	222	1	0.37	0.41	1.68	202	75	127	183.47	75.68	1.10	-0.13	0.11	1
Utah059a	185	105	234	8	0.37	0.42	1.57	208	77	131	183.93	83.28	1.10	-0.05	0.03	1
Utah059b	180	117	242	2	0.37	0.42	1.54	208	77	131	184.43	84.92	5.49	-0.07	0.02	1
Utah059c	183	118	242	2	0.37	0.42	1.54	208	77	131	184.43	85.07	1.39	0.03	-0.02	0
Utah060a	173	125	244	4	0.38	0.45	1.62	218	82	136	182.64	84.15	1.10	-0.01	0.02	1
Utah060b	176	122	243	3	0.38	0.45	1.62	218	82	136	182.50	83.74	5.42	-0.01	-0.01	0

SITE	HILL180	HILLM	HILLX	ASPECT	MONSOON	EPS	EPW	MAP	MAPS	MAPW	PETS	PETW	FLOWACC	CURVE	PROFILE	PROCAT
Utah060c	176	132	246	4	0.38	0.47	1.62	222	85	137	182.01	84.46	1.10	-0.09	0.08	1
Utah060d	163	149	252	3	0.39	0.48	1.59	224	88	136	181.82	85.78	0.00	0.42	-0.03	0
Utah20e	176	157	245	5	0.31	0.37	1.71	232	71	161	191.87	94.18	0.00	0.96	-0.22	0
Utah28a	176	131	245	4	0.36	0.86	3.68	362	131	231	151.62	62.85	0.00	-0.03	0.03	1
Utah29a	175	121	243	3	0.37	0.63	2.43	277	103	174	162.96	71.46	1.79	-0.02	0.01	1
Utah32a	174	136	247	4	0.38	0.52	1.84	239	91	148	174.62	80.59	1.61	0.09	-0.03	0
Utah33a	174	129	244	4	0.37	0.52	1.90	243	91	152	173.75	79.80	0.00	0.04	0.00	0
Utah34a	157	111	240	2	0.38	0.55	2.05	250	94	156	172.00	76.08	0.69	-0.23	0.05	1
Utah37a	178	127	241	6	0.37	0.55	2.02	249	93	156	169.86	77.33	3.50	-0.01	-0.01	0
Utah42a	173	127	242	6	0.35	0.60	2.36	279	99	180	165.45	76.39	3.04	-0.20	0.10	1
Utah55a	178	122	243	6	0.33	0.85	4.39	361	119	242	140.52	55.13	1.10	0.22	-0.16	0
Utah61a	176	122	242	4	0.32	0.56	2.68	316	100	216	177.76	80.51	0.69	0.01	0.00	1
Utah61b	176	122	242	4	0.32	0.56	2.68	316	100	216	177.76	80.51	1.61	0.00	0.00	0