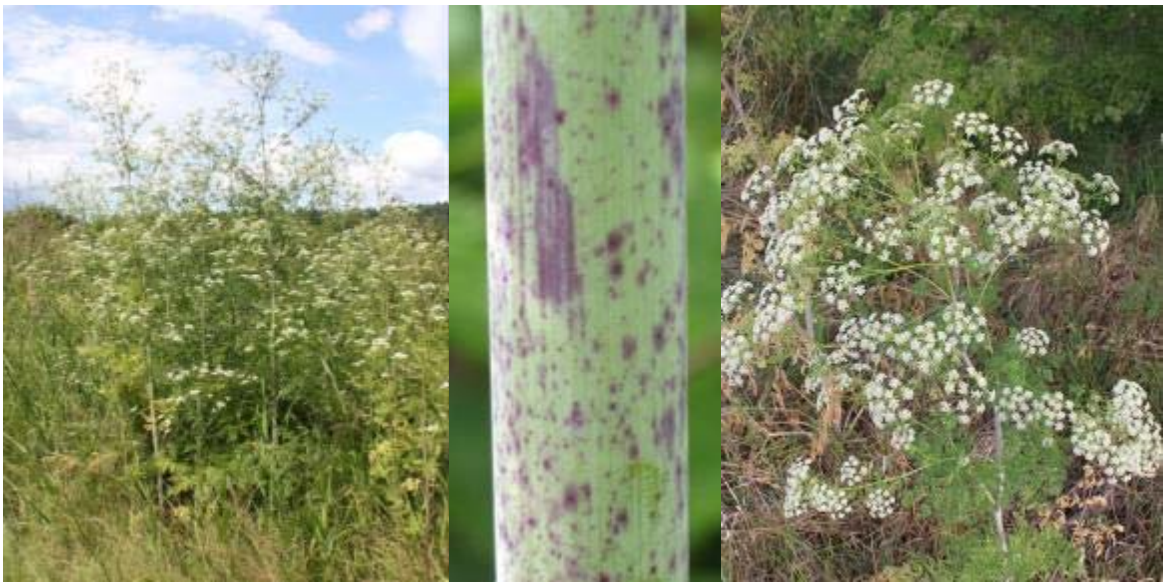
DRAFT: WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
Updated 2014

Scientific name: *Conium maculatum* L.

Common name: poison hemlock, carrot-fern, fool's parsley, spotted-hemlock, spotted-parsley,

Family: Apiaceae

Legal Status: Class C noxious weed in 1988; reclassified to Class B



Images: left, mature *Conium maculatum* plant habit; center, stem with the purple markings characteristic of *C. maculatum*; right, blooming umbels of *C. maculatum*, all images WSNWCB.

Description and Variation:

The genus *Conium* was derived from the Greek word Konas, meaning to whirl about, as ingesting the plant causes ataxia, tremors and convulsions (Vetter 2004). The species *maculatum* is Latin, meaning "spotted", or "blotched" and refers to the characteristic spots on the stems (Vetter 2004, Mitich 1998). William Shakespeare was the first to use the modern name "poison hemlock" in his story titled "Life of Henry the Fifth" (Erenler et al. 2011). *Conium maculatum* contains toxic alkaloids that can poison and cause death in humans and animals.

Overall Habit:

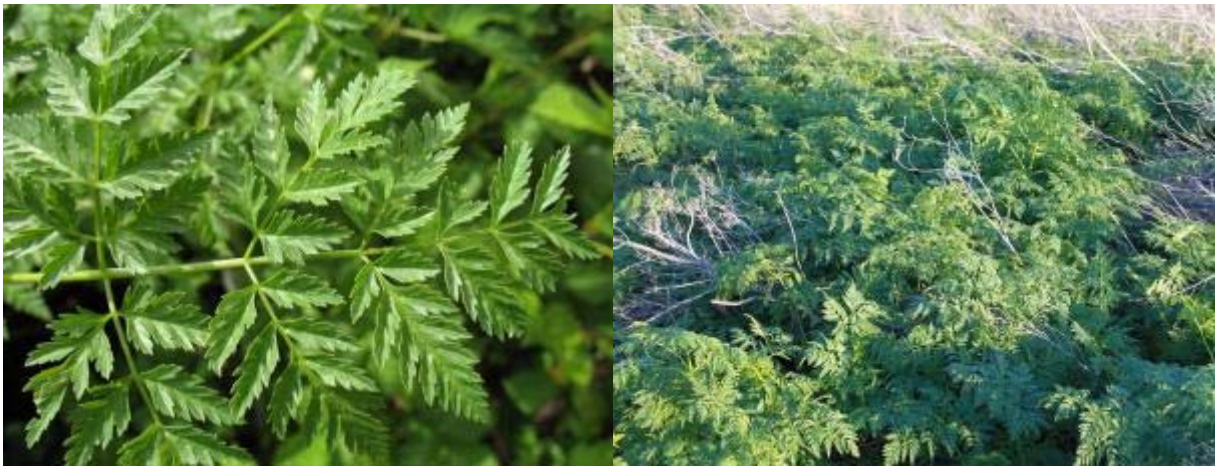
Conium maculatum is a biennial that starts as a rosette of compound leaves the first year, and develops stems that grow up to 12 feet tall the next year. Plants have smooth, purple spotted stems and petioles. Small, white flowers occur in umbels, forming small seeds with prominent ridges. Plants are often described as having a disagreeable smell, sometimes compared to mouse urine or just as 'mousy' (Burrows and Tyrl 2013).

Roots:

Conium maculatum has a solid, white taproot, similar to that of parsnip (*Pastinaca sativa*) (López et al. 1999).

Stems:
Stems grow 2.6 to 9.8 ft. tall (80 to 300 cm), and are branched near the tips (Vetter 2004). They are hollow, erect, glabrous, with fine shallow longitudinal ridges, and covered in varying degrees of purple to purplish-red spotting (López et al. 1999, Mitich 1998).

Leaves:
Leaves in the basal rosette have long-petioles, 2.75 to 9.8 inches (7 to 25 cm) long and leaf sheaths are small and narrow (Zehui and Watson 2005). Leaf blades are triangular, 2-4 times pinnately compound, 4 to 12 inches (10 to 30 cm) long by 2.4 to 11 inches (6 to 28 cm) wide, finely divided, with ultimate segments oblong or ovate-lanceolate, 0.4 to 1.2 inches (1 to 3 cm) long (Zehui and Watson 2005, Burrows and Tyrl 2013). Stem leaves are alternately arranged and gradually reduce in size going up the stem and sometimes nearly stalkless (without petioles) (Zehui and Watson 2005, Vetter 2004). The leaves have a strong odor when crushed.


Images: left, close up of compound leaf; right, dense growth of *C. maculatum* rosettes, images WSNWCB.


Images: left, compound umbel in bloom, image WSNWCB; right, *C. maculatum* seeds, image Steve Hurst, USDA NRCS PLANTS Database, Bugwood.org.

Flowers:

Flowers are in open, compound umbels, 1.6 to 2.8 inches (4 to 7 cm) across (Zehui and Watson 2005). Umbels are composed of 10 to 20 loose umbellules (López et al. 1999). Peduncles are 0.8 to 2.8 inches (2 to 7 cm) long, and there are 4 to 8 flexed, lance-shaped bracts at the base of the main umbel (Vetter 2004). Flowers have 5 white petals with inflexed points. Stamens have white anthers that are longer than the petals (Vetter 2004).

Fruits and Seeds:

The fruit is an oval to circular schizocarp (a double achene), and is composed of two grayish-brown seeds (indehiscent mericarps) with five prominent wavy, longitudinal ridges (Vetter 2004, Mitich 1998). Fruits are 2 to 4 mm long by 1.5 to 2.5mm wide (López et al. 1999).

Look-alikes:

Other plants in the Apiaceae family can appear similar to *Conium maculatum*. The following table provides some key traits to help distinguish *C. maculatum* and these other species.

(Sheh and Watson 2005, DiTomaso et al. 2013, Douglas et al. 1998)

	Size and stems	Leaves	Flowers	Fruits
Poison hemlock, *Conium maculatum* Class B noxious weed	Up to 8-10 feet; stems hairless, hollow, have purple blotches; plants have strong odor, especially when crushed	Compound, fern-like, finely divided; hairless; overall leaf blades up to 12 inches long	Small, white flowers in open, compound umbels that are 4 to 8 inches in diameter	Grayish brown with five prominent, wavy longitudinal ridges
Wild carrot (Queen Anne's lace), *Daucus carrota* Class C noxious weed	To 4 feet tall; stems ridged, covered with bristly hairs; no purple blotches on stems	Distinctly hairy, oblong, pinnate/pinnatisect, ultimate segments linear to lanceolate; 1.5 to 5 inches long	Flowers in compound umbels, 2-4 inches in diameter; bracts under umbels usually pinnate (rarely entire or 2-3 lobed); flower petals white, 5, tipped with two unequal lobes; sometimes the central flower of the umbel is dark red to purplish	Compound umbels become convex at maturity; fruits have five bristly, longitudinal ribs and four winged ribs lined with barb-tipped bristles
Wild chervil, *Anthriscus sylvestris* Class B noxious weed	Flowering stems 1 to 3.3+ feet tall; stems are hollow and ridged/furrowed; hairless to sparsely soft-hairy	triangular blade to 1 foot long, 2–3 pinnately compound; petiole, axis and branches of leaves grooved or furrowed on the upper surface; hairs present above, sparsely below or	At the apex of most pedicels there are small tooth-like hairs	Lance-shaped fruit, dark brown or black, shining, smooth or sometimes with scattered bumps, with somewhat ribbed beak 1/4 to 1/3 the

		without hairs; leaf blades inflated toward base		length of fruit, persistent stigmas
Burr chervil, *Anthriscus caucalis*	1.3 to 3 feet (40 to 90 cm) tall	Coarsely-hairy leaves		Egg-shaped fruit are covered with hooked prickles and have an unarmed short stout beak
Water hemlock, *Cicuta douglasii,* native, toxic	Perennial, 1.6 to 6.6 feet tall; hairless; with tuberous, thickened, chambered base;	1-3 times ternate-pinnate compound; leaflets are 3 to 4 times as long as wide; sharply toothed margins, with lateral leaf veins terminating at base of teeth	Compound umbels, compact clusters of flowers	Fruit glabrous, orbicular, 2-4 mm long, thickened ribs wider than the often darkened intervals.
Giant hogweed, *Heracleum mantegazzianum* Class A noxious weed	Capable reaching 15-20 feet tall; stems hollow, with bristle hairs and purple bumpy blotches, 2 to 4 inches in diameter	Large compound leaves, leaf edges deeply cut (incised); up to 5 feet in diameter	Broad, flat-topped compound umbel, up to 2.5 feet in diameter	Flattened, elliptical fruit with brown resin canals

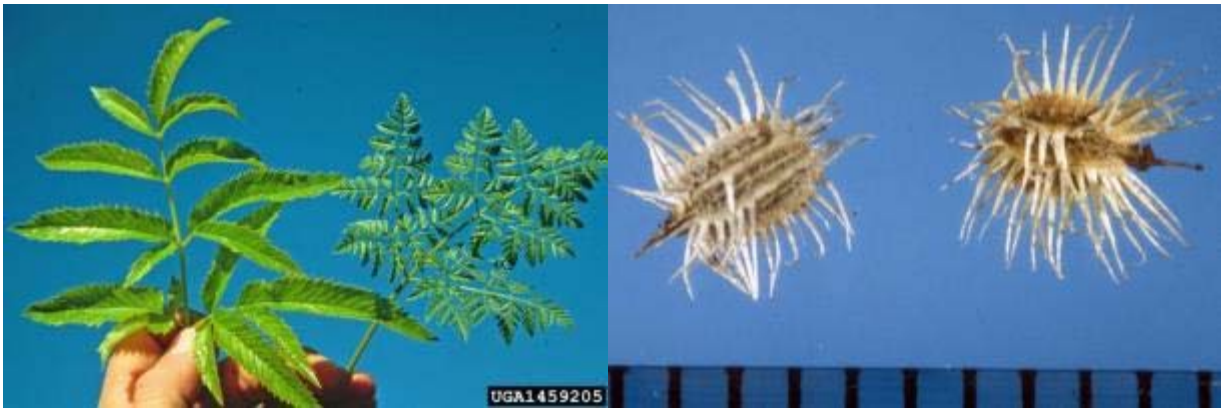


Image: left, comparison of water hemlock leaf (left) and poison hemlock leaf (right), image by Steve Dewey, Utah State University, Bugwood.org; right, wild carrot fruits, image by Ken Chamberlain, The Ohio State University, Bugwood.org.

Habitat:

Conium maculatum grows in disturbed habitats, including roadsides, ditches, and abandoned construction sites. It is also found as a weed in pastures, meadows, cultivated fields, stream and riverbanks, and woodlands (Vetter 2004, López et al. 1999, Mitich 1998). *Conium maculatum* can also invade

undisturbed, native plant communities (DiTomaso et al. 2013). When growing in pastures and crops, it can inadvertently be included in hays and silages (López et al. 1999). Plants prefer moist soils but can also survive on drier sites (DiTomaso et al. 2013, López et al. 1999).

Geographic Distribution:

Native Distribution:
According to USDA ARS GRIN Database (2014), *Conium maculatum* is native to parts of Europe, Asia and Africa, specifically:

- Europe: Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czech Republic, Germany, Hungary, Netherlands, Poland, Slovakia, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, Albania, Bosnia and Herzegovina, Bulgaria, Greece, Italy, Macedonia, Montenegro, Romania, Serbia, Slovenia, France, Portugal, Spain
- Asia: Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation (Ciscaucasia, Dagestan, Western Siberia), Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, India (Jammu and Kashmir), Pakistan
- Africa: Algeria, Morocco, Tunisia, Ethiopia

Distribution in North America:
It is thought that *Conium maculatum* was introduced to North America as an ornamental plant during the 1800s (DiTomaso et al. 2013). It is now documented in much of the United States, being widely distributed in the western U. S. (EDDMapS 2014, DiTomaso et al. 2013).

Invasive and noxious weed listings:
Conium maculatum is listed as invasive and as a noxious weed in many states. Legal listings for poison hemlock in the U.S. include:

- California
- Colorado C list noxious weed
- Iowa: secondary noxious weed
- Idaho
- Illinois
- Kentucky
- New Mexico: Class B noxious weed
- Nevada
- Ohio: prohibited noxious weed
- Oregon: Class B noxious weed
- South Dakota
- Tennessee
- Utah
- Washington: Class B noxious weed
- West Virginia
- Wisconsin
- Wyoming

(EDDMapS 2014, USDA NRCS 2014).

History and Distribution in Washington:

The first herbarium specimens in Washington were collected in 1926 in Walla Walla, Pierce and Clark counties (WTU 34882, 34847, 353JWT). Specimen labels list the plants being common on waste ground. Soon after, specimens were collected in a number of other Washington state counties on both sides of the Cascade Mountains, and it is now widely distributed throughout the state in a wide variety of habitats (WSDA 2011).

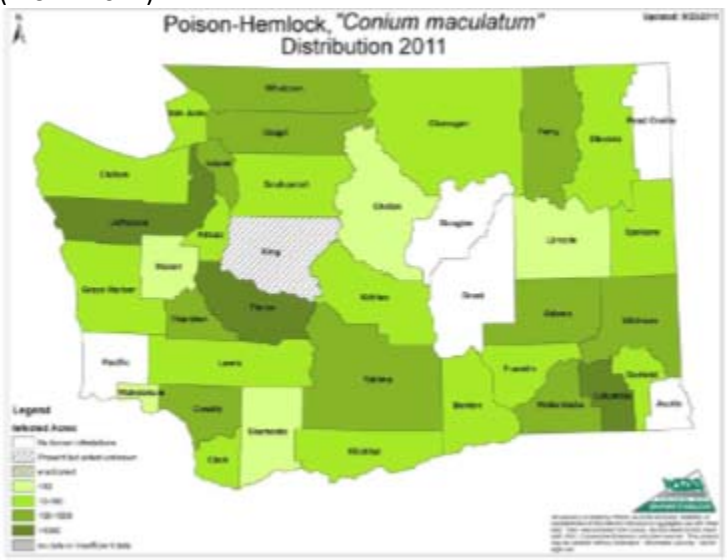
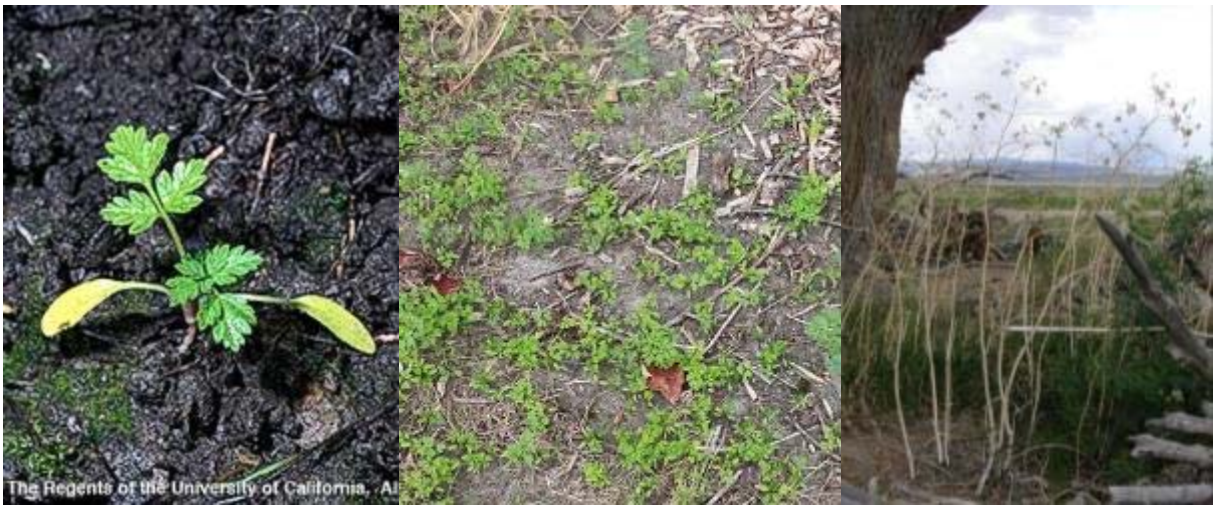


Image: WSDA distribution map of *Conium maculatum* in Washington State in 2011.

Biology:

Growth and Development:

In temperate climates, *Conium maculatum* begins growing mid-winter, often when the growth of other plants is low or has not started (López et al. 1999). *Conium maculatum*'s cotyledons are tapered at the base, elliptical, and have prominent veins on their undersides (DiTomaso et al. 2013). The first true leaves are smooth and triangular, with many deeply lobed leaflets arranged along both sides the main leaf stalk (DiTomaso et al. 2013). Plants typically form a basal rosette the first year (DiTomaso et al. 2013). In the spring of the following year, rosettes develop upright stems that terminate in inflorescences (DiTomaso et al. 2013). Flowers bloom during the spring and summer, from May to August in Washington (WTU 2014). Plant typically die after setting seed, leaving upright dead stems that can remain into the winter (DiTomaso et al. 2013).



Images: left, *Conium maculatum* seedling with cotyledons, image Joseph M. DiTomaso, University of California-Davis, Bugwood.org; center, dense distribution of *C. maculatum* seedlings in a native plant restoration site on disturbed soil, image WSNWCB; right, dead stems of *C. maculatum* after going to seed, image Bonnie Million, National Park Service, Bugwood.org.

Reproduction:
Conium maculatum spreads by seed. A single plant may produce as much as 38,000 seeds (Whittet 1968), which usually fall near the parent plant, resulting in a clumped distribution, but also can be spread by water, rodents, and birds (DiTomaso et al. 2013, Holm et al. 1997; Panter et al. 1988 in Mitich 1998). Seeds disperse over an extended period of time, typically July to February (DiTomaso et al. 2013). Up to 85% of the seeds mature on the plant by mid-July, prior to dispersal (DiTomaso et al. 2013). Once dispersed, these non-dormant seeds can readily germinate if conditions are favorable (DiTomaso et al. 2013, Baskin and Baskin 1990). The remaining seeds are dispersed in a state of dormancy. Seeds remain viable for 2 to 3 years (DiTomaso et al. 2013).

Economic Importance:

Detrimental:
Conium maculatum is an invasive plant that is best known and studied for its toxic properties. Due to its high seed production and spread, plants can crowd out native plant communities, desirable forage species and invade and contaminate perennial crops and harvested seed (DiTomaso et al. 2013). It can pose a significant problem for the first cutting in alfalfa, but subsequent regrowth of alfalfa can suppress the regrowth of *C. maculatum* (DiTomaso et al. 2013). *Conium maculatum* can also be a toxic contaminate for animal feed, though dry plant material can be less toxic due to the volatility of the alkaloids found in the plant (Galey et al. 1992). Though the alkaloid content shifts from γ-coniceine to coniine, which is less toxic, as the plant dries, the conversion rate could be slow. So, in dry forage it may retain its toxicity, at least in fresh hay (Galey et al. 1992).

Toxicity:
Conium maculatum is toxic to both humans and animals. *Conium maculatum* contains eight piperidinic alkaloids (Biberci et al. 2002). Two of these alkaloids are γ-coniceine and coniine, account for most of the plant's acute and chronic toxicity, with γ-coniciene being about 8 times more toxic than coniine (The Merck Index 1996 in Lopez et al. 1999). The other six alkaloids contained in *C. maculatum* are conhydrione, conhydrine, *N*-methylconiine, pseudoconhydrin, *N*-methylconhydrine, and 2-

methylpipreine (Biberci et al. 2002). Acute poisoning of *C. maculatum* results in death through a neuromuscular blockade affecting the respiratory muscles (Biberci et al. 2002). Chronic poisoning with C. maculatum causes malformations of the fetus in pregnant animals such as palatoschisis, arthrogryposis, scoliosis, and torticollis (Keeler 1974, Panter et al. 1988, Frank and Reed 1990 in Biberci et al. 2002).

The relative concentrations of alkaloids in *C. maculatum* can change with the stage of plant development, environmental conditions, season, and time of day (Panter et al. 1988 in Mitich 1998). For example, when plants are grown in hot, dry regions, higher concentrations of alkaloids are found in the fruits and seeds (Holm et al. 1997; Parsons 1973 in Mitich 1998). And in another example, concentrations of alkaloids in green, maturing fruits are at their highest and then lower when nearing maturity (López et al. 1999).

Please refer to the review written by Vetter (2004) that summarizes information on concentrations of alkaloids content in plant parts.

Humans:
There are no antidotes to *Conium maculatum* poisoning. Early and proper diagnosis is vital for patients with *C. maculatum* poisoning. The treatment is symptomatic, requiring supportive care and ventilation support (West et al. 2009). Accidental ingestion of the plant could result in central nervous system depression, respiratory failure and even death (Erenler et al. 2011). Mitich (1998) lists *C. maculatum* poisonings occurring with people mistakenly eating the plant for parsley, parsnips, or the seeds for anise. Children have been fatally poisoned by blowing through the hollow stems (Everist 1974 in Mitich 1998). The most famous death from *C. maculatum* is the death of Socrates in 399 BC, who was executed by having to drink a cocktail of extract from *C*. *maculatum* (Dayan 2009).

Erenler et al. (2011) explains that in high doses, the toxic alkaloids in *C. maculatum* produce a stimulus of the skeletal muscles and a subsequent neuromuscular blockage through the action on nicotinic receptors. When respiratory muscles become paralyzed due to phrenic nerve paralysis, respiratory failure follows and then death occurs (Lopez et al. 1999). Symptoms that can occur in the first 15 to 60 minutes may be nausea, vomiting, salivation, bronchorrhoea, hypertension, tachycardia, agitation, ataxia, confusion and muscle fasciculations (Erenler et al. 2011). Delayed symptoms can also occur in large ingestions, including diarrhea, aponea, bradycardia, hypotension, weakness, muscle paralysis, and lethargy (Salomon 2006 in Erenler et al. 2011).

There is a small amount of documentation in the literature on human poisonings, and of these, pediatric cases are rare (West et al. 2009). One case, described by Biberci et al. (2002), is of a 19 year old girl in Turkey who had acute intoxication due to *C. maculatum* ingestion. Her symptoms included dizziness, headache, double vision, muscular weakness in extremities, and chills with rapid progression to pulmonary arrest. After 25 hours of ventilatory support, the patient was in good condition. In Washington State in 2010, a man in Snohomish County accidentally ingested *C. maculatum* and with supportive hospital care was able to recover (The Associated Press 2010).

While supportive hospital care can save people who have accidentally consumed *C. maculatum*, there are also recorded deaths from its consumption. West et al. (2009) document a 1995 case series from Australia describing poison hemlock ingestion and deaths in 2 adults and 1 child. In Washington State in 2010, there was a death from accidental *C. maculatum* ingestion in Pierce County. The woman in Pierce County mistakenly put the C. maculatum in a salad she ate (The Associated Press 2010).

Alkaloids may also be passed along to humans via animals that have fed on *Conium maculatum*. There is a report from Italy of people being poisoned through the eating of songbirds that were presumed to have fed on *C. maculatum* buds (West et al. 2009). All patients exhibiting symptoms of ingesting *C. maculatum* were found to have toxic alkaloids in their urine, and 4 of the 17 patients found over an 18 year period died (West et al. 2009). Some of *C. maculatum*'s alkaloid compounds have the ability to pass into animals' milk when they feed on sub-lethal amounts, which can adversely alter the flavor (taste and smell) and safety of milk used for human consumption (DiTomaso et al. 2013).

Besides the poisoning of *C. maculatum* through ingestion, sensitive people may experience contact dermatitis when handling this plant (DiTomaso et al. 2013).

Animals: All information on animal poisoning is from López et al. (1999) unless otherwise noted. Animals tend to avoid *Conium maculatum* and typically feed on the plant only when forage options are limited or by accidentally ingesting it when green chop, silage, or hay is contaminated (DiTomaso et al. 2013). *Conium maculatum* begins growing early in the spring, at a time when y-coniceine predominates (Panter et al. 1988), and this may lead to animals feeding on the plants (Mitich 1998). Losses from *C. maculatum* poisoning can be direct--death, performance and reproduction losses (Panter et al. 2002)—and indirect—from trying to prevent poisoning or costs incident to poisoning (Vetter 2004). The economic losses can only be estimated, as most deaths from plants go undiagnosed and unreported (Vetter 2004).

López et al. (1999) provides an in-depth review on the poisoning, acute and chronic, of different species of livestock. The rate of onset of symptoms varies depending on the species. They report that acute toxicity or poisoning results in the alkaloids producing a neuromuscular blockage conducive to death when the respiratory muscles are affected. The signs of acute poisoning with *C. maculatum*, including muscular weakness, incoordination, excessive salivation, and cold limbs, are similar in different animal species. These symptoms are followed by the initial stimulus of the central nervous system, then by depression, fast and shallow respiration turning slow and laborious, dilated pupils, frequent micturition and defecation, coma and death caused by respiratory paralysis (Panter et al. 1985, 1988a,b; Galey et al., 1992).

The chronic toxicity of *C. maculatum*--animals eating the plant but not in lethal amounts--affects only pregnant animals. Ingestion of *C. maculatum* during pregnancy causes malformations of the fetus, mainly palatoschisis and multiple congenital contractures. Animals that ingest non-lethal amounts of *C. maculatum* may recover from symptoms on their own, though further exposure should be avoided. It has been noted that animals that ate *C. maculatum* in the past, tend to return to feed on it again, even after suffering symptoms of poisoning.

Control:

It is important to protect yourself when handling and working around *Conium maculatum.* Wear gloves and protective clothing to prevent accidental exposure to the plant's toxic juices. Beside toxicity and potential death brought on by ingestion, sensitive people may experience contact dermatitis when handling *C. maculatum* (DiTomaso et al. 2013).

Target *Conium maculatum* control methods when plants are in the rosette stage and before they produce seeds. In grazing areas, once *C. maculatum* is under control, maintain desirable forage species with proper pasture management, including fertilization, irrigation and drainage, to help prevent

reinfestations (DiTomaso et al. 2013). Frequently monitor areas for seedlings and potentially missed rosettes. Repeated monitoring will be needed since seeds can germinate so readily.

When *C. maculatum* is present, prevent and minimize injury to livestock by not allowing their grazing of the poisonous plants, especially during pregnancies (DiTomaso et al. 2013).

Since pulled plant material may remain toxic, bag and dispose of pulled plant material. Do not burn plants or plant debris, as burning can release toxins into the air (DiTomaso et al. 2013).

Mechanical Methods:
Individual plants and small infestations can easily be removed by hand removal. When pulling *Conium maculatum*, make sure to remove the taproot to prevent regrowth (DiTomaso et al. 2013). Plants are easier to pull when they are small and when the soil is moist. When possible, try to limited soil disturbance when hand pulling as it can encourage germination of *C. maculatum* seeds in seedbank.

Another option with larger infestations is to use cultivation or plowing of newly germinated plants to prevent establishment (DiTomaso et al. 2013). Repeat cultivation may be needed depending on if there are resprouts or further seed germination.

Cultural Methods:
Poisoning from *C. maculatum* is usually associated with management errors, such as lack of available forage, drought, and other events that would cause livestock to consume a plant they would typically avoid (James et al. 1992). Often, a sequence of events such as a storm, frost, cold, and other occurrences can influence an animal to eat too much of a toxic plant too fast (James et al. 1992). It is important to plant and provide native and non-invasive forage plants for livestock, which will also compete with *C. maculatum* seedlings.

Mulching can smother seeds of *Conium maculatum* and prevent their germination. Sheet mulching (for example using a layer of cardboard and then woodchips) an area that was freshly hand weeded can prevent seeds in the seedbank from germinating, even if the soil was disturbed while removing the plants.

Biological Control:
Currently, there are no USDA approved biological control agents for *Conium maculatum*. The European palearctic moth, *Agonopterix alstroemeriana*, is the main herbivore that can be found feeding on *C. maculatum* (DiTomaso et al. 2013). This moth was accidentally introduced into the Unites States and is not a USDA approved biocontrol agent (IWCP 2014). Field observations so far find that *C. maculatum* looks to be the moth's only known host plant (IWCP 2014). The moth's larvae live in conspicuous leaf rolls and feed on the plant's foliage, buds, and flowers during spring to early summer (DiTomaso et al. 2013). Despite its widespread occurrence and defoliation of the plant, the moth hasn't been shown to be an effective control agent for most infestations of poison hemlock (DiTomaso et al. 2013).

For information about the biological control of noxious weeds in Washington State, visit the Integrated Weed Control Project's website at http://invasives.wsu.edu/index.htm or call 253-445-4657.

Chemical methods:
While hand-pulling and other methods work well on smaller infestations of *Conium maculatum*, herbicides may be an effective method on large infestations. Herbicides are applied to plants in seedling to active

growth stages. Avoid applying herbicide to fully mature plants since plants typically die after producing seed. Repeated applications may be necessary to treat seedlings (DiTomaso et al. 2013).

Herbicides such as glyphosate, 2,4-D and metsulfuron can be used to control *Conium maculatum*. Please refer to The Pacific Northwest Weed Management Handbook for information on timing, herbicides and herbicide rates to use for *C. maculatum* control. http://pnwhandbooks.org/weed/control-problem-weeds

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