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9 August 2017

Re: Proposed management activities Monarch Grove Sanctuary and George Washington Park September 2017

The following recommendations and assessments are based on site visits and a field tour with City Arborist Albert Weisfuss and Public Works Director Daniel Gho in on July 19, 2017. They are addressed in the context of the 2011 Management Plan and subsequent consultations with City staff and residents, including annual recommendations from 2014-2016. The recommendations are based on previous scientific work, professional judgment, and detailed field assessments. They carefully balance monarch habitat needs, hazard reduction, and forest health, based on both short-term and long-term perspectives.

We have included background data on Monarch Grove Sanctuary (Xerces Society Thanksgiving Counts) to put it in context of the entire California monarch population. Also, we have also incorporated butterfly monitoring data from the Pacific Grove Museum since 2013 to document habitat suitability and monarch use patterns relative to weather and time of season. This reporting on monarch abundance and distribution will constitute a long-term accessible record for the local community.

Recent History and Current Conditions

Monarch Grove Sanctuary (MGS) continues to support one of the largest overwintering aggregations in California (Table 1). The ultimate size of the MGS aggregation is dependent on range-wide breeding success the previous summer, and the ability of the site to attract butterflies in the fall and provide suitable temperature, light, and wind conditions through the fall and winter. Since 1998, MGS supported between 1% and 14% of the Thanksgiving Count estimates for the entire state. From 2001 on, MGS supported between 17% and 58% of the Monterey County population (note that during 1997-2000 coverage of other Monterey County sites was poor).

From 1997 to 2008, the Sanctuary supported between 4,700 and 45,000 butterflies (Table 1). The severe drop in 2009 to 800 butterflies reflected a sharp decline rangewide from 220,000 to 55,000 likely because of a three year drought across the Western United States. The low numbers at MGS in 2009-2010 also followed hazard branch trimming (summer 2009) along the southern boundary where monarchs had clustered in most years. The relative contributions of low overall California numbers and branch trimming to the sharp decline compared to other aggregations are difficult to quantify. MGS had supported as few as 20% of the Monterey County population (in 2004) compared with 17% in 2009.

Numbers and ranking recovered in 2010 and 2011 with the end of the drought. In fall 2010, Robert Pacelli placed potted along the southern edge in fall 2010 to fill in low wind gaps. Adventitious branches filled the mid-level gaps created by the trimming, and wind shelter improved on the southern boundary. Importantly, the blue gum trees planted in 1999 achieved heights (50-60') and crown volume that provided critical NW wind shelter, as envisioned in the 1998 management plan. In 2011-2012, butterflies moved from the southern edge into the grove interior for much of the season. Since then they have regularly used those interior trees for substantial parts of the season.

Ongoing Monitoring

Creekside staff mapped the location of trees that have been tagged by monitoring crews from the Museum (Figure 1) green triangles. Note the two distinct areas for monarch clustering; the southern and far southeast boundary and the Monterey Pine on the adjacent property (*southern boundary and neighbors yards* [210 and 212 Ridge Road]), and the interior stretching from the hotel driveway to 30-40 m west into the grove (*interior*). These maps combined with the monitoring database collected by the Museum paint a dynamic picture of monarch distribution and abundance in the Sanctuary for 2013-2017.

Details of the 2013-14, 2014-15, 2015-16, and 2016-17 overwintering seasons have been obtained from the Pacific Grove Museum of Natural History (Figure 2). The monitoring data have some limitations- small changes in numbers are likely sampling error, but large numerical trends (factor of 1.5 to 2 approximately) are detectable. The overall movements of butterflies between the southern boundary and interior can be tracked as a measure of habitat suitability and response to weather. Wind data from Monterey Airport (Figure 3) provide context for local shifts in distribution.

2016-2017 season summary

The stormy winter from Oct 2016 – Mar 2017 (WY 2017) had many large wind storms (Figure 3), starting in mid-October (a remnant typhoon), three strong storms in December, and seven days of gusts >30 mph in January, and several more strong storms in February. Overall, it was a very wet winter (23.1") compared with 20.8" in WY 2016, 13.4" in WY 2015, 7.3" in WY 2014, 11.0" in WY 2013, 8.9" in WY 2012, and 18.1" in WY 2011.

In fall 2016, butterflies arrived as usual in October (50 observed on October 8, rising to 7,100 by October 29) and hit peak numbers of 17,100 in mid-November (Figure 2). Numbers dropped to ~10,000 by late-November, and 4,400-5,500 through December. By mid-January, numbers were down to 3,200 and dropped to 1,250 by early February. Butterflies started clustering in early October along the southern boundary on a mix of Eucalyptus and pines. But by Oct 22-29, they had moved to the interior, probably in response to strong winds around Oct. 15 (peak gusts ~40 mph). The butterflies then moved to the Eucalyptus on the southern boundary by Nov. 12, and into the neighbors' yards (210 and 212 Ridge Road) on cypress through December. On December 31,

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butterflies were split between the hotel driveway and the southern neighbors. On the final two dates, Jan 14 and Feb 4, the butterflies were in the interior of the grove.

The large decline (~3-fold) from peak in mid-November to mid-December was likely a response to several major wind events (>30 mph gusts) in December (Figure 3 top). Many other monarch sites in Northern California suffered declines in butterfly numbers between the Thanksgiving Counts and New Year's counts (Table 2, Xerces Society 2017), and none exhibited an increase. The high winds were region wide, and it was one of the windiest periods in the past 4 years. Further declines in January were likely in response to numerous windstorms during that month. Where butterflies went after leaving the obvious clusters is unknown – they could have found refuge in small, hard to detect clusters elsewhere in the Sanctuary, or left entirely, or died. The same general declines were observed in San Luis Obispo, Santa Barbara, and Ventura Counties – only a few sites increased in numbers.

In January, an attendee at Dr. Weiss' talk at the Pacific Grove Museum called attention to a non-native squirrel that had been disrupting monarch clusters, which over time may have reduced numbers in the clusters and scattered or killed butterflies. Options for controlling this factor are at the end of the recommendations.

2013-2016 season summaries

Thanksgiving counts of 10,790 in 2012, 13,420 in 2013, and 18,128 in 2014, 11,472 in 2015, indicate that the Sanctuary continued to attract large numbers of butterflies that remained through the overwintering season.

In 2012-2013, the butterflies largely moved onto pines and cypresses in the interior of the grove following strong storms in November and December 2012. The interior habitat provided suitable light and wind conditions through the remainder of the season. The 1999 blue gum trees grew to 40-60' tall and provide critical NW wind shelter as part of a multi-species windbreak. Viewing opportunities were provided from the hotel driveway.

In 2013-2014, butterfly numbers peaked in late-November at 13,500 and remained at ~10-11,000 through early February, with a sharp drop in mid-February to <5,000 as they dispersed to the breeding grounds. Butterflies remained at the southern boundary through early January 2014. The strongest wind events during this period were in early December (max speeds 21-22 mph, gusts of 28-31 mph). By January 27, 2014, they had moved into the interior of the grove and were clustered on pines and cypress. There was a wind event on January 11 (max speed 16 mph, gusts to 28 mph). By February 14, butterflies had moved back to the southern boundary on Eucalyptus prior to dispersing away to breeding rounds.

In 2014-2015, numbers declined from 24,000 in mid-November to 16,000-18,000 from December through early January and persisted through strong storms in November-December. The decline to 6,000-7,000 by late January through February 10 represents dispersal to breeding grounds during a record warm January. Butterflies started

clustering on the southern boundary, but by early December, following strong storms (max winds 25 mph, gusts 40-65 mph) they moved to the interior and remained there through February 10. Apparently the interior conditions were suitable during the warm relatively calm January (one wind event with 30 mph gusts), and butterflies did not move back to the southern boundary. The butterflies that remained in the grove persisted through another high wind event in early February (32-37 mph gusts).

In 2015-2016, butterflies arrived as usual in October and hit peak number quite similar to 2013-2014 (11,000, Figure 2). Numbers remained steady into late-January, and dropped in February as butterflies left the grove. A warm dry February led to dispersal to breeding grounds by the end of the month. Butterflies started clustering in October-November in the western and southern part of the grove, and by December had moved to the interior of the grove following several wind events (40 mph gusts), with the strongest gusts of the season (50 mph) in December (Figure 3). In early January, Dr. Weiss observed monarchs clustering on a tall Monterey cypress about 25 m off the northern boundary, well north of the typical interior cluster sites (Figure 1). They moved back into the interior and hotel driveway later that month.

These observations from 2013-2017 indicate that Monarch Grove Sanctuary continues to provide enough wind shelter and varied light conditions to support a large monarch aggregation early in the season, and maintain substantial numbers of butterflies through the remainder of the winter. There is sufficient wind shelter for the interior of the grove for butterflies to remain there following storms, and sufficient light that they can take flight as needed. The major wind directions that produce the highest sustained winds are SE-SW and W-NW (Figure 3) and the grove is now much better protected, especially from W-NW than in previous decades because of the growth of the 1999-planted Eucalyptus trees. 2016-17 provided a real test of wind shelter given the large number of storms and high wind events.

A long-term view

Management of Monarch Grove Sanctuary is a long-term process. This section looks ahead to anticipated changes and issues over the next decades, so that current management recommendations can be put into context.

- 1) The 1999 blue gum plantings are working as anticipated, growing to 40-60' tall and providing NW wind shelter and allowing monarchs to stay in the interior of the grove following storms. These trees will continue to function for many decades as part of a multi-species windbreak that includes pines and cypress.
- 2) The authorized blue gum plantings inside the southern boundary have been growing to heights of 15-20' and are beginning to provide additional wind shelter at low heights. These trees will eventually reach heights where monarchs can roost in a more wind sheltered dappled light environment – some roosting has been observed on the taller trees. They will provide redundancy for the southern windbreak trees, and will eventually replace them decades from now.

- 3) The overplanted unauthorized trees should be thinned year by year to encourage healthy blue gums that can grow rapidly (see recommendations below). The canopies of remaining trees will fill in any gaps left by removal of the overplanted trees. Boxing trees that are removed at this point may be difficult, but boxed trees can be moved at will *but not planted in the ground*.
- 4) The pines continue to succumb to pitch canker, and drought effects are still being expressed. Continuing plantings to maintain a substantial pine component in the grove is important, but pines still cannot be counted upon to provide long-term overstory. Removal of pines heavily infested with pitch canker can slow, but not stop the spread.
- 5) Many of the cypress planted over the last decade are in their period of rapid growth and will provide significant wind shelter in coming years and decades. The cypress along with blue gums will provide the backbone of the grove, given the uncertainties on pine survival in the long run. Some densely planted cypress stands could be thinned.
- 6) Understory live oaks could fill in parts of the grove and provide good native habitat. Understory native shrubs (toyon and ceanothus in particular) and forest floor forbs could be introduced in parts of the Sanctuary, but need to be protected from deer browsing.
- 7) Maintaining the irrigation system for tree establishment and for watering during droughts, as well as developing a rigorous irrigation management plan implemented by City staff, is critical.
- 8) Continued provision of tested fall blooming nectar plants will help retain butterflies early in the season in October and November. The yellow Buddleia has proven attractive (Photo 1), and the flowering red gum also attracted nectaring butterflies (Photo 2). The beds should be maintained with those plants that prove to be used by butterflies. Away from the nectar beds, use of bottlebrush was noted each fall from 2014 to 2016, and early-blooming *Prunus* has provided winter-spring nectar in addition to the blooming blue gums.

Management Recommendations for 2017

Monarch Grove Sanctuary

Several issues in forest and habitat management at Monarch Grove Sanctuary were identified in the field, and are keyed to zones identified in Figure 4.

- 1) **Zone 1 Removal of pines with pitch canker (Photo3):** Near Grove Acre Avenue, a dead Monterey should be removed in 2017. Additional pines should be planted in this zone and receive irrigation, along with continued monitoring of the remaining trees.
- 2) **Zone 1 and 6 redwood management (Photo 4):** The redwood trees have clearly not worked. They are water-stressed, most are growing poorly and have dead tops and branches. Redwoods are not well suited for Pacific Grove close to the ocean because of salt spray. We recommend phasing out the redwoods over a few years and planting cypress and pine as replacements. There is sufficient wind

shelter in this area that removal of the short redwoods will not diminish the butterfly habitat.

- 3) **Zone 1 and elsewhere Cypress growth:** The rapidly growing cypress in Zone 1 will provide greater wind shelter in several years and replace the pines that have died, as well as providing an alternative to the redwoods. In general, many of the cypress across MGS planted in the late 1990s and 2000's are hitting peak growth and will provide canopy functions well into the future.
- 4) **Zone 2 Understory Pines:** Many recently planted understory pines died and were removed in recent years 2015 and 2016. We recommend that these sites be replanted where appropriate with 5 gallon Monterey pines, using pitch canker resistant stock if available. Provision of drip irrigation until the trees are established is critical for high survival of these trees. All irrigation scheduling should be done by the City Arborist.
- 5) **Zone 2 Dead Pine removals:** Small dead pines in the interior are still present, but do not need removal unless they provide ladder fuels.
- 6) **Zone 3 Authorized blue gum plantings (2011) status:** City-authorized plantings of blue gums were carefully planned to fill in gaps in wind protection, be appropriately spaced, and their rapid growth and health is essential to the long-term habitat suitability of the Sanctuary. A minimum of 10-15 feet (3-4.5 m) between trees is necessary for tree health and rapid growth in the long-term. These trees are now ~15-20' tall (Photo 5), and occasionally support clustering monarchs early in the fall.
- 7) **Zone 3 Unauthorized blue gum plantings (2013) status:** The unauthorized blue gums (formerly potted) were planted much too densely in 2013 (Figure 5 and Photos 6). Crowding the authorized trees with the additional unauthorized plantings serves to slow growth and create unhealthy individual trees. We recommended each year 2014 to 2016 that unauthorized blue gums in this area be thinned back to the originally planned configuration. A number of these trees were removed (mainly dead ones), but many are still too closely planted. No trees appear to have been removed in 2016. A close-up of the SE corner shows the numerous trees planted in this area (Figure 3). Some trees were planted too shallow and may be structurally deficient.
- 8) **Zone 3 Removal of unauthorized blue gums:** We recommend that additional unauthorized trees be removed, preferably 10'+ spacing, but to a minimum spacing of 6'. Several trees have died and should be removed. Selection of individual trees for retention and removal will be conducted in the field by the City Arborist and others prior to any actions. Because the remaining trees will respond positively to the thinning, any reduction in low-level canopy will be temporary.
- 9) **Zone 3 Potted Trees:** The potted trees can be moved around to fill gaps, but should not be planted in the ground without City authorization.
- 10) **Zone 3 Mulch Management:** Surface blue gum duff was raked from around the small trees in 2015. This duff is important mulch to retain limited water, and such raking should be discouraged in the future. The duff also provides structure for monarchs to climb away from the ground if they are dislodged.

- 11) **Zone 2 Acacia management:** An acacia with much dead foliage is noted along the western edge of Zone 2, and some removal of dead branches is appropriate (photo 7). But, the dense fine branches are filling an important gap for SW wind shelter for the interior cluster sites, and removal of all of these dead branches at once should be delayed until established trees and new plantings can fill the gap. There is an acacia growing in the corner of a nectar bed (left in photo) and a pine sapling that can fill this gap in coming years.
- 12) **Zone 2 Oak plantings:** In Zone 2, live oaks should be planted just east of the trail to create low windbreak. Provision of irrigation for the first few years should be a priority.
- 13) **Zone 7 Cypress thinning:** In the interior of Zone 2, several young cypresses have failed to establish straight trunks and should be removed (Photos 8 and 9). Three cypresses were identified for removal to thin the stand. The remaining cypress plantings are dense enough to fill in for these removed trees. Final selection of trees to be removed will be made in the field by the City Arborist.
- 14) **Zone 7 Replanting pines and oaks next to snags:** In Zone 7, there are opportunities to replant pines alongside the many wildlife snags in the open area, to re-establish forest cover. These snags were dead or hazardous Monterey pines that were removed and left to act as a habitat / granary snags. Natural re-forestation is non-existent in Zone 2. Oaks would be a suitable understory in this area. While the canopy is open overhead, this site does not receive much direct light during the overwintering season because of tall canopy to the south. Again, provision of drip irrigation for the initial plantings increases chances for success.
- 15) **Zone 7 Removal of dead pines near driveway:** A large pine is standing nearly dead, and should be considered for removal because it could reach the driveway or damage other trees should it fall.
- 16) **Zone 7 Removal of cracked acacias:** Some acacia branches are in danger of breaking (Photos 10 and 12).
- 17) **Zone 3 South fence line trees:** The trees planted next to the fence will eventually damage the fence as they grow in girth (Photo 5). No immediate actions are suggested other than removing the dead trees, but monitoring the situation is important. At some point in the future a realignment of the fence, or removal of what will then be much larger trees will be necessary.
- 18) **Zone 4 Hazard branches/trees over trail.** No further hazard reduction actions appear necessary here.
- 19) **Zone 4 Closing south edge gap:** On the south edge of Zone 4, there is a substantial low canopy gap that should be filled in by planting one of the potted trees or a nursery raised blue gum.
- 20) **Zone 5 no action:** No actions are suggested for Zone 5 in 2016 at this time.
- 21) **Zone 6 NW corner:** There dead redwoods and a ceanothus (Photo 9) that should be removed. In addition, a couple of acacias are largely dead and should be removed (Photo 11) .
- 22) **Nectar beds:** It is clear that the yellow Buddleia is a favored fall nectar source. The bushes are getting quite large, and accumulating dead foliage and branches in their interiors. We suggest that half of these bushes be trimmed in spring 2017, to

- allow for refreshed growth, and the other half be trimmed back in 2018. There are species that have been tested that are not favored, so replacement of some of the other species with Buddleia should be considered. The bottle brush and red gums do provide alternatives to Buddleia. Continued experimentation with fall blooming species should be continued in at least one of the beds. Appropriate irrigation management – not overwatering – is essential for the nectar beds.
- 23) **Understory plantings:** Toyon and blue blossom ceanothus are two species that can thrive in the grove and provide native understory. Plantings of these two species need to be caged for several years to protect against deep browsing, but once established can live for decades.
- 24) **Irrigation system:** As noted through the document, maintaining and operating the irrigation system for establishing trees, and avoiding over-watering and under-watering is a critical management action. The reliable early survival of new plantings is dependent on appropriate irrigation.
- 25) **Governance:** We note a long history of governance issues regarding City control over activities in Monarch Grove Sanctuary, and ongoing controversies. In order to create a deliberate and open decision-making process, in 2014 we proposed a progression of meetings to discuss the rationale and implementation of these recommendations, adjust them if appropriate. This sequence is outlined in the Adaptive Management section of the 2011 report. Public input is sought at appropriate times and through official channels. This year (2017) is the fourth year where the deliberate process has been undertaken, with a written report presented to the BNRC, and a public tour of the Sanctuary soon thereafter (sponsored by Public Works), with work to be done in September.
- 26) **Management of trees at the Butterfly Grove Inn:** The City and the Hotel need to coordinate actions in this sensitive area. In summer 2016, the new owners of the hotel did major tree maintenance on their property to alleviate potential hazards. The trimming was brought to the attention of the City Arborist, who intervened and reduced the intensity of branch trimming and thinning. Fortunately, the hotel structure itself provides much of the wind shelter from that direction and the branch thinning will only affect the upper canopy where monarchs rarely cluster. And, the wind direction affected (NE, 0-45°) is relatively less important than others (Figure 3). The cypress above the hotel driveway, which has been a major cluster tree in recent years, had a broken branch that poses a hazard to people watching the butterflies from below, and that branch was removed. Removal of the dead branch should not affect use of the other branches on the tree because the wind shelter in this area is provided by surrounding trees and the hotel itself. Removing this branch may avoid death and injury to monarchs should the branch fall while butterflies are clustered.
- 27) **Southern Neighbors:** South of the Sanctuary, trees in the neighbors' yards provide cluster sites (the pine near the shed), and additional wind shelter. In 2016-2017, a few pines and cypress at 210 and 212 Ridge Road were heavily used by monarchs. While beyond the direct control of the City, maintenance of these trees by the neighbors is important. Outreach by the City is important to find out plans and anticipate changes. Management of hazards over these yards should be

done on a case by case basis. But, management actions within the Sanctuary itself are designed to eventually make it more self-contained and less reliant on neighboring property owners.

- 28) **Squirrel disruption of monarch clusters:** As mentioned above, a non-native squirrel was noted disrupting monarch clusters and may actually be responsible for some of the reduction in numbers over the season. Should this squirrel make a re-appearance, various non-lethal methods (trapping, hazing) might be attempted. Lethal trapping might also be considered should the squirrel persist.

George Washington Park

There are several issues in forest and habitat management at George Washington Park

- 1) This is a unique site for California monarchs; it is one of the few remaining Monterey pine/live oak habitats.
- 2) The site has been used intermittently by monarchs, a few individuals can be found there every year at some point, but major clusters were found in only a few years (Table 1). In 2006, for example, there were more than 10,000 monarchs at GWP and very few at Monarch Grove Sanctuary. Since then, there has been only one year (2011) with more than 1 or 2 monarchs at Thanksgiving. Individual monarchs have been observed here during other times of the overwintering season.
- 3) The historic cluster sites in GWP are losing sufficient wind shelter for monarchs, and additional senescence of mature trees threatens this important component of habitat suitability. In particular, the largest pine at the historical overwintering site has died, but there are several mid-story pines that are in positions to replace this tree over coming decades. Losses of forest cover to the south and west through overstory tree mortality is reducing wind shelter.
- 4) Removal of dead standing trees is recommended where they have stationary targets, especially around the edge of GWP. Dead trees that may fall across trails in the interior should be evaluated on a case-by-case basis. Trees can be left as safe wildlife snags where appropriate, but a more naturalistic topping should be considered.
- 5) Reduction of accumulated deadfall by CALFIRE in 2014, 2015, and 2016 removed large piles of downed tree debris. This is important preparation for eventual site restoration. Some branch and log piles have been retained and downed logs are used to redirect foot traffic to fewer trails.
- 6) Plantings of pine seedlings to the SW of the historical cluster site, similar to the plantings at the southern end of GWP, should commence assuming that sufficient rain falls in fall-early winter 2017-18.
- 7) Operations on the perimeter of the park are the priority, to maintain safety from falling dead trees on adjacent roads, and to create a fire buffer.
- 8) The full impact of the 2012-2015 drought will become clear this year and next (trees may take one or two years to die after major drought stress).

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- 9) Establishment of a designated trail system and decommissioning of meandering paths impacting root systems of the trees is occurring. Ingrowth of poison oak is effectively shutting some social trails.
- 10) Now that there have been reductions in downed trees and debris, and the full impact of the drought on mature trees will become apparent, the long-term suitability of George Washington Park for monarchs should be assessed, with methods similar to those employed at Monarch Grove Sanctuary.
- 11) Once the assessment is done, a long-term planting scheme (pines, oaks, and native understory shrubs) should be developed and implemented. The key elements of such a planting scheme should be to provide eventual replacements for canopy trees, create and maintain a mid-story of oaks and pines, and maintain wind shelter from all directions around defined canopy gaps.

In summary, forest management at George Washington Park is needed, and the first steps of removal of some dead standing trees, clean-up of some forest floor debris, and re-routing some informal trails have been implemented. This will set the stage for plantings and restoration of the forest in GWP.

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**Table 1. Monarch Butterfly Thanksgiving Counts Xerces Society
 Monarch Grove Sanctuary (MGS) George Washington Park (GWP), Pacific Grove
 and California Totals**

Year	MGS	GWP	CA Total	Monterey Co.	MGS % CA	MGS % Monterey	MGS CA Rank
1997	45,000		1,235,490	45,000	4%	100%*	10 (tie)
1998	35,000		564,349	41,000	6%	85%	5
1999	25,000		267,574	25,000	9%	100%*	3 (tie)
2000	20,000	0	390,057	20,000	5%	100%*	6 (tie)
2001	14,960		209,570	31,203	7%	48%	4
2002	4,700		99,353	11,593	5%	41%	5 (tie)
2003	22,802	2,750	254,378	68,979	9%	33%	2
2004	10,867	4,325	205,085	54,481	5%	20%	4 (tie)
2005	12,199	2	218,679	37,540	6%	32%	4
2006	28,746	11,795	221,058	59,957	13%	48%	1
2007	8,181	2	86,437	15,426	9%	53%	3
2008	17,866	0	131,889	31,063	14%	58%	2
2009	793	0	58,468	4,735	1%	17%	17
2010	4,968	0	143,204	8,634	3%	58%	4
2011	12,265	61	222,525	27,788	6%	44%	4
2012	10,790	0	144,812	29,048	7%	37%	4 (tie)
2013	13,420	1	211,275	35,772	6%	38%	3 (tie)
2014	18,128	0	234,731	55,879	8%	32%	3
2015	11,472	0	292,888*	27,787	4%	41%	3 (tie)
2016	17,100	0	298,464	64,804	6%	26%	3

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Table 2. Comparisons of Thanksgiving (Nov) with New Years (Jan) counts at Northern California sites. Red indicates a virtual abandonment of the site, orange indicates a substantial decline, yellow a small decline, and no color is steady. Note that none of the sites monitored exhibited an increase.

Site	County	Nov	Jan
Juniper & Kale, Bolinas	Marin	4,060	30
Charlotte, Muir Beach	Marin	1,206	350
Point Pinole, Point Pinole	Contra Costa	252	1
Ardenwood Historical Farm, Fremont	Alameda	2,468	1,256
Chuck Corica Golf Course, Bay Farm Island	Alameda	1,710	1,392
Skywest Mall	Alameda	96	112
Skywest Golf Course, Hayward	Alameda	160	0
Lighthouse Field, Santa Cruz	Santa Cruz	12,000	10,214
Moran Lake, Moran Lake	Santa Cruz	4,000	3,965
Natural Bridges State Beach, Santa Cruz	Santa Cruz	3,500	3
Butterfly Grove Sanctuary, Pacific Grove	Monterey	17,100	4,520
CH1 Private Site	Monterey	4,646	0

Figure 1. Monarch Occupied Trees (Green Triangles) 2012-2014, Grid in meters

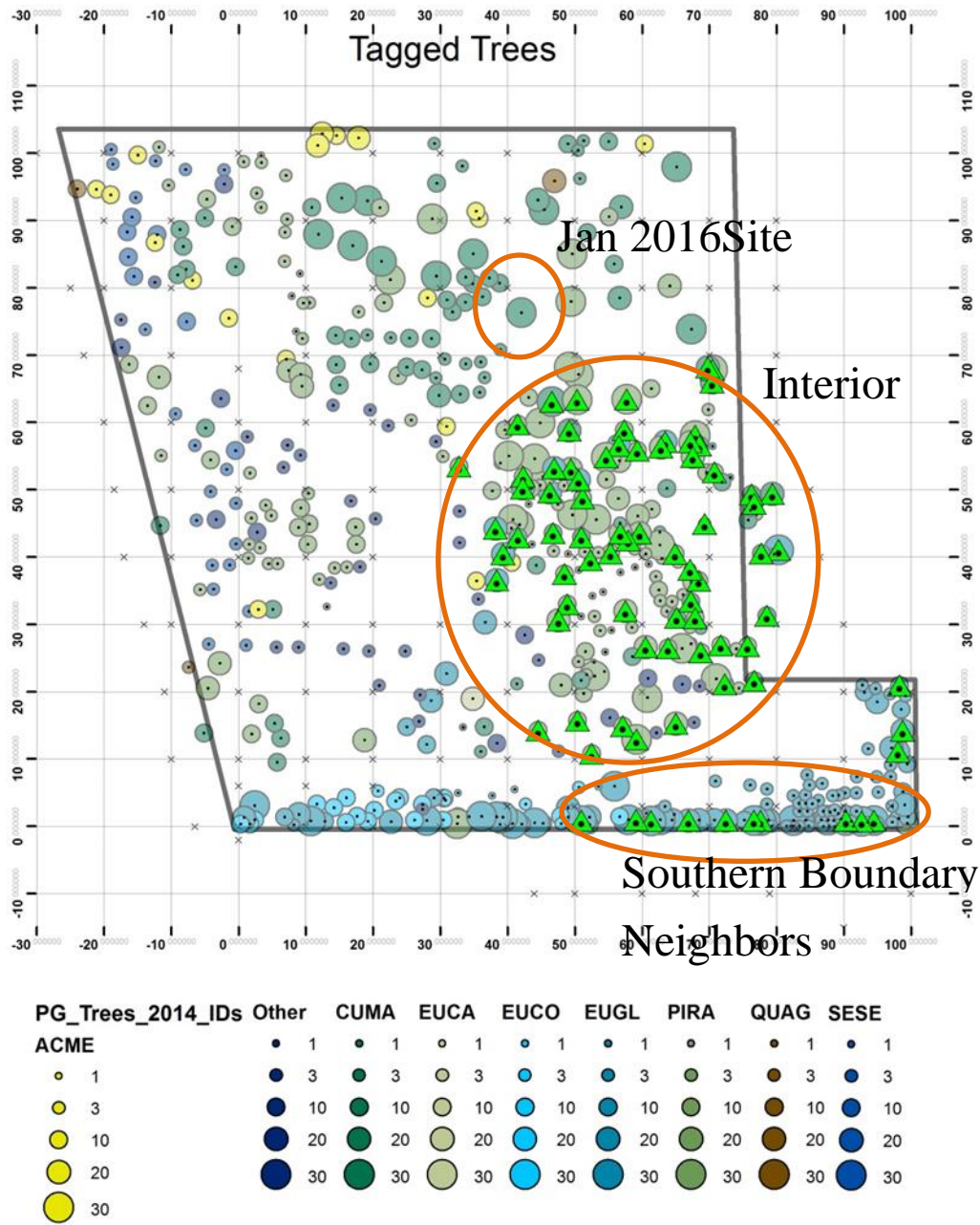


Figure 2a. Monarch numbers through season. Data from Pacific Grove Museum

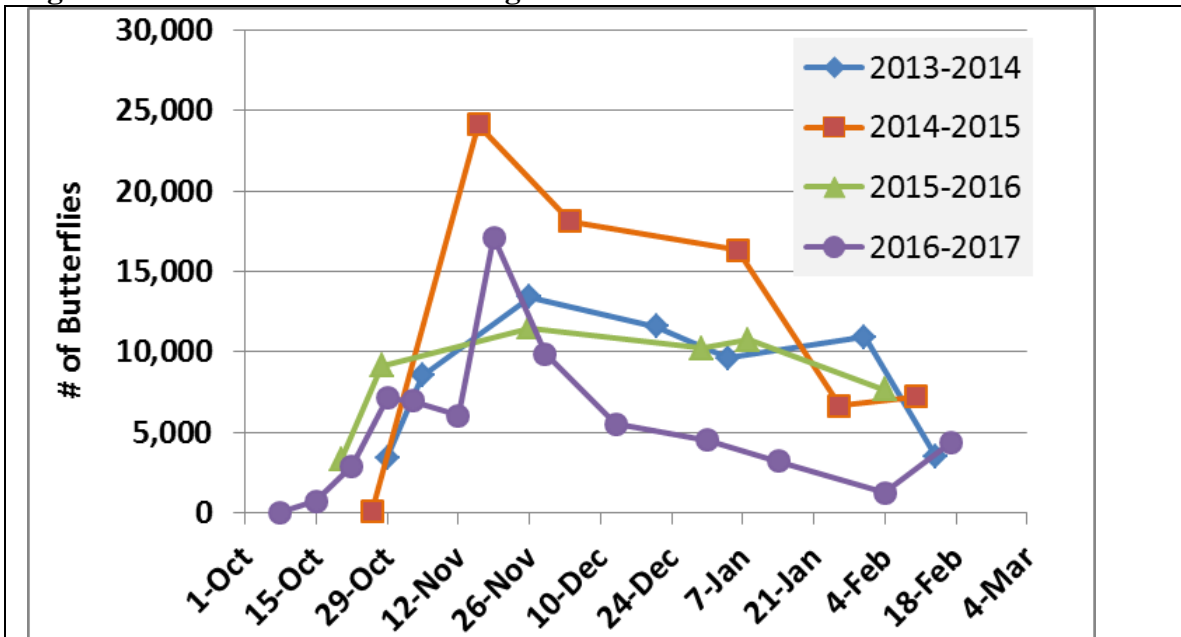


Figure 2b. Tree species usage by date

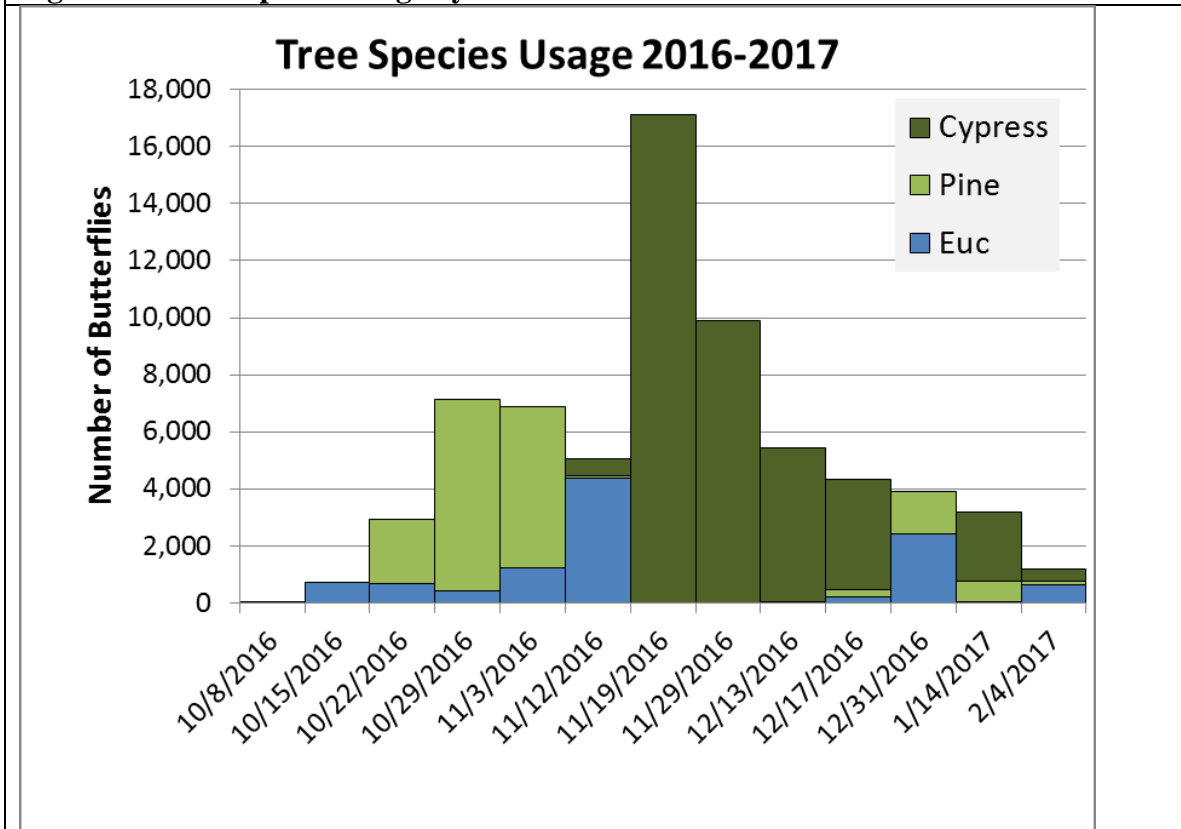


Figure 3. Daily Wind Data from Monterey Airport

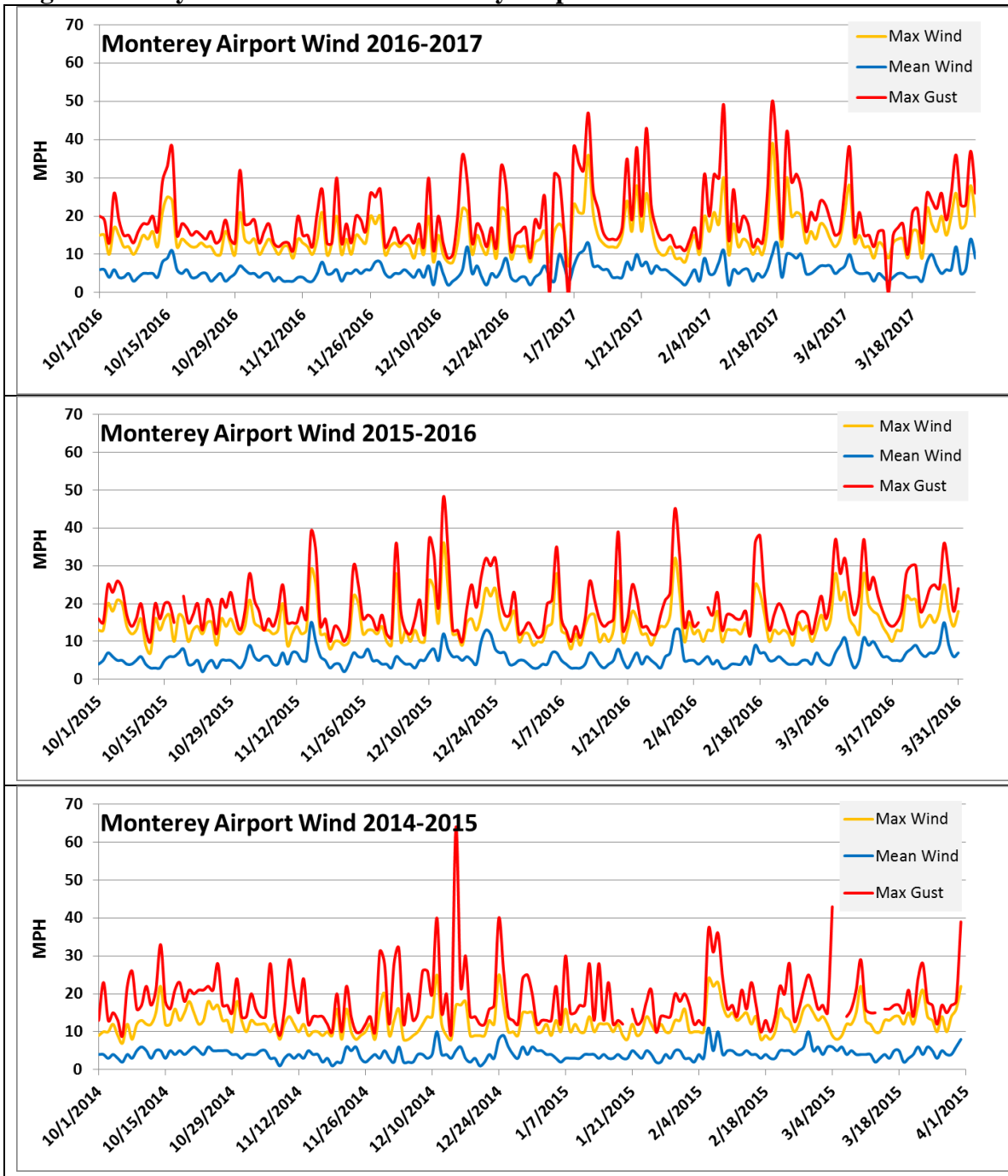


Figure 3 (Continued). Maximum wind and wind direction Monterey Airport

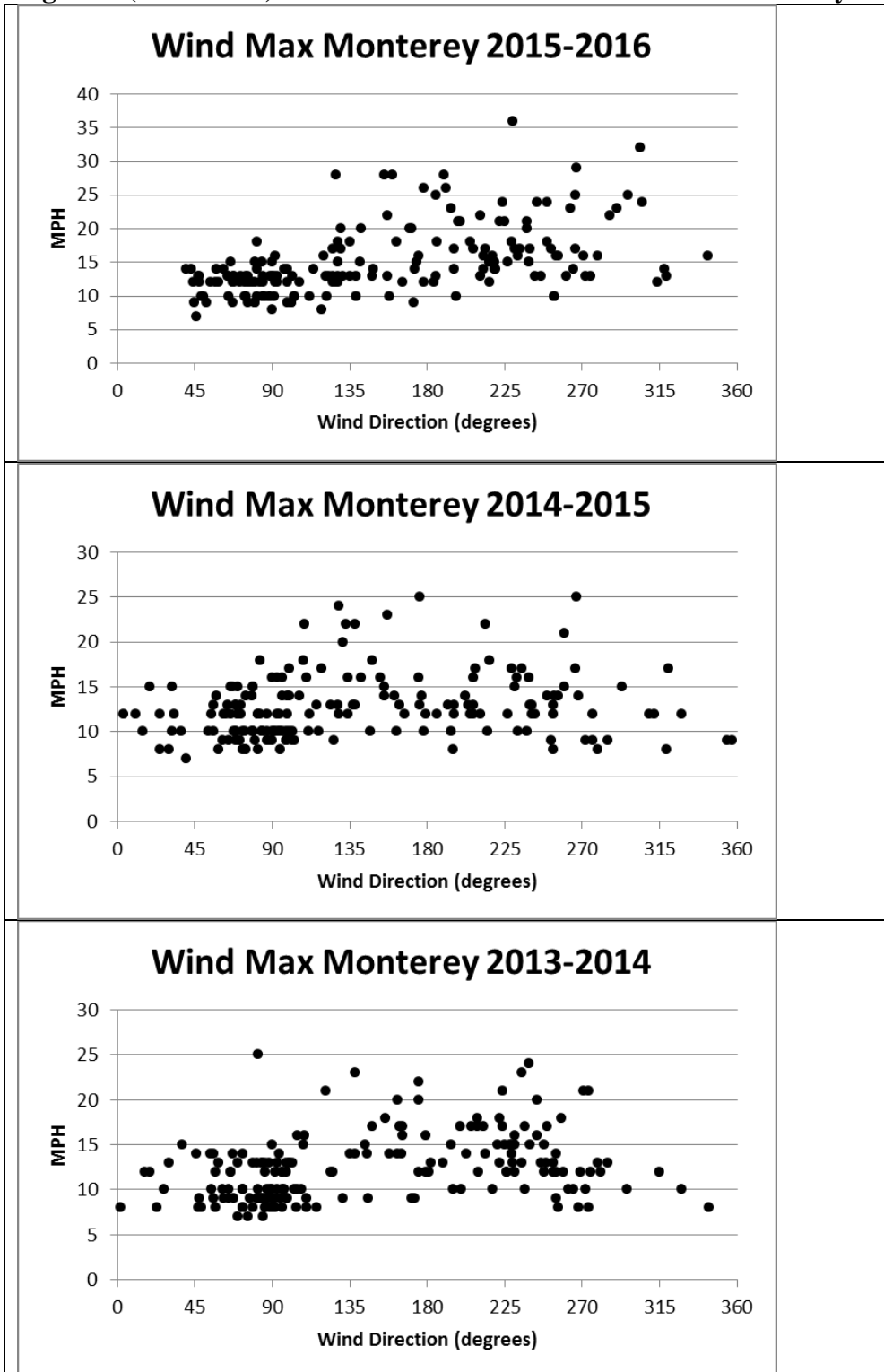


Figure 4. Management Zones. Grid in Meters

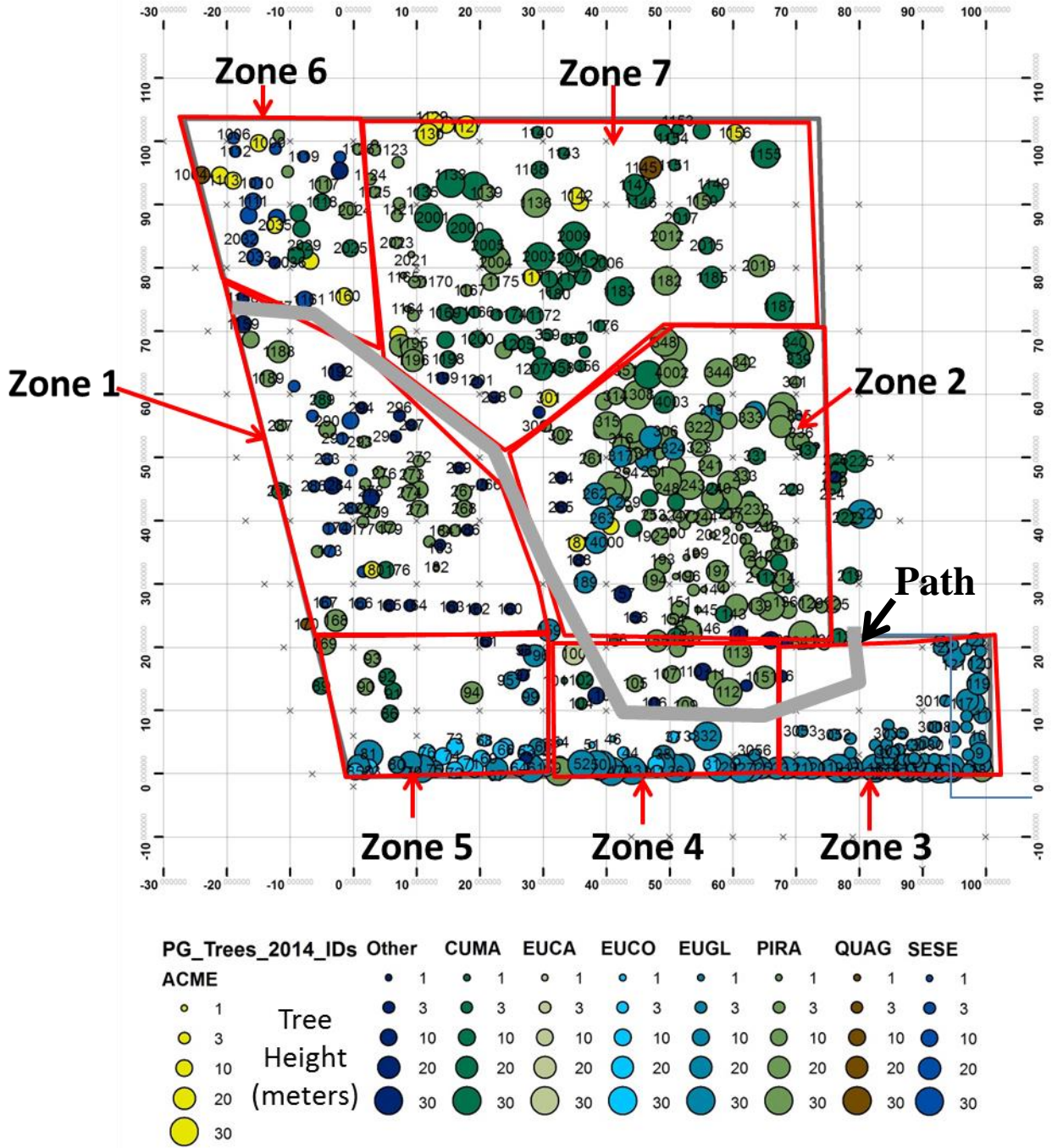


Figure 5. SE corner of Sanctuary, highlighting the closely spaced small trees. The grid is 10 m (33'); some of the trees are less than 1m apart.

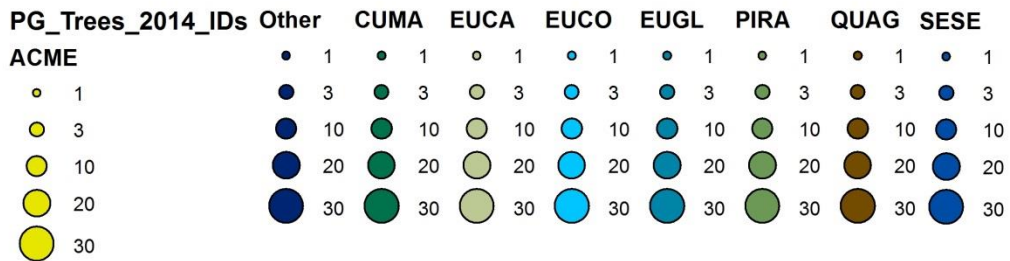
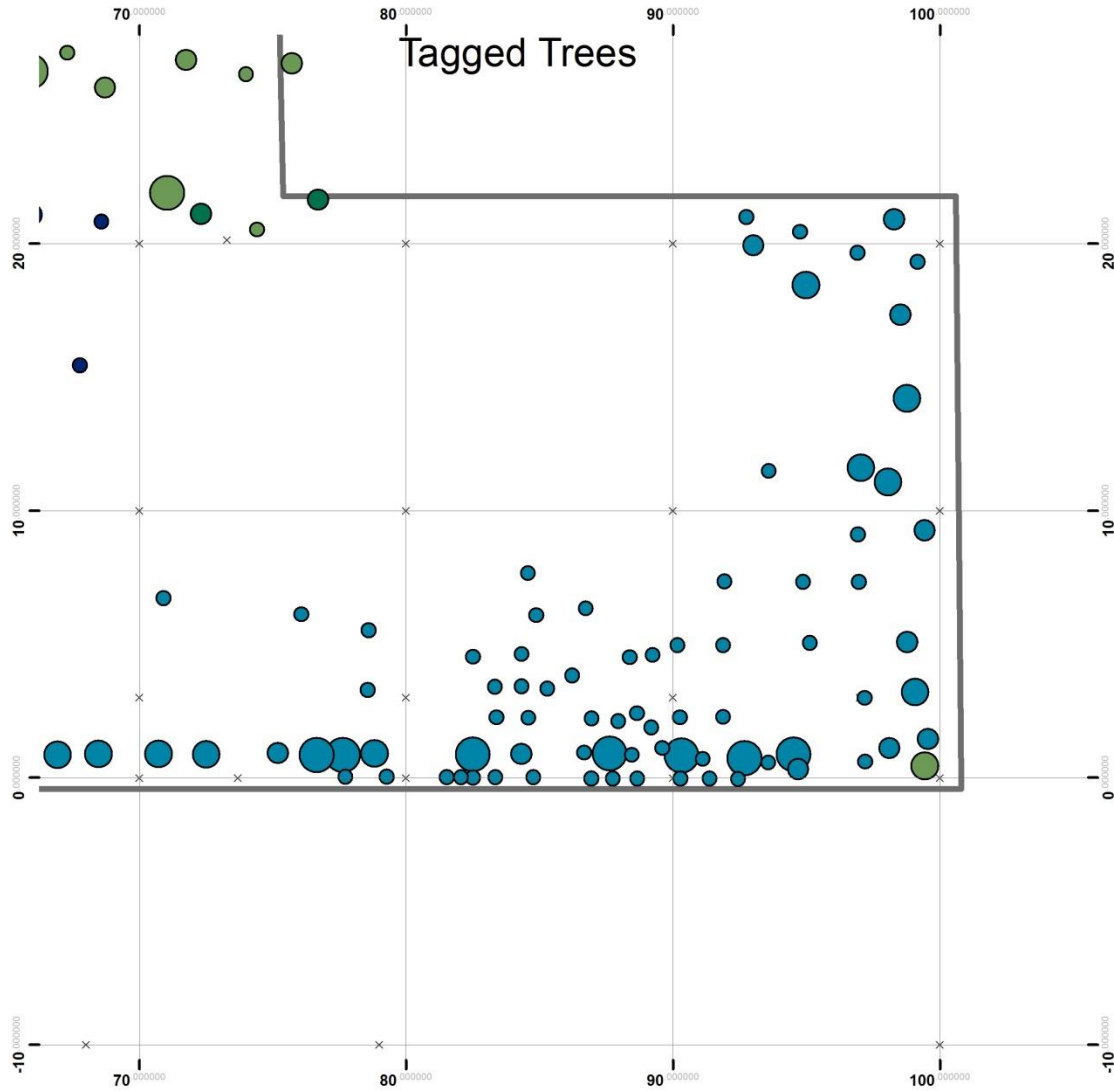


Photo 1. Nectaring on red gum October 21, 2015.



Photo 2. Nectaring on yellow Buddleia October 21, 2015.



Photo 3 Pitch Canker infested Pine Zone 1



Photo 4 Stressed Redwoods in Zone 1



Photo 5 2011 planted blue gums inside Note height (>20') of circled tree crown



Photo 6 Overplanted blue gums and boxed trees 2017



Photo 6 Blue gums by fence 2016



Photo 7 Acacias and Pine Sapling 2017



Photo 8 Bent cypress Zone 7



Photo 9 Cypress stand to thin Zone 7



Photo 9 Dead Redwood NW Corner



Photo 10 Acacia on North Boundary Falling apart



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Photo 11 Acacias in NW Corner



Photo 12 Other view of Photo 9 acacia

