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VEGETATION OF WETLAND BIOTOPES (KURUCAŞİLE/ BARTIN/ TURKEY)

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ABSTRACT: Today, biodiversity and ecological diversity are threatened by wrong and intense land use. However, the continuity and maintenance of ecosystems is possible through the existence and sustainable use of biodiversity. Biological inventories are needed for effective and sustainable natural resource management structure. Therefore, it is essential to determine the inventory of the natural asset in the area during ecological planning. Wetlands are ecosystems that shape cultural processes with their ecological importance and contributions to human communities. Recognition and protection of these areas which are open to anthropogenic effects with their environmental enhancing effects, and biological and socio-economic values are of increasing importance. In this study, vegetation analysis of the wetland biotopes and the immediate surroundings of Kurucaşile (Bartın) district was carried out. In this context, 34 woody and 71 herbaceous plants were determined from 6 sample areas and vegetation composition of these species and their frequencies were determined with Braun-Blanquet Method. Accordingly, the most common plants in the area; *Alnus glutinosa* subsp. *glutinosa*, *Platanus orientalis*, *Salix alba*, *Rhododendron ponticum* subsp. *ponticum*, *Buxus sempervirens*, *Smilax excelsa*, *Petasites hybridus*, *Sambucus ebulus* and *Anagallis arvensis* var. *arvensis*. *Petasites hybridus* is dominant taxa. By this way, it is aimed to create a database for the sustainable use of natural areas by explaining the wetland potential of the area.

Keywords: Wetland, habitat, flora, Bartın, Turkey.

SULAK ALAN BİYOTOPLARINDA VEJETASYON ANALİZİ (KURUCAŞİLE/ BARTIN/ TÜRKİYE)

ÖZET: Günümüzde yanlış ve yoğun arazi kullanımları ile biyolojik ve ekolojik çeşitlilik tehdit altına girmektedir. Oysa ekosistemlerin devamı ve bakımı biyoçeşitliliğin varlığı ve sürdürülebilir kullanımı ile mümkün olmaktadır. Etkin ve sürekliliği olan doğal kaynak

This study was produced from the PhD thesis titled “Mapping of the Biotopes in the Kurucaşile (Bartın) Coastline and its Surrounding Areas"

yönetim yapılanması için biyolojik envanterlere ihtiyaç duyulmaktadır. Bu nedenle ekolojik planlama yapılırken alandaki doğal varlığın envanterinin tespiti şarttır. Sulak alanlar, ekolojik önemleri ve insan topluluklarına katkılarıyla kültürel süreçleri de şekillendiren ekosistemlerdir. Çevre kalitesini arttırıcı etkileri, biyolojik ve sosyo- ekonomik değerleri ile atropojenik etkiye açık bu alanların tanınması ve korunması günümüzde önemi gittikçe artmaktadır. Bu araştırmada Kurucaşile (Bartın) ilçesinin sahip olduğu sulak alan biyotopları ve yakın çevresinin vejetasyon analizi gerçekleştirilmiştir. Bu kapsamda 6 örnek alandan 34 odunsu, 71 otsu bitki tespit edilmiş, bu bitkilerin Braun Blanquet Yöntemi'ne göre vejetasyon örtüsünün tür kompozisyonu ve türlerin örnek alanlarda tekrarlanma sıklıkları saptanmıştır. Buna göre alandaki en yaygın bitkiler; *Alnus glutinosa* subsp. *glutinosa*, *Platanus orientalis*, *Salix alba*, *Rhododendron ponticum* subsp. *ponticum*, *Buxus sempervirens*, *Smilax excelsa*, *Petasites hybridus*, *Sambucus ebulus* ve *Anagallis arvensis* var. *arvensis*'tir. *Petasites hybridus* ise baskın tür olarak belirlenmiştir. Bu çalışma ile alanın sulak alan potansiyeli açıklanarak doğal alanların sürdürülebilir kullanımı için veri tabanı oluşturulması amaçlanmıştır.

Anahtar kelimeler: Sulak alan, habitat, flora, Bartın, Türkiye.

INTRODUCTION

In developing countries, many of the current land use policies do not ensure ecological sustainability, resulting in degradation of habitats. Today, natural habitats and ecosystems are destroyed and 12 million hectares of forests are lost (UN, 2020). 35% of the wetlands in the world have been destroyed since 1970 (Ramsar Convention Secretariat, 2018).The threat to biodiversity increases because of the damages in habitats and ecological and economic losses occur. However, it is known that biodiversity, which is a natural resource, strengthens the green economies of countries as billions of people are directly and indirectly connected to it (Shah & Ayiemba, 2019). Therefore, the importance of habitat conservation is increasing, and potential ways, to support environmental protection efforts are being explored throughout the world (Chokor, 1992).
Sustainable land use planning and societies' living in healthy environments will be ensured through obtaining knowledge about the area (Naveh, 2007). Therefore, data collection is very important for protection of nature (Müller et al., 2003). Advanced data collection, analysis and data management ensure a scientific understanding of the area and long- term management of ecosystems. For this reason, the basic data within the scope of planning was determined as biotope research (Hong et al., 2005).

It is very difficult to conserve a biotope type without clearly identifying it and performing vegetation analysis. Biotope maps include biotope maintenance plans that enable intended conservation of biotopes in the region that are worth preserving in the long term and the motives for conservation, as well as planning such as biotope development plans to restore biotopes (Ssymank & Dankers, 1996). It also enables to develop an ecological view of biodiversity in spatial planning and to develop tools to protect biodiversity. Thus, decisions about biodiversity are made according to the ecological characteristics of the area (Löfvenhaft et al., 2002).

Wetland biotopes, which constitute the subject of our research, are of great importance in terms of preserving and maintaining biological diversity and ecological balance. These areas are ecosystems of physical, chemical and biological elements such as soil, water, plant, animal species and nutrients (Korkanç, 2004). According to the definition in the Ramsar Convention,

wetlands are all swamp, peat or water- covered areas at ebb tide period and with not more than 6- meters depth, either natural or artificial permanent or temporary, static or dynamic and with fresh, bitter or salty water (Ramsar Convention Bureau, 1992). Wetlands are very important biotopes that protect and improve water quality, soften the climate, produce oxygen, purify nutrients, control erosion and shape the nature and cultural processes with their visual effects that are subject to recreational activities (Çakır & Çakır (2019); Atalay et al., (2019); Gren et al., (1994); Kimmel et al., (2010); Wang et al., (2008); Kıymaz, (2010)). Although these ecosystems cover less than 1% of the total amount of water on Earth, they contain 40% of all living species in the world (Maraşlıoğlu & Salur, 2016). Although ecological and economic values of wetlands in Turkey has begun to be understood in recent years and important steps have been taken, there are serious threats and problems related to the protection and management of wetlands (Karadeniz et al., 2009). These highly sensitive ecosystems are adversely affected as a result of anthropogenic effects, which are increasing especially with the acceleration of urban development. Impairment of wetland functions leads to habitat destruction, reduced soil fertility, loss of biodiversity and temperature rise in climate (Wang et al., 2008). Studies to establish the balance of conservation and use can be made by defining the area and determining its natural potential. However, in our country, studies on the presence of flora, which is one of the main characteristics of wetlands, are quite inadequate. Despite some old- dated studies, the first serious research in this area entitled "Turkey's Wetland and Vegetation" was carried out by Seçmen & Leblebici (1997) (Özbey et al., 2015). Nowadays, it is important to investigate these ecosystems which are open to anthropogenic oppression and have a very dynamic structure in terms of biodiversity.

In this research, vegetation analysis of the wetlands biotopes and the immediate vicinity of Kurucaşile (Bartın) district were carried out. Similar studies were conducted in the surrounding of the research area and these are; Yatgın (1996), Başaran (1998), Yılmaz (2001), Vurdu vd. (2004), Yılmaz (2004), Kaya and Başaran (2006), Ekici (2012), Ekici (2017), Sarı Nayim (2010), Sarı Nayim and Ayaşlıgil (2015) and Sarı Nayim (2017). The reason why Kurucaşile has been selected as a research subject is that it increases the richness in biodiversity with its diversity of habitats and ecosystems. However, the lack of recognition of the natural and cultural values of the area prevents doing necessary and sufficient studies on nature protection. In this study, wetland biotopes were determined and their natural potential was revealed in order to determine the sensitivity of habitats in the area and to form a basis for decisions regarding the conservation- use balance.

MATERIALS AND METHODS

Kurucaşile is established on an area of 1 546 km² on the Western Black Sea coast (Figure 1). The surface area is 159 km² (Çilsüleymanoğlu, 1996). The district is surrounded by the Black Sea, Bartın, Cide and Amasra on the north, south, east and west respectively. The material of the study consists of wetlands biotopes in Kurucaşile district (Figure 2). Wetlands consist of rivers and a waterfall. The rivers are in the form of stream and streamlet and most of them are in the coastal area. All of these are poured into the Black Sea. Tekkeönü, Başköy, Elvanlar and Kapısuyu Stream are among the most important rivers of the district. The highest flow of these rivers are in February and March. The flow rate is very low in summer. In addition to the rivers, the hydrological structure also includes Gölderesi Waterfall, which starts at an altitude of 300 m, spans about 12 km long and pours into Çambu Bay. In Gölderesi there are four 6-10 m high

waterfalls and small lakes with a diameter of approximately 3 m, varying in size according to the seasons.

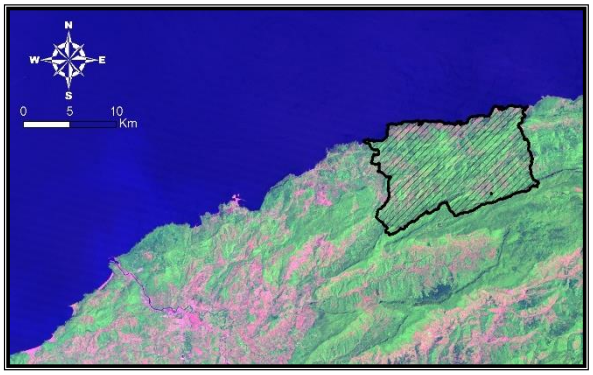

Figure 1. Satellite Image of Research Area

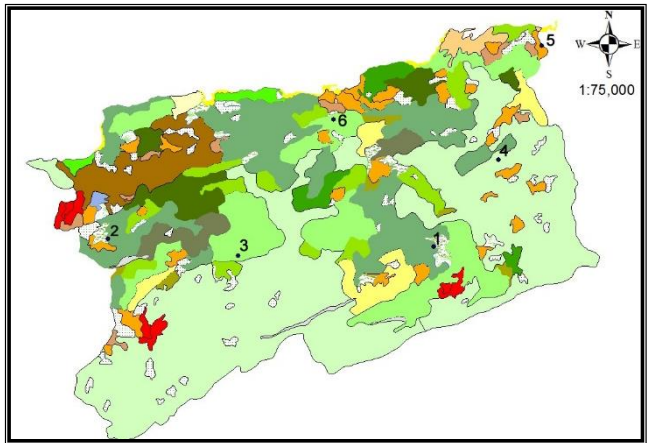

Figure 2. Wetlands of Kurucaşile (1: Başköy Stream, 2: Elvanlar Stream, 3: Gölderesi Waterfall, 4: İlyas Stream, 5: Kapısuyu Stream, 6: Tekkeönü Stream)

When the natural structure of the research area is examined, it is seen that it has a complex structure in the coastal areas and is more plain in the inner parts. There are Cenozoic and Mesozoic sedimentary rocks in the area. Cenozoics belong to Quaternary formations and Mesozoics belong to Cretaceous formations (Haner & Türk, 2000). In the research area, there are 4 large soil groups; gray brown podzolic, red yellow podzolic, alluvial and colluvial. The most common large soil group in the district is gray brown podzolic soils. Kurucaşile has the characteristics of temperate Black Sea climate which may receive rainfall in all seasons. According to Bartın meteorological station data, the average annual temperature is 13ºC, the hottest month is August (23.4ºC), the coldest month is January (4.9ºC), and the average annual rainfall is 1 026.6 mm. According to the water balance sheet prepared in regard to the Thornthwaite method, the research area is in the "humid climate" group. Accordingly, in terms of temperature it has "mesothermal climate", and it has no or very little water deficit. The diversity of Kurucaşile district and its immediate surroundings in terms of topography, climate, geology and geomorphological characteristics, also increases the diversity of the habitat. This diversity enriches the flora. The *Euxine* section of the *Euro- Siberian* floristic region dominates the northern slopes of the area facing the Black Sea due to the mild and humid sea climate. Pseudo maquis elements are also seen locally.

The study was carried out in three phases; analysis of the existing data of the area and the research subject, field studies and evaluation of the data obtained from field studies. In the first

phase, information about vegetation and climate, soil, geological, geomorphological and hydrological data were collected to characterize the growth medium. In the second phase, floristic researches were started. In this context, field studies were carried out in the sample areas and a plant was collected for diagnostic purposes and a "Field study form" was completed for each sample area. With this form, data were obtained about cover value of herbaceous vegetation, amount, combination and dominance of species, cover ratio of woody vegetation, length of layers and the size, coordinates, growth medium characteristics and habitat value of the sample area. Species composition of vegetation cover and frequency of species in sample areas were determined by means of this field study form. Accordingly, the characteristic species representing the biotope type were determined. As vegetation is an indicator in floristic studies, Braun- Blanquet (1964) method was used to show the ecological structure. With this method, the amount of existing plants in an area covered with vegetation is determined by observation and coverage values are expressed as % of the total area (Blanquet, 1964).

In the identification of the plants collected from the field and made into herbarium material, the herbarium of Hacettepe University Faculty of Science was used. In addition to herbarium facilities, especially, the works of Davis (1965- 1985), Davis et al. (1988) and Güner et al. (2000), as well as Symonds & Chelminsky (1958), Symonds & Merwin (1963), Tutin et al. (1964), Tutin et al. (1968- 1980), Hora (1981), Fitter et al. (1986), Yaltırık (1988), Schönfelder & Schönfelder (1990), Gibbons (1993), Yılmaz (1993), Baytop (1997), Uluocak (1994), Schönfelder & Schönfelder (1995), Seçmen et al. (1995), Yaltırık & Efe (1996), Kremer (1998), Erik et al. (1998), Zeydanlı et al. (1999), Altan (2000), Ekim et al. (2000), Durmuşkahya (2006), Akman et al. (2007), Namıkoğlu (2007) and Özhatay et al. (2010) were used.

RESULTS

Since a large part of the district is covered with forests and accordingly, there is plenty of rainfall, there are many creeks and streams of various sizes. All of these rivers originating from the mountains of Northern Anatolia pour into the Black Sea. Therefore, the coastal area displays a rich structure in terms of water availability. Snowy mountain regime prevails in the upstream basins of the rivers. Therefore, the water formed by melting snow has a significant place in the feeding of the river. The flow rate decreases at a great extent in winter due to snow and frost. The flow rates and regimes of rivers are irregular depending on the season. The highest flow is observed in February and March. In summer, the flow rate is very low. The fact that streams and creeks do not have a stable regime causes flooding. This threatens human life as well as the surrounding vegetation.

Başköy, Elvanlar, İlyas, Kapısuyu and Tekkeönü Stream are among the most important rivers in the research area. The streams found in these areas, where marn, limestone and sandstone bedrock are spread, are covered with trees and shrubs with high need of moisture.

The vegetation in the slope areas on both sides of the river bed consists of pseudomaki elements near the shore and this vegetation becomes *Tilia argentea* communities on the north- facing slopes dominated by limestone. *Carpinus orientalis* subsp. *orientalis* and *Fagus orientalis* communities stand out in the rivers and slopes in the inland. In rural settlements, hazelnut and poplar plantations are concentrated in the areas close to the rivers of agricultural areas.

In the south, sand and gravel accumulates in the parts where the creek beds and the slopes facing them are less inclined. The sides of these kinds of streams are covered with forests (Figure 3). The streams form woody or shrubs with humid character in the level areas where they pass. In these areas, where *Alnus glutinosa* subsp. *glutinosa*, *Carpinus betulus*, *Fagus orientalis* and *Salix alba* are dominant, *Acer campestre* subsp. *campestre* and *Platanus orientalis* species are also seen locally. The shaded undercover of tall trees is covered by *Buxus sempervirens*, while the open spaces contain *Corylus avellana* var. *avellana*, *Ligustrum vulgare*, *Pyracantha coccinea*, *Rubus caesius* and *Smilax excelsa* bushes. *Alnus glutinosa* subsp. *glutinosa*, *Platanus orientalis* and *Tilia argentea* communities are dominant in the northern slopes, while these taxa are replaced by *Juglans regia*, *Laurus nobilis*, *Olea europaea* subsp. *sylvestris*, *Salix alba*, *Populus nigra* ssp. *nigra* and *Prunus x domestica* species as you move to the coastal areas. *Myrtus communis* subsp. *communis*, *Phillyrea latifolia*, *Rosa canina* and *Rubus hirtu*s shrubs play an important role in these river slopes (Appendix 1).

Figure 3. Tekkeönü Stream Surrounded By *Carpinus betulus* Forests

Typha latifolia reeds are widespread along the rivers. As you go from the sea to the inner parts, it is seen that the river banks are covered with *Petasites hybridus* (Figure 4). *Galega officinalis*, *Lotus corniculatus* var. *corniculatus*, *Lysimachia verticillaris*, *Mentha x piperita*, *Ranunculus constantinopolitanus*, *Rumex crispus*, *Trifolium campestre* and *Veronica chamaedrys* species are dominant in humid herbaceous vegetation at the water sides (Table). These taxa are locally accompanied by *Hedera helix*, *Orobanche ramosa*, *Primula vulgaris* subsp. *vulgaris* and *Pteridium aquilinum* species that develop densely under trees (Appendix 1).

Figure 4. *Typha latifolia* and *Petasites hybridus*, Which Live Along The Banks Of The Elvanlar Stream

Anagallis arvensis var. *arvensis*, *Arabis caucasica* subsp. *caucasica*, *Arabis turrita*, *Carduus nutans*, *Cionura erecta*, *Cirsium vulgare*, *Coronilla varia* subsp. *varia*, *Crepis foetida* subsp. *rhoeadifolia*, *Erodium cicutarium* subsp. *cicutarium*, *Euphorbia helioscopia*, *Glaucium flavum*, *Hordeum murinum* subsp. *leporinum* var. *leporinum*, *Iris pseudacorus*, *Leucojum aestivum*, *Lythrum salicaria*, *Potentilla reptans*, *Prunella vulgaris*, *Rapistrum rugosum*, *Rostraria cristata* var. *cristata*, *Sambucus ebulus*, *Sedum stoloniferum*, *Sherardia arvensis*, *Sophora jaubertii*, *Tanacetum parthenium* and *Torilis arvensis* subsp. *arvensis* taxa have an important place in the sunny openings on the riverside. These species are partly accompanied by meadow vegetation elements such as *Argyrolobium biebersteinii*, *Barbarea vulgaris*, *Bellis perennis*, *Convolvulus arvensis*, *Lolium perenne*, *Phalaris arundinacea*, *Plantago lanceolata*, *Poa trivialis*, *Trifolium hybridum* var. *hybridum* and *Trifolium lappaceum* (Appendix 1).

Pollution occurs in these biotopes due to domestic wastes. Growth conditions caused by these factors have enabled the development of ruderal vegetation. Other plants in these areas where *Cynoglossum creticum* and *Euphorbia amygdaloides* var. *amygdaloides* taxa are dominant have been identified as *Anthemis cotula*, *Chenopodium album* subsp. *album* var. *album* and *Ficus carica* subsp. *carica* (Appendix 1).

Another formation of wetland biotopes within the boundaries of the study area is the Gölderesi Waterfall. Gölderesi is an important wetland system formed by stable water surfaces and streams. *Fagus orientalis* communities which grow best in humid environments are spread in the south of Gölderesi. In the areas where the river approaches the waterfall, these plant communities are replaced by mixtures dominated by *Alnus glutinosa* subsp. *glutinosa*, *Carpinus orientalis* subsp. *orientalis* and *Quercus infectoria* subsp. *infectoria* species. *Ilex colchica*, *Mespilus germanica*, *Rhododendron ponticum* subsp. *ponticum*, *Rubus caesius*, *Ruscus hypoglossum*, *Smilax excelsa* and *Vaccinium arctostaphylos* form the shrub layer of woody vegetation accompanied by *Laurocerasus officinalis* and *Sorbus torminalis* var. *torminalis*. There are scrub elements consisting of *Arbutus unedo*, *Cistus creticus* and *Staphylea pinnata* taxa on the south- facing slopes of the area which is sheltered from wind and cold weather conditions (Appendix 1).

The fact that Gölderesi and its surrounding areas are not highly covered, offers a floristic richness in terms of herbaceous vegetation. Typical vegetation elements dominated by *Mentha aquatica*, *Nasturtium officinale*, *Petasites hybridus*, *Tussilago farfara* and *Polystichum setiferum* taxa stand out on the waterfronts (Figure 5). Other herbaceous elements in the area consist of *Argyrolobium biebersteinii*, *Barbarea vulgaris*, *Cerastium glomeratum*, *Cirsium hypoleucum*, *Crepis foetida* subsp. *rhoeadifolia*, *Dorycnium graecum*, *Fragaria vesca*, *Galium palustre*, *Petrorhagia velutina* and *Veronica serpyllifolia*. *Euphorbia amygdaloides* var. *amygdaloides*, *Galium verum* subsp. *verum*, *Hypericum bithynicum* and *Poa trivialis* taxa occupy a large space in sunny openings (Appendix 1).

Figure 5. Moist Vegetation Samples; *Nasturtium officinale* And *Tussilago farfara* (Gölderesi Waterfall)

Geophytes such as *Crocus ancyrensis*, *Cyclamen coum* var. *coum*, *Galanthus plicatus* subsp. *byzantinus*, *Leucojum aestivum* and *Muscari neglectum* accompanies *Cardamine hirsuta*, *Cardamine quinquefolia*, *Geranium robertianum*, *Hedera helix* and *Viola odorata* taxa spreading in shady under cover of tall trees (Figure 6) (Appendix 1).

Figure 6. *Leucojum aestivum*, One Of The Geophyte Plants In The Area

DISCUSSION

Unplanned increase of urban development brings environmental pollution and causes contraction or elimination of limited wetlands. For this reason, the presence of wetlands, its potential, and its natural characteristics have recently taken their place near the top on the world agenda (Atalay et al., 2019). Ecosystems around water resources make up a small portion of forest areas but are highly effective for biodiversity, wildlife and human life (Yılmaz & Çiçek, 2003). Therefore, it is important to reveal their natural and cultural characteristics for the conservation and sustainable use of these areas.

Within the scope of the research, the wetland biotopes in Kurucaşile (Bartın) district were determined and the floristic composition of 6 vulnerable sample areas open to human pressure were explained. These areas are Başköy, Elvanlar, Gölderesi, İlyas, Kapısuyu and Tekkeönü Stream. The flow and regimes of these rivers, which occupy a wide place in the research area, change depending on the season and this causes flooding especially in spring. Accordingly, human life as well as the surrounding vegetation is under threat. Fresh water, which provides irrigation water for agricultural areas, is destroyed due to pollution from settlements. It has been determined that the pollution caused by construction and domestic wastes in the river beds negatively affects the quality, fauna and flora of the water and this pollution is seen intensely in Elvanlar and Başköy streams.

The research area provides a living environment for geophytes such as *Cyclamen coum* var. *coum*, *Crocus ancyrensis*, *Galanthus plicatus* subsp. *byzantinus*, *Iris pseudacorus* and *Leucojum aestivum* (Figure 7). Among these taxa, *Leucojum aestivum* is "VU" (Vulnerable) according to IUCN Red List categories (Ekim et al., 2000), while *Crocus ancyrensis* and *Galanthus plicatus* subsp. *byzantinus* are endemic and "LR" (Less Threatened) again according to IUCN categories. These taxa, which are very important in terms of preservation and maintenance of biological diversity, should be protected together with their living environments.

Figure 7. *Cyclamen coum* var. *coum* And *Galanthus plicatus* subsp. *byzantinus*

Gölderesi Waterfall, which consist of stable water surfaces and streams, are within the boundaries of the study area (Figure 8). Gölderesi is an important wetland system that hosts many bird species. It is observed that recreational use is not intense in the biotope which has great importance in terms of wildlife. In this context, the existing natural potential of the area should be revealed and necessary promotion should be made. At the stage of bringing the area in tourism, it is recommended to consider existing pressures and to evaluate the area according to sustainable ecotourism principles based on nature conservation- development.

Figure 8. Gölderesi Waterfall

Flour mills are operated on Gölderesi, which is formed by streams and small lakes of various sizes, taking advantage of the current power of water (Figure 9). This supports ecological life and makes economic contribution to local people.

Figure 9. Flour Mill On The Gölderesi

A wetland inventory is a prerequisite for effective management and monitoring of wetlands, including the collection of relevant data describing the quality of resources and area units. Establishing region- specific inventories is an ideal method to help achieving nature conservation objectives. The results of the research are intended to constitute a basis for land use decisions and nature conservation studies.

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APPENDIX

Appendix 1. Vegetation Analiysis Of Wetland Biotopes

(Abbreviations: PTrc: Çakraz formation (Red sandstone- claystone), JKrz: Zonguldak formation (Limestone- dolomitic limestone), Krkz: Kazpınarı formation (Andesite- tuff-agglomerate), Gr: Gray brown podzolic, P: Red yellow podzolic)

	Research area number	**1**	**2**	**3**	**4**	**5**	**6**	**Availability**
NO	**Aspect**	SE	SW	SW	NE	N	N	
	Slope (%)	20	10	30	40	30	40	
	Geological structure	Çakraz f.	Çakraz f.	Çakraz f.	Çakraz f.	Zonguldak f.	Kazpınarı f.	

	Soil structure	Gr	P	Gr	Gr	Gr	Gr	
	Tree species				**Cover value of vegetation**			
1	*Alnus glutinosa* (L.) Gaerth subsp. *glutinosa*	2	1			2	1	4
2	*Platanus orientalis* L.	1	1		2	r		4
3	*Populus nigra* ssp. *nigra* L.	1	+			2	1	4
4	*Salix alba* L.	1	2		2	2		4
5	*Acer campestre* L. subsp. *campestre*	+	1	1				3
6	*Carpinus betulus* L.	1	2		2			3
7	*Fagus orientalis* Lipsky	1		1			2	3
8	*Juglans regia* L.			+		r	r	3
9	*Arbutus unedo* L.		+	+				2
10	*Ficus carica* L. subsp. *carica*			r	+			2
11	*Laurocerasus officinalis* Roem.	+	1					2
12	*Laurus nobilis* L.					+	+	2
13	*Olea europaea* subsp. *sylvestris* (Mill.) Hegi					r	r	2
14	*Quercus infectoria* Olivier subsp. *infectoria*		r	+				2
15	*Prunus x domestica* L.					r		1
16	*Sorbus torminalis* (L.) Crantz var. *torminalis*		r	+				2
17	*Tilia argentea* Desf ex DC				+	+		2
				Shrub species				
1	*Rhododendron ponticum* L. subsp. *ponticum*	1	2	2	+	1	1	6
2	*Buxus sempervirens* L.	+	2	1			2	4
3	*Smilax excelsa* L.	1	r	+			1	4
4	*Ligustrum vulgare* L.	1		1	+			3
5	*Pyracantha coccinea* Roemer	+	+		r			3
6	*Rosa canina* L.		1			+	+	3
7	*Rubus caesius* L.	2			r			3
8	*Rubus hirtus* Waldst. et Kit.		2	1	2			3
9	*Vaccinium arctostaphylos* L.	r	+	1				3
10	*Mespilus germanica* L.	r		+				3
11	*Corylus avellana* L. var. *avellana*		1		2			2
12	*Cistus creticus* L.			+		r		2
13	*Ilex colchica* Pojark		+		r			2
14	*Myrtus communis* L. subsp. *communis*					+	r	2
15	*Phillyrea latifolia* L.				r	+		2
16	*Ruscus hypoglossum* L.	r		+				2
17	*Staphylea pinnata* L.					+	r	2
				Herbaceous species				
1	*Petasites hybridus* L.	2	3	1	2		1	5
2	*Sambucus ebulus* L.	3	2		2	2	1	5

3	*Anagallis arvensis* L. var. *arvensis*	+	+		r	1		4
4	*Cynoglossum creticum* Mill.	1	2	1			+	4
5	*Galega officinalis* L.	1	2		3		2	4
6	*Hordeum murinum* subsp. *leporinum* (Link) Arcang. var. *leporinum*	1	+		+	2		4
7	*Lolium perenne* L.		2		2	2	2	4
8	*Lysimachia verticillaris* Sprengel	2	+	3	r			4
9	*Mentha aquatica* L.	2	2			+	3	4
10	*Potentilla reptans* L.	1	2	1			1	4
11	*Ranunculus constantinopolitanus* (DC.) D'URV.	1	3		3	2	2	4
12	*Rumex crispus* L.	2	1	2	+			4
13	*Veronica chamaedrys* L.		+	2	+		2	4
14	*Chenopodium album* L. subsp. *album* var. *album*	+		r			+	3
15	*Convolvulus arvensis* L.	1				1	+	3
16	*Galium verum* L. subsp. *verum*		+	1	+			3
17	*Hedera helix* L.	1		+		2		3
18	*Leucojum aestivum* L.		1		2		1	3
19	*Lotus corniculatus* L. var. *corniculatus*	1		2	1			3
20	*Orobanche ramosa* L.	+		r		r		3
21	*Primula vulgaris* Huds. subsp. *vulgaris*	+		+	r			3
22	*Pteridium aquilinum* (L.) Kuhn.	r	1	+				3
23	*Typha latifolia* L.		1			1	2	3
24	*Anthemis cotula* L.	1					2	2
25	*Argyrolobium biebersteinii* P.W. Ball		1		1			2
26	*Cerastium glomeratum* Thuill.		r		4			2
27	*Cirsium hypoleucum* DC.			+	+			2
28	*Crepis foetida* subsp. *rhoeadifolia* (M. Bieb.) Celak.	+				1		2
29	*Dorycnium graecum* (L.) Ser.		1		+			2
30	*Erodium cicutarium* (L.) L'Her. ex Aiton subsp. *cicutarium*		+			r		2
31	*Euphorbia amygdaloides* L. var. *amygdaloides*	+		+				2
32	*Galium palustre* L.		1		+			2
33	*Glaucium flavum* Crantz.					+	+	2

34	*Hypericum bithynicum* Boiss.		r		1					2
35	*Lythrum salicaria* L.	+				r				2
36	*Mentha x piperita* L.		1		1					2
37	*Muscari neglectum* Guss	r				+				2
38	*Nasturtium officinale* R. Br.			1		1				2
39	*Poa trivialis* L.	1						r		2
40	*Prunella vulgaris* L.		+		+					2
41	*Sherardia arvensis* L.	1		r						2
42	*Trifolium hybridum* L. var. *hybridum*		2		2					2
43	*Trifolium lappaceum* L.	1						1		2
44	*Veronica serpyllifolia* L.		r		+					2
45	*Arabis caucasica* Willd. subsp. *caucasica*					1				1
46	*Arabis turrita* L.	r								1
47	*Barbarea vulgaris* R.Br.	1								1
48	*Bellis perennis* L.	+								1
49	*Cardamine hirsuta* L.			+						1
50	*Cardamine quinquefolia* (M. Bieb.) Schmalh			+						1
51	*Cionura erecta* (L.) Griseb.					2				1
52	*Cirsium vulgare* (Savi) Ten.					+				1
53	*Carduus nutans* L.	+								1
54	*Coronilla varia* L. subsp. *varia*					2				1
55	*Crocus ancyrensis* (Herbert) Maw.	+								1
56	*Cyclamen coum* Miller var. *coum*			+						1
57	*Euphorbia helioscopia* L.					1				1
58	*Fragaria vesca* L.			1						1
59	*Galanthus plicatus* Bieb. subsp. *byzantinus* (Baker) D.A. Webb	r								1
60	*Iris pseudacorus* L.			+						1
61	*Polystichum setiferum* (Forsk.) Moore ex Woynar	1								1
62	*Rapistrum rugosum* (L.) All.							2		1
63	*Rostraria cristata* (L.) Tzvelev var. *cristata*	1								1
64	*Rumex conglomeratus* Murray					1				1
65	*Sedum stoloniferum* S.G. Gmelin					+				1
66	*Sophora jaubertii* Spach.	1								1
67	*Tanacetum parthenium* (L.) Schultz Bip.					1				1

68	*Torilis arvensis* (Huds.) Link. subsp. *arvensis*	+			1
69	*Trifolium campestre* Schreb.			1	1
70	*Trifolium repens* L. subsp. *repens*			2	1
71	*Tussilago farfara* L.		1		1
	Dominant species			*Petasites hybridus*	

Appendix 2. Coordinates Of Research Area

Research area no	**Coordinates**	
	X	**Y**
1 Başköy Stream	4625650	475925
2 Elvanlar Stream	4626300	465150
3 Gölderesi Waterfall	4625550	469500
4 İlyas Stream	4628575	478075
5 Kapısuyu Stream	4632475	479550
6 Tekkeönü Stream	4630200	472700