SAND DUNE MIGRATION MONITORING ON THE NAVAJO NATION, SOUTHWESTERN UNITED STATES. R. C. Bogle[2], J. M. Vogel[2], M. Velasco[2], and M. H. Redsteer[2] [2]U.S. Geological Survey, 2255 N Gemini Drive, Flagstaff, AZ 86001 rbogle@usgs.gov

Native Americans of the southwest United States live on ecologically sensitive arid to semiarid lands, with increasing temperatures, decreasing precipitation, and fluctuating wind regimes transforming the landscape in ways that negatively impact its inhabitants. Annual rainfall in the western Navajo Nation has fallen below 80mm/year during the recent drought, directly contributing to an increasing areal extent of sand susceptible to mobilization and reactivating formerly stabilized dunes. Reservation housing and road networks are threatened by this increase in dune movement, while native plants and grazing lands are made more vulnerable.

As part of our research effort on the Navajo Nation, we have registered historical aerial photography, dating from the 1950s through the 1980s, to more recent orthorectified aerial photography. Using this collection of georeferenced aerial photographs, along with on-going high precision (+-5mm) GPS surveys, we have mapped the 60 year migration of entire dune fields as well as more recent, high precision, migration rates of smaller dune groups. While migration rates vary widely by year and location, preliminary findings demonstrate that some dunes in the southwest Navajo Nation advanced over 70m between 2007 and 2009.

Additionally, we are developing and testing a variety of methodologies and instruments to facilitate high-temporal precision measurement and monitoring of morphological changes in a dune field. These include: (1) The use of terrestrial LiDAR surveys of sample dunes to create volumetric models of the dunes, accurate to less than a centimeter, several times a year; (2) Establishing an automated digital imaging system, which records daily images as well as captures images of the dunes when wind speed averages exceed saltation thresholds. This imagery will provide us with a record of effects of individual storm events as well as a time-lapse record of dune migration. We are also using the imagery to assess the use of photogrammetric techniques as a low-cost alternative to performing terrestrial LiDAR surveys; (3) Establishing meteorological and climate variability measures through the use of multiple sensor sites in the dune field; and (4) Developing a low-cost alternative to the Sensit sensor that will be capable of recording the number of seconds each day in which particles saltate at various locations in the dune field.

This research, combined with data compiled from co-located weather instruments and other sensors, will provide a more sophisticated understanding of the processes driving dune migration, and provide mitigation options to the challenges that dune migration poses to the Navajo Nation.