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PHRAGMITES FIELD GUIDE: DISTINGUISHING NATIVE AND EXOTIC FORMS OF COMMON REED (*PHRAGMITES AUSTRALIS*) IN THE UNITED STATES

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This technical note describes the ecology and distribution of common reed (*Phragmites australis*) and provides images of morphological features used to distinguish native forms from introduced forms.

Adapted from:

Swearingen, J. and K. Saltonstall. 2010. *Phragmites* Field Guide: Distinguishing Native and Exotic Forms of Common Reed (*Phragmites australis*) in the United States. Plant Conservation Alliance, Weeds Gone Wild. http://www.nps.gov/plants/alien/pubs/index.htm

Preface

This field guide is the outcome of a request by Brock Benson, Range Management Specialist with the U.S. Department of Agriculture, Natural Resources Conservation Service in Utah, to have a handy guide for field use to help identify and differentiate between native and exotic forms of common reed. It is based on a PowerPoint "Phragmented *Phragmites*" previously posted on the Weeds Gone Wild website. This field guide presents the most current information available on the origin, distribution, taxonomy, genetics and morphological differentiation of native and introduced forms of *Phragmites australis*.

The authors extend a special thanks to Robert Meadows, Delaware Mosquito Control Section, and to Dr. Robert Soreng and Dr. Paul Peterson, Smithsonian Institution Department of Botany, for their helpful review and contributions.

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Introduction

What is *Phragmites australis*?

Phragmites australis (Cav.) Trin. ex Steud, or common reed, is thought to be one of the most widespread plants on Earth and is found in marsh systems world-wide. It is an erect perennial grass 6-15 ft. (2-5 m) tall that remains standing through all seasons and is fairly easily recognized by its plume-like inflorescences. Although the species name '*australis*' suggests it is native to Australia, it is believed to have originated from the Middle East. Recent research using genetic markers has demonstrated that three separate lineages occur in North America – one endemic and widespread (the native), one from Europe (the introduced invasive), and one whose nativity is currently unclear which occurs across the southern U.S. from California to Florida and into Mexico and Central America (the 'Gulf Coast' type).

Cultural Importance and Uses

Native Americans used common reed for many uses, including arrow shafts, musical instruments, ceremonial objects, cigarettes, and woven mats (figure 1). Preserved remains of native *Phragmites* that are 40,000 years old have been found in the Southwestern United States indicating that it is a part of the native flora of that region. In coastal areas, preserved rhizome fragments dating back 3000-4000 years before present have also been found in salt marsh sediments indicating that it is also native to these habitats.

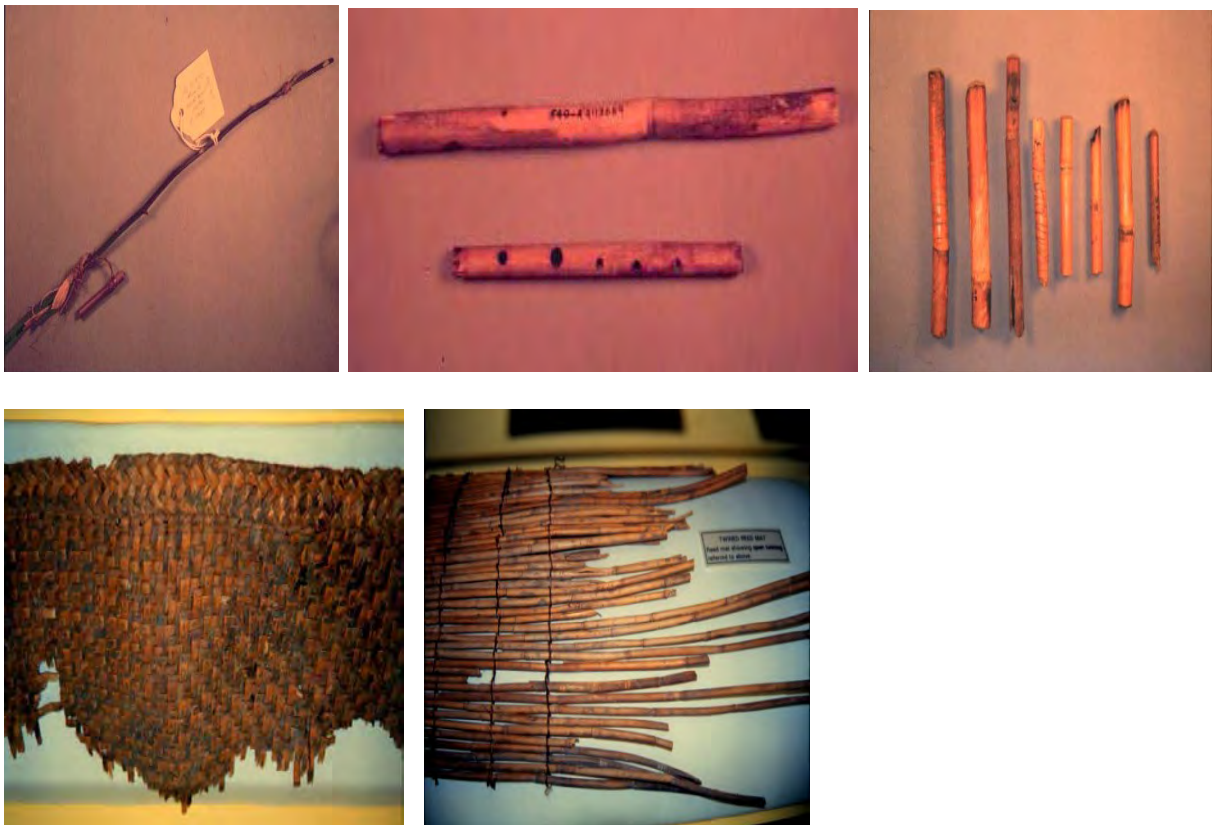

Figure 1. Artifacts from Anasazi Indians, Tucson, Arizona. Top row (l to r): prayer stick, flutes, cigarettes; Bottom row (l to r): Mat woven from leaves; mat made from stems. All photos by K. Saltonstall.

History of Introduction

European forms of *Phragmites* were probably introduced accidentally to North America in ballast material sometime during the late 1700s or early 1800s. Introduced *Phragmites* first established along the Atlantic coast and then spread across the continent over the course of the 20th century. In Europe, *Phragmites* is grown commercially and used for thatching, fodder for livestock, and cellulose production. Ironically, it is declining in parts of Europe and its long term survivability is a concern to natural resource managers there.

Figure 2. Duck blind made from *Phragmites* on Marshyhope Creek, MD. Photo by R.E. Meadows

Ecological Threat

Introduced *Phragmites* is a vigorous plant that, once established, rapidly takes over, creating dense patches that consume available growing space and push out other plants, including the native subspecies. It also alters wetland hydrology, increases the potential for fire, and may reduce and degrade wetland wildlife habitat due, in part, to its dense growth habit.

Phragmites is also used to construct hunting blinds (figure 2). This duck blind in Maryland along Marshyhope Creek, a tributary of the Nanticoke River, was constructed of introduced *Phragmites* adjacent to a stand of native *Phragmites*. No introduced *Phragmites* was found along the creek at the time of surveying indicating it was brought in for the purpose of making the blind.

Distribution of North American Lineages

Phragmites australis occurs today throughout the lower 48 states and southern Canada. It is not found in Hawaii or Alaska. In North America, *Phragmites* is represented by three distinct lineages based on genetic analysis. One is native and endemic to North America, one is found in both North and South America, and the third is introduced and invasive. The native endemic lineage (*Phragmites australis* ssp. *americanus* Saltonstall, Peterson and Soreng) (Fig. 3) was historically widespread, occurring throughout Canada and most of the U.S. except for the Southeast (Texas to Florida and north to South Carolina). It remains widespread in the western U.S.

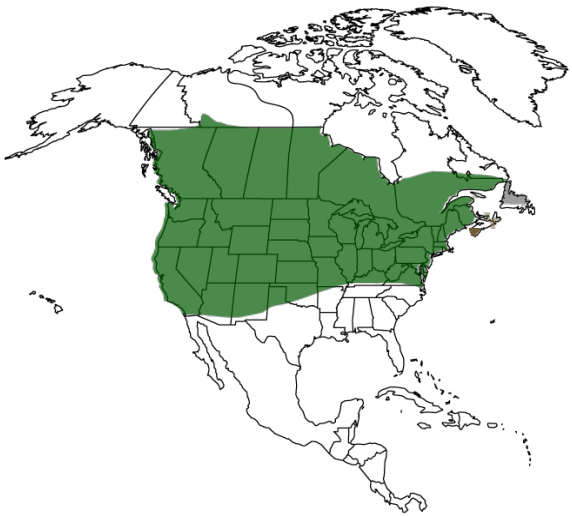

Figure 3. Native Lineage: *Phragmites australis* subsp. *americanus* Saltonstall, Peterson & Soreng. Saltonstall et al. 2004. SIDA 21(2): 683-692.

In the eastern U.S., the native has been largely replaced by the invasive lineage and is found in scattered locations throughout its historic range. Some remaining populations occur along several major rivers on the eastern shore of Maryland, part of the Chesapeake Bay watershed. In the Midwest and western U.S., native *Phragmites* persists in many natural areas and has been shown to be actively dispersing to new sites in recent years.

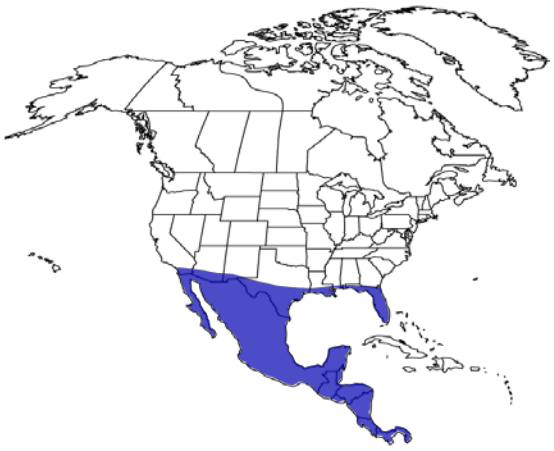

Figure 4. Gulf Coast Lineage: *Phragmites australis* subsp. *berlandieri* Saltonstall & Hauber. Saltonstall et al. 2004. SIDA 21(2): 683-692.

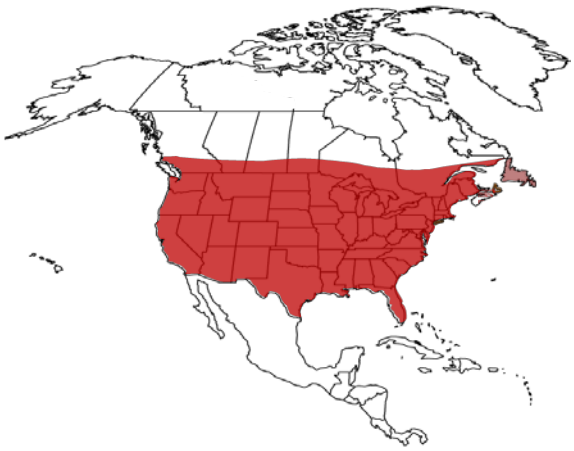

Figure 5. Introduced Lineage: *Phragmites australis* (Cav.) Trin. ex Steud, Saltonstall et al. 2004. SIDA 21(2): 683-692.

The 'Gulf Coast lineage' has been recognized as *Phragmites australis* subsp. *berlandieri* Saltonstall & Hauber (Fig. 4). Its distribution is restricted to the southernmost states and it has been introduced to southern Arizona and California. It is not clear at this time if it is truly native to the U.S. or spread north from populations in Mexico and Central America.

The invasive lineage of *Phragmites australis* (Fig.5) was likely introduced from Europe. It is now found throughout the continental U.S. and in southern portions of six Canadian provinces. In the southern U.S., where it overlaps with the Gulf Coast lineage, the invasive form has been confirmed to occur around the Mississippi River delta and has the potential to spread further to other parts of the Gulf Coast. South of the U.S. border, its distribution is not known.

Habitat

The habitat associations of native and introduced *Phragmites* overlap extensively. While both are found in tidal and non-tidal wetlands, inland marshes and fens, and along lakes and rivers, introduced *Phragmites* is more likely to be found in disturbed sites where soil may have been exposed and nutrient inputs may be high, such as along roadsides, construction sites, near agricultural fields, or near developed shorelines. Although the ecology of *Phragmites* in the West is not well studied native *Phragmites* is typically found in desert seeps, springs, lacustrine and riparian systems (figure 6). However, these wetlands are widely scattered, the overall abundance of native *Phragmites* is probably low across the region.

Growth and Spread

Spread of *Phragmites* to new locales is through seed, which is dispersed by wind and water, and vegetative means, through the movement of rhizomes or rhizome fragments (figure 7). Individual *Phragmites* plants produce hundreds to thousands of seeds per year. While seed viability is highly variable and there appears to be a great deal of inter-annual variation in fecundity, sufficient seed is dispersed to overcome these impediments.

Below ground, introduced *Phragmites* forms a dense network of roots and rhizomes which can extend downward several feet. It spreads horizontally by sending out rhizome runners which can grow 10 or more feet in a single growing season if conditions are optimal. New populations of the introduced type of *Phragmites* may appear sparse for the first few years after establishment but the plant's rapid rate of growth and spread allows it to form a pure stand fairly rapidly. Along rivers and coastal shorelines, fragments of rhizomes transported from infested sites far away settle in new spots and become rooted. Rhizome fragments may also be moved by heavy machinery.

Figure 6. Native *Phragmite*s in the Grand Canyon, Arizona. Photo by K. Saltonstall.

Figure 7. Florets of *Phragmites* taking flight (left). Photo by K. Chamberlain. Close-up view of rhizomes (center), and rhizomes of introduced *Phragmites* with *r*hizomes exposed by wave action (right). Photos by Ohio State Weed Lab.

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Telling Native from Exotic

Figure 8. Introduced *Phragmites* (above) and native *Phragmites* (below). Photo by K. Ssaltonstall.

In the picture above, two different forms of *Phragmites* are fairly recognizable based on color (the native form is on the right). However, because plants are often not found side-by-side, it can be very difficult to determine which form you have. There are also MANY overlaps in characters, making it necessary to look at multiple factors when making a determination based on morphology. The following pages will describe and demonstrate morphological characteristics that help differentiate between the introduced and native forms of *Phragmites*, based on observations of Drs. Kristin Saltonstall, Paul Peterson, Rob Soreng, and Bernd Blossey.

Morphological Characters

Vegetative and floral characteristics have been found to be useful in differentiating between exotic and native forms of *Phragmites.* Vegetative features include the length of the ligule, degree to which the leaf sheath adheres to the stem, stem color, presence or absence of stem spots, and leaf blade color. Density of stems, a measure of growth habit rather than a morphological character, can also be used to differentiate between native and non-native forms but is not always diagnostic. Floral characters include the length of the lower and upper glumes. These characters are defined and depicted in detail on the pages that follow. Characters marked with an asterisk (*) are the most diagnostic when distinguishing native from introduced *Phragmites*.

Vegetative Characters

Leaf blade and sheath. Grass leaves consist of a leaf blade (upper portion) and a leaf sheath (lower portion) separated by a ligule. The lower portion of the leaf sheath typically wraps tightly around the culm (stem).

Ligule. A membranous or hairy outgrowth on the upper leaf surface at the juncture of the leaf blade and leaf sheath. It can range from a thin membrane to a thickened appendage. In *Phragmites* the ligule is rimmed by a fringe of hairs.

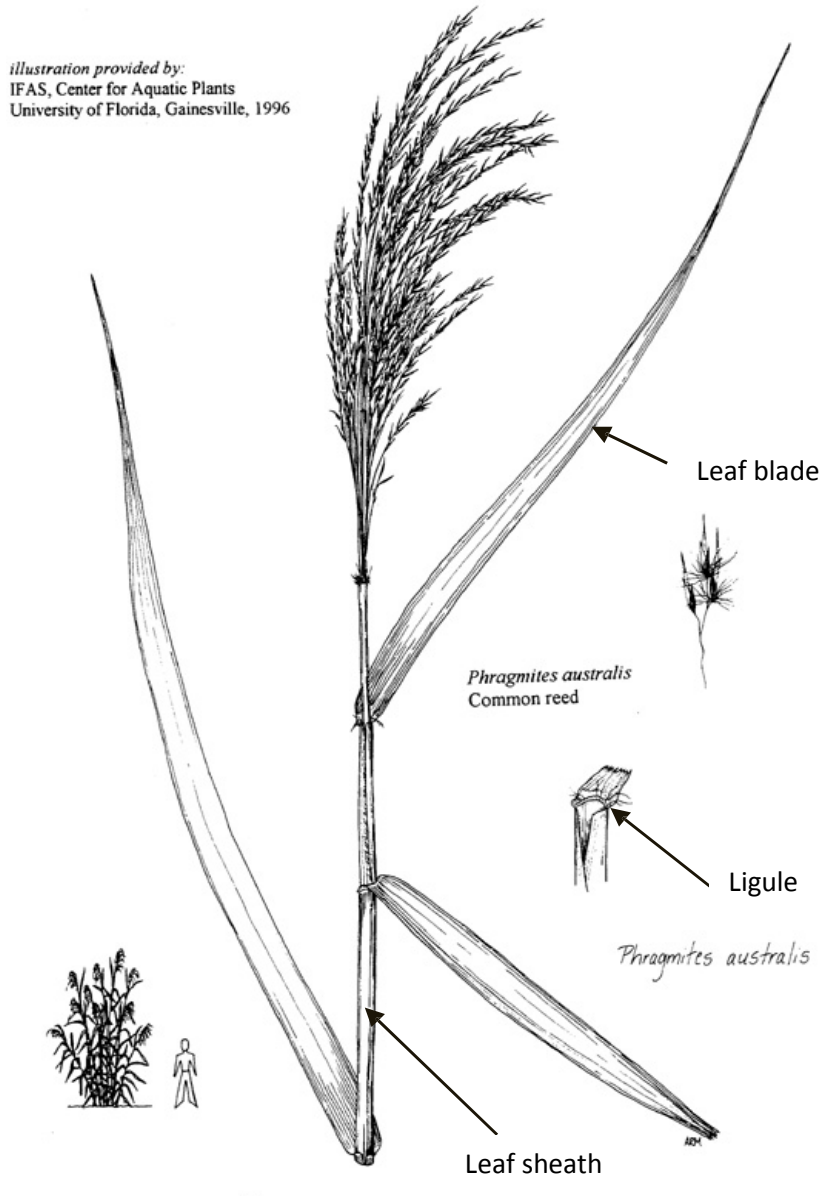
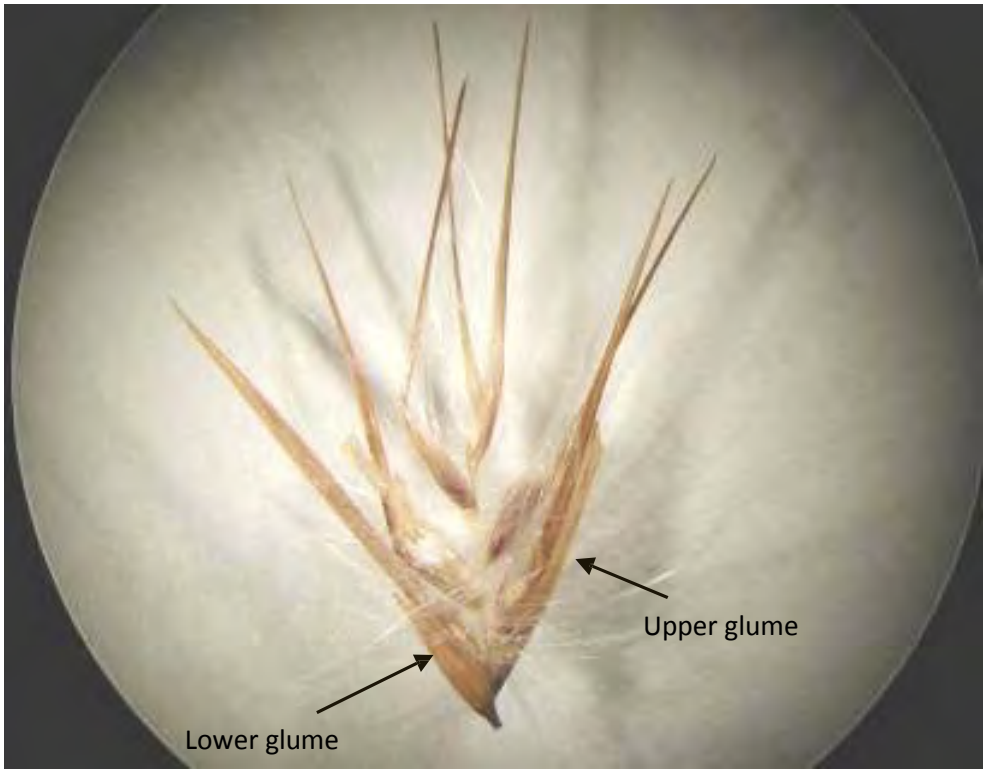


Illustration of *Phragmites* vegetative characters. Illustration provided by: IFAS, Center for Aquatic Plants, University of Florida, Gainesville, 1996.

Floral Characters



A spikelet of *Phragmites* showing lower pair of glumes and individual florets.
Photo by K. Saltonstall

Spikelet. The spikelet is the primary inflorescence in grasses.

Floret. A floret is an individual grass flower.

Glume. The glumes are the bracts at the very base of a grass spikelet. There are usually two - a lower and an upper glume, but in some grasses there is only one and in other grasses there are none.

A Note of Caution

The following pages will provide guidance for determining which *Phragmites* lineage you are dealing with. However, genetic evidence through DNA analysis, if available, is the most reliable and definitive method. Due to the plasticity of the species and its ability to adapt to a wide range of conditions, it is difficult to distinguish definitively the native and introduced forms of *Phragmites* without genetic testing.

The morphological characteristics described here can be used to determine a population's lineage. The characters can be subtle (e.g., color variation) and subjective making positive identification difficult. Given this, an assignment of native or introduced status to a population should not be made unless several characters clearly match the patterns shown in the following slides. Some features (ligule length, glume length, leaf sheath adherence) are more diagnostic than others and should always be used when attempting to identify *Phragmites* populations. Even then it will not be a simple task. A taxonomic expert should be contacted to confirm identification before any control projects are implemented to avoid eradication of native populations.

Additionally, these characters should NOT be used to distinguish between *Phragmites* populations along the Gulf of Mexico. In this area, the Gulf Coast type occurs and is very similar in appearance to the introduced lineage. Because the Gulf Coast type has also been found in southern Arizona and California, where it may have been recently introduced, caution must be taken when identifying *Phragmites* populations in these areas as well.

Overview of Native *Phragmites*

Detaching leaf sheaths on native *Phragmites*. Photo by K. Saltonstall.

Growth habit/density. Native *Phragmites* typically occurs in low density stands often comingled with other native plants but it can occur in very dense stands as is typical of the introduced form.

***Leaf sheaths** fall off the culm easily once the leaf dies particularly at the lower nodes where they may no longer be present when the plant flowers.

Leaves are typically lighter in color than the exotic, often yellow-green.

Culms (stems) are somewhat delicate, smooth to the touch, appear somewhat shiny and often have a red to chestnut color towards the base, particularly where the leaf sheaths have opened up or fallen away from the culm, exposing the typically enclosed culm to direct sunlight. Culms may not remain standing through the winter.

Spots on culms can occur and are caused by a native fungus that has not adapted to the exotic form.

Flowers occur 3-4 months after spring growth is initiated; the inflorescence plumes may be sparse in comparison to the exotic forms and may not persist though the winter.

Red color on exposed internode area of culm (left). Photo by K. Saltonstall. Fungal spots on culms (center). Photo by R.E. Meadows. Loose inflorescence (right). Photo by B. Blossey.

Overview of Introduced *Phragmites*

Growth habit/density. Introduced *Phragmites* typically forms very dense stands which include both live stems and standing dead stems from the previous year's growth.

***Leaf sheaths** adhere tightly to the culm throughout the growing season and persist on the culm as long as it remains standing.

Leaves are blue green and usually darker than the native forms.

Culms can reach 15 feet, are very rigid, and are slightly ridged with a rougher texture than the native.

No spots on culms. Fungal spots are not typically present but there may be some mildew.

Flowers occur typically in August and September and form bushy panicles that are usually purple or golden in color.

Live and dead culms form a dense monoculture. Photo by K. Saltonstall.

No red color at internodes (left). Photo by K. Saltonstall. No spots on culms (center). Photo by R.E. Meadows. Dense inflorescence (right). Photo by B. Blossey.

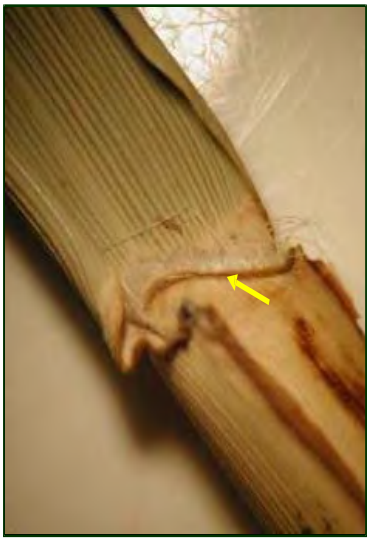
Summary of Morphological Characters that Distinguish Native & Introduced *Phragmites australis*

Character	Native	Introduced
***Ligule length**	>1.0 mm	<1.0 mm
***Lower glume length**	3.0 – 6.5 mm Most >4.0 mm	2.5 – 5.0 mm Most <4.0 mm
***Upper glume length**	5.5 – 11.0 mm Most >6.0 mm	4.5 – 7.5 mm Most <6.0 mm
***Adherence of dead leaf sheaths**	Loose, drop off easily	Tight, remain on dead stems
***Growth form (plant density)**	Typically in mixed communities, stem density may be low to high, dead stems less likely to persist to the next growing season.	Often grows as a monoculture, stem density is high, dead stems often persist to the next growing season.
Culm texture	Smooth, shiny	Dull or flat color, slightly ridged
Culm color	May be dark red at nodes and internodes, where exposed to UV. May be green as well.	Typically green, occasionally see some red color at the lower nodes
Spots on culms	May be present	Not present, mildew may be present
Leaf color	Lighter, yellow green to dark green	Typically darker green, but may be lighter in saline areas

*****Indicates most diagnostic features.

***Ligule Length**

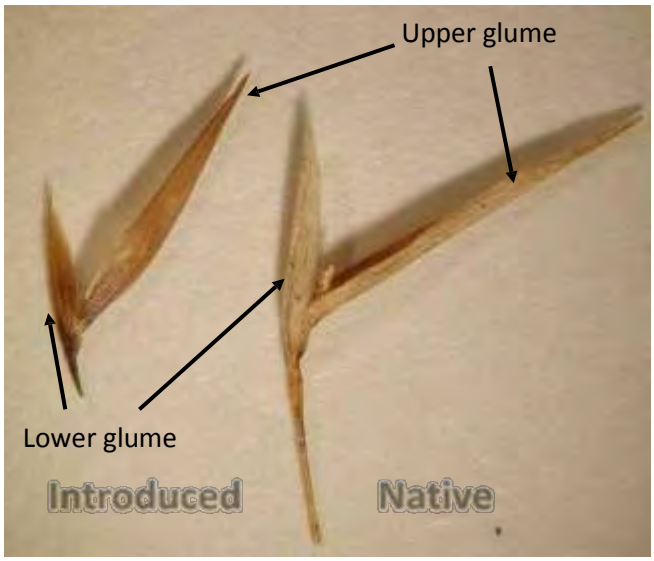
Native | Introduced



> **1 mm** (1.0 - 1.7 mm) | < **1mm** (0.4 - 0.9 mm)

Measurements of ligule length should include the **hairy fringe** of the ligule membrane. Measure at the center and on either side, and then take an average. Longer hairs break off easily and are not diagnostic.

***Glume Length**



Introduced	Native
Lower glume: 2.5-5.0 mm (most <4.0 mm)	Lower glume: 3.5-6.5 mm (most >4.0 mm)
Upper glume: 4.5-7.5 mm (most <6.0 mm)	Upper glume: 5.5-11.0 mm (most >6.0 mm)

Note: Measure from the base of the glume to its tip. Take measurements for at least 5 glumes (upper or lower) and then average. All photos by K. Saltonstall.

***Leaf Sheath Persistence**

Photos by R.E. Meadows.

Native: Most leaf sheaths are missing or very loosely attached to over-wintering culms.

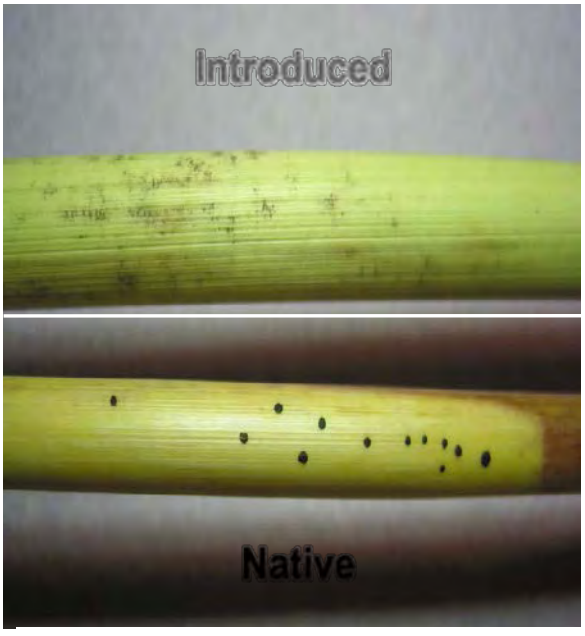
Introduced: Most leaf sheaths are present and tightly adhering to culms.

Culm Color
The red-purple coloration of the culm is more common on the native *Phragmites* (right and below), where the leaf sheaths have opened up or totally fallen away, exposing the culm to direct sunlight. Internodes may or may not show red color.

Sometimes a little red may be seen on the introduced form but it is usually limited to lower nodes.

Native *Phragmites* with red culms (two left photos), and, introduced *Phragmites* (right) showing green culms. Left photo by K. Saltonstall. Right two photos by R.E. Meadows.

Spots on Culm
The black spots sometimes found on culms of native *Phragmites* are caused by a native fungus. Culms of the introduced *Phragmites* may have a sooty like mildew but do not have the distinctive black fungal spots.



Spots formed from a native fungus shown on native *Phragmites* culm (below). Photos by R.E. Meadows.

Stem Density

Native *Phragmites* can occur as a monoculture but typically co-occurs with other plant species; stem density ranges from low to high. Photo by K. Saltonstall.

Introduced *Phragmites* typically grows as a monoculture; stem density is very high but young, newly established populations and those in areas of high salinity may be less dense. Photo by L. Mehrhoff.

Leaf Color

Native: typically lighter yellow-green

Introduced: typically darker blue-green

*Color differences are very subjective and are easiest to distinguish when seen side-by-side. Photos by K. Saltonstall.

Key to Lineages of *Phragmites australis* in North America
(Saltonstall and Hauber 2007)

1. Ligules 1.0—1.7 mm long; lower glumes 3.0 – 6.5 mm long; upper glumes 5.5—11.0 mm long; lemmas 8.0—13.5 mm long; leaf sheaths caducous with age; culms exposed in the winter, smooth and shiny; rarely occurs in a monoculture; chloroplast DNA haplotypes A- H, S, Z, AA, AB, AC (see Saltonstall 2002, 2003)..... ***P. australis* subsp. *americanus* (Native lineage)**

1. Ligules 0.4—0.9 mm long; lower glumes 2.5—5.0 mm long; upper glumes 4.5—7.5 mm long; lemmas 7.5—12.0 mm long; leaf sheaths not caducous with age; culms not exposed in the winter, smooth and shiny or ridged and not shiny; usually occurs as a monoculture; chloroplast DNA haplotypes I or M.

2. Culms smooth and shiny; southern California, Arizona, New Mexico, Texas to Florida, throughout Mexico and Central America; chloroplast DNA haplotype I ….....***P. australis* subsp. *berlandieri* (Gulf Coast lineage)**

2. Culms ridged and not shiny; southern Canada from British Columbia to Quebec south throughout the Continental United States; chloroplast DNA haplotype M .....***P. australis* (Introduced lineage)**

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USDA NRCS Plants Database. Common Reed (*Phragmites australis*). http://plants.usda.gov/java/profile?symbol=PHAU7

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Information Sources

The following websites provide additional information on identifying, controlling and better understanding *Phragmites*.

Ecology and Management of Invasive Plants
http://www.invasiveplants.net/phragmites/morphology.htm

Invasive Plant Atlas of the United States
http://www.invasiveplantatlas.org/

Plant Conservation Alliance, Weeds Gone Wild
http://www.nps.gov/plants/alien/fact/phau1.htm

Wisconsin Wetlands Association
http://www.wisconsinwetlands.org/phragmites.htm