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RESEARCH ARTICLE

Identification and Mapping of Wetland Plants in Erzurum

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ABSTRACT

The study aimed to determine the wetlands and the flora of the wetlands within the provincial borders of Erzurum. The study was conducted mainly in the running water (river, stream) in addition to the temporary wetlands, marshy lakes, and high-water table areas in the Erzurum province placed in the A8, A9, B8, B9 squares according to Davis. The wetlands plants were identified after collecting 287 samples in the 6 main locations, and herbariums of 110 plants were formed. As a result of the evaluations, 96 species belonging to 41 families were identified. Among these plants, 29 families were identified in Karasu location, 25 families in Serçeme location, 22 families in the Aras location, 19 families in Oltu location, 28 families in Tortum location and 23 families in Çoruh location. It was determined in the field studies that climate and altitude constitute significant limiting factors for the species diversity. The aquatic plants were observed in the still waters or slowly flowing waters, no plant was observed in the fast-flowing water and irrigation ponds. It was also observed in this study that wetlands are an important habitat not only for flora but also for fauna. It is thought that the study results can be used in both landscape design and landscape planning studies.

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Introduction

Wetlands are defined by the Convention that was signed in Ramsar city of Iran where Turkey became a party in 1993. According to the Convention, wetlands are defined as "areas of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water either static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six-meter". In addition to this definition, the areas that have borders to the rivers or sea and that are located near the wetlands and the seas the depth of which at low tide do not exceed six-meter are accepted as the wetlands. The wetlands are the most biologically productive ecosystems after the tropical forests. Providing appropriate nutrition, reproduction, and shelter environment for many species, the wetlands are regarded as the natural richness museums not only for the country they are located in but for the entire world. Having a significant place for the population living nearby and contributing to the economy of the region and the country, the wetlands have a prominent and specific place between the other ecosystems in terms of the protection of the natural balance and biological variety (Anonymous, 2007).

While all the plants need water, some of the plants live continuously and distinctly in the water. Subsequently it was

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named the aquatic plants. Seçmen and Leblebici (1982) and Şişli (1996) classified the plants as the Halophytes living in the areas where water intersects with land and the Hydrophytes living in the areas where the depth of the water is considerable. Akaya (1996) divides aquatic plants into 5 morpho-ecological groups: hydrophytes, floating plants, suspended, plants having the roots in the water, plants that floating on the water, and plants having the roots on the water. As it is possible to group the aquatic plants as the primary and secondary aquatic plants based on the environment (Anonymous, 2007), they may be classified as the plants partially or fully adapted to the life in water. Based on the presence in the water, these plants may be also grouped as high aquatic plants without flowers or aquatic plants with flowers. This group is also classified as the submerged aquatic plants that live entirely beneath the water surface, the emerged plants that have the roots in the water and that stand above the water surface, floating plants with leaves (the plants that float on the water) and the plants living in the coastline (Anonymous, 2007).

Most of the studies conducted on aquatic plants have been carried out within the scope of botanical research. The majority of the national studies regarding the wetlands and the plants living in that area have been conducted in the large reed fields and lakes and these studies usually examined the botanical characteristics of the plants (Turgut, 2009).

The study aimed to identify the aquatic plants in the permanent and temporary wetlands located in the provincial borders of Erzurum within the context of the Ramsar Convention in addition to the habitats, expansion areas, and taxonomic properties of these plants. It is believed that this study will contribute to the national plant inventory and protection of our germplasm while it will be efficient for bringing them into the economy.

Materials and Methods

Erzurum selected as the study area is the largest city in the East Anatolian Region with a surface area of 25.066 km^2. The rivers located in the provincial borders of the study were evaluated in 6 locations. These are named as the following: Karasu River (KL), Serçeme Stream (SL), Aras River (AL), Oltu Stream (OL), Tortum Stream (TL) and Çoruh River (ÇL). In these locations, there are lakes, rivers, dam lakes, irrigation ponds, a leading part of minor streams and rivers, temporary wetlands, and high-water table area. Figure 1 presents the map of the locations while Table 1 presents the fundamental information on the locations that are created.

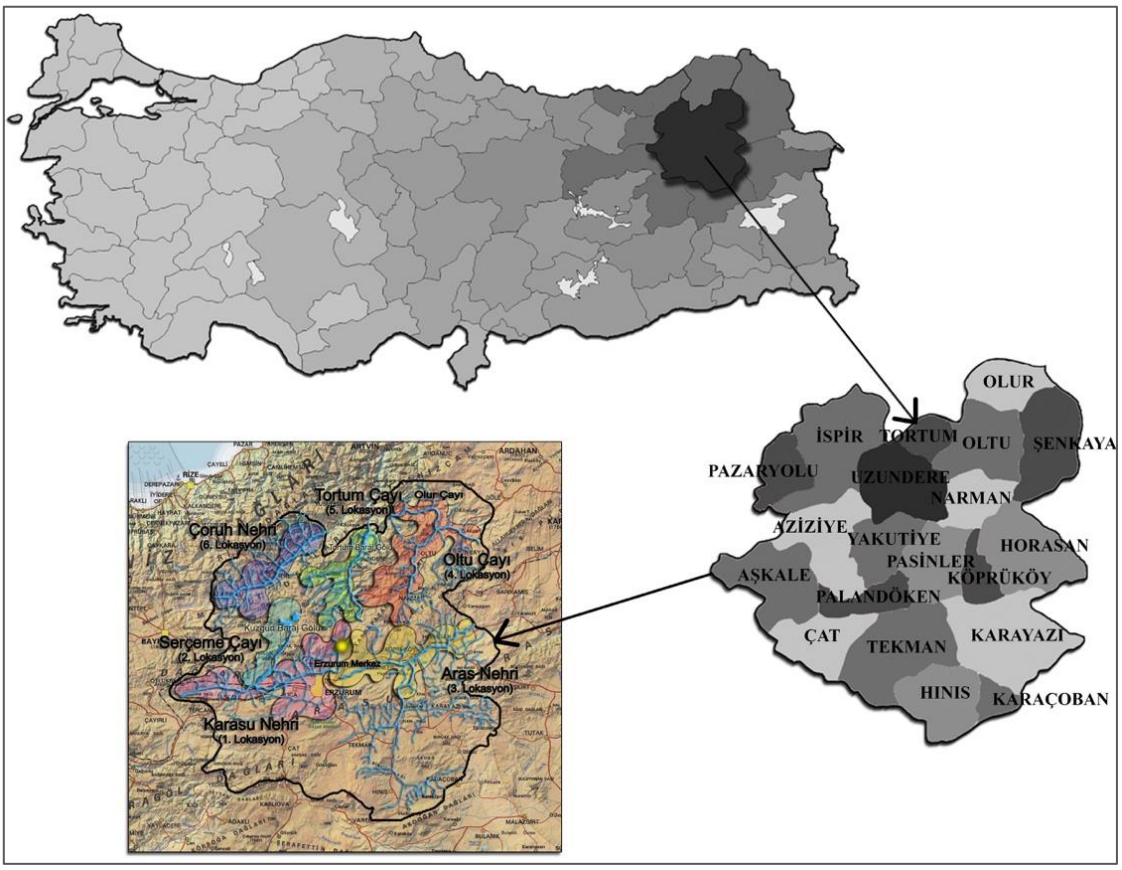

Figure 1. The geographic position of the study area

Table 1. Some information of locations

Location	Running waters	Lakes, marshy lakes wetlands	Observation length (km)	Line	Sample size
Karasu (KL)	Karasu	Erzurum plain wetlands	140	Dumlu-Erzurum Plain (Adaçayı, Dereboğazı Özbek, Kümbet, Konaklı, Kan köyleri)- Aşkale	70
Serçeme (SL)	Serçeme stream	Kuzgun dam lake	72	Kuzgun dam lake-Karasu	29
Aras (AL)	Pasinler stream- Aras river	Köprüköy temporary wetland	80	Pasinler-Köprüköy-Horasan	65
Oltu (OL)	Bardız stream, Narman stream, Oltu stream	Narman temporary wetlands	110	Erzurum-Horasan-Şenkaya (Gaziler) Erzurum-Pasinler-Narman-Tortum Erzurum-Tortum-Oltu-Olur-Uzundere	56
Tortum (TL)	Tortum stream	Tortum dam lake, Yedigöller Tortum marshy lake	80	Erzurum-Tortum-Uzundere	40
Çoruh (ÇL)	Çoruh river		36	Ilıca-Pazaryolu-İspir	27

For the plant samples, the coast at a distance of 0 to 50m from the river beds, watersheds, high water table area, temporary wetlands, swamp lakes, lakes, irrigation ponds, and dam lakes have been scanned. 287 samples were collected for this purpose and coordinates of the sampling locations were defined by GPS. Photographs of the sampling locations and the plants were taken. The information was filled in the observation card after determining the status of these plants in the natural landscape. A hydrography map of the research area was created by using the ArcGIS module of ArcGIS software. The hydrography maps obtained from DSI (State Hydraulic Works) were used as the bottom layer in the formation of this map. The coordinates used in the study and sampling were entered on the maps. The studies of Altınayar (1988), Cook (1996), Söğüt (1996), Seçmen and Leblebici (1997), Behçet and Özgökçe (1998), and Anonymus (2005) were used in the identification of the plants. Furthermore, the professional experts made the herbariums by benefiting from Atatürk University Department of Plant Preservation and Atatürk University Department of Biology for the plants gathered as an herbarium. The study of Uluğ et al. (1993) was used for identifying the names of the plants diagnosed.

It was verified whether these plants exist in the regional records according to the studies of Davis (1982), Altınayar (1988), Tatlı (1988), Tatlı and Behçet (1989), Behçet (1994), Behçet and Altan (1994), Behçet and Özgökçe (1996), Seçmen and Leblebici (1997) and the endemic characteristics of the plants were identified according to Turkey's Endangered Species Rare and Endemic Plant Types (Ekim et al., 2000).

Hydrological Structure of the Erzurum

ArcMap module of ArcGIS software was used for drawing the hydrography maps of Erzurum. The hydrography maps obtained from DSI were used as the bottom layer in the formation of this map (Figure 2).

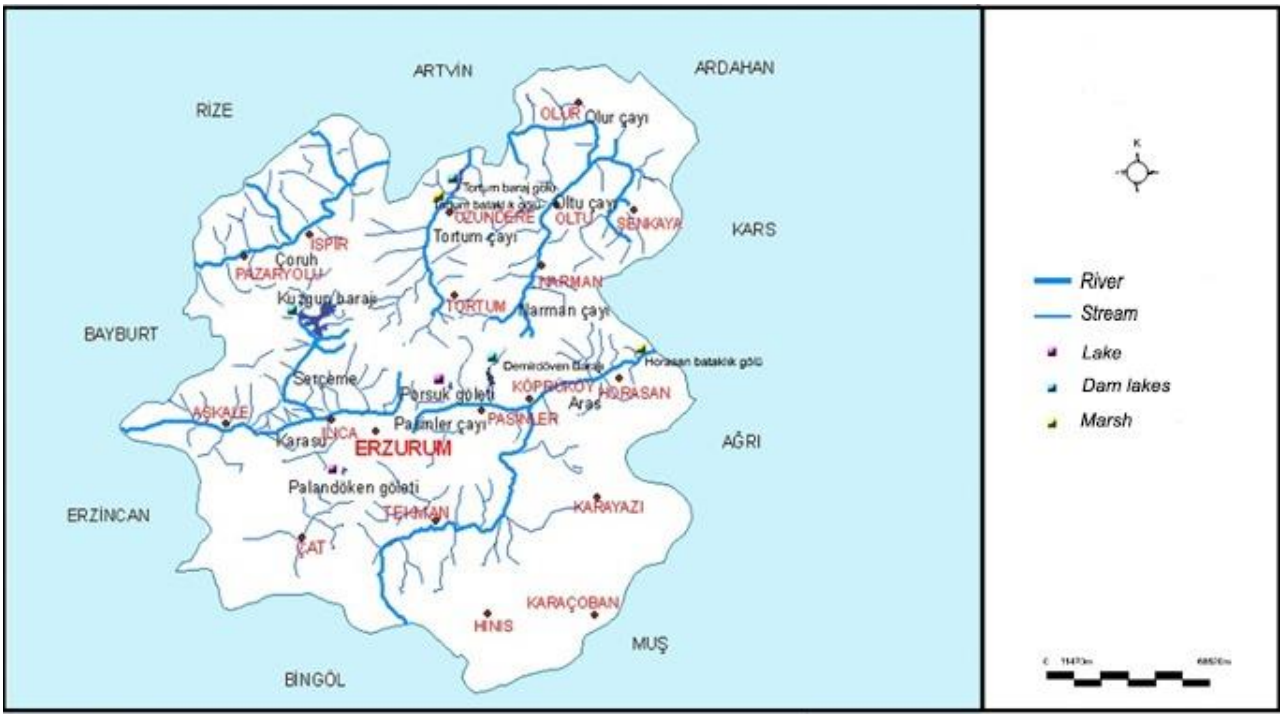

Figure 2. Hydrography map of Erzurum

The hydrography maps included the rivers, lakes, ponds, temporary and marshy lakes. The characteristics of wetland plants identified in the study were reviewed and their distribution in the study area was defined by generating the maps based on location. 3 large streams among the major water resources of the country, namely Aras (217km), Çoruh (199km), and Karasu (140km) flow in the borders of Erzurum province. In addition, many small streams and streams were present in the hydrological structure of the province (Anonymous, 2020a). They are present 900ha of natural lakes, 115ha of ponds, and 1265ha of dam lakes in Erzurum province. Tortum Lake is the largest lake with a surface area of 6.7km^2. It is followed by Aygır Lake with 1.4km^2 and Şah Lake with 1km^2. 23 Temmuz Lake is the largest irrigation pond with an area of 35ha (Anonymous, 2020c). Figure 3 presents the locations and observation points of the study area.

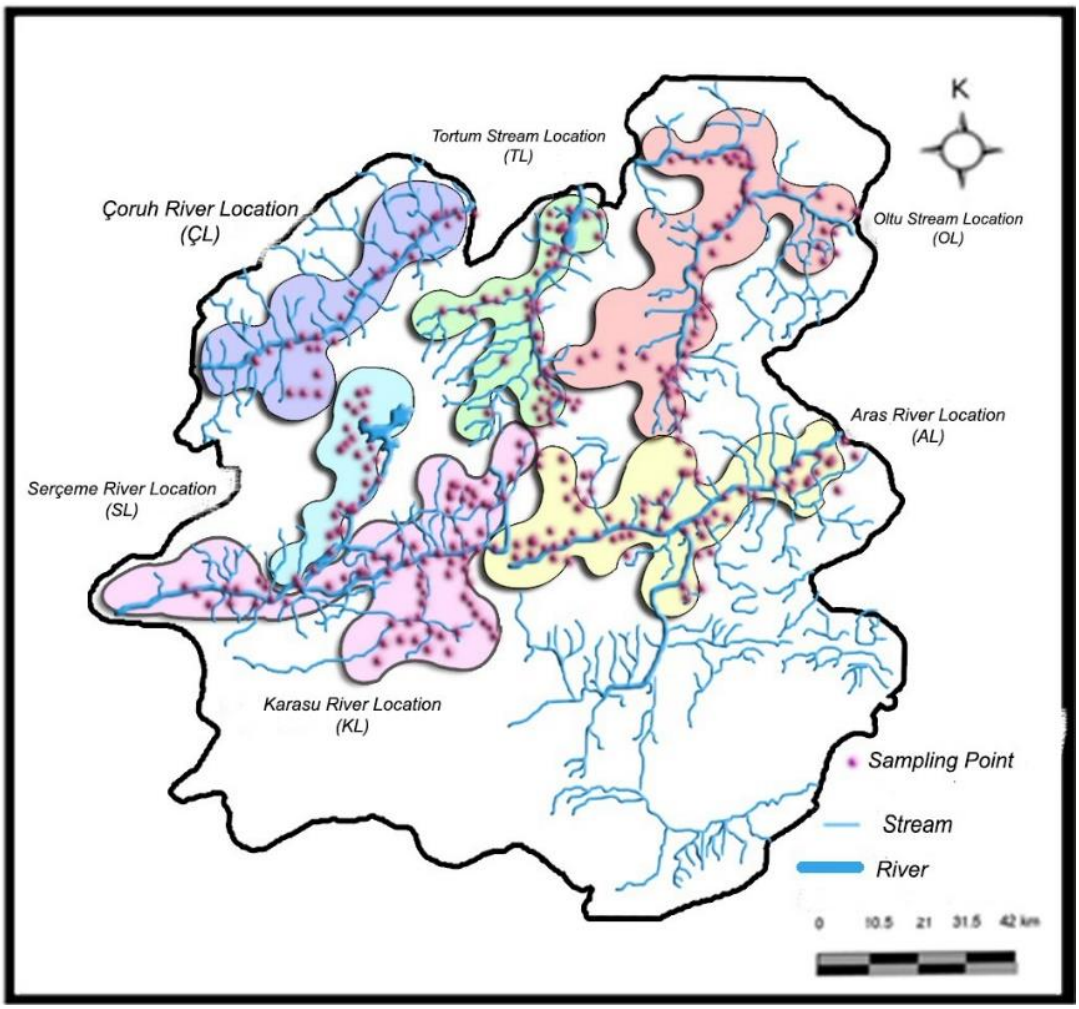

Figure 3. The map of locations

Temporary Wetlands

Temporary wetlands considerably enriching the hydrological structure of the province begin to form with the melting of the snow and normally dry out at the beginning of July or at the end of June. These wetlands are located at Karasu River location, Tortum Stream location, Aras River location, and Oltu Stream location. The temporary wetlands in the Karasu River location consist of Karasu Wetland and Dadaş Reed field (Çayırtepe wetlands). Dadaş Reed field indicates the eastern part of the Karasu Wetland. Since it is divided due to the Erzurum-Tortum highway, it is perceived as a separate area. This area is different compared to other areas in terms of water depth and the size of the area. Currently, because of the regulations in the state roads, the Dadaş Reed field is connected to the Karasu main drainage canal through the Çayırtepe drainage canal. Dadaş Reed field is locally identified as mainly Müdürge Swamp or Çayırtepe Wetlands or Kösemehmet Şorakları (Çorakları). These names are used because of this land's proximity to the settlements around the Reed field. However, the wetland is called the Dadaş Reed field in the topography maps (Anonymous, 2020c). This area was examined as "Erzurum Wetlands" in this study. Small-scale temporary wetlands unfound in the literature reviews were recorded in the field studies. Among these areas, the wetlands formed when the water was filled in the areas where the sand was excavated by dozens of trucks in Köprüköy district have become natural wetlands. The area located on the right side of the road on the 2nd km of the Köprüköy-Horasan road leads to the Aras river in a narrow lane. This area encloses a land of 500 decare. Another wetland is called Tortum Lake wetlands. It is located to the left of the road in the direction of Artvin at the source of the Tortum lake. The smallest wetlands in Oltu

Small Stream location in the study area is located at the vast plain in front of the Narman fairy chimneys. The abundant wetland plants were found in the area (Figure 4).

Figure 4. The original photographs from the study area (a: Serçeme location; b: Karasu location; c: Oltu location; d: Aras location; e: Tortum location; f: Çoruh location, g: Tortum Waterfall, h: Erzurum Marshy Land)

Topography of the Erzurum

Erzurum is one of the most elevated provinces in Turkey. Approximately 64% of its surface area consists of mountains. The mountains are followed by plateaus (20%), flatlands (12%), and lowlands (4%). Among the most significant mountains, there is the Kaçkar Mountains at 3937 m of elevation in the continuation of the East Black Sea Coast Mountains and there are hills at about 3.000 m. The Rize Mountains rise like a wall in the northern section and constitute the provincial border with Rize. The regular mountains parallel to the Black Sea do not allow to pass. The inner sections of the North Anatolian Mountains are located between Çoruh Valley and Aşkale-Erzurum-Pasinler's depression line. This range of mountains starts with the Kop Mountains, where the Çoruh and Karasu valleys come near in the west of the province, while the Kargapazarı Mountains between Pasinler plateau and the Georgian Strait extend through the south, become thinner and turn into a mountain range of mid-height. Hasanbaba and Güllü Mountains are located in the area between Oltu Small Stream and Aras Basin. The Karasu-Aras Mountains extending from the west as the continuation of the Munzur Montains and the Mercan Mountains form the Dumanlı, Palandöken, and the Sakaltutan Mountains towards the East (Anonymous, 2020a).

Natural Vegetation of the Erzurum

Erzurum is located between Europe-Siberia and Iran-Turan regions in terms of phytogeography. Consequently, this region contains both plant communities of both floristic regions. The upper section of the forest reaches 2700m in the east and northeast of the region, where the continental climate is felt the most. The elevation limit of agriculture also rises and passes 2000m. The forests in the province are normally located at the highest section of the natural spread of the forests and in the zone called "pinetum". Beyond this forest spread, the areas called "alpinetum" are observed. As this area is located at the upper section of the forest, we observe an excessive drought during the summer and sever colds between December and March, the trees cannot grow, thus the formation of xerophyte vegetation is enabled (Güçlü and Yılmaz, 1989; Anonymous, 2005).

Climate Characteristics of the Erzurum

Since the continental climate is dominant in the province, winter lasts long and the conditions are extremely harsh. The summer lasts short and the weather is very hot. There is a considerable difference in the temperatures between the winter and summer seasons and there is a significant change in the temperature of the day and the night. In the hollow areas that have an altitude of 1000m to 1500m in the north of the province, the climate is not that harsh. The data of the climate station of the General Directorate of Meteorology (DMI) for the provinces of Erzurum Central and districts between the years of 1929-2019 are presented in Table 2 (Anonymous, 2020b).

Table 2. Climate data of Erzurum (between 1923 and 2019)

Parameters	Months												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
Average temperature (°C)	-9.2	-7.7	-2.4	5.4	10.7	14.9	19.3	19.5	14.7	8.1	1.0	-5.9	5.7
Average max temperature (°C)	-4.0	-2.4	2.6	10.9	16.8	21.7	26.5	27.2	22.6	15.1	6.8	-1.0	11.9
Average min temperature (°C)	-14.0	-12.6	-7.1	0.0	4.4	7.3	11.2	11.2	6.5	1.8	-3.7	-10.3	-0.4
Average sunshine duration (h)	3.2	4.4	5.1	6.3	7.9	10.2	11.2	10.7	9.0	6.8	4.8	3.1	82.7
Average precipitation days	11.3	11.1	12.4	13.7	16.2	11.0	6.7	5.2	5.2	9.7	9.3	10.7	122.5
Total monthly precipitation (mm)	22.5	26.8	34.9	53.0	73.8	49.0	26.6	17.7	23.5	48.3	33.1	22.8	432.0
Max temperature (°C)	8.0	10.6	21.4	26.5	29.6	32.2	35.6	36.5	33.3	27.0	20.7	14.0	36.5
Min temperature (°C)	-36.0	-37.0	-33.2	-22.4	-7.1	-5.6	-1.8	-1.1	-6.8	-14.1	-34.3	-37.2	-37.2

Results and Discussion

Wetland Plants of Karasu Location

Samples from 70 points were collected in Karasu location (KL), and the floristic characteristics of the plants were identified. KL wetlands include the vegetation of the area where the Karasu river flows, including the plants identified in the streams of the lowland villages and in the areas of these villages, where the underground water is elevated. 45 species belonging to 29 families have been identified in this location. Table 3 provides some characteristics of the plants identified in this location.

The temporary wetland area in the Erzurum Plain is used for agricultural purposes during the low tide. The temporary wetland formed by the melting snow offers stunning views in terms of landscape. However, the orbital road that was built disrupted integrity by dividing the area. Moreover, the airport neighbouring the study area causes both noise and air pollution. The agricultural landscape along the road in the borders of the lowland villages and the Aşkale district in KL create pleasant scenes. Around the Karasu River, intact natural areas are typically observed. The borders of this location with Aşkale district mostly consist of natural areas. This part of the KL principally consists of the settlements. Intense pollution is observed in the areas near the cement factory. Pollution factors in the waters and a considerable degree of turbidity were detected in the waters in this section of the study. Alongside the waterline, the plants near the water are considerably covered with dust. Various bird species were recorded in the area, where the district's dump is located. Turbidity was observed in the waters due to pollution in this area. The landfills end with gravel pits. After the removal of sand and gravel, pits were filled with water and created small ponds. *Plantago major*, *Equietum* sp., and *Butomus umbellatus* were observed in these ponds.

Wetland Plants of Serçeme Location

After getting 29 samples from Serçeme Stream (SL) Location, the floristic lists were generated. 36 species belonging to 25 families were determined when examining these lists (Table 4). SL is one of the areas that have considerable recreational potential in the region. The area looks like a beautiful valley with the Serçeme Stream and the surrounding mountains. The shrubberies surround the Serçeme Stream, the major tributary of the Karasu River. Since it is close to the city center, the population of the city prefers this area for resting during the weekends. *Salix* sp. among the woody plants is intensively observed in the waterline. *Hippophae* sp. is the other woody plant observed in the area. Moreover, *Berberis* sp. and *Lonicera* sp. were also recognizable in groups in the area.

Table 3. The plant species of Karasu location wetland plants

Family	Species	Family	Species
Alismataceae	*Alisma plantago aquatica L.*	*Plantaginaceae*	*Plantago lanceolata L.*
	Sagittaria sagittifolia L.		*Plantago major L.*
Apiaceae	*Carum carvi* L.	*Poaceae*	*Agrostis stolonifera L.*
	Conium maculatum L.		
Asteraceae	*Bidens* sp.		*Alopecurus sp.*
	Cirsium arvense (L.) SCOP.		*Phragmites australis* (CAV.) TRIN. EX STEUDEL
Brassicaceae	*Nasturtium officinale* R.BR	*Polygonacea*	*Polygonum amphibium* L.
Butomaceae	*Butomus umbellatus* L		*Polygonum bistorta* L.
Ceratophyllaceae	*Ceratophyllum submersumm* L.		*Polygonum lapathifolium* L.
Cyperaceae	*Scirpus sylvaticus* L.	*Rosaceae*	*Rumex crispus* L.
Equisetaceae	*Equisetum arvense* L.	*Ranunculaceae*	*Caltha polypetala* HOCHST. EX LORENT
Geraniaceae	*Geranium collinum* steph. EX WIILD	*Potamogetonaceae*	*Groenlandia densa (L.) FOURR*
Juncaceae	*Juncus alpigenus* C. KOCH	*Potamogetonaceae*	*Potamogeton gramineus*
Lamiaceae	*Lamium album* L.		*Potamogeton natans* L.
	Mentha aquatica L.	*Primulaceae*	*Lysimachia vulgaris* L.
	*Mentha longifolia (*L.) HUDSON	*Primulaceae*	*Primula auriculata* LAM.
Lemnaceae	*Lemna* minor. L.	*Ranunculaceae*	*Ranunculus repens* L.
Liliaceae	*Muscari* sp.		*Ranunculus aquatilis*
	Colchicum speciosum	*Rosaceae*	*Sanguisorba officinale* L.
	Ornithogalum sp	*Scrophulariaceae*	*Veronica anagallis-aquatica* L. SUBSP.
Onagraceae	*Epilobium hirsitum* (L.)	*Sparganiaceae*	*Sparganium erectum* L.
Orchidaceae	*Dactylorzhia osmanica* (KL.) SOO VAR.	*Typhaceae*	*Typha laxmannii* LEPECHIN
	Orchis palustris JACQ.		

Table 4. The plant species of Serçeme location wetland plants

Family	Species	Family	Species
Alismataceae	*Alisma lanceolatum* WITH	*Onagraceae*	*Equisetum hirsitum* L.
	Alisma plantago aquatica L.	*Orchidaceae*	*Dactylorhiza osmanica* (KL.) SOO VAR.
Apiaceae	*Carum carvi* L.		*Orchis palustris* JACQ
Asteraceae	*Bidens* sp.	*Plantaginaceae*	*Plantago major* L.
	Cirsium arvense (L.) SCOP	*Poaceae*	*Phragmites australis* (CAV.) TRIN. EX STEUDEL
Butomaceae	*Butomus. umbellatus* L.	*Polygonacea*	*Polygonum bistorta* L.
Brassicaceae	*Nastirtium officinale* RBR.		*Rumex crispus* (L)
Campanulaceae	*Campanula rapunculoides* L.	*Potamogetonaceae*	*Groenlandia densa* (L.) FOURR
Cyperaceae	*Carex aquatilis*		*Potamogeton natans* (L.)
Ceratophylaceae	*Ceratophyllum submersum* L.	*Primulaceae*	*Lysimachia vulgaris* L.
Geraniaceae	*Geranium collinum steph.* EX WILLD.		*Primula auriculata* LAM
Iridaceae	*Gladiolus atroviolaceus* L.	*Ranunculaceae*	*Ranunculus polypetala* HOCHST.EX LORENT
Juncaceae	*Juncus inflexus* L.		*Ranunculus repens* L.
Lamiaceae	*Mentha aquatica* L.	*Rosaceae*	*Geum rivale* L.
Lemnaceae	*Lemna minor* L.		*Alchemilla stricta* ROTHM
Lentibulariaceae	*Utricularia vulgaris* L.	*Typhaceae*	*Typha latifolia*
Liliaceae	*Muscari* sp.		
	Colchicum speciosum		

Wetland Plants of Aras Location

Aras Location (AL) wetlands vegetation covers the Aras River taken as the primary line and the areas where the River flows like Pasinler, Köprüköy, and Horasan regions. 65 samples were collected in the study. 34 plants belonging to 22 families were distinguished in the area. Since the Aras river flows very fast in the winter and the river significantly runs dry in the summer, aquatic plants were unobserved intensively in the river. Significant soil losses were observed because of the severe erosion at the waterfronts. Since the plants cannot stay on the waterfronts, there is no variety in this section. Aquatic plants were mostly found on the Pasinler stream, where the water flows slowly. The sands pits in Köprüköy district constituted one of the remarkable places of the study. After the removal of the sand from the river bed, the deep pits formed were filled water again and created tens of ponds of various sizes. *Typha* species were mostly observed in these ponds. Various bird species were found in this area during the migration. Since there is no information about the area in the literature, it is impossible to give a precise date of the formation. The list containing all of the plants found in AL is presented in Table 5.

Wetland Plants of Oltu Location

Oltu Location (OL) wetland vegetation included primarily the Oltu Small Stream, Narman, and partly the wetland vegetation of Şenkaya district. 56 samples were collected from the area, and 37 species belonging to 19 families were recognized (Table 6).

Table 5. The plant species of Aras location wetland plants

Family	Species	Family	Species
Apiaceae	*Carum carvi* L.	*Plantaginaceae*	*Plantago major* L.
Brassicaceae	*Nastirtium officinale* RBR	*Poaceae*	*Agrostis stolonifera* L.
Butomaceae	*Carex aquatilis*		*Phragmites australis* (CAV.) TRIN. EX STEUDEL
Caltha	*Caltha polypetala* HOCHST.EX LORENT	*Polygonacea*	*Polygonum amphibium* L.
Ceratophyllum	*Ceratophyllum submersum L.*		*Polygonum lapathifolium* L.
Characeae	*Chara* sp.	*Potamogetonaceae*	*Groenlendia densa* (L.) FOURR
Cruciferae	*Isatis* sp.		*Potamogeton gramineus* L.
Equisetaceae	*Equisetum. arvense* L.		*Potamogeton natans* L.
Geraniaceae	*Geranium collinum* Steph. EX. WILLD		*Potamogeton trighoides* CHAM. ET SCHLECHT.
Iridaceae	*Ornithogalum* sp.	*Ranunculaceae*	*Ranunculus aquatilis*
	Iris sp.		
Juncaceae	*Juncus alpigenus* C. KOCH.		
	Juncus inflexus L.		
Lamiaceae	*Lamium album* L.	*Scrophulariaceae*	*Pedicularis comosa* L.
	Lycopus europaeus L.		*Veronica anagallis-aquatica* L. SUBSP.
Liliaceae	*Muscari* sp.	*Sparganiaceae*	*Sparganium erectum* L.
	Colchicum speciosum	*Typhaceae*	*Typha angustifolia* L.
Orchidaceae	*Orchis palustris* JACQ.		*Typha laxmannii* LEPECHIN.
	Dactylorhiza osmanica (KL.) SOO VAR.		

Table 6. The plant species of Oltu location wetland plants

Family	Species	Family	Species
Alismataceae	*Alisma. plantago aquatica* L.	*Orchidaceae*	*Dactylorhiza osmanica* (KL.) SOO VAR.
Apiaceae	*Berula erecta* (HUDS.) COVILLE		*Orchis palustris* JACQ
			Dactylorhiza maculata
	Carum carvi L.	*Poaceae*	*Agrostis stolonifera* L.
	Heraclium trachyloma		*Phragmites australis* (CAV.) TRIN. EX STEUDEL
Cyperaceae	*Schoenoplectus lacustris* (L.) PALLA SUBSP.		*Phalaris arundinacea* L.
	Schoenoplectus tabernaemontani		*Hordeum violaceum* BOISS. ET HUET
Equisetaceae	*Equisetum arvense* L.	*Polygonacea*	*Polygonum lapathifolium*
Iridaceae	*Ornithogalum platyphllum* BOISS.		*Rumex crispus* (L.)
	Iris sp.	*Potamogetonaceae*	*Polygonum. natans*
Juncaceae	*Juncacea articulatus* L.		*Potamogeton perfoliatus* L.
	Juncasea gerardi LOISEL	*Primulaceae*	*Lysimachia vulgaris* LAM
Juncaginaceae	*Triglochin maritima* L.		*Primula auriculata* LAM
Lemnaceae	*Lemna minor* sp. L.	*Rosaceae*	*Alchemilla bursensis* B. PAWL.
Liliaceae	*Muscari* sp.		*Potentilla recta* L.
	Colchicum speciosum	*Scrophulariacea*	*Pedicularis comosa* L.
Lycopus	*Lycopus europaeus* L.		*Veronica anagallis-aquatica*
Onagraceae	*Epilobium parviflorum* SCHREBER		*Rhinanthus angustifolius* C.C. Gmelşn
		Typhaceae	*Typha laxmannii* LEPECHIN

Wetland Plants of Tortum Location

Tortum stream, Tortum Lake, Seven Lakes formed by small ponds in connection, a temporary wetland vegetation on the Tortum road, and Tortum marsh lake vegetation have been evaluated as Tortum Location (TL) 40 samples were collected from the area, and 49 species belonging to 28 families were identified. *Salix alba, Populus tremula, Populus nigra, Hippophea rhamnoides, Tamarix,* and *Rosa canina* species were essentially found in the waterfronts. Moreover, the cultivated plants were intensely observed in the gardens near water. *Morus alba, Malus* sp., *Cornus mas*, and *Prunus* sp. are foremost among them. Table 7 lists all the plants that were identified.

Wetland Plants of Çoruh Location

The principal artery of Çoruh Location (ÇL) consists of the Çoruh River. Çoruh River as one of the fastest flowing rivers in the world completes its journey very quickly and passes to the provincial borders of Artvin by further intensifying its flow within the borders of Ispir district of Erzurum province. The variety of rich wetlands vegetation is affected by the fact that the aquatic plants cannot grow in the river because of the fast flow of the river and that there is a remarkably short flow distance within the provincial borders of Erzurum. 27 samplings were collected in the study area, and 32 species belonging to 23 families were distinguished. Table 8 lists the wetlands plants identified in the study area. *Salix* sp., *Tamarix* sp., *Hippophea rhamnoides, Cotinus* sp. were observed in the waterfront.

Table 7. The plant species of Tortum location wetland plants

Family	Species	Family	Species
Alismataceae	*Alisma plantago aquatica* L.	*Plantaginaceae*	*Plantago lanceolata* L.
	Alisma lanceolatum WITH		*Plantago major* (L.)
Apiaceae	*Carum carvi* L.	*Poaceae*	*Phragmites. australis* (CAV.) TRIN. EX STEUDET
Boraginaceae	*Cerinthe minor* L.		*Phragmites arundinacea* L.
Brassicaceae	*Nasturtium officinale*		*Gladiolus atroviolaceus* L.
Butomaceae	*Butomus umbellatus* L.	*Polygonacea*	*Polygonum amphibium* L.
Campanulaceae	*Campanula rapunculoides*		*Polygonum bistorta* L.
Ceratophyllaceae	*Ceratophyllum submersum* L.		*Poygonum lapathifolium* L.
Characeae	*Chara* sp.		*Poligonum persicaria* L.
Equisetaceae	*Equisetum arvense* L.		*Rumex crispus* (L.)
Graminaceae	*Geranium collinum* steph. EX WILLD.	*Potamogetonaceae*	*Groenlandia densa* (L.) FOURR.
Iridaceae	*Iris* sp.		*Potamogeton gramineus* L.
Juncaceae	*Juncus articulatus* L.		*Potamogeton pectinatus* L.
	Juncus inflexus L.	*Primulaceae*	*Colchicum speciosum*
Juncaginaceae	*Triglochin maritima L.*		*Lysimachia. vulgaris* L.
Lamiaceae	*Mentha aquatica* L.		*Primula auriculata* LAM
	Stachys cretica L.	*Ranunculaceae*	*Caltha polypetala* HOCHST.EX LORENT
Lemnaceae	*Lemna minor* L.		*Consolida orientalis*
Liliaceae	*Muscari* sp.		*Ranunculus repens* L.
	Ornithogalum sp.		*Ranunculus aquatilis*
Lythraceae	*Lythrum salicaria*	*Rosaceae*	*Sanguisorba officinale* L.
Onagraceae	*Epilobium hirsitum L.*	*Scrophulariaceae*	*Pedicularis comosa* L.
Orchidaceae	*Dactylorhiza. osmanica* (KL.) SOO VAR.		*Veronica baccabunga* L.
	Orchis palustris JACQ	*Typhaceae*	*Typha latifolia* L.

Table 8. The plant species of Çoruh location wetland plants

Family	Species	Family	Species
Alismataceae	*Alisma plantago aquatica* L.	*Onagraceae*	*Epilobium hirsitum* L.
Apiaceae	*Carum carvi* L.	*Plantaginaceae*	*Plantago lanceolata* L.
Brassicaceae	*Nastirtium officinale* RBR.		*Plantago major* L.
Campanulaceae	*Campanula rapunculoidse* L.	*Poaceae*	*Phragmites australis* (CAV.) TRIN. EX STEUDEL
Characeae	*Chara* sp.	*Polygonacea*	*Polygonum amphibium* L.
Cyperaceae	*Scirpus sylvaticus* L.		*Polygonum bistorta* L.
Equisetaceae	*Equisetum. arvense* L.		*Polygonum lapathifolium L.*
Graminaceae	*Geranium collinum steph.* EX WILLD.		*Rumex crispus* (L.)
Iridaceae	*Iris* sp.	*Potamogetonaceae*	*Potamogeton natans* L.
Juncaceae	*Juncus alpigenus* C. KOCH.	*Primulaceae*	*Primula auriculata* LAM
Lamiaceae	*Mentha aquatica* L.	*Ranunculaceae*	*Ranunculus repens* L.
	Mentha longifolia (L) HUDSON		*Ranunculus aquatilis*
Lilicae	*Muscari* sp.	*Rosaceae*	*Potentilla reptans* L.
	Colchicum speciosum		*Sanguisorba officinale* L.
	Ornithogalum sp.	*Scrophulariaceae*	*Pedicularis comosa* L.
Orchidaceae	*Dactylorhiza osmanica (*KL.) SOO VAR.	*Typhaceae*	*Typha shuttleworthii* W. KOCH ET SONDER

Common and Indicator Wetland Plants in Locations

Typha shuttleworthii that are globally at risk was common. On the other hand, a significant amount of *Typha laxmanni* grow in dozens of small ponds, formed by extracting the sand in the Aras river bed in Köprüköy district. Moreover, bulbous plants having great potential in terms of landscape design were observed in the study area as well. *Orchis palustris*, particularly *Dactylorhiza osmanica* (Endangered species in Europe) were remarked largely within the boundaries of the Pasinler plain and the adjacent area.

In the mainstream arteries in the study area, Erzurum Plain, Dumlu, Tortum, Pasinler Plain, Köprüköy, Narman, Oltu, Şenkaya, Aşkale and Ispir regions, *Typha* sp. were recorded. Another plant, which is among the most common plants in the study area and forms dense communities, is the *Butemus umbellatus*.

While the *Sagittaria sagittifolia* was recorded solely in canals around Dumlu within the study area, *Dactylorhiza maculata* was remarked only in the meadow area with the elevated groundwater at 2100m altitude of Narman district. While *Polygonum amphibium, Ranunculus aquatilis* were observed in the still waters or slowly flowing waters, no plant was observed in the fast-flowing water and irrigation ponds.

It was determined in the field studies that climate and altitude constitute significant limiting factors for the development of the plants. *Lemna* sp., which is extremely sensitive to the cold weather has been intensively encountered in the Şenkaya and Narman districts that have a milder climate. Similarly, it was observed that plant diversity in the region increases when the temperature increases. Small marshy areas were recorded within the adjacent area of the city in the hills facing the north. *Caltha polypetala* was recorded predominantly in these areas.

There were no heavy pollutant industrial areas around the rivers, lakes, and ponds that were examined within the study area. Nevertheless, it has been determined these areas are used as the discharge areas of domestic wastewater and even the solid wastes are discharged to the streams without any treatment. *Chara* sp. as the pollution indicator was intensively observed mainly in Tortum Stream as well as Serçeme Stream and Pasinler Stream as the tributary of Aras River. *Nasturtium officinale* grows in clean waters. This plant was recorded largely in the remote areas of Tortum Stream, Aras River, Karasu River, and Serçeme Stream. *Equisetum* sp. was seen extensively in the areas that have elevated groundwater around the cement factory in Aşkale district. It was observed that the plants were densely covered with dust particles.

Köprüköy temporary wetland was artificially created due to producing sand in river bed. Despite the emergence of human activities, habitat formation started and one of the major bird areas encountered *in this wetland. Tamarix* sp., *Populus nigra, Typha laxmanni, Juncus* sp., *Sorghum helepense, Ranunculus aquatilis, and Ceratophyllum submersum* were determined in the area.

In terms of biological diversity, wetlands host very significant ecosystems. Hence, it is important to know the variety of current plants and their protection for future generations. Aquatic plants that play a prominent role in the protection of water resources and aquatic organisms should be preserved in their natural environment. The literature screenings determine that aquatic plants play essential roles in cleaning dirty water (Rubio et al., 2009; Keskinkan et al, 2003; Hozhina et al., 2001).

While wetlands are regarded as ecologically significant areas due to their high biodiversity potential, they are also considered in the areas with high landscape value since they play a decisive role in the choice of recreational areas. Streams and their wetlands contribute considerably to the character and quality of the landscape in rural and urban areas (Şahin et al., 2014). A study conducted in the city of Erzurum and its immediate environments evaluated the recreational areas in terms of visual character and at the end of the study, it was determined that the views of Tekeresi, Serçeme valley, Tortum lake, and waterfall are the most preferred areas in terms of landscape beauty and integrity (Kıroğlu, 2007). It is comprehended that landscape integrity should be evaluated with the presence of plants and habitats in addition to water forms in landscape assessment studies. It was observed that the wetlands add a high value to the landscape according to the observations and it was concluded that it is necessary to examine the landscape integrity in terms of balancing use and protection of these areas. The wetlands constitute the primary picnic areas of the region for the local people. Since there are not many alternatives in Erzurum, the majority of people prefer the rivers, streams, lakes, and even irrigation ponds as picnic areas. Erzurum's swamp also known as Erzurum temporary wetland is one of the diminishing places due to anthropogenic pressures. Recommended to be protected as a Ramsar site, this area has the status of Ecologically Sensitive Area (ESA-13), Important Bird Area (IBA-82), and Locally Significant Wetland. As the area is biologically and floristically important, it is a shelter for numerous bird species.

Conclusion

Global warming and the drought associated with warming are the leading problems caused by climate change. Wetlands are buffer zones for water balances. It is also recognized that wetlands constitute an essential natural wealth and contribute to biodiversity. Nevertheless, there were drying activities carried out for several years in these areas. It was determined that the temporary wetlands in the study area were also under intense pressure. During low tides, the local people use these areas for pasturage and a significant part of the current plants faces a serious threat. Drying these areas for agricultural purposes constitutes another pressure faced by the temporary wetlands. Another problem encountered is the discharge of sewage and settlement wastes into rivers without treating the waste. Pollutants such as heavy metals, detergent residues, and pesticides contained in these wastes considerably threaten the flora and fauna in rivers. It was also determined that many wetlands lost their landscape character due to unplanned uses of the areas.

The field studies were carried out in many places ranging from areas with elevated ground-water to in-water areas. Also, a wide selection of samples enabled the sampling of very large areas in terms of climate, soil, and land use. Species diversity and density varied according to these parameters. It was also observed during the field studies that wetlands are an important habitat not only flora but also fauna, such as birds.

Wetland plants offer a wide variety in terms of planning. It should not be forgotten that every study to be carried out on this subject will bring a distinct perspective and a diverse interpretation and it will enrich the use and design studies of the landscape architectures. The use of aquatic plants in the cities should be increased accordingly, and the collection gardens should be established.

In this study, brief evaluations about the values of the landscape of the locations were bestowed and brief general information on the pressure applied to these locations was provided. It is necessary to reveal the significance of these pressures and the negative effects of the pressure on these locations by conducting new studies. Moreover, it is essential to evaluate the rehabilitation works to be carried out for correcting the damages in the locations. Comprehensive studies on the temporary wetlands on the migration route of the birds in the locations should be implemented, and the diversity of the bird species should be precisely defined. It is necessary to inform the DSI and Highways Regional Directorate, determine the areas, to which the protection status should be bestowed. With the regulations, these areas should acquire the status of the protected zones.

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