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STAZIONE ORNITOLOGICA ABRUZZESE

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Sede: c/o Museo De Leone, Riserva Naturale Regionale Lago di Penne, 65010 Penne
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Pescara, 17/10/2018 *INVIATA VIA PEC*

Comitato VIA della Regione Abruzzo

OGGETTO: progetto Fassa - ampliamento cava a Popoli (PE) - prime controdeduzioni alle integrazioni sugli aspetti idrogeologici

In relazione alle due integrazioni progettuali attinenti la materia idrogeologica dell'Università di L'Aquila e dell'Università di Torino, in attesa dell'audizione presso il comitato di domani, si forniscono le prime controdeduzioni.

Per quanto riguarda la questione sollevata dalla relazione dell'Università di Torino, ci permettiamo di rimanere quantomeno allibiti circa le considerazioni addotte sulla permeabilità degli acquiferi carbonatici. A mero titolo di confronto, facciamo sommessamente notare il solo titolo di una pubblicazione scientifica internazionale di due tra i maggiori esperti italiani di acquiferi carsici (e, non quindi, una relazione) che da sola basterebbe ad inficiare quanto sostenuto dagli autori della relazione in merito alle nostre osservazioni:

Massoli-Novelli R, Petitta M, Salvati R (1999) Analysis and protection of groundwater resources: Capo Pescara karst springs (Central Italy). In: Fendekova M & Fendek M (Eds.), Hydrogeology and land use management, XXIX IAH Conf., 449-454

Come vengono definite fin dal titolo le sorgenti del Pescara?

Per comprendere bene poi la vulnerabilità di questo acquifero, alleghiamo direttamente un'altra pubblicazione internazionale (GROUNDWATER MANAGEMENT AND PROTECTION IN CENTRAL ITALY PROTECTED AREAS: SUGGESTIONS FOR SUSTAINABLE USES) del Prof. Marco Petitta, un luminare nel campo della conoscenza degli acquiferi del Centro Italia, dove è del tutto evidente che le considerazioni degli autori della relazione sono del tutto fuori contesto e non conferenti rispetto in generale alla sterminata bibliografia sui rischi per gli acquiferi carbonatici. Qui una figura significativa.

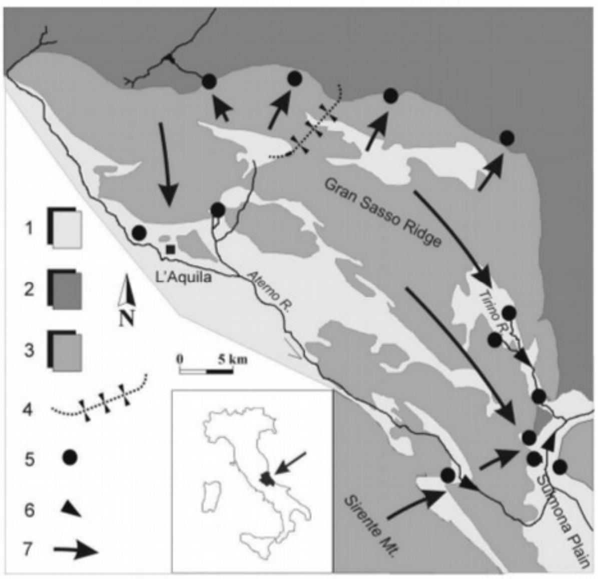

Figure 2: Hydrogeological setting of the Gran Sasso aquifer. 1: alluvial and clastic deposits (aquitards); 2: silicoclastic deposits (aquicludes); 3: carbonate and *karst aquifers; 4: motorway tunnel with drainage; 5: main springs; 6: main streambed springs; 7: groundwater flowpaths.*

Si può leggere, tra l'altro: "*Groundwater is an abundant resource in the Central Apennines, thanks to the presence of extensive regional aquifers. These aquifers, which consist of carbonate ridges, are highly permeable owing to karst and fissuring processes, resulting from their recent tectonic history*" oppure "*In fractured karst aquifers, the circulation of groundwater and the entrainment of possible pollutants in the subsoil occur at different times, making it necessary to have in-depth knowledge of groundwater dynamics.*"

Consigliamo caldamente la lettura integrale dell'articolo: si comprenderà la distanza siderale tra le necessità gestionali emerse nell'articolo rispetto al progetto in questione!

Per quanto riguarda, invece, la relazione dell'Università di L'Aquila, basterà evidenziare che:

1)viene svolta considerando omogenea la roccia interessata dagli sversamenti senza tener conto della fessurazione tipica dell'area già a livello superficiale;

2)addirittura non prende in esame i risultati stessi dei sondaggi che pure sono stati (parzialmente) fatti nell'area; anzi, sostiene bellamente che "*I risultati delle simulazioni sono necessariamente di tipo predittivo generale non conoscendosi eventuali particolari condizioni localizzate di grande permeabilità del suolo non prevedibili a priori in fase di modellazione* ***in assenza di puntuali sondaggi sul campo e relative dettagliate analisi geologiche."*** *(neretto nostro, ndr)*.

Cosa altro aggiungere (domani comunque sarà l'occasione per chiosare ulteriormente)? Sono queste le "approfondite" integrazioni richieste? La Regione Abruzzo non vuole proprio comprendere dagli errori già fatti (Bussi; Gran Sasso)?

Cordiali saluti,
Augusto De Sanctis - Stazione Ornitologica Abruzzese ONLUS

GROUNDWATER MANAGEMENT AND PROTECTION IN CENTRAL ITALY PROTECTED AREAS: SUGGESTIONS FOR SUSTAINABLE USES

PETITTA Marco

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Abstract.

This study proposes the inclusion of National Parks among the entities in charge of water resource management. The protected areas of the Apennine carbonate ridge coincide with the areas of recharge of springs that are exploited for drinking water supply. Park Authorities might guarantee the conservation of these resources in accordance with the applicable legislation and participate in their management, with benefits for them and for users. The study describes the application of this proposal to the Gran Sasso Park, in Central Italy. Although current Italian laws enable this new approach to groundwater conservation and management, Park Authorities may not be ready to shift from “guarantors” to “managers” of land and of its resources.

1 INTRODUCTION

Management and protection of groundwater resources to optimise their use and reduce their loss will be one of the main challenges of the third millennium, for both scientists and decision-makers (European Union 2000b, Miroladov & Marjanovic 1998). Nevertheless, there will be as well the necessity to find new amount of groundwater to supply drinkable and other needs, standing the current state of loss of groundwater resources in the shallower and strongly depleted aquifers: these resources could be defined as “strategic groundwater resources”. In Central Italy, these resources, whose exploitation is very limited, lie in protected areas.

In the last decades, the number of protected areas (national parks, regional parks, natural reserves, etc.) increased, especially in Italy, where many new national parks were established (Repubblica Italiana 1991). Park areas frequently host mountainous zones or wetlands, like in the Apennines. The Abruzzi Region, called “the green region” owing to its high percentage of protected areas (over 30%), has three national parks, one regional park and 40 natural reserves.

Groundwater is an abundant resource in the Central Apennines, thanks to the presence of extensive regional aquifers. These aquifers, which consist of carbonate ridges, are highly permeable owing to karst and fissuring processes, resulting from their recent tectonic history. Groundwater flows from the core to the borders of the reliefs, where the aquifers are drained in wetlands by springs that are frequently tapped for drinking uses (Boni et al. 1986, Celico 1979). On the regional scale, terrigenous sequences play the role of aquicludes. In other instances, the aquifer boundary coincides with the contact with alluvia or with the fills of intramontane plains, allowing groundwater seepage from the karst aquifer to the alluvial aquifer (Petitta & Tallini 2003).

The combined management of protected areas and aquifers might achieve the target of groundwater conservation in a relatively inexpensive way. This is a feasible proposal, because protected areas are already subject to limitations of use, in addition to those concerning groundwater exploitation. On the assumption covered by this study, Natural Park Authorities would be empowered with full control over their territories, including the conservation of water resources, as set forth in the relevant national laws and European Directives (European Union 2000a, Schultz 2001).

Hence, Natural Parks might become the new managers of the water resources located in their territories. The paper discusses the application of this approach to the case study of the Gran Sasso National Park.

2 HYDROGEOLOGICAL SETTING

The territories of the parks of Abruzzi coincide with the largest carbonate ridges of the Region (Fig.1): i) in the northern sector, the Gran Sasso massif represents the core of the Gran Sasso-Laga Mts. National Park; in the central sector, the Velino and Sirente Mts. ridge was designated as Regional Park; iii) in the southern sector, the historical Park of Abruzzi includes numerous carbonate aquifers; and, finally, iv) to the E, the Maiella Park matches the local regional aquifer. In other regions of the Central Apennines, many park territories correspond to carbonate ridges and thus to carbonate aquifers.

All these areas have a similar hydrogeological setting. The carbonate ridge is the preferential area of recharge of the regional aquifer thanks to its high permeability (fracturing and karst processes) and to the high elevation of its reliefs, with precipitation (including snowfall) ranging from 1,000 to 2,000 mm/yr.

The aquifer, generally extending over hundreds of square kilometres, is laterally bounded by synorogenetic silicoclastic sediments. These deposits give rise to such a permeability contrast as to represent a zero-flow boundary for the regional groundwater contained in the carbonates (Boni et al. 1986, Celico 1979). In some sectors (usually at the south-western edge of the ridges), the aquifer is bounded by continental clastic sediments of Plio-Quaternary age (alluvial valley floors, intra-montane basins). In these instances, the permeability boundary is less sharp and limited seepage towards the alluvial aquifers is observed (Petitta & Tallini 2003). The massive groundwater resources contained in the carbonate aquifers supply springs which have a very high discharge (from hundreds to thousands of L/s). These springs lie at the margins of the massif, along its permeability boundaries, i.e. in its topographically lowest area. The springs have a very stable regime (absence of karst features in groundwater discharge areas), testifying the large size of their recharge area (Petitta & Tallini 2002).

In the core of the ridges, the regional groundwater has a depth of several hundred of metres. In these areas, anthropic pressure is very limited, due to the scarcity of built-up areas. At the margins of the ridges, the high discharges of springs often create wetlands of significant environmental (flora and fauna) value (Bradford & Watt 1998). Water uses are concentrated in groundwater discharge areas. These waters are dominantly used for supplying drinking water to the major human settlements located on valley floors and in intra-montane basins.

The Abruzzi carbonate aquifers deliver 75 m^3/s on average (Petitta et al., 2001), of which roughly 7 m^3/s are tapped for drinking water supply. The springs are located in protected areas, i.e. in Parks' territories, or in special Regional Natural Reserves: as much as 60% of local groundwater resources spring inside protected areas.

This unique setting is particularly favourable to groundwater protection, since spring recharge areas lie inside protected areas with low risk of pollution.

The purpose of this study is to demonstrate that leveraging the synergies between land conservation authorities (National and Regional Parks and Reserves) and water management entities (Regions, Aqueduct Authorities, Basin Authorities, etc.) can benefit both parties, which are often in conflict with each other.

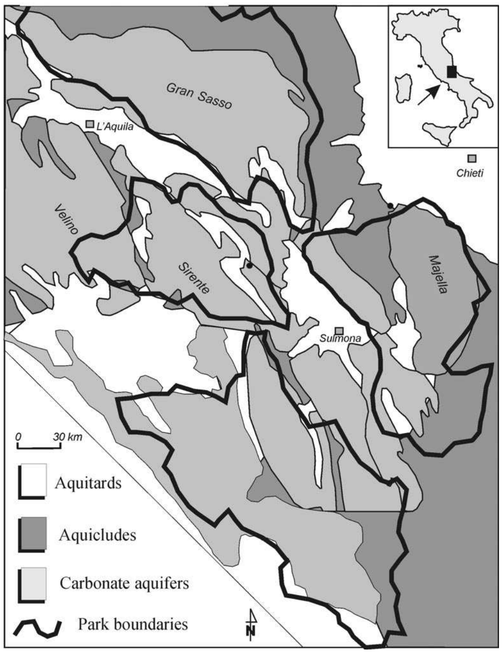

Figure 1 – Hydrogeological setting and Park territories in the Abruzzi region.

3 PROTECTED AREA MANAGEMENT

In Italy, the management of protected areas is governed by law 394/1991 (Repubblica Italiana 1991), which also established many new National Parks, including the Gran Sasso-Laga Mts. one. This legislation lays down the "fundamental principles for the designation and management of protected natural areas, with a view to guaranteeing and promoting the conservation and enhancement of the natural heritage in a co-ordinated way". These areas comprise "geological formations of high natural and environmental value". The duties of Parks include "the conservation of their water and hydrogeological budget", as well as the "protection and restoration of their water and hydrogeological budget". Finally, the law authorises the siting of sustainable production or manufacturing activities in the Parks, as well as the marketing of products with the Parks' labels.

This regulatory framework largely provides for conservation and management of groundwater resources, although the current water legislation (following paragraph) fails to explicitly incorporate Park Authorities among the entities involved in water conservation and management.

Although Park Authorities are theoretically empowered to oversee and enforce water protection, this objective is almost always expressed in terms of conservation of ecological and landscape equilibria, neglecting hydrogeological aspects. This attitude might depend on cultural and historical factors, which led to a protection-centred rather than to a management-oriented approach to protected areas. For political reasons (green parties, environmental organisations), as well as for cultural and scientific ones (dominance of biologists over geologists in environmental organisations and Park Authorities), Italian Park Authorities are much more aware of ecological and biological issues than of geological and hydrogeological ones.

Recently, there have been signs of increased awareness of water issues and of the need for pursuing policies of management of water resources aimed at enhancing not only their landscape and tourist value, but also their economic value (lease of rights for bottling of mineral waters, siting of low environmental impact power generation facilities, etc.). Nonetheless, there is still a general feeling of mistrust towards the granting of rights on groundwater resources, which are perceived as conducive to depletion rather than to beneficial use of a renewable resource. In some cases, this mistrust might be justified by prior negative experiences (actual depletion, wastes, etc.). However, Park Authorities are often unwilling to gain greater insight into land planning & management issues and thus give reasoned answers to specific cases.

The Gran Sasso massif is a case in point. In the 1970s, its aquifer experienced the dramatic impact of the construction of a motorway tunnel, which drained the regional groundwater and decreased the discharge of many of its springs, mostly exploited (Massoli-Novelli & Petitta 1997). This prior experience has resulted into opposition to any new project of development of water resources and of construction of new underground infrastructures (enlargement of underground laboratories of INFN, the National Institute of Nuclear Physics). The position of the Gran Sasso Park Authority has two categories of consequences:

- risk of enactment of regulations authorising the siting of new structures - in spite of the Park Authority's opposition - in view of priority needs, which would be imposed and thus not negotiable;

- failure to participate in the management of water resources, with loss of opportunities of development, employment and - last but not least - of revenues for the Park.

This position, which is contrary to any compromise, leads water resource managers to authorise the intensification of water withdrawal in areas adjacent to protected areas (belonging to the same aquifer) under lease agreements. The end result is the depletion of the Park's water resources and the Park Authority's failure to exercise control.

A different attitude and the devolution of water resource conservation and management powers to the Park might benefit both the Park and the other entities involved in its management. In this context, the strength of the Park lies in its capability of easily guaranteeing the protection of the recharge areas of springs and wells exploited for drinking and other uses. However, although this protection is specified in the relevant legislation, it is hardly enforceable owing to the numerous constraints that it involves.

4 RULES FOR GROUNDWATER PROTECTION

The recent Italian legislation (Repubblica Italiana 1999, 2000) on water protection (Laws 152/99 and 258/00), which also implemented European Directives 91/271/EEC and 91/676/EEC on pollution, identifies four fundamental targets:

- preventing and reducing pollution and rehabilitating polluted water bodies;
- improving quality of water and instituting adequate measures of protection of waters for designated uses;
- pursuing sustainable uses of water resources, with priority to drinking water;
- maintaining the natural self-purification capability of water bodies, as well as their capability of sustaining fauna and flora communities and their diversity.

Needless to say, these targets are among the tasks of National Parks, although Parks are not explicitly identified among the entities entrusted with their achievement.

As is known, the protection of groundwater resources allocated for drinking water supply requires the designation of "source protection zones", subject to limitations of use that decrease with the increase of their size (Muratori 1988, European Commission 1995, Custodio et al. 1998).

In particular, the Italian legislation (Repubblica Italiana 1999, 2000, Celico et al. 1999) provides for the designation of:

- an inner zone with water abstraction facilities (min radius 10 m); in this zone, anthropic activities are banned;
- an intermediate zone surrounding the inner zone and subject to such limitations of use as to protect the exploited water resource qualitatively and quantitatively; in this zone, the legislation bans many anthropic activities, i.e. the same that are already banned in park areas; the size of this zone depends on the hydrogeological characteristics of the area;
- an outer zone, which corresponds to the entire area of recharge of the exploited resource, where anthropic activities are to be controlled.

The enforcement of this legislation (and the designation of source protection zones for each drinking water exploitation site) encounters major difficulties owing to hydrogeological factors (knowledge of groundwater flowpaths) and anthropic factors (prior human settlements endangering the quality and quantity of the water resource).

In particular, in fractured and karst aquifers (Daly et al. 2002) of considerable size, such as those in the Central Apennines, it is very hard to designate the intermediate zones and to limit anthropic activities in source protection zones (Biondic & Pavicic 1998).

As a matter of fact, in a karst aquifer, no geometric or time-based criterion can be applied for the designation of the outer zones. In fractured karst aquifers, the circulation of groundwater and the entrainment of possible pollutants in the subsoil occur at different times, making it necessary to have in-depth knowledge of groundwater dynamics.

In view of this hydrogeological setting, the conservation areas should include areas that are very distant from groundwater discharge areas, such as those of concentrated recharge. Therefore, the introduction of limitations of use in non-adjacent areas can be extremely problematic (Celico 2001).

In the Apennine Parks, the issue can be easily addressed by vesting the Park Authority with the responsibility for designating the outer zones included in the Park's territory. Most of the limitations to be introduced are already part of the Park's routine tasks and additional bans would be certainly limited.

As to the recharge zones (corresponding to the entire area of recharge of the exploited resources), it is difficult to distinguish the recharge areas of the individual springs in a karst aquifer that has no direct links (evolved karst conduits) between recharge and discharge areas (European Commission 1995).

Moreover, the size (hundreds of km^2) of the Apennine carbonate aquifers actually inhibits the adoption of limitation measures, unless the Park Authority's institutional protection role is invoked.

5 THE GRAN SASSO CASE STUDY

The Gran Sasso massif is the regional aquifer most suited to demonstrate a new philosophy of groundwater resource management, given its hydrogeological setting, the presence of an important National Park, the availability of in-depth knowledge of the dynamics of its groundwater, the impact of human settlements and the modes and extent of water withdrawal.

The Gran Sasso massif (about 800 km^2 wide and with a height of 2,912 to 270 m a. s. l.), is a carbonate ridge consisting of Meso-Cenozoic units belonging to slope-to-basin lithofacies. The sequence has evidence of tectonic movements due to the Apennine orogenesis, such as overthrusts and extensional faults. The massif holds a regional aquifer, with high values of recharge (700 mm/yr vs 1,100 of precipitation) due to fractures and karst features. The aquifer supplies minor local springs of perched aquifers and especially the large basal springs located at the boundaries of Gran Sasso (total discharge: 19.5 m^3/s) as shown in Fig. 2. These boundaries of the regional aquifer are well defined by stratigraphic and tectonic contacts with aquicludes (Miocene terrigenous deposits) or aquitards (Quaternary clastic continental deposits) with groundwater seepage. The karst morphology is dominant in recharge areas, vadose and epikarst zones, while it is absent in discharge areas, such as conduits and caves, owing to the fast emplacement of clastic deposits in the Quaternary valley (Petitta & Tallini 2003).

Recent hydrogeological investigations (Petitta & Tallini 2002) classified the main springs of the study area into different groups, according to their hydrogeological setting (Fig. 2). Along the main thrust fault on the northern side of Gran Sasso, there are multiple springs (1 m^3/s), which drain the regional aquifer. These springs, located inside the Park and already largely exploited, are key to preserving the minimum in-stream flow. Furthermore, the regional aquifer is also drained by the Gran Sasso motorway tunnels (1.4 m^3/s for drinking uses).

The area of L'Aquila accommodates springs with a very steady discharge (1 m^3/s), and other springs (0.9 m^3/s) that receive significant contributions (Petitta and Tallini, 2003) from a multi-layer clastic aquifer. These areas are highly urbanised and thus not recommended for drinking water exploitation.

In the south-eastern part of the study area, the main springs (Tirino Valley and Sulmona Plain) drain the Gran Sasso aquifer and are chiefly supplied by the regional aquifer at the lowest elevations (20 m^3/s). These springs, creating wetlands of high natural value, are in part exploited also through well fields (Petitta & Massoli-Novelli 1998). Since they lie at the boundaries of the Park, their uses are highly diversified (bottling of mineral water, hydropower generation, industrial uses, fisheries, etc.).

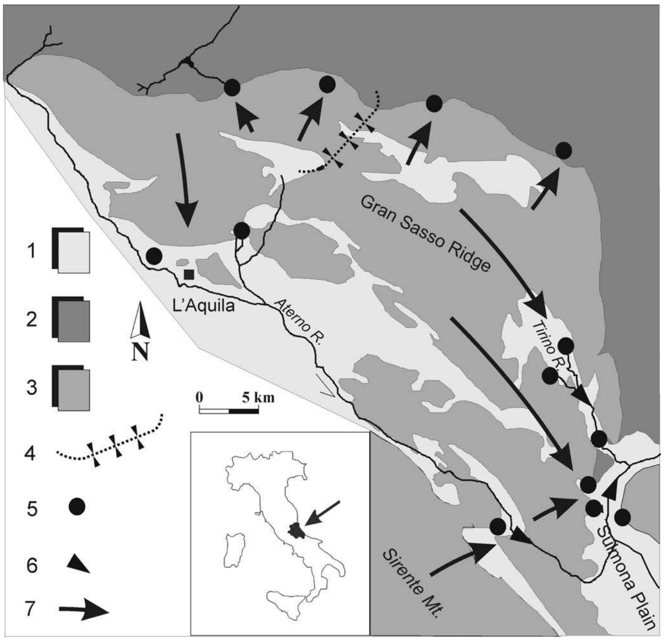

Figure 2: Hydrogeological setting of the Gran Sasso aquifer. 1: alluvial and clastic deposits (aquitards); 2: silicoclastic deposits (aquicludes); 3: carbonate and *karst aquifers; 4: motorway tunnel with drainage; 5: main springs; 6: main streambed springs; 7: groundwater flowpaths.*

6 NEW PROPOSAL FOR WATER RESOURCE MANAGEMENT IN THE GRAN SASSO PARK

In view of the hydrogeological setting and current level of utilisation of the Gran Sasso water resources, a future scenario might be envisaged where the Park Authority would be active in conservation of local water resources and – to a certain extent – in their management.

On the northern side (Fig.2), it would be very simple for the Park Authority to designate outer zones and recharge zones, since the springs being exploited are in the Park's territory. In this way, the Park Authority would have the assurance of a minimum in-stream flow.

The ongoing dispute concerning water drainage in the tunnel (Fig.2) is more difficult to solve, taking also into account the economic interests at stake. In this case, too, the Park Authority might require water resource managers to ensure a minimum in-stream flow and to install a water quality monitoring system. The latter obligation is, among others, specified in the legislation governing the outer zones.

The area that might need more demanding efforts is the south-eastern sector extending between the Sulmona Plain and the Tirino valley; it is here that regional groundwater springs and drinking water abstraction facilities are concentrated (Fig.3). Out of the springs located in this sector, only one lies in the Park's territory, while the largest spring (Capo Pescara) coincides with the territory of the Capo Pescara Regional Natural Reserve (Massoli-Novelli et al. 1999). The recharge areas of these springs are mostly located in the Gran Sasso Park and are in part under the jurisdiction of the nearby Regional Sirente-Velino Park.

The springs that do not belong to the Park's territory are exploited for hydropower generation, irrigation, fisheries, drinking water supply, thermal spas and also industrial uses (Fig.3). Additional abstraction of regional groundwater for drinking uses is being considered. Owing to the density of its springs, this area accommodates numerous anthropic activities.

The proposal of reorganisation of water resource planning & management activities, in order to harmonise environmental protection with human needs and water protection, is outlined in Fig. 3:

- extension of the Park's territory to include all the main springs and the Capo Pescara Regional Natural Reserve;

- enhancement of the tourist value of the artificial lake of Capodacqua - a point of passage of many migratory birds (bird viewing sites) - and, at the same time, continuing of hydropower generation and irrigation activities under the Park Authority's management;

- enhancement of the value of the Presciano Spring and resumption of freshwater crayfish breeding under the Park Authority's management;

- Park Authority's control over the three existing fish breeding facilities (water intake and release) and collection of a lease levy;

- increased withdrawal of water for drinking in the well fields of Bussi and at S.Calisto, and designation of related conservation areas (inner, outer and recharge zones) under the Park's Authority oversight; here, water withdrawal might rise from 0.5 m^3/s to 1.5-2 m^3/s; these additional water abstraction facilities should be planned in such a way as to use the renewable water resources of the two main springs (Capo Pescara and Basso Tirino) to the extent of less than 10% of their natural discharge (1-2 m^3/s out of roughly 20 m^3/s);

- cancellation of the lease for industrial use of the Basso Tirino spring and issuing of a new lease including withdrawal from the Pescara River surface waters;

- new designation of the Capo Pescara Natural Reserve and its inclusion in the Park's territory; the discharge from the springs of this area is expected to drop owing to the granting of new water withdrawal leases in nearby areas;

- Park Authority's acquisition of a holding in the operation of mineral water facilities (under lease) and use of the Park's label.

- Part Authority's acquisition of a holding in the operation of the Popoli thermal spas (under lease) and use of the Park's label.

In spite of difficulties of implementation, due to the involvement of both private- and public-sector entities, this project might optimise water resource management without causing harm to the environment, maintain the current level of water exploitation and thus ensure the sustainable development of local strategic groundwater resources. A minimum part of these resources might be allocated for extension of withdrawal for drinking water supply.

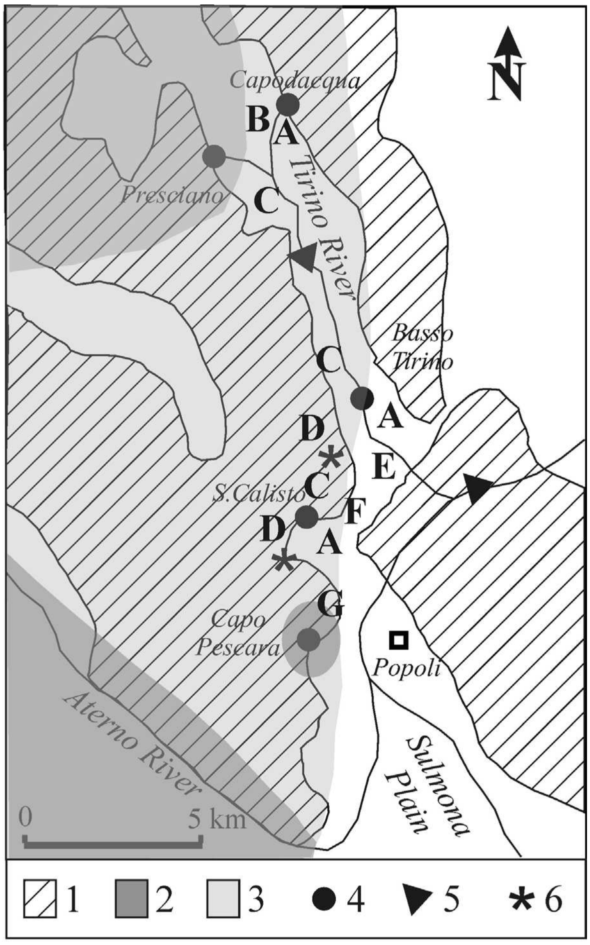

Figure 3: Action plan in the south-eastern sector of Gran Sasso. 1: Carbonate aquifer outcrop ; 2 : Park and Reserve areas ; 3 : Area proposed to be included into the Park's territory; 4: Main springs; 5: Streambed springs; 6: Proposed location of well-fields for drinking uses. Letters identify water uses: A: hydropower; B: agricultural irrigation; C: fisheries; D: drinking water supply; E: industrial uses; F: thermal spas; G: mineral water.

7 FINAL REMARKS

The first step for entrusting Park Authorities with responsibilities of water resource management is the amendment of Art.3 of Law 152/99 (Repubblica Italiana 1999). This amendment might allow Parks to be included in the list of entities in charge of conservation and sustainable management of water resources. In the case of Regional Parks, co-ordinated by Regional Authorities, the fulfilment of this task would be simpler, since Regional Authorities are already designated as water management entities.

With this approach, Natural Parks might become the new managers of water resources in their territories, with the following aims:

- protecting groundwater for drinking use from pollution;
- guaranteeing the conservation of unused "strategic groundwater resources";
- using a small part of their water resources to obtain revenues, e.g. through mineral waters, fishing farms, tourism in wetlands, etc.; at present, these activities are run by private firms and not directly by Parks;
- participating in decisions on the granting of water rights, fulfilling their institutional obligation of protecting the biological, hydrogeological and natural environment and overseeing the exercise of such water rights, sometimes exceeding the specified limits.

The role of guarantors of the quality of water resources would enable Park Authorities to regulate and monitor the present abstraction of water (at present, Park Authorities are not vested with this power), so as to protect the local environment and avoid the risks of groundwater exploitation occurring beyond the boundaries of protected areas but having an impact on them.

Furthermore, in exchange for the granting of water rights (with careful assessment & monitoring of sites and extent of use), the Park might market its water resources, e.g. through the bottling of mineral waters or the granting of leases for thermal spas.

With this approach, users would obtain the guarantee of the conservation, enhancement and promotion of their water resources - otherwise hardly practicable - and, concurrently, a decrease in the operating costs of conservation activities.

In the case of Gran Sasso, the success of the project obviously requires the Park Authority to shift from a policy merely based on protection to a policy of pro-active management of land and water resources and of dialogue and consultation with public and private stakeholders.

Apart from minor regulatory amendments, there are no particular obstacles to the implementation of the above project. The Gran Sasso Park is a site particularly suitable for a pilot project – which, if successful, might be extended to other areas - for the following reasons

- presently high groundwater availability, in spite of high water exploitation;
- scarce human settlements in the mountain areas of the Park;
- hydrogeological setting (springs located at the boundaries of the aquifer, absence of karst processes in discharge areas, considerable size of the aquifer).

Considering the growing local anthropic pressure, especially in terms of applications for drinking water abstraction, the current conflicts between the Park Authority and water resource managers, any wait-and-see attitude or delay would be deleterious.

The approach proposed in this study may also serve as a test pad for determining the feasibility of reconciling environmental protection with human needs, both defined as priority areas in the European Directives for the third millennium.

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