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Ecogeography of Kaz Mountain ecosystem

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Abstract

Kaz Mountain (Mt Ida), with an elevation of 1774 meters, is the highest landform on the Biga peninsula located in the northwest of Turkey. This mountainous area is situated on the transition zone between the Mediterranean and Black Sea climates. Thus, it has ecologically interesting features. The purpose of this study is to explain the ecogeographical features of the ecosystem of Kaz Mountain. To that end, all physical features such as geomorphological, geological, climate, soil, hydrographical, vegetation, and fauna features were examined. The data obtained was compiled and classified. Hence, ecogeographical features of the area were revealed. Some parts of Kaz mountains were previously declared a national park for the purpose of protection. However, the national park does not cover all of the mountainous mass. The population pressure on the area is constantly increasing. For this reason, national park boundaries should be expanded to protect the whole ecosystem.

Keywords: Ecosystem; ecogeography; Kaz Mountain, Turkey

1. Introduction

Mountain ecosystems that cover approximately one fifth of the landmasses on earth and habitats found in these areas are substantially different from the other ecosystems. Ecosystem elements encountered in mountainous areas display huge variations compared to flatlands and plains. Temperature and precipitation suddenly change based on elevation and consequently soil and flora display enormous differences. These areas highly rich in biodiversity are

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also the regions where the sources of all rivers in the world are located (Ives et al., 1997; Atalay, 2006; 2008). One tenth of the world population resides in mountain ecosystems or in their close vicinity.

Turkey is a mountainous country and half of her surface area is composed of areas with elevations higher than 1000 m. Elevation increases from the west to the east and a substantial part of the population lives in or around mountainous areas. Mountain areas in Turkey are rich in flora in addition to possessing an abundance of endemic species (Atalay and Efe, 2010; Öztürk et al., 1991; 2008).

Reciprocal relationships between living (natural flora, animals and mankind) and non-living (rocks, land formations, climate, soil and water) environmental elements in Kaz Mountain are rather fragile and sensitive (Efe, 2001; 2005; 2010). However, Kaz Mountain is one of the rare areas in Turkey which has conserved its natural properties. Climate and hydrological characteristics have played an important role in this conservation. The area receives sufficient amount of rain and is rich in terms of surface and ground water. Protected areas in the region also have an important function in the sustainability of the ecosystem. Geomorphologic characteristics, climate, natural vegetation, flora and water are among the main factors that determine the operation and ecology of the ecosystem in Kaz Mountain.

Mediterranean climate prevais around the Kaz Mountain. However, to the north; Bayramiç and Yenice depressions that are fed through the rain and snowfall in the higher areas in Kaz Mountain and to the south; various rivers that flow into Edremit Bay also exist. Inner parts of each of the valleys have microclimatic areas and habitats. Anthropogenic impact is very strong on Kaz Mountain ecosystem. The vicinity of the mountains has been used for thousands of years by humans and therefore the natural vegetation were damaged, destroyed or degraded substantially.

2. Material and Method

Kaz Mountain is situated on the northern coasts of Edremit Bay in the west-northwest of Turkey and forms the border between the Aegean Region and the Marmara Region. The south and east of the mountain mass with roughly 1.000 km^2 surface area is located in Balıkesir province and the north and west of the mountain mass is included in Çanakkale province. The north and south of the mountain mass is surrounded by Bayramiç Evciler depression and Edremit Bay respectively.

The goal of this study is to identify the ecology and ecosystems of Kaz Mountain. Climatological data from Edremit Meteorology Station related to temperature, precipitation and wind for a lengthy period (1959-2005) were utilized to present the relationship between vegetation that change vertically due to orographic impact and climactic parameters. Topographic maps of the study area scaled 1/25.000 were used in general geomorphologic assessment and in profiling and cross sections. Geological maps scaled 1/50.000 and 1/100.000 were utilized in compiling information about the geology of the study area.

3. Findings and Discussion

Kaz Mountain is a large natural mechanism, an ecosystem that completes each other with its physical and biological elements and that works together in mutual relationships. Biogeography elements along with geological, geomorphologic, pedological and hydrological elements provide the ecosystem's integrity.

This ecosystem was established on a foundation composed of living and non-living elements. These are geomorphologic and geological structure, climate, soil and water, flora, fauna and mankind.

3.1. Geomorphologic Characteristics:

Geomorphologic characteristics are the foundation of Kaz Mountain ecosystem. Mountains, hills, valleys and their directions, elevations, exposure conditions and slope degrees carry characteristics that affect the ecosystem. Internal and external factors played an active role in the formation of the topography of the area. Tectonic movements caused the formations of faults that divided the mountains into blocks. General direction in which Kaz Mountain lies is east-west and as a result, the slopes face north and south. Rivers that settled in latitudinal fault lines opened wide valleys (Bilgin, 1969; Efe et al., 2007; 2008a; 2008b). The direction in which the mountain lies affects

both the climate and the flora. The mountain mass obstructs the cold northern winds that are dominant in the region and prevents their entrance into Edremit Bay. Therefore, winters around the bay sheltered this way are mild.

Elevation in the majority of the Kaz Mountain area is above 1000 m. Temperatures drop and precipitation increases due to elevation factor. Contrasts between southern and northern slopes in Kaz Mountain ecosystem are strong in every respect. While relatively xerophilous plants with higher temperature needs grow in southern slopes, hygrophilous plant communities and species are more common in the northern slopes. As a phytogeographical reflection of the impacts of exposure, plant communities and species in Mediterranean character have expanded in southern facing slopes whereas plant communities and species that belong to the Black Sea phytogeographical region are observed in the slopes that face the north.

In Kaz Mountain variations are observed in the amount of sun light received by the slopes that face south and north in summer and winter. Rugged area in the southern slopes causes sunlight to arrive at these slopes with right or close to right angles which results in more energy intake and stronger heat. Therefore insolation is stronger in the southern facing slopes of Kaz Mountain. That situation also plays an important role in the fact that winters are milder.

Abundance of valleys in Kaz Mountain, their directions, depth and humidity are among the most important physical elements in the ecosystem. About ten valleys at the least cross these mountains horizontally in the north and in the south. However none of these valleys cross Kaz Mountain from end to end in the north-south direction. The valley systems of southern and northern slopes are independent of each other. Some of the valleys were cut deeply due to the severity of the tectonic movements and erosion. In some cases, approximately a relative altitude difference of 1000 m exists. Difference in elevation between the valley floor in the lower sections of Şahin Creek Valley and the highest section in the upper basin is about 1000 m. valley floors are narrow and slopes are steep. Therefore some of the valleys carry the characteristics of canyons.

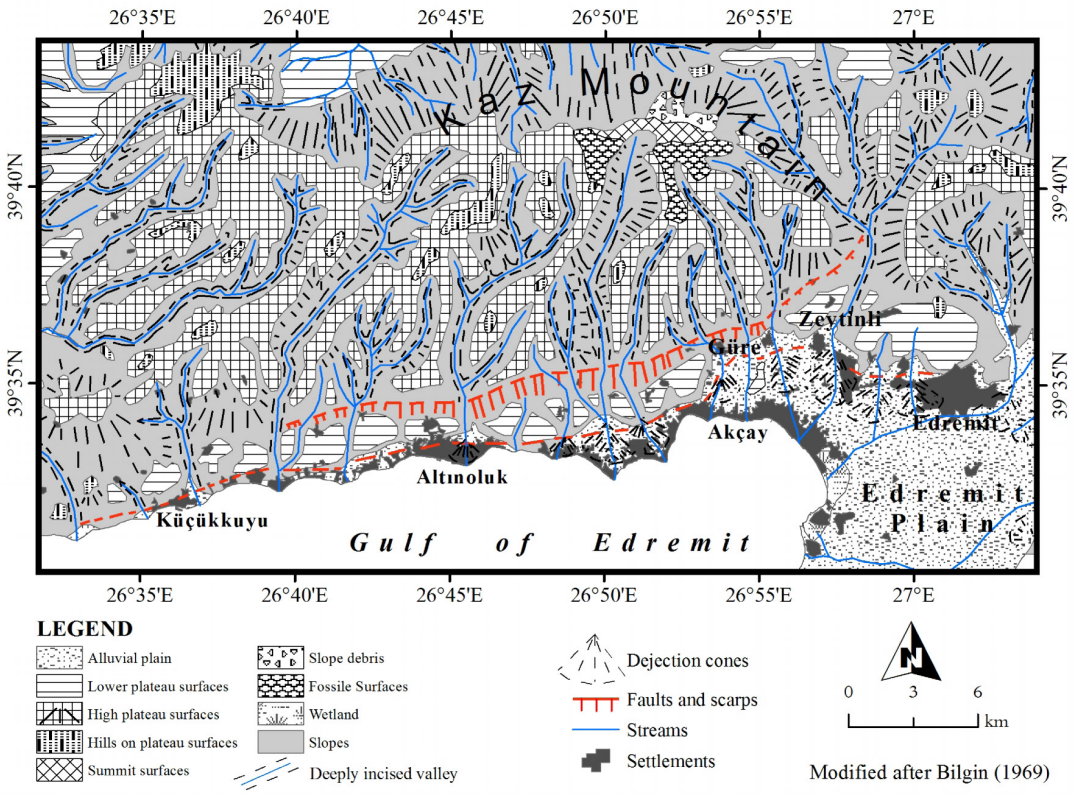

Fig. 1. Geomorphological map of the Kaz Mountain

These characteristics of the valleys affect the conditions of their insolation, humidity, air masses and microclimates. Duration of insolation and therefore the impact of sun decreases in deep valleys and a humid environment is generated. Each valley on the southern slopes of Kaz Mountain that receives high insolation is a microclimate area in the second degree with humid environments. Therefore many plant varieties that are sensitive to low temperatures which enjoy water can be found in these valleys. Laurel (*Laurus nobilis*), myrtle (*Myrtus communis*) and storax (*Styrax officinalis*) are among the plant species found in valleys.

Especially during the summer, valleys channel the breezes that are generated as a result of local air pressure between the higher sections of the mountain and the sea and increase their impact. In summer nights, the cool air of the higher sections of the mountain descends towards the costs by preserving its velocity and impact. This cool air eases the hot and muggy air of the summer season. However, this impact is felt more intensely at the lower sections of the valleys and in areas where valleys expand towards the coast.

Flatlands included in the low and high sections in Kaz Mountains have a function in the ecosystem and they provide diversity in the ecosystem. Some of these flatlands are by the coasts and others are located in higher lands.

Flat areas by the coasts are embankments where materials such as sand, clay, silt and pebbles are collected. Vegetation composed of halophytic species can be found on the salty soil by the areas close to the sea.

Flatlands with narrow surface areas generated by structural reasons and erosion can be seen on the slopes of Kaz Mountain that face the south. They usually constitute the areas where villages are situated and some of them are small scaled plateaus. These breezy areas with a view of the bay and surrounded with forests are generally found in levels between 400 m and 800 m.

Flatlands related to geomorphologic erosion periods exist in the summits of the mountains. All these flatlands are the plateaus used in the summer months.

3.2. Geological Characteristics

Kaz Mountain has the characteristics of a open-top plutonic a dome whose core was composed of tectonically by granite-granodiorite based gabbro. It is a unit of Eybek Mountains outcropped by granite rocks in the system. Cover layers which have metamorphic characters are partially open. The tectonics, structure and lithological characteristics of the rocks are effective on the operation of the ecological mechanism.

Rock diversity with various lithologies have caused enrichment of macro and micro relief species by affecting the conditions of weathering and erosion and established a ground for soil diversity. Transported soil such as alluvial and colluvial and soil whose textures and structures are different from each other such as clayed and sandy soil, rendzinas, non-calcareous brown soil and brown soil emerged. Bed rock played a primary role from time to time in determining the soil characteristics.

3.3. Climate

Therefore Kaz Mountain is included in the Mediterranean region. Since elevation creates an oromediterranean layer, it has two separate characteristics in terms of ecosystem climate as lower and upper zones. Temperature, precipitation, wind, relative humidity and cloudiness are the main climate parameters which are effective on the ecosystem in various ways and manners.

Mediterranean climate conditions are dominant in the south lower zone. Winters are mild and rainy and summers are hot and dry. Seasonal distribution of precipitation is not even. About 49.3% of precipitation occur in winter and 3.2% in summer respectively.

Summer temperatures are higher considering the altitude. Summer temperatures of the stations with continental conditions are also lower. The reason for this change is based on the fact that the sea prevents heat exhaustion at nights by acting like a thermostat that controls the temperature. Since the area is under the effect of high pressure (anticyclone) conditions during the summer months the weather is clear and insolation period is longer. Annual insolation period is 2605 hours around Kaz Mountains (Güçlü, 2010).

Hot and sunny summers have promoted the expansion of species with high need for temperature and light that are resistant to drought.

The seasonal course of precipitation in the Kaz Mountains is getting modified by the influence of orography due to altitude. Maxima precipitation in Kaz Mountain ecosystem accur in the winter because the general atmosphere conditions show that Mediterranean turns into a low pressure field, marine polar (MP) air mass increases its effect and forms a front with the marine tropical (MT) air mass. Since these fronts create mobile depressions that arrive from the west, rainy air masses reach the Kaz Mountain ecosystem from the western sector (southwest) and are let into through the Edremit Bay. This wind that brings the rainy air masses is the southwest wind. The weather is cloudy, humid and warm in the winter months. When the incoming air masses arise on the slopes of Kaz Mountain, severity of the precipitation increases. Mountains create an orographic effect that results in abundance of rain. Winter precipitation is generally in the form of rain and it takes the form of snow in the upper zone when the temperature is very low. Winter precipitation seeps underground and forms ground water deposits (aquifers) in areas where the lithological characteristics of the ground are suitable. They generate springs and resources with abundant flow which seep over the topography in appropriate areas.

Arid conditions are dominant in Kaz Mountain during the summer. Share of summer precipitation in the area is 3.2% in the summers. Hot and arid summers with clear skies and abundant sunlight have resulted in the expansion of heliophitic and xerophitic plant species and communities in the southern slopes in the lower zone.

Summer aridity does not constitute an important problem in Kaz Mountain ecosystem which is rich in terms of water since the geological and geomorphologic structure allows storage of abundant winter precipitation in suitable areas and passage of the underground water to the surface in the form of gushing springs.

Kaz Mountain ecosystem causes the northern sector winds (especially the northeaster) dominant in the direction of general pressure centers in Turkey to blow in the eastern direction. The dominant wind direction in the southern wing of the ecosystem is the east. Although eastern sector winds are cold during the winter they gain a cool and dry character when they reach the coasts.

Eastern winds blow as dry winds during the summer. Although somewhat warmed, they are still the coolest winds of the summer.

Winds that dominant from the second degree in the southern sector in the Kaz Mountain ecosystem are southeastern winds which are characterized by dryness and warmth. They warm up as a result of blowing from high ground to low ground and gain heat. During the summer they are still dry but warm.

Winds that blow from the direction of east and southeast have the effect of relatively decreasing the humidity. That's why the flora is xerophilous in all places other than valley floors and areas rich in underground water. Turkish pine communities, xerophilous oak forests and maquis are plants that prove these conditions.

The winds that bring precipitation in the Kaz Mountain ecosystem by blowing over the sea are southwest and west winds. Although in the third rank in terms of annual numbers of blows, they are important due to establishing a base for the rest of the precipitation due to the humidity they provide. These winds are humid-warm in the winter and warms the air, increases the humidity and causes precipitation. During the summer, they are less observed. The most important characteristic of these winds is the humidity they bring during the winter and the summer. Southwestern and western winds are one of the reasons why winters are mild in the southern sections of the Kaz Mountain ecosystem. Therefore conditions for the expansion of species and communities that are sensitive against frost are provided. Even maquis elements typical to Mediterranean climate such as gum (Pistacia lentiscus) and myrtle (*Myrtus communis*) have found suitable habitat for themselves.

Climate conditions in the northern slopes of Kaz Mountain are different from those in the south. Annual average temperature is 2°C lower compared to the south. Rather than based on differences in latitude, this is mainly due to the openness of the Kaz Mountain ecosystem to cold air masses coming from the south. Research results clearly shows that winters have partially lost their mild character and that summer temperatures have somewhat dropped. It is observed that some maquis species sensitive to frost have been replaced by other types that do not highly need warmth in northern areas. For instance gum (*Pistacia lentiscus*) and myrtle (*Myrtus communis*) are not found in slopes that face the north. However, the beech (*Fagus orientalis*) which is not observed in the slopes facing the south is the dominant element in the northern slopes of the ecosystem.

Although there are not big differences between the south and the north sector in terms of precipitation regime, the share of summer precipitation in the north increases up to 5%. That situation shows that the severity of drought is decreased by northern effects. The share of winter precipitation is close to one another in the north and the south.

Cloudiness during summer months is more apparent in the north. Annual average relative humidity is 63% in the south and 69% in the north. This situation may be related to the effects of the air masses arriving from the north.

The primary dominant wind directions of the ecosystem in the south and north are east and northeast respectively. In actuality, both winds are the products of the same pressure mechanism. Northeastern winds arrive at the southern sector from the east since they cannot go over the Kaz Mountain mass. Since the ascending rather than descending character of the northeastern winds in Bayramiç depression is dominant, humidity is increased.

Southwestern winds are dominant during the fall-spring period. This humid-warm air mass comes over the sea and causes the humid air to collide with Kaz Mountain system and condense to generate abundant amounts of precipitation. The effects of these winds are felt in Bayramiç depression through Karamenderes stream. Kalkım depression separated from Bayramiç depression with a threshold is more open to the impact of the north. Since the northern section of the system is open to humid and cool air that arrives through Marmara, the ecological conditions are positive in terms of flora. Therefore, humid forests composed of hygrophilous species have emerged in the north. Humid-cool conditions that increase their impact with orographic factors at work have let the beech, sessile oak (*Quercus sessiliflora*), hornbeam and Kaz Mountain fir (*Abies equi-trojani*) to obtain suitable habitat in the northern slopes.

3.4. Soil Characteristics

Bedrock and geomorphology play a determinant role in the soils of Kaz Mountain ecosystem. Alluvial (entisol) soil developed on the collection deposits in the lower zone. However they are replaced by sandy and pebbled beaches near the shores. They are replaced by alluvial materials gradually. Alluvial soil is rich in terms of salt and is haliomorphic. Halophyte plants expand on these soils. Salt content of the soil decreases from the shoreline towards the inland. Plant species that starts with *Salicornia europaea* (*Salicornia* sp.) continues inland with tamarix (*Tamarix* sp.) and reed (*Phragmites* sp.).

Hydromorphic soil is found in areas where underground water levels are high in alluvial coastal valleys and the soil has alkaline character and found in arshy (*Thypha* sp.) and reedy (*Phragmites* sp.) areas. Juncus species (*Juncus* sp.) occur in some areas. Alkalinity decreases in inner areas which are used for fruit and vegetable farming in recent years.

Alluvial soil (entisol) is found in the southern segments of the Kaz Mountain ecosystem where olive groves and orchards are common.

Colluvial (inceptisol) soil formed on debris collected in the skirts of slopes as a result of rain-wash and gradual mass movements. The soil that consists of various rocks is rich in terms of plant nutrients. Due to enough porosity, their aeration is sufficient for the development of woody plants.

Rendzinas develop on calcareous and marly soil of the Neocene era commonly found in the area. Rich in lime, the soil has alkaline reactions. Vertisols develop on Neocene lime- calcareous and lime materials. Both of these soil types are not common in the southern sector of Kaz Mountain ecosystem. Non-calcareous brown soil (inceptisol) is found on non-calcareous rocks in the lower zone of southern sector slopes along with non-calcareous brown forest soil (inceptisol). Dwarf shrub with maquis character develop on non-calcareous brown soil (inceptisol) and non-calcareous brown forest soil (inceptisol) is deeper. Especially granite rocks and schist with cleavage have a thick layer of soil due to ease of disintegration. Non- calcareous soil takes the form of podzol in the upper zone as a result of being washed out. It obtains light acid reaction instead of neuter reaction and becomes rich in terms of humus. Black pine trees of the upper zone normally develop on these types of soils. Partially washed reddish soil is observed on limestone of the Eocene period. Forest vegetation with broad leaves is found on these soils.

Non-calcareous brown forest soils (inceptisol) occur in the lower zone of the northern part of Kaz Mountain ecosystem. This soil turns grayish and gains podzolic character in the upper zone as a result of being washed out. Primary vegetation on both types of soil is species of larch and hygrophilous oaks.

3.5. Hydrographic Characteristics

Hydrography, the important element in Kaz Mountain ecosystem, has direct and indirect effects on the operation of the mechanism and ecological balance through surface water, underground water bodies and marine water mass.

Some of the precipitation on the upper zone generated as rain and snow seeps underground or evaporates and the rest transforms into surface flow to form the rivers along with the springs. Mıhlı stream, Şahin stream, Manastır btream, Kızılkeçili stream, Zeytinli and Edremit streams are the most important of these rivers. All these streams carry water throughout the year. They are fed with the precipitation in the form of rain and snow in the upper zone and the underground water in the form of karstic resources. They carry large amounts of solid loads during severe rainfall during the winter. Stream water with strong karstic loads is usually clear. For instance Kızılkeçili and Zeytinli streams have this characteristic. It is observed that Manastır stream and Edremit stream causes floods as a result of severe and dense rainfall.

A hygrophitic flora with rich diversity exists along the rivers in the deep valleys of the ecosystem. Plane (*Platanus orientalis*), the tree elements of this flora, are very common in the valleys. Plane trees are grand, splendid and usually very old trees (Efe et al., 2010). Deep canyons, ever flowing water and splendid sycamores form humid and cool areas along the valleys. Some fault lines that cross these valleys horizontally formed small waterfalls. There is an estuary like formation at the mouth of the stream. Salty water currents from the bottom up and fresh water current to the sea from the top are observed.

Since Kaz Mountain ecosystem was formed by rocks with large amounts of diaclasis and rocks that can melt such as calcareous, most of the precipitation seeps ground and feed underground water sources. Padişah springs feed Şahin Creek, Gölcük springs feed Kızılkeçili Stream and Gökbüvet spring feeds Zeytinli Stream. Calcareous-schist contact plays a role in the formation of the springs. Schists take an active role as impermeable base rocks. In topographically suitable areas, they go up the surface as springs with abundant flow (ex-surgence, resurgence, karstic springs). The most important of among them is the Pınarbaşı springs in the Güre stream valley. While the upper section is a dry and arid canyon full of rock blocks, flora density and diversity increases starting with the spring.

There are very important and strong springs in the northern areas of the ecosystem. Dalak water and Ayazma are among these. Kaz Mountain is one of the main mountains in Turkey with the richest, most abundant and high quality water sources. Here, geomorphology, geology, climate and vegetation work together to create a monumental ground water deposit.

The Sea: Edremit Bay is an element that completes the ecosystem. Temperature, precipitation, wind mechanisms and relative humidity play an indirect role on climate. It is not an ostentatious claim to state "*If it were not for Edremit Bay, Kaz Mountain ecosystem would not exist*". Everyone who climbs the skirts, slopes and summit of the mountain first glimpses towards the sea and its splendid beauty. The mountain, the sea and the forest complement each other and are parts of a whole.

3.6. Vegetation

Vegetation is the combination of the physical factors in the Kaz Mountain ecosystem. Vegetation is like a green cover that entirely covers the Kaz Mountains. Mountains keep the scenery where green is the dominant color throughout the year. This situation gives a unique quality to Kaz Mountain ecosystem. The forest is always green as well as the maquis. In an area where arid periods are effective, it is rare to see the green landscape throughout the year.

The characteristics of the forest in the Kaz Mountain ecosystem are different in the south and north sides. The main element of the Kaz Mountain green landscape is the forests. Annual precipitation and regime shows that the main vegetation is the forests. Forests in the south side are composed of tree species resistant to aridity which lasts about 4 months.

Black pine (*Pinus nigra*) is dominant up to the summits. Hungarian oak (*Quercus frainetto*) and durmast oak (*Quercus sessiliflora*) are also observed along with black pine communities. Aspen (*Populus tremula*) and beech (*Fagus orientalis*) are also found starting in the 1300th m of the southern sector. The area with no trees in the summit of the ecosystem is not a real alpine layer because the upper elevation limit of the forest in Marmara goes up to 1950 m. This grass layer created as a result of local conditions (topography, wind effect, lithology and soil) and that contains polster plants mixed with dwarf black pine should be considered a pseudo-alpine layer.

Maquis: The climax flora of Kaz Mountain ecosystem is the forest while maquis is a secondary formation created as a result of anthropogenic impact.

Maquis commence from the sea level and increases up to 350 m. Some species can be seen as high as 800 m under right conditions. The dry forest in the southern slopes of the ecosystem was destroyed as a result of environmental use for thousands of years and was replaced by maquis groups.

Herbaceous plants: Kaz Mountain ecosystem is a forest area in terms of climax. However grass communities are also observed in sections where forest cover is removed or based on ground characteristics. Herbaceous species are seen as the representatives of various habitats at the sides of agricultural fields, inside the maquis and as the lower layers of the forest. Herbaceous flora of the Kaz Mountain is very rich in terms of species. Some of them are endemic. Species with flowers that makes visuality prominent have an important place among the herbaceous plants. Since herbaceous plants can find the ecological conditions they need in small spaces in the south and north slopes, they expand in narrow areas.

3.7. Fauna

Kaz Mountain ecosystem has geomorphologic and geologic integrity in the area in Çanakkale province as well. The ecosystem can form interactive relationships with Yenice towards the north, with Armutçuk mountains in the west of Gönen and Erdek bay. In terms of fauna, it can also connect with the Madra mountain system through Şapçı pass and with North Aegean and Central West Anatolian mountains. Fauna is a part of Kaz Mountain ecosystem and contributes to its regular mechanism. Kaz Mountains have a very rich invertebrate fauna which is effective on the plants and in the food chain. The most common members of the vertebrate fauna in the Kaz Mountain are the fish, amphibians, reptiles, birds and mammals.

4. Results

The area of 21.463 ha between Şahin creek and Zeytinli stream in the southern slope excluding the coastal area (other than a few points) and the villages in the mountain skirts until the watershed was declared as National Park in 1993 in order to conserve the natural landscape, physical, biological and cultural resources of the Kaz Mountain. However, it is still difficult to state that the area can be fully protected and ecosystem is unharmed.

The sections in Kaz Mountain ecosystem that are outside National Park and other official protected sites are damaged by improper management, insensibly built roads in forests, mineral explorations, unregulated motor vehicle traffic, poaching, fires, illegal felling and unplanned development.

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