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THE HYDROGRAPHY AND TOURISTIC ACTIVITY OF THE NATIONAL PARK OF ABRUZZO, LAZIO AND MOLISE (ITALY)

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Abstract: National Park of Abruzzo, Lazio and Molise (NPALM) is situated in central Italy, in the South-Central Apennines, also called the Appennini Abruzzesi. Its surface measures 50,683 ha and it also includes a surface of 75,683.6 ha of External Protection areas. NPALM is included in the administrative territory of three regions: a 75.2 % surface in Abruzzo, 16.7 % in Lazio and 8.1 % in Molise, thus its denomination. The main rivers which cross the NPALM are: Sangro, Melfa, Giovenco and Volturno. Of these, Sangro is the main river which drains the territory of the NPALM while the others flow on limited surfaces of the Park. Vivo Lake, of karstic and glacial origins is the only natural lake found in the internal protection area of the NPALM. However, the external protection area includes the largest natural lake of the Apennines: Scanno Lake. Pantaniello Lake is also a natural lake included in the external protection area and has been declared State Natural Reserve in 1972. Of the 5 artificial lakes that have been built for hydroelectric purposes, Barrea Lake is the most representative; situated on the river Sangro, it is well integrated in the landscape of the region. According to the Ramsar Convention, Barrea Lake was declared a sensitive humid-area in 1972. The hydrographic potential is influenced by the morphometric and morphologic particularities of valleys (lengths, width, slope, thresholds, passes, defiles, waterfalls etc), by the specific biota of watercourses, by the qualitative, quantitative and dynamic characteristics of watercourses. The main type of tourism encountered in this region is ecotourism (hiking, bird and animal watching), cycling and mountain biking along valleys' courses and alongside lakes; however, other types of touristic activities are practiced, based on recreational navigation (canoeing, kayaking and windsurfing) and on sport fishing. Swimming and birdwatching are practiced during summer.

Key words: Hydrography, National Park, Tourism

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INTRODUCTION

The case of the National Park of Abruzzo, Lazio and Molise (NPALM) is extremely interesting due to the fact that it is not located in the most renown and spectacular segment of the Apennines, it does not include in its delimitations the Gran Sasso d`Italia mountain range with the highest peak of the

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entire Apennines mountain range (Corno Grande Peak, 2912 m), as we might expect. It is actually located in the Central Apennines. This compact and isolated range includes the picturesque drainage basin of Sangro river as well as man-made Barrea Lake (which is perfectly integrated in the landscape), human settlements which add specificity to the scenery of this National Park. The territory of the NPALM is almost exclusively included in Sangro river's drainage basin which comprises its springs, the Barrea gorge situated downstream of the Barrea reservoir, etc. Other parts of NPALM's territory are included in adjacent but less extended drainage basins: Giovenco in the NW and Tasso-Sagittario in the north, Melfa drainage basin in the south and Volturno drainage basin in the SE.

The water flow of the Sangro River has suffered significant modifications due to human activities, a situation which is uncharacteristic to protected areas, especially in the case of a historical one such as NPALM. However, Barrea Lake was created in 1951 as a result of the damming of Sangro River, downstream of the Barrea gorge. Other reservoirs used in hydroelectric purposes included in the external protection area are: Grottacampanaro Lake on the River Melfa and Montagna Spaccata Lake on Rio Torto River, Castel San Vincenzo Lake on Volturno River and La Selva Lake created by the damming of Schiavona, a tributary of the Rapido River.

Vivo and Pantaniello Lakes are natural, season lakes while Scanno Lake is the largest natural lake of the Apennine Mountain range. Pantaniello and Scanno are situated in the external protection area of the NPALM. In what concerns tourism, artificial lakes are important nowadays as they have been perfectly integrated in the scenery of the area and represent, alongside valleys and other significant watercourses, the foundation of the touristic potential of NPALM.

THE LOCATION OF THE NPALM

The NPALM is located in the center of Italy, at the middle of the distance which separates the Tyrrhenian Sea and the Adriatic Sea, in the South-Central Apennines, also called the Appennini Abruzzesi (figure 1).

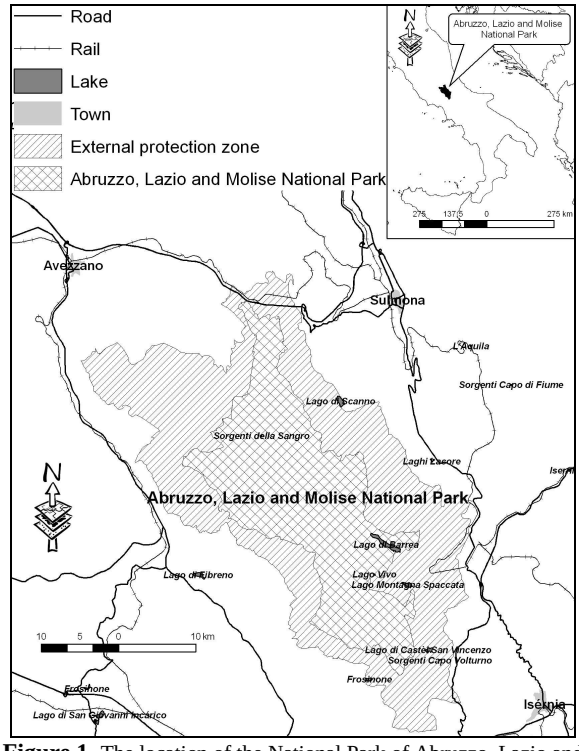

Figure 1. The location of the National Park of Abruzzo, Lazio and Molise (Italy)

NPALM is one of the historical national parks of Europe, as it was founded in 1923. It stretches over 50,683 ha, to which 75,683.6 ha are added, representing its external protection area. It is included in the administrative territory of three regions: a 75.2 % surface in Abruzzo, 16.7 % in Lazio and 8.1% in Molise and it comprises a total of 24 communes of which 5 are located in the park's perimeter (the so-called internal communes) while the other 19 are external communes, located in the external protection area.

The Abruzzo area is not only the most extensive but also the most important and renowned sector of the park.

WATER COURSES

If one studies the "*Carta d'identità del Parco Nazionale d'Abruzzo, Lazio e Molise*" (the Identity document of the park), it is noticeable that the watercourses of the area are described before local vegetation and fauna even though the latter are strongly promoted and popularized and represent the main attraction of the NPALM. This is understandable, however, as water represents the foundation of the plants' and animals' life, therefore bearing a higher importance.

NPALM is crossed by several rivers: Sangro, Giovenco, Volturno and Melfa. In what concerns its hydrography, NPALM is almost exclusively included in Sangro River's drainage basin which comprises its springs, the Barrea gorge situated downstream of the Barrea reservoir. Other parts of NPALM's territory are included in adjacent but less extended drainage basins: Giovenco in the NW and Tasso-Sagittario in the north. The southern sector which includes Melfa's drainage basin is more significant, while the south-east mountain area is included in Volturno's drainage basin. Thus, the NPALM's territory is located in the hydrographic center of the Apennines, comprising three different drainage basins: Sangro River, which flows into the Adriatic Sea, Liri-Garigliano drainage basin corresponding to the Melfa and Volturno Rivers' drainage basins. These last two flow into the Tyrrhenian Sea.

Sangro, the main river which drains NPALM's territory is the second longest (117 km) river of the Abruzzo Region and occupies the same position in what concerns the surface of its drainage basin (1,515 sqkm). Its birth place, La Penna Spring, is situated at a 1370 m altitude, at the foot of the eastern slope of Turchio Mountains, close to the Diavolo Pass, on the administrative territory of the Gioia Vecchio commune. It flows towards the eastern limit of NPALM (also called the Marsican limit) and descends, passing through a narrow valley, towards the Pescasseroli Depression (closed in the SE by the steep slope on which Opi lies through a narrow pass). It then streams towards Villetta Barrea village and, further on, is dammed, creating Barrea Lake.

Drainage basins are constrained by the geological massiveness and especially by great regional faults which prevents the creation of ramified basins. The north limit of Sangro's upper basin is situated downstream of Barrea Lake and of Barrea Pass, near Alfedena village. Here, the river exits the mountains of the NPALM territory and enters Castel di Sangro Depression.

The studied sector of Sangro River is, in what concerns its course and its drainage basin, Apennine oriented (NW-SE), from its spring to Pescasseroli where its orientation changes to a W-E one. It is in this sector that Sangro gathers its main tributaries. The Vandra River meets it from the right, near Opi, while Val Ciavolara and Profluo flow into Sangro near Villetta Barrea. These tributaries are not perennial and their hydric contribution is minimal. To the hydrographical right, the main tributaries are Fondillo Valley and Scerto Valley (of the Camosciara sector), both originating in the Meta Mountains' Massif. These two tributaries represent an important source of Sangro's flow capacity, flowing constantly at an average flow of 150 l/s each. Downstream of Barrea Dam, Sangro flows for 5 km through Barrea Pass until it reaches Alfedena where it exits the mountain sector so that it crosses the inner mountain depression of Castel di Sangro (Pratesi and Tassi, 1998, pp. 49-50).

LAKES

ARTIFICIAL LAKES

From a hydrological point of view, Sangro's water flow has suffered significant alterations in time due to the impact of human activities, which is common to all Italian watercourses, particularly those situated in mountain areas. However, these anthropic modifications are uncharacteristic to protected areas, especially in the case of such an historical area, as it is NPALM.

In the Barrea floodplain, the dam (figure 3) situated at the river's outfall is manmade. It was constructed in 1952, thus creating Barrea Lake (figure 2), a reservoir used in hydroelectric purposes which perfectly blends in the natural landscape. It is 4.6 km long and 500 m wide, measuring a water level of 973 m and a capacity of 25 million m^3 of water (Ferraretto, 1998).

Figure 2. Barrea Lake seen from Barrea village

Figure 3. Barrea Dam

The fauna of this drainage basin includes: the white-throated dipper (Cinclus cinclus), the grey wagtail (Motacilla cinerea), the mallard or wild duck (Amas platyrrhinchos), the coot (Fulica Atra) and many other species, some migrating birds such as the grey heron (Ardea cinera) etc.

The endemic ichthyologic species specific to this area are: the brown trout and rainbow trout (Salmo trutta fario, Salmo trutta iridaeus), the tench (Tinca tinca), the Carpathian brook lamprey (Eudontomyzon danfordi), the common carp (Cyprinus carpio), (Tassi, 2002).

This system of modifying the natural course of rivers for hydroelectric purposes also affects the tributaries of Melfa and Rio Torto (tributaries situated in the external protection area of NPALM) due to the construction of the two artificial lakes: Grottacampanaro Lake on Melfa and Montagna Spaccata Lake on Rio Torto (tributary of Sangro, flowing through the external protection area).

Other artificial drainage basins included in the external protection area are Castel San Vincenzo on Volturno, La Selva, created by damming Schiavona, a tributary of Rapido (which is a tributary of Volturno). The construction of these reservoirs has engendered benefits, even though it had been very much debated as a controversial matter. In 1976, Barrea Lake was declared a Ramsar sensitive humid-area.

NATURAL LAKES

In what concerns natural lakes, Lake Scanno is the largest one. It is located at an altitude of 992 m in the upper drainage basin of Sagittario, between Monte Genziana and Montagna Grande. Scanno Lake (figure 4) was created as a natural dam, due to tectonic processes. It is 1722 m long, 700 m wide, measuring a 5.65 km perimeter, a 0.93 sqkm surface and a maximum depth of 32 m.

Vivo Lake (figure 5) is also a natural lake as it originated in a depression created by a tectonic uplift at an altitude of 1600 m. Springs and snow melt supply the lake's water resource, its measurements being variable.

Pantaniello Lake, situated in the external protection area was created due to karstic as well as glacial processes.

Figure 4. Scanno Lake

Figure 5. Vivo Lake

Other lakes created in the Pleistocene era on Sangro's upper course have disappeared because of natural causes but still mark the landscape (Ardito, Monasterio, 1998) . Thus, the river bed has deepened by passes and gorges, Opi Pass and Barrea Defile being the most important.

THE TOURISM IN NPALM

According to a study conducted by the Osservatorio Permanente sul Turismo Natura: "*the touristic product represented by National Parks, Natural Reserves etc., in other words, protected areas*" is preferred by 55.6 % of the "nature-loving" tourists of Italy. This fact highlights the increased attention of tourists towards vacations which allow them to directly experience a protected natural environment (www.parcoabruzzo.it, Bozza Rapporto Diagnostico document). NPALM is the most sought-after national park in what concerns Italian tourists while foreign tourists prefer Cinque Terre National Park (Liguria). Following a series of statistics and researchs conducted by the competent authorities, NPALM decided to gain the European Charter for Sustainable Tourism in Protected Areas (CETS). This charter mirrors the interest manifested by institutions and tour-operators which administer protected areas towards the development of tourism according to the principles of sustainable development (www.parcoabruzzo.it, Bozza Rapporto Diagnostico document).

As it is a protected area, sustainable tourism is encouraged (Amodio, 2001). The main touristic activities of the area include: ecotourism (especially hiking (figures 6 and 7) and animal watching) and leisure tourism which comprises recreational navigation (canoeing, kayaking (figure 8) and, during summer, windsurfing) and swimming during the warm season.

Figure 6. Map route along Barrea Lake

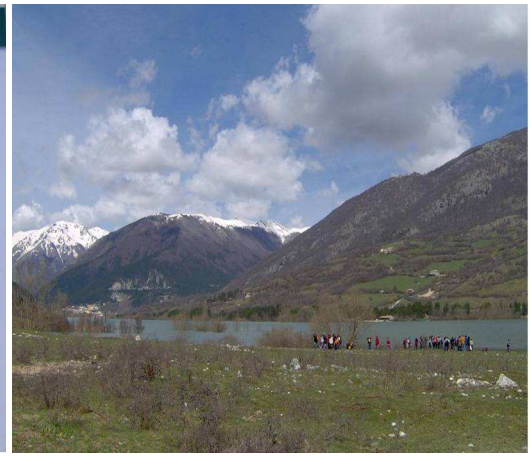

Figure 7. Group of tourists along Barrea Lake

Figure 8. The school of canoe and kayak from NPALM (Barrea village)

Canoeing competitions are organized each year due to the fact that they attract the tourists regularly practicing these sports and enhance the touristic flow of NPALM. The Canadian canoeing competition is representative, as it has reached its eight edition (figure 9).

Figure 9. Poster of National Contest for Canadian Canoe

Figure 10. Representative indicators for Barrea Lake

A path suitable for cycling circles Barrea Lake so that tourists can engage in cyclotouristic activities (figure 10). Birdwatching is a new type of tourism which is practiced in the area while recreational fishing and sport fishing are practiced according to a calendar that is carefully organized by the NPALM administration.

On the left bank of Barrea Lake, a beach bar has been constructed; equipped with lounge chairs and small recreational boats (figures 11 and 12) it allows tourists to cool off and to enjoy their spare time in a peaceful ambiance, surrounded by the mountains and forests of NPALM.

Figure 11. The bar La Gravara - Barrea Lake

Figure 12. Pleasures craft on Barrea Lake

Figure 13. Park of recreation organized by the municipality Villetta Barrea

Located near the lake, a park organized by the Villetta Barrea municipality comprises an area equipped with tables and benches suitable for picnicking, playgrounds, a bar which serves lunch as well as an area for practicing gymnastics (figure 13).

There are numerous proper accommodation options due to the fact that Sangro's drainage basin includes 5 of NPALM's most important municipalities: Barrea, Villetta Barrea, Civitella Alfedena, Opi, Pescasseroli, the historical nucleus of NPALM (Zarrilli and Iozzolino, 1995).

THE TOURISTIC POTENTIAL OF THE SANGRO RIVER

Hydrographical elements are considered to be natural resources bearing a high touristic importance. This is due to the fact that they imprint a certain aesthetic on the landscape, they posses several complex scientific uses and they also provide the infrastructure for several leisure activities and sports.

The touristic potential of watercourses is highlighted by four types of attributes: morphometric and morphologic characteristics; dynamic, quantitative and qualitative features; the specific biota of watercourses; the touristic potential of the cities and communes crossed by rivers (Bătinaş, Sorocovski, 2008).

Figure 14. Indicators with Sangro river

Here are some of the most interesting morphometric and morphologic characteristics of Sangro (figure 14) in what concerns its length, it is the longest river of NPALM, measuring approximatively 30 km. Other rivers which originate in the NPALM do not cover significant surfaces as opposed to Sangro. Also, its tributaries are usually mountain springs of reduced lengths and widths, varying along their course. In what concerns its longitudinal profile, the waterfalls of Scerto Valley represent significant elements (Tre Cannelle waterfall and delle Ninfe waterfall), situated in the Camosciara Complex, classified as a maximum protection area. They can be visited as the touristic route follows an asphalted road which was paved at the beginning of the '80s during the economic boom prone to touristic speculation.

Sangro's morphology is quite spectacular: close to its spring it creates Opi Pass and then on Barrea Defile, located near the commune of Barrea.

The quality of the watercourses crossing NPALM is high due to the fact that humans have not influenced it negatively through pollution as it is a legally protected area.

Since Barrea Lake has been declared a sensitive humid-area, it is clear that both its specific biota as well as that of Sangro River are important (figure 15). A representative reason for this is the presence of the Little Egret (Ardea Garzetta) (Tassi, 1984).

As Barrea Lake is situated near Villetta Barrea and since Sangro River flows through this area, (figure 16) the aesthetics of the region is enhanced and rendered dynamic. Also, as the commune of Barrea is situated on a steep slope as Sangro enters the Defile, the landscape is picturesque (figure 17), perhaps unique. The most popular touristic areas of NPALM are located in the upper drainage basin of Sangro: the historic sector of the park, comprising Fondillo Valley and Camosciara Complex.

Figure 15. Vegetation specific to Barrea Lake

Figure 16. Sangro River in Villetta Barrea village

Figure 17. Barrea Lake and Barrea village

The dynamics of the landscape is revealed in the richness of the forest and implicitly of the flora, in the crystalline water which flows and ripples across the white limestone substrate (Boccazzi-Varotto,1982). And when the lucky tourist encounters the wild animals which populate the region, he feels fully satisfied. NPALM is one of the few reserves of Europe where wild animals such as deer and wild boars can be spotted only meters away from highways, picnic areas, tourist routes and even settlements, without having to hike for miles. Following the course of Sangro River, there are several well defined areas where deer can be spotted as they descend to drink water.

Fondillo Valley (figure 18) is shrouded in myth as archeological discoveries have demonstrated that this was a sacred ground for the local population due to the numerous springs which were dedicated to gods in antiquity. This valley includes several tourist routes and thematic paths used for environmental interpretation and education (Furlani and Pratesi, 2000).

Figure 18. Fondillo Valley

Figure 19. Tre Cannelle and Ninfe Waterfalls

Essentially, this area housed the first environmental interpretation and education programs planned, created and implemented by NPALM. Nocturnal trips are organized in Fondillo Valley, providing tourists the opportunity to communicate with the natural environment as well as to increase their awareness and sensibility to environmental problems. This valley has become one of the main outdoor classrooms for environmental interpretation and education.

The Camosciara Complex (Latini, 2003), represents the main touristic attraction of NPALM, the preferred spot for organized trips. It is shaped as an amphitheatre with rocky, alpine crests and includes Scerto Valley with its two waterfalls: Tre Cannelle and Ninfe (figure 19) which were created due to the presence of rigid dolomite rocks.

Camosciara owes its denomination to Camoscio, namely the chamois (Rupicapra rupicapra) due to the fact that this species is commonly found on its rocky crests. Camosciara was declared a maximum protection Area in 1972 (Rossi, 1993) and the access routes are limited as the area, which streches beyond the two waterfalls, is not to be trespassed. In ancient times, the floodplain located by the foot of the mountains housed the main settlement of the region. However, in medieval times, due to feudal conflicts, Villetta Barrea and Civitella Alfedena were founded at a distance of 4 km and 6 km respectively from Camosciara and the original settlement was abandoned. The floodplain located by the foot of the Camosciara Amphitheatre now houses picnic area, a football field, a bar, bicycle and open carriage renting facilities, an electric train, equestrianism facilities and other touristic activities.

Villetta Barrea also harbors the Water Museum (figure 20); it houses the old mill which has been reconverted into a small hydroelectric power station that produces most of the power required by public illumination

Figure 20. The Water Museum in Villetta Barrea

CONCLUSIONS

Water represents an indispensable element for life and, in the case of protected areas, it also plays an important part in the protection and the preservation of the environment. While regular human activities do not regularly imply a thorough research in this direction, water surface studies, ground water studies, pollution and exploitation studies are indispensable and represent a priority for NPALM. Water interacts with the geologic and geomorphologic system due to springs, erosion mechanisms, sediment transport and infiltration. It also interacts with the flora system which is tightly linked to water resource localization and availability. Furthermore, in what concern resource exploitation, water quality and water integrated circuit interact with the anthropic system (water interception, the purification of polluted waters etc. (Pratesi and Tassi, 1998, pp. 49).

Thus, the touristic potential of NPALM is enhanced due to hydrographic elements. Sangro's drainage basin is exceptionally picturesque while Barrea Lake blends in the natural NPALM landscape. The park's administration was initially very much reluctant and opposed the authorization of the proposals and projects for the construction of the Barrea dam and, therefore, to the creation of Barrea Lake. However, in 1976 Barrea Lake was declared a Rasmar sensitive humid-area, the only one of its kind in the Abruzzo Region. As it shelters important bird populations and represents a rest area for migrating birds which travel from Africa to the north of Europe, it enhances the touristic potential of NPALM and encourages the development of new types of tourism.

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