

## ***Eucrypta chrysanthemifolia***

*Eucrypta chrysanthemifolia* is a delicate native plant most commonly found among other endemic species making up the thick chaparral that dominates what is known as the California Floristic Province and the Baja peninsula of Mexico (11). It is one of those plants that while recognized in botanical literature dating as far back to the early plant explorers of the late 18<sup>th</sup> century, has largely been ignored.

### **Taxonomy:**

*Eucrypta chrysanthemifolia* was first classified as a member of the Hydrophyllaceae or Waterleaf family of plants under the genus and species name *Ellisia chrysanthemifolia* (4). In 1789 Jussieu retired the Hydrophyllacea family designator and reassigned three of the five genera, the Hydrophyllum, Phacelia, and Ellisia, from the family Hydrophyllaceae to the family Boraginaceae (4). In the early 1800's more new species were being formerly defined by practices of the day and botanists engaged in great debates about where plants should be classified to better reflect the order found in nature. New orders were defined and families were reassigned but not all accepted the new classifications. It wasn't until 1875 that the well-respected botanist Asa Gray made what was accepted as a standing argument for a clear natural order under which the family Hydrophyllaceae could be reconstituted (4). The retirement and then reinstatement of the family and movement of the genera within it creates the initial challenge for the researcher trying to follow familial lineage of this species through the historical accounts. Normally one could relegate searches to genus and species, however with *chrysanthemifolia* this can prove equally difficult. With advances in scientific knowledge researchers began to investigate how chromosome numbers could be used to solve issues of phylogenetic relationships. Lincoln Constance, Professor of the Integrative Biology Department of Berkeley and last living relative of Willis Linn Jepson of the famous Jepson Herbarium (1), said of the family Hydrophyllaceae, "To some extent the family appears to be a collection of morphological and geographical odds-and-ends, held together by the floral and capsular characters..."(4). He and another researcher, Marion Cave, began investigating how chromosome numbers could be used to better classify plants into natural orders. In 1940, Constance and Cave identified a unique polyploidy characteristic of the species and the plant was finally reclassified from *Ellisia chrysanthemifolia* to its present *Eucrypta chrysanthemifolia* (4). Understanding the movement of the species within family and genus classifications and the subsequent synonyms created from such is important because in both historical and more present day accounts the nomenclature can vary. Within the varying accounts is found relevant data that helps the assessment of the species for potential commercialization.

Beth Lande

### Additional Names and subspecies:

In addition to *Ellisia chrysanthemifolia* as a synonym of *Eucrypta chrysanthemifolia* there is the additional synonym of *Eucrypta foliosa* (8). Two varieties or subspecies exist and their common names include "hideseed" or "spotted hideseed" which refers to seeds hidden in the plants small green fruit and spots found in the leaves of a subspecies variety *bipinnatifida* (figure 1), which distinguishes its self with a more rounded and deeply lobed leaf than that of the *chrysanthemifolia* (figure 2) varietal subspecies (8). The latin translation of *Eucrypta* is "well-hidden" (6).



Figure 1: *Eucrypta chrysanthemifolia* var. *bipinnatifida* with more rounded leaves and shows spots. Steve Matson © 2010



Figure 2: *Eucrypta chrysanthemifolia* var. *chrysanthemifolia* which shows more pointed leaves at the tips. Jeff Keller © 2013

### Taxonomic Description and Morphological Characteristics:

*E. chrysanthemifolia* is an **annual** plant, that is said by some to have a lemony scent(7) but others claim the scent is less than attractive (10). The **stem** glandular, and sticky stands erect or it can be openly spreading and measures less than 9 dm in circumference (7). The root system consists of a tap root equal in length to the shoot with numerous secondary lateral roots. The lower **leaves** are opposite, 2 to 10 cm long and 1 to 5 cm wide and the petioles are less than 1/2 cm long and clasp around the stem (7). The **leaf blades** (figure 1 and 2) are oblong to widely ovate, pinnate (more so on *bipinnatifida*) with 7 to 12 lobes and the margins are obtusely toothed (7). The upper leaves alternate and are smaller and narrower (7). The **inflorescence** cymes (figure 3) have 4 to 15 flowers on thread like pedicels that curve downward when loaded with fruit (7). The **flowers** (figure 4) are perfect, both female and male structures, are radial and the calyx is 2 to 4 mm (7). Bloom time is in early spring and a secondary bloom occurs in late spring (7). The **petals** are oblong to spoon-shaped, half-fused and arranged in a bell-shape flower (7). The flower petals are glandular and ciliate and the corolla measures from 2 to 6 mm usually slightly larger than the calyx (7). The petals have a V-shape transverse fold and the lobes are hairy on back (7). The **ovary** has two chambers, one on each side of the placenta(4)(7). There is one **style** less than 3 mm long bearing two **stigmas** and there are five **stamen** also 3 mm long (figure 4). The **fruit** are

Beth Lande

capsulate measuring 2 to 4 mm wide and spread the calyx with their ovoid spherical shape and have a bristly exterior (7). Each fruit has 6 to 8 **seeds** which are dark brown (7). The seeds formed on the inner face of the placenta are round and more smooth (figure 5-3) and those formed on the outer face of the placenta have been found to be wrinkled and unevenly shaped (figure 5-4) (2). The seed surface is porous (2).



Figure 3: The cyme florescence bears 4 to 15 flowers. Image: Santa Monica Mountains Nat'l Recreation Area 2004



Figure 4: Perfect flower glandular petals, 1 style, 2 stigmas, 5 stamen. Image: Santa Monica Mountains Nat'l Rec. Area 2004

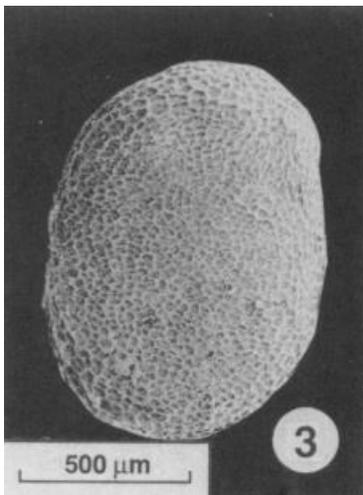


Figure 5-3: Chuang and Constance 1992

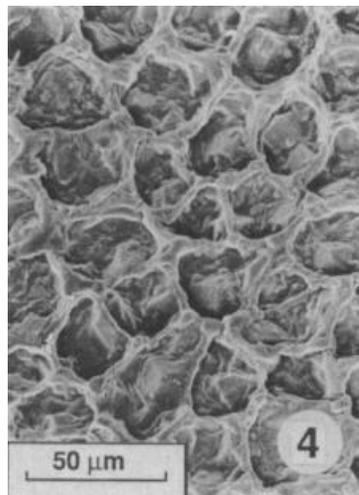


Figure 5-4: Chuang and Constance 1992

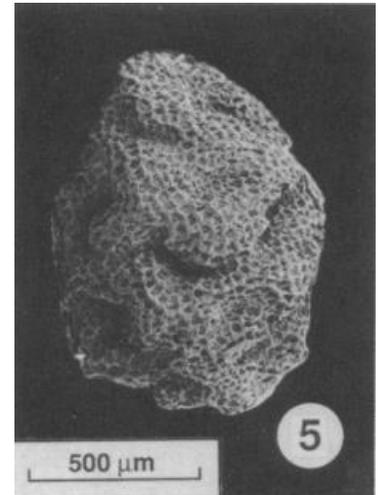


Figure 5-5: Chuang and Constance 1992

*Eucrypta chrysanthemifolia* seeds taken with a scanning electron microscope (SEM). (Jepson 1674, Booth 1064, JEPS). Figure 5-3 shows a whole seed from the inner face of the placenta with minutely irregularly reticulate seed coat. Figure 5-4 shows an enlarged portion of the seed coat porosity. Figure 5-5 shows the irregular shape of the whole seed taken from the outer face of the placenta.

Beth Lande

**Cytological Findings:**

As previously mentioned, Constance was a leading expert on the Hydrophyllaceae family and his worked helped to define the genus and species within the family by deciphering chromosome numbers (4). He found that the family was heterogeneous and there was no one typical chromosome number for the haploid karyotypes; some genera had aneuploidy, having particular genes or chromosomal regions present in extra or fewer copies than in the normal type (4). *Eucrypta* was found to have polyploidy in each of its two annual species; chromosome numbers in species *chrysanthemifolia* can be 10 or 20 (4) (5). From these findings Constance states, "Thus evolution would appear to have occurred both without change in chromosome number, and accompanied by aneuploidy or/and polyploidy" and further states that any phenotypic variations related to chromosome numbers were yet to be discovered at the time of his publication (4). The author can find no further documentation on the matter of this relationship. No information could be found regarding any self- incompatibility (SI) genetic mechanisms and there appear to be no spatial or temporal segregation of floral reproductive structures that could serve to prevent self-fertilization which is not surprising since the species has not been largely commercialized.

**Geographic and climatic conditions in native habitat:**

*E. chrysanthemifolia* is one of the many endemic to the canyons, disturbed areas, slopes and chaparral that largely covers the areas referred to as the California Floristic Province (CFP) (9). This area defined by Conservation International covers approximately 293,804 km<sup>2</sup> centered around the latitudinal coordinates of 27.74°N and 113.6°W (3). The CFP is most famous for being the home of the giant sequoia and its relatives in the California Redwood Forest (3). In 1996, the CFP joined the ranks of 33 other regions in the world that are biodiversity hotspots, that is they contain species and plant life that cannot be found anywhere else in the world (3). *E. chrysanthemifolia* is one of those plants. *E. chrysanthemifolia* is considered rare with only a few hundred documented sightings; its tendency for invasiveness has not been established (8).

The CFP area includes 70% of California and extends into southwestern Oregon, a small part of western Nevada and northern Baja California (3). The north border of the CFP consists of the Rocky Mountains and ends in Baja California (3). *E. chrysanthemifolia* is known to extend further into the Baja peninsula of Mexico (8). The mountain ranges found all along the coast of these areas divides the weather patterns (3). To the north there is a more Mediterranean climate with winter rains and summer drought (3) and along the narrow center valley between the mountains the weather is more humid (3). To the east of the mountain ranges, the Sonoran Desert dominates the landscape. In the south, the weather becomes drier and gives way to the Vizcaino Desert (3).

Beth Lande

### Associated Flora:

Other species found in this region with *E. chrysanthemifolia* include *Ferocactus*, *Calliandra eriophylla*, *Lycium cf. exsertum*, *Gallium stellatum*, *Cylindropuntia acanthocarpa*, *Ephedra*, *Encelia farinosa*, *Eriogonum fasciculatum*, *Krameria grayi*, *Larrea tridentata*, *Justicia californica*, *Lycium cf. berlandieri*, *Ambrosia deltoidea*, *Parkinsonia microphylla*, *Viguiera parishii* (8)

### Climatic or Geographic Influence on Subspecies:

A review of the distribution of the subspecies of *E. chrysanthemifolia* indicates there may be some affinity for subspecies to the more coastal versus inland regions found in its native habitat (Figure 6). The distribution map which shows the documented sightings indicates that the subspecies variety *chrysanthemifolia* (yellow) tends to inhabit the more coastal regions, where the subspecies variety *bipinnatifida* (blue) tends to inhabit the more inland areas of the region. It cannot be said definitively that this is the case however, because some of the documented sightings do not indicate the variety (red). Furthermore, it is not completely understood how urbanization and large scale farming may impact the distribution.

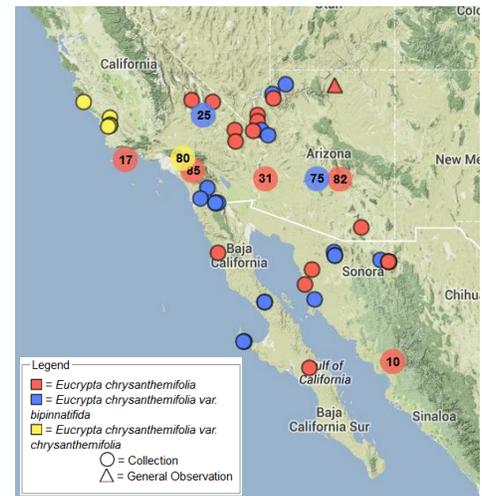


Figure 6: Distribution of *E. chrysanthemifolia* by subspecies variety. Image: SEIN 2014

More telling may be the distribution found across the specific bioregions of the area. The subspecies variety *chrysanthemifolia* is most largely dispersed in the foggier, cooler climates of the San Francisco Bay area and the outer South coast mountain ranges (light and dark turquoise). A few sightings are document in the more fertile San Joaquin Valley (yellow) (Figure 7). The subspecies variety of *bipinnatifida* is more largely dispersed on the east side of the mountain ranges and in the drier desert climates (Figure 8). Because moisture and temperature varies in these regions, it isn't clear which or if both are the reason for the given dispersal. All sightings cross from 0 m above sea level to 2300 m (7).

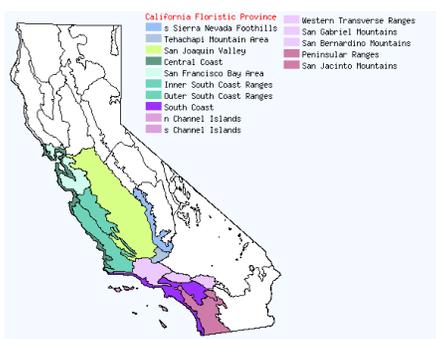


Figure 7: Distribution of variety *chrysanthemifolia* across coastal bioregions. Jepson Flora Project 2014



Figure 8: Distribution of variety *bipinnatifida* across coastal bioregions. Jepson Flora Project 2014



Beth Lande

**Potential Commercialization:**

*E. chrysanthemifolia* has not been found to be widely available in the market place. Two seed companies have seed for sale on the internet as a way for residence of the South West to restore native habitats.

It has attractive, light, foliage and the spots on the spotted hideseed make it unique. A market niche for this variety in a northern climate may be as a potted house plant but further testing of it in a container would be necessary to determine its habit under normal house lighting and temperatures. Consumers for house plants may be interested because not only is the foliage attractive and somewhat unusual there would be a boost of flowering.

Perhaps another market would be as an addition to cut flower bouquets for weddings or other special events. It would provide a little heavier greenery than baby's breath, and more floral appeal. It might be nice in Christmas arrangements and would perhaps carry on as potted plant after the holiday. There is another species in the *Eucrypta* genus that is purple in color but it has been classified differently phenotypically (4) so a separate review, grow test and assessment would need to be performed. Depending on its habit it might be nice for Easter or Mother Day arrangements and also be a gift that could keep giving.

Most likely, the Northern Midwest climate would be too cold for outdoor growth. Perhaps because it is known to live on hilly outcrops and rock formations it could tolerate some shade in a higher zone in a rock garden application. Certainly, it is drought tolerant and also survives in a humid cooler environment in higher zones. This might make it very marketable in the Southern states as an alternative shade plant that has some floral appeal.

People like the rare and unusual so *E. chrysanthemifolia* may have some market appeal and for the Southwest market, it can be sold as an ideal plant for the area that is native and will help to restore the dwindling ecosystem. Seed sales may be the way to go, although there are already some in the market place doing this. Also its small flowers could be attractive to small native pollinators like bee flies and could be promoted as a plant to help the dwindling pollinators in the landscape.

**Breeding improvements:**

Perhaps this plant could be bred for more flower power, however, part of its quality lies in the small flowering habit and spotted leaves when a sprinkle of show is wanted. Breeding for this trait could make it more ordinary like other crops already on the market. It isn't known if this plant has any SI that would need to be overcome and its sparse populations suggest that it can self-pollinate. Growing several plants for testing self-pollination, the necessity for insect vectors for pollination, and inbreeding depression issues definitely need to be performed before attempting to grow for production.

Beth Lande

**Works Cited:**

1. Brent D. Mishler, Bruce G. Baldwin, Roderic B. Park. 2001. Lincoln Constance
2. Chuang TI, Constance L. 1992. Seeds and systematics in hydrophyllaceae: tribe hydrophyllae. *Am. J. Bot.* 79(3):257
3. Conservation International. 2014. Overview - California Floristic Province. [http://www.conservation.org/where/priority\\_areas/hotspots/north\\_central\\_america/California-Floristic-Province/Pages/default.aspx](http://www.conservation.org/where/priority_areas/hotspots/north_central_america/California-Floristic-Province/Pages/default.aspx)
4. Constance L. 1963. Chromosome number and classification in hydrophyllaceae. *Brittonia*. 15(4):273–85
5. Ferguson DM. 1998. Phylogenetic analysis and relationships in hydrophyllaceae based on ndhf sequence data. *Syst. Bot.* 23(3):253
6. Global Biodiversity Information Facility. 2013. *Eucrypta* Nutt. - Checklist View. *Eucrypta* Nutt.: Genus in Backbone Taxonomy. <http://www.gbif.org/species/2928375>
7. J.C. Hickman, editor Jepson Manual. SEINet - *Eucrypta chrysanthemifolia*. <http://swbiodiversity.org/seinet/taxa/index.php?taxon=2114>
8. Jepson Flora Project of University of California Berkely. 2014. Jepson Interchange Taxon Report. <http://ucjeps.berkeley.edu/cgi-bin/LN2C.pl?genus=Eucrypta&image=yes>
9. Jepson Flora Project of University of California Berkely. 2014. Map of bioregions. [http://ucjeps.berkeley.edu/cgi-bin/draw\\_jmap.pl?f9c027fc03](http://ucjeps.berkeley.edu/cgi-bin/draw_jmap.pl?f9c027fc03)
10. Mary Elizabeth Parsons. 1897. The Project Gutenberg eBook of The Wild Flowers of California. San Francisco: Doxey Press
11. Vanderplank SE. 2011. The flora of greater San Quintín, Baja California, Mexico (2005–2010). *Aliso J. Syst. Evol. Bot.* 29(2):65–103