

**THE VARIATIONS OF WATER LEVEL AND INFLUENCE OF  
ARTIFICIAL REGULATIONS IN MARSHY WOODLAND OF *ALNUS  
GLUTINOSA* IN THE PELIGNA VALLEY (ABRUZZO, CENTRAL  
ITALY): 4 YEARS OF INVESTIGATION**

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**Abstract:** The Sulmona basin (province of L'Aquila, Abruzzo, central Italy), also known as Valle Peligna, is characterized by calcareous and argillaceous fluvial-lacustrine deposits. The bottom of the basin is almost completely cultivated and built-up, but a few strips of azonal natural vegetation still remain. Among these, of special interest is the marshy vegetation with *Alnus glutinosa* (*Carici ripariae-Alnetum glutinosae* belonging to the class *Alnetea glutinosae*). In this work we present the water level variation in the *Carici ripariae-Alnetum glutinosae* over four years of observations (2010–2013). This association is developed in some valley bottom depressions. Measuring for monitoring water level was carried out in 6 depressions. For each measurement site, observations were always made at the same fixed points. Supply random measurements have revealed the discontinuous profiles of the territory, with deepest and highest points. The water level has a maximum level in winter and a minimum in summer. Water level is related to rainfall, which in the Valle Peligna is typically Mediterranean, with a strong reduction in summer. In all measured places the deepest points are almost always flooded during the year. The analyzed marshy forest of *Alnus glutinosa* have proved to be a relatively constant system during the years, but artificial activities have easily changed or destroyed this habitat.

**Key words:** Waterlevel, Peligna, flooding, *Alnus glutinosa*, marshy, forest, dynamics, destruction.

**Introduction**

The gradients and trends of waterlevel dynamics and flooding are necessary to distinguish riparian from marshy (with more persistent flooding) vegetation. This is reflected from a biodiversity point of view in floristic (species composition) and ecological (habitats) differentiation, as shown in various works [i.e. 4,9,6,1]; it can also cause differences in the development of functional traits of plants. Monitoring and analysis of the flooding cycles can manifest the state of health, conservation or degradation of habitats, especially regarding desertification and the alterations of ecosystems caused by water regulation [8]. The plant associations of wetlands are strongly related to change in water flow throughout the years, which however do not have always constant characteristics. In the study area the marshy community of black alder (*Carici ripariae-Alnetum glutinosae* Weisser 1970) is developed in some bottom valley depressions, from a few centimeters to 2 meters deep. This can distinguish that from the black alder forests riparian community (*Aro italici-Alnetum glutinosae* Pedrotti et Gafta 1996). This paper presents the water level variation in the *Carici ripariae-Alnetum glutinosae* complex system, during four years of observations (2010–2013).

### Characteristics of the study area and the recording stations

The study area is located in the Sulmona basin, province of L'Aquila, Abruzzo region, in central Italy, also known as Valle Peligna. The area is delimited by the highest limestone mountains of the Apennines, and drains into the Aterno-Pescara river basin. Analyzing the meteorological data reported in the “Annali Idrologici” networked by “Ispra - Istituto Superiore per la Protezione e la Ricerca Ambientale” website, compared with the data of the Weather Station “Sulmona Acquasanta”, plus some evidence in the field, it can be concluded that the climate of the area falls between Mediterranean and Temperate (according to RIVAS MARTÍNEZ *et al.*, 2004) with continental influences due to the high surrounding mountains. According to the bioclimatic classification of the area, the macro-bioclimate is of Mediterranean type; the precipitation is strongly reduced in summer and the average annual rainfall for the Sulmona basin is from 320 mm to over 700 mm per year. The average temperature is highest during August, with 31.7 °C, and at a minimum in January, with -0.1 °C. In summer frequently repeated values occur of around 40 °C. In winter common values below -12 °C to -20 °C are rarely reached in the colder patches. These geographical conditions allow the development of certain species such as: *Alnus glutinosa*, *Apium nodiflorum*, *Berula erecta*, *Nasturtium officinale*, *Carex pendula*, *C. remota*, *C. riparia*, *Eupatorium cannabinum*, *Filipendula ulmaria*, *Frangula alnus*, *Galium palustre*, *Hypericum quadrangulum*, *Iris pseudacorus*, *Lemna minor*, *L. trisulca*, *Lycopus europaeus*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Myosoton aquaticum*, *Mentha aquatica*, *Phragmites australis*, *Populus nigra*, *Salix alba*, *S. cinerea*, *S. apennina*, *S. viminalis*, *Scrophularia umbrosa*, *Sium latifolium*, *Solanum dulcamara*, *Sparganium erectum*, *Stachys palustris*, *Typha latifolia*, *T. angustifolia*, *Valeriana officinalis*, *Viburnum opulus*, etc.

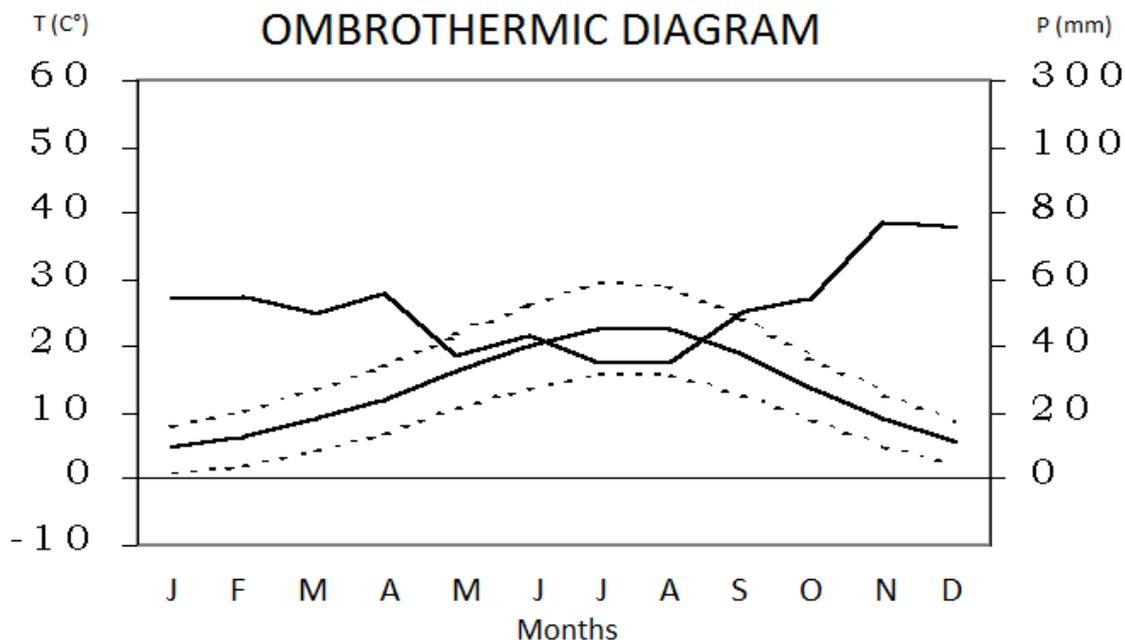


Fig. 1: Ombrothermic diagram of Sulmona, Valle Peligna

The bottom of the basin is characterized by calcareous and argillaceous fluvial-lacustrine deposits, between 300 and 350 m a.s.l.. It is almost completely cultivated and built-up (Fig. 1), but there are still a few strips of azonal natural vegetation formed by marshy vegetation of *Alnus*

*glutinosa* (*Carici ripariae-Alnetum glutinosae*) belonging to the class *Alnetea glutinosae*, all of exceptionally rare distribution in Italy [1]. The data obtained are in agreement with those known in the literature [e.g.: 7] for Central Europe. The marshy series of *Alnus glutinosa* is composed of woodlands from the *Carici ripariae-Alnetum glutinosae*, shrublands from the *Salicion cinereae* and meadows from the *Galio palustris-Caricetum ripariae*. The marshy alder woods have been recently proposed by SBURLINO *et al.*, (2011) to be renamed under a new plant association (*Scrophulario umbrosae-Alnetum glutinosae* Sburlino, Poldini, Venanzoni and Ghirelli 2011), needing to some extent and further clarifications in the future, to be confirmed.

### Materials and Methods

The measuring was carried out in six depressions. For each measurement site, observations were always made at the same fixed points. The water level was detected by a graduated metric tube. After a general survey, the tubes were placed in depressions, within the six stations identified as: 1) Bagnaturo1 [42°5'43.14"N-13°54'22.32"E]; 2) Villagiovina di Bagnaturo [42°5'42.23"N-13°54'20.04"E]; 3) Bagnaturo, depuratore [42°5'46.60"N-13°54'17.77"E]; 4) Roccacasale [42°6'58.96"N-13°52'21.05"E]; 5) Corfinio [42°7'41.04"N-13°51'52.91"E]; 6) Sulmona [42°3'32.50"N-13°54'57.16"E]. The measurements were recorded at least once a month, over the whole period of observations.



Fig. 2: The typical winter aspect of the marshy alder wood of Valle Peligna, in the picture the Roccacasale point. Photo: Kevin Cianfaglione, 2013

### Data analysis

Supply random measurements have revealed the discontinuous profiles of the territory, marking the deepest and highest points. The deepest points are almost always flooded during the year. A first assessment of the flooding phenomenon in this area has been described by

CIANFAGLIONE (2009, 2011), distinguishing the riparian vegetation (*Aro italici-Alneto glutinosae* sigmetum) from the more swampy (*Carici ripariae-Alneto glutinosae* sigmetum), differentiating the level of flooding. The ground level of all stations is never homogeneous, but with numerous small patches of concavity and convexity that accentuate the complexity of the vegetation in the area, creating different flooding or emergences, according to the average level of the water. Therefore, we can find some stages between the deep and perennial flooding of the more depressed places, up to the more emergent point, where the flooding phenomenon is increasingly marginal. For this, in a few cases we can find a mix of marsh and riparian species in a few square meters; not always similar over the years. The canopy covers are very important, up to 100%. Also in this case the discontinuity of the canopy can sometimes affect the entry of grassland species; not always at the same level over the years (Fig. 2).

### Series trends

The trends recorded at the six stations are all similar, according and directly proportional to the trend of annual rainfall in Valle Peligna, which affects not only directly but also indirectly the flooding phenomenon. In fact, the rain induces an increase in the availability of ground water from the mountains, which is able to flood several areas. Despite the direct flooding from rainfall or river floods, regeneration has been much limited by the reclamation work carried out until now. In any case, if for instance we have in the Valley a few points of regeneration of old coppices and some strips of secondary succession, the destruction is always an important phenomenon. In the first station (Fig. 3) the biggest variation was from +0 to +50 cm; in the second (Fig. 4) was from +1 to +90 cm; the third (Fig. 5) was from +0 to +120 cm; the fourth (Fig.6) was from +0 to +40 cm; the fifth (Fig. 7) was from +5 to +90; the sixth (Fig. 8) was from +10 to +50. In remarks 1 and 2 are to be reported the presence of some limnocrenic springs with low but relatively constant flow rate. In observations at 1, 3 and 4 in the summer, when there is 0 cm level of water, the soil remains always moist. During summer, with the floodwater retreat, the floating and the more aquatic vegetation retires in the depressions, as small fragmented population. Remarkably, *Lemna minor* can still survive at this, also in the herbaceous layer, thanks to the humidity of the soil and to the appropriate shading produced by the canopy.

The trend of stations 5 and 6 is different to the stations 1, 2, 3 and 4, because at 5 it happened that the station (Bagnaturo, depuratore) was drained, coppiced, mostly deforested and filled in, partly canalized and leveled with material carried over, reducing the manner and the volume of the flooding – although the trend remains visible in the still floodable portions. Here was found an extraordinary, very dense and extensive population of *Solanum dulcamara*, floating on the floodwater and not yet recovered after. On the other hand the station of Sulmona (no. 6) where there was a residual population of native crayfish (*Austropotamobius pallipes*), the station marked also in reports and surveys of the documentation of the European LIFE project [“LIFE03NAT/IT/000137 - *Austropotamobius pallipes*: tutela e gestione nei SIC d'Italia centrale” (protection and management in the Sites of European Community interest of Central Italy)] has been completely deforested, drained and then filled out, smoothed with landfills and partly canalized, so that the floods have ceased completely (Fig. 9).



Fig. 3: Trend of Bagnaturo 1 place

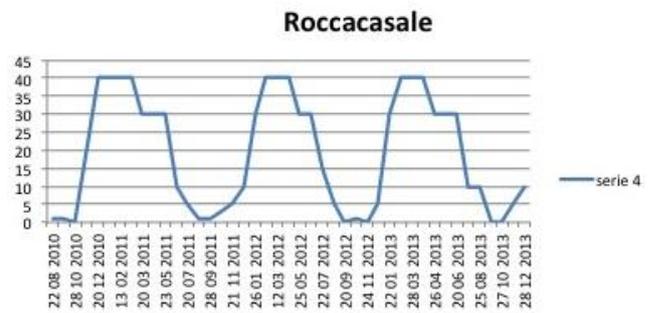


Fig. 6: Trend of Roccacasale place



Fig. 4: Trend of Villagiovina di Bagnaturo place

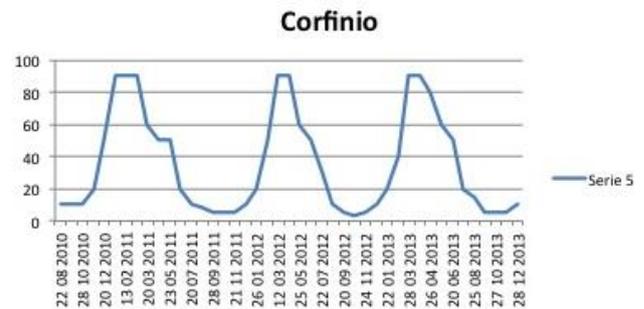


Fig. 7: Trend of Corfinio place



Fig. 5: Trend of Bagnaturo depuratore place

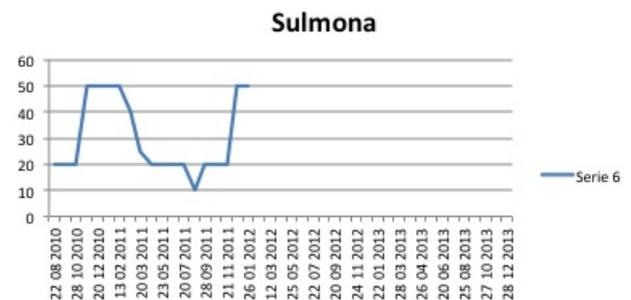


Fig. 8: Trend of Sulmona place.



Fig. 9: Example of Reclamation activities in Sulmona. Photo: Archive of Pro-Natura Abruzzo organization Rangersg

### Conclusions

In the study area, the water level has a maximum in winter and a minimum in summer; the flooding level is directly and indirectly related to rainfall levels, which in the Valle Peligna are typically Mediterranean, with a strong reduction in summer; the average annual rainfall for the Sulmona basin is 350–600 mm per year. The period of maximum precipitation is in winter, and the minimum is in summer, and we can see a correspondence that the water level has a maximum in winter and a minimum in summer. The flood range is from a maximum of 120 cm of water to nothing. If as stated the Valle Peligna bottom has a few point of regeneration of old coppices and some strips of secondary succession, the remaining natural ones are undergoing continuous risk.

The analyzed marshy forest of *Alnus glutinosa* have proved to be a relatively constant system during years, but artificial activities have easily changed or destroyed this habitat. According to Corbetta and Pirone (1988); Di Felice and Di Felice (1991); Cianfaglione (2009); Cianfaglione and Di Felice (2012), the status of the Valle Peligna bottom is undergoing continuous and progressive disturbance and anthropogenic degradation, through the excavation of a drainage canals, buildings, filling of landfills, logging, tree felling, quarries for building material and waterways canalization. The principal causes of degeneration and regression of vegetation are: the continual advance of construction, roads and other interventions; the new intensive agriculture expansion policies; pollution and legal/illegal garbage dumping.

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**VARIAȚIILE NIVELULUI APEI ȘI INFLUENȚA REGULARIZĂRILOR ARTIFICIALE ÎN ZONELE MLĂȘTINOASE CU *ALNUS GLUTINOSA* DIN VALEA PELIGNA (ABRUZZO, ITALIA CENTRALĂ), DUPĂ 4 ANI DE INVESTIGAȚII**

**(Rezumat)**

Bazinul Sulmona (provincial L'Aquila, Abruzzo, Italia centrală), cunoscut și ca Valea Peligna, se caracterizează prin depozite calcaroase și argiloase fluvial-lacustre. Partea inferioară a bazinului este cultivată aproape în totalitate, dar mai există totuși câteva benzi de vegetație naturală azonală. Aici sunt incluse și asociații cu *Alnus glutinosa* (*Carici ripariae-Alnetum glutinosae* aparținând clasei *Alnetea glutinosae*). Lucrarea prezintă observații privind variația nivelului apei în *Carici ripariae-Alnetum glutinosae*, timp de patru ani (2010/2013). Această asociație se dezvoltă și în depresiunile din partea inferioară a văii. Măsurătorile pentru monitorizarea nivelului apei au fost făcute în 6 depresiuni. Pentru fiecare loc de măsurare, observațiile au fost făcute întotdeauna în aceleași puncte. Măsurătorile aleatorii suplimentare au arătat discontinuitatea profilului zonal, cu punctele cele mai joase și mai înalte. Nivelul apei are un maximum iarna și minimum vara; acest nivel depinde de precipitații, care în Valea Peligna sunt tipic mediteraneene, cu scădere puternică vara. În toate locurile de observație, cele mai joase puncte au fost întotdeauna inundate în timpul anului.

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