

## PLANNING AND DEVELOPMENT OF TOURISM IN THE ŞUREANU MASSIF. ANALYSIS OF THE HYDROGRAPHIC TOURISTIC POTENTIAL

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**Abstract:** *The planning and tourism development of a geographical area is influenced by the richness of water resources. The hydrographic component has an important role in stimulating and developing tourism activities, imposing itself from this point of view through all forms of water storage, both surface and underground. From this point of view, tourism knows favorable conditions for development, benefiting from an extraordinary complexity and richness of the attractive elements offered by the hydrographic network. Each of them generates through its different effect, specific forms of tourism. The hydrographic network is thus imposed by the landscape and balneotourism impact, the Şureanu mountains constituting a huge natural castle of underground and surface waters.*

**Keywords:** *GIS, hydrography, tourism planning, tourism development, touristic potential, territorial planning.*

### 1. Introduction

The planning and tourism development of the Şureanu area is influenced by the richness of water resources, both from the point of view of the possibility of water supply of tourism settlements and infrastructures, and from the aspect of resource with tourism attractiveness of water resources. Through the relief forms developed by the hydrographic network and through the numerous rhythmic interruptions offered by the high degree of fragmentation of the territory, the landscapes are spectacular and interesting. From this point of view, tourism knows favorable conditions for development, benefiting from an extraordinary complexity and richness of the attractive elements offered by the hydrographic network.

### 2. Materials and Methods

A first step for achieving the desideratum of superior tourism planning and development of the Şureanu Massif is its correct spatial delimitation. The boundaries of the region have been drawn and treated in different specialized studies, each of the authors having his own opinion on this issue (Voicu, Voicu, 2018).

The analysis of the general potamological and hydrological framework was made by reporting to two planes: a close one (at the level of the Şureanu massif) and a general one (the hydrographic basins of Mureş and Jiu). The characteristics of the hydrographic elements were

captured in the first phase by vectoring all the geographical reference elements (hydrographic network, lake elements, groundwater bodies), followed by field visits where, by mapping and photography, the initial data of the elements were analyzed and corrected. hydrographic and after analyzing these elements, the main components of the hydrographic tourism potential were identified, morphometric indicators were calculated, correlations were established (geology-groundwater quality), etc.

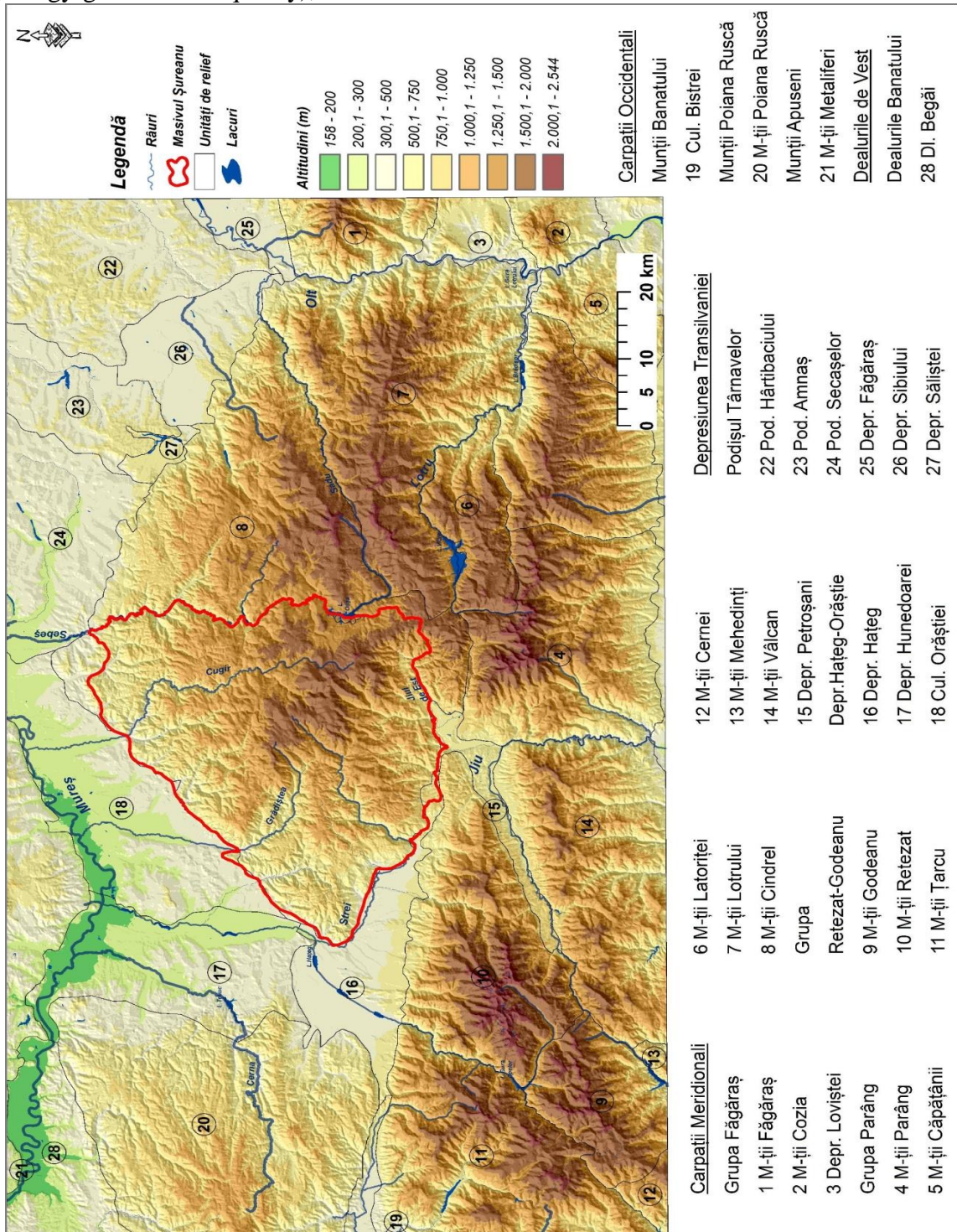


Fig. 1. The Șureanu Massif. Geographic location

### Groundwater

At the level of the Şureanu Massif, the groundwater can be classified into aquifer complexes differentiated according to the type of rock on which it develops. The most extensive aquifer complex belongs to metamorphic rocks, which "due to the network of cracks, schistosity and alteration, accumulate significant amounts of water (from rain and melting snow)" (Trufaş, Trufaş, 1986). They appear on the surface through numerous springs, whose flows are generally low, below 1 l / s. At the opposite pole, the aquifer complexes developed on strongly tectonized and milotimized rocks appear on the surface through springs with important flows (5-10 l / s).

Table 1. Qualitative and quantitative characteristics of the main groundwater bodies from the Şureanu Massif

Crt. No.	Nomenclature	Code	Area (km <sup>2</sup> )	Geological / hydrological characterization			Water use
				Type	Under pressure	Strate acoperitoare (m)	
1	Mureş Corridor (Alba Iulia - Lipova)	ROMU07	843	P	No	<3 - 4	I, PO, Z
2	Cugir - Sebeş Mountains	ROMU08	175	F+P	Mixt	0/variabilă	I, PO, Z
3	Ohaba Ponor (Şureanu Mountains)	ROMU19	120	K+F	No	0/variabilă	I
4	Neag's field - Petrila	ROJI01	151	F	Mixt	0/variabilă	PO

Crt. No	Pollutants	Overall protection	Risk		Effective infiltration (mm / year)	Q at discharge (l / s)	Chemistry	Data source (p.)
			Qualit.	Quantit.				
1	I, Z, M	PG, PM	B	B	31,5-63	1,5-2,5	calcium bicarbonate - calcium sulfate - chlorosodium	80-83
2	*	PU, PVU	B	B	157,5-220,5	0,14-10	*	83-84
3	*	PVU	B	B	315-472,5	0,03-1200	calcium bicarbonate	94-95
4	*	PVU	B	B	315-472,5	0,14-6	calcium bicarbonate, calcium sulphate	98, 100

Source: Jiu River Basin Management Plan (2015), Mureş River Basin Management Plan (2015)

*Surface waters*

It participates differently in increasing the tourist attractiveness of the studied geographical area, through the two components: the lake areas and the hydrographic network.

The lake surfaces are strongly individualized in the territory, their tourist value being closely related to their genesis (natural or anthropic). On the extent of the Șureanu massif there are natural lakes, which arose through glacial or level processes and anthropic lakes, of accumulation created by arranging the energy system “Sebeș” (Oașa, Tăul Bistra and Obreja de Căpâlna) (Voicu, Voicu, 2015).

The four accumulation lakes: Oașa, Tău Bistra, Obreja de Căpâlna (on Sebeș) and Canciu, were arranged to capitalize on the hydropower potential of the Sebeș River. Initially arranged for economic purposes (energy, drinking and industrial water supply, regularization of river flows), they have become an integral part of the landscape of the area where they were built. Currently, their water is used in terms of hydropower and microregional system in the water supply of localities and leisure, as well as Lake Cugir on the Small River (Voicu, Voicu, 2015).

Table 2. Accumulations on the Sebeș Valley

Crt. No.	Accumulation name	Dam height	Altitude average retention level (m)	Accumulation volume (mil. m <sup>3</sup> )		Area (ha) at NNR	C.H.E.	P <sub>i</sub> M W	Category of use
				Total	NNR				
1	Oașa	91	1255	136,23	121,23	454,73	Gâlceag	150	Energy
2	Tău - Bistra	78	790	21,3	21,3	81	Șugag	150	Energy
3	Obreji de Căpâlna	46	409	3,92	1,80	35,2	Săsciori	42	Feeding

Source: Trufaș V., Trufaș C., 1986, with additions

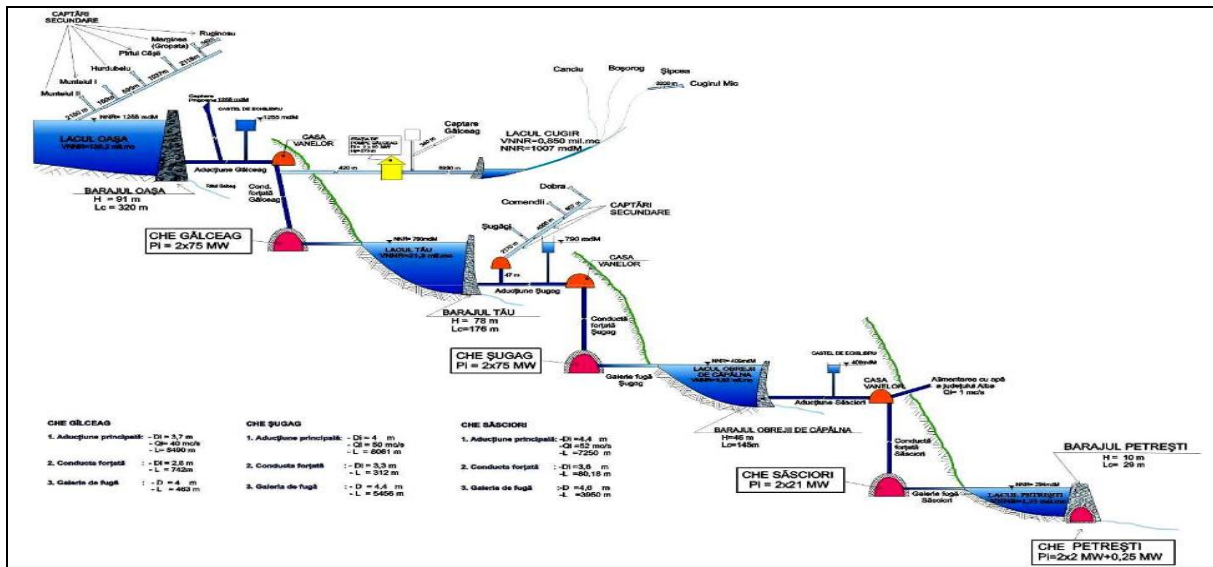


Fig. 2. Hydropower development of the Sebeș River, Source: Ștef I.I., 2010



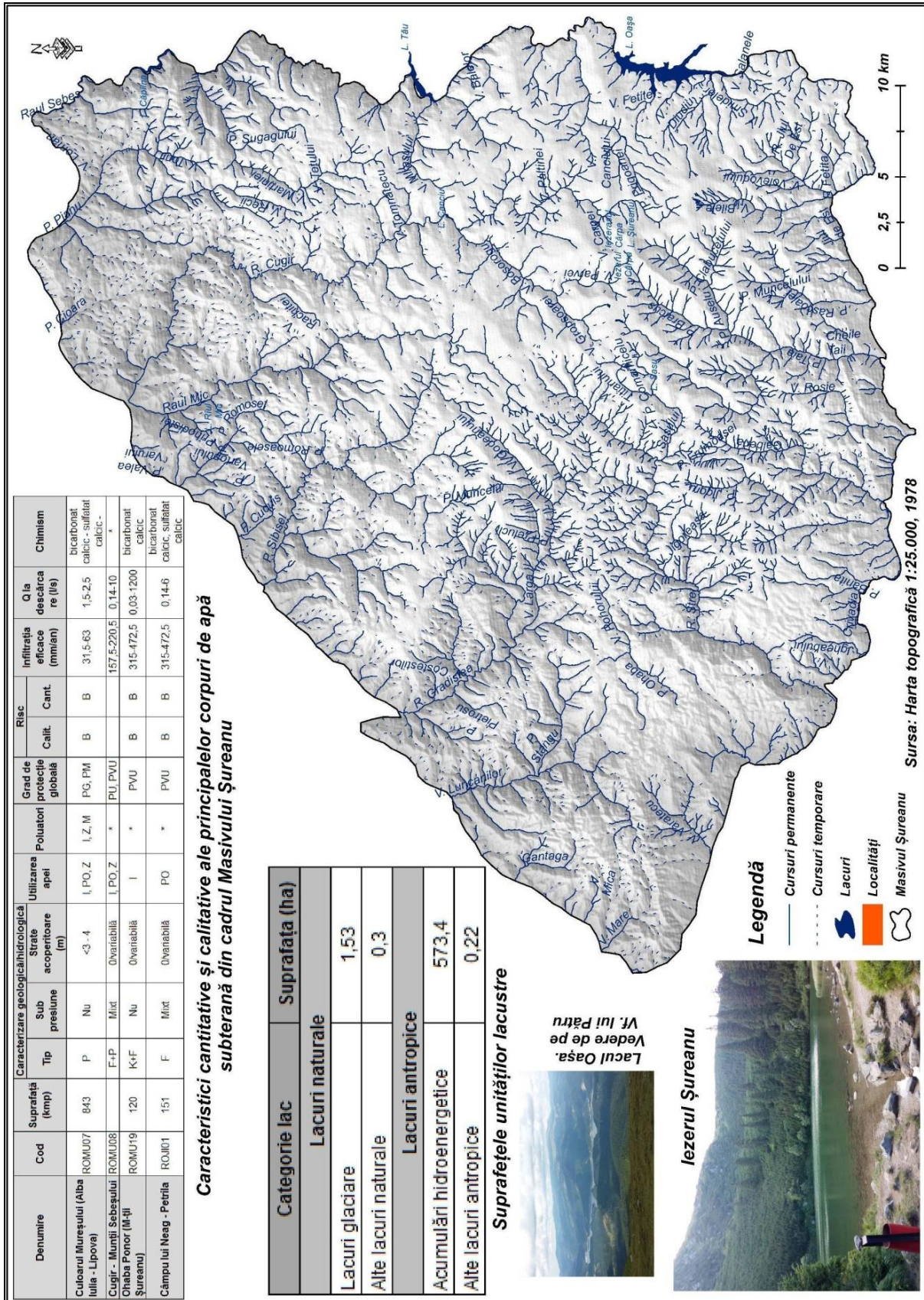


Fig. 3. Șureanu Massif. Hydrographic elements

The hydrographic network forms a dense network, which starts radiating from the high central area Vf. Lui Pătru - Șureanu - Cârpa - Bătrâna. The general aspect of the valley network is divergent, the rivers starting from the high peak of the Șureanu Mountains to the north (Mureș corridor), west (Hațeg Depression), east (Sebeș Valley) and south (Jiu Valley). They are disputed by two large hydrographic basins: Mureș and Jiul, whose basin is faithfully delimited by the main peak of the Șureanu Mountains. The most important tributaries of Mureș are: Sebeș, Pianul, Cugir, Romos, Grădiștea and Streiul. Around the main collecting valleys - Sebeș, Cugir, Grădiștea, Petros and Jiul de Est, the tributaries are grouped in dendritic networks. (Drăguț L., 2003: 110)

Regarding the morphometric characteristics of watercourses and receiving basins, we can mention the total length of watercourses with values of 3152.96 km, of which permanent courses have a majority of 68.54% (2161.14 km) and the temporary courses have the value of 31.46% (991.82 km).

### ***Density of the river network***

A parameter of the hydrographic network, indicator of the richness of water resources, is the average density of permanent streams, whose high value of 1.36 km / km<sup>2</sup> provides a relevant image related to the potential of the area from this point of view.

### **3. The tourism potential of the hydrographic elements**

The fluvial relief, made on the main valleys that belong to the Mureș and Jiu river basins, delimited by the main peak of the Șureanu Mountains, contain special landscape elements. The current network of valleys was completed following the movements in the Wallachian and Pasadena phases. The overall appearance of the valley network is divergent, the rivers starting from the high peak of the massif to the north (Mureș Corridor), west (Hațeg Depression), east (Sebeș Valley) and south (Eastern Jiu Valley). The hydrographic network generates complex and spectacular forms of relief, such as: keys and gorges.

Groundwater in turn shapes the rocks in which they are located. The most interesting and obvious forms of relief are the karst, following the action of corrosion and erosion of water resulting in surface forms such as massive plateaus, gorges, gorges, oaks, sinkholes, poles and karst or underground depressions - in which it is noted caves. A representative example of the relief modeled on limestone within the Șureanu Massif is Fundătura Ponorului. Located within the Grădiștea Muncelului-Cioclovina NP and formed by the excavation of limestones from the Jurassic period by groundwater, their infiltration into riverbeds and the complete erosion of the limestone layer to the substrate formed by crystalline rocks, can be considered one of the most spectacular karst depressions from the Șureanu Massif.

The keys represent the first and wildest stage of the valleys, formed by the actual sculpting of the morpho-hydrographic narrowing, when the water overlaps a permanently flooded valley. Some representative examples of keys found on the massif, some included in the list of nature reserves and monuments under Law no. 5/2000 would be Crivădiei Keys, Taiei Keys, Roșiei Keys, Small River (Cugirului) Keys and Băniței Keys. The Sebeș Valley, characterized by a succession of wide and narrow sectors, develops a spectacular physiognomy, especially in the gorge sector between Tău and Șugag (Voicu, Voicu, 2015).

The hydrographic elements that are of interest regarding the tourism exploitation of the Șureanu Massif are: groundwater, hydrographic networks rivers and lakes. The hydrographic network has a general aspect of the divergent network, the rivers starting from the high peak of the Șureanu Mountains to the north (Mureș corridor), west (Hațegului



Depression), east (Sebeș Valley) and south (Jiu Valley). Around the main collecting valleys - Sebeș, Cugir, Grădiștea, Petros and Jiul de Est, the tributaries are grouped in dendritic networks (Draguț L., 2003).

Characterized by rugged longitudinal profiles and often steep slopes, which give a unique and spectacular look to the landscape and increase the tourist value, the river network is crossed by modernized roads or only roads, which serve actual tourist destinations or as access roads. to the high mountain region. The main or secondary hydrographic arteries enrich the landscape value of the areas they cross through the vegetation and fauna within the riverbeds.



Fig. 4. Taiei Keys

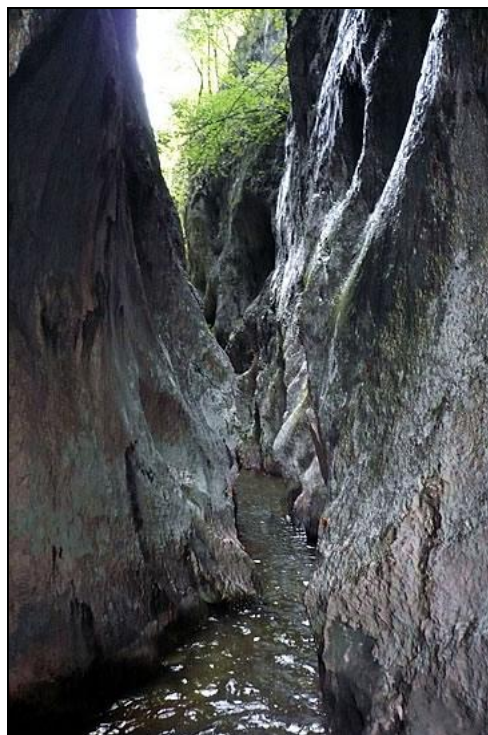


Fig. 5. Crivadia Keys (right)

The lake surfaces are strongly individualized in the territory, their tourist value being closely related to their genesis. On the extent of the Şureanu massif there are natural lakes, which arose through glacial or level processes and anthropic lakes, accumulation, created by arranging the energy system "Sebeş" (Oaşa, Tău - Bistra, Petreşti and Obreja de Căpâlna).

Şureanu lake is located on the lower stage of the circus from the east of the homonymous peak, being formed by glacial subsurface and moraine dam. Nicknamed "bottomless lake", it is located at 1,840 m altitude and has an area of 5,334 m<sup>2</sup> and 7.3 m depth. The glacial lake imposes itself through the picturesque surrounding landscape, of great spectacularity, being considered a monument of nature. It is part of the natural site "Frumoasa", which houses one of the most beautiful pastoral regions in the Carpathians and populations of capercaillies and woodpeckers - endangered species (P.A.T. Ski Area Şureanu, 2006).

The Şureanu Lake complex reservation includes the lake and a swamp, has an area of 20 ha, being located in the glacial circus on the eastern slope of the Şureanu peak, at 1,750 m altitude. Approximately 300 species of endemic diatoms during the Quaternary glaciation and a typical alpine microfauna are preserved in the lake waters. The lake has been populated for several years in a row with native trout seedlings and trout brought from the Frumoasa River.

The entire glacial circus is covered with an almost continuous carpet of junipers, junipers and blueberries (P.A.T. Ski Area, 2006).

On the upper steps of the Cârpa circus we meet two lakes (Trufaş, Trufaş, 1986): the Cârpa lake and the Cârpa little lake, formed by the accumulation of water behind some level horseshoes whose heads rest on the slopes of the circus. Cârpa lake is situated at an altitude of 1,830 m and has an area of 846 m<sup>2</sup> and a maximum depth of 1.6 m and Cârpa little lake is located at 1,840 m altitude, surface: 156 m<sup>2</sup>, maximum depth: 1,65 m.



Fig. 6. Şureanu Lake

The second category of lakes is the accumulation lakes, with a built dam, having as main purpose the obtaining of electricity and water supply and secondary tourism (fishing, leisure tourism, etc.). There are four of them: Oaşa, Tău Bistra, Obreja de Căpâlna (on Sebeş) and Petreşti. They were initially arranged for economic purposes (energy, drinking and industrial water supply, regularization of river flows), but along the way they became an integral part of the landscape of the area where they were built. For the fishing but also for the



development of other leisure activities, the lakes Oaşa, Tău - Bistra, Obreja de Căpâlna and Cugireana (fishing pond) are available to tourists (P.A.T. Ski Area Şureanu, 2006).



Fig. 7. Lake Oaşa (seen from Pătru Peak)

#### **4. Conclusions**

The hydrographic tourism potential of the Şureanu Massif can be summarized in the following aspects of major attraction, which can be considered catalysts of the development of the mountain area:

- the river relief made by the courses of the main rivers / streams in the area, with spectacular and attractive routes (keys, waterfalls), including Taiei and Roşiei Keys, Crivadiei Keys, Valea Frumoasei Keys (upper river Sebeş), Small River Keys (modeled in metamorphic rocks), Streiului Valley, Şugagului Valley and Cugirului Valley;
- the presence of groundwater bodies, with a good condition in terms of quality and quantity, used in various fields (water supply, industry, agriculture and animal husbandry);
- glacial lakes: Şureanu Lake - declared for its scientific importance, monument of nature and Cârpa - Lake and Little lake, water holes that enrich the landscape aspect of the Şureanu and Cârpa glacial basins;
- accumulation lakes (anthropic): Lake Oaşa, with a potential of over 130 million m<sup>3</sup>, serves the hydroelectric power plant from Gâlceag, Lake Tău - Bistra and Lake Obreji de Căpâlna;
- hunting sport fishing fund (the presence of species with hunting value is noticeable, especially in the water of the accumulation lakes on the Sebeş river).

The optimal planning of the hydrographic tourism potential, by outlining some tourism planning strategies that include all the initiatives necessary for a sustainable development is an important step in the efficient tourism development and planning of the Şureanu Massif.

## 5. References

1. *Drăguț, L. (2003), Munții Șureanu. Studiu geomorfologic, Universitatea Babeș-Bolyai, Cluj-Napoca, Teză de doctorat;*
2. *Ștef, I.I. (2010), Studiul lacurilor de acumulare din bazinul hidrografic Sebeș, Universitatea „Babeș- Bolyai” Cluj- Napoca;*
3. *Trufaș, V. (1978), Apele subterane din Munții Sebeș, Studiu de Geografie, București;*
4. *Trufaș, Constanța, Trufaș, V. (1986), Munții Șureanu. Ghid turistic, Editura Sport-Turism, București;*
5. *Voicu, G. E., Voicu, Florina, (2015), Urban Development of the Touristic Area Poarta Raiului Through the Implementation of GIS, 15th International Multidisciplinary Scientific GeoConference SGEM 2015, Conference Proceedings, ISBN 978-619-7105-35-3 / ISSN 1314-2704, June 18-24, 2015, Book2 Vol. 2, 1183-1190 pp;*
6. *Voicu, G. E., Voicu (Gavrilă), Florina, (2018), Identification Of Climate Phenomenes Which Are Influencing the Tourism Activity in Sureanu Massif Area, International SGEM GeoConference on Cartography and GIS, SGEM2018 Conference Proceedings, ISSN 1314-2704, Albena, Bulgaria;*
7. *\*\*\* (2006), P.A.T. Domeniu Schiabil Șureanu, Județul Alba, P.A.T.Z.I.O. – Cugir - Șugag (zona Șureanu), Proiectant TRANSCABLU S.R.L. Brașov & Institutul Național de Cercetare-Dezvoltare pentru Urbanism și Amenajarea Teritoriului București;*
8. *\*\*\* (2015), Planul de Management al Bazinului Hidrografic Mureș, Administrația Bazinală de Apă Mureș;*
9. *\*\*\* (2015), Planul de Management al Bazinului Hidrografic Jiu, Administrația Bazinală de Apă Jiu.*