



Spotted Knapweed

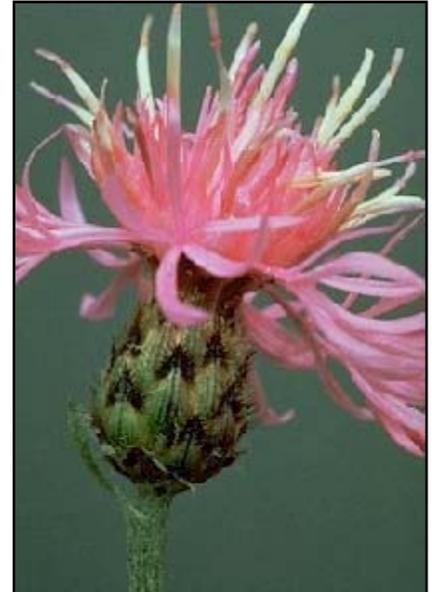
Centaurea biebersteinii DC.
Sunflower family (Asteraceae)

NATIVE RANGE

Central Europe, east to central Russia, Caucasia, and western Siberia

DESCRIPTION

Spotted knapweed is a biennial or short-lived perennial. Its name is derived from the spots formed by black margins on the flower bract tips. Spotted knapweed typically forms a basal rosette of leaves in its first year and flowers in subsequent years. Rosette leaves are approximately 8 inches long by 2 inches wide, borne on short stalks, and deeply lobed once or twice on both sides of the center vein, with lobes oblong and wider toward the tip. The taproot is stout and deep. Flowering stems are erect, 8 to 50 inches tall, branched above the middle, and sparsely to densely hairy. Stem leaves alternate along the stem, are unstalked, and may be slightly lobed, or linear and unlobed. Leaf size decreases towards the tip of the stem.



Flowers are purple to pink, rarely white, with 25 to 35 flowers per head. Plants bloom from June to October, and flower heads usually remain on the plant. Flower heads are oblong or oval shaped, ¼ inch wide and ½ inch across, and are single or borne in clusters of two or three at the branch ends. Leaf like bracts surrounding the base of the flower head are oval and yellow green, becoming brown near the base. The margins of these bracts have a soft spine like fringe, with the center spine being shorter than the lateral spines. The brown, oval seeds are 1/16 to 1/8 inch long, with pale longitudinal lines and a short fringe on one end.

ECOLOGICAL THREAT

Spotted knapweed infests a variety of natural and semi-natural habitats including barrens, fields, forests, prairies, meadows, pastures, and rangelands. It outcompetes native plant species, reduces native plant and animal biodiversity, and decreases forage production for livestock and wildlife. Spotted knapweed may degrade soil and water resources by increasing erosion, surface runoff, and stream sedimentation. It has increased at an estimated rate of 27% per year since 1920 and has the potential to invade about half of all the rangeland (35 million acres) in Montana alone.



DISTRIBUTION IN THE UNITED STATES

Spotted knapweed is a widely distributed species reported to occur throughout Canada and in every state in the U.S. except Alaska, Georgia, Mississippi, Oklahoma and Texas. It has been designated as a noxious weed in Arizona, California, Colorado, Idaho, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

It has been identified as invasive in natural areas by eighteen organizations in twenty-six states (Arizona, California, Colorado, Connecticut, Delaware, Kentucky, Idaho, Illinois, Massachusetts, Maryland, Michigan, Minnesota,

Montana, North Carolina, New Jersey, New York, Oregon, Pennsylvania, South Dakota, Tennessee, Utah, Virginia, Washington, Wisconsin, West Virginia, and Wyoming). Fifteen national parks also identify spotted knapweed as an invasive plant and a threat to natural habitats.

HABITAT IN THE UNITED STATES

Spotted knapweed is found at elevations up to and over 10,000 feet and in precipitation zones receiving 8 to 80 inches of rain annually. Spotted knapweed prefers well-drained, light-textured soils that receive summer rainfall, including open forests dominated by ponderosa pine and Douglas fir, and prairie habitats dominated by Idaho fescue, bluebunch

wheatgrass, and needle-and-thread grass. Disturbance allows for rapid establishment and spread; however, spotted knapweed is capable of invading well managed rangelands. Spotted knapweed does not compete well with vigorously growing grass in moist areas. In seasonally dry areas, spotted knapweed's taproot allows it to access water from deep in the soil, beyond the reach of more shallowly rooted species.

BACKGROUND

Spotted knapweed was introduced to North America from Eurasia as a contaminant in alfalfa and possibly clover seed, and through discarded soil used as ship ballast. It was first recorded in Victoria, British Columbia in 1883 and spread further in domestic alfalfa seeds and hay before it was recognized as a serious problem.

BIOLOGY & SPREAD

Spotted knapweed plants in North America generally live 3 to 7 years but can live up to nine years or longer. Plants regrow from buds on the root crown. Reproduction is by seed, and plants are capable of producing 500- 4,000 seeds per square foot per year. About 90% of the seeds are viable at the time of dispersal, and they can remain viable in the soil for 5-8 years. Most seeds are dispersed near the parent plant but can be transported by people, wildlife, livestock, vehicles, and in soil, crop seed, and contaminated hay. Gravel pits, soil stockpiles, powerlines, grain elevators, railroad and equipment yards are important seed distribution points.

MANAGEMENT OPTIONS

The most cost effective management strategy for spotted knapweed is to prevent its spread to non-infested areas. Spread by seed can be minimized by avoiding travel through infested areas; by cleaning footwear, clothing, backpacks, and other items after hiking through infested areas; by not grazing livestock when ripe seeds are present in the flower heads; and by using weed free hay.

Manual and Mechanical

Small infestations of spotted knapweed can be controlled by persistent hand-pulling done prior to seed set. Gloves should be worn because of the possibility of skin irritation. Because spotted knapweed can regrow from the base, care must be taken to remove the entire crown and taproot.

Biological

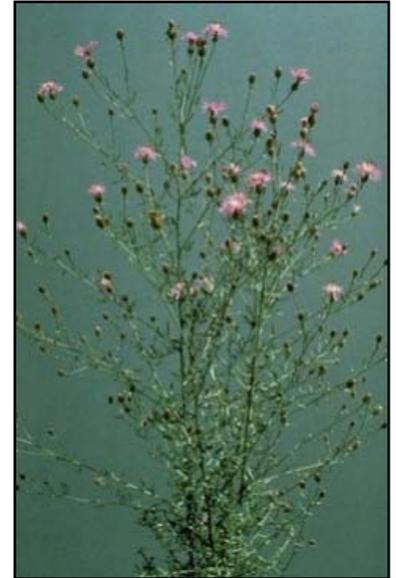
A variety of natural enemies are used as biological control agents for large infestations of spotted knapweed. Most biocontrol techniques use insect larvae to damage the root, stem, leaf, or flower. Two species of seed head flies, *Urophora affinis* and *U. quadrifasciata*, are well-established on spotted knapweed. The larvae of these species reduce seed production by as much as 50% by feeding on spotted knapweed seed heads and causing the plant to form galls. Three moth species (*Agapeta zoegana*, *Pelochrista medullana*, and *Pterolonche inspersa*) and a weevil (*Cyphocleonus achates*) that feed on spotted knapweed roots have also been released.

The collective stress on the plant caused by these insects reduces seed production and may lead to reduced competitiveness. Biological control agents may be more effective when combined with other control methods such as herbicides, grazing, and revegetation with desirable, competitive plants.

Chemical

Control of spotted knapweed infestations using three chemical herbicides (2,4-D, clopyralid, and picloram) has been reported but is problematic. Existing plants can be killed with 2,4-D but it needs to be reapplied yearly to control new plants germinating from seed stored in the soil. Picloram is a more persistent herbicide and has controlled knapweed for three to five years when applied at 0.25 lb/acre at any stage of plant growth; or with clopyralid (0.24 lb/acre) or clopyralid (0.2 lb/acre) plus 2,4-D (1 lb./acre) applied during bolt or bud growth stage. In the absence of desirable native grasses, longevity of control may be increased by revegetating with competitive grasses and forbs. Picloram may pose a risk of groundwater contamination where soils are permeable, particularly where the water table is shallow.

Other



Long-term grazing by sheep and goats has been found to control spotted knapweed. Burning, cultivation, and fertilization typically are not effective on spotted knapweed unless combined with other methods of control.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS

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- Steve Dewey's Weed Web (<http://www.ext.usu.edu/ag/weeds/index.htm>)
- Peter Rice, Montana Noxious Weed Trust (<http://invader.dbs.umt.edu/>)

OTHER LINKS

- <http://www.invasive.org/search/action.cfm?q=Centaurea%20biebersteinii>
- <http://www.lib.uconn.edu/webapps/ipane/browsing.cfm?descriptionid=45>

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PHOTOGRAPHS

Washington State Noxious Weed Control Board

REFERENCES

- Boggs, K.W. and J.M. Story. 1987. The population age structure of spotted knapweed (*Centaurea maculosa*) in Montana. *Weed Sci.* 35:194-198.
- Chicoine, T.K. 1984. Spotted knapweed (*Centaurea maculosa* L.): Control, seed longevity and migration in Montana. MS Thesis Montana State University. Bozeman, Mont. 96 pp MIN 25 8430038.
- Chicoine, T.K., P.K. Fay, and G.A. Nielsen. 1985. Predicting weed migration from soil and climate maps. *Weed Sci.* 34:57-61.
- Groh, H. 1944. Canadian weed survey. 2nd Ann. Rep. Can. Dep. Agric.
- Kartesz, J.T. 1994. A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland. Vol.1 - Checklist. 2nd ed. Timber Press, Portland, OR. 622 p.
- Lacey, J.R., C.B. Marlow, and J.R. Lane. 1989. Influence of spotted knapweed (*Centaurea maculosa*) on surface water runoff and sediment yield. *Weed Technol.* 3:627-631.

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<http://www.nps.gov/plants/alien/>

- Lacey, C.A., J.R. Lacey, P.K. Fay, J.M. Story, and D.L. Zamora. 1995. Controlling knapweed in Montana rangeland. Circular 311, Cooperative Extension Serv., Montana State Univ. Bozeman.
- Mauer, T., M. J. Russo, and M.Evans. 1987. Element Stewardship Abstract: Spotted Knapweed (*Centaurea maculosa*). The Nature Conservancy
- Muller, H., D. Schroeder, and A. Gassmann. 1988. *Agapeta zoegana* (L) (Lepidoptera: Cochyliidae), a suitable prospect for biological control of spotted and diffuse knapweed, *Centaurea maculosa* Monnet De La Marck and *Centaurea diffusa* Monnet De La Marck (Compositae) in North America. Can. Ent. 120:109 24.
- Rees, N.E., P.C. Quimby, Jr., G.L. Piper, E.M. Coombs, C.E. Turner, N.R. Spencer, and L.V. Knutson. 1996. Biological control of weeds in the west. Western Society of Weed Science, USDA Agric. Res. Serv., Mont. Dept. Agric., Mont. State Univ.
- Roché, B.F. Jr., and C.J. Talbott. 1986. The collection history *Centaurea* found in Washington State. Agri. Res. Center. Res. Bull. XB0978. Washington State University Cooperative
- Roche, B.F., G.L. Piper, and C.J. Talbott. 1986. Knapweeds of Washington. Washington State Univ. Coop. Exten. EB1393. 41p. Extension, Pullman, WA. 36 pp.
- Sheley, R.L., M. Manoukian, and G.Marks. 1996. Preventing Noxious Weed Invasion. Rangelands. 18(3):100 101.
- Sheley, R.L., J.S. Jacobs, and M.F. Carpinelli. 1998. Distribution, biology, and management of diffuse (*Centaurea diffusa*) and spotted knapweed (*Centaurea maculosa*). Weed Technol. 12:353 362.
- Sheley, R.L., J.S. Jacobs, and M.F. Carpinelli. 1999. Spotted knapweed. In: R.L. Sheley and J.K. Petroff (eds.), Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis, OR. pp. 350 61.
- Shirman, R. 1981. Seed production and spring seedling establishment of diffuse and spotted knapweed. J. Range Manage. 34:45 47.
- Spoon, C.W., H.R. Boweles, and A.Kulla 1983. Noxious weeds on The Lolo National Forest. A situation analysis staff paper. USDA Forest Ser. North. Reg. 33p.
- Story, J.M., K.W. Boggs, W.R. Good, P. Harris, and R.M. Nowierski. 1991. *Metzneria paucipunctella* Zeller (Lepidoptera: Gelechiidae), a moth introduced against spotted knapweed: its feeding strategy and impact on two introduced *Urophora* spp. (Diptera: Tephritidae). Can. Entomol. 123:1001-1007.
- Swearingen, J. M. 2003. Weed-US Database: Invasive Plants of Natural Areas. Plant Conservation Alliance. (draft)
- Thompson, M.J. 1996. Winter foraging response of elk to spotted knapweed removal. Northwest Sci. 70(1):10 19.
- Tyser, R.W. and C.H. Key. 1988. Spotted knapweed in natural area fescue grasslands: an ecological assessment. Northwest Sci. 62:151 160.
- Virginia Department of Conservation and Recreation. 1999. Invasive Alien Plant Species of Virginia: Spotted knapweed (*Centaurea maculosa* Lam.). 2 p.
- Whitson, T.D. et al. 2001. Weeds of the West. Western Society of Weed Science. 628 pp.