



## **The role of attached kelp (seaweed) fronds in lowering threshold of coarse gravel entrainment in tidal flows.**

Paul Carling

Geography & Environment, University of Southampton, Southampton, United Kingdom (p.a.carling@soton.ac.uk)

There is a long history of reports of attached kelp (seaweed) fronds aiding entrainment of coarse sediment by flotation. In the intertidal zone of the Severn Estuary (UK) cobbles were observed to overpass fine gravel plane-beds and pebble-gravel dunes in those instances where seaweed fronds were attached. However, overpassing clasts without attached fronds were rare.

Flume experiments were conducted to measure the reduction in velocity and shear stresses required for initial motion when fronds were attached. A range of factors influence entrainment including the ratio of seaweed weight:clast weight and length:width ratio of the seaweed frond. Reynolds stresses for entrainment, and the critical velocity for entrainment were reduced by around a factor of two for attached fronds in contrast to stones without fronds. Reductions in the critical velocity were associated with an increase in the values of drag coefficients for clasts with attached fronds; the majority of the drag being associated with the frond widths rather than the frond lengths.

The significance of this study is manifold with respect to deposition of oversized clasts in the modern marine environment and in the geological record. The reduced entrainment values explain the presence of large clasts in near-shore and off-shore environments where measured velocities otherwise are not competent. In addition, when clasts are deposited and buried by sediment the seaweed fronds decay and so the role of kelp is not immediately evident. Thus in the geological marine sedimentary record buried oversized clasts may be related to kelp transport in some instances.