Native Species Planting Guide for the Elkhorn Slough National Estuarine Research Reserve February 2001

Native Species
Planting Guide
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Grassland Natives

Acaena pinnatifida var. californica

California acaena grows from branched, subwoody rhizomes which travel through rocky soils atop coastal bluffs (Keator 1990). It flowers April-May, prefers full sun, and is best propagated using rhizomes (Keator 1990). If using seeds, pretreat them with 4-6 weeks of stratification (Emery 1987).

Achillea millefolium

Yarrow is a vigorous perennial that arises from a weakly spreading root system (Whitson et. al. 1996). It flowers April to October (May through June according to Reserve volunteers), and the seed matures from late summer into early fall. *Achillea* can reproduce from seed and rhizomes from early spring and it matures from August through October (UCDANR 1996).

Yarrow is very easy to grow. Collect mature inflorescence when ray flowers have fallen and disc flowers are brown. Seeds are light tan at maturity**.** Seeds do not need to be cleaned (Sue Shaw, pers. comm). Seed longevity is 3 to 5 years in sealed containers at 1C, and seeds do not need any pretreatments (Emery 1987). Seeds per kilogram: 4,700,000/kg (Evans et. al., 2000a).

At Glacier National Park, Montana, workers have grown yarrow in an outdoor nursery, using a growing media made up of 50% milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9

month release rate at 21C) and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at the rate of 1 gram of Osmocote and 0.20 gram of Micromax per 172 ml container. There, containers are filled and sown in late fall and irrigated thoroughly prior to winter stratification (Evans et. al., 2000). After sowing, media is kept slightly moist during germination. Germination occurs at 22C, and shoot and root development occur rapidly following germination. Additional fertilizer is not required. Plants flower approximately 6 weeks after germination. To harden the seedlings, irrigation should be gradually reduced in September and October. Plants can then be flushed with clear water and fertilized with 10-20-20 liquid NPK fertilizer once before winterization (Evans et. al., 2000).

Yarrow can also be grown using divisions since this species is rhizomatous**.** Plant in full sun (Keator 1990).

Aesculus californica

California buckeye is a small, relatively short-lived, deciduous tree. It flowers May through June (or April through September in Southern California). The seeds ripen in the fall, and they are pale brown in color, smooth and shining, and have a large, light-colored hilum resembling the pupil of an eye. October through December the capsules split and release the seeds. Trees must be at least 5 years old to produce seeds, and there are generally 1-2 years between large seed crops. The fruits may be collected by picking or shaking them from the trees as soon as the capsules turn yellowish and begin to split open, or by gathering them from the ground soon after they have fallen (Rudolf 1974).

The fruits should be dried for a short time at room temperature to free the seeds from any parts of the capsules that may still adhere to them, but great care must be taken not to dry them too long. When this occurs, the seedcoats become dull and wrinkled and seeds lose their viability. Fresh seeds need no pretreatment to germinate. The seeds should be sown at once or stratified for spring sowing. Initial viability of fresh seeds can be maintained for 6 months when they are stored in plastic bags at 5º C. This storage condition is the same as cold-moist stratification (prechilling) because of the high moisture content of fresh seed. When seeds of horse chestnut were stored at –2ºC in sealed packages without added moisture for 13 months, germination dropped from 80 to 60%. After 15 months germination was only 25%. (Young and Young 1992).

Aesculus californica germinates just after winter rains have begun, usually in November. In the nursery, seeds should be sown in the fall as soon after collection as possible to prevent drying. The seeds should be sown about 5 cm apart in rows 15 cm apart and covered with 2.5 to 5 cm of soil. Germination is complete 3 to 4 weeks after spring sowing (Rudolf 1974). When transferring larger containers, use 1 gallon treepots, not 1 gallon standard pots (Sue Shaw, pers. comm). Buckeyes cannot be held in the greenhouse over 2 years (Patti Kreiberg pers. comm).

Aesculus can also be propagated using cuttings. Plant in full sun or very light shade. Leaves and seeds are poisonous, so do not plant where young children wander (Keator 1994). Otherwise, *Aesculus* works well for hillside erosion control (Singer 1982).

Agrostis pallens

Dune bentgrass or thin grass is a warm season, perennial rhizomatous grass that occurs in dunes, open meadows, chaparral, woodland, forest, and subalpine areas. It grows 10 to 70 cm tall, and grows on dry to moist and sandy to rocky soils in full sun (CNGA 1999).

Raising large number of grasses from seed is easy: simply sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Care is needed during this process to keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind. Usually, careful study of weedy grasses in the garden beforehand will acquaint you with what to look for (Keator 1990).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Alnus rhombifolia

White alder is a quickly growing, deciduous, shallow rooted tree whose roots fix nitrogen, enriching the soil (Singer 1982). Clusters of male and female catkins occur on the same tree in March, and its fruit ripens late September through early October. Seeds disperse October-April. Seeds are small nuts borne in pairs on the bracts (scales) of the strobiles (cones). Strobiles may be collected from standing or recently felled trees when the bracts start to separate on the earliest strobiles. They will open after being exposed in

drying racks in a well-ventilated room for several weeks at ambient air temperature. They can be opened in a shorted time by drying them in a kiln at 25º to 35º C. Most of the seeds fall out of the strobiles during the drying process. The remainder, if needed, may be extracted by shaking or tumbling.

Seed purity of most lots of cleaned seed is usually between 30 and 70 percent, and seed viability is often very low (Emery 1987). To store, place air-dried seeds in sealed containers at 2º-5º F. *Alnus rhombifolia* does not need to be pre-treated before germination (Schopmeyer 1974). Sow in the fall, and plant in shade (Singer 1982).

Anaphalis margaritacea

Pearly everlasting is a perennial composite that is easy to grow. The plant spreads by rootstock, flowers July to September, and its seeds mature in late September and early October.

To grow, begin by hand collecting seeds in late September and early October. Its seeds are minute, oblong, achenes with a tuft of fine bristles, that are dark brown at maturity (USDA 1937, Wick et. al. 2000). Seeds do not need seed pretreatment (Emery 1987). Seeds can be sown in the greenhouse, or planted directly in the ground. If direct seeding this species on restoration sites, seed should be rolled into seed bed and care should be used not to bury seed too deeply (Wick et. al. 2000). Pearly everlasting can also be propagated using root divisions (Keator 1990). Plant in full sun (Keator 1990).

Arbutus menziesii

Pacific madrone or madroño is an evergreen tree varying in height from 25 to 130 feet. Its fruit is a 1/3 to 1/2 inch diameter berry, which is eaten by birds, especially quail. The fruit turns bright red or orange when ripe and has a thin, rough, granular skin. Flowering occurs from March to June, and fruits ripen in September and October. Fruits remain on the trees until December. Minimum seed-bearing age is 3 to 5 years and fruits are abundant almost every year.

Berries may be collected from standing trees from October to December. Berries can be dried at room temperature or seeds can be separated from the pulp immediately after being collected. Fresh or dried fruit can be soaked in water in a warm place to soften the pulp. Fruits than can be macerated and the seeds separated from the pulp by floatation. Seeds should be thoroughly dried before storage.

The dried berries or seeds can be stored at room temperature for 1 or 2 years, but airtight containers, such as sealed Mason jars or plastic bags, stored at 3º C to 5º C are recommended, especially for longer storage.

For germination, the fleshy layer should be removed from either dried or fresh berries before a pregermination treatment is started. Seeds must be stratified in a moist medium at 2º to 5º F for 60 days.

Pacific madrone has been propagated by germinating its seeds in flats and transplanting the resulting seedlings to individuals containers. This species has been propagated vegetatively by grafting, layering, and rooting of cuttings (Roy 1974).

Artemisia douglasiana

Mugwort. In general, *Artemisia* spp. are fall bloomers that set and mature seeds relatively late in the fall or early winter. Its seeds are small, ellipsoid, and hairless achenes without ribs or angles (USDA 1937). Determination of seed ripeness is difficult with sagebrush species because of the small seed size. When seed can be easily removed from the heads by shaking and is too hard to be easily crushed with a thumbnail, it is ready to harvest. Because seed matures so late in the season, it often has to be harvested quickly after maturity to avoid losses and storm damage. Harvest sagebrush seed by clipping the seed stalks and bagging the material in paper bags for air drying. Harvesting usually results in a mass of thrashy material from seed stalks and flower parts with the very small seeds lost in the mixture. Seeds can be threshed by rubbing the inflorescence through a screen and the seed separated from the chaff by using an air screen and a pneumatic seed blower (Young and Young 1992).

Artemisia spp. seeds germinate naturally at relatively cool temperatures. Seed should be sown on nursery beds during the fall or winter at a rate that will produce about 50 seedlings per square foot. The seed should be covered with 1/4 inch of soil and a light straw mulch. One- and 2-year-old seedlings should be field-planted early in the spring; fall transplantings are generally not successful. However direct seeding can be done throughout the late fall and winter on prepared sites. If seeding must be done in the spring, stratification may be of benefit (Deitschman 1974).

Aster chilenses

California aster. Asters have been strong competitors in Reserve habitats, and volunteers have found that they flower late August through October. They are easy to grow from seeds, which need no pretreatment (Emery 1987). They can be planted in grasslands, salt marshes (transition to upland?), and disturbed places (Jepson Manual).

Baccharis pilularis

Coyote brush is an invasive, pioneer evergreen shrub that occurs on dunes and headlands along the California coast, from Russian River to Point Sur, Monterey. It flowers July through October, its seeds ripen September through November and then disperse in the fall (Olson 1974). Its male and female flowers grow on separate plants, and both appear fuzzy and off-white. The fruit is an achene (a small, dry, hard, non-splitting 1 seed fruit) tipped by a pappus of bristly hairs. Seed crops are borne annually, and are dispersed by wind (Young and Young 1992).

Baccharis is easily grown from seed, especially if these seeds are propagated the same day they are collected (Sue Shaw, pers. comm). The ripe fruits can be collected by hand or by brushing them into containers or ground cloths. If not planting the same day as collecting, the achenes should be spread out to dry in a warm, well-ventilated room, or in the sun, protected from the wind (Olson 1974). When dried, they may be rubbed through a fine screen to remove the pappus for ease in handling. Cleaned seeds of *Baccharis* can be stored at 2 to 5º C in sealed containers (Young and Young 1992). Seeds do not need pretreatment (Emery 1987) and should be sown in the fall or early spring in flats or seedbeds using sandy soil mixtures, or one of the perlite or sphagnum

moss seeding mixtures (Young and Young 1996). Seeds usually germinate within two weeks. Seedlings can be shifted to four-inch pots after four months. When well rooted they may be set into the ground (Schmidt 1980).

Another simple propagation method is by short, tip cuttings taken from male plants in late fall to early spring. These may be rooted in clean, sharp sand, and then handled in the same manner as seedlings. Propagation by cuttings perpetuates plants have the best features and foliage color.

Baccharis thrives in full sun to very light shade. It is a low-maintenance, dependable plant for erosion control, and it performs admirably in heavy soils as well as sandy ones (Schmidt 1980, Singer 1982).

Baccharis viminea

Mulefat is an evergreen shrub that flowers through the spring and summer. It can be propagated using suckers and by seeds. Suckers are stump sprouts, produced at the base of shrubs or from their sometimes wandering roots. Propagation by suckers is straightforward: cut off each sucker with a clean, sharp knife, and include as many attached roots as possible. Treat suckers as you would a newly divided perennial or newly rooted cutting (Keator 1994).

Brodiaea elegans

Harvest Brodiaea. Available on Yampah Island. *Brodiaea elegans* flowers from May to July, and produces quantities of seed in upright, papery capsules that remain intact until autumn (Schmidt 1980, Keator 1990). A mature corm (a solid, bulblike, underground

stem) is produced in about three years. Around the base of a mature corm, *Brodiaea* produces cormlets that take two or three years to reach flowering size. The corms should be planted three to four inches deep in mid- to late autumn. Seeds can also be planted, and they usually germinate readily without pretreatment (Emery 1987). *Brodiaea* prefers full sun and semi-dry conditions, and naturally occurs in open fields, gravelly slopes, uplands, light oak woodlands, and occasionally in meadows and places of seasonal moisture (Schmidt 1980).

Bromus carinatus

California brome is a short-lived, cool season perennial bunchgrass (CNGA 1999). It is a highly variable grass that is abundant in California, and it is extremely variable in size, measuring from 20 in to 4 ft (45 to 150 cm). *Bromus carinatus* generally germinates in the fall, goes dormant over the winter, and then grows rapidly in the spring. Its seeds mature in spring and summer, and generally they have a collection window of 2-6 weeks (CNGA 1999). It grows in many habitats, including canyons and hillsides, seasonal riparian areas, woodlands, upland dry meadows, and disturbed habitats, from British Columbia to Baja California (Anderson and Anderson 1996, CNGA 1999). It is sometimes found as dense stands in the open pine or oak forests, but it avoids full shade. Its young seedlings are nutritious and are readily grazed by animals, although older plants are less palatable (Crampton 1974). It can be a very productive grass on fertile sites, and it is a good species for erosion control, revegetation and wildlife habitat.

Growing *B. carinatus* is easy: it has fast germination and good seedling vigor. Sow the seeds in potting soil, and separate while still quite young—otherwise the roots of

adjacent seedlings become inextricably entangled. Keep the soil free from weeds (Keator 1990). If seeding directly into the soil, use 35 lbs of seed/acre (Seeds/lb = 73,985 to 103,683. Seeds/ft^2 at 1 lb/acre = 2 (CNGA 1999)).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Dremann (1996) found that storing seeds of *Bromus carinatus* and *Elymus glaucus* in below-freezing temperatures (-7 degrees C), resulted in stunted growth of the grasses relative to those stored above freezing temps. He initially stored all seeds at room temperature for ~11 months. Later he separated the seeds into 3 treatments: storage at room temperature for the next 4 year, refrigeration for 4 years (0.6-6.0 degrees C), and frozen for the same time period.

With occasional heavy grazing or mowing in winter and early spring, California brome will persist or increase in overall cover. However, continuous grazing or mowing will injure plant vigor and reduce its cover. Because of its favorable response to early spring and late summer mowing, California brome is excellent for weed management, and it can be used to choke out exotics. Generally it performs best on fertile and well drained soil (Albright Seed Co. product information bulletin), in partial shade, openings, and full sun (CNGA 1999). It does not tolerate flooding (CNGA), but it is fire tolerant—fires kill the top portion, but *B. carinatus* resprouts from surviving root crowns the next growing season. Burns can be done in either spring or fall (CNGA 1999).

Calandrinia ciliata

Red maids. Available on Yampah Island. *Calandrinia* is an annual succulent found in moist areas. It germinates from November through January, and flowers in early spring (UCDANR 1996). Seeds are numerous, black and shiny (Whitson et. al. 1996).

Calochortus luteus

Yellow mariposa lily. Available at Yampah Island. These rare, drought tolerant bulb plants grow from a slender, coated corm. *Calochortus luteus* flowers April-May and grows sun, semi-dry, porous soil. All species of *Calochortus* may be grown from seed which germinates readily without pretreatment (Emery 1987). It is best planted in late autumn. Seed can be planted in deep pots, flats, or outdoor seed beds. Soil mixture should be porous, with an extra measure of sand or vermiculite. *Calochortus* requires three to five years to develop from a seed to a mature cone. Seedlings should be kept evenly moist during the period of active growth, but allowed to dry out when yellowing foliage indicates the need for a dormant period, generally by mid- to late summer. Plant the corms about three inches deep from late September through October. Most mariposas are drought resistant and should be used in full sun and lean soil (Schmidt 1980).

Camissonia cheiranthifolia

Beach evening primrose is found on sand dunes and it flowers April through August. It works well as a ground cover, and it has a high germination rate (Sue Shaw, pers. comm.).

Camissonia ovata

Suncup is a perennial primrose found in grasslands, coastal scrub and woodlands. On the Reserve, it can be found on the Long Valley Loop and Hummingbird Island. It has a long growing season that begins after the first seasonal rain, and dies back to its stout taproot in late summer/fall (Keator 1990). It flowers March through June, and is easily propagated by seed, which does not need any pretreatment (Emery 1987, Matthews 1997). However, only the lower portion of the ovary is fertile, so it is necessary to look for seeds near the base of the plant (Sue Shaw, pers. comm.). Plant in full sun away from taller plants—it is a poor competitor in tall vegetation (Keator 1990). Sun cups do best in clay (Patti Kreiberg pers. comm).

Ceanothus spp.

California lilac is important as wildlife food and shelter, and can aid in erosion control (Reed 1974). The roots of most *Ceanothus* spp. bear nitrogen-fixing nodules, making them an ecologically important component of range and forested sites (Young and Young 1986). Most species can be propagated using cuttings or seeds (Keator 1994).

Ceanothus cuneatus (Monterey ceanothus) is common on dry slopes and in chaparral, flowers March through June (January through May according to Matthews 1997), and its fruit ripens April through June (Reed 1974).

Ceanothus dentatus is found in sandy areas, and it flowers March through May (Matthews 1997).

Ceanothus griseus is found in scrub and forest habitats, and it also flowers March through May (Matthews 1997). Plant in full sun (Singer 1982).

Ceanothus thyrsiflorus (blue blossom) flowers January through June (March through June according to Matthews 1997), and its fruit ripens April through July. It is one of the fastest and easiest *Ceanothus* species to grow (Keator 1994). Plant in half to full sun in an area with good drainage. This plant works well for erosion control, and its roots enrich the soil with nitrogen-fixing roots (Singer 1982).

Ceanothus spp. seeds are smooth and convex on one side. Seed should be collected only from vigorous plants. Weak, diseased plants do not produce sound seed (Reed 1974). Capsules on ceanothus species split at maturity and the seeds are ejected with considerable force. Therefore a common method of seed collection is to tie cloth bags—preferred to paper—securely over clusters of green seed pods. It is also acceptable to pick ceanothus seeds when slightly green to avoid losing seeds before they are ejected. (Emery 1987). However, it is important to note that seeds found to contain milky or gelatinous substances are too immature to harvest.

Dry seeds in a screen-covered container at day temperature of 85º to 100ºF. If dried at much lower temperature, the capsules may not open, and then they must be thrashed by pounding with a heavy object in order to separate the seeds and chaff (Emery 1987). Or seed can be separated from capsule fragments by screening and fanning, or they can be passed through a fanning mill and floated. Number of cleaned seeds per pound averages 49,000 for *C. cuneatus* and 48,000 to 152,000 for *C. thyrsiflorus*. Seeds can be successfully stored for over 10 years in tightly closed containers kept in a warehouse or shed (Stein et. al. 1974).

Seed dormancy is common in this genus (Emery 1987). For most species germination can be induced using a hot water soak (160º F, until the water cools), and three months of cold stratification (Reed 1974, Emery 1987). Stratification is accomplished by storing seeds in a moist medium for 90 days at temperatures of 34º to 41º F. In lieu of cold stratification, a chemical treatment with gibberellin and thiourea can be used to induce germination of *C. cuneatus* (Reed 1974). For *Ceanothus griseus*, boil seeds in water for 1 minute, cool immediately to room temperature, and sow (Emery 1987).

Fall planting to satisfy prechilling requirements has given the best results. Seedlings are often transplanted to containers and grown for a season before being transplanted into the field (Young and Young 1992). Use a medium of five parts loam, four parts peat, and three parts sand. Leaf-mold may be substituted for the peat, but the peat is preferred because it is comparatively free of fungi. Sand is needed for drainage, a higher proportion being used in the seeding than in the potting medium. Seedlings are sensitive to sowing depth. As a rule of thumb, sowing of properly pretreated seed should be at depths of about twice the diameter of the seed at its greatest dimension. In one trial, *C. cuneatus* emerged best when sown at depths of 1/2 to 1 inch. Many *Ceanothus* species are sensitive to damping off, so for safety, soil should be sterilized. In California seeding is usually done in November, December, or January (Reed 1974).

When several sets of true leaves have formed the seedlings are pricked into 2 or 3 inch pots. A good potting medium is five parts loam, three parts peat or leaf mod, and one part sand. Care must be taken not to set the seedlings too deep in the soil. Root crowns should be just below the soil surface. Seedlings are susceptible to stem rot and

the loss will be great if young plants are kept in moist soil reaching above the root crown. The root development should be examined from time to time. When a loose root system has formed on the outside of the ball, the plant is ready for shifting to a larger pot or gallon can. It is best to discard pot bound plants rather than to carry them along (Reed 1974). Care should be taken to inoculate seedlings with nitrogen-fixing organisms (Young and Young 1992).

Chlorogalum pomeridianum

Wavy leafed soap plant grows from a large, coated bulb that blooms May to June, opening only in the late afternoon and evening. Its fruit is a small capsule, with rounded black seeds that are shed by early summer (Schmidt 1980, Keator 1990). *Chlorogalum* occurs on sunny, semi-dry areas including dry hills, plains and open woodlands of both mountain ranges from southern Oregon to San Diego. Soap plant can be easily propagated by seed (which do not need pretreatment), and bulbs that can be divided (Schmidt 1980, Emery 1987).

Cirsium occidentale var. californicum

California thistle flowers May through July and occurs on dry slopes, in chaparral, coastal sage scrub, and in woodlands (Matthews 1997).

Cirsium occidentale var. occidentale

Cobweb thistle flowers April though July (Matthews 1997), and it germinates easily. To collect, cut the seed head (or thistle) and then store in a paper bag until the seeds explode. Then plant (Sue Shaw, pers. comm.).

Clarkia rubicunda

Ruby chalice clarkia is an annual that grows in grassy, sunny areas with moderate water, and blooms over long periods from late spring into summer (mostly May through July) (Matthews 1997). Its fruit is a capsule (Young and Young 1986). *Clarkia* may be grown from seed broadcast in autumn, and again in early spring. They may also be grown in flats, and the seedlings transplanted while young to develop a good root system (Schmidt 1980).

Claytonia perfoliata

Miner's lettuce is a succulent annual usually found in moist, shady areas. Its seeds germinate from late fall through early spring, and it matures from April to May. Seeds are borne in a capsule that splits open at maturity. They are small, 1/16 inch in diameter, shiny, black, and lens shaped, with a whitish projection at the notched scar (UCDANR 1996). Seeds need 2 months cold stratification pretreatment (Emery 1987).

Conyza canadensis

Horseweed is a winter or summer annual that flowers and produces seed from late June to September. Seeds are numerous, small, flattened, about 1/16 inch long, with a white

bristle pappus (Whitson et. al. 1996). If using in restoration, be aware that this species spreads rapidly (Sue Shaw, pers. comm.).

Cressa truxillensis

Alkali weed is a low-growing perennial that grows in saline and alkaline soils. Its seeds germinate from April to May and the plant produces mature seeds from late summer into early autumn. The fruits are small, hairy capsules, each with one seed 1/8 inch long. The seed is broadly egg shaped and pinkish tan, with a smooth surface (UCDANR 1996). Available at Yampah Island.

Danthonia californica

California oatgrass looks similar to the invasive, alien wild oats. It is a low perennial bunchgrass that works well in lowland meadows (Keator 1990). It prefers moist soils or at least soils with adequate subsurface moisture—arid soils do not support these grasses at all (Crampton 1974). It grows to about 2-3 ft tall, and is valuable animal forage (Crampton 1974). According to ESNERR volunteers, ripe seeds can be difficult to find on the Reserve. To find seeds, check the base of sheaths for cleistogamous spikelets (or "bud-like, unopening flowers") (Sue Shaw, pers. comm.). Once collected, however, it is not necessary to pretreat seeds before sowing (Emery 1987).

ESNERR volunteers have found that propagating from seeds can be difficult. However, once the grass emerges and is growing well, it easy to separate. Be sure to separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Care is needed during this process to keep the soil free from

weeds, especially weed grasses which are difficult to distinguish at first from the native kind. Usually, careful study of weedy grasses in the garden beforehand will acquaint you with what to look for (Keator 1990).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Deschampsia caespitosa

Tufted hairgrass or Pacific hairgrass is a robust, cool season perennial bunchgrass with green, firm leaves and flowers with hair-like awns, hence the common name (CNGA 1999). These grasses occur primarily in wet sites, such as wetland meadows, perennial riparian sites, and coastal springy areas, seeps, marshes and bogs (Crampton 1974, Anderson and Anderson 1996, Stromberg and Kephart 1996). It is the most prevalent plant in the highest zone of northern Pacific coastal marshes. It is found in freshwater and in brackish waters up to 20 ppt. It is a good soil stabilizer, it is plentiful, and it is easy to plant (Knutson and Woodhouse, 1982). *Deschampsia* does well in full sun to semi-shade, and can tolerate short term flooding and mowing (CNGA 1999). It may be top killed by severe fires, but it generally survives low intensity fires, because the root crown survives all but the most severe fires, and the grasses recover to pre-fire levels in just a few years (CNGA 1999). It is one of the most important range species in the western U.S. since all classes of livestock forage on the plant; it is widely distributed, frequently in dense stands, it can withstand rather close grazing and recovers well. It is

also valuable in control of soil erosion (Crampton 1974). *Deschampsia caespitosa* is excellent for revegetation near ponds, streams, alluvial areas, ditch banks, and waterways. It is the most promising plant for use in the upper third of the intertidal zone (Knutson and Woodhouse, 1982). Seeds mature in late spring to mid summer (collection window = 2-6 weeks, varies), and they do not need pretreatments (Emery 1987).

Deschampsia caespitosa is easy to transplant and quick to establish. Plantings have been made using materials harvested from natural stands. Digging and separating sprigs is relatively easy and is a reliable plant material (Knutson and Woodhouse, 1982). To use seeds, sow them in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds (Keator 1990). If seeding directly into the ground, use a seeding rate of 5-12 lbs of seed per acre (Seeds/lb = 1,696,335 – 1,864,350, and seeds/ft^2 at 1 lb/acre = 40.9) (CNGA 1999). However Knutson and Woodhouse (1982) claim that direct seeding often fails.

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Deschampsia elongata

Slender hairgrass is a short-lived perennial bunchgrass that occurs in moist soils in meadows, near streams, along lake shores, on shaded slopes, and on open or wooded slopes (CNGA 1999). Although it is a fast grower, it is rarely found in dense stands, and it is a poor competitor among other plants (Crampton 1974). It grows 10 to 70 cm tall,

needs full sun to partial shade, and tolerates flooding well. Its seeds mature spring to early summer (collection window = 2-4 weeks), and they do not need pretreatments (Emery 1987).

According to ESNERR volunteers, *D. elongata* is easy to grow. Simply sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). If seeding directly into the field, seed at a rate of 3 –20 lbs. per acre (Seeds/lb = 1,626,156 – 1,651,857 and seeds/ft^2 at 1 lb/acre = 37.6) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

ESNERR volunteers have found that *Deschampsia* grows aggressively in the landscape, where it is well-watered.

Dichelostemma capitatum

Blue dicks are herbaceous perennials found in vernal pools, coastal strands, mixed evergreen and coniferous forests, chaparral, grasslands, oak woodlands, and along the fringe of salt marshes. They reproduce both from seed and vegetative means in the form of corms. The cormlets are attached to the parent corm by stolons or are sessile, produced in the axils of the old leaf bases on the mature corm. Blue dicks thrive in open,

disturbed environments. Plant using mature, flowering-size corms in the fall (Anderson and Rowney 1999).

Elymus glaucus

Blue wild rye is rhizomatous and stoloniferous; it grows aggressively in full sun and canopy openings and in dry to moist soil. It can be a cool or warm season grass depending on its altitude. Blue wild rye is one of the most common grasses of the West, and it is found in open areas, chaparral, woodlands, and forests, often in association with oaks and conifers (Crampton 1974, CNGA 1999). It rarely grows in dense stands, and it is often associated with other native grasses such as *Bromus carinatus*. *Elymus glaucus* has strong seedling vigor and it grows fast, allowing it to compete with exotic perennial grasses. It will tolerate sun but prefers light shade and is the best choice for growing under oaks. It is an excellent grass for binding soil on steep woodland slopes (Keator 1990), and it grows well along stream banks, meadows, and in swales. Some ecotypes tolerate short duration flooding, and all tolerate burning and mowing, if it is not cut too short (CNGA 1999). Mature stands exclude annual grasses such as ripgut and wild oats, but need occasional grazing in order to spread (Albright Seed Co. product information bulletin). Seeds mature late spring to summer (collection window = 2-8 weeks) and they do not need pretreatments (Emery 1987).

To grow, begin by collecting seed in late spring and summer, when florets turn papery and light tan and seed is easily stripped out of floret. Hand held sickles can be used to cut stalks. After collecting, dry the seeds. One method is to spread seed on open tarp in drying shed and turn twice a day prior to cleaning. After drying, clean seeds if

necessary. Seed storage is estimated at 4 years at 3 to 5 C in sealed containers (Evans et. al. 2000b). Sow seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). Nelson (1992) found that broadcasting and raking in *E. glaucus* seeds was an effective planting method. If using this method, seed at a rate of 10 –40 lbs. of seed per acre (Seed/lb = 96,000-134,900 and seeds/ft^2 at 1 lb/acre = 2.65) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Eriogonum spp.

Eriogonum nudum (wild buckwheat) and *E. latifolium*. *Eriogonum nudum* is a sturdy, evergreen, drought tolerant perennial found in Reserve grasslands that flowers July-August. It is common and capable of natural seeding in disturbed areas (Nelson 1992). *Eriogonum latifolium* occurs in coastal scrub habitats and flowers June through September (Matthews 1997). *Eriogonum* fruit is a hard, dry, three-sided achene. The achenes can be hand-stripped from the plants (Young and Young 1986). *Eriogonum* may be grown from seed which germinates well without any pretreatment (Emery 1987). In San Francisco, the National Park Service has found that hand broadcasting and raking in

Eriogonum spp. worked better than planting nursery propagated seedlings—in fact, their transplants had only 10% survival (Nelson 1992).

If plants must be greenhouse grown, plant seed in autumn using a coarse soil mix, and cover with sphagnum moss to help prevent damping-off. Seedlings may be transplanted to three-inch pots the following spring, and then transplanted in full sun and lean soil (Schmidt 1980).

Eschscholzia californica

California poppy is a native, short-lived perennial (or facultative annual) common in California's open lands. It is one of the relatively few native species to maintain a significant presence within the introduced annual grassland. As a measure of its invasive potential, it has spread to other continents with regions of Mediterranean-type climates, such as Australia and central Chile, where it is a widespread weed (Frias et al. 1975). In local natural populations, California poppy typically germinates during early winter through early spring, and may flower from February to well into fall. It produces multiple large, showy flowers. Fruits are long, slender, erect capsules that snap open when mature, ejecting ~80 round seeds over distances of ~1 m (Schmidt 1980, Robinson et al. 1995)

California poppy is easily grown from seed, and pretreatment is unnecessary (Emery 1987). However, *Eschscholzia* must be harvested when slightly green or immature, and then seeds can then be dried in loosely covered containers (Emery 1987). Broadcast seeds from late summer into the winter months (Schmidt 1980). Poppies prefer lean soil, full sun, and dry conditions, although they will tolerate water during their

periods of active growth. Well-established plants will continue to come up each year from the deep root and to provide a wealth of seedlings (Schmidt 1980).

Poppies can be double cropped by removing old foliage and watering once or twice. Pulling the old foliage off with a slight jerk will stimulate the second flowering. Collect the seed when the pods are brownish in color. The seeds will be black. Seeds will be ready about 6 weeks after flowering (Kreiberg's 1991 meeting with Kimple).

Poppies are among the most adaptable of all wildflowers, and once poppies are established they perpetuate themselves. However, poppies cannot be transplanted out of the ground from one site to another. If you need to plant in mature plants, grow poppies in the greenhouse in large enough containers, and then transplant these into the field (Sue Shaw, pers. comm.).

Gnaphalium californicum, G. spp.

California everlasting, pink everlasting. *Gnaphalium* spp. are annual or biennial herbs that generally germinate November through April and mature from June into Autumn. Their seeds are small (0.5 mm long) achenes (UCDANR 1996).

Hemizonia congesta, H. corymbosa

Hayfield Tarweed, Coast Tarweed. Available at Yampah Is.

Hordeum brachyantherum

Meadow barley is a cool season, short lived perennial bunchgrass that grows less than 90 cm tall (CNGA 1999). It occurs in moist soils in areas with full to partial sunlight, and is

found in meadows, stream banks, brush, and on grassy slopes (CNGA 1999). It tolerates flooding, mowing, and grazing well. Seeds mature mid spring to early summer (collection window 2-4 weeks—shatter quickly in dry heat), and no pretreatment is needed (Emery 1987).

To start in the greenhouse, sow the seeds in potting soil, and then separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). If seeding directly in the field, seed at a rate of 30 – 40 lbs. of seed per acre (Seeds/lb = 66,200 – 100,798 and seeds/ft^2 at 1 lb/acre = 1.9) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990)

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Horkelia californica, H. cuneata

Horkelia and wedge-leaved horkelia. Available at Yampah Is. *Horkelia* naturally occurs in coastal prairies, sandy or rocky soils on the edge of brush and woodlands, and occasionally on nutrient poor soils. *Horkelia californica* flowers from May to August, and is best planted in full sun and dry areas. *Horkelia cuneata* flowers April through September (Matthews 1997) Propagate using divisions (Keator 1990), or seeds. No seed pretreatment is necessary (Emery 1987).

Juncus lesueurii, J. phaeocephalus

Salt rush, brown-headed rush. Salt rush is available at Yampah Island. Seeds do not need pretreatment (Emery 1987). Docents have successfully used divisions to plant rushes on the Reserve.

Layia platyglossa

Tidy tips flowers May through June and occurs in coastal prairies (Matthews 1997). Seeds have temperature-related after ripening (Young and Young 1986).

Leymus condensatus

Giant ryegrass is a rhizomatous perennial grass that is stout and aggressive. Good on a large scale for stabilizing soils along the edge of woodland and coastal gardens (Keator 1990). Giant wild rye seldom occurs in dense stands but is a typical element of southern California woodlands and brush lands. As forage, the grass is palatable when young but too coarse by flowering time. Since it occurs in brush lands it is not always accessible to grazing animals (Crampton 1974). Its seeds do not need pretreatment before sowing (Emery 1987).

Raising large number of grasses from seed is easy: simply sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Care is needed during this process to keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind. Usually, careful study of weedy grasses in the garden beforehand will acquaint you with what to look for (Keator 1990).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Leymus mollis

Coastal ryegrass is a rhizomatous species which does an excellent job of binding loose sand and tolerates some salt and wind. The wandering rhizomes produce upright leafy culms at some distance from one another so that they do not exclude other vegetation between them as does the introduced European dunegrass. Leafy culms grow to 3 ft with graceful blue-green leaves and tight flattened spikes of spikelets. Excellent in coastal areas (Keator 1990). To propagate, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Leymus triticoides

Creeping wild rye or beardless wild rye is a cool season perennial, rhizomatous grass that grows in moist to saline soils, and under full sun to partial shade. It grows 45 to 130 cm tall, and it is highly tolerant of flooding and late growing season mowing, if not cut too short (CNGA 1999). It occurs in dry, wetland, and saline meadows, oak woodlands, riparian sites, valleys, foothills and mountain flats throughout California (Anderson and Anderson 1996). Creeping wild rye is one of the most common, most adaptable grasses

in California where soil moisture is abundant, and it may have been the dominant grass, prior to European impact, in the Central Valley. It can spread up to 1 foot per year.

Most ecotypes do not produce viable seed (CNGA 1999), and even viable seeds may have poor germination (Emery 1987). Therefore, use plug plantings, especially in riparian areas, for high restoration success (Anderson 1999). If you are pulling and planting *Leymus* yourself (as opposed to ordering it from a supplier), slice through the rhizomes between the grass clumps or rooted nodes with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990). Before outplanting, let the grass sit in water until it grows new rhizomes (Wirka 1999). Plant using bare-root plugs or plant in flats, not cells, to make your work easier.

Leymus should work to inhibit the growth of future weeds, because it often forms dense stands, but some follow up weeding will usually be necessary (Deb Hillyard and Patti Kreiberg, pers. comm.). The grass resists trampling and recovers well following close grazing. At low elevations it is much coarser than other succulent and tender annuals and is hence seldom utilized by grazing animals. The species is valuable as a soil binder, particularly along levees and river banks (Crampton 1974).

Lomatium caruifolium

Caraway leaf. Available at Yampah Island. Plant *Lomatium* spp. in full sun or light shade using seeds (Keator 1990).

Lotus scoparius, L. wrangelianus

Deerweed and Chile trefoil. *Lotus scoparius* is a short-lived opportunistic plant that after disturbances, especially fires, grows rapidly, flowers and seeds prolifically, and then dies. It can be grown from cuttings and seeds (Keator 1994), but ESNERR volunteers report that it can be difficult to keep alive. *Lotus wrangelianus* is available at Yampah Island. *Lotus* spp. flower from May to August (Keator 1990). *Lotus scoparius* fruit or cleaned seeds should be pretreated in hot water before planting (Emery 1987). Plant both species in full sun.

Lupinus spp.

Lupinus albifrons (silver bush lupine), *L. arboreus* (yellow bush lupine), *L. bicolor* (miniature lupine), *L. chamissonis* (blue beach lupine), *L. nanus* (Douglas's or sky lupine), *L. succulentus* (succulent lupine).

Lupinus bicolor, L. nanus, and L. succulentus are annual lupines. *L. bicolor* flowers March-June and grows well in full sun in semi-dry areas. *L. nanus* flowers April-May and prefers full sun, lean soil, and moderate water. *L. succulentus* flowers February through May. All three occur naturally in coastal grasslands and hills.

Lupinus albifrons, L. arboreus, and *L. chamissonis* are perennials. *Lupinus albifrons* and *L. arboreus* flower March through June, and are common in sandy and rocky areas (Mathews 1997). *Lupinus albifrons* seeds mature from early June to late July (Ratliff 1974). *Lupinus arboreus* flowers March through June, lives about 2-3 years, and needs full sun and good drainage. It grows well on inland sand hills, but keep in mind that it is poisonous (Singer 1982). This species works well for weed control (particularly

iceplant), despite its short life. After it dies back, replant the area with other native species (Sue Shaw, pers. comm). *Lupinus chamissonis* flowers March through July, and is found on sand dunes—it is unlikely that it will be planted on the Reserve.

Upon drying, lupine seeds dehisce (or discharge), and therefore must be harvested when slightly green or immature; pods can then be dried in loosely covered containers until they open (Ratliff 1974, Emery 1987). The coarse material can be removed by screening. When adequately dried, mature seeds of lupine can be stored for extended periods. Seeds stored for 30 years at room temperature were found to be viable, and variations in the color of these seeds had no effect on viability (Ratliff 1974).

Generally, fresh seeds need no pretreatment. Some authors report that stored seeds benefit from scarification or hot water treatment (Emery 1987), but local restorationists find these treatment unnecessary (Sue Shaw, pers. comm.). *Lupinus succulentus* seeds should be pretreated with hot water, scarification, or soaked in concentrated H_2SO_4 for 6-8 hours (Emery 1987). In San Francisco, the National Park Service has found that hand broadcasting and raking in *Lupinus* spp. seeds worked better than planting nursery propagated seedlings—in fact, their transplants had only 10% survival (Nelson 1992). To plant, seeds should be broadcast where wanted, raked in, and covered lightly with twiggy branches.

As a rule, lupines resent handling, but may be started in flats if shifted while still small and transplanted with no delay. Seeds may also be planted in fiber pots and the plants can be set intact into the beds, after first removing the bottom section of the pot. Do not plant in an overly moist area; too much water and lack of air circulation can cause mildew of stems and foliage (Schmidt 1980).

Melica imperfecta

Coast range melic is a cool season perennial rhizomatous grass that can be planted in dry soils in full sun to partial shade (CNGA 1999). Coast range melic is commonly associated with brush lands or rocky soils in oak woodlands (Crampton 1974). It works especially well in the margins of woodlands or lightly shaded meadows, although it can also tolerate some sun and drought (Keator 1990). Its seeds need no pretreatment, and are best sown in the fall (Emery 1987).

ESNERR volunteers have found that growing *Melica* from seed is easy. Sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). If sowing directly in the field, sow at a rate of 10 – 30 lbs of seed per acre (Seeds/lb = 500,000 and seeds/ft^2 at 1 lb/acre = 11.5) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Mimulus aurantiacus, M. guttatus

Sticky monkeyflower and large monkeyflower are both perennial monkeyflowers that flower March-November (Sue Shaw, pers. comm.). *Mimulus aurantiacus* is long-lived, highly branched and shrubby, and it grows best in dry habitats. It is very easy to grow

(Keator 1994). *Mimulus guttatus* is common in wet places. It germinates from March to May, matures from June to August (UCDANR 1996) and grows by rooting stolons. Both species are easily propagated from seeds that do not need pretreatment (Emery 1987). Their seeds are fine—to plant, lightly dust them over the soil, press in, and cover until germination takes place. After the formation of the second or third pair of leaves, a block of soil can be cut out and the seedlings separated and replanted in small pots. Seed planted in July or August in mild climates will give plants of flowering size by the following summer. *M aurantiacus* can also be propagated from soft wood cuttings taken in spring, and they should have full sun and lean soil. *M. guttatus* can be planted where it will get ample water, in sun to high or broken shade (Schmidt 1980).

Muilla maritima

Common muilla. Available at Yampah Is. Seeds do not need pretreatment (Emery 1987).

Nassella cernua

Nodding needlegrass or nodding stipa is a cool season perennial bunchgrass that grows on dry soil under full sun or partial shade conditions. This species is particularly tolerant of harsh growing conditions on marginal soils, and occurs in upland dry meadows and oak woodlands. It reaches up to 100 cm tall, and is mowing tolerant if grass is cut after seed set. It is not fire resistant, but the season of burn in the most important thing in determining fire effects. *N. cernua* will resprout after spring or fall burns. Larger plants that burn more intensely reach higher crown temperatures and are therefore more

damaged by fire than smaller plants. Needlegrasses tend to be susceptible to mid summer burns. Its seed germinate and regrowth occurs in early spring, and the plant matures in early summer (UCDANR 1996). Seed matures mid to late spring (collection window = 2-3 weeks), and does not need any pretreatment (Emery 1987).

To start in the greenhouse, sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled. Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). If sowing directly in the field, seed at rate of 20 lbs. of seed per acre (Seeds/lb = 186,985 – 223,675 and seeds/ft^2 at 1 lb/acre = 4.7) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Nassella lepida

Foothill needlegrass or foothill stipa is a cool season perennial bunchgrass that grows in dry soils in full sun to partial shade (CNGA 1999). It occurs on dry slopes, chaparral, and oak grasslands, does not tolerate flooding or fire (see *N. cernua*), but does respond well to mowing (CNGA 1999). Seeds mature mid to late spring (collection window 2-4 weeks), and do not need any pretreatment (Emery 1987).

To start in the greenhouse sow the seeds in potting soil, and separate while still quite young—otherwise the roots of adjacent seedlings become inextricably entangled.

Keep the soil free from weeds, especially weed grasses which are difficult to distinguish at first from the native kind (Keator 1990). If seeding directly into the ground, plant seeds at a rate of 20 lbs. per acre (Seeds/lb = 95,509 – 320,159 and seeds/ft^2 at 1 lb/acre = 4.8) (CNGA 1999).

To propagate vegetatively, slice through the grass clump with a sharp knife to divide it into new rooted sections. Be sure to dig deeply to get a full root ball—these grasses have deeply penetrating, fibrous roots, and may die if the roots are unduly damaged, or too much root mass has been damaged (Keator 1990).

Nassella pulchra

Purple needlegrass or purple stipa, the California state grass, is a cool season perennial bunchgrass that is dormant during the dry summer months (CNGA 1999). Research done by Jason Hamilton from UC Santa Barbara at the Hastings Natural History Reservation in Carmel Valley and Stromberg and Griffin (1996) indicates that individuals of purple needlegrass commonly live for several hundred years, and maybe much longer (over 1000 years), with seedlings appearing between old individuals during wet years. *Nassella* starts growing in late fall or early spring, flowers April-June, and goes to seed in mid to late spring (collection window = 2-4 weeks, shatters very quickly when hot and dry) (CNGA 1999). It also reproduces by tillers.

Nassella pulchra was probably much more abundant in many California grasslands prior to European settlement. It is currently distributed throughout lower elevation ranges from the California coast to the Sierra Nevada foothills and generally in upland and wetland meadows (*Nassella* is winter/spring flood tolerant), oak woodlands, and

perennial and seasonal riparian areas (Anderson and Anderson 1996, Huenneke 1989). It tolerates a wide range of soil moisture, and grows in full sun to partial shade (CNGA 1999). This species partially tolerates flooding and does well if mowed after seed maturity, but does not tolerate burning (see *N. cernua*) (CNGA 1999). Neighboring exotic annual species have a very strong negative effect on *N. pulchra*, especially on its reproductive growth (Dyer and Rice 1999). Increased competition for light during the spring, when the growth of exotic annuals is most rapid, suppresses growth and reproduction of *N. pulchra* (Dyer and Rice 1999). It is a good basic grass for dry meadows (Keator 1990).

Collect the seed when the seed comes off easily in the hand after pulling a seed head through the palm of the hand. Store in a paper sack, not plastic, in a cool dry place until ready to plant. Seed pretreatment is unnecessary (Emery 1987). Record on the sack when and where the seed was collected. *Nassella* can be directly seeded or greenhouse grown. In San Francisco, the National Park Service has found that hand broadcasting and raking in *N. pulchra* seeds works well (Nelson 1992). If using this method or if drilling the seeds, sow at a rate of 20 lbs per acre (Seeds/lb = 121,674 – 455,879 and seeds/ft^2 at 1 lb/acre = 10.5 (CNGA 1999). If using a drill to plant, it is necessary to de-awn the seeds. First cure seeds for a least a month, then remove its awn (Anderson 1999a). But awns can be left on if using straw as seed source—the awns work to drill the seed into the soil. Unlike some native bunchgrass species, it succeeds in areas that are grazed or otherwise disturbed (Bartolome and Gemmill 1981). It can also be used under eucalyptus (Anderson 1999).

If seeds are to be grown in the greenhouse first, germinate them in a flat and transfer to "Super Stubby" tubes for further growth. The seeds should be started at the end of August, transferred to the "Super stubbies" to grow out a bit, and planted when the rains come (Patti Kreiberg's 1991 meeting with S. Kimple).

Prescribed burning and short-term, wet season grazing may be useful in restoring *Nassella pulchra* grasslands. The health of *N. pulchra*, the survival of its seedlings, and the removal of exotic annual grasses depends on disturbances such as fire and light grazing that decreases the accumulation of debris. Summer grazing and prescribed burning, in particular, increase native forbs (Dyer, 1993). On the Reserve, mowing and raking may be substituted for burns

Oxalis albicans ssp. pilosa

Hairy wood sorrel. Available at Yampah Island.

Perideridia gairdneri

Yampah. Available at Yampah Island. *Perideridia* is a winter dormant perennial that flowers in the summer (July through August according to Reserve volunteers). To propagate, begin by hand collecting seeds in late August or when seeds turn dark brown and are easily stripped from the inflorescence (Hosokawa et. al. 2000). Its seeds are small and broadly egg-shaped or nearly round. They are hairless, and ribbed, and are crowned by 5 prominent projections (see illustration in USDA 1937). Hand clean the seeds after collection. Seed longevity is up to 5 years in sealed containers at 1C. Seeds per kilogram:250,000/kg. A minimum of 90 day stratification is recommended for

germination. If first growing in the greenhouse, be careful not to over water. This is a tap rooted species, so containers will not completely fill with a root mass and some media will break away from plug during outplanting (Hosokawa et. al. 2000). Outplant in full sun (Keator 1990).

Pteridium aquilinum var. pubescens

Braken fern is a perennial fern with branched, creeping, woody rhizomes. Brown spores are borne along the undersurface edge of each frond segment. It is most likely to occur in open woods or mountains where soil pH is neutral or acidic (Whitson et. al. 1996).

Ranunculus californicus

California buttercup is a native perennial that blooms in early spring (March according to ESNERR volunteers), grows rapidly, and readily reseeds itself (Keator 1990). It germinates in early spring, and the plant becomes dry during summer (UCDANR 1996). Volunteers report that buttercup is easy to grow on the Reserve. Seeds generally do not need pretreatment, although 1 month cold stratification may improve germination in some cases (Emery 1987).

Sisyrinchium bellum

Blue-eyed grass flowers March-October, has round capsule fruits, and grows in open, coastal, grassy fields or meadows, from Ventura to Humboldt. California blue-eyed grass may be grown from seed, either in flats or sown directly where wanted. New seeds require 1.5 months cold stratification, but older seeds (3-6 years old) need no

pretreatment (Emery 1987). Plants form clumps with many stems and a long succession of flowers from early to late spring. ESNERR volunteers have found that blue-eyed grass is easily propagated by separating clumps, which can be divided in early spring. It thrives in full sun, will tolerate both semi-dry and watered situations, and tends to naturally reseed generously (Schmidt 1980).

Solanum douglasii, S. umbelliferum

Douglas' nightshade and blue witch) are small shrubs with flowers that bloom almost year round (at least January through September) (Matthews 1997). They can be propagated using layering, cuttings or seed (Keator 1994). If using seeds, the fleshy fruits should be crushed, and the mashed pulp containing the seeds should be spread in a thin layer on paper to dry. The seeds and pulp can then be readily separated. Another method is to add water to the mashed pulp and seeds, preferably in a tall container. After standing for a day or two, the seeds and pulp will separate (Emery 1987).

Other than the initial preparation listed above, *Solanum douglasii* seed does not require pretreatment. Sow this species outdoors in the late summer. Spring planting can also give fair germination (Emery 1987). *Solanum umbelliferum* seeds should be scarified if stored, or subjected to a hot water pretreatment for 1 hour (Emery 1987). Plant in light shade to full sun (Keator 1990).

Triteleia ixiodes, T. laxa

Golden brodiaes and Ithuriel's spear are related to *Brodiaea*, and their corms may be treated in much the same manner (Keator 1990). *Triteleia ixiodes* occurs on sandy and

clay soils, in coastal prairies, and in woodlands, and it flowers May through August (Matthews 1997). *Triteleia laxa* flowers April through June, and this species is easy to grow in chaparral and woodlands (Matthews 1997, Keator 1990). Propagate using corms or seeds--the seeds do not need pretreatment (Emery 1987), but plants grown this way will take 3 to 4 years to flower (Keator 1990).

Vulpia microstachys

Pacific fescue is an annual grass that flowers May through July (Matthew 1997). Its seeds germinate without pretreatment (Young and Young 1986).

Wyethia angustifolia, W. helenioides

Mule-ears and gray mule-ears. *Wyethia* spp. are winter dormant perennials that grow from thick, creeping aromatic rhizomes which increase the size of colonies each year (Keator 1990). *W. helenioides* germinates in late winter, flowers from March, and matures in August (UCDANR 1996). Fruit is an achene (Young and Young 1986). Pretreat *W. angustifolia* with cold-moist stratification for 90-120 days, and then plant in sun/dry areas (Schmidt 1980, Young and Young 1986, Emery 1987). *Wyethia helenioides* seeds do not split at maturity and require no seed pretreatment before planting (Emery 1987, UCDANR 1996).

Zigadenus fremontii

Star lilies occur on dry grassy or brushy slopes, in chaparral, coastal sage scrub, and in woodlands. They flower March through May, and their seeds need no pretreatment,

although germination may be improved by stratification. Sow seeds in the fall (Emery 1987, Matthews 1997).

Oak Woodland Natives

Achillea millefolium

See Grassland section

Agrostis pallens

See Grassland section

Artemisia douglasiana

See Grassland section

Camissonia ovata

See Grassland section

Chenopodium californicum, C. rubrum

California goosefoot and red goosefoot. *Chenopodium* spp. has fruit that is a utricle with a membranous pericarp free from or adherent to the seed. Seeds of most species germinate readily without pretreatment (Emery 1987), although germination is often enhanced by nitrate enrichment (Young and Young 1986).

Chlorogalum pomeridianum

See Grassland section

Claytonia perfoliata

See Grassland section

Danthonia californica

See Grassland section

Dicentra formosa

Bleeding heart is found in damp shaded places, and it flowers March through July. Before planting, stratify seeds for three months (Emery 1987, Matthews 1997).

Eriogonum nudum

See Grassland section

Heteromeles arbutifolia

Toyon or Christmas berry is a rapidly growing and dense, drought resistant shrub common on semi-dry, brushy slopes and canyons of foothills and mountains (Schmidt 1980). Toyon flowers June-July, and its fruits are large clusters of bright red, berry-like pomes that ripen October through January. The fruit is about 6 mm long and turns from green to bright red when ripe. Each fruit contains 1 to 2 seeds. Good seed crops are produced annually (Young and Young 1992).

Pruning shears are needed to collect pomes in the fall. The pomes should be soaked in water and allowed to ferment in a warm place until the seed can be separated from the mash. Fruits can be run through a macerator and the seeds recovered by floatation. Cleaned seeds can be dried and stored at low temperatures in sealed containers (Young and Young 1992).

Heteromeles will germinate under natural conditions in about 36 to 40 days in the greenhouse (Young and Young 1992). Fresh seeds do not require pretreatment, but older seed requires three-months cold stratification (Emery 1987). Plants may be held in containers for the first year and then planted out in the second autumn. When planting, be careful not to bury the plant any deeper than 1/4 to 1/2 inch below the original soil line—*Heteromeles* is extremely intolerant of deep planting (Restoration Trust 2000).

Outside, untreated seeds can be sown in the fall, or prechilled seeds in the spring (Young and Young 1992). Plant in full sun to light shade (Keator 1994). Toyons are long-lived, and they will begin to flower and fruit after the third year. Toyon is also sometimes propagated by tip cuttings taken in late summer when the wood is hardened (Schmidt 1980).

Juncus patens

Common rush does not need seed pretreatment (Emery 1987)

Pholistoma auritum

Fiesta flower occurs on shaded slopes, in canyons, chaparral, coastal sage scrub, and oak woodlands. It flowers March through May (Matthews 1997). Its seeds do not need pretreatment. Seeds sown outdoors in late fall give good results. Alternatively, seeds can be germinated in cool temperatures (less than 70º F) and in darkness for the first 3 days (Emery 1987).

Polypodium californicum

Resurrection fern grows best in shady areas.

Pteridium aquilinum var. pubescens

See Grassland section.

Quercus agrifolia

Coast live oak is an evergreen oak that is common in coastal valleys and north-facing slopes below 3000 feet (Matthews 1997). *Quercus agrifolia* does not produce seeds until it is 15 years old.

When collecting seeds, it is best to use local sources. Most acorns ripen from early September to early November, and acorns on the lower branches ripen first. Acorns can be collected both directly from trees and picked up off the ground after they have fallen naturally. However, the healthiest acorns are those that are picked. To pick acorns off trees, use tools, such as long-handled loppers, or sticks to knock the acorns down. They can be picked up easily if tarps are first placed under the trees. Fully mature acorns will dislodge easier than unripe ones, but birds, deer, and insects quickly damage ripe acorns. Therefore, it is advisable to collect immature acorns as well—they will ripen during storage. Immature acorns are green. Mature acorns are brown, and their acorn caps can be twisted off cleanly without damaging the acorn. The biggest acorns are usually best (Bush and Thompson 1989, Young and Young 1992).

After collection, clean acorns by removing loose cups, twigs, and other debris. To separate viable acorns from defective ones, hand remove obviously defective acorns

(those with small holes where adult weevils have deposited eggs, cracked seedcoats, mold, etc), or soak all acorns in a pail of water, and keep only the sinkers. Many of the acorns that float have been damaged by insects or have not matured properly. Some sound seeds will float as well, but the proportion of viable seed in the sunken acorns will be much greater than the proportion of sound seed in the floating ones. If acorns were collected off the ground where they may have dried out, soak them longer – up to 24 hours – before discarding floaters. (Bush and Thompson 1989, Young and Young 1992).

Coast live oaks exhibit embryo dormancy, and their germination is enhanced if they are stratified, or chilled, before sowing. Stratification can be accomplished two ways: 1) naturally, and 2) in a refrigerator. To prechill acorns naturally, plant acorns in the fall. Acorns will be naturally prechilled in the soil during the winter, and they will germinate promptly in the spring. However, if acorns cannot be sown until later, stratify by storing acorns in a refrigerator at 38-40° F for 30-90 days (check regularly for germination). Before placing in the refrigerator, remove acorn caps and place the acorns in peat, saw dust, or perlite and vermiculite in a 3:1 mixture within "zip-lock" polyethylene bags. Include a note (written in pencil or waterproof ink) detailing where and when the acorns were collected. Polyethylene bags with a wall thickness of four to ten mils are ideal for storing acorns since they are permeable to carbon dioxide and oxygen but impermeable to moisture—two factors that help maintain acorn viability. Acorns cannot be stored for more than six months, and they must be kept cool and moist (Bush and Thompson 1989, Young and Young 1992).

Sowing directly outside: To prepare planting sites, scalp or scrape a 3-foot radius circle around planting spots to remove other vegetation. Competing vegetation—

especially grasses—often use up so much water from the soil that little is left for oak seedlings. Mulch can help keep this vegetation from re-establishing later.

If not planting in the fall, plant acorns in the late fall or early winter (early November until early March) when acorns will be well-watered by the rains. When ready to plant, you can float the acorns again, selecting only the sinkers. Out in the field, dig a hole ten inches in diameter and four to five inches deep. Break apart hard or compacted soil with a shovel. Place one gram of nitrogen fertilizer in the bottom of the hole and replace the soil, tamping it down and leaving a one to three inch depression at the top. Place six to ten acorns, tips sideways, in the hole. If the root a new white root tip has started to grow during storage, try not to break it and place the acorn such that the root is pointing down. If the root has grown too long to be manageable, trim it to 3 inches in length. Cover with remaining material and tamp down. Use cages to exclude both above and below-ground predators. Keep the soil covered with mulch and weed when necessary. Thin seedlings to two or three at the end of the first season and one by the third year.

The number of acorns or seedlings to plant in a given area will depend on how many oaks you eventually want to grow there. Unfortunately, it is very difficult to predict how many trees will be produced from plantings, since a whole host of uncertain factors including weather, animals and competing vegetation can influence this. When laying out the planting area, consider spacing seedlings or acorns in a naturalistic manner, rather than in straight rows, using surrounding oak trees as a model. One guideline for dense plantings is to plant oaks clusters (assuming that you are planting more than one acorn per hole (clusters)) about 15-20 feet apart (McCreary)

Alternatively, acorns can be drilled 20 to 25 cm apart, or broadcast and covered with 0.6 cm of firmed soil. Seedbed densities of 105 to 370 per m^2 are recommended. Fall-sown beds should be mulched to protect the seeds and seedlings. Partial shade is beneficial for germination (Emery 1987, Young and Young 1992).

If the site is on a steep slope, cut into the hillside to create a pocket for the seed. Plant the acorns on the lip of the pocket with the cut sloping slightly downward and deeper in to the hillside. This acts to reduce erosion and collect moisture for the seedling. It also keeps the seedling out of the seasonally-saturated soil at the back of the cut. Planting layout: the number of acorns or seedlings to plant in a given area will depend on how many oaks you eventually want to grow there. Unfortunately, it is very difficult to predict how many trees will be produced from plantings, since a whole host of uncertain factors including weather, animals and competing vegetation can influence this. When laying out the planting area, consider spacing seedlings or acorns in a naturalistic manner, rather than in straight rows, using surrounding oak trees as a model. One guideline for dense plantings is to plant oaks clusters (assuming that you are planting more that one acorn per hole (clusters)) about 15-20 feet apart (McCreary).

If the acorns are planted after heavy rains when soils are moist, watering is not needed. Otherwise, water thoroughly after planting. Periodic watering during the first several summers will increase seedling survival. Good sites may only need watering two or three times the first year, but dry conditions in poor or sandy soils may require watering as often as once a week. Always soak the soil thoroughly to stimulate root development, and allow the surface to dry between waterings. Taper off watering during the second and third year.

Unfortunately, success rates are generally low when acorns are directly sown into the ground, although direct planting of acorns eliminates the root disturbance that occurs with transplanting and allows maximum root developments. Restoration success can be increased by planting in areas particularly favorable to natural regeneration, including north-facing slopes, regions with more than 10 inches of rain per year, loamy, well-drained soil, alluvial sites, swales, or other places with subsurface water (Muick and Stewart 1989). Avoid planting close to buildings, under utility lines, in irrigated landscapes, close to sidewalks or paved areas, in poorly drained sites, or in sites with compacted soil (Bush and Thompson 1989).

Growing acorns in the greenhouse: To plant first into pots, plant acorns in loose potting soil in 1 gallon cans or deeper containers. Because oaks' tap roots grow quickly, the depth of planting containers, not their width, is important. Containers should have holes in the bottom to allow for drainage. Place acorns on their sides at a depth of one half to one times the width of the acorn. Keep the soil moist but aerated.

Greenhouse grown seedlings should be transplanted as soon as the first leaves open and become firm, before extensive root development occurs. Young trees in containers should be transplanted in the late winter or early spring, after the ground has begun to warm and before the leaves of deciduous trees begin to emerge. The hole should be twice as wide and deep as the can. Thoroughly wet the root ball. If roots have begun to curve around the inside of the container, prune them to allow placement in the hole without bending or folding. Prune a corresponding amount of foliage after transplanting. Gently set the root ball in the hole with the root crown at the level of the soil surface. Fill the hole with soil, firm tamp and soak.

Watering, weeding, and mulching transplanted oaks is important until seedlings are well established. If transplanting is done during the fall or winter, normal rains should be adequate until the dry season. For the first season, thoroughly soak seedlings so that water deeply penetrates the soil every two weeks or whenever the top two inches of soil is dry. Taper off as trees become established—many plantings are successful with only several supplemental waterings during the first season. If the transplant is to live in a irrigated environment, make sure the area around the root crown is adequately drained.

Protecting oak seedlings: Oaks will be protected from herbivory using a large wire cage with jute netting over the top. The larger cage allows more unobstructed growth and the development of secondary wood. Secondary wood is the main supportive tissue of stem and is critical in long term survival and healthy growth. Its production is directly related to environmental stimuli; the more stress, the more wood produced. Wire cages result in the best seedling survival and growth. The jute netting supplies shade, reducing seedling stress, surface temperature and water loss from evapotranspiration. Shade has been shown to significantly improve both percent emergence and seedling survival. Cages need to be monitored and jute netting removed as needed to prevent interference with seedling growth (Howald 1996).

Ranunculus californicus

See Grassland section.

Rhamnus californica

Coffeeberry is an evergreen shrub that flowers May-July (March through April according to ESNERR volunteers), and that has a long fruit ripening period, during which several color changes take place. Ripe fruits are available in the fall. They are black, berry-like drupes that contain 2 large, oval nutlets (Schmidt 1980, Young and Young 1992).

ESNERR volunteers have found that *Rhamnus* is easy to grow. Coffeeberry can be propagated from cuttings or seed (Young and Young 1992, Keator 1994). Seeds should be picked in September and October, about 2 weeks before the fruit is fully ripe. If harvesting is delayed, many seeds can be lost to birds. The fruits can be run through a macerator and the seeds recovered by flotation. Seeds can be stored for several years in sealed containers at low temperatures (Young and Young 1992). Fresh seeds require not pretreatment, but stored seeds should be cold stratified for 3 months (Emery 1987, Young and Young 1992). Young plants sown in the fall grow relatively quickly. They may be planted into individual containers and then set out when a year or more of age. When planting, be careful not to bury the plant any deeper than 1/4 to 1/2 inch below the original soil line—*Rhamnus* is extremely intolerant of deep planting (Restoration Trust 2000). Flowering and fruiting will begin after three to five years of growth. They require full sun, coarse soil, and very little water (Schmidt 1980).

Ribes divaricatum, R. sanguineum

Straggle gooseberry and red flowering currant. *Ribes* spp. are among the easiest shrubs to grow, and they are easy to propagate from semi hardwood cuttings in spring. They do especially well in oak woodlands (Keator 1994). *Ribes divaricatum* flowers March

through May and is found woodland edges, shaded canyons and stream banks. *Ribes sanguineum* flowers February through April, and it is found in moist shaded places (Matthews 1997). *Ribes'* fruit is a green, many-seeded, glandular or smooth berry 0.6 to 1.25 cm in diameter. The fruit ripens in early to late summer. *Ribes divaricatum*'s ripe fruit is black, while *R. sanguineum*'s is blue-black. Depending on the species, good seed crops are borne annually to 2- to 3-year intervals (Young and Young 1992).

Ribes' fruit should be picked or stripped form the bushes as soon as they are ripe to minimize losses to birds. If using seeds, the fleshy fruits should be crushed, and the mashed pulp containing the seeds should be spread in a thin layer on paper to dry. The seeds and pulp can then be readily separated. Another method is to add water to the mashed pulp and seeds, preferably in a tall container. After standing for a day or two, the seeds and pulp will separate (Emery 1987). Dried seeds can be stored for long periods in sealed vials at low temperatures. The seeds of most species of *Ribes* are highly dormant and require prolonged prechilling, warm stratification followed by prechilling, and/or a wide range of diurnal temperatures during incubation to obtain germination. Prechilling for 6 months may be necessary.

Ribes seeds are usually sown in the fall. The should be sown at the rate of 630 to 840 per m^2 and covered with 0.6 cm of soil. Seedbeds should be mulched. About 400 seedlings are produced per kilogram of seed. Most species can be readily propagated from hardwood cuttings taken in autumn (Young and Young 1992). Plant *Ribes sanguineum* in 1/4 to 3/4 sun (Singer 1982).

Rosa californica

California wild rose occurs in moist places, canyons, and along streams, although it can grow in full sun (Keator 1994, Matthews 1997). Wild roses are grown readily from root divisions, as well as from cuttings and seeds. *Rosa* flowers and seeds at a young age, blooming May through August. The seeds are achenes borne within a fleshy, berrylike hip that remains on the plant after ripening. The hips can be handpicked in the fall, soon after the dark green color turns to orange-red and any time thereafter (Keator 1994). Seeds collected shortly after ripening and not allowed to dry will be less dormant than fully dried seeds. The seeds can be recovered by macerating the hips and recovering the seeds by flotation. Seeds stored dry in sealed vials will maintain viability for 2 to 4 years. One of the most effective methods of propagating roses is to sow freshly cleaned seeds before they have a chance to dry. They can be either broadcast or drilled, and covered with a shallow layer of firm soil and mulched (Young and Young 1992). It may be useful to stratify seeds for 3 months (Emery 1987).

Rubus ursinus

California blackberry is found in woods and damp places, and it flowers March through July. *Rubus ursinus* has round main stems and leaflets arranged in groups of three. On the other hand, the non-native Himalayan blackberry (*Rubus discolor*) has 5-angled main stems, and leaflets in groups of five (Hickman 1993).

California blackberry can be grown from seed or easily from cuttings. *Rubus ursinus'* fruit, which ripens unevenly in the summer or early fall, is an aggregate of small, usually succulent drupes, each containing a single hard-pitted nutlet. Good seed crops

occur nearly every year. Mature fruit is black. When ripe the fruits of *Rubus* should be picked to reduce loss to birds. The fruits of most species mature over an extended period of time. Seeds may be extracted by maceration and flotation. Cleaned seeds should be dried before storage. They can be stored at low temperatures (Young and Young 1992).

Seeds of most species of *Rubus* have low germination because of hard seedcoats. Seeds require warm stratification followed by prolonged prechilling. Another alternative is to soak the seeds 20 to 60 minutes in sulfuric acid or a 1% solution of sodium hyperchlorite for 7 days prior to subjecting them to both warm stratification and prechilling. Sow scarified seeds in late summer or early fall, cover with a thin layer of soil and mulch (Young and Young 1992).

To grow from cuttings, plant the stem a few nodes into the soil. *Rubus* grows easily using this method (Sue Shaw, pers. comm.).

Scrophularia californica

Bee plant. *Scrophularia* spp. are herbaceous perennials that grow from widely branching and rapidly spreading rootstock. They are excellent colonizers of open spots in coastal scrub and woodlands. *Scrophularia* flowers April to September, is best propagated with divisions, and should be planted in full sun to light shade (Keator 1990).

Sidalcea malvaeflora

Checker mallow is a perennial mallow common in coastal grasslands and prairies. It grows using creeping rootstock or rhizomes which go dormant from summer through fall,

and it flowers mid-spring (Keator 1990). Propagate using divisions or seeds. If using seeds, soak in warm water for 6 hours before sowing (Emery 1987). Plant in full sun.

Stachys bullata

Hedge nettle occurs on dry slopes, and in canyons, chaparral, coastal sage scrub, and woodlands (Matthews 1997). Does not need seed pretreatment (Emery 1987)

Symphoricarpos albus var. laevigatus, S. mollis

Snowberry. *Symphoricarpos* spp. are thicket-forming deciduous shrubs that occur in woodlands and that flower mid-summer. *Symphoricarpos albus* flowers June through September (May through July according to Matthews 1997), and develops ripe, waxy white fruit August through October (Young and Young 1992). *Symphoricarpos mollis* flowers April through June, and also produces a white berry-like drupe (Matthews 1997). Each *Symphoricarpos* spp. fruit contains 2 nutlets that are flattened on one side. They are dispersed from late fall to the following spring, largely by birds and mammals (Young and Young 1992).

Snowberry can be easily propagated from cuttings (Sue Shaw, pers. comm.). Other planting methods include using root divisions or layering (Emery 1987, Keator 1994). On the other hand, nutlets of *Symphoricarpos* are very difficult to germinate. Ripe fruits can be collected any time during the fall and winter by stripping or flailing the shrubs. The fruits collected in the early fall contain more moisture and must be handled with care to prevent heating. The fruits can be macerated and the seeds recovered by flotation. Dried

fruits should be soaked for several days before macerating. Dried seeds can be stored in sealed containers at low temperatures for at least 2 years (Young and Young 1992).

The endocarp is hard and impermeable and requires from 20 to 75 minutes of acid scarification. The seeds also have embryo dormancy that requires both warm stratification and prechilling. Specifically, *Symphoricarpos mollis* seeds should be soaked in concentrated sulphuric acid for one hour (or warm stratified for 3 to 4 months), then cold stratified for 4-6 months before planting. Pretreated seeds can be incubated at 20/30º C using a suitable substrate. Emergence will not be appreciable with fall sowing until the second year after sowing (Young and Young 1992). Snowberry prefers partial shade, but can tolerate sun and full shade (Singer 1982). Common snowberry is susceptible to powdery mildew. Full sun exposure and good air circulation help to control the problem (Potter et. al. 2000). These species have rhizomes and dense roots, making them a good erosion control plant.

Toxicodendron diversilobum

Poison oak is a deciduous perennial shrub or vine. Its seed germinate and regrowth occurs from early March through May, and the plant matures from August through October. Its fruits are creamy white drupes that are 1/16 to ¼ inch in diameter (UCDANR 1996).

Trillium chloropetalum, T. ovatum

Giant trillium and wake robin are woodland members of the lily family. Small patches of *Trillium chloropetalum* occur in Cattail Swale woodlands, and along the south slope of

the woodland above Long Valley. *Trillium chloropetalum* flowers March through May, while *T. ovatum* flowers February through April (Matthews 1997). Fruits are capsule-like berries, that contain many seeds. Both species can be propagated from seed which requires five to seven years to produce a mature rootstock. Seed should be planted as soon as ripe, and kept moist and shaded until germination occurs. Alternate freezing and thawing of seed can aid in its germination. Under favorable conditions of shade and moisture, volunteer seedlings may appear; for the first few years these will be bright green, shiny, single leaves. When nearing the flowering stage, three small, but typical leaves will occur at the top of the stalk. Where plants are growing satisfactorily the rootstock may increase naturally, and old clumps may have two or three stems each season. Giant trillium requires rich, well-drained soil (Schmidt 1980).

Vaccinium ovatum

Huckleberry is a slow-growing shrub found in dry wooded slopes that flowers March through June (Mathews 1997, Young and Young 1992). However, in 2001 this species was flowering in January (Sue Shaw, pers. comm). The fruit ripens August through September, turning purplish black when mature (Young and Young 1992). Huckleberry is easily collected by handpicking the ripe berries or by shaking bushes over containers. After collection, the berries should be chilled at 50º F (10º C) for several days. After chilling, they can be shredded in a food blender and the seeds recovered by flotation. After drying for 48 hours at room temperature, the seeds may be stored at cool temperatures for years. Seeds should be planted on the surface of a fine, moist substrate (such as milled sphagnum moss or peat moss and sand mix) in flats and the flats covered

with clear plastic film until emergence occurs. Seedlings can be transplanted to containers and then to the field (Young and Young 1992). Huckleberry can also be propagated using cuttings. Plant in partial to full shade (Singer 1982, Keator 1994).

Other Native Plants

Adenostoma fasciculatum

Chamise is a chaparral shrub with tiny white flowers that bloom July through August (Matthews 1997). After flowering, blossoms dry to a rusty brown and remain on shrubs throughout the summer (Keator 1994). The fruit is an achene with a hard seed coat, and is enclosed in a flower tube. If seeds are collected directly from live plants, no seed pretreatment is required. Seeds collected from duff should be treated in hot water. Scarification in H_2SO_4 for 15 minutes is useful. Other scarification methods include burning a 1 inch thick layer of pine needles over the seed bed, or oven heating seeds in 212º F for 5 minutes (Emery 1987). Plant in full sun. Chamise can also be propagated using cuttings. If using cuttings, heat the bottom of the propagation bed to 70º F using a special cable or by placing a number of incandescent lights below the bed (Keator 1994).

The first years of growth are rapid, tapering off later. In hot weather, its leaves carry a volatile oil that makes plants combustible, so be sure to plant chamise well away from flammable structures.

Arctostaphylos pajaroensis, A. tomentosa

Manzanitas are evergreen, woody shrubs. *Arctostaphylos pajaroensis* flowers December-March, and grows in sunny, semi-dry, and sandy conditions (Schmidt 1980). It can be

found on Blohm Ranch and the Visitor Center landscaping (grown from Blohm Ranch cuttings). *Arctostaphylos tomentosa* flowers December through March, and is found in maritime chaparral (Mathews 1997). Plant in *A. tomentosa* in light shade (Keator 1994).

Arctostaphylos spp. may be propagated both from seeds and from cuttings. Manzanita generally have berry-like fruits 0.6 to 1.5 cm in diameter, which vary in color from red to dark brown, depending on the species. The fruits ripen in early summer, and consist of 4 to 10 stony seeds. Fruit can be picked from the shrubs or picked up off the ground. When the crop is heavy, fruit can be collected quite rapidly. The outer fleshy portion of the fruit can be separated by maceration and flotation, or by rubbing dried fruits through a screen and using an air screen (Young and Young 1992).

Seed is notoriously difficult to germinate and requires pretreatment, usually of more than one kind. Soaking the seed in sulphuric acid followed by a period of cold stratification will hasten the process. Other methods include burning 7-10 cm of pine needles over the flat after planting seed, watering thoroughly, and then setting the flat aside to await the slow, and often erratic germination. A newer method is to plant the seed in a deep flat of coarse soil, cover with a mulch of wood shavings (not redwood or cedar) mixed with a compost starter, and then set aside until germination takes place, possibly the following spring (Schmidt 1980).

To propagate manzanita from cuttings, take cuttings from firm, semi-ripe wood of the current year's growth, about four inches long, and with the lower leaves removed. This can be done in the winter (Sue Shaw, pers. comm.). Dip the cuttings in Rootone F which contains fungicide. Hormodin #2 or Hormex #3 are also satisfactory. Have ready a wooden flat, eight to ten inches square and about four inches deep, filled with equal

parts of peat moss and coarse sand. Water thoroughly and allow to drain. Firm this mixture with a wooden block, insert the cuttings, and water lightly to be certain the mixture is well set around the cuttings. Cover the flat with a light frame over which plastic has been attached. This will give a close atmosphere and help to retain moisture; the cuttings should never be allowed to dry out. Put the flat in a sheltered place where there is plenty of light but not direct sunlight. Cuttings may also be planted in a shallow pot or pan; slip the container into a plastic bag and secure it with a rubber band. Cuttings should root in four to eight weeks, and can then be potted in a mixture of peat moss, coarse sand, and loam. Young plants may be set out during autumn in well-drained soil, and light shade (Schmidt 1980).

If grown in containers, water the manzanita regularly after transplanting for about three years to insure survival (P. Kreiberg).

Artemisia spp.

Artemisia is a large genus including both aromatic herbs and shrubs.

Artemisia californica (California sagebrush) is shrubby and grayish, it occurs on dry slopes and in coastal sage scrub. Its inconspicuous, greenish flowers bloom August through December. *Artemisia californica* is easily propagated by seed, if dried seed is used (Sue Shaw, pers. comm.). It may also be planted using cuttings or by layering. Plant in full sun. On the Reserve it can be found on the path to the amphitheater, on Hummingbird Island, and near the overlook. Landscape plantings originated from Reserve plants. California sagebrush tends toward short life, and can unpredictably rot and die (Keator 1994).

Artemisia douglasiana (mugwort) is herbaceous and flowers June through October. *Artemisia pycnocephala* (beach sagewort)occurs on coastal and inland sand hills, and its greenish, inconspicuous flowers bloom June through August (Matthews 1997). *Artemisia* seeds are very small achenes, and most mature in the fall or early winter (Young and Young 1986). *Artemisia pycnocephala* is easily propagated using seed or cuttings. Plant in sandy soils and full sun (Keator 1994).

If growing *Artemisia* spp. from seeds, collect seeds from shrubs growing on or near the revegetation site. In general, *Artemisia* seeds are very small achenes, and most mature in the fall or early winter. Usually the entire inflorescence is stripped by hand, resulting in a trashy seed collection, so seeds will need to be cleaned. No pregermination treatment should be necessary (Young and Young 1986). Sow seeds directly in 164 ml supercell containers, and collect soil for the supercells from the field. After emergence, thin seedlings to one seedling per container. Grow seedlings in the greenhouse for two months, then transplant into the field. Keep planting site free of alien annual grasses—these significantly reduce *Artemisia* growth and survival (Eliason and Allen 1997).

In the field, *Artemisia* transplants fare better than directly sown seeds. In their experiment, Eliason and Allen (1997) found that even very small (164 ml) *Artemisia* supercells had a 20-40% survival rate in annual grasslands. Larger container sizes would likely do much better. Direct seeding of Artemisia must be accompanied by a reduction of grass and thatch cover.

Artemisia spp. seeds germinate naturally at relatively cool temperatures. Seed should be sown on nursery beds during the fall or winter at a rate that will produce about 50 seedlings per square foot. The seed should be covered with 1/4 inch of soil and a light

straw mulch. One- and 2-year-old seedlings should be field-planted early in the spring; fall transplantings are generally not successful. However direct seeding can be done throughout the late fall and winter on prepared sites. If seeding must be done in the spring, stratification may be of benefit (Deitschman 1974).

Asclepias eriocarpa

Indian milkweed is a perennial herb that flowers June through September (Matthews 1997). Fruit is a dry, pod-like fruit which opens along one side only. Its seeds are covered with long silky hairs, and they do not require pretreatment before planting (Young and Young 1986, Emery 1987).

Atriplex patula

Atriplex patula is an annual marsh plant, whose seeds are difficult to distinguish from the Australian native, *Atriplex semibaccata* (Mayer 1987). In Elkhorn Slough, *Atriplex* germinates January-March and flowers August-September (Mayer 1987). Fully mature fruit can be shaken or hand-stripped from the branches and collected in bags or baskets, or on a canvas spread around the bush. The seeds are ordinarily collected in the late fall or early winter, but they often remain on the bushes until April, so later collecting dates are possible (Foiles 1974). Fully mature fruits can be shaken or hand-stripped from branches (Young and Young 1986).

To clean *Atriplex* seeds, you need only to remove the wings from the hardened utricles (Stein et. al. 1974). Its seeds can be successfully stored for over 10 years in tightly closed containers kept in a warehouse or shed (Stein et. al. 1974). Seeds of most

saltbush species undergo after ripening. This process appears to take several months, varying by species, but pretreatments are not necessary or effective.

Seeds can be nursery grown, or directly seeded into the ground. Seed never should be covered by more than 1 inch of soil; 1/2 inch or slightly less is best. Rates of 4 to 8 pounds per acre of dewinged seed or 8 to 15 pounds per acre of winged seed are recommended for range plantings. Mulching usually has improved seedling establishment. Seedling emergence normally begins within 6 to 20 days if temperatures are favorable (Foiles 1974).

***Carex* spp.**

ESNERR docents have successfully used divisions of sedge in landscape plantings.

Castilleja densiflora, C. foliolosa,* and *C. latifolia

Owl's clover, woolly paintbrush, and Monterey paintbrush do not need seed pretreatment. *Castilleja densiflora* flowers March through May, and occurs in grassy places and in woodland understories. On the Reserve it occurs behind the greenhouse, by the boardwalk, and along the Long Valley Loop. *Castilleja foliolosa* flowers March through June, and is found in dry open rocky places. *Castilleja latifolia* flowers February through September, and is found in sandy soils and coastal scrub assemblages.

Sow *C. densiflora* and *C. foliolosa* with seeds of an herbaceous perennial as some *Castilleja* species are obligate parasites (Emery 1987, Matthews 1997). *Castilleja latifolia* does not require the presence of an herbaceous perennial. This species can

easily be grown to 4 inch pot size without another plant. However it may grow slowly until February or March (Tricia Lowe, pers. comm.).

Cornus spp.

Dogwoods can be grown using layering, or from cuttings and seeds (Keator 1994). Plant in moist areas in light shade. *Cornus* flowers in the spring (Young and Young 1992). Fruits are globular or ovoid drupes 1/8 to 1/4 inch (0.3 to 0.6 cm) in diameter, with a thin succulent or mealy flesh containing a single two-celled and usually two-seeded bony stone. Fruit ripens in the late summer or fall. To reduce losses to birds, fruit should be collected as soon as ripe by stripping or shaking from the branches. Seeds of flowering dogwood should not be collected from isolated trees because these may be self-sterile and the fruits empty (Young and Young 1992). Short ladders may be useful for collecting fruit from the taller species, but ordinarily this can be done from the ground.

Dogwood stones can be sown without extracting them from the fruit. After collection, the fruit may be sown immediately or stratified for spring planting. Seed to be stored usually is cleaned to reduce bulk. If cleaning cannot be done soon after collection, the fruit should be spread out in shallow layers to prevent excessive heating, but slight fermentation facilitates removal of the pulp. The stones can be readily extracted by macerating the fruit in water or running them through a hammer mill, allowing the pulp and empty stones to float away. Clean, air-dried stones may be stored in sealed containers at 38º to 41º F (3º to 5º C). Limited data indicate that stones may be stored for 2 to 4 years (Brinkman 1974a).

Natural germination of most species occurs in the spring following seed fall, but some seeds do not germinate until the second spring. Warm stratification for at least 60 days in a moist environment followed by a longer period at a much lower temperature may be necessary in some cases. Acid scarification enhances germination of seeds that require warm scarification. Enrichment with gibberellin has been used to enhance germination of seeds of some species (Young and Young 1992). Best results for most dogwood species are obtained when freshly collected stones or fruits are sown in the fall as soon after cleaning as possible. Dry-stored stones probably should be soaked in water and sown before October. Fruit collected too late for fall sowing should be cleaned, stored over winter and spring, stratified in summer and sown in the fall. An alternate procedure is to stratify the seeds at about 40º F for 3 to 4 months during the winter and sow them in the spring. Seeds in nursery beds should be covered with 1/4 to 1/2 inch of soil. Seeds sown in the fall should b e mulched during the winter with 1/2 to 1 inch of sawdust (Brinkman 1974a).

Corylus cornuta var. californica

Western hazelnut is a winter deciduous tree that can be grown by layering or by using seed (nuts). Plant in moist, shady areas (Keator 1994). It flowers January to February, and its fruit ripens September to October. Fruits are round or egg-shaped, hard-shelled, brown or dark-tan nuts. Each nut is enclosed in an involucre or husk consisting of two more or less united hairy bracts. Large seed crops are produced at irregular intervals, usually every 2 or 3 years. Hazel nuts may be eating by rodents, larger animals, or some

birds even before they are fully mature. To reduce such losses, fruits should be picked as soon as the edges of the husks begin to turn brown. This may be as early as mid-August.

The fruit should be spread out in thin layers to dry until the husks open enough so that the seeds can be removed by flailing. Seeds can be stored for a year in unsealed containers at room temperature. California hazel nut seeds will retain viability if stored at 5º C. Seeds should not be dried before storage, and high humidity should be maintained (Young and Young 1992). Hazel seeds require 2 to 6 months of prechilling (stratification) before germination will occur (Emery 1987). In nurseries this can be accomplished by fall sowing or by stratifying outdoors over winter before planting. Seeds may benefit from alternations of warm and cold stratification. Dormancy can also be overcome by exogenous application of gibberellin(Young and Young 1992). Most nurseries plant *Corylus* seed in the fall, but spring sowing of stratified seed is feasible (Brinkman 1974b). Plant seeds 2.5 cm deep, and cover with 2.5 to 3 cm of sawdust. Seedling densities should be kept low, from 42 to 63 m^2. Seedlings are planted out after one year (Young and Young 1992).

Cryptantha leiocarpa

Coast cryptantha flowers April through June, and its fruits are nutlets (Young and Young 1986, Matthew 1997)

Dendromecon rigida

Tree poppy is an openly branched, evergreen shrub 2 to 8 feet (0.6 to 2.5 m) high, sometimes to 20 feet (6 m). It grows on dry chaparral slopes, ridges, and washes. It

flowers April through June and sometimes into August. Fruits are linear, grooved capsules, 2 to 4 inches (5 to 10 cm) long. Ripe fruits may collected in May, June, and July. Seeds are black and have minute embryos (Neal 1974). Pretreat seeds using fire treatment or 1.5-2 months stratification. Three months stratification with a diurnal fluctuation from 46º to 70ºF may improve germination (Young and Young 1986, Emery 1987). *Dendromecon* is most easily propagated from stem cuttings in winter (Emery 1987). It can also be grown from root divisions. Tree poppy grows rapidly, but it is short lived. Plant in full sun (Keator 1994).

Distichlis spicata

Saltgrass is an aggressive perennial grass related to Bermuda grass that grows using creeping stolons. It forms large patches in brackish and salty habitats from the coast to the interior, throughout North and South America (Crampton 1974). It is a colonizer of bare areas, usually in mixture with other species, in the irregularly flooded portion of the intertidal zone roughly between mean lower high water and mean higher high water. Saltgrass is rarely dominant, usually occurring in small patches or bands (Knutson and Woodhouse, 1982).

Saltgrass is valuable as a range forage, often occurring on sites where there is a scarcity of other vegetation. It provides green forage over most of the year and recovers well from close grazing and trampling by animals (Crampton 1974). Saltgrass can also hold sand in places where few other ground covers can grow (Keator 1990). Saltgrass is second only to pickleweed in its tolerance to salinity. It withstands salinity up to 50 ppt (Knutson and Woodhouse, 1982).

Distichlis spreads vegetatively and by seed. Experience with this grass has shown it to be difficult to plant but quick to naturally invade stands of other planted species. Its seeds germinate and regrowth occurs form March to April, and the plant matures from July to September (UCDANR 1996). To plant, use bare-root plugs or container grow it (Habitat Restoration Group 1996). However, transplanting success using sprigs has been poor. Survival has been low and initial growth slow. One report stated that success was obtained with vegetative materials of saltgrass, but within two growing seasons the planting was displaced by invading species [*not named in this reference*]. Successful establishment has been reported using peat pot-grown seedlings. Because salt grass readily invades established stands of other species, artificial propagation of this species is seldom warranted (Knutson and Woodhouse, 1982).

Epilobium canum

California fuchsia is a winter deciduous subshrub that occurs on dry slopes, in chaparral and in coastal sage scrub. It flowers August through November (Matthews 1997). It is best propagated using root divisions and seeds in the fall. ESNERR volunteers report that fuchsia is easy to grow on the Reserve. It grows rapidly in full sun and works well in masses for erosion control (Singer 1982).

Eriophyllum confertiflorum

Golden yarrow can be propagated using half-ripened cuttings or seeds (Keator 1994). It occurs on brushy slopes and flowers April through August (Matthews 1997). Fruits are angled achenes, and often seeds do not require pretreatment for germination (Young and

Young 1986). However, the addition of a small amount of charate over the sown seeds greatly improves germination. Baking the seeds at 248º F for 5 minutes first further improves germination (Emery 1987).

Fragaria sp.

Wild strawberry forms low, compact lush mats of glossy green leaves. It spreads by runners, and flowers in spring. Plant in full sun or partial shade. Good erosion control on steep slopes (Singer 1982). Be aware that this species spreads quickly.

Frankenia salina

Alkali heath is found in high marshes, and it flowers June through October (Matthews 1997). Seeds need no pretreatment (Emery 1987).

Garrya elliptica

Coast silktassel is found on dry slopes and ridges, and can be propagated from cuttings and seeds (Keator 1994). It flowers January through March. and its fruit is a rather dry one or two-seeded berry that ripens to a dark purple in the fall. Ripe fruit can be gathered by stripping. Seeds can be recovered by macerating the fruits in water. Germination of silktassel seeds is variable depending on the species and source, but most appear to require cold-moist stratification. Stratification at 36º to 41º F for 30 -120 days has enhanced germination (Young and Young 1986).

Grindelia stricta

Coast gum plant can be propagated from seeds and half-ripened cuttings. It flowers June through September.

Helianthemum scoparium

Rush-rose is found on rocky slopes, chaparral, and coastal sage scrub. It can be propagated with cuttings and seeds. It flowers April through August. Seeds should be stratified before planting, and seeds should be planted in full sun (Keator 1994).

Holodiscus discolor

Cream bush is a deciduous shrub, 3 to 10 feet (1 to 3 m) tall that occupies a variety of sites, including the moist forests of the coastal plain. It is browsed to varying degrees by deer, with peak use in the fall and winter. Although flower buds appear early in the spring, full flowering does not occur until June or July and may continue in some areas on into late August. The fruits are light yellow achenes, 2 mm long that can be used as seeds.

Creambush can be propagated by layering, or by planting suckers or seeds (Keator 1994). To grow from seed, collect fruit when it turns brown in later summer or fall. The seed is very small and is best cleaned by hand-rubbing the inflorescences. Seed longevity is unknown. Seeds/Kg: 11,700,000/ kg. Before planting, seeds must be pretreated—stratification in either sand or peat at 41º F for 18 weeks appears to be about optimum for breaking dormancy (Stickney 1974). Creambush thrives with some protection from direct summer sun. Plant in light to moderately shady areas (Keator 1994).

Iris douglasiana, I. longipetala

Douglas iris and long-petaled iris. Irises are perennials herbs with creeping, tuberous rhizomes or bulb-like bases. Douglas iris flowers March through May and is common on grassy slopes and in open places. Long-petaled iris flowers April through May, and it is found in moist open places, in coastal prairies, and in woodland understories (Matthews 1997). Seeds do not need pretreatment, but may take months to germinate (Tricia Lowe, pers. comm.). Sow seeds outside in the early fall (Emery 1987). Irises grown in the greenhouse need fertilizer (Patti Kreiberg pers. comm). ESNERR volunteers have found that Douglas iris is easy to propagate from divisions. Plant in full sun to partial shade (Keator 1990).

Lathyrus jepsonii var. californicus, L. vestitus

Wild pea and Pacific pea. *Lathyrus* spp. are annual or mostly perennial herbs with rootstocks or sometimes taproots. *Lathyrus jepsonii* var. *californicus* flowers May through June, and occurs on brushy slopes. *Lathyrus vestitus* flowers March through May and is found on grassy slopes and on ridges (Matthews 1997). Seeds often have hard seed coats that require scarification as pregermination treatment (Young and Young 1986)

Limonium californicum

Sea lavender is a perennial marsh plant that flowers June through November. Fruit is membranous and indehiscent. Flower heads should be germinated as a unit (Young and Young 1986, Matthews 1997).

Lonicera hispidula var. vacillans, L. involucrata

Hairy honeysuckle and Twinberry. *Lonicera hispidula* is a rapidly growing, woody vine that starts life on the ground, but later climbs any support, where it flowers and fruits. It is found along streams and on wooded slopes, flowers April through July, and has red berries. It is easy to grow from layered stems and root divisions, and it spreads aggressively (Keator 1994). *Lonicera involucrata* is also easy to grow from layered stems, cuttings and seeds. It is found in moist places, it flowers April through June, and produces fruit that is reddish to purple-black.

Lonicera spp. fruit ripen in the summer or early fall, and depending on the species, each berry contains few to many small seeds. Hand collect when the fruit turns black. The inner seeds are tan at maturity (Evan et. al. 2000c). Unless the seeds can be extracted immediately, fresh fruits should be spread out in thin layers or kept in plastic bags to prevent heating. Extraction is accomplished by macerating the fruits in water, allowing empty seeds and pulp to float away. After a short drying period, the seeds are ready for sowing or storage. Air-dried seeds can probably be stored at room temperature for several years without serious losses in germination. If kept at 1 to 3C in sealed containers, seeds may last up to 15 years (Evans et. al. 2000c). Almost all *Lonicera* spp. show some dormancy. In most species this is caused by a dormant embryo; in others, it appears that the seedcoat also may retard germination. Stratification in sand or peat at low temperatures is recommended to overcome embryo dormancy, but for species in which seedcoat dormancy also is involved, this cold treatment should be preceded by warm stratification. Without any such treatments, germination may be prolonged over a

period of 6 months or longer (Brinkman 1974c). Stratify *L. hispidula* seeds for one month (Emery 1987).

Seed of *Lonicera* with embryo dormancy can be either broadcast sown or drilled in the fall, or stratified and sown in early spring. Seed of species believed to have an impermeable seedcoat as well, however, should be sown as soon as possible after collection to insure germination the next spring. Seeds should be sown 0.6 cm deep and then mulched. Germination is usually complete in 40 to 60 days. About 15% of the seeds sown produce seedlings. If grown in a greenhouse, be aware that this species develops an extensive root system rapidly and will require yearly repotting if it is to be held in the nursery for more than 1 year (Evans et. al. 2000c). Seedlings can be transplanted to the field after 1 or 2 years (Young and Young 1992). Many honeysuckle species also are grown from dormant or greenwood cuttings (Brinkman 1974c).

Monardella villosa

Coyote mint is an evergreen, shrubby mint. It can be propagated using cuttings or seeds. It is found in rocky and gravelly areas, and it flowers in the summer. Plant in full sun.

Myrica californica

California wax myrtle occurs in canyons, on slopes, and in coastal scrub, its catkins bloom March through April, and its fruit ripen in September. Ripe fruit are waxy, bumpy, brownish-purple berries. The fruit drops early in the winter. Ripe drupes can be stripped by hand into a container or shaken onto a canvas. The drupes are handled as seeds. The only processing needed is removal of the waxy coating prior to stratification

or sowing. During storage, however, the wax coating should be left on the seeds. Wax can be removed from the seeds before stratification by rubbing them dry over a screen (Young and Young 1992).

Cold stratify *M. californica* for 90 days in a soil-sand-peat mixture. Seeds of *Myrica* may be sown in nursery beds in the fall or spring. Drilling in rows 8 to 12 inches (20 to 30 cm) apart is preferable to broadcasting. The seed should be covered with about 1/4 inch (0.6 cm) of firmed soil. On fall-sown beds, put down a mulch of straw or leaves. Seeding must be done late in the fall to avoid germination during that season and seedling mortality during the winter. For spring sowing, seed should first be stratified at 34º to 40º F for 90 days (Young and Young 1992). Wax myrtle can also be propagated using cuttings. Plant in moist, rich soil, in shade or sun (Singer 1982). *Myrica* grows at a moderate rate, and is long-lived (Keator 1994).

Pinus radiata

Monterey pine has been successfully planted outside its native range on a worldwide basis. It has become a commercial success in South Africa, New Zealand, Australia, and South America. Pine provides habitat for birds at the Reserve's rookery pond. Unlike many other pine species, Monterey pine generally produces viable seed every year.

Monterey pine matures at 5-10 years of age, and grows to 46 m tall. Pines are monecious, with male and female cones borne separately on the same tree. *Pinus radiata*'s strobili (fruiting bodies) flower January-February. After pollination, female strobili close, and they begin to develop slowly. At the end of the first growing season they are about 1/8 to 1/5 the length of mature cones. Fertilization takes place in the

following spring and summer, some 13 months after pollination, and the cones begin to grow rapidly. As the cones mature they gradually turn from green to nut brown. Cones and seeds ripen rapidly during late summer and fall of the second year. By November the cones are fully mature. The mature cone consists of overlapping scales, each of which bears 2 seeds at its base, on the upper surface. The cones of most species open on the tree shortly after ripening, and the seeds are rapidly dispersed by mid winter. Mature seeds are ellipsoid. As in most pine species, Monterey pines have a membranous wing attached to the seed—they are easily detached.

Cones should be collected from healthy trees. Larger cones generally contain more seeds, but normally all cones are collected except those with obvious disease and insect damage. Ripe cones can be picked from standing trees or freshly fallen trees. Cone collection begins as soon as the cones are ripe and starting to crack because seeds are shed promptly from open cones. For closed cone species it is possible and often desirable to delay cone collection. Although the seeds of closed cone species may be mature in the fall, the cones are very hard to open then.

To avoid collecting immature seeds it is advisable to first check ripeness of seeds in a small sample of cones from individual trees. A mature seed has a firm white or cream-colored endosperm and a yellow to white embryo that nearly fills the endosperm cavity. Ripeness can also be estimated by changes in cone color. Mature Monterey pine cones are nut brown. Cones are often handpicked from the trees, either from ladders or by climbing.

Cones should be dried immediately after collection to avoid mold development and excessive internal heating, which lead to rapid seed deterioration. Drying can be

accomplished in 3 to 7 days by immediately spreading the fresh cones in thin layers on a dry surface in the sun or on trays in a well-ventilated building, or by placing them in sacks hung from overhead racks protected from the rain. The cones should be dried slowly to prevent hardening the cones, known as "hard casing." After initial drying, the Monterey pine cones should be heated in a kiln for 48 to 72 hours at 48º C (~130º F). Ripe cones will open satisfactorily under these conditions. Dried cones can be stored in well-ventilated bags or on trays. Monterey pine cones can also be opened by dipping them in boiling water for 60-120 seconds. Cones stored long enough in containers to have dried without opening or cones dried under cool conditions may not open properly during kiln drying. In such cases, the cones must be soaked in water for 12 to 24 hours, and then kiln dried.

After the cones are opened they are shaken to remove the seeds. Seeds are then dewinged by being flailed in a sack, or by rubbing. After completing the dewinging and cleaning process, empty seeds can be separated from viable seeds by floatation in water. High seed viability can be maintained for long periods with proper storage methods. As a general rule, seeds should be dried to a moisture content between 5 and 10%. Cold temperatures are preferred for long-term storage, with 2 to 5º C used most often.

Fresh seeds need no pretreatment (Emery 1987), but stored seeds should be prechilled (cold-moist stratified) before sowing. Seeds should be removed from storage a week before prechilling or sowing. Prechilling is accomplished by first soaking the seeds in water for 1 to 2 days and then placing them in a moist medium or in a plastic bag and holding them at a temperature between 3 to 5º C for 7-21 days. Sow seeds in the spring, at 0.9 cm depth. Germination is complete for most *Pinus* species from 10 to 50 days after

spring sowing. Seedling plants can be potted in five-inch containers, and then into gallon cans until ready for outdoor planting. Monterey pine can be rooted using cuttings (Young and Young 1992), although though they may be slow to root and require the most favorable conditions (Schmidt 1980).

Potentilla anserina ssp. pacifica

Pacific silver-weed occurs in damp places and coastal scrub. It flowers April through August, and its fruits are very small achenes, which can be hand picked (Young and Young 1986). Before planting, stratify seeds for 2 months (Emery 1987).

Salicornia virginica

Pickleweed is the dominant species in Elkhorn Slough's salt marshes, and it is usually found in the zone between mean lower high water and the elevation of the highest tides. It invades and covers bare areas rapidly, but is unable to persist in the regularly flooded portion of the intertidal zone. "*Salicornia* sets seed in October and November. Seed-producing shoot tips may be collected during this period and dried. The seeds of Salicornia are very small. Stored seeds germinate readily when treated with salt water. There appears to be no barriers to the direct seeding of pickleweed, though we know of no successful attempts to do so. All successful germination to date have been performed under nursery conditions" (Knutson and Woodhouse, 1982).

The use of cuttings has been attempted, but they have failed. Pickleweed seedlings have been produced under nursery conditions in peat-pots containing sand, vermiculite, and clay sediments. The seeds were planted dry and irrigated with salt

water. The seedlings were transplanted into an intertidal environment. The planting successfully established a cover of pickleweed. However, the unplanted controls in this experiment reached about 50% of the density of planted areas after two growing seasons. This experiment illustrates that the natural invasion of pickleweed is very rapid. Planting will be necessary only when rapid plant cover is required (Knutson and Woodhouse, 1982).

Salix lasiolepis and Salix spp.

Arroyo willow and other willows are riparian trees that work well in erosional areas and that can be propagated easily. Propagation can be done using layering and seeds, but local restorationists prefer to use cuttings (Emery 1987, Keator 1994, Sue Shaw, pers. comm.).

To plant willow cuttings follow these guidelines:

1. Obtain cuttings from local, live *Salix* trees. Cuttings should be dormant, or, if collected in the fall before the leaves fall, the leaves should be stripped from the stems.
2. Cut stems that are between 3/8 and 2 inches in diameter. Cuttings should be at least 12 inches long. Local restorationists often use 2 inch stems cut to 5 feet (Sue Shaw, pers. comm.)
3. Optional. Cut stems cleanly—do not fray the ends or the bark—and cut at a 45 degree angle to the stem. After cutting, keep all stems arranged with the bases down and the tops up. Bundle stems in groups of 25 to 50. Paint the tops with a

water-base paint (e.g., interior latex paint) to seal the cuts and to mark the top ends. A highly visible color such as red, orange, or yellow should be used.

4. Optional. The basal portions of cuttings should be treated immediately prior to planting with a rooting hormone and fungicide, such as hormodin powder. Allow cuttings to dry for 30 minutes to an hour in open air, but keep them out of direct sunlight.
5. Store cuttings under moist conditions. They can be kept outdoors in shade and submerged in water. If kept in water-filled containers, change the water daily. Another alternative is to wrap stems in wet burlap and store in a refrigerator set to 32-45º F. Willow cuttings should not be stored longer than one week.
6. When planting, keep stems moist until they are placed in the ground. This is most easily accomplished by carrying cuttings in planting bags or buckets, covered with moist vermiculite, sawdust, or water.
7. Plant by pre-digging a hole, and then dropping the cutting into the hole. Do not drive cuttings in with a hammer. If using 5 foot long cuttings, plant cuttings 3 feet deep, leaving ~2 feet of the of the stem length exposed. Tamp the soil around the willows firmly to eliminate any air pockets around the cuttings (Goldman 1996, Sue Shaw, pers. comm.).

If using seeds, use these guidelines:

Salix lasiolepis flowers February through early May. *Salix* fruit is a capsule occurring in elongated cluster, and it contains many minute, hairy seeds. These usually ripen in early summer, but seeds of some species mature in fall. Willow seeds must be collected as

soon as the fruits ripen, as indicated by the capsule turning from green to yellowish. Frequent observations are necessary to determine maturity, at which time the capsules can be collected by picking from the trees. Seeds from trees growing near the water can often be collected from the surface of the water or from drifts along the shore (Young and Young 1992).

It is unnecessary to separate the seeds from the open capsules, or to pretreat the seeds. The maximum period of storage is from 4 to 6 weeks, but germination rates drop off rapidly after 10 days for seeds stored at room temperature. Moistened seeds may be stored up to a month if refrigerated in sealed containers. Under natural conditions, willow seeds will usually germinate in 12 to 24 hours on moist sand or alluvium. Seeds must be sown immediately after collection. The opened capsules and seeds are broadcast on well-prepared beds, followed by light packing with a roller. The seedbeds must be kept moist until the seedlings are well established. If the initial stand density is too great, seedlings can be transplanted after 3 to 4 weeks (Young and Young 1992).

Salvia mellifera

Black sage is a common shrub in coastal-sage scrub and lower chaparral habitats (Hickman 1993). Flowering occurs in late spring (April through July), and good seed crops are borne nearly every year. The fruit consists of nutlets enclosed in a persistent, papery calyx. Seeds should be collected soon after maturity by stripping the inflorescence. After drying, the seeds can be recovered by air screening. They store well in sealed containers at low temperatures.

Salvia seeds are usually initially dormant and require scarification and 3 months stratification before they will germinate. Gibberellin can be substituted for prechilling. *Salvia mellifera* seeds may need to be exposed to charcoal. Pretreated seeds must be dried, and then they can be seeded in the spring (Young and Young 1992). Otherwise sow outdoors in the early fall (Emery 1987). *Saliva* can also be propagated using cuttings (Keator 1994).

Sambucus mexicana

Blue elderberry is a common shrub or tree that grows rapidly on brushy slopes, and in coastal sage scrub, chaparral, and oak woodlands. It flowers March through September (Mathews 1997). The fruit is a berrylike drupe containing 3 to 5 one-seeded nutlets or stones. When ripe, from the midsummer to early fall, the fruits are blue-black (Hickman 1993, Keator 1994). Elderberries are collected by stripping or cutting the clusters from branches. Collections should be made as soon as the fruits ripen to avoid losses to birds. If the seeds are not extracted at once, care must be taken to avoid heating. The fruits can be run through a macerator and the seeds recovered by flotation. Commercial seed may consist of dried fruits or clean nutlets. Seeds may be stored in closed containers at low temperatures for several years (Young and Young 1992).

Elder seeds are difficult to germinate because of their dormant embryos and hard seedcoats. Pretreatment usually consists of 90 days of warm stratification followed by 90 days of prechilling. An alternative is to soak seeds 10 to 15 minutes in acid followed by 2 months of prechilling. Elder seeds can be sown in the fall soon after collection or prechilled and sown in the spring. In either case, germination is not complete until the

spring of the second year after sowing. A seedling density of 370 plants per m^2 is desired. It may be desirable to sow seeds as soon as they are collected, without allowing them to dry (Young and Young 1992). *Sambucus* can also be propagated using suckers or cuttings (Keator 1994). Plant in full sun or partial shade. Elderberry works well for erosion control (Singer 1982).

Satureja douglasii

Yerba buena is a semi-woody member of the mint family found in shaded woods and coastal sage scrub habitats, and it flowers April through September (Matthews 1997). The fruit is a nutlet that requires no pretreatment for germination (Young and Young 1986).

Scirpus actus, S. americanus, S. robustus

Giant bulrush, Olney's bulrush, and prairie bulrush are wetland species that flower May through August (Matthews 1997). Store fresh undried seeds in water in a refrigerator at 35º to 39º F for 6 months, then germinate in water at 86º to 89.8º F i n continuous high light (Emery 1987). *Scirpus* can also be planted from rhizomes. Collect *Scirpus* plugs locally, being careful to get at least 3 inches of rhizome mass in addition to the aboveground parts. Plant the plugs the same day as they are collected. Keep the rhizomes moist and protected from sunlight and wind from time of collection to time of planting. Dig a planting hole large enough to hold the plant, install *Scirpus* making sure the rhizomes are 6 inches below the surface, and then backfill the planting hole with native soil—do not add amendments (Hillyard 1996).

Suaeda moquinii

California sea-blite is a member of the goosefoot family that inhabits saline and alkaline soils. It flowers August through November, and its fruit is a utricle enclosed in a calyx. Seeds are quite small, < 1 mm (Young and Young 1986, Hickman 1993, Matthews 1997).

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