

THE INVENTORY OF FISH FROM THE NATIONAL PARK CĂLIMANI - DIVERSITY AND DISTRIBUTION

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Abstract

*In the Călimani National Park, the inventory of the fish species of community importance, carried out in 2013 through a project from the Sectoral Operational Program for Environment, revealed that there is only one species of community interest in the park, namely *Cottus gobio* (bullhead). This is a normal fact given that the site is located at altitudes ranging from a maximum of 2083 m to a minimum of 470, and most of the waters are represented by alpine creek. In the all four fishing campaigns, 30 tributaries were investigated and a total of 220 individuals were fished out of which: 156 individuals of river trout (*Salmo trutta fario*), 9 individuals of common bullhead (*Cottus gobio*), 52 individuals of rare bullhead (*Cottus poecilopus*), 2 individuals of grayling (*Thymallus thymallus*) and 1 individuals of minnow (*Phoxinus phoxinus*). Ihtiofauna has a very low diversity, being constantly represented by one species of fish, *Salmo trutta fario*, which is well suited to the conditions of the creek situated on slopes of 1-3 m/km. Thus, out of the 30 investigated water courses, *Salmo trutta fario* is present in 17 water courses. Instead of this, *Cottus gobio*, a species of fish of community importance, has a very low presence on the territory of Calimani National Park, this situation is, to some extent, inadequate.*

Keywords: bullhead, grayling, minnow, river trout.

1. INTRODUCTION

Conservation of biodiversity in Romania

Conservation of biodiversity is a major concern of today's society. Consistent biodiversity monitoring is essential to maintain or restore the favorable conservation status of natural habitats and species and to prevent degradation (Baltărețu and Busuioc, 2009).

Romania has a particularly valuable natural heritage, including many endangered species and habitats at European level, which are an integral and significant part of the European natural heritage. The implementation of national, European and world protected areas is a key step in protecting and preserving these natural riches for future generations (Soran et al., 2000).

At present, in Romania there are a total of 11 categories of protected areas of which five are declared at national level, two categories are declared at European level and four categories are declared at world level. Apart from these categories of protected areas there are also at county level a series of protected areas declared at local level (Iojă et al., 2010)

The natural protected areas (PAs) of national level have approximately 8% of the country's surface. So, in the year 2010, in Romania there were a number of 2001 PAs of national level represented by: 64 Scientific Reserves (category I IUCN); 13 National Parks (category II IUCN); 206 Natural

Monuments, (category III IUCN); 669 Natural Reserves (category IV IUCN); 16 Natural Parks (category I IUCN) and other protected areas declared at county level (<http://www.anpm.ro/raport-de-mediu>).

In Romania, the natural protected areas of european level was established following the European directives on biodiversity (Habitats Directive, 1991, Birds Directive, 1979) and these are part of the Natura 2000, European Network of Protected Areas and are represented by the Sites of Community Importance (SCI) and Avifaunistic Protection Sites (SPA). The statistics presented on the occasion of the 25 years of the environment indicate that the Natura 2000 network in Romania included 383 Sites of Community Importance (SCIs) and 148 Avifaunistic Protection Sites (SPAs). The last 23 SPAs in Romania were approved in September 2016, so that the Natura 2000 Network now it has a total of 531 sites (<http://www.anpm.ro/natura-2000>).

The natural protected areas of international level from Romania, which appeared as a result of the signing and ratification of international conventions on the protection of the environment and biodiversity, are represented by: 3 Biosphere Reserves (category X IUCN); 19 Ramsar sites, category I, II, IV, V IUCN); 1 Natural site of UNESCO Heritage (category I, II, IV, V IUCN); 2 Geoparks (category II or V IUCN) (<http://www.anpm.ro/area-nutri-proteaza-de-interes-international>).

According to the data published by the Romanian Ornithological Society (SOR), at the end of January 2016, Romania held at the level of 2015, a total area of about 23% of the country's surface, up with 156.6% compared to 1990 reference year.

The geographical landscape of the Calimani Mountains

The Călimani Mountains, with an area of over 2,000 km², are located on the territory of four counties: Suceava, Mureș, Harghita and Bistrița-Năsăud, covering the inner part of the Eastern Carpathians, and being bounded by the Mures Gorge (Deda-Toplita) Bistrita, the Bârga Mountains and the Transylvanian Plateau. The Caliman massif has the approximate shape of a rectangle, with a length of about 60 km and an average width of more than 30 km (Naum and Butnaru, 1989).

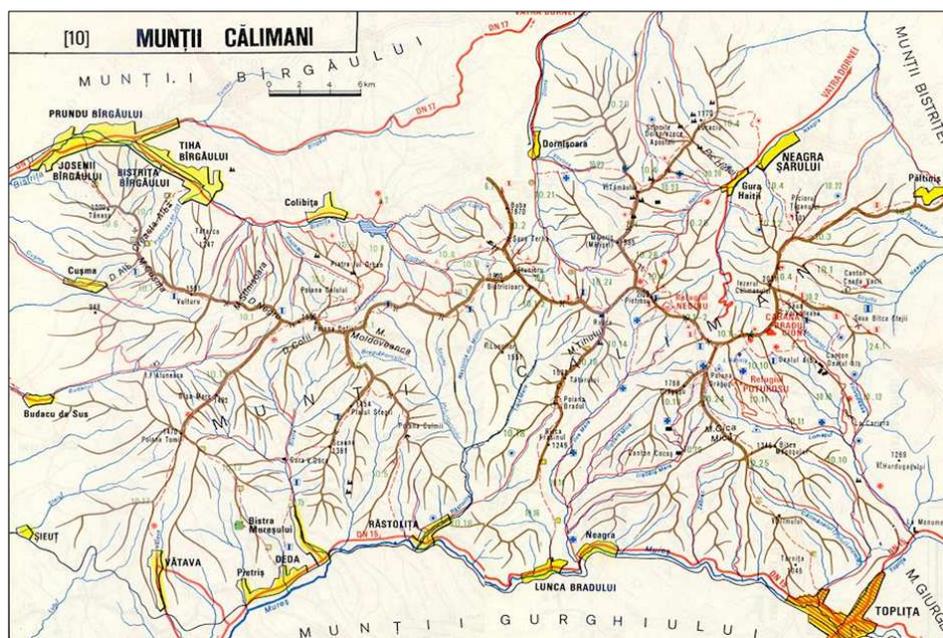


Figure 1. Map of the Calimani Mountains

Representing the largest volcanic massif in our country, the Călimani Mountains have as feature the largest volcanic crater (currently extinguished) with a diameter of about 10 km, located in the northern part of the massif. Thus, the huge horseshoe made up of ridges with altitudes of about 2000 m is nothing more than the edge of the old crater, and the slopes slightly inclined to the outside are the lava flows from the crater. Inside the crater the relief appears very roughly, with slope changes, saddles, sudden bumps. The slopes of the Caliman Massif have very varied aspects (Naum, 1972).

Calimani National Park (PNC)

Instituting of Calimani National Park (Order No. 7/1990 of MAPPM (15,300 ha), Law No. 5/2000 (24,041 ha) and Government Decision no 230/2003) as a protected area managed especially for the protection of ecosystems and recreation, enclosed in category IIa IUCN, confirms the special value of the natural capital of this area. Situated at the upper limit of Călimani Mountains, on the territory of 4 counties: Suceava, Mureș, Bistrița and Harghita, the National Park Calimani has an area of 24,041 ha, out of which 16,211 ha forestry, 7,517.3 ha of pasture, 14.5 ha of meadows, 297.7 ha of mining perimeter, 0.5 ha of administrative land and a structure of property divided as follows: 57% state property, 41% city hall property, 1% private property, 1% Ministry of Economy. Starting with 2004, the management of the park was entrusted to the Forestry Directorate of Suceava and consists of a team of 15 people (<http://www.calimani.ro/>).

The National Park Calimani (240 km²), located in the alpine biogeographic region, is included in ROSCI0019 Călimani-Gurghiu (136,657 km²), declared by Order no. 1964/2007 as an integral part of the Natura 2000 network, being 570 times smaller than the surface of the ROSCI0019, which is located both in the alpine biogeographical region and in the continental biogeographical region.

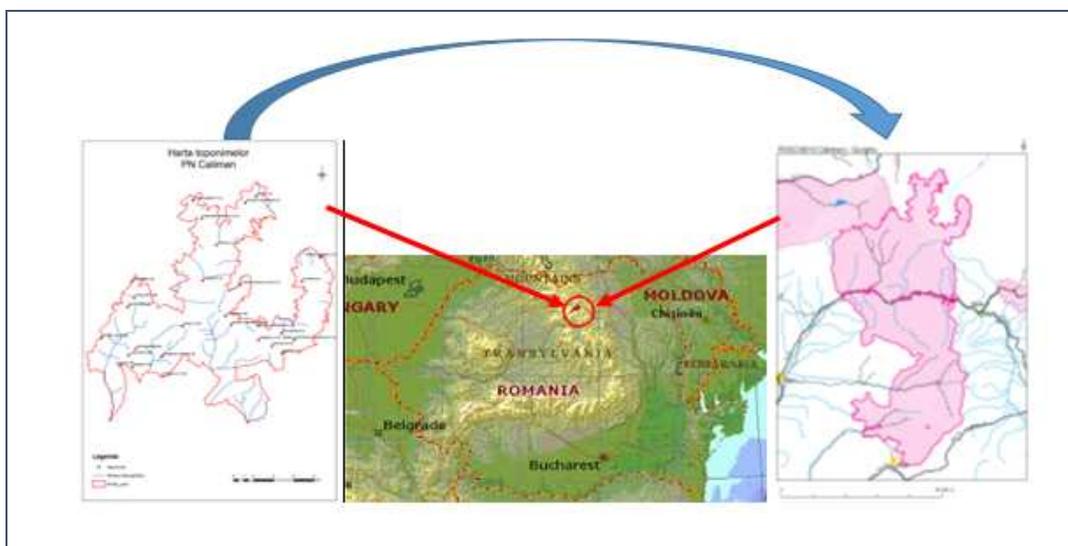


Figure 2. Positioning and maps of Calimani National Park and of the Natura 2000 site ROSCI0019 Călimani-Gurghiu

The access to the park area is possible from the towns: Vatra Dornei, Toplita and Saru Dornei, Panaci, Bilbor, Stânceni, Lunca Bradului, Rostolita, Colibita, Piatra Fantanele, Poiana Stampei, Dornișoara, Dorna Candrenilor and Poiana Negrii.

Hydrographic system of Calimani National Park

The waters that cross the Călimani Massif have a radial development, due to the shape and structure specific to the volcanoes, having a diverging development on the outer and a converging development inside the craters and dendritic development between the cones. The waters are tributary to the rivers Somes, Mureş and Moldavian Bistriţa. In the upper areas, the springs flow through narrow valleys, which increase their width in the medium and lower sectors (Naum & Butnaru, 1989).

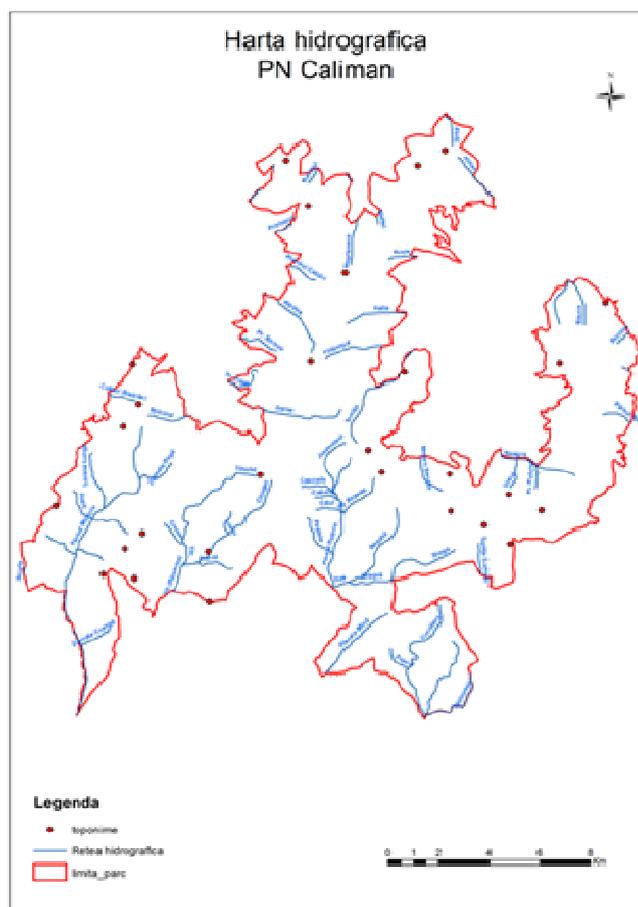


Figure 3. Hydrographic map of Calimani National Park

In the north, the Neagra Şarului River basin, which pierced the crater, presents the appearance of a huge funnel delimited by a mountain frame, which is marked by the highest peaks. The hydrographic basin is very branched, the valleys are narrow and deep, and are guarded by steep slopes. The Neagra Şarului River has many tributaries that spring from the highest peaks of Caliman, these are: Reţeiş, Pietricelul, Dumitreleul, Tarniţa, Paltinul, Harla, Bauca, the Tiganului brook, the Haitii brook. On the north-eastern part of the massif the waters are collected by Călimanel, a tributary of the Neagra Şarului River which flows later in Bistriţa.

On the south-eastern flank, the Topliţa river gathers the waters of the Lomaş stream that springs from the southern and eastern slopes of the mountains. The Puturosul brook, one of the tributaries of Lomaş stream, has its origin in the Rezeiş lake - a lake of natural dam, situated at the peak of the same name at an altitude of 1650 m.

To the south part there is the Ilva river basin and its tributaries, Illișoara Mare stream and Illișoara Mică stream on the right and Unguraş stream on the left. Ilva emerge in Mureş river, near Lunca Bradului village. The southern flank of Calimani Mountains is drained by many rivers, with wider valleys and slower flow, due to the lesser slope descending to the Mureş defile, where all the waters emerge. To the west part we meet the Răstoliţa brook that collects the streams Secu, Tihu, Mijlocu brook, Bradul brook and flows into Mureş river. The river valleys are narrow and guarded by steep slopes, where the rivers intersect volcanic cluster stacks.

The north-western part is crossed by the Dorna River and its tributaries. Of the most important tributaries we mention: Bârsanul and Vorova streams, Dornișoara and Negrișoara. Dorna stream,

with springs at an altitude of 1760 m, with a valley sprinkled with rapids streams, finally unites its waters with those of Bistrita river at Vatra Dornei town (Dinca, 2004).



Figure 4. Aspects of the Hydrographic Network in Calimani National Park

2. MATERIALS AND METHODS

Field activities

The capture of the fish from the rivers on the Calimani National Park was accomplished by the method of electronarkosis, which allows both qualitative and quantitative evaluation of the fish species. The use of this method is recommended because it is a reversible fish sedation based on the interfering of the artificial electrical signal over the nervous electric signal, that controls the muscle activity of the fish, which will involuntarily flote to the anode. The fish is removed from water and collected in water tanks to be identified and analyzed in the field. After identifying and measuring the species, the captured specimens are released. This method allows the collection of fish species living in hard-to-reach places. Using this method, valuable information has been obtained about the specific diversity in fish of the respective waters, the age structure and the size of the populations. In general, this method was used in all the fishing stations, over a distance of 5-20 times the width of the water course, depending on the concrete situation in the field. Because the mountain waters did not have great depths fishing took place without boat, on foot. The number of people who operated on the field was three: one person transports the device and manages the anode and pulse button, and two other people maneuver the fishing tackle and transport the plastic buckets for storing the fish. The fishing time in each station was approx. 30 minutes, and the lenght was of approx. 100 to 150 m. Fishing campaigns were conducted both in spring, after the floods, and in the autumn, before the temperature drops. The areas where the different species were identified were localized using the GPS (Figure 5).

Office activities

The field activities carried out in the Calimani National Park during the spring, summer and autumn of 2013 had a double approach:

- Scientific (establishing the diversity, distribution and conservation status of fish species)
- Technique (establishing pressures, threats and management directions for the conservation of fish species).

Assessing the conservation status of a fish species is a new activity for Romanian experts and therefore the use of the methodologies developed for this activity is absolutely necessary. However, for each species and for the particular areas, the expert must to find the concrete elements that lead

to the assessment of this status. The evaluate of a conservation status of species are based on the assessment of four criteria:

- the natural area of the species,
- population status of the species
- habitat status of the species,
- future prospects of the species.

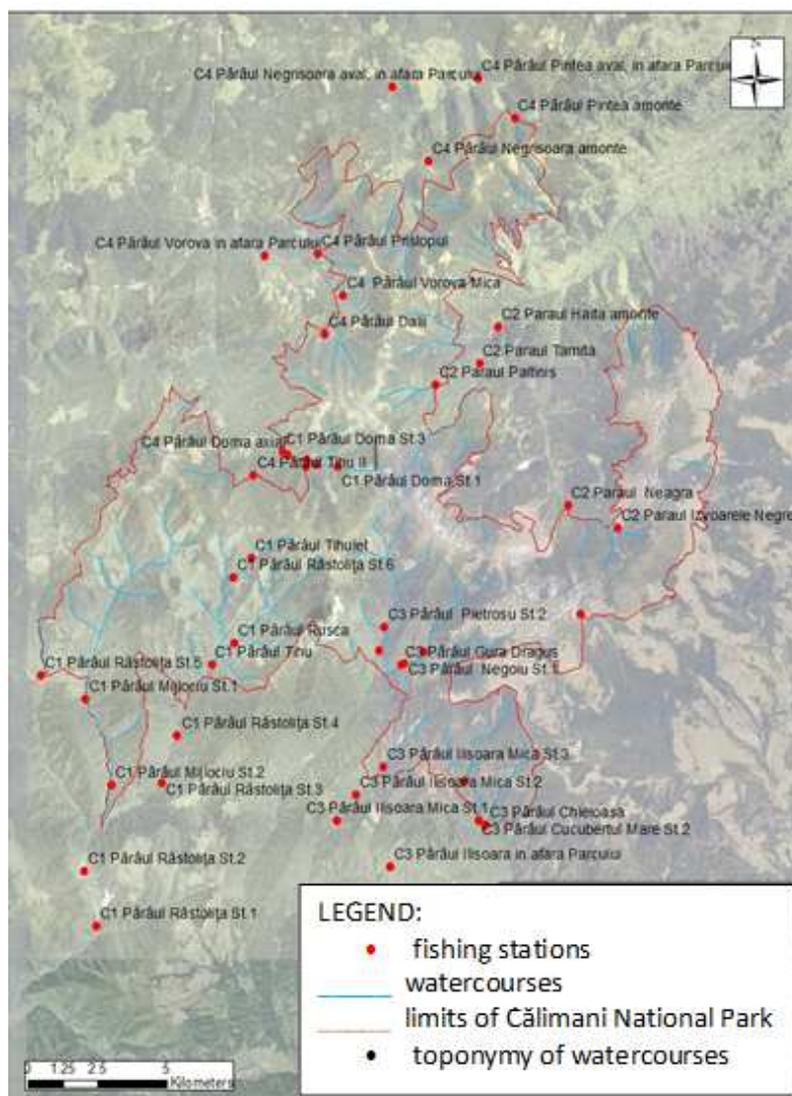


Figure 5. Distribution of fishing stations in 2013 campaigns

The algorithm for assessing conservation status of species is described according to the semaphore model, so that in the end the species can be classified into four classes of conservation status:

- favorable status (green): the species will continue to exist and is viable in the long-term (from 100 years upwards) in this studied region.
- unfavorable status (orange): it is likely that the population will diminish considerably in the studied region.

3. unfavorable status totally inadequate (red): the population may be considerably diminished, or the species no longer exists in the studied region.
4. unknown status (gray): if the information is insufficient.

3. RESULTS AND DISCUSSIONS

Fishing activities took place in four campaigns in the spring, summer and autumn of 2013:

- Fishing Campaign no. 1 (C1): 9-10 May 2013
- Fishing Campaign no. 2 (C2): May 11-12, 2013
- Fishing Campaign no. 3 (C3): 1-3 August 2013
- Fishing Campaign no. 4 (C4): September 27-29, 2013

Detailed results on each fishing station of the four fishing campaigns are shown in table no. 1, but at the cumulative level they have the following elements:

- fishing campaign no. 1: 4 water courses investigated; 15 fishing stations; 3 species identified; 61 individuals captured;
- fishing campaign no. 2: 8 water courses investigated; 9 fishing stations; 1 species identified; 1 individual captured;
- fishing campaign no. 3: 7 water courses investigated; 12 fishing stations; 3 species identified; 96 individuals captured;
- fishing campaign no. 4: 11 water courses investigated; 13 fishing stations; 2 species identified; 60 individuals captured;

Total: 30 water courses investigated

49 fishing stations

5 species of fish identified (fig.6)

220 captured specimens of which:

- | | |
|---|---------|
| - <i>Salmo fario</i> Linnaeus, 1758 (river trout): | 156 ex. |
| - <i>Cottus gobio</i> Linnaeus, 1758 (bullhead): | 9 ex. |
| - <i>Cottus poecilopus</i> Linnaeus, 1758 (bullhead): | 52 ex. |
| - <i>Thymallus thymallus</i> (Linnaeus, 1758) (grayling): | 2 ex. |
| - <i>Phoxinus phoxinus</i> (Linnaeus, 1758) (minnow): | 1 ex. |

The most important parameters which largely influence the habitat conditions from the creek are represented by the slope of the land and the type of the substrate. Of course there are also other environmental factors that influence stream life such as: water chemistry, light, water depth, etc. Minor riverbed morphology is very important and in the case of the fishing stations from Calimani National Park this morphology varied within quite narrow limits, the average width was around 2,0 m and the average depth was around 30 cm.

The geographical coordinates of the fishing stations (table 1) have been set by using the GPS that shows the latitude, the longitude and the altitude with an accuracy of 0.8 m. The determination of the land slope was done indirectly through calculation. The width and the depth of the water was measured directly on the field using a ruler.

Species identification was carried out according to several morphological characters, using determination keys for every systematical unit and species description from the literature (Banarescu, 1964). The recorded catch for each station is shown in table 1. On the whole, in the 49 fishing activities a total number of 220 fish individuals were collected. For each individual was made

the most important somatic measurements, total body length and body weight. For the body length we use a caliper and for the body weight we use an electronic balance.

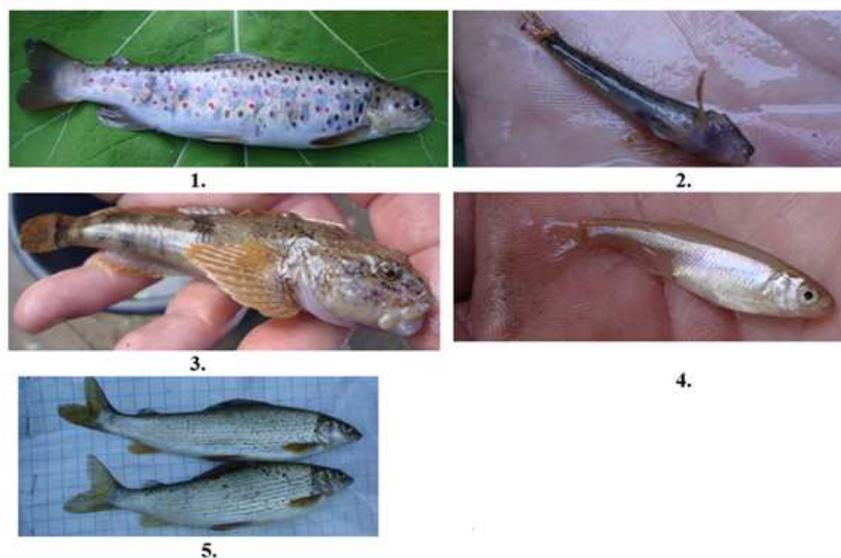


Figure 6. Captured fish species in Călimani National Park
 1. *Salmo fario*; 2. *Cottus gobio* 3. *Cottus poecilopus* 4. *Phoxinus phoxinus* 5. *Thymallus thymallus*.

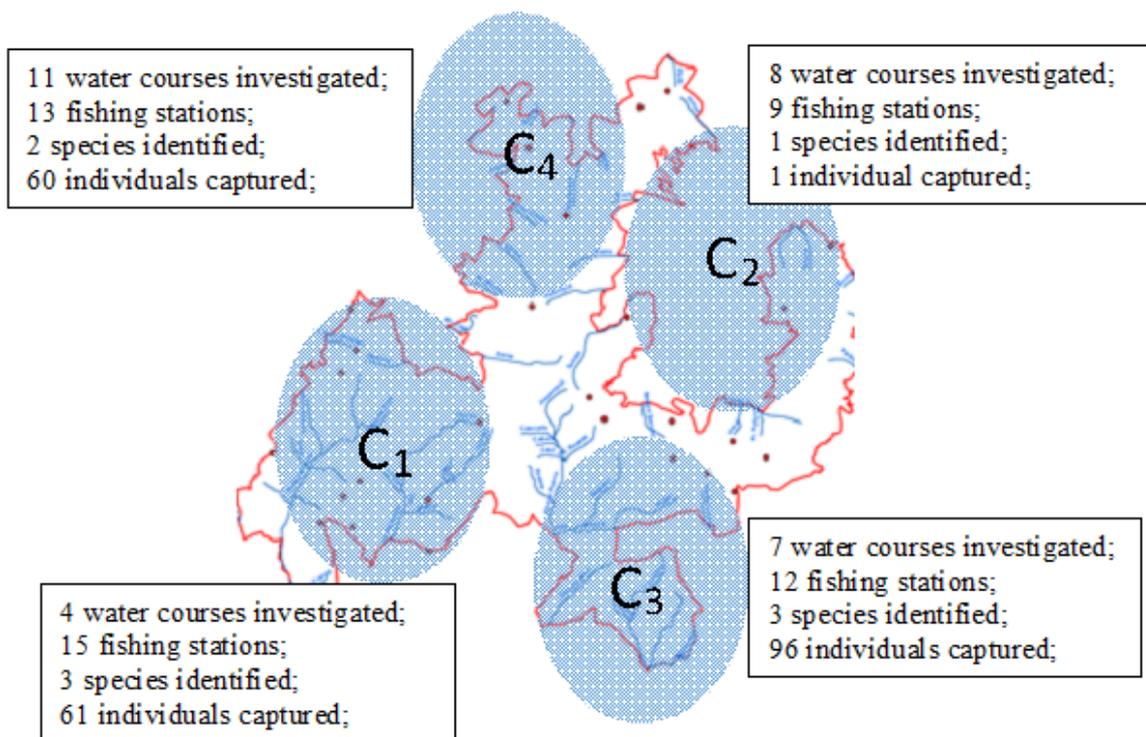


Figure 6. Distribution of watercourses, fishing stations, species and individuals captured in the four fishing campaigns in 2013

Table 1. Results of fishing activity in Calimani National Park waters in 2013

Station / Coordinates X / Coordinates Y	Species	No. ind.		
C1 creek Mijlociu St.1 502117.165/618731.222	river trout	4		
C1 creek Mijlociu St.2 503044.939/615848.523	river trout	2		
	bullhead (SCI) *	1		
C1 creek I Tihu 503044.939/615848.523	river trout	9		
C1 creek Tihulet 506668.400/619896.246	river trout	12		
C1 creek Rusca 508080.873/623490.650	river trout	2		
C1 creek Răstolița St.1 507457.912/620624.527	river trout	2		
	minnow	1		
C1 creek Răstolița St.2 502507.213/611110.976	river trout	14		
C1 creek Răstolița St.3 502507.213/611110.976	river trout	2		
C1 creek Răstolița St.4 502066.427/612958.885	river trout	6		
	bullhead (SCI) *	1		
C1 creek Răstolița St.5 504846.767/615908.758	river trout	4		
C1 creek Răstolița St.6 505423.180/617502.368				
C1 creek Dorna St.1 505423.180/617502.368				
C1 creek Dorna St.2 500523.677/619536.764				
C1 creek Dorna St.3 507440.622/622842.656				
C2 creek Haita amonte 511206.709/626554.025				
C2 creek Paltinis 510085.932/626779.450				
C2 creek Tarnita 509193.755/627087.426/				
C2 creek Tanau 516961.408/631272.613				
C2 Paraul Pancu St.1 514709.532/629339.035	river trout	1		
C2 creek Pancu St.2 619924.162/513588.399				
C2 Paraul Izvoarele Negrei 619943.323/514275.871				
C2 creek Neagra 516301.007 630059.126				
C2 lake Iezerul Calimani (Reșițiș) 1970 m altitudine 620346.740/512689.286				
C3 creek Cucubertul Mare St.1 620362.679/512872.906	river trout	3		
C3 creek Cucubertul Mare St.2 621178.256/511155.044	river trout	4		
C3 creek Chieloasa 516301.007/630059.126	river trout	5		
C3 creek Ilisoara in afara Parcului 521275.893/624496.827	river trout	4		
	bullhead (SCI) *	7		
	grayling	2		
C3 creek Gura Dragus 519485.811/625251.645	river trout	2		
C3 creek Negoiu St.1 519938.465/621603.166	river trout	4		
C3 creek Negoiu St.2 515785.508/616010.851	river trout	13		
C3 creek Pietrosu St.1 516258.030/614664.963	river trout	19		
C3 creek Pietrosu St.2 516530.987/614523.986	river trout	16		
C3 creek Ilisoara Mica St.1 513091.068/613096.546	river trout	8		
C3 creek Ilisoara Mica St.2 513091.068/613096.546	river trout	7		
C3 creek Ilisoara Mica St.3 513091.068 613096.546	river trout	2		
C4 creek Dalii 513490.199/614636.528	river trout	1		

C4 creek Vorova Mica 511849.312/615525.530	river trout	1
C4 creek Prislopul 512822.981/616461.098		
C4 creek Rizu 510725.532/631016.930		
C4 creek Vorova out of park 511393.955/632348.795	bullhead (RS) **	28
C4 creek Tihu II 510491.921/633759.236		
C4 left affluent of creek Dorna 508560.504/633680.983		
C4 right affluent of Creek Dorna 508169.952/626264.007	river trout	1
C4 Creek Dorna axial 510058.467/626575.206		
C4 Creek Negrisoara aval, out of park 510437.557/626654.798	bullhead (RS) **	19

C4 creek Negrisoara amonte 509374.602/626969.746		
C4 creek Pinteaa amonte 509374.602/626969.746	river trout	2
C4 Creek Pinteaa aval, out of park 513174.989/639375.263	river trout	3
	bullhead (RS) **	5
TOTAL fish capture: 220 individuals river trout: 156 ind. bullhead (SCI): 9 ind. bullhead (RS): 52 ind. grayling: 2 ind. minnow: 1 ind.		

Legend:

* *Cottus gobio* - species of community importance (SCI);

** *Cottus poecilopus* - rare species (RS),

C1- fishing campaign 9-10 May 2013; C2- fishing campaign 11-12 May 2013; C3-fishing campaign 1-3 August 2013; C4 - fishing campaign 27-29 September, 2013.

Elements for assessing the conservation status of *Cottus gobio*

- Type of population in this protected area: accidental population
- Standard size of population in protected area, in general:
 - Minimum population size - 50 specimen
 - Maximum population size - 100 specimen
- Quality of data about the population in this protected area: average (the data was estimated on the basis of extrapolation and/or modeling of the data obtained by partial measurements);
- Size of the reference population for the favorable status in this protected area: there is no data from the past about the populations of *Cottus gobio* within NPC.
- The magnitude of the current population trends of this species expressed by qualifiers: there is not enough information to appreciate this parameter;
- Trend of the conservation status of species: it is unknown. It can be estimated only after annual monitoring for a minimum of 3 years and implementing management measures.
- Conservation status of the habitats of the species in this protected area: is unfavorable - inadequate. Favorable conservation status can be achieved by eliminating major pressures, preserving the number and quality of breeding habitats, and, most importantly, artificially creating breeding areas.
- The future trends of the habitat surface of the species in this protected area: will be increasing if the management measures are applied.
- Intensity of current pressures / future threats on the species: environment - deterioration or disappearance of breeding and livelihoods habitats, grazing in the area of breeding and living habitats, impacts related to forestry works (cuts), tourism, collecting of forest fruits,

medicinal plants and mushrooms, regularization of the course of some streams, reconstruction works of the former sulfur exploitation.

Partial conclusions:

- Conservation status of the natural area of the species: favorable status (green)
- Conservation status of the population of the species: unfavorable status (orange)
- Conservation status of the habitat of the species: unfavorable status (orange)
- Conservation status of the future prospects of the species: unfavorable status (orange)

Final conclusions:

- The global conservation status of the species within the protected area of Calimani National Park: unfavorable status (orange)

Elements for the monitoring protocol of *Cottus gobio*

Cottus gobio was accidentally identified at the park's limit. The waters in the area of the Calimani National Park comprise mainly the springs, which due to the characteristics of the biotope make possible only the presence of the indigenous trout and only incidentally the bullhead. In the future, some indicators need to be monitored in order to establish population dynamics and conservation status of the fish protected species, in order to assess the impact and effectiveness of management measures.

The harvesting of fish will be done by fishing once a year at the end of summer (August), but it will be preferred September to October, because in August there are more juveniles and their disturbance can lead to negative effects on ontogenetic development. Rivers with rocky substrates, in which the species has been identified, will be monitored. A sufficient number of stations will be selected to cover all existing micro-habitats along the upstream gradient. In each monitoring area, they will fishing between 25-50 m of the length of the stream, over a period of 15 to 20 minutes. GPS and map records will be made for each portion of the stream to relocate in the coming years. Details, directions, and milestones will be recorded to reach each place.

The monitoring sheet (tab. 2) will contain a series of elements describing, as closely as possible, the link between the species presance and the conditions offered by the habitat.

Table 2. Monitoring sheet of *Cottus gobio* fish species

Station Name:				Date:				Hour:		
Station length (m):										
Width min / max (m):				Structure of the bed:	natural					
Depth: min / max (cm):					artificial					
Coverage (%):				Land Use:	right bank					
Shading (%):					left bank					
Number of meanders:				Water level:	very low	low	normal	high	very high	
Water velocity:	rapid	medim	slow		backwater	Transparency(cm):	0-5	5- 10	10- 20	20- 40
Species		Captured individuals (individuals)			Survey area (m)					
<i>Cottus gobio</i>										
Type of ecosystem (creek / river) and its name										
Favorability:		optim	optim - suboptim		suboptim - unfavorable		unfavorable			
Remarks:										

To calculate the degree of favorability, the following aspects will be taken into account:

- Optimal habitat: the species can be found with high frequency (at least 50% or more) in the investigated area;
- Sub-optimal habitat: the species can be found between 50 and 25% in the investigated area;
- Habitat unfavorable: the species can be found under 25% or not at all in the investigated area.

4. CONCLUSIONS

- On the territory of the Calimani National Park were identified five species of fish: river trout, two species of bullhead, grayling and minnow;
- The distribution of the fish population in the mountain creek of the Calimani National Park is unbalanced; the waters passing through the eastern regions are without fish, instead in the other three directions, the distribution of the fish populations is good (fig.7);
- The fish population is almost exclusively represented by the *Salmo trutta fario*, this being a normal situation because most of the watercourses in the park pass through the alpine area;
- *Cottus gobio*, a species of fish of community importance, has a very low presence on the territory of Calimani National Park, this situation is, to some extent, inadequate;
- Maintaining a monitoring program for *Cottus gobio*, according to the established model, is the first step in the conservation program of this species;
- To restore the population of *Cottus gobio* it is necessary to maintain the integrity of the aquatic habitats and on the other hand to repopulate the water courses with native *Cottus gobio* specimens fished in the downstream areas.

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