DRAFT: WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
DRAFT July 2013

Scientific name:	*Ficaria verna* Huds.
Synonyms:	Ranunculus ficaria L., *Ranunculus ficaria L. ssp. bulbifera (Marsden-Jones) Lawalree, Ranunculus ficaria L. ssp. calthifolius (Reichenbach) Arcangeli, Ranunculus ficaria L. var. bulbifera Marsden-Jones, Ficaria verna Huds.*
Common name:	Lesser celandine, fig buttercup, pilewort, figroot buttercup, figwort, bulbous buttercup, and small crowfoot
Family:	Ranunculaceae
Legal Status:	Proposed Class B noxious weed

Images from left to right: 1. Plant growth with flowers, image: Catherine Herms, The Ohio State University, Bugwood.org; 2.Tuberous roots of *Ficaria verna*, image: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; 3. Close up of flower, image: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; 4. Bulbils in leaf axils, image: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Description and Variation:

As Post et al. (2009) outline, North American treatments of *Ficaria verna* did not include subspecies or only included one while European treatments include five subspecies: subsp. *ficariiformis*, subsp. *chrysocephalus*, subsp. *calthifolius*, subsp. *ficaria*, subsp. *bulbilifer*. Through a review of herbarium specimens, Post et al. (2009) determined that all five subspecies existed here in the United States. Sell (1994) provides descriptions of all five subspecies. Whittemore (1997) states that the species is highly variable and that the different forms intergrade extensively and varieties are often impossible to distinguish. Listing *Ficaria verna* as a Class C noxious weed includes all subspecies of *F. verna* and any cultivars of the species and subspecies.

Overall Habit:

Ficaria verna is a highly variable, glabrous perennial with tuberous roots. Plants grow up to around 30 cm tall in a mounded rosette with basal and stem leaves. Solitary yellow flowers bloom at stem tips and form clusters of achenes.

Roots:
Plants have club-shaped tubers among fibrous roots that have rounded apices and are 5-50 by 3.5-6 mm in size (Stace 1997, Sell 1994). Pale aerial bulbils, which store starch and have adventitious buds, can form in leaf axils (Axtell et al. 2010).

Stems:
Stems are 3-40 cm long, ascending or erect (Sell 1994). Whittemore (1997) notes that stems do not root at the nodes while Sell (1994) states that stems often root at the decumbent bases.

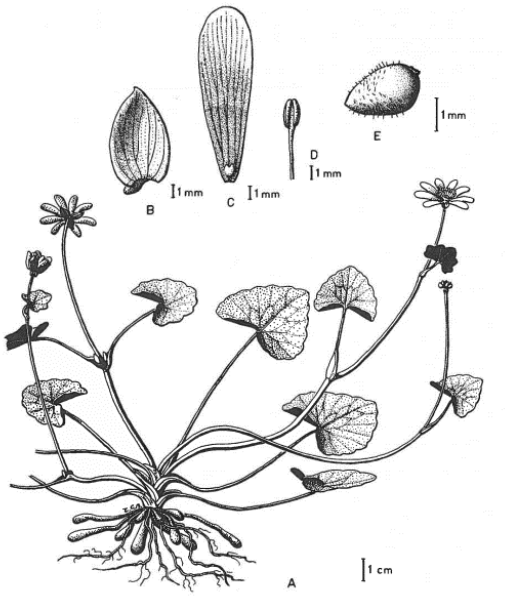
Leaves:

Image credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Plants have numerous, glabrous leaves that are medium to dark green above and often paler below with blotched or mottled coloring (Whittemore 1997, Sell 1994). Leaves are cordate to oblong to deltate in shape with entire or crenate margins and rounded or obtuse tips (Whittemore 1997). Plants have basal and stem leaves—basal leaf blades are 0.5-8 cm by 0.5-9 cm, and are on petioles up to 28 cm long while stem leaves are similar but smaller and on shorter petioles (Sell 1994). Upper stem leaves can be subopposite in arrangement (Brayshaw 1989). Petioles are soft, with dilated sheathing bases. Petioles of the lowest leaves very broad, and closely packed to form a small solid stock (Brayshaw 1989, Taylor and Markham 1978).

Flowers:
Flowers are typically solitary on stem tips. Flowers are shallowly cup-shaped, 2-3 cm (3/4 – 1 ¼ inch) in diameter, while noted in some sources as up to 6 cm in diameter (Brickell and Cathey 2004, Sell 1994). Each flower has 3 (sometimes 4) pale green, spreading sepals, 4-9 mm by 3-6 mm (Whittemore 1997). Petals vary in number, typically 7-13, and are 10-15 mm by 3-7 mm in size (Whittmore 1997, Sell 1994). Petals are pale to golden yellow, rarely orange, have a slightly darker center and fade to white with age (Brickell and Cathey 2004, Sell 1994). Flowers have numerous stamens and carpels, ranging from around 5 to 72 (Taylor and Markham 1978).

Fruits and Seeds:
Fruit is a globular shaped cluster of achenes. Each achene contains single seed and is 2.6-2.8 mm by 1.8-2 mm, shortly pubescent and does not have a beak (Whittemore 1997).



Images: Left, illustration of *Ficaria verna* with flower part details and achene (E), illustration by T. C. Brayshaw (1989); Right, potted *Ficaria verna* 'Brazen Hussy' for sale, image by Laurel Baldwin, Whatcom County Noxious Weed Control Board.

Cultivars:

A number of named cultivars and some forms have been selected for *Ficaria verna*. Brickell and Cathey (2004) list:

- f. albus: has pale yellow flowers fading to white and dark bronze marked leaves
- f. aurantiacus: syn. 'Cupreus', has silvery leaves with a bronze central mark, deep coppery orange flowers that are darker on the underside
- 'Bowles Double': has double flowers with green centers, turning pale yellow
- 'Brazen Hussy': has glossy, deep brown leaves and shining, golden yellow flowers with a bronze underside. Its seedlings often have bronze leaves.
- 'Collarette': leaves have bronze central bands and double yellow flowers with anemone-form centers.
- 'Double Bronze' has double yellow flowers with bronze undersides.
- 'Double Mud': syn. 'Double Cream', has double cream flowers with gray-tinted undersides.
- 'Salmon's White': has pale green leaves with bronze marks and cream flowers that are tinted blue-purple on its undersides.

Many other cultivars are also available in the nursery trade include 'Brambling', 'Coffee Cream', 'Crashaw Cream', 'Dusky Maiden', 'Flore-pleno', 'Limelight', 'Ragamuffin', 'Randall's White' and 'Yaffle'.

Look-alikes:

The native yellow marsh marigold, *Caltha palustris*, also in the Ranunculaceae family, may be confused with *Ficaria verna*. *Caltha palustris* is a perennial plant with dark green leaves that are on long petioles. The root system of *Caltha palustris* is short, stout and fleshy, while *Ficaria verna* has many tubers (Axtell et al. 2010). Also, *C. palustris* does not produce bulbils. *Ficaria verna* flowers have distinct sepals and petals while *C. palustris* only has petal-like sepals (see images below). *Caltha palustris* is primarily found

along the coast in moist areas, does not form a continuous carpet of growth, and also blooms later in the season, from July to August than *F. verna* (Swearingen 2010).

Images: Left, *Caltha palustris* showing petal-like sepals, image© 2010, G. D. Carr; Right, *Ficaria verna* flower with four shorter sepals and longer petals, image © 2011, Ben Legler.

Images: Left, *Caltha palustris* flower with its typically 5 petal-like sepals, image © 2010, G. D. Carr; Right, *Ficaria verna* flower, here with 8 petals, image Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

<u>Habitat</u>:

Ficaria verna grows in a variety of habitats from moist, shaded woodlands, wetlands, streambanks and riverbanks to lawns, landscaped areas and roadsides (Axtell et al. 2010, Post et al. 2009). Collections of *F. verna* have also been made in dry woodlands (Post et al. 2009).

<u>Geographic Distribution</u>:

<u>Native Distribution:</u>

The USDA (ARS) GRIN database (2013) lists *Ficaria verna* as native to:

- Northern Africa (Algeria, Libya, Morocco, Tunisia)
- Temperate Asia (Cyprus, Israel, Jordan, Lebanon, Syria, Turkey, Georgia, Russian Federation)

- Europe (Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Czech Republic, Slovakia, Germany, Hungary, Poland, Switzerland, Belarus, Estonia Latvia, Lithuania, Ukraine, Albania, Bulgaria, Former Yugoslavia, Greece, Italy, Romania, France, Portugal, and Spain)

Distribution in North America:

Ficaria verna was introduced to the United States as an ornamental plant, with its first herbarium collection in 1867 (Philadelphia County, Pennsylvania, *Burke s.n.,* PH, in Post et al. 2009). The GRIN database (USDA ARS 2013) lists *F. verna* growing in North America, specifically:

- Canada (British Columbia, Newfoundland, Ontario, Quebec)
- United States (Connecticut, District of Columbia, Illinois, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia, Washington, and West Virginia (USDA NRCS 2013, Axtell et al. 2010, Whittemore 1997)

In Oregon, small populations of *Ficaria verna* are documented in the larger Willamette Valley communities of Portland, Salem, and Eugene-Springfield. The largest population found in Oregon so far is a 5 acre infestation in Wilsonville (Oregon Dept. of Agriculture n.d.).

Ficaria verna has the following noxious weed and quarantine listings:

- Class B noxious weed and quarantine list in Oregon
- Listed as an invasive plant and is banned in Connecticut
- Listed as a prohibited plant in Massachusetts

(USDA NRCS 2013, Oregon Dept. of Agriculture n.d.).

Ficaria verna is also listed as an invasive species of concern by the Maryland Invasive Species Council, as a highly invasive species by Virginia's Department of Conservation and Recreation, and categorized as invasive by the Massachusetts Invasive Plants Advisory Group (Baldwin 2012).

History and Distribution in Washington:

Map, Herbarium collections of *Ficaria verna* in Washington State, image Consortium of PNW Herbaria 2013.

The earliest herbarium record at the University of Washington Burke Herbarium (WTU) is from 1999, collected from a forested wetland in King County (WTU 338899). Other herbarium records document additional Washington state sites in King County, Whatcom County, and Snohomish County (WTU specimens 384221, 377592, 387411, 366219, 379203, 350343, 350291, 352999, 374742, and 342739). *Ficaria verna* was added to Washington State Noxious Weed Control Board's monitor list in 2005 to gather more information about population locations and spread.

Whatcom County has populations of *Ficaria verna* totaling around 20 acres combined, with most all urban creeks and parks having populations (Laurel Baldwin pers. comm.). Laurel Baldwin, Coordinator of the Whatcom County Noxious Weed Control Board and monitor list sponsor for *Ficaria verna*, collected the following distribution information in Whatcom County (Baldwin 2012):

- Bellingham area lawns and yards (estimate 20-30 currently known)
- Six City of Bellingham Parks, including a baseball outfield

- Former nursery lot totaling over 4 acres
- 3 full acre riverbank population found in 2013
- Stimson Nature Reserve on Lake Whatcom
- One park in the City of Blaine
- Several locations along Padden Creek, Whatcom Creek, and Lincoln Creek
- Several locations along the Interurban Trail in Fairhaven
- Three locations on the Hertz Trail on Lake Whatcom
- Lake Padden Trail (under dense coniferous canopy)
- An estimated 100m² patch near Squalicum High School

In King County, horticulture staff at the University of Washington Botanic Gardens have been trying to eradicate *Ficaria verna* using herbicide and hand pulling for over seven years at the Washington Park Arboretum. Small populations of *F. verna* occur in over 13 acres of the Arboretum (UWBG 2013). There are a number of small populations in King County, including infestations in Ravenna Park and the Bellevue Botanic Garden (UWBG 2013). Arthur Lee Jacobson (2008) describes two of the subspecies in his book 'Wild Plants of Greater Seattle': subsp. *bulbilifer* and subsp. *chrysocephalus*. He states that subspecies *chrysocephalus* is rare in the greater Seattle area while subspecies *bulbilifer* readily escapes cultivation and is weedy. Ornamental plantings of *F. verna* may be present in other areas of the state. In Klickitat County there is at least one established planting that has survived a number of years. While it has not spread beyond the yard it is planted in, it is increasing its spread within the yard (Marty Hudson pers. comm.).

Biology:

Growth and Development:

Ficaria verna emerges before most other spring ephemeral plants, supposedly stimulated by increased light availability within leafless canopies of forested habitats (Cipollini and Schradin 2011, Hammerschlag et al. 2002). In the United Kingdom, the resting buds on the root tubers turn green and begin to elongate about December and the foliage leaves of the basal rosette begin to unfold in January (Grime *et al.,* 1988 in Bond et al. 2007).

Depending on the climate, flowers bloom in early spring from April to May (Whittemore 1997), though they have been noted to bloom in the Pacific Northwest as early as March (Oregon Dept. of Agriculture n.d.). The flowers are self or insect pollinated, however, in the case of one of the subspecies, b*ulbifera*, much of its pollen is non-viable (Bond et al. 2007). After flowering, some subspecies produce bulbils in the leaf axils (Sell 1994). After fruiting, leaves and stems begin to die back and are mostly gone by June to July (Brickell and Cathey 2004).

Images of *Ficaria verna* by Laurel Baldwin, Whatcom County Noxious Weed Control Board. Left, infestation in February prior to bloom; Center, infestation in bloom in April; Right, same area in July after plants have died back.

Reproduction:
Of *Ficaria verna*'s five subspecies, subsp. *bulbilifer* and *ficariiformis* produce bulbils and subsp. *calthifolius*, *ficaria*, and *chrysocephalus* do not (Sell 1994). *Ficaria verna* subspecies that produce bulbils spread primarily by vegetative means, by tubers and bulbils that can readily grow into new plants once separated from the parent plant (Swearingen 2010). In a study by Verheyen and Hermy (2004), 60% of *F. verna* bulbils sown in outdoor plots germinated while 80% germinated in container plantings. In the study, bulbils germination was not affected by vegetation presence. Tubers and bulbils are easily dislodged and spread by mowing, the movement of soil and plant parts, for example the digging by people and animals, as well as by flooding events (Swearingen 2010, Baldwin n.d.).

Plants can also produce viable seed, though *Ficaria verna* subsp. *bulbilifer* reproduces primarily by tubers and bulbils and produces mostly non-viable seeds (Axtell et al. 2010). Seeds produced by *F. verna* need an after-ripening period to become viable (Axtell et al. 2010). When seeds germinate, *F. verna* is unusual for a dicot in having seedlings with a single cotyledon, as the other one is suppressed (Bond et al. 2007).

Control:
Ficaria verna is a difficult plant to control since it can spread so successfully by vegetative means, and with the limited time the plant have above ground growth, timing control efforts can be a challenge. Soil and plant parts need to be properly disposed of as bulbils and tubers can be accidentally dispersed during control efforts, causing new infestations (Baldwin n.d.). Persistent monitoring and follow up control work will be needed to successfully control populations (Baldwin, n.d.).

Prevent the introduction of *Ficaria verna* by not purchasing or planting *F. verna* and its cultivars. Instead, select non-invasive and native plants to purchase and plant in your landscape. There are many native perennials and non-invasive ornamental plants that are available for sale that would be attractive alternatives to *F. verna*.

Mechanical Methods:
Small infestations can be controlled by hand digging (Baldwin, n.d.). Make sure to remove all root tubers and bulbils from the soil as any remaining parts can resprout into new plants (Baldwin n.d., Swearingen 2010). Due to the high density of tubers and bulbils produced from plants and the amount of disturbance to the soil from their removal, this control method is best for small infestations (Swearingen 2010). Carefully bag, seal and dispose of all plant parts in a landfill or approved disposal location (Swearingen 2010).

Mowing is not recommended for *Ficaria verna* control as it may promote the spread of bulbils and seeds (Reisch and Scheitler 2009). Mowing is suspected to be responsible for dispersing bulbils and starting new infestations around Whatcom County (Laurel Baldwin pers. comm.).

Images: Left, sprouting bulbils on surface of soil, image Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; Right, *Ficaria verna* growing in a lawn, image Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Cultural Methods:

UWBG (2013) reports that mulching over *Ficaria verna* with wood chips is effective only if the layer is about six inches deep. It can survive some smothering though, as in one case *F. verna* emerged through four inches of crushed rock in a driveway.

Biological Control:

There are no known biological controls for *Ficaria verna*.

Chemical methods:

The use of a systemic herbicide may be an effective control method for a large infestation because it kills the entire plant including the roots and minimizes soil disturbance (Swearingen 2010). In order to have the greatest negative impact on *Ficaria verna* and the least impact to desirable plants, herbicide should be applied in late winter-early to spring, before most native herbaceous plants have started to grow (Swearingen 2010) and before *Ficaria verna* flowers (Laurel Baldwin pers. comm.). Glyphosate, a non-selective herbicide has been tested and recommended for controlling *Ficaria verna*.

In Maryland, the Montgomery County Department of Parks (2009) recommends using products with glyphosate, such as Rodeo or Aqua Neat, at 1.5% with a 0.5% non-ionic surfactant. Since the treatment window is so short, they recommend starting as soon as plants begin to emerge in the late winter and continue control until the impact on native species can no longer be minimized, typically February 1-April 15. While the Montgomery County Department of Parks (2009) notes that treatment may be less effective once plants have started to bloom, Swearingen (2010) recommends applying herbicide up until about half of the plants are in flower.

Testing the effects of different herbicide concentrations of glyphosate (using the aquatic formulation Rodeo) at Rock Creek Park in Washington D.C., found that an early spring treatment using 1.5% Rodeo worked best (Hammerschlag et al. 2002). Lower concentrations tested, 0.5% and 0.25%, were considerably less effective at controlling *Ficaria verna* and are not recommended. Tests were also conducted using 0.75% Rodeo and did show good control but *F. verna* was able to reestablish more quickly at the 0.75% rate than from the 1.5% Rodeo treatment. Hammerschlag et al. (2002)

recommended two consecutive years of treatment of 1.5% Rodeo early in the season, before native species are growing, and then monitor and spot treat in the years following.

The company Invasive Plant Control has conducted control work on *Ficaria verna* at Rock Creek Park and other areas in the eastern United States. They use a 1% solution of glyphosate with an aquatic label (Rodeo) and treat in mid-February or in early March in the Mid Atlantic region. When possible, Invasive Plant Control treats and monitors an infestation for at least 5 years. Areas that were invaded should be monitored even longer if possible, to treat any outliers and monitors sites that may have nearby infestations (Steven Manning pers. comm.).

Control with glyphosate will require follow up treatments. At the Washington Park Arboretum, only a few of the patches within larger infestations sprayed with 1.5% glyphosate have been controlled and are considered eradicated, while in several spots *Ficaria verna* reappears after an absence of a year or more (UWBG 2013). In Whatcom County, a contractor has had success using 2% glyphosate prior to bloom, repeated over three years in controlling but not eradication populations (UWBG 2013).

Other herbicides that have been tried in Whatcom County were triclopyr and sulfometuron (Oust) (Laurel Baldwin 2012). Triclopyr was not effective and Oust had good results (Tim Miller pers.comm.) (Laurel Baldwin 2012).

Images: Left, herbicide treatment of *Ficaria verna* by Invasive Plant Control, image, Steve Manning, IPC; Right, Plot from experimental treatment of *F. verna* with glyphosate in Rock Creek Park (image Hammerschlag et al. 2002).

<u>Economic Importance:</u>

<u>Detrimental:</u>
Impacts for *Ficaria verna* are mostly anecdotal but it is observed invading and naturalizing in a broad geographic range, outcompeting native plants and negatively impacting wildlife habitat.

Ficaria verna is a vigorous grower, forming large, dense monocultures of growth early in the spring in moist woodlands and some upland sites. It outcompetes many native plant species, especially those with the similar spring-flowering life cycle (Swearingen 2010, Baldwin n.d., Oregon Dept. of Agriculture n.d.). It is associated with reduced abundance and richness of native species in spring and summer field surveys (Hohman 2005 in Cipollini and Schradin 2011). *Ficaria verna*'s dense growth may prevent native

species from completing their lifecycle, which in turn can negatively impact resident wildlife populations that depend on those native species for food and habitat needs (Swearingen 2010). In the northeast it is believed to impact native spring ephemerals like bloodroot, spring beauty, twinleaf, trillium, and others (Swearingen 2010). After the plants have died back, their dense network of underground roots and tubers remain in the soil, possibly excluding the growth of other plants (Baldwin n.d.). *Ficaria verna* may also have allelopathic effects on other plant species. Cipollini and Schradin (2011) studied *F. verna*'s possible impacts on *Impatiens capensis*, a native species to the eastern U.S., and found negative impacts that may be contributed to allelopathy or a modification of soil conditions by *F. verna*.

Plants for a Future (2013) states that all parts of the plant are poisonous but the toxins are unstable and of low toxicity, and they are easily destroyed by heat or by drying. Fresh leaves contain protoanemonin, which can cause sickness in livestock but rarely causes death (Taylor and Markham 1978 in Axtell et al. 2010). It is also noted that the sap can cause irritation to the skin (Plants for a Future, 2013).

Ficaria verna can also be a problem to private landowners and gardeners as the plant readily escapes from plants and can quickly spread into other plantings and into lawns (Oregon Dept. of Agriculture n.d.). Contaminated garden loam applied to new lawns can create problems in a few short years (Oregon Dept. of Agriculture n.d.).

Beneficial:
Ficaria verna and its cultivars are used in ornamental plantings. Cultivars are available with various flower and leaf colors that bloom in late winter to early spring, before many other plants are blooming.

Rationale for Listing:
Ficaria verna is invading and naturalizing over a broad geographic range in the United States and is outcompeting and excluding native plants. It emerges before most other spring ephemeral plants which can give it a competitive advantage over our native understory plant communities. Because lesser celandine emerges in advance of these native species, it may establish and overtake areas quickly. *Ficaria verna* is highly invasive and difficult to control and is spreading in Washington. Control of known populations, while they are small and more manageable, is needed before this becomes a widespread problem in the state.

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