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ANOTHER RANGE EXTENSION FOR *QUERCUS DUNNII* IN CENTRAL CALIFORNIA

J. M. Tucker, G. L. Holstein, Heather Stout, and Neil Havlik

Quercus dunnii Kell. (*Q. palmeri* Engelm.) is a xerophytic shrub with stiff, divaricate branches and small, hard, spinose-dentate leaves. Typically, it occurs in desert-border chaparral or pinyon-juniper woodland in Arizona, southern California, and northern Baja California. Usually it constitutes only a minor element in the vegetation, occurring in small groups or as isolated, scattered individuals. Its small, widely disjunct populations form an extremely "spotty" distribution pattern.

The range of *Q. dunnii* in Arizona is presented elsewhere (Tucker and Haskell 1960). Its known range in Baja California extends just south of the Sierra San Pedro Martir (R. Moran, pers. comm.: west of Agua Amarga, 1100 m, near 30°28'N, 115°17'W, Moran 11416). In southern California its principal occurrence is along the western borders of the Colorado and Mohave deserts in San Diego, Riverside, San Bernardino, and Los Angeles counties. We know of no occurrence in any of the mountains of the eastern Mohave in California, although the species reoccurs in the Hualapai Mountains in western Arizona. Also, a Late Pleistocene record has been reported (Leskinen 1975) from the Newberry Mountains in extreme southern Nevada.

A considerable range extension to the northwest was established during the U.S. Forest Service's extensive Vegetation Type Map Survey of the 1930's when another population was discovered several km west of Paso Robles (on Peachy Canyon Rd.), in San Luis Obispo County. Then, in 1974, J. R. Griffin discovered a tiny population of a few shrubs in southeastern San Benito County (Griffin and Tucker 1976), another range extension of 82 km. These cases illustrate dramatically how small isolated colonies of a chaparral species may escape detection for years; and the present paper records the discovery of still another northward range extension of this sort, of ca. 180 km.

This most recent find was made by Glen L. Holstein (Nature Conservancy), Neil Havlik (East Bay Regional Parks), and Ms. Heather Stout (California Department of Water Resources) in April 1981, as members of a larger group engaged in an ecological survey of a proposed dam site southwest of Byron in the Diablo Range, Contra Costa County. This location (Fig. 1) is on the Antonio Souza Ranch—extended section NW ¼ Sec. 31, R3E, T1S, Mt. Diablo Meridian.

Fig. 1. Location of recently discovered *Quercus dunnii* in eastern Contra Costa County, California. (See text for details.)

Here, forming a dense, continuous thicket about 45 m in its longest dimension, a single colony crowns the summit of a high hill at an elevation of ca. 309 m (Fig. 2). It consists of several dozen closely spaced individual trunks, the most massive of these being ca. 15 cm in diameter at 30 cm

above the base. However, much of the colony has probably resulted from vegetative proliferation of only a few individual clones. This is suggested by the relative morphological uniformity over large parts of the colony. Also there is much sprouting around the base of the trunks. The tallest part of the colony is 3–3½ m in height (Fig. 3), most of the colony, however, being somewhat lower. The height is apparently wind-controlled to some extent, noticeably on the west side. Browsing by cattle around and through the thicket has opened it up slightly, but much of it is essentially impenetrable.

On April 25, 1981, much of the colony was coming into flower, with elongating staminate catkins appearing in abundance. On May 31, a flush of new vegetative growth was evident, more conspicuous and vigorous on some sectors of the thicket than others—which seemed to delimit individual clones. By now most of the catkins were withered, but a few here and there were still fresh and shedding pollen (Fig. 4). We noted a great abundance of pistillate flowers, starting to enlarge in the early stages of acorn development. Obviously, this oak is capable of acorn production here, as evidenced by the frequent persistent old cups (and occasional dead acorns: Fig. 5) over much of the colony.

Initially, this new discovery of *Q. dunnii* came as quite a surprise. For one thing, it has obviously escaped the notice of generations of Bay Area botanists. But the explanation is that this property and surrounding areas have historically been occupied by families very protective of their own privacy and not receptive to the notion of trespass for any purpose. For another thing, so typically xerophytic a species as *Q. dunnii* seemed completely out of place ecologically in the hills southwest of Byron. However, when one considers the number of desert species known from the Mount Hamilton Range (Sharsmith 1945), and the fact that a number of these reach their northern limits not far south of our location, this new occurrence seems to fit a well-established pattern. And, more specifically, it fits exactly on two points noted by Sharsmith: that the desert species in the Mount Hamilton Range are restricted to a few isolated localities, and occur mainly on the east side of the Inner Coast Range.

However, the very different ecological setting here compared to the much more xeric situations where *Q. dunnii* grows in southern California and Arizona is quite remarkable. In Arizona, this oak typically occurs in pinyon-juniper woodland [*Pinus edulis* Engelm. and *Juniperus osteosperma* (Torr.) Little] often with *Quercus turbinella* Greene, *Yucca baccata* Torr., and *Mimosa biuncifera* Benth.; and in the most xeric sites, with *Ephedra viridis* Cov., *Opuntia*, *Canotia*, and other desert plants. The situation at our new site is strikingly different. True, there was an abundance of *Pholistoma membranaceum* (Benth.) Constance—a Mohavean species—growing beneath it in April. But the associates on the immediately surrounding hill slopes (aside from the now ubiquitous Mediterranean annual grasses of the

Figs. 2-5. 2. The single continuous thicket of *Q. dunnii*.—3. The tallest part of the thicket, showing its densely branched, impenetrable nature.—4. Staminate catkins in a flush of new growth, May 31, 1981.—5. Old dead acorns persisting from the previous year. (Photos by Daryl Koutnik).

Coast Ranges) were numerous shrubs of *Lupinus albifrons* Benth., a few *Artemisia californica* Less., and, within 150 m, *Mimulus aurantiacus* Curt., *Salvia mellifera* Greene, and other elements of coastal sage scrub vegetation. The west wind-controlled tops of the oak thicket afford clear evidence that this area is subject to coastal influence, at least through part of the year.

Geology

The new *Quercus dunnii* locality is on the summit of a hill formed by uplifted Upper Cretaceous sandstone of the Great Valley Group (Ingersoll and Dickinson 1981). Erosion of Sierran granodiorite produced the sandstone which dominates the Late Cretaceous (95-65 m.y. B.P.) part of the Great Valley Group. During the Pliocene and Pleistocene epochs (4-0.05 m.y. B.P.), these Cretaceous formations were folded vertically and subsequently eroded (Page 1981). The softer shales of the older part of the Great Valley Group were eroded readily, but the more resistant Upper Cretaceous

sandstone beds were left to form high ridges. One of these ridges forms the eastern flank of the Diablo Range in southeastern Contra Costa County, and the new *Q. dunnii* locality is located on a hilltop on this ridge. Kellogg Creek has eroded a gorge through the ridge to the north of the oak site, and it has been proposed that this gorge be dammed so that water can be stored in the valley formed when weaker shales west of the ridge were eroded.

Climate

There are no climatic data available for the new *Q. dunnii* locality and local climates can be quite diverse in mountain regions. It is likely, however, that the climate at this site is not greatly different from that at Livermore, located a few km south and ca. 200 m lower. Vegetation is similar at both localities and barriers to air-mass movement between them are relatively minor. Livermore, like most stations in cismontane California, has a well-developed mediterranean-type climate since virtually all of its 365 mm of mean annual precipitation falls in the cooler half of the year. Its mean January and July temperatures are 9 and 22 C, respectively (U.S. Weather Bureau 1965). Plants in such climates are stressed by cold in winter and drought in summer. Spring is the most favorable season for plant growth because temperatures are relatively warm then, some precipitation still falls, and excess moisture stored in the soil after winter rains is still available.

The *Q. dunnii* locality and Livermore are exposed to two different kinds of marine influences. They receive most of their precipitation during cool seasons from cyclonic storms which originate in the Pacific Ocean and move northeasterly. The Santa Cruz Mountains and Mt. Hamilton Range rain shadows are probably the most significant factors reducing precipitation from such storms in the vicinity of Livermore, but the East Bay Hills also intercept some precipitation which would otherwise fall further east.

The second marine influence is the advection eastward in summer of cool, moist marine air from the Pacific Ocean by the interaction of rising warm air in the Central Valley and general westerly air flow (Monteverdi 1974). Its rise is prevented by a persistent inversion which restricts its entrance to the Central Valley to a few gaps in the Coast Range. Such marine air is a major climatic influence since stations fully exposed to it have mean July temperatures below 15.5 C and low evaporative water loss because of its moisture, low temperature, and cloudiness. Stations fully protected from its influence have July temperatures above 27 C and very high rates of potential evapotranspiration because of their very low relative humidity and almost continuous insolation during summer.

Most marine air enters the Central Valley through the Carquinez Straits in summer, but enough can enter the Livermore Valley through Niles Canyon and the Dublin Gap to reduce summer temperatures considerably below those of the Central Valley. When westerly air flow is strong, marine air

can be advected further eastward through Altamont Gap in summer, but the usual presence of a shallow inversion causes the *Q. dunnii* locality to be exposed to drying winds at such times rather than advected moist air.

South of Altamont Gap the east slope of the inner Coast Range is isolated from summer marine air and has low winter precipitation because of the rain shadow of the high and continuous Diablo Range. Climatic stations are few here, but Panoche in San Benito County has a fully desertic climate in a similar topographic setting. Distribution of flora and vegetation makes it clear that the arid east slope of the inner Coast Range is a corridor and refuge which has allowed plants and animals typical of the southern California deserts to migrate into and survive in central California. While it is unlikely that the inner Coast Range north of Altamont Gap is truly arid, the desert taxa common on the drier slopes south of the gap provide propagules which can disperse to locally dry sites north of the gap. If desert taxa are in retreat following a Xerothermic expansion as Axelrod has speculated (1977), some could also persist as relicts at such local dry sites.

Vegetation

The vegetation of the new *Q. dunnii* locality has been mapped as grassland (Matyas and Parker 1979; Wieslander 1945) and as Blue Oak-Digger Pine forest (Kuchler 1977). Grassland probably covers the largest area in the vicinity of the oak site, but like much of central California, the region is best understood as a vegetational mosaic. Grassland, chaparral, coastal sage, riparian, and oak woodland taxa aggregate wherever local conditions favor the formation of their characteristic communities. Slopes below the *Q. dunnii* locality are dominated by annual grasses when gentle and by coastal sage scrub shrubs in an annual grass matrix when steeper.

Interesting and unusual plant communities in the vicinity include two distinctive types of vernal pools. One occurs in depressions on large sandstone outcrops near the *Q. dunnii* locality. These pools are unusual because they are retained by coarse-grained siliceous sandstone, whereas other described vernal pools in rock depressions are retained by fine-grained basic rocks like basalt. *Lilaea scilloides* (Poir.) Haum. provides most of the plant cover in these sandstone pools, but *Isoetes* and *Callitriche* spp. are also present.

A second and quite different vernal pool community occurs at the base of the Diablo Range near Byron, a few km northeast of the *Q. dunnii* locality. These pools are apparently restricted to the Solano Soil Series, which is a Typic Natrixeralf in the new Soil Conservation Service taxonomy (USDA Soil Conservation Service 1977) and a solodized solonetz in older terminology. Such soils have an acidic, leached A horizon and a dense B horizon made virtually impermeable to water by excessive exchangeable Na^+ . The

Solano Series is excessively hummocky near Byron, and a rich native wild-flower flora grows in association with introduced weedy annual grasses on the summits of the hummocks, which correspond to the upper part of the Solano A horizon. Depressions between the hummocks correspond to the upper part of the alkaline, sodic B horizon and have a sparse, impoverished flora of halophytes such as *Cressa truxillensis* HBK. and *Frankenian grandifolia* Cham. & Schlecht. A rich flora of herbaceous annual species typical of vernal pools grows on the slopes of the hummocks, which can have relief of 1.5 meters. The zone of vernal pool plants on the hummock slopes corresponds to the transition zone between the A and B horizons of the Solano Series. Seven species of *Lasthenia* have been identified here, including endangered *L. conjugens* F. & B. Greene.

In the vicinity of Byron Hot Springs the A horizon has been stripped from the Solano Series over several hectares, and the strongly alkaline B horizon exposed at or near the surface. This area is vegetated by the northernmost stand of *Allenrolfea occidentalis* (Wats.) Kuntze in cismontane California.

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