Plant Ecology

Heathlands.

Background.

The most extensive coastal heathlands in the United States today occur on Nantucket Island, Martha's Vineyard and on Cape Cod, primarily within Cape Cod National Seashore. One of CACO's most ecologically and culturally significant habitats, heathlands contain a diversity of species rivaled by few other plant communities in the region. Several heathland plants are endemic species found in no other habitats, and at least three state listed rare plants have been identified in CACO heathlands. Other species, though not considered rare due to their occurrence in the arctic-alpine flora, are not found close to sea level anywhere else in southern New England or New York.

Heathland plant species have been a component of Cape Cod's vegetation since the last ice age. They were the first to colonize the newly-formed Cape after the glacial retreat 15,000 years ago, followed by pine and oak trees, and eventually the hardwood forests first encountered by the Pilgrims. Early European settlers used this hardwood for building and fuel, and cleared the land for farming and livestock pastures. Without trees to shade out the smaller plants, the Cape once again became a haven for heathlands. In 1865, Henry David Thoreau recorded: *The old houses are built of the timber of the Cape; but instead of the forests in the midst of which they originally stood, barren heaths, with poverty grass for heather now stretch away on every side.*

These days, heathlands are rapidly disappearing worldwide. Development of heathlands for real estate plays a major role in their demise outside CACO boundaries. Within the protected lands of the Seashore, heathlands are also falling victim to natural processes, as forests overtake the heath in a repeat of the plant succession that occurred after the formation of the Cape. Since CACO's establishment in 1961, over 450 hectares of heathland have been lost to forest succession, representing a reduction of more than 64% over the last forty years. Moreover, the rate of heathland loss is apparently accelerating. Only nine major areas of heathland remain today in CACO; all have dramatically altered species composition, character and appearance since the seashore's establishment and all are threatened by forest encroachment (Carlson et al., 1991).

CACO's heathlands are some of the few areas worldwide where broom crowberry (*Corema conradii*), a species that has been considered for listing as federally endangered because of its globally restricted range, is actually abundant. Baseline information about crowberry-dominated heathlands in CACO, including life history, reproduction, recruitment and maintenance requirements of the threatened species, is currently being investigated by the University of Rhode Island (URI). Monitoring plots established in 1988 are being re-surveyed, a long-term monitoring protocol is being developed and drafts of a crowberry management plan are expected by 2003.

Heathlands, continued.

Given their aesthetic appeal, ecological significance, global rarity and rapid disappearance, protection of heathlands at CACO is a critically important resource management program objective. While active management of heathlands is occurring elsewhere (e.g. Nantucket), methods to successfully maintain this community and its biological diversity in CACO have yet to be implemented.

Research Needs.

Continue Heathland Monitoring: In 1988, Carlson and Godfrey established and quantitatively surveyed twelve long-term monitoring plots in the three types of heathland found at CACO. URI researchers are currently re-surveying these plots and developing a long-term monitoring protocol for CACO's heathlands; continued long-term monitoring according to this protocol is necessary to our full understanding of heathland community dynamics in the seashore. Specific attention should be focused on determining why some heaths have overgrown more rapidly than others. This information will also be valuable in evaluating the results of experimental treatments aimed at maintaining selected heathland areas.

Test Management Techniques: Limited work has been conducted to test the four available management strategies (burning, mowing, hand clipping followed by herbicide treatment and grazing) for maintaining heathland communities. The use of individual treatments and in different combinations needs to be investigated for site-specific conditions at CACO. This project should select several different heathland sites dominated by broom crowberry and bearberry (*Arctostaphylos uva-ursi*) and implement small- to moderate-scale experiments investigating which management strategies (and during which seasons) provide the best protection for these communities.

Develop Management Plan: In order to ensure proper management and long-term protection of this rare habitat, a comprehensive plan for the management of heathland communities at CACO needs to be developed. The plan should review historic and cultural landscapes associated with heathlands and the historic ecology of CACO upland plant communities, as well as all existing information on rare and endangered plants and animals in CACO heathlands. Historic and current data and vegetation maps should be used to identify the former extent of heathlands at CACO and to evaluate rates of successional change at different sites. Based on this analysis and on the appropriateness and ease of management for each site, the plan should identify areas of heathland to be managed, and outline a preliminary action plan for beginning management activities.

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Heathlands, continued.

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Landscape Revegetation.

Background.

Cape Cod National Seashore has been continuously inhabited by European settlers since the mid-1600s, with historical impacts that include deforestation, soil nutrient-depleting agricultural practices, human-caused wildfire and sand mining. The migrating sand dunes in Provincetown are partly the result of human deforestation dating back to the seventeenth century, exacerbated in modern times by frequently used pedestrian social trails through the dunes. Dune stabilization, primarily with plantings of beach grass (*Ammophila breviligulata*), has been attempted for many years and appears to be successful. However, beach grass is a primary successional species, and long term stabilization of dunes will require succession to woody plant species.

In addition to dune and beach erosion, eroded slopes at kettle ponds are a serious concern. The result of disturbed or destroyed vegetation and soil compaction due to heavy summertime use by anglers and bathers, pondshore erosion may be contributing to a deterioration in the water quality of the ponds.

Research Needs.

Evaluate Dune Planting Program: Historically, dune stabilization efforts have been conducted by various municipal and private organizations using both herbaceous and woody plantings. Over 900 acres of previously forested and currently barren dune area in Provincetown have been identified as in need of vegetation (Leatherman, 1981). CACO planting of open dunes for dune stabilization purposes began in 1985 and 110 acres have been planted with beach grass to date. Although allowing natural shoreline processes to take place unimpeded is a primary management objective at CACO, justification for these large-scale plantings was based on the premise that human deforestation of the land initiated dune migration. However, Winkler (1990) argues that the Little Ice Age with its corresponding cooler temperatures and drier winds may have been a contributing factor in dune advancement equal to or greater than human disturbance. A review of the dune planting program is necessary to determine:

1. if planting all remaining 800 acres is necessary;
2. if woody species can be introduced and survive; and
3. if human disturbance or climate change (or both) was the driving force that initiated dune migration.

Landscape Revegetation, continued.

Evaluate Vigor of Plants: Observations indicate that dune plantings of beach grass effectively arrest dune migration. However, the long-term endurance of beach grass and its corresponding ability to stem erosion is not known and, in fact, recent observations of extensive planted *Ammophila* culm mortality in locations receiving little or no net sand accumulation suggest that past strategies for revegetation should be reviewed. As a first step, a scientific and resource manager panel should be convened to review past plantings and research and to recommend future alternative actions including but not limited to fertilization, secondary plantings of woody species, inoculation with myccorhizae, further research on *Ammophila* ecology including parasites and diseases, and current surveys of planting success relative to original program directives. Based on recommendations from the panel, monitoring and research should be undertaken to determine if beach grass plantings survive after nutrient input from imported soil decreases with dune stabilization, and to evaluate the effectiveness and applicability of planting secondary successional species (e.g. oaks, pines and shrubs.)

Inventory and Monitor Trails and Impacted Visitor Use Areas: Trails created by pedestrian traffic off established walkways have created an indiscriminate and arbitrary network of paths to and from CACO facilities, roads and beaches. Although some such trails have been recently mapped by CACO staff, a systematic inventory of social trails has not been done since the late 1970s. In order to successfully confine pedestrian traffic to established trails and to revegetate impacted sites, a current inventory of all trails is needed. Collected data should be entered in the CACO Geographic Information System and, when possible, alternate routes should be identified. Until the extent of maintained and social trails and their use is evaluated, natural resource damage, including erosion, loss of sand and vegetation destroyed by soil compaction, will continue to accrue in high visitor use areas.

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Non-Native Plant Species.

Background.

Cape Cod National Seashore has been continuously inhabited by European settlers since the seventeenth century, leading, among other things, to the establishment of many non-native plant species within CACO boundaries. Salt-spray rose (*Rosa rugosa*), common along both ocean and bayside beaches and often used for erosion control, is a potentially noxious species that may compete with native beach plum (*Prunus maritima*) for space, pollinators and fruit dispersers. Japanese knotweed (*Polygonum cuspidatum*), an introduced invasive weed resistant to eradication, occurs just outside CACO boundaries in Provincetown, but can and does quickly invade disturbed sites. Morrow's Honeysuckle (*Lonicera morrowii*) has colonized and likely displaced native grasses and heathland species in Truro. Oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife (*Lycopodium sabinifolium*), Tree of Heaven (*Ailanthus altissima*), Norway Maple (*Acer platanoides*), multi-flora rose (*Rosa multiflora*) and numerous other introduced plants may also be displacing native species and altering plant communities throughout CACO.

Given the widespread potential impacts to native communities, documentation of non-native plant occurrence and density is critical. A baseline inventory of CACO's non-native plant species was completed in 2001; long-term monitoring and a plan for invasive plant management are now necessary in order to mitigate the impact of introduced plants on native species within the park.

Research Needs.

Based on the mapping and inventory completed in 2001, a comprehensive plan for the management of non-native plant species at CACO needs to be developed. The plan should assess the degree of threat to park resources posed by each species, as well as the feasibility of successful control. Also included should be area- and species-specific action plans with detailed management methodologies, to be used in determining control effort priorities. Once the plan has been implemented, continued monitoring will be necessary to track changes in both native and non-native populations, and to evaluate the success of management efforts.

Non-Vascular Plants.

Background.

Cape Cod National Seashore's ability to protect non-vascular plant species within its boundaries is severely hampered by a lack of baseline information about their abundance and distribution. Little or no inventory information exists for bryophytes, lichens, fungi or algae within the seashore. Due to their sensitivity to air quality and precipitation chemistry and given the high levels of ozone and other air pollutants recorded at CACO in recent years, lichen research is particularly critical for identifying species that may be extirpated with present impacts from diminished air quality. Mushroom research too takes on added importance at CACO, where the traditional harvesting of mushrooms continues every fall with unknown impacts to the seashore's fungi populations.

Research Needs.

Inventory Non-Vascular Species: A complete baseline inventory of fungi, mosses, lichens and algae within the seashore is needed. CACO-wide field surveys should be completed, and the density and frequency of non-vascular plant species in CACO should be mapped and measured. Voucher samples should be taken, and a computer database developed for long-term tracking of field data. Following this initial inventory, long-term monitoring is necessary in order to detect and track changes in CACO's non-vascular plant populations over time.

Assess Mushroom Harvest: Currently, little information exists regarding the species composition, distribution and density of fungi within CACO. During the annual fall harvest, most, if not all, edible mushrooms are removed in certain popular areas. The extent of this harvesting and its impact on local flora and fauna are unknown, as is the long-term effect of removing propagules from the local mushroom population. Once the above fungi inventory has been completed, an extended evaluation of the mushroom harvest is needed in order to protect this vital component of CACO's plant community.

State Listed Rare Plants.

Background.

According to the Massachusetts Endangered Species Act, a comprehensive law requiring stricter environmental review of listed species than the federal law of the same name, plant species facing possible extinction in Massachusetts may be designated by the state as Endangered, Threatened or Of Special Concern. Each classification reflects the species' population size and stability, its global distribution and threats to the viability of its habitat: Endangered Species are reproductively viable native species in imminent danger of extinction; Threatened Species are reproductively viable native species that are rare or declining within the state and are likely to become endangered in the foreseeable future; and Species of Special Concern are those native species where a population decline could threaten the species if allowed to continue unchecked, as well as those that occur in such small numbers or with such a restricted distribution or specialized habitat that they could easily become threatened.

Cape Cod National Seashore contains a total of 33 plant species listed as Endangered, Threatened or Of Special Concern by the Massachusetts Natural Heritage Program. Four of these species have been recorded historically but have not been confirmed in recent years. Although CACO successfully protects its listed species from many anthropogenic impacts, natural and artificial threats such as fire, forest succession, atmospheric pollution and human recreation still influence rare plant species and communities within the seashore. Rare plants in CACO have been identified and their distribution has been mapped (LeBlond, 1990); however, only sporadic census data on species abundance and density exist, and the consequences of human and natural threats to the species remain largely unquantified.

Research Needs.

An existing monitoring plan to collect abundance and density data from CACO's rare plant sites at least every three years needs to be implemented in order to track long-term changes in the park's rare plant populations. Monitoring should include distribution and site mapping of both existing and new rare plant sites on CACO's Geographic Information System.

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