



A PROJECT OF THE SONOMA-MARIN COASTAL PRAIRIE WORKING GROUP

## Prairie Described

### INVASIVE SPECIES

#### INVASIVE ANNUAL PLANTS

#### WILD OATS (*AVENA FATUA*) AND SLENDER WILD OATS (*AVENA BARBATA*) - NON-NATIVE

Grass Family (Poaceae)

Wild oats are annuals.

WILD OATS:

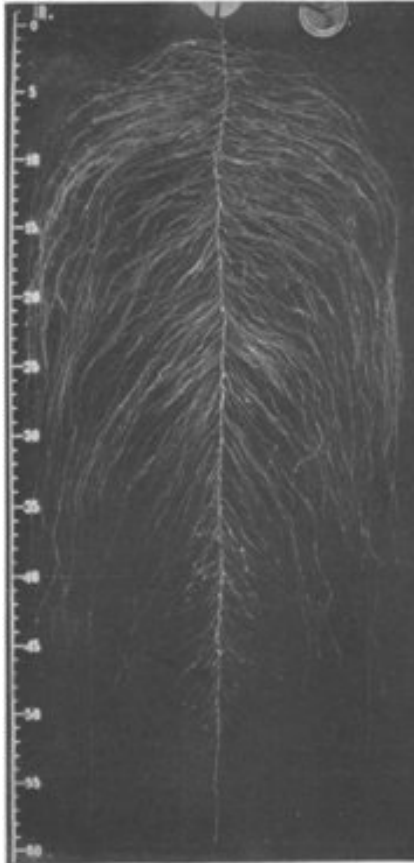
- ▶ Are native to Eurasia and North Africa.

WILD OAT ECOLOGY

- ▶ Is often dominant or co-dominant in coastal prairie (Ford and Hayes 2007; Sawyer, et al. 2009),
- ▶ Occurs in moist lowland prairies, drier upland prairies and open woodlands (Darris and Gonzalves 2008),
- ▶ Species Interactions: The success of *Avena* lies in its superior competitive ability:
  - It has a dense root system. The total root length of a single *Avena* plant can be from 54.3 miles long (Pavlychenko 1937) to, most likely, twice that long (Dittmer 1937).
  - It produces allelopathic compounds, chemicals that inhibit the growth of other adjacent plant species.
  - It has long-lived seeds that can survive for as long as 10 years in the soil (Whitson 2002).



Wild oats (*Avena*) in Marin coastal grassland.  
Photo by D. (Immel) Jeffery, 2010.



- Pavlychenko (1937) found that, although *Avena* is a superior competitor when established, it is relatively slow (as compared to cultivated cereal crops wheat, rye and barley) to develop seminal roots in the early growth stages.

#### MORE FUN FACTS ABOUT WILD OATS

- ▶ *Avena* is Latin for “oat.”
- ▶ The cultivated oat (*Avena sativa*), also naturalized in California) is thought to be derived from wild oats (*Avena fatua*) by early humans (Baum and Smith [2011]).
- ▶ Wild oats were either introduced accidentally or as forage for cattle during the Mission Period (1769- 1824) and have been widespread in California grasslands since that time (Hendry 1931).

**One crown root of wild oats (*Avena*) separated from the root system. The length of the main root is 63 inches (5.25 ft, 1.6 m). The combined length of its branches is 4.5 miles. The total root length of a single *Avena* plant can be from 54.3 miles long to, most likely, twice that long. Figure from Pavlychenko (1937).**

**RATTLESNAKE GRASS, LARGE QUAKING GRASS (*BRIZA MAXIMA*) - NON-NATIVE**

Grass Family (Poaceae)

RATTLESNAKE GRASS:

- ▶ Is a widespread annual.
- ▶ Can be dominant in grasslands in California and southern Oregon (California Invasive Plants Council)
- ▶ Is native to southern Europe.



Florets of rattlesnake grass with visiting bee. Photo by Jim Coleman 2010.

FUN FACTS ABOUT RATTLESNAKE GRASS



- ▶ Rattlesnake grass may be the earliest grass cultivated for ornamental rather than edible purposes (Snow, N. Utah State University c2001-2002).
- ▶ Rattlesnake grass escaped from gardens into the wild (Jepson c1902-1943).
- ▶ A lower stature, more delicate species, small quaking grass (*Briza minor*) is more widely distributed occurring in several states and in many habitats.

**Large Rattlesnake Grass (*Briza maxima*).** courtesy of Robert W. Freckmann Herbarium, University of Wisconsin-Stevens Point <http://wisplants.uwsp.edu/photographers.html>. Accessed 2010 Nov 5.

## INTRODUCTION TO ANNUAL BROMES (BROMUS)

- ▶ Bromus is a large genus of grasses found worldwide.
- ▶ Native annual bromes in California are rare. There are 13 annual bromes (*Bromus* spp; Grass Family, Poaceae) listed in the Jepson Manual (Hickman 1993); only one of those (*Bromus arizonicus*) is native to California; ten are introduced from Eurasia, two from South America, and one from Australia.
- ▶ The native perennial brome, California brome (*Bromus carinatus*) is an important coastal prairie species. However, it is considered a weed in croplands (Whitson 2002).

### RIPGUT BROME (*BROMUS DIANDRUS*) - NON-NATIVE

Grass Family (Poaceae)

Ripgut brome (*Bromus diandrus*) is a non-native annual.

RIPGUT BROME:

- ▶ Is often dominant or co-dominant in coastal prairie (Ford and Hayes 2007; Sawyer, et al. 2009),
- ▶ Occurs in moist lowland prairies, drier upland prairies and open woodlands (Darris and Gonzalves 2008),
- ▶ Is native in Southern and Western Europe
- ▶ Along with red brome (*Bromus madritensis*), can be dominant in grasslands in California and other western States (California Invasive Plants Council 2011a; Minnich 2008).



*Ripgut brome (Bromus diandrus). Illustration courtesy of USDA-NRCS PLANTS Database / Hitchcock, A.S. (rev. A. Chase). 1950. Manual of the grasses of the United States. USDA Miscellaneous Publication No. 200. Washington, DC.*

RIPGUT BROME ECOLOGY

- ▶ Life History:
  - The long rough needle-like awns aid in dispersal
  - Seeds can be dispersed long distances by wind and water and by sticking to animals and people (California Invasive Plants Council 2011a)



- ▶ Fire: Ripgut brome has been implicated as one of many non-native grasses that have increased fire frequency in forests and shrublands, sometimes converting them to grasslands (Cal IPC ??)

#### MORE FUN FACTS ABOUT RIPGUT BROME

- ▶ Ripgut brome was introduced to California sometime around 1860.
- ▶ The needle-like awns can injure animals by penetrating their eyes, nose and mouth parts.

#### SOFT BROME (*BROMUS HORDEACEUS*) - NON-NATIVE

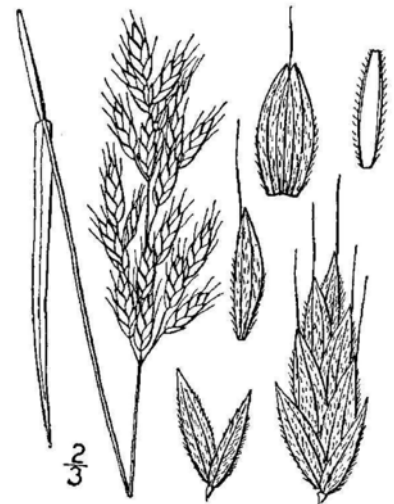
##### Grass Family (Poaceae)

##### SOFT BROME:

- ▶ Is native to Eurasia
- ▶ Has naturalized on all continents except Antarctica
- ▶ Soft brome is abundant in coastal prairies (CPEFS 2010).

##### SOFT BROME ECOLOGY

- ▶ Grazing: Soft brome was introduced as a forage species, although there are conflicting accounts of its nutritive value and palatability.
- ▶ Life History:
  - The seeds are short-lived (Howard 1998).
  - Bromus seeds readily germinate under mulch layers. Therefore the plant litter accumulation that occurs in the absence of fire and grazing tends to increase *Bromus* populations at the expense of native annuals and perennials whose germination is suppressed by litter (Heady 1988).
- ▶ Species Interactions: Soft brome threatens rare grassland species because it can outcompete them in the areas of infertile and serpentine soils that act as refuges for many rare plants (California Invasive Plants Council 2011b).



*Soft brome (Bromus hordeaceus).*  
*Illustration courtesy of USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols. Charles Scribner's Sons, New York. Vol. 1: 278.*

##### MORE FUN FACTS ABOUT SOFT BROME

- ▶ Soft Brome Is more abundant in the Mediterranean areas of California than in its native range in Mediterranean Europe (Howard 1998).
- ▶ *Bromus hordeaceus* was previously called *Bromus mollis* and is also known by the common name soft chess.

## MOUSE BARLEY, FOXTAIL BARLEY, HARE BARLEY, FARMERS FOXTAIL (*HORDEUM MURINUM*) - NON-NATIVE

### Grass Family (Poaceae)

#### MOUSE BARLEY:

- ▶ Is native to Eurasia
- ▶ Now occurs in every county in California (Calflora 2010).

#### MOUSE BARLEY ECOLOGY

- ▶ Life History: A common weed in disturbed sites in its native Eurasia, Mediterranean barley's origins are thought to be around seashores, sandy riverbanks, and animal watering holes (Utah State University c2001-2002).
- ▶ Species Interactions: The Kashaya Pomo, Ohlone, and the Mendocino Indians made use of this introduced annual grass by harvesting and eating the seeds of *Hordeum murinum* (Bocek 1984; Chesnut 1902; Goodrich, et al. 1980).



*Hordeum murinum*, 24 Mar 2008, along railroad tracks, Tempe, Arizona. [Miwatasoshi, Wikimedia Commons](#).

#### MORE FUN FACTS ABOUT MOUSE BARLEY

- ▶ More common than Mediterranean barley (*H. marinum*), this annual from Eurasia may have been brought by the Spanish settlers in California (California Invasive Plants Council).

### A COUPLE MORE.....

#### MEDITERRANEAN BARLEY (*HORDEUM MARINUM* SUBSP. *GUSSONEANUM*) - NON-NATIVE

- ▶ Mediterranean barley (*Hordeum marinum* Huds. subsp. *gussoneanum*) is an introduced annual from Eurasia. Although similar to mouse barley (*H. murinum*), it is less abundant in coastal prairies and in California as a whole.

#### PURPLE FALSE BROME (*BRACHYPODIUM DISTACHYON*)

- ▶ Wiry culms, sparse foliage, and stiff-awned seed heads make purple false brome poor forage for livestock (Crampton 1974:77).
- ▶ This introduced annual grass is considered a model organism for research because of its small genome, short lifecycle & stature, is self-fertile and because it is closely related to the major grain crops (wheat, corn, etc.) (<http://www.brachypodium.org/>).

## PERENNIAL PLANT INVADERS OF COASTAL PRAIRIE

### ITALIAN RYEGRASS (*LOLIUM PERENNE*) - NON-NATIVE

Grass Family (Poaceae)

Italian ryegrass is a European annual or short-lived perennial tufted grass.

#### ITALIAN RYEGRASS:

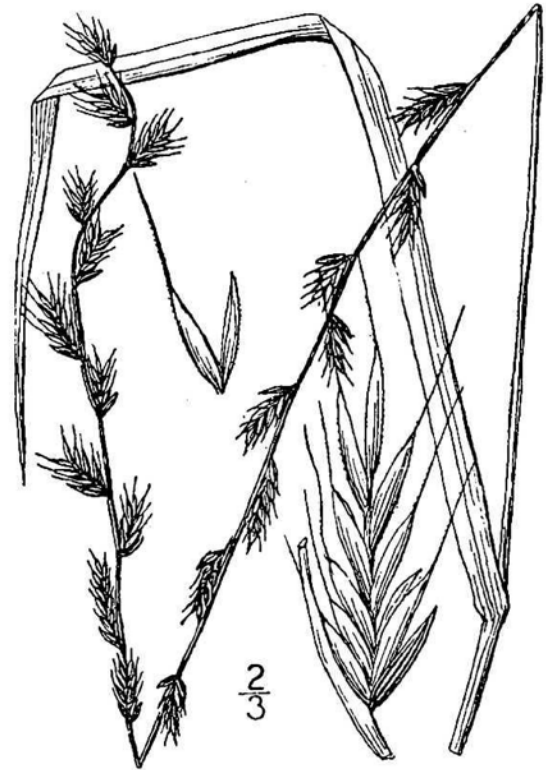
- Is found in wetlands, grasslands, and disturbed sites (Holloran, et al. 2004).
- Is now common in coastal prairies.

#### ITALIAN RYEGRASS ECOLOGY

- ▶ Life History: Seeds germinate readily leaving few in the seed bank (Holloran, et al. 2004).
- ▶ Species Interactions: The plants leave a thick layer of dead leaf litter on the soil each season which can inhibit the germination of other species.
- ▶ Drought: Roots can extend 3 or more feet into the soil on dry sites (Holloran, et al. 2004).

#### MORE FUN FACTS ABOUT ITALIAN RYE GRASS

- ▶ Italian ryegrass was cultivated in Italy from at least the 13th and 14th centuries (Carey 1995).
- ▶ Italian ryegrass often escapes into grasslands from cultivation where it is grown as livestock forage and as a turf grass (California Invasive Plants Council).
- ▶ It was for many years the most commonly used species for erosion control in the coastal areas of California (Carey 1995).
- ▶ Increased soil fertility due to nitrogen deposition from auto exhaust has been linked to the increase of *Lolium* in serpentine grasslands—grasslands with harsh, nutrient poor soils that often are refuges for native plants—in the San Francisco Bay area (Harrison and Viers 2007:154).
- ▶ Taxonomic Note: Perennial ryegrass (*Lolium perenne*) and annual ryegrass (*Lolium multiflorum*) are considered as separate species in the First Edition of the Jepson Manual (Hickman 1993). Some authors consider them both as subspecies of *Lolium perenne* (*L. perenne* ssp. *multiflorum* and *L. perenne* ssp. *perenne*). The *Lolium* section of the Jepson Second Edition (released for review on-line) moves both subspecies to *Festuca perennis* treating them as a single species



*Lolium perenne* ssp. *multiflorum*. USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols. Charles Scribner's Sons, New York. Vol. 1: 282.

(with a note stating that what was once thought to be the differentiating feature, awned or awnless florets, can often be found on the same plant; annual ryegrass is described as having bristle-like awns on lemma tip (a lemma is the lower of two bracts that subtend the floret) while perennial ryegrass is awnless. Regardless, the plants are found in coastal prairie habitats.

#### **SWEET VERNAL GRASS (*ANTHOXANTHUM ODORATUM*) - NON-NATIVE**

Grass family (Poaceae)

- ▶ Sweet Vernal Grass is a tufted perennial grass.

SWEET VERNAL GRASS:

- ▶ Is native to Europe
- ▶ Is widespread in the United States and other temperate climates. (University of California 2009).
- ▶ Is distributed from Santa Barbara through Del Norte Counties and common in coastal grasslands in northern California.



*Sweet vernal grass (Anthoxanthum odoratum) at Point Reyes National Seashore. Photo © 2010 National Park Service.*

FUN FACTS ABOUT SWEET VERNAL GRASS

- ▶ This species escaped from cultivation as a meadow grass
- ▶ It is named for its sweet vanilla-like odor from a chemical compound called coumarin, that has a bitter taste and, in large quantities, can cause hemorrhaging in cattle (University of California 2009).

#### **PURPLE VELVET GRASS (*HOLCUS LANATUS*) - NON-NATIVE**

Grass family (Poaceae)

PURPLE VELVET GRASS:

- ▶ Is dominant in many of California's coastal prairies (Sawyer, et al. 2009).

PURPLE VELVET GRASS ECOLOGY

- ▶ **Drought:** *Holcus lanatus* and other non-native perennials have the ability to use summer fog to extend its growing season much like California's native perennials (Corbin, et al. 2005).
- ▶ **Species Interactions:** *Holcus lanatus* unpalatability to sow bugs, also introduced, leads to increased litter accumulation in grasslands (Bastow, et al. 2008).



## MORE FUN FACTS ABOUT PURPLE VELVET GRASS

- ▶ *Holcus lanatus* was introduced from Europe and already widespread in North America by 1800 (Utah State University c2001-2002).
- ▶ *Holcus lanatus* is cultivated for forage and hay (Jepson manual).
- ▶ With the arrival of invasive perennial grasses, such as *Holcus lanatus*, coastal prairies may be undergoing the most significant change in species composition since the arrival of Europeans (Corbin, et al. 2005).
- ▶ The Coastal Prairie Enhancement Feasibility Study and others are working to find ways to control *Holcus lanatus*. Seedlings can be pulled easily, but mature plants develop dense fibrous roots that bind the soil and make removal difficult. The easiest time to pull adults is in late summer when the plants go dormant (Kathleen Kraft, personal communication). Mowing treatments are effective in controlling seed production but can stimulate spread through tillers. For information on controlling *Holcus lanatus* see the Cal-IPC (California Invasive Plants Council) website and the Weed Workers Handbook (Holloran, et al. 2004).
- ▶ *Holcus mollis* (Creeping Velvet Grass) is a rhizomatous grass that is also introduced from Europe, sometimes sold as an ornamental, and is a problem weed in prairie remnants and oak savannahs in the Pacific Northwest (Utah State University c2001-2002). There are no records of this plant in Sonoma or Marin County at this time (February 2011).



*Velvet grass (Holcus lanatus).*  
*USDA-NRCS PLANTS Database / Hitchcock, A.S. (rev. A. Chase). 1950. Manual of the grasses of the United States. USDA Miscellaneous Publication No. 200. Washington, DC.*

## **HAIRY OAT GRASS, POVERTY GRASS, PURPLE-AWNEED WALLABY GRASS (*RYTIDOSPERMA PENICILLATUM* FORMERLY MISIDENTIFIED AS *DANTHONIA PILOSA*) - NON-NATIVE**

Grass Family (Poaceae)

Hairy oat grass is an introduced perennial bunchgrass.

HAIRY OAT GRASS:

- ▶ Is native to Australia.

## HAIRY OAT GRASS ECOLOGY

- ▶ Grazing: This perennial bunch grass is considered of economic importance as animal forage in Australia and in New Zealand.

## MORE FUN FACT ABOUT HAIRY OAT GRASS

- ▶ Introduced and grown experimentally in California and in several other states, Hairy Oat Grass is now considered a troublesome pest in coastal areas of California and southwestern Oregon ([Jepson Interchange](#). Cited 15 Oct 2010).



*Hairy oatgrass flowers (Rytidosperma penicillatum). Listed as Danthonia pilosa in the first edition of the Jepson Manual). Photo by Jose Hernandez @ USDA-NRCS PLANTS Database.*

## TROPICAL NEEDLEGRASS, ANDEAN TUSSOCKGRASS (*NASSELLA MANICATA*) - NON-NATIVE RECENT INVADER

### Grass Family (Poaceae)

#### TROPICAL NEEDLEGRASS:

- ▶ Is native to Ecuador, Chile, Argentina, and Uruguay
- ▶ Is established in Sonoma, Monterey and Calaveras counties in California (USDA NRCS 2010; Utah State University c2001-2002).

#### FUN FACTS ABOUT TROPICAL NEEDLEGRASS

- ▶ It was introduced and established in California in areas associated with sheep grazing; misidentified as *N. formicarum* in the Jepson Manual (1993).
- ▶ Andean tussockgrass resembles the California native purple needlegrass (*Nassella pulchra*), but has shorter florets and more developed crowns (Utah State University c2001-2002).
- ▶ Other scientific names previously used for this species include: *Stipa manicata*, *Nasella formicarum*



*Tropical needlegrass north of Jenner. Photo by D. (Immel) Jeffery, 2010.*

## COMMON INVASIVE FORBS OF COASTAL PRAIRIE

### ITALIAN THISTLE (*CARDUUS PYCNOCEPHALUS*) - NON-NATIVE

Sunflower family (Asteraceae)

#### ITALIAN THISTLE

- ▶ Is an annual native to the Mediterranean regions of Eurasia and northern Africa (Bossard, et al. 2000).

#### ITALIAN THISTLE ECOLOGY

- ▶ Drought: It is thought that drought favors an increase in Italian thistle, but there seemed to be a substantial increase in thistle colonies along the Marin and Sonoma coasts during the high rainfall growing season beginning winter 2009 through spring 2010 (Brendan O’Neill, personal communication 2010). However, the wet winter of 2009-2010 followed three years of unusually low rainfall in California.
- ▶ Life History:
  - A single plant can produce 20,000 seeds (Bossard, et al. 2000).
  - Seeds germinate readily with fall rains and are quick to colonize areas where vegetation has been removed, such as after fire or in pastures that have been overgrazed and excessively trampled.
- ▶ Species Interactions:
  - Italian thistle is a poor competitor with established perennial plants.
  - The plants grow from basal rosettes of leaves that cover the ground blocking the growth of other species (Bossard, et al. 2000).



*Carduus pycnocephalus*, Korbblütler (Asteraceae) - Italien/Italia/Italy: Friuli-Venezia Giulia, Prov. Trieste, Sistiana, Rilkeweg/Sentiero Rilke, 23 May 2008, Franz Xaver, Wikimedia Commons.

#### MORE FUN FACTS ABOUT ITALIAN THISTLE

- ▶ This species was accidentally introduced into California between 1912 to 1930 (Bossard, et al. 2000).

## BURCLOVER (*MEDICAGO POLYMORPHA*) - NON-NATIVE

Pea Family (*Medicago polymorpha*)

Burclover has a clover-like leaf with three leaflets and yellow pea-like flowers, but it is not a true clover (*Trifolium*).

Burclover:

- ▶ This species was accidentally introduced into California between 1912 to 1930 (Bossard, et al. 2000).
- ▶ Is an annual native to the Mediterranean region,

Burclover Ecology

- ▶ Life History: The spirally coiled bur-like fruits stick to animal fur and to the socks and shoes of humans who help to spread the seeds.
- ▶ Drought: Jepson (1922, as *Medicago hispida*) says of burclover, “By cattlemen the plant is prized as a dry season stock feed, since the burs are produced in great quantity and are highly nutritious; it also furnishes a green pasturage in the rainy season. This is a rare instance of an aggressive immigrant herb having a high economic value.”

MORE FUN FACTS ABOUT BURCLOVER

- ▶ *Medicago polymorpha* is so widespread in California that its common name in the Jepson Manual is California Burclover (Isley 1993).
- ▶ Burclover was most likely brought into California in the wool of sheep accompanying the Spanish Missionaries (Hendry 1931; Jepson c1902-1943).



*Medicago polymorpha* (habit and flowers). Maui, Kula. 8 March 2007. Plants of Hawaii, Image 070308-5270 from <http://www.hear.org/starr/plants/images/image/?q=070308-5270>; Forest & Kim Starr



The spiny spiral-shaped seed pod of California burclover (*Medicago polymorpha*) Photo courtesy of Tracey Slotta @ USDA-NRCS PLANTS Database



**COMMON, ROUGH OR HAIRY CAT'S EAR, FALSE DANDELION (*HYPOCHAERIS RADICATA*)**

Sunflower Family (Asteraceae)

Cat's Ear is a perennial dandelion-like forb

CAT'S EAR:

- ▶ Is widespread in coastal terrace prairie
- ▶ Can be one of the more dominant species in coastal terrace prairie (Warner, P. 2003).

CAT'S EAR ECOLOGY

- ▶ Grazing and Fire: Cat's ear can resprout when cut, grazed or burned (Warner 2003).
- ▶ Life History: perennial that produces many seeds annually.
- ▶ It has a thick fleshy tap root in which it stores energy to resprout.
- ▶ Species Interactions:
  - The plants basal leaves, arranged in a rosette, spread over the soil obstructing other plants from growing around it.
  - Maria Copa: leaves eaten with salt (57).



*Hypochaeris radicata*. USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada and the British Possessions. Vol. 3: 309.

**LESSER HAWKBIT, HAIRY HAWKBIT (*LEONTODON TARAXACOIDES\**) - NON-NATIVE**

Sunflower Family (Asteraceae)

This dandelion-like plant (*Leontodon* means “lion’s tooth”) looks and behaves very much like hairy cat’s ear (*Hypochaeris radicata*). It is prevalent in the coastal prairies that are nearest to the ocean.

\*Reassigned as *Leontodon saxatilis* ([Jepson Manual](#) 2nd edition).



*Leontodon taraxacoides* in flower along northern Sonoma County coast. Photo by D. (Immel) Jeffery, 28 June 2010.

Citation: Jeffery (Immel), D., C. Luke, K. Kraft. Last modified February 2020. California’s Coastal Prairie. A project of the Sonoma Marin Coastal Grasslands Working Group, California. Website: [www.cnga.org/prairie](http://www.cnga.org/prairie).

## ENGLISH PLANTAIN (*PLANTAGO LANCEOLATA*) - NON-NATIVE

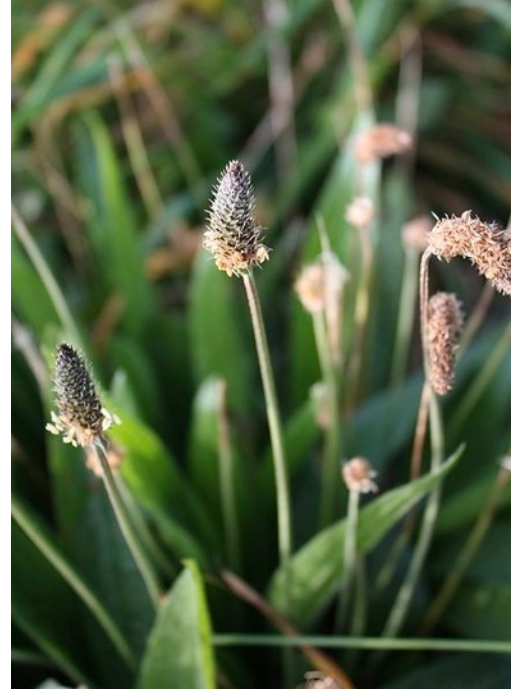
Plantain family (Plantaginaceae)

ENGLISH PLANTAIN:

- ▶ Is native to Europe
- ▶ Is wildly successful in cismontane California.

ENGLISH PLANTAIN ECOLOGY

- ▶ Species Interaction:
  - Tom Smith, Bodega Miwok, told Elizabeth Kelly that *Plantago lanceolata*, called *súgui-kole*, or just *kole*, was used for house thatching by placing the root end up (Kelly 1996).
  - Tom Smith added that after the Spanish came, the women saved and planted the seeds by scattering them on the ground.
  - Plantain (*P. major*, also native to Europe) was used medicinally by several groups in Mexico, Baja, and New Mexico (Timbrook 2007), but Tom Smith does not mention any medicinal use by the Bodega Miwok.
  - Chesnut writes that the Mendocino Indians did not use the plant although it covered the valley and that it was grazed only sparingly by cattle.



*Ribwort plantain, English plantain, or narrowleaf plantain (Plantago lanceolata) in Fredericia, Denmark. 17 September 2009. Anneli Salo. Wikimedia Commons.*

## RED-STEM FILAREE, RED-STEM STORK'S BILL (*ERODIUM CICUTARIUM*) - NON-NATIVE

Geranium family (Geraniaceae)

RED-STEM FILAREE:

- ▶ Is native to Mediterranean region (Mensing and Byrne 1999)

RED-STEM FILAREE ECOLOGY

- ▶ Life History: The barbed corkscrew-like seeds can disperse by becoming entangle in the fur of livestock (Mensing and Byrne 1999).

FUN FACTS ABOUT RED-STEM FILAREE



*Erodium cicutarium 14 May 2005, Darkone, Wikimedia Commons*

- ▶ Red-stem filaree may have been one of the earliest weeds introduced into California. Native to the Mediterranean region, it was probably first brought to Baja California in the 1750s and moved north with the pre-Mission Spanish explorers, its barbed corkscrew-like seeds stow-a-ways in the fur of livestock or as a contaminant in feed (Mensing and Byrne 1999).



*Red-stem filaree (Erodium cicutarium) seeds showing cork-screw dispersal feature of seeds. . Photo courtesy of Steve Hurst @ USDA-NRCS PLANTS Database.*

- ▶ There are only two *native Erodium* species in California in the Jepson Manual (Hickman 1993). *Erodium macrophylla*, the only native *Erodium* that occurs in coastal prairies was recently reassigned to a new genus as *California macrophylla* being segregated from *Erodium* on morphological, molecular data. The genus is named for the California Floristic Province ([http://ucjeps.berkeley.edu/tjm2/review/treatments/geraniaceae\\_all.html#80427](http://ucjeps.berkeley.edu/tjm2/review/treatments/geraniaceae_all.html#80427)).

## ANIMAL INVADERS OF COASTAL PRAIRIE

The most visible animal invaders in coastal prairies are feral pigs (see below). However, exotic animals of all sizes have found a home in coastal prairie. Even the smallest of introduced species can have big effects on community structure and composition.

### Feral pigs and wild boars (*Sus scrofa*)

"Pigs' effects may typify the complicated events to be expected when an ecosystem's regime of disturbance is significantly altered."

Peter Kotanen 1995



*Left: Wild boar Kiel, Germany. 12 April 2008. Volker. G. Wikimedia Commons: [http://commons.wikimedia.org/wiki/File:Wildschwein\\_12.4.2008\\_117.jpg](http://commons.wikimedia.org/wiki/File:Wildschwein_12.4.2008_117.jpg)*

*Right: Male pig at a farm in England. 27 August 2008. Amanda Slater. Wikimedia Commons: [http://commons.wikimedia.org/wiki/File:Gloucester\\_Old\\_Spot\\_Boar,\\_England.jpg](http://commons.wikimedia.org/wiki/File:Gloucester_Old_Spot_Boar,_England.jpg)*

### Pig Family (Suidae)

The Wild Boar/Feral Pig crosses of California have the typical large heads, and tusks (males) of their wild ancestors, but show a range of patterns in black, brown and white more typical of domestic pigs.

WILD BOAR:

- ▶ Is native to northern and central Europe, the Mediterranean region and Asia south to Indonesia.
- ▶ Were established in California in the 1800s around coastal Spanish settlements and expanded over the last century by hunting introductions of wild boar, domestic pig releases, and natural dispersal (Sweitzer and Van Vuren 2009).
- ▶ Occupy a wide range of habitats, including grasslands; their range is largely coincident with oak woodlands in California due to their dependence on acorns and cover (Sweitzer and Van Vuren 2009, Massei and Gunov 2004).

FERAL PIG ECOLOGY:

- ▶ Soil Disturbance:
  - ▶ Rooting, which occurs at an average depth of 5-15 cm, can cause 80-95% reduction in herbaceous cover, cause the severe reductions or local extinction in some plants and animals, and reduce the density of seedlings by 1.5 to 6 times (Massei and Gunov 2004)
  - ▶ In areas of high pig density, rooting can occur at least once per year on 74 to 80% of the soil surface and cause increased erosion on steep slopes, and nutrient leaching (Ca, P, Zn, Cu, and Mg) (Singer 1982). Although in a 4-year pig enclosure study in California grassland, Cushman et al. (2004) found no evidence that pig disturbances affected nitrogen mineralization rates or soil moisture availability.
  - ▶ Areas that have been rooted by Wild Boar show greater rates of organic matter decomposition, and can create more vigorous growth in plants that survive (Massei and Gunov 2004).
  - ▶ Wild Boars may serve as a dispersal agent for some plants. Seeds can pass through their digestive tract unharmed, and they have been shown to disperse seeds of invasive plants (Massei and Gunov 2004)
- ▶ Species Interactions:
  - Pig rooting may enhance colonization by non-native grasses and forbs. Based on the results of 4-year pig enclosure study in California grassland, Cushman et al. (2004) hypothesized that clearing by pigs provided greater opportunities for colonization and reduced intensity of competition for non-native plants.
  - Pig rooting may also prevent the colonization of grasslands by shrubs and trees: pig rooting significantly decreases colonization by oak seedlings in the understory of oak woodlands (Sweitzer and Van Vuren 2009).
  - Plants comprise 80% to 90% of the diet of wild boar. Pigs spend most of their time rooting for tubers, roots, bulbs and often eat fruit, fungi, and acorns (Massei and Gunov 2004). Their rooting can cause 80-95% reduction in herbaceous cover and declines in preferred species (Massei and Gunov 2004).
  - Animals are found in 97% of pig stomachs sampled and comprise 2-11% of the diet volume. Invertebrates, such as insect larvae, earthworms, and snails are regularly consumed. Seven years after removal of feral pigs, the total density of microarthropods in a forest nearly doubled and biomass increased by 2.5 times Impacts to small



vertebrates consumed, such as carcasses, small rodents, reptiles, amphibians, and fish, have also been found for ground-nesting birds, surface-tunnelling rodents, and small insectivores (Massei and Genov 2004).

- Where large carnivores are present, wild boar invariably appear in their diet and sometimes are one of the most important prey. Golden eagles (*Aquila chrysaetos*) recolonised the California Channel Islands with availability of pigs as prey and subsequently started to prey heavily on the native island fox (*Urocyon littoralis*), causing drastic declines.

#### MORE FUN FACTS ABOUT WILD BOARS

- ▶ Between the 1960s and mid-1990s, Wild Boar populations expanded from about 10 coastal counties to over 50 coastal counties in California. As of 1996, 25% of the total land area of California was occupied by Wild Boars and they were most abundant in the central and north-coast regions (Waithman et al. 1999).
- ▶ Wild boars have the highest reproductive rates among ungulates and, in areas with abundant food supply, are capable of 150% annual increases in population size (Massei and Genov 2004).
- ▶ The extent of rooting and the density of Wild Boar populations are directly correlated (Massei and Genov 2004).

#### SOW BUGS (*PORCELLIO SCABER*) - NON-NATIVE

Sow bugs are crustaceans (order Isopoda) that consume plant debris.

Sow Bugs:

- ▶ Are native to western Europe.

Sow Bugs Ecology

- ▶ Species Interaction:
  - Sow bugs are important detritivores in coastal grasslands (Bastow, et al. 2008).
  - The unpalatability of *Holcus lanatus* to sow bugs leads to increased litter accumulation in coastal prairies (Bastow, et al. 2008).



Common rough woodlouse (*Porcellio scaber*). 23 May 2009. Acélan. Wikimedia Commons

Fun Facts About Sow Bugs

- ▶ Sow bugs have been present in California for over a century (Bastow, et al. 2008).
- ▶ It is not known if there were native terrestrial isopods in California prior to European contact.

## SLUGS AND SNAILS

Introduced slugs and snails are major pests in California croplands. Slugs and snails eat seeds, leaves and other plant parts and can consume and kill seedlings. Researchers are just beginning to discover that slugs and snails can have large effects on wildland plant communities (Maze 2009; Strauss, et al. 2009). California has a rich variety of native slugs and snails.



An introduced gray field slug (*Deroceras reticulatum*) retreating back into the ground after consuming the seed leaves of a newly germinated showy Indian clover. Photo by D. (Immel) Jeffery.