CINQ CONTINENTS
REVUE ROUMAINE ELECTRONIQUE DE GEOGRAPHIE

Volume 1 / Numéro 2
Été 2011
ISSN: 2247 - 2290
p. 170-183

CONSIDERATIONS REGARDING THE IMPACT OF THE VIDRARU HYDRO FACILITY ON BIODIVERSITY

Remus PRĂVĂLIE

Licence Degree in Environmental Studies
Faculty of Geography, University of Bucharest
pravalie_remus@yahoo.com

Contents:

Cite this document:

Prăvălie, R., 2011. Considerations regarding the impact of the Vidraru hydro facility on biodiversity. *Cinq Continents* **1** (2): 170-183 [Available online]| URL: http://www.cinqcontinents.uv.ro/1/1_2_Pravalie.pdf

Considerations regarding the impact of the Vidraru hydro facility on biodiversity

Remus PRĂVĂLIE

Considérations concernant l'impact de l'aménagement hydrotehnique Vidraru sur la biodiversité. L'aménagement du lac de retenue Vidraru a déterminé des changements profonds dans le milieu régional, étant le plus fréquemment un facteur perturbateur des éléments de l'environnement. De cette manière, étant donné que les éléments biogéographiques sont l'un des composants le plus affectés de l'environnement, cet article traite des principales modifications apparues au niveau de la végétation et de la faune (ichtyofaune), la biodiversité ayant subi les effets les plus importants à la suite de cette intervention anthropique (humaine).

Mots clés: le lac Vidraru, environnement, biodiversité, impact, potentiel écologique.

Consideraţii privind impactul amenajării hidrotehnice Vidraru asupra biodiversităţii. Amenajarea lacului de acumulare Vidraru a determinat schimbări profunde în mediul regional, în cele mai multe cazuri reprezentând un factor perturbator asupra componentelor de mediu. Astfel, elementele biogeografice fiind unele dintre componentele de mediu cel mai intens afectate, prezentul articol urmărește principalele modificări apărute la nivelul vegetației și faunei (ihtiofaunei), biodiversitatea având cel mai mult de suferit în urma acestei intervenții antropice.

Cuvinte cheie: Lacul Vidraru, mediu, biodiversitate, impact, potențial ecologic.

1. INTRODUCTION

The regional environment of the Vidraru Reservoir can be viewed as a system composed of several subsystems that incessantly interact, this interrelationship being subject to human influence. By harnessing the Vidraru Lake, the initial system was strongly influenced by the emergence of new inputs (such as the appearance of the dam, inlets, access roads etc.). In most of the times, these inputs represent factors of restrictiveness in environment, the main negative consequences manifesting at the level of biodiversity. Before considering the impact on biodiversity, for a better interrelation between the environmental components, it is necessary to carry out a brief overview of the natural environment.

2. METHODOLOGY

The methodology used in order to write this study is based on conducting regular field surveys; using a specialized bibliography and processing meteorological and hydrological data using specific software such as ArcGIS 9.3., Microsoft Office Excel, etc.; and also using

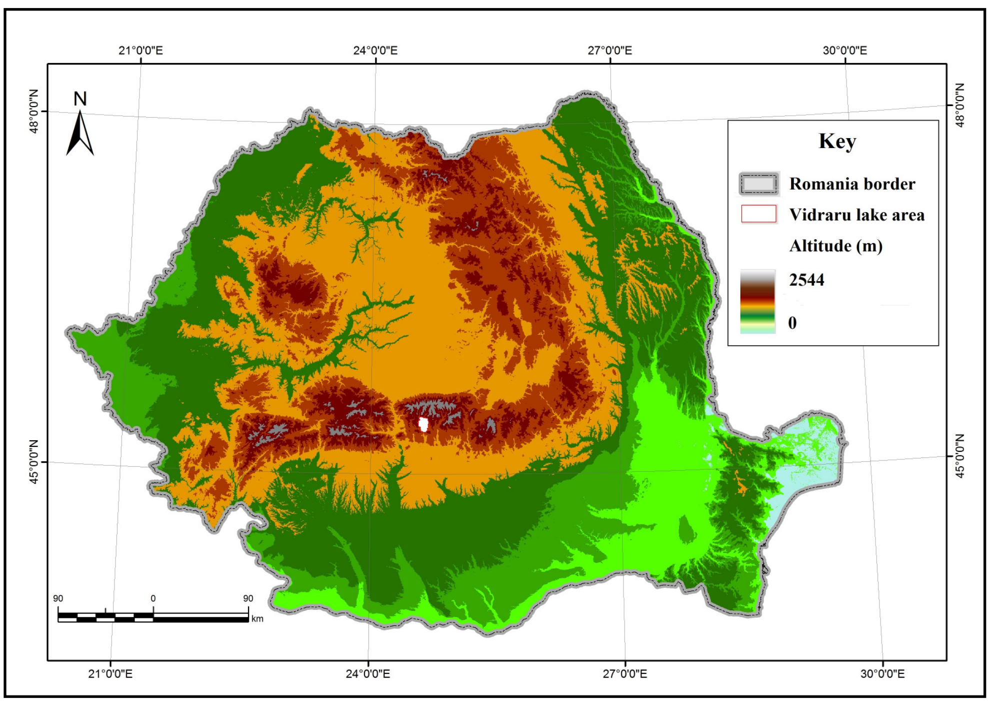

Figure 1. Localizing Vidraru lake area in Romania (data processing www geo-spatial.org)

international databases such as geo-spatial.org and eea.europa.eu.

3. ASPECTS REGARDING THE NATURAL CONTEXT

Located in the south of Fagaras Mountains, in the eastern extension of the Lovistea Depression, the Vidraru Reservoir presents obvious physical and geographical features. Occupying the largest area of the Loviştea eastern graben, the lake is bounded to the north by the Fagaras Mountains and to the south, by Fruntii and Ghitu Mountains (Figure 1). From an administrative point of view, the area that represents the object of this study belongs to the Arges County.

From a geological point of view, the region that is analyzed in this study (i.e. the south of Fagaras Mountains) was subjected to tectonic influence during the Austrian and Laramic stages (medium and upper Cretaceous). These stages led to folding, ascension or descent of the various sections of Fagaras Mountains [1]. In terms of lithology, in the northern side, we can note hard rocks such as gneiss, mica-schists, amphibolites (Fagaras Mountains), sedimentary deposits in the Loviştea Depression, and gneiss and paragneiss in the southern side (Fruntii and Ghitu Mountains). The Vidraru Dam is built mostly on rocks with a very high hardness, crystalline rocks, namely gneiss (the Cozia gneisses).

The morphologic and morphometric characteristics of the landform stand out because of the existence of four main units: the Făgăraş Mountains in the north, the Loviştea Depression in the central side and Frunţii and Ghiţu Mountains in the south. Overall, the Fagaras Mountains, the main unit in which is located the area subjected to this study, consist of two mountain ranges (alignments), almost parallel, having a west-east orientation. The northern side of the Fagaras Mountains, characterized by massiveness, high altitude (over 2,000 m), presents itself as a uniform and high peak. The second mountain range is represented by the alignment of Cozia - Fruntii - Ghitu - Iezer-Papusa Mountains. The Frunţii – Ghiţu mountain range is important for this study as it is located in the southern side of the Vidraru Lake.

The Fruntii-Ghitu alignement distinguishes by its granitic horst aspect, fragmented by valleys, the crystalline gradually entering in contact with sandstones, marls and conglomerates. The eastern division of the Loviştea Depression, called by some authors the Fagaras Central Corridor [2], intercedes between these two mountain units.

In terms of climate, the region is affected also by the existence of the Vidraru Lake that determines a topoclimate characterized by moderate temperatures, high humidity and a local air circulation in the form of local mountain-valley winds [3]. *The average annual* *temperature* is 6.0°C, the lowest value being recorded in January (-2.4°C), and the highest in July (16.1°C) [4]. The temperature drops with altitude according to the vertical thermal gradient, being of approx. 1.7°C at the upper limit of the forest vegetation.

The average annual depth of *precipitation* is 770.01 mm [4], being influenced by changes in altitude and terrain configuration, thus leading to an unequal distribution of rainfall. Altitude plays a decisive role: the southern part of the area receives a smaller amount of rainfall, whereas in the northern side rainfall is more pronounced due to higher altitudes.

The lake-related hydrographic network is represented by two main tributaries Buda and Capra, considered to be the sources of Arges River (they are located in the north), but also by other major tributaries such as Cumpana, Valea Calugaritei, located on the right side of the reservoir, or Valea Lupoaicei, Valea cu Pesti, located on the left side.

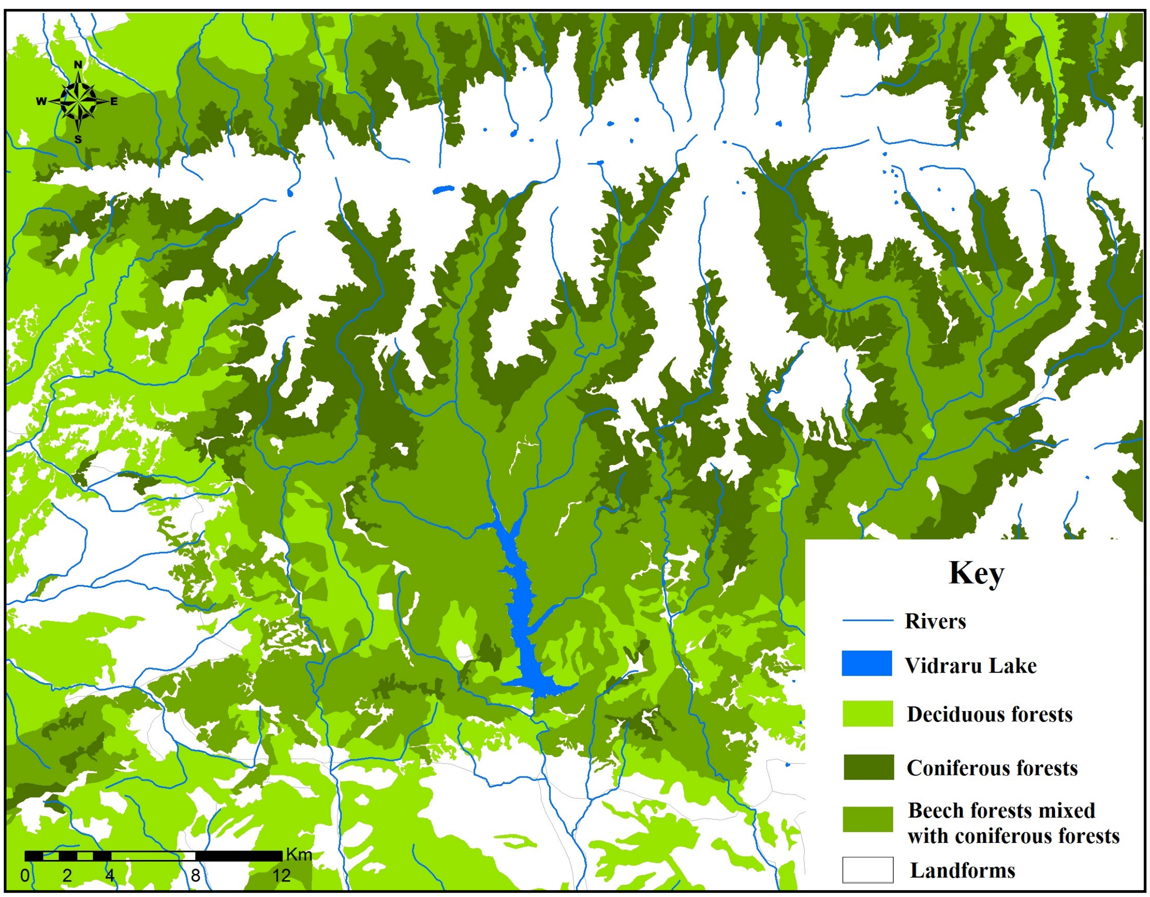

Figure 2. The map concerning the distribution of vegetation stories in the Vidraru lake area (data processing C.L.C., 2006)

In terms of vegetation, Fagaras Mountains region, and implicitly Vidraru Reservoir area are characterized by a variety of species. In terms of phytogeography, this area is part of the Fagaras Mountains Division. This belongs to the Central European Region and to the Eastern Carpathian Province where there is a prevalent number of indigenous elements, Dacian and Carpathian endemic plants [1].

In the area bordering the Vidraru Reservoir there are three stories of vegetation (the stories of deciduous forests, of mixed forests and pine forests) (Figure 2).

It is important to mention the subalpine story (represented, in particular, by the presence of the mountain pine) because it plays a protective role against erosion, since the Vidraru Lake is located downstream.

As for the shrubs, the most prevalent ones are the mountain pine (*Pinus mugo*), the juniper (*Juniperus sibirica*), and the blueberry (*Vaccinium myrtillus*). The mountain pine scrubs play an important role in anti-erosion soil protection, leading to cessation or reduction of the clogging process. But due to anthropogenic deforestation in the north in favour of pasture, the scrubs were gradually replaced by scrubs of juniper, blueberry, matgrass and festuce (*Festuca supina*) meadows [1].

In general, the vegetation is extremely important because it plays a significant role in stopping degradation processes (water flowing, surface erosion, streaming) [5]. On the contrary, deforestation caused a change in the upper limit of the forest (due to anthropogenic intervention, the upper limit of the forest has lowered) and also the degradation of soils and landforms.

4. THE RESULTS OBTAINED

Following the emergence of the Vidraru hydro facility, each component of the environment (geology, landforms, climate, etc.) was more or less modified [6]. The consequences are the emergence of processes and phenomena with disruptive role in the environment.

Biodiversity is one of the most important components of the environment that has suffered from the appearance of this hydro facility.

The impact on *biogeographical elements* is of particular interest, biodiversity being one of the most seriously affected components. In the area that we examined, ***vegetation*** plays an essential role in maintaining forest ecosystems in their natural state and, thus, keeping the natural balance. It also has an important hydrological role [5]. Vegetation has an important role in reducing/eliminating dynamic slope processes, processes that may have indirect repercussions on forest surfaces due to the destabilization and degradation of soils.

The Vidraru hydro facility has greatly influenced vegetation, depending on the location of the constructions and the ecological valence of plant species from the relevant vegetation stories.

The ecological potential also changes due to the emergence of a specific topoclimate characterized by changes in the rainfall regime, and changes in the diurnal and seasonal regime with thermal inversions. Changing these parameters is very important. Consequences appear, in particular, at the vegetation level, certain species of plants adapting to new conditions of temperature and precipitation [7].

Together with the emergence of the Vidraru Lake, the annual rainfall average has increased due to increased evaporation. Thus, certain species of trees have suffered. This is the case of the beech (*Fagus sylvatica*), a species that adapts very hard to excess moisture [8].

In order to highlight the change in the climatic parameters (such as rainfall), the Gams Index (GI) was calculated before and after the emergence of the Vidraru Lake. This fact confirmed an increase in rainfall after 1966 (the year the Vidraru Lake emerged) and also an alienation of the index value from the value 1 within the deviation, a value considered the most favorable for the development of the beech. In order to calculate the Gams Index before the emergence of the dam, rainfall-related data collected from the Romanian People's Republic Monograph were used [9]. After the appearance of the dam, the data were more easily obtained, presenting a greater relevance.

GI = P/Alt. = 879/680 => GI = 1.3 (the GI value before the Vidraru hydro facility).

More exactly, after processing the data regarding the precipitation (before the dam was built) during 1896-1955, the value of the Gams index is closer to 1. After the appearance of the lake, the index reached the value of 1.6, this meaning that the ecological potential for this species has declined.

GI = P/Alt. = 1008/680 => GI = 1.6 (the GI value after the Vidraru hydro facility).

Another impact on vegetation is represented by the massive deforestation that has been caused due to the construction of the dam and the Transfăgărașan Road that led to the emergence of adverse effects, such as water flowing, surface erosion, streaming, landslides. Deforestation was done for a long time. For example, during 1903-1905 logging was made by Lessel Company [10]. Since the company was liquidated, from 1905 until 1934, forestry logging was taken over by Argeş Company. It is at this time that the Cumpăna - Curtea de Argeş railway was built, timber logging being made by means of a *mocăniţă*[1] (Photo 1).

Once the building of the Vidraru Dam started, this track is replaced by forest roads. During 1961-1965, clear-cutting is prevalent in the lacustrine basin of the lake. After 1966, once the dam became operational, a great part of the forest area situated along the lake basin is flooded. Clear-cutting is also present during the construction of the Transfagarasan Road (1970-1974).

Currently, deforestation in the area of the lake created conditions for the reactivation of processes regarding surface and linear erosion, especially on the steep slopes that border the lake dam, resulting in a series of gullies, ravines and torrential bodies.

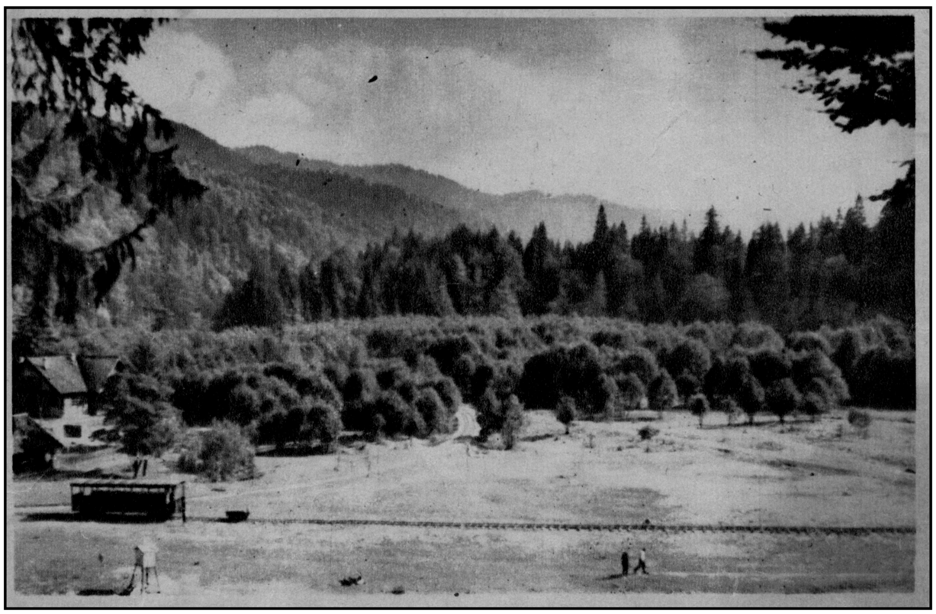

Photo 1. Forestry logging before the construction of the dam in the Cumpana area (1947)

The Vidraru hydro facility had a negative impact on vegetation because of the forest roads that led to the emergence of wild or ruderal plants [1]. These changes have effects at the level of composition and distribution of vegetation.

Except for these direct changes, the vegetation has also suffered indirect changes. Thus, due to the great volume of excavations and heavy vehicles driving along, changes

[1] A narrow gauge railway in Romania, most notably in Transylvania and nearby regions. These railways were built for cargo and passenger services.

occurred in the soil profile or permanent land subsidence arose, and also a slowdown in the growth processes of forest species. The occurrence of forest roads influenced vegetation by means of a high content of particulate matter which led, in many cases, to the covering of the stomata, and consequently, to the suspension of the gas exchange between plants and the atmosphere, resulting in the asphyxiation of plants in the surrounding areas of forest roads.

Another imbalance due to the hydrotechnical construction relates to the disappearance of species of common scientific interest, such as endemic species, as a consequence of the emergence of access roads and constructions, which resulted in the asphyxiation of plants.

At the same time, the achievement of this large-scale construction has repercussions on the ***fauna***, and particularly on ichtyofauna. This is the case of the endemic species *Romanichthys valsanicola* (Photo 2). The human impact on this species derives especially from the construction of the Valsan water project, involved in the Cernat – Valea Valsanului – Valea cu Pesti main inlet. In order to increase the water volume of the Vidraru Reservoir to augment the hydropower efficiency, a large number of primary and secondary inlets were built, the most important main inlet being the previously mentioned one.

Photo 2. Romanichthys valsanicola (Bănărescu, 2003)

In this respect, changes in the hydrographic system configuration of the Valsan River can be noticed. Indirect effects can be obviously seen in the case of the sculpin-perch, a *stenobiont* species, sensitive to fluctuations of environmental parameters.

As a consequence of the completion of the Cernat – Valea Valsanului – Valea cu Pesti main inlet, the water flow of the Valsan River decreased because a part of the water flow of this river is used to the Vidraru hydropower system. According to research, it was found that this decrease in river flow caused a fatal impact on the sculpin-perch (*Romanichthys valsanicola*), causing this fish to be on the verge of extinction [11].

The following picture (Figure 3) presents the variation in the water flow of the Valsan River before and after the emergence of the Valsan Lake. The water flow decreased after 1973, the year the Valsan facility and the main inlet in the Vidraru Reservoir were completed.

Hydraulic washing is also of great importance and occurs periodically along the main inlet that also covers the Valsan facility. These washes are performed in order to reduce the clogging phenomenon. They led to an increased aggressiveness on the sculpin-perch due to the turbidity, affecting their habitat, the negative effects being quite strong.

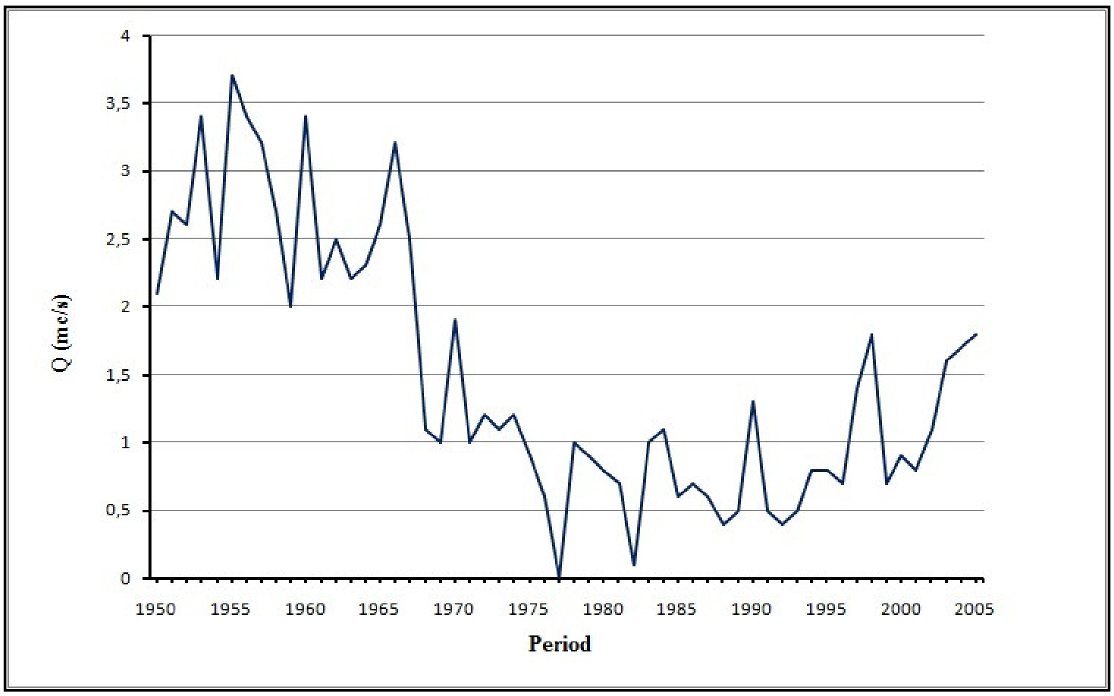

Figure 3. Change in the annual average flow (1950-2005) of the Valsan River before and after harnessing the Valsan Lake (data processing Water Board of Arges-Vedea)

Deforestation along the Vâlsan riverbed caused serious problems by increasing the amount of light that led to a change in the habitat of the sculpin-perch. As a stenobiont species, preferring half-shade places (under stones on the river thalweg), the increase in the amount of light produced changes in the habitat of this species.

All these effects that had impact on the sculpin-perch led to a strong change of its original habitat and to a drastic decrease in the natural environment that greatly diminished in recent decades (Figure 4).

Due to the biodiversity conservation principle and to the existence of the sculpin-perch as an endemic species at a global level and its association as a national symbol (its name - *Romanichthys valsanicola* – is relevant in this sense) important steps were taken to protect this species.

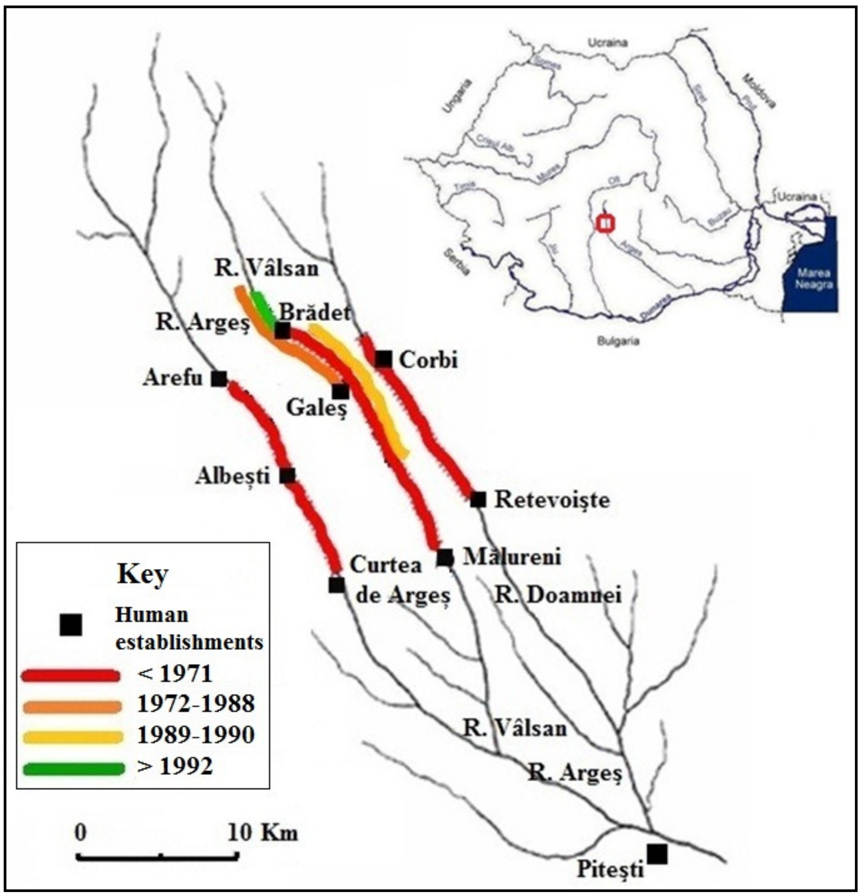

Figure 4. The spatial distribution of the sculpin-perch in the past and present in the higher Arges Reservoir (data processing T. Nalbandt and D. Stanescu)

The actions taken for this purpose consisted of various legislative approaches that led to the protection of the sculpin-perch by the national law. Thus, the Valsan Valley Nature Reserve was set up. Approaches have also reached the European level; in this case, a significant role was played by the Habitats and Rare Species Directive.

Note that the most important actions that led to the protection of the sculpin-perch consisted of intense debate between the *economic and ecological components*. In other words, both the engineers that opted for the use of hydropower resources of the Valsan River and those supporting the protection of the sculpin-perch agreed that, for the survival of the species, it is necessary to ensure a *servitude flow* that is critical for the survival of this species.

It is worth noting that other fish species were more or less affected because of the appearance of this hydro facility. This is the case of the trout, whose habitat (Arges River) was restricted upstream of the dam; its habitat is greatly diminished by the disappearance of the Argeș valley downstream of the dam, in the vicinity. Consequences that might occur due to this situation could be genetic, leading to discussions, at least in theory, regarding the emergence of the inbreeding phenomenon [12]. More exactly, reducing the trout habitat can lead to decrease in individuals, so that, for the survival of the species, the phenomenon of mating between close relatives, with consequences of genetic order, can occur. However, it is important to note that this premise is rather theoretical because the habitat of the trout has not been reduced so much so that this phenomenon may occur.

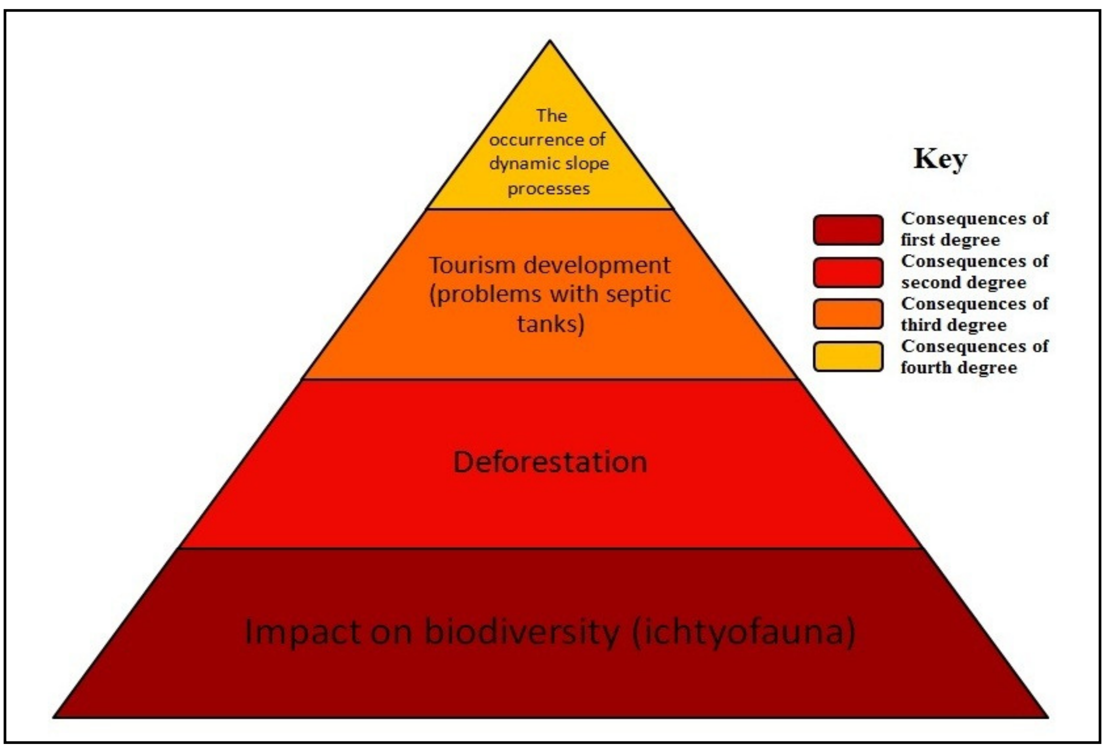

Figure 5. Representing major negative consequences incurred due to the Vidraru hydro facility

The introduction of reared species is another ecological problem; an example in this case is the introduction of whitefish in the lake ecosystem. This species, brought from Canada and acclimatized, has initially adapted to environmental conditions, but once entered into competition for food with the trout, its decline was triggered. This relates to the overlapping of the same ecological niches of these two species. The consequence was that the whitefish disappeared from the Vidraru Lake a few years after it was brought to the lake, this being due to the fact that the whitefish became feed for trout, especially when the trout reached larger sizes in mature stages, making it impossible for the whitefish to adapt and compete with the trout.

After analyzing the overall impact of the Vidraru hydro facility on the environment, out of personal reasons, I believe that the impact on biodiversity, especially on ichthyofauna (*Romanichthys valsanicola*), is one of the most important, this being, to my own scale of assessment, a negative consequence of first degree (Figure 5).

5. CONCLUSIONS

Following this survey, we can say that this hydro facility had a strong influence on the climate parameters, the water regime of the region (underground water table, natural flow regime of the Arges River), biogeographical and soil-related features, etc. Of all the environmental components affected, the most significant effects can be perceived at the biodiversity level.

Negative impacts on biodiversity are due to human intervention that caused a direct aggression on the environment (destruction of the habitat of some species, deforestation) and an indirect partial change in the ecological potential of the region.

6. REFERENCES

[1] NEDELEA, A. Valea Argeşului in sectorul montan. Studiu geomorfologic. Editura Universităţii din Bucureşti. 2006.

[2] FLOREA, M. Munţii Făgăraşului-studiu geomorphologic. Brasov: Editura Foton; 1998.

[3] GÂŞTESCU, P., DRIGA, B. Lacul de baraj antropic-un ecosistem lacustru aparte. Revista Geografică. Bucureşti: Institutul de Geografie 1996; Vol. I-III.

[4] *** Staţia Meteorologică Cumpăna, Administraţia Naţională de Meteorologie. 1997.

[5] ARGHIRIADE, C. Rolul hidrologic al pădurii. Bucureşti: Editura Ceres; 1977.

[6] PĂTROESCU N. M. Subcarpații dintre Râmnicu-Sărat şi Buzău. Potențialul biologic si exploatarea biologică. Bucureşti: Editura Carro; 1996.

[7] PRĂVĂLIE, R. Consideraţii generale privind impactul amenajării hidrotehnice a lacului Vidraru asupra mediului. Mss. Bucureşti: Analele Academiei Române. Secţia Ştiinţe; 2011.

[8] SĂVULESCU, I. Interrelaţiile dintre componentele fizico-geografice şi etajarea pădurii în Munţii Iezer, Editura Universităţii din Bucureşti. 2010.

[9] *** Monografia geografică a Republicii Populare Române. Geografie fizică. Bucureşti: Editura Academiei R.S.R. 1960; Vol. I.

[10] *** Amenajamentul Ocolul Silvic Voluntari, Amenajarea Generală a Zonei Vidraru, Institutul de Cercetări şi Amenajări Silvice. 1995.

[11] BĂNĂRESCU, P., VASILIU – OROMULU L., MATEI B. The survival of Romanichthys valsanicola, final report Life Project. 2003.

[12] PRIMACK, R.B., PĂTROESCU, M., ROZYLOWICZ, L., IOJA, I. Fundamentele conservării diversităţii biologice, Bucureşti: Editura AGIR; 2008.