ABOUT SOME UNFAVOURABLE NATURAL PROCESSES IN STRUMA RIVER BASIN

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ABSTRACT

The report is devoted to analysis of the expression of some of the most characteristic unfavourable natural processes in the river basin Struma on Bulgarian territory. As such are selected erosion and hydrological processes with risk character. Determined are areas, forms and scale of anthropogenic impact, causing the realization of these processes and phenomena.

Key words: *erosion, risk, climate change, maximum runoff, floods*

Introduction

The catchment area of Struma River is located in southwestern Bulgaria. It is located in several physico-geographical areas - West Srednogorie (with spring parts of the river in Vitosha), Kraishte, Osogovo-Belasitsa area and western parts of the Rila-Rhodope region. West the watershed borders the catchment area of Vardar River (on the territory of Serbia and Macedonia), north the catchment area of Erma River, northeast the watershed of Iskar River. East is the watershed of Mesta river. The south border coincides with the boundary between Bulgaria and Greece. Within these borders, the area of the catchment basin is 8545 km^2. The length of the main river Struma from the spring parts to the state boundary with the Republic of Greece is 290 km. The shape of the catchment area is elongated, submeridional oriented with an average length of about 250 km and an average width of 40 km. There is well expressed mountain character, which determines the larger average slope of the tributaries (from 1% to Konska River to 11,4% of the Petrichka River). The average longitudinal slope of the main river down to Pernik city is 65%, and downstream it decreases sharp on 5,3%. The average slope of Struma River to the border is 2,7%, the average altitude is 900 m, the horizontal segmentation of the relief is between 0,51 km/km^2 in the south, to 2,4 km/km^2 in northwest. The catchment area of Struma River occupies about one tenth of the country's territory and it is the second largest after that of Maritsa River. Among the largest tributaries of the Struma River are the right ones Konska, Treklyanska, Dragovishtitsa, Eleshnitsa, Tsaparevska and Strumeshnitsa River (with spring parts and parts of the watershed in Macedonia) and the left ones Dzherman (with the tributaries Razmetanitsa, Topolnitsa, Dzhubrena, Bistritsa a.o.), Rilska, Blagoevgradska Bistritsa, Gradevska River a.o. There is a wide variety of unfavourable natural processes in the research area. Here the erosion risk and the high waves with a significant peak are explored.

Morphology and erosion risk within the catchment area of Struma River

The main factors of erosion with the greatest impact on potential erosion risk in the watershed of Struma River are relief and erosion susceptibility of the soil. The relief influences by the slope of the slopes, the horizontal segmentation and the profile of the river-valleys. The erosion susceptibility depends on lithology, facial features and the degree and type of vegetation cover in the study area. A key indicator of the intensity of erosion is the specific yield of the floating sediment runoff. About 17% of the catchment area of Struma River are characterized by a maximal risk of soil erosion. Low potential risk is typical for about one third of the watershed, mainly flat and slightly sloping terrain. For the quantification and the grade of the main factors of erosion are used the Universal equation of Wischmeier and Smith by 1978, data from the project "CORINE Soil Erosion Risk and Important Land Resourses" by 1990 (Malinov, I. Ts. Marinov, U. Martensson, 2002) and GIS "ArcINFO". In the geological structure participate heterogeneous rock formations - from Precambrian and Paleozoic, which build the foundations of the surrounding block structures, to Holocene in the valley bottoms. The upstream is within Vitosha syenite pluton embedded in the Late Cretaceous volcanogenic sedimentary formations. From the spring areas on the southern slopes of Vitosha are distributed also limestones with Triassic and Jurassic age, nourishing karst springs. Large areas in the Struma valley are occupied by the oldest rocks - Precambrian metamorphic rocks presented by different types of gneisses, schists, amphibolites and marbles. Large igneous - granite and granodiorite plutons with Paleozoic and Cretaceous-Paleogenic age are embedded in the metamorphic rocks. The silicate rocks are heavily crannied and tectonic fault, making up a kind of hydrological systems. In the Paleogene and Neogene in Struma valley due to active deep faulting are formed graben sedimentary basins, where thick marine and lake-marsh sediments of breccia-conglomerates, blocks, sandstones, sands and sandy loam materials are deposited. Then were formed the Oligocene coal basins in Pernik, Bobovdol, Suhostrel and Brezhani and the Neogene coal basins in Kyustendil and Oranovo. (RBMP)

The uneven distribution of the forest vegetation especially in the Osogovo-Belasitsa area significantly affects the degree of erosion risk. It occurs more intensively in the areas of coniferous vegetation, which is naturally distributed in the high parts of the Rila and Pirin Mountains, and anthropogenic developed on the slopes of Vlahina, Maleshevska and Ograzhden Mountains. The adverse effect of coniferous vegetation is expressed by soil acidification. The densely developed deciduous vegetation in the lower parts of the Rila, Pirin and Vitosha, and on the slopes of Konyavska Mountains and the mountains of the western fencing of the Struma valley graben contributes to a lower risk of erosion. An increase of the risk of erosion is observed in areas of intense human activity, mainly in the Pernik Valley due to intensive activities in coal mining, mainly by open pit. The reducing of the overall assessment of the watershed from medium to maximum risk demonstrates the importance of vegetation cover as a factor limiting erosion and the need for its proper management (Malinov I., Marinov, W. Martensson, 2002).

The presented in **fig. 1** general schema of erosion risk visualizes areas threatened by erosion and is compiled from methodology of I. Malinov, Tz. Marinov and W. Martensson from Forest Institute by BAS. Based on this scheme and after analysis of the factors determining the level of activity of erosion processes can draw the following conclusions about the nature of the risk of erosion:

- The areas with maximum and increased risk coincide with areas with large gradients of slopes and formed series of deluvial-prolluvial cones. These are board, which fences the eastern part of the Struma valley graben (western slopes of Rila and Pirin block), some parts in the river valleys of the lower orders within Kraishte and Osogovo-Belasica area and areas, which are devoid of vegetation due to anthropogenic activities
- Areas with moderate and minimal risk occupy areas with small slope gradients and areas built of highly resistant to erosion Precambrian and Paleozoic metamorphic rocks along the western fencing of the Struma valley graben and of Mesozoic limestone complexes in the regions of Vitosha, Kraishte and Osogovo- Belasica area

When examined risk must define what is meant by the concept of risk. According us under „risk“ should be understood probability of occurrence of a process or phenomenon that would damage the economic and social infrastructure, as well as would lead to victims and wounded of the population. Under „risk degree“ should be understood territorial scope of the endangered area, the presence of conducive for dangerous phenomenon or process structures and action of exogenous factors.

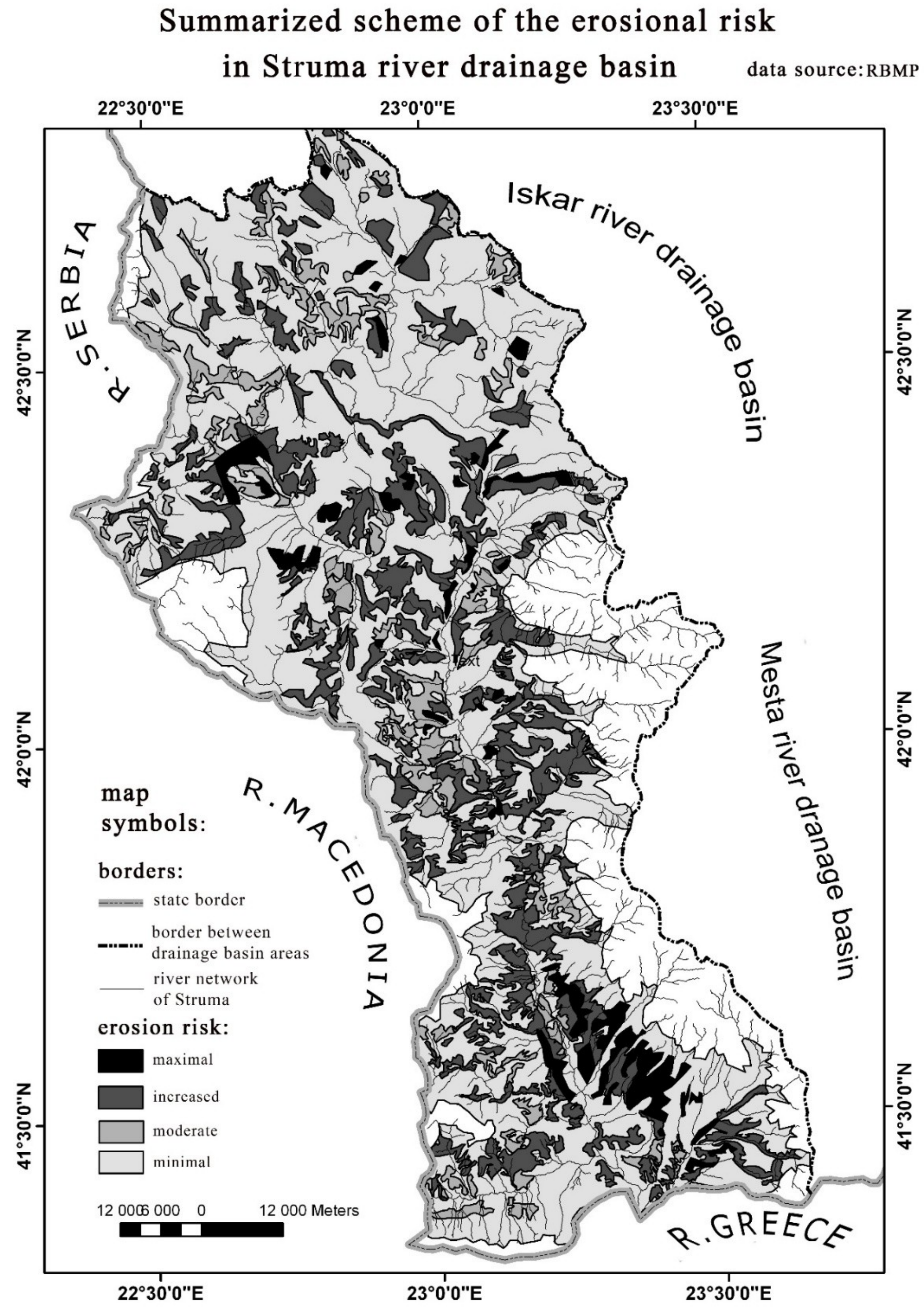

Fig. 1 Summarized scheme of the erosional risk in Struma river drainage basin

Based on analysis of the factors, it can be concluded that the study area is subjected to moderate to medium risk of erosion. It is necessary to be realized active anti-erosion activities in areas with maximum and increased risk through terracing and specialized processing of sections used for agriculture, strengthening and drainage of sections along the objects of transport infrastructure. It is possible to take measures in reforestation of denuded areas and it is recommended to do it mainly with deciduous vegetation.

Temporal occurrence of maximum runoff in decades

Another unfavourable natural process in the catchment area of Struma River is the emergence of high waves with significant peak and volume. During the course of their often the maximum annual quantities of water are register. It is possible that such high waves go out of the riverbed and cause floods associated with serious material damage and even casualties. This study aims to display when the maximum runoff in different parts of the basin of Struma appearance. The seasonal distribution of annual maximum runoff in decades of the 40-ies of last century to the present day is considered. Similarities and differences in its occurrence and configuration specifics of seasonal frequency, which sign climate change, etc. are sought.

Choosing the HMS for the study is determined by several criteria. These are the presence of more advanced data runoff, presence of limnograph and diverse location of gauging stations - at the main river and its tributaries (left and right), watersheds with different catchment area and different altitude and more. Data from 6 hydrometric stations in the watershed of the Struma River are analyzed. (Fig.2).

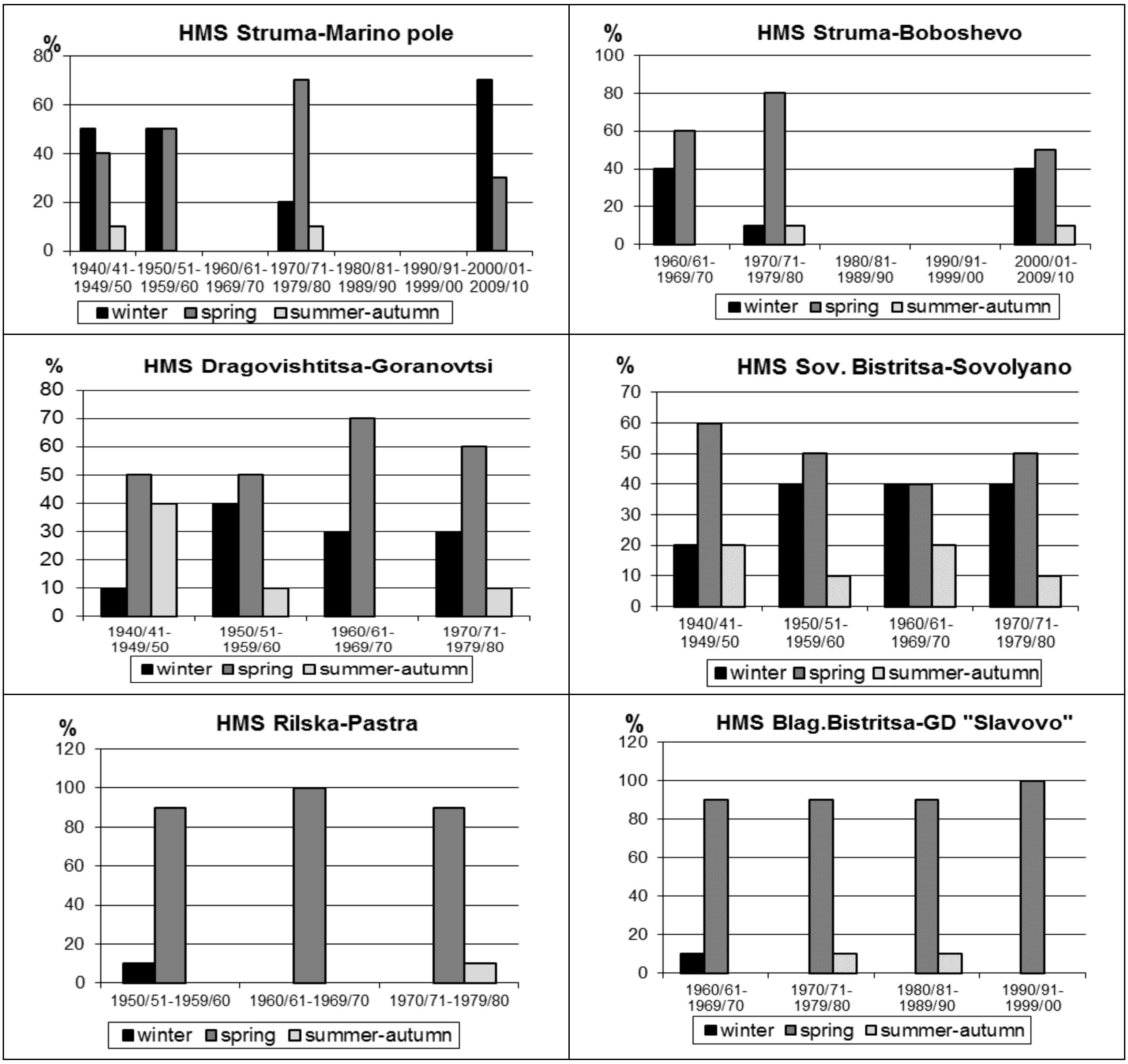

Fig 2. Seasonal frequency of maximum runoff in decades

According to a similar study for the 25 year period (Nacheva, 2002) frequency of maximum runoff in the basin of Struma is greatest during spring hydrological season (Panayotov, 1967). Secondly is the frequency during the winter hydrological season and latest - in the summer-autumn.

In the seasonal distribution of the maximum runoff, analysed for decades, the leading share of the spring rate does not change (**fig. 2**). Values ranged from 50% in the 40-ies and 50-ies at HMS Dragovishtitsa-Goranovtsi, in the 50-ies and 70-ies at HMS Sovolyanska Bistritsa-Sovolyano and in the first decade of 21st century at HMS Struma-Boboshevo to 100% in the 60-ies at HMS Rilska-Pastra and 90-ies at HMS Blagoevgradska Bistritsa-GD „Slavovo".

Exception is the 40-ies of 20th century and the first decade of this century at HMS Struma-Marino pole, where first in frequency is winter hydrological season. In 40-ies winter rate was 50%, in the coming decades is aligned with the spring rate and runs second only to her, but at the beginning of 21st century increased again to 70%. If we compare the results of the seasonal distribution of the maximum runoff with the other station, for which we have more recent data, we can see that at HMS Struma-Boboshevo also experienced a significant increase of the winter rate from 10% in 70 years on 40% in the first 10 years of this century at the expense of reduction of the spring rate by 30%. This can be explained by the relevant climate change, changes in annual and long-term course of meteorological elements and others. But the lack of free access to detailed information about the intense and heavy rainfall, air temperature and melting snow, as well as more recent data from gauging stations in the region do not allow to draw definitive conclusions and generalizations.

Another exception is the 50-ies at HMS Struma-Marino pole and the 60-ies at HMS Sov. Bistritsa-Sovolyano when equalization in the frequency of maximum runoff in spring and winter hydrological season respectively 50% and 40% is observed. Here we can say the same as for the above case.

Time analysis of the season with the second highest frequency of maximum runoff is made. In most stations and in most decades it is winter hydrological season. During this period the values of the frequency range from 10% to 40%. Exceptions are the 40-ies at HMS Dragovishtitsa-Goranovtsi when winter rate (10%) is replaced to third place by the frequency in the summer-autumn season (40%) and the same decade at HMS Sov. Bistritsa-Sovolyano when winter and summer-autumn frequency are equal in value (20%).

Of interest are the cases when a concentration of cases of maximum runoff in one season is observed. They are recorded at HMS Rilska-Pastra and at HMS Blag.Bistritsa-DG "Slavovo" where the period from the 50-ies to the last decade of the last century clearly feature the high frequency in spring season. The difference is that in the 50-ies and 60-ies the spring frequency is accompanied by isolated cases of maximum flow in winter (10%), but in the 70-ies and 80-ies years rare cases of maximum flow are realized in summer-autumn hydrological season (10%) instead in the winter.

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