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主 論 文 の 要 旨

論文題目 Flow and sediment-POM transport in stream with vegetation （河道内植生域での砂と粒状有機物の輸送と堆積過程に関する研究）

氏 名 全 浩成

論 文 内 容 の 要 旨

River management should be integrated from view point of flood mitigation, water resources management and ecosystem conservation, and management of river morphology with vegetation must be a key. Recently, 2D depth-averaged hydraulic analysis has become a powerful means and widely employed in river management. Firstly it is important to improve the applicability of 2D scheme to be applied fairly to flow with fluvial process in a stream with vegetation. Furthermore, particulate organic matters (POM) such as litters, seeds and so on are transported as well as sands in natural streams. The roles of POM are significant in consideration on ecosystem in rivers. In particular, the interaction in POM transport and deposition with sand transport must be the target of the study on this line. The point is how to deal with vegetation in streams, and in 2D depth-averaged scheme, taking account of form drag due to vegetation elements is a key and it has provided a fairly reliable solution of flow with vegetation. However, friction factor in depth-averaged scheme must be modified by the flow with vegetation, where the form drag is dominant to bring almost uniform velocity profile in the vertical direction though actually there must be a shear layer limited to the vicinity of the bed. Depth and depth-average flow velocity can be well described even without any consideration for it if the form drag due to vegetation is taken into account, but the shear velocity must be underestimated without consideration on the shear layer near the bed. Without fair evaluation of shear velocity, some phenomena as well as sediment transport and subsequent fluvial processes cannot be described properly. In this study the 2-Dimensional numerical model made by Nagoya hydraulic(hereafter, NHSED2D), which is able to simulate flow fields-vegetation-bed variation interaction directly, is used to investigate fluvial process and mechanics of sediment transport in vegetated area.

Several issues remained in numerical modeling in depth-averaged scheme has been discussed using newly developed numerical model: the friction resistance law should be reasonably

considered and the concept of "bed roughness boundary layer" is proposed and formulated against the vegetation density. Based on this concept, the shear flow structure in this layer is discussed and formulated. It brings the reasonable evaluation of the shear stress and subsequently the kinematic eddy viscosity as important parameter for discussion of sediment transport. In addition, vertical profile of suspended sediment concentration is discussed to relate the depth-averaged concentration to the bottom concentration of suspended sediment. And the proposed concept will affect other many kinds aspect in fluvial processes, which will be clarified successively.

Particulate organic matter is another topic in ecohydraulics. In aquatic ecosystems, most particulate organic matters (POM) with smaller specific weight are suspended in water, and gradually settles. In particular, many different types of material are transported by flood are captured and deposited on sandbar with riparian vegetation. Capture of POM there must be significant in ecosystem and it is important to understand how POM drifts are different from sediment behavior in riparian vegetation, because it influences vegetation productivity and supports diversity through riverine biogeochemical process.

Transport and deposition behavior of sand and POM are somehow similar with different specific weight of particles but they are mutually related each other. Though mechanics of sediment transport has been developed well to describe fluvial process, the complicated processes including behaviors of POM has not been well understood yet. In this study, transport and deposition of sand and POM in vegetated area are focused on and investigated by using a fundamental flume experiment and numerical calculation scheme.

As above mentioned, this study made 2D depth averaged model more powerful and reasonable to be applied to flow and fluvial processes in streams with vegetation by introducing the roughness boundary layer concepts. Furthermore, a conceptual model that ripples trap POM and cover them was proposed to evaluate POM deposition in vegetated area. Resultantly of this study, morphological change with POM deposition which is essential processes in river ecosystem can be described reasonably. Detailed analysis and technical development of research on this line would promise more reasonable river management.