

Initial Recruitment Mechanism of Riparian Vegetation onto Bare Bar in Sand Bed River

by

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Submitted in partial fulfillment of the requirements for the degree of
DOCTOR OF ENGINEERING

September 2019

ABSTRACT

It is important to identify the recruitment zone of riparian vegetation and the mechanism of vegetation recruitment since the recruitment of riparian vegetation may promote vegetation (forest) expansion, which can reduce the flood passage capacity and alter ecological balances.

This dissertation focuses on the initial recruitment of riparian vegetation onto bare bar. Three processes of the phenology of initial recruitment of vegetation, i.e., seed dispersal, seed germination and seedling settlement, were considered in this study. The mechanism of initial recruitment of riparian vegetation was clarified by a case-studied river, Suzuka River, which is a sand bed river and located at Mie prefecture, Japan. The dissertation consists of four main parts as following.

The distribution of accumulated seeds and the methods of seed dispersal were studied first. Generally, the relative large flood and shoreline area were considered in the previous studies and they were considered in this study too. As a new proposal of this study, different flow regimes and ground surface undulation such as dunes at the upland area of bare bar were also considered. The field investigation of accumulated seeds distribution in the upper soil layer of the bare bar under different flow regimes was conducted first. Then the possible influencing factors on seeds distribution and the possible methods of seed dispersal were analyzed. The investigation results showed that moderate floods were the most favorable condition for seed dispersal and seed accumulation. Hydrochory and wind dispersal seem to be the dominant methods of seed dispersal to the shoreline and the upland area of bare bar, including flat area and dune of bare bar, respectively.

Second, the characteristic of the distribution of initial recruitment, such as initial recruitment zone location and coverage rate of vegetation, was studied. The land cover

condition and river morphology were investigated by using UAV monitoring method. The distribution characteristics of initial recruitment zone and coverage rate of vegetation were analyzed by referring the high resolution of the UAV field survey results in ArcGIS. The field investigation results showed that the initial recruitment zone concentrated mainly along the shoreline, which has close relationship with the relative elevation, and the downstream side of dune of upland area of bare bar, which was a new discovery in this research. The coverage rate of riparian vegetation presented the decreasing trend from the internal boundary to the external boundary of the initial recruitment zone along the shoreline.

Third, the influencing factors on the distribution of the initial recruitment of riparian vegetation were analyzed by referring the field survey data and 2-D flow simulation results. The analyzed results showed that the physical environment of the bare bar, such as water content, was more significant than the seed density for the initial recruitment of riparian vegetation. The greater surface roughness, e.g., vegetation litter and gravel on river bed surface, may promote the initial recruitment of vegetation more. The location of the initial recruitment zone was determined by the annual maximum flood and the inundation frequency during the seed dispersal period.

Finally, an initial recruitment model was proposed from the viewpoint of hydro-morphology. The established recruitment model was calibrated by using the field survey results, and then it was validated in the object river, Suzuka River. The internal and external boundary of the initial recruitment zone was determined by considering the inundation frequency and flood magnitude during the seed dispersal period, respectively. The coverage rate of vegetation was calculated as the function of inundation frequency and the souring force of spring flood. The simulation results showed that the proposed initial recruitment model can well predict the initial recruitment zone and approximately represent the coverage rate of vegetation, and this means the inundation frequency and spring flood are dominant factors for the initial recruitment of riparian vegetation.