Dune Slack Wetland Monitoring

Background

Dune slack wetlands are found at the extent of the Outer Cape where post-glacial movement and accumulation of sediments, powered by wind and wave action, have formed the sand spit and dune landscape known as the Province Lands. Interspersed among this landscape, where topographic depressions in the dune system intersect the water table, one will find the formation of dune slack wetlands (Figure 1). The porous nature of the soils in the Province Lands along with seasonal shifts in precipitation, temperature, and vegetation uptake make for wetlands that contain surface water during certain times of the year only. Adding to the dynamic nature of dune slack wetlands is the constantly shifting geology of the area itself. Wind-blown sands can result in the formation of new and the migration of existing wetlands over a relatively short period of time (Figure 2). There are more than 350 wetlands, covering an area of approximately 135 acres, fostering over 100 different wetland plant species.

Methods, Status, and Trends

In 2003-04 all dune slack wetlands within the Cape Cod National Seashore (CCNS) boundary were identified and mapped. A subset of fifteen wetlands were randomly selected to undergo more intensive monitoring. In each of these wetlands, five permanent transects have been established. The transects serve as a reference line along which vegetation sampling can be repeated over the course of many years. Wetland sizes and ages were estimated from digitized, georeferenced aerial photographs taken in 1938, 1947,1960,1987,1994, and 2001.

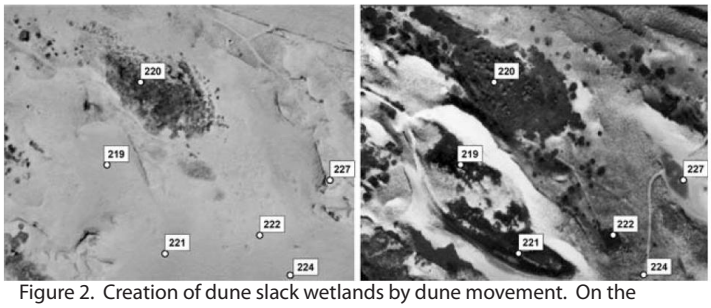


Figure 2. Creation of dune slack wetlands by dune movement. On the left is a photo from 1960. On the right is the same parcel of land in 1987. Present-day wetlands are labeled numerically.

Figure 1. Oblique aerial photo showing the dune landscape where dune slack wetlands form. The wetlands form in areas of lowest elevation where the topography intersects the lens of freshwater below the surface.

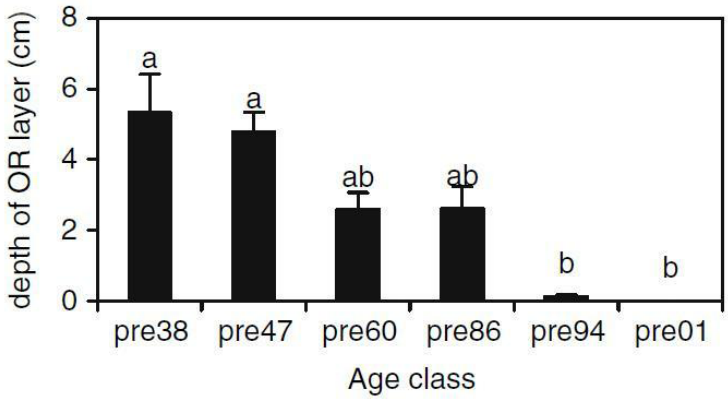
Vegetation structure and composition exhibited a distinct pattern of development with age and followed a pattern of succession from herbaceous, grass-dominated communities to shrub and/or tree-dominated communities. Soil organic matter accumulates throughout this sequence of change (Figure 4, top graph). As soil organic matter accumulates, wetlands trend towards a composition of more woody species such as shrubs and small trees (Figure 4, bottom graph). The close correlation of these vegetation and soil variables with age suggests that vegetation dynamics are primarily driven by internal processes and that environmental factors explain only a minor fraction of the variability of the general character among existing wetlands. Notwithstanding, any changes in the environment that alter the process of succession will collectively influence the character of these wetlands. In addition, stabilization of the dunes resulting in a reduction in the formation of new wetlands, may translate into permanent loss of early and mid-successional dune slack communities. Maintenance of these communities will depend on succession being periodically reset by disturbance such as hurricanes or drought.

Applications

These monitoring efforts have resulted in a greatly increased understanding of one of the most unique landscapes found at CCNS. The work done thus far has helped to build the conceptual model of how these wetlands are formed and which factors influence their physical and vegetative composition. Factors associated with hydroperiod (how long throughout the year standing water remains in the wetland) have been shown to be more complex than once thought. Thickness of underlying peat layers and differences in evapotranspiration rates (water uptake from plants) due to plant community composition have a more significant effect on water levels than was previously understood. A relationship between tides and the water levels of wetlands nearest to the shoreline has also been observed. Water levels in certain wetlands will rise on the order of several centimeters during high tides as the fresh groundwater lens, which rests atop the salt water lens, is pushed upwards. This relationship has implications for how wetlands may respond to sea-level rise and we may expect a change in distribution and total extent of dune slack wetlands as they do continue to rise in association with climate change.

Monitoring has also revealed that wetland age is the primary factor regulating species composition. This knowledge leads to a much improved ability to predict how these dune slack wetlands will change over time. How these systems will change is relevant to a number of other management issues including that of rare plant and animal species. Vegetation changes that occur over time and the resulting changes to hydrology may or may not influence suitability of certain wetlands for amphibian breeding sites, notably the state threatened spadefoot toad. Certain plant species occur almost exclusively in dune slack wetlands. Among them are the orchid species *Calopogon tuberosus* (tuberous grasspink) (Figure 3) and *Pogonia ophioglossoides* (snake mouth orchid). If CACO scientists can better predict how these systems will change over time, they may be able to anticipate shifts to sensitive species in this already dynamic landscape.

Figure 3. *Calopogon tuberosis.* Among the list of rare plant species at CCNS that occur only in dune slack wetlands.



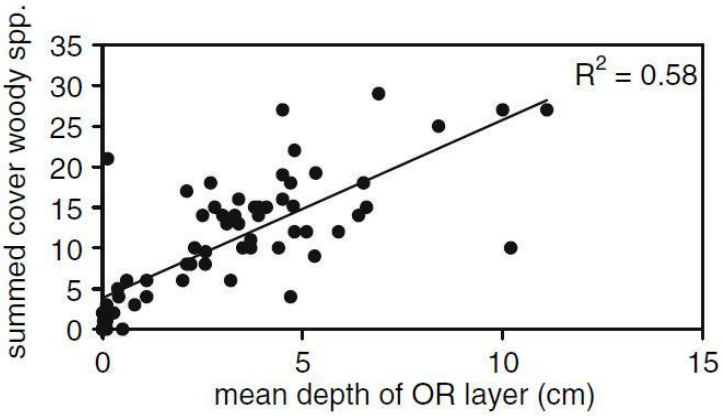


Figure 4. Relationships between the depth of the organic layer (OR layer) in dune slack wetland soil cores and age class (above) and cover of woody species (below). The R^2 value in the bottom graph of 0.58 represents a statistically significant relationship between the two variables. These graphs demonstrate the relationship between age and the accumulation of organic material (top) and the subsequent trend towards more woody vegetation over time (bottom).

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