Historical Oak Woodland Detected through *Armillaria mellea* Damage in Fruit Orchards[1]

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Abstract

The wholesale destruction of oak woodland by North American settlers in the Santa Clara Valley is attested in early county histories and other sources. Early plats and field notes by government and private surveyors, which are the most useful kind of sources as to the distribution and extent of the lost oak groves, still leave serious gaps in our knowledge. A further source of information is the dangerous legacy left behind in the soil by the original groves when they were chopped and the roots left to rot. The honey fungus or oak root fungus (*Armillaria mellea*) became a serious problem to the orchard industry in the early twentieth century. Upon vertical aerial photography made at a time when the valley was almost entirely under mature prune and apricot orchard cultivation, a sample 144-km^2 strip was chosen that shows clear cases of highly localized patterns of weakening of the fruit trees, typically in rings and circles of various sizes and ages. These patterns, and the percentages of the surface that they occupy within 25-ha blocks, were plotted on two maps along with any indications of the presence of former oak woodland and/or oak savanna that could be found in historical records. These graphic comparisons between two sorts of information—visible fungus damage and historical evidence of presence of oak trees—give a generally consistent picture that seems useful for filling in gaps in our information, even though a number of precautions have to be observed and some further verification is possible. Further comparisons with soil types or other conditions are also possible, and for similar landscapes, such a use of historical aerial photography may be helpful in delineating the former oak woodlands.

Introduction

The historic extent of native oak groves in central and northern California is rather poorly documented, despite their past economic and even political importance. In 1769, the first Spanish exploring expedition to reach the Santa Clara Valley named it the *llano de los Robles*, the White-Oak level, "a large plain…entirely grown over with white oaks—large ones, and ones of all sizes—and a few live oaks" (Crespí 2001: 603; cf. Stanger and Brown 1969: 103). The well-known description of the English navigator George Vancouver's visit to Mission Santa Clara from San Francisco in 1792 was calculated to attract the ambitions of non-Spanish nations. Key phrases were: "a country I little expected to find in these regions… [like] a park which had originally been planted with the true old English oak;… [with] the stately lords of the forest in complete possession of the soil"; "an imaginary park…requiring only to be adorned with the neat habitations of an industrious people" (Vancouver 1984: 718, 720). A generation later, another English party on the same route repeated the comparison to a British "nobleman's park" (Beechey 1968: 44–45). Only a year after that, a French sea captain, while traveling through the same "immense grove of splendid oaks mixed with several other mature trees," daydreamed of his native land's ancient Gaulish "druidesses" (priestesses of the oak), but he also coveted the

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contorted timber for shipbuilding purposes (Duhaut-Cilly 1999: 128). Fifty years further on, with the country now in North American hands, a guidebook for railroad travelers spoke of "the great oaks" that "add an indescribable beauty to this country, and grow in great profusion, particularly on the Murphy Grant" (present-day Sunnyvale; Crofutt 1878–1879). Yet the destruction had already been in progress for many years: in the Santa Clara Valley south of Palo Alto "squatters got early possession, and stripped the count[r]y side of the magnificent timber that adorned it, to sell for cord wood and charcoal" (Alley & Bowen 1883: xii).

More focused sources of information are scattered and hard to find. Notorious for the vagueness of their descriptions are the land-grant records stemming from the Mexican period, together with later court testimony and surveys relating to these private claims. Originals of most of the Spanish-language rancho records are in the U. S. National Archives, while copies of varying quality and some originals are held in land-case legal records at the Bancroft Library, Berkeley, and elsewhere. A designation of an area as *roblar* (white-oak grove) must indicate that deciduous oaks were conspicuous there, although not necessarily as the dominant species, and not impossibly only as a savanna. Descriptive names such as *roblar del Torotal*, meaning "the buckeye-patch white oaks," which occupied the area around the present I-280 and I-880 interchange in San José (Lewis 1857 and related records), and *roblar del Yedral*, "poison-oak-patch white oaks," located perhaps in present Menlo Park and East Palo Alto (Osio 1853), add some further information as to the composition of the individual groves. The great band of mixed white-oak and live-oak trees that extended from present Mountain View toward Santa Clara and thence toward Saratoga was designated as "the Roblar" even in American times. Many of these trees were cut down at an early date, although not before the edge of the Roblar had provided a principal call for the boundary of the Rancho Quito land grant (*fig. 1*).

Surveyors' records made in the early American period, comprising field notes and plats of public township and private land-grant tracts, are perhaps the most essential sources of information as to early conditions. Field notes, because of their inherent accuracy, are usually preferable to plats that were drawn up from them. However, for a crucial part of the area examined in this paper, the basic earliest maps exist only in extremely reduced, poor copies, and field notes made in 1866 for township section divisions are lacking (U. S. Surveyor General 1851 *et seq*.: Township 7 South, Range 2 West, Mount Diablo Base and Meridian).

To the above types of historical evidence may be added one more possible resource. During a large part of the twentieth century, fruit orchards filled the Santa Clara Valley from edge to edge, completely replacing such native oak groves as had remained after the earlier losses. Damage to the orchardists' trees from the oak root fungus or honey fungus, *Armillaria mellea*, was quite often believed to be connected with the vanished oaks. "Removing the tops of [oak] trees with infected roots frequently results in the fungus colonizing the whole root system and thus infesting a large area" (Raabe 1970: 133). As early as 1925, it was reported that "The belief has long been held among growers [in the Santa Clara Valley] that so long as its native host [the oak] is alive, the fungus does not leave it to attack fruit trees.… After the death of [the oak] the disease spreads throughout the dead or dying roots." Locally, "It is not difficult to find… authentic cases where the disease has developed in areas from which oak trees had been removed many years before" (Hendrickson 1925: 2-3). "The owner of [one] orchard still remembers the approximate location of the oak

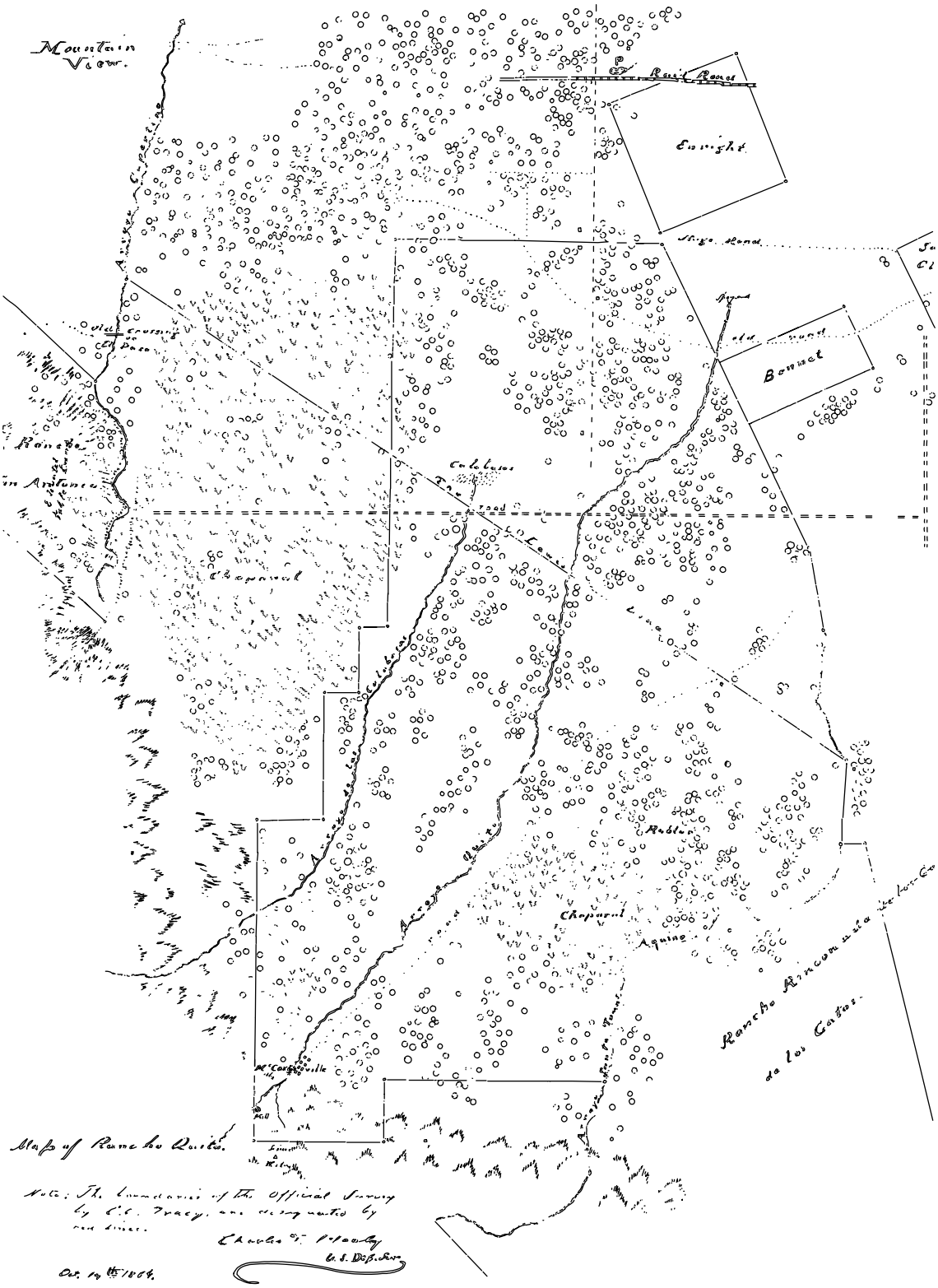

Figure 1—An early map (Healey 1864) indicating oak woodland (circles) and brush (**V**-like symbols) between Mountain View, Saratoga (McCartysville), and Santa Clara. Scale approximately 1:77,000 at page-size reproduction. Orientation is due north.

trees which were cut down more than 30 years ago. In some cases the location of these oaks apparently coincides with what seems to have been the beginning points of the disease in the orchard.… Other infected areas developed in various places and gradually spread until they came together to form one large diseased patch." The location described in this quotation (Hendrickson 1925: 6–8) appears to have been the Stockle (Stocklmeier) property on Stevens Creek.[3] Within the vast and almost uniform extent of the former orchards as shown on early vertical aerial photography (U. S. Agricultural Stabilization and Conservation Service 1939, scale 1:20,000), the evidence of areas ravaged by spreading fungus disease is clearly visible in patterns of bare ground in the form of rings, circles and patches of nearly all sizes, conspicuously interrupting the regular grid of planted trees.

Method

From prints of these aerial photographs, the outlines of denuded patches evidently caused by oak root fungus are simply and easily plotted. For this study, I chose a zone approximately 16 km long by 9 km wide, lying along the western side of the northern Santa Clara Valley roughly between Stevens Creek on the northwest and the old channel of Los Gatos Creek on the southeast. This area seemed suitable for study because there have been almost no trees left in it within the last century and there is historical evidence, but not much detailed information, as to their former considerable extent and importance. The smallest features that seem worth plotting are circular ones with a diameter of about 20 m, evidently representing a fungous patch that has spread so as to affect five adjacent fruit trees at their standard linear spacing of slightly less than 7 m. The circles that have expanded beyond this size tend to touch, overlap, and merge as they grow, and although many of the largest features are slightly less well defined or are somewhat eccentric, almost all of the clearings can still be clearly visualized as rings, sometimes even concentrically nested rings, and their centers often are defined by more or less circular patches of replanted or recovering orchard trees. The patterns are easily traced and plotted upon an adjusted background, and then can be further superimposed upon a graphical interpretation of available historical information (Healey 1863; Healey 1864; Hermann 1879; Howe 1851; Lewis c1850; Lewis 1850a; Lewis 1850b; Lewis 1857; Lewis 1861; Preuss 1849; Stratton 1865; Stratton 1866a; Stratton 1866b; Reed 1866a; Reed 1866b; Tracy 1853; Tracy 1859; U. S. Surveyor General 1851 *et seq*.; United States v. Mary Ann Bennett 1868; Van Dorn 1854; Wallace 1858; Whitcher 1861) concerning the distribution of oak woodland, oak savanna, and chamisal (mixed brush) (*fig. 2*). The sources do not consistently distinguish between oak woodland and oak savanna as these are now defined (Allen-Diaz and others 1999: 324-326), and although terms such as "scattering" are found quite regularly, it is not always clear whether, before the time of any given survey, an area of woodland might not have been turned into something like a savanna through timber cutting. Therefore, a generalized symbol covering both types of oak growth is needed, in addition to the symbol used for clearly attested woodland. In most areas it is not possible to give an exact plotting of borders of either woodland or savanna, and overall the limited and unreliable nature of the sources must be recognized.

[3] Information provided from History/San José (San José Historical Museum) office by Paula Jabloner, archivist.

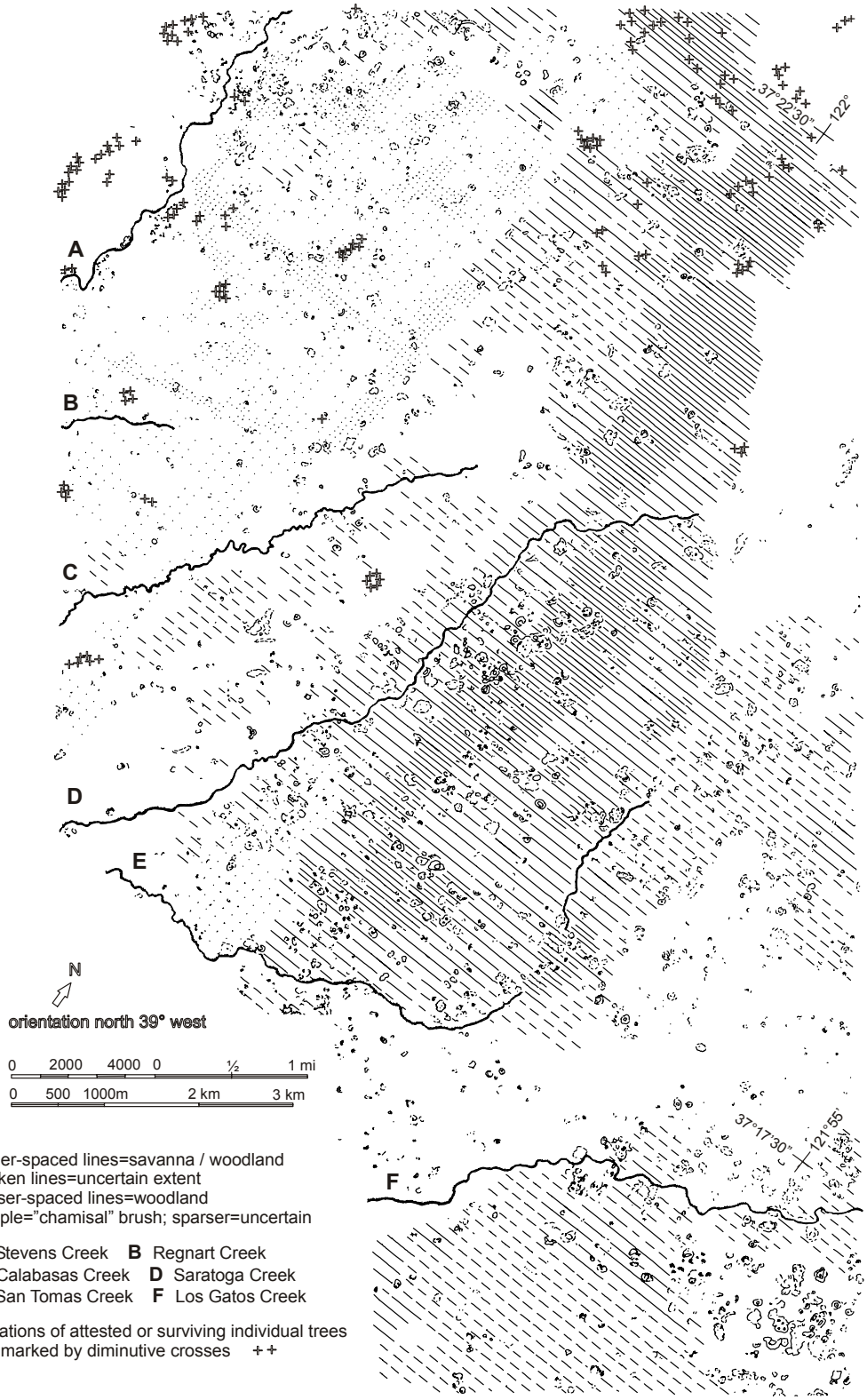

Figure 2—Oak root fungus damage in orchards, interpreted from vertical aerial photographs (U. S. Agricultural Stabilization and Conservation Service 1939. Scale 1:71,250 at page size.

In order to provide some numerical indication of the amounts of apparent fungus damage, the area was divided into squares measuring 127 m on a side (approximately 1.6 ha), within each of which the percentage of its area occupied by orchard marks was estimated, and these results have been summarized by plotting some 517 one-half-kilometer-square (25 ha) blocks marked according to percentage ranges of the areas of their surfaces occupied by affected patches (*fig. 3*). Historically known, although only very approximately locatable, outlines of the Roblar, and of the large body of brush and live oak within it known as the Chamisal (e.g., Beardsley 1926; Tracy 1859; Welch 1931: 257, 262), are added for comparison.

Discussion

Since the available historical evidence, sparse and unsatisfactory though it is, noticeably agrees with the detectable orchard marks, it seems quite likely that these may provide a method of discovering originally timbered areas. Occasionally, some other modern condition will be found that agrees with the historical and orchard-mark data. For example, the long shallow S curve of the present Saratoga Road leading from Santa Clara toward an early redwood lumbering area evidently skirted the main part of the Roblar, cutting inside outliers of woodland that stood in the midst of an oak savanna (*fig. 3*). The outer and the inner border of the northern Roblar were traced respectively by the original main San Francisco road and the upper or cutoff road (*camino de la desecha)* partly represented by present-day El Camino (*fig. 3*, the two roads marked **A** and **B)**.

I have found no historical evidence for or against the presence of trees corresponding to the prominent markings shown on the southeast side of the former bed of Los Gatos Creek in the lower righthand corner of the figures. If such evidence does exist, it may or may not show that this large patch once supported woodland. Elsewhere, the most noticeable orchard damage was in the vicinity of known woodland: around present I-280 in between the San Tomas Expressway and the Saratoga Road about half a kilometer inward from the approximately attested edge of the main Roblar; around present-day Hamilton and Campbell Avenues just southeast of Saratoga Road; and, at the top center of the figures, around the intersection of Remington Drive and Mary Avenue in Sunnyvale.

Near the upper right corner of both figures, there is a conspicuous marking in a place where historical sources suggest that there was a clearing bare of trees. This spot, southeast of the present Wolfe Road–Reed Avenue intersection, was the sink of an old natural drain or overflow stream channel, and perhaps the orchard mark represents something, possibly *A. mellea* or another fungus, existing in the soil and related to the resulting conditions. On the other hand, in the neighboring area at the north end of the historically known Roblar there are relatively few other orchard marks, an absence which might be connected with some condition such as the very close-to-the-surface water table that originally existed there (Clark 1924: 24–25; Cooper 1926: 20–22), or, according to the orchardists' belief, with the relatively large number of oaks that were left standing there until a late date.

During the symposium, a question was privately raised as to whether the distribution of fungus disease might not have been due to heavier irrigation of the fruit trees in some spots, thus stimulating spores widely latent in the soil. If that had been the case, then presumably the reason for overwatering orchard trees would have

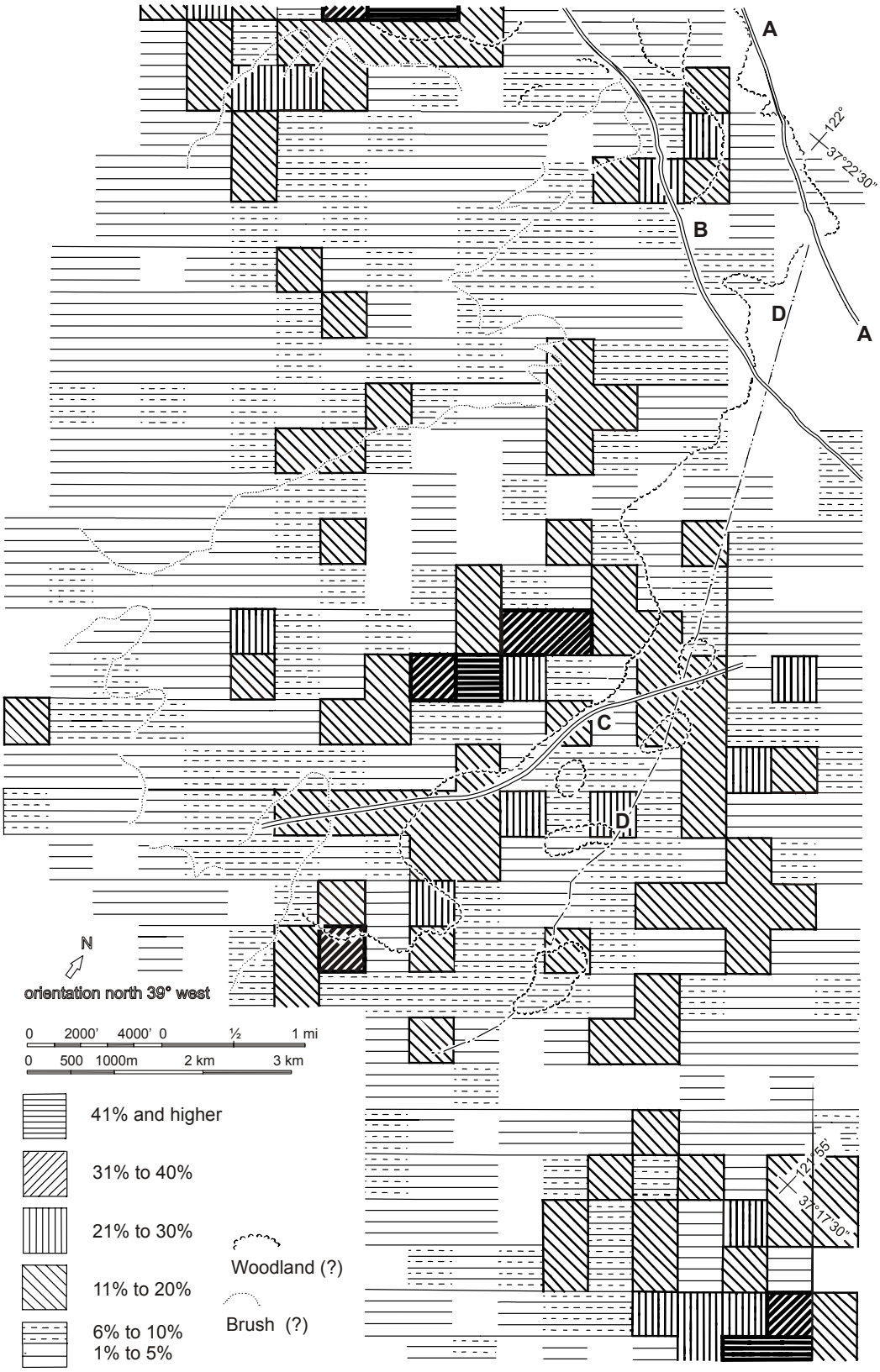

Figure 3—The data of Fig. 2 interpreted as ranges of percentage of visible orchard damage within 25-ha blocks. Scale 1:71,770 at page size.

been the nature of the ground—its water-retaining and runoff characteristics. The four soil classifications that supported the most extensive oak woodland are the same as those that show numbers of orchard marks.[4] These soil types are the Garretson, Pleasanton, Yolo and Zamora series (U. S. Soil Conservation Service c1969: 124, 193–196; cf. Lindsey 1974: 18, 29, 37–38, 63, 65, 67, 71, 75, 77; Welch, Lawrence 1977: 25, 54, 94–95, 107). The soil having the highest proportion (15 percent) of its area in orchard marks is the Garretson gravelly loam, which occurs in fingers of alluvium with a relatively high surface permeability, at the edge of larger old stream-built fans. It is characterized by a somewhat lower available water-holding capacity and a slightly higher runoff rate than surrounding soils. The fairly uniform distribution of fungus-affected patches within this soil type is expressed by the relatively strong correlation (0.63)—as sampled by the individual 25-ha blocks—between the percentages of areas occupied by this soil and areas of affected patches within it. It is possible that orchard trees grown on this soil had to be more heavily watered than others and that the over-irrigation caused the fungus problem to be especially widespread. Alternatively, or additionally, it is possible that the soil itself favored the growth of dense oak woodland—which does happen to be especially well attested for these areas—and that this density was reflected in the later intensity of the oak-root fungus problem.

Of the surrounding soils, a lower percentage (11 percent) of the Yolo loam is within fungus-marked areas, and the correlation (0.36) is much less, corresponding with the historical sources' indications of the uneven distribution of oak woodland, oak savanna, and clearings on this soil type. The Zamora clay loam (7 percent in orchard marks, and 0.30 correlation between these and the soil areas) is not dissimilar to Yolo loam in any of these respects. Yolo silty clay loam likewise has 8 percent of its area in marks and an areal correlation factor of 0.29. The Pleasanton series of soils are very strongly associated with historical attestations of chamisal brush: "unbroken stretch[es] of chaparral with… small islands of live oak and occasional [lone] live oaks scattered through it" (Beardsley in Cooper 1926: 12). These soils are well drained and even rather drouthy, with a very slow surface runoff (U. S. Soil Conservation Service c1969: 165–166; cf. Lindsey 1974: 29, 75; Welch 1975: 22, 80). These qualities would seem likely to increase the necessity of irrigation. However, it is these soils that show the smallest relative percentage of fungus-marked area (6 percent for Pleasanton gravelly loam, 5 percent for Pleasanton loam). Their area correlation figures rank somewhat higher (0.33 and 0.42, respectively), showing the relatively even distribution of marks. In this case, again, the fungus marks seem to have reflected the relative density and distribution of former oak growth rather than any necessary over-watering of orchard trees. On Pleasanton soils near Los Gatos (in the lower lefthand corner of the two figures), no marks appear that could be associated with a large "black oak roblar" mentioned in an early survey (Wallace 1858), where, despite the word *roblar*, "black oak" presumably refers to *Quercus agrifolia* as the dominant species, not *Quercus lobata*. The density of this oak growth is unknown.

[4] Annotated U.S. Soil Conservation Service aerial photomosaics now held at Loma Prieta Resource Conservation District office, Gilroy, CA; copies supplied by Patricia Marfia, clerk, along with extracts from U.S. Soil Conservation Service c1969.

Conclusion

The present investigation is a qualitative probe. Until any further verification is achieved by comparison with historical sources, or with similar studies for other areas, it must be used only as a hint of where to look for corroborating evidence, historical or other, of oak presence. The approach seems most likely to succeed if applied in such areas as the Santa Clara Valley as a whole and the Brentwood (Contra Costa County) vicinity, and possibly the Clayton and Ygnacio Valleys, all of which had continuous fruit orchard plantings. For areas where there were extensive oak groves but fewer orchards, as in Yolo County, the approach seems less likely to be useful. Quantitative approaches to the problem of locating ancient oak woodlands could, in order to allow further cross-checking between types of data, include in their basis careful attention to oak species, soil types, conditions of culture, former drainage and other topographical elements, and any further information that can be wrung out of existing historical sources. In the mean time, the accompanying diagrams (*figs*. *2* and *3*) provide an approximate representation of the belt of mingled valley oak, live oak, sycamore, laurels, and buckeyes that extended for ten or twelve miles around the edge of a large, brush- and live-oak-grown alluvial fan that reached out from the foot of the Santa Cruz mountains. The presence of the main Roblar conditioned early settlement and travel. Its grandeur was appreciated even while economic interests were leading to its piecemeal annihilation. The growers who removed the last trees to make room for their orchards were aware of where the oaks had been, and knew the aftereffects of their existence.

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