FLOW STRUCTURES AND SAND DEPOSITION BEHIND A COLONY-TYPE GRASS ON A GRAVEL BAR

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An invasive plant, *Eragrostis curvula*, also known as weeping lovegrass, affects the bio diversity of a gravel bed bar in Japanese rivers. It has a much higher bending strength and lower porosity than the native species, *Phragmites japonica*, also known as reed grass. As a result, *E. curvula* colonies provide much more drag to the flow field, increasing the depo sition of sediment in their wake.

Evaluating the effect of vegetation on resistance to river flow has become one of the ma jor interests of river engineers. However, except for experiments using a group of circular cylinders (Musik et al., 1996), only a few studies have been conducted on colony-type roughness. Therefore, flow structures and sand deposition around a colony-type roughness model in uniform flow were investigated to elucidate the difference of the roughness characteristics between *E. curvula* and *P. japonica*.

The flow was visualized, velocity and drag force were measured and the volume of sand deposited behind the colony was measured in experiments and field observations. In the emergent condition, the flow structure around the colony model changed with increasing L/D (L: spacing between each cylinder, D: diameter of a single cylinder). In the range of $0.25< L/D <0.5$, a large eddy street was formed behind the colony model, whereas a Kármán vortex street was generated behind individual cylinders when $L/D >2$. The flow and drag characteristics of the whole colony model changed when the L/D was around 1. The drag coefficient decreased with increasing inclination of the colony or with decreasi ng the aspect ratio H roughness, and the drag coefficient in the submerged condition was smaller than that in the emergent condition (Fig.1). The sand deposition capacity decreased drastically with increasing inclination. *E. curvula* forms a denser colony (L/D =1-2) than *P. japonica* (L/D >3) does, and the inclination of the *E. curvula* colony is smaller than that of the *P. japonica* colony. This caused the large difference in sand accumulation behind the colonies. The inclination and the deposited sand volume beh ind a model had a linear relationship, but not for *E. curvula* (Fig. 2). This is beca use the inclination and aspect ratio H/D_c changes with the colony diameter.

E. curvula is one of the species that has high sediment deposition capacity. This corresponds to the condition as $1< L/D <2$ (porosity=0.72-0.86). We need to control this species not only by ecological engineering but also from hydraulic engineering points of view. Similar colony-type species, especially invasive plants, that have a porosity of 0.7-0.9, also need to be controlled.

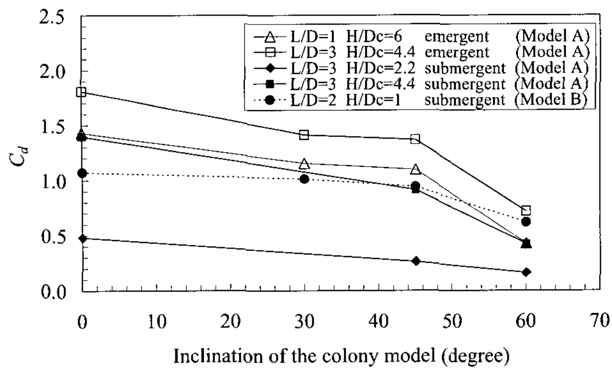

Fig. 1 Relationship between the inclination of colony model and C_d, Model A, B were formed by 7, 37 cylinders, respectively, H : water depth, D_c : outer-diameter of a colony, L : spacing of each cylinder, D : diameter of a single cylinder.

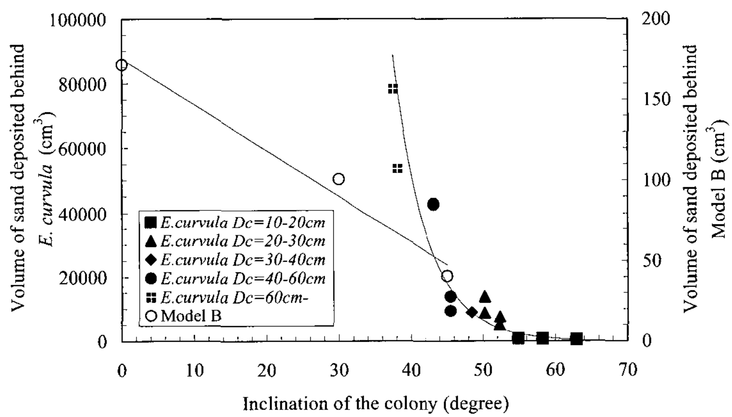

Fig. 2 Relationship between the inclination of the colony and volume of sand Deposited behind colony Model B and *E. curvula*

REFERENCES

Musik H. B., Trujillo S. M., Truman C. R., 1996. Wind-tunnel modelling of the influence of vegetation structure on saltation threshold, Earth Surface Processes and Landforms, 21, pp.589-605.