# The Central Coast Sustainable Landscapes Project

**A Report Written by the Participants of the Central Coast Sustainable Landscapes Project**

**A Work in Progress**
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**Project Coordination and Facilitation Provided by:**
**Common Ground: Center for Cooperative Solutions**
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## ACKNOWLEDGEMENTS

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# CHAPTER II

# MEASURES AND CRITERIA FOR SUSTAINABILITY

## *INTRODUCTION*

The Committee used its collective knowledge and observations, expert opinion, and the literature to develop a list of biological and socio-political factors (such as the presence of oak saplings, wildlife diversity, and tax base) likely to predict oak-woodland sustainability. These factors became the "measures". Specific numeric values were developed for the measures; these values became the "criteria".

Information available to the Committee did not usually provide a basis for unequivocal acceptance of a particular measure, and it was often difficult to assign values to criteria. The Committee agreed, therefore, that a final list of measures and a calibration of thresholds for criteria could be developed only from local field work, i.e., field observation and 'later validation.

## *APPLYING MEASURES AND CRITERIA*

Measures and criteria: which comes first? The goal of the CCSLP was sustainability of oak woodlands. This assumes that one can look into the landscape, make a judgement of the degree of sustainability of that landscape, identify measures or attributes for those properties judged to affect sustainability (ecological, biological and cultural) and associate criteria with each measure.

Thus the researcher can say, "This site has all the characteristics of the site on the other side of the hill that supports a *sustaining* oak population, but for some reason this site has no oaks. Therefore I think that this site can sustain an oak woodland". In the case of a landscape devoid of oaks, one could conclude that it is capable of sustaining oaks if it shares sufficient criteria with the reference landscape standard.

The process demands that measures be developed to define a sustainability standard. Thus, a set of criteria would have to be applied in the creation of the 'standard', and this would distill' first and foremost into the age structure of the woodland.

The researcher here says, "This site has a healthy, self-sustaining population of oaks, based on my criteria for defining 'healthy and self-sustaining'. I will now identify values for the measures. " These values will become the criteria and the measures and criteria will be used to evaluate sustainability potential at other locations. Presently there is considerable observer subjectivity in setting reference for other locations in the landscape.

## *THE QUESTION OF SCALE*

Developing a list ranking measures and criteria would depend on establishing the scale of the landscape element. Scale could vary from the 'foreground' description of the individual tree, its neighbors, the associated ecosystem and use of the land; the 'midground' view of the stand or group of trees and their relationship to each other and to the landscape elements close to the stand; and the 'background' description of the assemblage of stands, other plant communities and habitats over a larger area such as a watershed or view shed. The problem of scale is particularly important relative to ecosystem biodiversity and wildlife requirements ranging from root fungus to woodpecker habitat to deer migration to cattle forage and pasturing needs. In the CCSLP the approach to scale varied with the professions of those on the Committee. Planners and geographic information systems (GIS) experts preferred the large scale view, while the plant ecologists commonly held the small scale view, that the landscape was the sum of the stands and the stands were the sum of the trees.

Initial work by the Committee focused on the stand level. Initially the group thought that GIS could be used to find similar stands of oaks by using factors such as slope, aspect, etc. so that Technical Committee members could evaluate criteria for those measures. The original intent was to move quickly to the landscape level. However, some members of the Committee believed that it would only be possible to move to the landscape level after thoroughly investigating the stand level since the landscape is the sum of the stands. Others wanted to move to the landscape level more quickly, to enable faster mapping and decision making leading to political action, since there are many threats to the oak woodland on a regional scale. GIS is especially useful at the landscape level, but there was a concern that overgeneralization of measures could lead to errors in the evaluation of sustainability. The Committee discussed the meaning of landscape level in relation to the stand level, community, landscape, and bioregion; further discussion is indicated.

*Habitat Elements.* Certain measurable elements of habitats such as acorns, tree cavities and dead-anddown which are of great value to many wildlife, are likely candidates for measures of sustainability.

*Acorns.* About 50 game and non-game oak woodland wildlife eat acorns, and acorns play an important role in the condition and productivity of many, deer herds. The fact that acorns are an important wildlife food, that acorns affect wildlife productivity, and that acorn production can be measured contribute to the suitability of acorns as a valid measure of oak woodland wildlife sustainability.

The Department of Fish and Game (DFG) has developed a method to rank oak trees for acorn production. By this method, production is ranked 1 for trees with no visible acorns to 4 for trees with limbs sagging with acorns. Some useful information on acorn production came from an evaluation of the DFG technique from 1975 to 1985 in Tehama County. About 74% of 360 monitored blue oak trees produced few or no acorns (i.e., were class 1 or 2; class 2 trees produce only about 2 pounds of acorns per year). Only about 5% of trees were heavy producers, and these trees produced 90 pounds of acorns per year. The relationships are not well known between the DFG classification and pounds of acorns available to wildlife, and between acorn production and wildlife fitness.

Acorn production also varies from year to year and from species to species. White oaks mature acorns in one year while black oak trees take two years to produce acorns, and there is a tendency for species requiring one year to mature acorns to be out of synchrony with those requiring two years. A consequence of the asynchrony of acorn production is that variability in masting patterns are dampened and the otherwise potentially disastrous effects on wildlife of poor acorn years are moderated. Oak tree species diversity can therefore measure woodlandsustainability.

Tree *Cavities.* Most cavities in oaks occur in large, living, mature trees having wounds or dead branches. Flying squirrels, tree squirrels, raccoons, some owls, and certain amphibians and reptiles use cavities in oaks. A conspicuous group of animals depending on tree cavities are the cavity-nesting birds. Some of these, like the acorn woodpecker, Nuttall's woodpecker, and Lewis' woodpecker, are termed "primary cavity nesters" because they excavate cavities. Others, termed "secondary cavity nesters", use existing cavities. Secondary cavity nesting birds include bluebirds, ash-throated

classes of oaks, but few of intermediate to seedling age or mature age classes. In cases where all available habitat is occupied by old trees, the lack of young trees may not mean young trees could not be recruited into the stand when space becomes available. Oaks may stay in a seedling stage for as long as 25 years, waiting for circumstances amenable for growth to maturity[9].

*Herbivory: A Hot Potato Issue.* Most participants that herbivory is a very important measure. The herbivore is supported by the oak and, in some cases, the oak can benefit from herbivory (e.g., bird dispersal of acorns). Intense ground browsing by herbivores, however, can destroy oak seedlings and prevent regeneration of trees. This presented no problem within the Committee when the herbivore was a pocket gopher or ground squirrel, but produced some tension when the cow was the culprit. Rancher representatives on the Committee provided strong observational evidence that cattle operations can coexist with a sustaining oak woodland. Other Committee members noted that oaks seem to regenerate in highway right-of-ways but not in adjacent grazed lands, suggesting cattle/regeneration incompatibility. Ranchers were concerned about a linkage between cattle and loss of oaks being used to force burdensome regulations and ordinances that would make an already difficult business nearly impossible. They emphasized that observations and empirical testing indicate that use of resource evaluation tools, such as Holistic Resource Management, can allow a rancher to analyze land use and ranching methods so that large numbers of cattle can graze the land in a timely manner while other resources are protected.

*Regeneration Measures and Criteria: Which One and Where?* What do you do when regeneration sustainability is associated with different things in different places, and which criteria do you select for landscape level evaluation? This question arose when the use of multivariate or cluster analysis programs such as TWINSPAN was suggested as a method to choose the most statistically valid measures and criteria. However, use of these techniques to search for a simple list of measures among superficially similar sites within blue oak woodlands of Los Padres National Forest, California, proved frustrating to one member of the committee. Therefore, further research and field observation and later validation may help clarify and resolve unknowns and conflicting data.

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[9] California Agriculture, Vol. 48, No. 3, May-June 1994, page 5.

## *Wildlife*

Wildlife resources provide aesthetic, recreational, and economic benefits. The Committee agreed that wildlife habitats in Central Coast oak woodlands are decreasing, and that many are deteriorating in quality. Most people want a diverse representation of wildlife in the landscape and associate wildlife presence with habitat stability. The Committee concluded that it may be too expensive and difficult to use wildlife species diversity directly as a means of woodland sustainabiity. Species diversity together with presence or absence of other measures which distinguish indirectly a sustaining woodland were discussed and evaluated, some at the stand level (species diversity, keystone species, and habitat elements), and others at the landscape level (patch size, corridors and connectedness, and edge).

### *Stand Level*

*Species Diversity. The* Committee developed measures and criteria regarding the general relationship between species diversity and environmental stability at the stand level. Wildlife diversity seems to be correlated positively with environmental stability; therefore, a diverse fauna would be considered a predictor of a sustaining woodland. Rare animal and plant species usually have narrow limits of tolerance, i.e., they arc habitat specialists, so their presence or absence would serve as a measure of oak woodland sustainability. The Committee did not list specific criteria such as species or number of species as criteria but concluded that an abundance of rare bird species such as ground and canopy feeding birds may measure sustainability in oak woodland.

*Keystone Species.* Keystone species affect the well-being of others in the habitat. For example, population levels of the acorn woodpecker may present significant evidence of the level of sustainability in oak woodlands. Numerical relationships between species populations and whole communities were also discussed. Species assemblages often provide more reliable indicators than single species, since a better integration of conditions is reflected by the whole than by the part.

*Habitat Elements.* Certain measurable elements of habitats such as acorns, tree cavities and dead-anddown which are of great value to many wildlife, are likely candidates for measures of sustainability.

*Acorns.* About 50 game and non-game oak woodland wildlife eat acorns, and acorns play an important role in the condition and productivity of many, deer herds. The fact that acorns are an important wildlife food, that acorns affect wildlife productivity, and that acorn production can be measured contribute to the suitability of acorns as a valid measure of oak woodland wildlife sustainability.

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flycatchers, some owls, titmice, nuthatches, and wrens. Sustaining populations require about one cavity per acre of woodland. A study recently completed at San Joaquin Experimental Range in Madera County suggests that 9 cavity trees or 16 cavities per 10 acres is enough to maintain cavity nesting bird populations[10].

*Dead-and-Down.* Dead-and-down includes logs, tree branches, and other woody debris lying on the ground. This may be the state in which the oak tree provides the most value for wildlife. Criteria figures are available for old growth conifers: a standing conifer tree provides wildlife value for two or three hundred years, but once it falls it will benefit wildlife for an additional century or so. A similar relationship may occur with oak trees but this has not been investigated. A suitable amount of wood debris in appropriate areas will provide habitat for many oak woodland wildlife'species. Dead-and-down is the most important habitat component for amphibians and reptiles. Birds and mammals are also inhabitants of woody debris; quail and several species of songbirds nest alongside downed logs. Many kinds of small mammals nest in burrows under logs and use dead-and-down for cover.

*Landscape level*

At the landscape level, the Committee applied biogeography and landscape ecology principles as measures and criteria. The Committee concluded that patch sire, connectedness, and the ratio of edge to interior are measures, though values (criteria) are not yet available for oak woodland.'

*Patch Size,* Habitat fragmentation occurs when development *or other* anthropologic factors break up a block of habitat into smaller pieces. Habitat value is lost as the residual pieces become too small or too isolated to meet the food, water, and cover needs of the resident fauna.

*Corridors and Connectedness.* Strips of habitat that tie together habitat patches are called corridors. A corridor may be what is left over after a disturbance such as development or tree cutting. Corridors may result from planting a hedgerow or *other* vegetation along a roadway

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[10] Noon, Barry Dr., Jeffrey Waters. "An Investigation of the Breeding Habitat of Cavity-nesting Birds in a Hardwood Habitat, " Humboldt State University, 1987.

through a developed area. A corridor may also occur naturally; one example is the path a stream or river follows-the riparian corridor. Wildlife with requirements not found within one oak stand or small set of oak stands may be dependent upon corridors in the landscape. For example, mule deer in northern California annually move from high-elevation foraging areas to foothill oak woodland habitat. It is essential that the deer have travel lanes of habitat for protection and food during their journey. Many kinds of wildlife need corridors to meet food, cover, and water needs. A study in Orange County concluded that an isolated patch of habitat had to be at least 5,000 acres to support mountain lions. However, a patch of only about 300 acres, if connected by a corridor to a *larger* patch, would also support mountain lions.

*Edge.* Edge occurs where two or more *vegetation types* meet. Edge is related to habitat fragmentation because the amount of edge in a woodland is affected by the size of the habitat pieces; the smaller the pieces the greater the relative amount of edge. For example, when a large parcel of 16 acres is broken into 4 smaller parcels of 4 acres each and then into 16 l-acre parcels, the amount of edge to interior habitat increases, and the amount of interior habitat decreases until finally the habitat is all edge. In the past edge habitat was thought to be especially rich in wildlife, but recent research shows that edge habitat benefits only certain wildlife, such as deer, raccoons, sparrows, and opossums, at the expense of wildlife species that require interior habitat. A more complete inventory of information is *needed* to *refine the* preliminary measures and criteria the Committee developed under the wildlife category.

### *Socio-economic*

#### *Importance of Socio-Political Measures*

Socio-economic refers to economic (market) and political issues that might encourage retention or destruction of oak habitat at both the local *or* stand level and the landscape level. As one Committee member remarked, "For sustainable oak woodland there must be ecological soundness (the land base), economic viability (the dollar base), and social justice (the people base)."

*Possible So&-Political* ***Measures***

' ***Landowner Attitude and Past Land Use.*** *In* a **recent** survey", Yolo County, California, landowners indicated they value oak woodlands for farming, livestock grazing, firewood production and residential land. Because most oak woodland owners are interested in oak issues, oak woodland use and maintenance could improve if education and communication links were developed between owners, managers and local planners. Landowner attitudes could be a valid measure, though these attitudes may change with the introduction of new information.

**Many** of the **socio-political measures** and criteria may be affected by past management decisions made within the landscape. For example, the relationship between oak regeneration and a certain slope and aspect may reflect past use on that piece of land and its effects on soil fungi just as much as the physical measures, per se.

***Economic Forces.*** Landowners on the CCSLP stated clearly the importance of the land being productive and land-use enterprises being profitable enough to support those living on the land. This is the paramount issue determining whether the oak resources on private land will be sustained. Economic forces include the value and amount of **firewood,** the value of the land as wildlife habitat, the livestock production capability, and the value and possibility of using the land for alternatives such as housing development or vineyards: All of these factors could be expressed as economic measures of sustainability.

***Incentives.*** Incentives such as expansion of the Williamson Act or a similar legal vehicle were proposed to provide specifically for conservation of oak woodlands through relief of taxes. Another incentive, driven largely by a combination of market forces and California Department of Fish and Game policy, is the encouragement of managing the oak woodlands for hunting, sustained firewood production, and other alternatives or complements to grazing. It is also possible that tourists and urban residents might provide some financial support to land owners through the purchase of scenic easements to preserve oak woodlands. The acceptance of a protective incentive would be a **socio-economic** measure of sustainability, just as enrollment in the Williamson Act is a measure of the short-term sustainability of open space.

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[11] California **Agriculture, Vol. 45,** No. **6, Nov-Dec** 1991, pp. 16-18.

## *RELATED EXAMPLES OF UNRESOLVED ISSUES*

*Acceptable Management.* The introduction of socioeconomic issues challenged the assumption that sustainability and regeneration were desirable in all situations. Assuming that there actually is a determination that regeneration is desirable, and that it is not occurring on its own, what type of management will encourage regeneration, and would it be acceptable to the landowner? Examples might be the control of herbivores such as gophers and the management of grasses and other components of the plant community. How can we encourage active management incentives or regulations? What aspects of the interplay between ecology, economics, and politics could be considered measures, and how might criteria be developed?

*Kinds of Incentives and Educational Programs.* t u r e e x p l o r a t i o n involves further development of self-sustaining management options compatible with economic viability, creating ways to provide incentives to land managers to use such options. What kinds of incentives and educational programs can be provided for landowners and managers to encourage compatible uses and care?

*County vs. Regional Coordination.* Decisions are presently made at the county level, and historically have not been made at a coordinated regional level. The Committee's efforts have fostered an examination of the use of information at a coordinated regional level. Subsequent work can examine how this can be continued independently or folded into other regional planning and information efforts. Another unresolved issue is that the economic benefit of oak hardwood landscapes has not been fully quantified. This could be the basis for further study.

*Regulation vs. Incentives.* The extent to which further regulation might so interfere with private property rights that it would constitute a taking under the 5th Amendment was briefly discussed. This complex issue continues to be litigated in the courts and is outside the scope of this project. However, it raises fundamental questions as to how much regulation will be possible and underscores the importance of considering incentive programs as alternatives to regulatory programs for dealing with complex natural resource issues.

***The Feeling*** of ***Landowners Towards Government.*** Throughout the ***CCSLP, participants*** expressed a concern about the ultimate intent of the state beyond the project, and landowners were concerned about government interference of any sort in their lives, **especially** at the state and federal levels. This is a long-standing sensitivity and cannot be resolved through one project. However, the project has demonstrated **that** it is possible for state and local interests to cooperate in developing an informational tool for the mutual **benefit** of all.

***Measures Related to*** Prioritization. It was evident to all participants that it would be impossible to protect all oak woodlands to the same degree, and that some form of prioritization would be necessary. Prioritization involved the following measures:

- Site quality ranking relative to health of the oak ecosystem
- Site quality ranking relative to wildlife support
- **Support** for rare and endangered species
- Willing landowners relative to management options
- Economic constraints relative to nianagement costs, incentives etc.
- Logistic constraints relative to the ease of implementing management options.

## *A LZST OF SUGGESTED MEASURES, AND THE ORGANIZATION OF MEASURES INTO GROUPS*

### *Why is the list so long?*

Recognizing that various problems relating to sustaining oak woodlands could require the use of different subsets of measures, the Committee listed and organized measures and criteria. At this time the measures are not known for certain, and their assemblage into subsets is unclear. The three categories of regeneration, wildlife, and sociopolitical provided a framework for developing the measures and criteria, but overlap between the three categories limited attempts to group them by categories. Every measure that was suggested by the Committee, if not proven to be invalid, was included on the list. Committee members used field experience, cited references, and, in some cases, used intuition to come up **with** the list, but they realized that each measure would have to be field-tested in order to be useful. Some of the suggested measures were not ***universally*** accepted within the Committee.

## *WHY GROUPS? A QUESTION OF SCALE*

The relationships evident at the stand level between the oak and its environment are listed under Supergroup 1. This Supergroup has been divided into relationships between the oak and the non-living, or physical, aspects, the botanic aspects (the plant community), and the zoological aspects (domestic animals and wildlife) of the environment.

Supergroup 2 consists of those measures that are best seen "from afar", through the use of maps, aerial photographs and similar tools. In some ways these landscape views can be constructed using information gathered from individual stands of trees, but most often they include information derived from remote sensing tools. The Supergroup 2 list also includes a set of economic and geopolitical factors not directly evident from remote sensing data. These are included as measures that can be obtained by other means, but which would be important factors in sustaining the oak landscape. The measures may be developed as "layers" of maps within a geographic information system (GIS), so that physical and biological attributes of a landscape can be directly overlain by economic, political and other information.

## *SUPERGROUP I: MEASURES CONDUCTED PRIMARILY AT THE ST' LEVEL*

### *Measures Associated with the Physical Setting*

Climate:

*Description of the measure:* Composite climatic features, including rainfall, temperature, moisture, fog, etc.

*Criteria:* Amount of rainfall, variation of temperature, humidity and other climatic factors required to support a viable population of a targeted species of oak

*Issues:* Oaks have certain tolerances for climatic conditions. The degree to which a site is close to any of the climatic limits will affect the tolerance to disturbance.

Aspect:

*Description of the measure:* Aspect of the slope i.e., its orientation, which affects soil moisture, temperature, light, wind, and other factors.

*Criteria:* Range of slope aspect found to support a viable population of a targeted species of oak. (For example, blue oak in the Coast Ranges appears to prefer north or east-facing slopes).

Issues: Aspect is closely linked with stand microclimate, since it affects the amount of sunlight reaching the floor of the oak woodland and, therefore, soil temperature and soil moisture.

**Slope:**

*Description of the measure:* Steepness of slope, measured in percent.

*Criteria: Range* of slope gradient found to support a viable population of a targeted species of oak. (For example, Valley Oak appears to prefer flatter sites).

*Issues:* Ground slope affects drainage, erosion and the thickness of soils, the use of the site by cattle, and the probability of soil instability.

**Elevation:**

*Description of the measure:* Height above sea level.

*Criteria:* Range of elevations found to support a viable population of a targeted species of oak.

*Issues:* Elevation affects the maximum and minimum temperature of the site, the number of frost-free or foggy days, wind velocity, and plant associations at the site.

**Soil:**

*Description of the measure: Soil type,* depth, and chemistry.

*Criteria:* Range of USDA Natural Resources Conservation Service soil. types found to support a viable population of a targeted species of oak.

*Issues:* Soil type, depth and chemistry affect the germination of acorns, the amount of water and waterlogging of soils, ease of root penetration, support for tree and against wind load, nutrient supply, host opportunities for rodents, and stability of the site.

**Groundwater:**

*Description of the measure:* Depth of ground water, yearly and seasonal averages, growth of oaks.

*Criteria: Range* of water table depths and seasonal fluctuation levels found to support a viable population of a targeted species of oak.

*Issues:* Lowering of the water table can negatively affect sustainability by placing water out of the reach of root systems. Too high a water table can drown root systems or create toxic anaerobic conditions around the tree. Some trees are adapted to specific seasons of root wetting and drying.

*Measures Associated with the Plant Community*

Species Composition:

*Description of the measure:* Plant community associated with the oak.

*Criteria:* Species assemblage found to be associated with a sustainable population of a targeted species of oak.

*Issues:* Other plants in the plant community may provide direct or indirect support for the oak, or may be neutral or even deleterious to the oak. Some European annual grasses, for example, compete for space and soil water, or support populations of rodents which graze on the oak seedlings. Plants may have complicated interrelationships in space and time, e.g., fungal associations (the mycorrhizal grid). A plant community may be both dynamic and successional.

Canopy Cover:

*Description of* the *measure:* Percent of the ground surface that is overtopped by the branches (canopy) of the oaks.

*criteria;* Canopy cover is important for some animals, but less cover may encourage others of the oak community. Forage may also increase with some decrease of cover. Criteria must therefore be expressed in terms of goals.

*Issues:* Canopy cover controls the amount of light reaching the ground, and thus may have a direct impact on seed germination in the understory. It may also affect the animal populations that, in turn, may impact the trees.

Communitv Structure:

*Description of the measure:* Amount of plant cover, and proportion of tree overstory, shrub, and herb within the community.

Criteria: Community structure associated with a sustainable population of a targeted species of oak. This may vary with the age of the plant community, which may have evolved from, or will evolve into, a different community composition and structure.

*Issues:* Density of plants in the tree, shrub and herb layers, and amount of bare ground or litter are routinely measured when a plant community is being described. Many ecological interactions will be dependent on this structure, and some of these may impact directly on the oak.

Index:

*Description* of *the* measure: Height of the dominant tree of the stand at a given base age, usually 50 years.

*Criteria:* Index value for the species chosen from the species assemblage at the site, at the chosen age at which the index is assessed. There are several slightly different uses of the term 'site index'; it is commonly measured from the height of a tree at an age of 25, 50 or 100 years, depending on the species.

*Issues:* Site index is commonly used in the profession of forestry to describe site quality (soil, climate, moisture, aspect, etc). It is uncertain whether oak would lend itself to this methodology, but it may be a good indicator of site quality, and thus of sustainability.

Tree Diameter:

*Description of the measure:* Diameter of a tree at breast height (dbh-measured 4.5 ft above the ground).

*Criteria:* A predetermined value for use in age class definition.

*Issues:* In the profession of forestry, dbh is a standard index used to define the size of trees. Tree diameter may be correlated with age, but in some species diameter is only a rough indicator of age.

Tree Recruitment[12]:

*Description* of *the measure:* Relative abundance of young trees (seedlings and saplings) that survive to supplement trees in the stand, or replace trees lost from the stand.

*Criteria:* Number of saplings over 6 feet tall. This should be expressed as a percentage of the population; threshold percentages indicating sustainability are unknown.

*Issues:* The presence of small trees indicates recruitment. This may not always be true in oak, where trees can remain at seedling height for decades, and conditions under which the seedlings can advance to sapling and tree size are unknown or occur infrequently. The absence of seedlings and saplings suggests that recruitment is not taking place, but it does not rule out future recruitment. Field evaluation of this measure may require aging trees from ring analysis.

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[12] Jones and Stokes Associates, Inc., 1988 survey, Chapter 2: "The 'Oak Regeneration Assessment Problem: Definition and Description", report prepared for the CDF Strategic Planning Program (FRRAP) by Jones and Stokes Associates, Inc., *September 1988.*

Stand Size:

*Description of the measure:* Sizeareainacresofastandofoak.

*Criteria:* Critical area of stand, if any, associated with some level of recruitment.

*Issues:* Although little has been reported on the relationship of this measure to sustainability, stand size may affect the internal microclimate of the stand, animal use of the stand, risk from wind blowdown, and other factors impacting sustainability.

Change in Stand Size:

*Description of the measure:* Stability of the area occupied by the patch or stand. A long-term decrease in the size of the patch or stand may indicate that it may not be sustainable.

*Criteria:* A long-term drop in an area would suggest that the stand is not sustaining. (There was no general agreement on the percentage threshold. Small decreases in stand size may not mean that the entire stand is not sustaining, but that marginal environments within the stand might not be sustaining.)

*Issues:* *Changes in* stand size reflect the degree to which old trees are being replaced in the stand, or the occurrence of damaging site disturbances.

Health and Disease:

*Description of the measure:* Tree vigor could index site quality and environmental conditions.

*Criteria:* Presence of unusually large populations of fimgal infections, mistletoe, insect damage, or other evidence of stress in the stand. This may be expressed in terms of the percentage of trees within the stand. However, trees may show stress during intervals of extreme weather or other temporary conditions.

*Issues:* Disease is likely to be a symptom of environmental stress. Identification of a particular disease in a stand may be of trivial interest, or may be of great significance. Dutch Elm Disease and White Pine Blister Rust have decimated tree populations of other genera.

Disturbance:

*Description of the measure:* Grazing intensity, fire history, presence of aggressive exotic plants, and similar measures.

*Criteria:* *The* level of disturbances that determine whether recruitment will occur.

*Issues:* Disturbance may positively or negatively effect sustainability, depending on type, timing, and degree. A measure based on disturbance with known effects on stand recruitment would be of interest. Disturbance in a plant community might directly or indirectly affect the oak.

. *Measures Associated with Wildlife*

**Mast Production:**

*Description of* the *measure:* Weight of acorns produced in the stand.

*Criteria:* The presence of a critical number of acorns needed to ensure seedling production. Repeatedly low mast production in the stand may indicate that the stand is not sustaining. There may be a lower criteria value if the measure is linked to successful seedling production in the oak, and a higher value if a certain critical mass of wildlife has to be supported.

Issues: Sustained low mast production may indicate the stand is stressed. The information may be of value in the planning of landscape-scale migration'corridors, wintering ranges etc.

**Edge:**

*Description of the measure: The* length of the line delineating the edge of a stand, a successional stage, or a habitat type., The proportion of edge varies greatly with the shape and area of a stand.

*Criteria: Edge* length defines a measure of the degree to which outside influences could interact with a stand. The length of edge should be defined at the map scale of the mapping system. being used. Edge should be used in association with wildlife studies and may be calculated differently for animals with small ranges than for those with large ranges.

Issues: The edge of a plant community is the contact with neighboring communities. Some species exist only in one community, others live in one and forage in another, and others may be dependent on the narrow zone of the interface itself, i.e., the edge. Thus the length of community boundary, or edge, has different effects on different species. For the plant communities themselves, edges usually represent possible invasions from the neighboring community, and the community stability tends to be inversely proportional to the edge. Tracing the outline of a stand on an aerial photograph would seem an obvious way to measure the length of an edge, it may seem much larger to someone standing under the canopy of a tree on the edge of the stand, and marking the length of a line marking the edge of canopy cover.

Stand Dimensions:

*Description of the measure:* There are a number of measures on the shape of the stand, the height of the trees, and the presence of clearings, etc. Those may be developed as important habitat indicators for a target component of the ecosystem.

*Criteria:* Presence of sufficient quantities of the target measure to meet the requirements of the targeted ecosystem component.

*Issues:* The issues here are similar to those discussed above under Edge.

Snags:

*Description of the measure:* The number of standing dead trees compared to the number of live trees. Snags are important nesting sites and provide other habitat values.

*Criteria:* The presence of sufficient snags to meet the requirements of a sustained ecosystem.

*Issues:* Dead standing trees, or snags, offer home sites for mammals, birds, reptiles, fungi, etc. These in turn play a role in the stand ecology.

Snag Size (dbh):

*Description of the measure:* The range of sizes of standing dead trees.

*Criteria: The* presence of sufficient snag sizes to support all desired elements of a sustained ecosystem.

*Issues:* Snag dimensions may be important if specific species habitat *requirements are* being considered. It is a measure of available habitat for some components of the ecosystem.

Range Management:

*Description of the measure:* Grazing practices used *on oak* rangeland.

*Criteria:* Application of methods known to either encourage *or* prevent recruitment to the stand.

*Issues:* We need to know the land use practices associated with sustainability; grazing methods may be important. It is possible that past grazing methods rather than present methods are responsible for low recruitment in an oak woodland, and this measure should therefore be coupled with field interviews with the grazing operator. The types or timing of practices that allow oak recruitment are not fully understood at this time, but there is some indication that Holistic Resource Management or a similar system may be compatible with sustainability.

Adjacency:

*Description of the* measure: Site characteristics and land uses adjacent to oak woodlands influence the wildlife within, and to a lesser degree, the oaks themselves.

*Criteria: Specific* land uses and vegetative communities, and distance necessary for sustainability such as distance from roads, developments or clear cuts.

*Issues:* This measure may indicate the probability that disturbance could take place in the stand. As the measure can be applied to a large number of entities relative to the woodland, this may be an applicable measure when a known source of disturbance is being qualified for its future impacts.

Herbivory:

*Description of* the *measure:* Description of the identity and number of species that eat any partoftheoak.

*Criteria:* Populations of animals such as pocket gophers, deer, pigs, some insects, and ground squirrels may impact recruitment. Criteria would reflect critical numbers of a species, to be gained from field experience.

*Issues:* Herbivory was one of the measures universally accepted by the group as a major factor in oak regeneration. Problems may arise when the impacts cycle with other environmental factors, and with population cycles of the herbivores.

## *SUPERGROUP II: MEASURES CONDUCTED PRIMARILY AT THE LANDSCAPE LEVEL*

### *Measures Associated with the Oak Ecosystem*

The landscape level considers large areas of many square miles. At this scale, aerial photographs or regional maps are commonly used assessment tools, enabling changes in tree cover, at least gross changes that occur over decades, to be measures. It is unlikely that all of the geographic unit would be visited and measured in the field; so field data from a small percentage of the area is commonly extrapolated to the total area. Evaluation of oak woodland at the landscape level may be of particular advantage when large scale planning tools are being evaluated or proposed, or when habitat quality is being assessed over a wide area.

In the following list of measures and criteria, the phrase "project-specific, threshold-defined value" appears under the criteria for each measure. There is no universal criteria that

will fit all wildlife management goals. For example, the requirements to sustain the acorn woodpecker may be different from those needed to sustain the spotted owl. It is possible that the criteria selected for the maximization of biodiversity will not be those needed to protect a single endangered species.

Stand recruitment:

*Description of the measure:* Observed changes in the number of stands. (There may be problems in assigning outlying trees to a particular stand. A stand boundary recognition standard would need to be developed.)

*Criteria:* This would be a project-specific, threshold-defined value. It would need to be considered in association with canopy cover (see below).

*Issues:* This is possibly the most important measure in the regional inventory of the oak resource. The balance of areas where oaks are being removed or are returning to the landscape can be assessed in terms of cumulative impact.

Canopy cover:

*Description of the measure:* Percentage of the landscape beneath tree canopy.

*Criteria:* This would be a project-specific, threshold-defined value. The critical amount of cover for providing shelter to deer may differ from that needed to optimize a population of doves.

*Issues:* The issues are the same as for stand recruitment, although this measure allows the observer to measure thinning of trees within stands, showing stand alteration is not related to stand size. In most cases, however, total canopy cover is directly related to total stand area.

Canopy cover change:

*Description of the measure:* Observed changes in the canopy cover.

*Criteria:* This would be a project-specific, threshold-defined value. Reductions in canopy cover from a pruning operation may result in greater recruitment of young trees, or may represent disease or the destruction of habitat.

*Issues:* This is derived from the repeated measure of canopy cover and the estimation of change. It is of value in estimating change and the approach of critical thresholds in the ecosystem.

Patch size:

*Description of the measure:* Sizes of stands.

*Criteria:* This would be a project-specific, thresholddefined value.

*Issues:* This may be related to the ease by which weedy species can invade the stand, the degree to which a herd of deer can find cover, the degree to which a certain species of bird will feel secure enough to nest, etc.

Edge indices:

*Description of the measure:* Amount of habitat edge relative to habitat area.

criteria: This would be a project-specific, thresholddefined value.

*Issues:* This is a measure of particular use in the estimation of animal habitat availability. A stand with a large ratio of edge to area offers less interior habitat, and is more likely to suffer disturbances from neighboring communities.

Land cover class:

*Description of the measure:* Defined by classification system. This may be a classification of plant communities recognizable from satellite imagery.

*Criteria:* The percentage of a particular class present in the landscape. Presence may be positively, neutrally, or negatively associated with oak sustainability.

*Issues:* There are many ways in which measures of the landscape can be aggregated into mapping units, especially using GIS systems and mapping tools crafted by manipulation of several sources of data.

Abundance by Wildlife Habitat Relationships (WHR) type:

*Description of the measure:* Defined by classification system.

*Criteria:* Possible match to defined type.

*Issues:* Application of the accepted plant community and wildlife community definition within the WHR system as measured on the landscape. This is becoming a common mapping layer in GIS assessment.

Adjacencies by WHR type:

*Description of the measure:* Defined by classification system.

*Criteria:* Possible match to defined type.

*Issues:* Certain species must have two different plant communities in juxtaposition. The amount of juxtaposition of a particular type can be measured on a map; this form of data assessment is one of the advantages of GIS systems.

Connectivity between WHR types:

*Description of the measure:* Length, width, and consistency of habitat links.

*Criteria:* This would be a project-specific, thresholddefined value.

*Issues:* Certain species need a particular plant community within reach. The degree to which an animal is able to travel between plant communities or WHR community types can be assessed and used as a measure at the landscape level. Connectivity can be defined as: the presence of suitable habitat between two points, or as a space of either habitat or non-habitat that the target species will cross, either as seed, on wings, or on foot.

Soil type bv GIS overlay:

*Description of the measure:* USDA Natural Resources Conservation Service soil types.

*Criteria:* Possible match to defined type.

*Issues:* Soil maps are commonly developed as overlays on 7.5 minute photographic orthoquadrangles; thus, the data is presented at the landscape level. Soil types from these maps are readily available for input to GIS maps.

Fire History and Fuels:

*Description of the measure:* Time since last fire and loads of fuel on the ground.

*Criteria:* This would be a project-specific, thresholddefined value.

*Issues:* The build up of a heavy fuel base could result in very hot and destructive fires that could damage oaks beyond the ability to resprout. Certain conditions after a fire may enhance or hurt oak recruitment.

Rangeland Ownership/Management:

*Description of the measure:* Self explained.

*Criteria:* n/a

*Issues:* This would be an informational measure, to enhance implementation of proposed management strategies.

*Measures Associated with Land Use*

Local/Regional Economic Evaluation for Rangeland:

*Description of the measure:* Taxable value of the land, either directly or scaled to market value.

Criteria.- Value at which it appears ranching is no longer profitable, or the value at which it appears conversion takes place.

*Issues:* This is a problem at the urban fringe, where land costs and taxes have risen speculatively on the probability of conversion to urban use. If thresholds are known, based on knowledge of the economic problems of agriculture and land sales, this could be entered into a mapping system to identify sections of woodland that are 'at risk'.

Landowner Debt Load:

*Description of the measure: The* dollar value of loans, mortgages, etc. held by a landowner.

*Criteria: The value* at which it appears ranching is no longer profitable, or the value at which sale of the land or *conversion* takes place.

*Issues:* This measure may be difficult to obtain. A rancher heavily in debt may be forced to liquidate oak woodland as an asset, sell to developers, convert to another crop that could entail removal of the oaks, or have an incentive to make a debt-for-nature swap for conserving the woodlands.

inheritance Tax Exnosure:

*Description of the measure:* The dollar value of inheritance taxes payable by landowner's heirs.

*Criteria:* The value at which it appears taxes will force sale or subdivision of the land.

*Issues:* This measure may be difficult to obtain. A rancher may wish to subdivide the land in order to split assets between heirs. Such land division could result in fragmentation of land use, impacting the oak landscape.

Land Ownership Patterns:

*Description of the measure: The* degree to which different ownership patterns of the landscape is fragmented.

*Criteria:* . The degree of fragmentation resulting in significant problems in implementing land use incentives.

*Issues:* There could be too many people to deal with in the implementation of a plan to save oaks. If land ownership is rapidly changing, or the number of owners is quickly increasing, there could be development pressures that would damage the oak resource.

Zoning Changes:

*Description of the measure: The* degree to which there have been zoning changes in the landscape, and analysis of the changes.

*Criteria: The criteria* at which this becomes an issue cannot be defined exactly. It would need to be compared with statewide data.

Issues; Rapid and large scale up-zoning suggests that land uses are about to change. For rural lands this might work against sustainability of the oak resource, as the land is *converted* away from grazing and toward cropland or development. Similarly, the attitude of local governments toward upzoning lands may be revealed by the recent history of such decisions. Upzoning may not necessarily damage the oak resource if it is developed in an appropriate manner.

Williamson Act Status:

*Description of the measure: The* degree to which landowners have entered the Williamson Act may reveal short term shelter from land conversion away from agriculture. However it may also signal a coming agricultural land conversion, such as grazing lands being converted to grapes. Such conversion may be necessary for the economic survival of the fanner, but could be destructive of the oak resource.

*Criteria: This* depends on the local experience.

Issues: Self explanatory.

Political Incentives and Disincentives:

. *Description of the* measure: Degree to which policies to protect oak are existing, in place, actively implemented, and actively used by the landowners. This might include both incentives, such as the Williamson Act, or disincentives such as tree ordinances.

Criteria.- Degree to which a given program has been seen to yield results.

Issues; Self explanatory.

## *SOME ATTEMPTS AT GROUPINGS OF MEASURES*

### *Analogs Between Stand Level and Landscape Level Measures*

The issue of scale arose repeatedly. How do measures and criteria of sustainability vary at different geographic scales? As a preliminary approach, the Wildlife Subcommittee attempted to place wildlife measures into the stand and landscape categories. This was recognized to be an incomplete and untested list.

**STAND LEVEL MEASURES**

Tree recruitment, age structure size class, snag density

Species composition defined by dominant

Plant community composition

Wildlife species richness

Adjacencies by plant community

Basal area, stand shape

Local soil type, site index

**LANDSCAPE LEVEL MEASURES**

Stand recruitment, canopy cover, canopy cover change

Patch size, land cover class

Wildlife abundance by WHR type

Edge Indices

Adjacencies by WHR type

Connectivity between WHR types

Soil type by GIS overlay

## *EXAMPLES OF SUBSETS OF VALID MEASURES*

This subset is based on observations of a Committee member and a study conducted in the South Sierra which looked at the site characteristics of elevation, number of woody species, overstory, grazing, and fire history and their relation to the occurrence of blue oak seedlings and saplings. The following measures and criteria were associated with sustainability, defined as number of seedlings shorter than one foot and saplings between l-5 feet[13].

| MEASURE | CRITERIA |
|---|---|
| Elevation | 1,000-4,000 feet |
| Rainfall | 17-22 inches |
| Number of woody species | Two or more |
| Overstory basal area | 50-100 square feet |
| Grazing pressure | Moderate |
| Fire history | Periodic |

This list includes a number of measures that could be mapped by a GIS system. The Committee felt that, while this list was a start, it was painted with too broad a brush to be useful locally; it was noted that micro-environments meeting the criteria do not always have oak regeneration.

A shorter list was presented for blue oak woodlands where natural regeneration is present on north or east facing slopes: at least 10% slope and rainfall of at least 20 inches; or at least 20% slope and 10 inches, respectively. This list could be used to test a broader, GIS-based analysis of the landscape. These values will not apply uniformly to all blue oak communities on the Central Coast and would have to be developed specifically for geographical areas. On west- or south-facing slopes or level rangelands, control of annual vegetation, protection from small and large animals, and acorn seeding or seedling planting may be necessary for sustainable regeneration. Thus, the measures become slope, aspect, rainfall, and management options.

A study on oak communities in the Los Padres National Forest found little correlation between regeneration and various environmental and land management measures. The study suggests that environmental factors might be too complicated to be evaluated in this linear

[13] California Agriculture, Volume 46, Number 5, September-October 1992, pp. 30-32.

manner. Many measures discussed in this report had such a large spread of values that they may not accurately gauge sustainability. Members of the Committee cited locations where oak regeneration was clearly associated with certain landscape measures.

## *ORGANIZING MEASURES USING A MATRIX*

The Committee discussed the value of designing a matrix to show how measures might be grouped to analyze specific biological/ecological factors. The Committee had differing ideas of what were important measures. It was clear that there was such interaction between each of the categories that the Committee marked almost every cell with an 'x'. For example, slope gradient and aspect would directly affect vegetation and, in turn, wildlife. However, the slope may also benefit a certain grape crop, and be a factor in conversion of oak woodland to vineyard. Some Committee members disliked the idea of the matrix, due to the inherent subjectivity of cell markings. Although the question of whether it would be a useful tool was not resolved, a matrix is included for reference[14]. Such groupings may be useful in the assemblage of GIS tools. The matrix might have some value in recording the findings of field observation and later validation surveys.

## *FIELD OBSERVATION AND LATER VALIDATION*

### *Field Observation and Later Validation Background*

There was much discussion over which measures would best describe or predict sustainability. The list of criteria and measures were developed partly from the aggregate knowledge of the Committee, and partly through review of the literature. The Committee concluded that field research should be used. The association of measures with a certain degree of sustainability could be used at the landscape level only after the association was validated in the field.

Field observation and later validation was introduced as a means of developing a set of measures that could be applied to local mapping projects. Measures would be examined to detect

[14] See Appendix D for the matrix.

thresholds of sustainable recruitment in the target species of oak. Thresholds will be determined by experience gained at the landscape level, and the first fieldwork action would be a "landscape-wide field observation and later validation." The field observation and later validation would look at the oaks and search for evidence of recruitment. If there was no such evidence within the entire chosen landscape, the field observation and later validation would need to extend to areas that have recruitment, or assessment would fall back on the established body of knowledge.

Assuming that some recruitment was found, the correlative measures would be indexed according to how much and where recruitment was taking place. The landscape would be sampled over typical subareas, and Endings would be extrapolated to the landscape as a whole through application of GIS or other tools.

The procedure would therefore be applied as follows:

(a) Select target landscape.
(b) Select typical subareas of the landscape for field observation and later validation.
(c) Prepare a list of possible measures. for evaluation in the field.
(d) Apply the selected measures to the selected subareas.
(e) Define valid measures and criteria, if any.
(f) Apply to a larger landscape via GIS.
(g) Select new areas identified by GIS.
(h) Validate measures and criteria in the field.

*Detailed Discussion of the Field Observation and Later Validation Philosophy*

Two committee members, Deborah Hillyard and David Chipping, tried to develop a schematic by which the field observation and later validation process could be better defined. Two very similar schematics were developed and presented to the Committee[15], and received different reactions from the Technical and the Advisory Committees. The former generally approved of the methodology, while the latter felt that the schematics were too complicated to read.

A field observation and later validation is meant to allow evaluation of the degree to which a portion of the landscape is sustainable, which requires some quantification of quality

[15] See Appendix E for the Field Observation and Later Validation Schematics.

assessment. The definition of the sustainability threshold must be clear, and this can only be achieved after thorough field research to find areas where oak recruitment is taking place.

The first part of the field observation and later validation methodology is the search for areas that appear to be sustaining, using recruitment as a criteria, and then to describe all associated measures. There should be no a priori assumption about which measures may or may not be valid, as this can only be determined by statistically significant association. Both physical and biological measures of the landscape must be made, which could be a short list as a result of pragmatic judgment calls. Since management of the land is a vital issue in the sustainability of oaks, observations of measures should extend to the cultural and economic issues, as well as those most often targeted by ecologists. The Committee was reminded that the rancher and farmer and their actions are an integral part of the ecology[16].

Sustainability measures and criteria may differ between different oak plant communities, and therefore a feeling for the range of communities is essential. A preliminary plant community classification should be made, possibly from fast-assessment tools such as aerial photographs or regional drive-by. Thresholds must be defined, perhaps arbitrarily, about each plant community that is thought to be associated with distinct measures and criteria relative to other communities.

The field observation and later validation should focus on measures and criteria critically associated with sustainability. A stand of oaks visited during a field observation and later validation is evaluated through a list of valid measures, then compared in terms of the multiplicity of measures with those of known sustaining stands. Many measures can be obtained from regional GIS studies, including soil types, rainfall, temperature, etc. Others may be obtained from local aerial photos, such as canopy cover, stand size, edge length, wildlife corridors, etc. At each site the measures and their values are assessed. On the basis of the regional quick first look, and in association with regional landscape views from GIS and aerial photography, a selection of sites is visited for the more detailed evaluation of measures and criteria.

The idea of "brittleness" (a term not uniformly liked by the Committee) was developed to describe the ease with which a stand could be altered from its current level of sustainability or lack of sustainability. Field observation and later validation records any potentially disturbing influences, such as exotic plants or disease in the trees, evidence of ground compaction or

[16] George Work, rancher, Work Ranch, San Miguel, California.

extremely heavy grazing, mast predation levels, fire, and other indicators of problems. These influences may represent tools by which the sustainability of a stand might be advanced. Field observation and later validation could provide suggestions for land-use actions to better serve the oak.

Field observation and later validation selects stands that are thought to be representative to use for detailed studies. Information gathered from detailed evaluations is broadcast to the greater landscape through GIS extrapolation and other tools.

Field observation and later validation assesses wildlife conditions in a limited way. The field observation and later validation process, as conceived in Committee, was developed to gauge the sustainability of the oak landscape, with de-facto inclusion of its ecosystems. While indexed primarily toward the oak as a tree, as thresholds are defined by evidence of recruitment, the same process could also focus on measures critical to wildlife. However, factors that may be important to sustaining a deer herd may be different from those sustaining a root fungus. Factors of value to game habitat would include stand size, shape and fragmentation, juxtaposed plant community and habitat type, land use, cover types, stand structure, etc.

A key wildlife indicator is mast production. A wildlife expert on the committee[17] presented a table linking mast production with population objectives for deer, quail, and squirrels, allowing for 50% mast in their diets and certain food intake levels. The table assumed a 50% acorn loss to insects, which doubled the requirement for the actual number of acorns that should be produced from the tree. Thus it should be possible to assess at least one aspect of the wildlife condition from an evaluation of mast during field observation and later validation.

Sustainability may be impacted by ecological factors, as well as by land use changes. To a planner, the influence of people on the landscape is the most obvious threat to sustainability, and is one of the most easily measured factors. Field observation and later validation assesses trends in land use, and the impacts of those trends on measures of sustainability. Land use changes may affect the oak ecosystem in many ways, such as fragmentation of wildlife corridors, increase in invasive exotic plants, increased fire risk or altered grazing patterns, but the most profound change is the displacement of the oak community either to cropland or to urban development.

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[17] Jim Lidberg, wildlife biologist, Department of Fish and Game, Los Osos, California.

Another CCSLP participant[18] presented a photographic tour of coast live oak landscapes near Monterey where lack of sustainability was obvious. photos included oak trees totally surrounded by concrete, oaks with houses removing all possible space for regeneration, oaks in strawberry fields surrounded by a sea of plastic sheeting, and other vistas pertaining to a dire fate for oaks. The degree to which field observation and later validation can evaluate trends, and the degree to which planning tools such as GIS and satellite imagery can be used to develop time histories of the landscape may vary from place to place. Field observation and later validation may be used to calibrate the effects of broader-scale trends revealed by regional tools.

### *Field Observation and Later Validation and the Land Manager*

During the final stages of draft review, it was pointed out that field observation and later validation might seem to be a job for the professional ecologist or forester, rather than for the landowner. This is not true, however, since the wise land manager is constantly doing practical research on the impacts of management decisions on the land[19]. It is likely that the observant land manager could perform field observation and later validation and project those findings over a wider area of the land holdings. With the present lack of funds to support paid professionals, the land manager working on his/her own ground will be instrumental in performing a sustainability assessment on the local scale. Thus, developing a short checklist of things to look at and things to do could be one useful tool to develop and provide land managers in the future.

## *MANAGEMENT OF THE LANDSCAPE FOR OAK SUSTAINABILITY*

### *Measures Before and After Management Actions*

It was agreed from the first meeting of the group that few natural landscapes are left; almost everything is managed. Even a decision to leave an area alone, as in the case of the Pinnacles National Monument area, is a management decision. It is hard to determine when

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[18] Jack Massera, Bureau of Land Management, Hollister, California.

[19] When George Work held a field observation on his ranch in May 1994, he shared decades of practical research with his guests.

The Committee decided that more knowledge was needed to select a short list of measures that would estimate sustainability. It was concluded that measures would be accepted only after field observation and later validation. After measures were validated they could be used as tools at the larger scale or landscape level.

The Committee also stressed that observation and measurement of the oak landscape should not be a static "snapshot" taken at one moment in time, but rather should encompass the historic landscape and ongoing dynamics of change.

management options-such as actively planting oaks, modifying grazing practices, or instituting rules and regirlations-should be considered. If management options are considered to be factors influencing the landscape, the degree to which they are applied is a critical issue in the long-term sustainability of the landscape.

The list of measures and criteria presented previously do not consider the evaluation of actions in the landscape; they tend to describe for evaluation purposes a static snapshot of the landscape.

The goal of this project was to develop baseline data and methodology leading to actions in the field to sustain oaks woodlands. Once oak management strategies are in place, their effectiveness could be evaluated by periodic assessment of the measures and indexing of those values against the criteria. However, each management strategy, once applied, becomes a potential measure, in that it is a process that can be quantified to some degree, and will have a criteria set by the achievement of the management goal. These could be considered "operational measures.

operational measures would also apply to urban forests, as with the use of tree ordinances. Some evaluation of these has occurred, and information was introduced that may result in the willful destruction of trees to prevent them from growing to the threshold size where they would be covered by the ordinance.

## SUMMARY AND CONCLUSIONS

It was difficult to select measures and criteria for judging the sustainability of the oak landscape. The final list came as much from the Committee's study of available literature as from personal experience. There were differences over the geographic scales at which selected measures would be applied, and the strategy used to apply the measures. The Committee decided to divide the measures into those developed largely from field observations and later validations in a stand of oaks, and those measured at the landscape level from tools such as aerial photographs. Certain measures are best suited to describing the wildlife using the oaks and others work best using the oaks themselves; these two groups of measures were therefore segregated. The so&-political issues placed humans and their economic needs into the ecosystem, and required another set of measures often associated with the land use planning process.

# CHAPTER III

# METHODS FOR DEVELOPING AND USING OAK WOODLAND INFORMATION AND CONSIDERING A REGIONAL OAK WOODLAND PLANNING PROCESS .

## *INTRODUCTION*

This chapter examines how the informational process begun by the CCSLP can be incorporated into existing local planning processes. The chapter further details a number of informational and management took, in various stages of refinement, that can be adopted into different levels of an oak woodland management strategy. The need to develop a comprehensive Central Coast oak woodland planning program is discussed and one potential strategy is presented.

## *STRATEGIES FOR WORRYING WITHIN THE LOCAL RESOURCE PLANNING PROCESS*

### *Context and Issues Facing Local Resource Planners*

Planners who were a part of the CCSLP discussed specific needs in providing information and making planning/land use decisions: they requested that information be simple, easy to visualize, and in a form useful in public meetings.

Major issues that confront the land use planner and decision makers regarding use and development of oak woodlands (or any other natural resource) can be divided into three categories:

1) Short-term maintenance and development (new/upgrading) proposals.
2) Mid-term major phased development proposals.
3) Long-term land use plans including policy related to resource management goals. Incremental cumulative effects on resources are generally addressed at this level.

Public response and interest in oak woodlands management falls into three groups:

1) Individuals having a direct or indirect economic interest.
2) Individuals having an interest in maintaining, protecting and enhancing the resource related to its basic biological and aesthetic value.
3) Individuals that are ambivalent towards any value related to oak woodlands and promote government time and funds towards other interests.

*Developing Information and Management Strategies Consistent With Local Planning*

Any process that includes local planning for the management of oaks woodlands must include guidance and information responsive to people involved and issues addressed. Such a format would include the following components:

Planning Time Frames: 1 year; 5 year; 10 year; 20 year
Geographical Scope: Urban, Suburban, Agricultural/Rangelands, Parklands, Combined Areas Into Central Coast Sub-regions, Central Coast region (regions based on Ecological Measures)
Uses: Residential/Commercial, Parklands/Open Space, Agricultural, Rangelands

*A MANAGEMENT TOOL FOR LO- ISSUES*

*A Planner's Guide for Oak Woodlands*

A Planner's Guide For Oak Woodland?' provides local planners with a comprehensive tool to identify and address major oak woodland management issues. The Guide shows how to assess oak woodland value in the context of the needs of human society and how to examine the value of oak woodland to other plants and wildlife and the ecosystem in general. The Guide provides planning options in the context of current planning law and exhibits a case study of an oak woodland management program for the City of Visalia.

[20] Bleier, Cathy, Charles Bolsinger, Lynn Huntsinger, Douglas D, McCreary, Pamela Muick, Robert H. Schmidt, Thomas A. Scott, Richard B. Standiford, Tedmund Swiecki, Wiiam Tietje, Barry Garrison. 'A Planners Guide for Oak Woodlands, " University of California Integrated Hardwood Range Management Program (Berkeley), 1993.

Participants of the workshop familiar with the Guide agreed that it should be a basis and tool for implementing the local aspect of a regional planning process. The Guide is especially helpful with detailing the implementation of various types of management measures for different uses and settings. As a generic guide, it does not determine specifically when, where, or how much management should be required; answers to these management questionsmust be addressed through an active local-regional planning process.

### *The Holistic Resource Management Approach for* Oak *Woodlands*

The Holistic Resource Management Approach was offered as one potential basis or guideline for developing a comprehensive planning methodology for the management of oak woodlands. Holistic Resource Management is a goal-oriented, value-driven process using a standard model which encourages economically viable, ecologically sound, and socially just decision making. The model has been in development for twenty years and is being used in over twenty-two countries[21].

The model is based on addressing the full spectrum of i&rests--including environmental, social and economic-of a given situation. Goals are developed based on values, expected production of the land, and a vision of the future landscape. To implement the model, various tools and guidelines specific to the goals and circumstances of the situation are used. The model includes a control factor to monitor and test outcomes of the process, to assess whether original assumptions were correct and goals are being realized. If the process is found not to be effective in meeting specified goals, the model provides for corrective actions to be taken, refocusing the process to meet those goals.

[21] Further information may be obtained from the Center for Holistic Resource Management, Albuquerque, New Mexico, or contact George Work, Work Ranch, San Miguel, California.

*Considering several decision-making tools*

Planners must consider other values in the landscape besides those specific to the sustainability of oaks, including wildlife, fire protection, grazing rights or land use changes related to economic values. Many planners find a simple map overlay ranking the oak woodland on quality or the importance of preservation to be helpful; such overlays would be critical in the implementation of any conservation strategy.

Planning for conservation of a particular habitat may conflict with conservation of other habitats, or with the pattern of open space needs for visual/aesthetic requirements. Decision making in planning may have to optimize for several values.

*Many* in the CCSLP believe, based on ongoing processes to save habitat within California, that management for biodiversity (as with the Coastal Sage Scrub of Southern California) will be a prominent drive in the planning process. To this end, and because planners will need overlays for oak habitat quality, it will be necessary to define quality gradients. Resources for protection are limited, so pressures of other *competing* needs of society, agriculture, and other ecosystem management goals will require prioritization of action.

A decision making tool offered to the group, the Oak Restoration-Decision Tree by David Chipping[22], addresses the assessment of an existing environment to determine potential for restoration by evaluating the value and quality of a site. Levels of value and quality are judged based on the opportunity and potential success of restoring a degraded woodland to a healthy state. This value-oriented tool could be used to prioritize areas being identified for restoration. Also, the restoration tree could be adapted to assess the health of one, or several, oak woodland areas. Restoration is often suggested to mitigate an impact identified for a project or use that will affect oak woodlands.

Deborah Hillyard and David Chipping tried to develop schematics that could be used as an issues checklist for land planners. The schematics included reference to stand quality as might have been derived through a tool like the Oak Restoration-Decision Tree, but also to other pressures such as fire, grazing, pests, natural competition and ecosystem fragmentation that could

[22] See Appendix F for the Oak R&oration-Decision Tree.

affect the stability of a stand. Finally, it considers the relative risks of land conversion, including the land use patterns in the area over time. The schematics[23], which never advanced further than a draft stage, was considered too complicated by some in the project, but a useful start at defining a land use tool by others.

## *GEOGRAPHIC INFORMATION SYSTEMS (GIS)*

### *Helping to manage oak woodlands*

The geographic information system (GIS) is used to identify measures and criteria for sustainability in a number of ways. The first way is to better understand oak habitat, its characteristics and systems. At the landscape level, the GIS is used to determine patch size, edge length, and density. These can be studied in numeric form which illustrate the relationship between stand (patch) sire, density, and the various oak types[24]. The landscape can also be displayed in map form to determine spatial characteristics[25]. These measures can be studied, compared, and used in part to determine sustainability. Issues of the region, landscape, and site or stand level can all be studied to better understand oak habitats.

A second use of GIS technology is to create "models" of oak woodland sustainability. This, when coupled with different growth scenarios, can determine areas which may be at risk from future development. The relationship of oaks to development has been noted to be a significant part of oak sustainability.

Third, with a specific set of criteria the GIS can find potential areas of regeneration or restoration. These can then be used in the planning process to determine conflict and be part of the criteria for dispute of land uses.

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[23] See Appendix E for the Field Observation and Later Validation Schematics.

[24] See Appendix G for histograms by Dr. Walter Bremer, Landscape Architecture Department, California State Polytechnic University, San Luis Obispo.

[25] See Appendix H for maps.

*Development of a regional oak woodland database*

Measures and criteria generated from this project have led to the start of a "data list" for a regional database to use in planning. It became clear during the CCSLP that with GIS technology and a da&base including information related to the measures and criteria developed in the project, the planning process could better respond to issues of oak woodlands.

As the CCSLP process has progressed, there has been considerable interest in a continuation of GIS activities and further development of a regional database structure. The CCSLP discussion has suggested a multi-level structure with a State database, a regional component, and access at the county level. Certain data would be maintained at the state level, while data specific to a region would be captured and maintained at that level. This "distributed" structure is both flexible and efficient. Existing (TEALE Data Center) and planned (i.e. CERES) data sources would be the start of such a system.

During the CCSLP, participants identified accuracy and classification standards, security, and methods of access as important issues. Data standards issues are presently being addressed at the state and federal levels.

As a beginning for the regional database development, the Landscape Architecture Department at California State Polytechnic University (Cal Poly), San Luis Obispo has begun to acquire and organize the geographic data for the multi-county region using ARC/INFO GIS software. The system is connected to the INTERNET, allowing access to other state databases, including CDF. The data is being developed, including oaks, population, roads, streams, and various other layers, and use of the database is being explored. While map production is important, it is recognized that modeling with the database will also be useful.

Though access to GIS tools and data is yet to be Worked out for the region, participants are eager to continue these activities. Efforts are underway to continue developing the database and to develop methods of access with the geographic information system at Cal Poly. It appears that the Central Coast can become part of several distributed databases which can be used for exploring these issues.

## *COMBINING MANAGEMENT TOOLS AND INFORMATION*

### *Developing a regional oak woodland management program*

During meetings addressing the technical scientific/biological aspects of oak sustainability and habitat issues, many conflicts and impacts were shown to relate directly to current planning and management practices for areas containing oak resources. It was shown that even the data that needed to be collected and the areas that needed most study were dependent on how users and potential users were guided and regulated in the currentlocal planning process.

As the project progressed, it became apparent to oak woodland scientific and technical specialists and to local resource owners, users and land use planners, that in order to identify and analyze oak woodland resources, it would be necessary to devise a method to monitor and understand the evolution and character of the oak woodland habitat. It was determined that a comprehensive, regional, multi-jurisdictional planning and management program needs to be developed and implemented.

Major conclusions contributing to this determination were:

1) Oak woodlands are part of an ecosystem that crosses political boundaries.
2) Biological diversity regionally has an effect on, and is affected by, oak woodlands and their level of sustainability.
3) Past, present and future state and local planning/regulatory activities influence how oak woodlands are assessed regarding sustainability, and this will have a major influence on future management practices. State/local planning efforts and technical assessment must be internally consistent regarding data and management practices.
4) Local landowners, potential developers, and other user groups need to contribute to the planning process, and any planning and management initiatives must include and be responsive to their needs.
5) A regionally consistent approach towards educating users, potential users and planners must be implemented with a centralized forum to hear and form a common approach to resolving oak woodland management issues.

With these conclusions in mind, the subcommittee presented a regionally initiated program integrating state and federal agencies, entitled, "The Program For Developing and Implementing an Oak Woodland Management Program for the Central Coast Bio-region[26]."

The assumptions of this chart are:

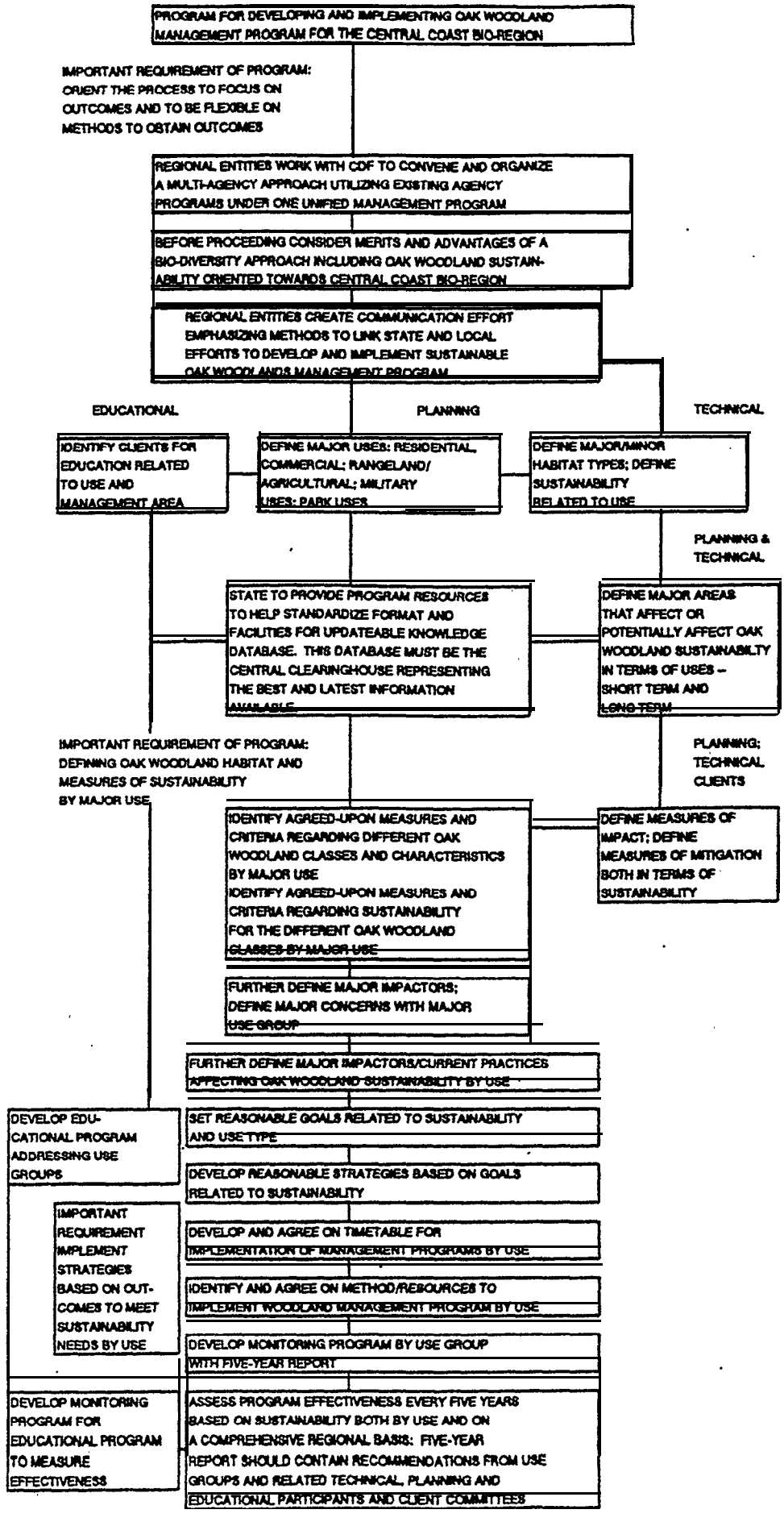
(1) People from throughout the region and state work together.

(2) The effort is sensitive to various user groups so that their needs are recognized and incorporated into the implementation strategies that emerge.

(3) State and local jurisdictions and user groups develop an action-oriented planning management process that is supported for the long-term.

(4) Baseline studies of the present state of the oak woodland are necessary for planners, as they must gauge both loss and gain quantitatively. Thus, an ongoing monitoring program must be established with guaranteed funding and support.

[26] Jeff Main, Planning and Building Department, Monterey County.


PROGRAM FOR DEVELOPING AND IMPLEMENTING OAK WOODLAND MANAGEMENT PROGRAM FOR THE CENTRAL COAST BIO-REGION
IMPORTANT REQUIREMENT OF PROGRAM: ORIENT THE PROCESS TO FOCUS ON OUTCOMES AND TO BE FLEXIBLE ON METHODS TO OBTAIN OUTCOMES
REGIONAL ENTITIES WORK WITH CDF TO CONVENE AND ORGANIZE A MULTI-AGENCY APPROACH UTILIZING EXISTING AGENCY PROGRAMS UNDER ONE UNIFIED MANAGEMENT PROGRAM
BEFORE PROCEEDING CONSIDER MERITS AND ADVANTAGES OF A BIO-DIVERSITY APPROACH INCLUDING OAK WOODLAND SUSTAINABILITY ORIENTED TOWARDS CENTRAL COAST BIO-REGION
REGIONAL ENTITIES CREATE COMMUNICATION EFFORT EMPHASIZING METHODS TO LINK STATE AND LOCAL EFFORTS TO DEVELOP AND IMPLEMENT SUSTAINABLE OAK WOODLANDS MANAGEMENT PROGRAM
EDUCATIONAL
PLANNING
TECHNICAL
IDENTIFY CLIENTS FOR EDUCATION RELATED TO USE AND MANAGEMENT AREA
DEFINE MAJOR USES: RESIDENTIAL, COMMERCIAL; RANGELAND/ AGRICULTURAL; MILITARY USES; PARK USES
DEFINE MAJOR/MINOR HABITAT TYPES; DEFINE SUSTAINABILITY RELATED TO USE
PLANNING & TECHNICAL
STATE TO PROVIDE PROGRAM RESOURCES TO HELP STANDARDIZE FORMAT AND FACILITIES FOR UPDATEABLE KNOWLEDGE DATABASE. THIS DATABASE MUST BE THE CENTRAL CLEARINGHOUSE REPRESENTING THE BEST AND LATEST INFORMATION AVAILABLE
DEFINE MAJOR AREAS THAT AFFECT OR POTENTIALLY AFFECT OAK WOODLAND SUSTAINABILITY IN TERMS OF USES -- SHORT TERM AND LONG TERM
IMPORTANT REQUIREMENT OF PROGRAM: DEFINING OAK WOODLAND HABITAT AND MEASURES OF SUSTAINABILITY BY MAJOR USE
PLANNING; TECHNICAL CLIENTS
IDENTIFY AGREED-UPON MEASURES AND CRITERIA REGARDING DIFFERENT OAK WOODLAND CLASSES AND CHARACTERISTICS BY MAJOR USE
IDENTIFY AGREED-UPON MEASURES AND CRITERIA REGARDING SUSTAINABILITY FOR THE DIFFERENT OAK WOODLAND CLASSES BY MAJOR USE
DEFINE MEASURES OF IMPACT; DEFINE MEASURES OF MITIGATION BOTH IN TERMS OF SUSTAINABILITY
FURTHER DEFINE MAJOR IMPACTORS; DEFINE MAJOR CONCERNS WITH MAJOR USE GROUP
FURTHER DEFINE MAJOR IMPACTORS/CURRENT PRACTICES AFFECTING OAK WOODLAND SUSTAINABILITY BY USE
DEVELOP EDUCATIONAL PROGRAM ADDRESSING USE GROUPS
SET REASONABLE GOALS RELATED TO SUSTAINABILITY AND USE TYPE
DEVELOP REASONABLE STRATEGIES BASED ON GOALS RELATED TO SUSTAINABILITY
IMPORTANT REQUIREMENT IMPLEMENT STRATEGIES BASED ON OUTCOMES TO MEET SUSTAINABILITY NEEDS BY USE
DEVELOP AND AGREE ON TIMETABLE FOR IMPLEMENTATION OF MANAGEMENT PROGRAMS BY USE
IDENTIFY AND AGREE ON METHOD/RESOURCES TO IMPLEMENT WOODLAND MANAGEMENT PROGRAM BY USE
DEVELOP MONITORING PROGRAM BY USE GROUP WITH FIVE-YEAR REPORT
DEVELOP MONITORING PROGRAM FOR EDUCATIONAL PROGRAM TO MEASURE EFFECTIVENESS
ASSESS PROGRAM EFFECTIVENESS EVERY FIVE YEARS BASED ON SUSTAINABILITY BOTH BY USE AND ON A COMPREHENSIVE REGIONAL BASIS: FIVE-YEAR REPORT SHOULD CONTAIN RECOMMENDATIONS FROM USE GROUPS AND RELATED TECHNICAL, PLANNING AND EDUCATIONAL PARTICIPANTS AND CLIENT COMMITTEES

## *TRANSITIONAL* ISSUES

It is clear that as one step toward a continuing effort, the group needs to determine its specific objectives, discuss possible financial resources, decide whether the group should be reconfigured in any way, and determine the organizational vehicle(s) by which its work will continue. One initial issue will be how the CCSLP wishes to interface with work presently occurring in the region. The following describes possible elements of a program for future work in the region.

## *POTENTIAL PROGRAMS*

### *The Institutional Work Program*

The Program For Developing and Implementing An Oak Woodland Management Program For The Central Coast Bio-region (discussed in Chapter 3) identifies a way to bring together institutional resources throughout the region in an integrated educational, technical, and planning effort to produce an information system and implementation strategies for sustainability. The group may wish to explore this model.

### *The Technical Work Program*

Subsequent technical work could finish assigning specific values to the criteria, evaluate the measures and criteria through a field observation and later validation or other agreed upon method of verification, examine future scenarios in relation to the criteria for sustainability, and provide this information in a form usable for implementers using the feedback and framework developed through this project.

*Development of The Regional Database*

As identified in Chapter III, participants want to support the development of a regional database. Participants may wish to explore other database efforts in the region to coordinate efforts, including addressing some issues identified in the CCSLP meetings regarding a regional database.

# APPENDIX A

# WORKPLAN

# Criteria for Sustainable Regional Landscapes

## Workplan

*Phase I: The Central Coast*
*Phase II: The Northern Sacramento Valley*

Project Manager: Beth Greenwood, Center for Cooperative Solutions, University Extension, University of California, Davis

RATIONALE

Monterey, San Benito, San Luis Obispo, and portions of Santa Crux and Santa Clara counties comprise the Central Coast region of California. Lower elevation portions of Shasta, Tehama, Butte, Glenn and Colusa counties constitute the Northern Sacramento Valley region. Oak woodland, annual grasslands and chaparral cover the majority of the wildland area in each region. Various mandates confer responsibilities for these vegetation types on the Board of Forestry and CDF. This project will operationalize existing policy pertaining to CDF's mission and will improve CDF's efficiency in achieving its mandates.

The Board of Forestry described specifically the State's interest in oak woodlands in its 1986 Policy Options for California's Hardwoods. That interest consisted of resource protection and enhancement, with provisions for continued resource management and land development. Objectives for resource protection and enhancement were described in terms of the ensuring the regeneration of hardwoods themselves, preserving soil and water quality, and conserving wildlife habitat. The Integrated Hardwood Range Management Program was subsequently established to achieve those objectives through research, monitoring and extension.

Over time it has become clear that IHRMP's effectiveness and the ability to evaluate IHRMP's success has been hampered by the unquantified nature of the objectives. A series of workshops in the summer of 1991 to review and revise the objectives concluded:

* A host of individual resource goals are achieved by maintaining oak woodlands as fimctioning ecological systems.

* The description of oak woodlands as functioning ecological systems involves the extent, and internal structure and function of a variety of woodland types, in the context of development, fire, resource management and climatic uncertainty.

* Quantifiable objectives for IHRMP should be expressed as desired landscape conditions in terms of woodland type, extent and internal structure and function.

It is difficult to generate specific desired future conditions for the entire oak woodland because of its size and diversity, and the variety problem of defining regional landscape criteria that assure the maintenance of oak woodlands as functioning ecological systems.

While the Board of Forestry specifically defined the State interest in oak woodlands, the Public Resources Code (Section 713) specifies CDF's responsibility for fire protection, fire prevention, maintenance and enhancement of the state's forest, range and brush land resources. On rangelands Public Resources Code (Section 4781) specifies a State interest in land clearance and revegetation, fire prevention and protection, watershed protection and conservation and the prevention of soil erosion. CDF deploys a number of programs, involving among others, fire suppression, vegetation management, and stewardship, to achieve these ends. The Department and the Board are currently evaluating their possible role in assuring compliance with the Clean Water Act on private rangelands. The definition of regional landscape criteria for these adjacent vegetation types would provide a means by which to coordinate the deployment of these different programs, thereby improving the efficiency of CDF operations.

## OBJECTIVES

This project will a) elaborate measures by which regional landscapes can be assessed for biological sustainability and long-term production of goods and services, b) assess a number of probable future landscapes using these measures and c) extract from an analysis of alternatives those criteria that characterize biologically sustainable landscapes. Measures refer to metrics used to quantify the landscape; e.g. the proportion of the landscape comprised by a given habitat. Criteria: refers to specific values for measures that are consistent with the goal of biological sustainability; e.g. habitat A should not comprise less than xx% of the landscape.

This effort will start first in the Central Coast. Once the procedure has begun and lessons learned during implementation, the effort will be undertaken in the Northern Sacramento Valley. The project will make extensive use of GIS data and analysis to develop the criteria and analyses of these landscapes.

The criteria for biological sustainability will be developed through a five-step procedure:

1. Identify and locate rare entities (species and communities) through the use of the Natural History Database of the Department of Fish and Game, as well as local knowledge of unique features.

2. Identify and characterize measures of ecosystem structure and function sensitive to regional disturbance regimes and human impacts. These measures may be structural, such as habitat diversity, and/or functional, such as rates of nutrient loss.

3. Define values or ranges for all measures under baseline conditions for major areas.

4. Quantify how land management and development change the value of measures.

5. Assess how the landscape will diverge from the baseline conditions as a result of alternative management and development scenarios, and establish criteria that will ensure long-term sustainability of the landscape.

## METHODS

The project requires eight steps:

Step 1 - (First month) Identify technical experts and advisory team members.

A. In the first month, identify up to 15 technical experts who can provide reliable information and advice, and serve on the technical committee to develop the criteria. Technical experts should be drawn from local, state and federal agencies, colleges and universities, private sector, professional societies, and land owner groups.

B. In the first month, identify 5-15 advisors largely from their region for the technical subcommittees. The advisory team will comment on the applicability of technical criteria within existing policy and administration, and assist in developing alternative scenarios. Alternative scenarios will incorporate probable CDF management activities (e.g. prescribed burning to create defensible space around settled areas).

Advisors should be regional administrators and representatives of state and federal land management agencies; planners; local officials; environmentalists; developers; representatives of key industry groups; and labor. Their participation should be coordinated as much as possible by existing local institutions.

C. During this time, the contractor will draft a plan for the creation and maintenance of a regional database at an appropriate institution within or related to the region. The database will utilize data developed by CNDDB of DFG, Teale Date Center, USGS, CDF, and another other source identified by the technical teams. Disbursement of funds to GIS technical support will occur only after approval of the plan by CDF.

Step 2 - (Five months) Technical subcommittee groups will meet and deal with items 1 - 3 under Objectives. Initial technical meetings will be organized as subcommittees concerned with landscape units (e.g., mountain ranges) acceptable by participants. In this initial phase, the technical groups will depend largely on existing materials and GIS data.

The technical teams will meet with the advisory team to describe their efforts and to ascertain from the advisory team possible future directions of change in land management and development. If spatial data pertinent to land use change are identified, the project will have the data captured through Duell Vocational Center.

Step 3 - A one-day workshop with both the technical teams and the advisory group to finalize agreement on measures and baseline data, as well as their implications for criteria.

A. Describe answers to items 1 - 3 under Objectives, particularly distinguishing between areas of general agreement and areas where there is little consensus.

B. Discuss the form that criteria might take and assess the feasibility of their use within existing policy.

C. After the workshop, the contractor will develop a workplan and budget for the Northern Sacramento Valley phase of the project incorporating lessons learned in Steps 1 - 3. Implementation of Phase II will begin after approval of the workplan and budget as a contract amendment.

Step 4 - (Three months) Subcommittees and the advisory team will develop alternative future scenarios and evaluate them in terms of their effect on landscape measures.

A. The advisory group will share with technical experts the current trends on the landscape, what is likely to continue, and what alternatives exist over the long-term. The groups jointly create a number of alternative scenarios for each subcommittee geographic area. These scenarios will include, but not be limited to, assessments of the location and type of future development and measures that will be employed to mitigate fire hazard in developed areas.

B. Technical subcommittees will assess these alternative scenarios with respect to measures developed under Step 2. They will then use best professional judgement to assess the risks to sustainability posed by each alternative. By examining a number of alternatives, the technical team will extract the criteria of landscapes that confer sustainability over the long-term.

Step 5 - A one-day workshop to bring together technical subcommittees with the purpose of creating regional criteria by which to judge resource conditions.

A. Each technical subcommittee will explain the expected impact of the alternative scenarios on the landscape measures in their area and the logic whereby they developed criteria for each measure.

B. The technical subcommittees will develop recommendations for creating a unified set of criteria for the Central Coast.

Step 6 - (Two months) Implement subcommittee recommendations for creating a unified' set of criteria. Staff will prepare drafts and involve technical subcommittee members in revision as needed.

Step 7 - One-day meeting of technical subcommittee members and the advisory team to review the consensus on criteria sustainability of the wildlands of the Central Coast.

Step 8 - (One month) Complete and produce a final report summarizing the activities of the project, as well as the measures, alternatives and criteria developed in the course of the report.

This sequences of tasks will be executed in the Sacramento Valley region starting approximately 9 months after the process has begun in the Central Coast and will be governed by an amendment to this workplan developed under Step 3.

## PROJECT DURATION

*Phase I: 12* months
Phase *II:* 12 months, starting 8 months after project inception

***Total duration:*** *20* months

# APPENDIXB

## WORKING RATIONALE, FOCUS, PROCESS, PRODUCTS AND DEFINITIONS PRODUCED BY THE CENTRAL COAST SUSTAINABLE LANDSCAPES PARTICIPANTS

**Criteria for Sustainable Landscapes Project**

**Working Rationale, Focus, Process, Product and Definitions**
**May 1993**

**Rationale:**

Oak woodlands have been a dramatic part of the Central Coast landscapes, figuring prominently in the area's natural and cultural history. This landscape feature contributes significantly to social and economic vitality as well as to the environmental quality of those who reside in the region. There is widespread concern that many of the native oak landscapes are in trouble. Loss of some wildlife species, fragmentation of habitats and apparent problems with regeneration of some oak species have raised concern among broad segments of the community and agencies at all levels of government.

To enhance our ability to create an approach that protects this national resource, while addressing other needs and interests of our communities, we need better information and improved processes for relating that information to decisions made in the public and private sectors.

Broad Project Focus:

Building the knowledge base and information systems needed to help sustain oak woodland landscapes. This includes adjacent and interdependent natural features that contribute to sustainability of this major landscape feature. It also recognizes the economic and incentive factors which are critical to landowner/manager decisions, whether, on public or private lands. Such decisions, ideally, should be mutually beneficial to the landowner and the oaks, that is, how to both use and maintain the resource.

The'project entails several steps:

1. Defining the combination of conditions required to support a sustainable oak woodland resource.

2. Assessing the impacts of different utilization, management and nurturing practices of sustainability.

3. Pulling together the information and analytical tools needed by individuals, community groups and agencies to help them make better informed choices.

4. Performing this process of building up the information resources in such a way that is useful to those making choices and contributes to the ability to build consensus among those in key positions to influence the sustainability of the oak woodland resources.

Process:

1. Assemble the data and information pertaining to area of focus.

2. Use information to define a combination of conditions which sustain the oak resource.

3. Use regional data to determine regional sustainable landscapes.

4. Identify management direction that will lead to sustainability.

5. Collaborate with diverse community groups, technical specialists, landowners and managers, public agency resources and policy makers to enhance the utility of the information resources.

Products:

1. Databases: (spatial, management and biological research).

2. Information (criteria) and explanations for their application in evaluating oak woodland landscape sustainability.

3. Analyses of management practices to better understand impacts, conflicts, incentives and tradeoffs as they relate to resource outcomes.

4. Evaluation of the impacts of different land uses on oak woodland sustainability.

5. A report and analysis of the technical and advisory committees efforts to improve the utility of scientific information for decision-making among those groups to enhance management policy and practices over time.

Some Assumptions:

1. Some level of management is required to sustain oak woodland landscapes. Whether on private or public lands, for this management to be effective in the long-term, it must be economically viable, ecologically sound and socially just.

2. Today's intense population pressures will only increase, therefore, in order to maintain the present level of biodiversity in the central coast or the state, we will need to greatly increase the level of management applied to oak woodland landscapes.

3. There are areas of the central coast which in the recent past supported oaks, but do not currently. These areas may be considered for planting and establishment of a sustaining oak woodland. Such a decision, however, must recognize and evaluate the fact that we may be displacing a system that may be equally or more valuable.

Definitions:

1. Baseline - The baseline for this project is where oak woodland landscapes are currently located. The systems which exist today include many changes from pre-European settlement, i.e., air pollution, introduced plants, cattle, horses, lack of grizzly bears and reduced populations of large predators, etc. Some of these systems may be functioning in a sustainable manner today, while others may not. This recognizes the broad spectrum of land uses which presently contain oaks or are associated with oak landscapes.

2. Criteria - information, standards, means of judging, or an evaluation. Refers to specific values for measures that evaluate the situation in light of the goal of biological sustainability of the dynamic complex of Central Coast landscapes. Standards on which judgements, thresholds or decisions can be based, e.g., habitat "A" should not comprise less than xx% of the landscape, or net loss of riparian valley oak should not exceed xx %.

3. Landscape - The regional vegetative environment. A larger area which may include many stands, systems and topographies, i.e., valley bottoms, riparian corridors, hillside and ridge topes, which are all interrelated visually but more importantly physically and biologically. Oaks may or may not be present throughout the landscape.

4. Measures - Attributes of habitat, measures, measurements, metrics, data or parameters. Refers to metrics used to quantify the landscape, e.g., the proportion of the landscapes comprised of a given habitat, land use, the aspect of slope, elevation, ownership, zoning, crown density, number of stems per acre, etc.

5. Oak Woodland Landscapes - The oak species native, or presently growing in the Central Coast region. In this project, while the individual oak is of importance, the attention and concern is toward the entire physical and biological system which includes the oak. Unless specifically qualified, it is assumed that the landscape retains a full and appropriate complement of plants and animals.

6. Regeneration - can be defined as a collective phenomenon by which a stand of trees maintains its structure and density by recruiting new saplings into the tree overstory to replace mature trees lost to mortality. It is a component of sustainability. Four types of information are needed to assess the success or failure of oak woodland regeneration as a stand phenomenon:

   1) A description of the stand structure to be maintained over time.
   2) The rate of mortality in the mature tree size classes.
   3) The rate of seedling, sapling and tree recruitment into the stand.
   4) The historic frequency of regenerative pulses (adopted from Jones and Stokes, 1988).

7. Sustainable - To keep in existence over the long term...to maintain or prolong.. .to maintain the resource. Sustainable is a conclusion reached with a particular degree of probability or risk that the oak landscape will continue to regenerate itself for the foreseeable future. Infers a lack of understanding of all the factors and dynamics that relate to sustainability. This conclusion can be qualified to require a particular level of planting, pest control, irrigation, etc. Such a qualification may or may not require that the landscape or all of its component parts be present or fully functioning, self-maintaining, or viably reproducing. However, if we can demonstrate that oak dominated landscapes are sustaining themselves, then we can assumé with reasonable confidence that the various components of the landscape are also sustaining themselves.

# APPENDIX C

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# APPENDIXD

# MATRIX

**Biological/Ecological** Factors Matrix

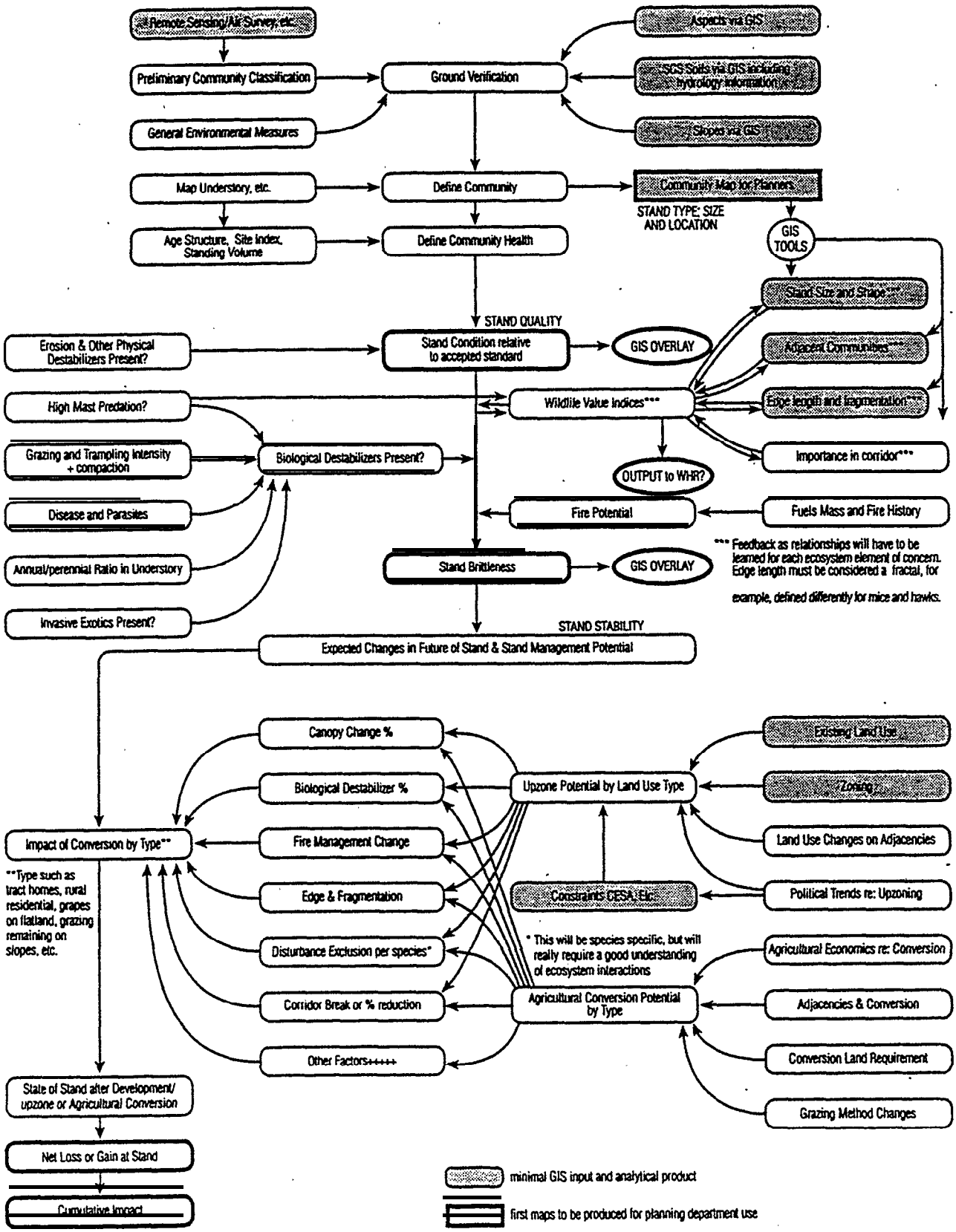
| Groupings- Measures ↓ | Regeneration | Wildlife | Economics | Political/ Stewardship |
|---|---|---|---|---|
| **Site/Physical** | | | | |
| climate | | | | |
| aspect | | | | |
| slope | | | | |
| elevation | | | | |
| soil | | | | |
| ground water | | | | |
| **Plant Community Descriptions** | | | | |
| species composition | | | | |
| edge | | | | |
| basal area | | | | |
| size class | | | | |
| site index | | | | |
| snag density | | | | |
| mortality | | | | |
| canopy cover | | | | |
| health/ disease | | | | |
| patch size | | | | |
| mast production | | | | |
| **Plant Community Dynamics** | | | | |
| recruitment | | | | |
| livestock/ management | | | | |
| disturbance regime | | | | |
| fire frequency | | | | |
| public policy/zoning | | | | |
| adjacency | | | | |
| herbivory | | | | |

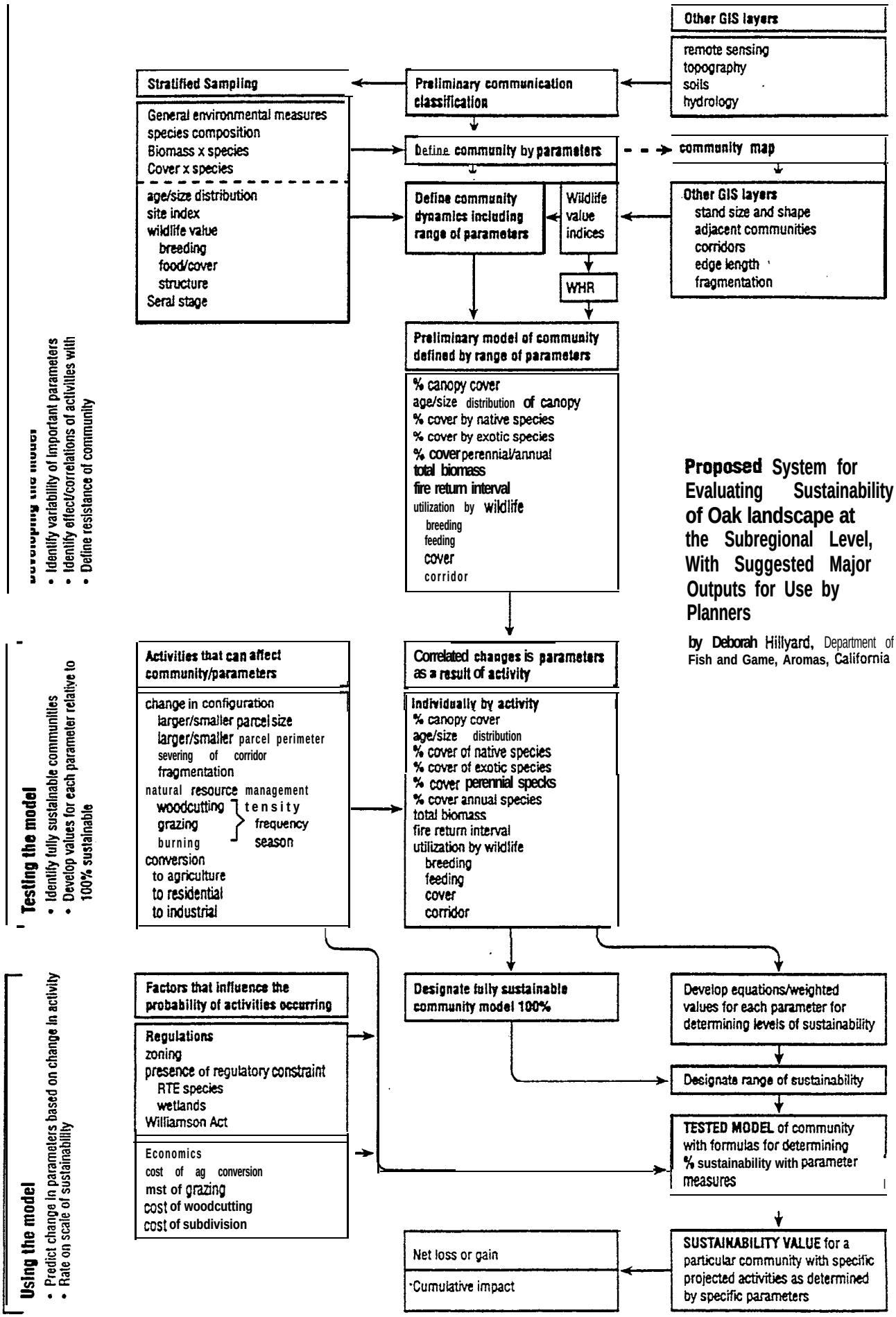
# APPENDIXE

## FIELD OBSERVATION AND LATER VALIDATION SCHEMATICS

# Proposed System for Evaluating Sustainability of Oak landscape at the Subregional level, With Suggested Major Outputs for Use by Planners

By Dr. David Chipping, California Polytechnic University, San Luis Dbiipo






**Proposed** System for Evaluating Sustainability of Oak landscape at the Subregional Level, With Suggested Major Outputs for Use by Planners

by Deborah Hillyard, Department of Fish and Game, Aromas, California

# APPENDIXF .

OAK RESTORATION-DECISION TREE

# OAK RESTORATION-DECISION TREE

The following key represents an attempt by David Chipping to show how measures and criteria could be used in a site quality ranking process. The key has been modified from some earlier drafts in this final report, basically because they contained some comments meant only for the working committee. The key was developed originally to rank sites for oak restoration projects, but is equally applicable to the assessment of site quality. The method is dependent on a prior acceptance of standards against which other sites can be compared, and hence on either prior field observation and later validation or other substantial research. It represents consideration of a very large number of measures in a deliberate way, and results in a site ranking that itself becomes a measure, with a value that may be compared to a movable criteria such as available funding.

1.0 Is site originally habitat for species of oak to be planted?

No 3.0
Yes 2.0
Don't know 3.0

2.0 Was oak once

greater canopy cover than present
2.1
about same canopy cover than present
2.2
lesser canopy cover than present

2.1 Is canopy loss due to

cutting. Ask the locals, check for stumps etc. 2.1.1
stand senility. This means there are insufficient young trees to replace those dying from age
2.1.2
disease, competition or other environment stress. There may be heavy watering that encourages root rot, excessive grazing and soil compaction, evidence of girdling by horses. However lack of large trees may not mean that the stand is dying young, as some species stay dwarfed.
2.1.3

2.1.1 Is cutting being countered by

vigorous regrowth of stump sprouts and/or seedlings/saplings. We will assume that oaks are happy here. There may be no need for restoration. Go to 10
some regrowth of stump sprouts and/or seedlings/saplings. The big problem is the and/or, as sprouting stumps may not mean that conditions will allow saplings to recruit, and the issue is to judge if conditions can be manipulated to benefit the oak
Go to 11
very little regrowth of stump sprouts and/or seedlings/saplings, and the environmental indicators don't look easy to manipulate or reverse (i.e. The Alien covered with oak sawdust, more cows that you have seen, or at least one goat) Go to 12
' no regrowth of stump sprouts and/or seedlings/ saplings 12

2.1.2 Is any recruitment taking place?

Some. There could be some hope here. Caution should be used in marginal conditions, such as the edge of a species range. Possibly conditions have changed, or a rare set of

environmental conditions has not coincided for a while. If you think you can see a way that a small environmental management could better things

Go to 11, or to 10 if the way is simple and clear.

None This could be depressing, but described much oak woodland today. You would rank this below any location where recruitment was taking place, but the environment might be manipulated. Go to 11 if you think you can manage your way to oak happiness through intensive management, but if it looks too difficult Go to 12

2.1.3 Can the problem be

identified and simply solved. Go to 11, or possibly 10 if we REALLY mean simply.
identified but solved with difficulty. Go to 12
identified but not solved. You should probably go to 12
not identified. You could try poking around in the ecological dark, but rank the site low. Go to 12

2.2 We have an implied stability here. Is canopy area composed of just mature trees. 2.2.1
mix of young and old trees 2.2.2

2.2.1 Canopy with just mature trees

Shading or competition with mature trees is preventing recruitment. It is possible that recruitment is episodic, and that stand replacement takes place every once in a geologic while. The stand may be looking after itself, and you should not expend energy on restoration. Go to 12. Site quality may rank high.

But maybe similar stands do have a mix of ages, and something has prevented recent recruitment. Perhaps you can enhance the population Go to 11

2.2.2 Mii of tree ages present
All or most potential recruitment sites occupied. Reject site.
Unoccupied recruitment sites present. Go to 10

2.3 Assess reason for oak canopy gain
Oak recruitment taking place 2.3.1
Past cohort reaching full size, with no new recruitment 2.3.2
Past cut regenerating from stump sprouts 2.3.3

2.3.1 Is recruitment patchy or can it be augmented by planted trees

Are new recruits in an identifiable oak-compatible microhabitat with space available? If it looks like nature won't get to these sites for a while, but will eventually, you have to make a judgment call on the value of the mitigation. Would nature have done what you intend to do? On the other hand, you do have a good chance of success, go to 10, or if uncertain, try 11

Are new recruits in an identifiable but filled microhabitat. You probably cannot improve things and should reject the site. If microhabitat is 'just about filled' you might go to 11 or 12 according to the scale of your project

2.3.2 Is lack of recruitment due to

Shade and competition from existing stand. Like the citizens in a Senior Park, they are trying to tell you something, Reject the site for restoration purposes or go to 12

Other factors such as acorn or sapling predation are causing the lack of recruitment. You can, maybe, change things. Go to 11

2.3.3 Is recruitment taking place between resprouting trees
Yes 2.3.3.1
No 2.3.3.2

2.3.3.1 Recruitment present
If apparent recruitment space is not saturated, go to 10. Note that it may be difficult to determine the saturation level. Savannas are savannas and not woodlands for a reason. You had better assess conditions in nearby and similar sites first. If you don't know why recruitment space is unoccupied, go to 11
If apparent recruitment space is saturated, or unsuited to oaks, reject site or go to 12.

2.3.3.2 No recruitment: Is lack of recruitment due to
Shade and competition from existing stand; reject site or go to 12
Other factors such as acorn or sapling predation. The site may be open to management options, such as rodent control, so go to 11

3.0 No indication of past occupation by oak at site.
Site is close to existing or historic stands of oak species 3.1
Site far from existing or historic stands of oak species 3.2

3.1 Site close to existing or historic. stands
Most site factors at first glance similar to those sites having oaks
If comparison site is healthy, Use site factors comparison match chart.
If match large 11, if small 12
If comparison site is 'unhealthy', in that recruitment is not taking place
find another comparison site in 'healthy' condition. If that cannot be done assess as much as possible. You need to be very cautious if one or more site factors is 'wrong' for the species of oak, such as slope aspect for blue oak Most probable 12, possible 11

3.2 Site far from existing or historic stands
Even with good site factors comparison match, Probably Reject or 12.
You will probably not achieve true ecosystem restoration, even if the trees live.

So far you have divided sites into 10 (Good), 11 (Possible or "Iffy"), and 12 (Poor). Use SITE COMPARISON MATCH CHART (20), THB ALTERNATIVE PLANT COMMUNITY (30) AND POLITICAL, ECONOMIC AND MANAGEMENT ANALYSIS (40).

BUT FIRST.... Let us examine 10, 11, and 12 in greater detail

**GOOD SITES**

10.0 Habitat appears excellent for oak restoration based on existing trees
The 'best' sites may already be fully stocked. We should have detected this earlier in the decision tree, but here you are anyway. If sufficient natural recruitment is taking place to maintain historic canopy, management change is not needed. Find another site.
Recruitment is not taking place 10.1
Some recruitment is taking place 10.2

10.1 Recruitment is not taking place. Go to Site Comparison Match Chart or Species specific chart* to isolate probable factors. (* these should be made up FOR THE LOCAL AREA. 'The requirements of Valley Oak may be different in Atascadero and Chico, but there is some Chico-generality and Atascadero-generality of condition that will enable you to assess "how close is it?" So go to (20)

If list of problem factors appears substantial, back out of 10 and go to. 11

If list is of problem factors is small, assess site management requirements. Rank sites needing one time installation of herbivory protection over sites needing supplemental water, and sites close to service roads over sites far from service roads. Use economic/political check off chart in creating site ranking (40), and check through (30)

10.2 Some recruitment is taking place. Things look good, but you will have to check out the possibility that all possible sites in the microenvironment suitable for oak have been taken. Chances are that an under saturated site of this type will be the very best, highest ranked provided you can check through (30) & (40)-

'IFFY' SITES

11.0 Habitat appears to have some potential for oak restoration based on existing trees

Assess alternative plant community values, Go to 30 for assessment with expectation of return to 11.1 if there is no serious conflict. Rank the Site Factors at 20.

11.1 Back from (30). Alternative Plant Community values show....

11.1.1 Indicate a values conflict. Find another site

I 1.1.2 Show no values conflict: Rank site characteristics at (20), assess site management requirements. Rank sites needing installation of herbivory protection over sites needing supplemental water, and sites close to service roads over sites far from service roads. Use economic/political check off chart in creating site ranking (40) Expect these sites to rank lower than sites selected under 10.1

POOR SITES

12.0 Habitat appears to have little potential for oak restoration based on existing trees or the lack thereof. Rank site characteristics at (20), assess site management requirements (40), only if resources stretch this far. Assess alternative plant community values, Go to 30 for assessment with expectation of return to 12.1

12.1 Alternative Plant Community values

12.1.1 Indicate a values conflict. Find another side

12.1.2 Show no values conflict: assess site management requirements. Rank sites needing one time installation of herbivory protection over sites needing supplemental water, and sites close to service roads over sites far from service roads. Use economic/political check off chart in creating site ranking (40)

Expect these sites to rank lower than sites selected under 10.1 and 11.1

In actuality these sites will be very difficult and should probably not be considered.

**20 Site** Comparison Match **Chart***

Soil Condition:

Soil Type: Sand to loamy sand, clay to loamy clay, sandy loam to clay loam (or another classification breakdown. Thii might be specific to a particular tree, such as riparian Valley Oak.

Soil Thickness

Soil Compaction

Soil Drainage

Soil **Chemistry/Salinity,** including Ph, Electrical Conductivity

**Hardpan** or root restricting layer

**Mycorrhizal** information, or pathogens

Political attitudes of Earth Worms, and other stuff that we will learn along the way.

Slope

Slope Aspect

Elevation (this is **important** if you have **stock** to plant, as you need to be at about the same elevation as the stock acorn source)

Hydrology:

Height above water table

Seasonal inundation

Rateofdrainage

Seasonal rainfall amount and pattern

Vegetation:

similar plant community

**Presence** of **known** competitors

Density of known competitors

Grazing and predation:

Cattle, deer, rodents (squirrel, rabbit, mice, voles and pocket gopher), feral pig, and their stocking densities

* **This can** be modified by a site characteristic checkoff that is species specific. See for example Swiecki and others (1991) checkoff for evaluating Valley Oak restocking sites. The checkoff examines, in turn, historical presence, elevation, **soil** type, soil depth, soil compaction, soil salt content, density of competing vegetation, grazing and predation pressure.

**30.0 Alternative Plant Community Analysis**

**This** section sets up a serious of value assessments. Should the proposed planting be challenged by values **conflicts,** a *new* site should be sought. Return to 10.1, 11.1, or 12.1 as appropriate

What is the Holland or **CNPS** Plant Communities description of the community presently at the site?

**30.1** Is the community of native or non-native plants?

**30.2** Is community extremely common, common, rare, or extremely rare **within the** watershed? What would be the percentage loss to that community relative to the percentage gain for the oak woodland?

30.3 Does the **community** support any species that could be considered threatened, endangered, or a species of special concern?

30.3 Does the community have a very high, high, moderate, or low wildlife value in its present state?

30.4 Does the community have the potential for restoration to a state of equal or better ecological value that the proposed oak woodland?

30.5 Does the act of replacing the habitat raise or lower general biodiversity level in local area and region?

40 Political, Economic and Management Analysis
Rank sites by the following, then return to departure point

40.1 Number of person hours/tree *required,* availability of that labor, and time conflicts for that labor relative to other worthy projects

40.2 Ease of access and turn-around time for servicing replant

40.3 Stability of site relative to the expected life of the oak

40.4 Degree of trust in land manager maintaining fencing, gates or other controls vital to the replant effort.

40.5 Relative importance of the site relative to larger regional goals, such as producing continuous sanctuary under canopy for migrating deer etc.

40.6 Stability of the land relative to possible agricultural conversions, either to housing or to vineyards, row crops etc.

Return to departure point

# APPENDIX G

# HISTOGRAMS

**Stand Size by Density**
11.21.93
w. Bremer

Blue Oak Woodland - scattered<1 0%

| Stand Size | Frequency |
|---|---|
| 0 | 8 |
| 40 | 7 |
| 180 | 16 |
| 360 | 13 |
| 640 | 19 |
| 1280 | 11 |
| 2560 | 11 |
| 5120 | 4 |
| 10240 | 4 |
| 20480 | 0 |

Blue oak - digger pine woodland - scattered<10%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 1 |
| 180 | 3 |
| 360 | 2 |
| 640 | 2 |
| 1280 | 2 |
| 2560 | 2 |
| 5120 | 0 |
| 10240 | 1 |
| 20480 | 0 |

Blue Oak Woodland - low 10-33%

| Stand Size | Frequency |
|---|---|
| 0 | 8 |
| 40 | 8 |
| 180 | 5 |
| 360 | 5 |
| 640 | 8 |
| 1280 | 9 |
| 2560 | 3 |
| 5120 | 3 |
| 10240 | 0 |
| 20460 | 1 |

Blue oak - digger pine woodland - low 10-33%

| Stand Size | Frequency |
|---|---|
| 40 | 1 |
| 180 | 3 |
| 360 | 0 |
| 640 | 0 |
| 1290 | 0 |
| 2560 | 4 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Blue Oak Woodland - medium 34-75%

| Stand Size | Frequency |
|---|---|
| 0 | 3 |
| 40 | 4 |
| 180 | 8 |
| 360 | 3 |
| 640 | 1 |
| 1280 | 6 |
| 2560 | 2 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Blue oak - digger pine woodland - medium 34-75%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 1 |
| 180 | 2 |
| 360 | 1 |
| 640 | 1 |
| 1280 | 1 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 1 |

Blue Oak Woodland - high 761 00%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 0 |
| 180 | 0 |
| 360 | 1 |
| 640 | 1 |
| 1280 | 0 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Blue oak - digger pine woodland - hiih 76100%

| Stand Size | Frequency |
|---|---|
| 0 | 1 |
| 40 | 0 |
| 180 | 1 |
| 360 | 2 |
| 640 | 3 |
| 1280 | 0 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Valley oak woodland • scattered<10%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 0 |
| 180 | 0 |
| 360 | 2 |
| 640 | 0 |
| 1280 | 1 |
| 2560 | 1 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Coastal oak woodland • scattered<10%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 7 |
| 180 | 2 |
| 360 | 12 |
| 640 | 14 |
| 1280 | 10 |
| 2560 | 9 |
| 5120 | 1 |
| 10240 | 2 |
| 20480 | 0 |

1

Valley oak woodland • bw 10-33%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 0 |
| 180 | 2 |
| 360 | 0 |
| 640 | 1 |
| 1280 | 0 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

Coastal oak woodland - low 10-33%

| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 7 |
| 180 | 12 |
| 360 | 10 |
| 640 | 16 |
| 1280 | 13 |
| 2560 | 8 |
| 5120 | 1 |
| 10240 | 3 |
| 20480 | 0 |

Valley oak woodland - medium 34-75%

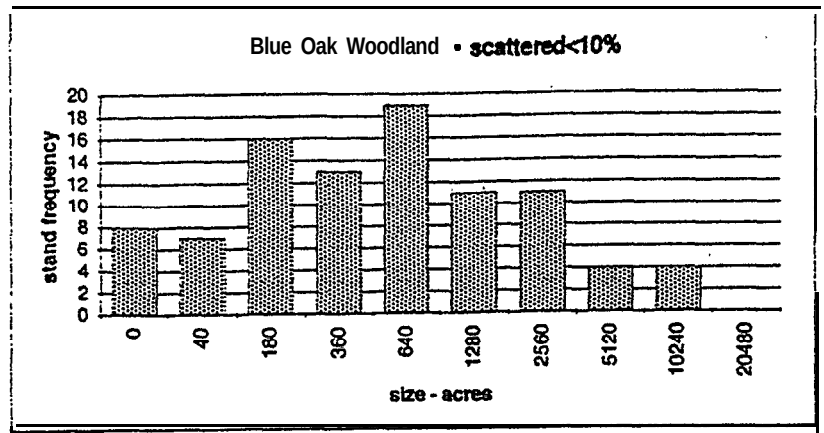
| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 2 |
| 180 | 0 |
| 360 | 0 |
| 640 | 0 |
| 1280 | 0 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

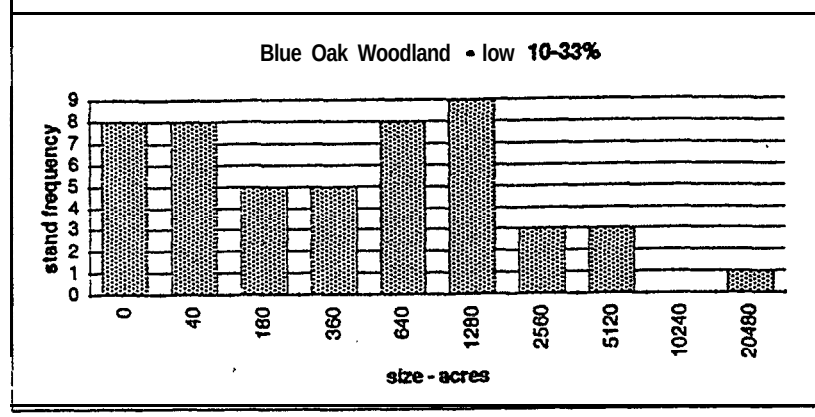
Coastal oak woodland • medium 34-75%

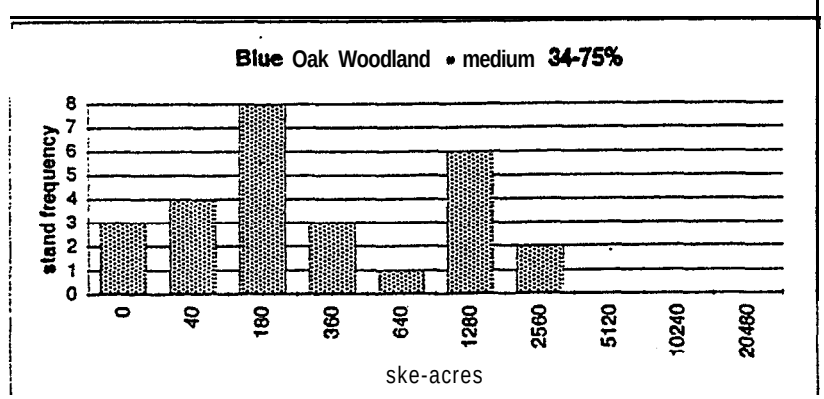
| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 6 |
| 180 | 5 |
| 360 | 12 |
| 640 | 12 |
| 1280 | 8 |
| 2560 | 6 |
| 5120 | 4 |
| 10240 | 1 |
| 20480 | 0 |

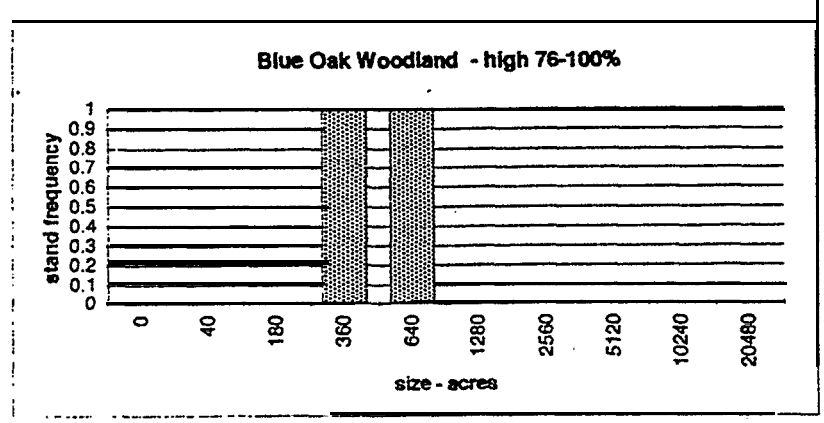
Coastal oak woodland • high 76-100%

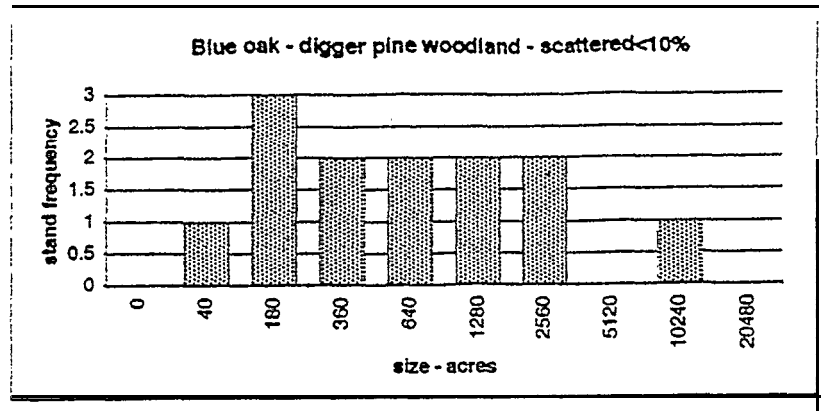
| Stand Size | Frequency |
|---|---|
| 0 | 0 |
| 40 | 4 |
| 180 | 8 |
| 360 | 5 |
| 640 | 7 |
| 1280 | 6 |
| 2560 | 0 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

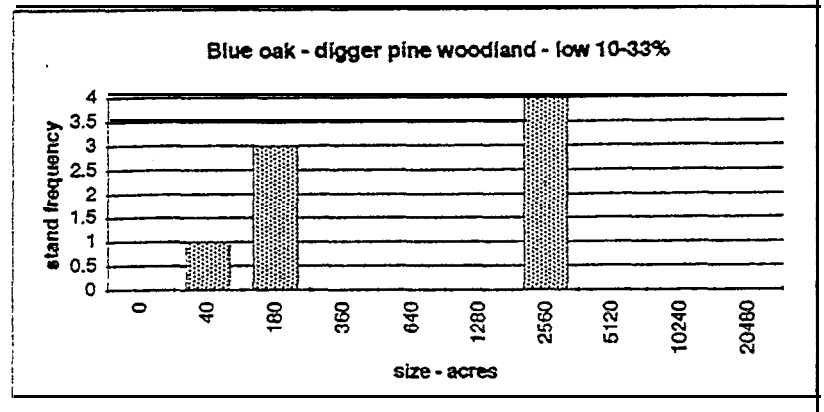

Blue Oak Woodland • scattered<10%
stand frequency
0
2
4
6
8
10
12
14
16
18
20
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

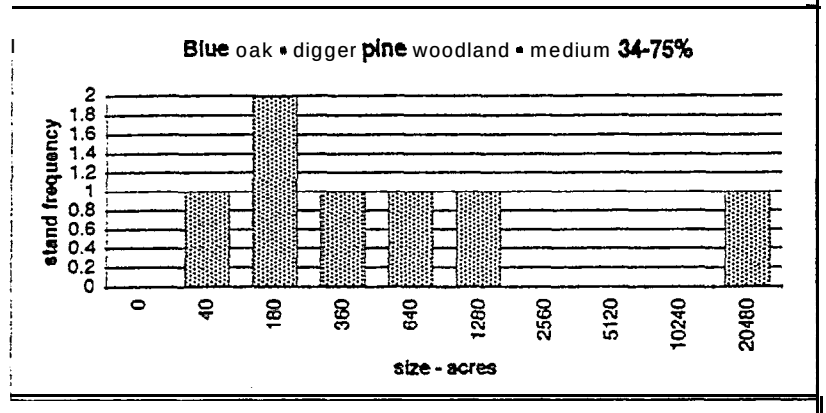

Blue Oak Woodland • low 10-33%
stand frequency
0
1
2
3
4
5
6
7
8
9
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

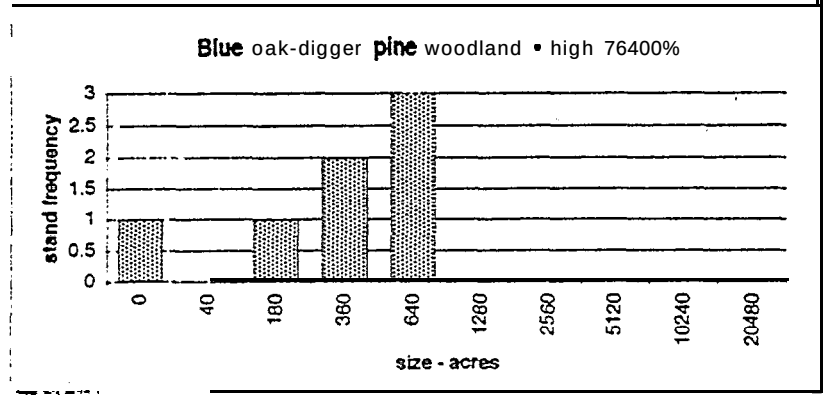

Blue Oak Woodland • medium 34-75%
stand frequency
0
1
2
3
4
5
6
7
8
0
40
180
360
640
1280
2560
5120
10240
20480
ske-acres

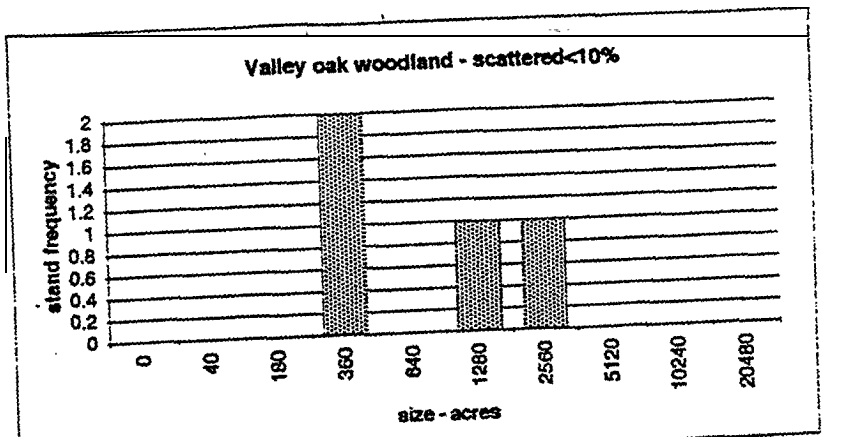

Blue Oak Woodland - high 76-100%
stand frequency
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

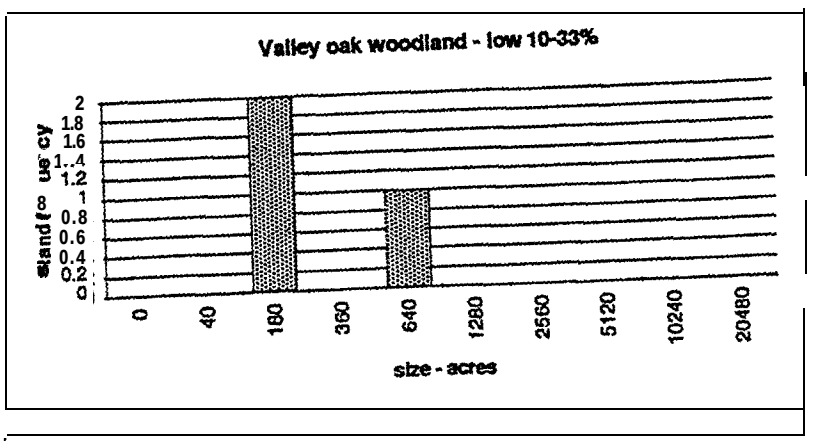

Blue oak - digger pine woodland - scattered<10%
stand frequency
3
2.5
2
1.5
1
0.5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

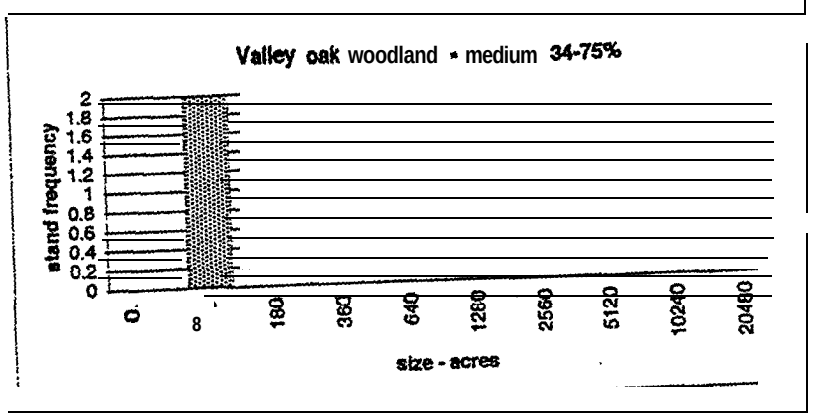

Blue oak - digger pine woodland - low 10-33%
stand frequency
4
3.5
3
2.5
2
1.5
1
0.5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

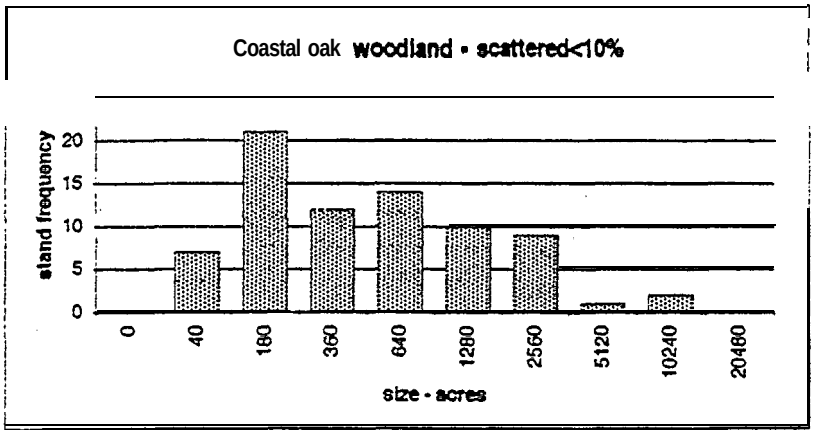

Blue oak • digger pine woodland • medium 34-75%
stand frequency
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

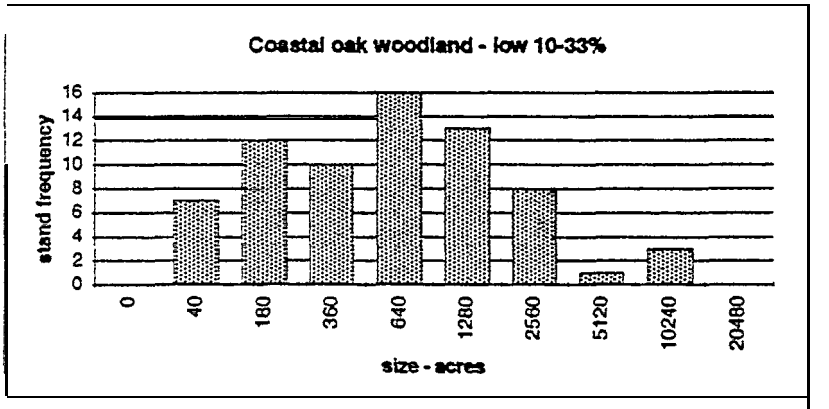

Blue oak-digger pine woodland • high 76400%
stand frequency
3
2.5
2
1.5
1
0.5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

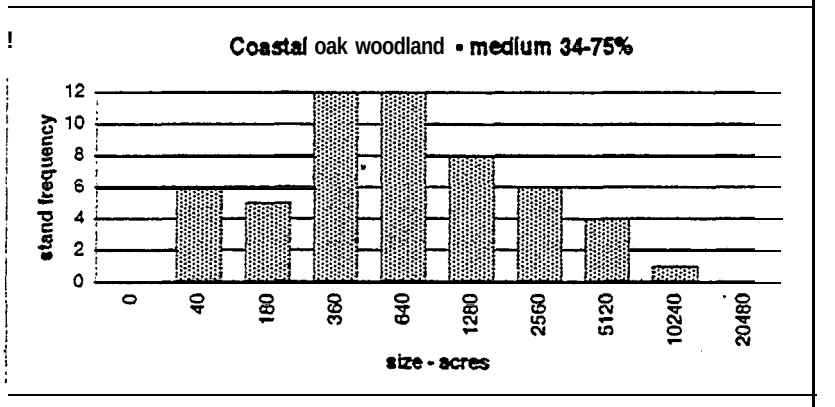

Valley oak woodland - scattered<10%
stand frequency
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

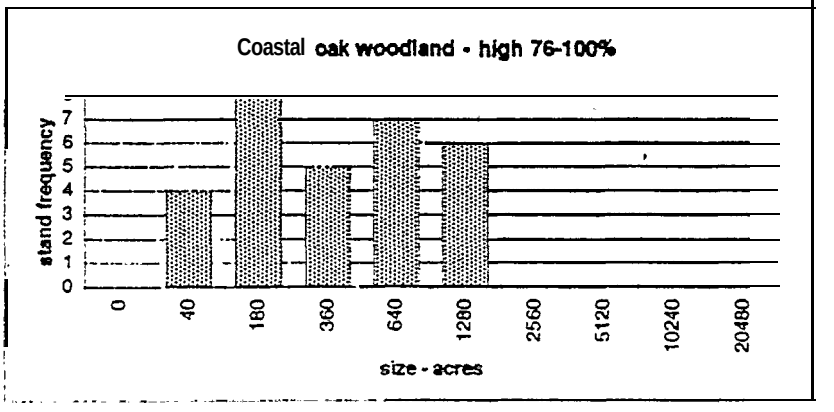

Valley oak woodland - low 10-33%
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Valley oak woodland - medium 34-75%
stand frequency
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
180
360
640
1280
2560
5120
10240
20480
size - acres


Coastal oak woodland - scattered<10%
stand frequency
0
5
10
15
20
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Coastal oak woodland - low 10-33%
stand frequency
0
2
4
6
8
10
12
14
16
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Coastal oak woodland - medium 34-75%
stand frequency
0
2
4
6
8
10
12
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Coastal oak woodland - high 76-100%
stand frequency
0
1
2
3
4
5
6
7
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

Sustainable Landscape Project
Statistics - Oak Woodlands (Pillsbury) - San Luis Obispo County
11.21.93 - w. Bremer

Frequency - density classes - numbers of polygons

Blue oak woodland

| Bin | Frequency |
|---|---|
| scattered<1 0% | 106 |
| low 10-33% | 58 |
| medium 34-75% | 34 |
| high 76-l 00% | 9 |

Blue oak - digger pine woodland

| Bin | Frequency |
|---|---|
| scattered<10% | 13 |
| low lo-33% | 8 |
| medium 34-75% | 7 |
| high 76-100% | 7 |

Valley oak woodland

| Bin | Frequency |
|---|---|
| scattered<1 0% | 4 |
| low lo-33% | 3 |
| medium 34-75% | 2 |
| high 76-100% | 0 |

Coastal oak woodland

| Bin | Frequency |
|---|---|
| scattered<10% | 76 |
| low 10-33% | 70 |
| medium 34-75% | 54 |
| high 76-100% | 30 |

| Type | acres | |
|---|---|---|
| Blue oak | 284258 | |
| Blue oak-Digger pine | 80488 | |
| Valley oak | 8413 | |
| Coastal oak | 350958 | |
| | 724097 | TOTAL |

Frequency - patch (polygon) size

Blue oak woodland

| size-acres | Frequency |
|---|---|
| 0 | 19 |
| 40 | 19 |
| 180 | 29 |
| 360 | 22 |
| 640 | 29 |
| 1280 | 26 |
| 2560 | 16 |
| 5120 | 7 |
| 10240 | 4 |
| 20480 | 1 |

Blue oak - digger pine woodland

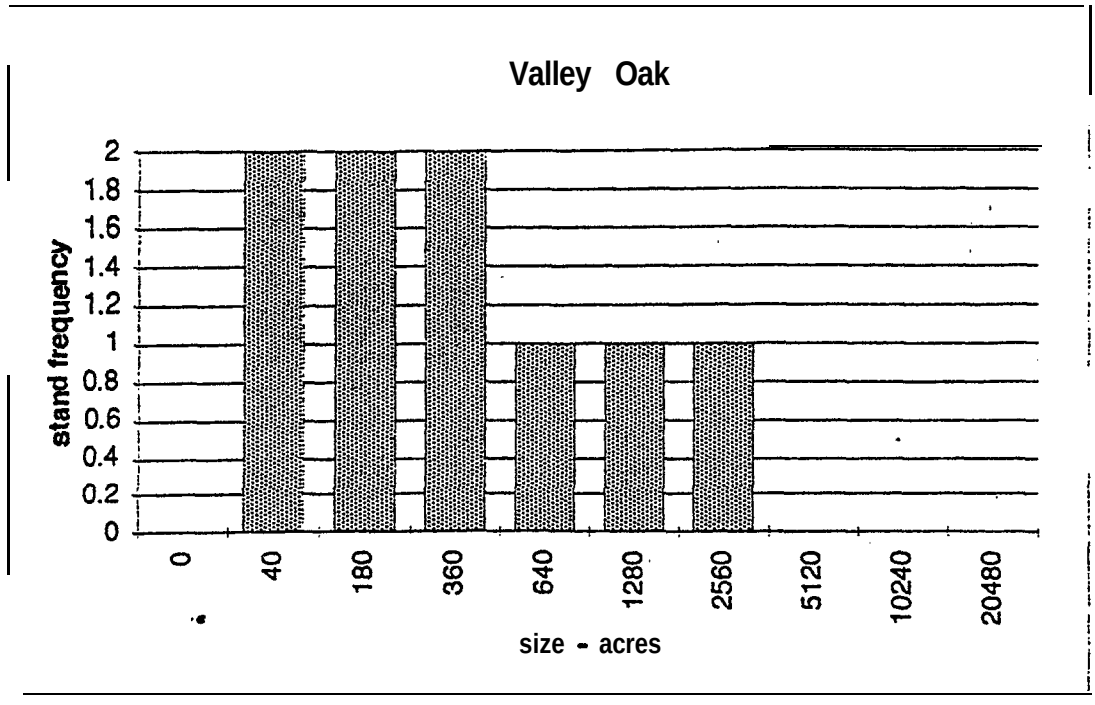
| size-acres | Frequency |
|---|---|
| 0 | 1 |
| 40 | 3 |
| 180 | 9 |
| 360 | 5 |
| 640 | 6 |
| 128-0 | 3 |
| 2560 | 6 |
| 5120 | 0 |
| 10240 | 1 |
| 20480 | 1 |

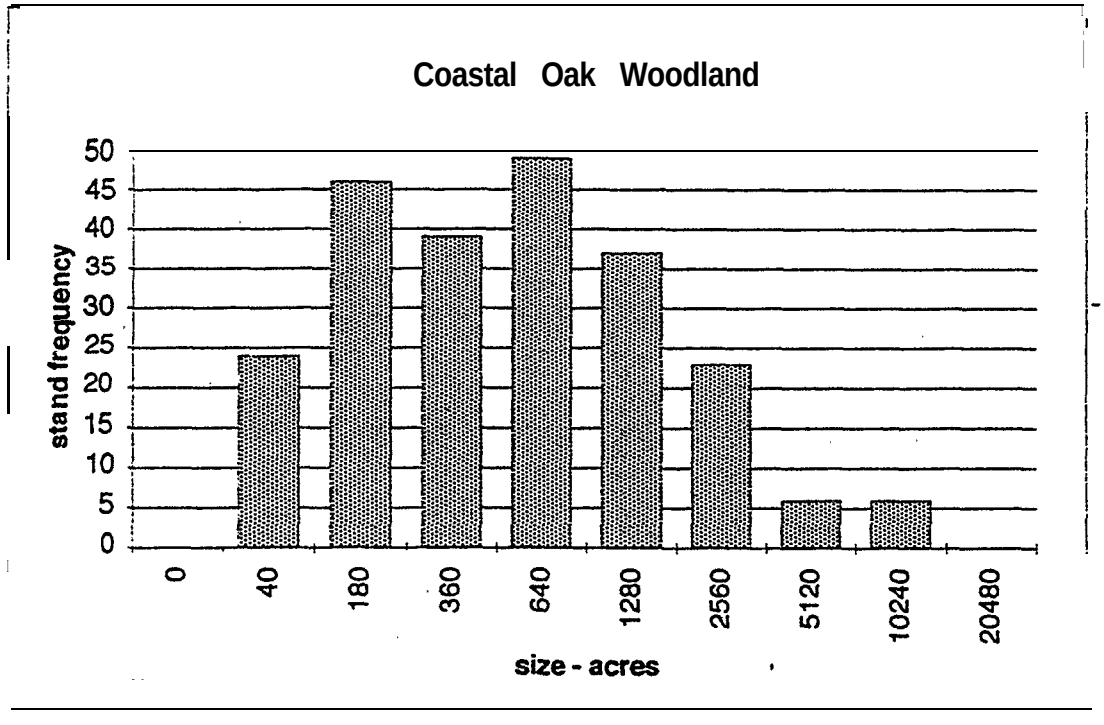
Valley oak woodland

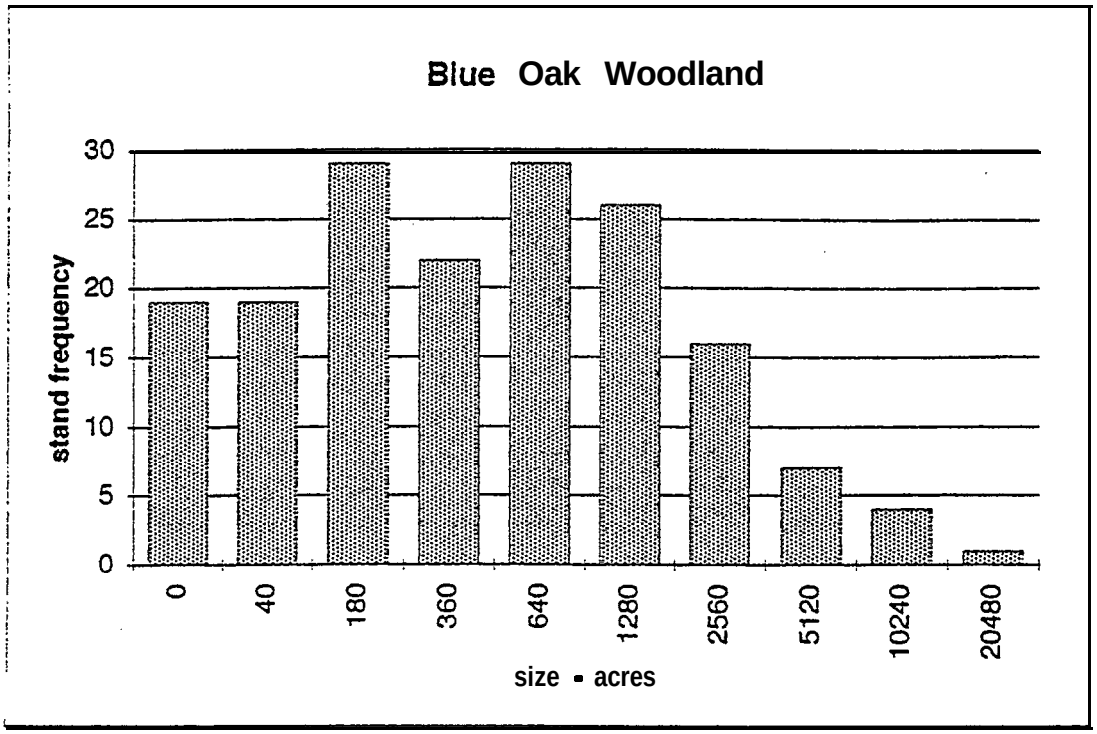
| size-acres | Frequency |
|---|---|
| 0 | 0 |
| 40 | 2 |
| 180 | 2 |
| 360 | 2 |
| 640 | 1 |
| 1280 | 1 |
| 2560 | 1 |
| 5120 | 0 |
| 10240 | 0 |
| 20480 | 0 |

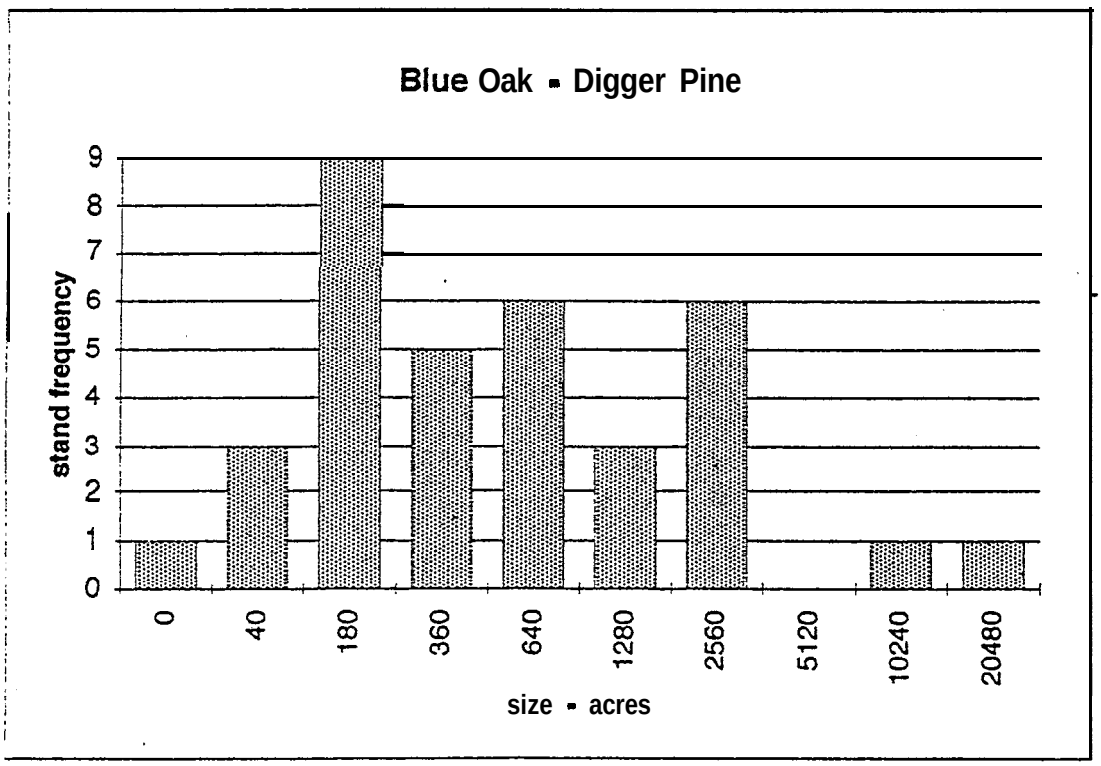
Coastal oak woodland

| size-acres | Frequency |
|---|---|
| 0 | 0 |
| 40 | 24 |
| '18-0 | 46 |
| 360 | 39 |
| 640 | 49 |
| 1280 | 37 |
| 2560 | 23 |
| 5120 | 6 |
| 10240 | 6 |
| 20480 | 0 |

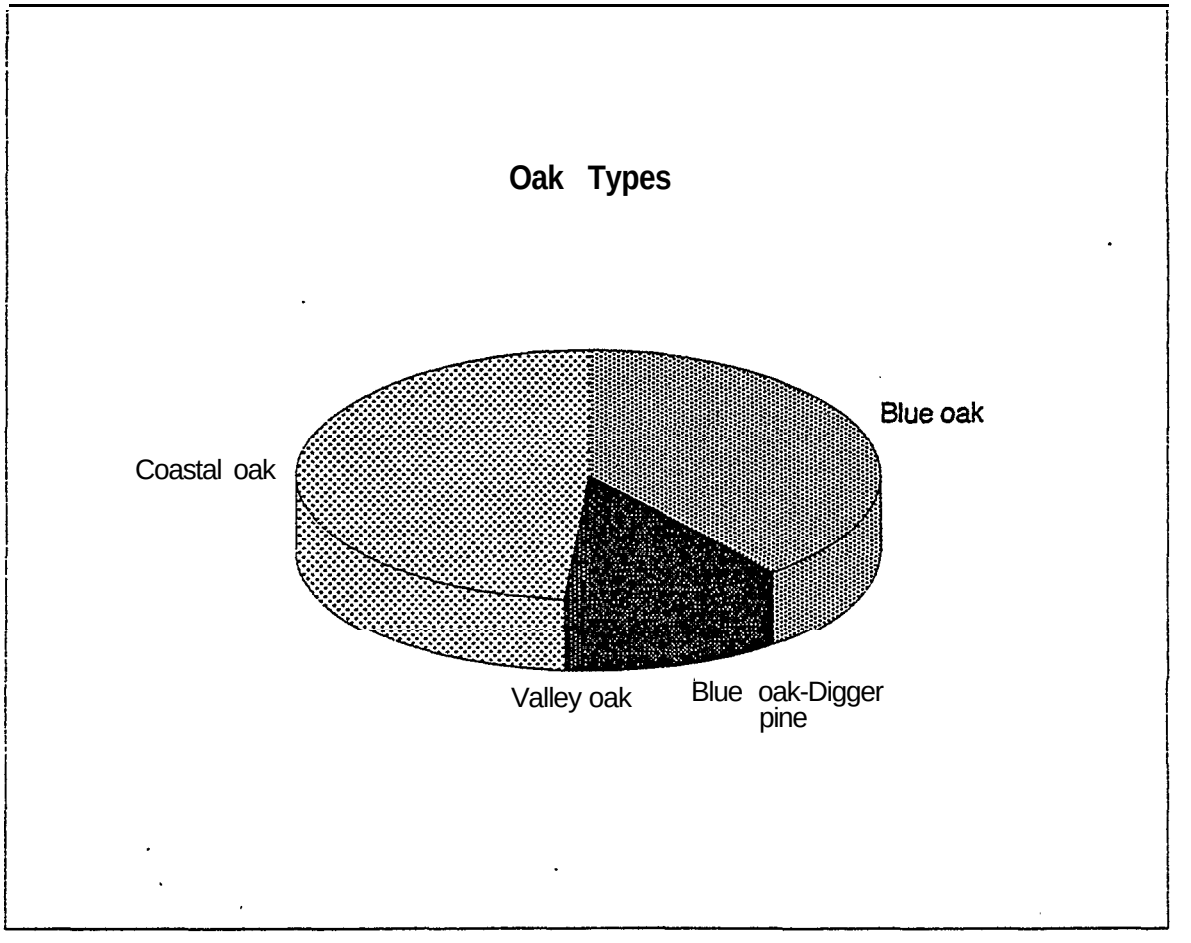

Valley Oak
stand frequency
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Coastal Oak Woodland
stand frequency
50
45
40
35
30
25
20
15
10
5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres


Blue Oak Woodland
stand frequency
30
25
20
15
10
5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

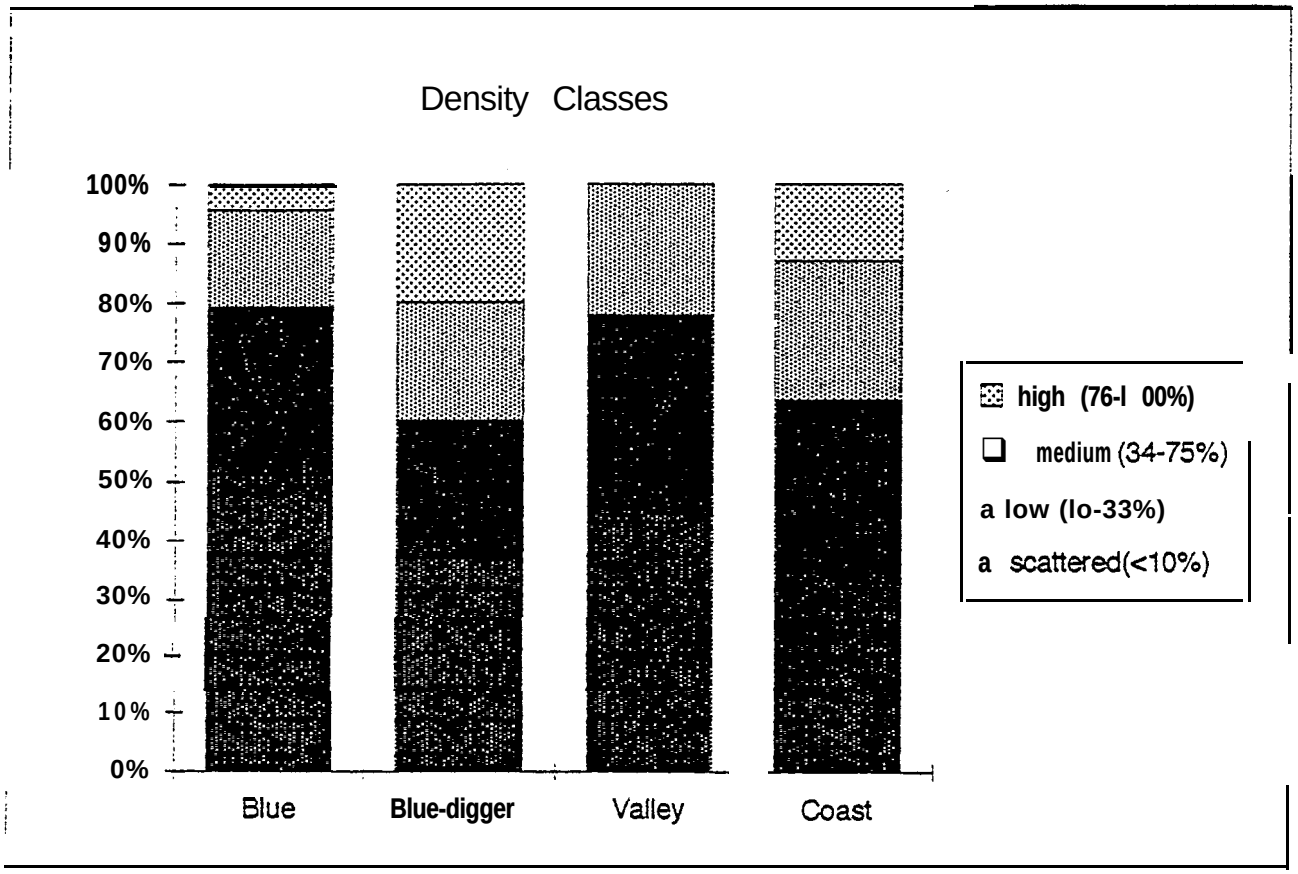

Blue Oak - Digger Pine
stand frequency
9
8
7
6
5
4
3
2
1
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres

| Type | acres |
|---|---|
| Blue oak | 284258 |
| Blue oak-Digger pir | 80468 |
| Valley oak | 8413 |
| Coastal oak | 350958 |



## Density Classes - compared

| | Blue | Blue-digger | Valley | Coast |
|---|---|---|---|---|
| scattered(<10%) | 106 | 13 | 4 | 76 |
| low (10-33%) | 58 | 8 | 3 | 70 |
| medium (34-75%) | 34 | 7 | 2 | 54 |
| high (76-100%) | 9 | 7 | 0 | 30 |



Stand Size by Density - Combinations
11.21.93
w. Bremer

Blue Oak Woodland

| Stand Size | Frequency scattered<10% | Frequency low 10-33% | Frequency medium 34-75% | Frequency high 76-100% |
|---|---|---|---|---|
| 0 | 8 | 8 | 3 | 0 |
| 40 | 7 | 8 | 4 | 0 |
| 180 | 16 | 5 | 8 | 0 |
| 360 | 13 | 5 | 3 | 1 |
| 640 | 19 | 8 | 1 | 1 |
| 1280 | 11 | 9 | 6 | 0 |
| 2560 | 11 | 3 | 2 | 0 |
| 5120 | 4 | 3 | 0 | 0 |
| 10240 | 4 | 0 | 0 | 0 |
| 20480 | 0 | 1 | 0 | 0 |

Valley Oak Woodland

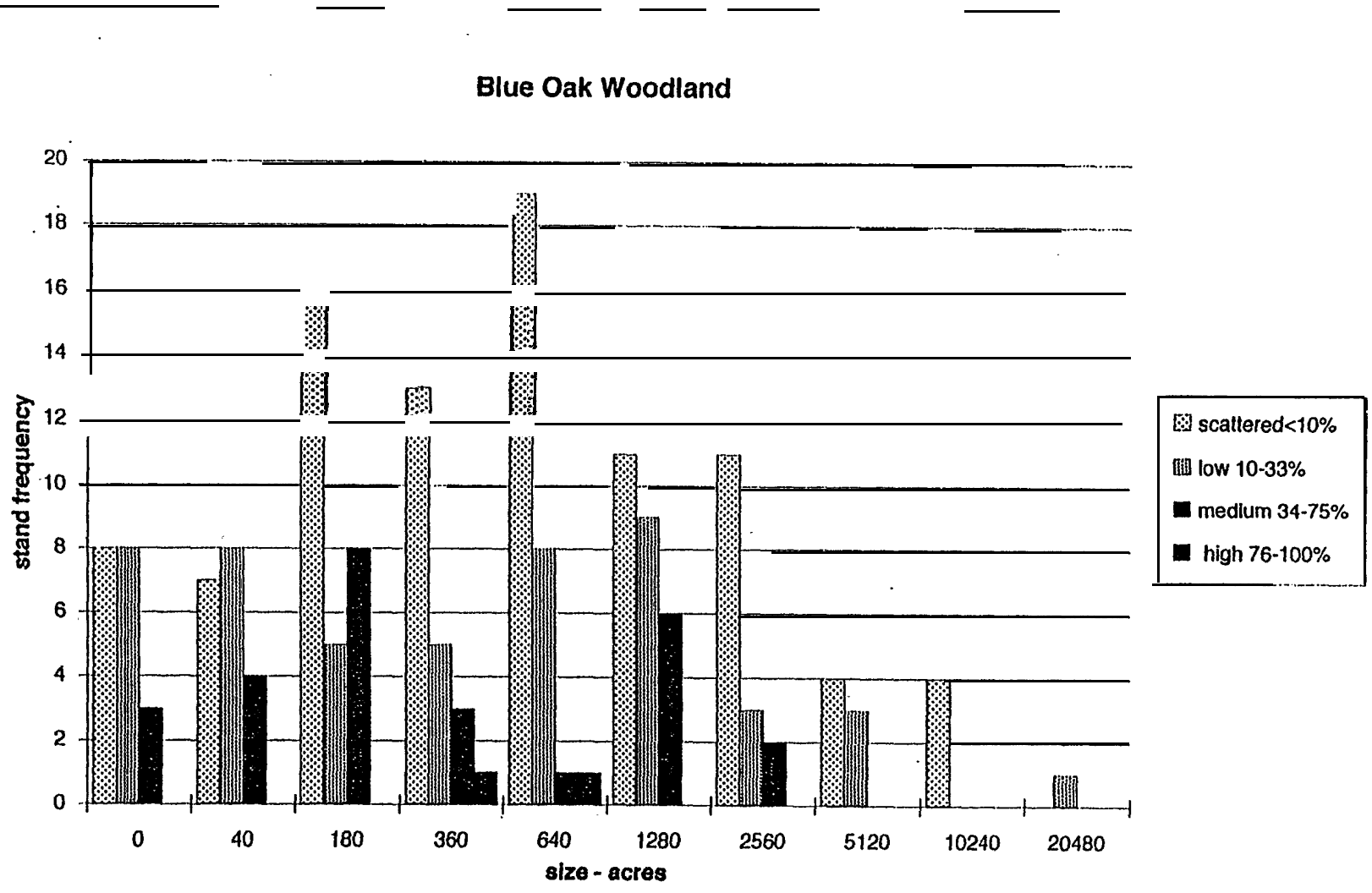
| Stand Size | Frequency scattered<10% | Frequency low 10-33% | Frequency medium 34-75% |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 2 |
| 780 | 0 | 2 | 0 |
| 360 | 2 | 0 | 0 |
| 640 | 0 | 1 | 0 |
| 1280 | 1 | 0 | 0 |
| 2560 | 1 | 0 | 0 |
| 5120 | 0 | 0 | 0 |
| 10240 | 0 | 0 | 0 |
| 20480 | 0 | 0 | 0 |

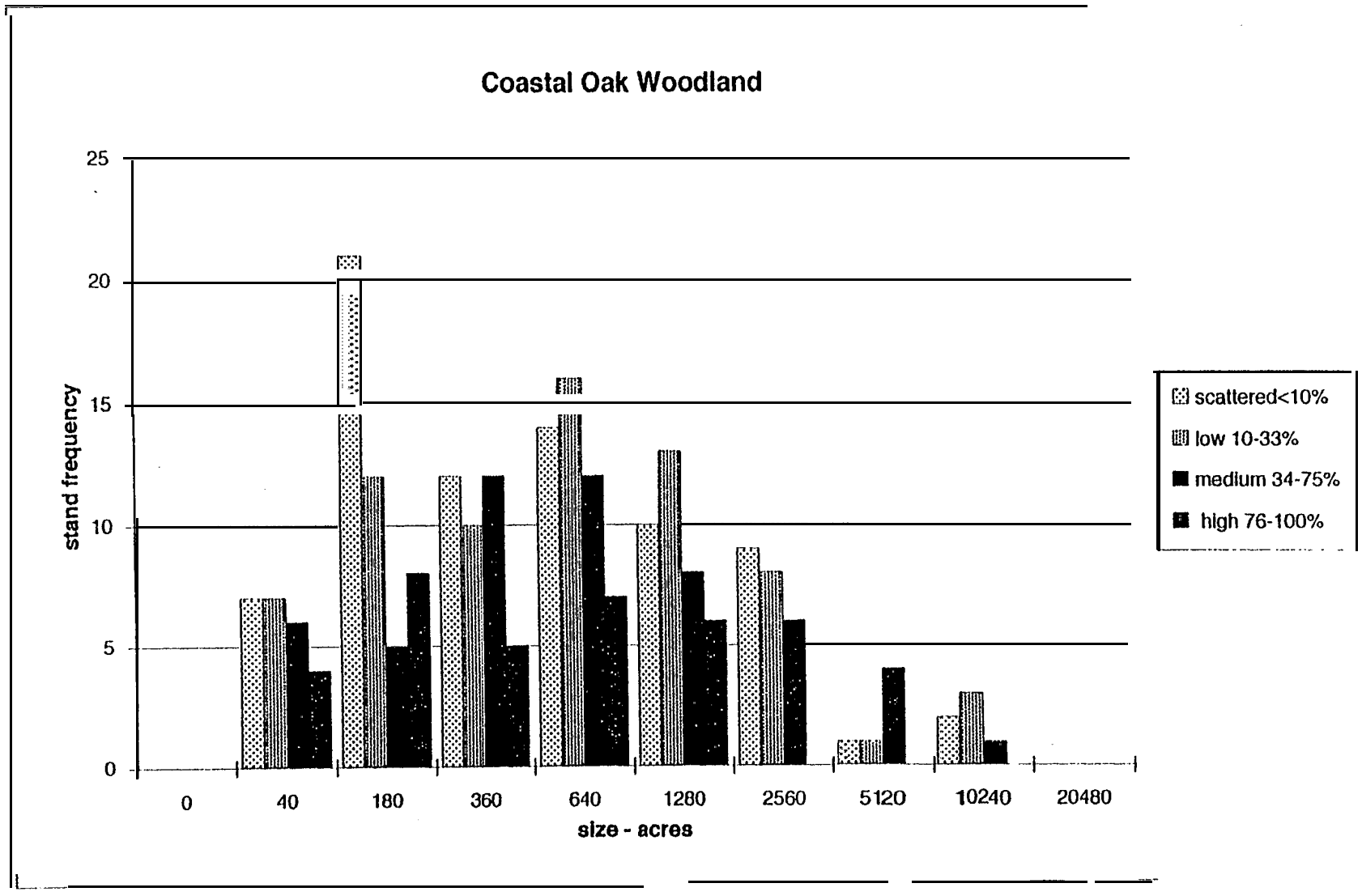
Blue Oak - Digger Pine Woodland

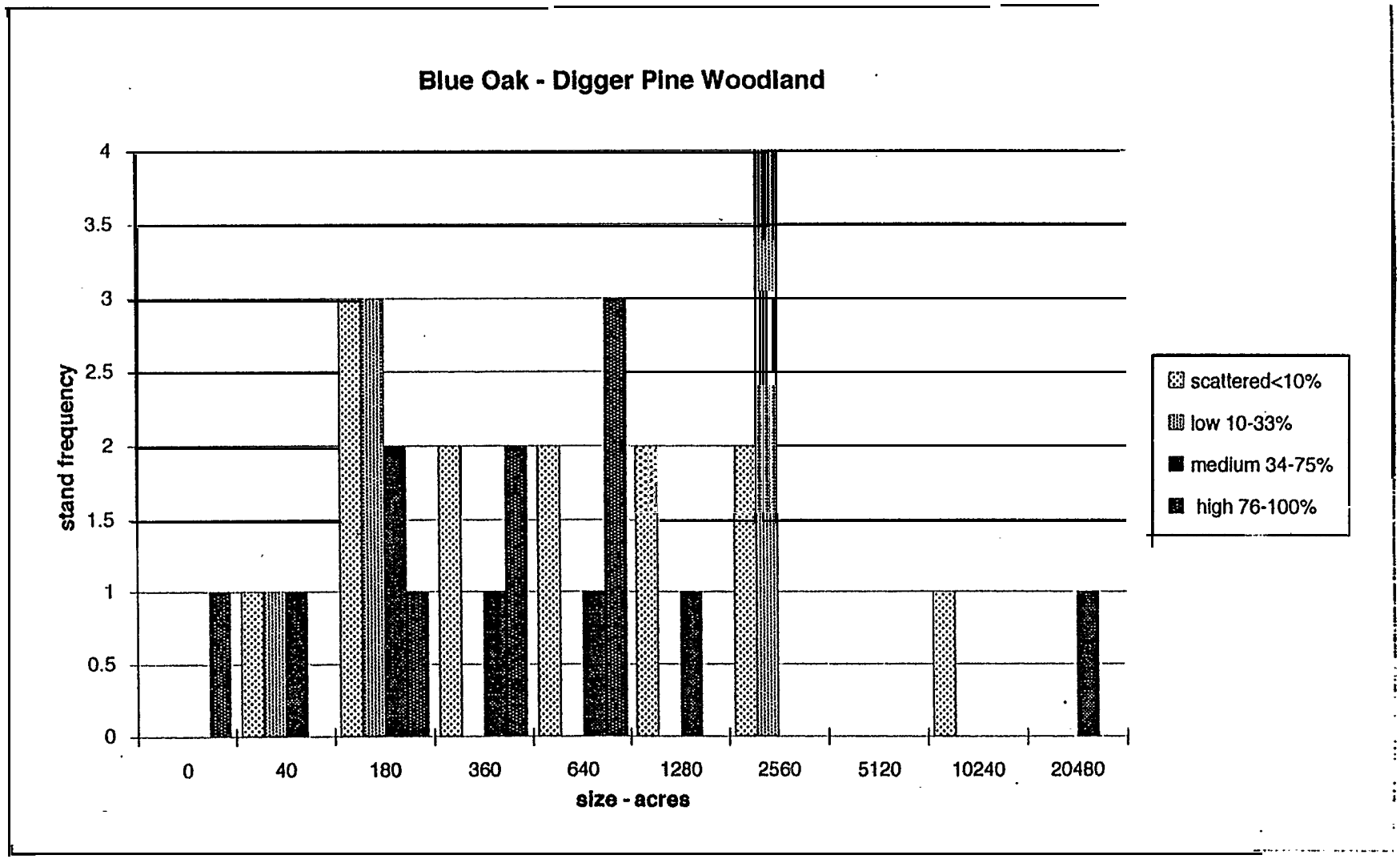
| Stand Size | Frequency scattered<10% | Frequency low 10-33% | Frequency medium 34-75% | Frequency high 76-100% |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 40 | 1 | 1 | 1 | 0 |
| 180 | 3 | 3 | 2 | 1 |
| 360 | 2 | 0 | 1 | 2 |
| 640 | 2 | 0 | 1 | 3 |
| 1280 | 2 | 0 | 1 | 0 |
| 2560 | 2 | 4 | 0 | 0 |
| 5120 | 0 | 0 | 0 | 0 |
| 10240 | 1 | 0 | 0 | 0 |
| 20460 | 0 | 0 | 1 | 0 |

Coastal Oak Woodland

| Stand Size | Frequency scattered<10% | Frequency low 1043% | Frequency medium 3475% | Frequency high 76-100% |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 40 | 7 | 7 | 6 | 4 |
| 180 | 21 | 12 | 5 | 8 |
| 366 | 12 | 1 0 | 12 | 5 |
| 640 | 14 | 16 | 12 | 7 |
| 1260 | 10 | 13 | 8 | 6 |
| 2560 | 9 | 8 | 6 | 0 |
| 5120 | 1 | 1 | 4 | 0 |
| 10240 | 2 | 3 | 1 | 0 |
| 20460 | 0 | 0 | 0 | 0 |


Blue Oak Woodland
stand frequency
20
18
16
14
12
10
8
6
4
2
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres
scattered<10%
low 10-33%
medium 34-75%
high 76-100%


Coastal Oak Woodland
stand frequency
25
20
15
10
5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres
scattered<10%
low 10-33%
medium 34-75%
high 76-100%


Blue Oak - Digger Pine Woodland
stand frequency
4
3.5
3
2.5
2
1.5
1
0.5
0
0
40
180
360
640
1280
2560
5120
10240
20480
size - acres
scattered<10%
low 10-33%
medium 34-75%
high 76-100%

# APPENDIX1

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BIBLIOGRAPHY

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# CHAPTER IV

# SUMMARY OF PROGRESS TO DATE AND FUTURE REGIONAL WORK

This report should be viewed as a snapshot of current work in progress. As of this writing, the CCSLP has made valuable and unique contributions to the Central Coast region through:

(1) Developing the means for participants representing various interests to more effectively understand one another and how to approach regional oak landscapes sustainability issues.

(2) Understanding available regional resources and user needs to be developed into an informed process.

(3) Identifying measures and developing criteria for the sustainability of the oak woodland landscape in the Central Coast region.

(4) Designing a management implementation model coordinating future educational, technical and planning work throughout the region.

(5) Establishing a regional database.

(6) Identifying other potential planning tools.

## *FUTURE REGIONAL WORK*

Many participants expressed a desire to continue their work through the Central Coast Resource Conservation and Development Council. The following presents possible next steps for CCSLP work.

## *TRANSITIONAL* ISSUES

It is clear that as one step toward a continuing effort, the group needs to determine its specific objectives, discuss possible financial resources, decide whether the group should be reconfigured in any way, and determine the organizational vehicle(s) by which its work will continue. One initial issue will be how the CCSLP wishes to interface with work presently occurring in the region. The following describes possible elements of a program for future work in the region.

## *POTENTIAL PROGRAMS*

### *The Institutional Work Program*

The Program For Developing and Implementing An Oak Woodland Management Program For The Central Coast Bio-region (discussed in Chapter 3) identifies a way to bring together institutional resources throughout the region in an integrated educational, technical, and planning effort to produce an information system and implementation strategies for sustainability. The group may wish to explore this model.

### *The Technical Work Program*

Subsequent technical work could finish assigning specific values to the criteria, evaluate the measures and criteria through a field observation and later validation or other agreed upon method of verification, examine future scenarios in relation to the criteria for sustainability, and provide this information in a form usable for implementers using the feedback and framework developed through this project.