

# Vernal Pools

of the Del Sol Reserve

By David A. Pritchett and Wayne R. Ferren Jr.  
Illustrations by Kathryn Simpson

Isla Vista Recreation and Park District  
Santa Barbara County, California



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This booklet was published in January 1988 with funds provided by grant no. 85-073-86-020 from the California State Coastal Conservancy to the Isla Vista Recreation and Park District.

Photographs by Wayne Ferren and David Pritchett, who are affiliated with the UCSB Herbarium, Department of Biological Sciences, University of California, Santa Barbara.

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COVER: A diverse assemblage of plants is evident in the spring at a Santa Barbara vernal pool.

COVER INSET: Visitors examine closely one of the larger vernal pools at the Del Sol Reserve.



Spike-rush (left) and coyote-thistle (right) are common plants of the Del Sol vernal pools.

## What Are Vernal Pools?

Vernal pools are a particular kind of ecosystem. They form as a result of a distinctive climate, topography, and soil, and are distinguished by the organisms within them. The climate must have mild winter temperatures and a summer drought. Such a "Mediterranean climate" occurs in several regions of the world, including most of California. The topography of a vernal pool must be a shallow depression that will catch water from the winter rains. The soil of a vernal pool must contain an impermeable layer, such as clay layer or mineral layer, and, in conjunction with proper topography, must allow flooding for several weeks or months during the winter wet season.

The organisms of vernal pools are the ultimate indicator of the vernal pool habitat. The physical conditions in a vernal pool provide a particular habitat for some plants adapted to survive nowhere else. Some animal species also may be restricted to vernal pools. The presence of any of these specialized plants and animals distinguishes vernal pools from other types of aquatic ecosystems. In brief, a vernal pool is a specific ecosystem having organisms restricted to special habitats that flood temporarily in the winter and early spring, but are dry the remainder of the year.

## Life in a Vernal Pool

The annual cycle of flooding and drying in a vernal pool creates an environment where few species can survive. Species that occur in permanently wet areas such as a freshwater marsh cannot tolerate the long drought when the pool is dry. Conversely, species that occur in dry habitats such as an annual grassland, an ecosystem that seldom or never floods, cannot withstand the prolonged inundation when the pool is wet. Species that do persist in vernal pools, however, are unique because they can grow, reproduce, and survive — as a seed, egg, or dormant adult — in these habitats when most other plants and animals cannot endure the environmental extremes. Within a vernal pool depression, different plant species may be most abundant at different elevations. Some species, though, grow along a wide elevational gradient, whereas others grow only within a narrow elevational range.



The buckeye butterfly (*Junonia coenia*) is widespread, and often is found in vernal pools.

One example of a species adapted for life in a vernal pool is the annual plant woolly-heads (*Psilocarpus brevissimus*). It has floating seeds that disperse throughout the vernal pool as the water level rises. The plant seldom germinates and grows to maturity unless pools flood with water. Native plants such as woolly-heads, which have specific adaptations for surviving in a vernal pool, usually cannot grow in any other type of habitat. In fact, some vernal pool plants are rare or endangered because they naturally occur in only a few vernal pools, or because they occur in pools that may be endangered by agricultural or urban expansion. For example, in Isla Vista, a species of goldfields (*Lasthenia conjugens*) was last observed in 1950, but it is now no longer found in the area. In addition to the native species occurring in vernal pools, other vernal pool plants include non-native species, such as rabbitsfoot grass (*Polypogon monspeliensis*), that have become naturalized members of the ecosystem.

## Four Environments in One Ecosystem

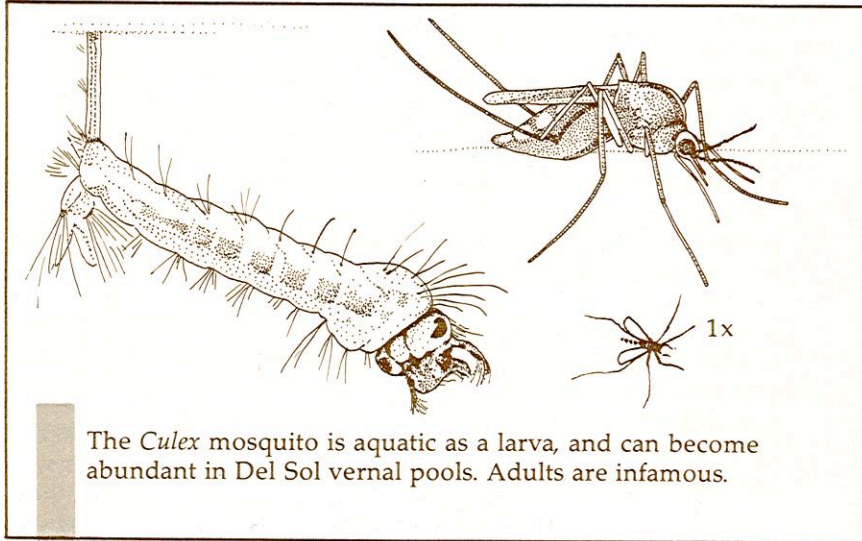
From an ecological point of view, the annual cycle of flooding and drying creates four distinct environments in a vernal pool at different times of the year. Only during the winter and early spring months do vernal pools typically have pools of water with characteristic species apparent. At other times of the year, the pools are dry, and various species that occur in other types of habitats may be more abundant.

During late autumn, when the first rains fall, the soil becomes saturated, and seeds of annual plants germinate. Shoots of perennial plants such as the spike-rushes (*Eleocharis* spp.) resprout after dying back during the summer drought. The vernal pool may have a dense carpet of new growth.

At the height of the winter rains, the pools fill to their maximum. Vernal pool animals flourish: aquatic insects and zooplankton swarm in the water, ducks visit to feed, and Pacific treefrogs (*Pseudacris regilla*) breed and lay eggs after a long chorus of croaking. Non-aquatic plants such as filaree (*Erodium* spp.), which colonize the pool shortly before it floods, die after prolonged submergence. Species of coyote-thistle (*Eryngium* spp.) sprout long tubular leaves during this aquatic phase of their life history.

During late winter and spring, when the water level recedes, most of the vernal pool plants mature to full flowering. Different species often occupy distinct zones within the vernal pool depression, creating concentric rings of various flowering colors. This show of plants in the spring, when the vegetation outside of the pool is usually dry and dying, is why "vernal" pools have their name. Aquatic animals by this time of year have either died and laid eggs or become dormant.

From late spring to early autumn, a period of extended drought, vernal pools are dry, and little life is apparent. The soil may have deep cracks. However, various species of tarweed (*Hemizonia* spp.), a common annual plant maturing in the summer, may be abundant in the dried basins of the pools. In early summer, coyote-thistle has lost its leaves, and instead produces spiny heads of minute flowers.

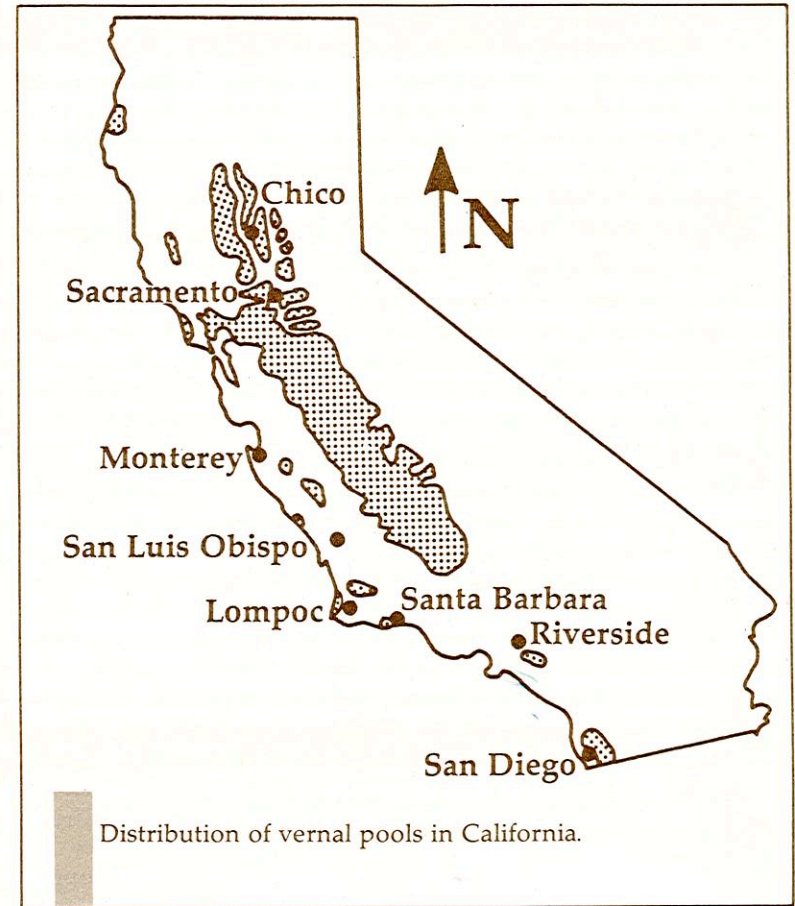


The *Culex* mosquito is aquatic as a larva, and can become abundant in Del Sol vernal pools. Adults are infamous.

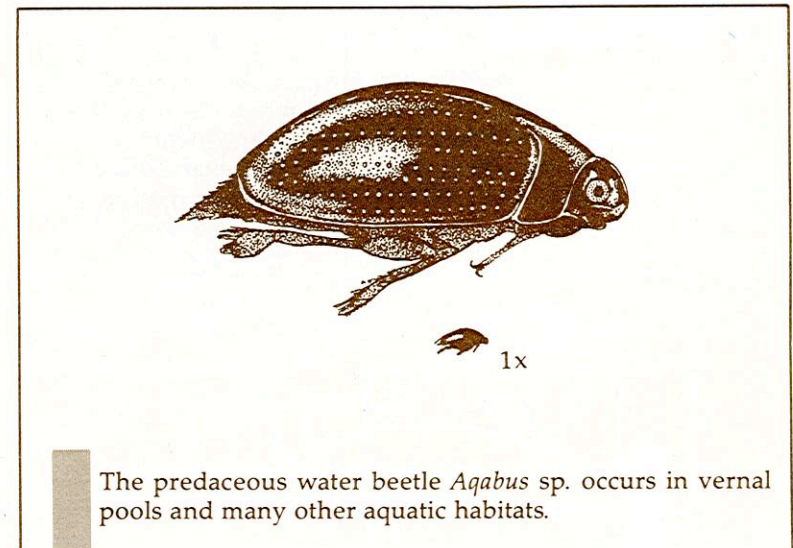
## Vernal Pools in California

Vernal pools occur throughout the State where conditions are favorable. Many areas in California with a Mediterranean climate, gently undulating topography, and impermeable soil have or once had vernal pools. They are most common along the eastern Central Valley at the lower foothills of the Sierra Nevada. They also occur in other parts of the Central Valley, as near Sacramento. Lava flows and volcanic mudflows in north-central California near Chico and in southern California near Riverside also have vernal pools. Others are located in the eastern valleys of the mountains between San Luis Obispo and Monterey. In addition to these interior locations, vernal pools exist on many terraces and mesas along the California coast. They are very numerous, for instance, in the San Diego region.

Vernal pools also occur outside of California. Pools similar to those in California exist in south-central Oregon and north-coastal Baja California. Other temporary pools with specialized organisms exist at many places throughout the world, and many of these habitats could be considered types of vernal pools.



Distribution of vernal pools in California.



The predaceous water beetle *Aqabus* sp. occurs in vernal pools and many other aquatic habitats.

## Vernal Pools at Santa Barbara

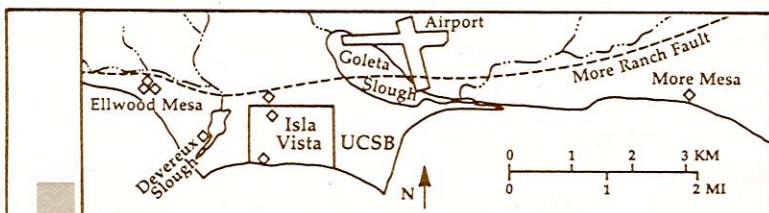
Vernal pools of the Santa Barbara area occur immediately west of the city at the coastal sites of More, Isla Vista, and Ellwood mesas. Each of these sites sits on the south side of the More Ranch Fault, a geologic feature along which the coastal zone has been uplifted to create relatively flat marine terraces. The vernal pools have formed on this flat topography at sites having minor depressions and an impermeable clay layer in the soil.

More Mesa has one vernal pool, which sits above the ocean bluff at the southeastern corner of the mesa. A dense stand of Harding grass (*Phalaris aquatica*), a robust naturalized plant, surrounds the pool, but several uncommon vernal pool species occur within it. Treefrogs are abundant at this vernal pool.

Isla Vista Mesa has 20 vernal pools, all but five of which are located at the Del Sol Reserve. Two not on the Reserve are at the south (ocean) side of Del Playa Drive near Camino Lindo. One of these is at the County Park Annex, a property of the Park District. These two pools on Del Playa Drive are the southernmost range for the plant *Eryngium armatum*, a coyote-thistle. Other vernal pools exist at the areas west of Camino Corto and north of Francisco Torres dormitory. In the dry season especially, dense grasses dominate most vernal pools in Isla Vista. Before urbanization in the 1960's, vernal pools were very common throughout the southern half of Isla Vista.

Ellwood Mesa, also known as Santa Barbara Shores, includes 17 vernal pools scattered over 80 hectares (200 acres). The vegetation of these pools is low, and has a high diversity of species. A history of horse grazing, or the particular soil there, may suppress many weedy species, allowing the high diversity. In 1985, near Ellwood Mesa on UCSB property west of Devereux Slough, a few vernal pools were created as an experimental effort to mitigate the destruction of vernal pools in the area immediately west of Isla Vista.

Vernal pools also occur in northern Santa Barbara County, such as in the Santa Rita Valley east of Lompoc. Northwest of Lompoc at Vandenberg Air Force Base, other vernal pools occur in low spots among old and stabilized sand dunes. Several of these support the coyote-thistle *Eryngium armatum* and plants not found in the Santa Barbara area.



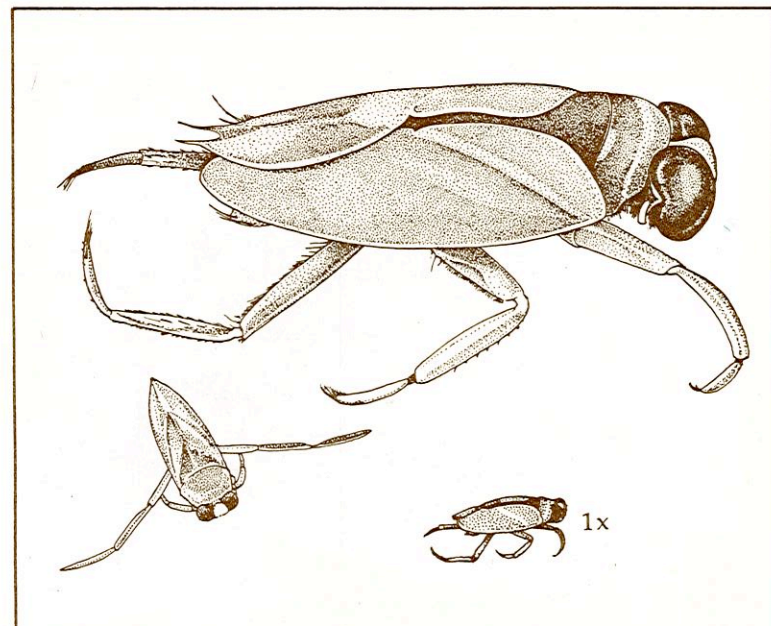
Locations of vernal pools (◊) in the Santa Barbara area.

## Vernal Pools at the Del Sol Reserve

The Del Sol Vernal Pool Reserve is a parcel 4.8 hectares (11.8 acres) in area located at the southeastern corner of El Colegio Road and Camino Corto. The property is owned by the Isla Vista Recreation and Park District. In addition to vernal pools, it also includes coastal scrub, which is represented by coyote bush (*Baccharis pilularis*), and grassland.

Fifteen vernal pools exist at the site, some of which are quite shallow and are dominated by naturalized ryegrass (*Lolium multiflorum*). The shallow vernal pools do not undergo enough flooding to support large populations of native plants such as popcorn flower (*Plagiobothrys undulatus*) or wooly-heads (*Psilocarphus brevissimus*), two species that grow only in vernal pools. Nevertheless, they are important aquatic habitats because many animals characteristic of vernal pools occur there.

The deeper Del Sol vernal pools that undergo prolonged flooding and support large numbers of indicator species are more numerous than the shallow pools. At their margins, the deeper pools typically support much ryegrass, but at their centers, the prolonged flooding provides conditions that support vernal pool plants such as coyote-thistle (*Eryngium vaseyi*) and pillwort (*Pilularia americana*). During late spring and summer, dense annual grasses dominate most of the vegetation of the Del Sol pools and other pools in Isla Vista.



Backswimmers (*Notonecta* sp.) are widespread aquatic carnivores that swim upside down.

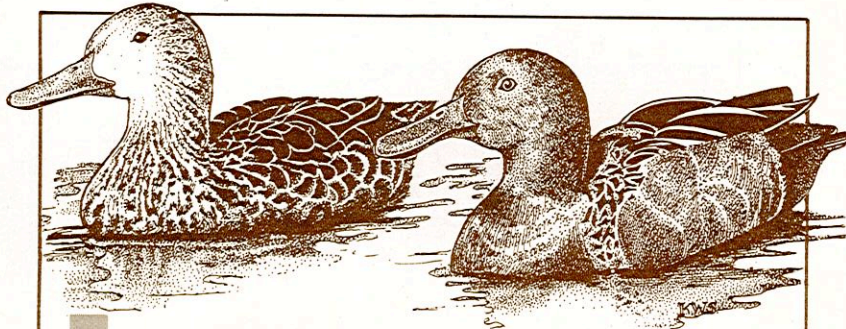
## Origin of the Del Sol Vernal Pools

The origin of the Del Sol vernal pools is attributed to several processes. The bigger pools probably were once seasonal seeps at the upper ends of troughs draining into Goleta and Devereux sloughs. Construction of the nearby streets isolated the habitats to form enclosed basins that are now the vernal pools. The seeps apparently functioned like vernal pools, and probably supported similar organisms. Other pools may have been isolated depressions that were connected to the troughs only during maximal flooding.

The pools that are presently crossed by footpaths very likely are expanding in depth and width as people walk through and around them. The soil also is becoming compacted, and retains more water. Although the location in a footpath has a high potential for disturbance, the organisms in these vernal pools are diverse because people avoid these flooded areas during the wet winter. At this time of year, the vernal pool environment is most susceptible to disturbances affecting the soft mud and fragile plant seedlings.

## Enhancement, Restoration, and Creation of Vernal Pools

In 1986, some of the Del Sol vernal pools were enhanced, restored, or created, three managerial techniques often practiced on aquatic ecosystems. This work was funded by a grant from the California State Coastal Conservancy to the Park District. In addition to modification and creation of the vernal pools, the project included removal of litter and debris, and the establishment of a low barricade around the site's perimeter to prevent vehicular access. To promote public awareness of the environmental resources at the Reserve, interpretive signs were installed, and this booklet and a pamphlet describing the site were published. The staff of the UCSB Herbarium assisted the Park District with most aspects of the project.



Cinnamon teal (*Anas cyanoptera*) occasionally visit Del Sol vernal pools during the winter.

One of the larger Del Sol vernal pools was *enhanced* by constructing two small dams to prevent water from draining out of the pool through ditches dug for mosquito abatement. Because it now floods to a greater depth, weedy species such as ryegrass, which have been some of the dominant plants within the vernal pool, should decrease in abundance with the increase in the depth and duration of flooding. Conversely, native vernal pool species should expand in abundance with an increase in flooding.

Two vernal pools were *restored* by removing mounds of soil, concrete, and other debris that had been dumped into them since the 1960's. Material was excavated with large and small tractors, and was mounded on top of an old parking lot, which is now a landscaped picnic and observation area. After excavation, the restored vernal pools were nearly tripled in size, and should support a greater population of native species.

Six vernal pools were *created* by excavating depressions into a dry grassland in the northeastern section of the Reserve. Three of them were inoculated with seeds obtained from surface scrapings of natural vernal pools at Ellwood Mesa. The other three were not inoculated, thus providing an experimental comparison. Excavation of both the created and restored vernal pools did not penetrate the impermeable clay layer in the soil.

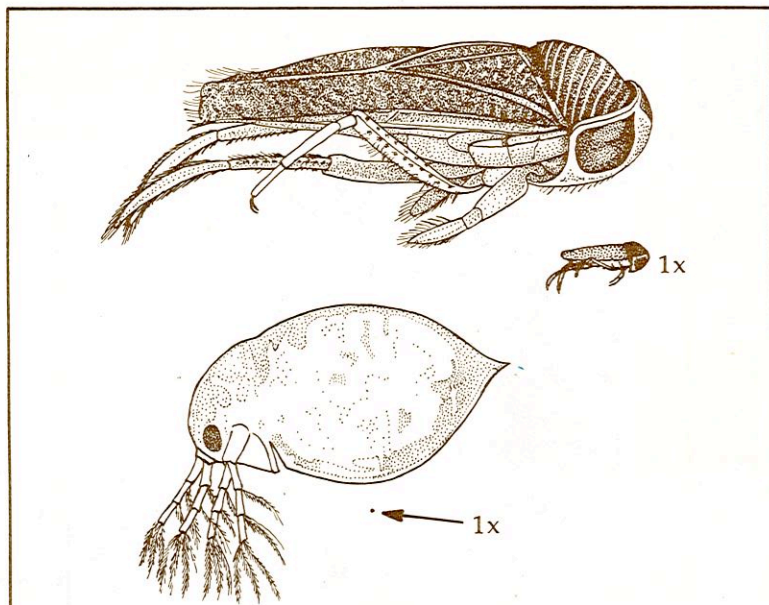


A small tractor excavates one of the created Del Sol vernal pools.

# Vernal Pool Organisms

The flora and fauna of the Del Sol vernal pools, as in all other vernal pools, include many groups from both the plant and animal kingdoms. A fern is included, as are many different monocots and dicots, which are the two categories of flowering plants. The list on page 11 includes the vascular plant species of the Del Sol pools. Most of these species can grow in habitats other than vernal pools, but those restricted to vernal pools in general or to vernal pools when the plants occur in the Santa Barbara area are noted accordingly. The fauna of the vernal pools is understood poorly, however, and no complete list is yet available.

No species presently listed by regulatory agencies as threatened, rare, or endangered occur in any vernal pools of the Santa Barbara area. Nevertheless, preservation of the vernal pool habitats and the organisms within them is extremely important to perpetuate regionally rare species such as pillwort (*Pilularia americana*) or Pacific foxtail (*Alopecurus howellii*), as well as the entire diversity of life in the local pools. A diversity of life can provide aesthetic satisfaction as well as economic gain. For instance, the seeds of meadowfoam (*Limnanthes* spp.), a vernal pool plant from other areas in California, produces an oil that may be a substitute for the financially and environmentally expensive oil from sperm whales.



Above: Water boatmen (*Corisella* sp.) are omnivorous, and occur in many types of pools.  
Below: The water flea *Daphnia magna* is a very small crustacean that is an important source of food for larger vernal pool animals.

# Plant Species Occurring in Vernal Pools of the Del Sol Reserve

## Ferns:

Marsileaceae, marsilea family

- \* *Pilularia americana*, pillwort

## Monocots:

Cyperaceae, sedge family

- \* *Eleocharis acicularis*, needle spike-rush
- + *E. palustris*, spike-rush

Juncaceae, rush family

- + *Juncus bufonius*, toad rush
- \* *J. tenuis*, yard rush

Poaceae, grass family

- \* *Alopecurus howellii*, Pacific foxtail
- † *Avena barbata*, slender wild oat
- † *A. fatua*, wild oat
- † *Bromus diandrus*, ripgut grass
- † *B. mollis*, soft chess
- † *Cynodon dactylon*, Bermuda grass
- *Distichlis spicata*, salt grass
- \* *Hordeum brachyantherum*, meadow barley
- † *H. geniculatum*, Mediterranean barley
- † *H. leporinum*, foxtail
- † *Lolium multiflorum*, ryegrass
- \* *Phalaris lemmonii*, lemmon canarygrass
- † *Poa annua*, annual bluegrass
- + *Polypogon monspeliensis*, rabbitsfoot grass
- † *Vulpia myuros*, rattail fescue

## Dicots:

Apiaceae, celery family

- \* *Eryngium vaseyi*, coyote-thistle

Asteraceae, sunflower family

- †† *Cotula coronopifolia*, brass buttons
- \* *Hemizonia australis*, tarweed
- *H. fasciculata*, tarweed
- † *Lactuca serriola*, prickly lettuce
- \* *Psilocarphus brevissimus*, woolly-heads
- † *Sonchus asper*, prickly sow-thistle
- † *S. oleraceus*, common sow-thistle

Boraginaceae, borage family

- \* *Plagiobothrys undulatus*, popcorn flower

Callitricaceae, starwort family

- \* *Callitriche marginata*, willow starwort

Caryophyllaceae, pink family

- † *Spergularia arvensis*, corn spurry
- † *Spergularia bocconii*, sand spurry

Convolvulaceae, morning glory family

- † *Convolvulus arvensis*, bindweed

Crassulaceae, stonecrop family

- \* *Crassula aquatica*, stonecrop

Elatinaceae, waterwort family

- \* *Elatine brachysperma*, waterwort

Euphorbiaceae, spurge family

- *Eremocarpus setigerus*, dove weed

Fabaceae, pea family

- † *Vicia angustifolia*, narrowleaf vetch
- † *V. benghalensis*, purple vetch
- † *V. sativa*, common vetch

Geraniaceae, geranium family

- † *Erodium botrys*, broadleaf filaree
- † *E. cicutarium*, redstem filaree
- † *E. moschatum*, whitestem filaree

Lythraceae, loosestrife family

- + *Lythrum hyssopifolia*, loosestrife

Plantaginaceae, plantain family

- † *Plantago lanceolata*, English plantain

Polygonaceae, buckwheat family

- † *Polygonum aviculare*, common knotweed
- † *Rumex angiocarpus*, sheep sorrel
- †† *R. crispus*, curly dock

Portulacaceae, purslane family

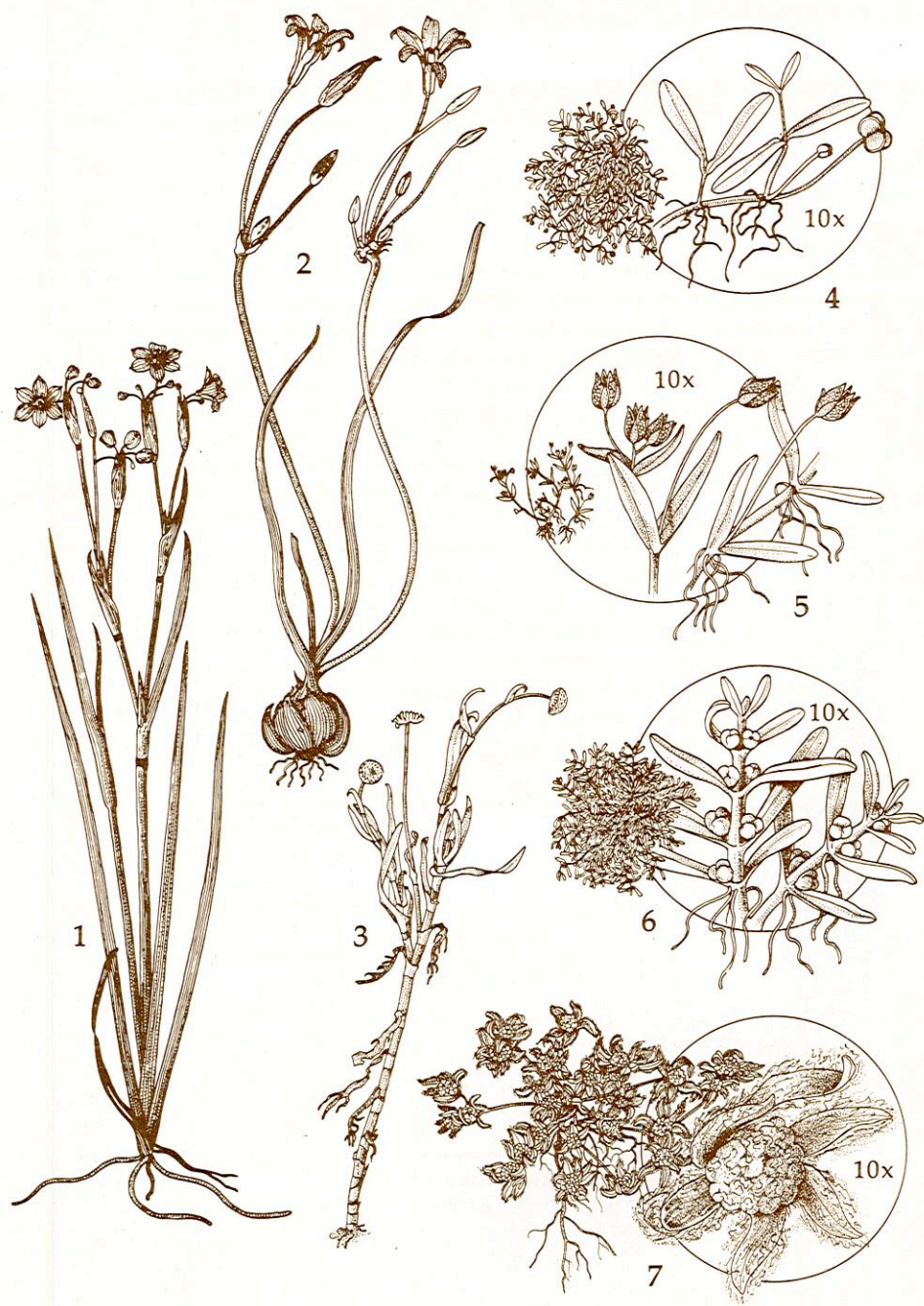
- *Calandrinia ciliata*, red maids

Primulaceae, primrose family

- † *Anagallis arvensis*, scarlet pimpernel
- \* *Centunculus minimus*, common chaffweed

- \* Species restricted to vernal pools in general or to vernal pools when the plants occur in the Santa Barbara area.
- + Species restricted to vernal pools and other aquatic habitats.
- † Naturalized, non-native species.
- Native species occurring in many habitats.

Vernal pool plants surveyed in 1987 by Holly C. Forbes.

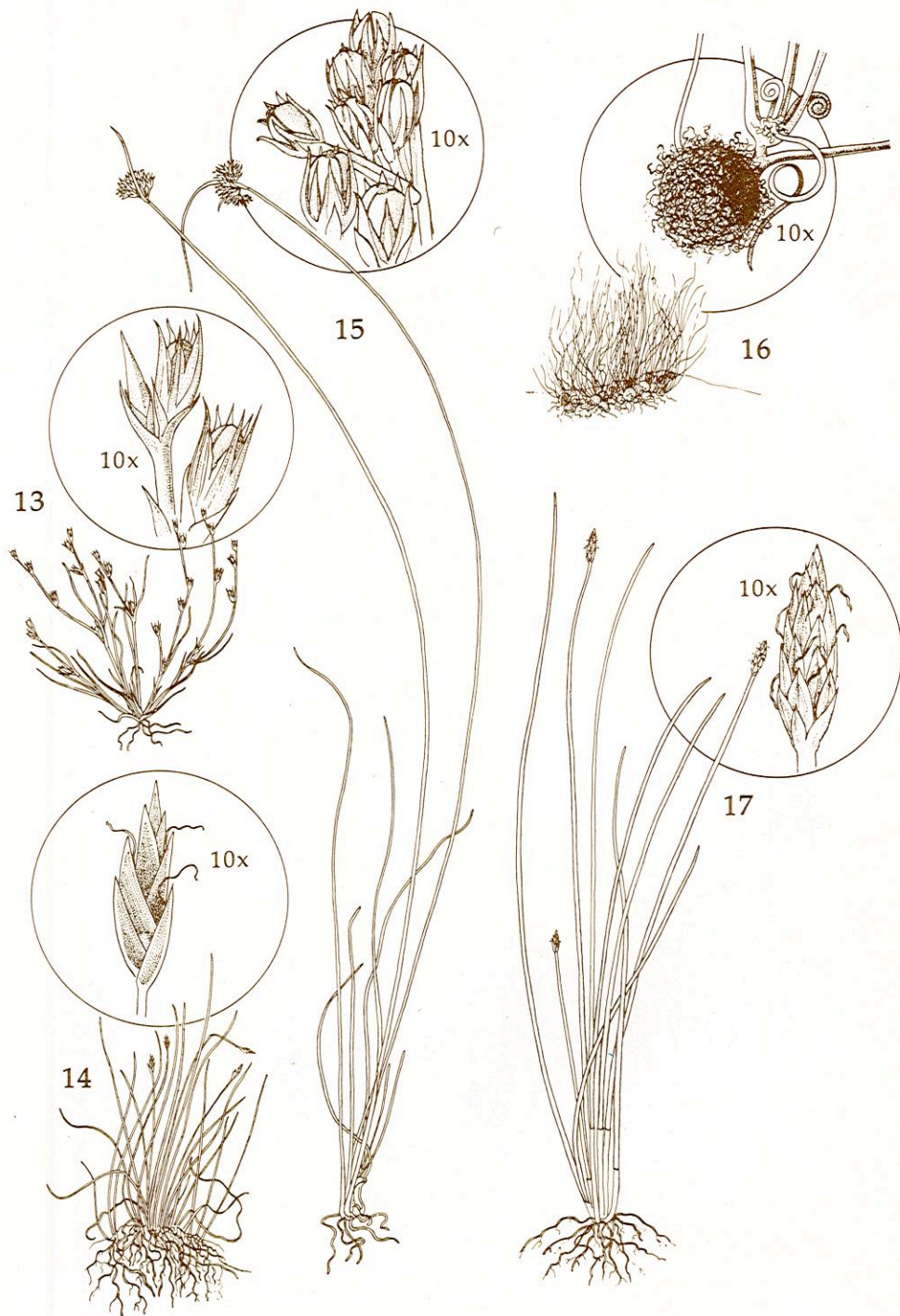


1. blue-eyed grass (*Sisyrinchium bellum*), 2. dwarf brodiaea (*Brodiaea jolonensis*), 3. brass buttons (*Cotula coronopifolia*), 4. wallow starwort (*Callitriche marginata*), 5. stonecrop (*Crassula aquatica*), 6. waterwort (*Elatine brachysperma*), 7. woolly-heads (*Psilocarphus brevissimus*). 1 and 2 show plants that grow on the margins and outside of vernal pools. Illustrations are  $\frac{2}{3}$  actual size.

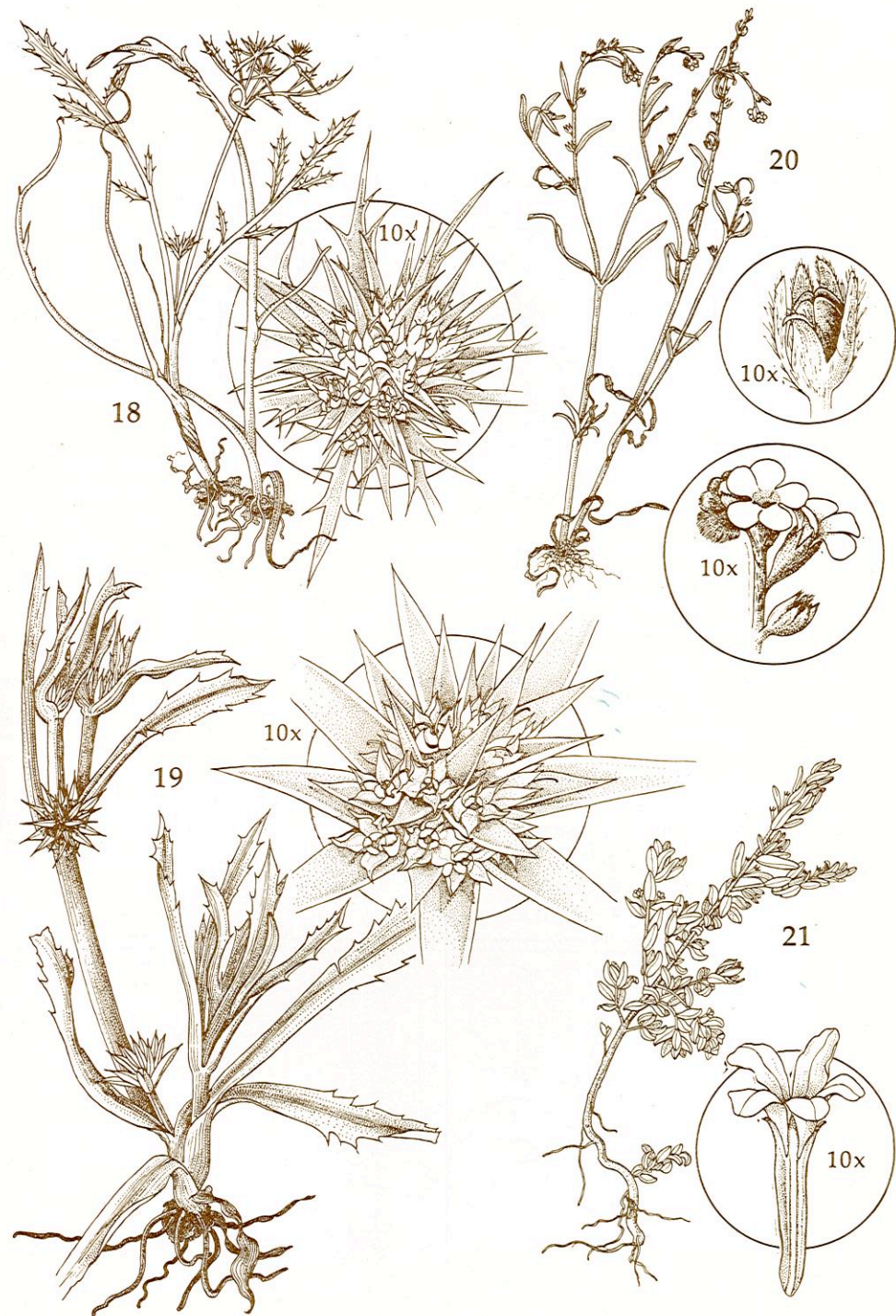


8. meadow barley (*Hordeum brachyantherum*), 9. ryegrass (*Lolium multiflorum*), 10. Pacific foxtail (*Alopecurus howellii*), 11. Mediterranean barley (*Hordeum geniculatum*), 12. Lemmon canarygrass (*Phalaris lemmonii*). Illustrations are  $\frac{2}{3}$  actual size.





13. toad rush (*Juncus bufonius*), 14. spike-rush (*Eleocharis acicularis*), 15. yard rush (*Juncus tenuis*), 16. pillwort (*Pilularia americana*), 17. spike-rush (*Eleocharis palustris*). Illustrations are  $\frac{2}{3}$  actual size.



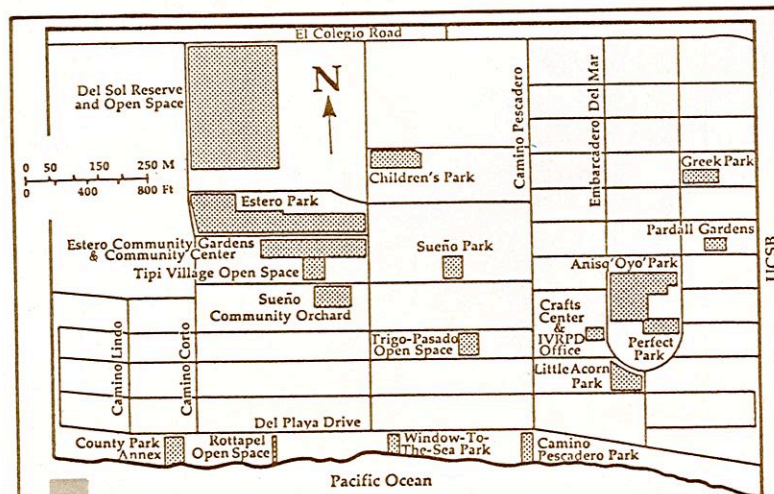
18. coyote-thistle (*Eryngium vaseyi*), 19. coyote-thistle (*Eryngium armatum*), 20. popcorn flower (*Plagiobothrys undulatus*), 21. loosestrife (*Lythrum hyssopifolia*). Illustrations are  $\frac{2}{3}$  actual size.

# The Isla Vista Recreation and Park District

Established in 1972, the Isla Vista Recreation and Park District (IVRPD) is a governmental body with an elected Board of Directors and a professional support staff. According to its Master Plan, the purpose of the District is "to enhance, improve, and protect the quality of life in the community" and to "contribute to the health, enjoyment, and thriving satisfaction of the people, and to the safety, cleanliness, and beauty of the environment, its flora and its fauna." The District is financed primarily through bonds and property taxes in Isla Vista. IVRPD endeavors to preserve open space in Isla Vista through the acquisition and maintenance of land as parks, gardens, or nature reserves.

Parcels owned by the District are managed as one of three categories: Natural Open Space, Improved Park, or Developed Park. A Natural Open Space, such as Del Sol Open Space and Reserve, has undergone minimal disturbance or development, and is characterized by native or naturalized flora and fauna. An Improved Park, such as Anisq' Oyo' Park or Children's Park, consists mostly of landscaped vegetation and natural land forms in conjunction with buildings, walkways, or other structures. A Developed Park, such as the Craft Center or Estero Community Center, includes mostly various buildings and structures with minimal open space and vegetation.

In addition to the preservation of open space in Isla Vista, the promotion of recreation and cultural arts also is an important goal of the District. Annual festivals, for instance, are sponsored in the fall and spring. The Park District office is located at 961 Embarcadero del Mar, Isla Vista, CA 93117, telephone 805-968-2017.



Parcels within the Isla Vista Recreation and Park District.



A natural vernal pool at Del Playa Drive and Camino Lindo in Isla Vista. Santa Cruz Island is visible on horizon.



At an Ellwood Mesa vernal pool, plants within are beginning to flower, whereas plants outside already have become dormant.