THE USE OF WINTER GROWING PLANTS AS A DESIGN STATEMENT
FOR CALIFORNIA LANDSCAPES

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Special thanks to my friend Lani Stephenson for convincing me that I needed a catch phrase for describing my designs. She was the source for the phrase “winter-green, summer-shape”, which I plan to use in interpretation for the project described in this thesis and future designs. Thanks also to Lani for helping me see the perspective of people uninitiated to horticulture.

Special thanks to Jerry Taylor, Joan Woodward, and Ken McCown for supporting my [unusual] design ideas. Thanks to Jerry Taylor, Joan Woodward, and the Department of Landscape Architecture for giving me space for implementation of a design. Thanks to Noel Vernon for an excellent design crit early on in the thesis project.
"Winter growers", plants that grow upon the start of the Mediterranean rainy season, can make a strong design statement for southern California, emphasizing the poetic beauty of seasonal change. Because these plants are often dormant during the summer, they are environmentally friendly, requiring little irrigation.

A list of winter growing species was made, design guidelines were developed, and a landscape design was made and implemented. The main criterion for inclusion in the list of winter growing species was an appearance which emphasized seasonal change upon the summer drought and winter rains. As such, drought deciduous species, which leaf out with the first fall rains and shed their leaves during the summer drought, were considered prime choices. Design guidelines were developed that emphasized the distinctive qualities of the drought deciduous species. For example, it is suggested that evergreens would make a good contrast to the bare branches of drought deciduous species. A landscape was designed within these guidelines, with the list of winter growing species.

A study is proposed to test receptiveness of subjects to the winter growing, drought deciduous study species. A word association test, where subjects would associate words with the four seasons, would study seasonal imagery of subjects. It is hypothesized that lower levels of local seasonal associations, as in summer with dormancy, will correlate with a lower
preference for the study species. It is hypothesized that for most subjects, the study species will be disliked because of their seasonal changes. The drought deciduous plants are also hypothesized to be preferred less than other species because of the unusual characteristics of succulence and coarse branching.
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"The old complaint about California not having any seasons is, of course, wrong. The dry season is California's winter, its plant dormancy period. For some reason, though, our culture doesn't really want to acknowledge the dry season. Millions of people swear by cold winters, and like nothing better than to put on down parkas and romp in the snow. Very few revel in cavorting through the Chaparral and dry grass on a blazing California August day. The very idea seems perverse"

David Rains Wallace, The Fifth Season

In the Mediterranean climate, the winter is the time of rain, and many plants take advantage of it. After the first rain, many plants germinate or flush new leaves. Through the winter, growth continues, and with many of these plants, dormancy sets in as the rains recede. Those plants that initiate growth with the first fall rains, and whose main season of growth is in winter, are called winter growers.

Winter growth is a phenological process. Phenology is defined as the relationship between climate and organic natural phenomena (Stobelaar et al. 2004). The initiation of growth upon the fall rains is an example of a phenological event.
There are many plant phenologies that occur in Mediterranean climate wildlands, including those phenologies where growth is initiated in the spring, or where dormancy occurs in the winter (Floret et al. (1989), Orshan (1989c), Le Roux et al. (1989), and Montenegro et al. (1989)). But winter growth indicates most directly the pattern of water availability in the Mediterranean climate. Winter growers, as exemplified by local coastal sage scrub species, respond rapidly to the first rains of the fall (Barbour and Major 1988), and their season of growth coincides with the period of dependable rainfall.

This study aims to use winter growers as a design statement of seasonal water availability and constraint in the Mediterranean climate. In addition to responding quickly to seasonal fall rains, and growing during the winter, many winter growers also go dormant during the summer. The summer dormancy is often a direct expression of water deprivation, with brown leaves or leaf shedding indicating drought. Thus, winter growers are a mirror of the Mediterranean climate pattern, of winter water and summer drought.

Designs featuring winter growth embody the life-giving importance of water. Vegetation types with seasonal, rain driven growth alternating with long drought-dormant periods are called raingreen (Box 1996). Raingreeness is a critical phenomenon, in the sense of Reigner (1993), a "clear window through which to behold a natural principle". Through observation of the direct connection between rain and plant growth, people can experience the Mediterranean seasons in a more direct way than is commonly experienced.
Because winter growers are raingreen, with dormancy and growth in phase with seasonal drought and rain, they do not require much irrigation. A type of winter grower, the drought deciduous, is among the most drought resistant of all plant types in the Mediterranean climate, needing little or no irrigation in California gardens (Costello and Jones 2000).

In spite of its expressive potential of water availability in the Mediterranean climate, designers have not fully used the raingreen characteristics of winter growers as a theme in landscapes. In a review of three publications that pertained to Mediterranean climate gardens and landscapes (Francis and Reimann 1999, Gildemeister 2004, Perry 1992) there was no suggestion of the use of winter growing shrubs to create a seasonally dramatic landscape, e.g., raingreen and summer dormant.

The reasons for the lack of seasonally dramatic designs appear to have been 1) summer dormancy was not considered an important design characteristic, 2) even in gardens with winter growing, summer dormant plants, they were in combination with other types of plants which muted their design message, and 3) summer dormancy, where it did occur in gardens, often did not give a strong design message.

Summer dormancy has not been considered an interesting seasonal characteristic. One dormancy characteristic is drought deciduousness, common to many winter growers. Landscapes comprised of these plants make the maximum possible changes with the seasonal rains and drought. But review of three major publications (Francis and Reimann 1999, Gildemeister
2004, Perry 1992) made no mention of summer leaf shedding as a design theme. Gildemeister (2004) did include photographs of a landscape featuring one such species, *Euphorbia dendroides*, but in the text did not suggest the use of drought deciduous species as a theme in landscapes.

Perry’s compendium of drought tolerant plants for California gardens contains planting design guidelines (Perry 1992). These guidelines reveal a further reason why the strong seasonal changes of winter growers have not been fully expressed in landscapes: winter growers were combined with plants of different phenologies. That is, alongside winter growers would be placed plants that grew during the spring or summer. Most of these were evergreen. The use of plants with evergreen habit and varied phenology mutes the raingreen characteristic of winter growth, making it less visually dominant.

Even in gardens with a preponderance of winter growers, the dormant season is often nondescript. For example, in Mediterranean-type wildflower meadows, the season of flower color is in winter and spring, and indistinct looking dried foliage is left in the summer (page 5). This is undesirable in gardens featuring dormancy, when a stronger visual statement is needed. An example of a strong dormancy statement is that of the winter grower *Euphorbia misera*, with a bonsai-like, twisted silhouette of bare branches during the summer (page 6).
Wildflower meadow at Rancho Santa Ana Botanic garden in Claremont, California

Left: April,

Below: July

© Keith, 2005, Rancho Santa Ana Botanic Garden website

© Eisenstein, 2005, Rancho Santa Ana Botanic Garden website
Euphorbia misera, summer aspect, at the University of California Riverside Botanic Gardens. Note the distinctive branching pattern, suitable for giving interest to a design in summer.
Plant Selection

The aim of this study is to emphasize seasonal water availability and constraint by using winter growers. There are many types of winter growing plants, including evergreen and drought deciduous trees, shrubs, perennials, annuals, and bulbs. Those plants that make the strongest statement of water constraint during the summer are those that make the strongest visible indicator of dormancy. As such, those plants that lose their leaves during the summer, as opposed to being evergreen, make the strongest statement of water constraint.

The priority, then, is for drought deciduous, winter growing species. However, there are some exceptional species that are seasonally dramatic without losing their leaves. Examples include seasonally dramatic succulent genera, and poikilohydric species. The succulent genus *Aeonium* contains species whose leaves reflex into a ball during summer, to conserve moisture (Schulz 2007). Poikilohydric plants are resurrection plants, which tolerate desiccation of leaf tissue, to revive quickly upon rehydration (Scott 2000). An example is the winter grower *Borya nitida*, which makes a dramatic statement of summer dormancy in its desiccated foliage (Gaff and Churchill 1976).

Among the drought deciduous, winter growing species, I suggest that the species that are woody are best for suggesting Mediterranean seasonal rainfall. This is because the human eye is hardwired to seek out and identify objects (Ramachandran and Hirstein 1999), and the drought deciduous winter
growers that are woody have object-like characteristics throughout the year. On the other hand, soft stemmed plants lose structure in the summer. For example, plants with a permanent woody framework would have a branching pattern in summer dormancy, whereas plants with stems that died in the summer would disintegrate and present little pattern. Seasonally dramatic plants with an above-ground structural framework would include drought deciduous woody species, some succulents, and poikilohydric species. The plants which die back to ground level during summer include annuals and bulbs.

The distinction between the plant types with and without an above-ground dormant structure is not hard and fast, however. Some annuals and bulbs have a highly distinct structure during summer. Examples include *Nigella hispanica*, a winter growing annual, and *Asphodeline lutea*, a winter growing perennial, both of which have long-lasting seed heads in summer. These plants do have structural, object-like characteristics during summer in spite of their above-ground parts being dead.

There is a further aspect of the need for clear visual structure. Some species meeting the requirement for above ground structure in dormancy do not drop their dead leaves until the winter rains, e. g., *Crossosoma californica* (Citron 2000). Unfortunately, the dead leaves mute the plant’s clarity as an object. Once leaves die, their blades change under the process of decay, losing the functional patterns they hold when they were alive. For example, often leaves are organized to minimize self shading, resulting in a pattern.
After the leaves die and decay, the pattern is broken by changes in angles of the blades.

A buildup of dead twigs is also problematic. This is unaesthetic for the same reason as leaf retention of drought deciduous species. For example, the shrub *Lotus scoparius* builds up dead twigs that obscure the distinctive visual characteristics of the living branches. Their red color becomes muted, and their branching pattern distorted, by interspersed dead branches.

In sum, this study aims to use winter growing, seasonally dramatic plants, which have defined structure during dormancy, as a statement of seasonal water availability in the Mediterranean climate. A unified use of this plant type in landscapes would make a strong design message of Mediterranean seasonal rainfall.
Phenomorphological studies, while not focusing on ornamental plants, were good sources of information on winter growers. Phenomorphology is defined as the temporal changes in morphology of plants and plant organs during their life span (Orshan 1989b). Floret et al. (1989), Orshan (1989c), Le Roux et al. (1989), and Montenegro et al. (1989) conducted the most extensive phenomorphological research project on Mediterranean-type ecosystems. They worked in France, Israel, South Africa, and Chile, respectively. Seasonal changes in individual species were charted. Some smaller phenomorphological studies in Mediterranean-type ecosystems have also been completed, including de Lillis and Fontanella (1992) and Pilar and Gabriel (1998).

There is limited horticultural information on winter growing landscape plants. No lists of drought deciduous shrubs were found in horticultural publications.

The study aims to feature winter growth as a design theme. No studies pertaining to this kind of Mediterranean plant phenology in landscape design were found. However, there have been phenological design studies in other climates. Stobbelaar et al. (2004) provided a comprehensive study of phenology in landscapes of the Netherlands. They rated phenological quality of landscapes. Two important themes from their work are germane to this study. One was a concept called coherence of change. This term denotes the presence of symbols of previous seasons and the presence of symbols that
point to what is going to happen. This allows people to be able to interpret phenological changes without prior knowledge of the landscape. The second important theme from Stobelaar et al. (2004) was rating of visual quality of phenological changes. They rated color, form, and texture at different times of year to arrive at an overall assessment of phenological quality. The proviso was that it is not enough to incorporate plants that are seasonal; their different seasonal aspects, and their placement with regard to other plants, have to be regarded as well.
In designing with winter growers to emphasize changes in seasonal water availability, winter growth and summer dormancy would have to be emphasized, as well as the response to the first rains, and the onset of dormancy in the spring (e.g., brilliant leaf color before summer dormancy). Since most of the seasonally dramatic study species are drought deciduous, I focus on them in the following recommendations.

It is recommended that these species be given little or no irrigation during the summer, to fulfill their design message. Many are facultative drought deciduous, keeping their leaves if irrigated. Fewer species are obligate summer deciduous (Barboni et al. 2004), staying dormant even if irrigated.

Regarding the emphasis of winter growth, there are two important characteristics of the winter growing, drought deciduous species. In comparison to other Mediterranean climate vegetation during the winter, the leaves of drought deciduous species tend to be softer, and their brighter green color tends to advance visually. The two characteristics are related to the fact that the study species are in leaf only during periods of adequate moisture, whereas other species have to keep their leaves under moisture stress. The species that keep their foliage in summer are called sclerophylls (Dallman 1998). They have protective mechanisms against desiccation, like wax layers and internal supportive tissue. The leaves of the drought deciduous species tend to be softer and thinner because of the relative lack of protective tissue. Also, often
the green pigmentation of the study species is less modified by protective layers, making their colors appear brighter.

To emphasize the soft, bright green or grey leaves of drought deciduous winter growers, they can be contrasted with the recessive leaf color and leaf toughness of sclerophylls. Sclerophylls’ visually recessive green color would throw focus on the drought deciduous study species, unless the sclerophyll had glossy foliage, which advances visually.

Sclerophylls tend to grow later in the season than the winter growing study species. Many start growth in mid to late spring, and end a couple of months later (Orshan 1989a). Since it is proposed that sclerophylls are being used as contrast to the study species, their different growth periods may not be a liability, depending on the intended design message. For example, drought deciduous species that are initiating dormancy in June would read in strong contrast to actively growing sclerophylls. However, in some venues phenological changes would need to coincide with each other. Some designers may think that the most emotional portrayal of summer in Mediterranean climate zones is as a season of complete dormancy, with little green. This would necessitate the use of sclerophylls with a growth period coincident with the growth of the study species, if any sclerophylls were used at all.

It is suggested that evergreen sclerophylls are effective as contrast to the study species. However, in the contrast, the drought deciduous study species tend to appear less substantial. Their soft, thin leaves appear even
softer and thinner against sclerophylls’ tough, leathery foliage. Equivalent use of the two plant types in a design, e. g., use of sclerophylls with the same height or volume as the drought deciduous species, would result in the sclerophylls becoming visually preponderant. This is undesirable because the plants being featured are the drought deciduous species. The sclerophylls should have lesser height and volume, to the extent that they do not read as dominant. For example, ground cover evergreens could be used as underplanting for larger volumes of drought deciduous shrubs.

A related issue in the planting combinations with sclerophylls is the thin summer aspect of some of the study species, as in *Ribes speciosum*. The *Ribes* has thin branches that do not divaricate very much, leading to a lack of body when not in leaf. Except in cases where sclerophylls are clearly the design backdrop, as in a hedge behind a planting bed, study plants with a thin aspect should be combined with much lower sclerophylls. The vertical separation between the two types would avoid a contrast in density which would make the deciduous species appear insignificant. Perhaps sclerophylls could be restricted to heights below where the stems of the drought deciduous species divaricate, e. g., of a size that would fit directly underneath the deciduous species. This recommendation for restricted use of sclerophylls would not be necessary in combinations with the more substantial study species like *Euphorbia balsamifera*.

Some of the drought deciduous study species have a dramatic silhouette of bare branches during summer, emphasizing dormancy. This may be
associated with a morphological characteristic, absolute brachyblasts. Absolute brachyblasts are shoots that are very short (less than a few millimeters) but bear leaves and flowers (or spines) as an ordinary shoot would. Many of the drought deciduous winter growing shrubs produce absolute brachyblasts from their main branches, rather than developing larger twigs (Ginocchio and Montenegro 1992). This leads to a dramatic structural pattern, because the main stems are made more distinct by lack of twiggy side growth. There are different design strategies to emphasize branching pattern. The foliage of sclerophylls could be used as a contrast to the bare stems of drought deciduous species. The drawing precept of negative spaces, e. g., that objects are seen with respect to surrounding voids, suggests that plain backgrounds would emphasize silhouettes (Edwards 1999). Therefore, hardscape like walls and paths, and a backdrop of sky, would be effective as backdrop, but perhaps not other plants, because of their visual complexity.

Another characteristic of some of these plants, which could be used to emphasize summer dormancy, is bark color. Some of the study species have an unusual bark color. For example, *Ribes speciosum* has golden-colored, spiny bark. This is in contrast to most woody species, which have bark in shades of grey, brown, and green (Reimer and Mark 2003-2004). Color theory suggests that to differentiate an object from its background, contrasting or complementary, but not harmonizing, color should be used (Itten 1961). Some of the study species have light colored bark, which would contrast with a dark
background. For example, the study species *Aeculus parryi* has pale grey bark.

Bare branches and bark color are important characteristics of the summer aspect of the study plants. Other important seasonal indicators of winter growers are the autumn leaf out with the first rains and the onset of dormancy in the spring.

The autumn leaf out is analogous to the spring leaf out of the North Temperate Zone. Leaf out, as exemplified by local coastal sage scrub species, occurs two to four weeks after the first significant fall rains (Barbour and Major 1988). Juvenile foliage is sometimes red-tinted (Price and Sturgess 1938), and is thinner than adult leaves (King 1999). In combinations of the juvenile foliage of the study species with sclerophylls, I suggest a careful consideration of foliage colors. This is because there is a strong contrast with the sclerophylls in texture, of very soft versus leathery, and color chroma, of visually advancing versus visually receding greens. Without similar foliage hues, the contrast becomes too acute, making the sclerophylls seem lifeless, because of their recessive color and leathery toughness, and the drought deciduous species seem rank, because of their soft, bright green growth. For example, the green drought deciduous species *Ribes aureum* forms an acute contrast with some of the native scrub oaks which have less green hue, while the sclerophyll *Quercus agrifolia* combines well with the *R. aureum* because of a similar hue (yellow toned green).
Design becomes different as the colors of the study species change with the approach of dormancy. When the leaves change color, it seems natural that there would be a strong contrast with sclerophylls. Sometimes during the onset of dormancy the study species show leaf colors analogous to the fall colors of the North Temperate Zone, as in the red color of maple leaves. These colorful species can be juxtaposed with each other, or contrasted with sclerophylls.
PROJECT

A plant list of winter growing, summer drought deciduous species was developed, and a garden featuring these species was designed and constructed.

Identification of study species

Plants were identified by surveying the horticultural and scientific literature and by visiting botanical gardens. Horticultural plant encyclopedias (Brenzel 2007 and Citron 2000) were surveyed for mention of these plants, as well as plant phenomorphological studies (Pilar and Gabriel 1998, de Lillis and Fontanella 1992, Floret et al. 1989, Orshan 1989c, Le Roux et al. 1989, and Montenegro et al. 1989). Botanical gardens were visited at those times of year when seasonal changes in plants could indicate winter growth. For example, on fall visits I would survey for plants that were starting into new growth. Botanical gardens visited included Rancho Santa Ana Botanic Garden, Huntington Botanical Gardens, Fullerton Arboretum, University of California Riverside Botanic Gardens, and Quail Botanical Gardens. Certain sections of these gardens provided good sources of study plants. For example, the Canary Island section at the Huntington Botanical Gardens was good because of the source of plants having a mild and dry Mediterranean climate.
The search was for winter growing plants. Winter growth was defined as green out upon the fall rains, including the opening of leaf buds or other changes indicating the onset of active growth, followed by a sustained winter period of growth.

After identification of potential plants, they were subjected to the design criteria of structure during dormancy, absence of dead leaves and twigs, and seasonal drama, as discussed in the introduction. The other primary concern, not related to the visual aspects of design, was that plants would not invade native ecosystems.

Visible structure in dormancy. Landscape plants would need to provide a definite above-ground structure in dormancy. While plants that die back to ground level, e. g., geophytes or annuals, do express the changes in season, people would be less aware of them while they were dormant, because they die back to visually indistinct organic matter. Dormancy must remain an eye-catching statement.

Persistence of dead leaves or twigs. Some species go completely dormant, but do not drop their dead leaves until the winter rains, e. g., *Crossosoma californica* (Citron 2000); these were rejected because the dead leaves mute the structural characteristics of the shrub. Some species do not drop their dead twigs, e. g., *Lotus scoparius*, and were also rejected because it causes the plants to have a less distinct branch structure.

Seasonally dramatic change. The greatest numbers of species meeting this criterion were drought deciduous. In addition to the drought
deciduous species, some succulents and a poikilohydric species (resurrection plant) were found.

In regards to the deciduous winter growing species, many have a complex phenomorphology that includes the production of drought-resistant small leaves for summer photosynthesis (Westman 1981); these seasonally dimorphic plants were omitted in favor of plants that are completely drought deciduous, because the completely deciduous plants were considered a stronger statement of summer drought.

Non-invasiveness. Many of the plants identified are new to cultivation in California. There may be a danger that some of these plants will invade wild lands, to the detriment of the native ecosystem. Plants have naturalized in wild lands directly from gardens, through movement of reproductive propagules from the garden site, e.g., wind dispersal of seed, or through establishment from dumped yard waste (Randall 2007a).

The best predictor of invasiveness of wild lands is a prior history of invasiveness (Rejmanek 2000). Potential study species were surveyed in the Global Compendium of Weeds (Randall 2007b), an online weed research review of 20,000 taxa. Those under the category of environmental weed and naturalized weed were struck from the list, but not those that were casual aliens. Randall (2007a) defined environmental weeds as those species that invade native ecosystems, and defined naturalized weeds as those species that maintain and expand their populations without necessarily harming native
ecosystems. Casual aliens were defined as plants that do not develop permanent naturalized populations (Randall 2007a).

To summarize the questions used to decide on plants in the list:

1. Is it a winter grower?
2. Is it completely drought deciduous or does it show another dramatic dormancy characteristic?
3. Does it have above ground structure in dormancy?
4. Does it not show dead leaves or twigs in the summer?
5. Is it noninvasive in native ecosystems?

See Table 1 on page 22 for the list of drought deciduous species. See Appendix 1 for representative photographs. In the table, references are included for the first 2 criteria. The third criterion is met because all of the species are woody. It was not possible to rigorously review the fourth criterion, because of a lack of local examples of many of the study species. However, photographs of all potential species were reviewed for buildup of dead twigs and/or leaves.

Non-drought deciduous, highly seasonal plants included Aeonium spp. Aeonium is a succulent genus, of which some species retract their leaf rosettes into a ball during summer, and grow actively during winter (Schulz 2007). See Appendix 1 for photographs of the spring and summer aspects of A. aureum. The pertinent species are A. aureum, A. sedifolium, A. spathulatum, A. simsii, and A. saundersii (Schulz 2007).
<table>
<thead>
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<th>Species</th>
<th>Winter Grower</th>
<th>Drought Deciduous</th>
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<td>Rundel and Mahu 1976</td>
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<td>Bibiloni 2003-2006</td>
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<td>Ginocchio and Montenegro 1992</td>
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<tr>
<td>Tylecodon wallichii</td>
<td>Benesi 2005a</td>
<td>Stein 2004</td>
</tr>
<tr>
<td>Withania aristata</td>
<td>Benesi 2005a</td>
<td>Barnhill 2006c</td>
</tr>
<tr>
<td>Withania frutescens</td>
<td>presume based on W. aristata</td>
<td>Alicante Town Hall 2001-2008</td>
</tr>
</tbody>
</table>

*a personal observation
b Barboni et al. 2004
c personal communication from Chris Barnhill, curator at the Fullerton Arboretum
The resurrection plant *Borya nitida* met the design criteria of growing during the winter (Gaff and Churchill 1976), and having a tidy appearance, e.g., remaining largely clean of dead material. Unlike the drought deciduous species, *B. nitida* is not woody, and its dormancy symbol is desiccated foliage, rather than a bare framework of branches.

Raingreen Garden

The College of Environmental Design at Cal Poly Pomona gave me a space for implementation of a winter growing garden. It is on campus, by the college, in the Neutra Plaza between building 7 and building 2. The plan is shown in Figure 1 on page 24.

Featured study plants include *Euphorbia misera* and *Pelargonium echinatum*. Contrasting evergreens include *Haworthia* sp. and *Cneorum tricoccon*. Pertaining to the design guidelines, the evergreens are less tall than the drought deciduous species, allowing the deciduous species to be visually dominant. Also, the colors of the evergreens are darker, allowing the light colored branches and foliage of *Euphorbia misera* and *Pelargonium echinatum* to read in contrast. Trex decking material was installed to separate the different plant groups, and create an abstract design. Its rubberlike quality matches the succulent stems of the *Euphorbia misera* and *Pelargonium echinatum*. Please see Appendix 2 for photographs of the study site.
Figure 1. Plan view of winter growing garden.

- Cneorum tricoccon
- Euphorbia misera
- Aeonium aurea
- *Haworthia attenuata* var. *cespitosa*
- *Haworthia fasciata*
- *Pelargonium echinatum*
- Intended Signage
- Decorative Rock
- Trex Edging

Cal Poly Pomona
Signage is planned for the garden. The planned text and layout is shown in Figure 2 on page 26. The sign is a point of interest marker in the Cal Poly Pomona Exterior Signage/Wayfinding Program (Facilities Planning and Management 2002).

It was intended that the garden subsist on rainfall after establishment. The drought deciduous species (*Euphorbia misera* and *Pelargonium echinatum*) need little or no irrigation in California (Costello and Jones 2000). The *Haworthia* species, *Aeonium* and *Cneorum* are also hypothesized to tolerate zero-irrigation conditions because of their dry native habitat. The sclerophyll *Cneorum tricoccon* occurs in maquis (Riera 2002), the Mediterranean analog of chaparral; *Haworthia* occurs in dry, rocky habitat in the more arid regions of South Africa (Pilbeam 1983); and *Aeonium aureum* is from rocky habitat in the Canary Islands (Schulz 2007).

Please see Appendix 3 for my suggestions for project evaluation.
This garden features plants which show winter green and summer shape, leafing out upon the winter rains and developing bare branch shapes in the summer drought. The garden is meant to show the poetic beauty of seasonal change in the Mediterranean climate. It receives no water other than the winter rains, allowing the full development of drought-induced summer dormancy.

Figure 2. Planned sign for the Neutra Plaza garden.
PROPOSED STUDY

Whether or not people enjoyed the study plants would have a strong effect on whether they were planted in southern California landscapes, so it was decided to design a survey for aesthetic preferences for my study species. Of course, their seasonal changes in relation to climate (phenology) are the principle characteristic differentiating my study species from other landscape species.

I propose that one factor in preference for the winter growing, summer dormant species is a lack of cultural symbolism for local, Mediterranean seasonal changes. Indeed, there appears to be an normative seasonal imagery in the United States which is derived from the four seasons of north temperate climates (Kammen 2004). Kammen (2004) notes that these seasonal expectations are upheld even when they are unrealistic to the local climate; for example, winter decorations in shop windows in Los Angeles that feature cold weather themes like artificial snow (Kammen 2004). The norms for seasonal change may influence seasonal expectations for plants. My study species are opposite to the traditional four seasons, going dormant in the traditional seasons for growth and becoming active in the traditional season of dormancy. A lack of a seasonal imagery for winter growers could confound appreciation for them, even if merely because of a lack of association of the plants with other things. Plants that fit the traditional seasons appear to have
many different connections to our culture. For example, they are often associated with seasonal events, as in falling leaves with football season.

However, there are some local cultural associations with California seasons. For example, the Tournament of Roses Parade, held every year on New Years Day in Pasadena, California, was formed to showcase the mild winter climate of California through displays of seasonal flowers and fruits (Womack 2005). It appears that part of the attraction of California for people from different parts of the United States has been the continuous production of fruits and flowers that is possible in our climate. Padilla (1961) documents the emphasis on perpetual growth and flowering that was used to promulgate new California towns in the late 1800s. For example, Judge J. W. North, as quoted in Padilla (1961), distributed descriptions of the city of Riverside throughout the east coast states:

…”The orange groves, which may always be seen in both fruit and blossoms, are unrivaled in beauty. The pomegranate, always with fresh foliage, bearing fruit and flowers; the lemon and lime always ornamental, as well as profitable; the oleander tree, wonderfully rapid in its growth, always green and always ornamental with gorgeous blossoms”…
Thus, locally, there are at least two different ways of perceiving seasonal changes in plants. There appears to be a conception of seasonal change that harks to the four seasons of temperate climates (Kammen 2004), and there is a desire for perpetual growth and bloom (Padilla 1961). Both of these seasonal conceptions would influence preference for the study species. That is, I hypothesize that winter growth itself would not be disliked by subjects, because of the desire for perpetual growth and bloom, in spite of its conflict with the traditional seasonal conception of winter as dormant. On the other hand, the extreme summer dormancy of my study plants is opposed to both the emphasis on continuous growth and the traditional seasonal conception of summer as green, and is hypothesized to be disliked.

At the symbolic level, the traditional four seasons appear to be more important to residents than the horticultural emphasis on perpetual growth. This was determined by an assay on the Internet for seasonal imagery of California autumn. I studied the first 300 hits of a Google image search for the words *California* and *Autumn* in 2008, only including images that apparently came from within the state. The search yielded photographs and artwork that largely conformed to traditional themes of fall, especially colored leaves (120 images containing colored leaves). Only five of the images of colored leaves appeared to come from natural areas of lowland California. Most of the photographs of colored leaves came from cultivated plants, such as *Liquidambar styraciflua*, or high elevations. The other principal category of images was unrelated to autumnal themes, e.g., an image of a guitar (94
images). Some photographs did depict some local seasonal characteristics, as in a cultivated landscape full of flowers or wildland landscapes without traditional autumn colors (21 images). Therefore it appears that California autumn is thought of mainly in traditional terms. Local characteristics do appear, but are less important than the non-local themes.

Ben-Porat (1986) also found the traditional four-seasons imagery in Israel, which has a Mediterranean climate like California:

...the ultimate domination of the European repertory [symbols of seasonal change]...is so complete that a realistic representation of an Israeli autumn, using a local repertory, will not be generally recognized as a seasonal poem (Ben-Porat 1986).

Ben-Porat (2001) did a word-association study of Israeli residents with "autumn", and found local elements, e.g., squill blooming (Scilla autumnalis) to be much less consistently and less commonly named than the traditional European elements, e.g., falling leaves and wind.

Currently, a lack of cultural symbolism for summer dormancy and a desire for perpetual growth is hypothesized to interfere with liking for summer dormant plants. Presumably, both the lack of symbolism and desire for ongoing bloom could be reflected in seasonal imagery of subjects. For example, "summer" could associate with "green grass", which reflects the summergreen characteristic of north temperate climates. Desire for continuous
growth and bloom could be reflected in frequent mention of flowers, regardless of season.

To study local seasonal imagery, a word association test is proposed. Subjects will be asked to associate three words with each of the four seasons. It is proposed that subjects with a background in biology will be more aware of seasonal changes in local wildlands, as reflected in a greater number of such associations, e.g., summer associated with golden hills, than students in majors outside of the natural sciences. The hypothesis is that students that associate with seasonal changes in natural areas will be more likely to prefer summer dormant species.

Therefore, subjects tested for word associations will be given a preference survey for the study species. Subjects would be exposed to a group of photographs of the drought deciduous study species, winter deciduous plants, and evergreen plants, and asked to rate preference.

Because of the hypothesized difference in preference between summer deciduous and other plant types, it was deemed necessary to expose each subject only to the aspects of one season. One group of subjects would be exposed only to the summer aspects of the plant types, when winter deciduous plants would be in full leaf and drought deciduous species would have bare branches, and another group would be exposed to only the winter aspects, when the winter deciduous species would be bare and the study species would be in leaf. Direct comparison of different seasonal aspects may result in breakdown of differences in preference, as it becomes apparent that there is no
difference in actual attractiveness of the winter and summer deciduous plants. For example, it may be realized that a winter deciduous plant in winter and a summer deciduous plant in summer do not actually look very different from each other when they are directly compared.

Because of the potential importance of a direct comparison between the types on preference, it was decided to test the effects of direct comparisons of the winter and summer seasonal images on a separate set of subjects. Each subject would be exposed to images of the study plants, evergreen plants, and winter deciduous species in different seasonal aspects. The hypothesis is that a difference in preference would attenuate. For individual photographs seasons would be noted.

Besides summer deciduousness, there are further important visual characteristics of the study species. Many of my deciduous study species have absolute brachyblasts (Ginocchio and Montenegro 1992). Absolute brachyblasts are shoots that are very short (less than a few millimeters) but bear leaves and flowers (or spines) as an ordinary shoot would (Orshan 1964). The absolute brachyblasts limit the amount of twiggy growth at the ends of the branches, leading to an unusual silhouette. My study species also are often succulent, giving them unusually thick branches.

Therefore, in a comparison of the study species with other types of landscape plants, both summer deciduousness, and in many species, unusual branching and/or succulence are important characteristics.
The characteristics of unusual branching and succulence may be an important factor in preference. Halberstadt and Rhodes (2000, 2003) studied the effects of familiarity and morphological averageness on aesthetic preferences for animals. Groups of one type of animal, e.g., passerine birds, were “averaged” as composites. The most average image (one that was an average of many different animal species of one category, rather than a few species) was preferred by people. Familiarity had a strong effect also, but was less important than averageness.

Some of my study plants are hypothesized to have an unaverage aspect as the result of absolute brachyblasts and/or succulence. They also are unfamiliar, not being found in local gardens generally. Therefore, provided the effects in aesthetic preferences for animals also hold for plants, my study plants are predicted to be low in preference. I felt that these effects needed to be studied in comparisons between my study species and conventional landscape species.

Methods

A total of thirty-six drought deciduous species have been found which meet the selection criteria (see list pages 24-25) for design.

Slides would be prepared by taking photographs of the study species at local botanical gardens during the dormant season in summer and the growing
season in winter. Photographs will include the entire plant. Photographs will not be taken while the plants are in flower or fruit because their general aspect, rather than their color value in flower or fruit, is being evaluated.

The study species will be compared to slides of winter deciduous plants, taken in the summer and winter, and evergreen plants. The summer and winter slides of the study species, evergreen species, and the winter deciduous species need not be of the same species, since the hypothesized affects on preference are from averageness, familiarity, and season of dormancy.

The winter deciduous plants will be subjected to the same design criteria as the study species, except the phenological requirement is reversed:

1. Is it a summer grower?
2. Is it completely deciduous in winter?
3. Does it provide a clear structure in dormancy?

Winter images of winter-deciduous plants were found in Hightshoe (1988). Images from Hightshoe (1988) were easy to survey for the first two questions but it is unclear whether finer textured species remain clear of dead twigs. Hightshoe (1988) does note, however, those species with stems of short life expectancy, e. g., cane growers like *Rubus* sp. Short lived stems would be used as a proxy for the third question, eliminating plants with this characteristic from the slides.

Hightshoe (1988) has many images. The number required for the survey would depend on the number of images I was able to gather of the study species. Images from Hightshoe (1988) will be randomly selected.
Analogous summer images of the winter deciduous species, taken when species were not in flower or fruit, can be found in Wikipedia, the online encyclopedia, and flickr, the online photograph sharing application. Photographs need not be of the same species as in the winter images of the winter deciduous species.

It was deemed necessary to compare the slides of summer deciduous and winter deciduous species to evergreen plants. Summer and winter images of these evergreen species, taken when species were not in flower or fruit, can be found in Wikipedia and flickr. It was decided to disregard phenology as a requiring characteristic, e. g., it mattered less, because of the evergreen habit, whether or not the species in question was a summer or winter grower. A pertinent question, to make the evergreens experimentally equivalent to the other species, is:

1. Does it provide a clear structure, e. g., does it remain clear of dead foliage?

All of the images would be prepared to have the same format. The photographs of the species in Hightshoe (1988) are side views. That is, the picture plane of the photographs of the species in Hightshoe (1988) is vertical, and the photographs are centered mid-way up the plants. All photographs in Hightshoe (1988) are in black and white, so all images would be converted to black and white. In photographs, all background will be cleared to leave a silhouette with a white backdrop. See page 36 for representative photographs.
Figure 3. Examples of survey slide photographs.
In sum, the summer and winter aspects of both the study species, winter deciduous species, and evergreen species, will make up the slide series.

Part 1. Averageness and Familiarity

Sixty students would be recruited from classes. Sets of twenty students will be randomly selected to rate either familiarity, averageness, or preference for slides. Subjects rate only one factor to avoid influence of the different factor constructs on each other (McBurney 1994).

A computer lab on campus will be selected for testing. Subjects will be tested simultaneously in sets, whose number is determined by the available computers in the laboratory. Each subject in the set will be randomly assigned to rate one of the three factors. Instructions will be presented on the computer (derived from Halberstadt and Rhodes (2000)):

Familiarity: If you saw shrubs you had seen before, they would look “familiar”. Some shrubs will seem familiar, whereas others will not. The computer will show a series of shrubs, some of which are dormant and bare of leaves, and some of which are in leaf. Please rate each shrub by your initial impression about how familiar each shrub looks, using the 5 point scale provided.
Averageness: If someone asked you to think of a typical shrub, what would that shrub look like? This is your “average” or “prototypical” shrub. Some shrubs look relatively similar to this prototypical shrub. Other shrubs look relatively unusual or distinct from this prototypical shrub. The computer will show a series of shrubs, some of which are dormant and bare of leaves, and some of which are in leaf. Please judge how unusual looking they are to you, using the 5 point scale provided.

Preference: If you were to think of an attractive shrub, what would that shrub look like? The computer will show a series of shrubs, some of which are dormant and bare of leaves, and some of which are in leaf. Please rate how attractive you find each shrub, using the 5 point scale provided..

The entire set of photographic slides of study species, winter deciduous species and evergreens, will be used. Season will not be noted. Subjects will be presented slides in varying random orders. Five introductory slides will be given to subjects before rating begins. They will be asked to rate preference on a 0-5 Likert Scale, by clicking a computer mouse on the rating chosen. The scales will be anchored with “very unfamiliar”-“very familiar”, “very prototypical”- “very unusual”, and “very attractive”-“very unattractive”. On each slide subjects will be given a prompt, as in “how prototypical do you find this shrub?” Participants can change their rating for any slide before clicking a “continue” button to advance to the next slide, but they cannot return to a previous image.
Part 2. Seasonal imagery versus preference for the different plant types

A word association test was constructed for determining seasonal associations of subjects. The words for the four seasons will be placed on a survey instrument with three blanks attached to each word, as such:

Autumn __________ __________ __________

Subjects will be given this instruction: “Please answer each of the four seasonal prompt words with the first three words or phrases you think of.”

It is hypothesized that biology students may be more aware of local seasonal changes than the general student body. Thirty biology students and thirty students not majoring in the environmental sciences will be given the word association test.

The same subjects will be given a survey. Treatment design for the survey would depend on the range of levels of local associations, e. g., if some students score high for local associations or if there is a consistent low level, the treatment groups will be designed differently. In the hypothetical case where some students do score high on levels of local associations, particularly associations with local wildlands, the treatment groups will be designed thus:

Students will be ranked for levels of local association. The different levels will be randomly distributed to three different groups of 20. The three groups of twenty subjects will be given different slide sets. Slides will be separated based on season of photograph. The different groups will be exposed to either the winter slides, the summer slides, or a combination of winter and summer slides.
The survey set-up will be identical to Part 1, in the use of a computer laboratory and simultaneous surveying of subjects.

For the subjects rating summer slides, this instruction for rating preference will be given on the computer (derived from Halberstadt and Rhodes (2000)):

Preference: If you were to think of an attractive shrub, what would that shrub look like? The computer will show a series of shrubs photographed in the summer. Some plants in the series are dormant and bare of leaves, and some plants are in leaf. Please rate how attractive you find each shrub, using the 5 point scale provided on the screen.

For the subjects rating winter slides, say “winter” instead of “summer”.

For the subjects rating both winter and summer slides, intermix seasons randomly and label the season for each slide, immediately beneath the image. Give this instruction for rating preference:

Preference: If you were to think of an attractive shrub, what would that shrub look like? The computer will show a series of shrubs photographed in the winter or summer. Season will be provided immediately beneath the image. Some plants in the winter or summer slides are dormant and bare of leaves, and some plants are in leaf. Please rate how attractive you find each shrub, using the 5 point scale provided on the screen.
Subjects will be presented slides in varying random orders. Five introductory slides will be given to subjects before rating begins. They will be asked to rate preference on a 0-5 Likert Scale, by clicking a computer mouse on the rating chosen. The scale will be anchored with “very attractive”–“very unattractive”. On each slide subjects will be given a prompt, as in “how attractive do you find this shrub?” Participants can change their rating for any slide before clicking a “continue” button to advance to the next slide, but they cannot return to a previous image.

Data Analysis

The fundamental question of the study is whether or not people will dislike the study species because of their extreme dormancy during the summer. The hypothesis, tested in Part 2, is that a lack of seasonal imagery and a desire for perpetual growth and bloom, as reflected in seasonal word associations, leads to low preference for the study species.

However, the two characteristics tested in part 1, averageness and familiarity, are hypothesized to be an important influence on preference ratings for the study species. Averageness and familiarity are considered covariate variables, which are variables that effect the dependent variable (preference) but are not the main variable being tested for causality (Tabachnick and Fidell 2007). Analysis of Covariance (ANCOVA) handles experimental data with
these type of variables. ANCOVA tests the effects of the covariates, averageness and familiarity, and removes their effects from the dependent variable, preference. Then the main statistical test on seasonal preferences can be performed.

The two covariates, familiarity and averageness, can be tested for their relative importance by comparing differences between their regression slopes (Todman and Dugard 2007).

Cronbach’s coefficient alpha will be used to measure internal reliability of constructs of familiarity and averageness (Cohen and Lea 2004). This would indicate whether subjects understood my definitions of familiarity and averageness.

It was expected, in part 2, that subjects would change their preferences upon direct comparison of the winter growers and other landscape species. The Cronbach’s coefficient alpha can be used to study whether there is this change in preference during the survey.

**Expected Results**

The summer slides of the study species are expected to be preferred less than the winter slides of the study species and the slides of the winter deciduous or evergreen species. This is because of the hypothesized dislike of summer dormancy, and because the study species are predicted to be rated
unaverage and unfamiliar because of their branch structure, which is more visible in summer.

For the word association test, seasonal references to the North Temperate Zone, e.g., autumn and falling leaves, are expected to be the most common. Biology students are hypothesized to make more local seasonal associations occurring in wildlands than students from outside the environmental sciences. The lower the number of local associations, particularly local associations pertaining to summer dormancy, the lower is the expected preference for the summer deciduous species.

Within all of the different plant types, preference is expected to positively correlate with rated averageness and rated familiarity. Rated averageness is expected to affect preference more strongly than rated familiarity, as found by Halberstadt and Rhodes (2000, 2003) for animals.

I expect there to be less difference between preferences for summer and winter deciduous plants when they are juxtaposed together in Part 2 of the study.
CONCLUSION

The project work included determination of the plant characteristics necessary to emphasize seasonal change upon the winter rains and summer drought, and generation of a list of plants meeting those characteristics. Design guidelines were developed to feature the species. This included use of another plant type, the sclerophyll, as contrast. Then a design was generated and implemented.

The other component of the thesis was the proposed study, which addressed seasonal imagery in the population. The hypothesis is that word associations will reflect the four seasons of the North Temperate Zone, with local seasonal associations being of less importance. Low levels of local associations, particularly low levels of association with seasonal changes in wildlands, are hypothesized to predict dislike of the study species. If the hypothesis is corroborated, and if most subjects have low levels of local associations, then perhaps the proposed garden type would be adopted slowly, if at all. This would be because of a reluctance to accept seasonal changes opposite from traditional seasonal conceptions.

It may be that there is variation between people in levels of local seasonal associations. To find characteristics of subjects which correlated with greater local seasonal associations, I proposed contrasting seasonal associations of biology students and students in majors outside of the natural sciences. The hypothesis was that a background in biology would bring more local seasonal associations, particularly those reflective of wildland landscapes,
and that higher levels of such associations would predict higher preference for the study species. If this is corroborated, then education in biology may be suggested as a factor in acceptance of the study species. Further work could identify whether other groups of people with greater local associations also had greater levels of preference for the seasonal pattern of the drought deciduous, winter growing species. The opposite finding, that there was no difference between biology and students in majors outside of the natural sciences in seasonal imagery, may indicate that seasonal imagery is semantically different from scientific knowledge. For example, an ecological knowledge of summer drought deciduousness may not result in an emotional association with summer, as perhaps personal seasonal activities, like surfing, would.

The hypothesis in the proposed study was that summer deciduous species would be less preferred than winter deciduous species because of a lack of seasonal association with summer dormancy, and because of a hypothesized dislike of dormancy in general. However, extraneous factors could confound the expectations. For example, many of the species in my study are stem succulent. Subjects could view them as a type of succulent and associate the study species with the well established local succulent gardens. Presumably this would lead to greater preference for the study species. Even if the hypothesized dislike for summer dormancy were found, the importance of seasonal imagery versus other preference based decisions for plants, such as a liking for certain flower colors, should be studied.
The proposed study addressed familiarity and averageness and their effects on preference. The hypothesis was that low familiarity and averageness would negatively affect preference for the study species. If the hypothesis was corroborated, then further work should be to identify the “unaverage” characteristics of the study species. One unaverage characteristic is the presence of absolute brachyblasts in many of my study species. A study could include comparison based preference and an “averageness” rating for plants with and without the absolute brachyblasts.

Other further studies could be to analyze responses to installed winter-growing gardens, including changes in seasonal percepts of garden viewers.

Avenues toward acceptance of the study species

The hypothesis in the proposed study was that familiarity increases preference for landscape plants. If this were true, then a strong use of the study species in designs, so that they were more familiar, would increase liking. Another hypothesis was that averageness increases preference. If this were corroborated, then the most average looking study species could be used to increase acceptance of the study species.

Another factor in acceptance of the study species could be an education in ecology. The hypothesis in the proposed study was that greater levels of education in biology would predict more local seasonal word associations, and
that greater levels of local associations may be associated with greater acceptance of the study species.

Seasonal associations may be learned in a formal, educational context, as proposed. But it is also important that winter growth be a poetic image. Landscape architecture, gardening, literature, and the visual arts are venues for showing the beauty of local seasonal change, including winter growth and summer dormancy. For example, the artist Sandra Mendelsohn Rubin studies seasonal colors and light qualities in her paintings of southern California (Tidwell 1991), sometimes incorporating the seasonal changes of wild winter-growing plants.

These cultural professions should be conscious of the differences between local seasons and traditional seasonal imagery. For example, the traditional poetic imagery of autumn is “sad” from the co-option of plant dormancy and cold winds as a symbol of old age (Ben-Porat 2001, Ben-Porat 1986). But in southern California the phenology of autumn is not as sad as in the north; it is even joyful, expressing renewal and the life giving importance of water. From my assay for images of autumn in California there was indication that residents felt irony at the local seasonal differences from colder climates. Some images reflected local characteristics, as in a cloudless blue sky over a perfectly green residential landscape, which opposes the conception of autumn as the onset of plant dormancy and wintry weather. Artists should take advantage of the tendency of California residents to note regional differences
by showing them the truly special aspects of our seasons. My own suggestion has been that the winter growers are a trope for local seasonal changes.

Some of the winter growing study species are being used in a new artistic medium, SMOLA, or Succulents as a Medium of Living Art (Vosjoli and Lime 2007). The term was coined to differentiate the artistic use of potted succulents from traditional bonsai (Vosjoli and Lime 2007). Many of the species used are dramatically drought deciduous, and some are winter growers. The proposed study hypothesized that some of the winter growing study species will be disliked because of their unaverage appearance, but SMOLA appears to make use of the distinctive branch structure of the study species and other succulent types to create a strikingly beautiful art form. Perhaps SMOLA will be one important venue for understanding the beauty of winter growth.

A premise in the proposed study was that a dislike for the study species was caused by a lack of connection to local seasonal changes and a general dislike of dormancy. Plants whose seasonal changes coincided with tradition, e. g., autumn brings leaf color, or with the desire for continuous growth and bloom, would be preferred. However, some non-traditional characteristics of the study species make them acceptable to modern culture. They can be co-opted as symbols of sustainability and regionalism in ways that summer-green plants cannot. They symbolize sustainability in that they are an embodiment of water conservation, able to curtail themselves in drought, but then dramatically express the life giving importance of seasonal rain. They are a symbol of
regionalism in that the phenology of the study plants follows the Mediterranean rainy season, which is unique to California.

Many of the study species sprout leaves and flowers from the main stems without production of twigs. This leads to an unusual appearance which I hypothesized would not be preferred. However, the study species could eventually have so much symbolic value for water conservation and regionalism that first impressions may be less important in preference judgments than I assumed.
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Appendix 1. Photographs of study species

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*Oxalis gigantea*, close up of stem. Chile, July (early winter). Note absolute brachyblasts, the peglike structures with flowers and leaves.
Left: *Aeonium aureum*, flowering in April, Canary Islands

© Marianne Perdomo, 2007, flickr Website

Left: *Aeonium aureum*, leaves reflexed during dormancy, early summer, Canary Islands

© Rudolf Schulz, 2007, *Aeonium in Habitat and Cultivation*
Left: *Euphorbia lactiflua*, Chile, July (early winter)

Below: *Euphorbia lactiflua*, Chile, dormant in late September (early spring)
Left: *Euphorbia balsamifera*, October, leafed out under irrigation

Below: *Euphorbia balsamifera*, October, dormant in wild habitat in the Canary Islands
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Below: *Carica chilensis*, Chile, April (autumn)
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Below: *Ribes malvaceum*, July
Above: *Fuchsia lycioides*, Chile, March (summer). Some of the study species flower while leafless.

Below: *Euphorbia xantii*, spring, Huntington Botanical Gardens
Left: *Cistanthe guadalupensis*, winter aspect

Below: *Cistanthe guadalupensis*, dormant summer aspect
Left: *Senecio kleinia*, February, Canary Islands

Below: *Senecio kleinia*, October, Canary Islands. The species flowers while leafless
Appendix 2. Photographs of study site.

Foreground plant is *Pelargonium echinatum*; shrubs in background are *Euphorbia misera*. December 2008.

Foreground is *Haworthia attenuata* var. *cesp.*; midground is *Euphorbia misera* underplanted with *Haworthia fasciata*. December 2008.


It was not possible to evaluate the project within the time frame of the thesis because the plants were not established. After the garden is filled in, I would suggest a photographic survey for preference.

The premise of the design guidelines was that people’s preference for the seasonal changes of raingreen species could be influenced through the use of sclerophylls. They are used as a contrast to the bare summer branches and lush winter foliage of the study species. However, the guidelines suggested careful use of the sclerophylls, because the contrast between the two types could become too acute, and because the sclerophylls can easily visually dominate the study species.

If the project and design guidelines were successful, then people would prefer the planting combinations in the project rather than combinations that did not meet the guidelines. Therefore, the two types of planting combinations could be compared for preference. Photographs of the two study species featured in the project, *Euphorbia misera* and *Pelargonium echinatum*, and photographs of sclerophylls used or not used in the project could be combined in mock planting combinations with graphics programs. Subjects would be asked their preference for the different combinations. It would be important not to include photographs of the project itself, because the project photographs would have greater naturalness than the artificially generated planting combinations.