

COOPERATIVE STUDIES OF EOLIAN MATERIALS AND PROCESSES

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INTRODUCTION

The work proposed here will permit the application and further refinement of techniques developed on the CPER LTER by applying them to the Jornada LTER, where eolian transport rates are thought to be much higher. It will also provide the opportunity for comparative regional studies. Nearly all eolian geomorphic studies made in the U.S. have been associated with large dune fields, agricultural applications, and coastal dunes. Consequently, there is a dearth of information regarding the relative importance of these processes in most desert terrains. Finally, it is hoped that this study proposed will provide valuable insights to ecologists working at the Jornada.

The Jornada LTER Site is located in Mexican Highlands Section of the Basin and Range Province; in the Jornada Del Muerto Basin east of the Rio Grande River and west of the San Andreas Mountains. Since much of the site is located in a basin of interior drainage, fluvial processes are not capable of removing sediment but function to rearrange these materials within the basin. The introduction and removal of sediment must be left to other agents that can operate in an upslope direction. Wind is one such agent.

The climate at the Jornada Site is dry. Periods of high wind occur during the Spring and are also associated with summer convective storms. High wind velocities and dry, cohesionless, soils are needed for eolian erosion to be effective. These conditions exist at the Jornada during part of the year and the region has experienced at least five droughts during the past century. It likely that eolian processes constitute an important, if not the dominant, geomorphic agent currently operating at the site. The introduction, removal, and rearrangement of materials affects the ecosystem through soil genesis, impacts to the hydrologic balance, and direct effects on flora and fauna.

During the past two years studies at the Central Plains Experimental Range LTER have focussed on three aspects of eolian geomorphology. They include: an inventory of eolian materials with special emphasis on their spatial distribution with respect to landform elements, assessment of the importance of eolian processes during Post-Pleistocene (i.e., Holocene) times, and modern rates of deposition. In addition to mapping and C^{14} dating of paleosols, we are using Cesium 137 occurrences to

estimate deposition during the past 40 years. We have also deployed a network of fifty sediment samplers to measure transport rates on various slope elements and at different aspects. What is emerging is a rather peculiar pattern of eolian deposition that has apparently existed since the Altithermal (about 7,500 years) and has continued through the last forty years. Moreover, it appears that wind is a significant factor in maintaining the shortgrass steppe. Blue grama grass (Bouteloua gracilis) is not tolerant of burial beneath litter and can be readily removed by mulching. Removal of the litter by the wind seems to be an important aid to the viability of this species.

Cooperative Studies at the Jornada Site

We propose here a preliminary study of eolian processes and materials at the Jornada Site. The study will include evaluation of sediment transport rates and patterns at various aspects on different landform elements. For example, we may wish to sample the footslope, midslope, and upperslope of bajadas at different orientations and compare them to measurements made on playas or in other geomorphic settings. The object is to measure and document the movement of windborne sediment through the system. The BSNE sampler, developed by the Agricultural Research Service in Big Spring, Texas, has proven very useful for this purpose. Its cost is nominal and its trapping efficiency is equivalent to the more expensive Bagnold Sampler. We also use a circular template to lay out circles of fine sand that have been dyed with fluorescense. Distortion of the circle provides an indication of net transport direction during a short-term event such as a single windstorm. The circles are especially useful on playas and other flat unvegetated terrains.

The study proposed here will also include a first order inventory of eolian deposits if such work has not already been done. The goal is to identify and map these deposits, to attempt to find a pattern to their occurrence, and to identify their source. The eolian deposits will also be sampled and Cesium 137 analyses performed to determine modern deposition rates. In 1985, J.C. Lance published the results of a study of modern rates of sediment movement versus mean annual precipitation. Cesium 137 occurrences were used for this work. Samples were taken along a transect reaching from Georgia to Arizona and depth of Cesium 137 (a measure of deposition since the onset of subaerial atomic testing) regressed against mean annual precipitation. The found a strong correlation between the variables in all cases except samples taken from the CPER. It was conjectured that this anomalous datum point results from wind patterns between the Nevada Test Site and the CPER. We believe that the samples from the CPER were the only eolian materials used in the study, that the datum is accurate, and that the high deposition rate has nothing to do with wind patterns between Nevada and Colorado not with mean annual precipitation rates. Similar measurements taken at the Jornada can be used to test our hypotheses.

In summary, the work proposed here includes an inventory of eolian materials, determination of sediment transport patterns and rates, estimation of modern depositional rates, and identification of source areas. It is proposed that the same methods used on the CPER Site be used at the Jornada and that a team of NMSU and CSU researchers will perform the work. The CSU workers will aid in setting up the field instruments and will do the inventory of eolian materials. NMSU personnel will be in charge of the field monitoring and laboratory analysis will be performed at Colorado State University. The study will allow us to refine methods being developed at the CPER by applying them in an area with higher transport rates and will allow us to perform regional studies. It is hoped that the insights gained from our studies will be of use to ecologists working at the Jornada.

Budget for the proposed study is listed below. It includes 1/2 month salary for Dr. Ward and Dr. Doehring, a Graduate Research Assistantship split between NMSU and CSU, thirty BSNE samplers, travel between CSU and NMSU as well as travel for field work and monitoring, field supplies and nominal costs of analyses.

BUDGET

Dr. Ward, 1/2 month.....	\$ 2,000.00
Dr. Doehring, 1/2 month.....	2,000.00
G.R.A., 1/2 time split between NMSU and CSU	6,000.00
Travel	1,500.00
BSNE samplers, 30 @ \$50	1,500.00
Laboratory analyses	300.00
Supplies	300.00
Total	13,600.00