The Morphology and Evolution of the Most Downwind of the Parabolic "Walking Dunes" in Napaque, New York

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The southernmost stable dune of the "Walking Dune" system at Napeague, New York (Dune 1 in Figure 1) is being studied to gain further insight into its morphology, evolution and interactions with the underlying glacial topography. Ground Penetrating Radar (GPR) was used to map out the dune's internal structural development, and its position in relation the underlying topography. This was augmented by aerial, Digital Elevation Mapping (DEM), and satellite images using Geographical Information Systems.

Figure 1) *Aerial image of the Walking Dune system. The youngest dunes (3, 4, and 5) are to the north and are almost completely bare of vegetation. Dune 1, the topic of this abstract, is the most southerly of the dunes. Although aerial images from the mid-20th century showed it largely bare of vegetation, it is now rather well vegetated. Note the short distance from the front of this dune and the south shore of Long Island.*

We find that, despite this dune's overall apparent stabilization, it remains a very dynamic system within its essentially unchanging geographic boundaries. A GPR transect along the main axis of the dune clearly shows separate, superimposed episodes of sand deposition under different wind directions and aerial imagery shows that much of the top of the dune was bare of vegetation through much of the 20th century. Despite a dearth of restraining vegetation, however, the dune did not advance beyond its previous southern limit. Today, even with heavy vegetation atop the dune, there still remain abundant indicators of active deposition and erosion. Observations on the other dunes suggest that small disturbances, such as human and animal trails, can lead to disproportionately large effects including significant blowouts.

The location of this dune and the leading (southern) end of the Walking Dune system causes it to be subject to, and impeded by, onshore breezes that are of little importance to the other dunes. Those breezes are clearly an important factor in restricting further advance, and appear to be responsible for at least one episode of reverse (northward) sand propagation that is clearly imaged in our GPR data.

The relationship between this dune and its underlying topography is making it increasingly clear that pre-existing topography can play a significant role in parabolic dune development and stabilization. Furthermore, that role may, at times, be counterintuitive. For example, we find that the southern edge of this dune corresponds almost exactly to the southern end of elevated glacial topography, now concealed by sand. Instead of facilitating large-scale advance of sand down this pre-existing slope, it appears that the topographic relief may serve to enhance the retarding effects of the northward onshore breezes.

Although this southern dune lies upon considerable pre-dune topography, so its total volume is considerably less than one would expect on the basis of surface geological investigation alone, it is sufficiently voluminous compared to the more northerly dunes that sand supply at the time of its initial development must have been considerably greater than at present.

Ongoing GPR surveys are concentrating upon an investigation of the complex flanks of this dune. Our most recent survey, along the intersection between two parallel ridges within Dune 1, shows evidence indicating that they have evolved non-synchronously.

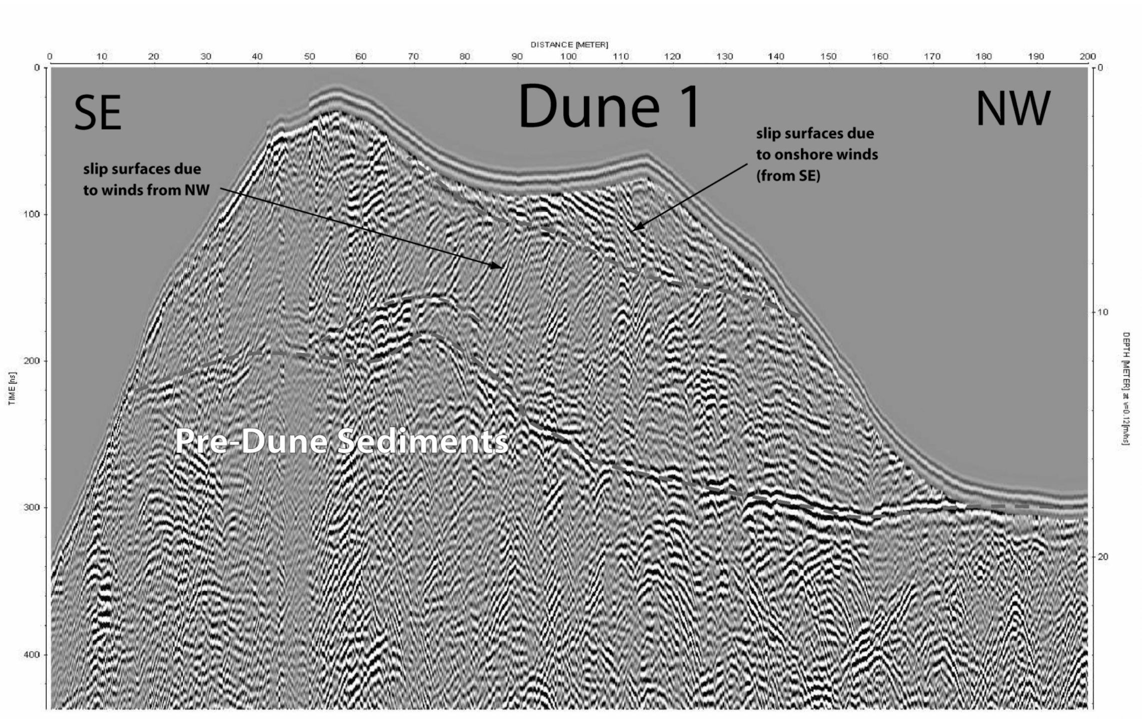

Figure 2) *GPR transect of Dune 1. Note the significant pre-dune topography beneath the sand, as well as the presence of distinct domains of reflectors (dune slip surfaces). Much of the bulk of the dune consists of a zone (approximately 5 m thick), which was deposited under winds from the NW. On top of it in the northern half of the dune is a region with slip surfaces indicating deposition due to onshore breezes from the south.*