Attachment 1

Dead wood removal and monarch butterfly habitat effects

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Removal of dead downed wood and dead standing trees benefits monarch butterfly habitat and forest health. Forest habitat is best for monarch butterflies when it provides a balance between cover and room for flight. Wind shelter by a dense outer screen of trees is critical. Inside that screen, dappled light is key to monarch aggregation locations. Very dense canopies from overcrowded trees or open canopies from death of trees are not suitable as monarch aggregation habitat.

The Xerces Society guidelines for managing monarch groves (The Xerces Society 2017) suggests that even very important trees (VITs), "…that are also hazard trees should be replaced." (pg. 14). "Completely dead trees and branches generally do not contribute to monarch habitat and are a potential liability. Felled debris from diseased and infected trees should be removed from the habitat to eliminate host material." (pg. 19). "Standing dead trees generally do not contribute to monarch habitat and are a hazard to people and other trees." (pg. 25).

The 1993 Monarch conservation and management guidelines (Bell et al. 1993) state, "The authors recognize the importance of removing hazardous trees from forests." (Recommendation 18). And, "Understory levels should be managed to prevent a localized buildup of dead plant materials." (Recommendation 30).

Monarch Habitat

In our experience of visiting scores of monarch butterfly aggregation sites during more than 30 years of observation, monarch butterflies prefer to aggregate in locations with a wind protection buffer surrounding a more open center that allows access and patrolling space for flying butterflies.. Monarchs leave roosts subject to disruptive wind (Leong 2016) for protected locations that provide dappled light and ameliorate temperature and humidity extremes. Monarch aggregation habitats often have low to moderate densities of ground vegetation with an open mid story within the wind protected area. Several famous monarch butterfly aggregation sites, such as Pismo Beach and Pacific Grove have highly managed understories free of downed wood. The relatively clear floors in those groves include wide walking paths that are not detrimental to monarch aggregations that form in the surrounding trees..

In Ellwood, monarchs have sought out wind-sheltered gaps in the forest to form their aggregations. Ellwood Main prior to the recent drought die-off was the exemplar of an aggregation site with a “Cathedral” structure consisting of an open understory, minimal ground cover, and a high vertical open space encompassed by protective trees. Surrounding slopes contributed to wind shelter and tall canopy trees formerly provided ideal dappled light and room to fly. The northern entrance to the aggregation site remained open and thicker vegetation around the edges of the site provided excellent wind buffering. The drought die-off of trees changed the site and where protective trees stood west and east of the grove, tangles of dead fallen wood and standing dead stems occupy the space and allow wind to penetrate far deeper into the grove than previously. Within the aggregation site, standing dead trees place other trees at risk,and downed trees and debris interfere with recruitment of replacement trees. Ellwood Main no longer provides the excellent aggregation habitat as in past years.

Monarchs are often observed flying through stands of trees investigating habitat. This behavior can lead them to aggregations. Groves where trees are too dense, or where debris and tangles of dead wood block patrolling areas, reduce access and increase effort to locate suitable roosting locations.

Historically, Ellwood forests were managed to remove dead wood and maintain healthy stands of trees through normal forestry practices (Santos 1997, Meade pers. observ.). Failure to manage a grove results in over recruitment of trees during periods of higher rainfall and then death of trees during times of water stress (droughts). Appropriately managing tree density based on water demand creates a more stable grove and is a fundamental tenet of forestry management, even for groves managed for wildlife (Grebner et al. 2021, Taylor 2018)

Eucalyptus does not break down as quickly as native vegetation and wood and bark debris that accumulates on the ground retains nutrients and can inhibit new growth. Fallen blue gum eucalyptus trees decompose very slowly (DiTomaso et al. 2013), especially in dry climates. The high level of phenolics in eucalyptus inhibits fungi from breaking down the wood and allows accumulation of fire fuel (Reid et al.2005). Chipping will aid the release of nutrients from woody debris by converting coarse wood to fine pieces (Russell et al. 2015). Mulching around new forest plantings can increase planting survival and growth rate (Cahill et al. 2005, Chalker-Scott 2007).

Wildfire Risk

Accumulation of bark and dead wood on the ground and leaning into the tree canopy creates a major fire hazard to monarch habitats (Xerces 2017). Ignition from camp fires and other human sources can feed on ground debris and quickly escalate into a catastrophic fire event. This risk can be managed by reducing fuel load through removal of dead branches, trunks and highly flammable vegetation that can create fire ladders into the forest crown. The Ellwood groves, once managed for wood production, now present a tangle of downed wood, dead leaning trunks and over abundant understory shrubs. The City of Goleta Community Wildfire Protection Plan (2012) provides management recommendations to reduce, “potential fire intensity, rate of spread, and severity of effects.” (pg 58). Management prescriptions in the CWPP whenimplemented will help to protect life, property, and natural resources including monarch butterflyhabitat.

The presence of large quantity of dead wood at Ellwood results in:

- Increased wind penetration and speed at aggregation locations due to downed trees.
- Higher risk to remaining live trees
- Reduction in shade at aggregation sites
- Loss of cover for butterflies from predators
- Poor recruitment and growth of replacement trees
- Increased wildfire risk - intensification of fires and a fire ladder to canopy
- Public safety hazard from dead standing and leaning trees and ground debris

Removal of dead wood from the Ellwood forests and monarch groves will have positive effects for monarch butterflies.

- Removal and replacement of dead trees will increase humidity and shade and boost protection of monarchs.
- Removal of downed trees and branches eliminates debris tangles that interfere with recruitment of saplings and growth of trees with good form.
- Space for planting trees will be opened by removing dead wood.
- Removal of leaning dead trees and branch and debris tangles will improve patrolling and clustering habitat for monarch butterflies.
- Reduction of hazards for visitors to the grove
- Preserve habitat by reducing intensity and rate of spread of fires.

Photo 1 shows the dead stand along the trail that runs west of the gully at Ellwood Main. Large tangles of fallen trees lie among the standing dead, and the canopy is very open.

The hemispherical photographs (hemiphotos) below show some of the impacts of tree mortality on the effectiveness of windbreaks. Photo 2 was taken near the same site as Photo 1 above. The hemiphoto is taken straight up - the horizon is at the circular edge, and the zenith is the center of the circle. North is at the top of the photograph, and east and west are reversed from a map view because the photograph is looking upward. The opening in the orange circle in the SW direction is where many trees died (the site in Photo1), allowing wind to penetrate well into the aggregation site. The dead standing trees block only a tiny fraction of the sky compared with the live trees in other directions. Photo 3 was taken 10 meters south of Photo 2, showing the same wind shelter gap, which affects a large area downwind. In this case, the loss of shelter against prevailing SW winds has degraded the quality of Ellwood Main.

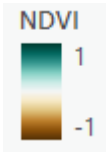
Photo 2

Photo 3

The map below shows a measure of canopy greeness (Normalized Difference Vegetation Index, NDVI) where the blue-green shows healthy foliage and the brown shows dead canopy (and brown grass outside of the forest). Note how much of the canopy around Ellwood Main has died, leaving dead standing trees, and large piles of downed wood.

The orange circle is the gap in Photos 1-3., which leaves the aggregation area to the east of the photograph sites (424 and 425) vulnerable to prevailing SW winds. Note also the numerous dead tree crowns throughout Ellwood Main, and the particularly large dead area at the western edge of the map, which is shown from the ground in Photo 4.

Normalized DIfference Vegetation Index (NDVI) map of Ellwood Main. Blue-green is live foliage (high NDVI) and brown is dead trunks, branches, and grass.



Map 1

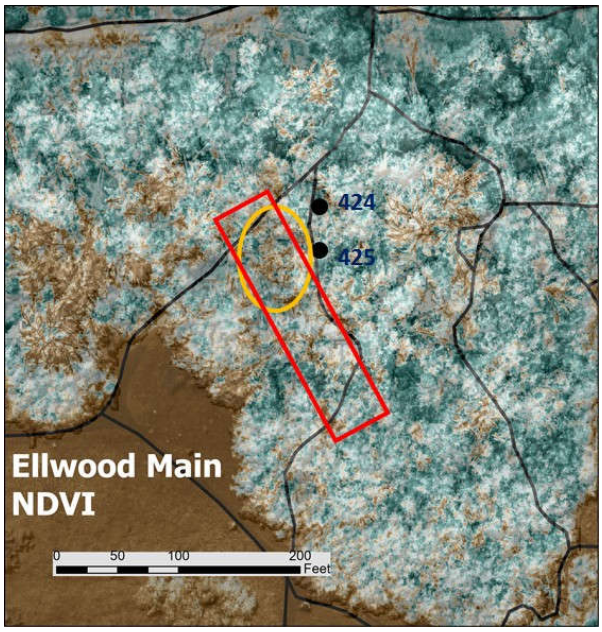
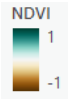
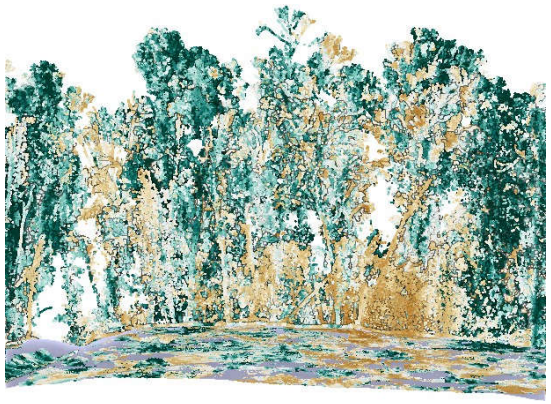
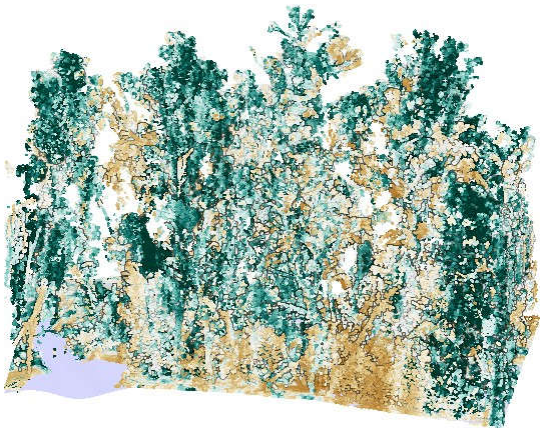


Photo 4

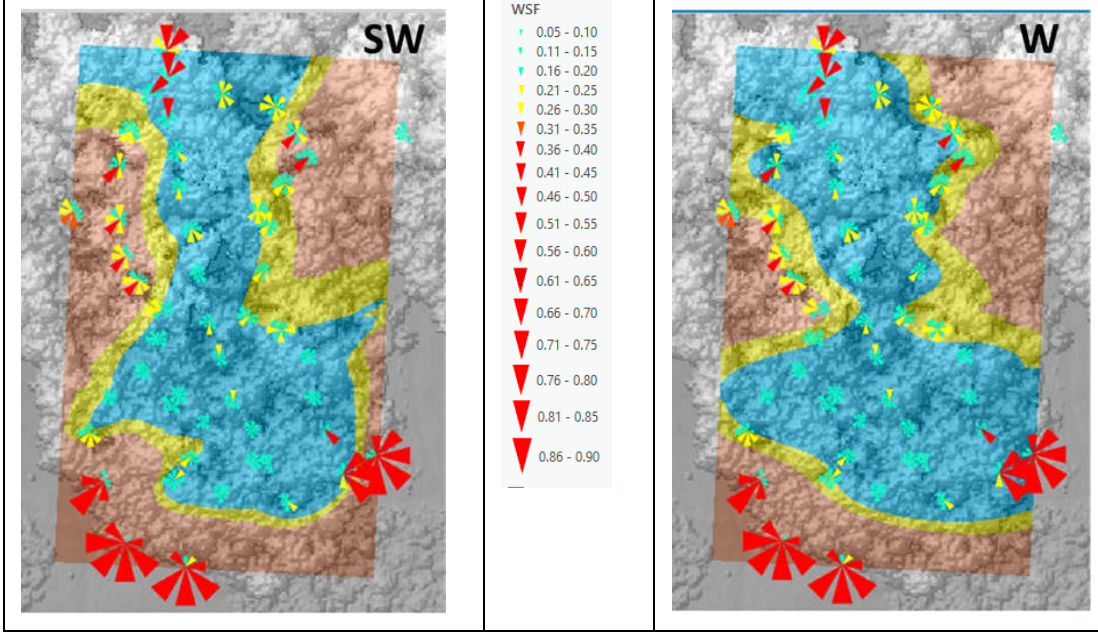
Below is a profile of forest, with the same NDVI color scale as Map 1, taken along the west edge of Ellwood Main (red rectangle). The small dip at the left is the road from the mesa going down to Deveraux Creek. The large masses of brown dead trees stand out, with a particularly dense mass of dead trees at the center-right. The oblique view gives some sense of the depth of the dead zone. All of the dead standing material will eventually fall to the ground, further opening up the canopy to wind.

Profile view west side Ellwood Main 	Oblique view west side Ellwood Main
	

Maps of wind exposure

The map below shows “wind roses” of the exposure from eight cardinal directions, with size of the arrow being proportional to the fraction of open sky in that direction. The arrows are color coded where blue is well-sheltered (<0.20), yellow is marginal (0.20-0.30) and red is high exposure (>0.30). The same colors are used for the interpolated surfaces of SW wind (left) and W wind (right).

The increased wind penetration into the western edge, caused by the tree deaths, is apparent in the red and yellow intrusions. Sealing up this edge will greatly increase habitat suitability within Ellwood Main.



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