SCHWEINITZ'S SUNFLOWER *HELIANTHUS SCHWEINITZII* TORREY AND GRAY, (ASTERALES: ASTERACEAE) IN UPPER PIEDMONT SOUTH CAROLINA

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Numerous biotic and abiotic factors affect the reproductive ecology of any single species of plant. However, no valid discussion of ecology, reproductive or otherwise, can exclude humans. All species interact with other species and their environment, but because humans have been most successful at adapting to and changing their environment, their impact often occurs on a grand scale. Anthropogenic habitat destruction is probably the single greatest threat to biological diversity on the planet. Because plants are sessile, they are particularly vulnerable to habitat loss. Processes such as pollination and seed dispersal are especially important processes to the reproduction of angiosperms, but for some species with limited distribution or population size, survivorship alone is a critical issue.

One such species is Schweinitz's sunflower, *Helianthus schweinitzii* Torrey and Gray. Very little official information is published on *H. schweinitzii*. As a result, much of the information presented in this paper comes from field observations, personal communications, and unpublished data. Still, the U.S. Fish and Wildlife Service published technical reports and electronic information on the World Wide Web. Furthermore, research and conservation efforts have been underway for several years by regional scientists including Dr. Richard Houk and Dr. John Schmidt of Winthrop University in Rock Hill, South Carolina and Dr. Larry Barden of the University of North Carolina at Charlotte. This paper will present an overview of the biology of *H. schweinitzii* and address anthropogenic effects on the distribution and reproductive ecology of the species.

Helianthus schweinitzii

Schweinitz's sunflower is one of many species within the North American genus *Helianthus* in the composite family Asteraceae. This sunflower is a perennial herb with erect stems, opposite (some upper alternate) lanceolate, cauline leaves, yellow disc flowers, and tuberous roots (Fig. 1). Flowering occurs in late summer from September to November in the Carolinas (Radford et al. 1968). Individuals can reproduce clonally through underground rhizomes and are capable of producing seeds that mature in late autumn.

Figure 1 – Helianthus schweinitzii *in bloom at prairie preserve, Historic Brattonsville in southern York County, SC. Image taken by S. Fields October 2001.*

Historic habitat and distribution

The original habitat of *H. schweinitzii* was most likely the "Piedmont prairie ecosystem" described by Davis et al. (2002). While the exact historic range of the prairies and their flora is uncertain, early explorers such as John Lederer, John Lawson, and Mark Catesby reported large regions of prairie or savanna in the Carolina Piedmont. Natural forces were no doubt a factor in keeping succession at bay in historic times. Mammalian megafauna (bison and elk) that survived the mass extinction at the end of the Pleistocene Epoch were reported in historic times in the Carolina Piedmont (Davis et. al. 2002, Lawson 1709). The grazing and trampling of plants by these large herbivores may have maintained Piedmont savannas, similar to the ways that large herds of modern herbivores are thought to maintain prairies and other grassland environments (Knapp et al. 1999, Van De Koppel and Prins 1998). Fire is also known to be a key element that favors certain grasses and forbs and prevents encroachment of woody invasives (Howe 1995). To a certain degree fires are natural, often started by lightning during thunderstorms. However, Native Americans also set fires to maintain open landscapes for agriculture and hunting (Barden 1997). This anthropogenic practice probably facilitated a large distribution pattern for *H. schweinitzii* and other prairie-adapted species.

Current habitat and distribution

Schweinitz's sunflower is considered a Carolina Piedmont endemic (USFWS 1991). While the possibility exists that this and certain other prairie species may have always been endemic to the region, the range and abundance are no doubt greatly reduced. A few fragments of prairie persist in the Carolina Piedmont, but there are few fires and essentially no megafauna to maintain the grassland habitat (Davis et al. 2002, USFWS 1991). Extant populations of *H. schweinitzii* naturally occur in upland wood edges or openings, roadsides, and utility rights-of-way (USFWS 1992).

Another factor that may affect the distribution of *H. schweinitzii* is geology. At sites in York County, South Carolina, natural populations seem to have an affinity with Iredell soils (see Camp 1965) associated with near-surface and outcropping gabbro (dark-grained rock of volcanic origin) and metagabbro (altered gabbro) rocks (Schmidt and Barnwell 2002). So-called "Blackjack" regions tend to be flat and retain moisture better than soils associated with the more common granites (Camp 1965).

***Figure 2**. Aerial photo showing known occurrences of* H. schweinitzii *in a power transmission corridor in York County, SC. Image adapted from J. Sorrow, SC Department of Natural Resources.*

Although habitats are fragmented, current populations of Schweinitz's sunflower seem to thrive in power line rights-of-way and along roadsides (Fig. 2). This is likely due to the periodic disturbance of such microsites by mowing, the effects of which would be similar to the effects of grazing.

Reproduction

As a composite angiosperm *H. schweinitzii* produces numerous fertile disc flowers subtended by sterile ray flowers. Like other species of *Helianthus*, the bright, yellow flowers are entomophilic (attractive to insects). However, there are no published studies on the pollination biology of *H. schweinitzii*. Numerous unpublished observations suggest a number of potential pollinators. Bees, flies, wasps, and beetles have been observed feeding on nectar (B. Hilton, pers. comm.). Because bees are principal pollinators of other *Helianthus* species, they likely play an important role in the pollination of *H. schweinitzii* (J. Schmidt, pers. comm.). I have observed Monarch butterflies (*Danaus plexippus*), soldier beetles (*Chauliognathus* sp.), and flesh flies (Family Sarcophagidae) visiting flowers in southern York County, South Carolina (Fig. 3). Flowers remain in bloom through November or the first frost (Radford et al. 1968).

Figure 3 *– Potential pollinators of* Helianthus schweinitzii. ***Left*** *– Monarch butterfly* (*Danaus plexippus*). ***Right*** *– Flesh flies (Fam. Sarcophagidae). Images taken by S. Fields October 2001.*

Pollinated flowers produce fertile seeds in late autumn. Seed heads dry as the stem and foliage die back. Minimal seed dispersal is accomplished when plant stalks fall over and seeds contact the ground with a dispersal radius, depending on the height of the plant, of up to 2.5 meters (R. Houk, pers. comm.). Much greater seed dispersal is accomplished as seed-eating birds consume the seeds (which pass through the digestive tract) and defecate them some distance from the parent plant (J. Schmidt, pers. comm.).

Anthropogenic effects on pollinators and seed dispersal have not been studied in detail but seem to be minimal or negligible compared to other forms of impact.

Genetics - It is not uncommon for endangered and endemic species to exhibit low genetic diversity. Until recently, the genetic variation across the range of *H. schweinitzii* was unknown. Originally, the chromosome number was reported as n = 51 (hexaploid), and *H. schweinitzii* was thought to be a hybrid between *H. giganteus* and *H. microcephalus*. However, this was corrected to n = 34 (tetraploid) by Matthews et al. (1997). Furthermore, genetic studies indicated that *H. schweinitzii* could have originated from diploid *H. giganteus* (2n = 34) or *H. microcephalus* (2n = 34), but not hybridization of the two species (Matthews and Howard 1999, Matthews et al. 1997) The results of another investigation revealed that *H. schweinitzii* showed moderate genetic variation (H_e = 0.108), and although this level is still more than many known endemics, it suggested a

close genetic affinity among existing populations (Matthews and Howard 1999). At least three hypotheses have been proposed to account for the genetic similarity:

1) Plant tubers were used by Native Americans as a food source and were possibly relocated and cultivated – a major impact on gene flow.
2) Relatively rapid speciation within the Genus *Helianthus* could point to a recent evolution of *H. schweinitzii* from its ancestors.
3) Anthropogenic habitat fragmentation since European settlement has isolated populations, but genetic divergence is undetectable in such a relatively short time.

Endangered status - The official status of *H. schweinitzii* is as follows (CPC 2006):

- Global Rank G2 "Imperiled with six to 20 occurrences or few individuals or acres occurring"
- Federal status: LE "Listed Endangered - The U.S. Fish and Wildlife Service has listed these species as endangered under the Endangered Species Act."
- According to the U.S. Fish and Wildlife Service, there are currently ten populations in North Carolina and six in South Carolina.

All of the listed reasons for extirpation (USFWS 1991) are anthropogenic in nature. The increasing settlement of the land by Europeans led to a reduction and displacement of Native Americans and their burning practices. The large grazing herbivores such as elk and bison reported by Lawson (1709) were quickly removed from the landscape by European settlers (Davis et. al. 2002). Lack of fire and grazing left little to arrest woodland succession. As land development continued even to modern times, increasing amounts of natural prairie habitat were converted. Ironically, the last refuge of *H. schweinitzii* is also the result of human activity. Most known populations are within utility rights-of-way or along roadsides. Even these populations are imperiled by human impact when roadways are widened, mowing is conducted during flower and fruit season, or herbicides are used instead of mowing to maintain sites (USFWS 1992).

Management and Restoration - Just as historical anthropogenic effects have been detrimental to the survival and reproduction of *H. schweinitzii*, present day human intervention seems to be the only hope for recovery of the species. To preserve populations *in situ*, simple steps can be taken to mitigate the harmful activities that further endanger this plant. For example, mowing of roadsides and utility rights-of-way should occur after the fruiting season. The use of herbicides should be curtailed or scheduled around the growth of *H. schweinitzii*. Although investigation of such a hypothesis is warranted, properly scheduled herbicide applications may remove competitive plants and favor the sunflowers. Regardless of management practices, the preservation of populations in place is not always possible.

Transplanting of populations in danger of habitat loss is advisable, since there is little concern for genetic loss or outbreeding depression (Matthews and Howard 1999). Studies have shown that more robust plants (more flowers and seeds) result from transplanting tubers in disturbed soil with exposed rocks (Davis et al. 1999). Several locations in the Carolina Piedmont serve as mitigation sites for *H. schweinitzii*. One such site is the Rock Hill Blackjacks Heritage Preserve (see Schmidt and Barnwell 2002). Another site was established as a ten-acre conservation easement at Historic Brattonsville in southern York County, South Carolina, where two populations of *H. schweinitzii* were transplanted in

2000 and 2002, respectively. The ten-acre site is maintained with prescribed burning and other practices to favor prairie-adapted plants.

CONCLUSION

The reproductive ecology of *Helianthus schweinitzii* is one of the many aspects of this endangered species that needs intensive study. Most factors affecting current status and distribution of the sunflower have indeed been anthropogenic, but these factors seem more related to basic survival of the species than to reproduction. Official investigations of pollinators and seed dispersers need to be conducted and published. Until then, baseline information from unpublished observations must account for much of what is known about the reproductive ecology of this imperiled species. Even with no detailed ecological data it seems clear that without human intervention, extinction will come sooner rather than later for this species.

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