MANZANITA

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Pacific Coast Irises, a Lineage With High Diversity in California *by Carol Wilson*

Iris thompsonii

Two color variants of *Iris innominata*

photos by Bart O'Brien

Introduction to Irises

There are about 300 species of the genus *Iris* in the Northern Hemisphere, and many of these have high cultural importance. The name is often attributed to the mythological Greek goddess, Iris, who delivered messages from heaven to Earth traveling along the rainbow, and also accompanied female souls to heaven. The flowers are often described as coming in an array of colors representing the rainbow. I have witnessed white irises planted on grave sites in Turkey, Syria, Mexico, and Spain where they are thought to represent purity. I have also seen purple/violet irises planted on hillsides in China where earthquakes and slides have entombed villagers, and on mountains where corpses are left in the Tibetan tradition of "sky burial." When asked, villagers in China reply that family members gather these irises from nearby mountain areas and plant them as protection from evil. At New Years I have received images of diminutive blue-gray native irises from colleagues in Iran and Turkey as a sign of hope and faith. In the USA, the more familiar symbol of irises is the "fleur-de-lis," an important symbol across Europe, dating from Medieval times, and is especially significant in the flags of France and the Canadian Province of Quebec.

Irises are perennials that provide food resources such as nectar, pollen, fleshy seed appendages, and underground storage organs—rhizomes, bulbs, tubers, and tuberous roots—rich in carbohydrates and oils. They have economic importance in horticulture and the cosmetic industries and are often used by indigenous peoples both as a medicinal and for cordage. Their flowers are generally easily recognized with floral parts in threes and colorful sepals, petals, and style branches. Unlike most other monocots that have six stamens in two whorls of three, irises have a single whorl of three stamens. Their ovaries are at the base of the flower, below a floral tube formed by fusion of the bases of sepals, petals, and the style. Their leaves are strap-like in most species.

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Iris thompsonii

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Iris bracteata photo by Emerald Canary

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Morphology of Pacific Coast Irises

The Pacific Coast is particularly rich in irises with 21 of the 35 taxa that are native to the USA occurring in the region. Eighteen of these are members of the Pacific Coast Iris (*Iris* series Californicae), which includes 12 species, five subspecies, and one variety (Table 1). The other three irises native to the Pacific Coast region are the distantly related central coast iris (*I. longipetala*), Clackamas iris (*I. tenuis*), and western blue flag (*I. missouriensis*). Other regions in the USA have relatively low diversity with only one to four different native irises present. Most of the Pacific Coast irises have slender rhizomes, narrow, almost grass-like leaves, and yellow or purple flowers. However, they also have genes for a broad range of colors. These other colors are often seen on flowers as signal patches for pollinators or at the base of leaves (commonly red) and flower organs (cream or light blue). Horticulturalists have taken advantage of these color genes to produce a collection of cultivars and hybrids, typically referred to as the "Pacificas," with diverse flower coloration and patterning. Development of new forms began in England in the late 1800s using seed collected in California from the purple Douglas iris (*I. douglasiana*) and golden iris (*I. innominata*). California horticulture is now important in the production of "Pacificas" with new forms of cultivars and hybrids resulting from experiments involving many of the taxa of Pacific Coast irises.

Currently the use of Pacific Coast irises is mostly based on their ecological and aesthetic value in the native landscape and/or horticultural practice. Indigenous Californians hold these irises in high esteem for their utility, using their strong yet flexible fibers for fishing nets, animal snares, rope, and bags, while leaves are commonly used for baskets and rhizomes for medicines. Irises have always been one of the most important fiber plants available to California tribes and continue to be gathered and stored each year. (Pulling at the edge of an iris leaf enables the removal of long thin fibers. The leaf edges are typically translucent due to the presence of fibers that lack the green pigments associated with photosynthesis.)

Identifying individual taxa of Pacific Coast irises can be daunting because they share an overall form. However, with familiarity of several key plant parts and the forms present, most can be determined using available descriptions and botanical keys.

Table 1. Taxa currently recognized in Pacific Coast irises (*Iris* series Californicae) listed from north to south. Typical flower color and core distributions, stem leaf form, and floral tube length are given, although some populations may fall outside of the distributions given.

COMMON NAME	SCIENTIFIC NAME	FLOWER COLOR	STEM LEAF	FLORAL TUBE	CENTER OF DISTRIBUTION
Toughleaf iris	*I. tenax* subsp. *tenax*	Purple	Leaf-like	< 1 cm	SW WA to SW OR
Gorman's iris	*I. tenax* var. *gormanii*	Yellow	Leaf-like	< 1 cm	Narrow endemic near Forest Grove, NW OR
Yellow-flowered iris	*I. chrysophylla*	Yellow	Leaf-like	> 3.5 cm	Lower NW OR to near border with CA
Golden iris	*I. innominata*	Yellow	Bract-like	~1.5 cm	Endemic near the Rogue River, SW OR
Thompson's iris	*I. thompsonii*	Purple	Bract-like	~1.5 cm	SW OR to extreme NW CA
Siskiyou iris	*I. bracteata*	Yellow	Bract-like	< 1 cm	SW OR to extreme NW CA
Douglas iris	*I. douglasiana*	Purple	Bract-like	~1.5 cm	SW OR coast to central CA coast
Orleans iris	*I. tenax* subsp. *klamathensis*	Yellow	Bract-like	~1.5 cm	Narrow endemic near Orleans, NW CA
Shasta iris	*I. tenuissima* subsp. *tenuissima*	Cream/yellow	Leaf-like	> 3.5 cm	N CA
Long-tubed iris	*I. macrosiphon*	Purple/yellow	Leaf-like	> 3.5 cm	N CA
Plumas iris	*I. hartwegii* subsp. *pinetorum*	Yellow	Variable	~1.5 cm	Narrow endemic near Greenville, N Sierra
Slender-tubed iris	*I. tenuissima* subsp. *purdyiformis*	Cream/yellow	Bract-like	> 3.5 cm	Narrow endemic near Belden, N Sierra
Sierra iris	*I. hartwegii* subsp. *hartwegii*	Yellow	Leaf-like	< 1 cm	Foothills of N Sierra
Purdy's iris	*I. purdyi*	Cream/rose	Bract-like	> 3.5 cm	Endemic to N CA coast
Fernald's iris	*I. fernaldii*	Yellow	Leaf-like	> 3.5 cm	Endemic N & S of San Francisco, N CA
Tuolumne iris	*I. hartwegii* subsp. *columbiana*	Yellow	Leaf-like	< 1 cm	Narrow endemic near Columbia, mid Sierra
Munz's iris	*I. munzii*	Blue purple	Leaf-like	< 1 cm	Narrow endemic, foothills of S Sierra
Southern Hartweg's iris	*I. hartwegii* subsp. *australis*	Purple	Leaf-like	< 1 cm	San Gabriel & San Bernardino Mtns,

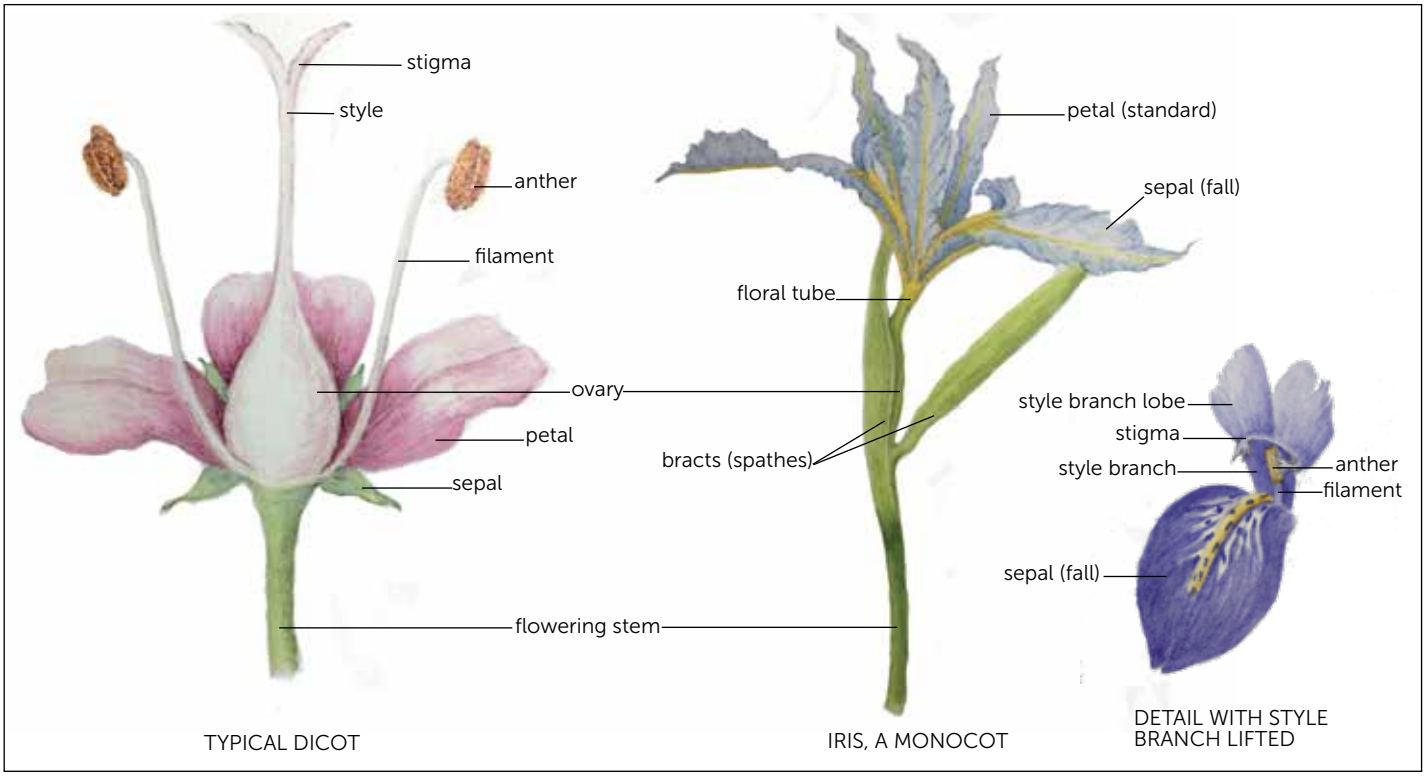

Figure 1. Flower morphology of dicots and monocots. Detail of iris flower parts normally hidden by the style branch. Illustrations by Cheryl Perko

Figure 2. Distribution of Pacific Coast Iris in Washington, Oregon and California outlined in black. Areas outlined in purple are regions of high species diversity.

Figure 1 compares the morphology of an idealized dicot with the morphology of a beardless iris. The visible parts of the iris are labeled. Irises do not have a typical style (the upper portion of the female part of a flower). They have a style arm or style branch, an expanded style that is petal-like. The ovary and floral tube are obvious in this drawing because the two lower bracts are spread apart and diverge from the stem at different levels. This arrangement can be observed in the Plumas Iris, (I. *hartwegii* subsp. *pinetorum*). Nectaries are present in the floral tube. A close-up of the area between the style branch and the falls is shown in the detail of Figure 1. Here you can see the stigma, a small outgrowth on the lower side of the style branch. This is where pollen lands and germinates. The detail also shows the filament and anther that make up a stamen. These flower parts are not readily visible in the iris flower because they lie between the base of the sepal and the lower part of the style branch.

An important character for recognizing taxa in Pacific Coast irises is the nature of leaves along the flowering stem. Sometimes the free end of the stem leaf that is not clasping the stem is very short, giving the entire leaf a bract-like form. Sometimes the stem leaf is long enough that it looks leaf-like. In the Plumas iris, the stem leaves are usually short, but are occasionally longer and almost leaf-like, making this character variable.

Longer leaf-like stem leaves are the more common condition in Pacific Coast irises (Table 1). Other characters useful in identification are the width of basal leaves, position and sizes of bracts, length of floral tubes, and width and shape of petals, sepals, and style branches. Photos accompanying this article demonstrate some of the characteristics that distinguish these

taxa. Most have narrow grass-like leaves and bracts that are open and arise opposite each other on the flower stem. Floral tubes in Pacific Coast irises vary in length from 0.5 cm to over 7 cm; however, within a taxon, there is generally little variation in floral tube length. Taxa with long floral tubes tend to have bracts that are closed tightly, possibly providing additional support for the flower. In comparison to the commonly grown, bearded horticultural irises all except one of the Pacific Coast irises are small in stature and have a short flowering season, with only one to three flowers per flowering stem. The exception is Douglas iris (*I. douglasiana*) that has wide leaves forming large clumps and tall flowering stems that commonly branch and typically have three to six robust flowers. In contrast, three species, Shasta

Bart O'Brien

Douglas iris (*Iris douglasiana*)

(*I. tenuissima* subsp. *tenuissima*), slender-tubed (*I. tenuissima* subsp. *purdyiformis*), and yellow-flowered (*I. chrysophylla*) irises, are relatively short and have very narrow flower parts giving them a distinctive and similar delicate appearance.

Biogeography of Pacific Coast Irises

The 18 Pacific Coast irises are distributed in Oregon and California with toughleaf iris (*I. tenax* subsp. *tenax*) extending north into Washington (Figure 2; Table 1). Most of these irises are found in open forests or forest edges. These sites are often rocky and dry, like pine forests of the Sierra and oak/madrone forests of the Klamath Range. Alternatively, they also occur in more moist sites, such as with Douglas fir in western Oregon and Washington, and redwood forests in northern California. The casual observer most commonly encounters these irises along road cuts where drainage is good and they are not shaded by the forest canopy.

In Washington and Oregon these irises occur from foothills of the western Cascades to the coast and also in the transverse Klamath Range in the southern portion of the state (Table 1). Two Oregon species, toughleaf (*I. tenax* subsp. *tenax*) and yellow-flowered (*I. chrysophylla*) irises, are unusual within the Pacific Coast Iris group because they occupy a wide range of habitats in valleys, foothills, and low- and mid-elevation mountains. Other Oregon species are limited to the southern portion of the state and occupy narrower ranges and habitat types. Distributions of Pacific Coast irises are more complex in California due to the presence of the Central Valley that is bounded by the Coast Range and the Sierra. California species are absent from the Central Valley (Figure 2) and are mostly limited to either the Coast Range or foothills of the Sierra (Table 1). One species, Douglas iris (*I. douglasiana*), is not associated with foothills or mountains but instead occurs on coastal headlands from southern Oregon to Santa Barbara, California. A second taxon, southern Hartweg's iris (*I. hartwegii* subsp. *australis*), is disjunct from other taxa and endemic to the transverse San Gabriel and San Bernardino Mountains in Southern California.

Carol Wilson

Two plants of Shasta iris (*I. tenuissima* subsp. *tenuissima*) east of Weaverville, Trinity County, delicate looking iris with long and narrow floral parts and long stem leaves.

Evolutionary Relationships

More than 60 years ago Lee Lenz published the most comprehensive studies of Pacific Coast irises. He produced a monograph of this group that included details on the taxonomy, morphology, and distribution of each taxon he recognized (Lenz, 1958). Lenz recognized three species complexes that included subspecies and/or varieties: "*tenax* complex" comprising toughleaf (*I. tenax* subsp. *tenax*), Gorman's (*I. tenax* var. *gormanii*), and Orleans (*I. tenax* subsp. *klamathensis*) irises; "*hartwegii*

Bart O'Brien

Hybrid of Southern Hartweg's iris (*I. hartwegii* subsp. *australis*), in the Regional Parks Botanic Garden

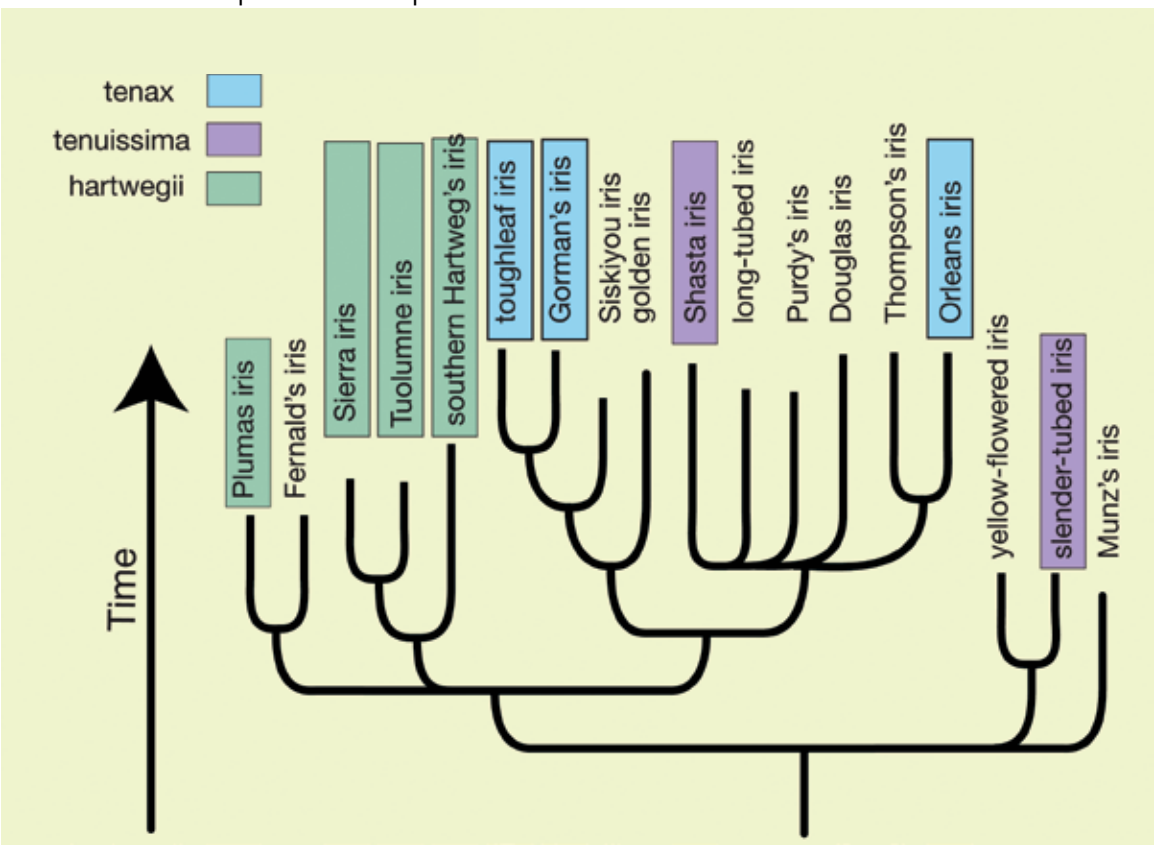

Figure 3. Phylogenetic tree of Pacific Coast irises based on molecular data. Taxa assigned to Lenz's species complexes shown by colored boxes.

complex" comprising Sierra (*I. hartwegii* subsp. *hartwegii*), Plumas (*I. hartwegii* subsp. *pinetorum*), Tuolumne (*I. hartwegii* subsp. *columbiana*), and southern Hartweg's (*I. hartwegii* subsp. *australis*) irises; and "*tenuissima* complex" comprising Shasta (*I. tenuissima* subsp. *tenuissima*) and slender-tubed (*I. tenuissima* subsp. *purdyiformis*) irises (Table 1). He also hypothesized that there were two groups of related taxa based on floral tube length: the long (> 3.5 cm) and short (< 1 cm) floral tube taxa (Table 1). (He did not specify the relatedness of taxa with intermediate length floral tubes.) Lenz (1959) also completed a study outlining populations that he hypothesized as hybrids between taxa. Each of these studies was based on analyses of morphological similarities and differences, and represented the taxonomic thought at that time, when morphological similarity indicated relatedness.

I have been researching phylogenetic (evolutionary) relationships among irises since my dissertation in the mid 1990s. As part of this research I have included taxa from Pacific Coast irises in molecular phylogenies (Wilson, 2009) and have preliminary results on their relationships (Figure 3). These studies are designed to determine changes in characters that indicate ancestor-descendant relationships, where the ancestral character was inherited from earlier ancestors and the descendant character is newly evolved. Most current phylogenetic studies, including mine, use genetic data where changes in nucleotide bases provide evidence for ancestor-descendant relationships. Tests of alternative trees and statistical support for branches can be determined for hypothesized relationships that are displayed on resulting phylogenetic trees. In Figure 3 hypothesized ancestors occur at the base of branches leading to the present day taxa that occur at branch tips. Closely related taxa share a recent ancestor, such as the Sierra and Tuolumne irises that have a common ancestor at the base of their respective branches. The next closest related iris is southern Hartweg's iris that shares an ancestor with the other two irises at the base of the branches leading to these three taxa.

My recent research indicates that some taxa in each of Lenz's species complexes are not closely related and require taxonomic revision (Figure 3), where taxa that should not be included in a complex are elevated to the rank of species. Orleans iris (*I. tenax* subsp. *klamathensis*) is not in the same lineage as the Oregon taxa in the "*tenax* complex." Three of the four taxa in the "*hartwegii* complex," Sierra (*I. hartwegii* subsp. *hartwegii*), Tuolumne (I. *hartwegii* subsp. *columbiana*), and southern Hartweg's (*I. hartwegii* subsp. *australis*) irises, are confirmed as closely related based on recent research, while one species, Plumas iris (*I. hartwegii* subsp. *pinetorum*) is more closely related to Fernald's iris (*I. fernaldii*) than other taxa in the "*hartwegii* complex." The final species complex that is not supported with molecular studies is the two subspecies in the "*tenuissima* complex." These two subspecies are quite similar morphologically with long floral tubes and reduced stem leaves. The stem leaves of slender-tubed iris (*I. tenuissima* subsp. *purdyiformis*) are smaller and bract-like while those of Shasta iris (*I. tenuissima* subsp. *tenuissima*) are short but leaf-like. Overall both are delicate plants, with narrow floral parts and small stature. Morphologically they are both similar to yellow-flowered iris (*I. chrysophylla*).

Bart O'Brien

Long-tubed iris (*Iris macrosiphon*)

The slender-tubed iris (*I. tenuissima* subsp. *purdyiformis*) is closely related to this species.

The molecular data in Figure 3 also do not support Lenz's hypotheses of relatedness based on floral tube length because taxa with floral tubes of similar length do not form exclusive lineages. Floral tube length is most likely to be important in pollinator preferences and may not accurately indicate the form inherited from an ancestor. Nectar is produced at glandular regions within the tube, and flowers may attract pollinators that can more easily access their nectar. The floral tube may also reduce predation of ovules by separating the open flower from the ovary and/or to elevate flowers above their leaves or surrounding vegetation. The results shown in Figure 3 are preliminary and I am currently undertaking a comprehensive study with about 90 populations of Pacific Coast irises and a large molecular dataset using methods that allow sequencing of many gene regions simultaneously.

There are two geographical areas where populations of Pacific irises particularly overlap. These two regions are outlined in purple on Figure 2. The region that includes portions of California and Oregon is in the Klamath Range where there is a high diversity of taxa and several taxa are found in close proximity. Especially interesting is the border between the two states where Douglas (*I. douglasiana*), Thompson's (*I. thompsonii*), and Siskiyou (*I. bracteata*) irises each occur. Lenz (1959) hypothesized that these species hybridized in this area because plants were found with stem heights, flower colors, and floral tube lengths that were intermediate between these species. The second interesting area is near Chico, California where two coastal taxa, long-tubed (*I. macrosiphon*) and Shasta (*I. tenuissima* subsp. *tenuissima*) irises, co-occur with Sierra iris (*I. hartwegii* subsp. *hartwegii*), a Sierran subspecies. This area is north of where the Central Valley of California separates these two mountain ranges. In current studies, I am sampling these two regions of species-overlap more densely than other areas to explore hypotheses of hybridization.

In addition to providing information on evolutionary relationships among currently described taxa, it is likely that the comprehensive study of Pacific Coast irises that is underway will reveal diversity that is currently unrecognized. During fieldwork that was conducted in 2018 and 2019, several plants were found that do not fit currently recognized taxa and are not likely to have resulted from gene flow (hybridization) between taxa. One of the interesting plants is from the northern portion of the Sierra (*I. hartwegii* subsp. *hartwegii*) iris range that has longer floral tubes and is less robust than plants from the rest of its range. Also of interest are yellow-flowered plants that share some similarities to Fernald's iris (*I. fernaldii*) but differ in the shape of their floral tubes, time of flowering, and leaf morphology. A third interesting plant is from southern Oregon. It shares a short floral tube and diverging bracts with toughleaf iris (*I. tenax* subsp. *tenax*), but differs in its leaf morphology and sepal shape.

We may consider the Pacific Coast region an area of suburbs, freeways, high rents, and over development but it is remarkably wild and beautiful. My current research on these irises reflects the interesting discoveries remaining hidden within nature, awaiting investigation.

Carol Wilson received her Ph.D. at the University of California, Berkeley in the Department of Integrative Biology in the mid-1990s where her dissertation research was on the evolution of the Pacific Coast Iris. She recently returned to Berkeley in a research scientist position in the University and Jepson Herbarium where she continues her research on Iris and collaborates on research on mistletoes.

"Regional Patterns of Diversity," an additional article by Carol Wilson, will appear in the July issue of the e-newsletter.

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Some Trends in Pacific Coast Iris Hybridization *by Ken Walker*

All photos accompanying this article are from the Society for Pacific Coast Native Iris (SPCNI) photo archives and are used under permission granted to the Society by photo's owners.

Lewis and Adele Lawyer

Figure 1 Del Norte County iris (*Iris thompsonii,* formerly included in *I. innominata*).

Richard C. Richards

Figure 2 'Claremont Indian'

Hybridizers have done a great deal of work in developing Pacific Coast irises into the garden plants we grow today. Several years ago I made a slide show for the Society for Pacific Coast Native Iris (SPCNI) and presented it at the 2012 American Iris Society Convention. It chronicled the development of eight colors and seven patterns in Pacific Coast Iris. For this article I'll narrow my focus to one color and one pattern, adding the development of one flower form.

Red Color

There are no fire engine red flowers in the genus *Iris*, but that does not prevent hybridizers from pushing the boundaries of what kinds of reddish blooms can be produced. Figure 1 shows a very rich purple-red form of the wild Del Norte County iris (*Iris thompsonii*, formerly *I. innominata*). Dr. Lee Lenz did early studies and hybridization of Pacific Coast irises. In 1956 he introduced 'Claremont Indian' (Figure 2). Its parents are just listed as "seedlings," but it likely traces its color to the Del Norte County iris. In the 1960s, hybridizers were still often working with this species. In 1972, Marjorie Brummitt registered 'Banbury Gem' (Figure 3) whose parents are each crosses between a Del Norte County iris and a Douglas iris (*I. douglasiana*). It is a slightly cooler purple-red than the previous two flowers.

'Claremont Indian' was used as a parent numerous times in the early 1970s and produced

Figure 3 'Banbury Gem' Lewis and Adele Lawyer

14 named offspring, many showing red or burgundy coloration. These provided a genetic basis for numerous red irises to follow. Another important red Pacific Coast Iris was 'Emigrant' (Figure 4). It was introduced by Joseph Ghio in 1981 and was described as originating from a "Hargrave seed of unknown parentage from Australia." It must be noted that Joe has been the world's most prolific hybridizer of Pacific Coast native irises for the last several decades and few stories about modern Pacific Coast irises can be told without including his cultivars. In the 21st century, he has produced a series of deep reds which trace their ancestry to both 'Claremont Indian' and 'Emigrant'.

As an example from this series, in 2002, Joe introduced 'Epicure' (Figure 5) a dull dark red. Its child, 'Now Showing' Joseph Ghio 2006, (Figure 6) is a rich black red. 'Epicure' appears more than once in the ancestry of 'Take The Red Eye', Joseph Ghio 2017, (Figure 7) a mid-red bloom with a suggestion of burgundy.

Richard C. Richards

Figure 4 'Emigrant'

Ken Walker

Figure 5 'Epicure'

Figure 7 'Take The Red Eye' Ken Walker

Figure 6 'Now Showing'

Ken Walker

Valley Banner Pattern

A particularly striking flower pattern among Pacific Coast irises is named after the iris, 'Valley Banner', Ruth Hardy 1958, (Figure 8). This iris is a wild-collected natural hybrid involving the toughleaf iris (*Iris tenax*) and the yellow-flowered iris (*Iris chrysophylla*). Its pattern is characterized by dark purple styles along with white petals and distinct purple veining on the falls. Both 'Valley Banner' and other

Richard C. Richards

Figure 8
'Valley Banner'

Jay and Terri Hudson

Figure 9
'Allen Grossman'

Ken Walker

Figure 10
'Corralitos Creek'

collected plants have injected this pattern into the gene pool for Pacific Coast Iris breeding. The plant, 'Allen Grossman', George Gessert 2006, (Figure 9) is an example of the grandchild of a "collected Valley Banner type." In 2013, Joe Ghio introduced 'Corralitos Creek' (Figure 10). It descends from Valley Banner's child, 'Foothill Banner', L. Lawyer 1990, through multiple lines of breeding. Many of those lines are via Joe Ghio's 2004 introduction, 'Bar Code'.

Round, Flat, and Frilly Form

When discussing Pacific Coast Iris flowers, the American Iris Society's "Handbook for Judges and Show Officials, 2007" states that the "[Flower] form should be appealing and consistent with the species, although pleasing variations are acceptable." The first part of the sentence is demonstrated by 'Allen Grossman' (Figure 9); it is a relatively recent introduction with an appealing form that does not stray far from that of the Del Norte County iris shown in Figure 1. The second clause of the sentence permits what I refer to as "round, flat, and frilly" blooms. This flower form is popular with fanciers of several types of beardless iris beyond just the Pacific Coast Iris.

The rationale for "round and flat" is that a complete circle provides a large canvas for displaying colors to a person viewing the flower from above. The "frilly" part is, presumably, an attempt to compensate for the loss of the three-dimensional, sculptural form taken on by the flowers of most wild iris species. Joe Ghio has put much effort into developing the "round, flat, and frilly" form to its greatest potential in Pacific Coast native irises. This is demonstrated by 'Take The Red Eye' (Figure 7), and 'Corralitos Creek' (Figure 10). It is interesting that in hybrids with the most advanced frilliness, the petaloid crests at the end of the style arms may interfere with bee pollination; this is obviously not a problem for human hybridizers.

Ken Walker's interest in flower gardening goes back to his childhood on a Vermont farm and comes from both sides of his family. However, he didn't obtain a garden of his own until he was nearly 40. He has spent the last quarter century trying to make up for lost time, developing a particular passion for irises in their many forms.

The Flower and the Fly *by Jean-Paul Ponte*

The Pacific Coast irises (*Iris*: series Californicae, hereafter PCI) are well-known among wild-flower enthusiasts and gardeners for their beautiful flowers and, among botanists, for their propensity to hybridize. Several species are widely distributed in California, and their showy flags are familiar sights along roadsides and forest edges, but somewhat surprisingly, very little is known about their pollination biology, especially the insect visitors and pollinators (Uno 1982, Borkent and Schlinger 2008).

One explanation may be that earlier researchers assumed *a priori* that PCI species, like most other members of the genus, rely on bees for pollination services. Virtually all irises have the same basic pollination mechanism (Rodionenko 1987, Goldblatt and Manning 2008, Guo 2015). A pollinator lands on one of the three sepals, and then walks beneath a petal-like style to the center of the flower in search of nectar. In the process of walking in and out, the visitor contacts stigma and anther, and pollination occurs. This system resembles what we see in plants with nototribic or bilabiate flowers (e.g., various mints and figworts), and requires a degree of behavioral sophistication and consistency that are ordinarily associated with bees. Thus, pollination biologists may not have questioned who pollinates PCI because they assumed bees were the most important pollinators.

Contrary to this assumption, some evidence suggests that the most important pollinators of PCI may instead be an unheralded genus of spider flies, *Eulonchus* (Acroceridae). This suggestion is surprising because flies have generally been regarded as erratic flower visitors and poor pollinators. Nevertheless, recent observations suggest that spider flies (*Eulonchus*) frequently visit PCI flowers, exhibit foraging behaviors similar to bees, and carry iris pollen on their bodies. Thus, spider flies appear to be important pollinators. However, published evidence supporting this claim is inconclusive (Borkent and Schlinger 2008).

For my graduate research, I investigated the relative importance of spider flies and other insect visitors to the pollination of a rare Pacific Coast Iris species native to the Siskiyou Mountains in northern Del Norte County, CA, and southern Josephine County, OR, the Siskiyou iris (*Iris bracteata*). For each insect visitor, I measured (i) the average rate of flower visitation (*visitation rate*) and (ii) the probability of contacting stigmas during visits (an index of *visitor effectiveness*), and based on these two parameters, (iii) their relative importance as pollinators. In the process, I also estimated the average number of pollen grains a visitor delivers to stigmas during a single visit (*expected pollen delivery*). Documenting stigma contact and pollen delivery is essential because not all flower visitors contact reproductive whorls nor do they deliver the same amount of pollen grains to stigmas (King et al. 2013, Ballantyne et al. 2015).

Jean-Paul Ponte

Siskiyou iris (*Iris bracteata*)

In my 2018 Master's thesis (available for free on researchgate.net and digitalcommons.humboldt.edu), I present a catalog of insect visitors and report their relative importance as pollinators of the Siskiyou iris. I show that the flowers attract a diverse array of insects which differ substantially in their flower visitation frequency and their probability of contacting stigmas (*visitor effectiveness*). My results reveal that the spider fly (*Eulonchus tristis*) accounted for the majority of visits to flowers, had the highest probability of stigma contact, and delivered large loads of conspecific pollen grains. These findings contribute to our general understanding of the role that flies play in pollination. Specifically, they show that flies in the genus *Eulonchus*—and not bees—are the main pollinators of a rare iris in northern California and southern Oregon. Resource

***The flowers of* I. bracteata *are among the largest and most attractive in the Californicae* —Lee Lenz 1958**

managers concerned about the conservation status of the Siskiyou iris should consider the life history requirements of the flies and, especially, the vulnerability of their larval spider hosts to habitat alteration—a fascinating parasitism story, where the fly larvae must find a spider host in which to grow until it is ready to pupate.

Lastly, I must pay homage to the spider flies. These flies are known to visit a large and morphologically diverse guild of flowering plant families (e.g. mint, geranium, lopseed, plantain, rose, evening-primrose, and many other families) throughout the Pacific Northwest and, in each case, they typically adopt a local foraging specialization on a single plant species. These characteristics suggest that spider flies may be important visitors to a myriad of flowering species in the northwest and thus, further research assessing their importance as pollinators is without a doubt warranted. Perhaps you've seen these little pollinating jewels visiting flowers in your neck of the woods?

Jean-Paul Ponte

Spider fly mating pair visiting a Siskiyou iris flower

Jean-Paul Ponte *recently received his M.S. degree from Humboldt State University and is now working for an environmental consulting company in the Bay Area. His research interests fall into four sets, reflecting the idiosyncrasies of his development as a biologist: restoration ecology, plant taxonomy and systematics, plant ecology, and pollination ecology. His passion is centered on the interactions between flowers and pollinators. Northern California is so rich in native plants and pollinators that he feels like he is in pollination paradise!*

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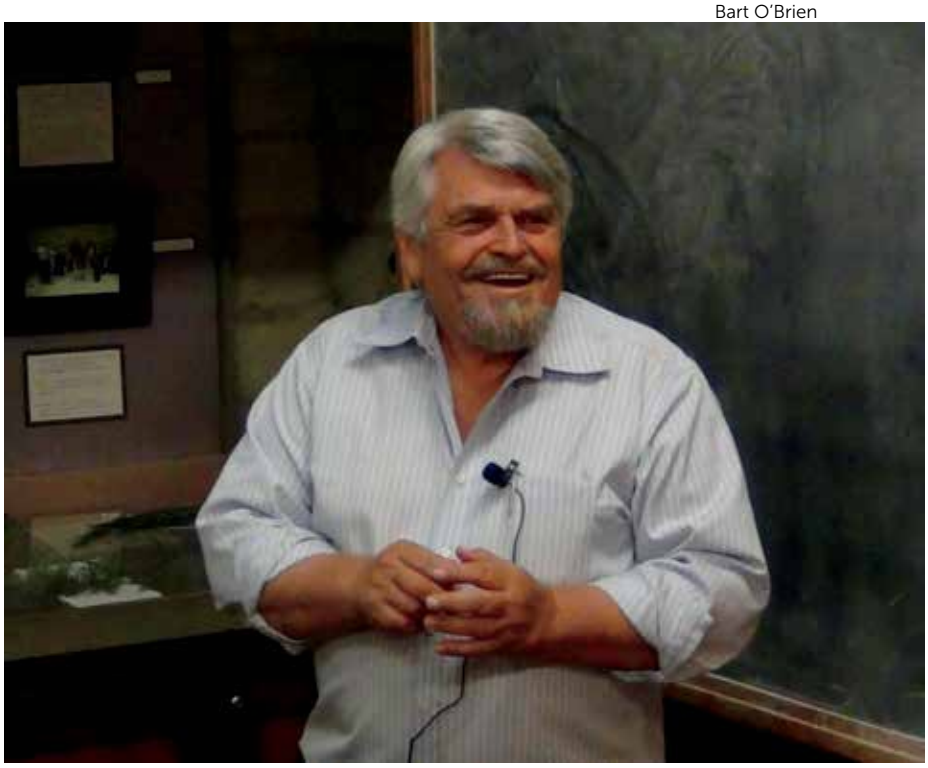
Insect exclusion cage construction for pollen deposition studies

Jean-Paul Ponte

Ted Kipping 1945-2019 *by Bart O'Brien*

On November 24, 2019, we lost Ted Kipping. How can one possibly sum up the tremendous contributions of a polymath such as Ted? It is an impossible task, and all such efforts will be lacking as no one person may have a clear picture of his complex network throughout the plant world. Ted was a life member of many plant and garden groups, including our Friends of the Regional Parks Botanic Garden, and among many others, Bromeliad Society of San Francisco, California Horticultural Society, California Native Plant Society, North American Rock Garden Society (for which he was also the chair of the Western Chapter), San Francisco Cactus and Succulent Society, Friends of the Arboretum & Botanic Garden (UC Santa Cruz), and Friends of the Botanical Garden (UC Berkeley). I heard him exclaim on a number of occasions words to the effect of, "We need a group to focus on [plant genus], and if [you/someone] will start one, I will be the first life member!" And he meant it.

Bart O'Brien



Ted Kipping presenting one of his many Wayne Roderick Lectures at the Regional Parks Botanic Garden on November 14, 2015 when he spoke on Botanizing in the Western Cape of South Africa. Along with his many other talents, Ted was a highly regarded speaker and photographer.

Ted was born in Fresno in 1945 but essentially was a life-long resident of San Francisco, though he traveled far and wide to see and photograph plants in their native habitats. He started gardening at age five. He studied natural history at Columbia University in New York. When he returned to San Francisco, he started working at Strybing Arboretum (now the San Francisco Botanical Garden). In 1976, he started his company Ted Kipping-Tree Shaper, and in 2002 he and Phil Danielson formed the partnership Tree Shapers that continues to this day.

Over the course of four decades Ted, through his company, provided targeted professional tree work to the Regional Parks Botanic Garden at no cost, oftentimes accomplishing detailed pruning work that was beyond what the Botanic Garden would ever be able to pay for. "Ted Kipping Tree Shaper" is the first name on the Botanic Garden's donor wall in recognition of his many gifts to the Garden. He provided such free services to numerous other public gardens in the region, frequently using such opportunities to train his capable staff.

His irrepressible enthusiasm for plants and natural history was always in evidence, and his outgoing generous spirit connected him to plant people throughout the country and internationally. To quote Ted, from Carol Olwell's book *Gardening From the Heart: Why Gardeners Garden* (1990), "I realized that plant people were some of my favorite people anywhere, regardless of what other sterling virtues non-plant people had. Plant people tend to be … very personable, very giving. That may have something to do with the nature of working with plants; with seeds and cuttings you always have an embarrassing abundance of things to give away."

Thirty-five years ago, Ted started his personal garden (often referring to it as his "cloud forest garden") in the frost-free Sunnyside District of San Francisco. It is absolutely jam packed with unusual plants from around the world featuring troughs of alpines, epiphytic bromeliads and orchids, Vireya rhododendrons, fuchsias, begonias, aloes, echeverias, cupheas, geophytes, California native plants, and more that he shared widely. Of course there are also exquisitely pruned conifers.

Ted was a perennial presenter at our Botanic Garden's Wayne Roderick Memorial Lectures, typically providing at least two talks per season, always attending the other lectures, and often stepping in to provide a talk when another speaker was unable to speak. I can hear him in my mind, in more than one of his memorable presentations, explaining that the Latin names of some plants are musical, and then hearing his *basso profundo* voice explode in full glorious operatic style (phonetically), "MOAN-ARE-DELLLLLLLLLLLLLA……. .O-DOOR-A-TEEEEEEEEESSSS-EEEE-MA!" He always had something germane to add during other talks, injecting his thoughts from his usual seat in the far back corner of our auditorium.

All of Ted's numerous talks and presentations were illustrated by his gorgeous photography. He could be spotted in gardens and in the wild, frequently flat on the ground, capturing beautiful images of our natural world, especially flowers and foliage. Indeed, his last completed presentation was a newly revised program titled "Hooked on Foliage," and it is a sumptuous summation of his passion for the beauty of plants. He freely shared his photos with others to enhance their presentations and publications.

No one was quicker with a sincere compliment, or expressions of love, friendship, and gratitude. In this, as in so many other aspects of his life, Ted is a role model for us all. He made the world a better place and enriched our lives and gardens. I will miss him terribly.

John D. Rusk 1937-2019 *by Bart O'Brien*

John Rusk with his appreciation plaque for 20 years of outstanding service to the Regional Parks Botanic Garden on December 21, 2017. John was the primary instigator of the Botanic Garden's social media presence, and was instrumental to the success of the Botanic Garden's volunteer plant propagators.

John D. Rusk passed away on November 21, 2019. John first became involved with our Botanic Garden back in 1990 when he started attending the Wayne Roderick Lectures on Saturday mornings during the winter months, and he began an impressive 23 years of service to the Regional Parks Botanic Garden in 1996.

John grew up on a farm in Indiana where he first became interested in plants. In 1955, he joined the U.S. Navy, and served our nation for 20 years. For many of those years he was stationed in Japan, where he met his wife, Michiko Kodama Rusk. After the Navy years, they briefly lived in Berkeley, but very soon thereafter they moved to Indiana where John earned a BA and an MA in history from Indiana State University. They returned to Berkeley in 1986 and John started working with a leasing company in San Francisco where he morphed into a computer programmer—because that role needed filling.

In 1996, shortly before his retirement from the company in 1999, John began volunteering with the Botanic Garden as a plant propagator. He quickly moved into a leadership role with the propagators, guiding the Thursday morning "in-house" potting shed activities of potting-up and labeling plants, while another long-time volunteer, *Friends* Board member and plant sales leader, Ron Clendenden, organized the gathering of cuttings, seeds, divisions, and seedlings. It was after those Thursday morning propagation sessions that John would wander

through the Botanic Garden taking beautiful photographs of our California native plants. John and Ron successfully led the propagators' efforts for many years, until a few years ago when John had to curtail his activities due to his growing infirmity and his role as primary caregiver for Michiko, who was also ill.

In 2002, John joined the board of the *Friends* of the Regional Parks Botanic Garden, where he initially took on the role of registrar and organizer of the group's classes and field trips; his exceptional organizational and written communication skills were greatly admired. Around 2010, he recognized that the Botanic Garden and the *Friends* could benefit from social media and immediately began developing an online presence for the Garden. He created the Garden's monthly e-Newsletter in March of that year and in May, he founded the *Friends*' Facebook page. Twitter followed in 2011. He always focused on photographs of plants in the Garden, as that is what he thought most people would want to see. He was correct. In 2015, in a report on his social media efforts to the *Friends* board, he wrote: "I think … you will find that printed media will become less viable year-by-year. I love the past probably even more than most of you. I am, after all, trained as a historian. I just know a few things about the present: one of which is that I bring more people into fleeting contact with the garden each day than all the printed media generated on behalf of the garden can ever hope to do. I know even less about the future, except for one thing: the future will be electronic." John embodied that future focus by posting daily images of the Garden and other botanical topics on multiple platforms, and by directly interacting with fans of his photography from all over the world.

In addition to his work in the Garden, John was also a plant propagator volunteer for the East Bay Chapter of the California Native Plant Society, and a life member of CNPS. John also continued his interest in history by serving eight years as a board member of the Institute for Historical Study (Berkeley, CA). John received the California Horticultural Society's Photography Award in 2018. At that time, John told me how surprised and pleased he was that he had such a successful second career so late in life.

John was always generous with his time and expertise. In addition to his volunteer work with the propagators and the *Friends*, John also provided valuable assistance and expertise to former Garden Supervisor Joe Dahl during the creation of the Garden's computerized plant accessions database from its paper records. John made all of his photographs freely available online—anyone can use them, as long as the images are attributed to him. John leaves a lasting legacy of extraordinary documented digital photographs of the Botanic Garden. He enriched our lives and made the Botanic Garden, and the world, a better place.

In 2018, Alicia Springer wrote an excellent profile of John in *Manzanita* 22(1): 14-15: "John Rusk, Botanic Garden Chronicler." It is in this article that John revealed, "My favorite subfamily of plants is the opuntioides. What can I say? I like prickly things."

John Rusk

Iris thompsonii

John posted his best digital photographs on the Flickr website, and used the app Hootsuite to post his photos and comments on multiple social media sites. He maintained either an individual or Garden presence on the following: Flickr (both), Facebook, Twitter, LinkedIn (individual), Pinterest, Tumblr, Reddit (as jdrusk), Instagram (as plantaholic1), and a few others that have since been closed or became inactive. Here are web links to some of John's digital photography and social media:

Flickr, John posted 1,566 identified photos of plants in the Regional Parks Botanic Garden's living collection:
https://www.flickr.com/photos/john_d_rusk/sets/72157632903771926/

John posted 2,416 identified photos (a majority of these are from the RPBG and many are repeated from the above account):
https://www.flickr.com/photos/john_d_rusk/collections/

As *Friends* of the RPBG, (this group was started on March 30, 2016):
https://www.flickr.com/groups/rpbg/pool/
2,300 photos have been posted by 28 group members.

Facebook:
https://www.facebook.com/pages/Regional-Parks-Botanic-Garden/111573845550809

Twitter: **https://twitter.com/FriendsRPBG**

Pinterest: **https://www.pinterest.com/john9411/regional-parks-botanic-garden/**

Tumblr: **http://friendsrpbg.tumblr.com/**

Instagram (John had this personal account since 2014):
https://www.instagram.com/plantaholic1/

To date, there is only one Botanic Garden social media account that was not started by John, and that's our current Instagram account that was started on December 15, 2017 by our Administrative Specialist, Ashika Narayan: **https://www.instagram.com/rpbotgarden/**

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NO SPRING PLANT SALE IN 2020

Our spring plant sale will be on hiatus while we continue to upgrade our nursery facilities. We'll see you at our fall plant sale!

Thank You to these Nurseries for Providing a Discount to *Friends* Members

Annie's Annuals and Perennials (510-215-3301), 740 Market Avenue, Richmond, www.anniesannuals.com

Bay Natives Nursery (415-287-6755), 10 Cargo Way, San Francisco, www.baynatives.com

Berkeley Horticultural Nursery (510-526-4704), 1310 McGee Avenue, Berkeley, www.berkeleyhort.com

California Flora Nursery (707-528-8813), 2990 Somers Street at D Street, Fulton (north of Santa Rosa), www.calfloranursery.com

Central Coast Wilds (831-459-0655), 336 Golf Club Drive, Santa Cruz, www.centralcoastwilds.com (please call before visiting)

East Bay Wilds Native Plant Nursery (510-409-5858), 2777 Foothill Boulevard, Oakland, www.eastbaywilds.com

East Bay Nursery (510-845-6490), 2332 San Pablo Avenue, Berkeley, www.eastbaynursery.com

Flowerland Nursery (510-526-3550), 1330 Solano Avenue, Albany, www.flowerlandshop.com

Larner Seeds (415-868-9407), 235 Grove Road, Bolinas, www.larnerseeds.com

Mostly Natives Nursery (415-663-8835), 54 B Street, Unit D, Point Reyes Station, www.mostlynatives.com

Oaktown Native Plant Nursery (510-387-9744), 702 Channing Way, Berkeley, www.oaktown@oaktownnursery.com