

## Seabeach amaranth restoration in South Carolina

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In 1993, the seabeach amaranth (*Amaranthus pumilus*) was placed on the national list of endangered and threatened species because it was extirpated from two-thirds of its historic range (Cape Cod, Massachusetts to mid-coastal South Carolina). Since that time, the populations in both North Carolina and South Carolina, which were its only remaining strongholds when listed, have suffered precipitous declines. However, populations and numbers on Long Island, New York increased throughout the 1990's and populations have also recently reappeared in New Jersey, Virginia and Maryland. Seabeach amaranth occurs on sparsely vegetated overwash flats and fore dunes of Atlantic coast beaches, often around inlets on accreting barrier island ends. It is a fugitive species, dependent on numerous temporary populations and an extensive seed bank on coastal islands around inlets and overwash flats. Coastal development has severely reduced available suitable habitat. Natural events such as hurricanes may reduce or eliminate populations on impacted coastal barriers.

A primary method for recovering this annual plant is to develop a successful means of propagating it and transplanting it back into suitable sites where it has been eliminated due to natural or anthropogenic impacts. If a sufficient number can be transplanted successfully, seed banks can be restored and populations may regain their functional position in the landscape. Genetic issues relative to ongoing and planned restoration work appear to be limited because preliminary results of genetic analysis show little genetic variation throughout the occupied range (Alan Strand, College of Charleston, personal communication).

Between May 30 and June 16, 2000, we planted 1176 seedlings on Cape Island (north) and Cape Island (southwest), Cape Romain National Wildlife Refuge, Charleston County, South Carolina. The Service's Charleston Field Office coordinated the planting effort with the assistance of Cape Romain NWR. Dickie Hamilton, South Carolina Department of Natural Resources (SCDNR), provided the greenhouse-reared seedlings, assisted with the planting efforts and trained Service employees and volunteers on habitat requirements and planting techniques. Plants were arranged in a circular pattern around a center stake in clusters of 15 plants with six plants on a two-foot radius and nine plants on a four-foot radius. Plants were placed in the fore dune zone and on beach flats. Plants were monitored monthly for survival and condition.

On July 13, 2000, the survival rate was 81 percent and the average radius was 11.6 cm. Many of the plants were flowering and producing seeds. Most of the early mortality occurred on the north end of Cape Island

and the primary cause of mortality appeared to be wash over with salt water due to high spring tides. On August 16, 2000, the survival rate was 80 percent and the average radius was 15.4 cm. Most of the plants were producing seeds. There was some moderate web worm infestation in the central clusters. Plants on the southwest section of Cape Island were in the best condition, perhaps because the beach is oriented due south. There was observable accumulation of fine sand around these plants. Based on these early results, the southwest section of Cape Island appeared to be the best site for transplanting.

On September 14, 2000, the survival rate was 68 percent and the average radius was 18.7 cm. Survival declined rapidly in October (47 percent) and November (seven percent), apparently due to a previously unreported fungal infection (white rust) of seabeach amaranth.

On May 17, 2001, we planted 293 seabeach amaranth seedlings and on June 7, 2001 we planted 196 seedlings on the southwest section of Cape Island. We planted the seedlings at a higher elevation on the fore dune (estimated 0.5 to 1.5 meters above mean high tide) than in 2000 to avoid mortality from saltwater over wash. On June 21 the survival rate of all plants was 79 percent and the average radius was 6.6 cm. Most of the surviving plants were very robust and healthy and many were flowering. On July 5 the survival rate of all plants was 74 percent and the average radius was 9.7 cm. We observed moderate webworm infestation and many of the plants were stressed. However, seed production was underway. On July 23 the survival rate of all plants was 73 percent and the average radius was 12.0 cm. Webworm infestation had decreased considerably and plants appeared to be healthy. Monitoring will continue throughout the growing season. We are attempting to estimate seed production by placing screen enclosures around the base of some of the plants.

In 1987 and 1988, 35 and 37 seabeach amaranth were counted during a thorough survey of Cape Romain. In 1989, Hurricane Hugo decimated the population and only a few plants were observed between 1990 and 2000. In early July 2001, we counted more than 100 plants coming up from seeds on Cape Island near last years' planting sites. In late July, high spring tides in conjunction with a northeaster, caused salt water to wash over many of these plants and may cause some mortality. On August 7 we plan to carry out a thorough survey effort on Cape Island to accurately count surviving plants coming up from seeds.

Restoration efforts on Cape Romain NWR demonstrate that seabeach amaranth populations can be successfully augmented with transplantation. Methods developed by SCDNR to propagate and transplant seabeach amaranth are highly successful, with greenhouse-reared transplants exhibiting excellent survival and reproduction in the wild. Unfortunately SCDNR can no longer afford to fund this project on a continuing basis and has terminated the project. We are seeking recovery funds to continue propagation and restoration efforts by constructing and operating a greenhouse on Cape Romain NWR. Without continuing efforts we expect success to date to be short-lived and extirpation in South Carolina is quite possible. It may take many years of propagation/transplantation to restore a sufficient seed bank to ensure recovery. With the restoration project, continued increases in the seabeach amaranth population are expected. As the seed bank expands near the planting sites, it may be possible to reduce the frequency of augmentation and redirect restoration efforts to other suitable Federal, State and private lands. Federal beach renourishment and other coastal projects provide additional opportunities for restoration. Corps of Engineers funding could be provided to support seabeach amaranth propagation. The plants produced could be placed on renourished beaches as an enhancement feature or on other suitable beaches as mitigation for projects that impact coastal processes.