Management information: *Centaurea biebersteinii*

**Physical:**

Mowing is a method of control that would be possible only in areas that are not too rocky or steep, or without shrubs. If mowed in the early flowering state, the plants will usually regrow and produce abundant late season seeds. Mowing would probably be a way to control populations, but not eradicate them. However mowing may also result in an increased proportion of plants with a low lying or decumbent growth habit. This will allow for continued seed production on stems below mower height. For this reason mowing should not be considered a long-term management option, rather a management tool that may produce a synergistic effect when combined with other management tools such as chemical control (Devlin and Witham, 1983).

Mauer *et al.* (1987) report that hand-clipping would probably be feasible only in small infested areas. Timing would be the same as mowing, and the stems and capitula should be removed from the area. Again, control might be slower because of continued emergence from seedbank reserves. Burning might be considered in areas with enough surrounding vegetation or litter to carry a controlled burn, although no literature specifically mentioned this as a control method for *Centaurea*. Often, however, dense stands have little surrounding vegetation, possibly because of allelopathy. Litter from the previous year's stems often decays or scatters during the current season, but it may accumulate in very dense stands and create more favorable burning conditions.

**Chemical:**

A. H. Bawtree, Provincial Range Specialist in British Columbia, cited a group of studies from which he recommended the application of picloram at no more than 6 oz. per acre followed by fall seeding of crested wheatgrass. *C. biebersteinii* can be controlled with picloram (4-amino- 3,5,6-trichloropicolinic acid) and 2,4-D but there are problems. Control by 2,4-D is temporary since it does not prevent germination from seeds in the
soil. Picloram persists in soils but in 4 years, enough is lost from a 0.4-0.6 kg/ha treatment to allow germination and reinfestation. The costs of applying picloram are prohibitive for very large infested areas.

**Biological:**

Mauer *et al.* (1987) cite that *C. biebersteinii* is increasing in its range and frequency in western North America. Several grasses and forbs, most of them non-native, have been used to explore the possibility of replacing Centaurea species by the seeding of a competitor.

The proportion of spotted knapweed plants may be reduced through long-term sheep grazing if seed production can also be eliminated. To eliminate seed production by sheep grazing, the sheep need to graze so that no seed heads are able to survive to maturity. Either sheep graze all bolting plants, or if flowering stems are produced, they are grazed before seeds become ripe. This may take continued, heavy grazing pressure. The treatment also should be long-term because spotted knapweed seeds persist in the seed bank for many years.

Four insect species have been introduced into North America for biological control of knapweeds. Two gall flies, *Urophora affinis* and *Urophora quadrifasciata*, and a moth, *Metzneria paucipunctella* attack seed capitula. A beetle (*Shenoptera jugoslavica*) that attacks the roots has also been introduced. Insects are available from USDA sources and could be released in target areas as a first step for control with relative ease and at no or little cost. Seed capitula attack percentages seem to rise quickly within a few years, but noticeable reductions in reproductively mature plants will take longer because of seed bank reserves and dormancy. This method, though slower, may be desirable because of minimal disturbance to soil and surrounding vegetation.

Zouhar (2001) states that in addition to insect control agents, several microorganisms have been considered for potential control of *C. biebersteinii*, including the fungi
*Sclerotinia sclerotiorum, Fusarium avenaceum, and F. oxysporum*, and the bacteria *Pseudomonas syringae*. A phytotoxin isolated from the black leaf blight fungus (*Alternaria alternata*), maculosin, was found to be the active ingredient in this host-specific pathogen of this weed, and was synthesized in the laboratory. Maculosin appears to be highly toxic only to *C. biebersteinii* and was being researched for potential field efficacy in 1993, though no work has been completed at publication time (Olson and Wallander, 2001).