species has been reported from four sites in North Carolina and one in Tennessee. In North Carolina the species has been recorded from two sites in Swain County, one in Yancey County, and one in Avery/Caldwell Counties (Coyle 1981, Harp 1992). In Tennessee, the species is known from only one site in Sevier County (Coyle 1981).

During 1989 and through 1992, both historic and potential habitat of the species was surveyed (Harp 1991, 1992). No new populations of the spruce-fir moss spider were discovered and of the five previously recorded populations, only one—the Avery and Caldwell County, North Carolina, population appears to be stable (Harp 1992).

The Yancey County, North Carolina, population appears to have been extirpated, and only one individual could be found at each of the two sites in Swain County, North Carolina (Harp 1992). The population in Sevier County, Tennessee, was surveyed in 1989 and was considered to be relatively healthy at that time (Harp 1991). However, revisits to this site in 1992 found that the population level is declining, apparently in conjunction with a rapid decline of Fraser fir occurring at the site and associated desiccation of moss-mat habitat (Harp 1992). Recent monitoring of this population indicates that it will likely be extirpated within the next 1 to 2 years (Harp, personal communication 1994).

The spruce-fir moss spider is very sensitive to desiccation and requires situations of high and constant humidity (Coyle 1981; Harp 1991, 1992). Loss of forest canopy (primarily the Fraser fir, the dominant canopy species in the forest stands where the spider has been found) leading to increased light and decreased moisture on the forest floor (resulting in desiccation of the moss mats) appears to be the major cause for the loss and decline of the spruce-fir moss spider at all four of these sites and the major threat to the species' continued existence. In a 1991 letter to Mr. Keith Langdon (National Park Service, Great Smoky Mountains National Park), Dr. Frederick Coyle (Western Carolina University) indicated that the spruce-fir moss spider was common at one of the sites in Swain County, North Carolina, as late as 1983 but was extremely rare by 1988. In his letter to Mr. Langdon, Dr. Coyle stated that many of the moss mats at this site had become dry and loose, which he suspected was due largely to deterioration of the forest canopy at the site.

Fraser fir at all four of these sites from which the spider has been recorded (the

Swain and Yancey County sites in North Carolina and the Sevier County, Tennessee, site) have suffered extensive mortality, believed to be primarily due to infestation by the balsam wooly adelgid (J. Harp, Oak Ridge National Laboratory, personal communication, 1993), a non-native insect pest believed to have been introduced into the United States, around 1900, from Europe (Kotinsky 1916; Eagar 1984). The adelgid was first detected in North Carolina on Mount Mitchell in 1957 (Speers 1958), though it was likely established at that site as early as 1940, and from Mount Mitchell it spread to the Fraser fir communities throughout the southern Appalachians (Eagar 1984). Most mature Fraser fir are easily killed by the adelgid (Amman and Speers 1965) with death occurring within 2 to 7 years of the initial infestation (Eagar 1984).

While the loss of the Fraser fir appears to be the most significant threat to the remaining spruce-fir moss spider populations, the combined effects of several other factors are also believed to be stressing and contributing to the decline of the high elevation spruce-fir forest stands. Bruck (1988) estimated that trees 45 through 85 years of age at the summit of Mount Mitchell, (the site in Yancey County, North Carolina where the species is now believed to be extirpated) showed an average defoliation of 75 to 90 percent and that all the trees exhibited some form of growth reduction. He hypothesized that atmospheric pollution was a possible factor in the decline. Regional scale air pollution in combination with other stress factors is believed to have played a significant role in the deterioration of the health of high elevation red spruce in the east (Johnson et al. 1992). Site deterioration due to past land use history (past logging and burning practices in southern Appalachians) and winter injury have also been identified as possible contributing factors (Peart et al. 1992). The death and thinning of the canopy trees within these stands also cause the remaining trees to be more susceptible to wind and other storm damage, which has become a major concern at the Sevier County, Tennessee, site (J. Harp, personal communication 1992).

The spruce-fir forest at the site harboring the Avery/Caldwell County, North Carolina, population of the spruce-fir moss spider has not experienced the degree of decline that has occurred (and is occurring) at the other sites known to support (or to have supported) populations of the spider. However, the same factors that are believed to have resulted in the decline of the spruce-fir forest and the associated loss of suitable moss-mat habitat at these other sites threaten this population and its habitat at this site as well.

B. Overutilization for commercial, recreational, scientific, or educational purposes. The spruce-fir moss spider is not currently known to be commercially valuable; however, because of its extreme rarity and uniqueness, it is conceivable that it could be sought by collectors. It is one of only two members of the genus *Microhexura*, it is the only representative of the primitive family Dipluridae in eastern North America and is one of the smallest of the world's "tarantulas." While collecting or other intentional take is not presently identified as a factor contributing to the species' decline, the low numbers, slow reproductive rate, and extremely restricted range of the spruce-fir moss spider make it unlikely that the species could withstand even moderate collecting pressure.

C. Disease or predation. It is presently unknown whether disease or predation have played a role in the decline of the spruce-fir moss spider. Further research is needed in this area. While predation is not thought to be a significant threat to a healthy population of the spruce-fir moss spider, it could limit the recovery of the species or contribute to the local extirpation of populations already depleted by other factors. Possible predators of the spruce-fir moss spider include pseudoscorpions, centipedes, and other spiders (Harp 1992).

D. The inadequacy of existing regulatory mechanisms. Neither the State of North Carolina nor the State of Tennessee include arachnids on their lists of endangered and threatened species; therefore, the species is unprotected in both States. Federal listing will provide protection for the spruce-fir moss spider throughout its range by requiring Federal permits to take the species and by requiring Federal agencies to consult with the Service when activities they fund, authorize, or carry out may affect the species.

E. Other natural or manmade factors affecting its continued existence. Only one of the four remaining populations of this species appears stable. The other three surviving populations are extremely small and all four populations are geographically isolated from one another. Therefore, the longterm genetic viability of these populations is in doubt. Also, the restricted range of each of the surviving populations makes them extremely vulnerable to extirpation from a single event or activity, such as a severe storm,