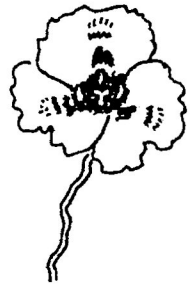

MARIPOSA

the newsletter of the ***CALOCHORTUS SOCIETY***
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C. venustus "2-spot form"

Species of the Issue – *Calochortus tiburonensis*

Background -- As others have noted, it is remarkable that *Calochortus tiburonensis* was not discovered until June 1971, by Robert C. West of Corte Madera, CA, a native plant "buff" who had joined a group of fellow-enthusiasts volunteering to survey the completely undeveloped north side of Ring Mountain (aka "Hill 602"), on the Tiburon Peninsula in Marin county, California, prior to a proposed urban development. What makes the discovery extraordinary is first, the plant's being previously unnoticed in such a densely populated location – Marin county is small in area (529 square miles) but is home to more than a quarter of a million people. It is immediately north of the Golden Gate, much of the county serving as a series of "bedroom communities" for San Francisco and other cities in the Bay Area. Further, Marin county in general, and the Tiburon Peninsula in particular, had been the subject of thorough botanical exploration for many years, yielding a number of classic publications, including John Thomas Howell's ***Marin Flora: Manual of the Flowering Plants and Ferns of Marin County, CA*** (1949, with the author's added ***Supplement*** published in 1969); and Javier Peñalosa's "A Flora of the Tiburon Peninsula, Marin County, California" (reprinted from the ***Wasmann Journal of Biology***, Vol. 21, No. 1, 1963). Interestingly, Figure 4 in Peñalosa's work is a photograph showing a significant portion of the *C. tiburonensis* site – yet no one had apparently noticed this plant or its uniqueness! Reviewing both Howell's and Peñalosa's work and other resources, Dr. West found he could not identify the plant, but he had taken a few photographs of it and began to show them to knowledgeable people at the University of California-Berkeley.

The plant was formally collected and distributed to several herbaria on June 19, 1972; and it was officially announced as a new species in 1973 by Albert Hill of the UC-Berkeley Botanical Garden ("A Distinctive New Species of *Calochortus (LILIACEAE)* from Marin County, California," in ***Madroño***, Vol. 22, pp. 100-04). (Two of the line drawings done for Dr. Hill's article by Charlotte Mentges are shown on page 3.) In 1979, the same journal published a note by Mitchel P. McClaran of UC-Berkeley (Vol. 26, p. 191), reporting that the chromosome count for *C. tiburonensis* had been determined to be 2N=20 (i.e., 10 pairs of chromosomes). Known only from the single location on the north side of the mountain, at an altitude of about 350 feet, this species ranges over an area less than half a mile across. Given its very limited occurrence, it was promptly listed as an endangered species in California by the State Fish and Game Commission, on October 6, 1978. In his announcement article, Dr. Hill commented: "Had this species not been noticed soon, it might well have become extinct without ever having been recorded." We have only to remember the fate of the apparently extirpated *C. monanthus*, known today exclusively from a few herbarium specimens collected in 1876 by Edward Lee Greene, to agree with Dr. Hill's concern (see ***Mariposa***, Vol. XIII, No. 1, July 2001).

A challenge for botanists – *C. tiburonensis* is exceptional in at least one other respect: it is something of a "misfit" in the world of *Calochortus.* Dr. Hill wrote: "in detail it shows a combination of characteristics unique in the genus. It is in fact so distinctive that its existence challenges the currently accepted infra-generic ["within-the-genus"–*Ed.*] classification." In his unpublished writings, Vic Girard commented:

> ...the plant is perhaps the most fascinating species in the genus, possessing characteristics which defy classification within the genus and make a virtual mockery of the traditional sections CALOCHORTUS, CYCLOBOTHRA, and MARIPOSA, as they have been painstakingly delineated since 1814, by combining those very features which were used as criteria for establishing the three sections.

We need a little history here. The division of the genus *Calochortus* into the three sections Vic named did not happen "all at once." The earliest authors – for example, W. J. Hooker (***Flora Boreali-Americana***, 1839) and Alphonso Wood (in the ***Proceedings of the Academy of Natural Sciences of Philadelphia***, 1868) – did not subdivide the genus into sections. I believe the first author to do so was J. G. Baker (in the ***Journal of the Linnean Society***, 1874), but he proposed four subgenera: MACRODENUS, PLATYCARPUS, CYCLOBOTHRA, and MARIPOSA; unfortunately this work is entirely in Latin, and I cannot follow the text well enough to be certain of the grounds he offered for his division. This was succeeded by Watson's treatment in 1879 (***Proceedings of the American Academy***, Vol. 14, pp. 262-68), which divided the genus into three sections – EUCALOCHORTUS, MARIPOSA, and CYCLOBOTHRA (this last essentially the Mexican species, plus a few California plants). Next came L. H. Bailey and Carl Purdy (***Cyclop. Hort.***, 1900), who offered a complex scheme dividing the genus into two sections – EUCALOCHORTUS (subdivided into "Globe Tulips", "Star Tulips", "Giant Star Tulips," and "Meadow Tulips") and MARIPOSA TULIPS (broken into three subgroups by capsule shape, then still further within each of those three groups by color and geographic location). Publishing separately in 1901, Purdy both simplified and complicated this last design, combining the four subgroups within Section EUCALOCHORTUS into just two ("Globe Tulips" and "Star Tulips"), and rearranging Section MARIPOSA into nine equivalent-level subgroups defined by various characteristics including color and geographic location. These treatments by first Bailey and Purdy, and then by Purdy alone, basically followed Watson's arrangement for the species, with some up-dating. In 1923 Abrams, perhaps tired of all these efforts to "organize" the genus (or perhaps fed up with the complexity of the results?) simply provided a "key" to the 41 *Calochortus* species he recognized as occurring in the westernmost United States, omitting the Mexican species and avoiding any discussion of sections or subgroups (***Illustrated Flora of the Pacific States***, Vol. I, pp. 431-46).

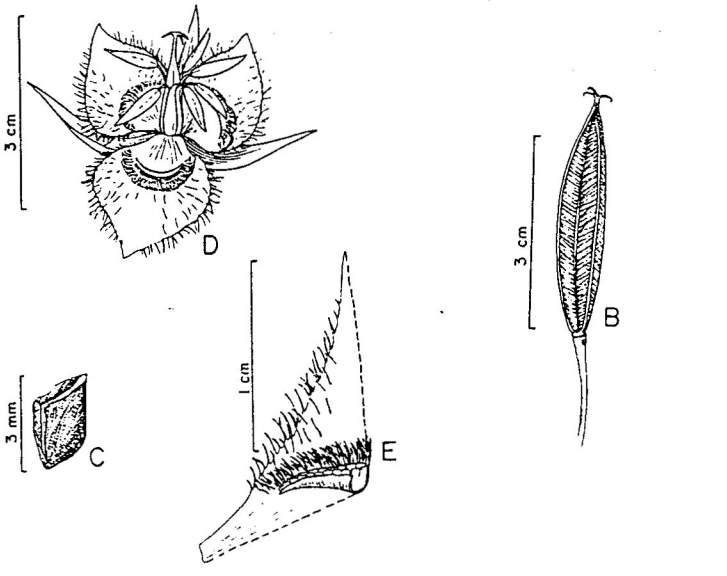
This brings us to Marion Ownbey, whose classic work, "A Monograph of the Genus *Calochortus,*" was published in its entirety in the ***Annals of the Missouri Botanical Garden*** (Vol. 27, No. 4, November 1940, 190 pages). Ownbey proposed the following "neat-and-complete" scheme:

Section I. EUCALOCHORTUS	Subsection	1. PULCHELLI	the "globe lilies"
[now called Section CALOCHORTUS]	Subsection	2. ELEGANTI	the "catsears"
[basic chromosome number = 10,	Subsection	3. NUDI	"southern star tulips"
with 2 known tetraploids]	Subsection	4. NITIDI	"northern star tulips"
Section II. MARIPOSA	Subsection	5. VENUSTI	"classic" mariposas,
[basic chromosome number varies;	Subsection	6. MACROCARPI	subdivided by various
may be 6 (?), 7, 8, or 9, with	Subsection	7. NUTTALLIANI	characteristics, especially
several known tetraploids]	Subsection	8. GUNNISONIANI	by chromosome counts

Section III. CYCLOBOTHRA ..... [basic chromosome number = 9]	Subsection 9. WEEDIANI	all occur in California
	Subsection 10. GHIESBREGHTIANI Subsection 11. BARBATI Subsection 12. PURPUREA	..... all plants in the last 3 subsections occur only in Mexico

(The reason for the "6" followed by a question mark under Section MARIPOSA is that in the report on various chromosome analyses published by Marion Cave (***Chromosomes of the California LILIACEAE***, University of California Press, 1970) some of the samples of *C. superbus* tested had yielded deviant results of N=6 or N=6+a-fragment or even N=10, while others produced the expected N=7 for plants in subsection VENUSTI. There were also anomalies in one sample of *C. luteus* from Sonoma county and one sample of *C. venustus* from Kern county.)

Ownbey's arrangement held great appeal, seeming to be simple and straightforward, offering clear-cut lines between not only the Sections but also the subsections. The only dissent of note to his proposal came from Robert F. Hoover, a botanist working at the California Polytechnic Institute in San Luis Obispo ("*Mariposa,* a Neglected Genus," ***Leaflets of Western Botany***, Vol. IV, No. 1, February 1944, pp. 1-4). Hoover believed that Ownbey's Section MARIPOSA differed from the rest of the *Calochortus* so distinctly that it should be detached from the others and elevated as a separate genus; indeed, he suggested that Section CYCLOBOTHRA might also be so elevated, although he considered himself too unfamiliar with that group of plants to "venture a definite statement as to its generic status." Whatever the merits of Hoover's proposal to subdivide the genus into two or three genera, the botanical "powers-that-be" did not embrace his ideas, while Ownbey's scheme gained wide acceptance and is still adhered to today.



Flower, seed, & pod of *C. tiburonensis*, from Hill... (C. Mentges)

But *C. tiburonensis* poses a problem. Unlike any other species of *Calochortus,* it displays some of the characteristics of Section CYCLOBOTHRA (for example, the general appearance of the plant and the flower, the capsule not being "winged", a relatively late bloomtime) and some of Section CALOCHORTUS (a similar gland, the irregularly shaped seed, and above all, the chromosome count). This so baffled Dr. Hill that in his announcement article, he believed he had to consider whether *C. tiburonensis* might be a hybrid, since it occupied territory which seemed to fall geographically between most of the species in those two Sections. The vast majority of species in Section CALOCHORTUS occur north of Marin county, and all of those in Section CYCLOBOTHRA are found only to the south of it. However, Hill considered it unlikely that the plant was a hybrid, given the general uniformity of the plants, the lack of reduced seed set, and the high rate of pollen fertility (96, 98, and 99 percent in the three cases examined). All of these characteristics would be extremely improbable in a hybrid population. So Hill (and subsequent botanists) have accepted *C. tiburonensis* as a valid taxon in its own right. A more interesting and perhaps more reasonable explanation for the mixture of characteristics was suggested by Vic Girard and his partner Stan Farwig:

Calochortus tiburonensis –

– Photographs by Jim Robinett

> It is our belief that *Calochortus tiburonensis* is most assuredly not a hybrid form but rather a "living fossil", representative of the genus prior to its speciesization. If that is true, then *C. tiburonensis* has been on the Tiburon Peninsula for many millions of years. Since the peninsula lies east of the San Andreas fault, it would appear that the plant is of this or a more northerly origin and not (as it would be if it lay west of the fault) of a southern origin. Land west of the fault has been moving northward at about one inch per year for eons [emphasis added–*Ed.*].

However it arose, *Calochortus tiburonensis* seriously challenged the best botanical thinking at the time it was discovered. Most botanists today group it with the CYCLOBOTHRA, based on its general appearance, but few would assert that as an "absolute."

Description – This is by any measure a plant with an unusual appearance. Its stems and leaves when fresh range in color from various shades of brown to a dark green strongly suffused with dark red – a fact which probably contributed to the delay in its discovery, because in the vegetative stage (pre-blooming), the plants tend to blend in with the soil and rock colors in their location. Flower petals are most often a yellowish-tan, sometimes "shot through" with shades of yellow-green, and sometimes flecked with reddish-brown. Each petal has a distinct point at its apex and is prominently marked with a single thin red-brown arc which goes nearly all the way across the petal, from near to well above its center. Immediately under this arc lies the crescent-shaped and deeply depressed gland, the (naked) surface of which may be hidden by rows of golden-to-red-brown processes (hair-like structures) above and below it. The entire petal is heavily haired, especially above the center; the hairs are mostly cream-colored but tend to take on the same reddish-brown hue of the petal markings toward the petal's central apex. The sepals are yellowish-tan to yellowish-green and are heavily flecked and marked with the same red-brown of the petal markings. They are slightly longer than the petals and are sharply rolled inward from side to side. The sexual parts of the flower are rose-tan in color. The stigma is strikingly trifid and recurved at its apex, with three long narrow lobes arching out and down. Finally, the deep depression of the glands gives the flower a somewhat "boxy" appearance, with the petals extending outward almost at right angles from the flower base, then abruptly upward nearly vertically above the gland.

Habitat, access, and risk – *C. tiburonensis* grows on and around a rocky serpentine outcrop on a north-facing slope a little more than halfway up the 602-foot high mountain. The location overlooks an arm of San Francisco Bay and has a very temperate climate, with frequent fogs in summer and little frost in winter. There are very few shrubs or trees near its site, only bunchgrasses and other low serpentine-tolerant annuals and perennials. Most of the plants occur amid a somewhat barren area of tumbled rocks, but they also appear to be thriving in the surrounding bunchgrass zones. These grasses have usually dried by bloomtime (typically mid-June) and are of similar height to *C. tiburonensis* (1 to 2 feet). With flowers of yellow, yellowish-green, tan, and red-brown, the plants tend to blend in with such surroundings and are difficult to spot, while those in the more barren, rocky areas are easier to find at bloomtime.

As noted earlier, after its discovery and identification as a new species during the years 1971 through 1973, *C. tiburonensis* was listed promptly as an endangered species by the State of California, with Federal listing soon after. The private land on which it occurs was purchased by the Nature Conservancy in the early 1980's and is maintained by the Conservancy as a Preserve, with no vehicular access inside its borders (except a fire road to be used only in emergencies). However, there are a number of well-laid-out footpaths, one of which traverses the northeastern and eastern edges of the population, and the hike from near sea-level up to *C. tiburonensis* is less than a mile and relatively easy. It generally blooms in early-to-mid June. (The Preserve is also home to a very nice population of *C. umbellatus*, the delicate little

"Oakland Star Tulip" which has all but disappeared from the Oakland area as a result of development, but still can be found on Ring Mountain and on nearby Mount Tamalpais. It grows in areas of short grasses, lower on the mountain than the *C. tiburonensis* but right along the path to that location, and usually blooms in mid-March.)

Its location entirely within the approximately 365-acre Ring Mountain Preserve provides *C. tiburonensis* with significant protection. The Sixth Edition of the California Native Plant Society's ***Inventory of Rare and Endangered Plants of California*** (2001) assigns it a "R-E-D" code of "3-3-3" (**R**arity = distributed in California in one to several highly restricted occurrences; **E**ndangerment = seriously endangered in California; **D**istribution = endemic to California). CNPS considers it "threatened by recreational activities and non-native plants." However, a study conducted of the entire Preserve by Fiedler and Leidy ("Plant Communities of Ring Mountain Preserve, Marin County, California," ***Madroño*** Vol. 34, No. 3, 1987, pp. 173-92) shows that "exotic species" (non-natives) account for only 12.5 percent of the plants in the "serpentine bunchgrassland" zone within which it grows. Its tolerance for serpentine is fortunate, as the vast majority of plants will not endure a growing medium of serpentine's toxicity. As for "recreational activities," it is my belief that, so long as Nature Conservancy exists as an organization, *C. tiburonensis* will continue to be protected – except from deer and rabbits, perhaps – unless there is a climate change of sufficient gravity to kill it – or unless it is decimated by illegal collections. CNPS monitors the site regularly, doing a "walk-through and plant count" every two or three years. My understanding is that so far they have found the population to be slowly but steadily increasing, both in numbers and in territory. As a consequence, its state listing status was recently down-graded from "Endangered" to "Threatened" (***Fremontia***, Vol. 29, Nos. 3-4, July/October 2001, p. 5).

Cultivation – With its protected status, there is little public information available about the cultivation of *C. tiburonensis.* Some seeds were collected in the first few years after its discovery, before it was given both State and Federal listing, and it is grown at UC-Berkeley Botanical Garden, as well as by a few hobbyists. In 1989 Jim Robinett was given permission by an officer of the Nature Conservancy to make a small (less than 100) seed collection (the seedset was high that year); and given our nearby location in Sonoma county at that time, he did fairly well with it, using his regular "well-draining, gritty mix" (1/2 commercial potting soil, 1/8 sand, 1/8 vermiculite, 1/8 perlite, 1/8 peat moss) with a little bone meal added. There were some losses around the edges of the wooden box they were in during the mid-1990's, at the time of an unusual "hard freeze" with five days never above freezing and overnight lows of 17° F; but when we closed the Robinett Bulb Farm in 1999, Jim had about 10 blooming-sized bulbs, which were passed along to friends, since we did not believe they would thrive in the colder, wetter climate of Brookings, OR, nearly as well as in that of Sonoma county.

Some Preliminary Results of DNA Analysis in the Genus *Calochortus*

I recently found on the Internet the abstract - not the full text - of a paper reporting the results of DNA analysis of "nearly all known species" of *Calochortus*, delivered to the 1998 Meeting of the Botanical Society of America by Tom Patterson and two other botanists. The data reportedly suggest that while the Mexican members of Section CYCLOBOTHRA "emerged from" Section MARIPOSA, the U.S. members (i.e., the WEEDIANI) "are basal to" Section CALOCHORTUS. The WEEDIANI are *C. obispoensis, C. plummerae, C. weedii* and its vars., and presumably *C. tiburonensis.* This at least helps to explain why *C. tiburonensis* seems to show mixed characteristics of both Section CYCLOBOTHRA and Section CALOCHORTUS. I am working on getting the full paper, as well as continuing my efforts to obtain a copy of Tom Patterson's complete thesis. Stay tuned !!