THE RELATIONSHIPS BETWEEN SEA LEVELS, 'BEACH RIDGE' AND FOREDUNE EVOLUTION

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ABSTRACT

Foredunes and foredune plains (a plain of foredunes and swales) have commonly been termed 'beach ridges' with little regard to genesis, morphology or evolutionary mechanisms (Hesp, 2006). At the most primitive classification level, a 'beach ridge' might be argued to be any ridge formed at or near the beach, but 'beach ridges' may be formed purely by wave action (e.g. gravel storm berms and ridges; e.g. Isla and Bujalesky, 2000; Vilas et al, 1999), wave action and some aeolian deposition (e.g. Hine, 1979; Hesp, 1999, Otvos, 2000), or purely by foredune development (where plants growing on the backshore trap sand and form foredunes; Hesp, 2002; Dillenbrug and Hesp, 2009). The author would argue that many 'beach ridges' around the world have been formed as foredunes, and therefore have a very different genesis than those formed by wave action. In addition, low or high energy wave deposition of sediments will result in a 'beach ridge' base that may be built considerably above the formative mean sea level, whereas it will be argued in this presentation that foredunes are more likely to be formed at a relatively fixed height above a mean sea level operating at the time of formation.

This paper will present data on the morphologic evolution of some foredunes that have developed over the past 6-7000 years as well as some modern (last 30-40 years) examples, the relationship between foredune toe position (or the seaward edge of vegetation) and the backshore, the relationships between mean sea level, backshore elevation and foredune formation, and GPR and stratification records within foredunes, to show that there is a very strong relationship between foredune formation and topographic position above sea level, and that the formative sea levels for so-called 'beach ridges' or foredunes may be determined by a careful analyses of stratification, drilling and GPR records.

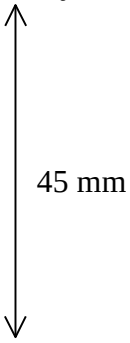


Figure 1 shows topographic profiles across a foredune and relict foredunes located at Dark Point, Fens Embayment, Myall Lakes National Park, Australia, that have been monitored since 1974 and surveyed since 1978. The numbers in circles indicate a foredune, the arrows indicate the edge of vegetation at the date of survey, and the numbers on the survey topograhic profiles indicate the year of survey.

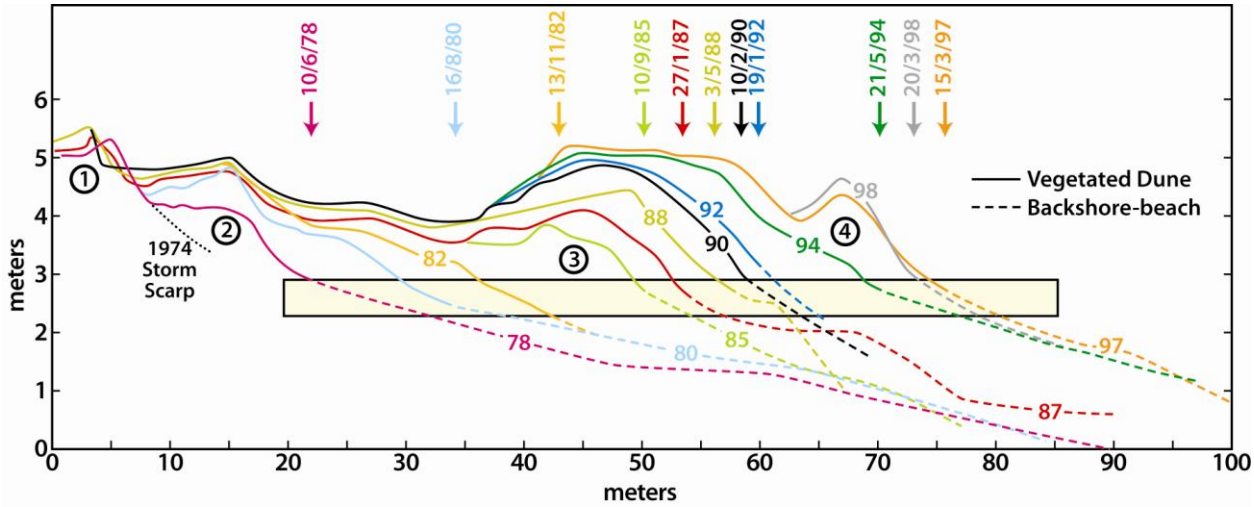
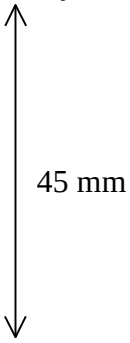


Figure 1: Topographic profiles illustrating the formation and development of a foredune and relict foredunes at Dark Point, Australia. The box indicates the range of vertical elevations within which the seaward edge of vegetation occurs.

While the morphology of each foredune varies according to the degree of vegetation density, rate of beach progradation, sediment supply, storms, etc, the actual location of the toe or edge of the backshore as indicated by where the edge of vegetation is located, never varies more than 50-60cm in vertical elevation. In fact, if one removed the 1982 profile, that elevation box narrows to around 30cm on average. This demonstrates that the edge of the backshore as defined here lies within a very narrow elevation window. This point on the backshore is strongly related to the height of spring tide swash, since swash and seawater inundation events will kill the seaward growing tips of the pioneer plants (*Spinifex sericeus* in this case). The data show that the height of the backshore is strongly related to sea level, since the height of spring tide swash is directly related to sea level, and therefore, the point at which the backshore (and predominantly marine laid sediment) joins the foredune toe (and becomes predominantly æolian sediment) and "beach ridge" (actually foredune in this case) is quite narrowly defined. Thus, the relationship between foredune toe, backshore elevation and formative sea level can be defined. GPR records from Brazil will be utilized to demonstrate that this relationship can also be defined in the stratigraphic record.



REFERÊNCIAS

Dillenburg, S. and Hesp, P.A. (Editors), 2009. Geology of the Brazilian Coastal Barriers. Springer-Verlag Lecture Notes in Earth Sciences 107.

Hesp, P.A., 1999; The Beach Backshore and Beyond. Chpt. 6 in: A.D. Short (Editor), Handbook of Beach and Shoreface Morphodynamics: 145-170. John Wiley.

Hesp, P.A., 2002. Foredunes and Blowouts: initiation, geomorphology and dynamics. Geomorphology 48: 245-268.

Hesp, P.A., 2006. Sand beach ridges: Definition and re-definition. J. Coastal Research SI 39: 72-75.

Hine, A.C., 1979. Mechanism of berm development and resulting beach growth along a barrier spit complex. Sedimentology 26: 333-351.

Isla, F. and Bujalesky, G.G., 2000. Cannibalization of Holocene gravel beach-ridge plains, northern Tierras Del Fuego, Argentina. Marine Geology 170: 105-122.

Otvos, I., 2000. Beach ridges – definitions and significance. Geomorphology 32: 83-108.

Vilas, F., Arche, A., Ferrero, M., and Isla, F., 1999. Subantartic macrotidal flats, cheniers and beaches in san Sebastian Bay, Tierra Del Fuego, Argentina. Marine Geology 160: 301-326.