

Spotted Knapweed (*Centaurea stoebe* Lamarck ssp. *micranthos* (Gugler) Hayek syn. *C. biebersteinii*, formally *C. maculosa*)

DESCRIPTION: Spotted knapweed is a short-lived perennial forb of the Asteraceae family. It commonly grows to 3-4 feet in height. The basal leaves are deeply lobed and arranged in a rosette. Stem leaves are arranged alternately and are not lobed. The upper stem leaves are bract-like. Stems are paniculate branched, polycarpic, and erect. The majority of stem growth occurs in June. The slender, hairy stems grow in an erect and branched arrangement. Single thistle-like, pinkish-purple flower heads reach 3/4 inch in diameter and occur at the tips of terminal or axillary stems from late June through August. Each flower head has stiff bracts marked with fine, vertical streaks and tipped with dark, comb-like fringes that give the flower head a spotted appearance. Seeds are brownish in color, under 1/4 inch in length, notched on one side of the base, and have a short tuft of bristles at the tip, enabling wind dispersal. Knapweed has a stout, elongated taproot.

Species similar to spotted knapweed include the following:

- Russian knapweed (*Centaurea repens*): found in disturbed areas
- Bachelor's button (*C. Cyanus*): currently in cultivation and common in "wildflower" mixes; with blue flowers generally larger than *C. maculosa*.
- White-flowered knapweed (*C. diffusa*): found in disturbed areas; generally with white flowers, but easily confused with *C. maculosa*.

DISTRIBUTION AND HABITAT: This plant was probably introduced in the 1890's as a contaminant in alfalfa or hay seed from Europe and Asia. Spotted knapweed has become a serious problem in the rangelands of the northwest United States. In recent years, the species has invaded relatively undisturbed natural areas in Wisconsin as well as heavily disturbed sites. The extent of the invasion and the communities potentially affected are not well known. Until recently, spotted knapweed was presumed to inhabit only heavily disturbed areas such as road ditches, agricultural field margins, railroad beds, pipelines, and recently installed utility lines; the plant has now been found in dry prairie sites, oak and pine barrens, and on lake dunes and sandy ridges. It seems to be especially problematic in the central sands, northern Wisconsin, and near the Great Lakes.

LIFE HISTORY AND EFFECTS OF INVASION: Spotted knapweed reproduces solely by seed. Individual flower heads bloom from late June through August for 2-6 days each. The bracts reopen after about 20 days and scatter seeds. Plants average about 1,000 seeds per plant. Seeds are viable for seven years, and germinate throughout the growing season. Seedlings emerging in fall develop into a rosette of leaves that resume growth in spring.

Spotted knapweed often attains high densities on sunny wild lands--even ones undisturbed by human or livestock activity. Knapweed tends to dominate sites at the expense of community diversity or forage production. Knapweed infestation can also increase surface run-off and sedimentation.



Spotted Knapweed
(c) John M. Randall/The Nature Conservancy

CONTROLLING SPOTTED KNAPWEED

Prevention is extremely important--spotted knapweed spreads readily in hay and on vehicle undercarriages. Caution is also necessary when using hay from the road ditches of primary roadways, or hay purchased from known infested areas. Outlying plants should be controlled before main populations.

Mechanical Control:

The most effective control is early detection and removal of pioneering plants. Small populations can be removed by digging or pulling. This is best done when the soil is moist. The entire root should be removed. Since spotted knapweed thrives on sites with disturbed soil, wide spread hand pulling and digging will expose knapweed seeds to the surface. Therefore only hand pulling very small populations or pioneering plants is recommended.



Spotted Knapweed
Wade Oehmichen

Mowing has not been successful--plants merely reflower at a lower height.

Once established, knapweed may be reduced by prescribed burns (spring or summer). Following a burn, reseed with native species.

BIOLOGICAL CONTROL:

Biological control of spotted knapweed in North America began in the 1960's with the release of two seed-head attacking flies *Urophora affinis* and *U. quadrifasciata*. Since then 11 additional agents were approved for release in the United States, 8 of these agents are seedhead feeders (*U. affinis*, *U. quadrifasciata*, *Terellia virens*, *Chaetorellia acrolophi*, *Metzneria paucipunctella*, *Larinus minutus*, *Larinus obtusus*, and *Bangasternus fausti*) and the other 5 are root-feeders (*Agapeta zoegana*, *Pelochrista medullana*, *Cyphocleonus achates*, *Sphenoptera jugoslavica*, and *Pterolonche inspersa*).

In Wisconsin, the predominant biological control agents used have been *U. affinis*, *U. quadrifasciata*, *L. minutus*, *L. obtusus*, *B. fausti*, *C. achates*, and *A. zoegana*.

Seedhead flies

In Wisconsin *U. affinis* and *U. quadrifasciata* are no longer actively collected and released because of their widespread distribution around the state. These agents damage spotted knapweed seedheads during their larval stage, reducing seed production. Adult seedhead flies emerge in the spring and lay their eggs in developing spotted knapweed florets. The eggs then hatch after 3-4 days, the larvae will burrow into the seedhead and their feeding induces the plant to form a gall around the larvae. These larvae will then pupate and emerge the following spring.

[Photos left to right – *U. quadrifasciata* larvae, *U. quadrifasciata* adult, *U. affinis* larvae, *U. affinis* adult]



Seedhead Weevils

In Wisconsin *L. obtusus*, *L. minutus*, and *B. fausti* populations are being established throughout the state to provide insectaries for future distribution around the state. These agents damage spotted knapweed by consuming developing seeds in seedheads and also by feeding on the foliage. The adults emerge from the plant litter from the previous winter and then mate and lay eggs in the knapweed seedheads. These larvae consume

the material in the seedhead and then pupate and emerge to feed on the foliage before burrowing into their overwintering sites in the duff layer of the soil.

[Photos left to right – adult *Larinus* spp. on knapweed seedhead, *Larinus* spp. larvae gall in seedhead, hole left by seedhead weevil in knapweed seedhead]



Root-mining Weevils

In Wisconsin *C. achates* and *B. fausti* populations are being established throughout the state to provide insectaries for future distribution around the state. These agents damage spotted knapweed by mining into the root causing the plant to become weakened or killed. The adults emerge from the root (early summer) from the previous winter and then mate and lay eggs at the base of the root of other knapweed plants. The eggs hatch and larvae burrow into the root. The larva then consumes the center of the root and will overwinter here until next summer.

[Photos left to right – adult *C. achates* on knapweed seedhead, *C. achates* pupae in knapweed root, *C. achates* larvae]



Root-Mining Moth

In Wisconsin *A. zoegana* populations are being established throughout the state to provide insectaries for future distribution around the state. This agent will damage spotted knapweed by mining into the root causing the plant to become weakened or killed. The adults emerge from the root (mid-summer) from the previous winter and then mate and lay eggs on the stem of the knapweed plants. The eggs hatch and larvae burrow into the root. The larva then consumes the outer portion of the root and will overwinter there until next summer.

[Photos left to right – adult *A. zoegana*, *A. zoegana* larvae on knapweed root, *A. zoegana* eggs]



Expectations

Spotted knapweed biological control is a long-term method of reducing knapweed prevalence, but since most of these agents only produce one generation per year the amount of time to achieve sufficient populations can take up to a decade. This is why the Wisconsin DNR is working with multiple agencies to explore methods to decrease the amount of time to achieve control.

Chemical Control

Application of herbicides is an effective to reduce knapweed populations in the short term, for long term effects a dedicated repeated application is necessary. Seeding suitable native perennial grasses is necessary to prevent weed reinvasion.

Aminopyralid (Milestone SH) is a pyridine carboxylic acid herbicide that provides post emergence control of spotted knapweed when applications are made during the spring, and it is non-lethal to existing grass stands. Though spring application of aminopyralid combined with same year spring or fall seeding of warm season grasses has reduced grass stands between 25% to 90%. Test plots are looking into the success of frost seeding (broadcast seeding over a light snow pack or thawing soil) after an aminopyralid application.

Clopyralid is more selective, affecting only legumes and composites. It can be applied at 0.25 pound acid equivalent per acre. A mixture of 0.19 pounds of clopyralid per acre plus 2,4-D at 1 pound acid equivalent per acre is also an option; both herbicides provide good control of spotted knapweed with less soil residual than picloram or dicamba. Spotted knapweed that is still in the rosette stage can be controlled by applying a 2,4-D low volatile ester, oil soluble amine, or water soluble amine formulations at 2 pounds per acre. Annual spraying for several years may be required to deplete the seed bank.



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