# Weeds & Fire

## Dewey-Humboldt, AZ

### Firewise Presentation

by Garry Rogers

February 19, 2020

# Presentation Introduction

- Focus is on local native and introduced weeds.
- Weeds defined by life-history traits.
- Pictures of our common fuelweeds.
- Control tactics.
- Ask questions at any point. Divergent subjects welcome.

# General Wildfire Elements

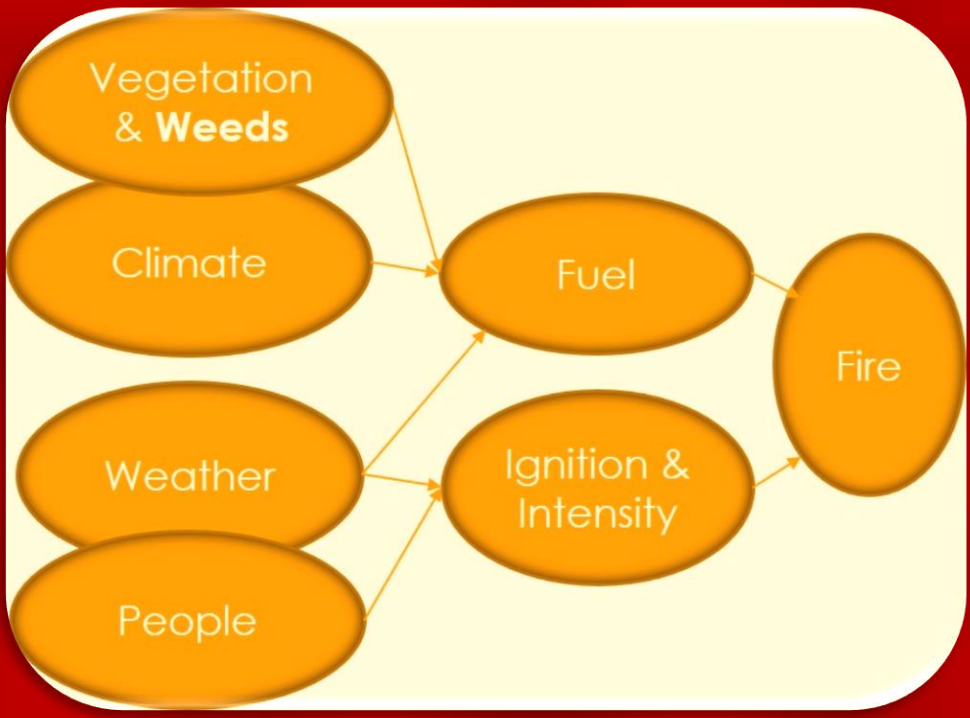


**Fig. 1.1** General wildfire elements

# The Future of the Weed Problem

At the U. S. Forest Service Fire History Conference held at the University of Arizona Tree Ring Laboratory in 1980, Jeff Steele and I showed that fire is not a necessary force maintaining desert ecosystems. “Perhaps no fire in the Sonoran Desert has been natural since the intro-duction and spread of exotic annuals. Both frequency and intensity may have increased” (Rogers and Steele 1980).

**Fig. 1.2** Fire scars and annual growth rings on Ponderosa Pine

At the time of the Fire History Conference, I had just finished a six-year study of vegetation change in the Great Basin Desert (Figs. 1.3 and 1.4). I had learned that “. . . Introduced annuals that are adapted to frequent disturbance will continue to replace native vegetation, probably at an accelerating rate” (Rogers 1982).

**Fig. 1.3** Cedar Mountains, 1901. Native shrubs (G. K. Gilbert)

**Fig. 1.4** Cedar Mountains, 2008. Weeds have replaced original shrubs (G. Rogers)

In 2010, I was hired to write the Weed Management Plan for the 3.2 million acres of public land managed by the U. S. BLM Phoenix District. Weeds were invading and replacing native vegetation both by competition and by increased fire size and frequency. I defined the steps managers could take to control the weeds and stop losing habitat. Major shifts in BLM management policies were required. BLM managers could not make the changes (Rogers 2010).

In *Weeds of Dewey-Humboldt*, I explored the value of weeds for nature and for people and I speculated about their future (Rogers 2018).

# Twenty-Seven Fuelweeds in Dewey-Humboldt, AZ

*Examples from a Growing Flora Approaching 200 Species*

February 19, 2020

Garry Rogers

Download this file at: https://garryrogers.com

## Contents

# 2.1 AMARANTH FAMILY—AMARANTHACEAE

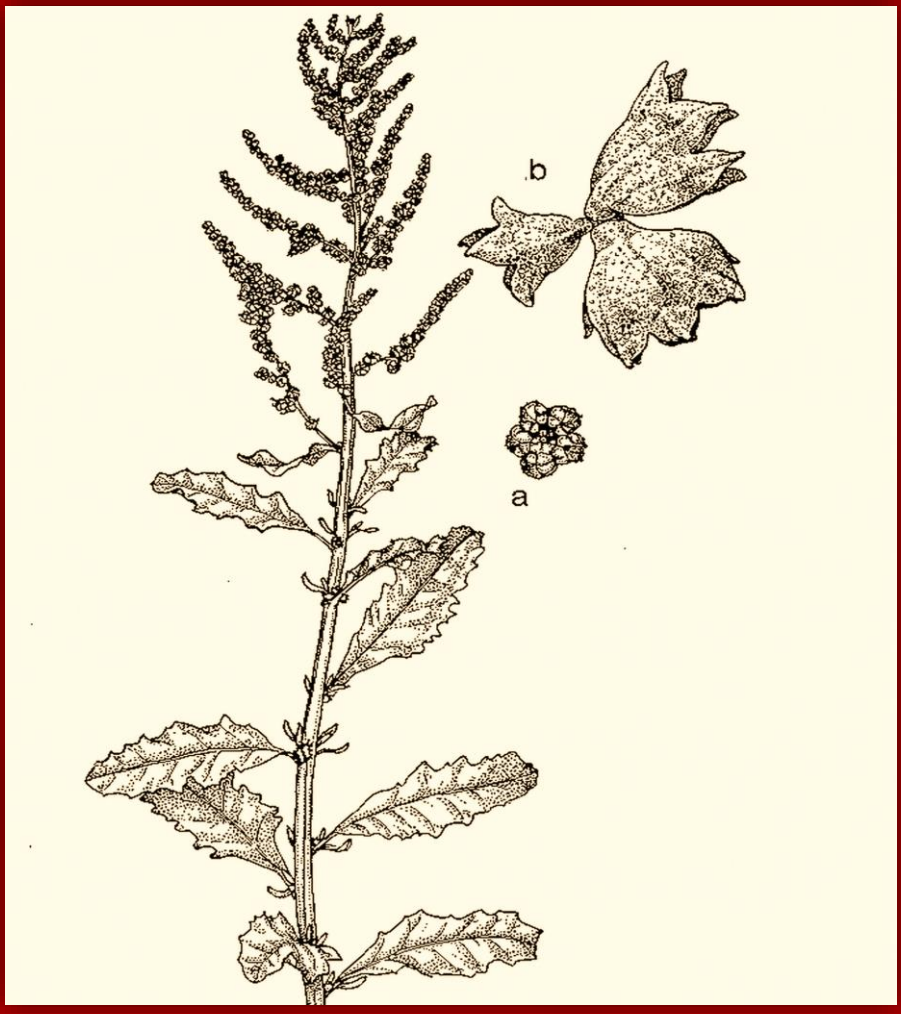


**Fig. 9.1.1** Wright Saltbush (*Atriplex wrightii*)—AMARANTHACEAE. Annual reproducing from seed. Erect stems 2-4ft high. **Leaves**: *Silvery powder below, bright green above, edges wavy or toothed*, alternate, 2-8cm long, 6-25mm wide. **Flowers**: Male flowers in 2-12in leafless spikes on stem tops; female flowers in small clusters in leaf axils. **Seeds**: Pale brown, 1mm wide, enclosed by pair of green or yellow fan-shaped bracts about 2mm wide with 3-7 short teeth across the top. **a**. Male flowers. **b**. Cluster of three fruits (Fig. 2.1.1 drawing by Lucretia Breazeale Hamilton © Arizona Board of Regents)

## Wright Saltbush (*Atriplex wrightii*) [A|N]

The distribution maps from websites offering information on this and other weeds sometimes disagree. The Encyclopedia of Life (EOL 2019) and Flora of North America (eFloras 2019) report that Wright Saltbush (Fig. 2.1.1) only grows below 4,000ft. However, the SEINet (2019) map showing the species around D-H is correct; the plant does just fine in D-H (altitude 4,600ft). The conflict might indicate that pressed plants were not present in the herbaria the describers were using when they wrote the descriptions.

Information reported in many published plant descriptions comes from studies of pressed and preserved plant specimens stored in herbaria. If no one has collected a specimen from a particular area, a botanist describing a species' distribution might not report that it occurs in that area. Though not perfect, relying on herbarium specimens to describe plants is an important practice. The stored specimens provide proof to support published descriptions.

Flora of North America (eFloras 2019) relies on Watson (1874) for the plant description. Male flowers at top of plant are shown in the figure below (Fig. 2.1.2).

**Fig. 2.1.2** Wright Saltbush male flowers (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.1.3** Common Lambsquarters (*Chenopodium album*)--AMARANTHACEAE. One to seven feet high with mealy flowers and leaf bottoms. **Leaves**: Alternate, 1-5in long and 12-50cm wide. Higher leaves lanceolate and entire; lower leaves are egg or wedgeshaped with lobes at base and often with toothed margins. **Flowers**: Inconspicuous greenish flowers cluster on branch tips. **a**. Enlarged leaf and seed (**b**.) (Fig. 2.1.3 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Common Lambsquarters (*Chenopodium album*) [A|E]

People have been cultivating and eating Lambsquarters (Fig. 2.1.3) for thousands of years. Asian and African farmers still plant it, but westerners consider it a useless weed. Cook the leaves or eat them raw, but limit your intake as they contain high levels of oxalic acid. The seeds are high in protein, vitamin A, calcium phosphorus, and potassium (U. S. Department of Agriculture Natural Resources Conservation Service 2019).

Lambsquarters readily invades crops and disturbed habitats. And if it makes seeds, it is difficult to eradicate—its seeds remain viable for up to 40 years.

This tough nutritious plant could be one of our major crops on the other end of the Anthropocene (Fig. 2.1.4).

**Fig. 2.1.4** Lambsquarters flowering branch (© GR).

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.1.5** Narrowleaf Goosefoot (*Chenopodium desiccatum*)—AMARANTHACEAE.
Annual 1-4ft high branching well above base and reproducing only from seed. **Leaves**: Narrow, pointed, white beneath, green above, 13-50mm long and 2-8mm wide (Fig. 2.1.5). **Flowers**: Stalkless, covered by white mealy scales, crowded on short branches in upper leaf axils and in *long leafless flowering branches at the tops of stems*. **Seeds**: Black shiny disks about 1mm in diameter. **a**. Fruiting calyx. **b**. Seed. Slimleaf Goosefoot (*Chenopodium leptophyllum*) is almost identical but has narrower leaves and dull seeds. **c**. Fruiting calyx. **d**. Seed (drawings by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Narrowleaf Goosefoot (*Chenopodium desiccatum*) [A|EMN]

Narrowleaf Goosefoot expanded here at CWF last summer. It was surely present before 2017, but I hadn't noticed it. In 2017, it spread over about 2000 square feet in front of the tractor shed. It is shorter and less troublesome than Kochia, which had dominated the site.

The local deer squad and various insects eat Goosefoot, showing how native consumers might limit the abundance of native weeds (2.1.6).

**Fig. 2.1.6** This photo shows just how delicious native insects find Goosefoot leaves (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.1.11** Fivehook Bassia (Smotherweed) (*Bassia hyssopifolia*)--AMARANTHACEAE. Erect annual 2-5ft tall with stout branches from the main stem. **Leaves**: Alternate, narrow, pointed, 6-13mm long. Each leaf axil has a cluster of shorter leaves or a short spike crowded with small leaves and flowers, all woolly with yellowish hairs. **Flowers**: Flower spikes longer at tips of stems sometimes forming branches 2-12in long. The tiny flowers have no petals. **Seeds**: Thin yellow hairy fruit has five separate chambers enclosing seeds. Each chamber develops a yellow hooked spine about 2mm long. Seeds are oval, about 2mm long with charcoal gray edges. **a**. Enlarged fruiting branch. **b**. Fruiting calyx. **b**. Seed (Fig. 2.1.11 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Fivehook Bassia (Smotherweed) (*Bassia hyssopifolia*) [P|I]

This weed's common name advertises the plant's principal means of dispersal: The hooks latch onto fabric and animal fur and ride along until brushed off or the fur sheds.

One ability of Fivehook Bassia (Figs. 2.1.12) that botanists find most interesting is its occasional hybridization with Summer Cypress (*Kochia scoparia*). This occurs in North America but never in the plant's Eurasian home territory.

**Fig. 2.1.12** Fivehook Bassia bushy growth (photo © Forest & Kim Starr)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

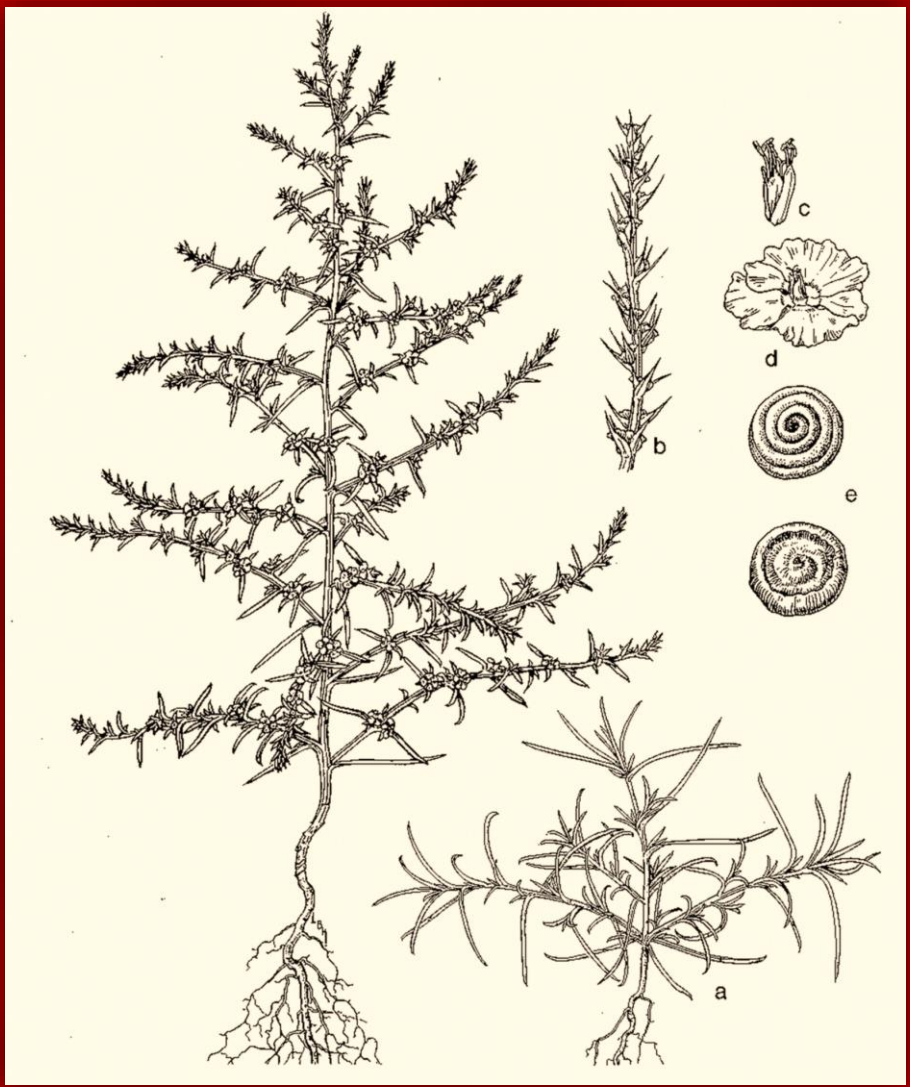


**Fig. 2.1.13** Russian Thistle (*Salsola kali*)—AMARANTHACEAE. At maturity, a densely branched globular annual 6-72in tall with ridged, sometimes red, and sometimes red-streaked stems. Breaks from root when dry becoming a seed-dispersing tumbleweed. **Leaves**: Stiff awlshaped leaves ending in a spine replace soft early leaves. **Flowers**: Tiny, white, cluster at bases of leaves on upper branches. No petals. **Fruits**: Flower parts form wings that merge to cover the red fruit. Each fruit contains one gray to tan seed with shape of coiled embryo visible. **a**. Seedling. **b**. Fruiting branch. **c**. Flower. **d**. Fruiting calyx. **e**. Seeds (Fig. 2.1.13 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Russian Thistle (*Salsola kali*) [A|EI]

People imported this prickly tumbleweed (Fig. 2.1.14) to the U. S. by accident in grass seed from Asia. Over the past century, the plant has spread across the arid West. For decades, it has been familiar on roadsides, disturbed areas, and overgrazed ranges everywhere. Dense tumbleweed drifts form against fences and other barriers and in one instance, the heap accumulating at the head of a train blocked the engineer's vision forcing the train to stop.

Tumbleweeds protect and restore soil better than some weeds. New shoots are edible, and some birds have learned to use the plants for cover. However, the weed is a misfortune for the West because it burns so well. When combined with other fuelweeds, it steps up fire frequency and this prevents succession back to the original vegetation.

**Fig. 2.1.14** Russian Thistle (photo © Dcrjsr)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

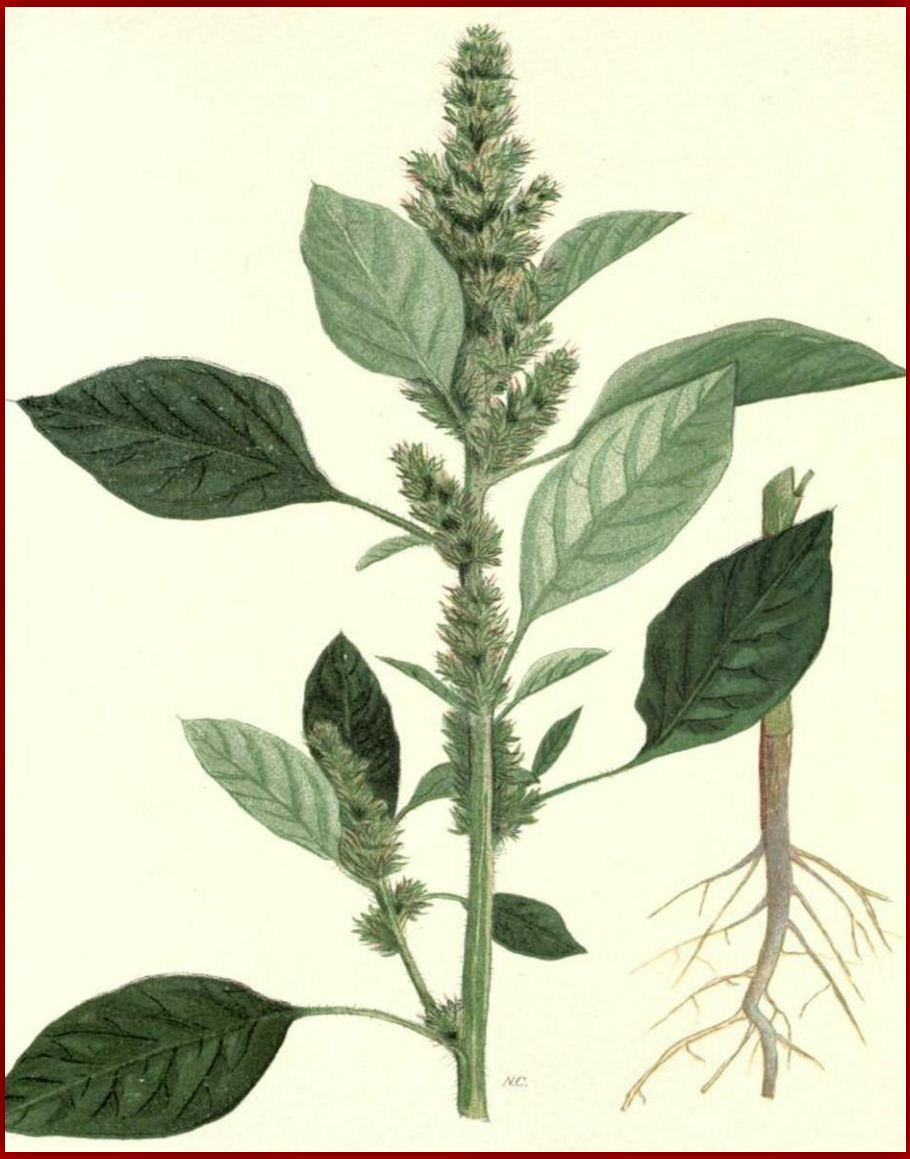


**Fig. 2.1.15** Redroot Pigweed (*Amaranthus retroflexus*)—AMARANTHACEAE. Annual 1-3m tall. Thick main stem red near base breaks at maturity to allow plants to tumble along dispersing seeds. **Leaves**: Lower leaves oval or lanceolate, hairy beneath at least along veins, 5-15cm long. **Flowers**: Staminate (male) at tips of inflorescences with pistillate (female) flowers clustered beneath. Short spikes form in leaf axils, terminal spike longest, 5-20cm. **Seeds**: Black to dark brown in a capsule less than 2mm long with a lid that opens to reveal the tiny seed (Fig. 2.1.15 painting by Norman Criddle, 1909)

**Redroot Pigweed (*Amaranthus retroflexus*) [A|EMN]**

Redroot Pigweed (Figs. 2.1.16) can grow to 3m tall, but I've seen none more than half that. Size doesn't matter, however; the weed is so variable it can make a little tuft of flowers and seeds when it's only 3in tall. I listed the plant as native, but it could have followed people into the Southwest from its tropical base farther south. Around D-H, it grows along roads, beside the Agua Fria River, and in gardens.

People cultivate Amaranthaceae for their seeds. Cultivars grow well in D-H with a modest amount of added water. The ones I grew for local birds produced heavy seed heads 30cm long but the birds were not interested and the seeds fell to the ground. I did not follow their fate, but local harvester ants and rodents gathered some.

**Fig. 2.1.16** Redroot Pigweed seed head (photo © Bogdan)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.1.21** Palmer Pigweed (*Amaranthus palmeri*)—AMARANTHACEAE. Annual 1-6ft and sometimes 15ft tall. Thick main stem often turns red with age. **Leaves**: Lanceolate or eggshaped, alternate, hairless, 5-20cm long and 1-12cm wide with prominent white veins on lower surface (**a**). **Flowers**: Staminate (male, **b**) and Pistillate (female, **c**) flowers on different plants, on long leafless spikes. Central spike 6-18in long. Both male and female flower parts stiffen to spines at maturity. **Seeds**: Dark brown, oval, about 2mm long (**d**) (Fig. 2.1.21 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Palmer Pigweed (*Amaranthus palmeri*) [A|EMNP]

Amaranths are a minor irritant in crops and gardens and on the margins of lawns, roads, and other disturbed areas. However, Palmer Pigweed and other Amaranth species have many uses. There was one warning by Moore (2003) worth noting: "Do not grow where inorganic nitrates are added to the soil—or even overly rich [say from manure additions] soil; the Amaranths concentrate nitrates and can be accumulatively toxic" (Moore 2003: 29).

Palmer Pigweed (Figs. 2.1.22) and other native amaranths are consumed by numerous wildlife species (Fig. 3.1).

As many other weeds have done, Palmer Pigweed has evolved resistance to glyphosate (the main poison constituent of Round-Up).

**Fig. 2.1.22** Palmer Pigweed (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.1.23** Kochia (Summer Cypress) (*Bassia scoparia*)--AMARANTHACEAE. Thornless bushy annual grows to 4m tall. **Leaves**: Alternate, stalkless, more or less hairy, 2-5cm long, 3-7mm wide. **Flowers**: Solitary or paired in axils of leaf-like bracts, stalkless, green, with five triangular sepals and no petals. Grow on hairy spikes 5-10cm long. **Seeds**: Persistent 2-3mm wide sepals enclose one 1-2mm wide, wedge-shaped, flat seed (Fig. 2.1.23 photo © GR)

## Kochia (Summer Cypress) (*Bassia scoparia*) [A|IP]

Kochia originated in Europe and has become abundant throughout North American deserts. The plants produce seed when as small as 3in tall, and many more seeds up to their maximum height of about 13ft. Large plants get so dense they impede movement (Fig. 2.1.23). When they dry out in the fall, they are a serious fire hazard (Fig. 2.1.24).

The plant was present in a few spots around CWF until 2012 when it made rapid gains. Two years earlier the last of our rescued cows died. I stopped irrigating the pastures, and as the grass dried, Kochia and other weeds spread. Kochia has taken over with 2-3ft tall plants in the dry sections of the pastures and taller plants in the wetter areas. It does not grow in the shade of any of the trees.

**Fig. 2.1.24** Dry Kochia stunted by drought (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.4.3** Slimleaf Bursage (*Ambrosia confertiflora*)—ASTERACEAE. Bushy perennial 1-3ft tall reproducing by seed and by sprouts from slender creeping roots. **Leaves**: So hairy they appear gray; alternate, 2-5in long, with narrow lobes often divided into smaller lobes. **Flowers**: Spikes at tips of branches 2-5in long with tiny male flowers in green drooping involucre. Female flowers cluster in leaf axils below males; almost invisible until they mature into spiny little burs 2-3mm long with 10-20 curved spines about 1mm long with hooked tips. **Seeds**: Each bur encloses 1 or 2 achenes. **A**. Slimleaf Bursage showing finely-divided leaves and male flowers above females in leaf axils. **Aa**. Enlarged male head with male flowers. **Ab**. Mature female flower (bur) with curved, hooked spines. **B**. Annual Bursage (*A. acanthicarpa*). Mature female flower head (bur) with straight spines (Fig. 2.4.3 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Slimleaf Bursage (*Ambrosia confertiflora*) [P|ENT]

Not following my weed-control advice, I acted late and this weed formed a colony beside the CWF front gate. I have pulled the shoots every year for at least ten years and still they come. The tenacity of this character is due to another negligence of mine; I forget to pull the shoots when they first appear in spring. The delay gives them time to harvest and store a little solar energy for next year. Slimleaf Bursage (Fig. 2.4.4) ranges from the southern Great Plains west to the Pacific coast and south to central Mexico.

**Fig. 2.4.4** Slimleaf Bursage (photo © Max Licher)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.4.17** Canada Thistle (*Cirsium arvense*)—ASTERACEAE. Plants 1-4ft high reproduce from seed and an extensive root system. Stems green and smooth. **Leaves**: Alternate, sessile, and clasping. Very spiny, lobed, to eight inches long and one inch wide. **Flowers:** 1-2cm wide, contain many small rose-purple tubular flowers. Bracts enclosing flower heads are spineless. Male and female flowers appear on separate plants (dioecious). **Seeds**: Bone or tan colored achenes 3mm long, oblong, smooth, with a tuft of feathery hairs that remain only until maturity. **a**. Underground roots. **b**. Flower head. **c**. Achene with tuft of hair (Pappus). **d**. Mature achene without tuft of hair, shows blunt apex with central tubercle (Fig. 2.4.17 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Canada Thistle (*Cirsium arvense*) [P|EIMT]

This Eurasian perennial is one of the most dreaded weeds in New World drylands. It grows in crops, fields, livestock ranges, and other disturbed areas. From those disturbed sites, Canada Thistle spreads into and replaces natural vegetation. The first Arizona record is from Flagstaff in 1920. By 1970, colonies had appeared across Coconino and Yavapai Counties.

Though it is not a native, Canada Thistle is a food source for many insects and for Lesser Goldfinches. Parts of the plant are edible, and Wikipedia notes that the Native American Cherokee used the feathery Pappus to fletch blowgun darts. These uses do not compensate for losing native vegetation to this alien invader.

Eradication of established colonies by mechanical means is difficult. I pulled aboveground shoots of a CWF colony for 10 years without success. New shoots appeared throughout the growing season making it difficult to pull them quick enough to prevent energy transfer to the roots (Fig. 2.4.18).

**Fig. 2.4.18** Canada Thistle (photo © Põldohakas)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.4.21** Stinknet (*Oncosiphon piluliferum)*—ASTERACEAE. Small shrub with bright yellow flowers. South African annual with persistent roots. Small, less than 2ft tall. One to five or more thin stems arising from base, sparse alterate **leaves** with glandular hairs, striking yellow **flowers** in small tight balls less than 10mm diameter. Fruit: Cylindrical smooth or ribbed achenes, resin-gland dotted face, less than 1mm long. Stinky (Fig. 2.4.21 photo © Max Licher)

## Stinknet (*Oncosiphon piluliferum)* [A|FIMT]

The first thought produced by Stinknet (also called Globe Chamomile) is that its bright yellow flowers are beautiful. The next thought for most people, however, is that something stinks. Stinknet produces resinous aromatic sap that smells like a rotten pineapple. The odor plus the tendency for the plants to grow in tight formation impedes outdoor activity. Even worse, Stinknet is a strong competitor that replaces native plants. But worse still, the dry plants are flammable and encourage destructive wildfires. Once Stinknet invades, the quality of natural habitats declines and many soil organisms, native plants, and native animals disappear.

Stinknet is spreading across the hot deserts of California and Arizona. Botanists have not collected the plant above 2300 ft in Arizona, and I assumed that at 4500 ft, D-H winters would be too cold for Stinknet. I did not even include it in the list of future weeds in *Weeds of Dewey-Humboldt, Arizona*. *Oops.*

However, in June 2019, I found one Stinknet growing beside the road about two blocks north of Old Black Canyon Highway (Fig. 2.4.22).

**Fig. 2.4.22** Stinknet found on Old Black Canyon Highway two blocks north of Prescott St. (photos © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.4.23** Sunflower (*Helianthus annuus*)—ASTERACEAE. Annual 1-4m tall reproducing only by seed. **Leaves**: Alternate, egg or heartshaped, toothed edges, pointed, 2-14in long, and 1-7in wide. **Flowers**: Yellow ray or marginal petals 2-5in wide surround many small female disk flowers that produce the achenes. **Seeds**: Achenes (shells) are 3-13mm long and 3-8mm wide, dark gray with black spots and pale stripes. **a**. The upper part showing flowers and leaves. **b**. Large basal leaf. **c**. Achene with dark spots and slightly hairy top (Fig. 2.4.23 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Sunflower (*Helianthus annuus*) [A|DEN]

Sunflowers are one of North America's most productive and beautiful weeds. They are present but not invasive in other arid parts of the world. Essential for many wildlife species, the plant serves as host for at least three species of local butterflies: California Patch, Bordered Patch, and Painted Lady. Lesser Goldfinches and an occasional member of other species eat the leaves and seeds. Bees, butterflies, and other insects feed on the nectar and pollen.

Cultivators have produced many colors and sizes of sunflowers and they all grow well in D-H. Cultivars and wild plants often cross making cultivated varieties difficult to classify (Fig. 2.4.24).

**Fig. 2.4.24** Sunflowers (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.4.25** Telegraphplant (*Heterotheca grandiflora*)—ASTERACEAE. Annual 1-2m tall branching toward top like a telecommunications pole. **Leaves**: Hairy, basal rosette, smaller above. **Flowers**: Yellow 25-40 ray flowers 5-8mm long surround 30-75 disk flowers with 4-6mm corollas. **Fruit**: The disc and ray florets drop away to leave a spherical head of achenes (fruit), each with a long white pappus. Ray fruit 2-5mm, disk fruit 4-6mm (Fig. 2.4.25 photo © Forest & Kim Starr)

## Telegraphplant (*Heterotheca grandiflora*) [A|N]

Common around D-H, and present in the Sonoran, Mojave, and Great Basin deserts, Telegraphplant is not a difficult plant to control using standard mechanical techniques. Its flowers attract butterflies and other insects, making it desirable for wildlife. However, the plant is too rough and shaggy to appeal to flower gardeners (Fig. 2.4.26).

**Fig. 2.4.26** Telegraphplant (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.4.27** Prickly Lettuce (*Lactuca serriola*)—ASTERACEAE. Annual or biennial 2-6ft tall with milky sap. **Leaves**: Alternate, blue-green, stalkless, clasp stem with 2 earlike lobes. Lower leaves 2-10in long lobed or unlobed with prickles along edges, the large white midvein, and other veins underneath. Upper leaves smaller and unlobed. **Flowers**: Many yellow heads 3-8mm wide on short stalks and composed of ray flowers. **Fruit**: 6-30 flattened light gray eggshaped achenes about 3mm long. **a**. Basal rosette of young plant. **b**. Achene with its parachute of hairs. **c**. Enlarged achene with linear ridges and short bristles near top (Fig. 2.4.27 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Prickly Lettuce (*Lactuca serriola*) [AB|MT]

This Eurasian annual is a cosmopolitan troublemaker familiar to every gardener worldwide. Though the plant's leaves are edible when young and tender, they can't compare to Collards, Kale, or Spinach. The plant is a persistent pest during the summer, but a sharp hoe before the plumed seeds form will prevent a full-scale outbreak.

Numerous insect species spend time on Prickly Lettuce flowers and foliage. I haven't found reference to any local bugs or butterflies that prefer it to other plants, but the possibility exists (Fig. 2.4.28).

**Fig. 2.4.28** Prickly Lettuce (photo © Jeantosti)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.4.33** Spiny Sowthistle (*Sonchus asper*)—ASTERACEAE. Hollow stemmed annual 1-4ft tall. **Leaves**: Alternate with deep lobes and *soft prickle-toothed edges*. Lower leaves to 12in long, stalked with 5-11 lobes on each side. Mid and upper leaves not stalked, clasp the stem with large round lobes. Highest leaves not lobed. **Flowers**: Numerous 1-3cm wide made up of yellow petallike ray flowers. **Seeds**: Achenes reddish-brown, flat, ringed with a narrow wing, oval, 2-3mm long with three ribs. Several achenes held together by the tangled hairs (6-10mm long) of the pappus. **a**. Leaf with earlike clasping lobes. **b**. Flower.**c** Achene (Fig. 2.4.33 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Spiny Sowthistle (*Sonchus asper*) [A|ET]

An Old World introduction to North and South America, Spiny Sowthistle is a tireless colonist of roadsides, lawns, gardens, fields, and other disturbed sites. The plants' hollow stems make them vulnerable to any form of mechanical control such as a swift kick to the base. Easy to remove, but difficult to eradicate, the plants spring from pappused (bristled) achenes that return on spring breezes every year (Fig. 2.4.34).

**Fig. 2.4.34** Spiny Sowthistle Dandelion-like flowers (photo © Matt Lavin)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

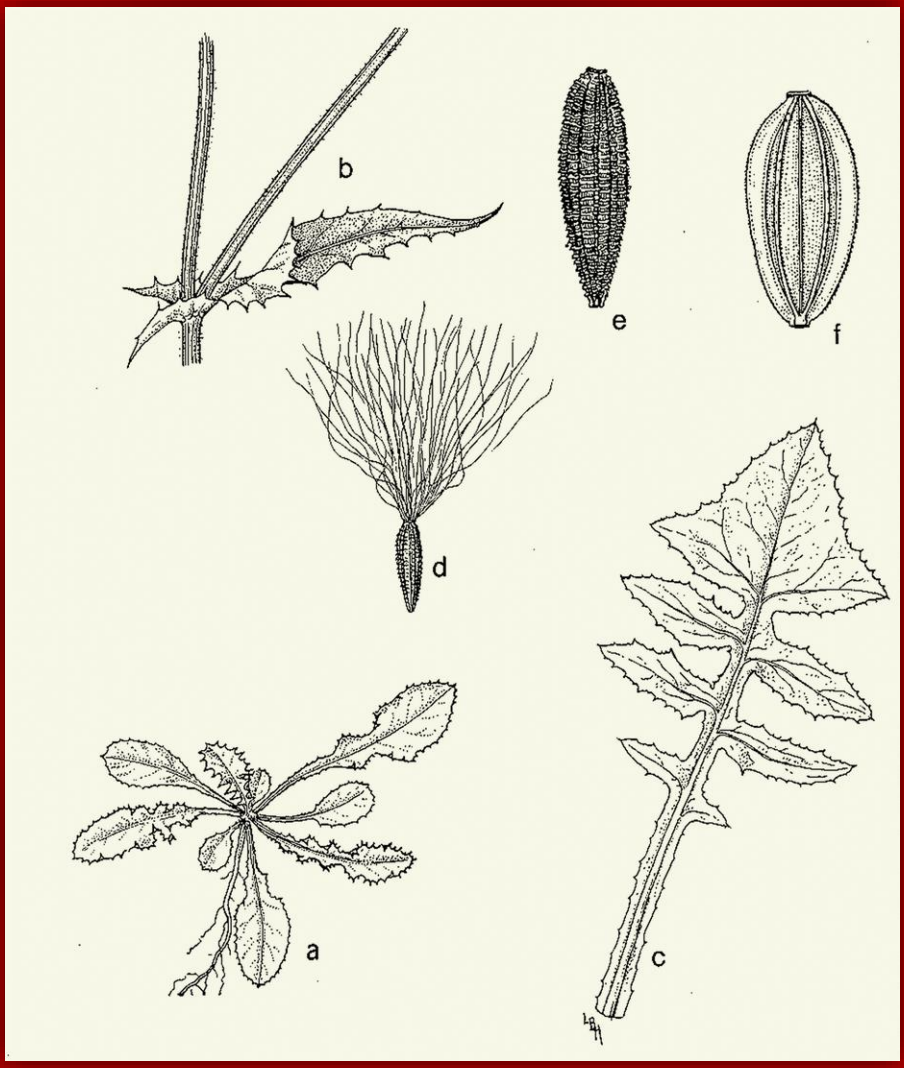


**Fig. 2.4.35** Annual Sowthistle (*Sonchus oleraceus*)--ASTERACEAE. Single stem to six feet tall. *Marginal prickles on leaves are smaller than those of Spiny Sowthistle above*. **a**. Main leaves of young plant showing large, one to three lobes, and a triangular-shaped tip lobe. **b**. Leaves clasp stem with two sharp projections. **c**. Stalked basal leaf. **d**. Achene with tuft of fine hair. **e**. Achene with five to seven indistinct ribs and strong cross wrinkling in furrows between ribs. **f**. *Achene of Spiny Sowthistle for comparison* (Fig. 2.4.35 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Annual Sowthistle (*Sonchus oleraceus*) [A|ET]

Annual Sowthistle resembles Spiny Sowthistle but its leaves don't look so dangerous. The toothy leaves of both plants are scratchy, but they are too thin to do much damage. The plant's stem is hollow leaving the whole business vulnerable to a swift kick.

A native of Europe and North Africa, Sowthistle is common across D-H often appearing on lawn and garden margins and poking up between other plants. Achenes with tufts of fluffy white hairs soon replace the spring and summer blooms. The plants reproduce only by seed and are easily pulled or mashed when they appear in spring (Fig. 2.4.36).

Fresh Sowthistle leaves are bitter, but become mild when blanched or boiled. They contain desirable nutrients and high protein content.

**Fig. 2.4.36** Annual Sowthistle (photo © Alvesgaspar)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

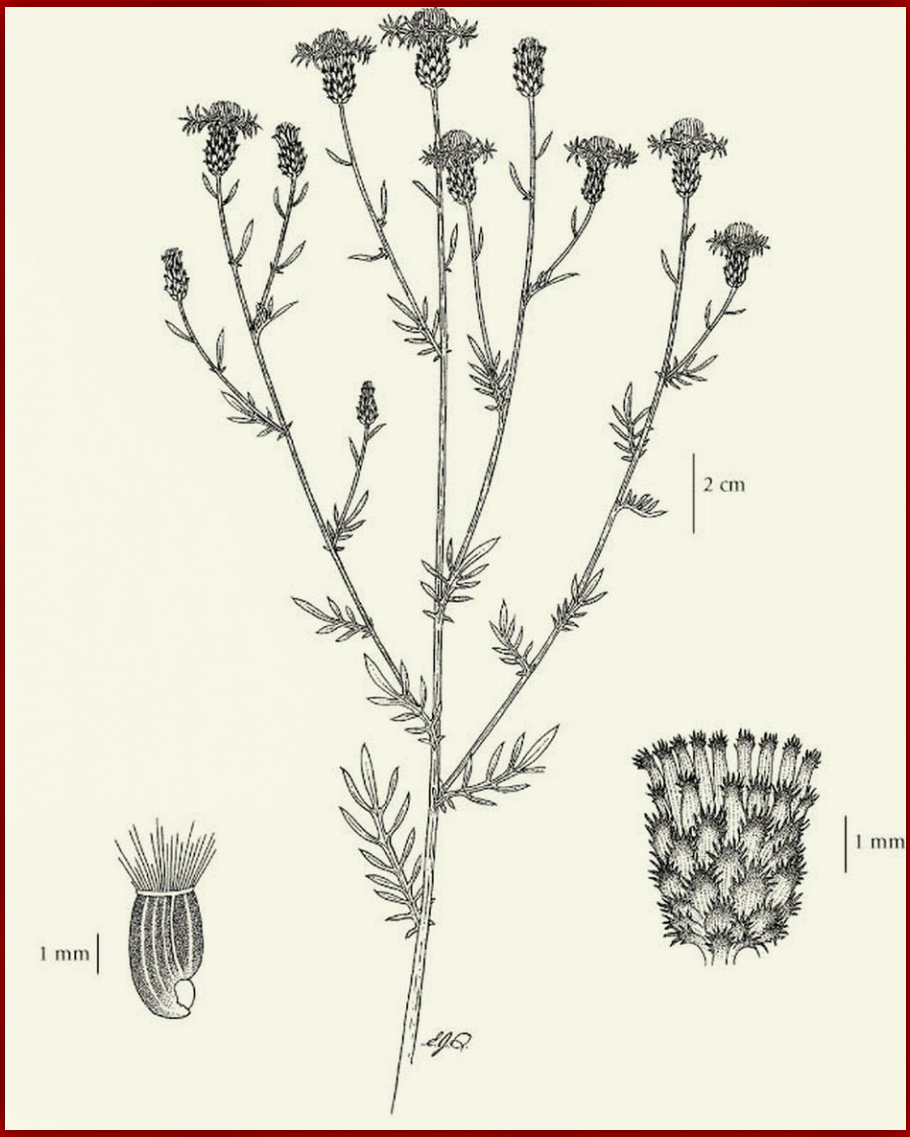


**Fig. 2.4.53** Spotted Knapweed (*Centaurea biebersteinii*)—ASTERACEAE. Biennial 30-150cm tall. **Leaves**: Pale gray-green, pinnate, alternate, up to 6in long. **Flowers**: Purple-pink at branch tips, involucre 4-13mm. **Seeds**: Achene about 3mm long with bristly pappus. Inset left, achene with short pappus. Inset right, Involucre showing dark tips on middle and upper bracts. (Artist unknown. Internet image with no active links (Fig. 4.1.53). Searches across botanical artists produced the possibility that the artist was Thomas Jenkinson Woodward, 1745-1820)

## Spotted Knapweed (*Centaurea biebersteinii*) [P|ITZ-2]

This eastern European weed is one that merits the most stringent vigilance and eradication by hoeing and pulling. Its wind-blown seeds germinate in disturbed areas from whence it spreads into yards and gardens and native vegetation. It produces and disperses thousands of seeds, it develops a taproot that absorbs moisture faster than its neighbors, it produces toxic chemicals that inhibit neighboring plant germination and growth, and it develops foliage of low appeal to cattle. Sheep can eradicate this weed, but if you don't have sheep, get the hoe (Fig. 2.4.54).

**Fig. 2.4.54** Spotted Knapweed (photo © Matt Lavin)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.18.3** Horehound (*Marrubium vulgare*)—LAMIACEAE. Dense, woolly stems branching from the base grow 9-40in tall. Upper portions of stems are square. **Leaves**: Green above, white woolly underneath, opposite, corregated, round with rounded teeth, 1-2in long including stalks. **Flowers**: Stalkless, white, tubular 6-8mm long in dense clusters around the stem. The clusters are at the ends of all branches and often extending over one foot down the stem. The persistent calyx has hooked spines. **Seeds**: The calyx contains four nutlets each holding one eggshapped dark brown seed 2mm long. **a**. Calyx with ten hooked spines. **b**. Views of the seedlike nutlet (Fig. 2.18.3 drawing by Lucretia Breazeale Hamilton (Parker 1972) 

## Horehound (*Marrubium vulgare*) [P|EIP]

Horehound is a perennial alien abundant in D-H. It thrives in the warm arid climate of the western U. S. and in similar environments worldwide. Hard candy and cough drops are its principal uses. Though Horehound use continues, it is a good example of the many plants that become problems when they escape cultivation.

Unlike the incoming tide of new weeds, Horehound has been here long enough to reach all the suitable sites in the region. When I moved to CWF in 1997, the plant had taken over the pastures and pond banks. I tried eradicating it by mowing it and spraying it with herbicides. Nothing worked, so I hired local kids to help me pull the plants. We pulled and disposed of mountains of Horehound. After that, mowing and occasional pulling along the pond banks has been effective.

Horehound disperses in animal fur. It has hooked seeds that form fur mats. To relieve your pets of their matted fur-cloaks, get out the scissors (Fig. 2.18.4).

**Fig. 2.18.4** Horehound flowers (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

# 2.24 EVENING PRIMROSE FAMILY—ONAGRACEAE

**Fig. 2.24.1** Velvety Gaura (*Oenothera curtiflora*)--ONAGRACEA. Annual 30-200cm tall, covered by soft long hair, branches near the top. **Leaves**: Basal cluster, alternate along stems, lanceolate 2-13cm long and 5-40mm wide. Small teeth line edges near the tip. **Flowers**: Small, asymmetrical, pale pink or white, self-pollinating, in 10-30cm long spikes at branch tips. The floral tube below the sepals is 1-5mm long, four drooping sepals 2-4mm long; four petals 2-3mm long. Petals fade to dark pink or red. **Fruits**: Woody capsule 5-10mm long with four angles, tapers to slender base. One-four oval seeds remain within the capsule (Fig. 2.24.1 photo © Mack Hitch)

## Velvety Gaura (*Oenothera curtiflora*) [A|N]

This tall native has distinctive, disorganized flower spikes extending up to a foot from its shoot tops. My next-door neighbor called it fireweed and claimed it caused rashes. However, the plant's dense hair coat is harmless and indeed feels like velvet (Fig. 2.24.2).

**Fig. 2.24.2** Enlarged section of Velvety Gaura flower spike (photo © Matt Lavin)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

## 2.28 GRASS FAMILY—POACEAE

**Fig. 2.28.1** Wild Oats (*Avena fatua*)—POACEAE. Annuals 8-160cm tall. **Leaves**: Sheaths of basal leaves with scattered hair; upper sheaths hairless; ligules 4-6mm long, pointed; blades 10-45cm long and 3-15mm wide. **Flowers**: Nodding, panicles 7-40cm long and 5-20cm wide. **Seeds**: Two or more spikes extend from each seed. (Fig. 2.28.1 painting by Norman Criddle in Clark and Fletcher 1909)

## Wild Oats (*Avena fatua*) [A|EM]

You can often see big-seeded Wild Oats from the car window as you whiz along. Is this roadside vagrant the archetype for the wild behavior of youth? *Fatua* is Latin for foolish, insipid, or worthless. But what is it about this plant that caused Linnaeus to label it worthless? Its genus, *Avena* is Latin for oats and the seeds are large and edible; why is the plant a weed and not a commercial field crop? In fact, Wild Oats is in commercial oat fields around the world, but not by design. The plant invades *Avena sativa* (*sativa* means domestic or planted) crops where it reduces overall productivity by using water and soil nutrients to make more leaves but fewer seeds than *sativa*. I guess from the human point of view, this is foolish. However, Kane and Moore report above average medicinal uses for Wild Oats (Kane 2017, Moore 1989). So, not too worthless (Fig. 2.28.2).

**Fig. 2.28.2** Wild Oat spikelets (photo © Alvesgaspar)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.28.9** Red Brome (*Bromus madritensis* ssp. *rubens*)—POACEAE. Annual grass 10-40cm tall. **Leaves**: Sheaths hairy, ligule 1-4mm, hairy, pointed with smooth edges, blades to 15cm long and 1-5mm wide, flat, hairy top and bottom. **Flowers**: Panicles 2-10cm long and 2-5cm wide, reddish brown; spikelets 18-25mm with 4-8 florets, lower glumes hairy 5-8mm, upper glumes hairy 8-12mm, 3-5 veins; lemmas 10-15mm hairy; awns 8-20mm; awns 2cm long, curving as plant dries (Fig. 2.28.9 photo U. S. National Park Service)

## Red Brome (*Bromus madritensis* ssp. *rubens*) [A|I]

This European annual is abundant west of the Rocky Mountains. It flourishes in the Arizona Uplands of the Sonoran Desert and the semiarid uplands of central Arizona and southern California. Like its cousin, Cheatgrass, Red Brome is a winter annual that completes its lifecycle by late spring, dries out, and stands waiting for a spark to burn in a hot flash across the land. It isn't the worst fuel plant in the region, Buffelgrass (*Cenchrus ciliaris*) invading the desert south of D-H claims that honor, but when combined with other alien weeds, Red Brome is a significant contributor to destructive wildfires (Fig. 2.28.10).

**Fig. 2.28.10** maturing stand of Red Brome (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.28.11** Cheatgrass or Downy Brome (*Bromus tectorum*)—POACEAE. Erect stems. **Leaves**: Hairy with 2-3 veins on each side of the midrib; ligule small 1-2mm, hairless, membranous, obtuse-lacerate. **Seeds:** Heads drooping with maturity with 1-2cm long awns on the lemma (Fig. 2.28.11 drawing Hitchcock and Chase 1950, public domain)

## Cheatgrass (*Bromus tectorum*) [A|IP]

Shoes become bushy during a summer stroll through a field of Cheatgrass. Designed for mammal dispersal, the plant's rough seeds burrow between shoelaces, around shoe tongues, and into socks where they poke and scratch. However, they don't generate the emergency reaction of the larger harder seeds of Ripgut Brome described next.

The ecological pain caused by Cheatgrass is much greater than the physical pain it administers to animals. This Eurasian annual germinates in winter or early spring and completes its life cycle by early summer. Through the rest of the summer and early fall it stands crispy dry ready to burn. Ignitions come from lightening, campfires, trains, careless smokers, and hot car mufflers. Once ignited, cheatgrass fires devour the land with intense heat that kills soil organisms, and ignites herbs, shrubs, and trees. A botanical irony, many cheatgrass seeds survive the fire. The seeds germinate the next spring and produce new plants and more seeds that wind and mammals spread across surrounding areas. After a few years and a few fires, almost nothing but Cheatgrass remains. This fire-resistant little grass has depleted biodiversity and productivity of millions of acres of native vegetation in the western U. S.

Enterprising American ranchers further deplete diversity by trucking in cattle to graze cheatgrass ranges in spring and then trucking the cows out as soon as the grass dries in early summer. Wildlife and feral horses struggling to survive on the impoverished land find and consume every plant on every fireproof rocky mound leaving few native plants for future recovery (Fig. 2.28.12).

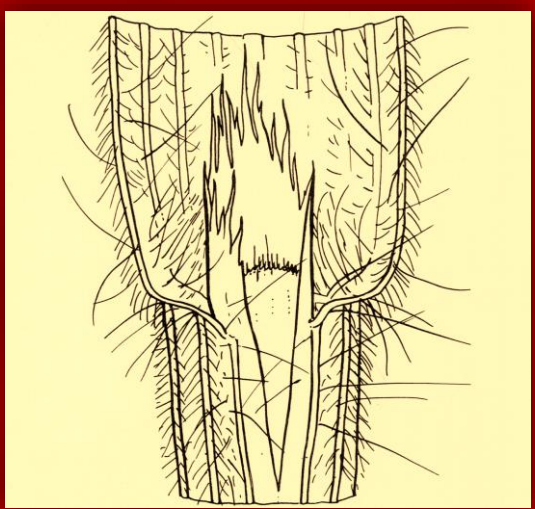

**Fig. 2.28.12** Cheatgrass sheath, collar, ligule, and blade (drawing by Copple and Pase 1967. U. S. Forest Service)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

**Fig. 2.28.13** Ripgut Brome (*Bromus diandrus* ssp. *rigidus*)—POACEAE. Annual with smooth stems and hairy sheaths and blades. **Leaves**: Blades 3-6mm wide; ligule 2-5mm, tattily toothed. **Flowers** 10-20cm on branches bearing one or two flower spikelets 3-4cm long. Awns 3-6cm long. **Fruit**: Ellipsoidal, grooved caryopsis hairy at apex. Tiny barb-like hairs that point backwards cover the seeds, allowing them to catch anything brushing by. Movement works the sharp-pointed seeds into fur, skin, and even eyes (Fig. 2.28.13 photo © Matt Lavin)

## Ripgut Brome (*Bromus diandrus* ssp. *rigidus*) [A|IP]

This is the most painful grass I've encountered. Unfortunately, it has claimed the area beneath the Cottonwood trees along the river. It germinates in early spring and covers the ground beneath the trees with lush waves of green that give no hint of the agony to come. The seed heads mature in May. Thereafter, the river is almost safe from marauding humans. One person who I repeatedly asked to use the streets for his walks and leave the river woods for wildlife was self-important enough to grumble that even with his snow gaiters on, the grass was too painful for pleasant walks anyway.

Ripgut in yards and gardens is easy to control by mowing and pulling. Periodic floods deposit rocks and debris over the river pasture and make mowing almost impossible. I wear snow gaiters when I want to spend time in that pasture during summer (Fig. 2.28.14).

I do not know for sure that Ripgut seeds harm wildlife, but I hope that most furry creatures have learned how to avoid the seeds or how to remove them.


**Fig. 2.28.14** Ripgut Brome and Cheatgrass (*Bromus tectorum*). Revegetation of disturbed natural areas is labor intensive and often fails because of the relentless arrival of invasive weeds (photo © Matt Lavin)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


**Fig. 2.28.15** Field Sandbur (*Cenchrus spinifex*)—POACEAE. Spreading annual forms mats 4-36in wide with ascending leaves and flower spikes. **Leaves**: Two to five inches long; ligule ciliate, membranous base very short, collar margins villous (long soft straight hair). **Flowers**: Spikes 4-10cm, often partly enclosed by upper leaf sheath and holding 3-15 loosely arranged burs but some with 20-30 tightly packed burs. **Seeds**: Spiny, hairy, yellowish burs, about 13mm long, contain two seeds. Up to 500 burs per plant. **a**. Bur with spikelets **b**. Top and bottom views of grain. **c**. Bur from the similar Southern Sandbur (*Cenchrus echinatus*) that may not reach D-H until the climate warms more (Fig. 2.28.15 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Field Sandbur (*Cenchrus spinifex*) [A|P]

This grass forms seeds with sharp spines that can exceed one-half inch. Not as terrible as Bullhead perhaps, but right up there. The first time I encountered Field Sandbur, I was wearing rubber wader boots while fixing an aerator line in a pond. After walking up the bank from the pond, I noticed seeds stuck to one boot. I brushed them off with a bare hand—yikes!—experience is a great teacher. The red of the young burs in the photo below is an appropriate warning (Fig. 2.28.16).

**Fig. 2.28.16** Field Sandbur fruit (photo © Macleay Grass Man)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


## 2.30 PURSLANE FAMILY—PORTULACACEAE

**2.30.1** Common Purslane (*Portulaca oleracea*)--PORTULACACEAE. Smooth fleshy leaves on reddish prostrate branches 6-24in long. Can form mats with tips turned up. Single plants can be upright to about 12in. **Leaves**: *The leaves are alternate not opposite as in similar Horse Purslane (Trianthema portulacastrum, AIZOACEAE family) a bitter tasting plant, and Wooly Tidestromia (Tidestromia lanuginosa) a hairy plant which I haven't tasted.* The leaves are spatulate with rounded tips, and grow singly or in clusters. Horse Purslane leaves are round. **Flowers**: Small stalkless flowers yellow, not purple like Horse Purslane, appear from April to June and are single or clustered in the leaf and branch axils and at stem tips. They open in the morning revealing 7-20 stamens. **Seeds**: The upper half of the globular seedpods falls when seeds are mature. The black flattened seeds are less than 1mm long with a white spot at the scar. **a**. Flower. **b**. Seed (Fig. 2.30.1 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Common Purslane (*Portulaca oleracea*) [A|DEZ-1]

This European annual has been with us a long time. As with Common Lambsquarters, Purslane cultivation has gone on for thousands of years.

Purslane occurs throughout the Old World. Its means of reaching the New World is unknown, but evidence shows it was present during pre-Columbian times from 1350 to 1539 (Byrne and McAndrews 1975).

Present in many prehistoric sites, the plant appears in historic records from the seventh century BC. Theophrastus advised sowing Purslane in April, and Pliny the Elder recommended wearing a Purslane amulet to block evil (Megaloudi Fragiska 2005).

Purslane contains more omega-3 fatty acids (alpha-linolenic acid in particular) than any other leafy vegetable. Moreover, one cup of cooked leaves contains 561mg of potassium, 90mg of calcium, and 2,000 units of vitamin A. Wikipedia describes harvesting and preparing plants for lunch (or dinner).

Despite its many benefits, weed scientists consider Purslane to be one of the ten most noxious weeds worldwide (Fig. 2.30.2).

**Fig. 2.30.2** Common Purslane (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

# 2.34 QUASSIA FAMILY—SIMAROUBACEAE

**Fig. 2.34.1** Tree of Heaven (*Ailanthus altissima*)—SIMAROUBACEAE. Tree to 20m often producing clonal thickets from rhizomes. **Leaves**: Pinnately compound 30-100mm long with 9-31 lanceolate leaflets 5-15cm long with a *single terminal leaflet*. (Arizona Walnut leaves are similar but smaller: 18-38cm long with 9-15 leaflets. They have a small terminal leaflet or none.) **Flowers**: In large terminal panicles 10-40cm long with small green to white flowers with wooly petals 2-3mm long. **Fruit**: Samaras (winged achenes) 3-5cm long, twisted one-half turn at the top (Fig. 2.34.1 photo © GR)

## Tree of Heaven (*Ailanthus altissima*) [P|IMT]

This common tree forms dense patches on roadsides and in yards. It tolerates harsh conditions, which could be good, but it is malodorous and spreads as fast as zombies did in the movie *World War Z* (Carnahan et al. 2013). The tree does grow throughout New York City where I've seen it doing just fine in dark slots between apartment buildings. Eradication of established clones requires initial sawing or chopping followed by vigilance to eliminate sprouts before they make leaves and contribute energy to the roots (Fig. 2.34.2).

Traditional Chinese medicine uses Tree of Heaven. Wikipedia gives a detailed example of a cure for mental illness that involves the tree's roots, urine from young boys, and a black-bean concoction. There are other, less exotic sounding medicines described in Wikipedia, but Moore (1989, 2003) doesn't mention Tree of Heaven.

**Fig. 2.34.2** Tree of Heaven leaves and samaras (photo © GR)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]


## 2.36 TAMARISK FAMILY—TAMARICACEAE

**Fig. 2.36.1** Saltcedar (*Tamarix chinensis*)–TAMARICACEAE. Small tree 10-15ft high with long gray-green upright or spreading branches; often forms dense thickets. Bark brown and smooth becomes ridged and furrowed with age. **Leaves**: Deciduous, narrow, pointed (needle-like), about 2mm long often overlapping. **Flowers**: Deep pink to white crowded on slender spikes 1-5cm long form dense mass at ends of branches. **Seeds**: Pink to yellow pods 3-5mm long contain many seeds less than 1mm long with a tuft of silky hair. **a**. Flower. **b.** Seed with tuft of hair (Fig. 2.36.1 drawing by Lucretia Breazeale Hamilton (Parker 1972) © Arizona Board of Regents)

## Saltcedar (*Tamarix chinensis*) [P|IM]

(Five-stamen Tamarisk, Tamarack) For two years, my family lived on the Little Colorado River floodplain. Exploring the maze-like alleys and tunnels floored by inches of accumulated needles and roofed by arching branches gave me many hours of entertainment in the dense Tamarix woodland beside the river. This Eurasian native smothers most other plants that once populated the floodplain. It is present beside the Agua Fria River in D-H and in other moist locations around the farm. I cut all the clumps along the river when I moved in. They have recovered, and it is time to cut them again. Left alone, they would spread to defeat the willows, walnuts, and cottonwood sprouts. According to contributors to the IUCN Global Invasive Species Database, this is one of the 100 world's worst weeds.

Gardeners use Saltcedar as a landscape ornamental, and it provides pollen for bees and cover for birds. The endangered Southwest Willow Flycatcher nests in the branches. According to SEINet, the plant is also useful for curing camel mange. Of course it is. Nevertheless, Saltcedar forests are impoverished places where few species live. Pity that day only they remain along our desert streams (Fig. 2.36.2).

**Fig. 2.36.2** Saltcedar flowers (photo © Arashiyama)

[Codes: A=Annual, B=Biennial, P=Perennial | D=Delightful, E=Edible, F=Future Colonist, I=Invasive, M=Medicinal, N=Native, P=Painful, T=Tough, Z-1, Z-2=Noxious in AZ]

# CONTROLLING WEEDS

Pesticides: One of my childhood chores was weeding. By the age at which I entered school, I had become adept at the wide swings of the weed hook. I always felt that there must be better ways to earn room and board than spending summertime battling the weeds. Then chemical companies invented herbicides and gave every child and land manager a magic wand. Wave a sprayer across the weeds and they shrivel and die. Now that was progress. Chemical manufacturers proclaimed the herbicides were safe and some of their representatives even claimed you could drink the pure undiluted chemical without injury (though I doubt anyone did it). Every year, government land managers, farmers, and homeowners spray millions of gallons across the land around the world.

Claims that the chemicals were harmful appeared. Reports of wildlife declines and human illness multiplied and governments banned some chemicals (Carson 1962, Jameson 2012). In the U. S., chemical manufacturers hired lobbyists and paid elected politicians and government officials to continue claiming the chemicals were safe. And though this continues, reports of wildlife and human injury are multiplying (Examples: Center for Food Safety [http://www.centerforfoodsafety.org/_files/_pesticide-report_annotated-bibliography_final-updated-81315_00651.pdf), Gillam 2017, Parvez et al. 2018, and Beyond Pesticides Daily News Blog (https://beyondpesticides.org/dailynewsblog)]. Whether you are dealing with weeds in your yard, garden, or field, the most prudent control methods are those of the organic farmer, those that eschew herbicides and insecticides. Here are the principal elements of a strategic plan to control weeds.

Weeds of Dewey-Humboldt, Arizona

**Fig. 3.1** Native Blister Beetles (probably *Epicauta pardalis*) on native Wright Saltbush (*Atriplex wrightii*). This beetle has limited the advance of Palmer Pigweed (*Amaranthus palmerii*) in D-H after its rapid spread during 2018 (photo © GR)

**Prevention**: Weeds spread into areas with available places to germinate. They love gardens. The bare soil and plentiful sunlight are the conditions in which they flourish. Add some supplemental water and weeds are all in. Most of them only colonize areas with bare soil. Thus, you can prevent weeds with mulch, lawns, and shade trees. My neighbor used a thick layer of straw between his hills and rows to block weeds. My daughter uses a durable landscape fabric. Nothing new here, the Rodale Institute has explained and promoted efficient, non-toxic mulching and other weed-prevention techniques for decades (https://rodaleinstitute.org. *Rodale's Ultimate Encyclopedia of Organic Gardening: The indispensable green resource for every gardener*. Martin and Bradley 2018).

**Inspection**: The edges of gardens, lawns, and the margins of the shade cast by trees are where most weeds will appear. Check these areas now and then and pull or mow weeds before they spread their seeds or roots.

**Monitoring**: Keep a monthly or at least yearly inspection schedule to spot and monitor weeds. You need not remove them all. Most weeds spread slowly, and most provide food for bees and other wildlife. The damage they do is only to your preference for uniformity. Live a little. Watch new weeds to see if they spread. Weeds along your fences or on the edges of your lawn or garden may have no measurable cost, but they will have benefits for wildlife.

**Elimination**: If you find problem weeds early, only a small amount of pulling, mowing, or hoeing is required to remove them. If the weeds are mature, or if mature weeds were present in the past, eradication might require several years of pulling and mowing during the growing season. Keep it up until surviving seeds are gone and remnant roots have run out of stored energy. You can also add cover plants that will replace the weeds. There are a few exceptional cases: If your weeds are too low to catch with the mower, you get to spend a few pleasant hours sitting on the lawn plucking individuals from among the grasses.

**Restoration**: Healthy native vegetation resists weed invasions. However, restoring native vegetation by eradicating invasive weeds and preventing their return while aiding establishment of native species is difficult and costly. Weeds often leave behind persistent propagules, changed soil chemistry, and depleted soil microorganism communities. Reestablishing biological soil crusts (Fig. 3.2), the original cover over many bare desert soils, can take several decades (Cole 1990). Restoration is generally so expensive that we can restore only the highest priority sites.

**Fig. 3.2** Intact biological soil crusts inhibit weed invasion. Crusts are quite fragile and are not able to withstand livestock tramp-ling or other forms of use. They can still be found in North American deserts perhaps because 500 years of livestock grazing has yet to reach high intensity over all areas, but they are uncommon in Old World deserts (photo © GR)

**Natural weed control** occurs as native long-lived plants return to disturbed sites and replace the weeds. It also occurs when native insects and other animals consume the weeds and limit their growth (Fig. 3.1). Sometimes, it has been possible to control a weed by importing insects and other consumers from its homeland.

## Global Warming

Naturalists have long considered invasive plants and animals to be the greatest dangers to nature second only to destruction of soil and vegetation by human digging, plowing, and building. Biologists and conservation organizations report that because of lost habitat, more than half of all wild animals are already gone (World Wildlife Fund 2016).

Over the past few decades, the effects of global warming have dominated concerns for nature and even for human civilization. According to the U. S. government, humans are causing substantial and growing climate changes. For years, I did not believe global warming could destroy the land like construction of a road or building does. I was wrong; human-caused climate change is not limited to separate places on the land, warming will occur everywhere. Many weeds have evolved metabolic systems that function more efficiently at higher temperatures than most other plants. Known as $C_4$ and CAM, these adaptations will give those weeds an advantage as Earth's climates warm and heat waves become more frequent. Earth's grasslands, shrublands, and forests will be replaced by weedlands with frequent fires, floods, dust storms. The normal sounds of life will be replaced by eerie silence or monotonous calls of only a few species of birds and insects.

During Earth's glacial episodes, ice-free enclaves called refugia sheltered groups of plant and animal species from physical destruction by spreading ice. Refugia were biodiversity reservoirs that resupplied species as the glaciers retreated. Global-warming refugia will include shady mountain canyons and riparian areas. However, extreme freezes, floods, droughts, fires, and heat waves will affect those areas, making invasive plants the most likely survivors and future dominants of the mountains and the plains.

# Sources

Abler, R., J. S. Adams, and P. Gould. 1971. *Spatial organization: The geographer's view of the world.* Englewood Cliffs, Prentice Hall.

Arizona Regulated and Restricted Noxious Weeds. 2019. State of Arizona. https://agriculture.az.gov/pests-pest-control/agriculture-pests/noxious-weeds. Accessed 26 June 2019.

Babbitt, Bruce. 1998. Statement by Secretary of the Interior on invasive alien species. In *Science in wildland weed management*. Denver, CO: U. S. Department of the Interior.

Beckman, N. G., J. M. Bullock, R. Salguero-Gomez. 2018. High dispersal ability is related to fast life-history strategies. Journal of Ecology 106:1349-1362.

Benbrook, C. M. 2016. Trends in glyphosate herbicide use in the United States and globally. *Environmental Sciences Europe*. https://doi.org/10.1186/s1230201600700.

Bennett, P. S., M. R. Kunzmann, and L. A. Graham. 2004. *Descriptions of Arizona vegetation represented on the GAP vegetation map.* Denver, CO: Biological Resources Division, U. S. Geological Survey.

Billings, W. D. 1990. Bromus tectorum, a biotic cause of ecosystem impoverishment in the Great Basin. In *The earth in transition: Patterns and processes of biotic impoverishment*, ed. G. M. Woodell, 301-322. Cambridge: Cambridge University Press.

BLM. 2007. *The Bureau of Land Management's Performance and Accountability Report for Fiscal Year*. Washington: U. S. Department of the Interior, Bureau of Land Management, Washington: Government Printing Office.

Brodie, Graham. 2018. The use of physics in weed control. In *Non-chemical, weed control*, ed. Khawar Jabran and Bhagirath S. Chauhan. https://doi.org/10.1016/B978-0-12-809881-3.00003-6.

Brown, David E. 1982. Biotic communities of the American Southwest—United States and Mexico. Desert Plants 4:1-342.

Burcham, L. T. 1970. Ecological significance of alien plants in California grassland. Proceedings of the Association of American Geographers 2:36-9.

Burkhardt, J. W. 1996. *Herbivory in the Intermountain West: An overview of evolutionary history, historic cultural impacts, and lessons from the past.*

Moscow, ID: Station Bulletin 58. Idaho Forest, Wildlife and Range Experiment Station, Univ. of Idaho.

CABI (Center for Agriculture and Biosciences International). 2019. Invasive Species Compendium. https://www.cabi.org/isc. Accessed 1 August 2019.

Carnahan, M. M., D. Goddard, and D. Lindelof. 2013. *World War Z*. Film based on the 2006 novel by Max Brooks.

Carson, R. 1962. *Silent spring.* New York: Houghton Mifflin.

Clark, G. H., and J. Fletcher. 1909. Farm weeds of Canada. Second ed. Ottawa: Canada Dept. of Agriculture, Branch of the Seed Commissioner. Government Printing Bureau.

Cocannouer, J. A. 1950. Weeds, guardians of the soil. The Devin-Adair Company, Old Greenwich, CN. PDF file hosted by Peter Andrews at: http://www.naturalsequencefarming.com. Accessed 1 August 2019

Colautt, R. I., and D. M. Richardson. 2009. Subjectivity and flexibility in invasion terminology: Too much of a good thing? Biological Invasions 11:1225-1229.

Cole, D. N. 1990. Trampling disturbance and recovery of cryptogamic soil crusts in Grand Canyon National Park. Great Basin Naturalist 50:321-325.

Copple, R. F., and C. P. Pase. 1967. A vegetative key to some common Arizona range grasses. U. S. Forest Service Rocky Mountain Forest and Range Research Station, Research Paper RM-27.

Cox, J. R. 1992. Lehmann lovegrass live component biomass and chemical composition. Journal of Range Management 45:523-527.

CropTrust. 2019. https://www.croptrust.org. Accessed 1 August 2019.

Crosby, A. W. 1952. *The Columbian exchange: Biological and cultural consequences of 1492*. Westport, CN: Greenwood Press.

Dillman, A. C. 1946. The beginnings of crested wheatgrass in North America. Journal of the American Society of Agronomy 38:237-250.

EOL. 2019. Encyclopedia of Life. https://eol.org. Accessed 25 July 2019.

eFloras. http://www.efloras.org. Accessed 25 July 2019.

Frenkel, R. E. 1970. *Ruderal vegetation along some California roadsides.* Berkeley: University of California Publications in Geography, University of California Press.

Genesys. 2019. https://www.genesys-pgr.org. Accessed 25 July 2019.

Gillam, C. 2017. *Whitewash, the story of a weed killer, cancer, and the corruption of science*. Washington: Island Press.

Gledhill, D. 1985. *The names of plants.* Cambridge: Cambridge University Press.

Gori, D. F., and C. A. F. Enquist. 2003. An assessment of the spatial extent and condition of grasslands in central and southern Arizona, southwestern New Mexico, and northern Mexico. The Nature Conservancy, Arizona Chapter. http://azconservation.org/ downloads /multi/category/Arizona. Accessed 28 June 2019.

Groh, H. 1940. Hoary cresses in Canada. Science of Agronomy 20:750-756.

Heady, H. F. 1977. Valley grassland. In *Terrestrial vegetation of California*, ed. Michael G. Barbour and Jack Major, 491-514. New York: John Wiley and Sons.

Hendricks, D. M. 1985. *Arizona Soils*. Tucson: College of Agriculture, University of Arizona.

Hitchcock, A. S., and Agnes Chase. 1950. *Manual of the grasses of the United States, Second Edition*. Washington: USDA Misc. Publ. No. 200.

Hobbs, R. J., and S. E. Humphries. 1995. An integrated approach to the ecology and management of plant invasions. Conservation Biology 9: 761-770.

Holm, L. G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. *The world's worst weeds*. Honolulu: University Press.

International Union for the Conservation of Nature (IUCN), Invasive Species Specialist Group. 2019. http://www.issg.org/worst100_species.html. Accessed 1 August 2019.

Jabran, K., and B. Chauhan (Editors). 2018. *Non-chemical weed control, first edition*. Cambridge: Academic Press.

Jameson, C. M. 2012. *Silent spring revisited*. London: Bloomsbury.

Janzen, D. H. 1967. Why mountain passes are higher in the tropics. American Naturalist 101:233-249.

Kane, Charles W. 2017. *Medicinal plants of the American Southwest*. Lincoln Town Press.

Köhler, F. E. 1883. Medizinal-Pflanzen in naturgetreuen Abbildungen mit kurz erläuterndem Texte Gera-Untermhaus, Germany. Artist unknown (Köhler?). Public domain.

Leopold, A. 1949. *A Sand County almanac and sketches here and there.* New York: Oxford University Press.

Leon-Sanchez, L., E. Nicolas, M. Goberna, I. Prieto, F. T. Maestre, and J. I. Querejeta. 2017. Poor plant performance under simulated climate change is linked to mycorrhizal responses in a semi-arid shrubland. Journal of Ecology 105:960-976.

Mabey, R. 2011. *Weeds, in defense of nature's most unloved plants*. London: Harper Collins Publishers.

Mack, R. N., and S. K. Foster. 2009. Eradicating plant invaders: Combining ecologically-based tactics and broad-sense strategy. In *Management of invasive weeds,* ed. Inderjit, 35-60. New York: Springer Science.

Marchand, P. J., and D. A. Roach. 1980. Reproductive strategies of pioneering alpine species: Seed production, dispersal, and germination. Arctic and Alpine Research 12:137-146.

Marlette, G. M., and J. E. Anderson. 1986. Seed banks and propagule dispersal in crested-wheatgrass stands. Journal of Applied Ecology 23:161-175.

Martin, Deborah L., and Fern Marshall Bradley. 2018. *Rodale's Ultimate Encyclopedia of Organic Gardening: The indispensable green resource for every gardener.* New York: D.K.

Masclef, Amédée. 1891-1893. Atlas des plantes de France. In *Librairie des Sciences Naturelles*, ed Paul Klincksieck, n.p. Paris, Sorbonne.

Maxwell, B. D., E. Lehnhoff, and L. J. Rew. 2009. The rationale for monitoring invasive plant populations as a crucial step for management. Invasive Plant Science & Management 2:1-9.

McReynolds, Kim. 2008. Invasive Plants: Sweet Resinbush. Rural living in Arizona 2: 9.

Mohlenbrock, R.H. 1989. *Midwest wetland flora: Field office illustrated guide to plant species*. Lincoln: Midwest National Technical Center, USDA NRCS Wetland Science Institute.

Mohlenbrock, R.H. 1995. *Northeast wetland flora: Field office guide to plant species*. Chester: Northeast National Technical Center, USDA NRCS Wetland Science Institute.

Moore, Michael M. 1989. *Medicinal plants of the desert and canyon west.* Santa Fe: Museum of New Mexico Press.

Moore, Michael M. 2003. *Medicinal plants of the mountain west*. Santa Fe: Museum of New Mexico Press.

Mueller-Dombois, D., and H. Ellenberg. 1974. *Aims and methods of vegetation ecology*. New York: Wiley.

Myers, J. H., and D. R. Bazely. 2003. *Ecology and control of introduced plants*. Cambridge, Cambridge University Press.

National Invasive Species Council. 2006. Invasive species definition clarification and guidance white paper. https://search.usa.gov/search?query=Invasive+species+definition+clarification+and+guidance+white+paper.+&op=Search&affiliate=doi.gov. Accessed 28 June 2019.

Native American Ethnobotany. 2019. Native American Ethnobotany database. http://naeb.brit.org. Accessed 3 August 2019.

Naylor, R. L. 2000. The economics of alien species invasions. In *Invasive species in a changing world*, ed. H. A. Mooney and R. J. Hobbs, 241-259. Washington: Island Press.

Parker, K. F. 1972. *An illustrated guide to Arizona weeds*. Tucson: University of Arizona Press.

Parvez, S. et al. 2018. Glyphosate exposure in pregnancy and shortened gestation length: A prospective Indiana birth cohort study. Environmental Health 17:23.

Pauchard, A., et al. 2009. Ain't no mountain high enough: plant invasions reaching new elevations. Frontiers in Ecology and the Environment 7:479-486.

Parker, K. 1972. An illustrated guide to Arizona weeds with drawings by Lucretia Breazeale Hamilton. Tucson: University of Arizona Press, Tucson.

Phillips, B. G., and Debra Crisp. 2001. Dalmatian toadflax, an invasive exotic noxious weed, threatens Flagstaff pennyroyal community following prescribed fire. In *Southwestern rare and endangered plants: Proceedings of the 3rd conference; 2000 September 25-28*; *Flagstaff, AZ*, tech. coords. Joyce Maschinski and Louella Holter, Fort Collins: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. RMRS-P-23: 200-205.

Pijl, L. van der. 1972. *Principles of dispersal in higher plants*. New York: Springer –Verlag.

Plants for a Future. 2019. http://www.pfaf.org. Accessed 1 August 2019.

Qasem, J. R., A. M. Al Abdallat, and S. M. Hasan. 2019. Genetic diversity of *Solanum elaeagnifolium*, an invasive problematic weed in Jordan. Weed Research. https://doi.org/10.1111/wre.12360.

Radosevich, S. R., J. S. Holt, and C. Ghersa. 2007. *Weed ecology: implications for management*. New York: Wiley.

Rapoport, E. H. 1982. *Areography: Geographical strategies of species*. New York: Pergamon Press.

Reichenbacher, F. W. 1984. Ecology and evaluation of Southwestern riparian plant communities. Desert Plants 6:15-22.

Reid, C. R., S. Goodrich, and J. E. Bowns. 2008. Cheatgrass and red brome; the history and biology of two invaders. In *Proceedings-Shrublands under fire: disturbance and recovery in a changing world; 2006 June 6-8; Cedar City, UT*, comps. S. G. Kitchen, R. L. Pendleton, T. A. Monaco, and J. Vernon, 27-32. Fort Collins: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, RMRS-P-52.

Ripple, et al. 2017. *World scientists' warning to humanity: A second notice.* BioScience 67: 1026-1028.

Ridley, H. N. 1930. *The dispersal of plants throughout the world*. Kent: Ashford.

Rogers, G. 2010. Weed management plan for the BLM Phoenix District. Unpublished Report. Garry Rogers, Humboldt, AZ.

Rogers, G. 2015. *Arizona wildlife notebook: Checklists and Conservation Status*. Prescott: Coldwater Press.

Rogers, G., and J. Steele. 1980. Sonoran desert fire ecology: Adaptive strategies of perennial plant species. In *Proceedings of the fire history workshop, October 20-24, 1980*, tech coords. Marvin A. Stokes and John H. Dieterich. Fort Collins: U.S. Forest Service, General Technical Report RM 81:15-19.

Rogers, R. W., and R. T. Lange. 1971. Lichen populations on arid soil crusts around sheep watering places in South Australia. Oikos 22: 93-100.

Salywon, Andrew, Dixie Damrel, and Wendy Hodgson. 2008. Agua Fria National Monument (in progress). http://swbiodiversity.org/seinet/checklists/checklist.php?cl=2624&pid=1. Accessed 29 June 2019.

Schmidt, A., and Johann Ibmayer. 1801-1809. *Icones et descriptiones Graminum austriacorum*. Vindobonae: A. Schmidt.

SEINet. 2019. Environmental Data Portal. http://swbiodiversity.org. Accessed 25 July 2019.

Shao, M. N., B. Qu, B. T. Drew, C. L. Xiang, Q. Miao, and S. H. Luo. 2019. Outbreak of a new alien invasive plant *Salvia reflexa* in northeast China. Wiley Online Library. https://doi.org/10.1111/wre.12357. Accessed 29 June 2019.

Sheldon, J. C., and F. M. Burrows. 1973. The dispersal effectiveness of the achene-pappus units of selected compositae in steady winds with convection. New Phytologist 72:665-675.

Simberloff, D. 2013. *Invasive species, what everyone needs to know*. Oxford: Oxford University Press.

Slate, M. L., R. M. Callaway, and D. E. Pearson. 2018. Life in interstitial space: Biocrusts inhibit exotic but not native plant establishment in semi-arid grasslands. Journal of Ecology. https://doi.org/10.1111/1365-2745.13117. Accessed 29 June 2019.

Southwest Biodiversity Program. 2017. http://swbiodiversity.org/seinet. Accessed 29 June 2019.

Southwest Monarch Studies. 2019. https://www.swmonarchs.org. Accessed 29 June 2019.

Southwest School of Botanical Medicine, Bisbee, Arizona. 2019. http://www.swsbm.com. Accessed 1 August 2019.

Strum, Johann Georg Strum, 1796. Deutschlands Flora in Abbildungen. https://doi.org/10.5962/bhl.title.507. Accessed 29 June 2019.

SWEPC. 2009. Southwest Exotic Plant Information Clearinghouse. http://sbsc.wr.usgs.gov/research/projects/swepic/swepic.asp. Accessed 29 June 2019.

Tackenberg, O. 2003. Modeling long-distance dispersal of plant diaspores by wind. Ecological Monographs 73:173-189.

Tackenberg, O., P. Poschlod, and S. Bonn. 2003. Assessment of wind dispersal potential in plant species. Ecological Monographs 73:191-205.

Tilford, G. L. 1997. *Edible and medicinal plants of the West*. Missoula: Mountain Press Publishing Company.

Tull, D. 2013. *Edible and useful plants of the Southwest: Texas, New Mexico, and Arizona*. Austin: Univ. Texas Press.

Turland, Nicholas J. et al. 2018. *International code of nomenclature for algae, fungi, and plants (Shenzhen Code), adopted by the Nineteenth*

*International Botanical Congress, Shenzhen, China.* Eibelstadt: Koeltz Botanical Books.

Turner, R.M., R. H. Webb, T. C. Esque, and G. F. Rogers. 2010. Repeat photography and low elevation fire responses in the southwestern United States. In *Repeat photography methods and applications in the natural sciences*, ed. R. H. Webb, D. E. Boyer, and R. M. Turner, 223-244. Washington: Island Press.

Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (Eds.). 2017. *Climate Science Special Report: A Sustained Assessment Activity of the U.S.* Washington: Global Change Research Program, U. S. Government Printing Office.

U. S. Department of Agriculture Food Composition Databases. 2019. https://ndb.nal.usda.gov/ndb. Accessed 25 July 2019.

U. S. Department of Agriculture Plants Database. 2019. http://plants.usda.gov/java/noxiousDriver. Accessed 29 June 2019.

U. S. Department of Agriculture , Natural Resources Conservation Service. 2019. Introduced, Invasive, and Noxious Plants. https://plants.usda.gov/java/invasiveOne. Accessed 29 June 2019.

Watson, S. 1871. *Botany. Volume 5 in C. King. Report of the geological exploration of the fortieth parallel*. Washington: Professional Papers of the Engineer Department, U. S. Army 18:i-Liii, 1-525.

Watson, S. 1874. Atriplex wrightii. Proceedings of the American Academy of Arts 9:113.

Whitson, T. D., L. C. Burrill, S. A. Dewey, D. W. Cudney, B. E. Nelson, R. D. Lee, and R. Parker. 2006. *Weeds of the West.* Las Cruces: Western Society of Weed Science.

Wilson, E. O. 2016. *Half-Earth: Our planet's fight for life*. London: W.W. Norton.

Wilson, J. S. 2015. *The bees in your backyard: A guide to North America's bees*. Princeton: Princeton University Press.

WWF (World Wildlife Fund). 2016. *Living Planet Report 2016. Risk and resilience in a new era*. Gland: WWF International.

Yasin, M., E. Rosenqvist, S. M. Jensen, and C. Andreasen. 2019. The importance of reduced light intensity on the growth and development of six weed species. Weed Research, Wily Online Library. https://doi.org/10.1111/wre.12352. Accessed 29 June 2019.

Young, J. A., R. A. Evans, and J. Major. 1971. Alien plants in the Great Basin. Journal of Range Management 25:194-201.

Zimdahl, R. L. 2010. *A history of weed science in the United States*. New York: Elsevier.

Zouhar, K., J. K. Smith, S. Sutherland, and M. L. Brooks. eds. 2008. *Wildland fire in ecosystems: Fire and nonnative invasive plants.* Ogden: Rocky Mountain Research Station, RMRS-GTR-42-Vol. 6.

# INTERNET RESOURCES

**A Note about Internet Sources**

Internet information is valuable for its accessibility, but it is not stable. Internet publishers often delete or change the addresses of reports, comments, maps, and data. If a link fails to connect, it might be possible to relocate an item by accessing the root directory of the site. For example, if the address for lists of weeds defined according to the Federal Noxious Weed Act of 1974, http://plants.usda.gov/java/noxiousDriver, changes it might be helpful to access http://plants.usda.gov or even http://usda.gov and search for the new location.

(Other sources of information cited in the text are in the Sources list above.)

Global Register of Introduced and Invasive Species. 2019. http://www.griis.org. Accessed 6 August 2019.

Heap, I. (2018).The International Survey of Herbicide Resistant Weeds www.weedscience.com. Accessed 6 August 2019.

International Union for the Conservation of Nature (IUCN), Invasive Species Specialist Group. 2019. http://www.issg.org/worst100_species.html. Accessed 6 August 2019.

National Fire Protection Association. 2020. https://www.nfpa.org/

North American Invasive Species Management Association. 2019. http://www.naisma.org. Accessed 6 August 2019.

Play, Clean, Go—Stop invasive species in your tracks. 2019. http://www.playcleango.org. Accessed 6 August 2019.

Society for Ecological Restoration. 2019. (https://www.ser.org). Accessed 6 August 2019.

U. S. National Invasive Species Information Center (https://www.invasivespeciesinfo.gov). Accessed 28 June 2019.

Weed Science Society of America. 2019. Publishes: *Invasive Plant Science & Management, Weed Science, Weed Technology*. http://wssa.net. Accessed 6 August 2019.

# GLOSSARY

Botanical terminology has a history that stretches back thousands of years. Some of the terms we use to label plant parts are unique to botany, but most of them are forms of common adjectives.

This glossary is limited to terms used in this book. For a more complete list, I recommend the Glossary of Botanical Terms on Wikipedia and the fine book by David Gledhill (Gledhill 2008). The definitions below are from several sources, but I tended to follow Parker's plain style (Parker 1972). Wikipedia has illustrations for most of them.

Achene - Small dry one-seeded fruit in which the ovary wall is free from the seed

Acuminate - Gradually tapering to a sharp point

Acute - Sharp pointed but less tapering than acuminate; angle less than 90 degrees

Allelopathic - Produces biochemicals that prevent the germination, growth, survival, or reproduction of neighboring plants

Alternate – Single leaves attached at a node

Annual - Plant that usually germinates, flowers, and dies in one growing season

Anther - Enlarged part at the top of the stamen; bears the pollen

Attenuate - Gradually narrowing to a slender apex or base

Auricle - Some grasses have small claw-like extensions of the collar that separates the sheath from the blade

Awn - More or less stiff bristle on the end of lemmas (lower bracts) or glumes (paired bracts)

Axil - Upper surface of angle between the stem and the leaf

Blade - Grass leaf above the sheath

Bract - Modified leaf underneath a flower or inflorescence

Bristle - Stiff, slender appendage

Bunchgrass - Grass without stolons or rhizomes; growth forms a bunch

Bur - Rough or prickly envelope around a seed or fruit

Calyx - Outer set of floral leaves, usually green, composed of all the sepals

Campanulate – Bell-shaped.

Caryopsis - Dry one-seeded fruit in which the ovary wall unites with the seed coat, typical of grasses

Ciliate - Fringed with hairs on edge

Collar - Region of the outer side of the grass leaf at the junction of the blade and sheath

Compound - Leaves divided into leaflets

Convolute - Rolled longitudinally

Corolla - All the flower petals

Corymb (adj. corymbiform) is a flower array or cluster with outermost flowers on longer pedicels than the inner

Creeping - Spreading just under the surface of the soil

Culm - Stem of grass plants

Cyathia - Euphorbia flowers appear to be individual flowers, but they are composed of bracts fused into a cup (involucre), with peripheral nectary glands supported by petal-like (petaloid) bracts. Within the cup, there is a ring of male flowers, each with a single stamen. Out of the middle protrudes a single, stalked female flower with no petals

Deciduous - Sheds leaves at the end of the growing season. Induced by cold temperature or by drought

Decumbent - Stems that lie flat and turn up at their ends

Decurrent - Extending downward from the point of attachment

Dehiscent - Splitting open at maturity

Dioecious - Plants with only male (staminate) flowers

Disk flowers - Tubular flowers in the center of the flower heads in the aster/sunflower family

Distally - Opposite point of attachment

Embryo - Young plant enclosed in a seed

Entire - Continuous smooth leaf margin

Entity - Natural vegetation unit defined by particular plant species

Erose - Irregularly notched at the apex; appearing gnawed or eroded

Flexuous - Bent alternately in opposite directions; a wavy form

Floret - Individual grass flower including its two bracts, lemma and palea, or flower heads in the sunflower family

Floret - Small flower in the spikelet of the grasses, or the flower head of the sunflower family

Flower head - Dense inflorescence of sessile (stalkless) flowers

Fruit - Seed case or seed pod (the ripened ovary); containing one to many seeds

Geniculate - Bent sharply, like a knee

Glabrous - Smooth without hairs

Glands - Secreting tissue

Glaucous - Powdery or waxy surface cover

Glumes - Two thin bracts surrounding the spikelet of a grass (forming the husk of a cereal grain); or one surrounding the florets of a sedge

Grain - The seed-like dispersal unit of the grass family

Hirsute - With straight rather stiff hairs

Hispid - With long stiff hairs

Hyaline - Colorless and translucent

Imperfect - Flowers with either pistils or stamens; unisexual

Indehiscent - Not opening at maturity

Inferior ovary - Sepals, petals, and stamens appear to rise from the very top of the ovary

Inflorescence - Flowering part of a plant

Internode - Part of a stem between two successive nodes

Introduced -Species people brought to North America

Invader - undesirable plants that invade and replace native vegetation

Involucre - Cluster of bracts below the inflorescence or cone (involucrate = having an involucre)

Involute - Rolled inward on the upper (dorsal) surface

Keel - Central dorsal ridge; the two united petals in some legume flowers

Knotty - Hardened mass at the base or nodes

Lacerate - Appearing torn at the edge or irregularly cleft

Leaflet - Division of a compound leaf

Lemma - Lower bract of the two bracts of a grass floret

Ligule - A thin lining on the inner side of the leaf sheath at its junction with grass and sedge blades

Ligule - the membranous, toothed, or hairy appendage on the inside of a leaf exposed at the junction of the sheath and blade

Membranous - Thin, like a papery membrane

Monocarpic - Flowering and bearing fruit only once and then dying; can apply to annuals, biennials, or perennials

Monoecious - Plants with only female (carpellate) flowers

Mycorrhiza - Formed by a combination of underground threads usually associated with plant roots

Native - Species that originated in North America

Nerve - Vein on glume, lemma, or palea

Node - Place on a stem where leaves and branches originate

Nutlet - Small nut; the one-seeded portion of a larger fruit that separates at maturity

Obtuse - blunt or rounded (apex or base), usually making an angle of more than 90 degrees

Opposite – Leaf pairs together one on each side of the stem

Ovary - Base of the female part of the flower (pistil); ripens into the fruit

Palea - Innermost of the two bracts of a grass floret

Panicle - Loose, irregularly branched inflorescence with stalked individual flowers

Pappus (plural pappi) - Modified calyx of a disk or rayflower in the sunflower family; consists of awns, scales, or bristles at the apex of the achene. Facilitates wind dispersal

Pedicel - Stalk of a spikelet

Perennial - Plant living more than 1 year

Perfect flowers - Both male and female reproductive parts in the same structure

Perianth - Outer part of flowers, consisting of the calyx (sepals) and corolla (petals)

Petaloid – Petallike

Phyllary – In asters, a bract that with others forms the involucre or cup that holds the flowers

Pilose - Covered with soft hair

Pinnate - Leaf divided into leaflets along a central stem

Pistil - Female reproductive structures of a flower

Polycarpic - Produces flowers or spores more than once during lifetime

Pubescent - Covered with soft hairs

Raceme - A flower cluster with the separate flowers on short equal stalks at equal distances along a central stem (rachis). The flowers at the base of the central stem develop first

Ray flower - Marginal petal flowers in the inflorescence of the aster/sunflower family

Retrorse - Directed back or downward

Rhizomatous - Having rhizomes

Rhizome - Horizontal underground stem

Rosette - Cluster of spreading or radiating basal leaves

Rotate – Wheel-shaped usually applied to a circular, nearly flat, short-tubed, sympetalous corolla.

Runner - Horizontal aboveground stem; a stolon

Samara – Winged achene

Scabrous - Roughened with stout projections

Scurf (adj. scurfy) – Small branlike scales on the surface of a leaf or other part.

Sepal - One of the outer set of floral leaves forming the calyx, usually green

Sessile - Stalkless leaves or flowers

Sheath - In grasses, the basal portion of the leaf forms a tube (sheath) wrapping around the stem

Silicles - Dry, dehiscent fruit of the Brassicaceae with two parts that separate at maturity; fruit is typically *less than three times as long as wide*

Silique - Dry, dehiscent fruit of the Brassicaceae with two parts that separate at maturity; fruit is typically *more than three times as long as wide*

Sinuate, sinuous (adv. Sinuately) – Having a deep wavy margin.

Sod-grass - Grass with stolons or rhizomes; may form continuous thatched surface

Spatulate - Narrow at the stem widening to the tip

Spike - An unbranched inflorescence with stalkless flowers

Spikelet - the part of a grass inflorescence consisting of two glumes and one or more florets

Stamen - The male portion of the flower

Stipules - Pair of tongue-like appendages at the base of the leaf

Stolon - Horizontal stem that roots along its length to form new plants; aboveground or at very shallow depth

Stoloniferous - Bearing stolons

Striate - Marked with slender, longitudinal grooves or lines, appearing striped

Strigose - Stiff, straight hairs laying on a surface

Succulent - Soft and fleshy in texture

Tomentose - Covered by dense matted and tangled hairs, velvety

Truncate – "Cut off" at the base or apex

Truncate-ciliate - Ligule with short fringe of hair tips

Tuber - A swollen underground stem

Umbel – Flower stalks arising from a common point a bit like an umbrella blown inside out.

Utricle – Small thin-walled fruit with a covering that is looser and more fragile than that of an achene. Common among Amaranths. The Tumble Pigweed drawing and one of the photos illustrate the utricle.

Villous- Densely hairy with long, soft hairs

Whorl - Three or more leaves or flowers arising from the same node

# Index of Illustrators and Photographers

## Cases

# General Index