



PHYTOSPHERE RESEARCH

October 26, 2006

To: Jane Rodgers
Point Reyes National Seashore

Subject: **Study of Marin Manzanita Population Distribution.**

From: Elizabeth Bernhardt
Ted Swiecki
Phytosphere Research

This report summarizes our project to verify and assess the condition of *Arctostaphylos virgata* (ARVI) populations previously mapped within Point Reyes National Seashore. This project also included survey of areas along the Bolinas Ridge and Randall Trails that had not been previously surveyed for ARVI populations.

Methods

Alison Forrestel (NPS) provided ArcGIS shapefiles which included mapped populations of *Arctostaphylos virgata* (ARVI), as well as shapefiles showing trails and roads, and high resolution aerial imagery covering most of the areas with existing polygons. We supplemented these data layers with topographic map layers and lower resolution imagery available from other sources.

We numbered the existing NPS ARVI polygons sequentially starting from the north for ease in referring to the different polygons. We uploaded vertices of these polygons into handheld GPS units (Garmin™ models 76 and 60) equipped with external high gain antennae (Gilson™) mounted on a mast that extended to a height of about 4 m to allow better reception in canopied areas. The mast could also be extended horizontally to take coordinates in areas that were not easily accessed by foot. We used the Garmin™ GPS to both locate existing polygons in the field and collect new coordinates. The GPS receivers we used include real-time WAAS differential correction and have a nominal accuracy of <3 meters when a differential signal is available, as it was for almost all of our survey work.

We hiked to all of the extant populations that had been previously mapped by the National Park Service that were accessible by foot either on or off trail. We did not visit polygon 22, which was reported to contain 16 dead ARVI skeletons in February 2002. We were also unable to hike to polygons 16, 17, 19 and part of 20. These are all located along the former Crystal Lake Trail. Although we were able to navigate a portion of this trail with some effort, near Crystal lake the unmaintained trail is completely overgrown by dense patches of poison oak. Parts of the trail are also occluded by stinging nettle, huckleberry, and brambles. See the attached narrative for field notes on the various polygons.

To the degree possible, we also assessed the area around the NPS polygons to determine the extent of ARVI populations in these areas. Along trails, we typically surveyed at least several hundred meters beyond the polygons or until the vegetation type was clearly unlikely to include ARVI. We also surveyed areas away from the trail where practical if the habitat was of a type where ARVI might occur. The included GPS track shapefiles indicate the areas we traversed during the survey. The surveyed area includes a line of sight buffer around the GPS tracks, which varied in distance due to terrain and vegetation. Lines of sight ranged from as little as a few meters in some directions to well over 100 m in open areas.

Where plant density was low, individual plants or small clusters of plants were recorded as point data using a single GPS coordinate. For larger, discrete groups of plants, we created polygons either by recording GPS waypoints around the perimeter of the group or by combining points along the edge of the stand with additional points referenced from recorded waypoints. We used a compass and a Leica Disto™ laser rangefinder to record the azimuth and distance to points that were remote from the GPS. In areas where vegetation was too dense to penetrate away from the trail and ARVI stands were more or less continuous, we collected data as strip transect that paralleled the trail and extended away from the trail as far as we could reliably identify ARVI. In dense stands of mixed ARVI and Bishop pine, this was typically only about 3 m.

We generally mapped ARVI points or polygons that included at least one live plant. However, in some places points or polygons including only dead ARVI plants were mapped for reference purposes. Hence, while the distribution data are as complete as possible for the live plants in the surveyed areas, they are not complete for the distribution of dead plants.

In addition to coordinates, we collected the following attribute data for each point or polygon:

- number of live ARVI plants (if estimated, this also noted)
- number of dead ARVI plants (if estimated, this also noted)
- minimum height class (to nearest m) of plants in the point or polygon
- maximum height class (to nearest m) of plants in the point or polygon
- width (to nearest m) of a plant or cluster marked as a point or the width of the polygon
- degree of canopy dieback of plants within the point or polygon
- degree of overtopping of plants within the point or polygon and the overtopping species.

If necessary, additional notes were used to describe specific attributes of the mapped point or polygon.

Waypoints were downloaded and saved as ArcGIS™ shapefiles using the DNRGarmin utility. Polygons were digitized with the aid of the aerial imagery. If necessary, waypoints were shifted up to about 3 m to match with the aerial imagery. Individual

polygon or point records were annotated to indicate whether waypoints were shifted and how polygons were constructed.

Metadata for the shapefiles containing ARVI point and polygon data are attached at the end of this document.

Results

The table below summarizes the results of our survey of the 31 existing NPS ARVI polygons.

Outcome	NPS ARVI polygon numbers
Not visited (see notes in methods above)	16, 17, 19, part of 20, 22
No live ARVI found or no ARVI found	3, 4, 11, 13, 14, 18, 21, 28, 29
ARVI nearby but not in NPS polygons	5, 20, 23, 24
ARVI within NPS polygons; may also be nearby	1, 2, 6, 7, 8, 9, 10, 12, 15, 25, 26, 27, 30, 31

The shapefiles transmitted to Alison Forrestel show the distribution of the plants we mapped. ARVI doubtless occurs in areas beyond those we mapped. ARVI extends an unknown distance into the dense regenerating Bishop pine forest along the Inverness Ridge and Drake's View trails. Due to the impenetrability of this vegetation, we could generally observe plants only within about 3 m of the trail in many areas. In one opening along the Drake's view trail, we saw that ARVI extended at least 30 m from the trail (polygon 1134A), but it unclear how widely this situation applies throughout the area. The expanses of chaparral around the McCurdy Trail and west of the Bolinas Ridge Trail south of the McCurdy Trail are also likely to contain additional ARVI. We also suspect there is more ARVI in the chaparral areas between the Ridge and Pablo Point Trails, and west of the Ridge Trail in the vicinity of the plants mapped near NPS polygons 25-27. Some of the steep rocky slopes around Crystal Lake also appeared to be the types of areas in which ARVI tends to persist.

The ARVI that we mapped was found in several habitat types. ARVI was found on somewhat eroded and often relatively steep areas with mineral soils that primarily supported chaparral species. *A. glandulosa* var. *cushingiana* was a common associate in these areas. Examples of this habitat include areas along the McCurdy Trail, portions of the Bolinas Ridge Trail and parts of the Ridge Trail. Plants in these areas were typically fairly healthy and had a robust spreading form. ARVI was also found in forested areas, intermixed with Bishop pine and Douglas-fir. In earlier successional stages, such as along the Inverness Ridge and Drakes View trails, it was intermixed with and becoming overtopped by dense post-fire Bishop pine regeneration. The ARVI generally formed rather tall, spindly plants in these locations. In later successional

stages, especially in less dense stands, ARVI was found as scattered individuals or clumps that were declining or sometimes entirely dead. Plants that were healthier were generally in canopy gaps. In some areas, very dense huckleberry, which is more tolerant of shading, was also crowding out and overtopping remnant ARVI. These stands appear to have been established following some sort of disturbance, including fire (especially in areas affected by the Mt. Vision fire) and/or clearing (e.g., the area around NPS polygons 2 and 23). The ARVI in NPS polygon 10 was in an apparently unique habitat type. At this location, the soil was relatively sandy and the most common associated shrubs were *Baccharis pilularis* and poison oak. No other mapped polygons were located within this habitat type, but we suspect that other examples may exist in areas inaccessible by trail.

Overall, the distribution of plants shown by points and polygons that we mapped was more limited in area than the more generalized polygons shown in the original NPS ARVI shapefiles. In general, the NPS ARVI polygons that were based on actual GPS coordinates collected in the field tended to match the current distribution of plants better than those based on digitizing of hand-drawn maps. However, virtually all of the NPS ARVI polygons included large areas that contained no live or dead ARVI.

Some of the mapped polygons contained few or no live ARVI because the plants had apparently died out under dense forest canopy, typically of bishop pine or Douglas-fir. Other polygons may have been mismapped, most notably NPS polygon 13.

Recommendations

Based on our experience, it is clearly impossible to map all the ARVI in the park on foot. In many of the forested areas and most of the chaparral areas where ARVI is found, the vegetation is impassibly dense. The terrain is also excessively steep in some areas, with poor footing due to loose rocky soil. Finally, the overall area is so large that mapping areas beyond established trails and roads is impractical. Furthermore, some of the old roads that show in the USGS topographic maps have not been maintained and are now covered with vegetation, further limiting the area that can be explored on foot.

Although remote sensing may be useful to help identify possible ARVI populations away from trails, it has several obvious limitations. ARVI populations that are largely or completely overtopped by conifers will not be detected using aerial imagery. In addition, even at relatively close range on the ground, it can be difficult to distinguish between ARVI and *A. glandulosa* var. *cushingiana*. Populations of these species are intermixed in some areas, and transitions between manzanita chaparral areas that have or lack ARVI are not obvious in many areas. Hence, although areas of open-grown manzanita chaparral may be identifiable from aerial imagery, we think that it is unlikely that ARVI can be distinguished from *A. glandulosa* var. *cushingiana* via remote sensing.

The polygons and individual plants mapped in this survey can be considered to be a non-random sample of the ARVI populations in the park, and periodic reassessment of these populations could be used to monitor the health and persistence of ARVI in various habitats. Future surveys should make use of GPS receivers with resolution equal to or better than that provided by our units. Due to difficulty in obtaining GPS signals in heavy forest canopy, we recommend the use of mast-mounted external antennae to improve GPS accuracy.

We observed that ARVI regeneration was favored by disturbance, including that associated with trail maintenance. The only places we saw young ARVI plants were in areas of bare mineral soil, often along trail or road edges. Hence, in some areas, clearing and disturbance associated with trails and roads create favorable habitat for ARVI establishment and growth. In some areas we surveyed, ARVI populations were closely associated with the trails and did not extend far into the landscape beyond the trails. Hence, periodic disturbances, due to fire or clearing, are probably important for maintaining active ARVI populations.

Our observations indicate that populations of ARVI under dense Bishop pine and Douglas-fir eventually die out, although these populations may regenerate following fire or other disturbances that remove the overtopping canopy and the duff layer. Hence, populations along the Inverness Ridge Trail, Drakes View Trail, and the Bayview Trail, which are rapidly being overtopped by Bishop Pine, will be unable to persist over the long term, although some seedlings may germinate in the bare soil of the trail itself. On the other hand, it seems likely the populations in chaparral conditions, such as those along the McCurdy trail, could persist for a relatively long time. Monitoring of these populations could provide insight as to the recurrence interval of disturbance needed to maintain populations in different habitats.

Furthermore, historical information on past disturbances could be used to estimate the longevity of ARVI stands in some sites. Many of the populations of ARVI overtopped by Douglas-fir and pine along the Ridge Trail between the Bolema Trail and the Pablo Point Trail, and along the Pablo Point Trail are in the final stages of dying out. By researching the disturbance history of these areas, including assessments of canopy closure from historical aerial photos, it may be possible to determine how and when these stands became established.

Finally, in considering management of the ARVI at Point Reyes, resource managers should be aware of two diseases that have a strong potential to affect ARVI and other vegetation in the park. The first and probably lesser known of these is *Phytophthora cinnamomi*, a highly virulent water mold with a large host range. Based on the susceptibility of other manzanita species, we would expect that ARVI would be susceptible to *P. cinnamomi*, and that *P. cinnamomi* could have the potential to severely impact or eradicate ARVI populations in areas where it is introduced. *P. cinnamomi* was probably introduced into California around 1900 and has been known as a problem in California agricultural lands, nursery plant production, and horticultural landscapes for many years. However, this soil-borne pathogen has been

appearing more frequently in natural areas in California in recent years. Its introduction in Australia has resulted in extensive mortality of native forests. We determined that it is the primary cause of extensive mortality of the endangered manzanita *A. myrtifolia* in Amador county (see <http://phytosphere.com/publications/ionemanzdis.htm> and http://phytosphere.com/publications/Pcinn_Amyrt_2005.htm). In addition, we have recently found *P. cinnamomi* associated with mortality of the endangered *A. pallida* and giant chinquapin in the Oakland Hills. At that location, giant chinquapin seemed to be more susceptible than the *A. pallida*. We had noted considerable mortality of giant chinquapin along the Bolinas Ridge trail. The cause of this mortality should be investigated. Matteo Garbelotto's lab at UC Berkeley is currently confirming the identity of a *Phytophthora* we isolated from soil in a Marin County park that was associated with mortality of manzanita and madrone. The possibility that *P. cinnamomi* could be introduced into ARVI stands along trails in Point Reyes needs to be considered in the management of this species.

The other disease agent of note is *P. ramorum*, the causal agent of sudden oak death. Our field observations suggest that this pathogen is the likely cause of significant amounts of tanoak mortality that has appeared recently in the park. This pathogen may also cause disease in manzanita that are growing in close proximity to infected California bays. We observed a possible situation of this at one site (plant 226, near NPS polygon 25). *P. ramorum* probably has the potential to have the greatest impact on ARVI on stands where the forest has begun to overtop the stand and California bay or tanoak are significant components of the tree layer. *P. ramorum* inoculum produced on these species that is splashed onto understory ARVI may cause enough damage to adversely affect the survival of ARVI in these habitats.

Please contact us if you have any questions.

Attachments:

Field notes

photos

ArcMAP® GIS shapefiles:

ARVIpolygonsPRall

ARVIptdataPRall

gpsalltracks7-24to8-30-06

gpstracks3-27to5-15-05

Metadata for shapefiles

ARVIpolygonsPRall

ARVIptdataPRall

List of characters that we used to distinguish ARVI from *Arctostaphylos glandulosa* var. *cushingiana*.



***Arctostaphylos virgata* survey, Point Reyes National Seashore**

E. Bernhardt / T. Swiecki

Edited 10/26/2006

Field Notes

NPS polygon 1- surveyed 3.27.06 and 4.6.06. ARVI still flowering. Polygon in a grazed area, somewhat shrubby, with a few scattered Bishop pines.

To our knowledge there was no *A. glandulosa* var *cushingiana* among the ARVI mapped in polygons 1 through 6. McCurdy trail is the first place we observed *A. glandulosa* var *cushingiana*.

NPS polygon 2-surveyed 4.6.06 and 5.15.06. Some patches of big plants along the road at the lower parts before the Bishop pine canopy gets dense. Some patches and individual plants where there is bare ground and breaks in the canopy, most large but a few smaller along the road. We weren't sure about the status of the buildings in the area, some of which were clearly occupied-nobody was around while we were surveying. Hence, we generally stayed clear of the buildings, although we mapped one ARVI near the gazebo of an uninhabited residence.

NPS polygon 3-surveyed 4.6.06. Has essentially closed Bishop pine overstory and shrub understory. Traversed the polygon but did not spot any ARVI. ARVI was still flowering at this time so should have been able to spot it if it was there, unless it was in really poor shape.

NPS polygon 4-surveyed 4.6.06. Has closed canopy Bishop pine overstory and dense huckleberry understory. Traversed the eastern half of the polygon without seeing any ARVI. Hard to imagine it could still exist there, assuming the polygon was correctly placed, which is also doubtful.

NPS polygon 5- surveyed 4.6.06- no photos. Has closed canopy Bishop pine overstory and dense huckleberry understory. Found some spindly ARVI in this area outside of the NPS polygon.

NPS polygon 6- surveyed 4.6.06. ARVI extends beyond the current mapped polygon boundaries to the east. Regeneration along the road cut on bare mineral soils. Older plants back in the forest along a ridge and scarp. Trying to compete with the Bishop pine and huckleberry. Also a good patch of ARVI under a power line, possible associated with previous clearing under this utility line.

NPS polygon 7 surveyed 5.15.06 and 8.28.06. Inverness Ridge and Drakes View Trails. Drakes View is mostly through very dense bishop pine forest. ARVI in this area are mostly tall and spindly because they are getting shaded out by the very dense Bishop pines. Visibility into the forest is poor due to the density of the pines. In general, ARVI not occurring in dense patches along this trail, except in a few relatively open areas. Dense patches of ARVI occur on the Inverness Ridge trail south of Drakes View Trail. These will



eventually be shaded out by the pines which are growing with them, but in general the pines are further from the trail, so the Arvi is currently bushy. In many of these areas the ARVI are very dense, with 6-10 stems per square m. North of Drake's View on the Inverness ridge trail there is a section of ARVI along rocky stretches of soil adjacent to the trail. The plants are bushy and mostly growing out into the trail itself. On the SW side of the trail which is shadier, there are fewer plants and more dead plants, than on the sunnier less shaded NE side of the trail.

NPS polygon 8-surveyed 5.10.2006. No photos and no contemporaneous notes. See attribute data from the GIS. A few outliers away from the main stand, several have been impacted by trail clearing activity, one killed.

NPS polygon 9-surveyed 5.10.2006. Very similar to polygon 7 along upper part of Drakes View trail. Very thick stand of Bishop pines which have resprouted after fire, and are now overtopping and suppressing the ARVI.

NPS polygon 10-surveyed 8.30.06. This was the most unusual ARVI distribution we have worked because the substrate was different from that in all the other patches. Usually ARVI is occurring on rocky ridges or slopes with bare mineral soil. Here the soil appeared to be mostly silty to sandy (trail was sandy in this area), with some rock outcrops mainly on the ridge top, outside of the main distribution of ARVI. Plants were bushy and healthy looking. In general the fruit did not seem as sticky as usual, but that could be due to exposure, or how late it was in the season. Baccharis the most common associate, but poison oak also common in areas, ceanothus up near the ridge, bishop pine toward the west.

NPS polygon 11-surveyed 8.16.06. Type mostly Doug fir forest with huckleberry, fern, or hazelnut understory, or combination thereof. Very few areas lack understory. When we got near polygon 11, found a big patch of long dead ARVI, had lunch in this area. The GPS layer shows polygon 11 along a road, but this road is long gone. We bushwacked off the Ridge Trail and eventually connected to this old road. There is still barb wire fence along part of it, ready to trip up the unsuspecting. Found a mostly decadent stand of ARVI with some *A. glandulosa* mixed in. Most of the ARVI was dead, but in a few places it was still alive. NPS polygons 11 and 12 essentially map the same population of ARVI, which is somewhat more discontinuous now than it must have been originally. Essentially it is growing on the knoll which appears to be between polygons 11 and 12. Appears to be on the west east and south sides of the knoll primarily. Assuming the ARVI got started following a fire event or clearing, it now is pretty much totally overtopped by Doug fir, with some canyon live oak mixed in. Most of the stand is dead or dying. There was one area of bare rocky soil which had some younger plants, but a good number of these were *A. glandulosa*.

NPS polygon 12- see notes for polygon 11.

NPS polygon 13 - we surveyed this polygon 5.10.06 but did not find any evidence of ARVI. We went as far up the abandoned road on the N side as far as was safe and somewhat passable and saw nothing but forest upslope toward the supposed polygon. Attempted to find the road through the polygon shown on the USGS topo, but is it either fictive or long gone. We had also attempted to find this road at the junction with the Bolinas Ridge Trail on 5.8.06, but it was not extant. We went a way down the trail S of the polygon, but saw



no ARVI or likely habitat. Ted bushwacked into where the polygon was supposed to be but saw nothing but dense bay forest.

NPS polygon 14 -surveyed 8.16.06. We were unable to find any sign of ARVI in polygons 14 and 18. These areas also contained closed canopies of Doug fir and thick understory of primarily huckleberry (with some hazelnut, especially for polygon 14). We also passed a patch of what must have been an ARVI stand of the same vintage as the one near our lunch spot, these were all dead and in a highly advanced stage of decay.

NPS polygon 15-McCurdy trail. Surveyed 4.19.06 and 4.21.06. ARVI in both fruit and flower. Polygon contains a mix of *A. virgata*, *A. nummularia sensitiva* (*A. sensitiva* according to Parker and Vasey draft key), and *A. glandulosa* var *cushingiana*. As first enter the polygon from the southwest there is a lot of ARVI on the north side of the road among the redwoods - mostly big plants. ARVI extended to the north an unknown distance, since we couldn't get through or around it - it was really a thicket. As you walk upslope there is a shift to manzanita chaparral, lots of *A. nummularia sensitiva*. Some big stretches of ARVI. Lots of apparent hybridization between *A. virgata* and *A. glandulosa* var *cushingiana*.

ARVI often but not always occurred near pines, Douglas fir, or redwood, more commonly at fringe of redwood or redwood/Doug fir or sometimes giant chinquapin. It may prefer soil that is deeper overall than found in chaparral dominated by *A. glandulosa* and *A. sensitiva*. It is often found as only a few individuals occurring in these areas or occasionally further out into manzanita chaparral. So far, large, relatively pure ARVI stands have generally been found only in partially to generally forested areas, not in open chaparral.

Along McCurdy trail big stretches of *A. sensitiva*.

NPS polygon 16-did not survey as no way to get in there; nonmaintained trail and off-trail area impassible due to vegetation

NPS polygon 17-did not survey as no way to get in there.

NPS polygon 18-surveyed 8.16.06.- see entry under polygon 14

NPS polygon 19-surveyed 7.24.2006. We could not actually get to polygon 19 as the Crystal Lake trail is no longer maintained and became too difficult to traverse (thick poison oak and stinging nettles, but eventually bushwacked our way and ended up across Crystal Lake from it. We scanned the opposite shore with binoculars, and couldn't see anything for sure that we thought was ARVI. However, the site itself still looked suitable, it is extremely steep, and not densely canopied, so it is likely those plants could still be there.

NPS polygon 20 surveyed 7.24.2006. No photos. Ted bushwacked in to polygon 20 from the Coast trail. He found a good population of ARVI growing on a steep south facing slope. On the north side of the slope the vegetation turns into DF with understory of huckleberry, so we are assuming few if any ARVI are likely to be extant there. He collected GPS point data and transmitted attribute data to me. Primarily mapped the downslope edge of the polygon and rounded off the polygon along the ridgetop. Extremely steep and the soil was loose and rocky. Couldn't get to the part of the polygon north of the Crystal Lake Trail.

A. virgata and *A. glandulosa* - Comparative characteristics

<i>A. virgata</i> Eastw.	<i>A. glandulosa</i> Eastw. subsp. <i>glandulosa</i>
diploid	Plants with fine-tomentose twigs are called forma <i>cushingiana</i> (Eastw.) P. Wells – T. Parker indicates that Pt Reyes primarily has <i>cushingiana</i>
Shrub, tree-like, 2–5+ m; burl 0	tetraploid – hybrids will appear as this species, not <i>A. virgata</i> (fide Parker) Shrub 1–2.5 m; burl large, generally wide, ± flat-topped; will form in first year (to baseball size) – need to uncover with trowel Not always very distinct, but sometimes quite obvious
branching pattern more uniform, regular commonly tends to lean over onto long, large diameter stems in larger plants	branching pattern more irregular, “oak like” (Parker)
Stem: twigs densely fine-glandular-bristly, ± sticky bark smooth, red-brown more apt to have shreddy bark, sometimes in large amounts	Stem: erect; twigs generally finely glandular-bristly or finely tomentose bark smooth, reddish shreddy bark less common, generally in small amounts
Leaves ascending, overlapping; petiole 2–4 mm; leaves near inflorescence with short petioles blade 3–5 cm, 1–2.5 cm wide, narrowly oblong-ovate to oblong-lanceolate, base truncate to slightly lobed, leaves more lanceolate, brighter green, held closer to stem margin entire or ± toothed at base, surfaces alike, bright green, ± shiny, sparsely glandular-hairy, papillate, scabrous leaves pliable (can roll around finger without snapping)	Leaf: ascending or erect; petiole 5–10 mm; leaves near inflorescence with petiole length similar to other leaves blade 2–4.5 cm, 1–2.5 cm wide, generally elliptic to ovate, base wedge-shaped to rounded, sometimes ± lobed or truncate, leaves more rounded, lighter green, sometimes scurfy-whitish below, reminiscent of a jojoba in coloration margin entire or toothed, surfaces alike, blade bright green, sometimes slightly glaucous, glandular-puberulent, papillate, scabrous or sparsely puberulent, smooth leaves stiffer / thicker feeling (like card stock)
Inflorescence dense; raceme or 1-branched; bracts 8–20 mm, leaf-like, linear-lanceolate, acuminate; pedicel 3–8 mm, finely glandular-bristly; immature inflorescence reflexed, axis 15–20 mm, ± concealed by long bracts	Inflorescence: branches 3–6, ± crowded; bracts 5–15 mm, leaf-like; pedicel in fruit 3–5 mm, finely tomentose to short-glandular-bristly; immature axes 10–30 mm, ± crowded, not concealed by long bracts
Flower: ovary densely fine-glandular-bristly, corolla white or pink	Flower: ovary hairs generally like pedicel hairs, corolla white
Fruit 6–8 mm wide, fine-glandular-bristly, sticky – will stick to hands (Parker) sepals ± reflexed in fruit	Fruit 6–10 mm wide, ± hairy, smooth (or finely glandular-bristly, sticky); <i>cushingiana</i> is not sticky, mostly non glandular (Parker) sepals ± appressed
Ecology: Sandstone, granite outcrops	Ecology: Slopes, ridges, chaparral, forest

yellow highlights—differences according to Jepson Manual and Tom Parker

blue highlights—additional differences according to Phytosphere Research field observations

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branching pattern more uniform, regular commonly tends to lean over onto long, large diameter stems in larger plants	branching pattern more irregular, “oak like” (Parker)
Stem: twigs densely fine-glandular-bristly, ± sticky bark smooth, red-brown more apt to have shreddy bark, sometimes in large amounts	Stem: erect; twigs generally finely glandular-bristly or finely tomentose bark smooth, reddish shreddy bark less common, generally in small amounts
Leaves ascending, overlapping; petiole 2–4 mm; leaves near inflorescence with short petioles blade 3–5 cm, 1–2.5 cm wide, narrowly oblong-ovate to oblong-lanceolate, base truncate to slightly lobed, leaves more lanceolate, brighter green, held closer to stem margin entire or ± toothed at base, surfaces alike, bright green, ± shiny, sparsely glandular-hairy, papillate, scabrous leaves ± pliable (can roll around finger without snapping)	Leaf: ascending or erect; petiole 5–10 mm; leaves near inflorescence with petiole length similar to other leaves blade 2–4.5 cm, 1–2.5 cm wide, generally elliptic to ovate, base wedge-shaped to rounded, sometimes ± lobed or truncate, leaves more rounded, lighter green, sometimes scurfy-whitish below; reminiscent of a jojoba in coloration margin entire or toothed, surfaces alike, blade bright green, sometimes slightly glaucous, glandular-puberulent, papillate, scabrous or sparsely puberulent, smooth leaves stiffer / thicker feeling (like card stock)
Inflorescence dense; raceme or 1-branched; bracts 8–20 mm, leaf-like, linear-lanceolate, acuminate; pedicel 3–8 mm, finely glandular-bristly; immature inflorescence reflexed, axis 15–20 mm, ± concealed by long bracts	Inflorescence: branches 3–6, ± crowded; bracts 5–15 mm, leaf-like; pedicel in fruit 3–5 mm, finely tomentose to short-glandular-bristly; immature axes 10–30 mm, ± crowded, not concealed by long bracts
Flower: ovary densely fine-glandular-bristly, corolla white or pink	Flower: ovary hairs generally like pedicel hairs, corolla white
Fruit 6–8 mm wide, fine-glandular-bristly, sticky – will stick to hands (Parker) sepals ± reflexed in fruit	Fruit 6–10 mm wide, ± hairy, smooth (or finely glandular-bristly, sticky); <i>cushingiana</i> is not sticky, mostly non glandular (Parker) sepals ± appressed
Ecology: Sandstone, granite outcrops	Ecology: Slopes, ridges, chaparral, forest

yellow highlights—differences according to Jepson Manual and Tom Parker

blue highlights—additional differences according to Phytosphere Research field observations



Citation_Information:

Originator: Phytosphere Research

Publication_Date: 10/31/2006

Titles: **ARVlpolygonsPRall.shp**

ARVlptdataPRall.shp

Geospatial_Data_Presentation_Form: vector digital data

Projected coordinate system name: NAD_1983_UTM_Zone_10N

Description:

Abstract: *Arctostaphylos virgata* (ARVI) polygon and point data collected 3-27-06 through 8-30-06. Data is complete for areas covered.

Purpose: Updated distribution of *Arctostaphylos virgata* individuals and polygons around previously mapped populations plus previously unmapped areas along the Bolinas Ridge Trail from Fairfax-Bolinas Road to the Randall Trail and including the Randall Trail.

Shapefile: ARVlpolygonsPRall

Field Label	Definition	Description	Notes
FID	Internal feature number	Sequential unique whole numbers that are automatically generated by ESRI / ArcGIS	
Shape	Feature geometry	Coordinates defining the features generated by ESRI / ArcGIS	
PRPOLYGON_ PRPOLYGON	Phytosphere Research polygon ID	Polygon number is composed of the range of waypoint values represented. IN some cases, not all waypoints in the overall range are polygon vertices.	A duplicate copy of this exists in the table as a cross check to ensure that join has not been corrupted
Poly_note1	Method used for polygon construction	<u>waypt outline</u> : connect the dots of field GPS waypoints <u>waypt outline with extra pts</u> : field GPS waypoints supply one or more vertices, additional points digitized heads-up based on field-collected distance (polygon width), alignment (relative to trails/roads), and bearing (azimuth) data	Several methods are used to create polygons, depending on the field situation.

		shifted waypts with extra pts: field GPS waypoints are shifted to match GIS imagery and supply one or more vertices; additional points digitized heads-up based on field-collected distance (width), alignment (relative to trails/roads), and bearing (azimuth) data dimensions centered near waypt: digitized heads-up based on field-collected distance (width), alignment (relative to trails/roads), and bearing (azimuth) data using GPS waypoint as center waypts plus adjacent polygon edge: connect the dots of field GPS waypoints plus the edge of an adjacent polygon	
IDENT	GPS waypoint cross reference	initial waypoint used for original data record	
NPSPOLYGON	nearest NPS ARVI polygon	Existing polygons in NPS ARVI.shp file were numbered by Phytosphere Research; trail name is used if no nearby polygon	New ARVI points and polygons are cross referenced to nearby polygons from the preexisting NPS data layer
DATETIME	date/time GPS stamp for ref waypoint	Corresponds to waypoint listed in IDENT field	
GPS	GPS unit used	GPS model followed by a number to indicate a specific unit	
ADJUSTED	GPS coordinates adjusted post-collection	indicates if original coordinate was shifted to align better with GIS imagery	this field retained for compatibility with the point data file but is unused because information is coded in Poly_note1
LIVE_PLANT	Count of live ARVI plants	Individual plants are defined as coming from a single base	
LIVE_EST	Indicates if live plant count is estimated	est indicates that the count is an estimate; blank if count is exact	
DEAD_PLANT	Count of dead ARVI plants	Dead ARVI are only counted if identity can be reasonably assessed.	Primarily more recent dead plants; very old dead plants are typically not recorded.
DEAD_EST	Indicates if dead plant count is estimated	est indicates that the count is an estimate; blank if count is exact	
MIN_HT_M	Minimum ARVI height class, m	Minimum ARVI height class represented in polygon, to nearest m	
MAX_HT_M	Maximum ARVI height class, m	Maximum ARVI height class represented in polygon, to nearest m	
SPREAD_M	Polygon width (if strip) or diam, m	For strip polygons, width of strip (m); for a few point based polygons, this represents overall diameter	Not recorded for polygons outlined by waypoints
DOM_DIEB	Dominant ARVI dieback class for polygon	Dieback category for the majority of the plants in the polygon. If evenly split, two codes are separated by a slash (e.g., good/poor) good: <20% -canopy dieback fair: 20-50% canopy dieback poor: >50% canopy dieback	Canopy dieback is scored as the proportion of the overall plant canopy that is dead (i.e., inverse of live crown ratio).

		Dead plants can be the dominant dieback class if they outnumber live plants.	
PROP_LT_20	Proportion of ARVI with <20% dieback (good)	Proportion of ARVI plants in polygon with <20% canopy dieback	Not recorded for all polygons, especially those with many plants
PROP_20_50	Proportion of ARVI with 20-50% dieback (fair)	Proportion of ARVI plants in polygon with 20-50% canopy dieback	Not recorded for all polygons, especially those with many plants
PROP_GT_50	Proportion of ARVI with >50% dieback (poor)	Proportion of live ARVI plants in polygon with >50% canopy dieback. Dead plants are tallied separately.	Not recorded for all polygons, especially those with many plants
OVERTOP	Overtopping rating	Overall degree of overtopping by other species for polygon. 0=0 1=1-25% 2=25-50% 3=50-75% 4=75-100%	Overtopping is rated based on direct overhead exposure to sky.
SPECIES_OT	Overtopping species	Species overtopping ARVI in polygon	See Species Table for species codes.
NOTES	Field notes	Miscellaneous notes on condition, location, or other factors	

Shapefile: ARVIptdataPRail

Field Label	Definition	Description	Notes
FID	Internal feature number	Sequential unique whole numbers that are automatically generated by ESRI / ArcGIS	
Shape	Feature geometry	Coordinates defining the features generated by ESRI / ArcGIS	
UTM_X	UTM easting, m	Coordinates are either direct from GPS download or are derived from ArcGIS (add XY coordinates) for shifted or distance/azimuth offset points.	Datum NAD 1983
UTM_Y	UTM northing, m	Coordinates are either direct from GPS download or are derived from ArcGIS (add XY coordinates) for shifted or distance/azimuth offset points.	Datum NAD 1983
IDENT	GPS waypoint	Unique waypoint identifier. Points with a letter suffix are determined from the waypoint of the same number using offset distance/azimuth data.	Laser rangefinder and standard compass were used for determining offsets
WAYPOINT	Duplicate of IDENT		
NPSPOLYGON	nearest NPS ARVI polygon	Existing polygons in NPS ARVI.shp file were numbered by Phytosphere Research; trail name is used if no near polygon	New ARVI points and polygons are cross referenced to nearby polygons from the preexisting NPS data layer
DATETIME	date/time GPS stamp for ref waypoint	Corresponds to waypoint listed in IDENT field; azimuth, distance, and reference waypoint are listed instead for points determined by offset	
GPS	GPS unit used	GPS model followed by a number to indicate a specific unit. Code "digitized" used for points determined by offset.	
ADJUSTED	GPS coordinates adjusted post-collection	Indicates if original coordinate was shifted to align better with GIS imagery. This does not apply to points determined by offset.	
LIVE_PLANT	Count of live ARVI plants	Individual plants are defined as coming from a single base	
LIVE_EST	Indicates if live plant count is estimated	est indicates that the count is an estimate; blank if count is exact	
DEAD_PLANT	Count of dead ARVI plants	Dead ARVI are only counted if identity can be reasonably assessed.	Primarily more recent dead plants; very old dead plants are typically not recorded.
DEAD_EST	Indicates if dead plant count is estimated	est indicates that the count is an estimate; blank if count is exact	
MIN_HT_M	Minimum ARVI height class, m	Minimum ARVI height class represented at point, to nearest m	For single plants, min and max heights are identical
MAX_HT_M	Maximum ARVI height class, m	Maximum ARVI height class represented at point, to nearest m	For single plants, min and max heights are identical
SPREAD_M	Diameter, m	Overall diameter of plant or plant cluster	
DOM_DIEB	Dominant ARVI dieback class	Dieback category for the majority of the plants listed for the point (or of the plant if a single	Canopy dieback is scored as the proportion of the

		plant). If evenly split, two codes are separated by a slash (e.g., good/poor) good: <20% -canopy dieback fair: 20-50% canopy dieback poor: >50% canopy dieback Dead plants can be the dominant dieback class if they outnumber live plants.	overall plant canopy that is dead (i.e., inverse of live crown ratio).
PROP_LT_20	Proportion of ARVI with <20% dieback (good)	Proportion of ARVI plants at point with <20% canopy dieback	Not recorded for all multiplant polygons
PROP_20_50	Proportion of ARVI with 20-50% dieback (fair)	Proportion of ARVI plants at point with 20-50% canopy dieback	Not recorded for all multiplant polygons
PROP_GT_50	Proportion of ARVI with >50% dieback (poor)	Proportion of live ARVI plants at point with >50% canopy dieback. Dead plants are tallied separately.	Not recorded for all multiplant polygons
OVERTOP	Overtopping rating	Overall degree of overtopping by other species for plant(s) at point. 0=0 1=1-25% 2=25-50% 3=50-75% 4=75-100%	Overtopping is rated based on direct overhead exposure to sky.
SPECIES_OT	Overtopping species	Species overtopping ARVI at point	See Species Table for species codes.
NOTES	Field notes	Miscellaneous notes on condition, location, or other factors	
MOVEDPT	Indicates points that have been shifted from original GPS coord	Binary field indicates if point has (1) or has not (0) been shifted in post processing of data. Unlike ADJUSTED field, offset points are shown as having been moved (1)	This field used in data processing primarily.

Species table

ACACI=Acacia
ARCTO3=Arctostaphylos
ARGLC3=Arctostaphylo glandulosa var cushingiana
ARME= Arbutus menziesii, Pacific madrone
ARSE11=Arctostaphylos nummularia var. sensitiva = Arctostaphylos sensitiva, depending on which nomenclature you are using
BAPI=Baccharis pilularis
CEANO=Ceanothus sp.
CHCH7= Chrysolepis chrysophylla, giant chinquapin
GASH=Gautheria shallon, salal
LIDE3= Lithocarpus densiflorus, tanoak
MOCA6=Morella californica = Myrica californica, California wax myrtle
PIMOM=Pickeringia montana var motana, Montana chaparral pea
PIMU=Pinus muricata, Bishop pine
PSME= Pseudotsuga menziesii, Douglas-fir
QUAG= Quercus agrifolia, coast live oak
QUCH2= Quercus chrysolepis, canyon live oak
SESE3= Sequoia sempervirens, redwood
UMCA= Umbellularia californica, California bay
VAOV2=Vaccinium ovatum, California huckleberry