

tree bases, and in sites of natural disturbance with little competition, such as a sloping mass of rock debris at the base of a cliff or on animal trails. The plants have a well-developed system of rootstocks that allow them to persist in these inhospitable sites. Sometimes the plants display a weedy tendency, colonizing recent road cuts or animal paths through the woodlands. The plants are rarely found growing among the leaf litter and herbaceous cover of the forest floor.

Within the Bluegrass Section of the Interior Low Plateaus in Kentucky, the Lexington Limestone Formation is common on the slopes entrenched by the Kentucky River and its major drainages (McDowell 1986). All but one of the Kentucky populations of *Arabis perstellata* are found on the Grier and Tanglewood members (laterally continuous distinct layers within a rock formation) of this formation. The exception is the population in Henry County, Kentucky, occurring on what is mapped as Kope and Clays Ferry members that have a higher shale component (Service 1997). However, the plants actually occur on limestone outcrops at this site similar to those occupied by the populations found in the Grier and Tanglewood members.

In Tennessee, *Arabis perstellata* sites are restricted to the Central Basin Section, which, like the Blue Grass Section, is underlain by Ordovician limestones. The primary rocks of the *Arabis perstellata* populations in Davidson County are Lebanon and Carters Limestone, while the sites in Rutherford County are characterized by Leipers and Catheys Limestone, as well as Bigby-Cannon Limestone (Wilson 1965, 1966a, 1966b).

The soils at *Arabis perstellata* sites are limestone-derived, with a rock outcrop component usually present in the soil complex. A clay subsoil is also common, but a notable difference is the acidity of the Tennessee soils (True *et al.* 1977) compared with the neutral to moderately alkaline Kentucky soils (Jones 1991; McDonald *et al.* 1985). The soils at the Tennessee sites are Mimosa-Rock outcrop complexes (True *et al.* 1977). The Kentucky sites contain Fairmont-Rock outcrop complexes and Eden flaggy silty clay (McDonald *et al.* 1985). The majority of the *Arabis* populations in Kentucky occur on Fairmont soils.

Common canopy trees of the slope forests where *Arabis perstellata* occurs are *Acer saccharum* (sugar maple), *Quercus muhlenbergii* (chinquapin oak), *Celtis occidentalis* (hackberry), and *Aesculus glabra* (Ohio buckeye). Jones (1991) listed the native herbaceous

species that are most indicative of *Arabis perstellata* habitat as *Saxifraga virginensis* (early saxifrage), *Sedum pulchellum* (stonecrop), *Arabis laevigata* (smooth rock-cress), *Draba ramosissima* (branched whitlowgrass), *Phacelia bipinnatifida* (forest phacelia), *Asplenium rhizophyllum* (walking fern), *Pellaea atropurpurea* (purple cliff-brake), and *Heuchera* sp. (alum root). These herbaceous species are all common forest forbs (flowering plants) in Kentucky and Tennessee, with the exception of *Draba ramosissima*, which is rare in Tennessee.

The only nonnative species which appears to be an important part of the *Arabis perstellata* plant community is *Alliaria petiolata* (European garlic mustard). Disturbed forests are most susceptible to rapid *Alliaria petiolata* invasion, and disrupted soil is most suitable for its establishment (Nuzzo 1991). This species competes directly with *Arabis perstellata* for areas of natural disturbance once it has become established in a forest. Management schemes for the control of *Alliaria petiolata* are being tested, but the species continues to spread into natural areas. This species poses a severe threat to *Arabis perstellata*.

Arabis perstellata is never a common component of the ground flora. It usually occurs in small groups (especially around rock outcrops) or as scattered individuals. The small size of the populations, the species' specialized habitat, and its apparent inability to expand into available or similar habitats suggests that it is a poor competitor. This inability to compete has likely limited its distribution and abundance. This species cannot withstand vigorous competition from invasive weeds or even native herbaceous species.

This species is most likely pollinated by insects, but we do not know nor do we know whether *Arabis perstellata* is self-fertile. Jones (1991) assumed that the plants are pollinated by insects, most likely by small flies and bees. Seed dispersal is likely occurring through wind or gravity rather than animal movements, as this species has no specific morphological (structural) mechanisms such as hooks or burs for seed dispersal. Seeds are probably most commonly dispersed downslope. Jones (1991) suggested that plants in the stable upper slopes (usually among the rock outcropping at a slope break) may be supplying seeds to chronically eroded areas below.

Arabis perstellata produces viable seeds, and plants can easily be grown from seeds under greenhouse conditions (Service 1997). It is not known whether the plant depends on a seed bank (seeds

in the soil from previous seasons) to take advantage of opportunities for seed germination and establishment. Bloom (1988) found that seeds of *Arabis laevigata*, a biennial rock-cress co-occurring with *Arabis perstellata*, remained germinable for several years and found evidence of a seed bank. Bloom (1988) also found that the presence of leaf litter suppressed germination in *Arabis laevigata*. Considering the similar habitat of the two species, it is reasonable to infer that leaf litter may also affect germination of *Arabis perstellata*. In several of the larger populations in Kentucky, the species occurs mostly in areas cleared of herbaceous vegetation and leaf litter by past colluvial slippage. It appears that the lack of leaf litter is likely a requirement for seed germination or seedling survival. The factors affecting seedling establishment are not known, nor is it known whether seed production changes in different environments.

The majority of the land containing *Arabis perstellata* populations is in private ownership. One site (Clements Bluff) in Kentucky is owned by the State and is part of the Kentucky River Wildlife Management Area. This publically owned site is under no formal management agreement at this time. One privately owned site, Strohmeiers Hills in Kentucky, is under a management agreement with the Kentucky Natural Heritage Program. Management activities include sediment and noxious weed control. The agreement is nonbinding and does not restrict the property owner's activities or property rights. Thus, the only protection granted by the management agreement is habitat enhancement.

The primary threats to this species are alteration or loss of habitat through development (primarily home and road construction), competition with native and exotic weedy species, grazing and trampling, and timber harvesting. *Arabis perstellata* is vulnerable to extinction because of its very small range, low abundance, and declining number of populations. Thirty-seven extant populations are known in Kentucky and four in Tennessee. The full range of this species in Kentucky is an approximately 518-square-kilometer (km²) (200-square-mile (mi²)) area, with four disjunct populations in Tennessee. This narrow range makes the species vulnerable to potential catastrophic phenomena, such as disease, extreme weather, and insect infestations. Also, population levels are declining (Deborah White, KSNPC, pers. comm. 2003). Eight sites previously known in Kentucky were found to be extirpated during a 1996 survey (KSNPC