Reconstruction of past flood events in the Neka River-North of Iran, using Dendrogeomorphology

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1. Introduction

Wood is the long-term memory of the history of a tree which is records the environmental changes by anatomic and formic changes. denderocronology uses the trees as natural evidences or "silent witnesses" to reconstructing the past environmental characteristics. ‘dendrogeomorphology’ is one of the subfields of dendroecology which has been widely used for study of past geomorphic processes. dendrogeomorphology is detected of spatial and temporal aspects of the surface processes by analyzing of annual growth tree rings and disturbances in tree forms. Also dendrogeomorphology enables to precise the event occurrences in annual and even seasonal time scales. Based on the principle of dendrogeomorphology affected trees by geomorphic processes react to the events as disturbances in their ring and forms, in other words these reactions recorded in the series of their rings. Trees in temperate climates generate one growth ring in each year and Flood as a river geomorphic process influences on the trees morphology in margins and river bed, and lead to different growth responses in the series of tree ring. Tilted and scared trees thought the river bed and banks are the most common types of dendrogeomorphological evidences created by paleoflood events. These tree disturbances have been used for dating and reconstruction of past geomorphic events. Stem tree scars can be used as a paleostage indicators(PSI) to help researchers for reconstruction past flood events.

2. Study area

With approximately 3 km length, the study area is part of the mainstream Neka River in the south of Neka city. The beginning of the study reach is located in 36˚ 37′ 24″ N latitude and 53˚ 21′ 52″E longitude. The end point of the study reach terminated to Abloo convert dam which is located at 36…N latitude and 7778 E. Neka basin is an oblong basin with an area over 1903km2 started from northern slopes of Albborz mountain range and drains to Caspian sea in the north side of Neka city. The main

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stream originated from the Shahkooh Mountain in the south of Grogan and after receiving other tributaries creates the Neka River, after passing across the Neka City flows into the Caspian Sea. The length of main stream channel is 150km measured from the upstream until basin outlet in the Ablo gage station.

3. Material and methods:

Research method of this study is experimental- historical. We Firstly collected the basic data including book and articles, statistical data, satellite images and digital elevation models (DEM). Then we have analyzed the frequency of peak discharge records obtained from Iran ministry of power (IMP) for Abloo gage station. As well as we prepared the base maps including contour, slop, aspect, and geomorphological maps.

Sampling method of our study was selective as we extracted 18 cores through stem tree scars using a 300mm increment borer. The sampling trees are been located in the margin of stream channel and river banks. Also we were taken 6 reference samples from the trees without growth disturbances to make a cross dating with damaged trees. We used an identification card to record the characteristics of the sampled trees, including of tree type, tree diameter, tree height and tree scar dimensions as well as we marked the tree coordinates using an Etrex Vista portable GPS. We continued the study stages after sampling as following steps: 1- the cores were fixed on wood holders, then exposed the samples for drying in the laboratory atmosphere for several days. 2- the sample surfaces were smoothed by special sand paper to produce better clearness of number and widths of the rings. 3- The number of rings and ring widths were counted and matured using digital table LINTAB attached to the stereomicroscope (Leica stereomicroscope) and TSAPWIN software program. These laboratory equipments provided a 1:100mmof measuring accuracy. 4- Tree growth curves were drawn by TSAPWIN package and then analyzed to reconstructing of the flood event times. 5- In the last stage, the results obtained by dendrogeomorpholology method are compared with stream peak discharge records of Abloo gage station for period of 111111. Also we surveyed 4 stream channel cross- sections to use them for assessing the surface, mean velocity and discharge of past large floods in the study sites.

4. Results and discussion:

In this study, we analyzed the biologic paleo stage indicators and stream channel flood marks to reconstruct the past large hydrological events. We dated the large floods according to the sudden decreasing in the growth trend and growth pattern of tree rings. Then the results obtained from the tree ring analysis were compared and adjusted with systematic instrument data of Abloo gage station. According to the results of dendrogeomorphological analysis, we found out that most of scars have originated from the floods of 2008 and1999 with 130m3/sec and 2000 m3/sec respectively. Most scared trees are resulted from above floods in the study reach as the flood impacts obviously recorded in the tree ring series. Also the flood of 2003 with 361 m3/sec peak discharge causes greatest impacts on tree growth trends in the margin of river bed. We reconstructed two past large flood events in the study river which is

occurred before establish of Abloo gage station. Based on changes in tree ring growth trends these two floods occurred in 1941 and 1955. With 270cm height from tree base, the largest stem tree scar in the study area relevant to Flood of 1941. Moreover the reconstructed floods by tree rings method were compared and coincidence with peak discharge data of Abloo hydrometric station and obtained results show that all of cases have coincidence and conformity with recorded data in the study station. We recognized the highest stem scar in the sample number 16 which is formed by a flood in 1935. The Scar height shows the flood mark of the largest paleo flood with 4277 m3/s in the study river. Reconstructed discharge has been calculated using the geometric data of study reach. We surveyed 4 channel cross-sections regarding to tree scar heights, then the area, perimeter, slope and bed roughness coefficient parameters determined in the cross- section sites. We used the manning equation for estimation of past flood discharges.

5. Conclusion

Based on the results of this study we reconstructed two largest floods in the Neka River which they are occurred in 1941 and 1955. With discharge of 4277 m/3, It seems these floods are been the largest floods of the study river during the last hundred years. Also flooding years reconstructed by the tree scars was in concordance with the flood discharges recorded in the Abloo hydrometric station. But the amount of flood discharges obtained by denderogeomorphology method is more than the recorded discharges by Abloo gage station. Then we can suggest that the analysis of trees rings and the height of scars in tree stem, are the very useful tools in the Neka River basin for reconstruction of the year of flood events and estimating of flood discharges.

Key words: Flood, Tree Rings, paleo Flood, Denderogeomorphology, Neka River.

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