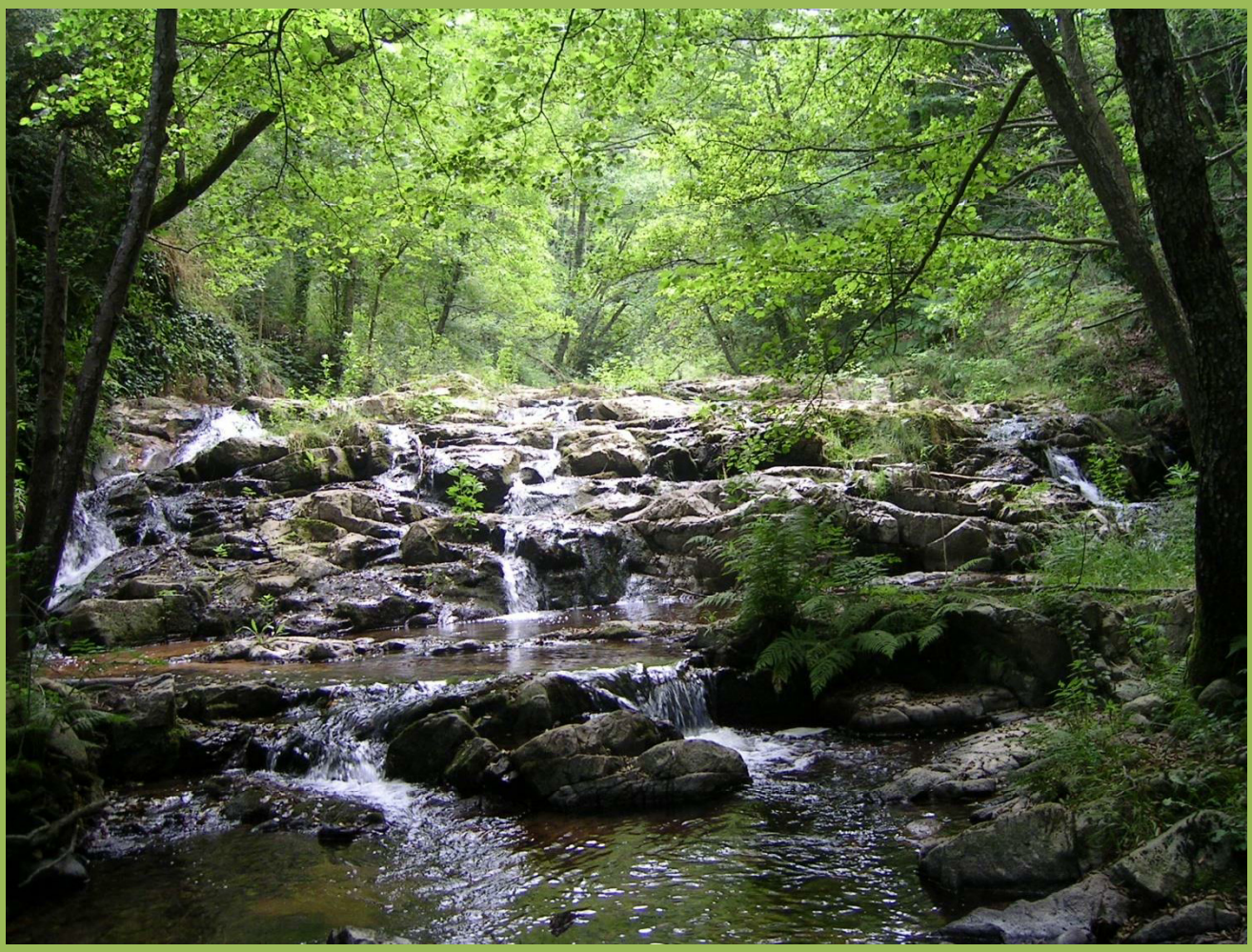
Czech University of Life Sciences Prague
Faculty of Environmental Sciences

2015

OSOR'S BROOK WATERSHED STRATEGIC PLAN



Faculty of Environmental Sciences, CULS Prague

Diploma Thesis

Author: Pep Carreras Artigas

Supervisor: Vojtěch Barták

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Department of Applied Geoinformatics and Spatial Planning

Faculty of Environmental Sciences

DIPLOMA THESIS ASSIGNMENT

Josep Carreras Artigas

Land and Water Management

Thesis title

Osor's Brook Watershed Strategic Plan

Objectives of thesis

To perform a geographic analysis of the study area and determine key directions of sustainability improvement.

Methodology

First, all the relevant available spatial as well as nonspatial data will be collected. Then, the spatial data will be analyzed using GIS. From all data collected, major strengths and weaknesses of the area will be identified using a SWOT analysis. Finally, suggestions for improvements leading to greater sustainability of the area will be made.

The proposed extent of the thesis

100-120 pages

Keywords

Strategic plan, Hydrological system, Water pollution, Ecosystem, GIS, Geographical analysis, Guilleries massif

---

Recommended information sources

Chapman D. (1996): Water Quality Assessments – A Guide to Use of Biota, Sediments and Water in Environmental Monitoring. Cambridge University Press.

McKinney D.C., Cai X. (2002): Linking GIS and water resources management models: an object-oriented method. Environmental Modelling & Software 17, p. 413 – 425.

Expected date of thesis defence

2015/06 (červen)

The Diploma Thesis Supervisor

Ing. Vojtěch Barták

Electronic approval: 20. 4. 2015

Ing. Petra Šímová, Ph.D.

Head of department

Electronic approval: 21. 4. 2015

prof. Ing. Petr Sklenička, CSc.

Dean

Prague on 21. 04. 2015

I hereby declare that this thesis entitled Osor's Brook Watershed Strategic Plan is my own work and all the sources have been quoted and acknowledged by means of complete references.

In memory of Rafael Llussà,
my grandfather Pep, and my
grandmather; Carme

ACKNOWLEDGES

To my parents, Jaume and Montse and to my brother, Miquel

To my girlfriend Iris

To Museu Guilleries, especially to Adriana Juvanteny and Anna Agulló

To La Gorga and Les Guilleries S.P.E.s, especially to Pere Masó and to Alex and Joan Plà.

To Osor and Sant Hilari Town Halls members, especially to Carles testart

To Sorea and especially to Marta Bronsoms

To my friends Michael Clark, Sage Sluter, Phil Cassidy, Andrea Bernardos, Domingo Martinez and Xavi Rotllant

To all the teachers from ČZU who help me during the project elaboration period, especially to my supervisor, Vojtěch Barták

And to everybody who helped and supported me during all this time.

Moltes Gràcies

Abstract

The elaboration of strategic plans with the help of GIS methods and the SWOT analysis is commonly known nowadays. The utilization of these systems allows a better performance of the evaluation processes. The Osor's Brook watershed is an area with a high natural value located within the Guilleries massif (Catalunya) which includes several ecosystems included on the EU Habitats Directive. This hydrologic system has suffered over time damages due to anthropic pressure causing losses in the ecosystems and its ecological value. A realization of a strategic plan for this area may help to enhance its conditions across the solving of its current issues and the implementation of measures to ensure the conservation of its natural values and the sustainable development of the human activities.

Abstrakt

Zpracování plánů pomocí GIS a SWOT analýzy je známým procesem. Využití těchto systémů nám umožňuje lépe hodnotit různou problematiku. Osor Brookovo povodí se nachází na území o vysoké přírodní hodnotě v blízkosti Guileriosova masivu (Katalánsko), zahrnující také několik přírodních stanovišť, které jsou obsaženy ve směrnici Evropské unie. Tento hydrologický systém utrpěl v průběhu času a lidských zásahů značné škody na své ekologické hodnotě. Realizace strategického plánu pro danou oblast, může zlepšit současný stav dané oblasti, napravit škody a případné problémy, zajistit udržitelný rozvoj aktivit v oblasti a ochránit přírodní hodnoty.

Abstracte

L'elaboració de plans estratègics amb l'ajuda de mètodes SIG I els anàlisis DAFO és una pràctica comunament coneguda avui en dia. La utilització d'aquests sistemes permet una millor realització dels processos d'avaluació. La conca hidrogràfica de la Riera d'Osor és una area amb un gran valor natural situat en el massís de Les Guilleries (Catalunya), el qual alberga diferents ecosistemes inclosos dins la Directiva d'Hàbitats de la Unió Europea. Aquest sistema hidrològic i el seu entorn ha patit diferents agressions al llarg del temps a causa de la pressió humana causant diverses pèrdues en els seus ecosistemes i el seu valor ecològic. La realització del Pla estratègic per a aquesta àrea busca ajudar a millorar-ne les seves condicions a través de la resolució dels problemes actuals i de la implementació de mesures per a garantir la conservació dels seus valors naturals i el desenvolupament sostenible de les activitats humanes que s'hi produeixen.

INDEX

PART 1: PRELIMS

PART 2: STUDY AREA DESCRIPTION

PART 3: FINAL RESULTS

PART IV: BIBLIOGRAPHY &APPENDICES

PART I: PRELIMS

1. INTRODUCTION

In the last decades there has been a remarkable change in the trend of landscape planning. The fast development of our societies forever changed the approach of territorial management; now being more conscious about the necessity of a sustainable development with the aim to guarantee an appropriate future for the following generations. The elaboration of strategic plans with the help of GIS methods and the SWOT analysis is commonly known nowadays in the discipline of planning processes. The utilization of these systems allows for a better performance of its evaluation, providing a more accurate analysis and monitoring of the studied area and increasing the quality of the strategies elaboration capacity. All of that may help to enhance the current situation of the area and to ensure its future sustainable development. The Osor's Brook watershed is an area with a high natural value located within the Guilleries massif (Catalunya) which includes a wide range of vegetation, wildlife and ecosystems. Furthermore, the presence of important geologic areas, the high percentage of forest covers and the richness of its hydrologic system (composed by a large and extended network of brooks and creeks as well part of one of the most important aquifers of the Iberian Peninsula), increases substantially the ecological value of the area. However, this hydrologic system has suffered damages over time due of the anthropic pressure causing losses on the ecosystems and its ecological value. Therefore it's important to determine the degree of such damages with the aim to reduce them as much as possible guaranteeing a proper conservation of the area. The realization of a strategic plan for this area may help us to enhance its conditions determining the current issues and reduce its effects through the achievement of correction strategies and the implementation of measures to ensure the conservation of its biodiversity, ecosystems and landscapes jointly with a sustainable development of human activities.

2. OBJECTIVES OF THE THESIS

The aim of the present work is to perform a geographic analysis of the study area and determine key directions of sustainability improvement. The main goal, then, is to develop a study based on territorial planning and geographic analysis of the area included in “Osor's brook” hydrological system to determine its characteristics and, especially, the diverse environmental problems that can be affecting the territory in order to, evaluate its situation and develop strategies to enhance its current situation and ensure a proper development on the future.

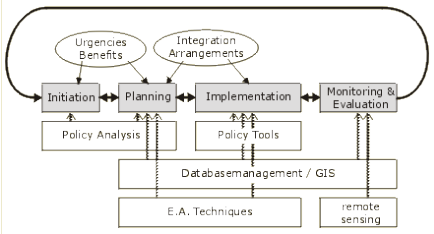
Simultaneously with this process, the project intends, as secondary goals, to evaluate the effectiveness of the used methods and to perform a process of data collection for a future elaboration of an hydrologic model of the system, which would be the subject of an upcoming project.

3.LITERATURE REVIEW

3.1. STRATEGIC PLANS CONTEXT AND METHODS

Strategic plans are a relatively old tool used in several branches of the society to ensure a good development of a concrete process. Basically, they are achieved by establishing a strategy to follow by a company or institution with the aim to achieve properly one or several goals (In companies are usually known as business plans). This methodology is commonly used, nowadays, on the territory management. The history of the strategic plans as landscape planning is also old, especially on its relation with urbanism, but the fast growing of the human society observed this last century generated the necessity to change the way how the territory is managed, especially increasing the importance of the rural and natural areas or the environment, leading to a sustainable development. "The challenge of responding to these new ways of functioning of the territories is not easy. Strategic planning is far from become the final solution, but it represents an attempt to overcome this complexity taking into account social and territorial future scenarios designed to ensure that, in addition, be flexible enough to adapt themselves to an actually that changes rapidly" (Ganau, Mallarach, 2003). The bases of this new kind of strategic management are nearly connected with EIA & SEA processes. These were originated during the second half of XX century, concretely appear for first time on sixtieths decade in United Stated. However, this figure takes greater scale across the celebration of several international conferences during next decades for example; Rio Earth Summit or Espoo Convention, where elements like Environmental protection or Public participation appeared or increased its value. In some way, this was the born point of the modern territorial planning based on the territorial or strategic plans. The methodology used on its processes is not clearly established, as well as how is known, especially cause may receive different names in function of the scale or aims is working. In territorial scale, for instance, may be known as Territory Plan (Catalunya, Australia), Strategic Plan (Malta), Strategic Territory Plans (Spain), Director Plans (Catalunya in lower scales), etc. Concerning the methodology, it was said, there is also a fairly non-concretion of the methods to use and these may change in function of the subject they are focusing. However, the modern plans related with the territory always have in common the use as GIS systems to develop as much as possible the knowledge about the studied territory. There is also common the use of the SWOT methods to determine the core spots of the strategy to follow. More generally, strategic plans

(including the ones used on other subjects not related with the territory analysis) are composed of five phases: one phase of development of goals, a second of monitoring of the territory, a third of evaluation of the territory or studied element, a forth of strategies elaboration, a fifth of strategies evaluation, a sixth of strategies applying, and lastly one with applied strategies monitoring and evaluation (The present plan will follow the first five causes as is not possible to carry out the remaining strategies). However, as it has been said above, this may be different within the function of the place, the scale, the goal, the subject or the developer which composes the study line of the strategic plan. Conversely, it's possible to observe four examples of strategic plan schemes from Rumania, Canada, international scale (FAO) or even from a football club company; demonstrating so the high variability of uses and shapes that such processes may take.



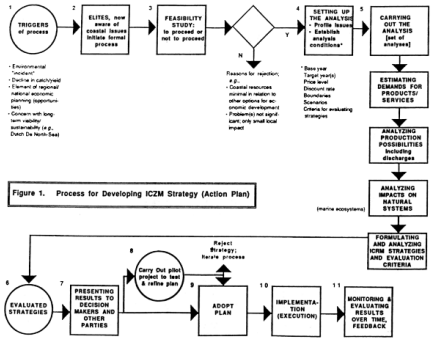
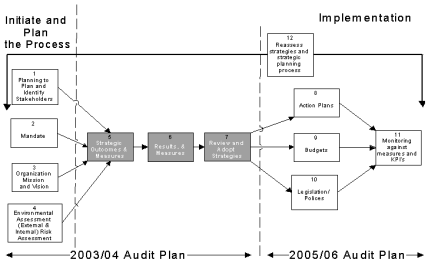
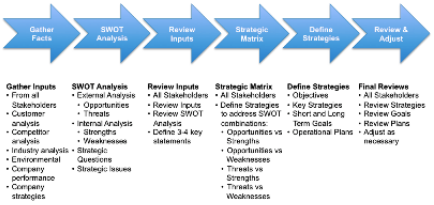


Figure 1. Process for Developing ICZM Strategy (Action Plan)



Strategic Plan Process



Source 1:www.biodiversity.ru
Source 2:www.fao.org
Source 3:www.tbs-sct.gc.ca
Source 4:http://tvfc.com.au/2014/country-action-grant-scheme-approval/

In Catalunya, the place that will compose the study line of the present plan, the strategic plans utilization is something especially developed on the last two decades. It has a structure based in a multi-scale system, with different levels of territory planning in function of its area. On first place there is the General Territory Plan, followed by the Partial Territory Plans, and the Directors Territorial plans. There are also other plans arranged in function of the subject is treated. Urbanism appears the Urban Director Plans, Supra-municipal Scope Urban Plans or the Municipal Ordination Urban Plans. On the other hand we can find the Territory Sectorial Plans, which includes a wide range of plans with different thematic [PEIN (Natural value), PIT (infrastructures), etc.].

So, the strategic plans applied to the territory are an important tool to the modern landscape planning to guarantee a future of sustainable development. The following is intended to perform such aim on relatively small area with special attention to hydrology.

3.2. REFERENCES OF PREVIOUS WORKS RELATED WITH GUILLERIES

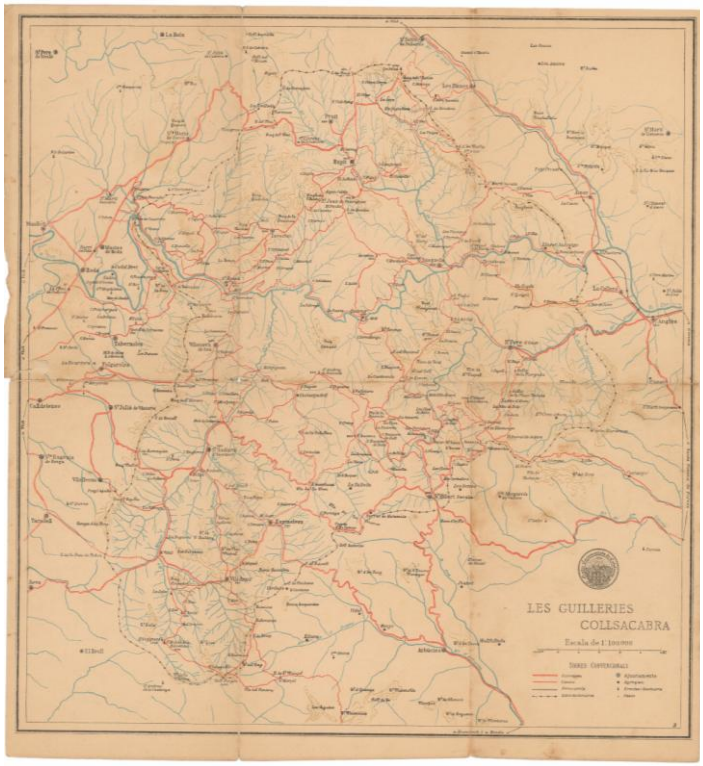
The knowledge of the geography and features of Guilleries was a matter of popular culture during much of its history. Its peaks, its calm, its rivers and their valleys were only known by the people who inhabited there. From first inhabitant still not so many generations above us, only those who moved regularly along this area had a minimal knowledge of the territory. So means that there isn't many ancient works about. The studies of this area had been something unusual during a long period of time, even when the great majority of the European continent was already studied and mapped. As we have said, the place become more than once as a perfect refuge by different rebels, and as last, as we said, by the carlists during the Carlist war. "During XIX century, carlists found refuge in mountainous and wild places. Guilleries (protected by Montseny), was close to populated areas as Barcelona or Girona. The liberal armies had difficulties in these zones due of the lack of knowledge of the terrain, and further of the area's population distrust, who often were carlist supporters. That derived difficulties for the military devices logistics (canons, etc.) and risk in the moment of get in these lands. A way to compensate that territory's lack of knowledge was building a detailed map. So, the Spanish army decided to elaborate the *Plano de las Guillerías*." (Tarrés, 2003). Therefore, it was the necessity of control the area which propitiates the elaboration of complete studies and notes about the zone. "There is no doubt that Guilleries always have been a big headache for the militaries, and even more the way to cross them" (Junquera & Tarrés 2009). "Guilleries maps born with a military aim and that doesn't stop till well arrived the democracy" (Tarrés, 2004). In the beginning these studies started with expeditions to Guilleries by different militaries along the XIX century. Curiously, but, the first of the notes we have reference to was in safekeeping of a bureaucrat and traveler, and not with the same aim as militaries have. His name was Francisco de Zamora and from his notes, taken during his trips to the zone during the end of 18th century (1790 in Sant Hilari Sacalm's case) we can find a first idea about the life and territory at that time. As well in this time it is possible to find the first cartographic elements of Guilleries. These do not encompass all the Guilleries area or, in case of do it, is in an inaccurate way. Some examples of that would be the "Camins de Vic a Girona" map, Ramon Folguera, 1809; "Plano geométrico de los terrenos comprendidos entre Montseny, Pla de las Arenas, Coll del Buch, Pueblo de Espinelbas y Viladrau", Jacinto Casasanpere, 1809; "El pont del Pasteral" map, José Masanes, 1814 or "De Vic a Hostalric" map, unknown author, 1815. Later, during the XIX century, there are three more expeditions on the area. The three, were looking for a fast and safe way to cross Guilleries to move the soldiers (companies, divisions, etc.) properly from Vic to Girona and vice versa. These expeditions were commanded by Commandant Sandalio de Sancha, on 1868, Captain Carlos Rivera, on 1867 and Captain Rafael Moreno, on 1880. All of them described the area highlighting especially its wildness and hard relief. But it was eight years later of the last named expedition, on 1888, when another group of militaries would visit the area to elaborate the first complete study about the area. The expedition, although really was divided in two, was leaded by Ramon Morera Galicia and Juan Ximenez

de Sandoval, accompanied by the lieutenants Chies Gomez, Arturo Mifsut Maeón, Donato Garcia Maldonado, Antonio Morer Rodriguez, Juan Gonzalez Gelpi, Tomàs Rodriguez Mata, Adolfo Fernandez del Villar, Rodrigo Carrillo Albornoz and, finally, the man who would be the artifice and author of that cartographic and bibliographic work, Juli Serra Castells. “Two expeditions to carry out the fieldwork (The Juli Serra one was composed by more than 20 militaries) that during eight months had to get a good map. Several experts of the zone point that the toponymy, the complete representation of masos, forges, mines, ways… make the map a great document for students and enthusiasts of the zone ” (Tarrés, 2003). The publication was during the period of 1888 and 1891 (The date changes in function of the author and the article). On 1890 appeared the article “El Plano de las Guillerías” in Girona’s magazine describing the book “Las Guillerías” (Serra, 1890) and the map “Plano de Las Guillerías” (Serra, 1888). But we cannot avoid the fact that this work becomes, not just the first, but also one of the most complete documents related with Guilleries in all history. And, as we have said, we must highlight the presence of the map. It’s important to say that this work, although being a written one, promoted the site maps elaboration which was the main tool which can explain in most suitable way all the Guilleries features. This was also relevant on these times when the most difficult action was to build a cartographic material of the zone cause of the irregularities of the terrain and the lack of modern devices, as planes or satellites. This cartographic work could be the most helpful element for military goal of these times. It’s due to this reason also, that one of the most studied features was related to the communication ways. “Firstly, the map was done using a military approach, therefore, point in detail all the elements with military interest and represent with detail the best accesses to the zone” (Tarrés, 2004). There are two important points to highlight about this work. On one hand, the fact that a study of this work was published in 2002 by Josep Tarrés and Emili Rams under the name “Un viatge per les Guilleries I el Montseny. Visió actual del recorregut fet el 1890 per Juli Serra”. That allowed the popular knowledge of the book, which, although it was known in academic circles, was quite unknown by the public so far.

In the image we can see the hill called “El Turó del mal sopar” on foreground and the church of Querós at the background. This engraving was made from photography of Rodrigo Carrillo, theJuli Serra military expedition photographer**. Source:**http://serrallonga1640.blogspot.com

Furthermore, the authors who prepared this "republishing" during their 8 months research work found a map which had been hidden during more than a century in the "Geographic center of the Spanish army". So far, the version which was known about the map was in larger scale (1:50.000), but the named article of 1890 on Girona's magazine spoke about a more accurate one. This new found map, so, was found to be the real one elaborated by Juli Serra, and its scale, 1:20.000, presented a higher precision of the territory. This discovery also allowed republishing of the map for the general divulgation. The result is a document which consists of a set of twenty-four sheets DIN-A2 which together becomes a 2,40 meters width x 2,,80 meters high map (original size of Juli Serra's one) with four extra sheets, attached in this new publishing, with information about the map, the expedition and the author. On the other hand, we must explain that the map, despite of be named "Guilleries map", occupies the area of the surrounding massifs: Collsacabra and Montseny. "The Juli Serra 1888 Guilleries map would have to be renamed Montseny, Guilleries and Collsacabra map because it covers these territories" (Tarrés, 2004). But that does not represent a unique case. Since this first map, especially on cartographic works, Guilleries area often have been related, at least, with the Collsacabra massif. "Historically, Collsacabra cartography has been merged with the Guilleries one. So indicates the beginning of the nineteenth century map, found in the Geographic Center of the Spanish Army and of the Plano Guillerias Juli Serra from 1888. The successive maps with hiker vocation (Llobet, Castells, Cardós ...) so have reaffirmed it." (Tarrés, 2004). This trend will continue during the next century.

The map of Les Guilleries and Collsacabra published on 1959 by Alpina Editorial and elaborated by the "Centre excursionista de Catalunya" (Catalunya Hiker Center) is another example of that. And will be not changed till the end of century. "Is during millennium change when is broken this unitary conception of Guilleries and Collsacabra kept during more than 100 years" (Tarrés 2004).



Les Guilleries and Collsacabramap, 1954, Alpina Editorial (Centre excursionista de Catalunya). **Source:** ICC webside

After that, this area has been also studied by biologists, geographers and geologists. Most relevant of these reports and works which have been made on are related with geology, physycal, hystorical and demographic approaches. Some of the most relevant examples of these would be "Notes

geo-morfológíquessobre les Guilleries", Solé I Sabarís, 1936; "Las Guillerías: Síntesis histórica y evolución demogràfica" Antoni Pladevall, 1958 or "El Paleozoico de les Guilleries", H. Duran, 1990. Also we can include the authors Emili Rams and Josep Tarrés Turón for their historical studies of the zone carried out these last years. But there have been a lot of other authors who have found in Guilleries a great interest in regards to their studies and an elaboration of their works. "Its exotic character (...) is reflected in various publications of the descriptions made by the travelers like Artur Osona, Juli Serra and others; or in the writings published on journals or books by Anton Busquets Punset, Prudenci Bertrana or Francesc Carreras Candi." (Tarrés, 2003). In this last cite, is included also other writers which speak about Guilleries: Jacint Verdaguer, Josep Gravalosa, Víctor Balaguer (with his novel "Serrallonga", 1858); Agustí Cardós (with the book "Guillerías", 1952); Coello, Rojas and Velez de Gevara (this lasts belonging to XVII century) between so many others.

Sheet 14 of "Plano de Las Guillerías". (Juli Serra, 1888) where is possible to observe the study area southern part located the upper part of the map.

Nowadays, is important to highlight the several works related with the area which have developed by the administration. The mentioned territorial plans are examples of that although its study area was not the Guilleries massif in itself.

3.3. DATA SOURCES DESCRIPTION

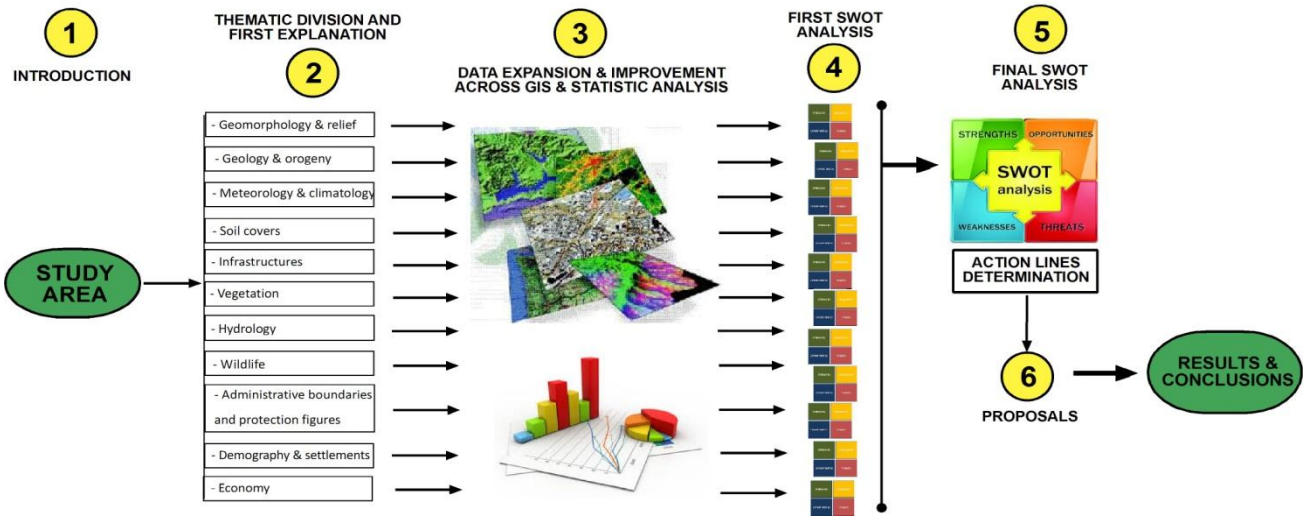
The information related with the study area exists only contained within larger scales. That means that usually, this data must be extracted from works which has as subject areas or topics that is related with study area in some way, as it can be the case of Guilleries massif, Selva comarca and others. So, the collection of data to elaborate the present project followed three different paths. In the first place there is a collection of bibliographic data related with the area. This is based in the works mentioned on the previous chapter. These are basically composed by Guilleries massif (also others in less degree) information but this is often valid to use as description of the study area. On second place there is the collection of cartographical or georeferenced data. This data allowed for the development of a more specific analysis of our study area, although this is also presented in larger scales. The GIS software analysis and the data features however, provide the necessary tools to change our approach just into the study area. This cartographic data has been collected from different cartographic servers related with the Catalan territory. The main ones are the ICGC (Catalan Cartographic & geologic Institute), the CREAF (Ecologic Research & Forest Applications Center related with the Autonomous Barcelona Universiy), the GENCAT (Catalan government), the ACA (Catalan Water Agency) or, in less degree, some other entities like the Spanish government or the UB (Barcelona University).Lastly, there are other kinds of data which have been collected from entities belonging to the study area or that develop some of their activities in which are related basically with numerical data. From these ones it's important to highlight the data ceded by the company SOREA (Sant Hilari waste water system), ACA (Osor's brook flow and water analysis data) Osor Town Hall and Bojos pel Temps association (meteorological data) or much more other information about several topics obtained from entities like Sant Hilari Town Hall, SPE La Gorga & SPE Les Guilleries (fishermen associations), Guilleries Museum, UdG (Girona University) and several persons related with the area. This last group information has been obtained across different ways like websites consultation, mail contact or personal interviews. Besides, it's the only kind of information that was fully related with the study area. The first two, as stated above, the data was related to bigger areas and that caused an obligation to re-elaborate the main part of the information to make it valid for the study area.

4. METHODOLOGY

4.1. SUMMARY

The process described in the following lines is the system used for the author of the present work to elaborate as much as possible accurate and close study area approach with the aim of determining the most features and problems to generate proposals in order to solve these.

Such methodology can be shortly described across **six main steps** carried out and whose are mentioned at continuation. In the following scheme is possible, as well, to observe the mentioned methodology functioning.



1.-The first part consists in a short introduction of the study area, including location and other remarkable data. **2.-**Then, it's made the step of divide the features study in **eleven main groups**, which will be the base to get better and more specific results. **3.-**In third place will come the amplification and analysis of the data obtained in second step to generate more concrete data of our study area or create new one which, for several reasons, may not be able from the consulted sources. **4.-** After that, the next step brings us to the first SWOT analysis. This will be done for each group with the target of obtaining the most relevant characteristics of the area. **5.-** In fifth place the step will consists of the summarization of fourth step results

in order to move on with another SWOT analysis, which will help us to remove the less suitable elements and choose the core ones. The numerical data extracted from this step will be used for the future hydrological model elaboration. **6.-** Finally, the last step will consists in the development of the action lines, followed by the proposals presentation and the results and conclusion presentation which will conclude this thesis.

4.2. PROCESS DESCRIPTION

The methodology we will use to carry out this project is based in different steps which will be explained in following paragraphs.

4.2.1. DATA COLLECTION

The data collection step is divided in two different parts and it will be the approach used in the study area analysis. The first part will be related with the description data of our study area.

It is important to explain that useable information is only for Osors Brook Watershed, not just for the study area. But so yes it's about the massif where the study area belongs, the Guilleries massif. Is for this reason that this first collection of data will explain the general features of the entire massif with some approaches (when possible) about the eastern part of the massif, where the study area is located. To carry out this step we extract the information from all the possible sources to then summarize them for the first part of this project elaboration, so, the Study area description part.

As well, we must highlight that all the data needed to perform this step it can be consulted and observed in Bibliography and Files dictionary chapters. This will be arranged in function of the typology (so if is literature or data), as well as the precedence and the utility which presents for the realization for this document. The description of this step is described more accurately in Section 2 of this chapter.

On the other hand, the second part, the data collection, will be related with the download of all the georeferenced files and data which we can find across all the websites and databases which contains this kind of information about our study area.

The Related bibliographic works and non-SIG data research and picking up is one of the most important bases for the elaboration of the present document. As well, is one of the largest works, when it refers to expend of time by the author.

As we said in the beginning of this section, we can divide this information between the purely bibliographical information and the one which, for its features, doesn't belong to the named one and the georeferenced information (explained on the next section). The first one is the ones which bring more work hours cause needs to be found, followed by a selection, (some works can look like suitable for our project across its titles or abstract but then to result non-useful for us) which requires a long time of reading and checking of its content and, after the selection, the following summarization and classification of them. This last step belongs directly to the elaboration of the "Bibliographical references" chapter of this project and entails a rigorous process with the aim of proof the academic validity and rigorousness of the present document.

For the other hand we find the data and information which we cannot include in the bibliographical section and neither in the georeferenced files one. This is cause this information comes in shape of excel tabs, graphics, picked up data from the fieldwork or directly from entities like halls or landscape agents/inhabitants and which, specially, are not reflected in any bibliographical work. This information can be also checked in the "Files dictionary" chapter.

4.2.2. DATA ELABORATION

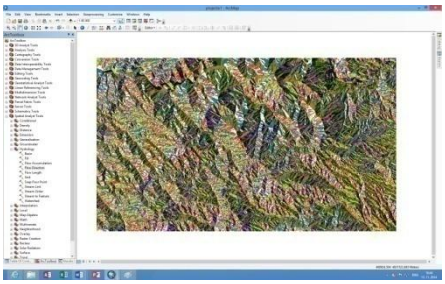
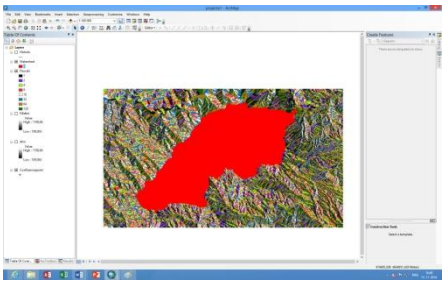
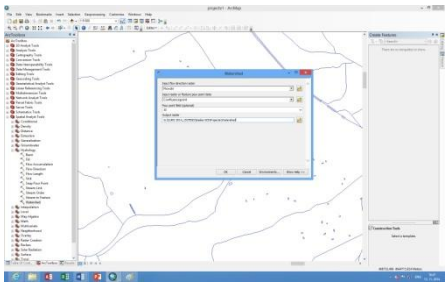
4.2.2.1. - Georeferenced files working

4.2.2.1.1. -Creation of study area boundaries

The first and most important step in the methodology will be the elaboration of the study area boundaries. This will be the area where, almost uniquely, we will work in this project. To find this area we will use the ArcGis 10.2.2 software and the following steps:

- Using the file Cuntours.shp we create the DTM raster file of the same across the tool "Topo to raster" from ArcToolbox/Spatial analyst Tools/Interpolation. In this case we use the default settings and we choose the option of "Output stream polyline features" to elaborate the streams file which we will use more forward.
- After that we use the tool "fill" ArcToolbox/Spatial analyst Tools/Hydrology to avoid the possible mistakes in the next step. From here we obtain the raster file "Dtmfill".

- The next step will be the creation of flow direction file using the just obtained DTM file across the tool ”Flow direction” from ArcToolbox/Spatial analyst Tools/Hydrology, We obtain the raster file “Flowdir”
- After that, we create a point shapefile which will attach the point located exactly in the last part of Osor’s brook, so in the part before its union with Ter river. This file is “Confluencepoint.shp”
- To carry out one of the last steps we use the tool “Watershed” from ArcToolbox/Spatial analyst Tools/Hydrology to find out the area which is the hydrographic basin of our brook. We obtain the raster file “watershed”
- The last step is the conversion of our resulting last file to shapefile across the tool “raster to polygon” from ArcToolbox/Conversion tools/from raster. We obtain the polygon shape file “Studyarea.shp”

4.2.2.1.2. -. Conversion of mmz files to shp

A large part of the georeferenced files used in this project comes from direct download from the websites of organisms related with the Catalan government (Generalitat de Catalunya). Those files get the peculiarity to belong of a tipology known as .mmm (MiraMon file). This is a kind of georeferenced file based in the software MiraMon.

“MiraMon is a Geographical Information System (GIS) and Remote Sensing software. Allows you to view, query, edit, and analyze both raster layers (remote sensing images, orthophotos, digital terrain models, conventional thematic maps with raster structure, etc) and vector layers (thematic or topographical maps that contain points, lines or polygons, etc) and WMS layers. Some parts of the code were written as early as 1988, but it was in 1994 that MiraMon started to become a Windows application to be used in scientific, educational and environmental management. MiraMon is developed cooperatively by different members of the Consolidated Research Group GRUMETS belonging to the Centre for Ecological Research and Forestry Applications (CREAF) and the Autonomous University of Barcelona (UAB), and aims to provide a low-cost software, powerful and rigorous. To date GIS is a general purpose, used by about 200,000 people in 37 countries. Developed to meet the most common needs of the user, the latter has a team of expert

programmers in GIS and Remote Sensing working closely with end users to improve the daily program." (Text extracted from the link http://www.creaf.uab.es/miramon/CAT/Presentacio.htm which is the official webside of the CREAF.).

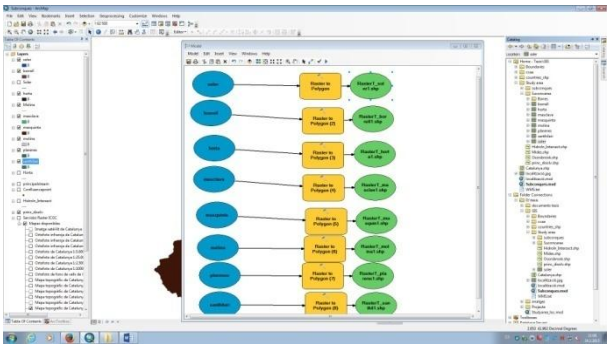
For incompatibility reasons between the .mmm files and the software ArcMap 10.2, is necessary a conversion action to convert the .mmm files into shapefile. To do this step we used the option "convert to shapefile" from the software Miramon which allows us to carry out the named conversion. After that, we just need to open the resulting file with ArcMap software and join it with the related .dbf file, which in this case doesn't need any performing.

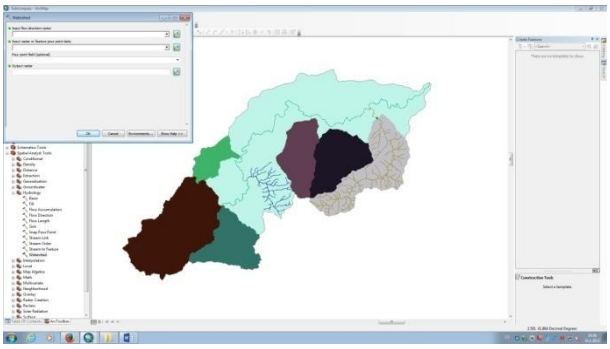
4.2.2.1.3. -. Study area with other data files interpolation

The next step we carry out after the study area boundaries obtaining will be the interpolation between this created core area and the other data files we obtained before. To achieve this process it will be used the ArcMap software with its tool "Geoprocessing/Clip" or "Geoprocessing/Intersect" which will allow us to to cut out a piece of one feature class using one or more of the features in another feature class as a cookie cutter.

4.2.2.1.4. - Determination of study area parts

This step is based in the arrangement of the study area in different parts. To do that we will use the criteria based in the distribution of the area in main courses and the help of the software Arcmap. The first step we will carry out will be the selection of each course of the brook from the file hidroln.shp for then use the tool data-export data to create a new shapefile for each sub-basin. After that, we will create a point shapefile to determine, in each case, the discharge point we will use in the following step. This step will consists in the use of the tool "Watershed" from ArcToolbox/Spatial analyst Tools/Hydrology to determine in each case the area of the courses. The last step will consist in the conversion of our resulting last file to shapefile across the tool "raster to polygon" from ArcToolbox/Conversion tools/from raster. To carry out all these repetition of the same action it can be used the tool "ModelBuilder".





In the case of the minor sub-basins or tributaries area we will use the same methodology for its obtaining

4.2.2.1.5. - . Map Exporting

As last step to carry out with the software ArcMap and the management of the georeferenced files we find its extraction as a map. In this case, all the maps have been exported as .JPEG file to can include them inside the document as is possible to see on the second part of the work. To elaborate such maps we use the "Layout View" of the software, where the final arrangements of the map like title, legend, north arrow, scale bar and others are introduced, to complete it. After this process it is achieved its exporting thanks of the tool "File/Export" map from the software.

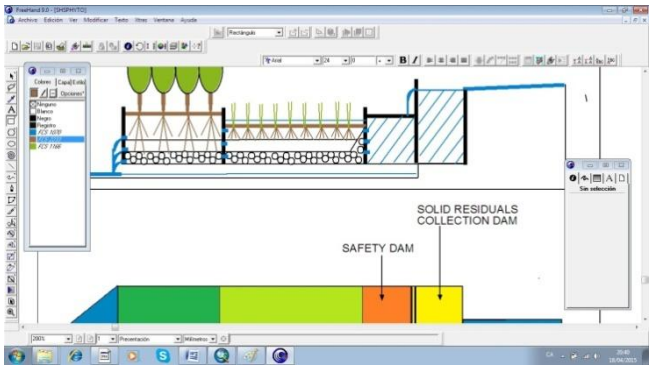
In the case of the graphs created and exported across the ArcMap software it has been used the tool "Create Graph" from Open attribute table/table/create graph and once created with the tool "Export".

4.2.2.2 - Non-georeferenced files working:

In the case of the rest of files which cannot be included of georeferenced ones, the elaboration of them is generally simpler than in the GIS files case. However, in the following lines it will be described the procedure used for its obtaining and this will be done distinguishing between the pictures or images with the graphs.

4.2.2.2.1.- Pictures and images

The pictures arrangements are one of the easiest steps of this process, which just is based in the selection of the part of the picture or the image which we want to show. To carry out this action is used the Windows software Paint with its tool "Select". The system is used as well with the maps obtained across the process explained previously. There are some cases where even it's not necessary to do this step.



For the other hand in some cases it has been necessary to elaborate some kind of schemes to facilitate or complement the explanations of the project. One example of that would be the scheme attached in the first page of this chapter. Moreover, it will be also possible to find them in several chapters along the work. To elaborate this schemes it has been used the software Macromedia Freehand 9 (see image of the previous page), which allow the

combination of several figures and images to obtain a new ones and export them across its tool "File/Export…".

4.2.2.2.2.- Graphs

The obtaining of graphs is another element present in the work. The main part of numerical data which is not related with georeferenced files is in this project treated with Microsoft Office tabs. The development of the graphs it's also made across this software and transferred, once ready, to the software Paint for its subsequent exportation to .JPEG file.

4.2.3. GENERAL INFORMATION PRESENTATION

Once all the information and data is collected and the maps, pictures and graphs created is time to its sorting and summarizing to carry out a presentation of the main characteristics of the study area. This process, which can be already considered as first results presentation, will be done to analyze all the information about the area that we have available and it going to be arranged following these next eleven study lines:

1. Geomorphology & relief
2. Geology & orogeny
3. Meteorology & climatology
4. Soil covers
5. Connectivity and infrastructures
6. Vegetation
7. Hydrology
8. Wildlife
9. Administrative boundaries and protection figures
10. Demography & settlements
11. Economy

Using this system, we can distribute all the information in a proper ordination and that allow us to determine the value for each of the lines and treat deeper the subjects which are more interesting from the point of view of the aim of the work. In this case, being a strategic plan of a hydrological system, the line treated most deeply will be the hydrology one, which is the core spot of the work. In the list, we can see that

all the topics are arranged such that the previous lines to hydrology are all the ones which affect directly and determine the features of the surface and underground water system.

4.2.4. DATA EVALUATION (SWOT) & ACTION LINES ACHIEVING

All the information presented as result of the realization of the previous step is the cornerstone of the data evaluation process. The data evaluation process consists in the selection of the most important and remarkable features from each of the subjects. There are several steps in this process. The first of them is about, as we said, the determination of most remarkable features for each of the subjects but also its subsequent arrangement in positive and negative effects in the territory. At the same time, the methodology consists in the interpretation of which of them can suppose a problem or a strong point in a future approach. This process is known as SWOT analysis. "With the SWOT method we can glimpse the limitations and potentialities of programming. This is based in make a reflection about what aspects are the ones which more and better can enhance the transformation of the territory or analyzed problem. The positive and negative aspects are displayed, both from inside and from outside, being so aware of which from those will be more empowered and in which we should pay more attention to avoid negative effects in subsequent actions." (Villasante, Montañés, Martín, 2001). The first SWOT analysis which is carried out, so, allows us to choose the most interesting features of each subject and determine its possible future effects. The final result of this the creation of eleven SWOT tables, one for each of the analyzed subjects. After this first analysis it is developed a second one is performed across the summation and summarizing of all the previous, getting so a final SWOT table with the most remarkable features of the study area distributed between positive or negative and presents or futures. The following and final step is based in the elaboration of action lines for the territory, so determine which should be the intervention basic lines. This must keep or enhance the strengths and promote the future opportunities at the same time that the weaknesses are reduced and the future threats avoided. The result of this process will be the elaboration of five (in this project case) basic action lines.

SWOT analysis scheme
Source: www.parkhurst-consulting.com

4.2.5. CREATION OF SUGGESTIONS

The proposals generating will follow the direction established by the action lines elaborated previously to develop several intervention proposals. This process is one of the most subjective of the whole work elaboration process cause is based in a brainstorming. The author, after it, chose which of the achieved ideas are most likely to apply successfully in the territory and develop briefly them. During this process some features of these proposals are taken into account like in which action line are based, the possible issues during the elaboration process, possible negative effects may cause its application, the expected results to achieve, etc. This process provides at the same time, future goals or aim for upcoming works.

4.2.6. RESULTS PRESENTATION, CONCLUSIONS & DISCUSSION

The last step to carry out in the project would be the final results presentation. These are arranged between the three aims of the project: Territory analysis to determine current issues, data collection for future hydrological model and how GIS and statistics methods allow a better performance of this kind of strategic plans. After it, there will be the presentation of each of them it will be the presentation the extracted discussion.

As last, the chapter of conclusions will evaluate the whole project elaboration process, taking in account the effectiveness in the results obtaining or the general utility of the work.

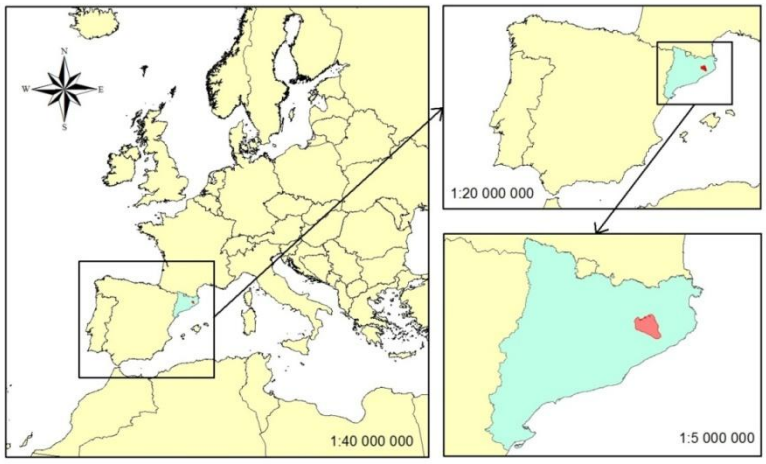
PART II: STUDY AREA DESCRIPTION

5.1. STUDY AREA INTRODUCTION

5.1.1. – GUILLERIES INTRODUCTION

The study area which has been selected to analyze in this work's elaboration is located fully inside the Guilleries massif. This reason is why main part of the information we will use to carry out the description and following evaluation of the area will represent the general characteristics of the massif, although, across the help of GIS, statistical and, a more specific analysis, we will try to describe in more concrete way just the features of the territory compressed in the pure limits of the study area. But as we have said, in all process will be present this information duality. Then, first part of the introduction will be more related with the general characteristics of Guilleries massif. Guilleries massif is located in Catalunya's north-eastern area, in the north-eastern part of the Iberian Peninsula. To describe this location accurately, we can say that the massif area is contained in the area which move from 2° 21 ' E and 2° 38' E of latitude and between a 42° 1' N and 41° 50' N of longitude. However, is important to understand that the non-square shape of the massif makes this coordinates just as an approximation.

Guilleries location within european frame



The massif is also located in the northeast area of the Catalan Pre-coastal Mountain Range and in the south of the called Transversal Range (which becomes, somehow, an extension of the Pyrenees). Here we can see one of the first description problems between many about the limits and belongings of this area. For one side, the massif can be considered that belongs to the Catalan Pre-coastal Mountains Range, together with Montseny massif. On the other hand, it can be considered as well as part of the Transversal mountains Range, together with Collsacabra massif. Anyway, and from this work, we will describe it between a "hinge

spot" between the both mountain systems. Is not strange, then, that with this peculiarities the massif have been considered by several authors like a natural "comarca"([1]) or region. "A study born from the interest and knowledge of the three authors to a natural comarca not officially recognized, the Guilleries, located between the provinces of Barcelona and Girona". (Vila, Picanyol, Bigas – 2004). "In the early twentieth century, Guilleries were considered a natural comarca in the same category as l'Empordà or La Selva·" (Tarrés, 2003)."By the fact to be a natural comarca, never had a defined boundaries and that have been always a debate reason", (Junquera I Segarra, 2006)."Because of it was required the detailed knowledge of the Guilleries comarca or, named also, Serra de Puig l'Agulla[2]" (Serra, 1891). "Due to that it's largely composed by very thick forests in the comarca named Les Guilleries" (Moreno, 1880).

The Lluís Artigas "Catalunyacomarcal" map, dates from 1908 and becomes a good example of the Guilleries importance in the Catalan frame. – **Source**: Pladevall, "Una terra administrativament esquarterada"

Another example of these can be observed in the map called "Catalunya Comarcal", by Lluís Artigas, which shows Guilleries like another comarca.

Leaving apart these observations, and going back to the main line of this section, is important to express the difficulty which brings the task of describe Guilleries boundaries. For sure, we can describe Guilleries as part of the comarcas of Osona(Barcelona province)and Selva (Girona province) and include mainly the municipalities of Anglès, Arbúcies, La Cellera de Ter, Espinelves, Sant Sadurní d'Osormort, Sant Hilari Sacalm, Osor, Vilanova de Sau and Susqueda However, other authors also includes other municipalities which by nearness can have part of its areas inside the massif limits like Amer, Brunyola, Fogars de la Selva, Hostalric, Massanes, Riudarenes, Sant Feliu de Buixalleu, SantJulià de Llor I Bonmatí,([3])Viladrau, Tavèrnoles, Folgueroles or Roda de Ter. The village of Sant Hilari Sacalm is considered popularly like its capital due to its location in the central part of the massif and by the fact that is the biggest town in the massif (with the exception of Santa Coloma, although this is not fully belonging into the massif). In this work will use the

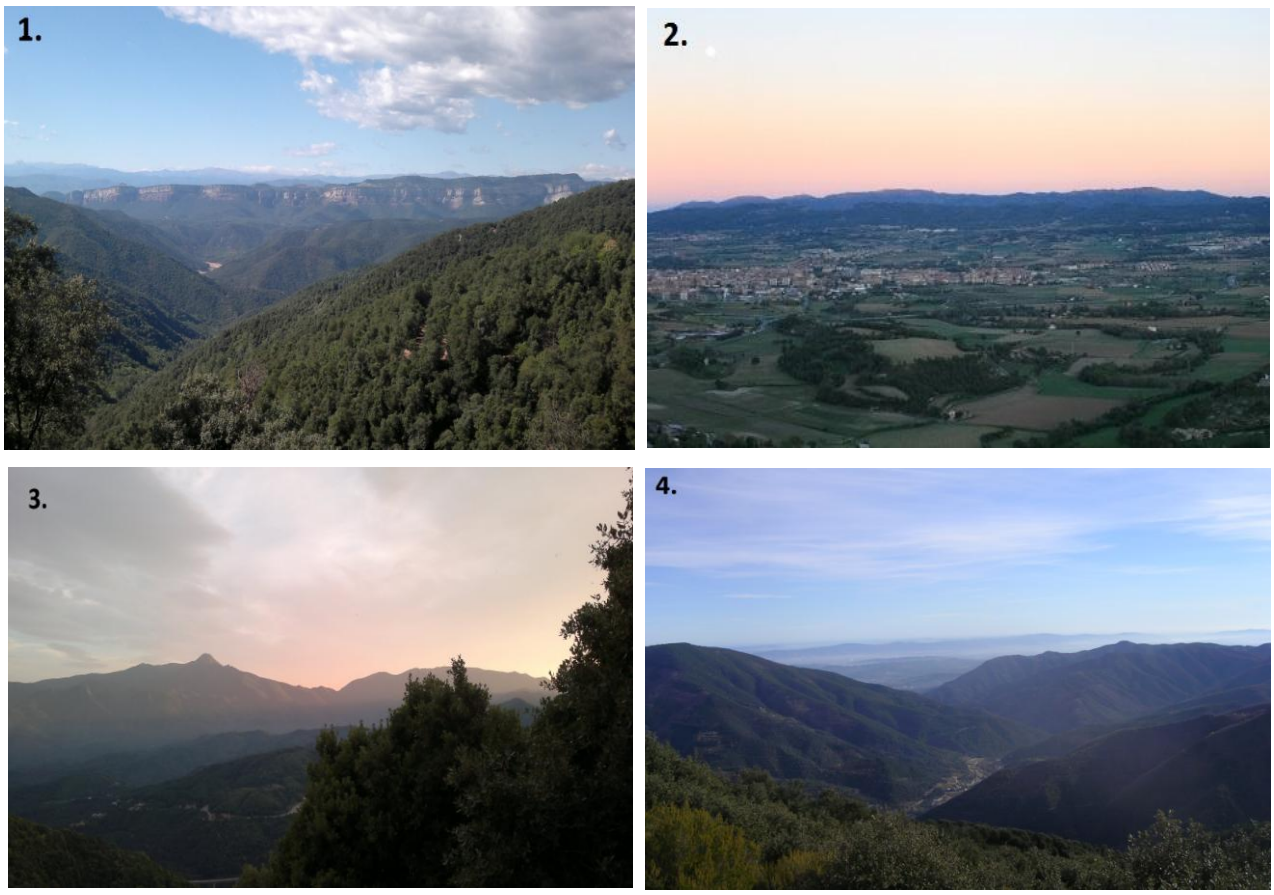
(1). Comarca is a traditional region or local administrative division found in parts of Spain, Portugal, Panama, Nicaragua, and Brazil. The term is derived from the term "marca", meaning a "march, mark", plus the prefix co- meaning "together, jointly".

(2) Puigl'Agulla is the name of a peak (…)of the old Vilalleons municipality, now joined with SantJulià de Vilatorta where everybody locates the limit between Vic's Plain and Guilleries. (Pladevall, 2003)

(3) Observatori del paisatge de Catalunya – Unitat 13

boundaries which are close to be considered like “natural ones”, but this will become just like an approximation because of the determination of the Guilleries limits is a matter which is still presently, discussed by different authors and its debate is not part of the goals of the present document. Therefore, the boundaries we will use in maps and data elaboration will have been gotten taking into account the different opinions of the bibliographic references authors named in the work and my own considerations. The complete area of Guilleries in function of the selected boundaries by this work is 57.757,72 Hectares, so around 577,5 Km2. This data can be different than others work’s obtained data.

Guilleries are bounded to the north by the Serralada Transversal (Transversal Range), with Cingles de Tavertet, rugged cliffs which become the natural boundary between these two massifs. From western part is surrounded by Vic’s plain, a sedimentary plane of 500 meters high and, from the south, by Montseny’s massif. This border becomes the most difficult one in the way to determine its limits because of the similarity and the proximity between both massifs. “The limits of the part that touch with La Selva and Montseny are much more imprecise and make difficult to establish because of all the municipalities which have part of its limits within Guilleries has the great part of its territory in areas related with La Selva or with



1. **Nothern boundary**. In the picture we can see Tavertet’s Cliffs from Sant Benet’s Peak. **Source:** Author
2. **Western boundary**.Picture from St. Sebastia’s Peak where we can observeVic’s Plain on foreground and Guilleries on Background. We can appreciate end of Guilleries Mountains and start of Vic’s Plain. **Source:**http://boscam.blogspot.com/2013_01_28_archive.html
3. **Southern boundary**. In foreground the “Eix Transversal” highway which in this part moves in a similar line than the limit between Montseny and Guilleries. On the background we can appreciate the Montseny massif. **Source:** Author
4. **Eastern boundary**. On foreground the Osor’s valley, close to the Guilerieseastern border. On background, the Gironès plain. **Source:** Author

Montseny massif" (Pladevall, 2003). From the south is also bounded by Selva's Plain. As last, from eastern part, Guilleries is surrounded by the La Selva and Gironès plains.

The topography is generally mountainous and rugged and has a notable unevenness, with highest altitudes of 1,204m in Sant Miquel de les Formigues or Solterra peak and other peaks almost as high as it, like the Turó del Faig Verd, Sant Benet and Sant Gregori mountains (with over 1100 meters of high but Sant Gregori (1094m)).But another feature are the flats culminating in areas between 800 and 1000 meters, forming undulating landscapes like the Plà de les Arenes, Sant Hilari Sacalm or Vallclara. Is important to highlight the luxuriance of its vegetation, which covers almost all the territory; the high extension of smaller mountains, calms and hills that forms its horizon and which derives in a so complex network of streams, creeks and brooks. It is also remarkable the presence of the Ter River crossing the massif in its northern part with the presence of three reservoirs: Sau, Susqueda and Pasteral.

About the etymology of the name, there are several theories about its origins and meanings but is not a commonly studied topic. We know that during several centuries it was known as Ausona's Mountains, or even other periods just under the name of "Mountain" But the use of Guilleries name not first appeared in written documents till XVIII century "Guilleries or Guilleria. This name, in its second, form first appeared in 1778 in a complaints from Sant Pere de Castanyadell's rector", (Pladevall, 2003). During the following times, the name would be found increasingly in different documents. However, this last information draws attention in the way how also Leutnant Juli Serra, in his work "Las Guillerías", calls the area as Les Guilleries or Serra de Puig l'Agulla. Puig l'Agulla and Sant Pere de Castanyadell are located in a so close position each other (Both are in the south-western limit of Guilleries with Vic's Plain and, as we have already said, by most of the people Puig l'Agulla becomes the Guilleries beginning in this area). If we take into account this and the opinion of some authors which say that the origin of the name Guilleries comes from the Osona region like the case of Antoni Pladevall (2003) who says "I've always been under the impression that the name Guilleria or Guilleries was created in Osona's Region" and remembering also the fact that anciently these mountains were called Ausona's Mountains, it could be a relation between the name Guilleries and these area ancient inhabitants. If this was the case, is possible that the name Guilleries or Guilleria derived from the name Agulla. Agulla, which means needle, is also used to call some kind of rock formations, which receive this name because of its elongated shape. The Puig l'Agulla peak, certainly, receive its name due to the presence of this kind of formation on its top. Taking into account also there are other formations like this in the Guilleries north border (like for instance, the called, "Agullola de Rupit") or in close areas (like the called "Agullola de la tota") it could be a relation between the current name and an evolution of agulla name (i.e. L'agulla, l'agullera, la gullera, la gulleria, la guilleria.). However this is just a theory and it should be proved finding more needle formations along the Vic's border or with some more documentation. But this is much more complicated that other theories which, simply (and not due to this less probable to be true), determine

that name comes from the presence of foxes in the region (In the Catalan dialect of the zone fox is called "guilla"), so guilla – guilleria (foxes place)

5.1.2.-A BIT OF HISTORY

The known Guilleries history starts in ancient times. Its shelter character caused by its physical natural features (ruggedness and dense vegetation layer), has derived to the use of Guilleries like a refuge by a lot of the inhabitants which occupied the surrounding territories over the time. This occupation of the Guilleries starts already in prehistoric times. "Some archaeological remains found in different parts of the zone prove the presence of ancient human settlements. The first news that archaeology provides comes from the Paleolithic and the Neolithic" (Rams & Tarrés, 2001). And we can add "There have been prehistoric discoveries from Paleolithic and Neolithic in villages of Osor, Viladrau, Sant Hilari Sacalm and Savassona" (Rams & Tarrés, 2001). It is estimated that between 5.000 and 11.000 years ago. These first residents started with non-permanent abodes, like nomads, but then established their settlements, being this the beginning of an increasing trend in the presence of the agriculture and the forest and landscape resources utilization. This, marked also the beginning of the actions by the humans in the territory and, therefore, to change the landscape. We must highlight also the mineral extraction in these times. "Later, during the Iron and Bronze Ages, the humans excavated the earth looking for the precious minerals. They needed to melt large amounts of wood to produce charcoal. All these activities derived to a transformation of primary landscape which, with the passage of time and the increased production, has become essential." (Rams, 2003). Centuries later, Guilleries starts to be a living place to one Iberian tribe, the "Ausetans". Ausetans were the Iberian tribe which was dwelling in ausona's plane (Presently known as Vic's plain but also as Osona's comarca), limiting with Guilleries boundaries. Due to this, during several centuries Guilleries will be named as Ausona's Mountains. So, Ausetans occupied during long period Guilleries area. After that, the next ones which occupy that territory were the Romans. The Romans were also responsible of large changes of Guilleries covers and physiognomy. In first place, they enlarged the mineral extraction of the zone (almost non significant in earlier stages) especially in Osor's valley area. "We know that Romans already extracted from Guilleries, especially argentiferous galena (or lead glance), silver and, probably, auriferous feldspars and gold. *Investigación y ciéncia* magazine, in 1985, carried out different chemicals analysis by spectrometry process in different jewels found in Empuries ruins. The results concluded that some of the silver kinds from the found jewels belonged to the zone between Osor and Anglès villages" (Rams, 2003). On the other hand, the Romans also changed the forest cover of Guilleries across the introduction of plantations of chestnut trees. The chestnut tree (*Castanea Sativa*) is still, nowadays, a common tree in Guilleries forestry system. "The Romans also left they footprint. We must highlight the Chestnut tree introduction, from which it was used,

not just the wood, also its fruit, the chestnut, to obtain flour from it. A part of the current chestnut trees plantations has their origins in plantings done by Romans" (Tarrés, 2003). After this period there are different changes in inhabitants and cultures. From the V century till the IX century, there is a kind of historic hole about Les Guilleries. "Would come, below, a long period of so stirred times, from which we have very little information, and that coincides with Roman Empire falls, the Visigoths transition and the Arabic occupation" (Tarrés, 2003).

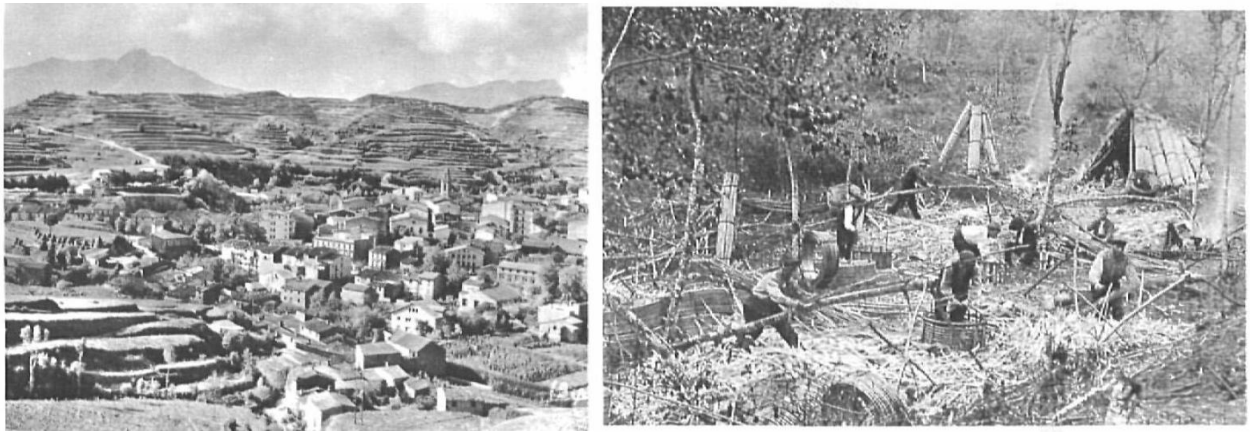
The following centuries, the area was occupied by several inhabitants which, due to Guilleries features, is difficult to establish the origin of them. They could be from direct offspring of Ausetans, Romans or visigoths. Even from Muslims and, most probably, from franks ([4]). Anyway, what we know about this time is the presence of different permanent settlements in the area. "During IX and X centuries Guilleries were already highly populated" (Ginebra, 2003).

Maybe is because of this reason that it's in these times when would appear the first mentions in documents that we have about this area. "The first document from Guilleries belongs to IX century, in the Carolingian period, (…). The first text we know dates from 844, and refers to a freehold that Sant Medir and Sant Genis monastery had on El Coll, in Osor's municipality," (Rams, 2003). Or another example could be the following: "Then, in the named document, in 10th of May of 942, the spouses Adalbert and Doda sales to Gonderic a piece of earth. Says *In comitatum Ausona, in terminio lovanneto, in parrochia Sancti llarii, in loco quedicunt Monte Ausonense* (…), so in Osona's counted, in Joanet's municipality, in Sant Hilari's parish, in a place named Osona's Mountain" (Ginebra, 2003). We must highlight, however, that some of the reasons about the fact that Guilleries, although being a wild and difficult to access place becomes a known and occupied area, is due to, on one hand, its shelter character and, on the other, by its geographic position, because of we know that some of the communication ways between Girona and Vic were in or around the massif. "It is known the existence of Bellapolla. One route or way which went from Vic's to Selva's Plain going through Guilleries", (Rams, 2003). The development of the area would carry in the following centuries. "During High Middle Age, Guilleries was not place of fights or great events; seems that this quietness that give a good refuge served to create the structure and the basis of masos([5]), parishes and villages in all this area. Some of the biggest current masos, like Sobirà, were built then." (Tarrés, 2003). It's important to say that already in these years and during the following centuries, the cover of Guilleries was increasing in number of crops at the expense of forest covering. Even with this occupation of the soil by the crops, the area had a great exploitable forest surface and allowed anyway large periods of wood production. "The exploitation of the

(3)The franks, concretely during Carolingian Empire, created the called Hispanic mark after the Arabic occupation as defense line. In this process it was a colonization of the area across population from the Empire territory.
(4)The "masia" or "mas" ("masies" and" masos" in plural) in Catalan and Occitan, is a type of rural construction common to the Catalan Countries, particularly during the ancient Crown of Aragon which have their origins in the Roman villas. They are often large but isolated structures, nearly always associated with a family farming or livestock.

forest was very intense during the XVI and XVII centuries because the coal obtaining, which was a first necessity fuel primarily used to maintain the Catalan Forge and the homes of the cities. We know also from the exploitation of chestnut. At this time Guilleries chestnuts regularly arrived at the port of Valencia." (Rams, 2003).

Another relevant period occurs during the end of the Middle Age, with the development of the banditry and the witchcraft. "From XV century, in Catalunya starts a period of decadency that has its consequences in Guilleries. The crisis situation allowed a sector of the population found there the proper conditions to develop the banditry and the witchcraft. The Catalunya's most popular bandit, Serrallonga, had in these mountains his permanent refuge." (Tarrés, 2003). The following times, this feature of refuge also would be used by its population and the surroundings folk for rebellions and resistance movements. "During the several French invasions in our land, always from Guilleries appear groups who fights against the foreigner domination" (Tarrés, 2003). The greatest example of these appears during the War of the Spanish Succession. "At the end of XVII century and beginnings of XVIII, a group of Guilleries inhabitants, together with people from Vic's Plane, fights against Philip V and its supporters with the aim to set Charles VI of Austria in Spanish throne. Within this group of politicians and militaries called "Vigatans", highlighted Josep Moragues, Succession War hero, born in Sant Hilari Sacalm." (Tarres, 2003). Also during the period known as Carlist wars, the area kept its value as refuge. "This quietness situation causes that, during Carlist wars, the defenders of the because of pretender Charles found in these mountains its ideal refuge" (Tarrés, 2003). Leaving aside this, Guilleries was living during this century one of its largest developments. The Industrial revolution in Catalunya (1840 - 1891) and the social evolution that this brought were increasing the wood demand, especially, because of the rural migration to the cities. This changed also its landscape, with the establishment of some factories or the construction of Pasteral's Dam. Furthermore, the growing number of new rich people and the current cultural movement in relation with the spas and health care favored the development of Guilleries like a "healthy touristic destination". "During these times, the wellbeing people



At left, a view of Sant Hilari Sacalm during beginnings of XX century. On right, forest workers during same period.
Source: For both, "Un espai per a protegir o un entorn que se salvaguarda per si sol?" Rams, 2003

were sensitized with the improvement of live quality. The existence of medical waters favored the building of spas. These circumstances allowed that places like Sant Hilari Sacalm became a health center of first order where "urban" people found relax and medicinal water within a natural weather" (Tarrés, 2003). Is important to explain that this is not considered as tourism yet, at least by several authors and theories, which considers the tourism born during XX century, and maybe to use this definition is not the most appropriate one. But we use it because of the similarities with the current tourism are several and it can be, from our point of view, the consideration of this healthy tourism like the forerunner of the current one. Anyway, this changes we expressed as well as the related development derived, also, in a population increase. "During middle XIX century, Guilleries got its top of population: in 1860 it was 8.321 inhabitants. Then, the vast majority of masos of the region, which were hundreds, were occupied by sharecroppers who alternated subsistence agriculture with the work in the woods (…). Forest gave a lot of job places and life at the whole region" (Ginebra, 2003). But was in the end of XIX century when Guilleries starts its decadency. On one hand, because of the "phylloxera[6]" arrival, which destroyed all of the vineyards of the zone. "At the end of XIX century phylloxera destroyed the vineyards, which during XVIII had won a lot of extension to the detriment of pines and corks" (Rams, 2003). But this was just the beginning because of the several wars affected the country during the first half of century and the trend changes by the new kinds of tourism introduction during the second half caused the decrease of visitors number who were going to Guilleries looking for its waters and quietness. This together with the increasing trend of the population to move to more urban centers looking to more economic chances as well as the masos abandonment derived to the state which they are presently: low population and abundant and dense forest mass. "Since around fifty years ago, Guilleries forest has growth up hugely in forest cover. Is the logical consequence by the masos abandonment and farmers work." (Rams, 2003.)We can observe that, also, in modern descriptions "The

Susqueda's valley on beginning of XX century (up) and nowadays (down), covered by the reservoir. Source: "Un espai per a protegir o un entornque se salvaguarda per si sol?" Rams, 2003 (old one) and author (color one)

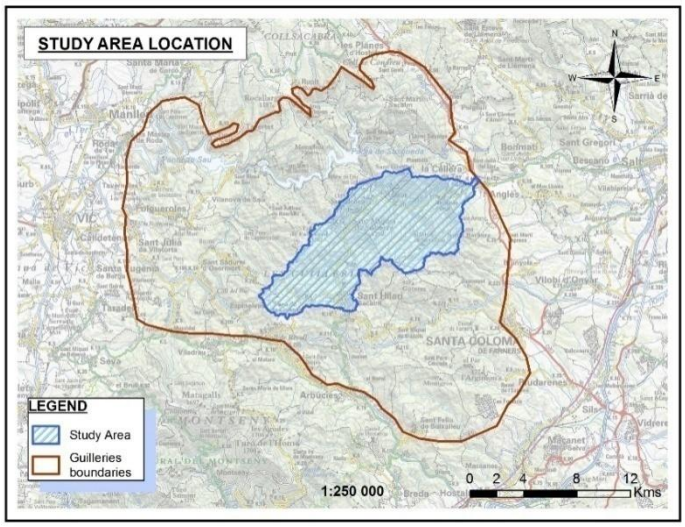
(5)In the late 19th century the phylloxera epidemic destroyed most of the vineyards for wine grapes in Europe, most notably in France and surroundings.

population is moderately decreasing, which fits with the current trend in rural areas of the country, especially in the mountains. This is more accentuated in small settlements or isolated farms (called in Catalan 'mas' or 'masia', in plural 'masos' or 'masies'), which are being abandoned in favor of larger villages." (Bonet, Parada, Selga & Valles, 1999).

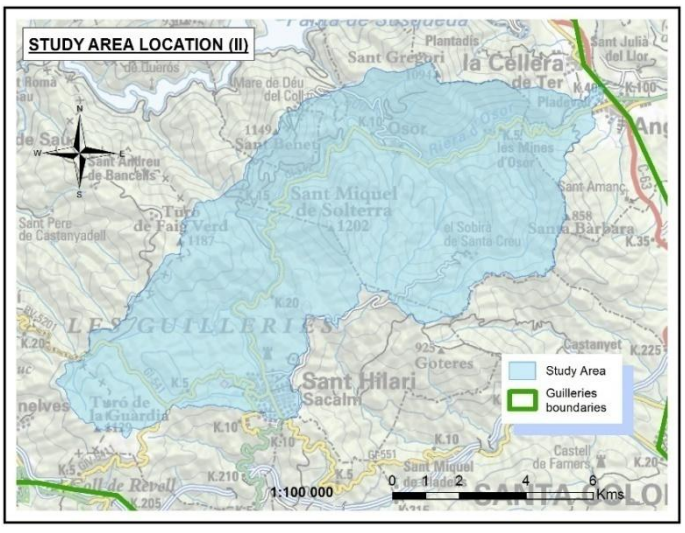
On the other hand, should be noted also the construction of dams during the 60s and which covered the villages of Sau and Susqueda as well as its valleys, moving a little part of Guilleries population out.

5.1.3. - STUDY AREA INTRODUCTION

The selected study area is compressed fully in the extension determined by the Osor's Stream watershed, so all its water catchment surface. The area has a longed shape and is located in the center/eastern part of Guilleries massif, almost crossing the entire massif from North-east to South-west direction.



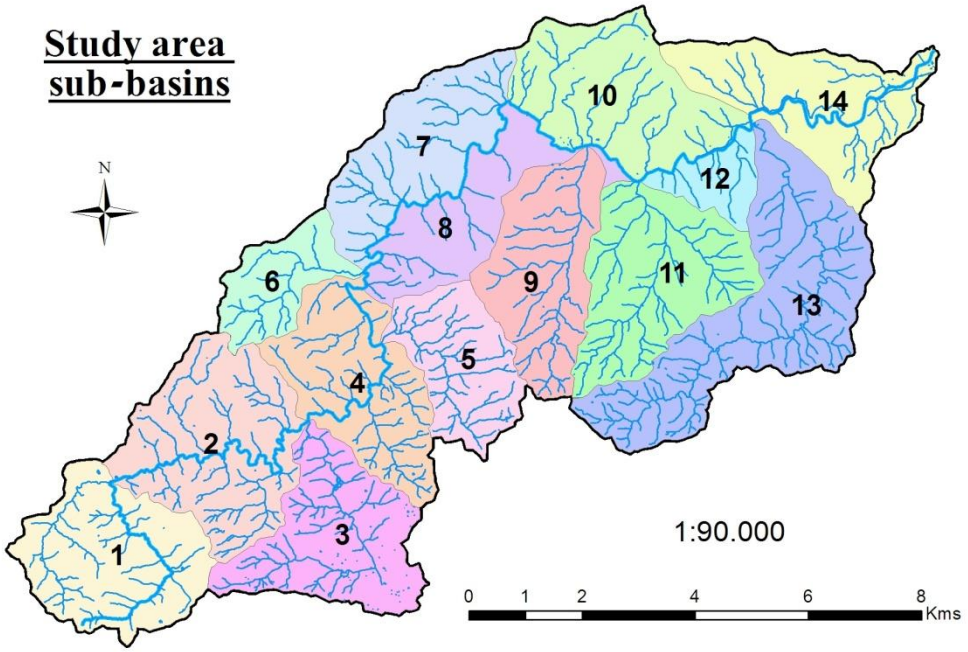
The area has a length of 18,6 Km and a Width of 7,8 Km. Is bounded by ridge composed by the peaks of Puigdefrou (838m), Sant Gregori (1.094m), Sant Benet (1.149m), Muntanya de la Coma (1.145m), Turó del Faig Verd (1187m), Turó de Cremada (1.041m), Turó del Grèvol (1.072m) and Turó de la Guàrdia (1.129m) in its northern part; by Sant Hilari's Hill in south and with the ridge composed by the last hill named above, peaks of Goteres (925m), Turó de Llumeneres (794m), Santa Bàrbara (858m) and Plà de Llancers (761m) in its eastern part. Its exit point is located approximately between the mountains of Santa Bàrbara and Puigdefrou, in North-eastern area where discharge in Ter River, in the village of Anglès. In the middle of the study area we find the peak of Sant Miquel de les Formigues (1.202m), the Guilleries massif highest point.



The Osor's book watershed, then the study area,

has an extension of 89 Km^2 (8.908 Ha) distributed all around the Osor's hydrologic system. The brook is born at Turó de la Guàrdia area, in the zone named Plà de les Arenes, and, more concretely, in the area within Plà de Juïa (1.110m) and the Mas les Gatalledes, at around 1.100 meters high, where start the creek named "Riera de la Font de l'Arç" and which will be named Osor's brook approximately since the middle of its course. The main watercourse crosses Guilleries avoiding several obstacles like mountains, cliffs and others which it finds in its way till the Ter River while is nourished by several tributaries. All of this leaving a stream main course of around 33.600 meters long.

Generally, the study methodology will consist in the general analysis of the explained area in multifocal way but it will be some chapters where we will use a more accurate vision of the area, distributing the area in minor ones based in the Osor's brook sub-basins or courses as we will see in upcoming chapters. It's important to highlight the large number of tributaries that the brook has, due to the complex geomorphology of the terrain and which generated a unique water network. This will be explained more deeply in the chapters of geomorphology and hydrology but the arrangement f the area in sub-basins will be composed in the following way: The distribution will consists in the separation between largest tributaries and zones composed by groups of minor ones. We take into account to elaborate that the popular knowledge and toponymy of the area as well. For example, the sub-basin 2 is part of the main course but is named and arranged in function of the Osor's brook name that is given by inhabitants during this concrete course, called Mas Quintà Brook.



SUB-BASINS NAMES

1.- PLÀ DE LES ARENES

2.- MAS QUINTÀ

3.- SANT HILARI

4.- MIDDLE PART TRIBUTARIES

5.- EL SOLER

6.- MAS CLAVÉ

7.- SANT BENET'S BASIN

8.- SANT MIQUEL'S BASIN

9.- EL BORRELL

10.- SANT GREGORI'S BASIN

11.- RIERA D'HORTA

12.- LA SÚRIA

13.- LA MOLINA

14.- LOWER PART TRIBUTARIES

SWOT ANALYSIS

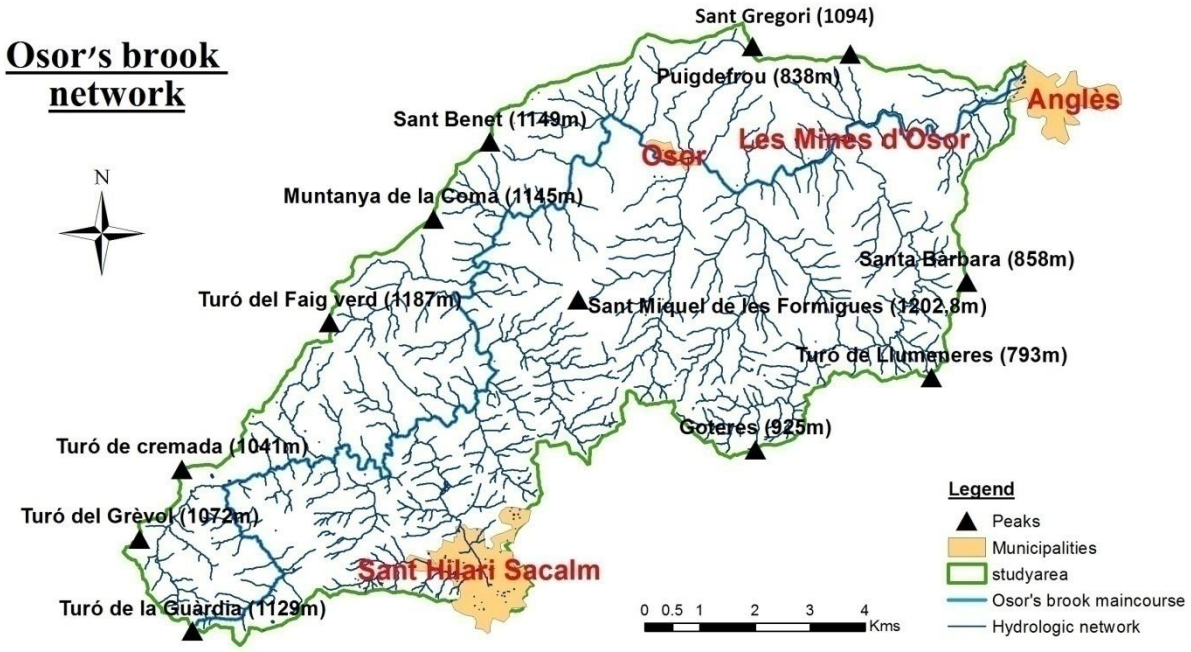
INTRODUCTION	
STRENGTHS	**WEAKNESSES**
- By some authors the massif area has been considered as a natural comarca - The lost of several hectares of crops during the last century allowed the forest regeneration. - The several documents and studies produced about the area shows the interest that can generate the area - The non large extension of the area allows a better performance for find issues and to solve them	- The importance of the place has decreased during the last decades. - The presence of Montseny, which is higher and better valued, next to the massif decrease the importance of Guilleries. - The old tourism tradition left several obsoletes several equipments which it has been disappearing along the years.

OPPORTUNITIES	THREATS
- The rich history gives to the area importance especially by the banditry and the witchcraft tradition. - It is surrounded by natural areas what causes a better conservation due to the non presence of large urban areas - The old tourism tradition left several obsoletes several equipments which it has been disappearing along the years The ones which are still, but, can be used in case of tourism increase. - The several documents and studies produced about the area shows the interest can generate the area	- The Montseny presence as Natural Park may disturb the chances to increase the level protection of Guilleries. - If the last century trend continues the area may arrive to a state of high abandonment.

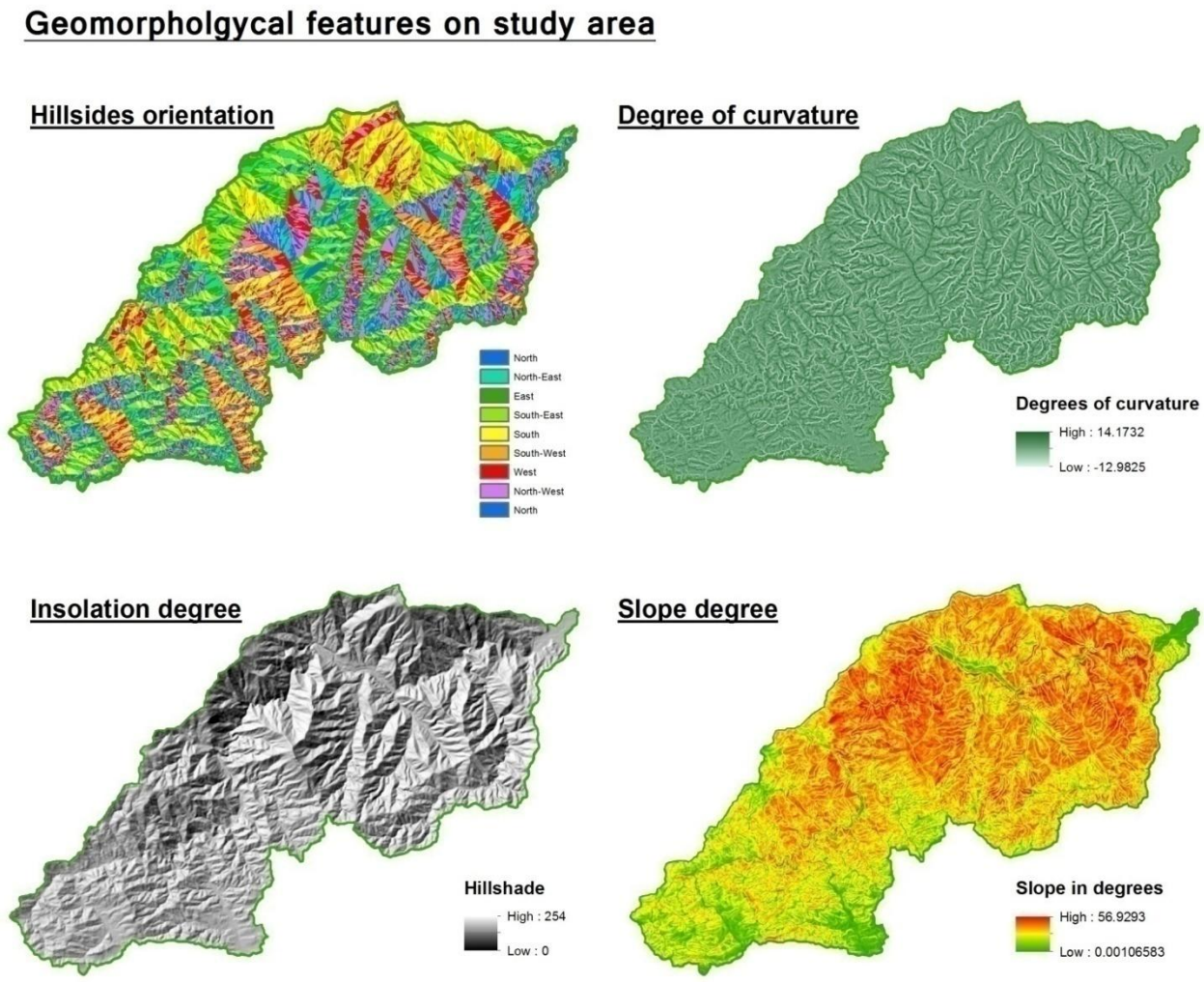
5.2.GEOMORPHOLOGY & RELIEF

As have been mentioned in the previous chapter, Guilleries massif and our study area is included in the zone contained between the Coastal Catalan Mountain Range and the Transversal Mountain Range, more specifically, between the massif of Montseny and Collsacabra, which can become by height a more relevant elements from the eye of the observer than Guilleries in itself. That is due to the age, geology, vegetation and clime of the Guilleries massif, which have modeled the geomorphology of the area over the millenniums. Specially, however, such characteristics may highlight by its relation with the most powerful agent who affected the area, and which is responsible of the main geomorphologic features that one can observe there, the water.

The water and so, the hydrologic system of Guilleries (which will be explained deeply in the chapter Hydrology), is the most important modeler of the territory. It's the responsible of the lower heights of Guilleries peaks in comparison with the neighbor massifs. Also so it's due to the complexity of its shapes or of the deep cliffs and pronounced slopes. Then, Guilleries is a perfect example of the effect of the water over the years. It's not strange so, that, as we have said, Osor's brook becomes as the main shaft of our study area. This area is surrounded basically by the most important peaks by height of the Guilleries area, is due to this reason that we can express that Osor's brook is the main hydrological system of Guilleries massif.

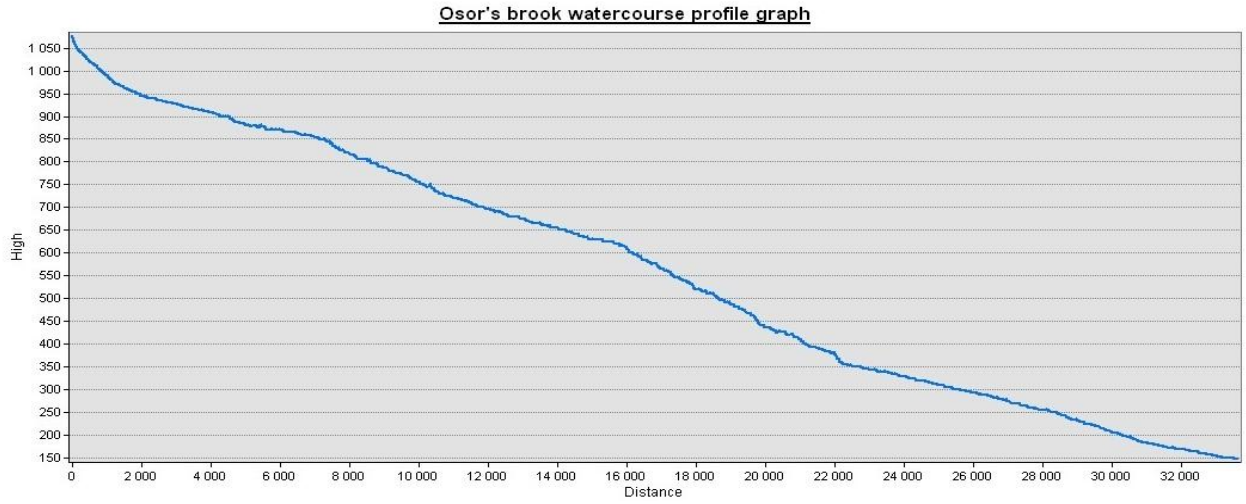


So, the geomorphology of the study area may include also all the features expressed above. The general formation include several peaks, hills and calms (1[7]), distributed in what is, apparently, an unordered formation of mountains. All these elements share the characteristic of a high erosion degree. For example on the peaks and hills, which its tops and hillsides have been rounded up by the years. That leaves the sensation of a poorly rugged system and, in some cases, the presence of the calms, a typical element in Guilleries landscape. This is an important characteristic in the way to analyze and determine the age of this massif, because of moves far from the youngest mountain systems, like can be the alpine ones, where the rough on its peaks is high and evident. Contrary what can seem with that, however, the Guilleries morphology also includes a pronounced slopes that derivates in deep cliffs. In the study area, this is especially because of the effect of the Osor's brook, which in meandering way have opened and created his route within this mountain system.

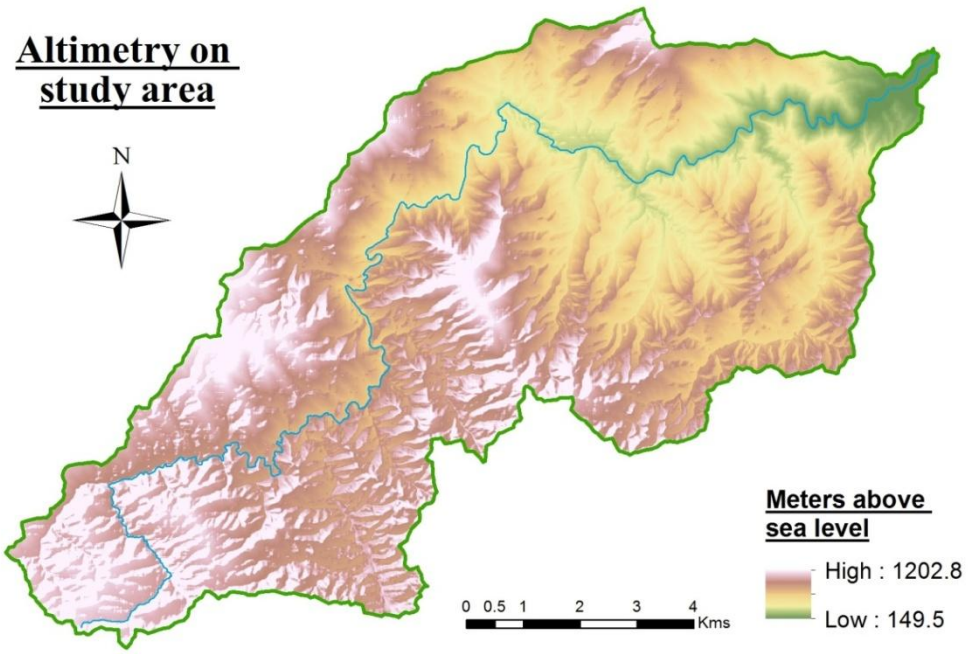


1. [7]Calm makes reference to an erosion surface slightly sloping formed in the Paleozoic. Are large surfaces, usually without forest, separated by deep, narrow valleys. The word calm is widespread in the region: Sant Hilari Sa**calm**, Sant Martí Sa**calm**, Pla de la Calma, etc.(Vila, Picanyol, Bigas – 2004).

The Osor's brook watercourse moves from heights of over 1100 meters above the sea level in its source in SW part of the area to 150 meters in NE part. That becomes as a grade of 950 meters throughout the 18.6 Km (in straight line) that separates the born place to the discharge one in Ter River. That would be a grade of the 5.1%. However, we must take into account that the real route of Osor's brook presence a length of 33.6 Km, which would leave us a grade of the 2.8%. In the following graph we can observe the profile of the Osor's brook course.



Is important to highlight that there is no coincidence between the heights we find in the course and the real heights of the area. The highest points of the area, located in Sant Miquel Solterra peak (1202.8 m) and in St.Benet, La Coma, Faig verd peaks (all three over 1100m), surrounds the brook when its course height moves between 700 and 300 meters high. It is also important to say that we can find grades of around 40 and 50 % within the area. In the following map is possible to see the altimetry of the brook watershed.



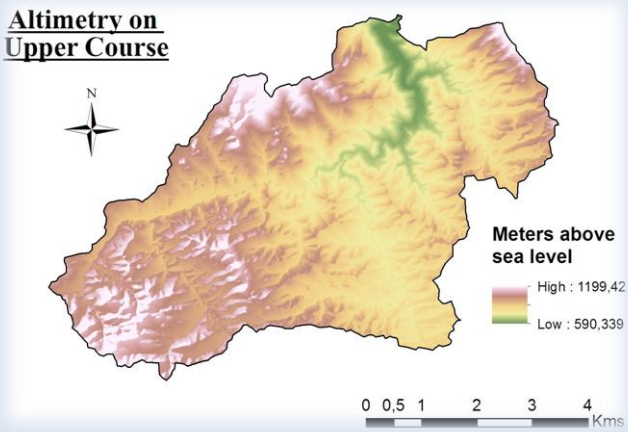
Taking into account the altimetry of the area, it is possible to distinguish between the different sections of the area, like can be the highest areas in the SW part, the large grades of the center area due to the presence of the already named highest peaks, or the plainest areas in the NE part. All of that, allow us to arrange the study area between three sections, where the morphology, the hydrological system behavior and even the meteorology may be different in each case. The distinction of these sections or courses that we will carry out is the following:

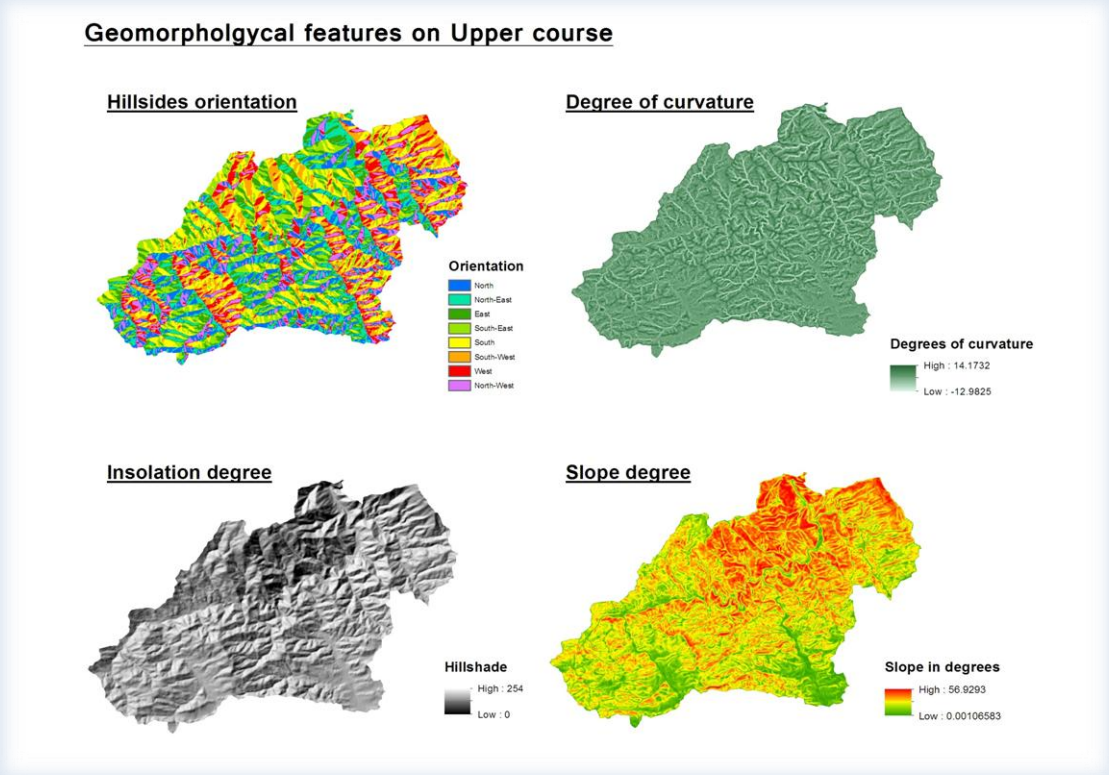
We can distinguish now between an upper course, a middle course and a low course. Each one is characterized by different features which distinguish each other and with the presence inside each of them of the three municipalities we can find related in the study area: In the upper course; Sant Hilari Sacalm, in the middle course; Osor and, in the low course; Anglès.

In the following pages we can observe a summary of the main features of each course.

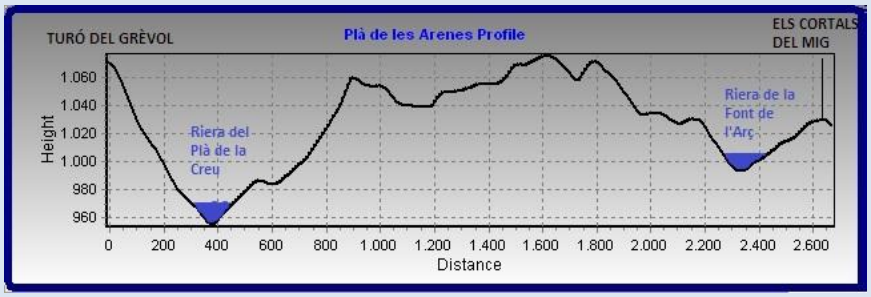
5.2.1. UPPER COURSE

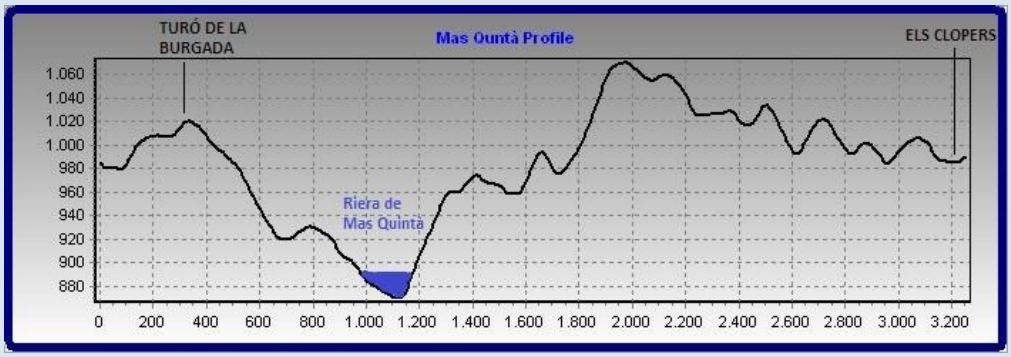
The Upper course is the one which has the highest height average. This is ranged between the 1200 and the 590 meters above sea. However, it's also the one with fewer grades. That's because of its morphology which, although has several peaks and mountains inside its area, these are hills with little height in comparison with their bases and the presence of the "calms" about we talked previously. The biggest grade is found almost in the border with the middle course, with the presence of Turó del Faig Verd peak and is also the part with the rugged slopes. About its morphology, the several hills which compose it generates the highest concentration of streams and creeks, Osor's brook tributaries, who feeds the natural course of Osor's brook, known in almost all that area by different names (Riera de Mas Quintà, Riera de la Font de l'Arç, etc) as we commented before. There is a small domain of the areas oriented to the SE which explains the behavior of the brook. In this area we reach Sant Hilari Sacalm's village in its southern part.

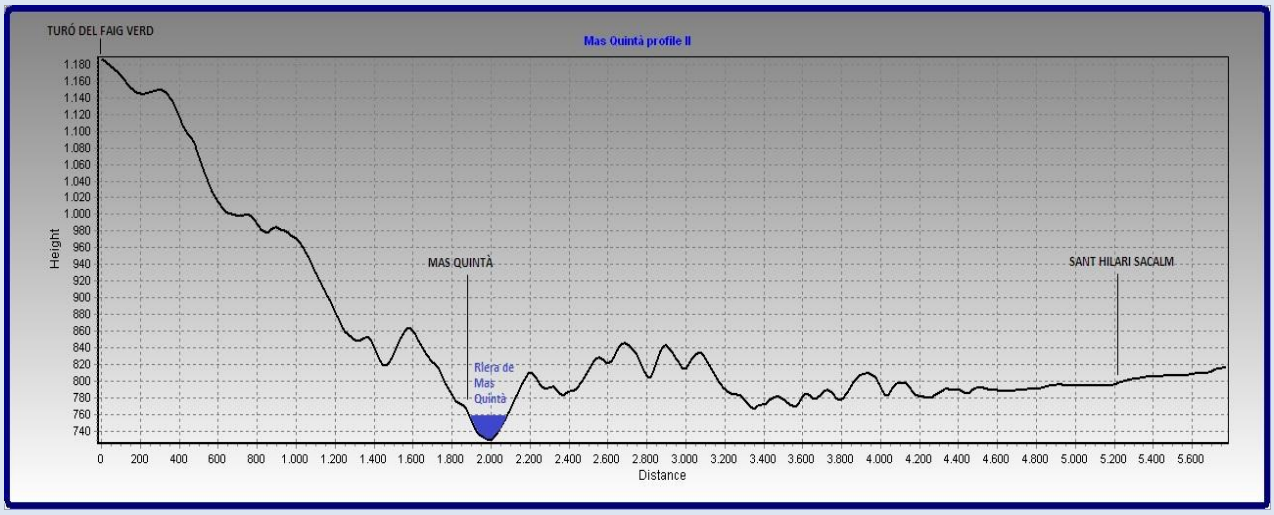




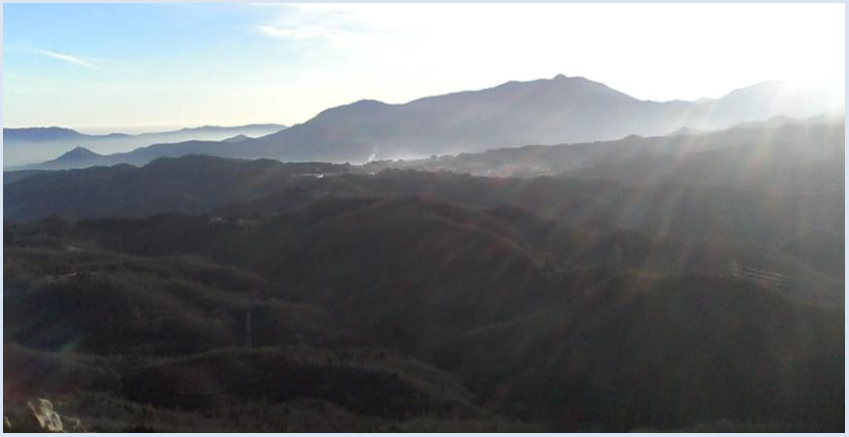
In the following graphs we can observe different profiles from the upper course with the position of Osor's brook remarked. All of them are profiles made by crossing straight lines done in a perpendicular way from the main course of the brook. All the lines have the NW-SE direction. We can see here how the grade is increasing in as the brook's height is decreasing.





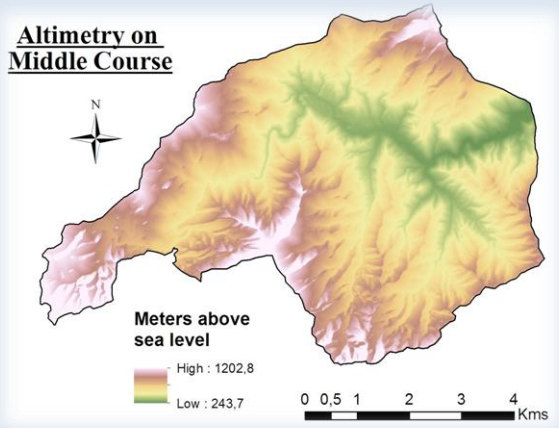


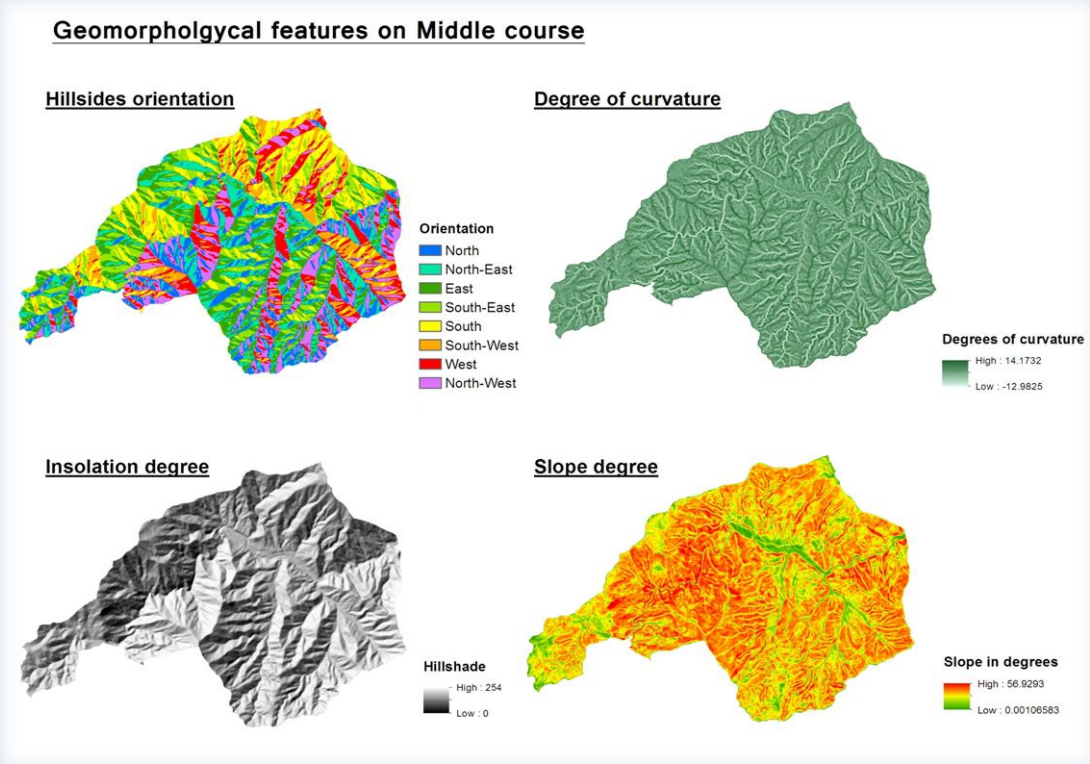
View of Upper course from Sant Miquel peak.



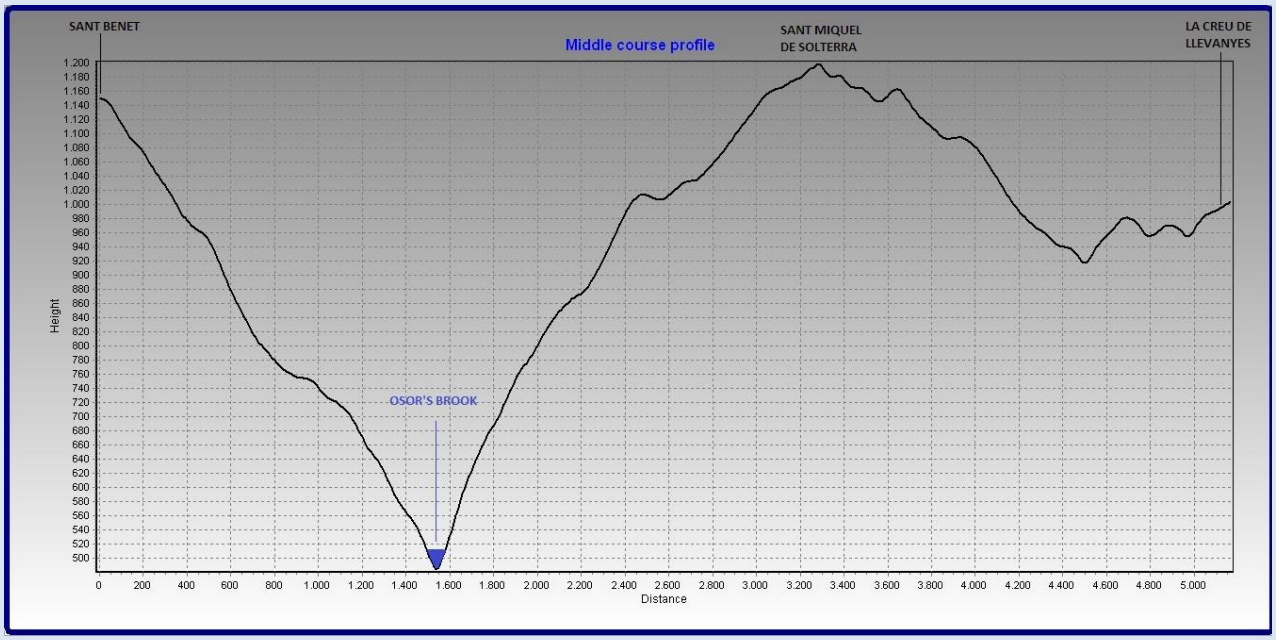
5.2.2. MIDDLE COURSE

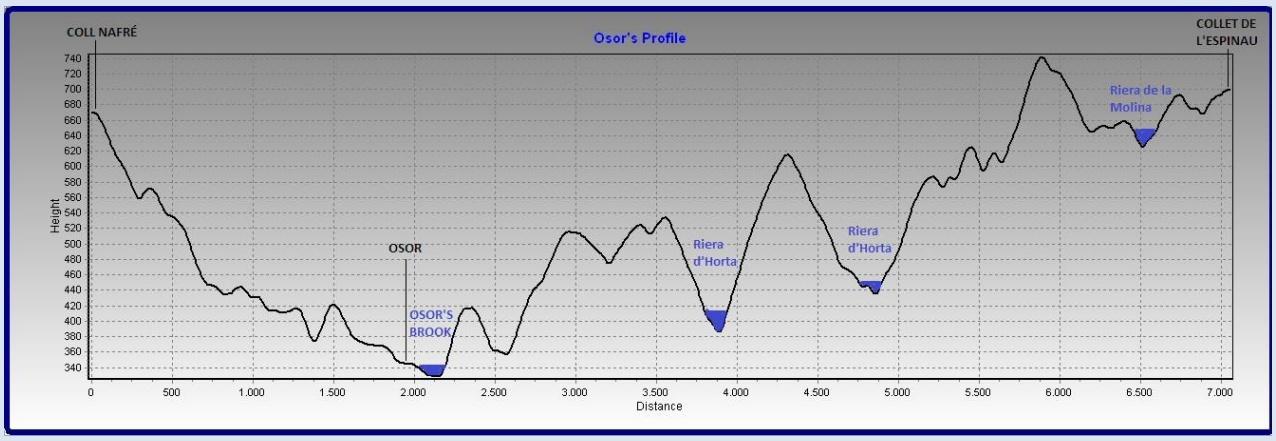
The Middle course is the one which has the highest grade and slope averages. This is due the brook in this area cross between the peaks of Sant Miquel, for one side, and Sant Benet, Sant Gregori and Puigdefrou range. Throughout this stretch, the average grade move around the 40 %. However and curiously, this is not the highest grade we find in the study area, which is located in the low course area. This grade gets lower when the brook starts to flow across Osor's valley. Although to don't have the highest height average, however, in this area it is reached the highest point of the whole Osor's brook watershed an also of the whole Guilleries massif, Sant Miquel de Solterra peak. So, the height in this area move between the 1202.8 to 243,7 meters above sea level. The morphology allows the presence of several tributaries as well. The area is the second one by importance in tributaries number. The area has a domain of the areas oriented to the south and east derived from the presence of the range named above. In the center of the area, a bit moved to its northern part, we find Osor's village.



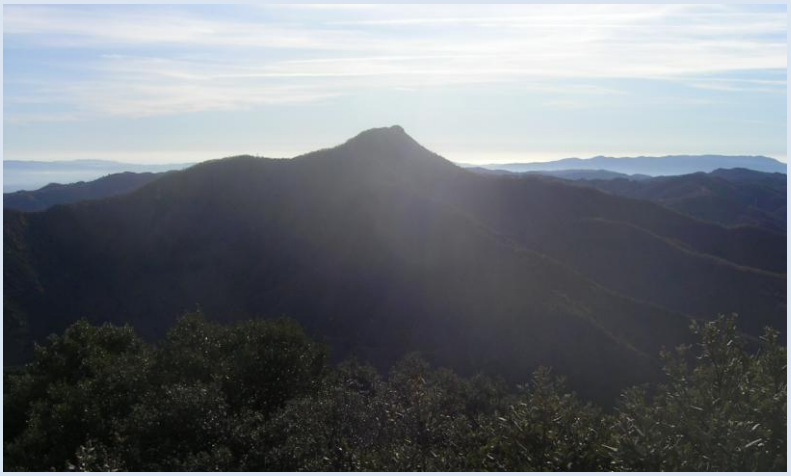


In the following graphs we can observe different profiles from the study area with the position of Osor's brook remarked, as we explained in the previous course description. We can see here, in the first graph, the grade of the Osor's brook cliff crossing between Sant Miquel and Sant Benet peaks. In the second, is possible to observe the lower level of grade when the brook arrives to Osor's valley.



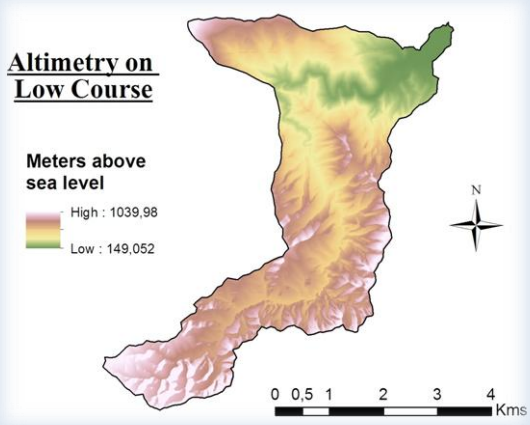


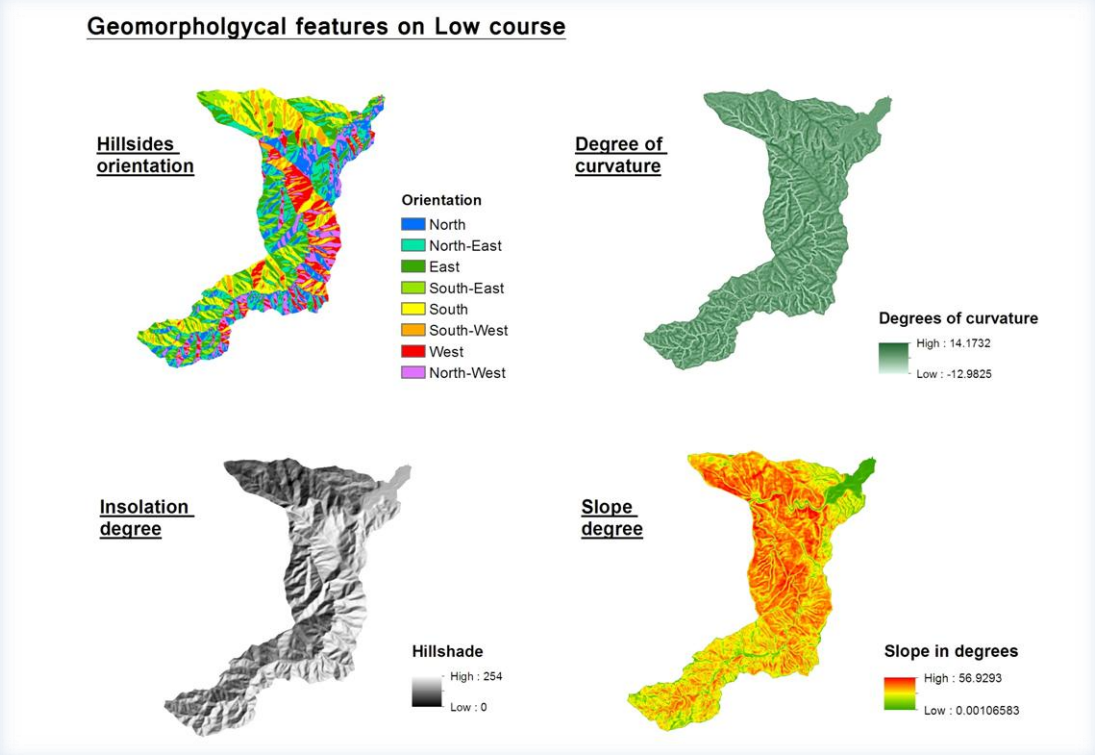
View of St. Miquel peak from St. Benet peak. In their feet runs Osor's brook.



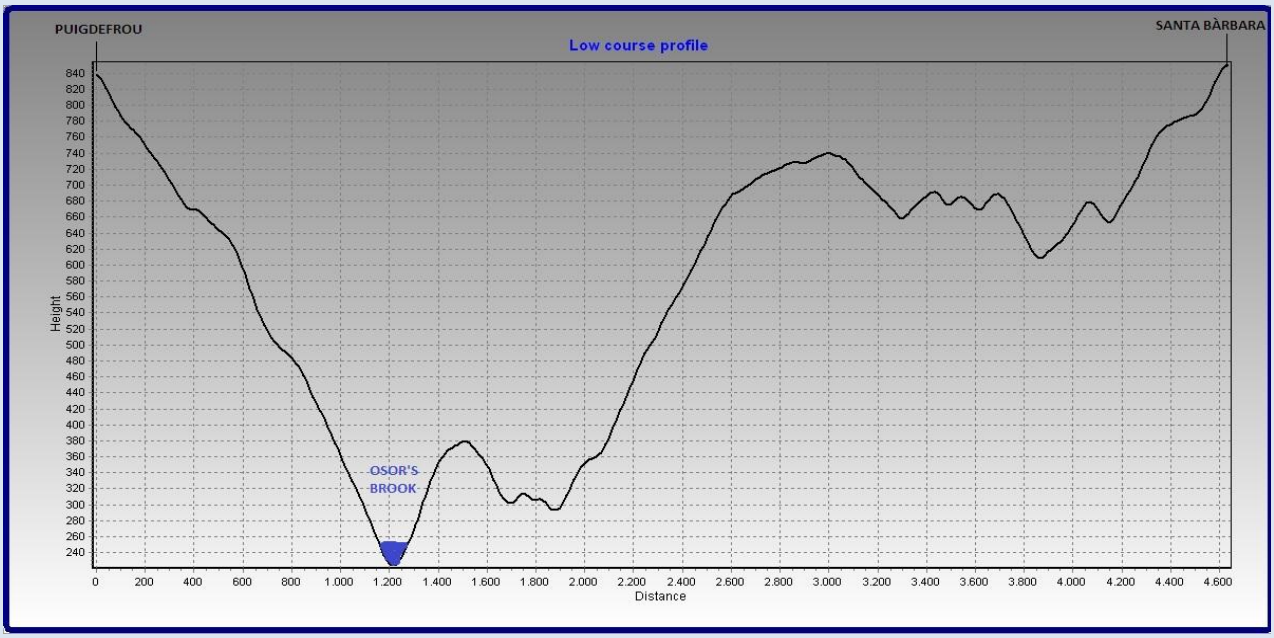
5.2.3. LOW COURSE

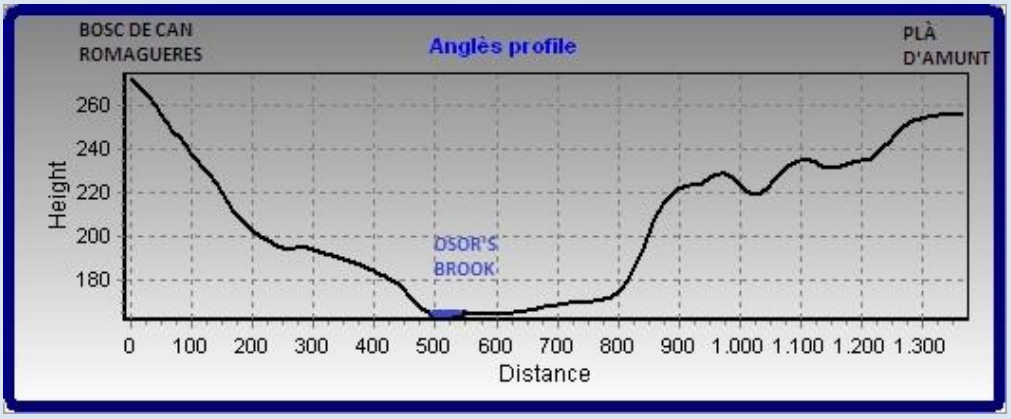
The low course is the one with the minor height as is usual in the water courses. However, the lower course has the peculiarity to reach the highest grade we can find in the entire studied watershed. This is because of the presence of the peaks of Santa Bàrbara and Puigdefrou, which have the common height of the peaks in this area (around 800 meters) and the brook located at 200 meters high. From this last one peak (Puigdefrou) to the brook there is just a distance of 1200 meters in horizontal line and a height difference of around 600 meters what leave us a grade of around 50%. After its pass between this two mountains the brook arrives to the end of Guilleries massif and beginning of Gironès plain, where the mean height keeps around the 150 meters or less, to discharge in Ter River. The height in the course moves between the 1040 to 149 meters above sea level. The highest one is due the elongation of the area by the presence of Molina tributary. But this last, the area doesn't contain the presence of so many tributaries. The area has a domain of areas oriented to the south and east, but also to north thanks of Santa Barbara's peak.





In the following graphs we can observe different profiles from the study area with the position of Osor's brook remarked. We can see here, in the first graph, the grade of the Osor's brook cliff crossing between Puigdefrou and Santa Bàrbara peaks peaks, where we find the highest grade of Study area. In the second, is possible to observe the huge decreasing of height found in the ending parts of Osor's brook course in its arriving to Ter River.



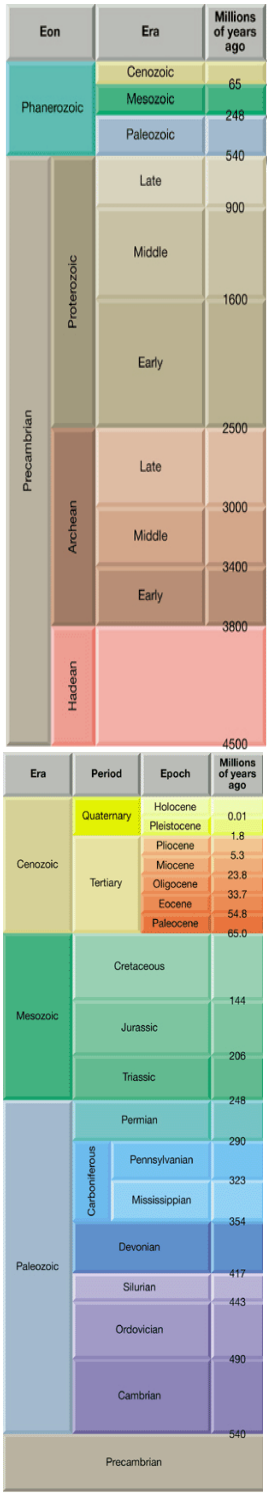


View of low course from St. Miquel's peak.

SWOT ANALYSIS

GEOMORPHOLOGY & RELIEF	
STRENGTHS	**WEAKNESSES**
- The high amount of water courses increases its natural importance. - Simultaneously, Guilleries is a smoothed relief and a rugged one. Its eroded and diverse peaks generate a unique landscape, with deep cliffs and plane areas. All of them generally, covered by vegetation. - The variety of climates and geomorphologies creates several environments.	- Montseny and Collsacabara can become by height more relevant elements from the eye of the observer than Guilleries, which for its features is a lower massif.
OPPORTUNITIES	**THREATS**
- The structure of Guilleries and the study area makes the area a unique place. - The rugged terrain may difficult the urbanization of its covers, becoming good for its natural conservation.	- The rugged terrain may difficult the conservation tasks.

5.3. OROGENY & GEOLOGY



Geologic periods table.

Source:http://imnh.isu.edu/exhibits/online/geo_time/geo_chart.htm

"The Guilleries massif consists on granitic masses, basically filolian and plutonic rocks emplaced at the end of the Hercynian orogeny in the Carboniferous and Permian periods. The northern part we find areas where emerge sedimentary and igneous rocks also from Paleozoic, but older than the previous because of corresponds to cambro-Ordovician period, and are affected by regional metamorphism and intense contact." (Observatori del paisatge de Catalunya, Unitat de paisatge 13)

Guilleries massif has been created and affected by several geologic periods and movements over its history. Presently, it's difficult to establish which would be the origin of Guilleries as a massif. It is known that during the Precambrian the Guilleries area was in the edge of the named Ebre's massif, which is the first relief known in Catalunya, when all the territory but this massif (which crossed Catalunya where nowadays is located the Central Depression). However, it's not possible to ensure that Guilleries rise as a massif was during this period. It is true that the Guilleries relief shapes, with rounded and highly eroded peaks and shapes could be related with the Caledonian orogeny due to its features (between the Ordovician and the Devonian), but it's also true that this could be because of its granitic formation, which tends more easily to the erosion. "The warm and humid climate alters quickly these rocks and forms a layer of gravel lands, offering because of this, almost always, a model of mature forms, characterized by soft, rounded ridges, slightly wavy, and wide valleys full of Lehmer granite". (Solé i Sabarís, 1936). "The Guilleries is a Paleozoic massif which is constituted by

Ilustration of Catalunya during the presence of Ebre's massif on Precambrian (up) and the Eocènic sea, on the Eocene (down).

Source fo the pictures: https://sites.google.com/site/fossilspuntcat/historia-geologica

metamorphic and granite slates. The warm and humid climate alters very quickly these rocks and forms the called “saulonian” lands. Due to the characteristics of these materials and external erosive agents give a mature relief of mild fairings, rounded and broad valleys.” (Vila, Picanyol, Bigas – 2004). In this way there is a close relationship between Guilleries and Montseny massif. “Guilleries, geologically, are the continuation of the Paleozoic Montseny massif.” (Solé i Sabarís, 1936). What changes especially between those two massifs is the geomorphology, because of the morphology of Montseny is higher and with more rugged peaks and slopes in front of the rounded Guilleries morphology, is the kind of rock. Montseny owe its shapes to the high presence of metamorphic slates, harder and more resistant to the erosion. “Metamorphic slates, good little tougher, ordinarily offer stronger forms (Montseny) or are preserved, because of their hardiness, the old forms of erosion which, moreover, in granite are degraded rapidly under the active chemical decomposition. In contact with granite, recrystallized slate offers, from the petrographic and mineralogical point of view, interesting areas of contact.” (Solé i Sabarís, 1936). Therefore, it’s difficult to affirm with certainty about the real age of the massif. Another element which makes that task more difficult is the lack of fossils in the area which allow the researchers to determine accurate results. “Sant Miguel Solterra includes considerable masses of gneiss, metamorphic slates and even marbles, the age of which is difficult to decide because of the fossils absence.” (Solé i Sabarís, 1936). But there are other reasons as well. “The stratigraphic succession includes terms ranging from probable Cambrian age to the Devonian, but the series is not complete due to the existence of a group of fault lines direction NE-SW that connect the Devonian and Silurian to the upper Ordovician and Middle-Upper Ordovician with Cambro-Ordovician series.” (H.Duran, 1990). Although that, it’s at least possible to determine the age of the different minerals which forms the Guilleries morphology and is interesting to highlight the geological importance of Guilleries massif. “In Guilleries emerges one of the series of Paleozoic metamorphic rocks most complete and ancient of Catalunya which are dated from lower cambrio-Ordovician, with more than 500 million years old.” (Museu Guilleries). “In Guilleries emerges one of the most complete Palaeozoic series of Catalan Coastal Ranges (…) and is also one of the few areas where is possible to find materials affected by high grade metamorphism”. (H.Duran, 1990).

These named rocks are found throughout Guilleries area and the one of the oldest ones are found in Osor’s brook area. However, the Guilleries orogeny and geomorphology is quite more extended and for this reason will be presented 3 processes which explain the succession of geological processes that have acted in the area of Guilleries from pre-Cambrian to the present day. In following lines will be explained the main typologies of Guilleries rocks as well as its origin periods and processes.

5.3.1.-Paleozoic Era

During the Paleozoic starts the formation of the first known rocks in Guilleries. In this period we can find the creation of several kinds of rocks, from sedimentary to metamorphic. This is also the period which leaves the first traces of volcanism known in Guilleries. “During Upper Ordovician times calco-alcaline volcanism took place at the North-Eastern corner of Catalonian Coastal Ranges. These volcanic rocks have Dacite to Rhyodacite composition”. (Ferrer Modolell, A.E, 1990). About the typology of rocks, we can see the main kinds of rock and the formation processes below.

5.3.1.1.- Paleozoic metamorphic rocks

“In the area of Anglès, Osor, Cellera de Ter, Pasteral-Susqueda or Amer we find the Guilleries gneiss and the anfibolitic rocks interleaved with shales, schists or filites. These materials date from the Cambrian-Ordovician (570-500 Ma)” (Agenda 21 La Selva).
About these gneisses it also important to express that “these gneisses presented clean contacts substantially parallel to bedding. They are completely fine and uniform grain, showing only a certain decrease of grain size in the vicinity of the contacts” (H.Duran, 1990)

5.3.1.2.- Paleozoic sedimentary rocks

“During the Paleozoic era, in addition to the metamorphic and igneous materials, there was deposition of materials, thus forming sedimentary rocks. It’s possible to locate this lithology in the area of Sant Martí Sacalm and Osor, forming patches of varying magnitude. These materials belong to the Cambrian and Ordovician periods (M. 500-570 years) and are presented as conglomerates, sandstones and schists”. (Agenda 21 La Selva). However, this is something not very common because of as some authors say, “The sedimentary cover is made almost exclusively during the Eocene, which begins with a lower level lake, characterized by conglomerates, sandstones and clays reddish” (Solé i Sabarís, 1936).

Related with the period and the kind of rock expressed above is related the following process.

PROCESS 1

Deposition of sediments and the layers successively, between which are introduced acidic igneous rocks.

Calcareousclays		Silurian-Devonian
Grauvaques		Ordovician
Limestone, acidigneous rocks, volcanic rocks, clays		Pre-cambrian

(Museu Guilleries)

5.3.1.3. - Hercynian granitoids

"These are the materials that form the massifs of Montseny and Guilleries, the contact area between the two groups, the Coastal Range and throughout the socket of Selva's Depression. The age of these materials move around to the late Paleozoic, between the Carboniferous and Permian, 280-345 M. years ago. Mostly, they are intrusive materials related to Hercynian orogeny, which ascended to levels close to the surface and, when crystallized, created different varieties of plutonic rocks, the main of which are:

- Susqueda's Diorite: is an igneous rock of intermediate to basic composition, which emerges around the reservoir Susqueda and in some parts of St. Benet Mountain.

- Monzogranite and coarse-grained pink granite: we can find a great spot to form around the Farners Castle and in some points Sant Benet Mountain.

- **Color gray granodiorite and biotite granite** (granite altered by climatic factors and transformed into gravel): forming a gentle in the west side of the mountains of Guilleries, in the limits of the municipalities of Santa Coloma de Farners and Sant Hilari Sacalm.

Example of Lamprofir vein on Osor's brook course

The most abundant granitoids are granodiorites and leucogranites, which between them is frequent to appear dikes of filonianes rocks or hipabisals very tough, which fill the fractures that suffered the granitoids once solidified. That creates structures which are visible between the granite softly weathered reliefs and are known as dikes or veins." (Agenda 21 La Selva)

Related with the kind of rock explained above we find the second geological process suffered during Guilleries massif formation.

PROCESS2

The Carboniferous Hercynian orogenic movement, which originated the Coastal and Pre-coastal Catalan Ranges, through granite intrusions, causes a withdrawal of sedimentary rocks and a metamorphic aureole of contact which give the following metamorphic changes:

Limestone		**METAMORPHISM**		Calcoesquits
Clay	→	**SOFT**	→	Slates
Greywackes				Greywacke sandslates

Limestone		**METAMORPHISM**		Marble
Highly acidic igneous	→	**HIGH DEGREE**	→	Gneis
Volcanic rocks				Amfibolites
Clays				Micaesquits

(Museu Guilleries)

After that period, during the Mesozoic, there is period of calm (in geologic terms) which allows the deposition of the minerals and the creation of some relief shapes like the calms. “Guilleries and Montseny present, at various heights, calms, that are extensive peneplains remains and sometimes deeply dissected by erosion today. As part of Europe, these surfaces are pre-Triassic age and pre-Eocene, due to these are two periods of stable continental block.” (Solé i Sabarís, 1936).

5.3.2.- Cenozoic Era

In Cenozoic Era appears the third process found during Guilleries orogeny. This is based in the following features:

PROCESS 3

1. Erosion of emerging materials and accumulation of sediments in the lower parts.

2. During the Paleocene and Eocene, held back a dive and a new sedimentation of red conglomerates and sandstones, limestone and marls , with a discrepancy between Paleozoic and Cenozoic

(Museu Guilleries)

5.3.2.1. Tertiary Materials

"The Cenozoic era are mainly sedimentary rocks of Miocene-Pliocene (22.5 to 5 Ma), therefore, more recent material. Basically we find gravels, silts and clays that were taken by the various rivers to the discharge areas. Predominantly, were

-. Reddish clay, with coarse-sandy channels, conglomerates and some carbonated level which are located in the area of Sant Martí Sacalm-El Far, from Paleocene (65 Ma).

-. Limestone with alveolines in the Transverse Range, specifically the area of Sant Martí Sacalm, dating from the Lower Eocene (55 Ma)" (Agenda 21 La Selva)

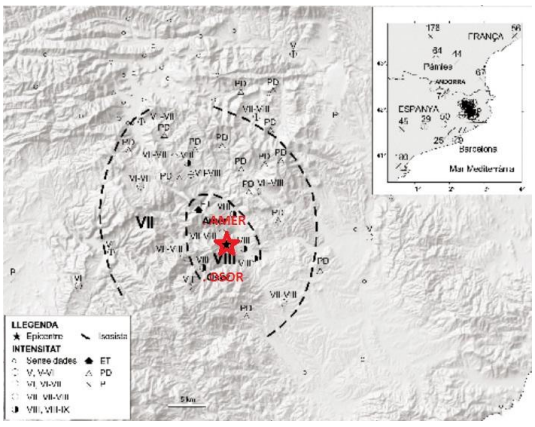
5.3.2.2. Quaternary Materials

These materials are more recent, mainly waste material storage tanks, from le immediate ridges, which are filling valleys as Selva's or Gironès depressions, areas bordering Guilleries massif.

It is also important to talk about the quaternary volcanism which affected the surroundings of Guilleries area, especially in the area of La Garrotxa, which its volcanism activity is dated between the 5,000 and 700,000 years ago. The "Parc Natural de la Zona Volcànica de la Garrotxa" is a natural park area covering a Holocene volcanic field. The volcanoes, of which there are about forty within the park, are no longer active, with the last eruption (Croscat) occurring about 11,000 years ago.

Although that, the area still becomes in some ways a hotspot in relation with seismic activity. An example of

Croscat volcano in La Garrotxa volcanic zone.
Source: verd2005.blogspot.com



Map of the 1927 eartquake.
Source: Doc. "Efectes dels Terratrèmols de 1427 i 1428 a les terres de Girona"

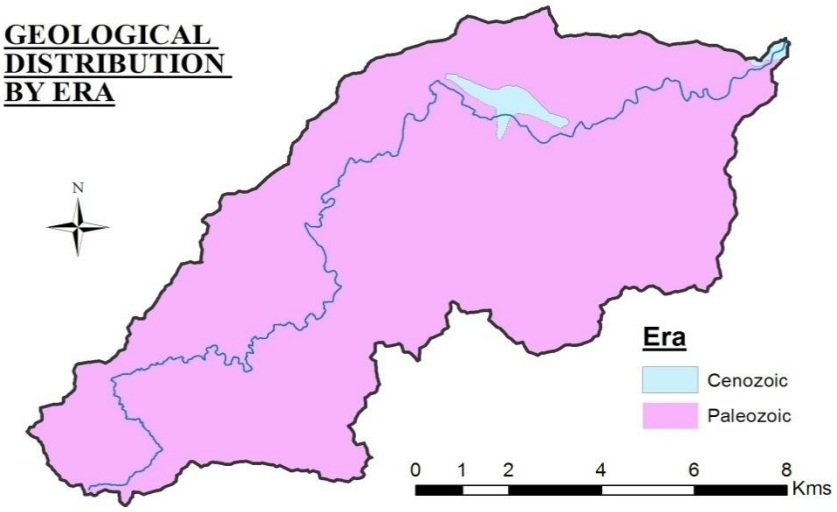
that was the earthquake of 1427 known of the Amer earthquake (because of the proximity of the epicenter to this village and the damage received by it, which was catastrophic.). Even thought, in 1426 they produced the first warnings of earthquakes, not was until 19 March 1427 that there was an earthquake of great intensity that had a catastrophic result with an epicentral intensity of VIII and the magnitude of 5.9. This had its epicenter between the localities of Amer and Osor, both in Guilleries area. In Lloret salvatge place, the earthquake was especially spectacular, because of the earth cracked and came out in sulphurous smoke and fumes which caused several deaths by poisoning. The earthquake also caused destruction and desolation in Osor's valley. This was just one between the several earthquakes which affected the north-eastern part of Catalunya during this period of time. The worse of them was in 1428 in Pyrenees and caused around 1000 deaths in Catalonia. In relation with 1427 one, is important to say that some researchers relate this earthquake with the origin of Sparkling sulphurous springs in the municipalities of Amer and Sant Hilari Sacalm. "Geological studies show that the sparkling waters of Sant Hilari originated at different stages in granitic terrains, which are carbonated and ferruginous and derived from the volcanic area of Olot. Part of Guilleries was subjected to a subsequent volcanism and there is direct relation between earthquakes of s. XV (1425) in the area and the formation of acidulous waters. This could be corroborated by the fact that had been not spoken about till recent times despite the ancient population of the territory." (Serradesanferm, 2003).

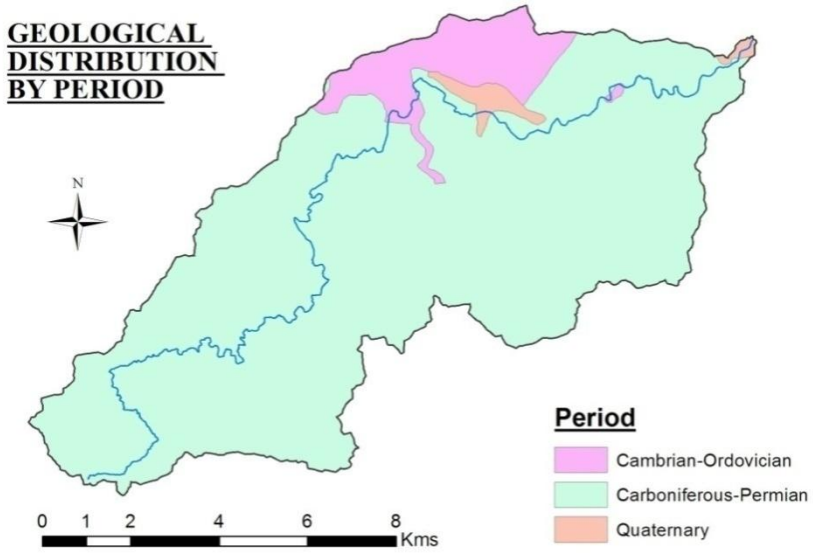
5.3.3. Study area geologic features

Although the geological features of study area are closely related with the described above, so with the main characteristics of Guilleries geology, in the following lines will be carried out a brief summary about the main geological features which belongs exclusively in the study area and obtained across the georeferenced geologic analysis.

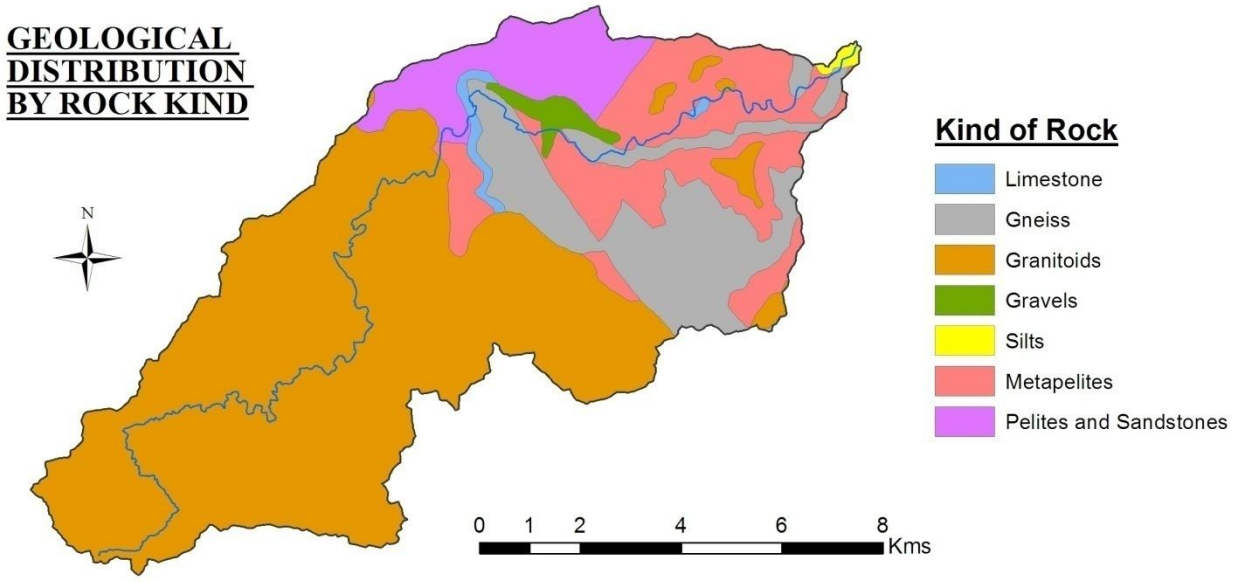
In study area, mainly all the land belongs the area expressed with origin in the Paleozoic era. There is just the exception of the Osor's valley and the beginning of Anglès area (so the Gironès Plain) where we can find elements from the Cenozoic.

On the other hand, when we move the view point more to periodicity direction, the appearance of the distribution keeps the same draw. The areas related with the Paleozoic belong to Carboniferous-Permian period, and ones related with to the Cenozoic belongs to the Quaternary period. Just is possible to see a difference in the Range formed by Sant Benet, Coll Nafré and Puigdefrou, where we find the metamorphic rocks expressed above as one of the most ancient in Catalunya belonging to the Cambrian-Ordovician. Is important to highlight here, also, the presence inside this block of the area known as Osor's Mines (the pink





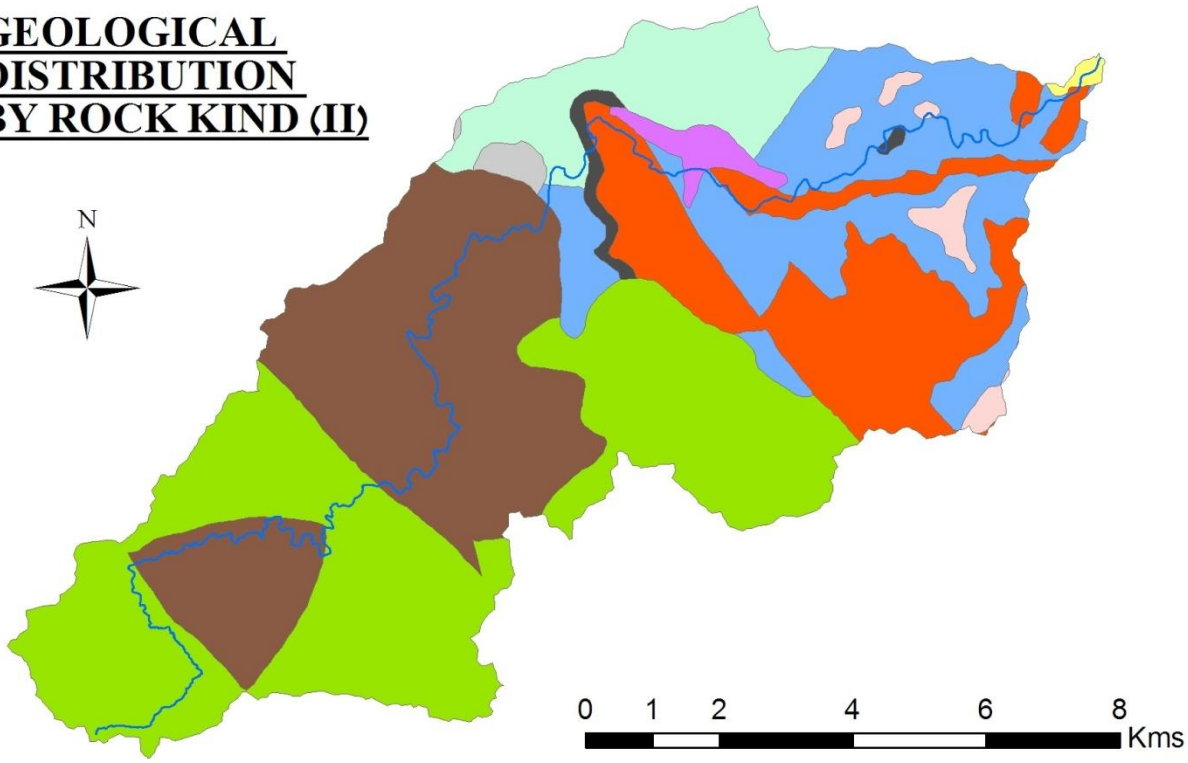
patch in the main course of the brook located between Osor and Anglès). This was an important mining place to the area and probably related with this geological fact. The mining Osor was an important economic spot during several decades. It is said that the Mine was working since the XVIII century (other people say that already ancient cultures were using them to mineral extraction.). The mines were closed at the end due to the depletion of useful minerals in 1979. The importance of the mine came by the presence of several minerals used to industrial purposes like the fluorine and, as secondary, the blende and the galena. In the following maps is possible to see that this area becomes as one of the main spots of limestone (which sometimes includes materials from the Caradoc-Ashgill) in the study area which is likely, the fact that led the presence of this peculiar mineral formation in the zone



About the typology of rock, all that is the upper course of the Osor's brook is formed by granitoids. As much, there is a distinction between the Granodiorites biotites and the Leucogranites (which we find in Mas Quintà Brook course). About these last ones, also forms the first stage of the middle course to then change to a wide variety of tipologies. In the area of Sant Miquel de les Formigues we find again the granodiorites biotites. Before the arriving to Osor's valley is possible to find an area with quartz appearance diorite, as well as metapelites, anatexites, gneiss and a path of limestone (these last three In Sant Miquel northern hillside). Within the range formed by Sant Benet, Coll Nafré and Puigdefrou we find pelites and sandstones, especially as Pyrethrum, sandstones and greywackes. And as last we can find the alluvial plane of Osor's valley with the presence of gravel, sand and silt.

Finally, the low course is formed by the presence of metapelites and anatexites. It's important to highlight in this area the presence of the granitoids known as Moskovitic leucocratic granites and, also, the presence in the area previous to the Osor's Brook discharge to Ter River of boulders and silt.

GEOLOGICAL DISTRIBUTION BY ROCK KIND (II)

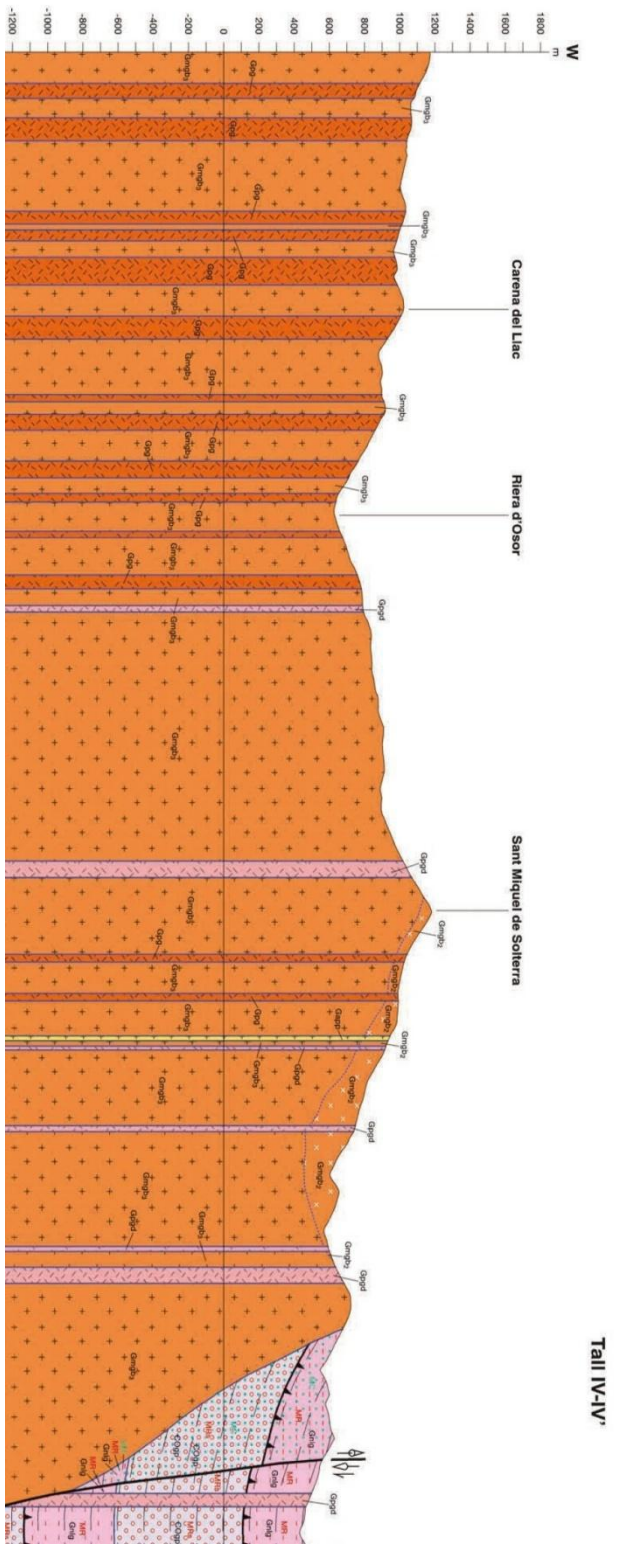


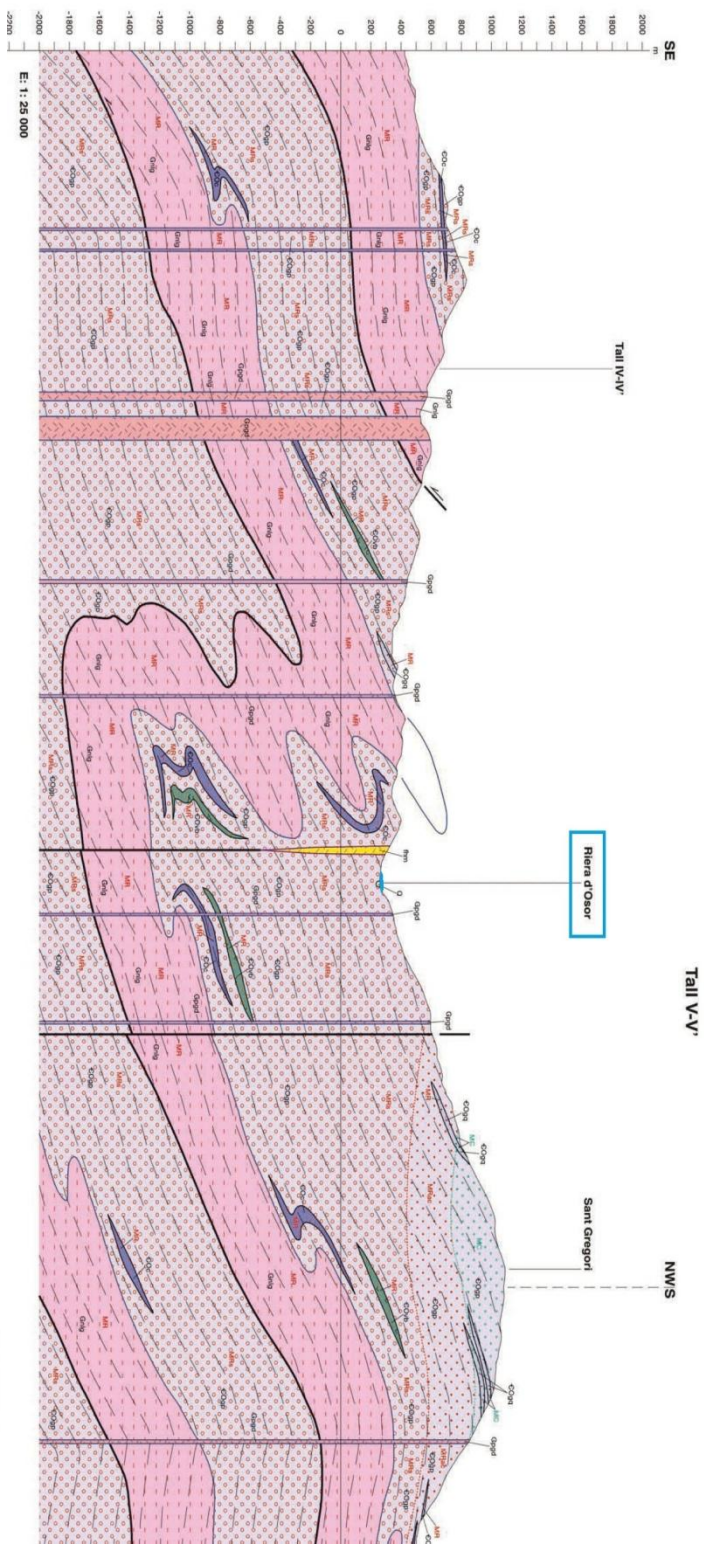
Description of the rocks

- Anatexites in genissos moscovítics-biotite
- Limestone. Locally includes materials from Caradoc-Ashgill
- Boulders and silt (valley bottom)
- Quartz appearance diorite, diorite and basic rocks
- Moscovític leucocratic granite (biotite)
- Granodiorites biotites
- Gravel, sand and silt (alluvial plain)
- Leucogranites (Bi) (Ms)
- Pyrethrum, sandstone and greywackes (ritmites)
- All iso metamorphism in metapelites. Area of sillimanita-potassium feldspar, anatexites.

GEOLOGIC PROFILES

Source: Mapa geològic Anglès 333-1-1 (75-25) Institut Cartogràfic I Geològic de Catalunya





5.3.4. THE SOIL

Climate, vegetation, and the existence of very different geological materials generate a wide variety of soils in Guilleries massif.

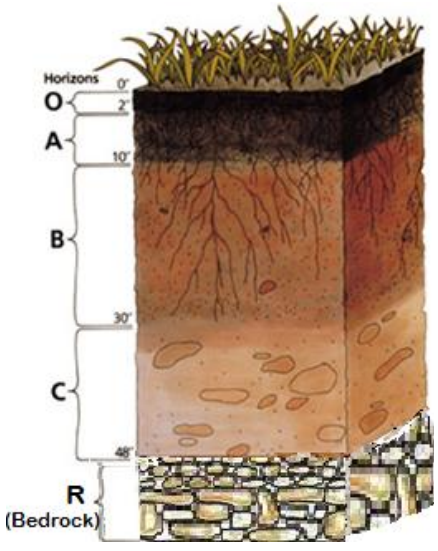
The parts are the most extensive and forestry in these soils are frequently developed with thin organic horizons to the surface (0 horizons), but under a horizon enriched with organic matter (A horizon); and before reaching the rock almost appears a B horizon soil with a certain structure or C horizon, where the material has lost some of its coherence. Although that today are under the forest, it is clear that many of them were cultivated. (These are called orthens, according to the American classification system, or Regosol, according to FAO).

In the highest parts, cooler and wetter, these soil types present a bigger accumulation of organic matter in the surface and tend to become more acidified. The low level of development of these soils makes their mineral part resembles the original material, with a very incipient weathering, and are presented in coarse textured.

They are also more developed soils with argillite B horizon (layer rich in clay due to water transport or illuviation from the top of the profile) although that its overall length is reduced. The rugged slopes found in many places have a high risk of soil erosion by water, something to keep in mind when forestry technologies to be applied are planned.

The grounds are alive, although they are often regarded as inert; the flora, fauna and soil microorganisms play a key role in the development and maintenance of life ecosystems.

Basic soil profile



Source:
http://en.wikipedia.org/wiki/Humus

Guilleries Soil profile

Are different soil layers in the area. An example of what we can find you see below:

-. Horizon O or organic. Is the litterfall and fallen leaves accumulation soil almost without decomposition. Is the layer where we found the called humus layer.

-. Horizon A. Formed by mineral matter, slightly obscured by the organic matter. It has an intense biological activity and a lot of roots. It is slightly acid and coarse textured (loam). A lot of nutrients for

plants are found in this horizon.

-. Horizon B. Clearer layer. Where there is less darkening due to organic matter and particles of sand, silt, clay get group to form larger elements, the aggregates. It is slightly acidic, thick texture and less root activity.

-. Horizons C and R. Towards the bottom of the profile, the weathering of the original material is weaker and their characteristics are increasingly more belonging to a rock (R horizon). The roots have more difficulty to penetrate, lacks the aggregation of horizon B and the biological activity is weak.

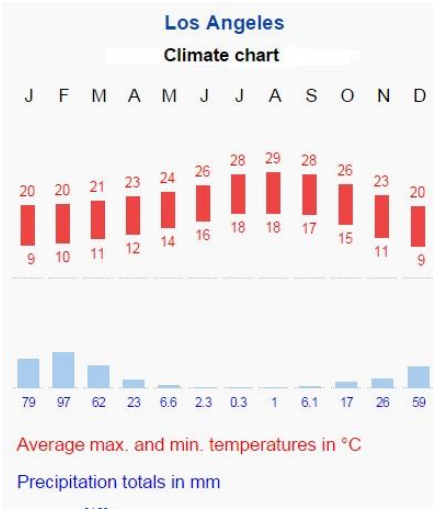
(Whole text of the last two pages extracted from Museu Guilleries – Sant Hilari Sacalm)

SWOT ANALYSIS

GEOLOGY & OROGENY	
STRENGTHS	**WEAKNESSES**
- The variety of geological rock kinds. - The presence of series of Paleozoic metamorphic rocks most complete and ancient of Catalunya found in Osor's brook area - The red conglomerates in brooks generate unique shapes.	- The kind of rock makes that, although the area has several points which could be used as attraction for climbers, they are in general composed by soft rock, easily breakable. - There is a lack of fossils in contrast of other close areas where yes it there is. - The geological outcrops are basically covered by vegetation surface. - The fast erosion and the slope does not allow a creation of wide soil layers
OPPORTUNITIES	**THREATS**
- The variety of geological typologies makes the area and interesting geological point. - In the brook course the erosion left the geological outcrops on surface, being an interesting study spot.	- The easy erodibility of the area. - The presence of granites in the upper course causes high level of erosion and sediment transport.

5.4. -METEOROLOGY & CLIMATOLOGY

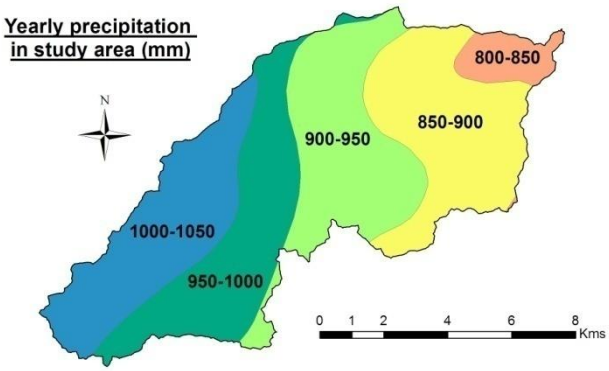
Guilleries area, because of its location and characteristics (around 42º N latitude, and a distance between 20 and 30 Km to coastal line of the Mediterranean Sea,), belong to one of the planetary regions where a Mediterranean or temperate subtropical climate prevails. That's characterized by a mild thermal regime, with quite warm summers and cool winters. Rainfall is moderate, with highs in the fall and spring, and has a summer drought period. That's caused by the accumulation of heat in water bodies during the summer, and the arrival of polar cold drops. The maritime polar air masses dominate in autumn and winter, and in spring as well; and are responsible of most of the precipitation. On the other hand, the air masses of Atlantic origin, when reach Guilleries, have not lost all its moisture and can produce some rain, though less substantial than those of Mediterranean origin. It highlights a marked torrential character in summer and autumn as well due to the presence of important storms which are, commonly, extremely intense but with a low duration. On the other hand "winter is relatively little rain due to the influence of high pressure and central European North Atlantic, while the subtropical high pressure (anticyclone of the Azores) determine a dry summer periods of 3 to 5 months aridity. However, the presence of mountains and raised areas causes increased precipitation: the moist air from the Mediterranean is forced to move up, cools and condenses moisture, resulting in much more rainfall". (Vila, Picanyol, Bigas, 2004), It's for this last reason, because of the mountains, that Guilleries climatology becomes an exception inside this Mediterranean area due to the relief can change the weather characteristics and constitute real orographic modelers of the clime features. The increase in rainfall due to altitude, for instance, produces than in Guilleries massif the Mediterranean dry summer does not occur fully.

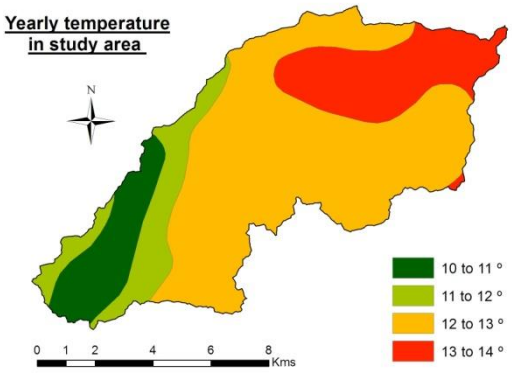


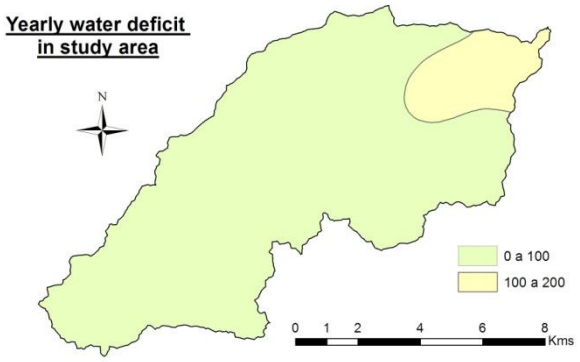
Example of Mediterranean climate histogram where is possible to see the summer drought.
Source:
http://en.wikipedia.org/wiki/Mediterranean climate

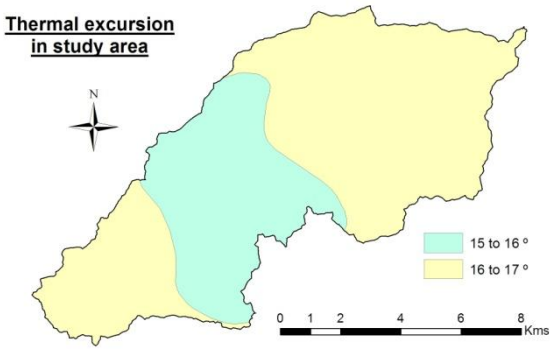
So, all these orographic factors and geographic location and position have the consequence of the presence of a real mosaic of micro-climates. Within the study area, this can be observed in different ways. Shortly explained the study area has one part with the Mediterranean climate humid continental (west) and another north littoral of the Mediterranean climate (east). But that's not all and every area changes its features, as we said, in function of its orientation and height. The eastern section of the study area is the one with the closest climate with the basic Mediterranean, in area close to Anglès village. As well, the presence of the

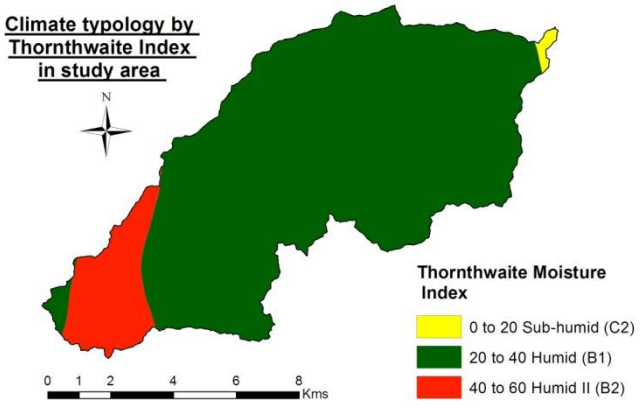
Gironès depression, the low height and the path created by Osor's brook course allows the entry of the climate and the winds coming from there. This can arrive till Osor's valley but the higher altitude and its location surrounded by mountains already changes its climatic features. This happens moving more to the upper course of the brook as well. In Mas Quintà area, for instance, there are similar features than in Osor but with more height and less meteorological elements related with the Mediterranean clime. On the other hand we find the plains of Sant Hilari Sacalm and Plà de les Arenes, where there is a direct influence of the Mediterranean air movements because of the fact there is not any barrier which stops that influence but its own height, which move around 800 and 1100 meters and that give to these sites a own climate kind, more humid than Mediterranean, and so a new typology of weather. Throughout all the study area there is always, more or less, this climatic difference between the low course and the upper parts. We can see that in the following maps:

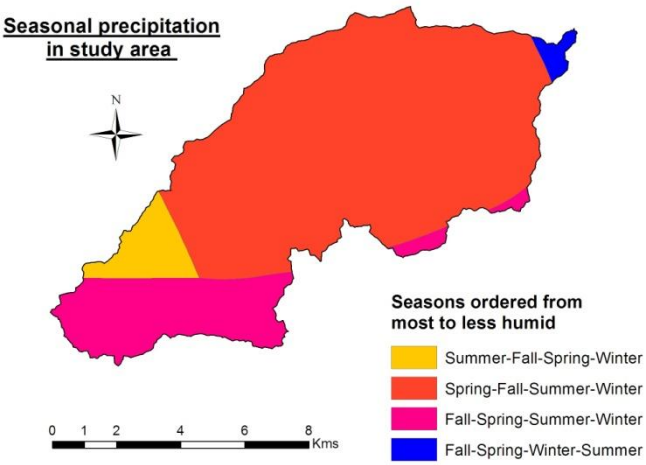








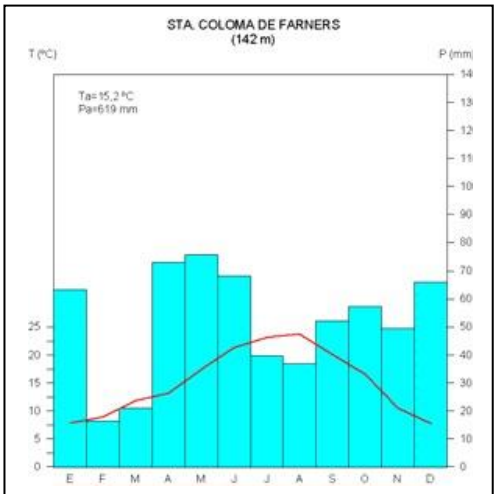




So, we can reach within the study area several kinds of climate in function of its geographical features. However, in broadly speaking, we can distinguish in the area three main kinds of climate. These are the followings.

5.4.1.- Mediterranean Climate

It's the most typical climate in the north-eastern part of Catalunya, where the study area is located. The annual average temperature is around 15ºC, the summers are a bit warmer (with an average of approximately 23 ° C) and short cold winters (average 8ºC). Within the varieties of Mediterranean climate we can find in Catalunya, (there is the Coastal Mediterranean Climate or the Plain Mediterranean climate; for instance), in the study area is present the Humid Mediterranean climate. The Humid Mediterranean climate, located halfway between the Mediterranean climate of the plains and the sub-Mediterranean, is a kind of Mediterranean climate with more rainfall indexes. The typical month of summer drought evolutes leaving just some periods with low rainfall, but never in the same levels as the other two kinds of Mediterranean climate. Mainly, what happens is and increasing of all the precipitations over the year. In the study area it is possible to find this climate in the final part of the low course, in Anglès village and some areas which represents Osor's brook final course.



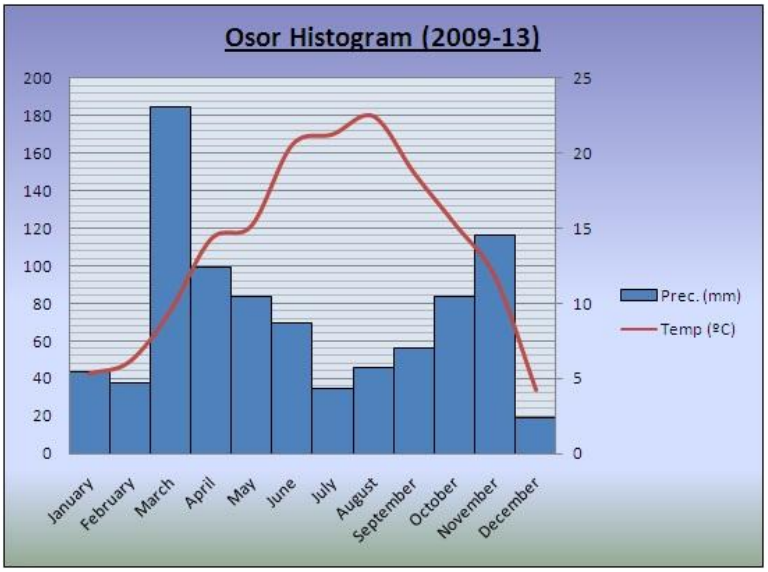
Histogram of the Humid Mediterranean Climate. It have been not possible to find an histogram from Anglès village but the case of Santa Coloma is also valid cause is one of the nearest places by distance and weather conditions.
Source: Vila, Picanyol, Bigas, 2004

5.4.2.- Sub-Mediterranean climate.

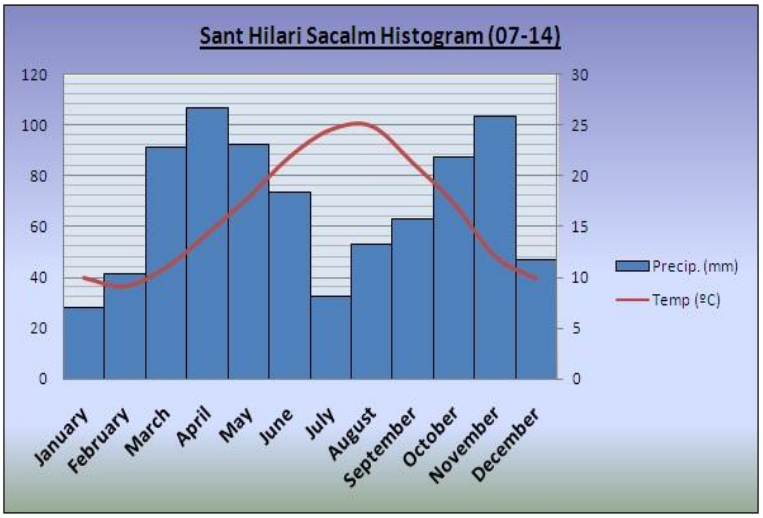
Between the 400 m and to 900 m of height, appears another climate that makes the transition between the Plain Mediterranean and the Middle Mountain climate which is called sub-Mediterranean climate. In this case, following the line of the one explained above, there is no dry months, so no summer total drought. We can find this weather almost in all the central part of our study area, from Osor to Sant Hilari Sacalm villages (just with the exception of the peaks of the mountains within). Is important to be highlighted here that, although belong to the same typology of clime these two point are located in the both extremes of the interval which separate the Mediterranean weather with the Middle Mountain Climate (which will be the next explained below) and that causes the presence of large differences between these two sites

meteorological records, specially about the precipitation mean. However, it's important to remember what have been said about the location and features of both. So, at 400 meters high and surrounded by 1000 meters mountains in Osor's case, and at 850 meters high and with direct orientation to the Mediterranean coast in Sant Hilari's case. In the following graphs we can see the main features of its meteorology.

Osor monthly means (between 2009-13)		
MONTH	Temp. AV	Precipitation
	C°	mm
January	5,3	43,48
February	6,1	37,73
March	9,5	184,25
April	14,3	99,53
May	15,2	83,35
June	20,6	69,70
July	21,3	34,85
August	22,5	46,08
September	18,7	56,15
October	15,3	83,58
November	11,7	116,53
December	4,2	19,25
Yearly Total		874,45
Yearly avarage	13,73	72,87



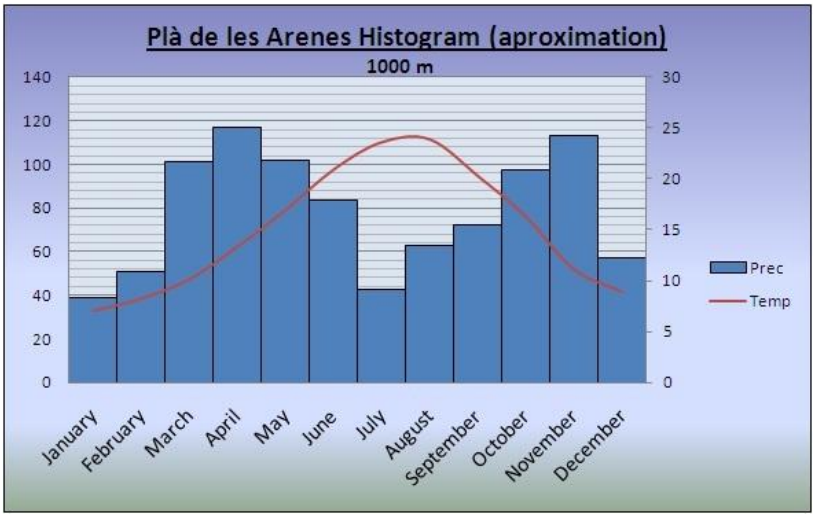
Sant Hilari Sacalm monthly means (2007-14)		
MONTH	Temp. AV	Precipitation
	C°	mm
January	10,01	28,25
February	9,19	41,66
March	11,05	90,99
April	14,35	107,00
May	17,90	92,11
June	21,89	73,65
July	24,56	32,45
August	24,90	53,25
September	21,28	62,89
October	17,30	87,46
November	12,11	103,16
December	9,93	47,13
Yearly Total		820,00
Yearly avarage	16,21	68,33

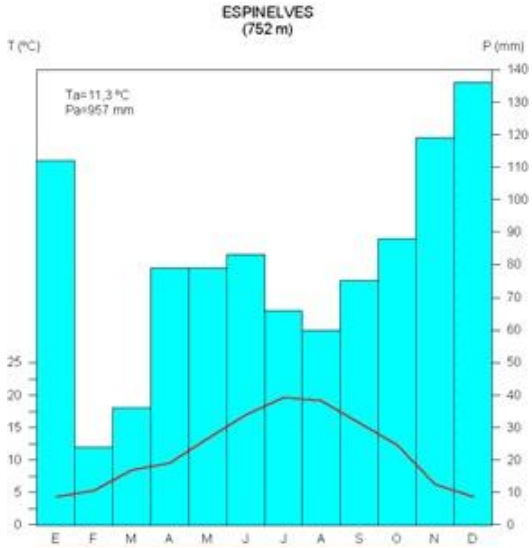


5.4.3.- Middle Mountain Climate

From approximately 900 m to the highest peaks of Guilleries there is the influence of a Mountain Climate. In the case, the Middle Mountain Climate due to the height values The main features are the coldest winters, averaging 3ºC in January, mild summers and an average of up to 20ºC in July. Rainfall is more abundant, without exceeding 1000 mm annually and with maximum also autumn. In this way, we can say that the trend of this climate kind is quite similar than the Continental or Center-European Climate. In the case of the study

area but, there is as well as in the last section, several differences between areas within the same climate typology because of the diverse orographic features. The only point we would find inside the study area with these features would be top of the main mountains, higher than 900 meters and, especially, the upper zone of the upper course, in the area named Plà de les Arenes. The geomorphology and orientation of this area (is a plain, as have been explained previously, and has not any barrier to the Mediterranean coastal air entry but its height), causes that its clime is more related with Humid Mediterranean than with Middle Mountain Clime, although be located in a height upper than 1000 meters. For the other side, there are places in Guilleries that, although are in heights below 800 meters, has climes more related with the Middle Mountain one or the Continental because of its location within mountains (like happened in Osor's valley, with higher rainfall average than in Sant Hilari). We can see that in the following histograms. The first one, referent to Plà de les Arenes one, is obtained by an approximation (due to the lack of meteorological data about the place) carried out using the data from Sant Hilari Sacalm and applying a thermal and precipitation gradient. The second one belongs to Espinelves village, the closest village to the western part of the study area located in Turó de la Guàrdia peak south-western feed.





Espinelves Histogram source: Vila, Picanyol, Bigas, 2004

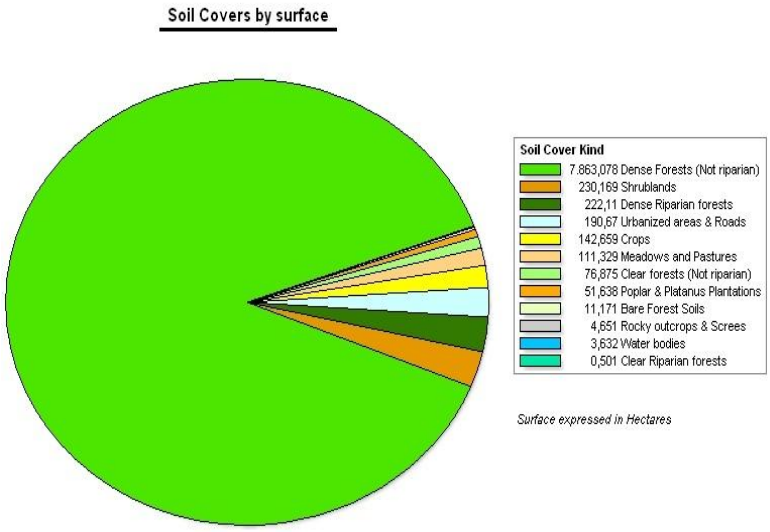
Summarizing, Guilleries climate is highly and basically influenced by the Mediterranean weather. Nevertheless, this clime is hardly changed by some elements. The continentality changes this weather making it more humid. The same happen with the relief in the places surrounded by mountains. These places become cooler in winters and warmer in summers as well. The relief can affect also with the orientation (insolation or air masses entries), providing weather variations too. Another element which affects the clime is the height, which decrease the temperature as upper becomes. All these elements can be mixed in different degrees all along the study area generating a rich matrix of micro-climes and so, ecosystems and habitats with different resources to the vegetation, the wildlife and the humans.

SWOT ANALYSIS

METEOROLOGY & CLIMATOLOGY	
STRENGTHS	**WEAKNESSES**
- During warmer months, the Area daily temperatures may be less extreme than the Mediterranean area ones, which make the weather pleasant. - The microclimates along the study area cause the presence of several ecosystems and environments.	- During nights the temperatures can get low levels and generates a cold sensation. - The presence of summer drought (though be minor than in pure Mediterranean. areas) affects negatively the water courses, drying them in some cases.
OPPORTUNITIES	**THREATS**
- The pleasant daily temperatures and the low amount of precipitations during the warm seasons may be used as attraction feature for the tourism	- The cold nights and the spontaneous storms may suppose a negative elements for the tourism - In extreme dry summers the brooks, in case they were used in some points as natural attraction, would lose its attraction capacity.

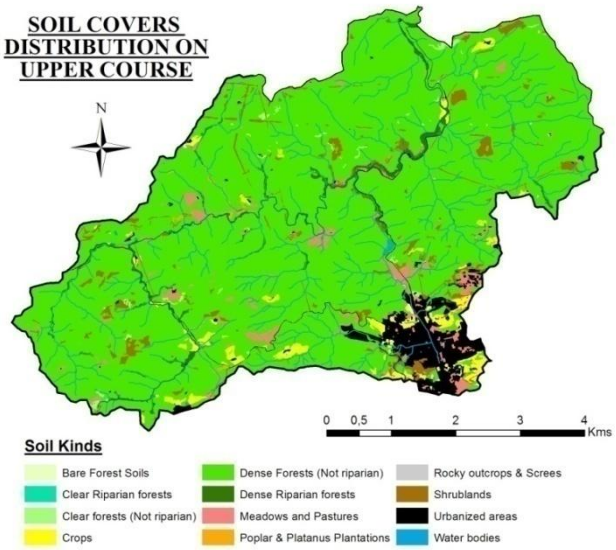
5.5.-SOIL COVERS

The soil covers in the study area are basically occupied by forests. The total cover of the area, as we said before, is around 8.908 Ha, so 89 Km^2. From this area, 8212 Ha are occupied by the forest cover, which represents the 92.2% of the total surface. The rest is shared between urbanized areas, water bodies and other natural or man-made surfaces.

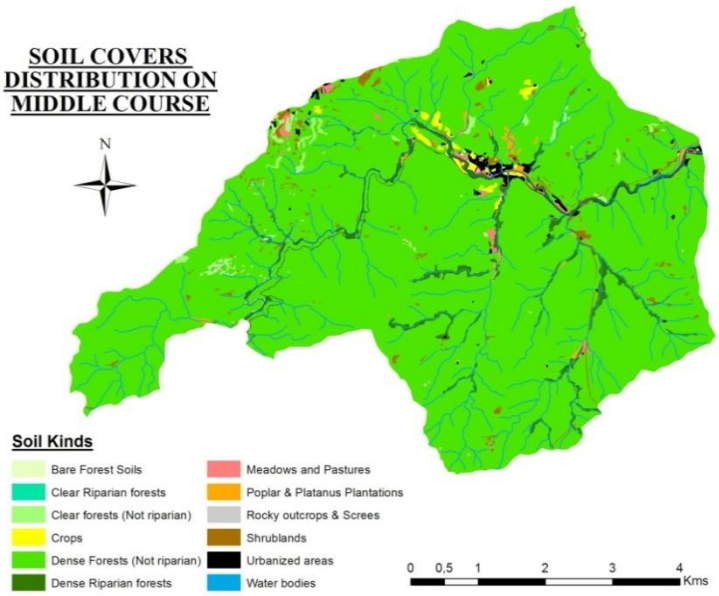


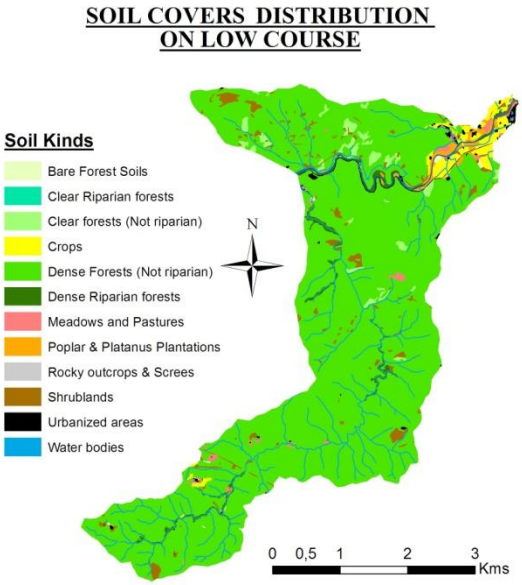
Actually, if we take together all the natural elements, so leaving out of the equation the urbanized areas, the roads, the crops and the meadows and pastures (which although could be token as natural landscape element is not a natural origin cover there), the total area occupied by natural elements is about 8.465 Ha covered by natural elements; so the 95% of the total surface. Knowing that, it's easy to imagine the wild character that the area can offer to the visitor.

Another interesting point is about the crops. As we explained in some chapters above, there was a remarkable crops extension during the end of XIX century and beginnings of XX, especially thanks of the vineyards and fields around the masos. But this crops surface was decreasing over all the XX century.

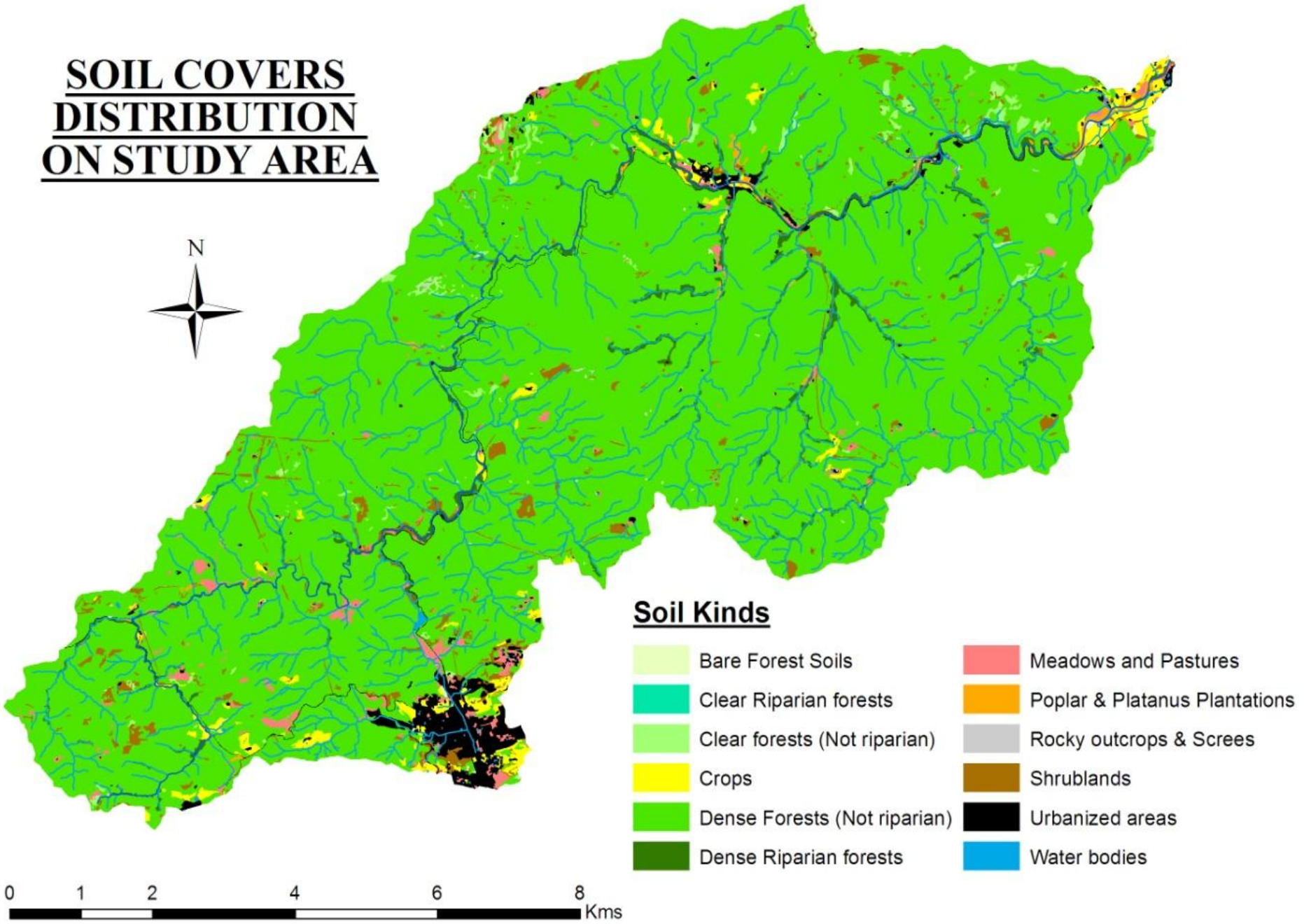


Nowadays, the surface occupied by crops is 142.6 Ha. Its distribution, is based in the proximity to the urbanized areas, especially around the municipalities of Sant Hilari Sacalm and Anglès, and also in the areas where the relief provide flatter terrains, where is possible a better management of the crops. The lack of this kind of terrain is the responsible that the covers by crops occupy just the 1.6% of the total surface. However, is important to say that instead of agriculture the cultivations moved to another shape and is the silviculture the dominant element in the area. Although in the graph there is just reflected the poplar and platanus plantations, exists a large surface of plantations. But we will see that in the Vegetation chapter of this document. About the forest covers, we already said that occupies the 92.2% of the total surface, but is interesting to say that from this 92.2, the 95.75% of the total forest area is composed by dense forest without take into account the riparian vegetation, which occupies just the 2.7 % of the total forest surface, being the third kind of cover by surface just surpassed by the shrublands and the dense forests. That reflects the importance of the hydrologic network in the area. On the other hand, the meadows and pastures presents also another activity in the area, as is the livestock, which becomes interesting though it doesn't represents a high surface occupation. We will speak more deeply about it in the Economy chapter. Finally is interesting too speak about the presence of several rocky outcrops along the study area and the electric lines, which doesn't appear in the map thought usually are made with a no wooded strips. We will talk more about this subject in the Connectivity & Infrastructures chapter as well.





SOIL COVERS DISTRIBUTION ON STUDY AREA



As last we will explain briefly some of the most relevant elements in Guilleries covering.

5.5.1. Forests

As we said above, forests become the main kind of cover in the study area. They are dense an extended and are formed with a large variety of species which composes the typical landscape of the area. We won't further into for now because of the presence of the deeper explanations about it in the Vegetation chapter.

5.5.2. Meadows and Pastures

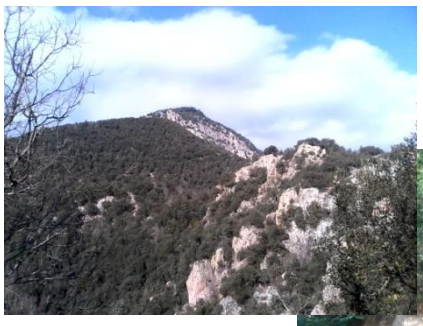
Usually, the meadows in the study area don't become a result of the natural formation, in contrast with the forest which usually appears in natural way (Although there are a lot of them with anthropic origin). However, it's typical to see these meadows in the flatter areas or around some masos.

About the pastures, also are present following similar features than the meadows. However, it's interesting to say that in several cases, the pastures used by the ranchers are the same forests of the area. That can be explained by the presence of a high number of goats in the livestock variety of the study area.

Casota d'en Comes and meadows around. **Source:**http://ca.wikiloc.com/wikiloc/imgServer.do?id=93756

5.5.3. Rocky outcrops and small scree deposits

As we exposed in the Geology chapter the presence of rocky outcrops in the area is something quite common. Is possible to observe them in some peaks where the vegetation cannot adhere themselves as we can see in the first picture. About the screes, its presence is due to the geological formation of the soil, which is easily breakable and generates this kind of forms. It's possible to see them in the rugged slopes. In some areas, these are hidden by the vegetation as we can see in the down picture. Also it's possible to see some kind of man-produced ones in road sides or also in the steeper slopes (Right picture).



5.5.4. Shrublands

The shrublands is, like the meadows, something which strangely appears by natural origin. Usually belongs to areas where, by deforestation, there is not wooded surface and we can find the vegetation typical of the earlier stages before the climax vegetation condition.

Source:http://www.solvia.es/Suelos-de-Banco-en-Sant-Hilari-Sacalm/40167_0/vivienda_50437.html

5.5.5. Urbanized areas

There are three main urbanized areas in the study area as we explained in other chapters; Sant Hilari Sacalm, Osor and a little part of Anglès. There is a little residential area near Sant Benet peak belonging to the municipality of Susqueda as well and dozens of masos scattered throughout the territory.

In the picture we can see a view of Sant Hilari Sacalm town, which becomes the largest extension of urbanized area of the study area.

5.5.6. Water Bodies

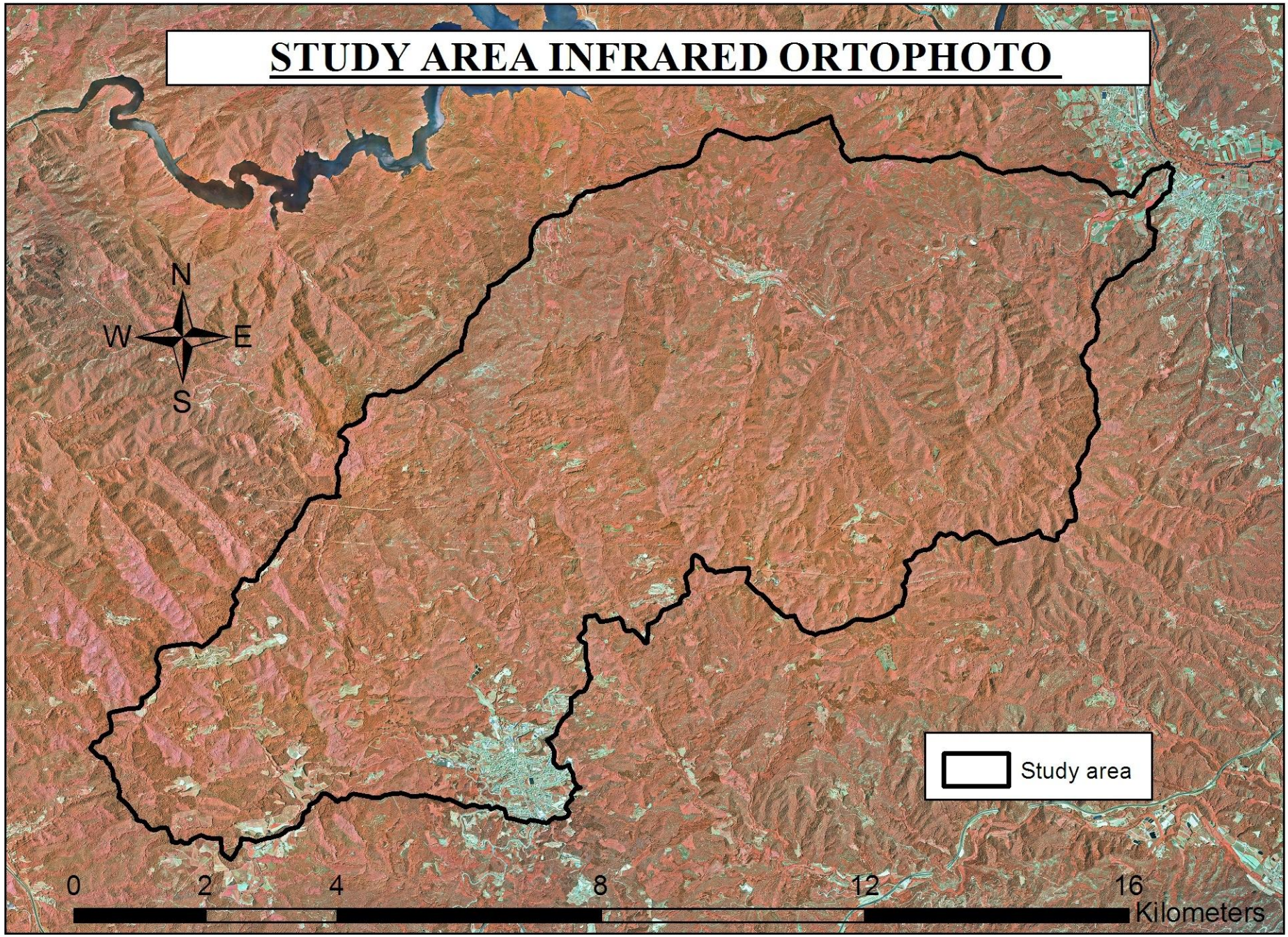
The water bodies are part of the main topic of the present work. As we said in previous chapters, the study area hydrological network contains a large number of brooks, streams, creeks and ponds named as “Gorga/ues” (we can see an example in the side picture, with the named “Gorga d’en Prim” view). We will talk more about the water bodies in the Hydrology chapter of this work

5.5.7. Croops and other plantations

We already spoke a bit about crops and plantation in this same chapter. We can see crops around masos as in the upper picture, where we see the mas Known as “Casota de Matamala” and its crops around. In this case the crop kind is Rapeseed (*Brassica Napus*). On the other hand and leaving aside the forestry plantations, there is another kind of cultivations based in the nurseries as well. The best example of that could be the Christmas trees production. Around the 90 % of the Christmas trees (the most usual specie is *Abies nordmanniana*) distributed to Iberian Peninsula proceed from the area of Montseny-Guilleries, where the study area is located. In the picture we can see a view of Jover’s cultivations, in Sant Hilari village.

Source: http://es.wikiloc.com/wikiloc/imgServer.do?id=93760

Source: https://plus.google.com/101826229365091639731/photos


STUDY AREA INFRARED ORTOPHOTO
N
W
E
S
Study area
0
2
4
8
12
16
Kilometers

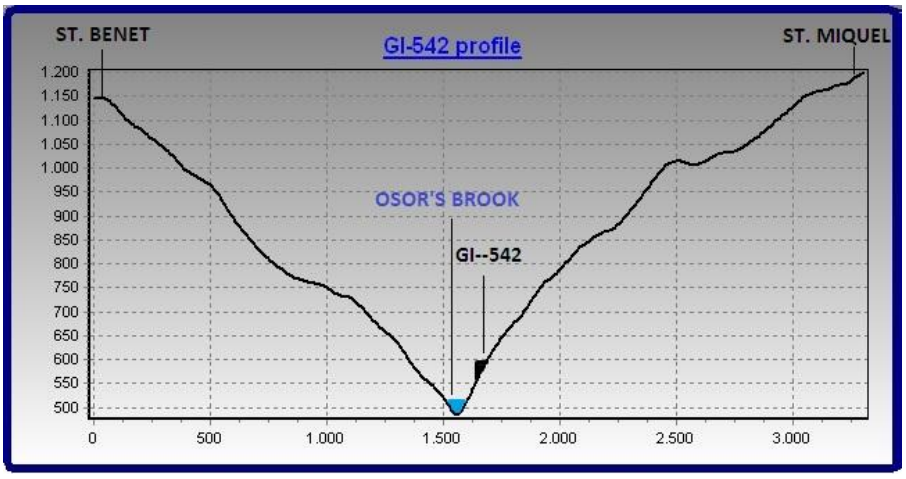
SWOT ANALYSIS

SOIL COVERS	
STRENGTHS	**WEAKNESSES**
- The area is occupied basically by forests - The natural covers in the area are over the 95% of the total surface	- The presence of not so many flat areas difficult the presence of crops - There is a high variability of covers although some of covers does not represent a large surface
OPPORTUNITIES	**THREATS**
- The high amount of forest covers facilitates the fact that if necessary, a little part can be taken out in favor of other surfaces without cause high damage.	- The high amount of wooden surface may difficult future conservation tasks.

5.6.-CONNECTIVITY AND INFRASTRUCTURES

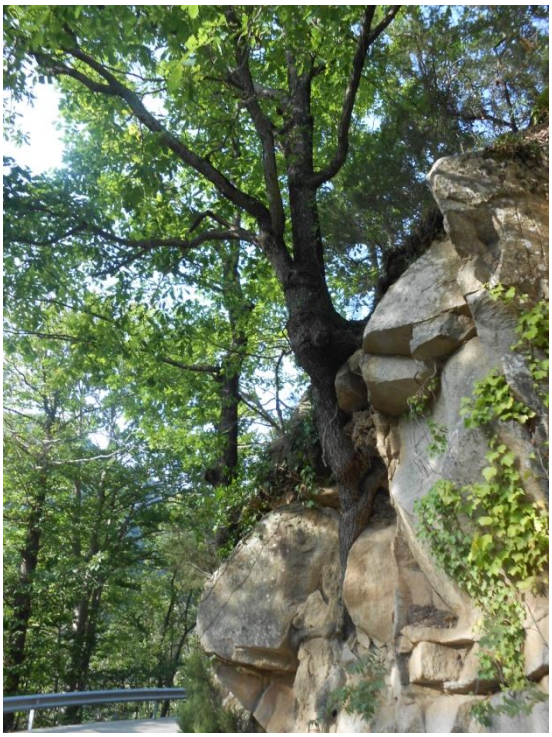
5.6.1.- CONNECTIVITY

On the study area the connectivity becomes, when one speaks about paved roads, a quite simple topic due of the lack of a large amount of them. Basically, there are just two main roads on the area. The first one, known as GI-542, is the one which connects the villages of Sant Hilari Sacalm, Osor and Anglès, crossing the study area following the Osor's brook on its whole course. This is due the cliff originated by the stream allows a better place for its building, especially during the time when was done, several decades ago. However, the terrain is rugged and that hindered a lot the creation of such road, which highlights for its amount of curves and its width (around 6 meters for double way). On the following graph is possible to see the location of the road on its pass between the peaks of Sant Miquel and Sant Benet, one of the most rugged areas during this road route.



For the other hand, is important to highlight the problematic of that road location. On first place, its location within wooded areas increase a lot the level of humidity on the weather, that involves less stability of the cars by wet pavement. This is especially a problem on winter when the low temperatures and the lack of insulation of several areas because of its position in the cliff allows the formation of ice over the pavement and becomes a risk by the inexperienced drivers. For the other hand, theslopes on the borders along the road can become another remarkable problem. First of all because of the solifluction on the upper slopes. These process, common on the wooded areas with high slopes, becomes a minor problem than in other

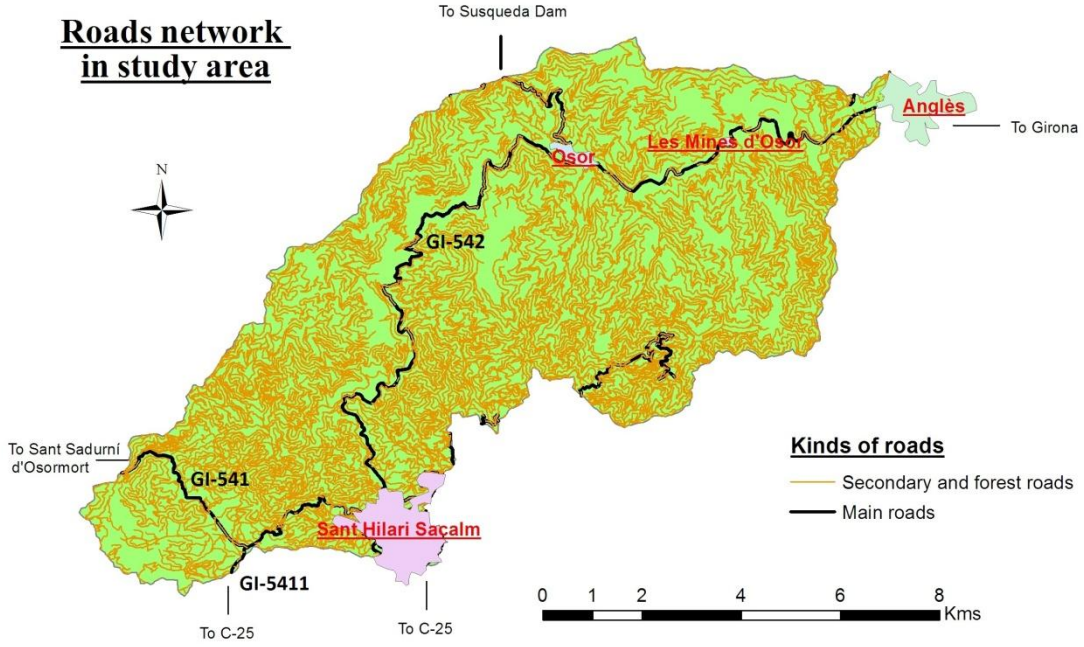
areas due to the minor presence of soils O, A, B and C; which, contrarily at what could seems, reduce the presence of solifluction. That's due the fact that the vegetation, especially the trees, introduces their roods directly inside the bedrock and that decrease the effects of that process. We can see an example of that on the next picture, where is possible to observe an oak (Quercus petraea) growing directly from the rock which belongs to a margin of the road. Although that, this same process which decreases the solifluction effects increases another process; the rock fallings. The area is formed basically by granitic rock, which has a high erosivity by the water. That fact, together with the one explained before where the vegetation introduces them roods directly to the rock cracking it, facilitates the water introduction within the rock cracks making them more unstable. That derives on common rock fallings, especially after important periods of rainfall, which occupies the roads and can produce crashes. Is for that reason that on some places the road shows the presence of man-made foothills, which helps the stability of the slopes. We can see an example of that on the side picture.



For the other hand, there is also the other kind of problem highly related with the above one, the landslides. That happens because of the infiltration of the water within the rock cracks, which make it unstable and can generate large soil detachments. On the side picture is possible to observe a piece of road make it new due to its collapse by landslide. Probably its base was destabilized due of water erosion within the bedrock cracks till the moment that its structure collapsed. That happened during a hard period

of rainfall.

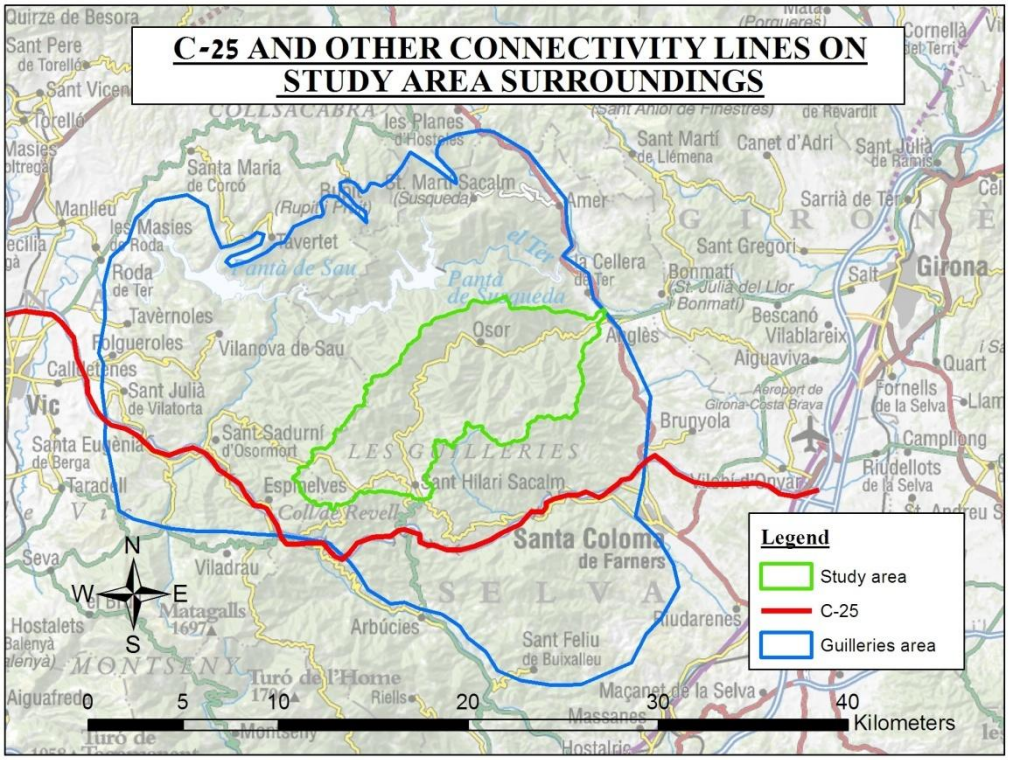
For the other hand, the other road which exists inside the study area is the called GI-541. It is located on the south-western part of the study area and it goes from Sant Hilari Sacalm village till out of study area boundaries, direction Sant Sadurní d'Osormort village. The features of the road are similar than the case of GI-542 but for the fact that this one doesn't move along a cliff. We must highlight that exists a variation of that road on the area of Plà de les Arenes. There exists a branching of this road which moves direction Coll de Ravell and is called then, GI-5411. We can observe them on the following map.



As we can see, in study area there is, besides of the explained roads, a large network of secondary roads which composes the internal connectivity network. These are, usually, non-paved and forest tracks with small width (around 2 and 3 meters), just passable by some kinds of cars. However, exists different kind of them, and is there are also wider tracks on the main internal communication ways. An example of that could be the Sobirà road, on the southern part of the study area and painted with black as we can see on the above map. Usually but, and as we said, the roads have bad conditions for its transitivity and even exists several abandoned roads which have fallen as obsoletes.

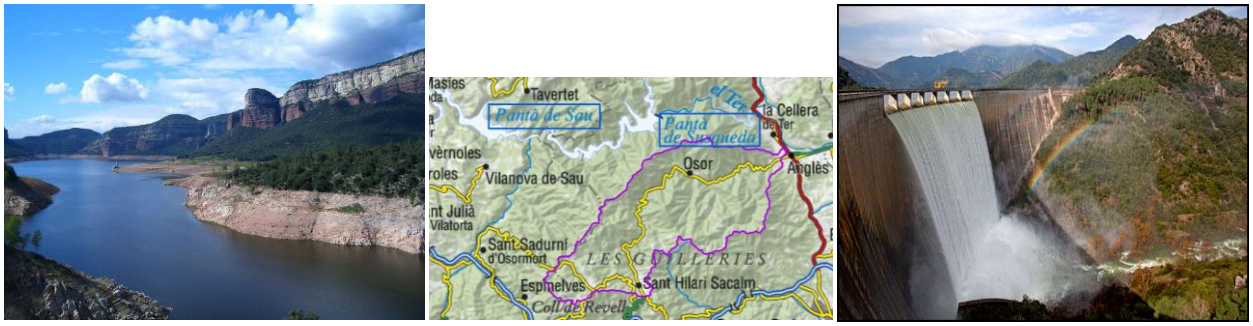
As main communications to reach the study area, is important to highlight the proximity of the highway C-25, which crosses within Guilleries area and becomes the most important access to the area. This road, which was build on 1997 and upgraded on 2011, connects the cities of Girona and Vic, the most important of the area, and allows a good connectivity between these two cities and all the villages along. From the study area, is possible to access there with the road GI-5411 direction Coll de Ravell and with the road GI-550 which is not inside the study area but one can take it from Sant Hilari Sacalm village. As last, there is another

important communication way on the eastern region of the study area, on the village of Anglès. There is possible to go directly to Girona city using the road N-141 or to take the road-C-25 across the road C-63.



5.6.2.- INFRASRUCTURES

About infrastructures elements, there is not so many of them within the study area. If we talk about the Guilleries area, we could highlight the presence of three reservoirs. Sau dam, Susqueda dam and Pasteral Dam become a system of three reservoirs settled on line in the course of Ter River. Sau Dam; with a capacity of 151,3 hm³, and Susqueda Dam,; with a capacity of 233 hm³, become the main ones. Pasteral one is the older but nowadays is not relevant because of its low capacity and energy production.

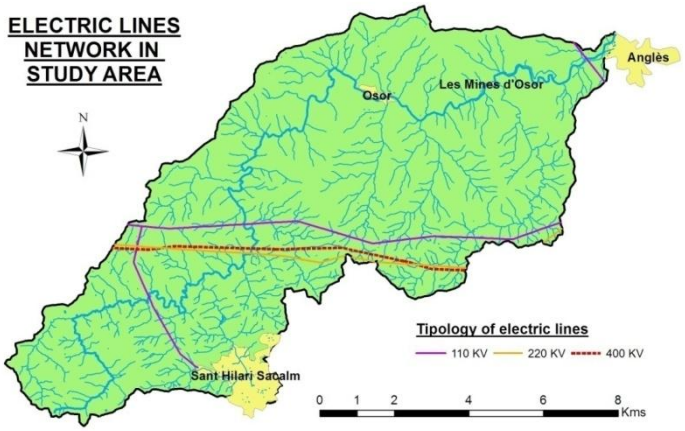


From left to right. Sau Reservoir, Location map and Susqueda Dam.
Source:http://ca.wikipedia.org/wiki/Pant%C3%A0_de_Sau#/media/File:PantaDeSau.jpg (Sau picture) & Toni VilchesFotografia (Susqueda picture)

Regarding energy infrastructure, in particular Guillerías highlights the following reservoirs:

However, as we said these are outside of the study area although so close of it. Within the study area, for the other hand, it is possible to find other kind of small dams and ponds along the Osor's brook course created for take advantage of the water energy, especially in form of watermills, which were settled on the masos nearest to the stream. Nowadays, but, most of them are unused or overthrown.

There is just one kind of infrastructures present on the study area the presence of them which is necessary to highlight: the electric lines. The Guilleries area and the study area does not have a high amount of power lines, as is natural to their importance and natural landscape. However, its geographical situation in the east of the Vic Plain and west of Gironès Plain and the presence of reservoirs its northern area imply the presence of different power lines. We can see them on the following map:



We can observe on the map that there are three different kinds of high voltagepower lines in function of their electrical potency. So on, there are the two lines of 110 KV, one of 220 KV and another one of 400KV.

The 110 KV ones are located, for one side crossing the study area on east-west direction. This has a direct connection with Sant Hilari Sacalm village. For the other side the other one is located on the north-eastern area, settled on NW-SE direction.

On second place the 220KV one follows the same direction than the first 110 KV one, explained above. This causes more impact on the territory because of the deforested area which must have for safety in some places of their route.

On third place an as last, we found the 400 KV power line, which becomes the largest one within the study area by potency and size. This 400 KV power line, is part of the electric highway of the Oriental Pyrenees known as MAT (Abbreviations of “Molt Alta Tensió” which mean So High Tension). The MAT project or high voltage line, aims to join the Iberian Peninsula with the rest of Europe by a 440,000 volts power line that crosses the north-eastern part of Catalunya and the Pyrenees. This project it is about to be completed. On December of 2014 it was finished the last connection located on the border between France and Spain and the line will start its working at some point of 2015. The peculiarity of this line is the amount of shadows and incongruences which surrounded its construction since the beginning of its planning. There have been the feeling from part of the

220 KV power line. On left side is possible to observe one of the MAT towers.

MAT tower.

View of MAT line from SantMiquel de les Formigues peak.

MAT line crossing Osor’s brook on Font Picant place.

population affected by these project that the documentation to get the scientific and technical knowledge necessary to understand this infrastructure, which is one of the most controversial in the history of Catalunya, have been, during several periods of its construction, difficult to access by the public. The several environmental impact studies necessaries for its proper elaboration seems that could presents irregularities and incongruences, as well as the presumed/suspected pressure carried out by the Spanish Government and REE (Spanish Electric Network) to get the necessary conclusions on these environmental impact studies elaboration. Also, it is suspected that the project was supported by a questionable legislation as well as results of from other documents and studies financed by the same parts favorable to its construction.

In the case of Guilleries massif and the study area its setting was unavoidable even with the opposition of almost all the population of the municipalities which composes the massif. This is due the little relevance of the population of the massif, which moves around the 10.000 inhabitants. That's different than what happened on other areas like, for instance, the expressed above one on the border with France. About this place, REE declares:

"The project includes preventive and corrective measures in order to minimize the impact on the natural and social environment of its layout:

1. We opted for the burial of the line and moved away as possible from urban centers and areas of higher population density and natural areas. The line also takes advantage, to the extent possible, the layout of existing ones such as the AP-7 motorway and TGV infrastructure.

2. To reduce the visual and environmental impact, the line passes under roads and through a system of micro tunnels, the same used to cross rivers with the aim of reducing the impact on river flows and water levels.

3. We used existing roads during construction and restored upon completion thereof.

4. In both countries, have created monitoring committees to monitor and verify that all the measures in environmental matters are accomplished.

5. Inelfe (Spanish and French electric network companies) generated direct and indirect jobs in the Roussillon and the Empordà over all development of the works."

Source:(http://www.ree.es/es/actividades/proyectos-singulares/nueva-interconexion-electrica-con-francia, 2014)

From all these features, which should be the common ones on the whole MAT construction, there is just one match in relation with the project within the study area, the fact that is away as from urban centers. Curiously, that generates that the affected area population opposition against its construction became easier to ignore. About the rest, everything is contrary at that premises. The line cross the Guilleries area,

considered as Natural Interest Area by the PEIN legislation (We will talk more about on this protection figure on the chapter Administrative Boundaries & Legislation from this document), when it was possible to use the already existing way generated by the C-25 highway. As well, its burial was discarded. There is not any kind of system to reduce the visual impact. The construction of roads for its construction destroyed areas with dense wooded covers and which need decades for its restoration. The created monitoring committees to monitor and verify that all the measures in environmental matters are accomplished keeps the same line of goals than the parts interested on its construction, so there is not objectivity. And, as last, the Spanish electric network company did not generate direct jobs on the area because of all the workers were foreigners. So, there is a important differences between territories and their environmental impact mitigation measures. That could be due of the media impact differences between a borderland area and an area, as we said, which low population. However, on the project elaboration there could have been several incongruences with the good practices established by EIA & SEA systems and the Aarhus Convention in order to allow the popular participation and be part of decision making process of these large infrastructures projects. There could have been also remarkable breaches of the bases of the program Natura 2000, of several principles of Rio Earth Summit (e.g. principles 1 and 4) and the following summits, of several chapter of the Agenda 21 program and, generally, of all the basic principles of public cooperation and sustainable development.

We have to highlight too that the real reason and necessity of its construction becomes still uncertain. Its promoters keep the point that was something necessary for the good regional electric system performance and for be on the energy network European standard. But is also known that was necessary especially for the guarantee the TGV (high-speed train) line operation. Other theories says that the real reason is the one of allow french energetic surpluses sale to the north of Africa. Irrespective of which are the real reasons, but, it's clear that the economic interests surpassed again the environmental and sustainable ones. From this work we cannot assert on clearly way that the infrastructure have been constructed following fully the legality due to the lack of evidences properly obtained, but it would be interesting the intervention of European organisms to check the process carried out on its building and with the aim to avoid this kind of infrastructures impositions could happen anymore on other places. But that leave us a question: the MAT project was subsidized by EU, so, would that affect the subjectivity of the process or, in other words, would be EU and derivates a fair judges in this case? And in negative case, who could help here the citizens in the hypothetic case that this infrastructure has been build really using illegal forms?

As we said the operation of the line will start this year. But there is not known by the people yet the impact that this infrastructure will cause but the visual one on a forested territory as is the study area. We know that exist possible issues related with the high tensions like the sparks on the air and the lighting (which can be dangerous for humans or fire risk) and others like the Arc flash and the exploision hazard, or the

electromagnetic field which can generates. And for now we don't know the effect over the wildlife and the ecosystems that will generate such infrastructure.

As last, keeping the line of electric network on the study area, it's important to remark the presence of low power lines along the territory. These are settled to guarantee the electric supply to all the villages and masos distributed throughout the area. These don't appear on the above map case have been not possible to find a representation of them in some georeferenced file and would involve a long work time its elaboration. However, is important to say that, generally, this low tension network does not generate a high visual or ecological impact. Anyway, there is a personal experience episode of the author that I would like to share on these lines. On the study area, concretely on the forest roads surrounding the Osor's brook when still is named as Riera de Mas Quintà, I was witness of an uncommon fact. What happened was that I found a specimen of eagle wounded on one side of the way. The animal was in consciousness state and had its own claw nailed on one side of its face (and some minor wounds). When we saw it the animal was trying to liberate itself. The point is that due the features of the situation, which leaded us to think that the animal fells or collided somewhere and somehow, and the fact that some meters away from the animal it was one of the explained low tension lines, is so probable that the element that caused the accident was the same line. So that would mean that even to have a low impact on the territory, the low tension lines can be hazardous elements for the flying wildlife. About the eagle, this was aided by us and once free, escaped from us so the animal probably survived. The animal was a kind of eagle not common on the Guilleries area and I believe that for its characteristics could be a specimen of Golden Eagle (*Aquila chrysaetos*) and here is where remains the rare fact because of this specie, from which there are counted only around 200 specimens in whole territory of Catalunya, is not at all common on this area.

Specimen of Golden Eagle

Source: Francesc Cordova (http://www.pratdipturisme.com/viu-pratdip/que-visitar/serra-de-llaberia/fauna-de-la-serra-de-llaberia)

SWOT ANALYSIS

CONNECTIVITY AND INFRASTRUCTURES	
STRENGTHS	**WEAKNESSES**
- The few amounts of roads make the mobility within the main towns of the area easy. - The vegetation fixation helps the problems of landslide, - The connectivity to outside of the study area is good; especially because of the proximity of C-25 highway. - The proximity of Girona city and its connectivity across road N-141 and the road C-25. - The electric powerlines just affect one part of the area.	- The large amount of non-paved roads difficult the access to several spots. - Gi-542 road has the risk of rock falling, especially during rainfall periods. - The presence of High tension powerlines decreases the natural and visual value of the area. - The minor powerlines has not measures to the birds protection.
OPPORTUNITIES	**THREATS**
- The non paved roads network could generate increase of natural value and interesting tourism attraction due to the features within the nature. - The C-25 highway allows the fast and easy reaching to the place across Gi-5411 and the C-63 roads. - The proximity of the Ter River reservoirs and its surroundings may help on touristic attraction.	- The rock falling could become a real problem accidents in case of vehicles affluence increase - The non-paved roads could be dangerous in case of access without adequate vehicle kind. - The high tension powerline switching on will produce lost of natural, ecological and touristic values across the noise, visual impact and unhealthy area they generate. - The minor lines may cause losses in some important species of birds, especially the bigger ones (daily and nocturne raptors or others).

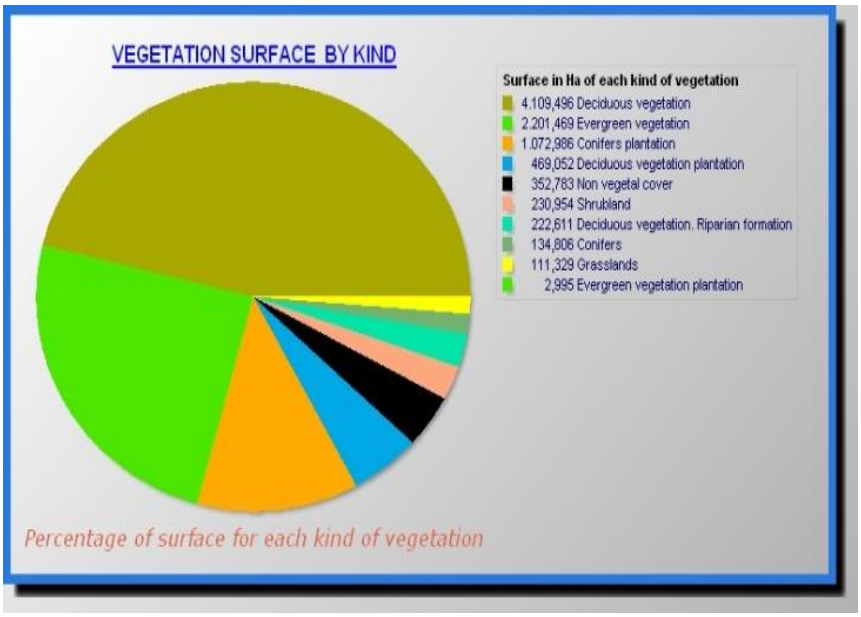
5.7.- VEGETATION

5.7.1.-General description

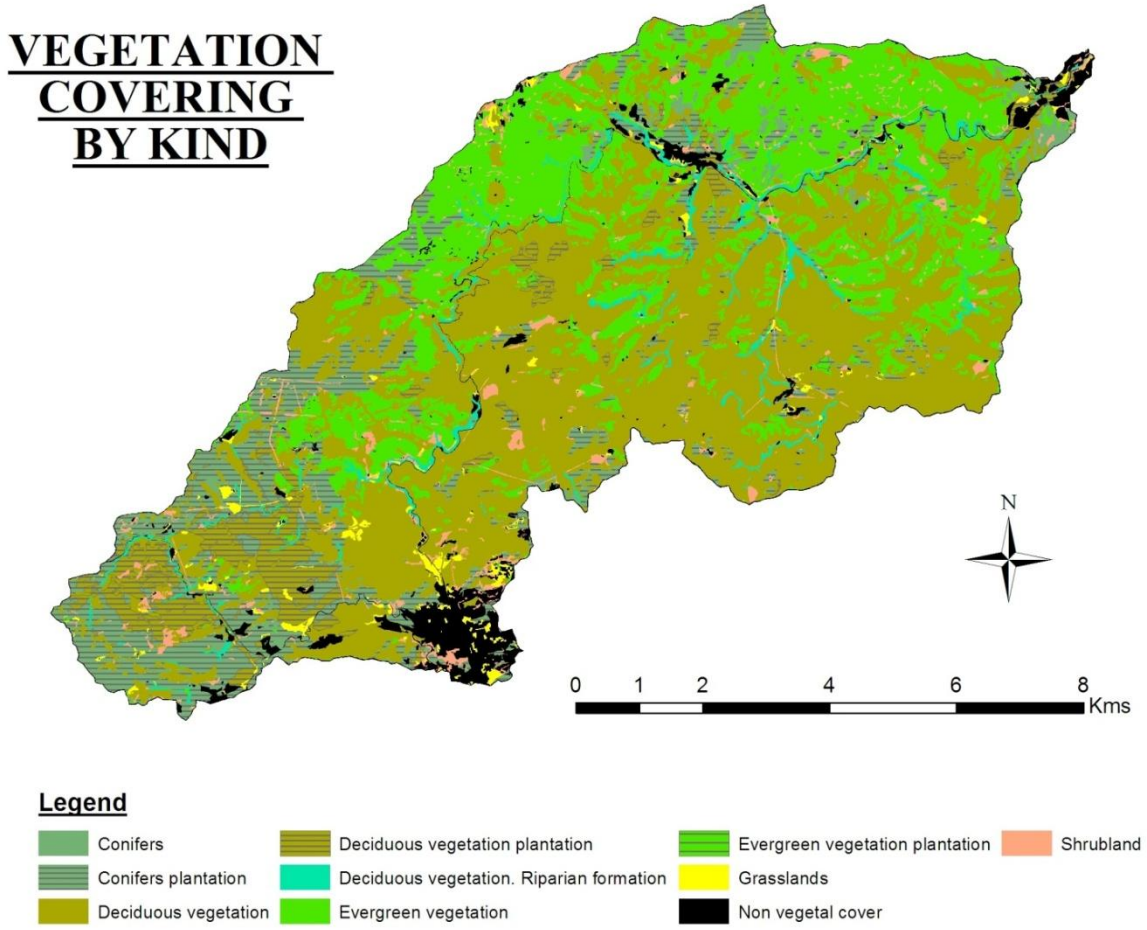
As we said on the Soil Cover chapter, the forest covering on the study area takes over 90% of the study area total surface. This derivate in a highly wooded area. Study area landscape is characterized by a large extension of forest with different spots and patches formed by several kinds of vegetation. Each of them, distributed along the mountains and hills of theterritory, becomes a rich ecosystem that may include hundreds of species. Vegetation is determined by the natural climate of the area, which changes in function of its orientation, elevation and location of the terrain. These also depend of the human action, which affected strongly the territory along the years, as well as thesoil and the geology.

On the territory dominates the Mediterranean and the Middle mountain landscape, with some tones of continental environment in some areas. We can find, from evergreen forests, composed by the Holm Oak (*Quercus Ilex*) and the Cork Oak (*Quercus Suber*) forests, to deciduous forests as the formed by Oaks (*Quercus pubescens & Petraea*), Beeches (*Fagus Sylvatica*) or Chestnut trees (Castanea Sativa). Besides of much more other ones formed by different species of coniferous or riparian vegetation among others.

The deciduous vegetation occupies almost the fifty percent of the territory, with over 4000 ha, followed by the evergreen forests, which occupies almost a quarter of the total surface with more than 2.200 ha. We must also highlight a large presence of coniferous, with over 1000 hectares, as well as shrublands (230 ha) or riparian formations (222 ha). Within all of them there is a high amount of forests planted by the man but we won't deepen more for now because of the presence of a section dedicated fully to this topic. We must highlight, anyway, the peculiarity of the coniferous

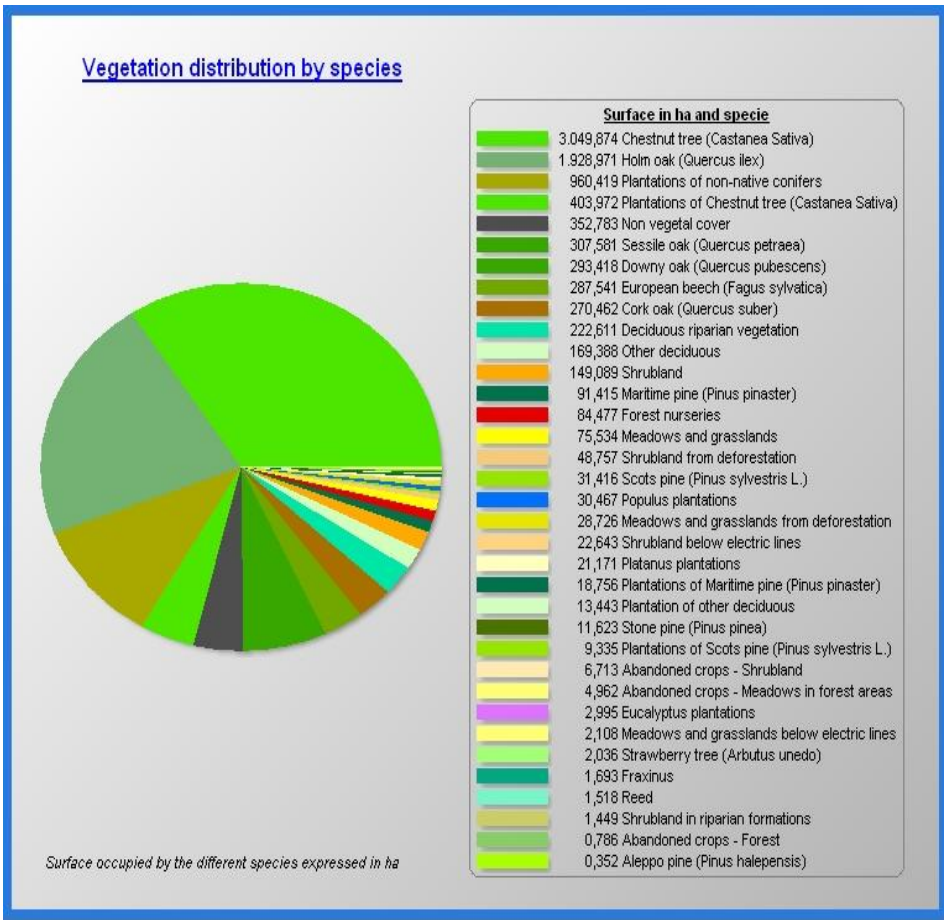


formations, which almost just exists by the man-made plantations (1.072 ha) in front of the natural coniferous forests of the zone (134 ha).



About the distribution we can observe on the above map that exist three areas more or less good defined. On first place the coniferous area is specially located on the highest area of the Upper course, between the northern hillsides and the area known as Plà de les Arenes, especially in form of plantations. Along these last two, is possible as well to observe deciduous plantations. This larger concentration of plantations is due the flatter orography of the zone, which allows better conditions for the planting. For the other side and on second place, it's possible to distinguish other two areas distributed between the end of the upper course, the middle and the low course, where is possible to see a northern patch composed especially by an evergreen sector and a southern one composed by deciduous landscape. On the first case, the evergreen distribution belongs mainly to the parts where the hillsides are oriented, on more or less degree, to the south; what causes a high degree of insolation and, therefore, dryer conditions. For the other side we find the deciduous landscape on almost all the surfaces belonging to the south of the Osor's brook watercourse with the exception of different spots of evergreen vegetation and two spots where the deciduous area is located on the other side of the watercourse. The different geomorphology of the area is probably the causing of that, by the orientation, the elevation andthe disposition on the southern sector. Finally, there is a

distribution of little spots of shrublands along the three courses, but without a concrete disposition. Most probably, these are located on the flatter terrains and on the area close to masos. As last, and as is common, is possible to observe the presence of the riparian vegetation areas on the surroundings of the brooks and streams which composes the hydrologic network.



About the kind of species that formed the vegetation cover we find the chestnut tree as main specie. That tree, occupies over 3.000 ha of surface, almost a third part of the territory. But that just on “natural growing” (this natural growing is, on some way or another, from man-made origin due to the tree, as we said, was introduced centuries ago) because of there is as well 500ha else of surface occupied by plantations of chestnut tree.

The other protagonist of the forest occupation is the Holm oak, with almost 2.000 ha of forest, being almost a quarter of the total surface. On third place we can observe the plantations of non native coniferous, with almost 1.000 of ha. After this, we must highlight, as other remarkable forests, the Sessile and Downy oaks, the European beech, the Cork Oak and the Riparian vegetation (composed particularly by Fraxinus, Populus, Alders (especially *Alnus glutinosa*), Willows (especially *Salix Alba*), Elms (especially *Ulmus minor*) or even surfaces occupied by Reed on the areas of the lowest course). In less degree is possible to find forests of


View of the cliff generated by Osor’s brook where is posible to observe the división between the evergreen area (left) deciuous area (right)

several kinds of coniferous (Maritime Pine, Scots Pine, Stone Pine, Spruces, Aleppo Pine or cedars by importance degree) and other species like the Platanus and the Eucalyptus (which its presence is, jointly with some of the coniferous species, due the plantations, so by forestry.) or the Strawberry tree, which, although does not create pure forests composed exclusively by specimens of that specie, is quite common on the area.

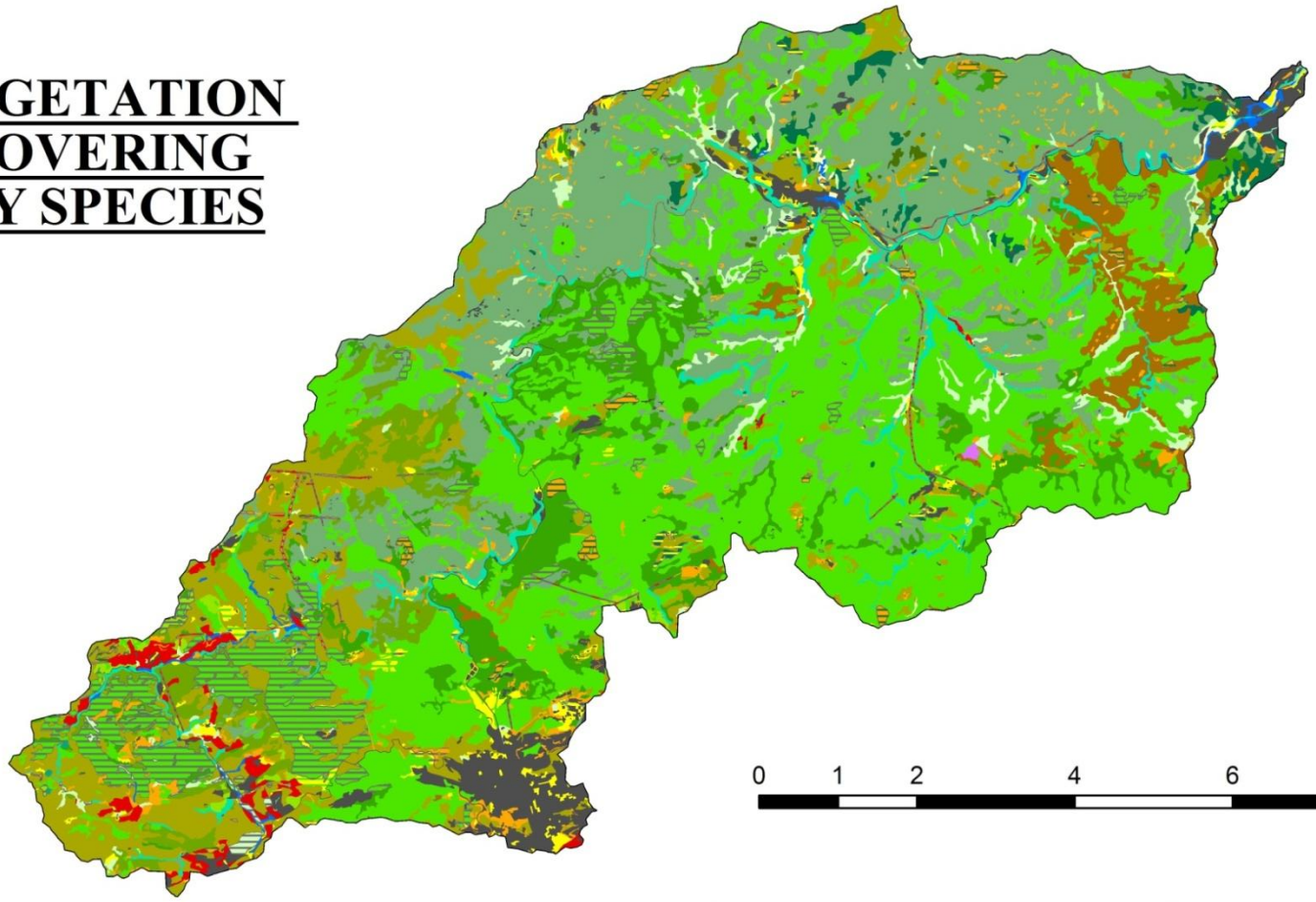
Zone occupied by Reed on the Osor's brook mouth

There are, as well, curious cases of introduced species which highlights for its exotic character. The most remarkable of these cases, and as anecdote, is the presence of a little group (around 30 individuals) of sequoias on the Plà de les Arenes area, concretely, on the forest located ahead of the mas known as Casota de Matamala. The trees have several sizes and age (from 30-40 meters to young ones) what drives us to

Specimens of Sequoia in Plà de les Arenes Area
Source: Jaume Carreras

think that the plant is adapting well and reproducing itself properly. It should be studied if this invasive species may suppose a problem by uncontrolled extending. This particular formation is surely coming from human origin because of the presence of sequoia on the study area cannot be natural (so originated by wind transport of seeds from other specimens), even taking in account the fact that there is not the first case of sequoias inside Guilleries massif. There is a mas inside Guilleries but out of the study area known as Mas Joan, popular for being a hotspot of the cultivation of different and strange species (it is possible to see within their terrains the tallest Spruce of Catalunya, e.g) which has two different species of sequoia.

VEGETATION COVERING BY SPECIES



Legend

- Abandoned crops - Forest
- Abandoned crops - Meadows in forest areas
- Abandoned crops - Shrubland
- Aleppo pine (Pinus halepensis)
- Chestnut tree (Castanea Sativa)
- Cork oak (Quercus suber)
- Deciduous riparian vegetation
- Downy oak (Quercus pubescens)
- Eucalyptus plantations
- European beech (Fagus sylvatica)
- Forest nurseries
- Fraxinus
- Holm oak (Quercus ilex)
- Maritime pine (Pinus pinaster)
- Meadows and grasslands
- Meadows and grasslands below electric lines
- Meadows and grasslands from deforestation
- Non vegetal cover
- Other deciduous
- Plantation of other deciduous
- Plantations of Chestnut tree (Castanea Sativa)
- Plantations of Maritime pine (Pinus pinaster)
- Plantations of Scots pine (Pinus sylvestris L.)
- Plantations of non-native conifers
- Platanus plantations
- Populus plantations
- Reed
- Scots pine (Pinus sylvestris L.)
- Sessile oak (Quercus petraea)
- Shrubland
- Shrubland below electric lines
- Shrubland from deforestation
- Shrubland in riparian formations
- Stone pine (Pinus pinea)
- Strawberry tree (Arbutus unedo)

These are the Giant Sequoia (*Sequoiadendron giganteum*) and the Coast Redwood (*Sequoia Sempervirens*). So, one could deduct that the wind could bring the seeds of the specimens of that place to one we are talking inside the study area, but it is known that the sequoia seed usually don't move more than 60-120 meters (in case of Coast Redwood) or 180 meters (in case of the Giant Sequoia) around the origin tree, and the two points are separated by over 5 Km so is not possible that transport. There is also another sequoia specimen closer to the mentioned place, almost in the border of the study area. It is called Sequoia de Tortadès for be near the mas named Tortadès and is considered a monumental tree. However, the distance to the study area group of sequoias is 500 meters, so to far as well unless it was the presence of other specimens hidden on the forests between these two points.

Back to the main line of the chapter, the distribution of the species, as we explained before, is distributed following different features of the terrain. So, for example, is possible to find the Maritime Pine (*PinusHalepensis*) just on the areas which are most affected by the Mediterranean climate like the main brook mouth area, or the Osor's valley area. The Cork oak (*Quercus Suber*), for the other side, also follows this search of the Mediterranean climate and is possible to find it occupying a large part of the Low course, especially on the surroundings of the tributary known as Riera de la Molina. The altitude is also another relevant element and is the one which causes the high concentrationof coniferous plantations and European Beech (*Fagus Sylvatica*) forests on the Upper course and the north-western areas of the middle course. About the two largest areas named before, the evergreen one, so the one on the south oriented hillsides, is especially composed by the Holm Oak (*Quercus Ilex*), which becomes the climax stage of vegetation on the majority of the study area as is common on the Mediterranean environments. The deciduous one, for the other hand, on the wettest areas, is composed mainly by the chestnut tree (*Castanea Sativa*). However and as is normal, but, there is not nowhere a homogeny distribution of species, just domains, and the variety of species and forests give to the area a high degree of natural and ecological richness

Besides of all of that, there is on the study area several trees considered as monumental by the Catalan Government for its features. Usually they are old trees, which for its size or age highlight within the rest. It's presence is something difficult to find on the study area for the large forestry tradition which causes that often these trees are cut off due the value of their wood. Officially, there are recognized as monumental trees the Soler's Pine, the Soler's Cherry tree, the Coma's Holm Oak, the Ca n'Iglesias Pine and the Ca n'Iglesias Oak. So, they are five in total inside the study area. However, it is necessary to add that exist other trees which could be considered as monumental as well but, for some reasons, they don't receive the tract of monumental for now; for instance some centenary chestnuts or cedars.

From left to right: Soler's Pine, Coma's Holm Oak, Centenary Chestnut on Sobirà's surroundings and Himalayan cedar(*Cedrus deodara*) near the place known as Font del Gavatx.

After all the forest cover is important also to speak a bit about the other layers which composes the vegetation system of the study area. We can remark especially the Shrublayer, the Herbaceus layer and the Cryptogamic or moss layer.

5.7.1.1. Shrublayer

The shrublayer is an important system which occupies, commonly simultaneously with the arboreal layer, the study area soils. On the surroundings of the riverside, especially, becomes an important element by the easy water access because of the proximity of the water table. The most important of them, which generates the largest and densest shapes is the Elmleaf blackberry (*Rubus ulmifolius*), which can creates real walls that avoids the pass for humans and even, but less commonly, for the wildlife. There is also the European box (*Buxus sempervirens*), which sometimes becomes a remarkable minor forests.

Blossoming Weaver's broom
Source:
https://pepquimic.wordpress.com/2012/06/07/avui-corpus-recordem-el-corpus-mes-quimic-a-blanes/

However, all of them depend of the sunlight accessibility, which they can find especially on the non wooded area created by the stream course. It is also possible to find other species like Ferns, the Grey willow (*Salix atrocinerea*) or Weaver's broom (*Spartium junceum*). All of them are also found on areas far to the brook, especially in the case of the Weaver's broom, which need a high amount of sunlight. We must highlight as

well the presence of the mentioned previously Strawberry Tree which, although being called as tree due of can be considered as small tree as well, is considered usually inside the shrub group.

5.7.1.2. Herbaceous plants

There are diverse species of shrubs and plants which have the capacity to grow up directly from the rock. On the picture, view of Gi-542 margins with presence of several plants and shrubs adhered.

The Guilleries and the study area contain a high amount of herbaceous plants species. There are known over a hundred of species and that number could arrive perfectly to the two hundred or more. One of the most remarkable and related with the group explained before are the nettles. The nettles, belonging to the genus Urtica, grow along all the territory. On the areas like the stream shores, the high concentration of water and light can generate large extensions of these plants. Other plants we should do mention could be the Sage (*Salvia officinalis*), the St John's wort (*Hypericum perforatum*), Phoenicean Juniper (*Juniperus phoenicea*) between much more others. There are also "Asteraceaes (*Santolina chamaecyparissus* and *Matricaria recutita*) Lamiaceaes (*Thymus vulgaris, Rosmarinus officinalis, Mentha pulegium* and *Prunella vulgaris*) or Apiaceaes (*Foeniculum vulgare Mill*.)" **(Bonet, Parada, Selga, Vallès, 1999)**.

This high presence of different varieties and species of plants is, mainly, the responsible of the historically high presence of witchcraft about which have been related the territory historically. The knowledge of the properties of many of these plants is something that prevailed till our days on the popular knowledge. A curious case would come with the elaboration of the most typical liquor of the area which is known as "ratafia". "Ratafia very often contains nut (*Juglans regia L*.) pericarp, together with many spices (like *Laurus nobilis* L. and *Syzigium aromaticum* (L.) Merr. et Perry) and other aromatic (like *T. vulgaris* and *R. officinalis*) and medicinal (like *Scabiosa atropurpurea* and *Asperula cynanchica*) plants" **(Bonet, Parada, Selga, Vallès, 1999**). Some of ratifies can contain over fifty species of plants, shrubs and trees and there is the belief that was used on ancient times as medicinal beverage.

The elaboration of liquor known as ratafia contains parts a large number of plants, shrubs and trees.
Source:http://bosquerol.blogspot.cz/2011/06/ratafia-des-de-1925.html & http://cuinacatalana.net/ratafia/ratafia.html

5.7.1.3. Cryptogamic or moss layer

It is composed by lichens and mosses, with a few millimeters in height. Although that, on the study area these species become one of the richest stages, especially on the areas with a high humid climate. These plants grow almost on any kind of surface (soils, rocks, trunks). About the lichens we can say that are largely extended and are the responsible often of different diseases that vegetation suffers. For the other side, the mosses are a special element of the area, so much so, that these plants are protected by law and it's forbidden its recollection.

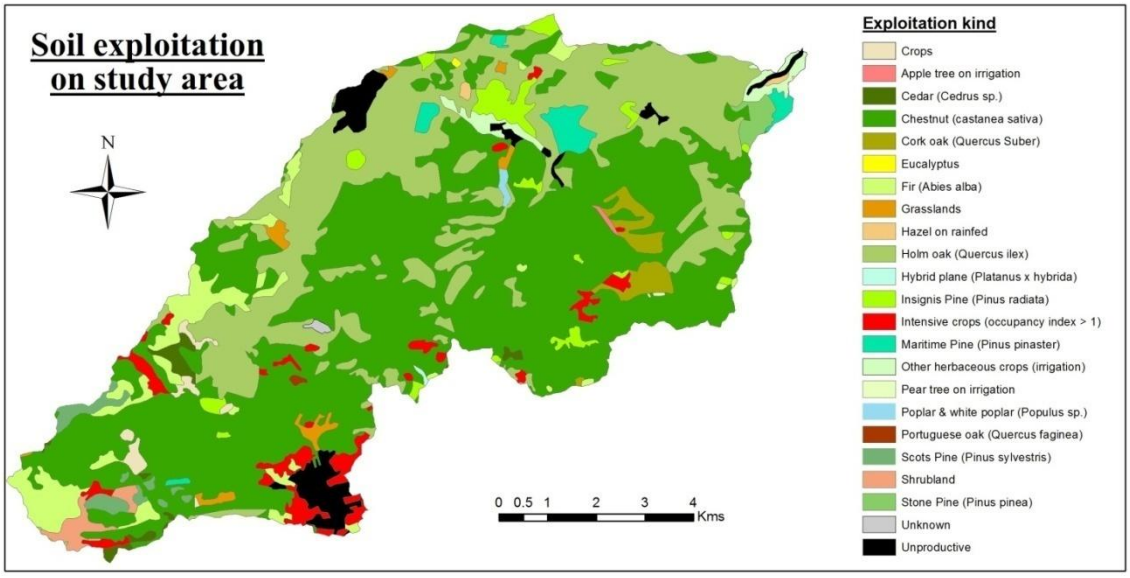
Moss on the emerging bedrock caused by the water of Osor's brook.

We should include on this section a brief comment about other element related with the forests and which is an important and typical live form of the area, the mushrooms. There is a large presence of many species of mushrooms which occupies Guilleries and study area forests, shrublands and grasslands. The exact number of species is not concrete but it is known that there are hundreds. As well as other areas on the world, there is a high presence of mushrooms which derives on an extended fondness integrated on the folklore. Depending on the area is possible to find 80Kg per Hectare and season, what indicates a the high presence of these fungi. The most suitable seasons for its collection are the spring and the autumn.

As we said, the Mushrooms collection becomes a common activity for the study area population. On the picture we can see a collection of *Cantharellus cibarius*.

5.7.2.- THE EXPLOITATIONS

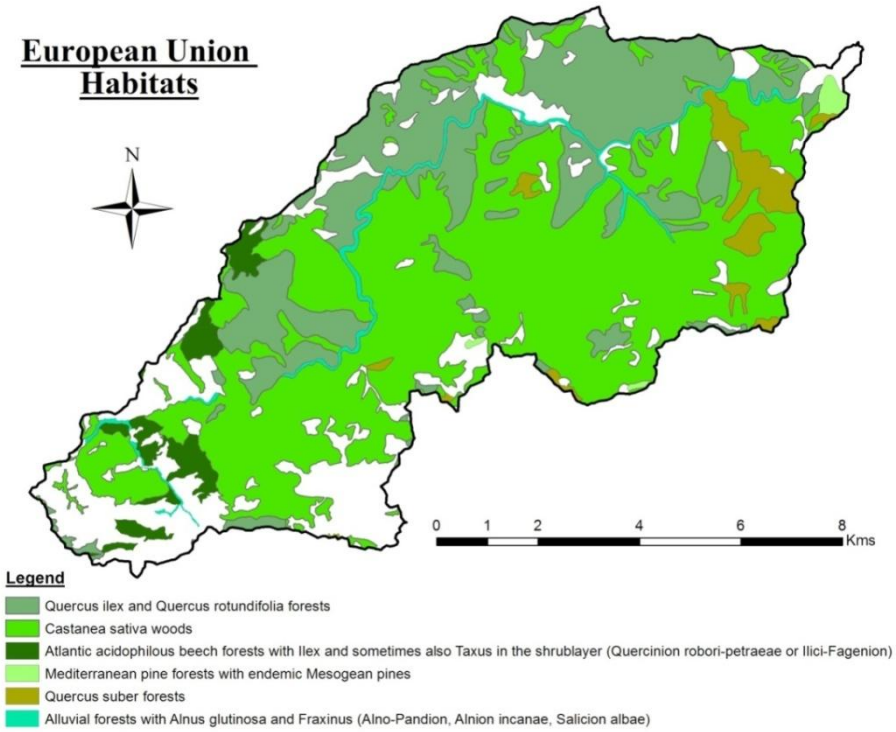
We explained before that there is a high amount of forests which have been created by the man hand. The silviculture represents a common business on the area even after the abandonment of the forest works that the area lived during the past century. The fact that almost all the study area surface is based on the private property generates that almost all the forest cover becomes suitable to be exploited by forestry aim. Maybe the specie which is less affected by that is the Holm Oak, which need a long time to get proper size and is not competitive nowadays despite the high quality of its wood. On the opposite side, we find the chestnut, which suppose insigne tree refereed with the forestry in Guilleries. That's due the several forms which can take its exploitation. From the forests where the tree is left to grow during over 20 years for the production of wood, to the ones which produces results in 5-6 years or even less. All within the coppice system, that allows serial cuts without the need to replant again the trees.



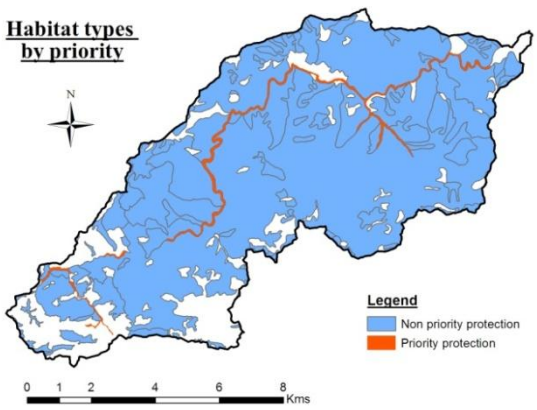
There are also other plantations which become important like the Eucaliptus, the platanus and the coniferous. As we said before, the main part of the coniferous growing in study area belong to plantations. We mentioned already the different pines we can find on the area but we should include, talking about forestry, some other species like the Insignis Pine (*Pinus Radiata*) or the Cedars (*Cedrus sp*.). We find also other kinds of oaks like the Portuguese Oak (*Quercus faginea*). There are as well plantations for the fruit exploitation, group where we could include the chestnut tree, and that is composed by some species like the Apple tree, the Pear tree or the Hazels. Finally, as we commented onprevious chapters, we must highlight the presence of several nurseries on the area, which cultivates a large amount of species and where highlight the production of the fir, much especially, the production of Caucasian Fir (*Abies nordmanniana)*. It should mentioned as well the fact that the there is a lack of proper keeping of some of the exploitations and that derived on dirty state of the understory or the presence of several diseases which affects the trees.

5.7.3.-HABITATS

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. All in all the directive protects over 1.000 animals and plant species and over 200 so called "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance.There are currently 198 defined habitats of Community interest in the European Union, related to Annex I of Directive 97/62 / EC. They can be priorities habitats or non priority habitats. The priority habitats (61 of the total 198) are the habitats, which its preservation is a special responsibility to the EU. In Catalonia have been identified 94 habitats of Community interest, of which 22 are priority. In the study area is possible to find till 6 habitats declared of interest by the EU which occupies around the three quarters of the total surface. We can see that on the following map.



Besides of that, from these six there is one which is considered as priority protection which increases the importance of the territory on the ecological conservation line. This habitat is thealluvial forests with Alnus glutinosa and Fraxinus excelsior, located on the main course of the Osor's brook and in some of their tributaries. In the following lines we can see the description of each one of the habitats of interest that composes the study area.



5.7.3.1. Study area habitats of interest

9340 Quercus ilex and Quercus rotundifolia forests

PAL.CLASS.: 45.3

1) Forests dominated by Quercus ilex or Q. rotundifolia, often, but not necessarily, calcicolous.

2) Plants: Quercus ilex, Q. rotundifolia.

9260 Castanea sativa woods

PAL.CLASS.: 41.9

1) Supra-Mediterranean and sub-Mediterranean Castanea sativa-dominated forests and old establishedplantations with semi-natural undergrowth.

2) Plants: Castanea sativa

9120 Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (Quercinion robori-petraeae or Ilici-Fagenion)

PAL.CLASS.: 41.12

1) Beech forests with Ilex, growing on acid soils, of the plain to montane levels under humid Atlanticclimate. The acid substrate corresponds to alterations of acid rocks or to silt with flints more or lessdegraded or, to old alluvial deposits. The soils are of acid brown type, leaching or with an evolutiontowards podsol type. The humus is of moder to dysmoder type.

2) Plants: Ilex aquifolium, Taxus baccata, Ruscus aculeatus, Deschampsia flexuosa, Hieracium sabaudum,H. umbellatum, Pteridium aquilinum, Vaccinium myrtillus, Lonicera periclymenum, Melampyrumpratense, Teucrium scorodonia, Holcus mollis.

9540 Mediterranean pine forests with endemic Mesogean pines

PAL.CLASS.: 42.8

1) Mediterranean and thermo-Atlantic woods of thermophilous pines, mostly appearing as substitutionor paraclimactic stages of forests of the Quercetalia ilicis or Ceratonio-Rhamnetalia. Longestablishedplantations of these pines, within their natural area of occurrence, and with anundergrowth basically similar to that of paraclimactic formations, are included.

2) Plants: Pinus pinaster ssp. atlantica, Pinus pinaster ssp. pinaster (=Pinus mesogeensis), Pinus pinea,

Pinus halepensis, Pinus brutia, Pinus mugo, Pinus leucodermis.

9330 Quercus suber forests

PAL.CLASS.: 45.2

1) West-Mediterranean silicicolous forests dominated by Quercus suber, usually more thermophile andhygrophile than 45.3.

2) Plants: Quercus suber.

91E0 * Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae)

PAL.CLASS.: 44.3, 44.2 and 44.13

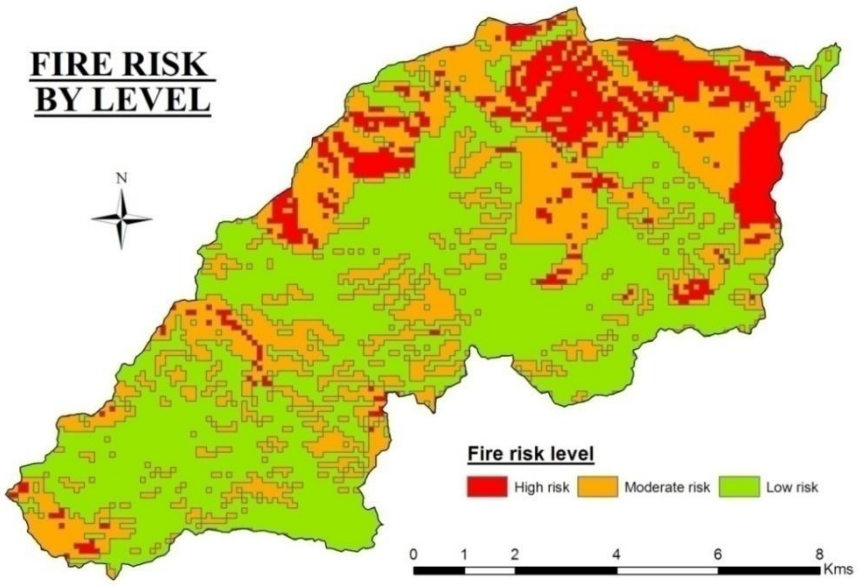
1) Riparian forests of Fraxinus excelsior and Alnus glutinosa, of temperate and Boreal Europe lowlandand hill watercourses (44.3: Alno-Padion); riparian woods of Alnus incanae of montane andsub-montane rivers of the Alps and the northern Apennines (44.2: Alnion incanae); arborescentgalleries of tall Salix alba, S. fragilis and Populus nigra, along medio-European lowland, hill orsub-montane rivers (44.13: Salicion albae). All types occur on heavy soils (generally rich in alluvialdeposits) periodically inundated by the annual rise of the river (or brook) level, but otherwisewell-drained and aerated during low-water. The herbaceous layer invariably includes many largespecies (Filipendula ulmaria, Angelica sylvestris, Cardamine spp., Rumex sanguineus, Carex spp.,Cirsium oleraceum) and various vernal geophytes can occur, such as Ranunculus ficaria, Anemonenemorosa, A. ranunculoides, Corydalis solida.

2) Plants: Tree layer - Alnus glutinosa, Alnus incanae, Fraxinus excelsior; Populus nigra, Salix alba, S.fragilis; Betula pubescens, Ulmus glabra; Herb layer - Angelica sylvestris, Cardamine amara, C.pratensis, Carex acutiformis, C. pendula, C. remota, C. strigosa, C. sylvatica, Cirsium oleraceum,Equisetum telmateia, Equisetum spp., Filipendula ulmaria, Geranium sylvaticum, Geum rivale,Lycopus europaeus, Lysimachia nemorum, Rumex sanguineus, Stellaria nemorum, Urtica dioica. (**Source:** European Comission/Environment)

5.7.4.- FIRES

Like on the rest of the Mediterranean areas, the fire risk becomes a real problem for the landscape, the ecosystems and the humans. The summer drought common on the areas under the Mediterranean climate is the main reason of this increase of fire risk compared with other regions of the world. This drought causes less accumulation of water inside the plants and the increase of dry biomass easier to become the origin point or combustible for the fires. During the driest summers, the risk is largely increased and the probability of fire is increasing together with the difficultness to fight against that fire.

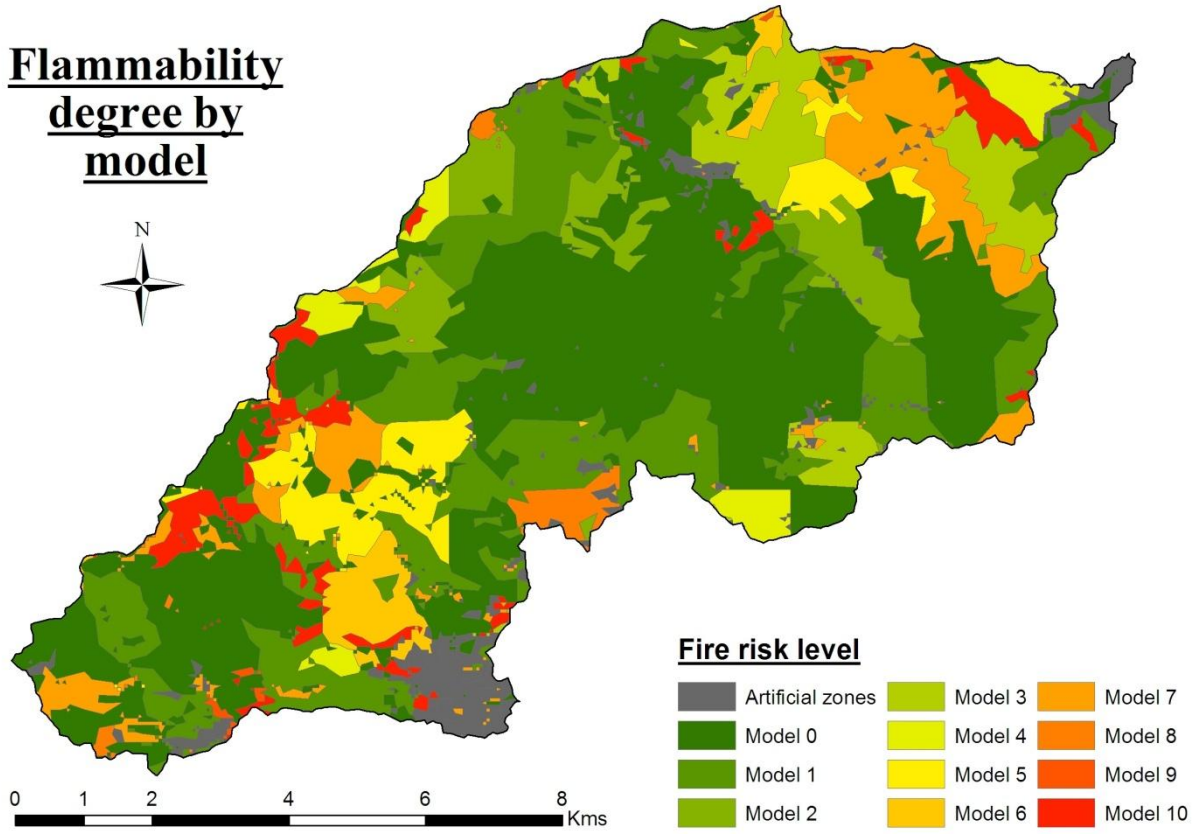
In the study area the minor level of presence of Mediterranean weather favors a less degree of fire risk due to the higher concentrations of humidity on the ecosystems. The mountainous relief as well, generates shadow areas where the insolation does not affect as much as other places. The vegetation cover also helps on that way although that at the same time becomes as a huge extension of combustible for the possible fires. The forest works abandonment generates a dirtier understoreys as we explained above, which can be problem in case of fire for the increase of biomass residual from the death plants that is dry and easy to take flame. On the below map is possible to observe the fire risk on the study area. Related with what we said on the beginning of this section, we can see that the areas with highest risk are the ones which receive more Mediterranean influence or the located on hillsides oriented to the south, where the insolation is higher.



To elaborate such kinds of risk maps, it is necessary to take in account several features of the landscape and the weather. In relation with the vegetation, the feature used is called specific flammability.

“The specific flammability is a measure of the ease with which a given species can emit a flame in front of a constant focus calorie. The flammability of a species depends on specific factors, such as its ability to maintain a certain degree of humidity, the amount and nature of flammable volatile substances that is containing and its surface-to-volume ratio, but also depends on external conditions such as climate, current and wealth weather variables, soil type, etc. A final factor to note is seasonality in the degree of flammability and presenting some species that often is related to its phenology” (**Source:** CREAF)

On the following map we can observe the degree of flammability of the study area surfaces where we will see that there are not exact matches with the above first one map but yes quite many similarities. That could be due a difference of periods. It’s important to understand that the fire risk and the flammability change in function of the season and the year and that one map from one year can be different than other of the same area but from other period. With the aim to facilitate the work of fire risk maps generation exists a system based on different models which determines a higher or less degree of flammable species on the terrains.



To generate the models that we can observe on the map, “it was determined the total capacity cover fraction (CCF) and the one of very flammable species for thetree, shrub and-herbaceouslayers.“

Model 0	CCF from 0 to 9 % of very flammable species
Model 1	CCF from 10 to 19 % of very flammable species
Model 2	CCF from 20 to 29 % of very flammable species
Model 3	CCF from 30 to 39 % of very flammable species
Model 4	CCF from 40 to 49 % of very flammable species
Model 5	CCF from 50 to 59 % of very flammable species
Model 6	CCF from 60 to 69 % of very flammable species
Model 7	CCF from 70 to 79 % of very flammable species
Model 8	CCF from 80 to 89 % of very flammable species
Model 9	CCF from 90 to 99 % of very flammable species
Model 10	CCF over 100% of very flammable species

Source: http://www.creaf.uab.cat/mmci/lleg_minflam.htm - Models de Combustible i Models d'Inflamabilitat

SWOT ANALYSIS

VEGETATION	
STRENGTHS	**WEAKNESSES**
- The large extension of vegetation increases the natural value of the area - The several kinds of vegetation generates several ecosystems - The fire risk is not very high within the area - There are several community interest habitats within the area including a high protection one. - Presence of herbaceous plants and bushes growing on the road margin helps to its fixation. - The large amount of species of mushrooms that	- The coppice is in some cases dense and dirty what makes lose visual value of the forest - The presence of some kind of introduced and non-autochthonous species of tree. - The large amount of plantations which derives in large non permanent wooded areas. - The coniferous plantations surface increases the amount of areas with higher fire risk. - The diseases which affect some species of tree.

produces the area between spring and autumn. - The forestry kind doesn't affect hardly the vegetation cover	
OPPORTUNITIES	**THREATS**
- The presence of large extension of vegetation cover, as well as interest habitats can contribute to the protection legacy increase in the area. - The adequate management of the coppice could generate clearer forests getting at the same time biomass production and workplaces. - The presence of several monumental trees and rare species could become a touristic attraction. - The mushrooms collection could be an attraction to the foreigners and visitors.	- The presence of high tension powerlines may increase the fire and erosion risk. - The natural expansion of introduced species extension - Soil quality lost by the introduced species which get faster soil impoverishment. - The increase of fir production could because of a decrease of natural value. - Extension of the current diseases.

5.8.-HYDROLOGY & HYDROPEDOLOGY

5.8.1.- INTRODUCTION

The Study area hydrological system is a complex network of brooks, streams and creeks. The geomorphology of the landscape is composed by several forms within the mountains. Each of this shapes have been created mainly by the water action. One can say that all the little ravines and gullies that is possible to see on the hillsides of the mountain and between them has a watercourse running within. These courses have crystalline and well-oxygenated waters and generate an environment which has a particular interest to the formation of small ecosystems with a wealth and variety. And not just that, the study area heart is a large system of cracks and materials which create a rich groundwater system. In this chapter will be explained all the elements which composes the network and its features. In first place, it will be a short description of the main elements that composes the system.

5.8.1.1.- Physical elements to consider in the superficial hydrographic environment

5.8.1.1.1.- The streams

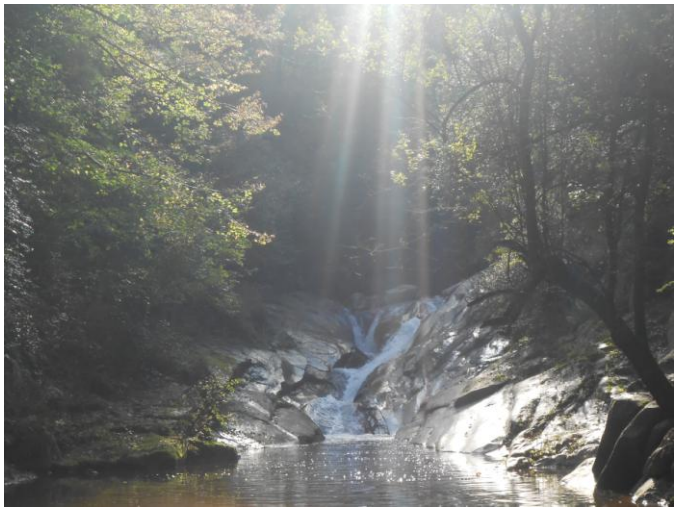
The network of rivers and streams flowing through the basins of cold water are, as we said, well oxygenated and weak mineralized, with a reduced, but strong flow. The primary production is low because this strong flow and of the dense canopy of the trees which forms the riparian vegetation along, which does not let light into the water and so, to allow the photosynthesis to aquatic plants. But there are ads of organic matter in form of leaves and twigs or other elements coming from the wildlife or the water

Osor's brook and its surroundings becomes a rich ecosystem. On the small picture is posible to appreciate a detail of the brook bottom with rest of organic matter, aquatic plants and a Young trouth.

transport. The life community of the stream is richas well, and it's composed by some aquatic plants, lichens and mosses which cling to the stable surfaces to hold the water current. The wildlife, for the other side, is composed by several kinds. There are crushing small invertebrates, which are characteristic indicator organisms or clean water, as well as some kind of larva, pupa or water insects, on one hand. On the other is possible to find crustaceous, amphibious and fishes. And that's not all, because of there are a large amount of faun species related with that ecosystem although they are not fully residents in, like reptiles, birds and mammals

5.8.1.1.2.- The "Gorgues"

Gorga (or Gorgues in plural) is the name which receives a kind of small ponds which are formed along the stream course due to the oscillations of the ground. The formation of Gorges occurs in a hole or plane space produced by the erosion of the water somewhere, especially after waterfalls (small cascades), which gives an area where water can naturally stagnate. It must be said that although we talk about the concept of pond it becomes just a slowing of the watercourse flow. The water flows naturally, so always there is a runoff point from where the water continues its course. Even during drought period, where can looks as there is not discharge from the gorga, there is some kind of other discharge. Sometimes this is due to the presence of a second brook layer, located underground within a kind of sandstone accumulation, and which keeps flowing even when there is not apparent flow on the surface. The hydrological features of these little ponds are even better for the biodiversity presence, because of their slower flow and extension. However, it is also true that is often difficult to access them cause the high erosion which suffer their surroundings.



Gorga named "Gorga dels ànecs", on Osor's Brook maincourse

5.8.1.1.3.- The marshes

The marshes in study area are points located in the flat lands, which are often located in the previously mentioned calms, which its soil bottom composition hinder the drainage to underground due to the presence of low permeability materials. These sites may be located on very humid areas, affected for

seasonally rainfall and which creates temporary flooded soils or permanently water-soaked soil. It is important to say that nowadays the presence of these elements is almost null cause of the human action. In ancient times it is known about the formation of large extension marshes in the calms and other plane surfaces, which because of the proximity of the water table or the low permeability base generated extended marshes. The human necessity to get terrains for the agriculture or the livestock farming causes the drainage and the drying of these surfaces across the plantation of several species of plants highly consumers of water. The place where is located the Sant Hilari municipality is an example of that. Presently we just can find some small spots, especially close to the streams, where this kind of formations are developed.

Some gorgues becomes a marshes when are covered by high amount of sediments. On the picture, place named "Bassa dels Vivers", on Plà de les Arenes sub-basin.

5.8.1.1.4.- The network

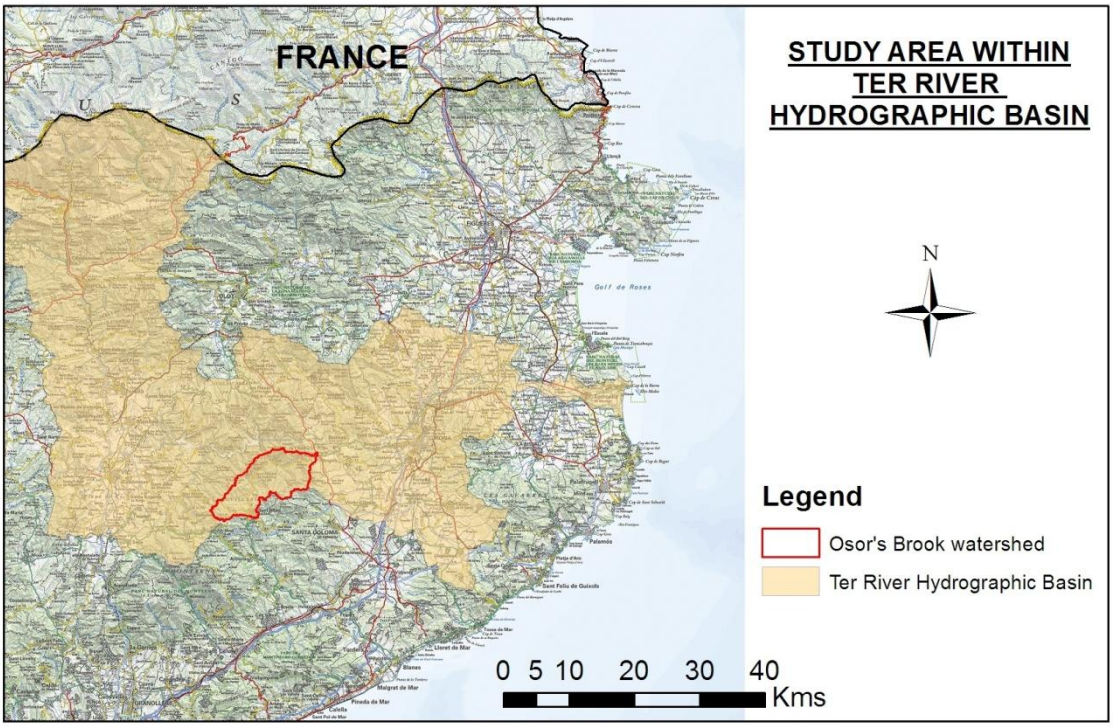
All the elements jointly compose the basic physical elements of the superficial hydrographic environment. Such area is a place where one can find several places with a high level of beautifulness. The several streams there are, together with the vegetation which surrounds its courses; compose a rich environment to the nature lovers. The gorgues, located in flatter areas, not just become also majestic places to the visitor, they are places where its features allows the sunlight entry as well and which invites to the bath on warmer days although the water can be so cold even during summer. (Water can have a temperature around 10 ºC). So, all the formation could be perfectly a place which could be used as touristic spot although the access to area is difficult and complicated. However, but, for carry out that would be necessary follow strictly the bases of the

On the top, picture of the place known as la Roca Foradada. We can see the Stone block of 8x5 meters aprox. That gives the place namewhich has been sustained standing from two small footholds since several decades ago. Below, the Gorg de la Plana, which is a large gorga of the maincourse. **Source of down one:** Pere Masó

ecotourism, promoting the respect for these natural ecosystems and without allow that such area can be damaged for any kind of activity.

5.8.2.- HYDROLOGICAL NETWORK ANALYSIS

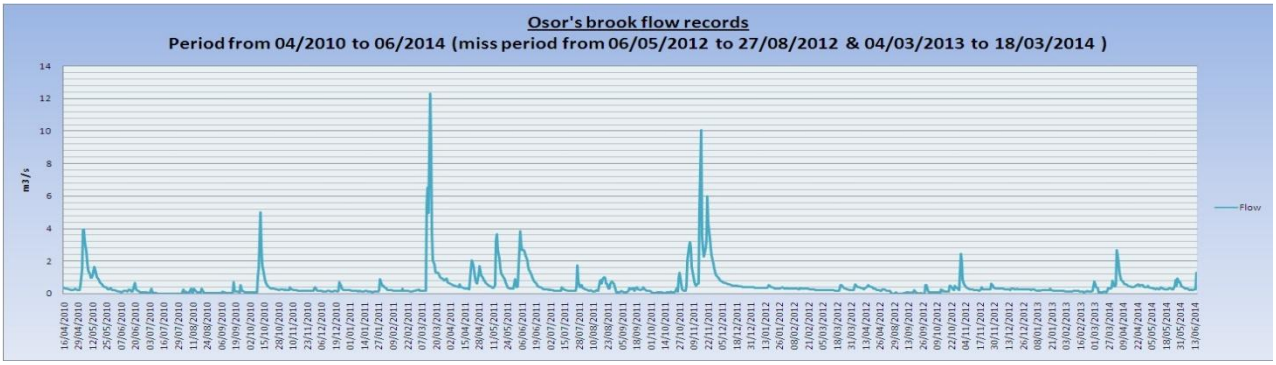
The Osor's Brook hydrological network is the main element of the current project. Its watershed, as we said on previous chapters, becomes as the frame of the area to be studied on the current process. Its location, on the Mediterranean area and so, within the influence area which Mediterranean weather generates is, together with the geomorphology features, the base of its characteristics. It's part of the rich hydrological system of the Guilleries massif, as well as of the Ter River hydrological system. The Ter River system is the largest one of the north of Catalunya, with around 300.000 ha of extension. It has a course that moves throughout 208 Km from the High Pyrenees (It born at 2400 meters high) to the Mediterranean Sea, where has a mean flow of 25 m^3/s. Osor's brook system represents just the 3% of the total Ter River basin, and contribute with less than 1.4 % of its final flow. Although that, the Osor's brook becomes as one of the most rich (on ecological richness way) tributaries of the whole Ter River watershed.



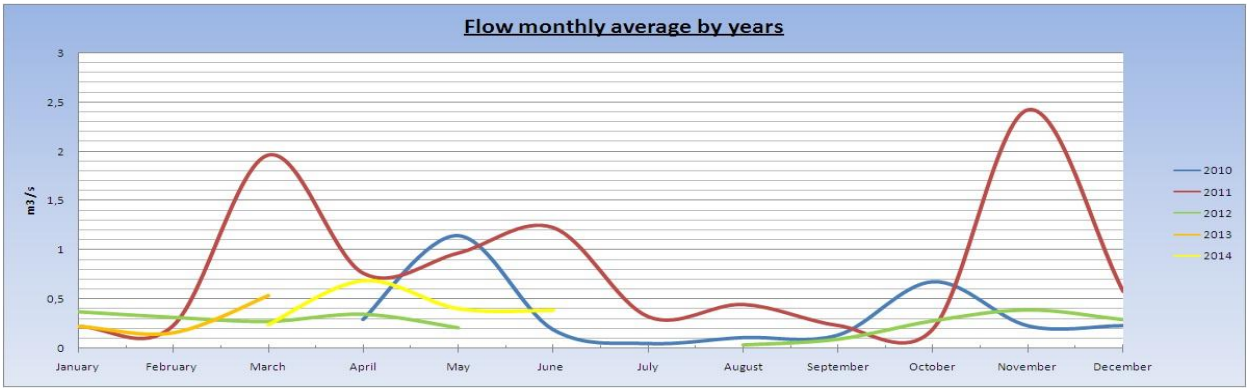
The location of the Osor's Brook is, probably, the main reason about its singularity. The position within mountains and between lush vegetation has given to the brook the chance to don't present highly alteredfeatures by the man hand, like happen with many of the other Ter River tributaries. That doesn't

mean that the brook does not present some pollution problems, as we will see on the final part of the chapter.

Back to the line, Osor's Brook is specially characterized by a seasonable behavior as all the streams included in the Mediterranean area. This seasonality is the main feature which composes its flow and it's directly related with the weather and meteorology conditions of the area where is included. Also because of that reason, the brook does not have a fully Mediterranean behavior. The Mediterranean stream, also called torrent, has periods of total drought, especially on summer, and usually are not a permanent water courses. The meteorological conditions of the study area, with some features of the Middle Mountain and Continental environments, allow the permanent flow of the brook although it can arrive to high levels of drought. We will see that in brief. First of all is important to speak about the Osor's brook flow. This is, as we said highly related with the weather conditions, but also with the geomorphology, the extension and other features of its catchment area.



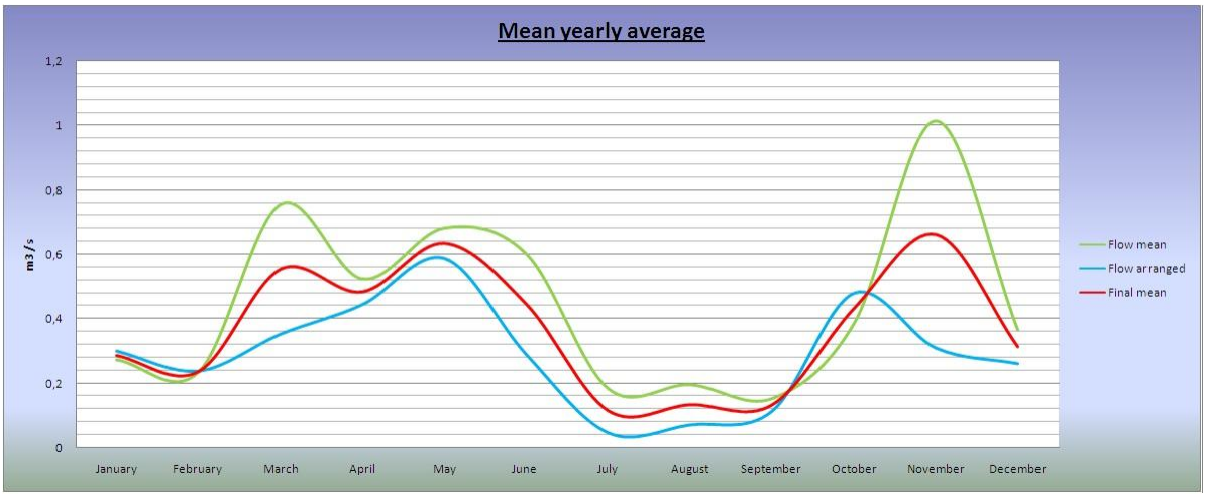
With the aim to determine the mean flow, it has been used data ceded from the Catalan Water Agency measured from the Osor's brook discharge point to Ter River. We say that, which is information more suitable to express on the methodology chapter, because the data that will be expressed on the following pages about the brook flow have been computed by data which, by some technical problems of the agency measurement system, are not completed and it's probable that other upcoming studies carried out with more complete information could get different and more accurate results. So, the flow has been computed across the daily flow measurement of different periods, getting so monthly average flow results.



The number of years about we have the data is one of the premises which make that the results maybe don't express the real behavior of the stream. There is data from 5 years and just the data of one of these years (2011) is complete. Besides that 2011, was an unusual year on precipitation level cause of the large amount of rainfall occurred. We can see that on the upper graph, where 2011 move far from the data computed on other years, especially in the months of March and November. It's for this reason that, to carry out the calculation of the real mean brook flow, the computing has been arranged taking out weight of that uncommon year. To do that, it have been firstly computed the total mean together with another average where we neglected the data from 2011 period. Later, it has been computed the mean of the both to obtain what will be the final mean (so, a 50% reduction of 2011 flow weight). We can see that on the next table and graph, with the normal calculation, the calculation without neglect the named year and the mean between the both results.

Flow monthly average

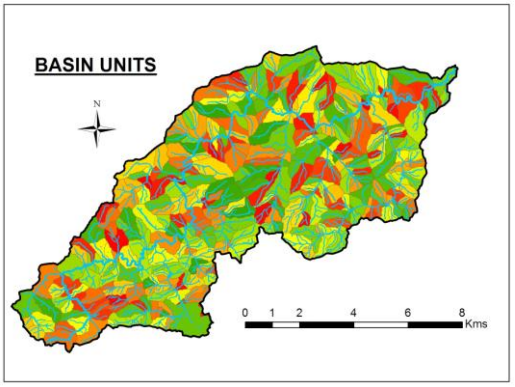
	Mean							
Month	2010	2011	2012	2013	2014	Total	Arranged total	Final mean
January		0,218064516	0,373548387	0,226129		0,272581	0,29983871	**0,286209677**
February		0,226785714	0,316551724	0,16		0,234446	0,238275862	**0,236360837**
March		1,960967742	0,27483871	0,5375	0,244286	0,754398	0,352208141	**0,553303091**
April	0,292	0,760666667	0,348		0,690667	0,522833	0,443555556	**0,483194444**
May	1,143548387	0,96483871	0,21		0,406452	0,68121	0,586666667	**0,633938172**
June	0,188666667	1,224			0,39	0,600889	0,289333333	**0,445111111**
July	0,047096774	0,319032258				0,183065	0,047096774	**0,115080645**
August	0,107741935	0,442580645	0,036			0,195441	0,071870968	**0,133655914**
September	0,134	0,228666667	0,094285714			0,152317	0,114142857	**0,133230159**
October	0,675483871	0,197741935	0,281612903			0,384946	0,478548387	**0,431747312**
November	0,226333333	2,421666667	0,392			1,013333	0,309166667	**0,66125**
December	0,228709677	0,573870968	0,293225806			0,365269	0,260967742	**0,31311828**
Total	**0,338175627**	**0,794906874**	**0,262006324**	**0,307876**	**0,432851**	**0,427163**	**0,335227324**	**0,381195279**



In the upper graph is possible to observe that the two first obtained flows have large differences, especially about periodicity. The final difference between them, as we can see on upper table is a bit less than 0.1

m^3/s, which is a considerable difference on the results. It's due to that reason and, especially for don't neglect directly the only complete data year from the equation, that we use this system, where the weight of the 2011 data in the computation is reduced to a half. The final result, which we can see in the right column of the table and with the red line in the graph, will be considered as the real one during the rest of this document. Looking forward to next related works, it would be interesting to have available more accurate data about. Especially with the aim to generate a good hydrological model in upcoming projects.

So, the final result of that process gives us the conclusion that the Osor's brook mean annual flow is 0.381 m^3/s and that there is remarkable differences between seasons. There are two drought periods: during winter (around 0.3 m^3/s), from middle December to February; and much especially during summer (around 0.1 $m^3 \cdot/s$), which moves from July to half September. On the other hand, we find two periods of maximum flow: the ends of winter and the spring period (from March to June, where we find the highest flow mean, around 0.55 m^3/s) and the fall period, from middle September to half December (with an average of around 0.5 m^3/s).



Basin units on the study area. The study of all of them would be a so extended work and for this reason the number have been optimized at fourteen.

Once we have the mean flow of the study area the next step consists in the determination of the several flows by basin, so the amount of flow that each basin provide to the whole system. There are a large amount of sub-basins that composes the study area but as we explained in the geomorphology chapter, in this document will be used a distribution based in 14 main sub-basins. The lack of flow data for each of the basins bring us to the computation of them. To carry out that process and get and approximation of the flow in each area we will use the following way. The first process will come with the neglecting of a part that comes from the villages. This is due the villages obtains its water directly from the underground aquifers and change (minimally) the real flow. This taken flow will be added later to the pertinent basin.

Flow contribution to Osor's Brook flow by municipalities			
	Population	m3/Day	second
Sant Hilari Sacalm	5740,000	1200,000	0,014
Osor	456,000	95,331	0,001

After that, starting with the premise (non true) that all the area provides the same amount of flow by surface unit we will divide the total flow between the total surface to get the flow by surface unit and

Pure flow calculation	
Total Q (m3)	0,38120
Sant Hilari Water consumption (m3)	0,01389
Osor Water consumption (m3)	0,00110
Total water without municipalities procedence (m3)	0,36620
Total Q per surface unit (m3/ha)	0,00004

then we will multiply that with the surface of each basin, creating so our approximation. This is based, partly, in the occupation of the total surface, which is covered in a 95 % by the vegetation (mainly by forest – 92.2 % of the total surface), and that give us the chance to take the premise that the surface runoff and the infiltration velocity are similar for the whole area. However, it is known that this is not the only fact to take in account in this computing and for that reason and with the aim to make that calculation more accurate in upcoming works, it would be necessary to apply also some kind of correction based on the meteorological features of each area, so the amount of rain water received and, so directly provided to the system. In the same way, would be necessary to determine the percentage of water exchangedfrom the groundwater sources to the stream and vice versa. This will depend of the pressure present on each course spot."Interactions between groundwater and surface water basically proceed in two ways: groundwater flows through the streambed into the stream (gaining stream), and stream water infiltrates through the sediments into the groundwater (losing stream). The direction of the exchange flow depends on the hydraulic head." (Kalbus, Reinstorf & Schirmer, 2006). To carry out all that also would be necessary some kind of fieldwork to, at least, determine the flow in each basin and, so, to can compute the difference between the observed results and the computed ones finding the mean error of the model. Without that model, however, which is expected to be the topic of next projects, the obtained results are the followings:

Flow Calculation by sub-basins

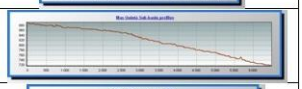
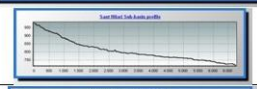
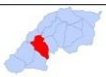
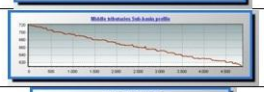
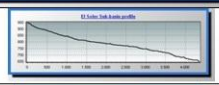
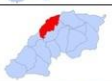
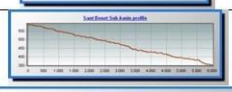
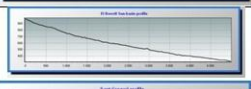
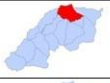
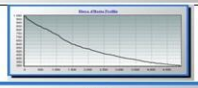
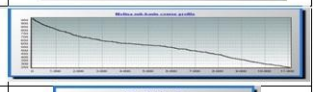
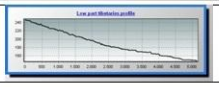
Sub-basin code	Area (Ha)	Percent	Catchment attributable (m3/s)	Catchment attributable (l/s)
11	764,013	8,576	0,031	31,407
13	1092,487	12,264	0,045	44,909
9	642,923	7,217	0,026	26,429
6	303,566	3,408	0,012	12,479
5	459,240	5,155	0,019	18,878
2	862,845	9,686	0,035	35,469
1	720,212	8,085	0,030	29,606
3	675,243	7,580	0,028	27,758
14	672,472	7,549	0,028	27,644
12	182,910	2,053	0,008	7,519
10	742,546	8,335	0,031	30,524
8	502,485	5,641	0,021	20,656
7	599,627	6,731	0,025	24,649
4	687,853	7,721	0,028	28,276
Total	8908,422	100,000	0,366	366,203

It must be highlighted that the results to Sant Hilari and Sant Gregori's basins miss the part taken before. So the real results would be 0.0419 m^3/s to Sant Hilari's basin and 0.0321 m^3/s to Sant Gregori's one.

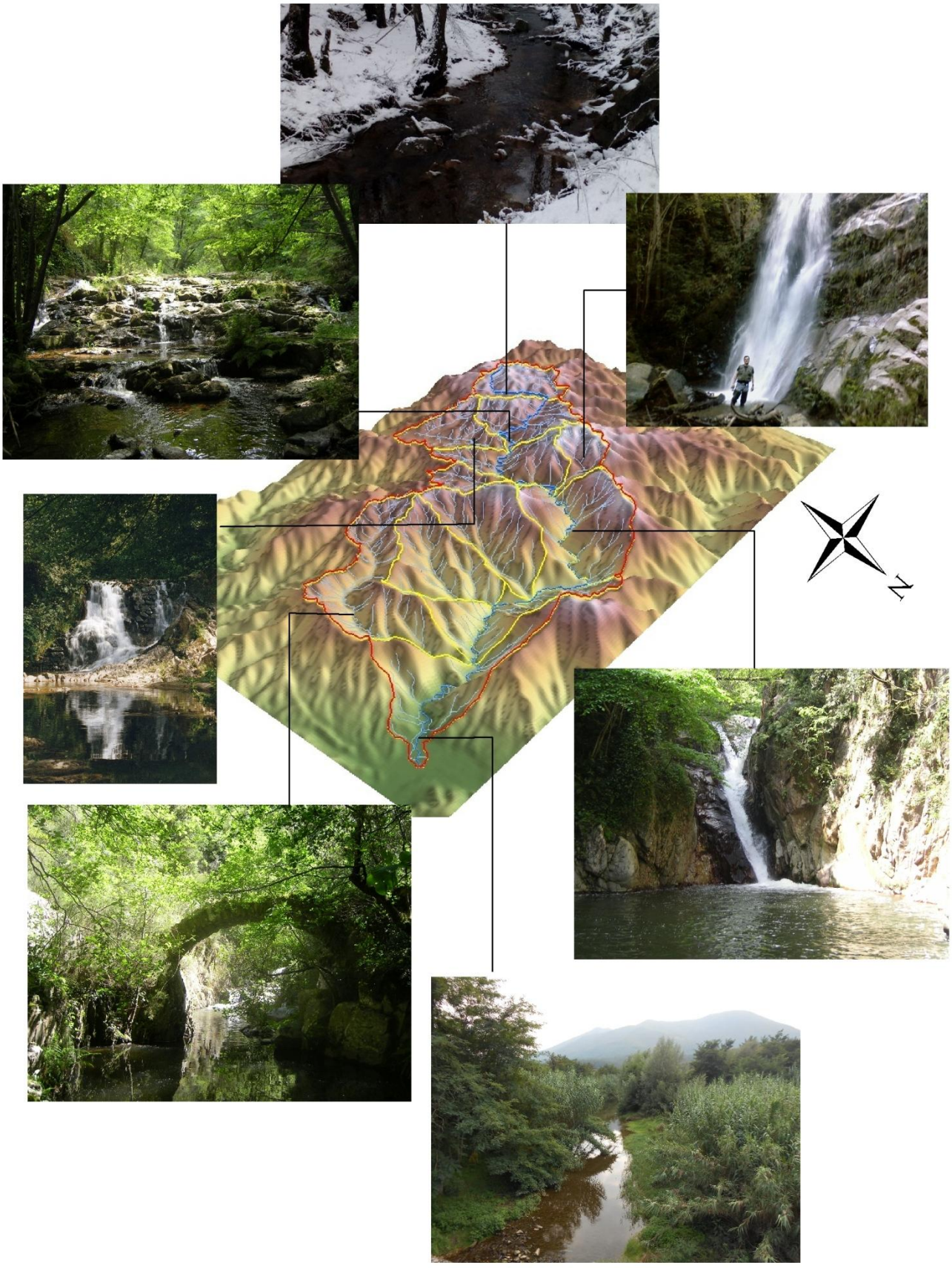
The following part will be based in a short description of each of the different sub-basins as well as its features.

5.8.2.1.-Description of study area tributaries

As we said, there are in total 14 tributaries arranged which forms the study area. These are divided in two kinds, the ones which represent a catchment area of a concrete stream and the ones which represent several streams and its main course is part of the same Osor's Brook course. In this way, there are six which make reference to single streams (Sant Hilari, El Soler, Mas Clavé, Riera d'Horta, El Borrell and La Molina) and eight which are based in several streams being part of the main course (Plà de les Arenes, Mas Quintà, Middle Tributaries, Sant Benet, Sant Miquel, Sant Gregori, Suria and Low tributaries). All the tributaries are surrounded basically by forest but the case of the low tributaries area, where in its last part we find the presence of surfaces covered by reed and other plants and shrubs. Another feature which affects the kind of tributary is the slope. Usually this is sharp but there are some areas like in the low tributaries, Sant HIlari, Plà de les Arenes or La Molina where is possible to find flat areas where the course decrease its rate and increase its surface. In the following table is possible to see the basic characteristics of each sub-basin.

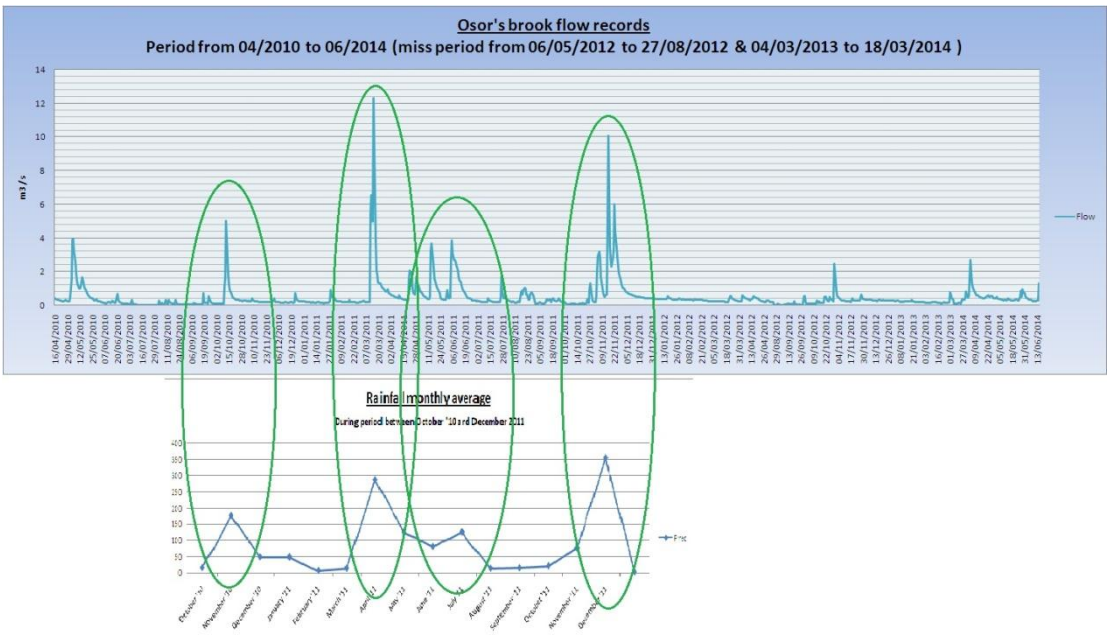
SUB-BASINS FEATURES						
Name	Area (Ha)	Area (%)	Catchment (l/s)	Final Flow (l/s)	Location	Profile
1.- PLÀ DE LES ARENES	720,21	8,08	29,61	29,61		
2.- MAS QUINTÀ	862,85	9,69	35,47	65,08		
3.- SANT HILARI	675,24	7,58	41,90	41,90		
4.- MIDDLE PART TRIBUTARIES	687,85	7,72	28,28	135,25		
5.- EL SOLER	459,24	5,16	18,88	18,88		
6.- MAS CLAVÉ	303,57	3,41	12,48	12,48		
7.- SANT BENET'S BASIN	599,63	6,73	24,65	> 185,25		
8.- SANT MIQUEL'S BASIN	502,49	5,64	20,66	> 238,34		
9.- EL BORRELL	642,92	7,22	26,43	26,43		
10.- SANT GREGORI'S BASIN	742,55	8,34	32,62	347,28		
11.- RIERA D'HORTA	764,01	8,58	31,41	31,41		
12.- LA SÚRIA	182,91	2,05	7,52	302,37		
13.- LA MOLINA	1092,49	12,26	44,91	44,91		
14.- LOWER PART TRIBUTARIES	672,47	7,55	27,64	374,92		
Total	8908,42	100,00	366,20			

3D View of Sub-basins distribution



5.8.2.2.- The overflows

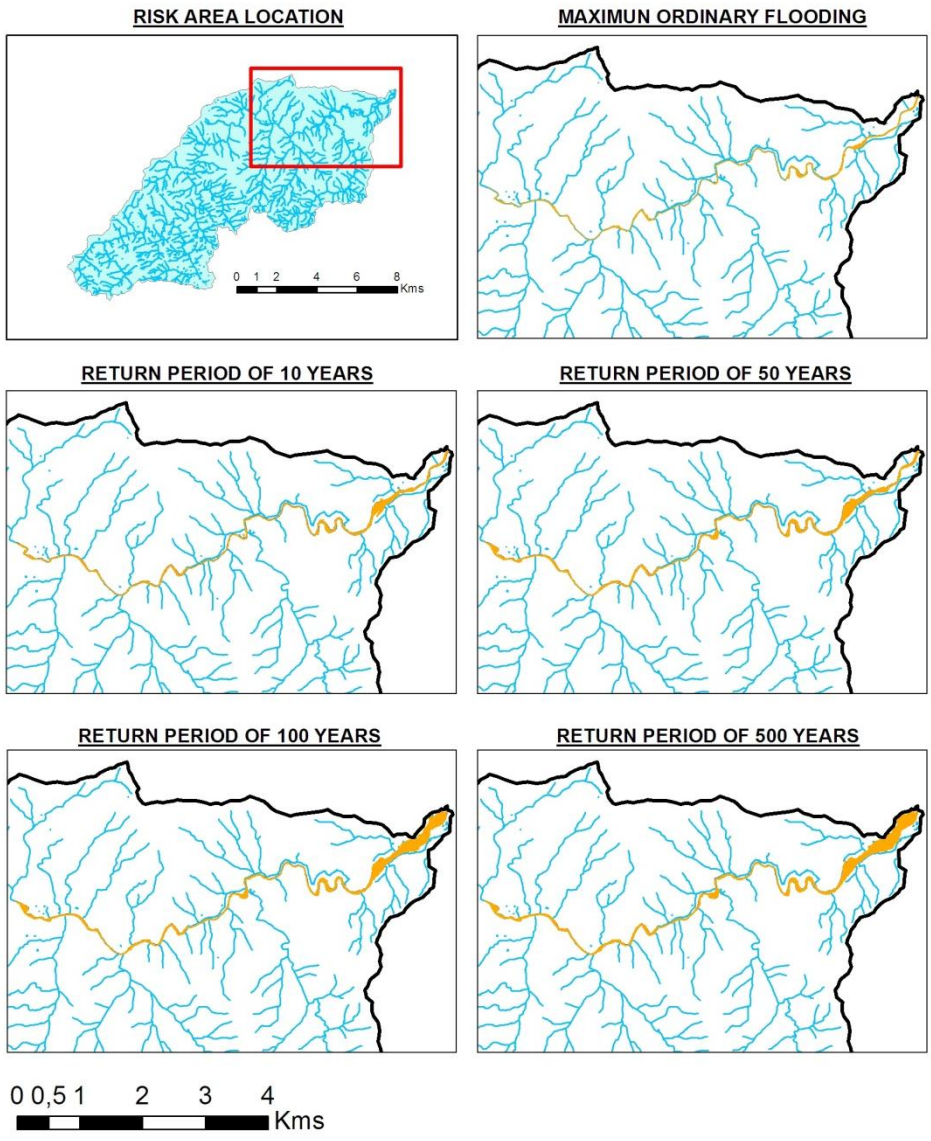
The floods and overflows in the study area are something, as happen usually to all the streams with Mediterranean influence, quite common in its behavior. The features which composes the Osor's Brook landscape give to the stream a certain ease to the floods generation. Although the covers in the area are composed specially by forest (over 92 %), fact that should help to the water retention during the rainfall periods, the course is highly sensitive to the precipitation and its flow changes often and fast. This is mainly due to the geomorphology of the place. The steep slopes that are in its surroundings hinder strongly the water retention by the soil and generate a fast precipitation of all the water collected to the stream. At the same time, the geological composition of the area keeps the infiltrated water inside and creates a constant flow of water from the bedrock to the stream instead of infiltrate all to the deeper layers. All of that, then, causes a fast growing of the water level when the system receives an input. The flow of the stream can be multiplied more than 30 times; getting flows over 12m^3/s (almost the half part of the Ter River average flow). In the following graphs we can see these flow maxims and its relation with the precipitation.



The floods are often highly strong, becoming dangerous to humans and wildlife. Its force drags all what find in its pass, including large stones with hundreds and thousands of kilograms of weight, which are deposited in lower parts of the brook.

However of that, the overflows don't represent a big problem for the area. This is because of the same steep slopes which favor the floods are the ones which avoid its spreading, limiting considerably the inundated area. There is problem just on the flatter areas with lower slopes. In this way, the part of the study area located from Osor's valley to the brook discharge point is the one with more likely to suffer floods in the brook surrounding areas. We can see this in the following maps, which are generated taking into consideration different return periods.

View of floods on Osor's brook upper course.
Source: Societat de Pesca Espotiva La Gorga



5.8.3. THE GROUNDWATER NETWORK

In the study area, the groundwater system is the most relevant element we can find. Its richness and magnitude make it something that is necessary to highlight when one speaks about the area hydrology. Its presence is because of the soils are formed by granite and stoneware (which when eroded and weathered generates sandstone and gravel) that provide good drainage of rainwater and makes this penetrate, especially by infiltration, flowing until to fill fractures in bedrock. The most relevant element related with that feature is the high amount of natural springs that appear from naturally occurring in the area. Most of these springs, which are distributed along the territory, are output natural water stored in the porous medium, thing that doesn't happen with the deeper aquifers, which presents a groundwater accumulation within the fractured bedrocks. The water from these springs, classified as calcium bicarbonate of weak mineralization and high quality ones are highly prized as water for consumption. They are also exploited commercially as we going to see in the following lines. On the other hand we can find water ferruginous from the contact of water with pyrite (ferrous minerals) that go outside the iron precipitate, making distinctive red sediment and, finally, sparkling waters that originate in the basement when gas spots from volcanic origin joins with groundwater. From this confluence appear recognized medicinal waters.

On the uper image the spring known as Font de la Formiga. Below the place where is located the spring named Font Picant (Sparkling water)
Source of lower picture:
http://www.elracodenserrallonga.cat/?page_id=198

Within the study area, is possible to find several of these springs distributed for all the territory. In the Osor's brook watershed it have been counted over 60, but could be more. Some of them are really hidden within the vegetation and the slopes, and its access way may be a good route for the ones who appreciate the natural landscapes. Actually, most of them are managed and marked to facilitate toreach them. There is also several routes elaborate to offer to the tourism the possibility to visit them by walk. Unfortunatelly, there have been cases of contaminated springs as well which; for some chemical products added in its source,became non-potable. Usually, however, its conservation and quality is good and there is not any problem on its consumption by humans.

In the following list it's possible to see the 63 springs counted within the study area.

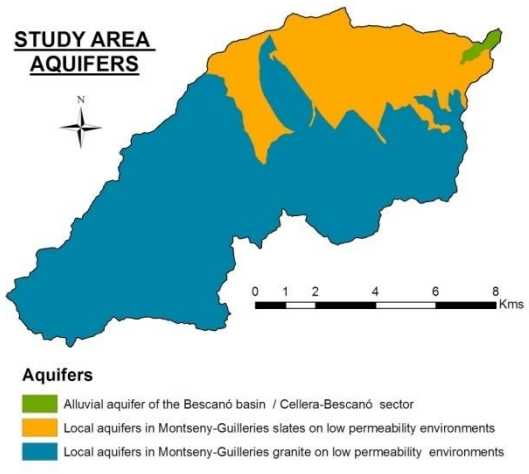
sor's Brook springs

1-	Font dels Cortals	22-	Font del Sastre	43-	Font del Brunyoler
2-	Font de l'Arç	23-	Font de Saleta	44-	Font de Can Salvi
3-	Font de la Cau	24-	Font de la Cascada	45-	Font de la Senyora
4-	Font Maria	25-	Font Freda	46-	Font de les Clotes
5-	Font de la Talleda	26-	Font de Can Pistola	47-	Font Serradeures
6-	Font del Jonquerol	27-	Font del Moro	48	Les fontiques de Can Pla
7-	Les formigues	28-	Font de la Serp	49	Font de Joanhuix
8-	Font d'en Gurb	29-	Font Semallera	50	Font del Gavatx
9-	Font de la Casilla	30-	Font Cervera	51	Font de Can Pla
10-	Font Vella	31-	Font del Gaig	52	Font del Capellà
11-	Font del Pic	32-	Font de la Coma	53	Font de la formiga
12-	Font d'en Joaquim Gasol	33-	Font de la Gavarra	54	Font del Borrell
13-	Font del Petrinxo	34-	Font Fresca	55	Font del Soler
14-	Font del carrer Montsolís	35-	Font del Faig	56	Font de Sa Guarda
15-	Font del carrer Rocosa	36-	Font de Sant Daniel	57	Font de Rius
16-	Font del Fondo	37-	Font de Sant Roc	58	Font del Bordegàs
17-	Font del carrer Hospital	38-	Font del Rector	59	Font del Gascó
18-	Font del Cirerer	39-	Font de Santa Teresa	60	Font del ferro
19-	Font d'en Jové	40-	Font de Sant Joan	61	Font del Parc
20-	Font Burgada	41-	Font de Sant Josep	62	Font del Serrat
21-	Font de la Baga	42-	Font de Santa Ecolàstica		
63	Font Saguarda				

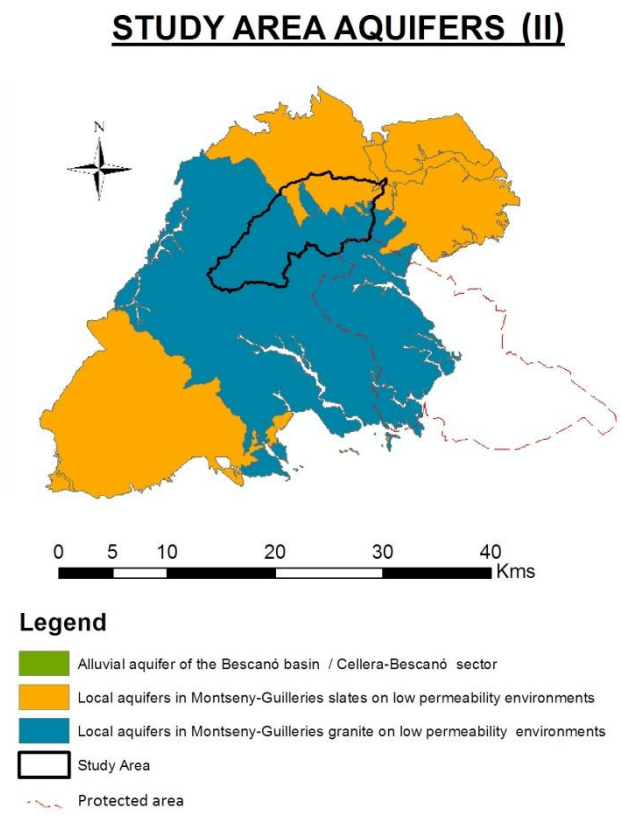
Source: Museu Guilleries

The same process which causes the presences of springs in the study area is the same that causes the presence of another peculiar element of the area, the named crying rocks. The crying rock it's just a casual spring or water output which appears from the crack of the rocks, usually positioned in vertical or very steep way. It's is possible to see them in the places with the explained features. One of the most typical cases is in the sides of the roads (Especially in the Gi-542 road), cause of the rock walls originated in its construction that one can find on its side. We can see an example of a crying rock on the side image.

The study area groundwater network is basically part of the granitic aquifer named Guilleries-Montseny. However, there are two more kinds of aquifers in the area, thought that with less relevance. These are, in first place,the Alluvial



aquifer of Bescanó Basin, which occupies 52.6 ha of the total study area surface (0.59 %). It is composed by gravels and sands with an intergranular porosity and is free of typology kind. In second place we find the Montseny-Guilleries slate aquifer which occupies a surface of 2261.7 ha (25.39 % of the total surface) and it's composed by sandstones, shales and schists; with a porosity based in cracking and partly free. Finally, the granitic Montseny-Guilleries aquifer occupies and area of 6140 ha (74.02 % of the total surface) and its features will be explained in more accurate way during the following lines. This aquifer is one of the main water production spots in Iberian Peninsula. Almost the half part of all the bottled water consumed in Spain, for instance, proceed from this aquifer. "Nearly 40% of bottled water without gas drunk in Spain comes from Montseny and Guilleries." (Tarrés, 2003). This is due to the high presence of bottling water companies in the area as can be Font Vella, Font del Subirà or Font d'Or. The reason of their presence is the amount of water, but also the quality. "The granitic formation which occupies the massif (Guilleries) main part, jointly with erosion materials, makes the most important mineral aquifer of Peninsula. The surface material is altered generating sandstone, which acts as a filter in hydrological effects, so the water has little mineralization and high purity and quality." (Serradesanferm, 2003). The surface hydrological network also helps to this quality. "Water exchange between groundwater and surface water may have a significant impact in the water quality of either of these hydrological zones." (Kalbus, Reinstorf & Schirmer, 2006). However, it is known that the aquifers are a limited resource and its conservation is important. Because of that it's necessary a constant control of its level and quality due to, as say some authors "The preservation must guarantee the quality of both surface water and groundwater, but also to ensure the sustainability of human development in the territory." (Tarrés, 2003). Back to the Montseny-Guilleries granitic aquifer, it occupies a surface of 44.400 ha (so the study area contains the 13.8 % of the aquifer surface). It is one part that is protected by the Catalan aquifers law and that follows the southern border of the study area (see side map). It is granitic, Paleozoic and alluvial and contains free and confined aquifers with a domain of the free ones. The gravel superficial layer which allows the presence of the springs on the area can arrive to the 28 meters of width in some areas like Sant Hilari Sacalm. Then, there is another layer of cracked rock and the one composed basically by the bedrock. Its water circulation is based especially on the porosity. The material which composes its



structure has, on hydrological parameters, permeability between 0.1 and 18 (granites), storage capacity of 18 (altered granite) and 1 (non altered granite) and a transmissivity which moves from 270 to 1500.

It is considered that have a good state of conservation and as well good chemical features. There is not, so, pollution evidences. In the following table is possible to see the chemical features of the Montseny-Guilleries granitic aquifer.

Chemical conditions of the aquifer

Aqüífer: 3012H11 - Aqüífer granític Montseny - Guilleries

pH *(u.pH)*	**CE** *(uS/cm)*	**HCO3** *(mg/l)*	**Cl** *(mg/l)*	**SO4** *(mg/l)*	**Ca** *(mg/l)*	**Mg** *(mg/l)*
7,1	372,64	192,11	17,3	17,03	52,21	8,96

Na *(mg/l)*	**K** *(mg/l)*	**NO3** *(mg/l)*	**NH4** *(mg/l)*	**Fe_total** *(ug/l)*	**Mn_total** *(ug/l)*
15,26	1,26	10,5	-	527,33	126,58

Source: MASSES D'AIGUA SUBTERRÀNIA DE CATALUNYA - MONTSENY-GUILLERIES - 13

5.8.4.- ACTIVITIES &POLLUTION PROBLEMS RELATED WITH THE BROOK

5.8.4.1.- The fishing

The fishing on Osor's brook water network is something common since ancient times. That activity, which in its origin was carried out for the food obtaining (fish and crabs), was reformed later as a sportive and leisure pastime. It could seem that such activity is not relevant but it is, especially, because of the presence of the fishing associations. Presently, there are two fishing associations in the study area context: For one side, the Societat de Pesca Esportiva La Gorga (SPE La Gorga)" from Sant Hilari Sacalm town and, for the other hand, the "Societat de pesca esportiva Les Guilleries (SPE Les Guilleries)" from Osor town. The fishing associations are usually created to manage the fishing activity in their respective areas. Besides that, however, these associations develop some activities related with the streams ecosystem preservation. On one hand, it is typical that these entities develop the function to become the first guard line of the government organizations against some kind of issues that may appear in the system and which is responsibility of those state entities to solve. An example of that could be the brook monitoring to alert the authorities in case of pollution or other damages hazard. On the other hand, they develop several tasks of conservation related with pollution and biodiversity. The best example of that comes with the fish repopulation. The fishing activity can be harmful for the fish population if the amount of captures overcomes the limits. It's for that reason that fishing associations proceeds to repopulate yearly the brook with fishes obtained by the breeding. Moreover, these associations act also against the over-sedimentation of some spots of the brook. The excessive sedimentation process which is lived in the study area streams, especially in the main course, is due to the human interaction in the course surroundings, usually in form of crops or other works. What happen with such activities is that they generate a destabilization of the terrains, what causes an

Fish nursery pools on Plà de les Arenes area. The repopulations carried out by the SPE La Gorga take place thanks of the breeding of fish developed on this place.
Source: SPE La Gorga

easier erosion and transport of their soils which moves into the water courses. Once deposited in the stream bed, the sediments increase the width of the gravel and sand layer. The water infiltrates within the layer which allows its circulation and moves as underground flow, but the sand layer occupies the main part of the bed and avoids the proper development of the biodiversity. That generates a "desertification" process which can kill the wildlife presence in the brook. For this reason there are throughout the course several artificial ponds originated by a little dams construction which generates a barrier to the sediments and avoids its transport to the rest of the stream. Although that, the process is too constant and the sediments withdrawal is an expensive process (Especially talking from the economic point of view of these associations), which causes that not always is possible to carry out such processes.

Emptying process of the named Bassa del vivers/de la Font de l'Arç wall pond. It is posible to see the pond before, during and after the withdrawal.
Source: SPE La Gorga

Related with the last comment, it is important to highlight that often this kind of associations carry out some these works without an economic support of the authorities and state organisms although that the ecological value keeping they provides with their activity is high.

As last, it's important to say that some of the activities harmful for the hydrological network which will be explained in the following lines were already alerted to the authorities by some of these associations years ago, some of them still now without answer. There are four study cases which have been selected as pollution hot spots in the Osor's brook course.

In general, the brook analysis shows that exist different levels of pollution. In these analysis, carried out by the Water Catalan Agency, there are analyzed the biological, physiochemical and chemical quality of the water. Looking the results, the data express that the biological quality of the water is good, being the parameters which composes the analysis considered between good and so good. For the other side, the physiochemical quality is also evaluated as good. In this case, however, the parameters analysis reveals some bad quality cause the high amount of Zn (445.9µg/l). Other authors also detected such element. "The most polluted site in this study was defined as moderately polluted (M), with maximum Zn values around 11 µmol L-1." Bonet, Corcoll, Tlili, Morin, Guasch, (2013). There is also some amounts of TOC - Total Organic Carbon (2.3 µg/l), toluene (1 µg/l), As (1.2 µg/l) and ammonium (0.1µg/l), but inside the acceptable

parameters. As last, the chemical state is evaluated as bad. This is due to the high amount of Cd (0.0917 µg/l), Pb (0.3333 µg/l) and Ni (2.75 µg/l) that it has been found in the water analysis process. The final evaluation, describes the general state of the system as "close to good".

Within the Osor's brook hydrological network there are some known points of pollution discharge inside the water course or harmful to the system which could be related with the above expressed results. There are, probably, some others which are not knowledge about as well. These lasts, but, has not much relevance cause the degree of pollution and damage they generate due to, usually, the remarkable harmful processes can be observed and followed to its origin ease across its effects in the environment. The known ones, presently, are three and will be explained on the following section. It will be, besides, a fourth one which is just a speculation and that would need a deeper analysis before to report it in official way. For this reason, it that just will be exposed briefly as last hotspot.

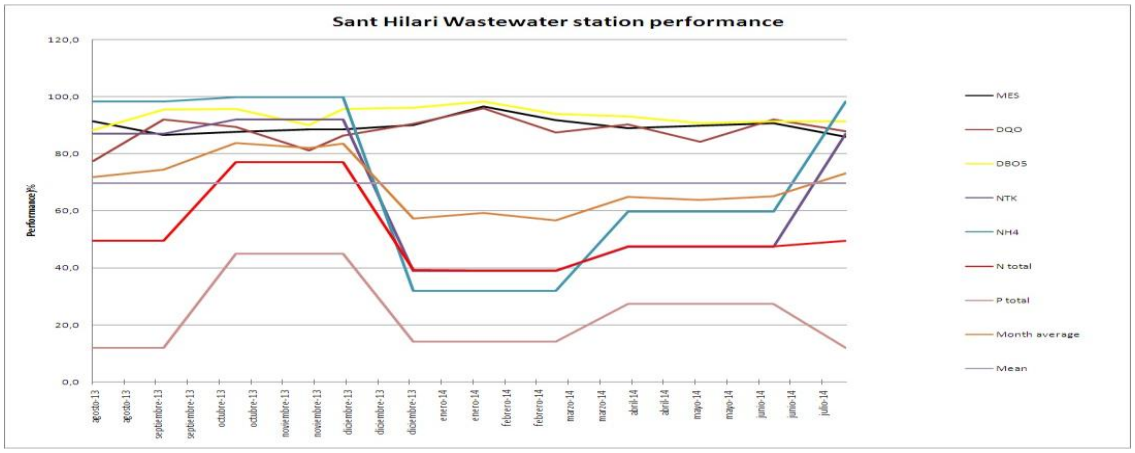
5.8.4.2.- Sant HIlari Sacalm wastewater system

The problems related with the Sant Hilari Sacalm Wastewater station started several years ago. Its performance and affectivity was topic of discussion during large period because of the pollution evidences one could find without any kind of scientist analysis. In short, the problem was related with the high amount of polluted water that the station released to the brook after the cleaning process which was possible to observe across the simple observation and the stink that generated the water course, affecting all the part of the Sant Hilari brook from the station to its joining with Osor's brook and the rest of the course.


In the left picture, taken on 2004, is possible to see the discharge point of Sant Hilari brook on the Mas Quintà (Osor's brook main course) course. On the down part of the image we see how the effluent which comes from Sant Hilari wastewater station is discharging on Osor's brook main course clean water (up of the picture) and polluting it. On the right picture (also from 2004) we can see as well the same situation when Soler's brook course (up) discharge on the Osor's brook maincourse (down).
Source: SPE La Gorga

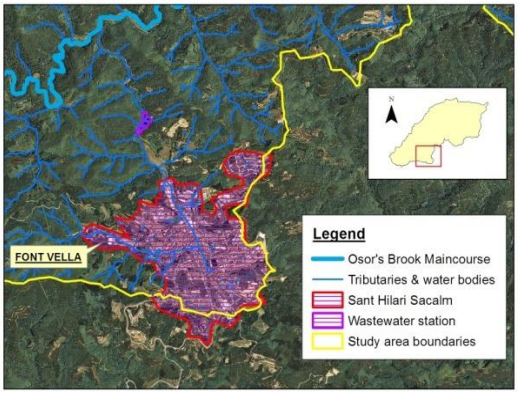
However, the problem was mostly fixed (we say mostly because the pollution in that brooks keeps being remarkable as we will see below) across the station management change few years ago, starting to get good

results in the station operation and performance. Nowadays, the Sant Hilari wastewater station is working in a performance levels close to the maximum of its capacity. We can observe that on the following graph.



Although that in the graph appears the mean performance around the 70%, this is due to in the graph data calculation is included the performance of treatment of nitrates and phosphors, which are not possible to remove properly because of the station kind features. The station is basically created to treat the PM (suspended particles) as well as the COD (chemical oxygen demand) and the BOD (biochemical oxygen demand), which as we can observe in the graph, its results move close the maximum performance.

SANT HILARI'S HOT SPOT LOCATION



So, the fact that the pollution problem remains in the brook suggest there is a different origin point of them. That point is located in the Sant Hilari Sacalm village water collection system. The problem consists in a wrong design of the system (see side scheme), where the wastewaters can move directly to brook course instead of be treated first. The common design of the villages consists in one collection system for the rainwater separated of the other wastewater and solid residues system where the first one can be directly released to the stream and the other one brings the water to the station to be cleaned. The reason why the wastewaters can be discharged directly to the brook before its sanitation is because of there are several rainwater

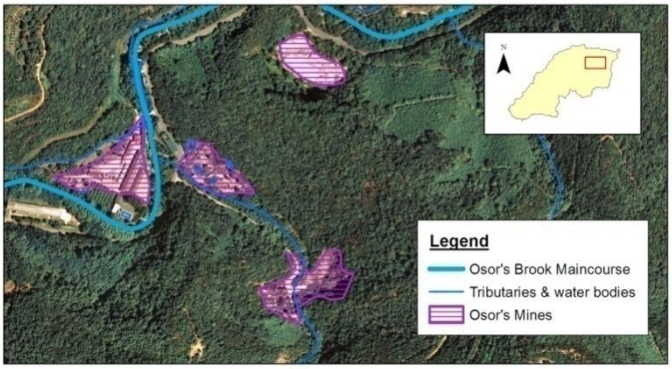
SANT HILARI SACALM WATER DISCHARGE SYSTEM

Detail of the covered brook on its pass for Sant Hilari. On the left of the image we can see the collection tube which brings the wastewater to the station.
Source: SPE La Gorga

collection tubes which discharge in the wastewater tube. During normal days that does not suppose a big issue, but during the raining days the wastewater tube gets easily its overcharge and that generates several spill points of the polluted water to the stream course.

That suggest a big problem cause although this issue is well known and, even it is being carried out nowadays a project with the aim to detect the points where the rain water collection is discharging in the residues tube and replace them, the process achieving is presented as long term realization and, furthermore, high expensive. That includes more long time of permanence of the pollution problem in the hydrological system even if the reparation process is started immediately, which is not possible to ensure because of the difficult economical period which is living the country.

OSOR'S MINES HOT SPOT LOCATION



5.8.4.3.- Osor mining

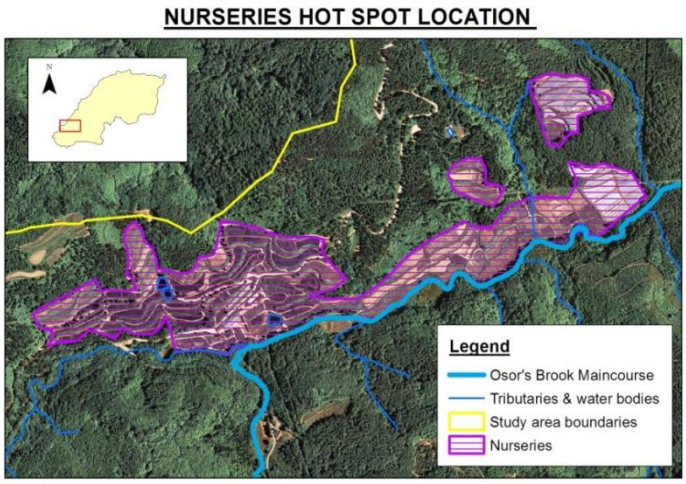
As we said in previously chapters, the mining in the study area and, specially, in the place known as Osor's mines is an activity which has been carried out since long time and that it was stopped by the mentioned mines closing in the ends of 1979. The mine was specialized in the extraction of fluorite, sphalerite and lead. The main harmful chemical elements which are found nowadays in the Osor's brook water analyses are due to this mine activity, which is located just in the side of the course and besides that was closed without any kind of ecological protection measure, allowing that the sediments deposited out of the mine and composed by waste material from its old activity are dragged by the water to the stream. The relation between the chemical elements found in the water analyses and the mine is evident. Not just for the presence of lead, also for the precedence of Zinc and Cadmium, which is because of the extraction of sphalerite. The removing of such elements from the river is hard due to its weight, what make the elements remain in the stream bottom, increasing its concentrations during periods when the flow is low and resisting even highest flows. "In contrast, when water flow was low, the highest values of metals were observed (…) showed an enhancement attributed to metal toxicity." Bonet,Corcoll, Tlili, Morin, Guasch, (2013).

Remains of one of the Osor mines old entries.

5.8.4.4.- Mas Quintà brook and the Molí Roquer nurseries

The Molí Roquer issue is a problem related with an event which happened in 2010 during a rainfall period. After a high rains for one or two days and the common course flow increase, it was found throughout Mas Quintà brook a high amount of death crayfishes. The witnesses observed during the following days the accumulation of the corpses of these animals in the stream sides which could be counted by dozens (some witnesses affirms that by hundreds but we don't know even if the population in these period reached such numbers). The kind of crab we are talking about is White-clawed crayfish (*Austropotamobius pallipes*), which is the specie of autochthonous crab of Osor's brook watershed. This specie is considered as threatened – endangered by the IUCN (International Union for Conservation of Nature). In the study area, although the specie was so abundant some decades ago it was about to disappear cause of the capturing by the man (It was a highly appreciated food) and the presence of the disease caused by the water mold *Aphanomyces astaci*, also known as Crayfish plague. The disease, although the invasive species which carry the water mold are not present in the study area, affected the population which just was saved in the upper part of some creeks.

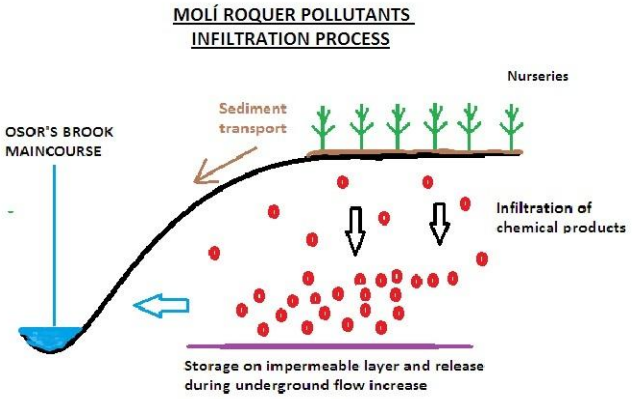
Specimens of *Austropotamobius pallipes.*
Source: SPE La Gorga



Back to the main line of that section, the real reason about this spontaneous high mortality is still now not confirmed but there is a line to investigate. The event features indicates some kind of poisoning after discard causes like the water force during the flows (the main part of species which dwell the brook are adapted to the flows, which detect it time before its advent and proceed to take shelter) or the high levels of pollutants in the water (days after the water was analyzed without give enough concentration pollutants to cause such mortality). This poisoning had to come from the upper part of the Mas Quintà brook or the Plà de les Arenes basin because of the places where were found the crabs. There is not any kind of industries or other sites where an accidental dumping was occurred, so most plausible origin place is a group of nurseries located

just in the point where Plà de les Arenes course ends, in the beginning of Mas Quintà course. These nurseries are composed by two different business, one dedicated to the ornamental bushes and trees farming, called Vivers Tortadès; and another one dedicated currently to the strawberries and beans production called Agro hol cat s.l. The both companies are together and occupy mainly the surface located on the side of the stream. The total cultivated area is around the 35 ha of field. The activity of those companies involves the utilization of several kinds of pesticides, insecticides and fertilizers which are used for the good development of the plants. This could be the reason of the poisoning but the application of such products is a common and periodical action in this business and never was observed any harmful effect in the hydrological system but the normal over-erosion process derived from the terrain presence with insufficiencies in vegetation fixation, which causes a sedimentation process that affects the brook ecosystem. So, the explanation for the crab mortality had to be different. In this way, the only explanation of such pollutants release from the place (discarding a human mistake where a high amount of a chemical product was dump to the brook directly and which, behind the negation of the business, it could not be proved) is the pollutants accumulation in the underground layers over the time. That process, would consists in the pollutants accumulation due to chemical products used along the years in some kind of permeable or semi-permeable layer located in the nurseries underground which, during periods of abundant precipitations, increases the underground flow force and speed, avoiding the natural soil filtration process that would keep the pollutants in the soil during normal infiltration periods and releasing them in the water course. Anyway, for now this is just a theory (although the problem is really existing) and would be necessary to carry out soil analysis in situ to determine the validity of the exposed explanation.

View of Vivers Tortades, one of the businesses of the nurseries hotspot



The following hotspot, as we announced previously, is and assumption related with rumors which have not been enough studied and documented but which would become a serious acts against the Osor's brook ecosystem in case to be true.

5.8.4.5. Font Vella?

Font Vella S.A. is the biggest and most important company of Sant Hilari Sacalm village. Its business consists in the water bottling, which extracts from the previously mentioned Montseny-Guilleries aquifer. Sant Hilari's brook course passes, in its arrival to the village, just under the company installations. Some witnesses express to have seen some kind of spontaneous discharges to the stream during some nights or weekends of dirty water, which causes odor and foam in the brook. The factory is using some chemical products in its activity like soaps or sodium hydroxide and would be so worrisome if such elements were released into the water course. The problem comes from the lack of proofs about that activity and the fact that this company provides the largest amount of workplaces of the whole village, which makes that people become reluctant to do accusations against the company.

In the upper picture, point where Sant Hilari's brook get into the subterranean pass below Font Vella bottling plant. In the lower, image of the discharge point where some witnesses affirms to have seen the sporadic dumpings.

SWOT ANALYSIS

HYDROLOGY& HYDROPEDOLOGY	
STRENGTHS	**WEAKNESSES**
- The high amount of superficial water courses is an important natural value because of the generation of rich ecosystems within. - The exchange between underground and superficial water in some points helps to the not total dry of the course during drought periods. - The diversity of tributaries located in different places are affected by the multiple environments of the area generating a diversity of water courses (size, flow, slope, flora, and ecosystems) - The richness and large amount of the groundwater system is an important feature of the area. - The high amount of outcrops of springs along the area and the already existing current management and monitoring of it is an insurance of conservation - The constant flow of the springs is a sign of groundwater system health. - The actions carried out by the fishermen association helps to the hydrological system conservation and to the ecological awareness. - The current well performance of Sant Hilari waste water station and the recent opening of the Osor's one.	- The old main part of surface covered by marshes is an important lost difficult to recover. - The pollution in the brook, especially in the upper part cause of Sant Hilari wastewater issue and in the lower by Osor's mines heavy metals transport, decrease the ecological quality of the system. - The seasonality of the brook may be presented in some periods of almost non flow in some points of the water course. - The exchange between underground and superficial water in some points helps to the dry of the course during drought periods. - The lack of helps to the fishermen associations and the lack of conservation actions carried out by the authorities. - The presence of nurseries in some points without measures against harmful effects caused by their activity - The lack of knowledge and study by the authorities about possible hidden activities within the brook such as uncontrolled spills. - The reconstruction of Sant Hilari wastewater network is an expensive and long term action.

OPPORTUNITIES	THREATS
- The beautifulness of the system allows using some spots (especially some gorgues) as touristic attraction. - The springs as touristic attraction. - The water courses cleaning would generate a even more rich system with better natural value. - The proximity of some obsolete structure from old touristic times close to the brook which could recover its function again in case of tourism increasing/recovering. - The importance and name of the Montseny-Guilleries aquifer can be used as well as attraction - The recovering of almost lost species with a proper management. - The reconstruction of Sant Hilari waste water network will help to avoid the dirty water discharge into the brook.	- In case to use some spots as touristic attraction there is a high risk of damage to the area by pollution and other harmful features of the tourism. - Ter river proximity is a gateway from where invasive species may penetrate to the system. - The floods may generates loses to structures around the brook and be risky for the people. - The casual pollution of some springs water. - The over exploitation of the aquifers in the area could cause important lost for the ecosystem. - The spontaneous and extended deaths of river crab on Mas Quintà area may become an irrecoverable (or long time recoverable) losses for the biodiversity. - The possible non-monitoredactivities like uncontrolled spills may cause lost of biodiversity and natural quality of the system.

5.9.- WILDLIFE

The study area contains a large amount of ecosystems which allows the presence of several wildlife species, especially because of the forests and natural environments extension. The character of the study area (Guilleries) forests determines the presence of wildlife habitats linked to forest ecosystems characteristic of Catalan mountainous areas. The fauna of these wet environments is fully represented. One can find a strong gradient between the Mediterranean and sub-Mediterranean wildlife, and the ones purely center European.

There is as well the presence of the stream surroundings, which becomes the richest ecosystem of the area for its extended wildlife. The rivers of the area with oxygenated waters and beds of sand, sustain very rich and diverse ecosystems. It highlights the interstitial faun, with groups of daphnids very interesting as well as various species of fish representatives of Iberian wildlife and European origin typical of the high and middle watercourses.

5.9.1.- MAIN SPECIES

In the following lines it will named briefly the main species by kind which conforms the fauna of the territory.

5.9.1.1.- Birds

The most common animals in the study area are, by number of species, the birds, which is possible to find distributed by the whole area in function of the ecosystem typology. Generally, the most typical birds are represented by the small species. Main ones could be the Great grey shrike (*Lanius excubitor*), European Robin (*Erithacus rubecula*), Common nightingale (*Luscinia megarhynchos*), Common Stonechat (*Saxicola Torcuata*), Hawfinch (*Coccothraustes coccothraustes*), Cirl Bunting (*Emberiza cirlus*), Great Spotted Woodpecker (*Picoides major*), European green woodpecker (*Picus viridis*), European turtle dove (*Streptopelia turtur*), Eurasian woodcock (*Scolopax rusticola)*, Mistle thrush, (*Turdus viscivorus*), Great spotted cuckoo (*Clamator glandarius)*, Common linnet (*carduelis cannabina*), Song thrush (*Turdus philomelos*), Eurasian jay (*Garrulus glandarius*), Common wood pigeon (*Columba palumbus*) , White wagtail (*Motacilla alba*), Brambling (*Fringilla montifringilla*), Eurasian wryneck (*Jynx torquilla*), Hoopoe (*Upupa epops*), House sparrow (*Passer domesticus*), Great tit (*Parus major*), Stock dove (*Columba oenas*), Spotless starling (*Sturnus unicolor*) and the Common magpie (*Pica pica*). There is also bigger species more related with the forest and the fields

like the Red-legged partridge (*Alectoris rufa*) or the Common pheasant (*Phasianus colchicus*). In the aquatic environments (besides of the species named above which can be found also there spontaneously) there is adapted species which spend most part of their live in the streams surroundings like the Northern lapwing (*Vanellus vanellus*), White-throated dipper (*Cinclus cinclus*), Common snipe (*Gallinago gallinago*), Common kingfisher (*Alcedo athis*), Spotted crake (*Porzana Porzana*), Calidrid (*Calidris sp.*), Little grebe (*Tachybaptus ruficollis*) and the Grey heron (*Ardea cinerea*).

On the other hand is possible to find as well several species of raptors like the Common kestrel (*Falco tinnunculus*), Common buzzard (*Buteo buteo*), Eurasian sparrowhawk (*Accipiter nisus*) or the Northern goshawk (*Accipiter gentilis*). Also other species less common like the mentioned on a previous chapter Golden Eagle (*Aquila chrysaetos*).

As last, is important to highlight some kind of nocturne predators as can be the Barn owl (*Tyto alba*), Little owl (*Athene noctua*), Tawny owl (*Strix aluco*) and the Eurasian eagle-owl (*Bubo bubo*).

From left to right: *Accipiter gentilis, Ardea cinerea, Erithacus rubecula* and *Tyto alba*
Source: Wikipedia

5.9.1.2.- Mammals

Study area counts also with a several species of mammals. The most popular of the territory, which probably give the name to the Guilleries area, is the Red fox (*vulpes vulpes*), named as “Guilla” in the region dialect (on standard Catalan is known as “Guineu”). Actually, the Guilleries logo, which we can see on the right, is inspired in this animal. Besides that the fox, however, there are many more species of mammals. We find different kind of small mammals like European mole the (*Talpa europea*), the Red squirrel (*Sciurus vulgaris*), the European Hedgehog (Erinaceus europaeus), the House mouse (*Mus musculus*) or theEdible dormouse (*Glis glis*). Then, there is also middle size mammals like the European badger (*Meles meles*), the Wildcat (*Felis silvestris*), the Common genet (*Genetta genetta*), the

Common rabbit (*Oryctolagus cuniculus*), the European hare (*Lepus europaeus*),the European polecat (*Mustela putorius*) or the Beech marten (*Martes foina*). Finally, is possible to find also bigger mammals like the European roe deer (*Capreolus capreolus*) andthe Wild boar (*Sus scrofa*). About this last one, it's important to highlight the fact that the specie was, in the study area and in Guilleries territory, crossed with the domestic pig (*Sus scrofa domesticus* or *Sus domesticus*), fact that caused the increase of its procreation till the point to being nowadays a problem due of the amount of specimens which are distributed throughout the area. Every year many of them are hunted with the aim to control the populations. The difference between the hybrids and the original wild boar is the length of the snout, which is larger on the original specie and shorter on the animals crossed with the domestic pig.

As last, is important to highlight that the last years have been detected some specimens of European mink (Mustela lutreola) on the areas close to the streams. This is a complicate case because of, on one hand, this specie is invasive, and can be so harmful for the autochthonous faun. On the other hand, the European mink is critically endangered species by the IUCN and its hunting is forbidden, fact that avoids the chance to remove it from the invaded ecosystem.

From left to right: *Glis glis, vulpes vulpes* with a prey, *sus scrofa* and couple of *capreolus capreolus*
Source: Viquipèdia

5.9.1.3.- Reptiles

The reptiles are also a common group in the study area environments. The most common of them is the Iberian wall lizard (*Podarcishispanica*), but there is also lizard species like the *Lacerta sp.*or theMediterranean gecko (*Tarentola mauritanica*). On the other hand there are different snake species. The most dangerous are the vipers, like the European asp (*Vipera aspis*) and Snub-nosed adder (*Vipera lataste*), for the fact to be poisonous. The rest of the snake species, like the Grass snake (*Natrix natrix*), Viperine water snake (*Natrix maura*), Slowworm (*Anguis fragilis*) or Montpellier snake (*Malpolon monspessulanus*) has not poison or not harmful to humans.

From left to right:*Vipera aspis* and *Podarcis hispanica*
Source: Viquipedia

5.9.1.4.- Amphibious

The amphibious in the territory also becomes as an important group although be a small one because of its sensitivity to the pollution, that make them a good quality indicators. Between the main species there are we can find the Fire salamander (*Salamandra salamandra*), the Common toad (*Bufo bufo*), the Common midwife toad (*Alytes obstetricians*) and the Marsh frog (*Rana ridibunda)*

Salamandra Salamandra
Source: Viquipedia

5.9.1.5.- Invertebrates

The invertebrates are, as is usual, the group with major number of species within the study area. As well as the birds, there is a group adapted to the live close to the water courses. Between them highlights the group of dragonflies (*Anisopters*), Skimmers (*Libellulidae*) or the Copper Butterfly (*Lycaena Sp*). There is also good populations of False March brown (*Ecdyonurus venosus*), Caddisfly (*trichoptera sb.*), True bug (*gerris palustris*), Water scorpion (*Nepa cinerea*) and Great diver (*Dytiscus sp.*). As last, there is the White-clawed crayfish (Austropotamobius pallipes), about we talked on previous chapters, representing the crustaceous group

Sympetrum flaveolum
Source: Viquipedia

5.9.1.6.- Fishes

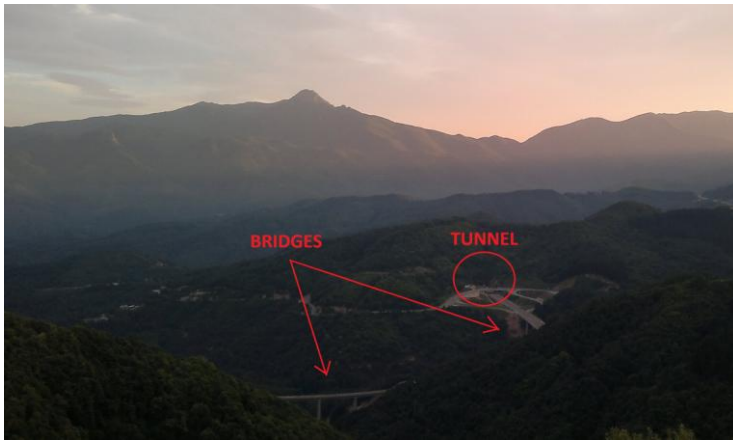
The last group makes reference to the fishes. The fishes on the study area water courses suffered several changes on its populations. At the beginning, several decades ago, the brooks and streams where occupied by the Mediterranean barbel (*Barbus meridionalis*) and theIberian Chub (*Squalius pyrenaicus*). Time later, it was introduced the trout on the system, with species like the Common trout (*Salmo trutta*), theBrown trout (*Salmo trutta fario*) or theRainbow trout (*Salmo Irideus*) which started to win space to the first two. Nowadays the population of barbell and chub are existing but limited in some areas. The main part of the water bodies is occupied by the species of trout, with the exception of the Rainbow trout which is just located on the Molina basin.

From left to right: *Barbus meridionalis, Salmo trutta fario, Squalius pyrenaicus and Salmo Irideus*

Source: Barbel and Chub (SPE La Gorga). Salmo trutta (http://wallpapersup.net/result/10/brown-trout.html) and Rainbow trout (http://beekman1802.com/reading-water/rainbowtrout-04/)

5.9.2.- ECOLOGYCAL CONNECTIVITY

The ecological connectivity along the study area is something that can be described briefly as good. In the area studied, the only elements which cause some physical barrier effect are the roads described on the connectivity & infrastructures chapter. As we said, there two main ones and their features make them an easily avoidable obstacle. On the other hand it could be exposed the high tension powerline presence but, although it is expected a deforested fringe along its route, this neither suppose a difficult element to get through by the wildlife. There are natural elements like the geomorphology and the water courses which also could be valued as barriers in some points but generally does not become a problem by the faun. The only two elements can be considered as ecological barriers the surrounding natural areas are located outside the study area borders. Those would be, the Tavertet walls, which are natural cliffs located in the northern part of the territory separating the Collsacabra massif with Guilleries massif (see introduction chapter) which for its features becomes a natural barrier just crossable in a few points. On the other hand, there is the C-25 highway located on the southern part of the territory which separates the Montseny and Guilleries massif and it can be considered as a remarkable obstacle although the terrain features obligated to design the road building several and large bridges and tunnels that become as ecological corridors. So, in short, the ingoing connectivity of the study area is, as we said, very well; and the outgoing connectivity can be considered as close to suitable.



View of C-25 highway from Sant Hilari hill. It's possible to observe two bridges and one tunnel although there are more of them along its path.

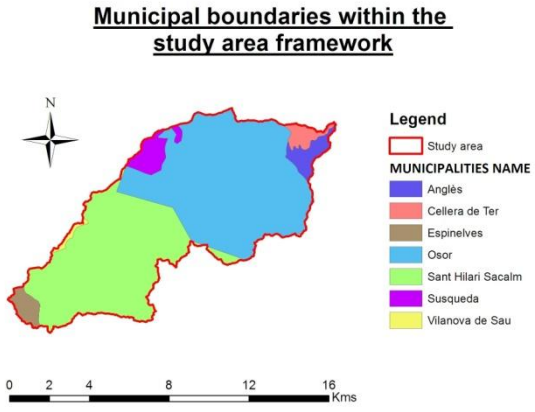
SWOT ANALYSIS

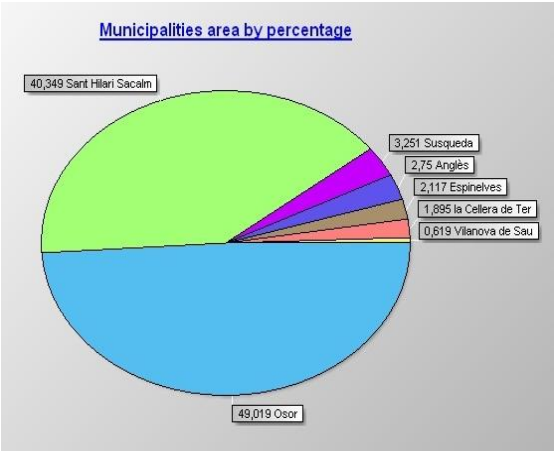
WILDLIFE	
STRENGTHS	**WEAKNESSES**
- The large amount of wildlife species resident in the study area - The reduced number of deathanimals by car crash. - The good outgoing and internal ecological connectivity of the area	- The infrastructures build by humans intervene in the natural working of the ecosystems and the biodiversity. - The C-25 highway supposes a problem for the outgoing ecological connectivity in some spots. - The presence of the wild boar hybrid. - The presence of reduced populations of some species caused by human interaction.
OPPORTUNITIES	**THREATS**
- The conservation of all the species in the study area helps to guarantee a rich biodiversity. - The recovering of endangered species would cause an enrichment of the biodiversity	- The wild boar hybrid could become a problem without the current balancing system (hunting) - The presence of the European mink could generate imbalances in the biodiversity and its protection avoids the chance of intervention.

5.10.- ADMINISTATIVE BOUNDARIES & PROTECTION FIGURES

5.10.1.- Administrative boundaries

The studied territory is located in an area where there are several administrative borders. This is applicable as well when one speaks about the massif which contains our area, Les Guilleries. In this chapter, the aim of which is to study the different issues that can proceed from the presence of such boundaries, it will be showed the relation between the study area and the Guilleries massif with the administrative boundaries and protection figures which delimitates the region. The massif, as we said in previous chapters, becomes a problem when one tries to establish delimitations about. "The region belongs to two "comarques", two provinces and two bishops. And this is its main problem" (Antoni Pladevall, 2003). When the author affirms that this transboundary location is the main problem of the place, makes reference in the administration which is necessary to carry out a proper development for this natural area. The fact to being divided in different administrative areas decrease the capacity to manage the area as a unit, which may impair the territory and the study area by the fact to belong to it. The most basic administrative boundaries which affect the area are the municipalities. As we said, the study area contains two villages (Sant Hilari Sacalm & Osor), and is so close to a third one, where the brook ends (Anglès), which the town is not inside included but a neighborhood. Curiously, some of the neighborhoods we can find in this part are belonging to the La Cellera de Ter village, although being closer of Anglès municipality. These kinds of disseminations are common cause of the municipal boundaries. There is also another neighborhood located inside the study area, on Sant Benet Mountain, which belongs to Susqueda municipality but it's located next to Osor village. As last, there is a small part of the upper course following its northern border which belongs to Vilanova de Sau, and another one just in the south-western edge of the area, to Espinelves. Generally, however, the main municipal areas of the territory are Sant Hilari and Osor, as we said, which

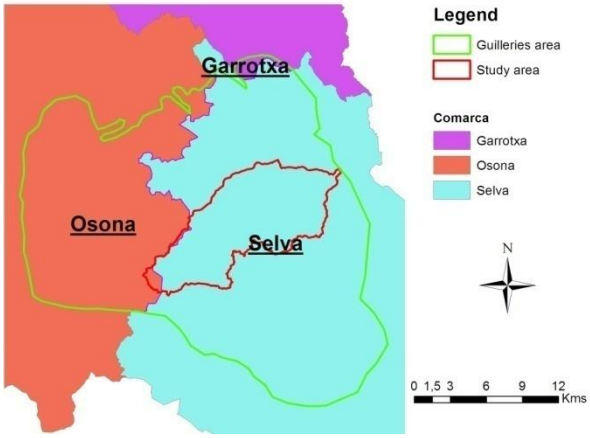




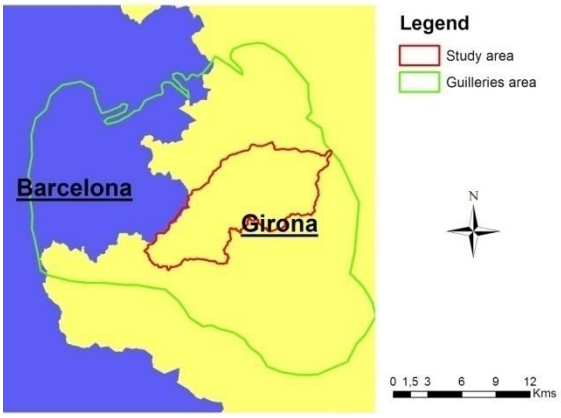
occupies the 40.3% and the 49.01% of the total surface respectively, being Osor the one with more extension.

About Guilleries, we already explained in the introduction chapter the municipal composition of the massif and it will be explained again in the proposals chapter, so is not necessary to introduce to topic in the present chapter. Furthermore, the municipal boundaries are the ones which less affect the territory in the way explained above. A delimitation which affects Guilleries on greater degree is, for example, the comarques. The comarca is used to carry out a management of a larger territory and that derives in more landscape planning and economic capacity. The study area is almost not affected by the comarcal division and there is just an area of 243.52 ha (2.73% of the studied area surface) which belongs to the Osona comarca in coincidence with the Vilanova de Sau and Espinelves boundaries. The rest of the territory belongs to La Selva comarca (8664.5 ha and 97.27 % of the area). On the other hand, Guilleries massif becomes a bit more complicated. It's basically split by the two named comarques (Osona, 34.48% of its total surface (19914.44 ha) and La Selva, 64.82% (37440.18 ha)) and, although that with a small surface, by a third one, La Garrotxa. (0.70 %, 403.1 ha). This major division is also observed in the provincial delimitation. The provinces are the next administrative figure after the comarca by size. The ones which are present in the study area are the Barcelona and the Girona provinces. Usually, the provinces are formed by a comarques group but there are exceptions. In Guilleries there are, for instance, the municipalities of Viladrau and Espinelves which belongs to the Osona comarca and, although this comarca belongs to Barcelona Province, this does not happen with the two named towns, which belongs to Girona Province. It's for this reason that the effect of provincial division to the study area is almost null (just 0.62 % of the surface belongs to Barcelona.) Back to the line, however, as happened above, the provincial division divides the massif between Barcelona (16633.86 ha – 28.8 %) and Girona (41123.86 ha – 71.2 %).

Comarcal boundaries within the study area & Guilleries framework



Provincial boundaries within the study area & Guilleries framework



Besides of the administrative division, study area and Guilleries have other divisions which are related with natural protection figures possible to find within the Catalan territory. The first of them is the named PEIN.

5.10.2.- The PEINs and the ENPEs

There is a long tradition of protecting nature in Catalonia, going back to the end of the 19th century with the emergence of the mountaineering, hiking and rambling movement (it is worth remembering that the Catalan Mountaineering Association was founded in 1873). The first regulations laid down by the Administration in this respect were in the 1930s, mainly during the Second Republic. However, it was not until some years later that the State Administration, firstly, and later on the Autonomous Government, decided to intervene and legislate on this issue, which means that most of the protection agencies are relatively recent. Meanwhile, in the 1970s, in the framework of the work and sessions on territorial planning, the Congress of Catalan Culture discussed the problem of the deterioration of the natural environment, and in 1985 it approved the Law on Natural Areas, and mainly after the enactment of the Plan for Areas of Natural Interest (PEIN) the issue was institutionalized and achieved an interest that continues today.

We could say that there are three traits that characterize natural areas in Catalonia: their tremendous diversity and biological variety; the intensive humanization that these areas and catchment areas have had to endure, and finally their relative proximity to densely populated urban areas. These characteristics are what have justified the conservation of large swathes of land in Catalonia under different levels of protection in order to “ensure the continuity of many of our landscapes, foster their wealth and diversity, and also reserve part of this land to guarantee the viability of natural balance and the conservation of living resources” (Department of the Environment of the Generalitat of Catalonia).

The protection of natural areas is consistent with the European Union’s Maastricht Treaty, which sets the Community the objective of “promoting sustainable development that respects the environment”. The main purpose of protected natural areas is to preserve their biodiversity, but there are other reasons of a scientific and educational nature, and there is also a need for economic development, especially, but not exclusively, for rural areas at risk of demographic or economic decline.

Aside from the general legislation that applies to the whole of Catalonia, regardless of the territorial sphere, concerning any form of nature conservation regulations (forestry, urban, coasts, etc.), there are two levels of protection:

- The PEIN (Plan for Areas of Natural Interest)

- Natural Areas of Special Protection

The PEIN sets out the legal system for regions that contain natural assets of general interest. The PEIN tries to avoid, in the demarcated region, any possible changes or major transformations in industrial or urban development activities, seeking to conserve specific natural assets. The fact of being covered by the PEIN

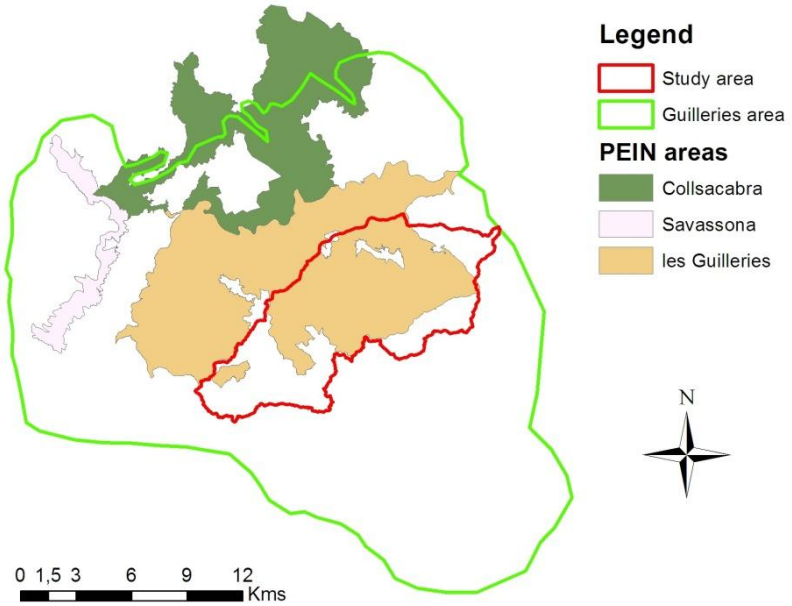
does not necessarily imply that there is a particular protected area management behind it; it is simply a demarcation. Meanwhile, these areas may subsequently have a regulation implemented which increases their level of protection, either by means of a special plan to demarcate the area, or through section environmental and landscape protection plans.

Natural areas with special protection can adopt any of the following systems: National Park, Natural Park, Natural Site of National Interest, or Nature Reserve. These spaces also form part of the PEIN, but they have their own legal regulatory system and, most importantly, their own management and therefore they are assigned resources from the Generalitat of Catalonia.

(**Source:** Generalitat de Catalunya – Departament de Medi ambient I habitatge)

Guilleries massif area contains three different PEIN spaces within. There are the named Guilleries PEIN, which is fully inside the massif and occupies an area of 12403.8 ha (21.47 % of massif surface); the Savassona PEIN, also fully included and with an area of 1211.88ha (2.1 %); and the Collsacabra PEIN, which is partially

Spaces of Natural Interest (PEIN) within the study area & Guilleries framework



contained in and occupies 4055.40 ha of Guilleries surface (7.02%). In total, the massif contains 17671,08 ha of PEIN spaces (30,6 %). About the study area, it contains just part the Guilleries PEIN, which occupies the area equivalent to the 57.54% of the Osor's brook watershed surface (5122.1 ha).

The PEIN plan, is highly related with the European Union Natura 2000 network, as we will see next.

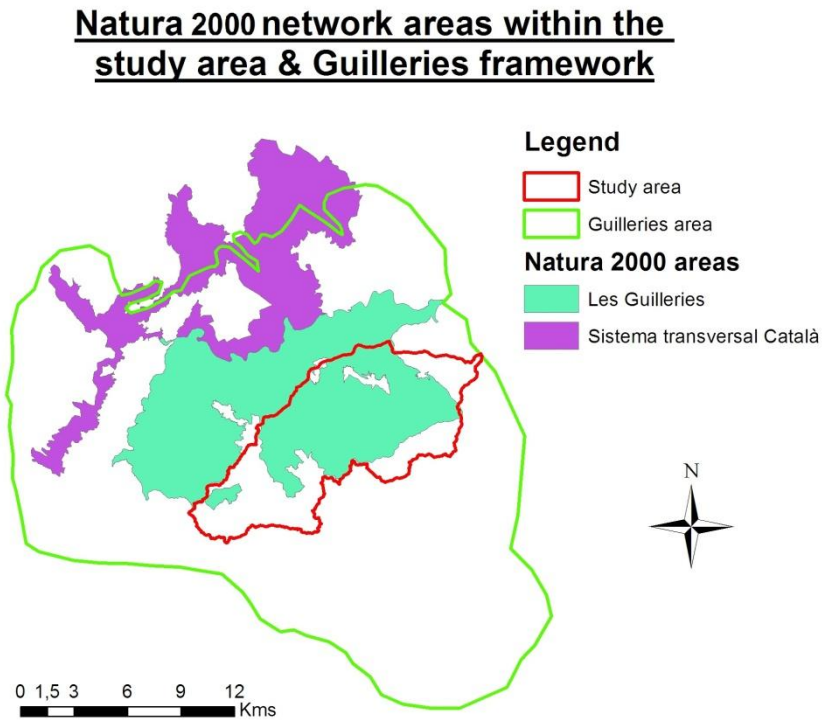
5.10.3.- Natura 2000

Natura 2000 is the centerpiece of EU nature & biodiversity policy. It is an EUwide network of nature protection areas established under the 1992 Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs) which they designate under the 1979 Birds Directive. Natura 2000 is not a system of strict nature reserves where all human activities are excluded. Whereas the network will certainly include nature reserves most of the land is likely to continue to be privately owned and the emphasis will be on ensuring that future management is sustainable, both ecologically and economically.The establishment of this network of protected areas also fulfils a Community obligation under the UN Convention on Biological Diversity.

Natura 2000 applies to Birds Sites and to Habitats Sites, which are divided into biogeographical regions. It also applies to the marine environment.

Source: European Comission website

Although we already spoke about the habitats directive on the vegetation chapter, which is also included within the Natura 2000 network framework, the delimitation Natura 2000 areas is also used in the Catalan



legislation frame and get some coincidence with the PEINs. Guilleries massif contains two Natura 2000 areas. The first of them matches with the Guilleries PEIN in extension and shape, and is also known as Guilleries.

o, the area contained within the study area is equal than the PEIN one. The second one would match with the area of Savassona and Collsacabra PEINs together. It is called Sistema Transversal and occupies and area of 5267.04 ha (9.12% of massif surface). The both are considered inside the Habitats Directive (SAC) and the Birds Directive (SPAs), fact that demonstrate the natural richness of the area.

Summarizing, the Guilleries massif is composed by several protection figures which should provide a proper degree of ecological conservation. Nevertheless, the split of the massif between two different administrative areas (Barcelona and Girona provinces / Osona and La Selva comarques) causes that the part which belongs to the division with more economic capacity (for instance, Barcelona province) may receive better attentions than the other part although being with less natural value (The massif area included on Girona province, without discrediting Barcelona's part, could be considered as the main Guilleries part.). On the other hand, the fact that the massif is divided in different comarques makes that the interest (and so the invested resources) to the area is minor in front of other areas which, in opinion of the Comarcal Council, need more attention cause is higher amount of population or other reasons. The study area, included in the Girona and La Selva's part of the massif, is impaired in this way.

SWOT ANALYSIS

ADMINISTATIVE BOUNDARIES & PROTECTION FIGURES	
STRENGTHS	**WEAKNESSES**
- Study area has a high percentage of PEIN and Natura 2000 network surface within(including habitats and bird protection zones). - Guilleries area includes three different PEIN areas and two Natura 2000 network sites within its surface (including habitats and bird protection zones).	- The division of Guilleries in different administrative boundaries hinders its proper management and this affects negatively the study area. - The Protection figures included in the area are inadequate to avoid the construction of macroinfrastructures (High tension power line, for instance) which harms severely its natural value. - Some kind of boundaries generates imbalances between the areas belonging to one area or another.
OPPORTUNITIES	**THREATS**
- Better management of the study area could be carried out if is included in a larger unit as Guilleries massif and its management can be done as a unit. - The different protection figures included in the area (also Guilleries) increase its natural value and could be reasons to help the area to get a better management.	- The current trend continuity makes weaker study area and Guilleries in front of future projects related with constructions or even in front of its current issues. - The imbalances generated by the boundaries in Guilleries may generate the losses of part of the ecological value in the areas with less economic capacity (study area).

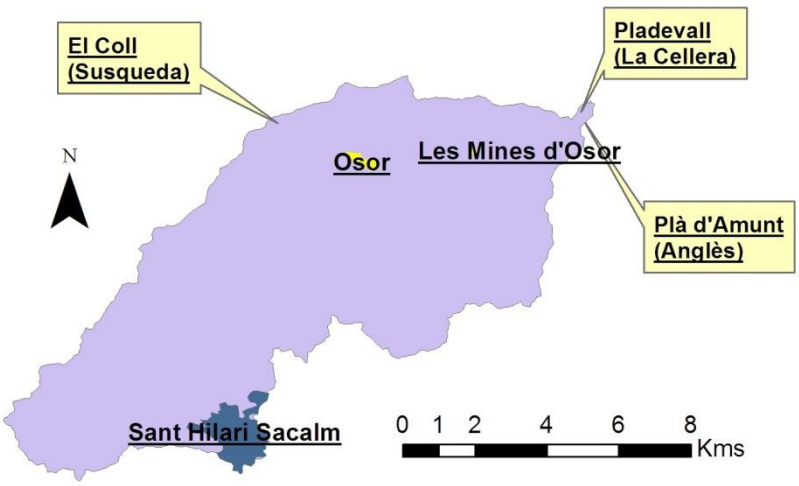
5.11.- DEMOGRAPHY & SETTLEMENTS

5.11.1.- General features

Statistical Nomenclator	
OSOR	
Osor Core	345
Les Mines d'Osor	7
Santa creu d'Horta	40
Disseminated	32
SANT HILARI SACALM	
Sant Hilari Core	5585
Disseminated	96
LA CELLERA DE TER	
Pladevall	133
ANGLÈS	
Pla d'amunt	104
SUSQUEDA	
El Coll	34
TOTAL STUDY AREA	6376

Study area is composed basically by the municipalities of Sant Hilari Sacalm and Osor (Anglès, which we mentioned previously doesn't have its core urbanized area in the borders of the study area). Nevertheless, there are other population spots included within the area. With the aim to compute the total population of the territory, it's important to take into account all the population points that one can find within. To carry out such action it has been used the system known as NOMENCAT 2012. The NOMENCAT 2012 goal is to provide a presentation of statistical Nomenclature of population entities in Catalunya, which contains the list of Infra population entities of the Catalan territory, with its population. This system so, allowed us to establish the total population of the study area in 6376 inhabitants. The majority of them belongs to Sant Hilari Sacalm village but there are as well others which comes from Osor village, El Coll (belonging to Susqueda town); located on Sant Benet Mountain, Pladevall (La Cellera de Ter) and Pla d'Amunt (Anglès); both located in the lower course of Osor's Brook, just before its discharge to Ter River. We could include than the study area population mean density is 71.64 inhab/km^2.

POPULATION CORES



5.11.2.- Osor

Osor is a town and municipality located in La Selva comarca. The name is of uncertain origin, but seems to be pre-Roman and refers to "Ausorum", i.e, the land of “ausetans” first and from Ausona county and diocese later. The municipality includes the urban neighborhoods and Les Mines d’Osor, Sant Creud’Horta, St. Gregori and St. Miquel de Ter. Osor Valley, where it is located, is surrounded by a rugged terrain

Its demography is based in a low population. The town has nowadays 452 inhabitants distributed between the populations cores expressed above. However this number, its municipal area has a considerable surface what derives in a so low population density (8.7 inhabitants/km^2).

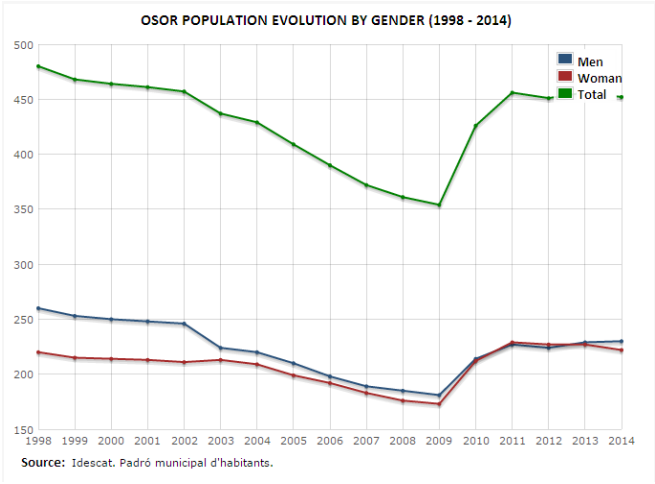
The population distribution by age is not so old, so there is only around the 25% of the population which is older than 65 years, data which usually is higher on other little isolated towns.

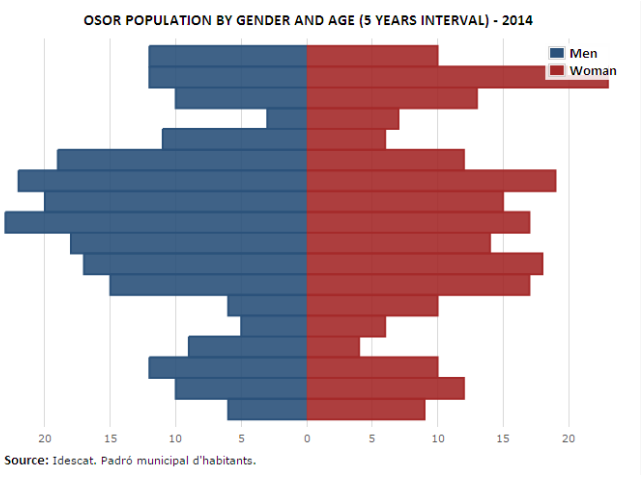
Its amount of population formed by immigration is relatively low (in contrast with Sant Hilari Sacalm, for instance).

The real problem which one can find in Osor is about its negative population balance. There are more deaths than births and that may affect negatively its future. The natural population increase is nowadays located at the -7.31 and the historical population trend graph shows a constant decreasing in its population during the last two decades (with the exception of the period between 2009 and 2011).

The gender distribution is, however, balanced on the other hand.

Osor Population	
Population density	
Surface (Km2)	52,1
Density (inhab/km2)	8,7
Population by ages	
From 0 to 14	59
From 15 to 64	286
From 65 to 84	85
From 84 to up	22
Total	452
Population by nationality	
Spanish	426
Foreign	26
Total	452
Births by gender (yearly)	
Men	1
Womans	0
Total	1
Deaths by gender (yearly)	
Men	4
Womans	1
Total	5
Evolution ‰	
Natural population increase	-7,31





5.11.3.- Sant Hilari Sacalm

Sant Hilari Sacalm is a town and municipality located in the Selva comarca located around 800 meters height. Traditionally it has been always called the Guilleries capital, being the main population of this natural region. It is also called "The 100 springs town" due of in the municipality are counted over a hundred springs. One of its most important celebrations is the Via Crucis Vivent, traditional festival with around three centuries of history declared of national interest.

Sant Hilari Sacalm Population	
Population density	
Surface (Km2)	83,3
Density (inhab/km2)	68,2
Population by ages	
From 0 to 14	857
From 15 to 64	3.728
From 65 to 84	911
From 84 to up	185
Total	5.681
Population by nationality	
Spanish	4.733
Foreign	948
Total	5.681
Births by gender (yearly)	
Men	29
Womans	30
Total	59
Deaths by gender (yearly)	
Men	32
Womans	25
Total	57
Evolution ‰	
Natural population increase	0,91

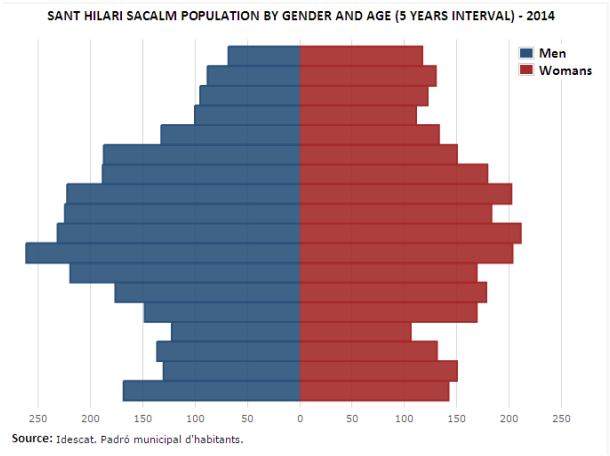
Its population is the largest demographical spot of all the study area. It represents the 89.1 % of the territory population. Contrarily than in Osor's case, Sant Hilari has not different population cores, being the main town and a disseminated area based in masos distributed around its area. There is as much the place known as Cal Sastre Urbanization which could be considered as another single core but its proximity to the main town avoids such possibility.

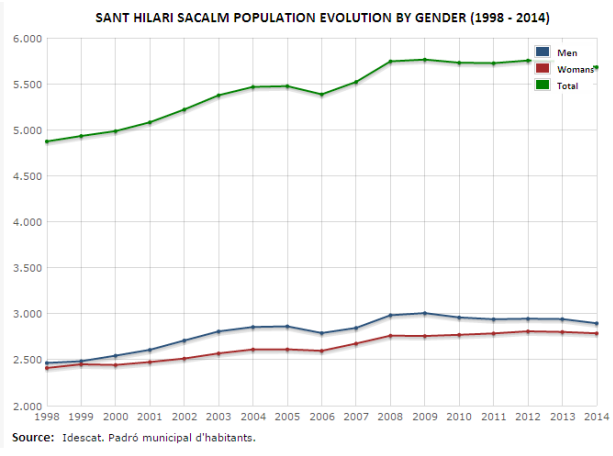
Its density of population is 68,2 inab/km^2 but this taking into account its whole municipal area. The real density in the urbanized area would be around the 2.400 inhab/km^2.

Almost the 20% of its population are over 65 years or old, what suggest a not high amount of aged population.

The 16,7 of its population is formed by immigrants which came especially to the job acquisition, what make belongs this group in young age interval (between ages from 20 to 40).

In general, the village population has a constant and slow increasing (the natural trend is 0.91) although the last years has suffered some phases of decreasing like the period 2005-2006 or the period 2009-2010.





SWOT ANALYSIS

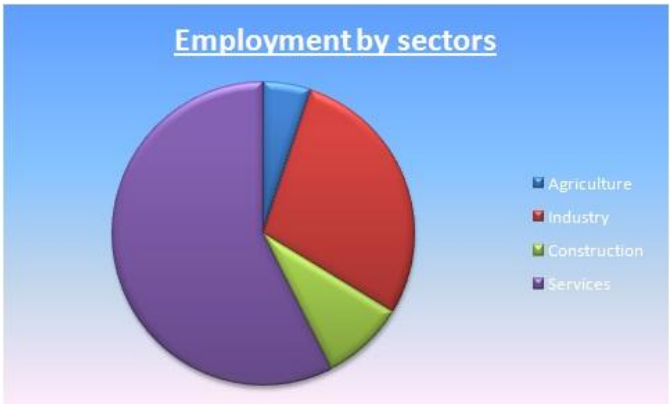
DEMOGRAPHY & SETTLEMENTS	
STRENGTHS	**WEAKNESSES**
- Low population of the study area helps to fewer effects in the territory due to the minor amount of activities and soil occupation. - Low population increases the natural value of the territory.	- The low population of study area hinder a better management because of its reduced economic capacity. - The size of the villages includes reduction of opportunities (formation, jobs, etc)
OPPORTUNITIES	**THREATS**
- Low population may be an attraction point for the foreigners, especially for the people living in more populated and noising areas. - Low population facilitates that it are needed less amount of success actions carried out to generate good results.	- Some population negative trends like in Osor town moves to population decrease and this is worrisome to the future sustain of the village. - The size of some villages and the lack of opportunities may generate young population running away. - In case of young people outgoing mobility, it could be produced a population aging.

5.12.- ECONOMY

5.12.1.- GENERAL DESCRIPTION

The economy of the study area is directly related with its population levels. The presence of just a few settlements (let's remember, just two municipalities and four small population cores) causes the limitation of economy level. However of that, such economy has its own features and is enough to guarantee, in more or less degree, the wellbeing and support of the inhabitants. In some way, the area economy keeps the features of the cultural old trend, with the difference than the little workshop converted to small companies or industry points and also there has been an increase of the services sector. Another remarkable change which worth to speak about is the already explained decreasing of the tourism. As we said previously, the area, especially Sant Hilari Sacalm village and surroundings, was a tourism hotspot during the first half of XX century but it disappeared causing the abandonment of its equipments and structures, leaving them obsoletes in some cases. However that touristic trend didn't disappear completely and looks like that the last years is recovering a part of its importance because of the revaluation of the nature tourism. An example of that are some new touristic places appeared recently like the Vilar Rural (A rural hotel), the Cabanyes als arbres (a forest hotel with huts on the trees) and the Balneari de la Font Vella (a spa). Some traditions of the area like the Via Crucis Vivent may have helped to this minimum level of tourism presence (During Easter, when is celebrated such festivity, the village receive an affluence of around 20.000 visitors) and to keep the name of the village. This increase of the touristic and service part has been so important to alleviate the recent losses in industrial and commercial way. The crisis which is affecting the zone during the last years decreased substantially the amount of business in the village. This happened as well on Osor village, which jointly with the decreasing demographical trend affected negatively its economy. In Osor, one of the worse economical moments was during the closure of its mines, leaving several people without work and causing the subsequent moving of people out searching for jobs. After this crisis process, but, it looks like the study area economy has entered in a period of stabilization, stopping the business closures although it left worrisome levels of unemployment (see tables Sant Hilari sacalm and Osor). Nowadays, the economy is based especially in the services, which represents more than the half of the employment. In some way, there is not in the study area a remarkable lack of services. As much, we can speak about the lack of nigh emergency health centers, which were removed a few years ago cause the state economic readjustments. In this way, presently it's just possible to find them in the neighbor town of Santa Coloma de Farners. About the rest, one can find all the basic services in the set of the territory. There is just a small lack of basic services in the Osor village (Secondary school or continued health attention, for instance) but these are

STUDY AREA ECONOMIC SECTOR		
Affiliations to general system of S.S. according to location. 2014		%
Agriculture	9	1,03
Industry	324	37,07
Construction	39	4,46
Services	502	57,44
Total	874	100,00
Affiliations of freelancers in the system of S.S. according to location. 2014		%
Agriculture	62	12,16
Industry	71	13,92
Construction	84	16,47
Services	293	57,45
Total	510	100,00
Employment by sectors		%
Agriculture	71	5,13
Industry	395	28,54
Construction	123	8,89
Services	795	57,44
Total	1384	100,00



offset by the Anglès town proximity. The rest; shops, touristic equipments, restaurants, sportive areas, etc, may be found without complications. In Sant Hilari village, because of its larger population proportion, the availability of all those services is higher so we can say that, in general, the services availability of the study area is appropriate.

The second pillar of the territory economy is the industry (over a quarter of the employment places), especially in Sant Hilari Sacalm area, where we find big and middlee industries like Font Vella S.A (water bottling) and MOCA (metallic pieces production), for instance. In Osor's area we could highlight the company Font del Subirà (water bottling). The general trend of the industry, however, is the middle and little businesses. In the both villages, is remarkable also the presence of the woodwork and the carpentry, which although is a sector which have lost much in comparison with its best times (it was the first industry by kinds two decades ago), is still an important sector within the study area industry. It happen a similar thing with the forestry. There is also an important production of cork and chestnut wood in the study area but the economical weight that acquires is higher than the impact in the workplaces that generates.

After the industry there are the construction, which although became an important sector several years ago it was the most affected sector by the economical crisis. In the area it's also based in the small size business.

SANT HILARI SACALM	
MACROMAGNITUDES	
Gross domestic product (base 2008). 2010	
GDP (million)	131.6
GDP per capita (thousands of euros)	23.9
GDP per capita (Catalonia Index = 100)	86.3
ECONOMIC SECTORS	
Utilised agricultural area (UAA). Hectares. 2009	
Cultivated land	143
Permanent pasture	137
Total	280
Cultivated land. By type of crop. Hectares. 2009	
Herbaceous	44
Fruit	8
Olive tree	0
Vineyard	0
Other	91
Total	143
Livestock by species. 2009	
Bovine	0
Sheep	526
Goats	6920
Porcine	1318
Poultry	7
Mother rabbits	296
Equine	4
Tourist accommodation. 2013	
Hotels	8
Hotels Places	486
Campings	0
camping places	0
Rural tourism	8
Rural tourism places	73
WORK PLACES	
Population in relation to activity. 2011	
People employed	2272
Unemployed population	837
Workforce	3109
Inactive population	2602
Population 16 years and over	4860
Affiliations to general system of S.S. according to location. 2014	
Agriculture	9
Industry	299
Construction	34
Services	472
Total	814
Affiliations of freelancers in the system of S.S. according to location. 2014	
Agriculture	55
Industry	66
Construction	74
Services	272
Total	467
Source: IDESCAT	

As last, is possible to find the agriculture. The agriculture sector, composed by farming and stockbreeding, plays a discreet paper within the territory. It highlights the herbaceous cultivation with forage and cereal grain (wheat and barley) to the farming part; and porcine, goats and sheep breeding for the stockbreeding.

It's as well important to highlight the presence of the nurseries, which in study area reaches levels that could make it comparable with an industry (see Vegetation chapter) although it's included in the agriculture sector. There is a paradox in this case cause, despite is one of the most important sectors by its surface extension and economy, this activity does not need a high amount of workers which derives in a relatively low number of generated workplaces.

OSOR	
ECONOMIC SECTORS	
Utilised agricultural area (UAA). Hectares. 2009	
Cultivated land	10
Permanent Pasture	4
Total	14
Cultivated land. By type of crop. Hectares. 2009	
Herbaceous	9
Fruit	1
Olive tree	0
Vineyard	0
Others	0
Total	10
Livestock by species. (2009)	
Bovine	0
Sheep	410
Goats	0
Porcine	0
Poultry	0
Mother rabbits	0
Equine	0
Tourist accommodation. (2013)	
Hotels	1
Places of hotels	18
Campings	1
Camping places	114
Rural tourism	2
Rural tourism Places	23
WORK PLACES	
Affiliations to general system of S.S. according to location. 2014	
Agriculture	0
Industry	25
Construction	5
Services	30
Total	60
Affiliations of freelancers in the system of S.S. according to location. 2014	
Agriculture	7
Industry	5
Construction	10
Services	21
Total	43
Source: IDESCAT	

Summarizing, the changes in the market affected basically negatively the industry of the study area, especially because the lower demand of wood products, which its production was the main activity during decades. The water bottling is in the limit, and an increase of its production could damage seriously its sustainability. On the other hand, the geomorphology of the area restricts the agriculture development, which is less competitive than in flatter areas with just the exception of goats and lambs breeding for the stockbreeding part and the nurseries for the cultivation part. So, looks like the services, most probably across the tourism restoration, are the most viable development point looking forward to the future. Especially across the Ecotourism, Rural tourism and Nature tourism typologies.

SWOT ANALYSIS

ECONOMY	
STRENGTHS	**WEAKNESSES**
- The prevalence of the some industrial companies in the area - The presence of bigger settlements (Vic, Girona) with more job opportunities close to the area - The presence of basic and other services is, thought not totally complete, appropriate.	- The current level of unemployed people - The lack of job opportunities in the area - Lack of capital for industry or workplaces generation.
OPPORTUNITIES	**THREATS**
- The presence of several touristic equipments and services avoid the necessity of its creation in case of tourism affluence increase. - Enough equipments and services for touristic absorbance. - There is place for new future industries without destroy natural areas.	- Some kind of new industries could become harmful for the ecological system - The future lost of more work places.

PART III: FINAL RESULTS

6.FINAL SWOT AND ACTION LINES

In the present chapter will be the description of the final results obtained in the project. In the first place there will be the final SWOT analysis results, with its summary. The following step will be the presentation of the lines of action or intervention lines. These determine the diverse proposals or recommended measures which are presented as the author's solution suggestions and are also presented in the chapter. As last, it will be the presentation of the additional results obtained throughout the process.

6.1.-Final SWOT

The final SWOT is the first major result which was the aim of the present document. This contains the main characteristics of the study area (strengths and weaknesses) as well as their future projection (Opportunities and threats).

FINAL SWOT
STRENGTHS
- Guilleries massif is an important natural area as isproved by the resultsof several documents and studies produced about it. Within the massifare three different PEIN areas and two Natura 2000 network sites. Its importance is significant enough that some authors considered it a natural comarca. - Study area is basically covered by natural landscapes, mainly by forestsdue to the abandonment of agriculture in the area during the last century. Also, the current form of forest management hardly effects the vegetation cover. The natural cover has a rich and large variety of vegetation species, which, combined with the presence of several relief forms and the high number of water courses, increases the natural value of the area substantially, as is possible to see by the variety of habitats which are of interest to the community. One of these habitats has a high degree of protection. The vegetation also helps to the stabilization of the landscape, helping the soil fixation and decreasing its erodibility. - The area has a large degree of biodiversity and a variety of ecosystems due to the variety of

topographical relief which is present, several kinds of clime, vegetation, soil and a rich wildlife (benefited by the good outgoing and internal ecological connectivity). The ecological connectivity is increased thanks of the surface water network (formed by several tributaries with different features), a rich groundwater system and a low level of population. It is possible to find inside important and unique elements like a rich variety of geological elements (some of the most complete and ancient Paleozoic metamorphic rocks of Catalunya in Osor's brook area or the Guilleries red conglomerates.) and the high percentage of PEIN and Natura 2000 network surface (including habitats and bird protection zones).

- The area has several attractive features like soft temperatures during the summer (in contrast with typical Mediterranean areas which surround the zone), a simple internal mobility and good access to the area and the complete presence of basic services. We could include here other minor elements like the amount of species of mushrooms that the area produces between spring and autumn or the presence of the high amount of natural springs with potable water in the area.

- Although the area is affected by some issues or negative elements, the impacts are not extreme. Examples of these could be the electric powerlines, which have a lot of impact on the area, but they are located in concrete spots leaving the rest of the area unaffected; or the number roads, which is low and generates a low impact. There is also a low, but present, fire risk; helped also by the semi arid weather in the area.There is also a low impact from the human population because of its size.

- The economy of the area is small but relatively stable for now, as we can observe with the prevalence of some industrial companies, and its shortcomings are helped by the presence of bigger settlements (Vic, Girona) with more job opportunities close to the area.

- There are existing processes and activities which help the natural conservation and protection like those carried out by the fishermen associations, the recent improvement of Sant Hilari's waste water station and creation of the Osor's one or the constant water monitoring and analysis of the natural springs to keep its quality high.

WEAKNESSES

- The importance of the place has decreased during the last decades which is evident by the abandonment of equipment and infrastructure. Nowadays the place is considered less important than some neighbor massifs, affecting its management and good conservation negatively. This is aggravated by the disaggregation caused by the several boundaries which split the area and the ineffectiveness of the

protection figure to which it belongs. The low population and economic problems also contribute to this lack of management capacity and the high amount of forested areas indicates low economic activity (i.e. presence of crops).

- The geology features of the zone hinder tourism appeal because of the lack of fossils, The lack of climbing areas because of the vegetation which covers the outcroppings. The fast erosion and the slope, furthermore, hamper the wide soil layer creation and increase the risk of landslide and rocks falling in some places like roads.

- The weather can be non pleasant because of the low temperatures or other climatic features, an element which affect negatively the touristic value of the area. Also because of the high number of non-paved roads it is difficult to access several spots. The summer drought affects negatively the hydrological network, drying the courses in some cases, and this may be worsened by the surface water and groundwater exchanges.

- The vegetation cover has a remarkable presence of introduced species. Some of them, together with the coppice dirtiness increase the risk of fire in some areas.

- There is a pollution problem on Osor's brook course by urban waste and chemical elements because of harmful activities and malfunctions in protection measures.There is little action by the authorities to resolve these problems and not enough support from the associations which are focused on that subject. Some of the projects carried out may be effective but needs time and high economical inversions.

- The wildlife is affected by some infrastructures and human activities. Some of them already caused imbalances in the environment. The wild boar hybrid introduction, the presence of high tension power lines, the lack of bird protection measures on the small ones or the external ecological connectivity interruption in some points by the C-25 presence are examples of that.

OPPORTUNITIES

- The area has several strong points as is possible to observe across the presence of a large amount of documents which speak about many of these features. The most important of them are related with the rich history of the area, especially for the banditry and the witchcraft; with its geology; the unique kinds of rocks and environments created by the natural processes; and with its natural and other physical conditions. The low population facilitates solving issues within the area, but in order to do it properly it

would be necessary to manage the area as a larger unit such as the Guilleries massif.

- Its natural conditions make the place unique and facilitate its conservation because there is a low urban pressure due to remoteness of large urbanized areas and the rugged terrain, which hamper the construction. The solving of some of the current problems, like the wastewater issue or biodiversity conservation measures, jointly with the current presence of some protection figures (PEIN or Birds & habitats sides) may contribute to the process of increasing the degree of protection and conservation. This, if carried out, would generate a better conservation of the biodiversity and the ecosystems.

- There are many attractive elements in the area which could be used to generate a touristic offer. The weather, the good connections, the proximity of other known spots (Reservoirs, Rupit and Tavertet hills, Montseny), the natural character of the area and its ecological richness, the hydrological system (brooks, aquifers, springs, etc…), the several kinds of activities (hiking, mountaineering, mushrooms collection, fishing, etc) or the low population are examples that. Besides that there are services and equipment with a capacity to absorb visitor fluxes and it is also possible to restore those that have become obsolete.

- There are also other economic opportunities aside from the tourism like the presence of adequate places for the new industry which could be established without a high environmental impact; the implementation of new soil uses taking a little part of forest surfaces without causing high damage; or the nature conservation tasks (coppice and hydrological system keeping, for instance) which would generate biomass production and workplaces.

THREATS

- There are some anthropogenic elements which can decrease the natural value of the area across its temporary continuity. The power lines are the most remarkable element, with visual impact, increase of fire risk and natural value loss, in the case of the high tension ones; and impacts on birds due to the lack of preventative measures in the case of the low tension ones. At the same time, some introduced species presence or and an increase in species which degrade soil may cause a decrease of the natural value of the area and loses in soil and water table quality.

- The biodiversity of the area may be affected by several elements in case of conservation measures establishment failure. Ter river proximity is a gateway from where invasive species may penetrate to the system as it has been seen with the case of the European mink, which is a problem because of the fact that it is an invasive species, but its protection status prevents intervention. But it could be also a problem if

other species like the American Red Crayfish (*Procambarus clarkii*) or the Signal Crayfish (*Pacifastacus leniusculus*) would penetrate the system because they could cause the disappearance of the autochthonous Crayfish, which is also affected by activities on brook riverside. These activities also may affect the rest of the stream ecosystem. Another element is the presence of the wild boar hybrid, the population of which needs to be controlled to avoid overpopulation.

- During the last years there has been some population loss in the area. This trend, if continues could become a problem which would affect negatively the economy and sustainability of the settlements and the conservation and protection capacity of the study area.

- There are different elements which could hinder the conservation tasks of the area like its ruggedness or the large wooded surface. The erosion and the flood presence could become a problem also in this way and even about human safety in the case of tourism increase (landslides on some roads or floods harmful effects risk).

- In case of betting for the tourism, there are elements which can decrease the touristic value like the weather (cold days or water bodies drought), the high amount of non-paved roads which may make the connectivity to some spots more difficult or the casual pollution of some springs water. Furthermore, the same tourism pressure may become a serious threat for the environments in case of appropriate measures are not developed.

- The imbalances generated by the boundaries in Guilleries and the Montseny presence as Natural Park (and area with higher natural value) may disturb the chances to increase the level of protection and conservation of the area.

6.1.1.- Summary

The area is composed from a large variety of natural elements like its lush vegetation, wide biodiversity, complex and rich hydrological system or unique orography, geology and variety of climes. All of that due to its location, low population and physical characteristics, which allows an environment with a low degree of harmful affect from humans. Also due to some nature conservation measures carried out over the time. Several protection figures and the studies performed over the years about the massif to which Guilleries belongs, proves that. The area is well connected with the surrounding areas but isolated enough to keep its natural features. The projection of the area with the proper intervention can be very positive, increasing its ecological value and its economy. All of that across measures to protect and help the recovering of its biodiversity, getting a natural area with a high landscape and ecological value and leading economic

development following the guidelines of sustainability. One of the activities which seem to have better projection on these lines would be the tourism sector motivation. Nevertheless the area also has several weak points and it's necessary to take them in account. There are pollution issues in some of the brooks which compose the hydrological system. This also create problems with the wildlife, also affected by the seasonality of the weather, the presence of some invasive or hybrid species and the activities along the brooks. Such activities also cause pressure on the health of the groundwater system. The vegetation cover is partly affected by the presence of introduced species in the forestry process, some of them with a high degree of soil impoverishment. There are infrastructures which affect the flora and wildlife of the area as well and also cause visual impacts. These may generate some future risks like the increasing of fire risk, the soil value decreasing or the lost of natural and ecological value of the area. Furthermore, there is an deficiency of conservation measures aggravated by the administrative fragmentation of Guilleries massif and the ruggedness of the terrain, which may make difficult the conservation tasks. Moreover, the economic and demographic negative trends of the area may result in study area abandonment, affecting, among others, the natural protection capacity. Most of those issues must be solved for the proper economic and ecological development of the area.

6.2.- Main Lines of action

After all the above process, it's possible to observe the most important hotspots that are present in the study area nowadays. Taking them into account, we can consider that there are some basic lines of action which should be followed with the aim to solve the main issues of the area and avoid its future problems or the creation of others. The lines extracted from these first conclusions to try to guarantee an improvement of the territory are the following:

1.- Increase the management of natural conservation to improve its intervention capacity and to ensure the preservation of its ecological values.

2.- Corrections of the current issues and he avoidance of the future ones related with the biodiversity caused by human activities or natural trends.

3.- Stimulate the economy of the place supplementing the existing sectors or creating new ones.

4.- Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks.

5.- Recovering old use or giving new utilities to the obsolete equipments of the area.

7.PROPOSALS

With the aim to help to solve some of the issues highlighted in the previous part of the present chapter and to give an example of how to follow the obtained mainlines, the next section will be dedicated to the presentation of some proposals which from the present document we recommend to carry out for the study sustainability and proper functioning of Osor's Brook hydrological system.

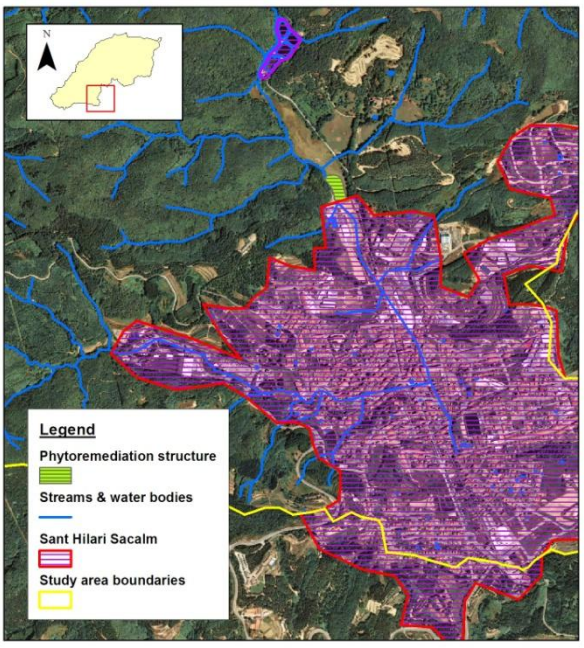
Before unveil them, however, it's necessary to remark that the following proposals are one of the most subjective parts of the work. So, they are just presented ideas which since the point of view of the author would help appropriately to solve most of the study area issues but most of them would need a deeper analysis and a second revision of them (especially in the cases where is needed an expert for concretes subjects) to ensure its real availability as it will be possible to observe across the non large development of them (which could be also subjects for future projects). Nevertheless, the main part of the proposals has been thought with its respective consultations to specialized sources with the aim to determine its viability.

7.1.- PROPOSAL 1

Sant Hilari's Brook phytoremediation marsh

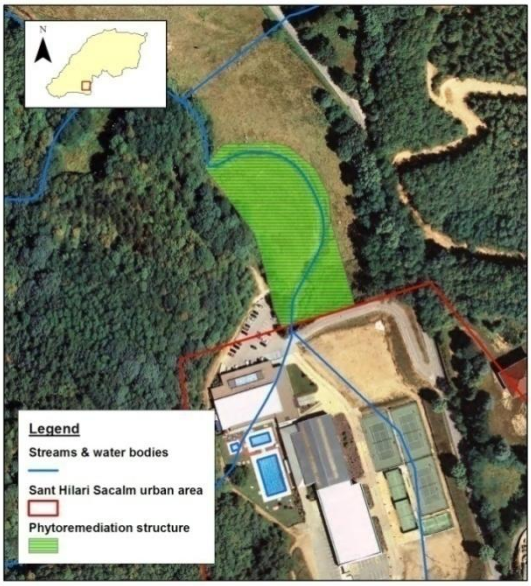
Description: For the problem of the Sant Hilari's brook splits by the waste water collection system malfunctioning and the fact that its correction works can become expensive, complicated and with realization at long-term; the proposed solution for the author point of view is the creation of a phytoremediation structure on the end of Sant Hilari urban area with the aim to clean the brook waters. This process could help to solve the pollution on the brook along all the duration of the water collection system problems reparation due of the fact that it's not a highly expensive action and achievable in a relatively reduced term.

SANT HILARI PHYTOREMEDIATION STRUCTURE LOCATION

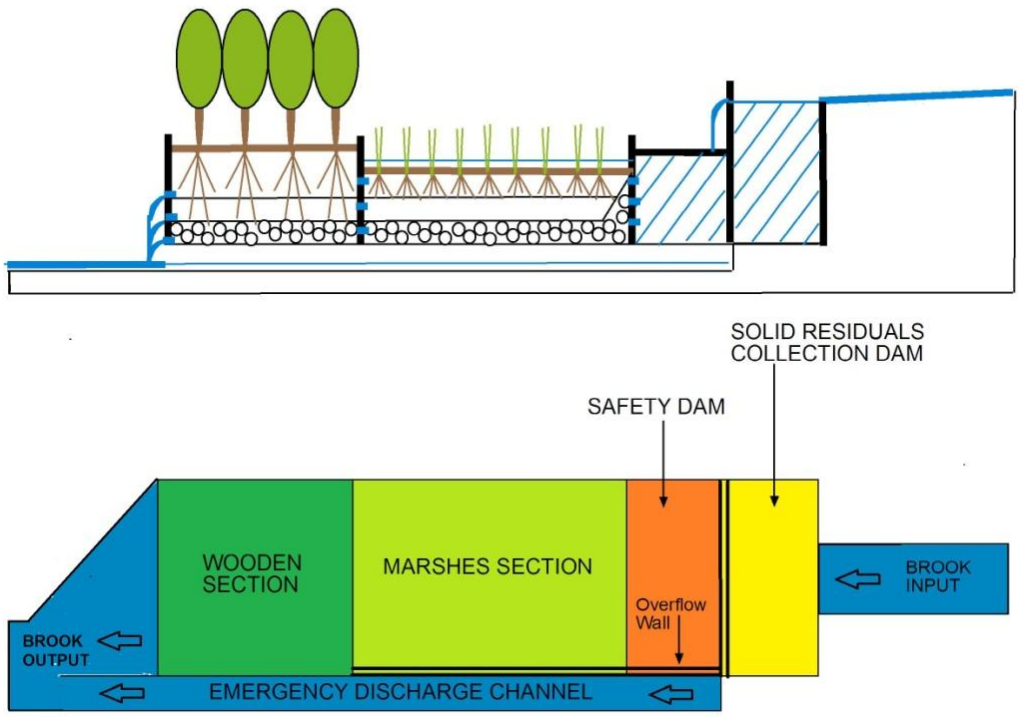


The process will consist on the building of four pools which would have different functions. The two lasts should be made with some waterproof material (concrete with internal parts covered by plastic is an option). On first place, it should be carried out the creation of a solid residual collection dam, which would help to clean the water from the bigger solid residues. After this, it would be a second dam which would be used to distribute the water properly into the phytoremediation pool accumulating the water to introduce it by several inputs at different heights across access valves and to protect the structures from the possible flows with an overflow wall approximately at the same height as the expected level of the water into the first remediation pool. This over flow wall would connect with an emergency discharge channel connected with the brook output at the end of the process. After this safety dam, we would find a first pool which would be an artificial marsh. The water level always would be a bit up of the soil level (made by several materials layer which would carry out at same time a water filtration process) to keep the species which will be used to carry out the main water cleaning. We propose to use Common Cattail (*Typha latifolia*) and Club-rush (*Scirpus lacustris*) to compose the marsh vegetation. This

SANT HILARI PHYTOREMEDIATION STRUCTURE LOCATION (II)



SANT HILARI BROOK PHYTOREMEDIATION STRUCTURE SCHEME



vegetation would extract part of the harmful substances of the water leaving it in a better condition for its following release. After that process the water would move to the last section, composed basically by wooden vegetation (we propose to use some varieties of *Salix* and *Populus*) which also could be accompanied by other herbs or minor bushes to increase the efficiency of the process. After this last process the water would be released to the brook course.

Expected issues during process: We expect to find troubles on the terrain obtaining cause it's a private property. It is necessary to deal with the owner for its purchase. For the other hand it is important to develop a deeper analysis for the sizes of the structure, which will be directly related with the infiltration rate of the kind soils and materials which will be used on the different layers of the third and forth pools as well as its proportions. Also is important to observe the behavior of the system in front the winter low temperatures an the frost periods. Another element to take in account is that during intense flooding the water diverted to the emergency discharge channel wont be remediated. As last, i front of possible dry periods it would be necessary to can regulate the low which pass across the different valves which are between pools to can keep, at least, the water level of the marsh secion.

Related Line/s of action: The related action line on the present proposal is the number two: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends.

Expected results: The decrease of high amount of nitrates, sulfurs and other pollutants mixed with the water. This would generate also an increase of the water quality and the improvement of the ecosystems related with the water course till its joining with Osor's Brook and further.

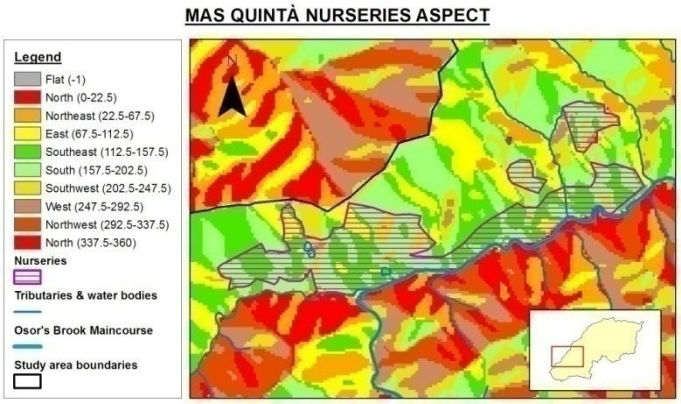
Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement.

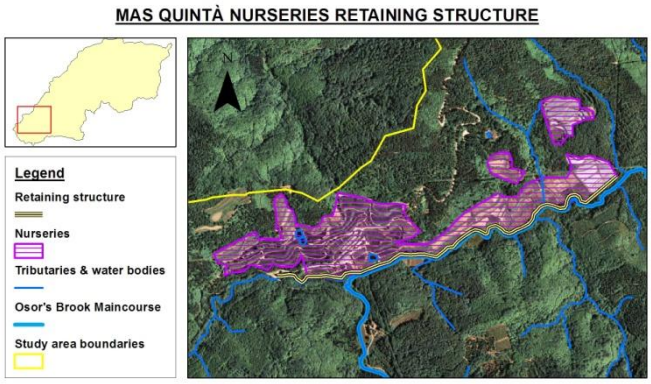
Implementation schedule: Short/middle term. The terrain and other studies as well as the structure construction can be made in a year or two. The vegetation species plantation is what can determine if the term gets more or less longer in case to start with young individuals or growth ones.

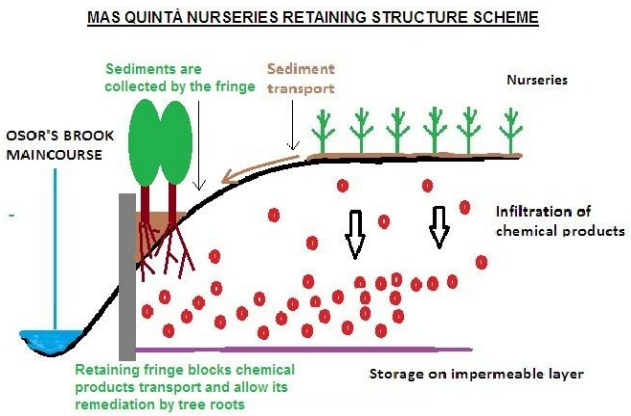
7.2.- PROPOSAL 2

Mas Quintà nurseries soil study and retaining fringe construction

Description: In front of the sediment transport which occurs on the upper part of the Mas Quintà Brook (Part of Osor's Brook Main course) and the prediction that chemicals stored in underground layers could be washed out in periods of high flow, the following proposal will try to determine the existence of such process and remediate it. The sediment transport it is already demonstrated and is caused by the weak soil fixation there is in nurseries together with a slope orientated to the brook as we can see on the side map. Thanks of this it's possible to appreciate that all the area covered by the nurseries is oriented to the south (with some variations to south-east and the south-west) which causes that the entire sediments generated by the erosion on the zone caused by the low soil fixation are transported to the water course. The chemical products accumulation, for the other hand, is something none demonstrated yet and is just a theory. With the aim to determining if the place is or not the reason of the sporadic poisonings of the brook during intense rainfall periods it will be necessary to carry out an in situ soil analysis of the place for diagnose the current state of the underground layers and verify the presence of the chemical products accumulated existence. The depth of the accumulation, however, asks for specialized hand on the process because it is unlikely to find results on the depths accessible by normal analysis with hand tools. After this first step, the second part of the proposal it is based in a retaining structure construction along the border of the nurseries with the brook. The structure will consists in a sediments blocking fringe which would help to stop the sediments transport to the stream. This structure would be helped by the construction of a wall that would hold the soil and the transported sediments and also by the plantation of trees







which would fix the soil to avoid its running away. Nevertheless, the results of the soil analysis would determine the final structure to be used. In case of negative results, the function of the fringe would be just to avoid the surface sediment transport which would be perfectly accomplished by the system explained above. But in case of positive results would be necessary a modification of the system, making the subjection wall base as deep as possible until arriving at the impermeable layer. After that, it would be important to move down the level where the fixing vegetation would be planted to make their roots accessible to the pollutants concentration and choose species with high absorption capacity. Examples of that could be the use of poplars genus (*Populus sp.*), willows (*Salix*) or other pesticides resistant trees or shrubs like the Norway Spruce (*Picea Abies*) or the Juniper (*Juniperus Communis*) which are able to resist high toxic pesticides like the 2,4-D, 2,4,5-T or the simazine (Karthikeyan, Davis, Erickson, Al-Khatib, Kulakow, Barnes, Hutchinson, Nurzhanova, 2004). However, in case of positive results on the soil analysis process it would be more information about the pollutant/s features that would allow determining the better species to use in the structure achievement.

Expected issues during process: The geomorphology of the area is the main problem which could make difficult the realization of the proposal. Especially because of the ruggedness of the terrain. A deeper terrain analysis will determine the difficulty degree of its construction. For the other side, another possible issue is the treatment with the owners, who can be in more or less degree disposed to help. On this same line, the determination of responsibility and, jointly, of who would be responsible for the project funding. To get better results, from this project is recommended the highest possible degree of funding by the administration to avoid impairment as much as possible the owners. However, if the used system didn't respect some of the soil laws it would be logic a higher degree of payment by the owners.

Related Line/s of action: The current proposal is basically related with the second line of action: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends.

Expected results: With this action we expect to avoid future cases like the autochthonous crayfish massive deaths and to ensure its population recovering as important part of the study area biodiversity. At the same time, the other expected result is to decrease the over sedimentation of several parts of the Mas Quintà brook, what generates loses of ecosystems and impair the biodiversity of the place.

Possible negative effects: The main negative effect in case of develops the present proposal is the visual impact which could cause the wall construction.

Implementation schedule/term: Middle term. To carry out the analysis operation is a short term action but the achievement of the retaining strcuture as well as its planification needs for a larger period of time.

7.3.- PROPOSAL 3

Study of Font Vella's case

Description: This proposal is important to find out if the information which says that Font Vella company spills occasionally chemically polluted water on the Sant Hilari's Brook is true for carry out the opportune measures. The proposal, then, will consist in the analysis of the water of the brook course which is just located after the last discharge channel coming from the factory. With the aim to avoid the fact that this analysis would just give results if the water is taken in the proper moment, point that could be complicated for the ignorance of the moments when such spills are done, the process will consist in the using of an element able to store the punctual polluted flows. The best, from our point of view is to set a water cage on the commented stream part with crustaceous and/or fishes within which can life into the water course normal conditions but which would be sensitive to the pollution. The death of such animals (fishes) or the analysis of them (as is possible to do with the crustaceous for its filtration habits) could give results about if the company is achieving polluting spills into the brook. To ensure the validity of such results and avoid baseless accusations it would be necessary to make a similar structure on the part of the brook before its arriving to the factory and, so, ensure that the pollution would come from the expected process.

Expected issues during process: The worse probable issue would come with the knowledge of the company about such study cause could proceed to stop the spills or change the place of its discharge.

Related Line/s of action: The present proposal is related with the second action line: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends. For the other hand the fact that it would be necessary a responsible to carry out the study generates also relation with the forth one: Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks.

Expected results: To determine the validity or not of the rumors to ensure the water quality of Sant Hilari's Brook.

Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement.

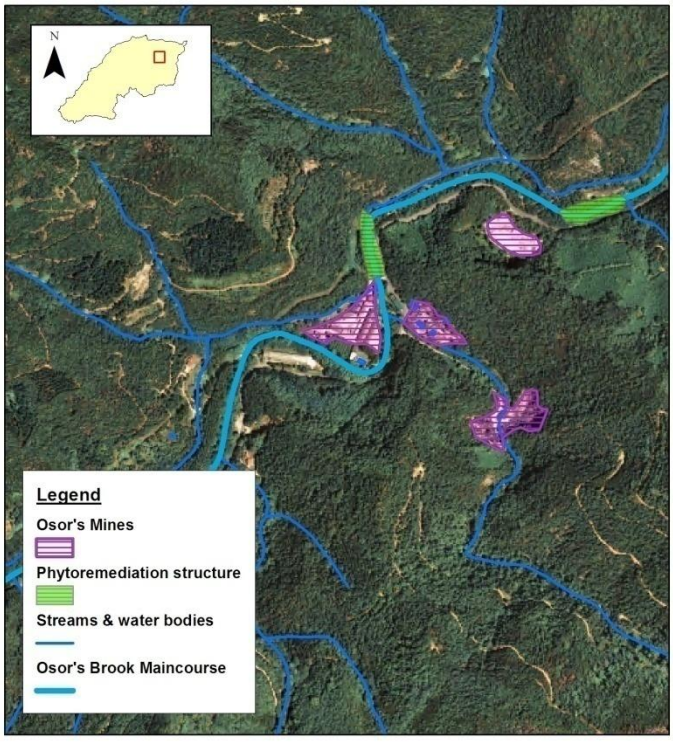
Implementation schedule/term: Short term. Possible to carry out in a period of one year approximately, or less in case to find results before.

7.4.- PROPOSAL 4

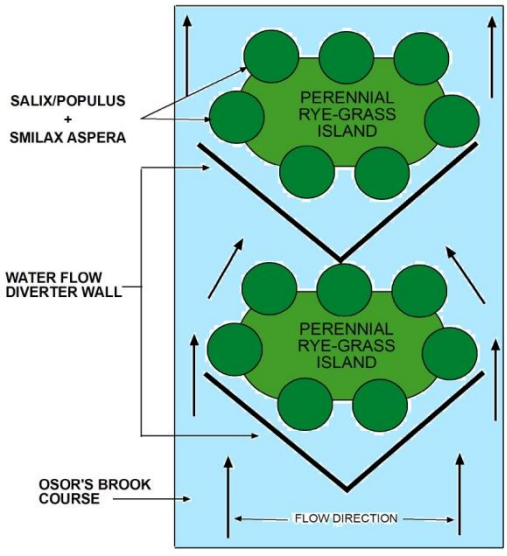
Osor's Mines phytoremediation system

Description: The present proposal is based in the implementation of a phytoremediation system on the lower course of Osor's Brooks just after its pass for Osor's Mines. As we explained on previous chapters, the pollution by metals on the water course has been properly demonstrated and this is higher than should be, what causes that the brook water quality becomes poor. Furthermore there are several problems which can be related to this issue like the presence of areas on the lower part of the brook which takes the water of the course to use it for agriculture (with all the human health problems which can cause) or the fact that it can arrive high concentration of metals to the humans across the food web. With the aim to try to fix that situation this proposal is based in the setting of phytoremediation structures. Concretely, it would be to action spots, when on the place just after the Osor's Mines and the second below, on the other side of the hill where the mines are located. These structures would be constructed on the middle of the course and would consist in islands of plants protected by flow diverter walls. This system will be used because is necessary to extract the metals directly from the water of the course or its bed. The highest concentration are probably located on the closest area of the pollutants source and for this reason the location is just next to the mines. The island would consist in green areas constructed a bit upper than the normal flow level formed basically by perennial rye-grass (*Lolium perenne*), which has been evaluated as high resistant and accumulator of metals, especially of zinc (Zn) and lead (Pb) (Gutierrez-Ginés, Hernández, Pastor, 2011), which is at the same more resistant to moist soils than other species of the same genus. It would be possible also to use other species which has been classified as good phytoremediation species like the Alpine Penny-grass (*Thlaspi caerulescens*) (Sierra, 2006), the corn (*Zea Mays*) (Bosch, Iglesias,

OSOR'S MINES PHYTOREMEDIATION STRUCTURES LOCATION



OSOR'S BROOK PHYTOREMEDIATION STRUCTURES SCHEME



Virgili, 2008) or the sunflower (*Helianthus annuus*). All these plants would help to extract part of the metals transported by the water. Besides of that, the islands edges would be planted with some wooden riparian species like *Populus* or *Salix*, which at the same time would become holders for the introduction of the common smilax (*Smilax aspera L*.), which also has been documented as a useful remediation plant for the metal polluted areas (Poschenrieder, Llugany, Lombini, Bech, Barceló, 2012). So, this wooden part would become a fixation for the soil of the island and, at the same time, another system for metals phytoextraction. As last, the part formed by the diverter walls would be created to protect the islands during the flow periods, so the structures must be highly resistant for the hardness of the water force during the floods.

Expected issues during process: One of the main issues expected in case of carry out the proposal is the possibility that high concentration of metals into the plants could become a problem if these are eaten by the wildlife. Is for this reason that should be necessary the protection of the islands by fences to avoid the faun entry, as well as the periodic withdrawal of the plants and reintroduction of young ones to remove the polluted biomass. For the other hand, another important issue is about the location of the polluted areas and the performance of the system. The stream bed is polluted along its entire course because the density of the metal particles, which are easily deposited on the bottom of the brook. That means that the total remediation of the course is difficult and the maximum effect of the system implementation is the reduction of the metal influx to the lower part of the water course. As last, it would be necessary to study if the selected plants could resist the conditions into the islands, especially because of the high amount of water around. In this case, would be interesting to take in account the using of water better adapted species like the named on the Proposal 1 (*Typha latifolia* and *Scirpus lacustris*). It should be also tested the effective functioning of the diverter walls.

Related Line/s of action: The proposal is based on the second action line: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends.

Expected results: The expected result, as we commented already above, is the reduction of the metals presence in the water course flow.

Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement but the non successful results of its implementation.

Implementation schedule/term: Middle term. To carry out the construction of the structures may be done in a relatively short time but the project previous studies and tests can make it longer. Then, the process will be a long term one because of the time necessary by the plants to clean areas affected by metal pollution.

7.5.- PROPOSAL 5

Osor Mines Restoration

Description: The proposal is based in the restoration of Osor's Mines as visitable place. The mines, closed in 1979, have eleven levels with a total depth of 290 meters. The mine was specialized on the extraction of fluorite, sphalerite and lead. The process would consist in the restoration of some of the galleries of the upper levels to make them visitable. It is logic to consider that the lower levels has a high degree of risk and for that reason is recommendable to avoid to try to restore them unless the experts would consider it available and safe. With this action it could be jointly the restoration of some of the old buildings to create a visitors center and a little museum of the mining in the place. In case of carry out such project, the place would become the tenth Catalunya visitable mine, the first lead and sphalerite mine of Girona's province (In Catalunya there are other two on Bellmunt de Priorat and on Vall d'Aran). The other mines can be used as model to follow during the restoration process. Also other mines around Europe. One example could be the Příbram Silver Mine on Czech Republic, which has similar features than the Osor case although being largely deeper.

Expected issues during process: The most probable problem which can be found along the process is the danger and difficulty to carry out the restoration. Depending of the current state of the mines this will be more or less secure. And this is important because the safety must be the main element to take in account to can offer the place to visitor with all the guarantees. Finally, it is necessary to consult to the already restored mines about the economical availability of the place.

Related Line/s of action: This proposal is related especially with the third action line: Stimulate the economy of the place supplementing the existing sectors or creating new ones; because it's addressed to increase the touristic attraction of the zone. At the same time, it is also related with the fifth line: Recovering of old use or giving new utilities to the obsolete equipments of the area.

Expected results: With this action it is expected to supplement the touristic sector in the area, create a few new workplaces and recover the use of obsolete structures. At the same time, the obtained benefits can help to repair the costs of its construction as well as allocate a part of them to ecological tasks like could be the achievement of the Proposal 4, directly related with place.

Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement but the possibility of not success as interesting point, which would suppose a loss of the invested money. However, for this reason on the section of expected issues it is recommended to consult such subject to the existing restored mines.

Implementation schedule/term: Depending of the current conditions of the mine tunnels and the difficulty of its restoration and the availability of financing the process may be a short term one, made in one, two or three years, or in middle terms (five or more).

7.6.- PROPOSAL 6

The brook as touristic attraction

Description: The Osor's Brook, with its cascades, gorgues, dense riparian forest and rock outcrops, has several spots with a high natural value and a high degreeof beauty which could be perfectly used as attraction point by the visitors. Despite that, its accessibility degree is low because it is often located on the bottom of cliffs or ravines with a high amount of vegetation and rugged slopes. These conditions only changes in the first parts of the upper course or in the last ones of the lower as well as in some tributaries, where at the same time the spectacularity of the place decreases. It's for this reason why, in the case of trying to use some of these spots as touristic points it would be necessary to carry out several arrangement actions. In first place it would be necessary to clean and adapt some of the accessibility ways to the place, which usually are in bad conditions, full of rocks and vegetation where it is even is difficult to distinguish the way from its surroundings. With this action, it would be possible the accessibility on foot or in car in some cases. After that, it would be necessary to arrange ways beside the brook to make it more suitable for the visitor. This ways would be just prepared as small ways with signaling and also some passages made by wood on the places with rugged conditions like may be the cascades or waterfalls. All of that, should be carried out taking seriously in account one single condition. The reduction as much as possible of the affect to the brook. It's for this reason that would be necessary to create a small route which just affects a little part of the course with the possibility to have some guides if necessary as well as keepers who ensure the good conditions of the area. The proposal from this work is to use the area around the place named "La Roca foradada" with a several hundreds of meters route.

Expected issues during process: The main issue is the ecological affect on of the place. Its well keeping is the most important aim to avoid the effects which the tourism usually causes on the territories which is applied. The kind of tourism in this case must be ecologic and sustainable. For the other hand the other issue probable to find is in case the proposals are not carried out like the three first ones because the state of the brook, especially for the quality of its water and the garbage that occasionally is found on the river side, is nowadays not proper enough to offer it to the visitor. As last, the fact the natural elements like the floods may make difficult the keeping of the ways, passages and signals.

Related Line/s of action: The current proposal is related with three of the lines of action. Firstly with the third: Stimulate the economy of the place supplementing the existing sectors or creating new ones. In second place by the forth: Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks; because the conservation tasks would be necessary to insure to not affect the place by the tourism and the same time can offer a quality place to the visitor. As last, by the fifth action line: Recovering old use or giving new utilities to the obsolete equipments of the area; because it would be a recovering of some of the old forest roads of the area, most of them impassable nowadays.

Expected results: With this proposal we expect to increase the touristic attraction capacity of the place, generating a few new workplaces and providing to the services of the area, like restaurants, shops or others, a higher influx of visitors.

Possible negative effects: The ones which we expressed above, especially the possible damage which could be caused to the brook ecosystem in case of don't carry out the performance of the action in a proper way. This could happen as well by the disrespect of the visitor to the natural environment.

Implementation schedule/term: Short term. Its design and construction is easy and can be carried out in less than one year. For the other side, the popularization of the activity could take longer.

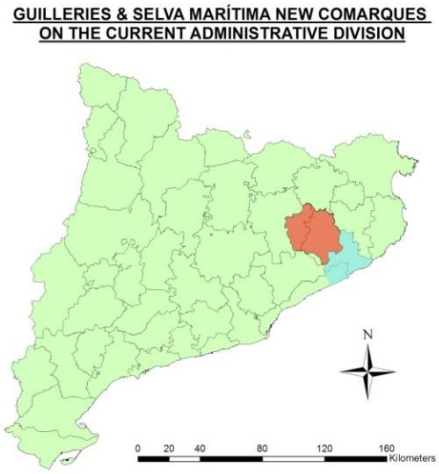
7.7.- PROPOSAL 7

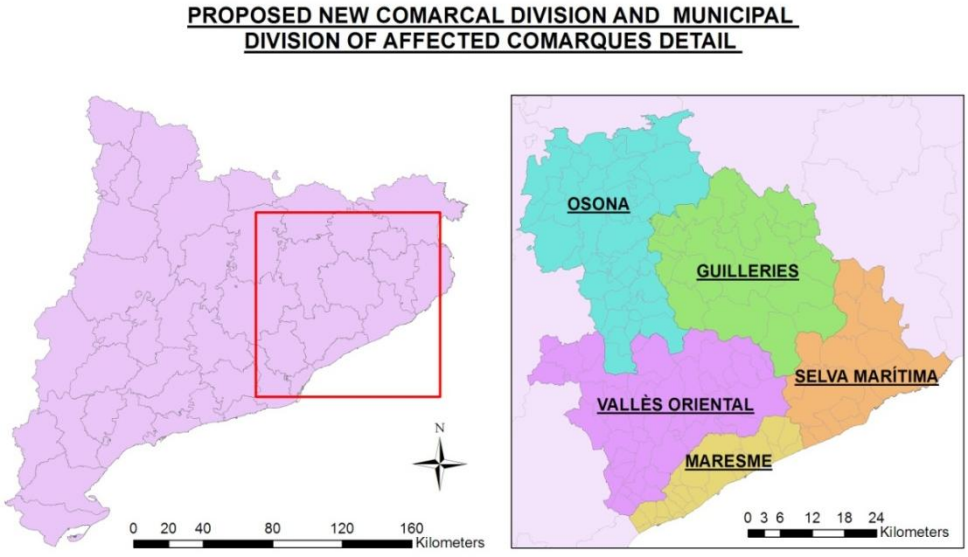
"Les Guilleries" comarca creation

Description: This proposal is based in the creation of a new comarca with Guilleries as core. As we have seen before, there have been several authors along the time which considered Guilleries as a natural comarca. However, the current situation is that Guilleries is fragmented between different administrative boundaries and this fact reduces strongly the capacity to manage it in a proper way. This is the reason of the present proposal, which has the aim to provide Guilleries with a united administrative structure and its own management capacity. At the same time, it will be related with the creation of Maritime Selva Comarca. Nowadays, Selva Comarca has a issue with its double capitality. The official capital is Santa Coloma de Farners but there is another city on the comarca, Blanes, which exceeds over three times Santa Coloma's population (12.448 in front of 39.785 inhabitants in Blanes) and has elements which are usually in the official capital as could be the comarcal hospital. This situation has been during many years a debate subject. The Selva Marítima idea was proposed on December of 2000 by the Report on the review of the territorial organizational model of Catalunya, carried out by the Catalan Government. The Roca Report (as is known popularly this document) introduced the proposals of six new comarques creation and to change different

elements of the administration boundaries arrangement. One of these six new comarques it could be taken as case to follow to carry out the present proposal, the Moianès comarca, which was created on April of 2015, becoming the 42nd comarca of Catalunya. This case is so recent that is difficult to find the new comarca into the shapefile database available and is for this reason that on the following used maps this comarca won't appear. Back to the main line, the process of its creation is the one which will be followed for the present proposal.

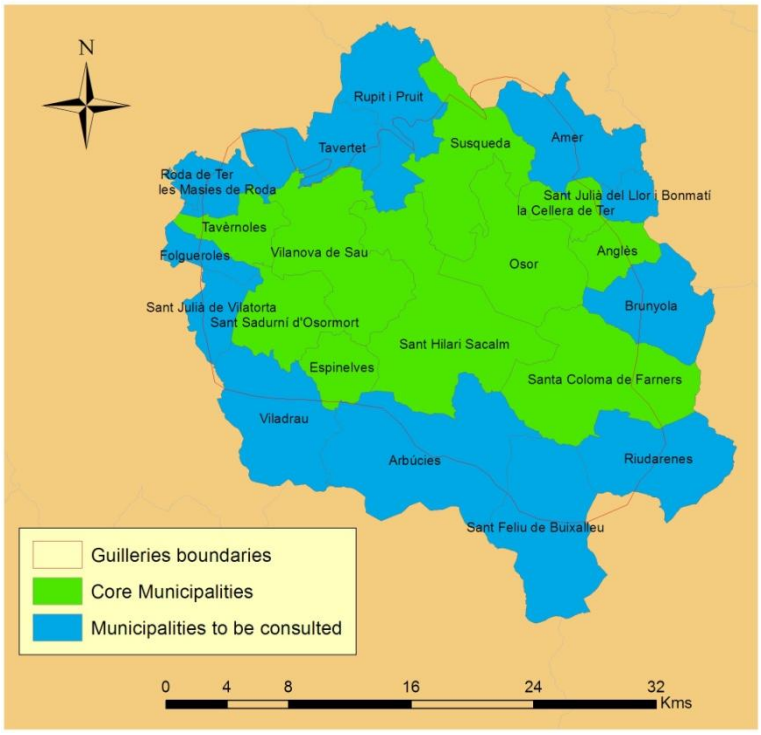
The creation of a new comarca is a process considered on the Legislative decree 4/2003, of 4th November. This document express that the power to create a new comarca belongs to the municipalities, the comarques and to the central government. The process consists in referendums carried out on the different municipalities which choose if they accept to be part of the new comarca. The final decision, however, is always in the hands of the central government. The idea in this case is to use the municipalities procedure but that means it must be a referendum in all the villages which would be affected by the new division. In our proposal it would be between three and four comarques which would be affected by this process. In first place, logically, the Selva comarca because this would be split into





two new comarques: Selva Marítima and Guilleries. Also would be affected the Maresme comarca, which loses villages by its joining to the new Selva Marítima comarca (this is already expressed on the Roca Report). For the other hand in the present proposal there is affected as well the Osona comarca, which would lose up to eleven villages; all the municipalities which are inside the Guilleries area. As last, the Vallès Oriental comarca could win some municipality in cause the split of Selva comarca if these municipalities consider it appropriate, but they also can join to any of the both new comarques. The proposal of the new comarca from this project would be based in Guilleries as a new single administrative area composed by between 10 and 22 municipalities. This range is because there are 10 municipalities which are considered as basic ones and 12 others can choose where to belong. This second group could be expanded by other two municipilaties which have been not included on the side map; Sils and Breda. Nevertheless, is important to express that all the municipalities can choose whether or not to the new boundaries. In this line, the process to carry out such action have to be firstly based on the consultation of folks opinion across single referendums or surveys, followed by the inter-municipal connectivity trends or territorial elements study to determine which of the villages really may be benefited and/or desire to participate in the process, including the ones which would belong to Selva Maritima comarca because the process would be altogether between the two new comarques creation; Selva Marítima (with Blanes as capital) & Guilleries (with Santa Coloma de Farners as capital). After the final arrangement of the new territorial composition, it would be carried out the pertinent referendum and, depending of its result, the moving of the proposal to the central government which would decide in last instance the approval of the project.

NEW GUILLERIES COMARCA MUNICIPALITIES



Expected issues during process: There are several of them. The most important of them is the opposition by some municipalities contradictory to the acceptance of others. This may make difficult significantly the process performance. It can be, also, cases where a village may desire to be part of the new comarca but if this is just connected to it by the presence of a village who decide to not participate the first one cannot be attached to the new comarca because is necessary a territorial continuity by law. Also in situations where a

town may be included in one area although to have better connectivity with its old comarca villages. The provincial boundaries also may affect the area because it could be territorial problems like the belonging of one village to one province and to one comarca which may belong to another province. This case happens nowadays in the municipalities of Viladrau and Espinelves. In general, to avoid all the possible issues is important to elaborate a complete report of the situation of the area, with all the data necessary to determine if the process can be achieved and also the most suitable way to carry it out in case of implementation. As we said previously, the current proposals are just ideas which need deeper analysis, better elaboration and a second studying with the necessary modifications before they are carried out.

Related Line/s of action: It's is related especially with the first of the action lines, Increase the management of natural conservation to improve its intervention capacity and to ensure the preservation of its ecological values. However of that, the performance of this action could also be favorable for the other ones because the increase of the intervention capacity which would win the place and the fact that Guilleries massif (and study area as part of it) would occupy most of the comarca surface, which would cause that most of the invested capital would affect the massif.

Expected results: The expected results are based on the creation of Guilleries new comarca jointly with Selva Marítima new comarca. This process would allow a better management of the Guilleries area as a unit, gaining capacity to carry out action to benefit its inhabitants and environment and solving, at the same time, the double capitality problem present nowadays in Selva Comarca.

Possible negative effects: The loss of the coastal part of the comarca (which is as well the most touristic one) or the Blanes and Lloret economic contribution to the comarca (with the highest GDPs of the comarca) may reduce the economic capacity of the new region.

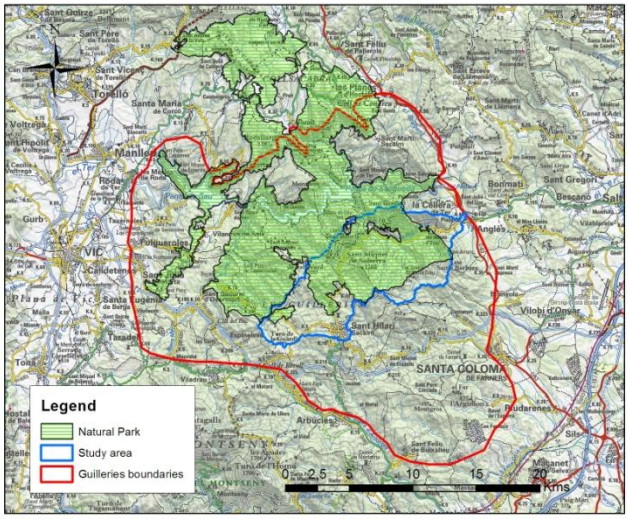
Implementation schedule/term: Middle/Long term. The process in Moianès case lasted over ten years since the first requests and actions. And it was started with a certain existing initial consensus which doesn't exist nowadays with Guilleries municipalities. That could mean a longer process than in the named case.

7.8.- PROPOSAL 8

Guilleries-Collsacabra Natural Park

Description: The Guilleries-Collsacabra Natural Park creation is a proposal elaborated especially to increase the protection level of Guilleries area with the aim to give to the area a real protection. Nowadays the area is under PEIN figure which is not very effective on the natural and ecological protection lines as it was observed with the allocation of the High Tension powerline route (MAT) within its area. With the aim to avoid future actions on territory with this level of damage on the environment the increasing of the protection level is necessary. The high natural value of the area has been already highlighted on previous chapters (Priority and non priority interest habitats, PEIN, Bird protection areas, protected species, etc) and such elements presence is what increase the protection necessity of the area. The project would consist on the creation of the Natural Park Guilleries-Collsacabra, which would be composed of the current areas included into the Guilleries, Collsacabra and Savassona PEINs. The reason of this union comes from the necessity to become an important natural area, as can be the neighbor Montseny massif, and the joining of these three natural areas generates an area with a high ecological values comparable with the Montseny massif. The proximity and continuity between them facilitates such joining. The final area would have a surface of over 24.470ha. One of the most important reasons of the creation of this Natural Park, is to guarantee the ecological connectivity in Catalunya across the conservation of these areas which are the connection point for the wildlife between the Catalan Pre-coastal Range(with Montseny Natural Park) and the Transversal Range (With La Garrotxa Natural Park and), creating one of the cornerstones of the Catalan ecological connectivity. So, taking in account what the LAW 12/1985 of 13 June, of natural areas says about the Natural Parks description: “Natural parks are natural areas that have qualified natural values, protection of which is done with the aim of achieving their conservation in a manner compatible with the orderly use of their resources and activity of their inhabitants.” And considering that the ones named above are enough reasons to demonstrate that the area deserves to be qualified, the viability of the proposal is evident. The same expressed law stipulates that the organisms with the authority to request the natural park creation are the local entities or the owners of the area in addition to the central government. In this case, the recommendation from this work is to start the process across the halls of the municipalities included on the PEIN areas which compose the proposed Natural Park area.

GUILLERIES-COLLSACABRA NATURAL PARK



It would be also a sub-proposal included in the present one. In case of the creation of the Natural Park and depending of the tested damages which the current High Tension Powerline may present it would be recommendable to divert it out of the Natural Park area. An option could be to use the pass of the C-25 highway to avoid the destruction of natural environment into and around the park.

Expected issues during process: It could be objections from the owners of the area which have exploitations or other economical interests on the area against the implementation of increased protection. In this case, however, should be necessary to deal with them taking in account that the natural park figure doesn't forbid the human activity and that all the basic rules of protection have to be written during the proposal document. The Natural Park is a figure arranged on the protection code V of the International Union for Conservation of Nature (IUCN) and about which says that the areas included in this category should promote a balance between people and nature and may include activities such as traditional agriculture and forestry activities carried out in conditions that ensure the protection and ecological restoration of the area. The category V is one of the most flexible categories of protected areas. As a result, you can integrate simultaneous activities such as ecotourism; in the same time that it remain traditional practices can facilitate the sustainability of agricultural and / or water biodiversity.

Another issue during its process it could be the denial from the central government to create of the park.

Related Line/s of action: The proposal is directly related with the first one:Increase the management of natural conservation to improve its intervention capacity and to ensure the preservation of its ecological values; and with the forth one: Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks; because the Natural Park management needs introduction of different territory agents to guarantee its conservation. Besides of that it could be indirectly related with the second and third lines: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends; because logically the main environmental issues would be solved faster within natural park protection, and stimulate the economy of the place supplementing the existing sectors or creating new ones.; because the Natural Park presence may increase the tourism attraction or generate newworkplaces.

Expected results: If the proposal is carried out the expected results is the proper level of protection on the area which would ensure the ecological and environmental conservation of the area jointly with the human activity sustainable development.

Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement but the non successful results of its implementation

Implementation schedule/term: Middle term. In case of fast consensus between the municipalities which compose the area and the success on the on the acceptation by the central government the term could

become even shorter. However, the procedures which are necessary to carry out this project point for a middle term action.

7.9.- PROPOSAL 9

Financing to the nature protection existing associations

Description: This proposal is based on the economical help to the associations which nowadays are carrying out actions with the aim to preserve the environment or help to its conservation. As we said previously some of these associations, like the fishermen association develop conservation tasks of some natural elements like the water courses without or with little support of the local administrations. To take advantage about the existence of such associations is important to support them and their actions across financing. This financing, however, should be used exclusively by restoration activities.

Expected issues during process: The only probable issue is the refusal of the administrations to provide such financing.

Related Line/s of action: This proposal is basically related with first line of action: Increase the management of natural conservation to improve its intervention capacity and to ensure the preservation of its ecological values, for one side. For the other is also related with the forthone: Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks.

Expected results: With this proposal, we expect to get a better capacity to develop conservation actions which these associations carry out. This fact could help to obtain a better quality on the natural values of the area and richer and better conserved ecosystems.

Possible negative effects: There haven't been appreciated possible negative effects caused by this proposal achievement but the non successful results of its implementation.

Implementation schedule/term: Short term. The achievement of the financing may start at any moment. For the other hand, the results neither would delay a lot to appear but its perception would increase along the time.

7.10.- PROPOSAL 10

Create forest cleaner brigades

Description: The area has a remarkable part of its economy that has its provenance to the tourism. Part of this tourism is based on the natural routes in wooded areas. As we said previously the conservation of the coppice of the forest is poor in several cases and that may cause the loss of visual value of the forest. At the

same time, increases the risk of fire by fuel accumulation. With the aim to avoid this issues the present proposal is based in the creation forest cleaner brigades, which would carry out cleaning tasks on the coppice of the study area. This process, at the same time, would collect biomass which can be used for different activities like fertilizing of fields, using as fuel and so on. As last, it would be important to develop other keeping tasks related with the vegetation diseases control and mitigation.

Expected issues during process: There hasn't been appreciated possible issues presence during this proposal achievement but the lack of capital to carry it out.

Related Line/s of action: The proposal is basically related with the third action line, On one hand: Stimulate the economy of the place supplementing the existing sectors or creating new ones. And for the other hand, with the forth: Introduction of territory agents or increasing the support to existing ones to carry out conservation tasks.

Expected results: With the development of the present proposal is expected to get cleaner coppices, with more natural and visual value, also with a lower degree of fire risk and, at the same time, the generation of a few workplaces and the obtaining of biomass to use in different activities.

Possible negative effects: The high degree of cleaning may affect negatively the biodiversity. The cleaning must be done just removing the dead plants or the dense concentrations of species which might limit the ecological good functioning.

Implementation schedule/term: Short term. In a period of less than a year the brigade can be hired and the cleaning of the coppice started. The dirtiness of the places and the growing capacity of some would define how long a period the brigade needs to clean a section of the area.

7.11.- PROPOSAL 11

Bird-saver markers on the minor powerlines

Description: The following proposal is based on the installation of bird-saver markers on the minor lines which are along the territory. The minor lines don't present a high problem for its reduced size, especially in terms of visual impact. Moreover, its proximity with the wooded areas and the little size in itself may become an issue for some kind of birds, which occasionally collide with their cables and fall to the ground. This action especially happens with the bigger ones or the raptors. Although the study area doesn't have a high concentration of this kind of birds small populations are present in the area. Besides, is so difficult to compute the number of birds which may be affected by these accidents because just is possible to corroborate the accident across its direct observation due of, in case of survival or poor damage, the animal

its able to move away and, if contrarily the animal die or is strongly damaged, it's eaten by other predators quickly. For this reason would be recommendable to install this kind of devices which would allow the birds to distinguish the cables and avoid them.

Expected issues during process: There hasn't been appreciated possible issues presence during this proposal achievement but the lack of capital to carry it out.

Related Line/s of action: The proposal is related with the second line of action: Corrections of the current issues and the avoidance of the future ones related with the biodiversity caused by human activities or natural trends.

Expected results: With this measure we expect to reduce the bird deaths by collision with electric cables on the area. This could increase a bit the raptors and big birds presence on the study area.

Possible negative effects: The visual impact caused by the presence of the markers.

Implementation schedule/term: Short term. The action can be achieved in one or two months.

8.DISCUSSION

The results obtained after the project finalization follow the line expected with the aim of the work. These results are presented in three different ways: In first place observe the results obtained following the first goal, based on the determination and description of the main issues which affects the study area. In second place, the procedure carried out during the area monitoring and issues search gave us numerical data which will be used, as we said previously, for the future creation of a hydrological model of the study area water system. These two first will be evaluated in first place because of they have been obtained in first place, just after the finalization of the SWOT analysis. The third one, Geographic Information Systems (GIS) and statistical methods utilization on the performance of strategic plans, is the last one explained because its utilization has been carried out also on the proposals, as essential element of the strategic practice. All of them are evaluated with its subsequent conclusions in the next lines.

8.1. Previous results.

8.1.1.- Issues determination.

The issues determination results are based on the first results expressed in the beginning of this third Part of the project. Concretely, these are based on the Final SWOT analysis as well as its summary and the Action Lines developed following the bases of the first one. The Final SWOT analysis shows us all the information used along the study area analysis compressed and simplified to its minimal expression, ignoring the non relevant elements and highlighting the most important ones. These, at the same time, are divided by its contribution to the territory (so strengths and opportunities as positive contribution toward weaknesses and threats as negative) and its temporally effects (so strengths and weaknesses as present time and Opportunities and threats as future projection). The obtained results on this first part have been satisfactory from the author point of view because we may considerer that these results express the main issues of the area in a proper way despite is true that, for be completely honest on the valuation, a more accurate analysis of the territory which could have been done with the availability of more time, resources and researchers would have provided a more concrete and close to the reality results than the obtained ones. However, as we said, the results obtained in this way may be considered as satisfactory.

8.1.2.- Numerical data collection

The numerical data collection is based on the process which has been carried out during the elaboration of the Second Part of the project, so the description by fields of the study area. The majority of the obtained results can be observed across its presence in this study area description and more accurately, this may be consulted in the different shape files and excel documents included on the attached information disks. About this numerical data we must express that this may be classified into two basic groups. For one side we find the data obtained directly on numerical from the source across its consultation from specialized persons or organizations, often presented on excel tab format but also in other kind of tabs and documents. Examples of that could be the flow and the rainfall records. For the other hand, it has been a large part of the numerical data obtained directly from the georeferenced files, which give us the extra value, its geographical distribution along the study area. Examples of that could be the slopes, extensions and aspects distributed along the surface and which determines the watershed behavior. For more accurate information about the both kinds of data consult Files Dictionary chapter. About these, we must evaluate them as is incomplete, especially on the first kind of data case. To carry out properly the hydrological model it is necessary to possess a minimally accurate data from the flow of the different tributaries or parts of the water course. At the same time, is also necessary to obtain accurate data from the precipitation range on each area of the territory. This last would allow us to determine the total inputs distributed by area and compare them with the brook flow or outputs in its different stages with the aim to determine the behavior of water collection and transport of the system in each place as well as the temporary functioning of the surface water runoff or the infiltration degree. This real data is a necessary step for the elaboration of suitable hydrological model. That's due to in the model validation it must done the process of comparison between the obtained data across the model and the real data, which allow us to determine the mean error as well as other parameters and correct the model properties or change them with the aim to find better results and so, to obtain a model able to carry out forecasts of the system. Although we are able to obtain this theoretic data across the computing of georeferenced data and the use of some formulas or equations, this is just effective in ideal cases and for this reason the results from the real case would be probably far from the reality because of the large amount of parameters are necessary to understand the behavior of a real system. It's for this reason that is necessary the achieving of real data, to determine properly the effectiveness of the model and arrange it adequately.

So, as final evaluation of these obtained results, it's important to say that these are not complete and to elaborate a future hydrological model of the Osor's Brook water system will be necessary the collection of the expressed real data.

8.2.- The GIS systems utilization in the performance of strategic plans.

The usefulness of the GIS procedures along the realization of the present document has been largely demonstrated during its elaboration. Especially about the GIS, which have given the tools to analyze the territory in a good level of accuracy. The GIS systems utilization on the performance of strategic plans, especially the ones more related with the geography, is a methodology where there are a very few things we can add as new, especially on the GIS way. However, the elaboration of this work was based in the beginning across information related with the Guilleries massif written on several documents which had this area as core. It's for this reason that the massif name appeared so commonly along the pages of this work. If we wanted to carry out a more concrete approach to our study area it was necessary the utilization of some kind of tool which facilitate us this action and in that way the GIS has been the most important tool. Across the GIS systems we could determine the boundaries of our study area and distinguish between a large part of Guilleries features and the ones related just with our study area. And not just that; in the cases where the needs of the process ask for a change of scale on the procedures the GIS analysis was able to realize this change of approach and provide accurate information about the area and its features. It has been widely useful, for instance, during the delimitation and analysis of the several courses and sub-basins, for one hand, or during the proposals elaboration where sometimes the scale was highly reduced, for the other hand. Besides, in itself, the tool allows us to deal with large amounts of information related with numerical data and to carry out several operations of basic statistics. There are also statistics methods included in the georeferenced files attribute tables management which also has been a helpful tool during the process. The lack of some numerical data expressed, moreover, limited a lot the capacity to handle them and that derived in a poorer analyses in some cases than in others. The lack of time also helped this fact, which could allow the realization of several studies of correlation between different elements, physicals and anthropics. And for these reasons, it has to be expressed that it hasn't been used all the potential of this science and is important element to take in account on the elaboration of future works. In short, we can describe the obtained result of this third section as basically good because although it hasn't been exploited at the maximum the possibilities of these methodologies, the aim on this section was to analyze how useful they were in the process of evaluation and issues search within the study area and this has been carried out in acceptable way.

9.CONCLUSIONS

As we expressed above, the obtained results has been considered generally as adequate. The issues research has been carried out in a proper way. This affected positively the results evaluated in the GIS & statistical systems utilization in the performance of strategic plans evaluation, which are evaluated also positively. The only considered goal as partly unaccomplished is the data collection for the future hydrologic model because of the lack of proper data, but this one has the positive point that just affected the proper development of the work in a minor degree and just caused some lack of data in some concrete points but without affecting largely the basic description of the features. Besides, this issue lost value for the presence of another kind of shortage data that there is present in the work which has been caused for the dimensions of the work and the physical time to elaborate it. From that, is possible to deduce that the present work is not as good as could be but should be well considered taking in account the typology of resources at our disposal during its achieving. Furthermore, the work follows the basic lines of the empiric analysis, at least the first two pillars which are observation and hypothesis formulation, what causes that the results are not fully reliable although they are, from the point of view of the author, valid enough to be taken into account for future works or projects, mainly the ones related with study area. This is probably the main difference between the present work and other thesis projects, which usually try to demonstrate a theory. In this case, the work just tries to increase the knowledge about a territory, enhancing its problem solving capacity and performing simultaneously a process of data collection and evaluation of the used methods. It has been several cases where it was tried to clarify, especially on the proposals chapter, that the information presented on this project should be supplemented with more exhaustive studies. And this is one of the bases which will be followed for the elaboration offorthcoming works goals, concretely onthe realization of full studies for some of the most achievable proposals elaborated. Other lines of research which are going to be followed, for sure; on future studies will be the elaboration of the Osor's Brook hydrological model or the elaboration of strategic plans in different areas in more effective way thanks of the experience acquired in the present project.

PART IV: BIBLIOGRAPHY & APPENDICES

BIBLIOGRAPHY REFERENCES

English language

E. Kalbus, F. Reinstorf, and M. Schirmer (Kalbus, Reinstorf, Schirmer, 2006). **Measuring methods for groundwater – surface water interactions: a review.**UFZ – Centre for Environmental Research Leipzig-Halle in the Helmholtz Association, Department of Hydrogeology.

Berta Bonet, Natàlia Corcoll, Ahmed Tlili, Soizic Morin, Helena Guasch (Bonet, Corcoll, Tlili, Morin, Guasch, 2013). **Antioxidant enzyme activities in biofilms as biomarker of Zn pollution in a natural system: An active bio-monitoring study.** Science of the Total Environment

M. Angels Bonet, Montserrat Parada, Anna Selga, Joan Valles (Bonet, Parada, Selga, Valles, 1999). **Studies on pharmaceutical ethnobotany in the regions of L'Alt Empordà and Les Guilleries (Catalonia, Iberian Peninsula)**.*Laboratori de Botànica*, *Facultat de Farma`cia*, *Uni6ersitat de Barcelona*. *A*6. *Joan XXIII* (*Catalonia*), *Spain*.

David Maidment (Maidment, 2002). **Arc Hydro GIS for Water Resources.** Center for Research – University of Texas and Austin. ESRI Press

Catalan language

Joan Ganau Casas, Jordi Mallarach Isern (Ganau, Mallarach, 2003). **La planificació estratègica a Catalunya. Qunze ans d'evolució.** Observatori de Desenvolupament Estratègic a Catalunya (ODECAT)

Josep Tarrés i Turón (Tarrés, 2008) **El Vapor Burés d'anglés, un patrimoni industrial rellevant de Catalunya**. Actes d'història de la ciència i de la tècnica nova època / Volum 1 / Pages 243-253

M.V. Vives-Balmaña (Balmaña, 1986**). La diversitat faunistica a la muntanya mitjana catalana: El cas de les Guilleries.** AUSA XII/116 Pages 53-64. Patronat d'estudis ausonencs

Joan Boquera (Boquera, 2004). **Les aigües minerals a Catalunya.** III Simposio Ibérico sobre Geología, Termalismo y Sociedad Arenys de Mar (Maresme, Catalunya). July of 2004. P. 05 pp. 121 – 128

Josep Tarrés Turón (Turón, 2003) **Les Guilleries. Terra de refugi**. AUSA XXI/152 - Pages 195-200 - Patronat d'Estudis Osonencs

Lluís Solé i Sabarís (Solé i Sabarís, 1936**). Notes geo-morfológíques sobre les Guilleries**. reprinted in 1991 by SCdG (Catalan Society of Geography)

Pladevall, Antoni (Pladevall, 1958**). Les Guilleries: síntesi histórica y evolución demográfica.** AUSA Vol. III (1958-1960)

Xavier Junquera, Josep Tarrés (Tarrés, Junquera, 2009). **La descripció dels camins de les Guilleries a finals del segle XIX segons els militars.** Quaderns de la Selva, 21 - pg. 107 a 116

Junquera i Segarra, Xavier (Junquera i Segarra, 2006). **Les Guilleries: l'esplendor d'una natura primitiva**. Publicacions de l'Abadia de Montserrat – Guies del Centre excursionista de Catalunya

Junquera i Segarra, Xavier (Junquera i Segarra, 2007). **El present d'un passat: Les Guilleries**. Publicacions de l'Abadia de Montserrat – Guies del Centre excursionista de Catalunya

Josep Tarrés (Tarrés, 2002). **LA UNIÓ CARTOGRÀFICA DEL COLLSACABRA AMB LES GUILLERIES**. Unkown magazine

Josep Tarrés i Turon (Turón, 2004). Un **gran mapa de 1888.** Revista de Girona - Num. 219

Josep Tarrés i Turon (Turón, 2005). **L'antiga xarxa de camins de les Guilleries.** Anuals de l'Institut d'Estudis Gironins. Vol. XLVI Girona

Rafael Ginebra (Ginebra, 2003). **Per "Muntanyes d'Osona" a Guilleries**. Revista de Girona Num. 219

Emili Rams (Rams, 2003). **Un espai per a protegir o un entorn que es salvaguarda per si sol?.** Revista de Girona. Num. 219

Emili Rams, Josep Tarrés (Rams, Tarrés, 2001). Les Guilleries.. Revista de Girona, Num. 91

Antoni Pladevall (Pladevall, 2003). **Una terra administrativament esquarterada.** Revista de Girona, Num. 219

SPE La Gorga (Sportive Fishing Society of "La Gorga", (2009). Composition: Àngel Valls Andreu,Photographic colaboration: Salvador Bosch i Cornellà. **La Gorga: Mig segle de pesca… Per un riu viu!!.** SPE La Gorga

Spanish language

Ferrer Modolell, A. E. (Modolell, 1990). **Aspectos metalogenéticos ligados al volcanismo explosivo calco-alcalino del ordovícico en los macizos de Les Guilleries y Les Gavarres (Cordilleras Costeras Catalanas)**. 1990 - Cuaderno Lab. Xeolóxico de Laxe Coruña. Vol. 15, pp. 79-88

Marc Bigas Bau, Miquel Picanyol Sadurní, Jordi Vila Capdevila (Bigas, Picanyol, Vila, 2004). **EL OLVIDO DE LAS GUILLERIES (CATALUÑA). ESTUDIO GEOGRÁFICO DE UN ESPACIO RURAL EN DECADENCIA.** Centro de Estudios sobre la Despoblación y Desarrollo de Áreas Rurales. Number 4

H. Duran (Duran, 1990). **El Paleozoico de les Guilleries.** Universitat Autónoma de Barcelona

Manuel Montañés Serrano (coord.), Tomás Rodríguez-Villasante Prieto (coord.), Pedro Martín Gutiérrez (coord.). (Montañés, Rodriguez, Martín, 2000). **PRACTICAS LOCALES DE CREATIVIDAD SOCIAL: CONSTRUYENDO CIUDADANIA.**ED. EL VIEJO TOPO, 2000

Oscar Delgadillo, Alan Camacho, Luis F.Pérez, Mauricio Andrade (Degadillo, Camacho, érez, Andrade, 2010) **Depuración de aguas residuales por medio de humedales artificiales.** Centro Andino para la Gestión y Uso del Agua (Centro AGUA)

Ruben Sierra Villagrana (Sierra. R, 2006). **Fitorremediación de un Suelo Contaminado con Plomo por Actividad Industrial.** UNIVERSIDAD AUTÓNOMA AGRARIA"ANTONIO NARRO". DIVISIÓN DE INGENIERÍA. DEPARTAMENTO DE CIENCIAS DEL SUELO

Gutierrez-Ginés, Mª.J., Hernandez, A.J. Pastor.J (Gutierrez, Hernandez, Pastor, 2011). **Estudio de comportamiento del Lollium Perenne L. en los suelos del centro de España contaminados por metals pesados.** Departamento de Ecologia. Universidad de Alcalá – Departamento de Biologia ambiental, CCMA, MNCN, CSIC.

ADMINISTRATIVE WORKS

(1986).**ORDENANÇA REGULADORA DE L'APLICACIÓ DE DEJECCIONS RAMADERES, FANGS DE DEPURACIÓ I FERTILITZANTS QUIMICS ALS CAMPS.** Sant Hilari Sacalm Town Hall.

Original language: Catalan

(2011). **Catàleg de paisatge de les Comarques Gironines - Unitat de paisatge 13: Guilleries.** Generalitat de Catalunya - Departament de Política Territorial i Obres Públiques Observatori del Paisatge de Catalunya - Universitat Politècnica de Catalunya - Universitat de Girona (UdG)

Original language: Catalan

(2002)**. MASSES D'AIGUA SUBTERRÀNIA DE CATALUNYA: MASSA 13 - MONTSENY GUILLERIES.** Generalitat de Catalunya - Departament de Medi Ambient i Habitatge

Original language: Catalan

(2007). **GEOZONA 351 GUILLERIES (PASTERAL – SUSQUEDA)** Generalitat de Catalunya - Departament de Medi Ambient i Habitatge - Direcció General del Medi Natural

Original language: Catalan

(2011). **Avaluació preliminar del risc d'inundació al districte de conca fluvial de Catalunya. Annex 2: Àrees de risc potencial significatiu en front inundacions (ARPSI).** Generalitat de Catalunya - Departament de Territori i sostenibilitat

Original language: Catalan

(2004)**Plà d'Acció Comarcal per a la Sostenibilitat (PALS) de la comarca de la Selva.** "Departament d'Organització de l'Entorn i el Territor" and "Departament de Promoció Econòmica i Desenvolpuament Local"

Original language: Catalan

Roser Campeny, Carme Rosell, Marc Fernández Bou, Ferran Navàs, Marcel Fontanillas, Moisès Guardiola (Campeny, Rossell, Fernandez, Navàs, Fontanillas, 2007)**. ANÀLISI DE LA CONNECTIVITAT**

ECOLÒGICA A LA COMARCA DE LA SELVA. Consell Comarcal de la Selva

Original language: Catalan

(2010). **Modificat del projecte constructiu dels col·lectors I de l'estació depuradora d'aigües residuals d'Osor (La Selva).** Departament de Medi ambient i Habitatge – Generalitat de Catalunya

Original language: Catalan

(2012). **PLA D'ORDENACIÓ URBANÍSTICA MUNICIPAL D'OSOR.** Serveis Tècnics del Consell Comarcal de la Selva and Ajuntament d'Osor

Original language: Catalan

11. APPENDIX

11.1.- GIS FILES DICTIONARY

In this first section we will see the files which have been acquired directly from primary source. So, the aim of that section is to express the non-appropriation of this sources and to declare that this ones have been only used for the elaboration of the project all expressing the non-pertinence of them by the author and leaving clear its precedence and its sources.

The following files have been directly extracted from an official website. These are original GIS files without or with basic manipulation. In this section, are not included the elaborated in second degree GIS files due of we consider these are clearly reflected and expressed in the next section and in the methodology chapter.

In this stage we can see these downloaded files sorted by the source from where have been adquired and a brief description of each website organism.

A.1- Quick summary

ICGC (Institutcartogràfic I geològic de Catalunya)

1.- Contours.shp

2.- Hidroln.shp

3.- Hidropol.shp

4.- Roads.shp

5.- Municpol.shp

6.- Municln.shp

7.- Bm50mv33sh1fpm1r170

8.- Bm50mv33sh1fpc1r170

9.- Bm50mv33sh1fpp1r170

10.- Bm50mv33sh1ftm1r170

11.- Ortofoto 1:2500

12.- Mapatopogràfic 1:10000 (Topographic Map 1:10000)

13.- Igc_BG250M_v2

CREAF

14.- Covers.shp

GENCAT

15.- Aquprot.shp

16.- Watersheeds 1.50.000

17.- Subter.shp

18.- Super.shp

19.- Paedar.shp

20.- Extaig.shp

21.- Extcata.shp

22.- Extaba.shp

23.- Depur.shp

24.- Grm_31122013.shp

25.- Ampter.shp

26.- Defhid.shp

27.- Evapot.shp

28.- Panual.shp

29.- Regimp.shp

30.- Tanual.shp

31.- Tipcli.shp

32.- XEMA.shp

33.- Pein.shp

34.- AreesInteresFaunisticFloristic_ETRS89.shp

35.- Adf.shp

36.- Arbmon.shp

37.- Agescin.shp

38.- Uses_aprof.shp

39.- Litologia.shp

40.- Contactes litologics.shp

41.- Elements puntuals.shp

42.- Tall.shp

43.- Mre.shp

44.- Patrigeo.shp

45.- Xarnat2m.shp

46.- ZPescaC.shp

47.- ZLL_SM.shp

48.- CipSal.shp

49.- Accidents_ETRS89.shp

50.1.- AreesPrioritaries_ETRS89.shp

50.2.- ZonesProtecAvifauna_ETRS89.shp

50.3.- MosaicplansRecupP_ETRS89.shp

51.- Habitats.shp

52.- Inflam.shp

ACA

53.- Aqüífers.shp

54.- Rius_CARACT.shp

55.- Subterranies_CARACT.shp

56.- MASSES_AIGUA_estat_ma_rius_2007_12.shp

57.- MASSES_AIGUA_estat_ma_subterranies_2007_12.shp

58.- INUNDABILITAT_ligeo_web.shp

59.- INUNDABILITAT_Ter_Mig_limco_100b_polygon.shp

60.- INUNDABILITAT_Ter_Mig_li10_100b_polygon.shp

61.- INUNDABILITAT_Ter_Mig_li50_100b_polygon.shp

62.- INUNDABILITAT_Ter_Mig_li100_100b_polygon.shp

63.- INUNDABILITAT_Ter_Mig_li500_100b_polygon.shp

64.- CART_REF_Demarc_Territorials.shp

65.- CONQUES_XARXA_RIUS_xarxa50m_g0pc_arc_web.shp

66.- CONQUES_XARXA_RIUS.shp

67.- CONQUES_XARXA_RIUS_conques50m_region_con_ppals.shp

68.- CONQUES_XARXA_RIUS_conques50m_polygon_web.shp

69.- CABALS_t_hid_mosaic_arc_web.shp

70.- USOS_SOL_habic.shp

MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE

71.- CCAA.shp

Grup de Recerca de Geobotànica i Cartografia de la Vegetació (UB)

72.- veg333_2012_ETRS89.shp

73.- veg332_2006_ETRS89.shp

In this second part we can see also a brief description of each shape file with their features, kind of projection used and others.

A.2 - Extensed summary

Base topogràfica 1:5 000 (Topographic base 1:5 000)

- Description: Topographic base contains basic georeferenced data of an area. This data are presented in shapefile under several parts of 1:5000 scale and a specific coordinate system. That means that for reach our study area complete shapefile will be necessary the union of all this parts in one. The initial parts used in the present work moves from 295-98 to 301 – 103 (in order from left to right and from up to down) with a total of 42 different parts.

- Composition: Each file of the topographic base is composed by the following shapefiles:

Shapefile name	Topic / matter	Kind
bt5mv20sh0f*cccfff***an***mrrro***.shp**	**Altimetry / relief elements**	**point**
bt5mv20sh0f*cccfff***al***mrrro***.shp**	**Altimetry / relief elements**	**Line**
bt5mv20sh0f*cccfff***ap***mrrro***.shp**	**Altimetry / relief elements**	**polygon**
bt5mv20sh0f*cccfff***hl***mrrro***.shp**	**Hydrography**	**Line**
bt5mv20sh0f*cccfff***hp***mrrro***.shp**	**Hydrography**	**polygon**
bt5mv20sh0f*cccfff***pn***mrrro***.shp**	**Settlements / auxiliary infrastructure**	**point**
bt5mv20sh0f*cccfff***pl***mrrro***.shp**	**Settlements / auxiliary infrastructure**	**Line**
bt5mv20sh0f*cccfff***pp***mrrro***.shp**	**Settlements / auxiliary infrastructure**	**polygon**
bt5mv20sh0f*cccfff***cl***mrrro***.shp**	**Roadways**	**Line**
bt5mv20sh0f*cccfff***vl***mrrro***.shp**	**Vegetation / covers**	**Line**
bt5mv20sh0f*cccfff***vp***mrrro***.shp**	**Vegetation / covers**	**polygon**
bt5mv20sh0f*cccfff***tl***mrrro***.shp**	**Toponymy**	**Line**
bt5mv20sh0f*cccfff***rn***mrrro***.shp**	**Landmarks**	**point**
bt5mv20sh0f*cccfff***xl***mrrro***.shp**	**(x="without classify") information cut**	**Line**

Green color shows used shapefiles.

- Reference coordinates system:ETRS89

- Source: InstitutCartogràfic de Catalunya (Cartographic Institute of Catalonia)

-. The derived files from this base are the followings:

1.- Contours.shp

- Description: Countours.shp is the resultant file by joining all the parts extracted by the Topographic base 1:5000>bt5mv20sh0f*cccfff*al*mrrro*.shp and which together forms the contours line shape file of our study area first approximation

- Source: Across files downloaded from ICGC (Cartographic and Geologic Institute of Catalonia) and with the tool "Merge" from ArcGis 10.2.2 to get the union of them in one single file.

2.- Hidroln.shp

- Description: Hidroln.shp is the resultant file by joining all the parts extracted by the Topographic base 1:5000>bt5mv20sh0f*cccfff*hl*mrrro*.shp and which together forms the hidrography line shape file of our study area first approximation.

- Source: Across files downloaded from ICGC (Cartographic and Geologic Institute of Catalonia) and with the tool "Merge" from ArcGis 10.2.2 to get the union of them in one single file.

3.- Hidropol.shp

- Description: Hidropol.shp is the resultant file by joining all the parts extracted by the Topographic base 1:5000>bt5mv20sh0f*cccfff*hp*m*r*rro*.shp and which together forms water bodies network polygon shape file of our study area first approximation.

- Source: Across files downloaded from ICGC (Cartographic and Geologic Institute of Catalonia) and with the tool "Merge" from ArcGis 10.2.2 to get the union of them in one single file.

4.- Roads.shp

- Description:roads.shp is the resultant file by joining all the parts extracted by the Topographic base 1:5000>bt5mv20sh0f*cccfff*cl*m*r*rro*.shp and which together forms the roads network line shape file of our study area first approximation.

- Source: Across files downloaded from ICGC (Cartographic and Geologic Institute of Catalonia) and with the tool "Merge" from ArcGis 10.2.2 to get the union of them in one single file.

Cartografiatopogràfica 1:1000 (Topographic cartography 1:1000)

- Description: The topographic cartography contains in detail, the settlements structure across different kinds of shapefiles. So, the files contains the vectorialized shape of streets, squares, roads and houses which are in the town and other settlements or constructions which belong at the same municipality for administrative bordering. We use, in this work, four different file packs related with the four municipalities present in the study area. These bases are the followings:

- **SantHilariSacalm:**ct1mv22sh0f001755004900ac0r010 (Field code 1)
- **Osor:**ct1mv21sh0f00164312100ac0r010 (Field code 2)
- **Susqueda:**ct1mv21sh0f001844016600ac0r010 (Field code 3)
- **Anglès:**ct1mv21sh0f00157310700ac0r010 (Field code 4)

- Reference coordinates system:ETRS89

- Source: InstitutCartogràfic de Catalunya (Cartographic Institute of Catalonia)

-. The derived files from this base in which are included the 4 municipalities are the followings:

5.- Municpol.shp

- Description: Minicpol.shp is the resultant file by joining all the parts extracted by the Topographic cartography 1:1000>ct1mv21sh0fxxxxxxxxxxxaxp0r010 and which forms the municipalities polygon shape file of our study area first approximation.

- Source: Topographic cartography 1:1000 database

6.- Municln.shp

- Description: Minicln.shp is the resultant file by joining all the parts extracted by the Topographic cartography 1:1000>ct1mv21sh0fxxxxxxxxxxxaxl0r010 and which forms the municipalities line shape file of our study area first approximation.

- Source: Topographic cartography 1:1000 database

Base Municipal (Municipal Base)

- Description: Municipal base contains different shape files about the administrative boundaries in Catalonia.

- Composition: Each file of the topographic base is composed by the following shapefiles:

Shapefile name	Topic / matter	Kind
7.- Bm50mv33sh1fpm1r170	**Municipalities boundaries**	**polygon**
8.- Bm50mv33sh1fpc1r170	**Comarcal (shire) boundaries**	**polygon**
9.- Bm50mv33sh1fpp1r170	**Provincial boundaries**	**polygon**
10.- Bm50mv33sh1ftm1r170	**Towns names**	**polygon**

- Reference coordinates system:ETRS89

- Source: InstitutCartogràfic de Catalunya (Cartographic Institute of Catalonia)

11.- Ortofoto 1:2500

- Description: Ortofotos data base (version 3.3 - revised in 2010) presented in format MrSID (.sid) and following the codification of25cv33sd0fnnnnnns1r050, are ortofotos in scale 1:2500 of Catalonia. The number which appear in the grey letters place give us the information about the leave number (and its position) in the network database

- Composition: This data are presented under several parts of 1:2500 scale and a specific coordinate system. That means that for reach our study area complete shapefile will be necessary the union of all this parts in one. The initial parts used in the present work moves from 295-98 to 301 – 103 (in order from left to right and from up to down) with a total of 42 different parts.

- Reference coordinates system:ETRS89

- Source: Institut Cartogràficde Catalunya (Cartographic Institute of Catalonia)

12.- Mapa topogràfic 1:10000 (Topographic Map 1:10000)

- Description: The topographic map contains the vectorialized scale 1.10.000 map with different data about the territory. It can be considered as the union of the basic cartographic bases which are explained here so is possible to observe well the toponomy, roads, villages, isolated houses, peaks, rivers and lakes between others. The net of this map is composed by several leaves. In our case we toke the leaves 148 – (49, 50, 51, 52), 149 – (49, 50, 51, 52), 150 – (49, 50, 51, 52). So 16 in total.

- Reference coordinates system:ETRS89

- Source: InstitutCartogràfic de Catalunya (Cartographic Institute of Catalonia)

13.- Igc_BG250M_v2

- Description: Geological base which contains different shape files about the geological units in Catalonia. Its data includes the era which the kind of rock belongs, age, period, epoch and description of the rock kind.

- Composition: This base is composed with several shape files and data base files from which we will use only the called carpol.shp (Which will be renamed Lito.shp). Furthermore, its attribute table will be complemented with the database EPIS250MV2.XLSacross the tool "Joins and relates/Join…"

- Reference coordinates system: None(we must give ETRS89 projection)

- Source: Institut Geologic de Catalunya (Geological Institute of Catalonia)

CREAF

Mapa de cobertes I usos del sòl de Catalunya (Catalunya Soil uses and coversmap)

The Catalunya soil uses and covers map is a database from the CREAF(Center for Ecological Research and Forestry Applications) which is actualizated in continued way and belongs us to get the soil covers and uses map in georeferenced way. The files are downloaded in mmz format (the system to convert them is explained in the chapter 2.B of the methodology section).

The gotten file which we shall work is the following.

14.- Covers.shp

- Description: Polygon shape file with soil cover uses of Catalonia with CORINE and other levels of distribution. This one have been obtained across the merge of four different leaves (under the code 33221, 33222, 33311 and 33312) which belongs to "Mapa de cobertes del sòl de Catalunya" system. To get the final file, we used the file (…) to complete its attribute table.

- Reference coordinates system:ETRS89

- Source: CREAF (Centre de RecercaEcològica I AplicacionsForestals (Center for Ecological Research and Forestry Applications))

- Other actions carried out: Across files converted to shp with the help of Miramon software and with the tool "Merge" from ArcGis 10.2.2 to get the union of them in one single file.

GENCAT

WATER

15.- Aquprot.shp

- Description: Polygon shape file with delineation of protected aquifers in Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

16.- Watersheeds 1.50.000

- Description: Polygon shape file database with the limits of the main sub-basins in Catalonia. In our case we choose the Ter river basin cause is which our study brook belongs. This shape file is called **Ter.shp**

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

17.- Subter.shp

- Description: Point shape file with distribution of basic sampling points of groundwater in Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

18.- Super.shp

- Description: Point shape file with different control networks managed by the Surface Water Unit Control Department in Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

EMISSIONS

19.- Paedar.shp

- Description: Point shape file with points of discharge of wastewater treatment plants in Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

20.- Extaig.shp

- Description: Point shape file with points of areas affected by mining activities on public water regulated by Law 29/1985 of waters in Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

21.- Extcata.shp

- Description: Polygon shape file with the limit of the areas affected by mining activities in Catalonia.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

22.- Extaba.shp

- Description: Polygon shape file with the limit of the areas affected by abandoned mining activities in Catalonia.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

INFRASTRUCTURES

23.- Depur.shp

- Description: Point shape file with georeferenced location of the sewage treatment plants currently in operation, under construction or planned in the implementation of the Recovery Plan for Catalonia.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

24.- Grm_31122013.shp

- Description: Point shape file with location of facilities for municipal waste management in service in Catalunya.

- Reference coordinates system:none

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

METEOROLOGYCAL

25.- Ampter.shp

- Description: Polygon shape file with annual thermal excursion range areas in Catalunya.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

26.- Defhid.shp

- Description: Polygon shape file with annual water deficit range areas in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

27.- Evapot.shp

- Description: Polygon shape file with potential evapotranspiration and thermal regions in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

28.- Panual.shp

- Description: Polygon shape file with mean annual precipitation range areas in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

29.- Regimp.shp

- Description: Polygon shape file with seasonal rainfall range areas in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

30.- Tanual.shp

- Description: Polygon shape file with mean annual temperatures range areas in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

31.- Tipcli.shp

- Description: Polygon shape file with kind of climatic areas in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

32.- XEMA.shp

- Description: Point shape file with meteorological automatic measurement stations situation in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

LAND AND NATURAL HERITAGE

33.- Pein.shp

- Description: Polygon shape file with EIN (Natural interest Spaces) situation in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

34.- AreesInteresFaunisticFloristic_ETRS89.shp

- Description: Polygon shape file with AIFF (Faunistic and floristic interest Spaces) situation in Catalunya.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

35.- Adf.shp

- Description: Polygon shape file with the ADF (Forest defense Associations) actuation area in Catalunya.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de TerritoriiSostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

36.- Arbmon.shp

- Description: Point shape file with the points which reaches the monumental trees and groves of Catalonia since the first declaration Order 1987 (Decree 214/1987 on declaration of historic trees) until 2005 (Environment Ministry Order / 228 / 2005 DOGC 4393 2 May 2005.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

37.- Agescin.shp

- Description: Polygon shape file with territorial limits of the various figures derived from the Law 1/1970, of April 4, of hunting regulation in Catalunya.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

38.- Uses_aprof.shp

- Description: Polygon shape file with cultivation areas and forest exploitations. Initially downloaded in mmz format (pages/leaves 332 & 333), the final file have been gotten across files converted to shp with the help of Miramon software and with the tool “Merge” from ArcGis 10.2.2 to get the union of them in one single file.

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

Geologic database

- Description: Geological base which contains different shape files about the geological units in Catalonia. Its data includes the era which the kind of rock belongs, age, period, epoch and description of the rock kind. Furthermore, its attribute tables will be complemented with the database file which is downloaded in the same zip file and joined across the tool “Joins and relates/Join…“. We selected the leaves/parts 333 & 332 and each one contains the following files (which will be joined across the tool “Merge” from ArcGis 10.2.2 to get the union of them in one single file):

39.- Litologia: Polygon shape file about the litology areas.

Related dbf: Simbologialitologia.dbf

40.- Contactes litologics: Line shape fileabout the litological contacs.

Related dbf: Simbologiacontacteslitologics.dbf

41.- Elements puntuals: Point shape file with relevant points to take in account.

Related dbf: SimbologiaElements puntuals.dbf

42.- Tall: Line shapefile with line which is related the profile image ().

Related dbf: none

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

43.- Mre.shp

- Description: Polygon shape file with fire risk by categories in Catalunya.

Related dbf: mre_cat.dbf

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

44.- Patrigeo.shp

- Description: Polygon shape file with Geosites and Geological interest spaces in Catalunya.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

45.- Xarnat2m.shp

- Description: Polygon shape file with Natura 2000 Network spaces in Catalunya.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

46.- ZPescaC.shp

- Description: Line shape file with fishing controlled areas in catalan hydrological network.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

47.- ZLL_SM.shp

- Description: Line shape file with fishing free areas without death in catalan hydrological network.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

48.- CipSal.shp

- Description: Polygon shape file withS almonids and cyprinids areas in catalan hydrological network.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

49.- Accidents_ETRS89.shp

- Description: Point shape file with car crashes due “angulats” (word used to call boars and dears families) in catalan roadways network.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

50.- areesPrioritaries_ETRS89.shp, ZonesProtecAvifauna_ETRS89.shp&mosaicplansRecupP_ETRS89.shp

- Description: Polygon shape files which defines the priority areas for breeding, feeding, dispersion and local concentration of threatened bird species in Catalonia.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

51.- Habitats.shp

- Description: Polygon shape file with the habitats of community interest in the Catalan region based on the interpretation and adaptation of the classification of habitats in the European Union proposed document "CORINE biotopes manual", published by the European Commission in 1991, the Directive 92 / 43 / EEC, 97/62 / EEC on the Interpretation Manual of EU habitats and report on the correlation between Catalonia habitats and habitats of Community interest. Initially, it have been downloaded in mmz format (pages/leaves 332 & 333), the final file have been gotten across files converted to shp with the help of Miramon software and with the tool “Merge” from ArcGis 10.2.2 to get the union of them in one single file

- Reference coordinates system:ED_1950_UTM_Zone_31N

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

52.- Inflam.shp

- Description: Polygon shape file with classification of wooded areas in terms of fuel models (spread of fire within a structure of vegetation) and Flammability models (risk of ignition). Initially, it have been downloaded in mmz format (pages/leaves 332 & 333), the final file have been gotten across files converted to tiff raster with the help of Miramon software and with the tools “Raster to polygon” from ArcGis 10.2.2.

- Reference coordinates system:ETRS89

- Source: Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Territory and environment department of Catalonia government)

ACA

53.- Aqüífers.shp

- Description: Polygon shape file with aquifers areas in Catalunya based in geological map.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

54.- Rius_CARACT.shp

- Description: Line shape file with rivers features in Catalunya.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (CatalanWater Agency)

55.- Subterranies_CARACT.shp

- Description: Polygon shape file with underground water main bodies features in Catalunya.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (CatalanWater Agency)

56.- MASSES_AIGUA_estat_ma_rius_2007_12.shp

- Description: Line shape file with streams and rivers of Catalunya features related with chemistry, ecological function and quality according to analyses done within the 2007-12 period.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

57.- MASSES_AIGUA_estat_ma_subterranies_2007_12.shp

- Description: Polygon shape file with underground water bodies in Catalunya features related with chemistry, amount and quality according to analyses done within the 2007-12 period.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

58.- INUNDABILITAT_ligeo_web.shp

- Description: Polygon shape file with possible flooding areas in Catalunya based in geomorphological characteristics.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

59.- INUNDABILITAT_Ter_Mig_limco_100b_polygon.shp

- Description: Polygon shape file with possible flooding areas inmiddle Ter River stage area based in maximum ordinary rise.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

60.- INUNDABILITAT_Ter_Mig_li10_100b_polygon.shp

- Description: Polygon shape file with possible flooding areas inmiddle Ter river stage area based in a Return period T = 10 years.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

61.- INUNDABILITAT_Ter_Mig_li50_100b_polygon.shp

- Description: Polygon shape file with possible flooding areas inmiddle Ter River stage area based in a Return period T = 50 years.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

62.- INUNDABILITAT_Ter_Mig_li100_100b_polygon.shp

- Description: Polygon shape file with possible flooding areas inmiddle Ter river stage area based in a Return period T = 100 years.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

63.- INUNDABILITAT_Ter_Mig_li500_100b_polygon.shp

- Description: Polygon shape file with possible flooding areas inmiddle Ter river stage area based in a Return period T = 500 years.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

64.- CART_REF_Demarc_Territorials.shp

- Description: Polygon shape file with hydrology boundaries from administrative perspective.

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

65.- CONQUES_XARXA_RIUS_xarxa50m_g0pc_arc_web.shp

- Description: Polyline shape file with the main items ofhydrological network in Catalunya (But Ebre river watershed).

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

66.- CONQUES_XARXA_RIUS.shp

- Description: Polyline shape file with the all elements ofhydrological network in Catalunya (But Ebre river watershed).

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

67.- CONQUES_XARXA_RIUS_conques50m_region_con_ppals.shp

- Description: Polygon shape file with main watersheds in Catalunya

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

68.- CONQUES_XARXA_RIUS_conques50m_polygon_web.shp

- Description: Polygon shape file with complete watersheds network in Catalunya

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

69.- CABALS_t_hid_mosaic_arc_web.shp

- Description: Polyline shape file with computed flows during floods in north of Catalunya

- Reference coordinates system:ETRS89

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

70.- USOS_SOL_habic.shp

- Description: Polygon shape file with areas included in habitats directive of the European Union in Catalunya.

- Reference coordinates system:ETRS89

- Related files:

- Source: Agència Catalana de l'Aigua (Catalan Water Agency)

Ministerio de Agricultura, Alimentación y Medio Ambiente

71.- CCAA.shp

- Description: Polygon shape file with autonomic communities boundaries in Spain.

- Reference coordinates system:ETRS89

- Source: Ministerio de Agricultura, Alimentación y Medio Ambiente

Grup de Recerca de Geobotànica i Cartografia de la Vegetació (UB)

72.- veg333_2012_ETRS89.shp

- Description: Polygon shapefile with autonomic vegetation communities.

- Reference coordinates system:ETRS89

- Source: Ministerio Grup de Recerca de Geobotànica i Cartografia de la Vegetació (UB)

73.- veg332_2006_ETRS89.shp

- Description: PolygonPolygon shape file with autonomic vegetation communities.

- Reference coordinates system:ETRS89

- Source: Grup de Recerca de Geobotànica i Cartografia de la Vegetació (UB)