

THE INFLUENCE OF HIDROCLIMATIC RISK FACTORS ON THE EVOLUTION OF NATURAL SITES

INFLUENȚA FACTORILOR DE RISC HIDROCLIMATIC ASUPRA EVOLUȚIEI SITURILOR NATURALE

LUCA M¹., AVRAM Mihaela¹, LATEȘ Iustina¹

e-mail: mluca2004@yahoo.com

Abstract: *The paper presents an analysis of hydrological risk parameters and record linkage on the river Moldova in the area of Soci, Iași County. This area is framed in a natural site "Oniceni – Mitești" which is situated on the river Moldova. The site is part of the natural "Oniceni – Mitești" integrated European Ecological Network Natura 2000 site in Romanian. Natural protected area of the site was affected by multiple floods in recent years. Floods have changed morphologically and major minor riverbed of the River and this situation has influenced the evolution of parameters and safety. The study focused on the analysis of fluid flow (minimum, medium and maximum) and solid measured over a period of 50 years in the area of research. Processing of data showed more flood flows during that year (e.g., 2004, 2006 and 2008). The positioning of the river within the site's natural "Oniceni-Mitești" imposes special conditions on the design of hydrotechnic constructions.*

Key words. river, flows, hydrological risk, flood, natural site, river habitat

Rezumat. *Lucrarea prezintă o analiză a parametrilor de risc hidrologic înregistrați pe râul Moldova în zona localității Soci, județul Iași. Această zonă este încadrată în situl natural Oniceni – Mitești, care este amplasat pe râul Moldova. Situl natural Oniceni - Mitești este parte integrată a rețelei ecologice europene Natura 2000 în România. Zona protejată a sitului natural a fost afectată de multiple viituri în ultimii ani. Viiturile au modificat morfologic albia minoră și cea majoră a râului, situație ce a influențat parametri de evoluție și siguranță ai habitatului. Studiul s-a axat pe analiza debitelor lichide (minime, medii și maxime) și solide măsurate pe o perioadă de 50 de ani în aria de cercetare. Prelucrarea datelor a evidențiat mai multe debite de viitură în cursul aceleiași an (ex. 2004, 2006, 2008). Poziționarea unor lucrări de regularizare a râului Moldova în cadrul sitului natural „Oniceni - Mitești” impune condiții speciale la proiectarea construcțiilor hidrotehnice.*

Cuvinte cheie: râu, risc hidrologic, debite, inundație, sit natural, habitat fluvial

INTRODUCERE

Conservation geographical areas with special flora and fauna imposed creating "natural sites" protected by law. Europe was created ecological network "Natura 2000", which was implemented in Romania through a series of

¹Technical University "Gheorghe Asachi" of Iasi, Romania

community sites protected by law. These sites include protected areas where human action is limited. Part of the Moldova river and waterside fall into the "site of Community importance ROSC10363 River between Oniceni and Mitești".

In the last 20 years have produced a number of climate changes in the world, with direct influence on the hydrological cycle. These changes are present in Romania and influence the distribution of annual rainfall and flows in river basins. The high value of the changes creates a risk hydroclimatic important in the evolution of flows and levels on rivers. Hydrological changes influence the behaviour of the river, but also existing constructions in the river bed and bank.

Hydrological regime of rivers in Romania is characterized lately by the high frequency of floods. During the year there was two or three flood of high value.

Hydrological risk elements affect existing habitat in the major and minor river bed. The effect of changes can be noticed immediately or appear after a longer time. Existing habitat in the river bed and riparian area is influenced by the work of regularization of the river. These works are directly dependent on the hydrological parameters. Disruption of hydrological parameters determines the default behaviour of the regularization and conditions of existence of river habitat (Bica, 2000).

MATERIAL AND METHOD

Natural site "Oniceni - Mitești" is set in the river Moldova in Suceava, Iasi and Neamt county. Site area is 3215 ha. Site coordinates are: N latitude 47° 17' 22"; E longitude 26° 29' 3". The minimum altitude is 235 m site, maximum 339 m and average 271 m. Biogeographical region is of the "Alpine Continental Pannonian Pontic". Natural site "Oniceni - Mitești" contains habitat type classes rivers, lakes, arable land, grassland and deciduous forests. The present site mammal species listed in Annex II of Council Directive 94/43 / EEC. Investigated the river section fall into the "Site of Community Importance ROSC10363 River between Moldova and Mitești Oniceni" (fig. 1a).

The research material consists of hydrological studies, hydraulics, surveying, geotechnical safety of constructions etc. made on the river. Studies and research are carried out for a period of about 15 years. Theoretical and experimental research was conducted on the following areas (Luca, 2012):

1. Research on hydrological parameters of catchment area considered in the study. Analyzed parameters are: liquid flow, solid flows, levels, frequency of floods, flooding areas etc.
2. Research hydraulic parameters on the section of river located in the study area. Analyzed parameters are flow, level, and speed (average, minimum and maximum, speed distribution) in the sector analysis sections of the river.
3. Research hydrological risk parameters on the morphology of the river bed of the river studied.
4. Effect of hydrologic and hydraulic risk parameters on riparian habitat.

The primary data were processed using statistical computer programs and hydrological and hydraulic calculation software applicable in this case studies.

RESULTS AND DISCUSSIONS

In research were used climate and hydrological data collected from the nearest hydrometric station on the river Moldova (HS Tupilati). For more correct analysis, hydrologic and hydraulic parameters were calculated characteristic

sections on the river. Analysis debit transiting realized in the characteristic intervals of 10 years, 25 years and 55 years (Luca, 2012).

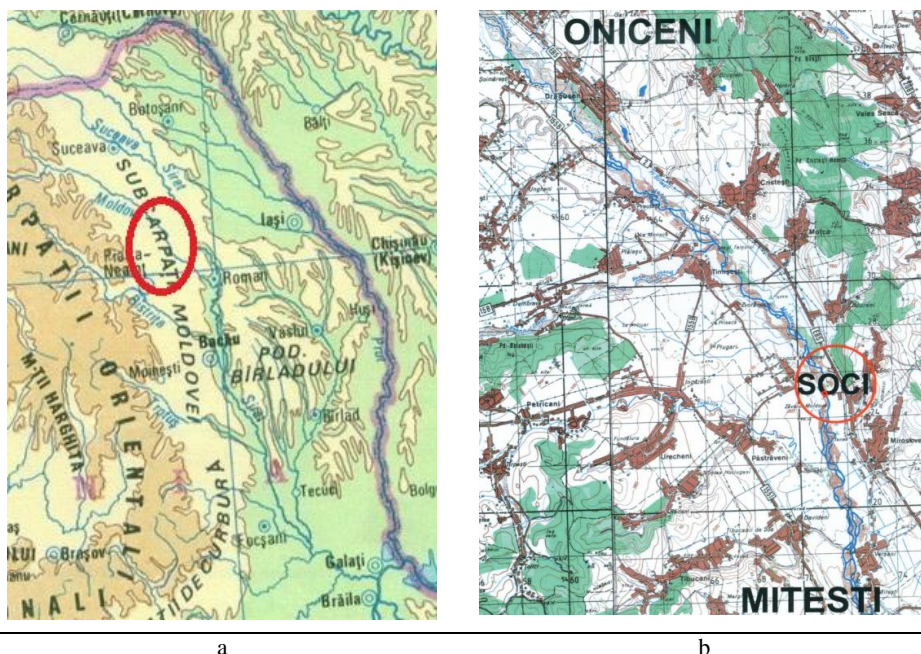


Fig. 1 Framing the study area Sochi river Moldova in "natural site Oniceni - Mitești"
 a - natural site location in Moldavia; b - natural area of influence of the site.

From the analysis that heavy rains are more present in the last 20 years in the basin of river (fig. 2). This led to changes in rainfall and multi pace generated with very high flow rates in a very short time (tab. 2). Situations of this kind were recorded in 1992, 2005, 2008 and 2010. Flash floods caused by river Moldova in recent years have negatively influenced waterside, river habitat, agricultural land adjacent, adjustment works, bridges, roads etc. (Luca and Stoenescu, 2007)

Table 1

The multiannual average precipitation at H.S. Tupilați (l/m²)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
R(l/m ²)	179	192	242	436	655	835	861	629	47.7	28.5	24.3	22.7	526.1

From the analysis that extreme values of rainfall were recorded at different times of the year (April-May, June-July, September-October). In the period 2004 - 2015 prevailed summer and autumn. In the period 2004 - 2012 occurred most damage on the river section studied (Moldova River Soci area). Monthly and annual maximum flow analysis revealed high frequency of the near-equivalent of filling the riverbed flow (Luca, 2012, Vamanu and Olaru, 2002)

Processing of hydrologic data for the period 1959 - 2014 (Hydrometric Station Tupilați) showed that the annual maximum flow is set to 1402 m³/s (1991, July,

probability calculation $p \approx 3\%$). In the first study period, the years 1990 - 2014, the highest values of maximum flow are shown in Table 2. The lowest maximum flow was registered in 1986 and 1990 ($Q = 105 \text{ m}^3/\text{s}$). Historical minimum flow was $1.0 \text{ m}^3/\text{s}$ and was registered in 1991, February. The ratio of maximum flow rate at historically low historically and is about 1.400 (Luca, 2012).

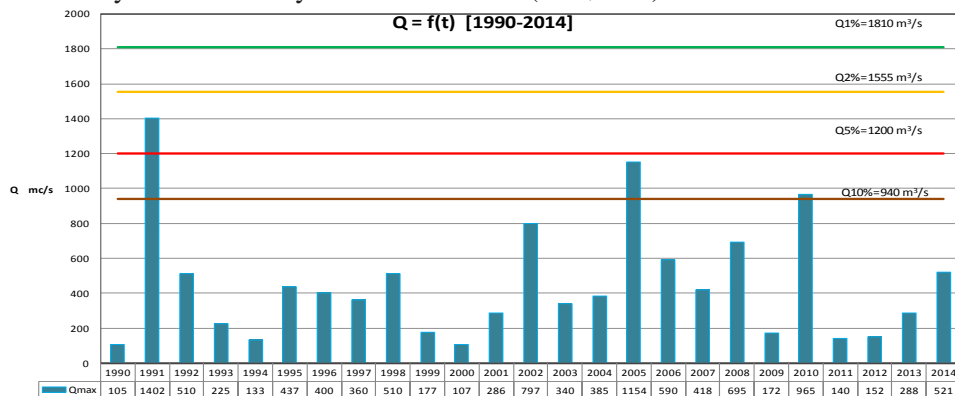


Fig. 2 The frequency of annual maximum flows during of the analyzed period 1990-2014

Table 2

Maximum flows during the study HS Tupilati							
Year	1991	2002	2005	2006	2008	2010	2014
$Q_{max}(\text{m}^3/\text{s})$	1402	797	1154	590	695	965	521

To highlight the hydrological risk parameters were analyzed monthly and annual maximum flow rates. In the analysis were considered and debits term average interval of time.

Processing of data showed that the annual average flow for the period 1959 - 2014 amounts to $31.806 \text{ m}^3/\text{s}$. Data processing during 1990 - 2014 indicates a value of $29.298 \text{ m}^3/\text{s}$. The annual average flow of the lowest in the analyzed period (1959 - 2014) is $9.59 \text{ m}^3/\text{s}$ and the highest value on the same period is $57.80 \text{ m}^3/\text{s}$ (Luca, 2012).

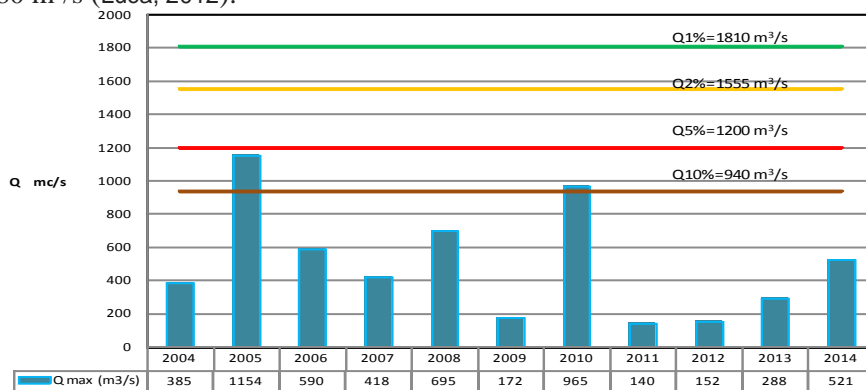


Fig. 3 The frequency of annual maximum flows during of the analyzed period 2004-2014

A special analysis was performed over the interval 2004 - 2014 on the river Moldova in Soci area, Iasi County. The habitat in this area is disrupted by the presence of regularization of constructions riverbed and riverbank protection. They changed bed morphology and habitat conditions have negatively affected (Luca and Ignat, 2007). The frequency analysis of annual flood flows showed a risk hydro - climatic (fig. 2). The river bed Moldova has crossed in 2005 a flood flow $Q = 1168 \text{ m}^3/\text{s}$. In 2010 there were in the Soci zone the floods were recorded in three consecutive months: May with $Q = 505 \text{ m}^3/\text{s}$, June $Q = 945 \text{ m}^3/\text{s}$ and July with $Q = 965 \text{ m}^3/\text{s}$ (fig. 3) (Luca, 2012). The effects of floods have resulted in erosion and degradation defence riverbed shores.

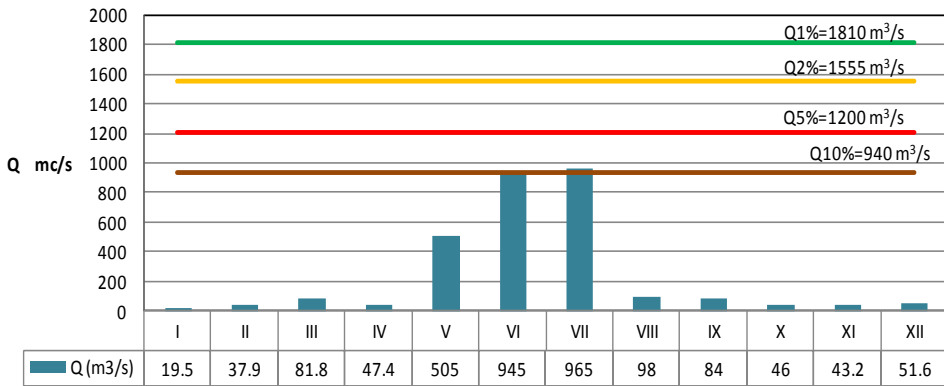
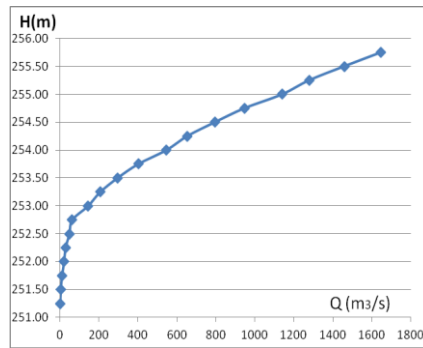


Fig. 4 The frequency of maximum monthly flow in 2010, the river Moldova, the Soci zone

An important morphological change of the river Moldova in the village Soci is the minor riverbed branching into two arms. The first arm consists of original bed and the second arm was performed undercrossing construction consists of the implementation of adduction pipes Timișești - Iasi. The two arms have led dividing flow and flow- through change. A first consequence of branching riverbed is increasing water velocity on each arm crossing floods.



a



b

Fig. 5 Elements of the hydraulic analysis on the river Moldova in Soci area, "Natural site Oniceni - Mitești"; a - view of the study area; b - the correlation $Q=f(h)$ on the left arm.

The right arm of the river (the original riverbed) carrying about 60-70 % of the total flow of floods. Debits taken from the riverbed at maximum level are $Q = 989 \text{ m}^3/\text{s}$ on the first arm and $Q = 305 \text{ m}^3/\text{s}$ on the second arm (Luca, 2012).

The riverbed in the construction undercrossing no shows favorable characteristics for the habitat of species in natural site. Negative influences on the natural site held by current way of structuring the river bed in the area of undercrossing. Influences are produced by high water speed and the presence pitching concrete. Albia calibrated does not allow rest areas, breeding and feeding of aquatic fauna. Flora is influenced by the presence of mobile ballast layer of foundation bed. Moldova River presents the final (specific area Sochi) a channel with a large development in the transverse plane. The presence ballast foundation affecting the morphological transformations the river (Ujvari, 1972). This determines the special conditions of development of the natural habitat of the site "Oniceni Mitești".

CONCLUSIONS

1. Hydrological regime of rivers in Romania is characterized lately by the high frequency of floods; during the year there was two or three flood of high value of the flow.

2. Territory natural site "Oniceni - Mitești" located on the river Moldova has been affected in the last 15 years of hydrological phenomena and hydraulic nature of the disaster, which influenced the major coastal habitat and the riverbed.

3. In the period from 2000 to 2015 occurred in the area analyzed a series of flood with high flow rates and low high frequency intervals of time, that changed the riverbed morphology and degraded work regularization and protection shore.

4. Climatic phenomena in the catchment area of river in the last 15 years can be characterized as hydroclimatic risk phenomena by their destructive influence on the evolution of morphological riverbed and hence on riparian habitat area.

REFERENCES

1. **Bica I., 2000** - *Elemente de impact asupra mediului*, Editura Matrixrom, București.
2. **Luca M., 2012** - *Expertiză tehnică privind lucrări de reabilitare în zona de subtraversare râu Moldova a conductelor de aducțiune apă Timișești, sat Soci, jud. Iași*. SC POLIAS-INSTAL Iași.
3. **Luca M., Ignat A., 2007** - *Morphological Changes Caused by Floods in 2004-2007 on Soci Area at the Moldova River*. International Conference „Disaster and Pollution Monitoring – IC.DPM. 3”. 1-2 nov. Iași, I, 83-92 pp.
4. **Luca M., Stoenescu I., 2007** - *Current Issues Concerning Regularization Works Behavior under Disaster Conditions*, International Conference „Disaster and Pollution Monitoring – IC.DPM. 3”. 1-2 nov. Iași, 93-98 pp.
5. **Ujvari I., 1972** - *Geografia apelor României*. Edit. Științifică, București.
6. **Vamanu E., Olariu P., 2002** - *Riscuri hidroclimatice în Spațiul hidrografic Siret în contextul modificărilor geografice*. Culegere de lucrări, Sesiunea științifică anuală INMH București.