

Genetic Analysis and History of the Mount Wanda Olive Orchard at John Muir National Historic Site



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Project Overview

Orchards in the United States have changed over time from growing a number of diverse varieties before 1900 to the emphasis, in commercial orchards, on growing a very limited number of preferred varieties with specific traits suited to larger-scale production and changing marketing opportunities.

Understanding which varieties were planted over time is key to filling in a complete history of agriculture, human settlement, and development patterns that we see today. The analysis of historic fruit varieties that exist today is part of the mission of the National Park Service (NPS) to identify, evaluate, and list significant cultural resources to the National Register of Historic Places in order to preserve and interpret these resources for the public.

Within California, olive production has played a significant role in the state's agricultural development. Understanding California's history of olive production is important to accurately assessing the significance of olive orchards of the past as compared to current olive orchards. Few historic olive orchards have been identified in California. There are two known olive orchards in the NPS system, one at Channel Islands National Park, and one at John Muir National Historic Site (John Muir NHS).

Using John Muir NHS as a case study, this project has identified the varieties of olives at John Muir NHS located in the orchard at Mount Wanda, and a history of those varieties has been prepared to provide the historic context of orchard production throughout the state. The genetic testing and analysis protocol developed by Foundation Plant Services at University of California, Davis (FPS) has been used to identify the olive varieties in the orchard. The NPS study of United States orchard history and National Register nomination requirements has been used to develop the context for the historic analysis.

Project Scope

John Muir NHS is located in Contra Costa County, California in the city of Martinez. While there are several orchards within the National Park unit, the scope of this project is to conduct genetic analysis and historical research of the Mount Wanda olive orchard at John Muir NHS (See Appendix A for location map). The genetic analysis results have been used to guide the historic research into primary source material related to historic olive production in California. The intent of this study is to further inform the park management's decisions into how to best care for the trees, provide public access to the orchard, and interpret to the public the historic development of olive production in California. The genetic analysis of the olive orchard involves DNA-based variety identification of sampled olive trees using a standardized protocol developed by Foundation Plant Services, UC Davis.

Methodology

The project required collection and analysis of leaf tissue from selected trees in the Mount Wanda olive orchard and historic research on the orchard. To preserve the DNA in the leaves for subsequent extraction and testing, several leaves from a given tree were rapidly dried between two pieces of blotting paper in a sealed, labeled envelope; several envelopes were then placed in sealable plastic bags with approximately 20 grams of silica desiccant. Leaves processed and stored in this fashion can be used as sources of DNA for five or more years.

Foundation Plant Services used Simple Sequence Repeat (SSR) DNA markers to identify the olive varieties in the Mount Wanda orchard. Also known as microsatellite markers, SSR markers are particularly useful for fruit and nut tree crops, including olives, where varieties are maintained by clonal propagation. The DNA profiles generated by this method are unique to the single, original, sexually-derived seedling (the ortet) that, through subsequent cycles of clonal propagation, was the original source of all other trees of the variety (the ramets). The variety of a given tree is determined by matching that tree's DNA profile to a database of reference profiles of known varieties. Analysis of DNA profiles can also provide information on the parentage of an individual and can be used to study broader genetic relationships.

The 18 specific SSR markers used by FPS were published initially by other researchers (see Table 1). These publications also provide detailed protocols for using these markers, though protocol details differ from lab to lab depending on equipment and other considerations. The core of the database of reference profiles used by FPS was published online by European researchers.¹ This data set was expanded by FPS to include additional markers and reference profiles of many accessions in the National Clonal Germplasm Repository, Davis (NCGR-D), some 150 unique reference profiles total.²

NCGR-D is one of several repositories under the U.S. Department of Agriculture (USDA) National Plant Germplasm System (NPGS) sharing the responsibilities of germplasm acquisition, preservation, preliminary evaluation, and distribution. The Davis, California facility holds the national collection of olive and other important perennial crops: grape, almond, pistachio, walnut, cherry, peach, plum, pomegranate, and others.³ The olive collection at NCGR-D includes 164 accessions that are maintained as trees in the field.⁴

As with most orchards, the Mount Wanda olive orchard was planted in a grid pattern with uniformly spaced rows of trees. This pattern is still clearly discernable. In production orchards with multiple varieties, the trees of one variety will typically be planted in blocks of adjacent rows or portions of rows to facilitate variety specific horticulture. On July 24, 2020, NPS collected leaf samples from 135 tree from the Mount Wanda orchard. To determine the existence of blocks of different varieties of olives, samples were taken from every tree around the periphery of the orchard and every other tree within the orchard. FPS provided initial variety identification results to NPS on August 20, 2020.

Based on these results and suggestions by FPS, NPS collected an additional 31 samples on October 2, 2020. Three trees not previously sampled were included to clarify the extent of a variety block or to define the continuity of a row (trees: 28, 38 & 50). The remaining samples (28) were collected from previously tested trees to determine if any of the material came from scionwood grafted onto rootstock or if the original samples were collected from trunk portions or branches that originated as sprouts from a

¹ "Olea Databases," accessed January 28, 2021, <http://www.oleadb.it/>.

² "GRIN-Global: U.S. National Plant Germplasm System," accessed January 28, 2021, <https://npgsweb.ars-grin.gov/gringlobal/search>; A.K. Koehmstedt, M.K. Aradhya, and D. Soleri, J.L. Smith, V.L. Polito, "Molecular Characterization of Genetic Diversity, Structure, and Differentiation in the Olive (*Olea europaea* L.) Germplasm Collection of the United States Department of Agriculture," *Genetic Resources and Crop Evolution*, Vol.58 (2011), p.519–531, <https://doi.org/10.1007/s10722-010-9595-z>.

³ National Research Council, "Chapter 2 Elements of the National Plant Germplasm System," in *The U.S. National Plant Germplasm System*, (Washington, DC: The National Academies Press, 1991), p.44-45. <https://doi.org/10.17226/1583>.

⁴ "Olive Collection," from Field Tour of the USDA National Clonal Germplasm Repository for Tree Fruit, Nut Crops, and Grapes in Davis, California, accessed April 1, 2021, <https://colostate.pressbooks.pub/davisrepositoryfieldtour/chapter/olives/>.

rootstock. To search for possible rootstocks growing under a previously tested scion, three samples were collected from more recent water-sprouts originating from around the outside edge of the trunk at ground level. To determine if the original sample was from a rootstock, thus hiding the presence of a scion variety, one sample was collected from each of three main scaffolds in the middle of the tree. The results of these samples were sent by FPS on October 22, 2020.

In August and September 2020, NPS historian Sang Bae conducted historical research, using available online sources, due to all repositories being closed due to the COVID – 19 pandemic, and a history of the Mount Wanda olive orchard was prepared in September and October, 2020.

Table 1. DNA Markers

DNA Marker Name	Citation ⁵	DNA Marker Name	Citation ⁶
GAPU71B	Carriero et al. 2002	ssrOeUA-DCA3	Sefc et al. 2000
GAPU89	Carriero et al. 2002	ssrOeUA-DCA5	Sefc et al. 2000
GAPU101	Carriero et al. 2002	ssrOeUA-DCA8	Sefc et al. 2000
GAPU103	Carriero et al. 2002	ssrOeUA-DCA9	Sefc et al. 2000
UDO99-11	Cipriani et al. 2002	ssrOeUA-DCA11	Sefc et al. 2000
UDO99-28	Cipriani et al. 2002	ssrOeUA-DCA13	Sefc et al. 2000
UDO99-42	Cipriani et al. 2002	ssrOeUA-DCA15	Sefc et al. 2000
EMO90	De La Rosa et al. 2002	ssrOeUA-DCA16	Sefc et al. 2000
IAS-oli16	Koehmstedt 2009	ssrOeUA-DCA18	Sefc et al. 2000

Genetic Results

Of the 138 trees sampled, 92 are the Mission variety, 24 are the Redding Picholine variety, 12 are the Manzanillo variety (also known as Manzanilla de Sevilla) and 10 appear to be seedlings, with Mission and Redding Picholine being the parents (see Appendix B). Appendix C shows the variety identification results in the context of a plot of the orchard. The bulk of the orchard is a mostly intact and contiguous block of Mission trees. The Manzanillo trees and the Redding Picholine trees in the south-east appear to be arranged as distinct, two-row blocks, both of which may have been more complete and symmetrical in

⁵ F. Carriero, G. Fontanazza, F. Cellini, and G. Giorio, "Identification of Simple Sequence Repeats (SSRs) in Olive (*Olea europaea* L.)," *Theoretical and Applied Genetics* 104 (2002), p. 301-307, <https://doi.org/10.1007/s001220100691>; G. Cipriani, M.T. Marrazzo, R. Marconi, A. Cimato, and R. Testolin, "Microsatellite Markers Isolated in Olive (*Olea europaea* L.) are Suitable for Individual Fingerprinting and Reveal Polymorphism within Ancient Cultivars," *Theoretical and Applied Genetics* 104 (2002), p. 223-228, <https://doi.org/10.1007/s001220100685>; R. De La Rosa, C.M. James, and K.R. Tobutt, "Isolation and Characterization of Polymorphic Microsatellites in Olive (*Olea europaea* L.) and Their Transparency to Other Genera in the Oleaceae," *Molecular Ecology Resources*, Vol. 2, Issue 3 (September 2002), p. 265-267, <https://doi.org/10.1046/j.1471-8286.2002.00217.x>; A.M. Koehmstedt, "Analysis of Genetic Structure and Differentiation in Olive (*Olea europaea* L.) Using Microsatellite Markers," (Thesis, University of California, Davis, 2009).

⁶ K.M Sefc, M.S. Lopes, D. Medonça, M. Rodrigues Dos Santos, M. Laimer Da Câmara Machado, and A. Da Câmara Machado, "Identification of Microsatellite Loci in Olive (*Olea europaea*) and Their Characterization in Italian and Iberian Olive Trees," *Molecular Ecology*, Vol. 9, Issue 8 (August 2000), p. 1171-1173, <https://doi.org/10.1046/j.1365-294x.2000.00954.x>.

the past. The past organization of the other Redding Picholine in the same area and of the Redding Picholine trees in the north-east is less obvious.

The DNA profiles used in this study, based on 18 SSR markers, are unique to the original, sexually-derived ortet and subsequent ramets generated by clonal propagation. The likelihood of two unrelated olive varieties randomly sharing a profile is infinitesimally small. Even for close relatives, such as siblings, the likelihood of matching profiles is impossibly small. This point is illustrated by comparing the DNA profiles of the 10 trees identified as Mission X Redding Picholine seedlings (see Appendix D). The profiles of these full siblings differ from one another by seven or more of the 18 markers.

Though the profiles are unique to a variety and vary significantly among varieties, there were also slight variations within the Mission and Redding Picholine genotypes. This variation was limited to one or two of the 18 markers (appendix D). Variation at this level is the result of mutations in the maternal (somatic) cells of a developing bud. When such a bud is taken on a cutting for clonal propagation, the mutated cells become the genetic lineage of the entire new tree, and the somatic mutation can be found in various tissues of the new tree, in this case the leaves.⁷ Somatic mutations are well-documented in woody crop species and have been detected using SSR markers, including in olives.⁸ A typical feature of somatic mutations is the appearance of an additional allele at a given SSR marker (e.g. Mission at marker *ssrOeUA-DCA3* and *ssrOeUA-DCA16*).⁹ Somatic mutations that are expressed as changes to SSR alleles are typically not linked with observable characteristics, though some somatic mutations result in very significant changes (e.g. Pinot noir and Pinot blanc in grape).

The matching reference profile for Mission is based on multiple accessions in the NCGR-D (DOLE 57, DOLE 140) and samples from commercial and historic orchards. This profile is also shared by several other varieties with names other than Mission, including accessions at the NCGR-D and other published sources. As discussed below, these matches represent synonymous names, acquired over time as the variety was grown in different places. Eight of the trees identified as Mission appear to be somatic mutants.

The reference profile for Redding Picholine is an accession in the NCGR-D (DOLE 71), which matches samples from several historic orchards, including the Smuggler's Cove Orchards on Santa Cruz Island, Channel Islands National Park. The majority of the Redding Picholine trees have a third allele at the marker *ssrOeUA-DCA13*.

There were no clonal variants among the 12 trees identified as Manzanillo. The Manzanillo reference profile is based on accessions at the NCGR-D (DOLE 11, DOLE 77)¹⁰ and is consistent with the profile for the well-documented synonym Manzanilla de Sevilla published by European researchers.¹¹

⁷ These slight variations in genotypes between different trees at the Mount Wanda olive orchard are likely the product of different source trees. While it is possible that the variation occurred in the bud that generated the current, tested, tree, it is a less likely scenario.

⁸ Cipriani et al., "Microsatellite Markers."

⁹ The mechanism for the appearance of an additional allele is well documented in the scientific literature: S. Riaz, K.E. Garrison, G.S. Dangl, J.M. Boursiquot, and C.P. Meredith, "Genetic Divergence and Chimerism within Ancient Asexually Propagated Winegrape Cultivars," *Journal of the American Society for Horticultural Science*, Vol. 127, Issue 4 (July 2002), 508-514, <https://doi.org/10.21273/JASHS.127.4.508>.

¹⁰ The NCGR-D changed the name of an accession labeled as Manzanillo.

¹¹ DOLE numbers are searchable on <https://npgsweb.ars-grin.gov/gringlobal/search>.



Figure 1. MW-6 Redding Picholine clonal variant A (NPS Photo, October 2020).



Figure 3. MW-6 Redding Picholine (NPS Photo, October 2020).



Figure 2. MW-12 Manzanillo (NPS Photo, October 2020).



Figure 4. MW-25 Mission (NPS Photo, October 2020).



Figure 5. MW-38 Redding Picholine clonal variant B (NPS Photo, October 2020).



Figure 6. M-50 Mission (NPS Photo, October 2020).



Figure 7. MW-83 Manzanillo (NPS Photo, October 2020).

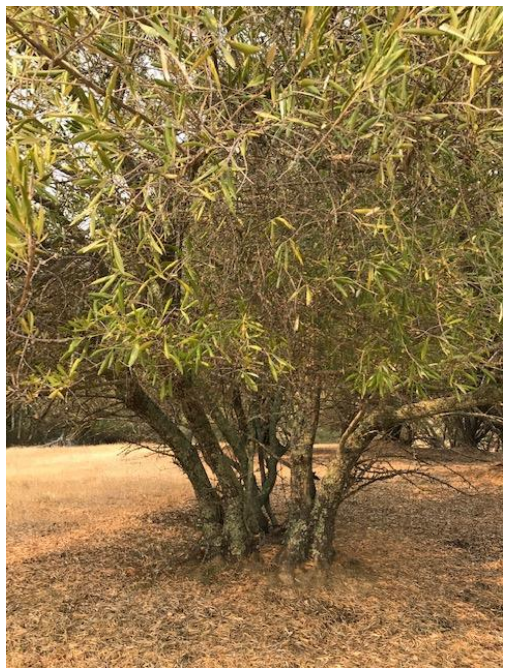


Figure 8. MW-148 Mission (NPS Photo, October 2020).



Figure 9. MW-149 Redding Picholine clonal variant A (NPS Photo, October 2020).



Figure 10. MW-59 Mission x Redding Picholine Seedling, Tree ID tag (NPS Photo, February 2021).



Figure 11. MW-59 Mission x Redding Picholine Seedling (NPS Photo, February 2021).



Figure 12. MW-59 Mission x Redding Picholine Seedling (NPS Photo, February 2021).



Figure 13. MW-59 Mission x Redding Picholine Seedling (NPS Photo, February 2021).



Figure 14. MW-61 Manzanillo (Manzanilla de Sevilla), Tree ID tag (NPS Photo, February 2021).



Figure 15. MW-61 Manzanillo (Manzanilla de Sevilla) (NPS Photo, February 2021)



Figure 16. MW-61 Manzanillo (Manzanilla de Sevilla) (NPS Photo, February 2021).



Figure 17. MW-61 Manzanillo (Manzanilla de Sevilla) (NPS Photo, February 2021).



Figure 18. MW-61 Manzanillo (Manzanilla de Sevilla) (NPS Photo, February 2021).



Figure 19. MW-63 Mission, Tree ID tag (NPS Photo, February 2021).



Figure 20. MW-63 Mission (NPS Photo, February 2021).



Figure 21. MW-63 Mission (NPS Photo, February 2021).



Figure 22. MW-81 Redding Picholine clonal variant A, Tree ID tag (NPS Photo, February 2021).



Figure 23. MW-81 Redding Picholine clonal variant A (NPS Photo, February 2021).



Figure 24. MW-81 Redding Picholine clonal variant A (NPS Photo, February 2021).



Figure 25. MW-81 Redding Picholine clonal variant A (NPS Photo, February 2021).

History

The mature olive orchard on the southern slopes of Mount Wanda at John Muir National Historic Site is associated with Dr. John Strentzel and his early agricultural endeavors in Alhambra Valley during the mid- to late-nineteenth century. Established between 1873 and 1880, the Mount Wanda olive orchard reflects the gentleman farmer's passion for experimental pomology and his participation in the new, and very much experimental, olive industry.

History of Olives in the New World

The edible olive has been a part of human existence since as early as the early Bronze Age (3150 to 1200 BCE) and still retains a prominent place in the human agriculture and diet. Originating from the areas along the eastern Mediterranean Coast (present-day Turkey, Syria, Lebanon, Palestine, and Israel); by 2000 BCE in Syria, these olives were pressed into oil, the value of which exceeded that of wine by fivefold and that of seed oils by over twofold. By about 1700 BCE, olives were introduced into Greece, Egypt, and western Turkey, where archaeological sites show olive-related findings such as milling stones, decantation basins, storage vessels, frescos, and ancient writings. Olives continued to move westward into Sicily, Algeria, Tunisia, and Morocco: the Phoenicians took olives into Spain and North Africa around 1000 BCE and the Greeks imported the trees into Italy. With the prosperity of the Roman Empire, the olive plantings and oil processing facilities further proliferated all around the Mediterranean Basin: the Iberian Peninsula and the north coast of Africa quickly became the prolific production areas of olive oil that was shipped in large amphorae to England, Germany, France, and Italy. The production and spread of the olive oil continued to increase through the Middle Ages, primarily in Spain, Italy, and

Greece. All cultures used olive for similar purposes: primarily as lamp fuel, but also for ritualistic, medicinal, and cosmetic use. Despite the varying uses for the oil, however, very little record exists of olive oil being used for human consumption.¹²

Though the planting of olives persisted through the centuries, the greatest expansion of olive oil production occurred in the 1700s, when large plantings of olives, largely relegated to the worst land,¹³ were made to supply the growing populations of cities. It was also during this century that the olive finally reached the present-day United States. In 1769, Spain's King Carlos III, concerned that the English and French were a little too interested in his far-western possessions in North America, ordered the Franciscans to start moving north to Alta California. The Franciscans' priorities in this move northward were first and foremost saving souls, closely followed by raising cattle for hides, growing enough staple crops to sustain themselves, and finally, planting orchards and vineyards. In this effort, the Franciscans established various fruit orchards on their mission grounds, including olive orchards. They had brought with them to Alta California not only holy oil ("chrism"), pressed and blessed by the bishop in Mexico for religious anointments, but also olive cuttings to contribute to the orchard efforts. The first olives trees were reported to have been planted by the Spanish missionaries at San Diego in 1769. The earliest known cultivation of the Mission variety in California was at Mission San Diego de Alcalá in 1795 with the construction of screw presses and stone mills at the mission.¹⁴ The Mediterranean climate belt of California presented an ideal setting for the olives, native to the Mediterranean Basin, to adapt to the new environment with little difficulty. The olives prospered in the Spanish missions throughout Alta California. By the turn of the century when the missions in Alta California were pressing their own olives,¹⁵ the "holy oil" took on a prevalent role in the mission culture, adopting numerous new functions in addition to its sacramental ones: the leftover oil from the chrism was used for cooking, lamp fuel, and to soften the wool from sheep.¹⁶

In 1834, when the Mexican governor of California, Brevet Brigadier José Figueroa, ordered the secularization of the Spanish missions, the historically mission-associated olive orchards were also, in effect, secularized. While the secularized mission grounds were to be converted partially into pueblos, or villages, with small parcels of land granted to the clergy and neophytes, the dramatic increase in the number of large, private land grants made post-secularization, some 600 grants between 1834 and 1846, compared to the 50 made prior to 1834, suggests that ownership of the mission properties passed primarily to locally powerful and influential individuals.¹⁷ The mission-related vineyards and other

¹² Paul Vossen, "Olive Oil: History, Production, and Characteristics of the World's Classic Oils," *HortScience* Vol. 42 (5), August 2007, 1093-1100.

Very little record exists of olive oil being used for human consumption up to the Middle Ages; it is unclear when the oil shifted primary use from fuel and topical, ritualistic use to consumptive use.

¹³ Ibid.

As propagation of olive trees by seed was tedious and time-consuming (the juvenile nonbearing phase of an olive tree was so long, ranging from ten to fifteen years), the first nurserymen and agriculturists of the Mediterranean Coast likely selected for varieties that came into bearing early, produced heavy yields every year, grew on poor soils in arid areas, and were easy to harvest.

¹⁴ Nancy Carol Carter, "San Diego Olives: Origins of a California Industry," *The Journal of San Diego History*, Vol. 54 No. 3 (Summer 2008), p.138-139.

¹⁵ By 1803, the priests of Mission San Diego de Alcalá had pressed their own holy oil, as recorded for the first time by Father Fermín Francisco de Lasuén, Father Serra's successor. (J.M. Taylor, MD, "Forward" in *California's Olive Pioneers – Early Essays on Olives & Olive Oil*, (Davis, CA: Robert Mondavi Institute for Wine and Food Science, University of California, Davis, 2009), x)

¹⁶ Ibid., ix.

¹⁷ J.P. Munro-Fraser, *History of Contra Costa County, California: Including Its Geography, Geology, Topography, Climatography and Description; Together with a Record of the Mexican Grants ... Also, Incidents of Pioneer Life; and*

agricultural fields that were to remain undivided and under the care and cultivation of the Native American neophytes, were also likely divided and passed into private property as parts of larger land grants.¹⁸ Through the tumultuous decades of land division and neglect, many of the old mission properties fell into disrepair. However, unlike many of the other crops and fruit orchards on the old mission grounds, many of the olive orchards, owing to their stress-resilient character, survived the decades of abandonment. Despite the thriftiness of the olives, however, the orchards were little pursued at this time: only a few settlers knew how to use the olives and made oil for themselves in small quantities.¹⁹ The “secularized” olives would not be speculated for commercialization for another three decades.

Mission by Any Other Name

Evidence suggests the Franciscans grew only one olive variety at the missions. Though it is possible the orchards contained other varieties that died from time and neglect, only one dominant variety persisted into the 1870s amid the renewed efforts to commercialize olive production in California. The variety became known as “Mission”. It is extremely hardy, long-lived, and productive. Mission is also a “dual-purpose” variety, the fruit being suited for both table olives and oil production. Mission may have been the only variety present in California until the mid-nineteenth century, when other varieties were imported from Europe, and the trees in the mission orchards were a significant source of cuttings for propagation.

There is much speculation on the origin of the Mission variety. The edible olive species, *Olea europaea*, is not native to the Americas. In the Old World, olive production was a centuries-old practice. Growing from cuttings, a form of clonal propagation, was and is the norm for planting olives and most other fruit and nut crops, a method that ensures the desirable traits of the source tree are maintained. Propagation from seeds does not ensure trait of the source tree are maintained; progenies are not identical to their parents. It is most likely the introduction of olive into the New World would have been in the form of cuttings of a favored and prominent varieties of the time, and it is reasonable to assume the trees in the California mission olive orchards were also planted as cuttings taken from other orchards established as the missionaries and other Europeans moved north into Alta California. Mission, then, would be a New World synonym for a genetically identical Old-World variety, directly connected by centuries of cycles of clonal propagation.

As early as 1888, the New World variety Mission was considered synonymous with a highly regarded Spanish variety.²⁰ Named Cornicabra in the publication, this variety, and Mission, are not the Cornicabra currently grown in Spain. Various studies, including past research by FPS, confirm that the variety known as Mission in the United States is genetically identical to a prominent European variety known by different synonyms in different regions. Mission matches Picholine Marocaine, currently the most prominent Moroccan cultivar.²¹ In 2008, Khadari et al. noted that Mission and Picholine Marocaine are

Biographical Sketches of Early and Prominent Settlers and Representative Men (San Francisco: W.A. Slocum & Company, 1882), p.267; “Mexican California,” from *California as I Saw It: First-Person Narratives of California’s Early Years, 1849 to 1900* Collection, Library of Congress, accessed January 25, 2021, <https://www.loc.gov/collections/california-first-person-narratives/articles-and-essays/early-california-history/mexican-california/>.

¹⁸ Munro-Fraser, *History of contra Costa County*, p.268.

¹⁹ Taylor, “Forward,” x.

²⁰ Arthur Tappan Marvin, *The Olive: Its Culture in Theory and Practice*, (San Francisco: Payot, Upham & Co., 1888), p.23.

²¹ Lisa Scarafia, “Are Mission Olives Actually Picholine Marocaine?” from *Olive Oil Times*, accessed February 4, 2021, <https://www.oliveoiltimes.com/opinion/are-mission-olives-actually-picholine-marocaine/29732>.

also the same as, i.e., synonyms of, the Spanish variety Canivano Blanco and Sigoise from Algeria.²² In 2011, Koehmstedt et al. noted that Mission matches Zitoun, another Spanish variety.²³ Across woody crop species, it is typical for successful old varieties to become widely distributed and to acquire many names as they move through time and space. This is clearly true for the olive variety called Mission in California. It is also clear that Mission came to the New World as cuttings and has been faithfully propagated by cuttings since its arrival.

The Mexican Republic, California Statehood, and Rancho El Pinole

When Mexico achieved independence from the Spanish monarchy in 1821, Alta California became a part of the newly established Mexican Republic. Under Mexican rule, the Spanish colonial policies that restricted landownership and foreign trade were lifted: trade between Californians and foreigners were allowed, governors were encouraged to make more land grants for individual ranchos, and foreigners, once naturalized and converted to Catholicism, could hold land in the province.²⁴ In an effort to populate its distant territories such as Alta California, the Mexican government granted and distributed lands liberally through the 1820s and 1830s, allowing individuals to apply for and receive tracts of land ranging from a league square (approximately 4,428 acres) to eleven leagues square (nearly 50,000 acres).²⁵ Some fifty grants were issued for large ranchos before 1834, and, upon secularization of the California missions in 1834, an additional 600 grants were made.²⁶

The study site, Mount Wanda, was claimed as a part of one of such land grants: Rancho el Pinole. In as early as 1823, Ignacio Martinez was reportedly granted a place called El Pinole comprising some three leagues (*sitios*). In 1834, Martinez claimed that he had lost his title papers to his land and solicited a renewal of title. When insufficient evidence of his claims required him to petition anew in 1837, he expanded his land grant to include an additional league. In the new petition, Martinez described the land as “three *sitios*, which are ‘Cañada del Pinole,’ and that which is called ‘La Hambre,’ straits of Carquinez, running towards the ‘Mar de la Norte,’ that is called Bay of Sonoma, adjoining the mouth of the same Cañada del Pinole.”²⁷ Mount Wanda, located immediately west-southwest of Cañada del Hambre, was situated at the eastern border of the said land grant.

Most of the land grant petitions made during the Mexican rule of California included graphic representations, *diseños*, of the land to show its shape and position, with reference to neighboring tracts, natural objects, and developments. These *diseños* often depicted houses, orchards and/or agricultural fields, and corral present on the rancho land. One such *diseño* of Rancho el Pinole dating to the 1840s depicts the extent of the land grant, including Cañada del Hambre, immediately west of which Mount Wanda is located.²⁸ This map labels Cañada del Pinole at the western boundary of the rancho where an

²² B. Khadar, J. Charafi, A. Moukhli, and M. Ater, “Substantial Genetic Diversity in Cultivated Moroccan Olive Despite a Single Major Cultivar: A Paradoxical Situation Evidenced by the Use of SSR Loci,” *Tree Genetics & Genomes*, 4 (2008), p.213-221.

²³ Koehmstedt et al., “Molecular Characterization,” p.519-531.

²⁴ “Mexican California”.

²⁵ J.P. Munro-Fraser, *History of Contra Costa*, p.255.

²⁶ “Mexican California”.

²⁷ Munro-Fraser, *History of Contra Costa County*, p.329.

²⁸ This *diseño* likely dates to the early 1840s as a correspondence from the Governor to the Prefect, dated June 1, 1842, stated that a grant had been issued to Martinez for El Pinole. This was likely in association with Martinez’s re-petition for El Pinole in the late-1830s after claiming that he had lost his title papers to his 1823 land grant.

encinal (oak grove) and two structures are demarcated by a stand of trees and two polygons. Contrasting the development in the western portion of the Rancho el Pinole, only the natural geographical and topographical forms are depicted in the eastern end of the land grant (see Figure 26). This suggests that there were no purposeful improvements, including an olive orchard, made in the study site, immediately west of Cañada del Hambre, by the early 1840s.

In 1851, a year after California officially entered the Union as the thirty first state of the United States, the U.S. government passed the California Land Act of 1851 that established the Board of Commissioners to ascertain and settle the private land claims in the new state.²⁹ This legislation was enacted to uphold the articles of the Treaty of Guadalupe Hidalgo of 1848 that ended the Mexican-American War and which stipulated the protection of property and civil rights of Mexican nationals living within the new boundaries of the United States.³⁰ The title confirmation process required the landowners to present to the board their title papers and other evidence of ownership. Upon finding the surveys of land grants during the Spanish and Mexican era lacking the precision necessary to confirm or reject these claims, the ranchos began to re-survey their landholdings while new petitioners, too, began to scope available lands.³¹

Three known boundary surveys from the early years of California statehood were executed in the area of Rancho el Pinole: plats dating 1857, March 1860, and December 1860. Like the *diseño* dating to the early 1840s, these three plats, too, suggest that the Mount Wanda olive orchard post-dates the mid-nineteenth century. While all depicting or describing improvements along the boundary of Rancho el Pinole, they exclude the mention of an orchard or an agricultural field in the vicinity of Mount Wanda. Of particular interest are the “Plat of the Rancho del Pinole, 1857” and the “Plat of the Rancho Cañada del Hambre de las Bolsas, March 1860” in which a house is depicted immediately south of the present-day olive orchard (see Figure 27 and 28). This house, labeled “Abelino” or “Abellino House,” refers to the adobe built by Don Abelino Altamirano, husband of Doña Encarnación Martínez and son-in-law of Ignacio Martínez, circa 1849.³² The representation of this particular building aids in more accurately locating the site of the olive grove within the plats: immediately northwest of the confluence of Arroyo del Hambre. Though an argument could be made that these two plats, with the exception of houses, only represent development bisected by the property boundary line and therefore the status olive grove cannot be confirmed, the third plat of the area, “Plat of Rancho Pinole, December 1860,” further supports the claim that an olive grove was not extant at this time. This plat depicts numerous agricultural fields, both those bisected by the property line and those fully intact and within the boundary. This plat depicts a large field immediately south of the confluence of Arroyo del Hambre but not one immediately north of it, where the olive grove stands today (see Figure 29). As such, the *diseño* and three plats of the area ranging from the early 1840s to 1860 suggest that the olive grove on Mount Wanda post-dates the Mexican Land Grant era and the early years of California statehood.

(F.A. Hyde, William A. Piper, and Aaron Augustus Sargent, *In the Matter of the Survey of the Rancho "El Sobrante," Castro Confirmees: Brief*, (United States Department of Justice: Central law and job print (W. Heughes'), 1889), p.49; Munro-Fraser, *History of Contra Costa County*, p.329)

²⁹ Section 1, California Land Act of 1851.

³⁰ Treaty of Guadalupe Hidalgo (1848), Articles VIII-IX.

³¹ Paul Gates, “The California Land Act of 1851,” *California Historical Quarterly*, December 1971, Vol. 50, No. 4 (Dec. 1971), p.396-399.

³² Marion Randall Parsons, *Old California Houses*, (California: University of California Press, 1952), p.33-34.

This adobe was restored by John Swett’s family and is extant today.

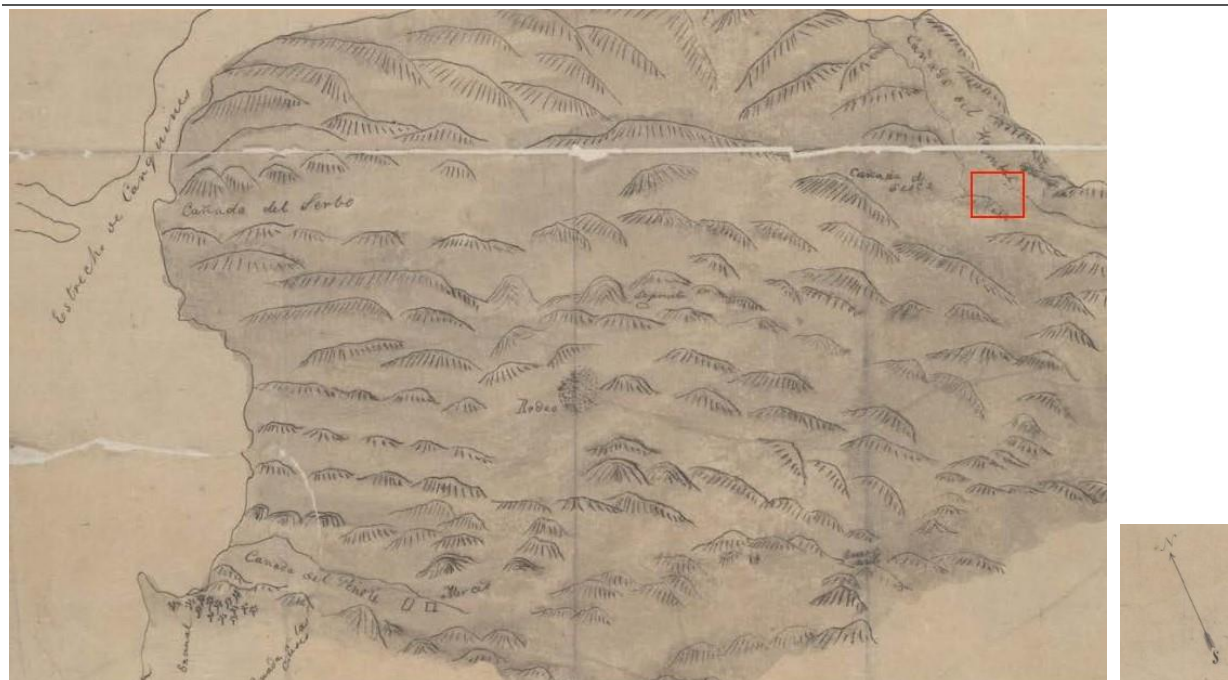


Figure 26. Crop of “Diseño del Rancho Pinole: California,” U.S. District Court. California, Northern District. Land case 205 ND, page 670; land case map D-450 (Bancroft Library), circa 1840s. Approximate study area marked in red.

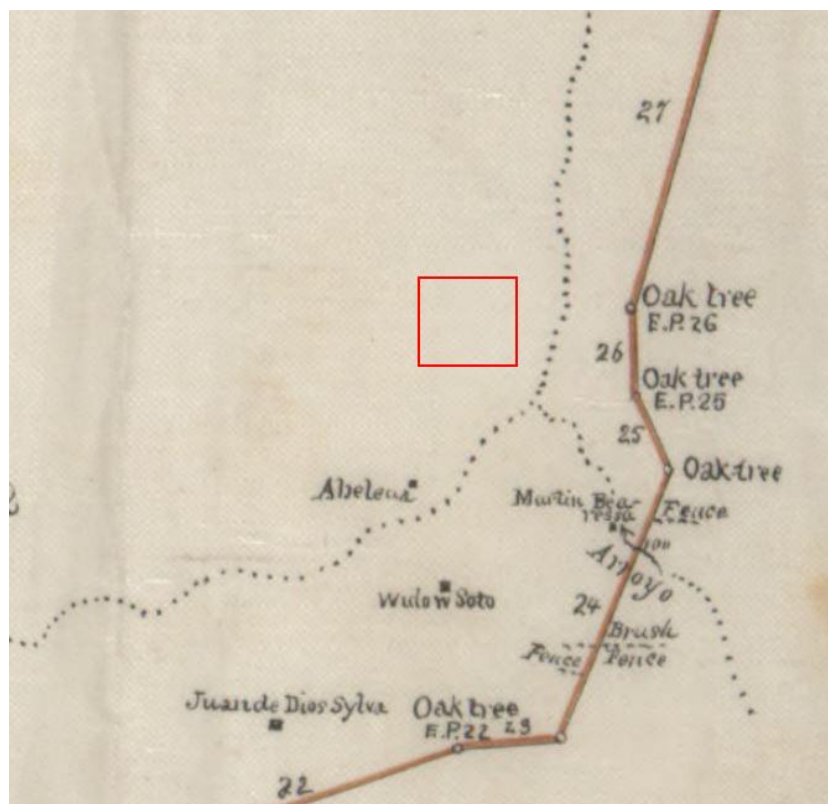


Figure 27. Crop of “Plat of the Rancho del Pinole, California, finally confirmed to Maria Antonia Martinez de Richardson, & al., containing 29,039 42/100 acres /surveyed under the direction of the U.S. Surveyor General by Andrew J. Coffee, Depy. Surveyor, 1857,” U S. District Court. California, Northern District. Land case 205 ND, page 674; land case map E-454 (Bancroft Library). Approximate study area marked in red.

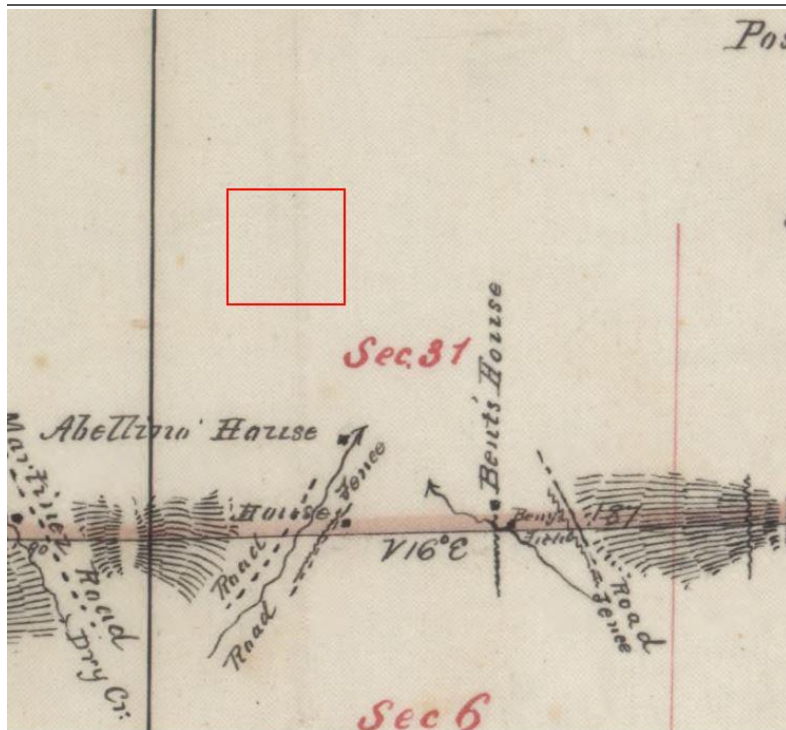


Figure 28. Crop of "Plat of the Rancho Cañada del Hambre de las Bolsas, California, finally confirmed to Teodora Soto / surveyed under instructions from the U.S. Surveyor General by A.W. Von Schmidt, Dep. Surr., March 1860," U.S. District Court. California, North District. Land case 308 ND, page 434; land case map E-617 (Bancroft Library). Approximate study area is marked in red.



Figure 29. Crop of "Plat of the Rancho Pinole, California," 1860, U.S. District Court. California, Northern District. Land case 205 ND, page 672; land case map E-452 (Bancroft Library). Approximate study area is marked in red. Note the hatched polygons in the adjacent lands that represent agricultural fields.

Development of the Olive Industry in California

In 1862, Congress passed the Morrill Act, establishing land grants and land-grant colleges throughout the United States. In California, this federal act aided in addressing the population boom (the continuing results of the gold rush in 1849 and California's admittance into statehood in 1850) and the associated demands for development. Under the Morrill Act, the University of California was founded, by merging of the private College of California and the Agricultural, Mining, and Mechanical Arts College. By 1869, a new College of Agriculture was established in Berkeley. This institution, under the leadership of its second dean, Eugene Woldemar Hilgard, informed and educated farmers of the west about the nature of their soil and how it would work best for them.³³ Information on olives would soon be included in this dissemination of knowledge.

For the first time, amidst the development of California under the Morrill Act, two American entrepreneurs, Ellwood Cooper and Frank Kimball, simultaneously but separately sought to commercialize olive oil in California. Recognizing the “cosmopolitan diet” of the new state, both men deemed the establishment of an olive oil market in California to be lucrative. Both men quickly collected thousands of cuttings from the neglected olive orchards within the abandoned mission grounds, Cooper from Mission Santa Barbara and Kimball from Mission San Diego, and each established their private orchards comprised of the Mission variety. By 1871, olives were pressed for the first time on a commercial scale in California.³⁴

Around the time that the first two private olive orchards came into fruition, Frederick Pohndorff collected and sent specimens of olive trees commonly grown in Spain, none of them the Mission type, to San Francisco.³⁵ In 1874, the following European commercial varieties arrived in California: Manzanillo, Nevadillo, and Sevillano olives, marking the beginning of a rush to plant and evaluate additional varieties in the young state. Hundreds of foreign olive varieties were imported and planted during this period. Production from these plantings resulted in an olive oil “bubble” in the late-nineteenth century that would continue until World War I.³⁶

This period of olive oil “bubble” in California corresponds to the “Golden Age” of historic orchards, characterized by the production of a diverse variety of olives within individual, and across numerous, orchards.³⁷ These earlier, more diverse orchards were likely experimental, to determine the characteristics of an olive variety and the quality of its fruit. The reports of multi-variety orchards are prominent in the newspapers throughout the late-nineteenth and early-twentieth century.

Starting in 1875, many farmers and other entrepreneurs planted dozens of olive orchards throughout California, excited to participate in the speculative industry. However, most of these olive growers were completely ignorant of how to successfully grow olives; they turned to the only books available, imported and most of them outdated by centuries, for help with their farming. In response to the farmers' difficulties, the College of Agriculture at the University of California and the newly established state boards of agriculture and horticulture published scientific research papers on the olive tree, the olive

³³ Taylor, “Forward,” xii.

³⁴ Taylor, “Forward,” xii; Vossen, “Olive Oil,” 1094.

³⁵ Pohndorff was the cellar master at Dreyfus wine merchants in San Francisco and had gone to Spain looking for better grapes and recognized the potential of the olive market when he saw the huge tracts of land dedicated to olives. Viticulture was also a developing market in California at this time.

³⁶ Taylor, “Forward,” xiii.

³⁷ Susan Dolan, *Fruitful Legacy: A Historic context of Orchards in the United States, with Technical Information for Registering Orchards in the National Register of Historic Places*, (Washing DC: GPO, 2009), 32.

variety, their temperaments, etc. and contributed to the development of a strong olive culture in California.³⁸

John Strentzel and Olives

Around this time, Dr. John Strentzel of Alhambra Ranch,³⁹ Contra Costa County, also likely ventured into the olive business. John Strentzel was an early settler of Alhambra Valley, arriving in 1853, and first started his fruit ranch with a pear orchard on twelve acres of fertile land alongside Alhambra Creek (originally Arroyo del Hambre) in the upper valley. Inspired by promoters such as Andrew Jackson Downing, Strentzel and other like-minded farmers embraced the golden age of pomology in post-Gold Rush California and helped transition the state's economic basis from mining to crops. Where acreage devoted to fruit and grain production was initially small compared to that devoted to grazing, these post-gold rush settlers began to transform the landscape of the Alhambra Valley. In the following years, he expanded his crops to include pears, apples, cherries, figs, oranges, peaches, pecans, plums, quinces, and walnuts. By 1869, Strentzel had established himself as a prominent gentleman, or model, farmer who supplemented his agricultural endeavors with the scientific approach of pomology, the science and practice of fruit growing, and produced some 375,000 pounds of produce.⁴⁰

John Strentzel possessed a passionate interest in pomology and continuously experimented with a variety of fruits to learn which grew best in the local climate of hot and dry summers and cool winters. In his experiments, Strentzel first concentrated on growing vines with imported varieties of grapes from Europe and later with hardier domestic grape stock, and eventually produced the first Muscat grapes in California.⁴¹

The developing olive business in California likely tempted Strentzel's horticultural pursuits and devotion to pomology. Like his early experiments in viticulture, the gentleman farmer likely pursued the growing olive industry from a speculative perspective, testing European varieties in the local climate. By April 1880, John Strentzel, who was deemed the "best and most successful Horticulturist in our State," was observed to have planted a variety of fruit trees, including olives, and now had "splendid large groves of each" which were a "joy to see."⁴² This description of Strentzel's ranch confirms that the fruit farmer had planted an entire grove of olive trees on his land, and not just a few specimen trees, during the early, speculative years of California's olive industry. By September 1880, the gentleman farmer was acclaimed to have the "most complete pomological display" in the state Horticultural Society's exhibit, to include, in addition to his varieties of apples, pears, plums, prunes, grapes, nuts, and quinces, "a host of interesting pomological graces in the shape of pomegranates, *olives*, etc."⁴³

Although there is no definitive documentation of the planting or the location of the olives on Strentzel's land at present time, an abundance of circumstantial evidence supports the claim that the present-day olive grove on the southern slope of Mount Wanda is the grove described in 1880. While there have been

³⁸ Taylor, "Forward," xvi.

In the adoption of scientific experimentation and analyses, the olive orchards of this period also adopts the characteristics of the historic orchards classified as "modern era" orchards. (Dolan, *Fruitful Legacy*, 63)

³⁹ The 1891 plat of Strentzel and Muir's property labeled their fruit ranch as the "Alhambra Ranch." This name is used throughout the document to refer to the Strentzel-Muir ranch.

⁴⁰ John Muir National Historic Site Cultural Landscape Inventory, National Park Service, 2004, Part 1 p.32, Part 2a p.2.

⁴¹ *Ibid.*, Part 1 p.35.

⁴² "Orange Culture," *California Farmer and Journal of Useful Sciences*, Vol. 49, No. 25, April 1, 1880.

⁴³ "The Horticultural Society's Exhibit," *Pacific Rural Press*, Vol. 20, No. 11, September 11, 1880. Emphasis added.

theories suggesting that the neighboring property owner, John Swett, planted these olives on the southern slope of Mount Wanda, the extent of his property ended south of this olive grove. Further, a survey of historic maps in the *Mount Wanda Historical Ecology Investigation*, 2015, shows that the land on which the olives were planted was a part of the Strentzel-Muir property until circa 1892 when this portion of the property was parceled and sold to Roger Cutler. The “Plat of a Portion of the Alhambra Ranch,” 1891, shows the area of the extant orchard as classified as “orchard and vineyard,” which is consistent with the keeping of olives (See Figure 30).⁴⁴ A field survey in 2019 also revealed an identifiable grid pattern of the olives, uninterrupted by the natural dominant species such as valley oak (*Quercus lobate*), coast live oak (*Q. agrifolia*), and buckeye (*Aesculus californica*) identified in the *Historical Ecology Investigation*.⁴⁵ These observations confirm that the extant olive grove was purposefully planted within the Strentzel-Muir property and not seedling olives that spread from Swett’s neighboring plantings.⁴⁶

DNA testing of samples of the Mount Wanda olives further supports the theory that the olive trees were planted during the Strentzel-Muir era of property ownership. The testing carried out by Foundation Plant Services, University of California, Davis in 2020 reveals that the extant olive orchard comprises of the Mission, Manzanillo, and Redding Picholine varieties. The presence of the multiple varieties of olives in a single grove is congruent with the orchard planting practices of the mid- to late-nineteenth century and reflects John Strentzel’s propensity for pomological experiments, similar to that of his earlier viticulture endeavors, during which time he likely tested and compared the European varieties against the domestically established ones. The presence of the Redding Picholine also points to a very specific window of planting that falls within the period of Strentzel-Muir ownership, as this particular variety enjoyed a very short period of popularity among olive growers: from the time of its arrival in California in as early as 1873, to the turn of the century.

⁴⁴ Sean Baumgarten, Erin Beller, and Robin Grossinger, *Mount Wanda Historical Ecology Investigation: a Reconnaissance Study Investigating Historical Landscape Data for the John Muir National Historic Site*, San Francisco Estuary Institute Aquatic Science Center, March 2015, p.12.

⁴⁵ *Ibid.*, p.15.

⁴⁶ John Swett was also known to have olives on his property south of the Strentzel-Muir land (“Alhambra Valley,” *Pacific Rural Press*, Vol. 37 No. 2, January 12, 1889).

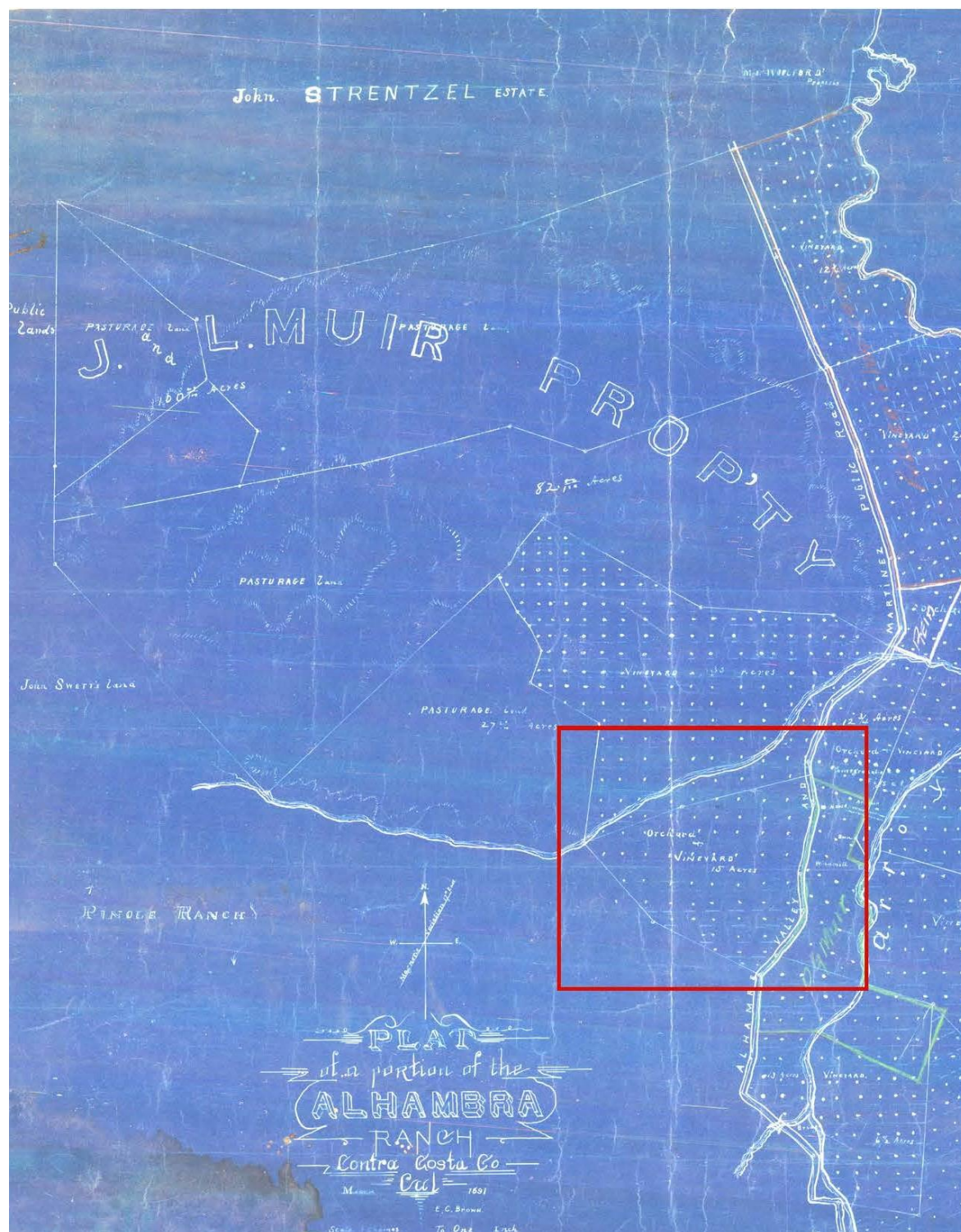


Figure SEQ Figure * ARABIC 30. "Plat of a Portion of the Alhambra Ranch, Contra Costa Co., Cal.," E.C. Brown, 1891, as cited in Mount Wanda Historical Ecology Investigation. Hard copy located at John Muir National Historic Site, JOMU 3889. Study area marked in red.

The Redding Picholine

The Redding Picholine was introduced to California around 1874, shortly following the other European varieties brought over by Pohndorff. Later named after its importer, Benjamin Barnard Redding, this olive enjoyed a very short, but significant, period of popularity. While various sources suggest different dates of arrival in California, ranging from 1873 to 1882,⁴⁷ as well as different origins,⁴⁸ it is most probable that the Redding Picholine arrived in the early- to mid-1870s as its importer died in 1882 and reports of multiple seasons of harvest are available by the mid-1880s. It is widely accepted that Redding intended to bring to California the variety Picholine, also known as the “Queen Olive,” “French Picholine” or “Picholine proper,” but what arrived was ultimately determined to be not true Picholine.⁴⁹ Literature on olives speculate that due to either a failed graft or a deceitful European propagator, Redding unknowingly presented California with a “semi-wild” olive, which now bears his name.⁵⁰ Fully believing he had imported the Picholine, Redding transferred a part of his original invoice to W.R. Strong & Co. of Sacramento who propagated and disseminated the variety across the state.⁵¹ Initially, the new variety was widely accepted and planted with great fervor by unknowing olive growers. The Redding Picholine, characterized by its small tree size and fast growth, was known to bear fruit “equally and prolifically,” and ripened “as early or earlier than any other variety.”⁵² Cheap and easy to raise, the Redding Picholine proliferated across the lands of hopeful olive growers during the 1880s.

In the following decade, however, as the trees started to fruit regularly, the hopeful growers began to question the quality of the Redding Picholine. The highly anticipated olives proved small in size and poor in its pit-to-flesh ratio. Though oil pressed from these olives was supposedly of “good” quality, the yield quantity was unfavorable. Still, many of the growers remained hopeful, believing that the olive size would grow with the maturation of the trees.⁵³

Around the same time, however, experts in the field began to realize that the Redding Picholine, referred to as the Picholine at the time, was, in fact, not what it was presented to be. Upon seasons of fruiting, those on the State Board of Horticulture observed that while these olives produced very good oil and a very sweet pickle, these extensively propagated olive trees were of a wild species. The Redding

⁴⁷ “The Queen Olive,” *Los Angeles Herald*, Vol. 20 No. 51, October 18, 1883; Taylor, “Forward,” xxii.

⁴⁸ Suggested origins of the Redding Picholine include Spain, France, and Italy. Taylor claims that Redding ordered many grafted saplings from France; Marvin states that Redding’s original intentions were to import the Queen olive from Spain; an article in the *Los Angeles Herald*, October 18, 1883, describes Redding’s personal journey from a site near Rome, where he purchased his olive cultivars, back to California by way of the Rocky mountains. While the true name of the Redding Picholine is not offered in any of the published papers of the time, an article in the *Sacramento Daily Union* on October 17, 1892 reports that in the Arodissement of Aix, Communes of Eyrogues (or Eyguieres) there is found a “small-fruited olive resembling the Picholine of California,” known locally as “Dendiverdi,” or “Dentiverti,” a variety that grows side by side with the Picholine proper (“Information on Olives,” *Sacramento Daily Union*, Vol. 84 No. 49, October 17. 1892). This name suggests an Italian origin.

⁴⁹ B.M. Lelong, “The Olive in California – Varieties, Budding, Grafting, New Methods, and General Observations,” in *California’s Olive Pioneers – Early Essays on Olives & Olive Oil*, (Davis, CA: Robert Mondavi Institute for Wine and Food Science, University of California, Davis, 2009), p.215.

⁵⁰ Taylor, “Forward,” xxii; Marvin, *The Olive: Its Culture in Theory and Practice*, p.29-30.

⁵¹ Marvin, *The Olive: Its culture in Theory and Practice*, p.29-30.

⁵² “In Favor of the Redding Picholine Olive,” F. Closs, Quisiana, Auburn, CA, *Pacific Rural Press*, Vol. 41 No. 4, January 24, 1891.

⁵³ *Ibid*.

Picholine's fecundity, low stature, and its hardiness all pointed to a wild variety of olives and this variety was ultimately determined best suited as a grafting stock.⁵⁴

The general public opinion of the Redding Picholine shifted from hopeful to resentment around the turn of the century, when, despite the maturing trees, the fruit remained small in size. By this time, the Redding Picholine had been propagated at such a scale, across thousands of acres, that its disappointing yields seemingly devastated the entire California olive culture. The growers had unknowingly planted and tended to olives wholly of a different variety from the expected French Picholine and the result was disastrous. As an olive grower explained, the Redding Picholine fruit was "a bore to the picker, to the pickler, to the oiler and consumer, and the would-be seller was the one sold."⁵⁵ The earlier proclamation of a "good" oil was overturned with reports claiming that oil from the Redding Picholine was the greasiest and the first to solidify, quickly assuming the appearance of partly melted, yellowish lard.⁵⁶ As so many of the previously hopeful growers went bankrupt from the disappointing results of the Redding Picholine, those struggling to survive either cut down their orchards or grafted them over to larger, more productive varieties. The Redding Picholine was condemned a "mistake," "worthless except as a grafting stock."⁵⁷

As rootstock, the Redding Picholines likely retained some investment value as they presented favorable conditions for those olive growers resorting to work over these otherwise commercially worthless trees. Despite the disappointing quality of its fruit, by the turn of the century, the Redding Picholine had already established as mature trees. Owing to their semi-wild attributes, these trees were thrifty and rooted vigorously, offering an already-established root system over which new varieties could be grafted. By the second decade of the twentieth century, plots of land planted with Redding Picholines were advertised as opportunities for new olive growers to enter the industry at low cost, with established rootstock waiting to be grafted over.⁵⁸

The Manzanillo Olive

Manzanillo was one of the first commercial non-Mission olive varieties to arrive in California, along with the Sevillano and Nevadillo varieties. Also referred to as Manzanilla de Sevilla, Manzanillo was a Spanish variety that came under notice of Frederick Pohndorff, a viticulturist who had traveled to Spain in search of better grapes. The cellar master noticed the huge tracts of land devoted to olives and sent cuttings of these trees to his employer in San Francisco in 1874.⁵⁹

⁵⁴ *Biennial Report of the State Board of Horticulture*, United States: n.p., 1890, p.93; Marvin, *The Olive: Its Culture in Theory and Practice*, p.30.

⁵⁵ "Olive Culture Not a Failure," *Los Angeles Herald*, No. 293, July 20, 1899.

The olive pit was too large in proportion to the flesh to produce high quality oil; consumers rejected the pickled Redding Picholine due to its diminutive size. The cost of picking these small olives was almost double that of other varieties.

⁵⁶ "Relative Value of Olive Varieties," *Pacific Rural Press*, Vol. 47 No. 24, June 16, 1894.

⁵⁷ "Relative Value of Olive Varieties"; "Olive Culture in San Ramon Valley," J.O. Steward, Jr., at the University Farmers' Institute at Danville, *Pacific Rural Press*, Vol. 57 No. 7, February 18, 1899; "Olives in California," F.T. Bioletti in Circular 86 of the Experiment Station, Berkeley, *Pacific Rural Press*, Vol. 85 No.12, March 29, 1913.

⁵⁸ "Grafting Old Olives," *Pacific Rural Press*, Vol. 91, No. 22, May 27, 1916.

By this time, grafting over old or ill-adapted trees had become common practice in orcharding "to secure more valuable and marketable varieties." (Edward J. Wickson, A.M., *The California Fruits and How to Grow Them: a Manual of Methods Which Have Yielded Greatest Success, With the Lists of Varieties Best Adapted to the Different Districts of the State*, Sixth Edition, (San Francisco: Pacific Rural Press, 1912), p.91.)

⁵⁹ Taylor, "Forward," xii.

Since its arrival in California, the Manzanillo olive was propagated extensively across the state. In the 1880s, it was deemed to produce one of the largest size of olives in California, second only to Sevillano Gordal, and quickly gained popularity. The Manzanillo olive tree was described as “[bearing] well,” producing fruit that, on average, weighed approximately seven grams with a circumference of twenty-three millimeters and a length of twenty-five millimeters. Its flesh-to-pit ratio was favorable, with the seed being one-eighth of the whole weight. The olive tree also required limited maintenance, “[exacting] limited pruning,” which made it even more favorable to olive growers.⁶⁰ By the 1890s, Manzanillo olives had become one of the most popular varieties among olive orchardists, ranking the top two in some of the nurseries.⁶¹

When first introduced in the 1870s, Manzanillo olives were propagated for both pressing (for oil) and pickling purposes. Literature dating within the first decade of its introduction describe the variety as a very good olive “as a pickling fruit and for oil.”⁶² However, by the late-1880s, Manzanillo olives were more often described as an excellent, if not “one of the best,” pickling fruit, with little to no mention of its use for pressing oil.⁶³ It was believed that a large olive like the Manzanillo was preferable for pickles over the extra-large varieties as the latter fruits would prove difficult in “extracting bitterness without softening the fruit.”⁶⁴ By the early 1900s, the Manzanillo olives were determined to produce some two to three percent less oil than the Mission olives at respective maturity.⁶⁵ It did, however, consistently maintain its status as a popular pickling fruit and it was declared to make “good green and ripe pickled products.”⁶⁶

The popularity of Manzanillo olives was also likely associated with its early maturation. At the onset of the olive industry in California, speculative olive growers determined that the Mission olive, the only commercial variety of olives available in the state prior to circa 1874, was adapted to only warmer parts of the country. The Mission olive is slow to mature. In cooler climates, it matured so late in the season that the fruit “[interfered] sensibly with the blooming of the next.”⁶⁷ Earlier ripening varieties were necessary for olive cultivation to expand into cooler regions of the state. Manzanillo, introduced around the same time this need was identified, was found to ripen very early, much earlier than the Mission.⁶⁸

Unlike the short-lived Redding Picholine, this olive variety continued to thrive through the development and establishment of the California olive industry. As of 2009, the Manzanillo remains one of the most frequently grown olive trees in California.⁶⁹

⁶⁰ Frederick Pohndorff, *Memoir on Olive Growing*, State Horticultural Society, San Francisco, February 29. 1884, p.7.

⁶¹ John S. Calkins, *Olive Grower's Handbook and Price List of Olive Trees Grown by John S. Calkins*, (Los Angeles: Pomona Progress Print, 1894), p.4.

⁶² Pohndorff, *Memoir on Olive Growing*, p.7.

⁶³ Calkins, *Olive Grower's Handbook*, p.4.

⁶⁴ Ibid.

⁶⁵ “A Chemical Study of the Ripening and Pickling of California Olives,” United States Department of Agriculture Bulletin No. 803, January 24, 1920, p.18.

⁶⁶ The Walker Nurseries, *Pedigreed Trees of Citrus and Tropical Fruits: Embracing Oranges, Lemons, Pomelos, Olives, Avocados, Mangos, Etc.*, San Francisco, CA, 1914, p.11.

⁶⁷ “Olive Culture in California, Suggestions as to Varieties, Modes of Culture, and Care of the Trees,” *California Rural Press*, October 1886, as included in “Olives, Scrapbook,” 1883-1900, <https://www.biodiversitylibrary.org/item/76976>, Accessed November 6, 2020.

⁶⁸ Calkins, *Olive Grower's Handbook*, p.4; “A Chemical Study of the Ripening and Pickling of California Olives,” p.3.

⁶⁹ Taylor, “Forward,” xii.

Mount Wanda Olive Orchard

When Muir had become a partner in Strentzel's fruit ranch in the 1880s, he had refocused production efforts toward the most profitable crops, namely table grapes and Bartlett pears. Such transition towards targeted production likely influenced Muir's decision to lease or sell parts of the family land. In 1891, John Muir passed the responsibilities of operating the fruit ranch on to various family members, and, having narrowed down the production types to table grapes and pears, parceled and sold other parts of Strentzel-Muir land in the following years to fund his writing and travel. By this time, the reputation of the Redding Picholine had steadily and irreparably declined and the parcel on which the Mount Wanda olive grove stood was sold from the family ranch.⁷⁰

Two adjoining parcels located at the southernmost part of Alhambra Ranch, where the olives were planted, were sold to a Roger Cutler in 1892 (See Figure 31).⁷¹ As there are no records of the removal of olives from the Strentzel-Muir land, and because the 1891 plat of the area continued to describe the land as part orchard, the olive grove likely transferred ownership as an improvement on the parcel.⁷²

Upon changing ownership, the olives on Mount Wanda remain a mystery. Very little is known of the new landowner around this time; there are no records available, to date, on Roger Cutler's involvement in the State Horticulture Society or association with the fruit ranching industry. This lack of information on Cutler, particularly among agricultural publications, suggests that he was not an active member of the ranching community and was unlikely to have removed, and later replanted, an olive grove on his new property.⁷³

Photographic documentation of the extant olive grove is available dating back to 1939. The planting site has been photographed once every decade through the 1960s and sporadically thereafter, in 1980 and 2000 (See Figures 32-36).

Adjacent Lands – West Hills

As of March 2021, the National Park Service is in the process of acquiring the "West Hills" property to the south-southwest of Mount Wanda. This property comprises a portion of land formerly owned by John Swett on which an olive grove stands. While further research and testing are required to determine the exact history and composition of these olives, organized rows of tree plantings are visible in this area alongside the Mount Wanda olives in the following aerial photographs. Given that John Swett was also a pomology enthusiast and was reported to have an olive orchard on his land by 1889, it is possible that the West Hills olives date to the time of John Swett's ownership of the land.⁷⁴

⁷⁰ John Muir National Historic Site CLI, Part 1 p.32-33.

⁷¹ Both land transactions took place in 1892 though one was recorded in 1893.

⁷² Had John Muir and family removed the olives and established a new orchard on the land during their process of refocusing ranch production, he would not have sold this parcel of newly improved land.

⁷³ An aerial photograph captured on January 1, 1939 shows an established grove, nearly identical in layout to the extant grove, on the southern slope of Mount Wanda. (Flight C-5750, Frame 280-107)

⁷⁴ "Alhambra Valley," *Pacific Rural Press*, Vol. 37 No. 2, January 12, 1889.

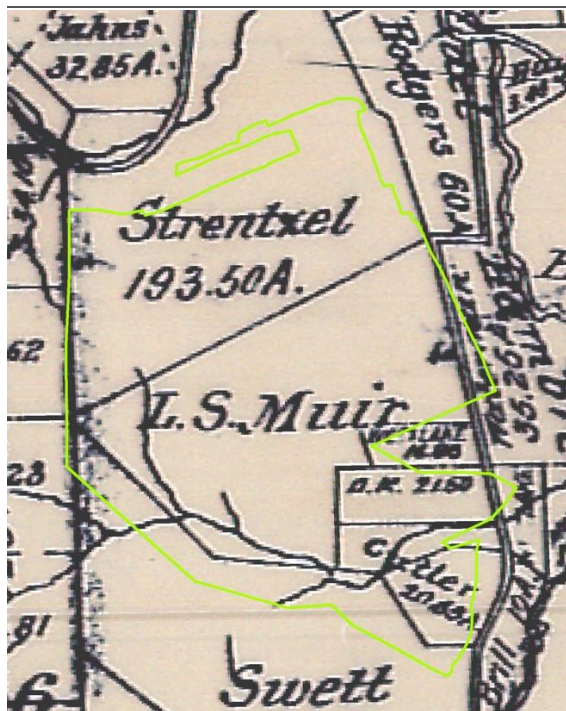


Figure 30. Crop of "Map Showing Portions of Alameda and Contra Costa Counties, City and County of San Francisco, California," George Sandow, 1894, as cited in the Mount Wanda Historical Ecology Investigation, showing the change in ownership of the study area from Muir to Cutler. The green polygon represents the present-day John Muir National Historic Site boundary.



Figure 31. Crop of aerial photograph captured on January 1, 1939, Flight C-5750, Frame 280-107.



Figure 32. Crop of aerial photograph captured on September 6, 1946, Flight GS-CP-5-106 (Earth Explorer Entity ID AR1CP0000050106).



Figure 33. Crop of aerial photograph captured on January 1, 1958, Flight BUU-1958, Frame 6v-201.



Figure 34. Crop of aerial photograph captured on May 1, 1965, Flight CAS-65-130, Frame 28-23.



Figure 35. Crop of aerial photograph captured on October 28, 1980, Flight S_VEZR, Frame 1-95.

Conclusion

Although there is no concrete evidence pointing to the exact time and location of planting, the available data on the olive industry in California, in conjunction with the known history of John Strentzel in Alhambra Valley, allow for the determination of a specific timeframe during which the olives would have been planted on Mount Wanda. The presence of the Manzanillo and Redding Picholine olive varieties intermixed in the orchard sets the planting date no earlier than 1873-74, as these European varieties did not reach California until this time. Although the spatial distribution of the olives on Mount Wanda, in which the Mission olives occupy a block at the highest elevation with the Manzanillo and Redding Picholine planted in the periphery at lower elevations (see Appendix C), suggests the possibility of the Mission olives having been planted at an earlier date, the historical data available from the California Rancho period suggests that these cannot pre-date 1860. As the olive culture did not become mainstream in California until the early- to mid-1870s, it is highly unlikely that John Strentzel would have planted an olive orchard during the 1860s. Further, if he had in fact planted the olives during this time, it is unlikely that it would have gone unnoticed and undocumented in horticultural publications as one of the first attempts at commercial olive production. As such, while the Mission olives may have been the first to be planted on Mount Wanda, they were likely planted during the early years of the California olive industry and did not pre-date the Manzanillo and Redding Picholine by long. As an olive grove was observed at Strentzel's Alhambra Ranch by 1880, the extant olives were most likely planted between 1873 and 1880 under Strentzel's management.

Given the spatial distribution of Redding Picholines within the Mount Wanda olive orchard, which are more irregularly placed than the Manzanillo olives, the possibility that these trees were planted at a later time as companion trees to the Mission and Manzanillo in a pollinizer role, must be addressed. While possible, these trees were highly unlikely to have been planted solely for this purpose. While literature on propagation, harvest, oil pressing, pickling, and pest remediation are abundant during the early decades of the olive industry (well into the twentieth century), information on pollination of olive trees is, in contrast, lacking if not completely absent. This suggests that little to no emphasis was put on cross-pollination. As the olive growers and pomologists like John Strentzel often consulted the existing publications to aid in their olive endeavors, they, too, likely gave little attention to cross-pollinizing their olives. Further, if planted at a later time, it is highly unlikely that an olive variety so widely deemed a "worthless" producer by the end of the nineteenth century would be chosen as a pollinizer when numerous other varieties that arrived in California after the Redding Picholine could both bear fruit and pollinate, thus more commercially and financially viable. As such, these trees, tested twice to confirm that they had not been used as rootstock, were likely planted during the time of its popularity for the purpose of olive production, alongside the Manzanillo and the Mission during the timeframe discussed above.

Taking into consideration that olives ceased to be discussed or observed at the Alhambra Ranch after the early 1880s, this was likely a pomological venture not long sought after, particularly as his son-in-law and partner John Muir transitioned the ranch operations toward targeted production through the decade.⁷⁵ As such, the olive grove observed in 1880 was likely the only one to have been planted at Alhambra Ranch, which further supports the claim that the extant olive grove, whose composition and layout point to a planting period of the late-1870s, is the grove planted by Strentzel on the southern slope of Mount Wanda.

⁷⁵ This shift in management strategy likely spared the Redding Picholines from being grafted over.

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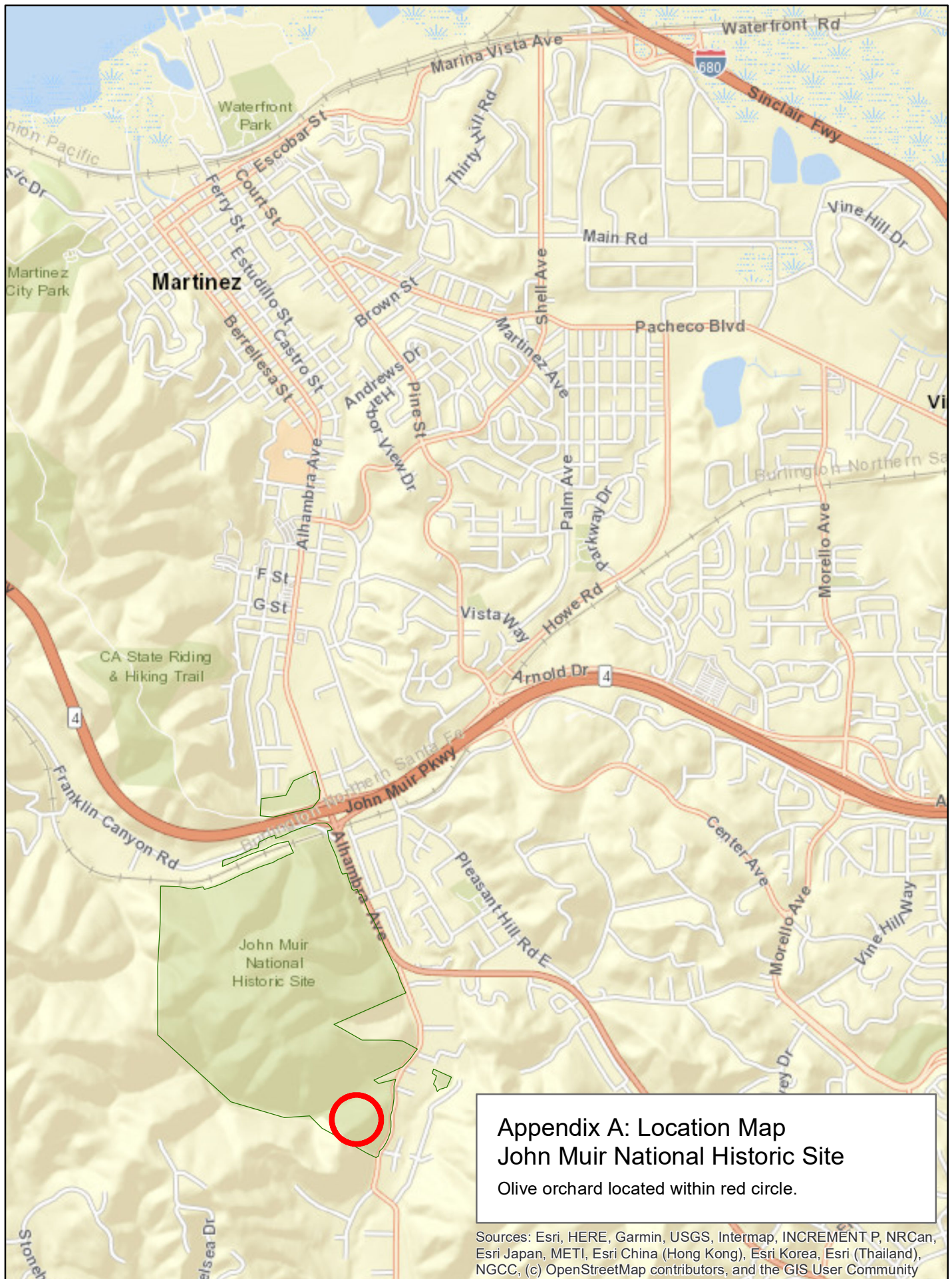
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Appendix A: Location Map



Appendix A: Location Map John Muir National Historic Site

Olive orchard located within red circle.

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Appendix B: Mount Wanda Results ID List

Appendix B: Mount Wanda Results ID List

All coordinate points are derived from World Geodetic System (WGS) 1984.

Sample Name	Match	Latitude	Longitude
MW-1	Mission X Redding Picholine seedling	37.97573455	-122.1277043
MW-2	Redding Picholine	37.97576317	-122.1278524
MW-3	Manzanillo	37.97582638	-122.1278386
MW-4	Redding Picholine	37.97589604	-122.1278234
MW-5	Redding Picholine	37.97597536	-122.1278826
MW-6	Redding Picholine clonal variant A	37.9759093	-122.1278971
MW-7	Manzanillo	37.97584246	-122.1279116
MW-8	Redding Picholine clonal variant A	37.97577736	-122.1279258
MW-9	Redding Picholine	37.97572236	-122.1279378
MW-10	Redding Picholine	37.97579189	-122.128001
MW-11	Manzanillo	37.97585699	-122.1279868
MW-12	Manzanillo	37.97580573	-122.1280727
MW-13	Manzanillo	37.97587063	-122.1280574
MW-14	Mission	37.97606715	-122.1280146
MW-15	Mission	37.97613187	-122.1280004
MW-16	Mission	37.97619381	-122.1279869
MW-17	Mission	37.9762565	-122.1279732
MW-18	Mission	37.97632274	-122.1279588
MW-19	Mission	37.97638726	-122.1279447
MW-20	Mission	37.97651608	-122.1279166
MW-21	Mission	37.9765806	-122.1279025
MW-22	Mission	37.97670634	-122.1278751
MW-23	Mission	37.97683605	-122.1278476
MW-24	Redding Picholine clonal variant B	37.97691619	-122.127914
MW-25	Mission	37.97685161	-122.1279282
MW-26	Mission	37.97678604	-122.1279425
MW-27	Mission	37.97672208	-122.1279566
MW-28	Mission	37.97666027	-122.1279701
MW-29	Mission	37.97659637	-122.1279842
MW-31	Mission	37.97646598	-122.1280128
MW-33	Mission	37.97633857	-122.1280407
MW-35	Mission	37.97620967	-122.128069
MW-37	Redding Picholine clonal variant B	37.97601944	-122.1281108
MW-38	Redding Picholine clonal variant B	37.97595268	-122.1281254
MW-39	Manzanillo	37.97588657	-122.1281399
MW-40	Manzanillo	37.97582144	-122.128154
MW-41	Manzanillo	37.97583669	-122.128233
MW-42	Manzanillo	37.9759018	-122.1282187

Sample Name	Match	Latitude	Longitude
MW-43	Mission	37.97616303	-122.1281618
MW-45	Mission	37.97635391	-122.1281201
MW-47	Mission	37.97648135	-122.1280923
MW-49	Mission X Redding Picholine seedling	37.97673751	-122.1280364
MW-50	Mission	37.97680148	-122.1280225
MW-51	Mission	37.97686704	-122.128008
MW-52	Mission X Redding Picholine seedling	37.97681704	-122.128103
MW-53	Mission	37.97675307	-122.128117
MW-55	Mission	37.97643399	-122.1281866
MW-57	Mission	37.97624054	-122.1282288
MW-59	Mission X Redding Picholine seedling	37.97611387	-122.1282564
MW-60	Manzanillo	37.97591736	-122.1282993
MW-61	Manzanillo	37.97593263	-122.1283784
MW-63	Mission	37.97619387	-122.1283214
MW-65	Mission clonal variant C	37.9763185	-122.1282942
MW-67	Mission	37.97644927	-122.1282656
MW-69	Mission	37.97657808	-122.1282375
MW-71	Mission	37.97670651	-122.1282095
MW-72	Redding Picholine clonal variant A	37.97689779	-122.1281672
MW-73	Mission X Redding Picholine seedling	37.97701432	-122.1281424
MW-74	Redding Picholine	37.97684762	-122.1282612
MW-75	Mission clonal variant D	37.97672181	-122.1282887
MW-77	Mission	37.97659338	-122.1283167
MW-79	Mission clonal variant A	37.97627111	-122.128387
MW-81	Redding Picholine clonal variant A	37.97601476	-122.128443
MW-82	Redding Picholine clonal variant A	37.97589922	-122.1285566
MW-83	Manzanillo	37.97596432	-122.1285424
MW-84	Redding Picholine	37.97603115	-122.1285278
MW-85	Mission	37.97616084	-122.1284995
MW-87	Mission	37.9762875	-122.1284719
MW-89	Mission	37.97641643	-122.1284437
MW-91	Mission clonal variant A	37.97660977	-122.1284016
MW-93	Mission	37.9767382	-122.1283735
MW-94	Redding Picholine clonal variant A	37.97692914	-122.1283294
MW-95	Mission X Redding Picholine seedling	37.97681672	-122.1284464
MW-97	Mission	37.97662646	-122.128488
MW-99	Mission	37.97649765	-122.1285161
MW-101	Mission	37.97630419	-122.1285583
MW-103	Redding Picholine clonal variant A	37.97611391	-122.1285998
MW-104	Redding Picholine clonal variant A	37.9760625	-122.12869
MW-105	Redding Picholine clonal variant A	37.97612857	-122.1286756

Sample Name	Match	Latitude	Longitude
MW-107	Mission	37.97638154	-122.1286204
MW-109	Mission	37.97657522	-122.1285782
MW-111	Mission X Redding Picholine seedling	37.97670564	-122.1285497
MW-112	Redding Picholine clonal variant A	37.97683138	-122.1285223
MW-113	Redding Picholine	37.97689535	-122.1285083
MW-115	Mission	37.97665662	-122.1286441
MW-117	Mission clonal variant A	37.97646328	-122.1286862
MW-119	Mission	37.97633435	-122.1287144
MW-121	Mission	37.97620769	-122.128742
MW-122	Redding Picholine	37.97607801	-122.1287703
MW-123	Mission	37.9762877	-122.128807
MW-125	Mission X Redding Picholine seedling	37.97641341	-122.1287808
MW-127	Mission	37.97654309	-122.1287513
MW-129	Mission	37.97667191	-122.1287232
MW-130	Mission X Redding Picholine seedling	37.97681545	-122.1287734
MW-131	Mission	37.97662112	-122.1288158
MW-133	Mission	37.97636475	-122.1288717
MW-134	Redding Picholine clonal variant A	37.97617447	-122.1289132
MW-135	Mission	37.97638019	-122.1289516
MW-137	Mission	37.97657364	-122.1289094
MW-139	Mission	37.97670245	-122.1288813
MW-141	Mission	37.97683088	-122.1288533
MW-142	Mission	37.97684667	-122.128935
MW-143	Mission	37.97678276	-122.1289489
MW-145	Mission clonal variant B	37.97665234	-122.1289774
MW-147	Mission	37.9765249	-122.1290052
MW-148	Mission	37.97634917	-122.1291252
MW-149	Redding Picholine clonal variant A	37.97641112	-122.1291117
MW-151	Mission	37.97660457	-122.1290695
MW-153	Mission	37.97679791	-122.1290273
MW-154	Mission	37.9768783	-122.1290897
MW-155	Mission	37.97668276	-122.1291348
MW-156	Mission	37.97661984	-122.1291486
MW-157	Mission	37.97655532	-122.1291626
MW-158	Mission	37.97648908	-122.1291771
MW-159	Mission	37.97642639	-122.1291908
MW-160	Mission	37.97629972	-122.1292184
MW-161	Mission	37.97657112	-122.1292444
MW-163	Mission	37.97676445	-122.1292022
MW-164	Mission	37.97689289	-122.1291742
MW-165	Mission	37.97690794	-122.1292521

Sample Name	Match	Latitude	Longitude
MW-167	Mission	37.97658617	-122.1293223
MW-168	Mission clonal variant B	37.97653515	-122.1294155
MW-169	Mission	37.97666591	-122.129387
MW-171	Mission	37.97679472	-122.1293589
MW-173	Mission	37.97692316	-122.1293309
MW-174	Mission	37.97693903	-122.1294131
MW-175	Mission	37.97687512	-122.129427
MW-177	Mission	37.97668178	-122.1294692
MW-178	Mission X Redding Picholine seedling	37.97661726	-122.1294833
MW-179	Mission	37.97656707	-122.1295808
MW-180	Mission	37.97663331	-122.1295664
MW-181	Mission	37.97669784	-122.1295523
MW-182	Mission	37.97676075	-122.1295386
MW-183	Mission	37.97682665	-122.1295242
MW-184	Mission	37.97689117	-122.1295101
MW-185	Mission clonal variant E	37.97697015	-122.1295742
MW-186	Mission	37.97677582	-122.1296166
MW-187	Mission	37.97664838	-122.1296444

Appendix C: Mount Wanda Olive Map

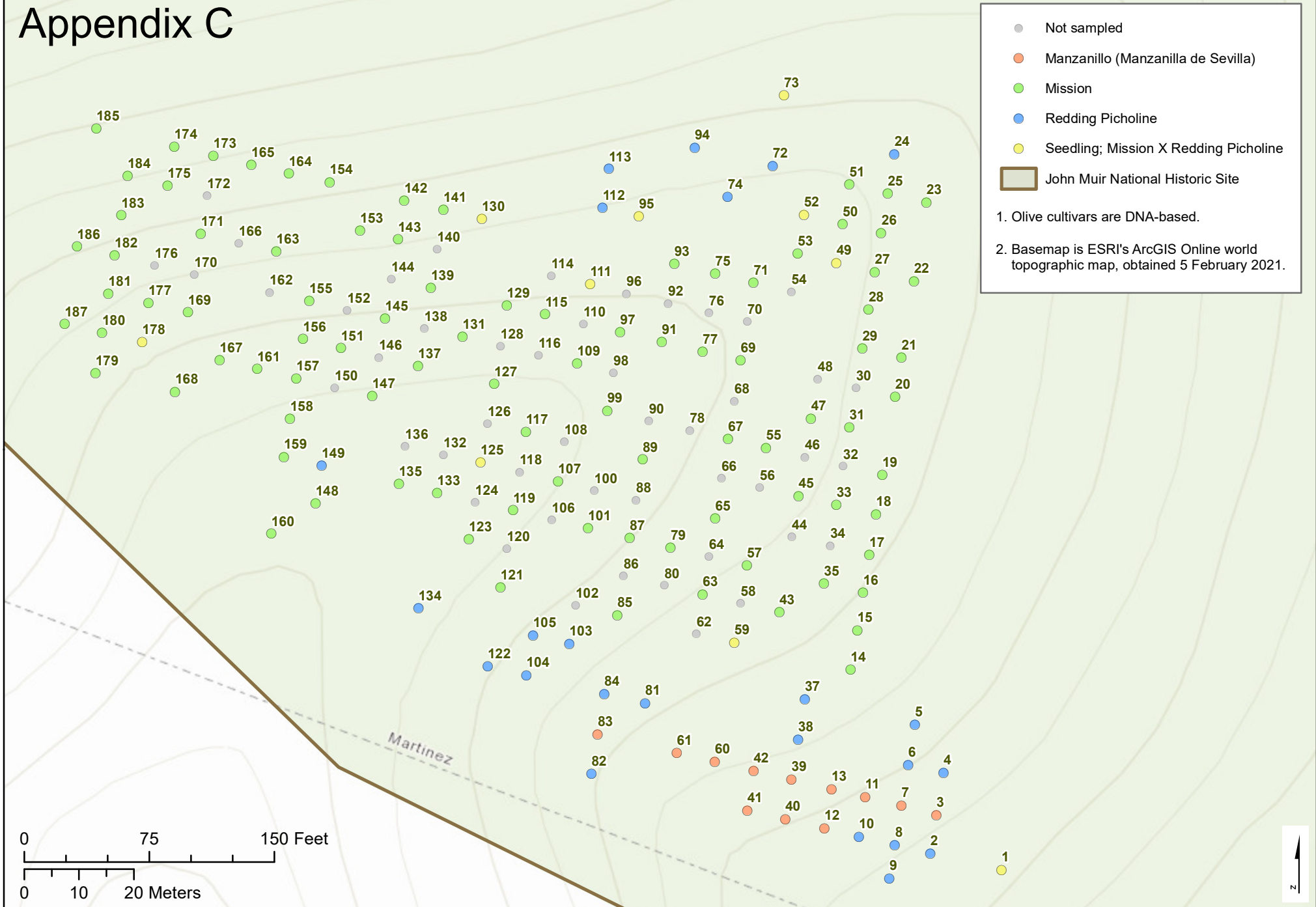
Mt Wanda Olive Species

John Muir National Historic Site
California

National Park Service
U.S. Department of the Interior



Appendix C



Appendix D: Mount Wanda Olive Genotypes

Appendix D: Mount Wanda Olive Genotypes

Cultivar	n	EMO90	GAPU71B	GAPU89	GAPU101	GAPU103	IAS-oli16a	UDO99-U11	UDO99-U28	UDO99-U42
Mission	84	184:186	117:126	158:204	198:218	134:148	155:162	121:126	147:149	146:146
Mission clonal variant A	3	184:186	117:126	158:204	198:218	134:148	155:162	121:126	147:149	146:146
Mission clonal variant B	2	184:186	117:126	158:204	198:218	134:148	155:162	121:126:128	147:149	146:146
Mission clonal variant C	1	184:186	117:126	158:204	198:218	134:148	155:162	121:126	147:149	146:146
Mission clonal variant D	1	184:186	117:126	158:204	198:218	134:148	155:162	121:126	147:149	146:146
Mission clonal variant E	1	184:186	117:126	158:204	198:218	134:148	155:162	121:126	147:149	146:146
Redding Picholine	9	186:186	120:126	156:192	192:198	158:173	145:152:158	89:111	121:131	140:144
Redding Picholine clonal variant A	12	186:186	120:126	156:192	192:198	158:173	145:152:158	89:111	121:131	140:144
Redding Picholine clonal variant B	3	186:186	120:126	156:192	192:198	158:158	145:152:158	89:111	121:131	140:144
Manzanillo	12	184:186	120:139	158:204	198:218	134:148	152:162	113:126	147:149	140:140
Mission X Redding Picholine seedling A	1		117:126	156:204	198:218	134:158	152:162	89:121	121:147	144:144
Mission X Redding Picholine seedling B	1	186:186	126:126	158:192	192:198	148:158	152:155	89:121	121:149	140:140
Mission X Redding Picholine seedling C	1	184:186	126:126	156:158	198:218	134:173	152:155	89:126	121:147	140:140
Mission X Redding Picholine seedling D	1	184:184	126:126	192:204	192:218	148:158	145:158:162	89:121	131:147	140:146
Mission X Redding Picholine seedling E	1	184:186	117:126	192:204	192:218	134:158	152:155:158	89:126	121:147	144:146
Mission X Redding Picholine seedling F	1	184:184	117:126	158:192		134:158	152:155:158	111:121	121:147	140:146
Mission X Redding Picholine seedling G	1	184:184	117:120	156:204	192:218	134:158	145:158:162	111:126	121:149	140:146
Mission X Redding Picholine seedling H	1	186:186	126:126	192:204	192:198	148:158	145:158:162	111:121	131:147	144:144
Mission X Redding Picholine seedling I	1	186:186	120:126	156:204	198:198	148:158	145:162	111:126	121:149	140:140
Mission X Redding Picholine seedling J	1	186:186	120:126	192:204	198:198	148:173	152:155	89:126	131:149	140:140

Cultivar	n	ssrOeUA-DCA3	ssrOeUA-DCA5	ssrOeUA-DCA8	ssrOeUA-DCA9	ssrOeUA-DCA11	ssrOeUA-DCA13	ssrOeUA-DCA15	ssrOeUA-DCA16	ssrOeUA-DCA18
Mission	84	238:252	204:204	138:140	194:194	141:161	120:138	244:255	154:174	170:178
Mission clonal variant A	3	238:252	204:204	138:140	194:206	141:161	120:138	244:255	154:174	170:178
Mission clonal variant B	2	238:252	204:204	138:140	194:194	141:161	120:138	244:255	154:174	170:178
Mission clonal variant C	1	238:252	204:204	138:140	194:194	141:161	120:138	244:255	154:156:174	170:178
Mission clonal variant D	1	238:252	204:204	138:140	194:194	141:157:161	120:138	244:255	154:174	170:178
Mission clonal variant E	1	238:252:254	204:204	138:140	194:194	141:161	120:138	244:255	154:174	170:178
Redding Picholine	9	238:242	198:204	136:136	172:176	141:147	122:129	244:255	144:149	172:176
Redding Picholine clonal variant A	12	238:242	198:204	136:136	172:176	141:147	118:122:129	244:255	144:149	172:176
Redding Picholine clonal variant B	3	238:242	198:204	136:136	172:176	141:147	118:122:129	244:255	144:149	172:176
Manzanillo	12	244:252	204:204	138:140	162:162	141:161	120:138	255:264	154:174	170:178
Mission X Redding Picholine seedling A	1	238:252	198:204	138:138	172:194	147:161	118:122	244:244	149:149	170:172
Mission X Redding Picholine seedling B	1	238:252	204:204	140:140	172:172	147:161	118:129	244:244	144:174	170:170
Mission X Redding Picholine seedling C	1	238:238	198:204	136:138	176:176	141:161	120:129:138	244:244	144:154	170:176
Mission X Redding Picholine seedling D	1	238:238	204:204	140:140	176:194	147:161	118:122	244:255	144:154	170:176
Mission X Redding Picholine seedling E	1	238:238	204:204	138:138	176:176	141:147	118:129	244:255	144:174	172:178
Mission X Redding Picholine seedling F	1	238:242	204:204	138:138	176:206	141:161	120:129:138	244:255	149:174	172:178
Mission X Redding Picholine seedling G	1	238:252	204:204	138:138	176:206	147:161	118:129	244:244	144:174	170:172
Mission X Redding Picholine seedling H	1	238:242	198:204	140:140	176:194	141:141	118:122	255:255	149:154	172:178
Mission X Redding Picholine seedling I	1	238:252	198:204	140:140	172:172	141:141	118:129	255:255	144:154	170:172
Mission X Redding Picholine seedling J	1	238:238	198:204	136:140	176:194	141:147	120:128:138	244:244	144:154	172:178