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Measuring Effect of Gravel Augmentation Using Radio Frequency Identification (RFID) in Mountainous Areas of The Trinity River, California

○Kanta KANO, David Gaeuman, Tetsuya SUMI, Yasuhiro TAKEMON

Introduction

The construction of dams and transportation water from the Trinity River into the Sacrament River have had an adverse impacts to habitat for salmon and steelhead that the Hoopa and Yurok tribes live together for thousands of years. The Trinity River Restoration Program (TRRP) has been at the forefront of putting much effort into coarse sediment management, gravel augmentation, channel rehabilitation activities and continuous monitoring below Lewiston Dam, to implement recovery of the Trinity River and its fish population.

The objectives of this study are 1) to assess sediment mobility and verify the effect of gravel augmentation by tracking sediment transport by using passive Radio Frequency Identification (RFID) transponder and antenna and 2) to propose effective place, amount and method of gravel augmentation to increase sediment supply to creating spawning bed and appropriate habitat for fish to increase populations in the downstream of Lewiston dam.

Study area and methodology

The Trinity River is the largest tributary of the Klamath River in northwest California. It originates in the Scott Mountains and Trinity Alps of northern California, approximately 98 km upstream of Lewiston dam that has a function of transferring water from Trinity River to Sacramento River Basin to satisfy water demand (Fig.1). The gravel injection was put into operation at Lowden ranch reach 12 km downstream from Lewiston dam in May 2016. (Fig.2)

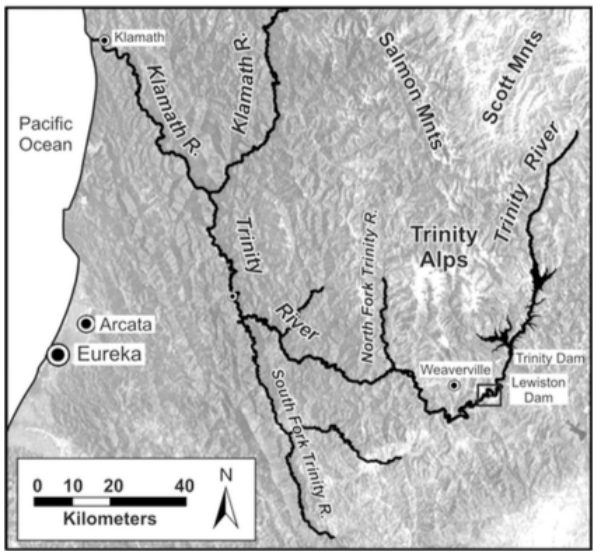

Fig.1: Basin of the Trinity River

Fig.2: Lowden ranch reach
(a red circle indicates the point of gravel injection)

The total 1231m^3 of gravels containing 960 rocks were installed PIT-tag on the inside of the rocks were injected.

We conducted field surveys from September to October 2017 in the Lowden ranch reach and the downstream of Lewiston dam, with RFID transponder

and antenna, raft boat, inflatable kayak and some equipment to detect PIT-tag rocks (Fig.3).

Fig.3: RFID antenna (detector)

As an analysis phase, we take the following three steps: 1) Setting calculating condition of analysis solver for river bed variation by using the result of tracking PIT-tag rocks; 2) Predicting future variation of river bed and examining the optimal amount of gravel augmentation; 3) Discussing the possibility of installing river structures combined with gravel augmentation to keep river bed in more good condition.

Results and future work

We have detected more than 80 percentages of PIT-tag rocks we injected at Lowden area (Fig.4). The length from injection point to rock found at most far point is approximately 300 m.

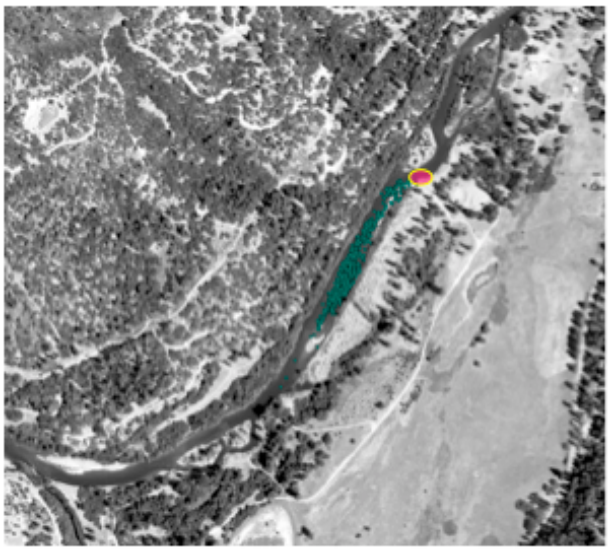

Fig.4: detection map

Mflow_02, Analysis solver for iRIC (Model for calculation two-dimensional plane unsteady flow and riverbed variation), was used for a calculation of the change of the riverbed. There are three large discharge periods from May 2016 to September 2017. Fig.5 shows the result of riverbed variation after the first discharge period and indicates that elevation change, up to more than 5 cm, can be seen just under the injection point and the range of elevation change extended to about 70m downstream.

By calculating the remaining two discharge periods, it is expected that the result of mobility of the gravels injected could be duplicated and discuss more desirable methods of the gravel augmentation.

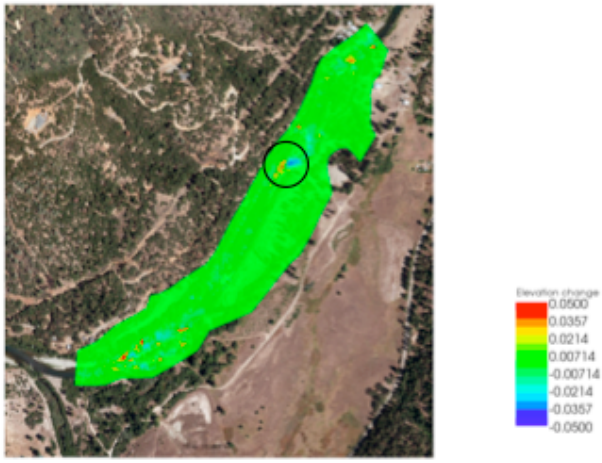

Fig.5: the result of elevation change of riverbed

Reference

Eric A. Stene: Trinity Division Central Valley Project, Bureau of Reclamation, 1996

Enrica Viparelli, David Gaeuman, Peter Wilcock: A model to predict the evolution of a gravel bed river under an imposed cyclic hydrograph and its application to the Trinity River, Water Resources Research, vol. 47, 2011

David Gauenman, Robert Stewart, Brandon Schmandt, Cort Pryor: Geomorphic response to gravel augmentation and high-flow dam release in the Trinity River, California, Earth surface processes and Landforms, 2017