Runoff Characteristics and Stream Loading of Coarse Woody Debris from the Forest in Haean Catchment

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Introduction

Inputs of woody debris (WD) contribute to the function in aquatic ecosystems as a main energy source. In Korea, runoff and transport of WD dramatically increase during strong rains in the monsoon season in a similar way to that observed for sediments and nutrients in agricultural area runoff. Therefore, stream loading with large amounts of WD should be recognized and controlled as a major polluting factor. We considered not only small sized WD (DOC, FPOC) but also large sized components (CPOC >1mm). This study was conducted to assess runoff and export of WD ranging from DOC to CPOC during rain events.

Material and Methods

The study area is located in Haean, Yanggu-gun Kangwon Province, Korea in the upper watershed of Lake Soyang. Field sampling was conducted in the headwater of a 100% forested watershed of 22 ha area. The sampling was conducted during the rainy season from 2011 to 2012, and included 10 rainfall events.

Four size groups were defined for WD loading as DOC (under 0.45 ㎛), FPOC (0.45 ㎛~1 mm), CPOC (1~2 mm), CPOC (over 2 mm). Flow was measured with a V-notch weir and water gauge (mini-TROLL). We collected WD of DOC and FPOC as water samples, and WD of CPOC by netting (1mm mesh) and screen installation (5cm grid). Analyses included loss on ignition at 550 ℃, and Shimadzu 5000A for DOC and CHN analyzer for POC.

Result and Discussion

Characteristics of WD in runoff differ according to discharge, precipitation, and rainfall intensity. DOC was much higher than POC in the dry season, or with small precipitation and low flow. TOC was invariable under 20 mm precipitation (Fig. 1- left), and only DOC showed a slight increase under 37 mm precipitation and 2.6 mm/hr intensity (Fig. 1- right).

Runoff of particle WD showed a distinguishable increase in medium scale discharge of which the peak was over 0.2~0.3 m/s (Fig. 2). Especially, CPOC (over 2 mm) started to increase after approaching 0.2 m/s discharge peak, but DOC showed higher concentrations than CPOC (over 2mm), 5.6 and 5.5 mg C/L, respectively.

Runoff of particle WD > 2 mm showed extreme increases approaching 0.4 m/s discharge (Fig. 3 - left). The rainfall event recorded the highest precipitation and discharge peak as 320 mm and 1.0 m/s among events in 2011~2012 (Fig. 3 - right). CPOC > 2 mm was 30 times higher than DOC in the peak discharge as 137.1 mg C/L and 4.6 mg C/L respectively, and CPOC concentration at the peak was about 12 times higher than that in July, 03~04.

Particle size of WD loading was distributed in the proportion 73~92% to 8~27% between DOC and POC in the small scale event. However, in the large scale event, it showed 11~33% to 77~ 89% between DOC and POC (Table1). As the precipitation and discharge increase, particle size of WD tended to increase as well as the loading.

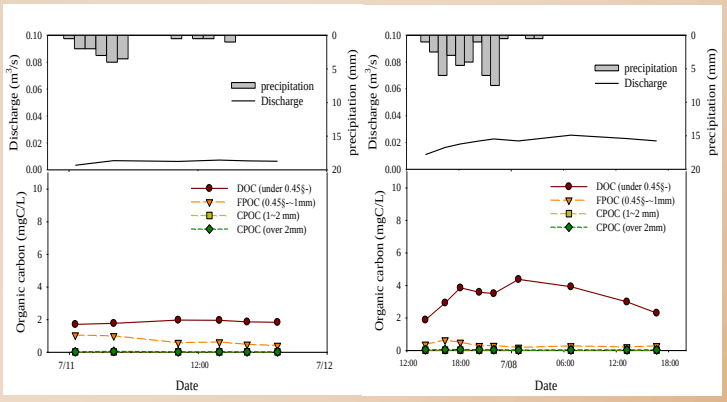

Fig. 1 WD runoff for small discharge and precipitation.

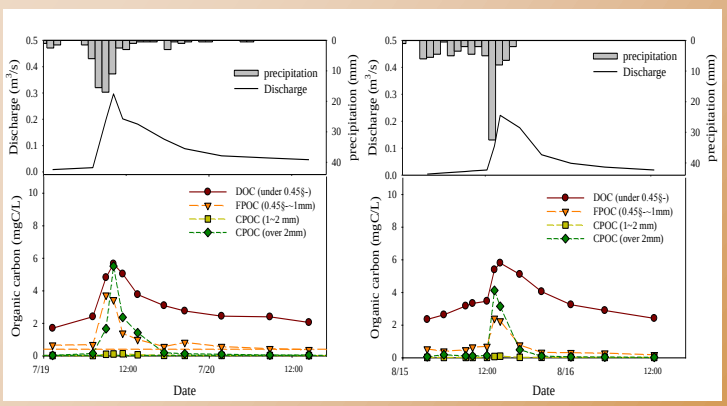

Fig. 2 WD runoff for intermediate discharge and precipitation.

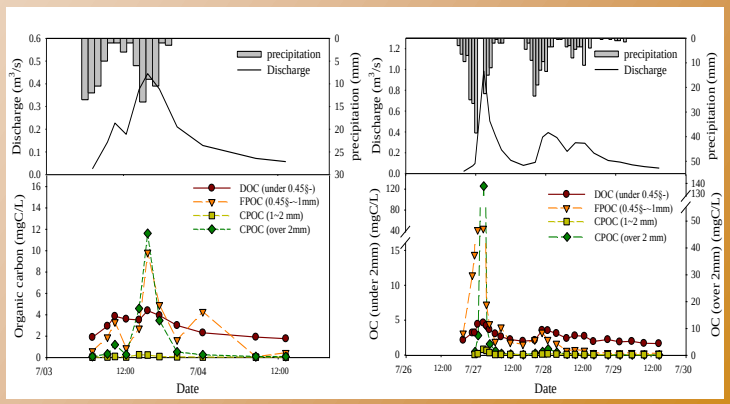

Fig. 3 WD runoff for high discharge and precipitation.

Table.1 loading of woody debris (WD) according to particle classification for each event. (unit: kgC/event/ha)

Event scale	Rainfall (mm)	Discharge (m3/d)	DOC (under 0.45㎛)	FPOC (0.45㎛~1mm)	CPOC (1~2 mm)	CPOC (over 2mm)	TOC of WD
Small	18	432	0.04 (72.6)	0.01 (26.8)	0.00 (0.0)	0.00 (0.5)	0.05 (100)
Small	37	2,065	0.07 (92.3)	0.01 (7.2)	0.00 (0.1)	0.00 (0.5)	0.08 (100)
Intermediate	70	11,812	1.96 (57.4)	0.72 (21.2)	0.02 (0.7)	0.70 (20.6)	3.40 (100)
Intermediate	88	6,785	1.40 (68.5)	0.30 (14.8)	0.01 (0.4)	0.33 (16.2)	2.04 (100)
High	89	18,886	0.62 (32.7)	0.71 (37.3)	0.01 (0.8)	0.55 (29.2)	1.90 (100)
High	320	51,639	1.59 (11.1)	4.29 (30.1)	0.09 (0.6)	8.28 (58.1)	14.25 (100)