Geobiomes of Burdur-Göhlhisar basin in the Lakes subregion of the Mediterranean Region in Turkey

Türkiye’de Akdeniz Bölgesinin Göller Yöresinde bulunan Burdur-Göhlhisar havzasının jeobiomları

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ABSTRACT

Geobiomes can be referred the effects of geologic parent materials and topographic particularities on some ecological properties of soil formation, plant growth and productivity, land capability classification, land-use of the given area. In order the importance of the geobiomes Burdur-Göhlhisar Basin containing different parent materials and geomorphic units is taken as study area in the northwest part of the Mediterranean Region of Turkey. **Serpentine-Peridotite Biome.** Serpentine forms a distinct habitat in terms of plant growth and soil formation. Deep weathered serpentine produces fertile soil due to almost all plant nutriment released, while unweathered and low weathered serpentine forms a poor habitat on which poor stand forest and bare land is common. Moreover, cracks on the serpentine supports the growth of individual trees. **Marl Biome** is found on the marl deposit. The amount of clay, sand-silt, and inclination of layer of marl deposit affect directly the soil formation and plant growth. Clay-rich marl deposit often prevents the vertical root structure of trees and soil formation takes long time more than a few millions. Good stand forests are found on the soft and inclined layered marl deposits. Severe erosion continues the steep slopes of marl deposit. **Karst Biome** occurring on the limestone creates a special environment depending on crackiness, amount of clay content and the inclination of limestone layers in the karstic land. Generally, red Mediterranean soil has developed along the cracks and among the layers on the sloping area. Other important property of karstic land is to allow forming a good natural regeneration of forest trees. **Conglomerate karst biome** occurs on the conglomerate and sandstone containing mostly limestone gravels and sands, and calcareous cement. The weathering of the calcareous cement material especially along the soft zones and cracks causes disintegration of conglomerates and sandstones as gravels and sands. Here sandy loam soil is widespread. **Halobiome** is common on the regressed Lake Burdur shore on which sparse halophytes grow. **Hydrobiomes** cover in places where ground water level is high and narrow swampland. Here hydrophytic vegetation grows on the hydromorphic soil and hydromorphic alluvial soil. **Psammo-litho biomes** are found on the dejection fans and cones, and lithosols on the sloping area.

Keywords: Geobiomes, Soil formation, Plant Growth, Geomorphology, Burdur-Göhlhisar Basin.

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1. INTRODUCTION

Biomes referring geological parent materials and some geomorphic units create special local environments on which vegetation community and its growth, soil formation and soil types, erosion especially sediment yield are different each other in the sloping areas of same climatic regions. Each biome has distinct and special ecological properties. For this reason, biome classifications are very important in the detail assessment of the environment and relationship between human and natural environment (Walter 1983: Bailey 1995a,b, and 1998: Atalay 2008, 2014).

Each parent material such as serpentine, limestone, marl, gneiss-granite, and conglomerate, for example, has distinct ecological conditions in terms of plant nutriment, soil texture, agricultural activities, forest productivity, silvicultural application, land-use and land capability class and so on.

The presence of the biomes is very important and key factor in the assessment of natural potential and problems in Turkey due to the fact that it has rugged topography and almost all parent materials belonging to different geological time. According to studies on the soil formation and soil texture in the karstic lands especially of Taurus Mountains, red Mediterranean soils are found within the cracks and among the layers in the sloping areas, while these soils are common on the flat lands notably in the karstic depressions. All red Mediterranean soils are in clay texture due to the calcium carbonate transport as calcium bicarbonate with water and clay remains in the limestone areas. Good stand forests are common on the karstic lands of Taurus Mountains because the root of trees develops toward deep parts along the cracks of limestone (Atalay 1997, 1995, 1999, 2011, 2008: Sarı et al., 2018). Conglomerate composed of mainly limestone pebbles and cemented with calcareous cement also brings about an environment resembling karst topography (Atalay et al., 2017). Peridotite-serpentine which is the crust of the geosynclines and composed of ferro magnesium silicate is very hard and very resistant against the weathering process. For this reason, poor stand forest is common on outcropped peridotite-serpentine in the sloping areas, while deeply weathered serpentine containing rich plant nutriment creates a good habitat for the productive growth of forests, soil texture is in clay and clayey loam (Atalay 2014, 2015, 2016, 2017: Atalay et al., 2019: Altunbaş 2018, Altunbaş et al., 2019). Marl deposits containing calcium carbonate and clay present a poor habitat in terms of soil formation and tree growth due to low weathering process and soil formation takes long time more than a few million years. On the other hand, the stratification and compactness of marl deposit is also important factor for the soil formation and agricultural-forest production. For example, horizontal layered marl mostly prevents the deeply development of the root, for this reason the productivity of forest is low as compared to limestone. Besides gully erosion development of the sloping area on the marl is common, because low infiltration capacity of marl leads to the increase of overland and/or runoff for the formation of severe erosion (Atalay and Efe 2014: Atalay 2014: Atalay et al., 2019).

Burdur-Göhlhisar Basin containing many biomes depending on parent materials and geomorphic units is selected as the study area (Fig. 1).

2. MATERIAL AND METHOD

In order to depict the presence of the parent materials effects on the soil formation and vegetation growth firstly the occurrence of the parent materials were established during the field study during the period of 2016-2019. The methods of biome classification and pedogeomorphology were taken the studies of Walter (1983), Bailey (1995a, b and 1999), Atalay (2014) and Altunbaş (2018). The studies relating to tree growth and parent materials made by Atalay (2014) and Altunbaş et al. (2019) were taken into consideration. Each biome properties were explained.

Diameter, height and age of Calabrian pine (*Pinus brutia*) and Anatolian black pine (*Pinus nigra* subsp. *pallasiana*) growing on the marl, serpentine and limestone and colluvial deposit derived from serpentine were measured to determine growth rate and/or productivity. The topographic map in the scale of 1/25 000, geologic-lithologic and geomorphic maps prepared by the authors and graphs were drawn to illustrate the relationship between parent material and tree growth.

The parent material and soil samples were taken at the bench mark sites for the analysing at laboratory. In the laboratory of Department of Soil Science and Plant Nutrition of Agricultural Faculty, Akdeniz University the texture of parent material and soil was made by the Bouyoucos method (1955) and Black (1957), organic material was made Walkley-Black (Black 1965), pH was determined and classified the method of Jackson (1967), CaCO₃ was determined with Scheibler calcimeter, Jackson (1967) and Cation Exchange capacity (CEC) was determined Kacar's method (Kacar 1995).

Figure 1: The location and topographic map of Burdur-Gölkışar Basin

3. FINDINGS

3.1. GEOLOGIC PARENT MATERIALS

The basement of the study is mostly composed of peridotite that spread mostly erupted from the mid-oceanic ridge the floor of Tethys geosyncline bottom and serpentine formed the result of hydration of peridotite in the Mesozoic era. The mud-rich calcareous and clayey materials were accumulated on the peridotite and serpentine basement of the geosyncline. Thus, thick limestone layer was formed and emerged with the uplifting and folding of the mud-rich calcareous and clayey materials in the upper Mesozoic. Tertiary conglomerate-sandstone formation was formed the accumulation of transported materials as sands and gravels originated from Mesozoic limestone and partly peridotite-serpentine terrains in the north-western part of Söğüt Mountains. The marl deposit was formed in the neogene lake environment in the collapsed area with the faulting movements that firstly occurred in the mid-Miocene (Atalay 1977: Atalay et al., 2017: Atalay et al., 2019: Fig. 2).

Figure 2: Geologic map of the Burdur-Göhlisar Basins

3.2. TOPOGRAPHY-GEOMORPHOLOGY

Present-day topography of the study area was formed by the vertical tectonic movements leading to the formation of the depressions along the faults and the resistance of parent material (rocks) against the fluvial erosion. Indeed, firstly the Burdur and Göhlisar basins were formed by the faulting movements occurred between mid-Miocene and Upper Pleistocene. These basins were occupied by Neogene Lake in which clayey and calcareous materials were accumulated. The relative altitude more than a few hundred meters has caused the rejuvenation of erosion in the upland areas and the fault scarps encircling the basins were dissected by triangular shaped valleys (Photo 1). The erosion surfaces that clearly are observed on the neogene marl deposit in the eastern and south eastern part of Burdur basin were formed according the altitude of base level of Burdur Basin.

Figure 3: Geomorphologic map of Burdur-Göhlhisar Basin

The limestones and partly serpentines form the highlands due to the resistance of the erosion (Atalay 1977: Atalay et al, 2017: Atalay et al., 2019). The altitude which is about 1000 m of elevation in Göhlhisar Basin and 850 m of elevation in Burdur basins climbs up to as high as 2500 m in the encircling high areas of these depressions.

3.3. CLIMATE AND VEGETATION

Semiarid mesothermal climate characterized with rainy and cool winters and hot and rainless summers experiences on the bottom land of the study area. The mean annual temperature which is 12-13°C on the bottom lands decreases c. 8°C at an elevation of 2000 m and 450 mm yearly rainfall on the lowlands probably rises up c. 600 mm on the upland areas. Depending on the climatic properties the lowland areas climbing 1200-1300 m is the main occurrence areas of Calabrian pine (*Pinus brutia* Ten.) and maquis vegetation notably *Quercus coccifera* communities. Oro-mediterranean forest mainly composed of Anatolian black pine (*Pinus nigra* subsp. *pallasiana* (Lamb) Holmboe) is found (Atalay and Efe 2010: Atalay 2012, 2014, 2015, 2016). Black pine destroyed areas have been replaced by juniper species commonly *Juniperus excelsa* and *J. foetidissima* (Fig.4).

Figure 4: Native occurrence areas of vegetation belts in the northern part of Burdur Basin

3.4. GEOBIOMES

The environments reflecting parent material effects on the sloping areas are classified as geobiomes. Here dominant and/or leading ecological-geomorphological factors on the plant growth, soil formation and land use are related to physical and chemical properties of the parent materials on the exposed sloping areas (Walter 1983; Bailey 1995a, b and 1998; Atalay 2014; Atalay et al., 2018; Altunbaş 2018). These biomes are divided into four biomes: Serpentine, limestone, conglomerate-sandstone and marl in the Burdur-Göhlhisar Basin (Fig. 6). These natural properties of these biomes are briefly explained below.

3.4.1. Serpentine-Peridotite Biome

Serpentine is the product of peridotite composed of ferro magnesium silicate hydration that erupted and spread on the Tethys ocean bottom. The natural green colour of serpentine changes different colour mostly pale red, brown, pale brow and yellowish depending on weathering stages as seen in the melange area which is located in the 2 km west of Yeşilova town (Photo 2, 3). The weathering process of serpentine-peridotite takes very long time due to ferro-magnesium-silicate composition. The CEC (cation exchange capacity) and/or plant nutriment is very low on the unweathered and low weathered serpentine. Here vegetation cover, especially growth rate and/or productivity of trees and shrubs is very low (Photo 2). While plant nutriment content especially clay, Mg and Ca cations and/or CEC capacity is higher on the deep and good weathered reddish serpentine than the yellowish and greenish serpentine (Photo 3). Good forest stands and fertile agricultural lands are found on the deeply weathered serpentine area. The highest quality timber and biomass productivity of Anatolian black pines (*Pinus nigra*) is found on the deeply weathered serpentine in western part of Taurus Mountains and SW of Anatolia (Tetik and Yeşilkaya 1997; Atalay 2014, 2015).

Sparse and poor stand Calabrian pine (*Pinus brutia*) appears on the low weathered serpentine in the northeastern part of the Göhlhisar depression (Photo 2). Here CEC changes between 20-10 cmol_c kg⁻¹. Bare lands are also seen on the exposed serpentine with CEC is about 2 cmol_c kg⁻¹ especially at Taşpınar locality in the southeast of Lake Ak. While productive of Calabrian pine trees with high tall are common on the colluvial deposit containing weathered serpentine materials (Table 1, 2, Photo 2, 3; Fig. 5, 6; Altunbaş 2018; Altunbaş et al., 2019).

Table 1: The height, diameter and age of *Pinus brutia* on serpentine experimental site at an elevation of 1110 m, Gölhisar and Çavdır highway connection in the 10 km NE of Gölhisar town, 37° 9'55.81"N and 29°42'8.89"E

Weathering degree of serpentine	Location of trees	Height (m)	Diameter (cm)	Age (year)
Good weathered	1.Small depression	14	38	45
Exposed serpentine	2.The upper part of hill slope	1.2	4	30
Semi weathered	3.Top of the hill	3.5	37	16
Weathered	4.Top of hill	3.2	14	37
Weathered	5.Top of hill	8	26	36
Semi weathered	6. Top of hill	4	26	36

Figure 5: Graph illustrating the diameter, height and age of Calabrian pine relationships on the different weathered serpentine at place of connecting highway of Gölhisar and Çavdır towns.

Table 2: Some physical and chemical analysis of different weathered serpentine in the study area

Sample Location	Weathering stage of serpentine	Sand (%)	Clay (%)	Silt (%)	Texture	pH	CaCO ₃ (%)	Organic material (%)	CEC (cmolckg ⁻¹)
SE of Burdur near Çendik beach	Upslope	91	2	7	Sand	9.5	6.5	0.3	3.16
"	Subsoil	77	8	15	SiL	9.73	11.5	0.3	2.19
Akçakale yolu	Serpentine soil	61	20	19	SiL	9.13	1.7	0.7	23
Kayacık köyü	Flour of serpentine	65	10	25	SiL	9.12	7.11	0.5	21
Connection of Gölhisar and Çavdır road	Green sand of serpentine	73	7	20	SiL	8.94	1.52	0.4	20
Same place	Weathered serpentine	59	21	20	SiCL	7.41	3.7	0.5	24.3
Same place	Weathered serpentine	79	7	14	SiL	7.62	5.11	0.5	33
Same place	Low weathered ser.	71	13	16	SiL	7.43	6.7	0.4	2
Taşpınar locality between Akgöl-Yeşilova town	Weathered serpentine with rill erosion	67	6	27	SiL	8.55	14.9	0.1	1.8
"	Bare area of serpentine	67	6	27	SiL	7.87	3	0.4	2.0
"	Same locality	71	13	16	SiL	7.49	1.6	0.2	12.9
"	Only herbaceous vegetation	65	9	26	SiL	7.28	2	2	14.5
Upper terrace level 1200 m in the east of Burdur Basin	Weathered serpentine	73	9	18	SiL	7.67	9.3	0.8	66
Same locality	Good weathered serpentine	65	7	28	SL	7.67	17	0.5	44

Table 3: Some physical and chemical analysis of serpentine melange area at 2km east of Yeşilova town, Burdur province

Parent material properties	Sand (%)	Clay (%)	Silt (%)	Texture class	CaCO ₃ (%)	K (cmolckg ⁻¹)	Ca (cmolckg ⁻¹)	Mg (cmolckg ⁻¹)	Na (cmolckg ⁻¹)	CEC (cmolckg ⁻¹)
Deeply weathered reddish serpentine	46	25	29	L	33	0.3	36.3	13.5	0.12	34.4
Deeply weathered reddish serpentine	37	29	24	CL	23	0.4	37.5	14.7	0.13	43.8
Less weathered greenish serpentine	79	9	12	LS	33.7	0.05	20.8	2.8	0.03	13.8

Other property of serpentine is to show profound effects on development of tree roots. The unweathered serpentine mostly prevents the root development due to hard surfaces. While serpentines with deep cracked structure form a good habitat for the growth of individual trees, because tree roots easily follow the partly weathered of the cracks and the growth of the roots also leads to enlarge of cracks. The release of the nutriment along the serpentine cracks achieves tend to increase the growth rate of trees. In addition to this, the increase of the released plant nutrients thrive the growth rate of the trees and agricultural productivity. The productive *Pinus nigra* forests are found on the deeply weathered serpentine, as observed in the west of Gölhisar and southern part of the Söğüt Mountains (Atalay et al., 2019).

The value of CEC of the serpentine depends on the amount of the released clay, and Ca⁺⁺ and Mg⁺⁺ cations. For example, the CEC is about 14 cmol_c kg⁻¹ at the serpentine containing 2.8 cmol_c kg⁻¹ Mg, while these figures are 44 and 15 cmol_c kg⁻¹, respectively. On the other hand, chestnut soil developed on the serpentine can be considered as fertile soil in local scale in the flat lands of the study area. Here CEC is over 40 cmol_c kg⁻¹ (Table 2, 3).

3.4.2. Marl Biome

Marl composed of approximately 50% clay and 50% calcium carbonate was formed with accumulation of calcareous mudstone on bottom of lake and shallow sea.

The main ecological properties of marl are indicated as follow:

a. It is plastic when wet and hard when dry. The weathering of marl is very hard due to very thin layered clay-rich materials. For this reason, soil formation on the marl deposit takes long time more than at least a few millions in age. Indeed, there is no mature soil cover on the upper neogene marl deposit. Although water hold capacity of marl is high, available water capacity for plant is low and when it saturated with the water marl changes to impermeable layer (Atalay et al., 2016b).

b. The root development of plants on the marl is very difficult; tree root develops in horizontal direction on the hard and compact marl layers, while taproot system takes place along the cracks and soft zones of marl deposits (Photo 5, 6). These situations affect the growth rate and/or productivity of trees and shrubs. As a matter of facts, the productivity of trees is low on the compact and horizontal layered marl deposit; while productive trees and forests are found on the soft and inclined layered marl deposits as are seen on marl deposit in the east of Burdur and in the south of Gölhisar (Photo 6).

c. The severe erosion continues on the steep slopes of marl deposit. For this reason, deep gullies and “V” shaped valleys are widespread along the fault scarps extending eastern part of Burdur Basin. The amount of runoff derived from the heavy rainfall is excessively high, because infiltration capacity of marl deposit is very low on sloping area. Initially rills developed on the steep slopes have convents small gullies and then large and wide gullies with the collecting of overland flow.

d. Soil formed on the marl deposits is rendzina (Mollisol ordo rendoll subordo, Rendzic leptosol), A horizon contains rich organic material and dantritic root system (Atalay 2016b: Kurucu et al., 2018). There is a somewhat carbonate and clay accumulation in the subsoil. CEC changes between 15-25 cmol_c kg⁻¹ depending on mostly the amount of clay, in general (Table 4). Neogene marl deposits on the flat lands especially in the study area are devoted to mostly dry farming areas on which cereals notably barley and wheat are harvested.

e. Erosion of marl deposit on the undulating area does not prevent considerably the agricultural production and fertility, because agricultural activities continue on the again exposed fresh marl deposit. In other words, erosion occurring on the sloping area is not preventing factor the continuation of agricultural production. Essentially, marl deposit can be assessed to be submature soil. Undulating areas are mainly covered by sparse *Quercus coccifera* because of the fact that this oak species is very resistant drought and over grazing.

f. Marl deposit on the sloping area is very sensitive for land degradation and desertification process (Atalay et al., 2019). Indeed, gully erosion is common on the sloping areas of the Neogene marl deposits. For example, “V” shaped valleys have been formed on fault scarps that were cut by the fault lines in the east of Burdur Basin. Besides, the steep slopes of these valleys have been dissected by the gullies and secondary gullies that developed on the wide and large gully slopes. The continual transportation of debris materials and seeds of trees and herbaceous vegetation also prevent the growth of the vegetation on the steep slopes. For this reason, bare land is common on the steep slope of marl deposit (Photo 6). Most of the gentle gully areas on the marl deposit are covered with the Calabrian pine forest and maquis vegetation notably kermes oak (*Quercus coccifera*).

Fluvio-lacustrine deposit composed of intercalation of marl and sand-gravel layers corresponds to also gully erosion areas (Photo 8).

Table 4: Some physical and chemical analysis of the marl deposit in the Burdur-Göhlhisar Basin

Sample location and altitude	Lithology of marl	Sand (%)	Clay (%)	Silt (%)	Texture	pH	CaCO ₃ (%)	Organic material (%)	CEC (cmolc kg ⁻¹)
Erosion surface 1350 m	Marl deposit	17	27	56	SiL	7.5	53.71	1.57	23.3
Same locality	Same	19	42	39	C	7.53	54.33	1.64	23.4
East of Burdur 1300 m	Sandy marl deposit	65	13	22	SL	7.32	17.65	2.13	15.4
Akyaka village arable land 1300 m	Silty marl deposit	19	19	62	SiL	7.50	42.41	1.83	21.4
Bottom of Burdur plain 950 m	Re- deposited marl	14	62	24	C	7.73	21.73	1.98	26.4
"	"	14	54	32	C	7.62	22.37	1.98	19.8
Kemer	Marl	1	69	30	C	7.66	31.6	0.6	22.1
Between Kemer-Kozluca	Hard, white marl	43	9	48	L	7.64	56.2	0.7	11.4
Same location	Wringled marl	21	23	56	SiL	7.64	40.6	0.4	10.5

3.4.3. Karst Biome

Limestone creates a special environment in the soil formation, land use and forest production and forest regeneration as compared other rocks (Atalay 1995, 1999). The crack structure, amount of clay content and inclination of limestone layers in the karstic land mainly determine the soil formation and land use properties. As a general rule, red Mediterranean soil has developed along the cracks and among the layers on the sloping area (Atalay 1997, 1995, 2011, 2016; Sarı et al., 2018). Rich red Mediterranean soils are found in the limestone containing abundant cracks and very low clay content in the middle part of the Söğüt Mountains in the NW of the Burdur Basin. While clayey limestones and marbles containing very low cracks are mostly prevent the formation of red Mediterranean soil. These areas are observed in the vicinity of marble quarries in the study area. Other red Mediterranean soil in the karstic land is common on the bottom of karstic depression as is found on Aziziye polje and karstic depressions in the middle part of Söğüt Mountain (Fig. 6; Photo 7).

Other important property of karstic land is to allow to form fast natural regeneration of forest trees and to remain the maquis vegetation as stabilized vegetation. Namely, tree seeds fall within the cracks with soil easily germinate, so karstic lands are covered densely with seedlings and then trees. Besides, even if maquis vegetation destroyed and cleared, and fired on the karstic land it regenerates with root suckers (Atalay 2014, 2015, Atalay et al., 2018b). Thus, such areas are again covered by maquis vegetation especially kermes oak (*Quercus coccifera*) communities that are found in the eastern part of Burdur Basin, the isolated hilly area between Göhlhisar and Burdur basins, fault scarps on the limestone in the north of Lake Akgöl basin, and the western slopes of Katrancık Mountains in the NE of the study area. On the other hand, the existence of the juniper communities are related to the germination of juniper seeds within the cracks of limestone.

Figure 6: Ecosystem-ecological region and geobiome map of Burdur-Göhlisar Basin

3.4.4. Conglomerate Biome

Conglomerate composed of mainly limestone gravels and calcareous cement form a similar karstic habitat and topographic features which is called conglomerate karst first time in Köprülü Canyon locality in the Köprülü river basin, SW of Mediterranean Region in Turkey (Atalay et al. 2016). Conglomerate-sandstones commonly composed of limestones gravels and sands appearing in the NW of Burdur basin were formed with the cementation of calcareous materials. The weathering of the calcareous cement especially along the soft zone and cracks causes disintegration of conglomerates and sandstones as gravels and sands. In other words, the formation of the sandy soil is related to the chemical dissolution and/or weathering product of calcareous cements to be found in conglomerate and sandstone. For this reason, soil developed on the soft zone and cracks of the conglomerate-sandstone are generally sandy loam in texture (Photo 9, 10: fig. 7). The clay and unweathered sand and gravel particles remain as residual materials in the weathered zone (Atalay et al., 2017 and 2019).

Figure 7: Sandy soil formation with the weathering of calcareous cement of conglomerate in the northwest of Burdur Basin

Soft zones and cracks of conglomerate-sandstone support the taproot development of Calabrian pine (*Pinus brutia*) and black pine (*Pinus nigra*) trees and shrubs mainly kermes oak (*Quercus coccifera*). Indeed, good stand forest and maquis vegetation are found on these areas.

This biome occurs in northwest part of the Burdur basin or the northern continuation of Söğüt Mountains in the study area. Flat land containing sandy soil that formed on the weathered conglomerate and sandstone is devoted to the gardens of rose and levanter (Photo 10).

3.4.5. The Biomes Relating To Geomorphic-Topographic Units

The colluvial deposit on the lower flanks of hilly and mountainous areas, dejection cone and fans lying on the between alluvial plain and the lower edges of mountains, and regressed shore of Lake Burdur and high ground water table areas in the lowlands form geomorphic-topographic biomes. The lithologic and sedimentary properties and occurring area of these biomes are briefly explained in the following paragraphs.

3.4.6. Psammo-Litho Biome

This biome is found on the dejection fans and cones, and lithosol on the sloping areas. Dejection fans which are found in the north-eastern and north-western part of Burdur basin have been formed the accumulation of the sandy materials derived from the conglomerate and sandstone. This biome containing sandy soil is devoted to rose plantation for production of rose oil and/or perfumer production. Because rose roots easily develop through the deep on the sandy soil. Sandy and gravelly dejection cones bring about a suitable habitat for the growth of some fruits like cherry, almond and so on as is seen in the NE parts of Lake Burdur (Photo 9-11).

The gravelly and sandy layers of the fluvio-limnic deposits that exposed in the west of Gölhisar basin also form also a lithobiome on which *Quercus coccifera* communities are widespread. Colluvial deposits on the lower edges of hilly areas correspond to the forest and productive growth areas of maquis vegetation.

Another lithobiome containing mostly gravelly materials has formed as the result of the dissolution process of the calcareous cement of conglomerate and sandstone on the sloping area. These areas appear in the eastern edge of Söğüt Mountains on which good stand black pine forest occurs.

Lithosol biome occurs on the sloping areas of serpentine, limestone and conglomerate. Lithosols on these areas can be regarded as skeleton of soil in place where solum horizon of soil completely eroded and partly weathered parent material is exposed. These areas which are found in the eastern and western part of the Gölhisar Basin and especially northern part of Söğüt Mountains are the main occurrence areas of poor *Pinus nigra* forest stand.

3.4.7. Hydrobiome

This biome encompassing lowland area with ground water table high is the occurrence areas of hydromorphic alluvial soil and hydromorphic soil on which hydrophytic and hydrophilic vegetation grows. These areas which are found along the shore belt of the lakes such as Lake Yarıklı, Lake Karataş and Lake Gölhisar are main breeding areas of birds, frogs, mosquito and lizards.

3.4.8. Halobiome

This biome is only found along the regressed lake areas of Burdur. Here the salty material accumulation occurring with the capillarity rising of salty ground water and the evaporation of the water of Lake Burdur water is responsible for the formation of Halobiome. Halophytic vegetation indicates the occurrence areas of this biome (Photo 12). Severe salty areas appearing as bare lands also are classified as hydrobiome areas.

4. CONCLUSIONS AND DISCUSSION

Biomes depending on parent material and geomorphic topographic units have various distinct habitats in terms of soil formation and its physical and chemical properties, vegetation communities and their growth rate and agricultural products are more different than that on lands belonging to climatic zonobiome. In other words, each parent material has a distinct ecological property depending on weathering process and fertility of plant in accordance the amount of released nutriment. Besides, each geomorphological-topographical unit brings about an environment in terms of land-use, land capability classification based on soil formation (Atalay 2014, Atalay and Gündüzoğlu 2015, Atalay 2016a, b, c). These properties of biomes in the Burdur Gölhisar basin are briefly introduced below:

1. Serpentine biome which is found on the flat and deeply weathered area corresponds to fertile agricultural field and good forest stand, while unweathered serpentine is one of the main land degradation areas on the sloping areas.
2. Marl biome on the flat land corresponds to the dry farming area on which cereal crops are harvested, while sloping marl area is the main gully erosion spreading areas where native vegetation has been destroyed.
3. Karstic land in the mountainous areas is one of the main productive forest growing areas, but the flat land in karstic depression is devoted agricultural area under the 1600 m of elevation. Karstic conglomerate biome on the flat land is the main agricultural field of rose and levanter production and hilly part corresponds to the productive forest stands.
4. Hydro and Halobiomes belonging to land capability VIII can be assessed wildlife area.
5. Parent materials affect not only determine the formation of soil and genetic soil types but also land capability classification.
6. The land classification and soil type researches made by TOPRAKSU contain many scientific mistakes due to the fact that natural environment properties like climate, parent material and geomorphic units are not sufficiently taken into consideration. For example, land capacity class I is shown every province of Turkey except Rize province. As it is known, this class is only found in the area that no limiting factors on the growth of agricultural products. The marl deposit in the Burdur basin was classified as brown forest and brown forest soil occurrence area (TOPRAKSU 1974). There is no sufficiently relationship conducted between parent material and erosion in many studies. For instance, the most of the karstic lands in the Taurus Mountains that are shown intense erosion area on the map is not reflect the exact situation. Because there is no intense erosion except chemical erosion on sloping area of karstic lands due to atmospheric water easily infiltrates along the cracks.
7. The studies relating to soil, land capability classification, land use planning, plant growth productivity and land degradation-desertification and so on the biomes relating to geologic parent material, geomorphologic-topographic units and climatic properties of the given area have to take into consideration.

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PHOTOS

Photo 1: Fault scarp cutting Mesozoic limestone and containing Neogene marl deposit in two sides and southern part of Burdur Plain Basin in foreground in the SW of Burdur Basin.

Photo 2: Different Calabrian pine (*Pinus brutia*) growth rate depending on the weathering stages of serpentine between road connection between Gölhisar and Çavdır towns in the west of the Gölhisar Basin.
Abbreviations: h. height (m), diameter (cm) and a. age (year)

Photo 3: Colours of Serpentine indicating the weathering stages in the melange area, of 2km west of Yeşilova town. Here Reddish colour shows good weathered serpentine, while greenish, pale brown, grey colour show low weathered serpentine.

Photo 4: The good stand Calabrian pine (*Pinus brutia*) forest and its regeneration area on the folded part of marl deposit in the Gölhisar Basin

Photo 5: *Pinus brutia* roots developed along the cracks and among the layers of marl in the east of Gölhisar Basin. The cracks and bedding surface is responsible for the growth of root and the increase of productivity of trees

Photo 6: The effects of deep gullies on the marl deposit and its negative effects on Calabrian pine growth on the upper part of stream in the Kemer basin, SE of Burdur Basin

Photo 7: Red Mediterranean soil developed along the cracks in the karstic land of Söğüt Mountains, NW of the study area.

Photo 8: Fluvio-lacustrine deposit with gully erosion and degenerated *Quercus coccifera* communities on the lower edge of Ak Mountain, west of Gölhisar Basin

Photo 9: Sandy and gravelly soil formed along the cracks and soft zone of the conglomerate and sandstone with the weathering of the calcareous cement and productive oak community

Photo 10: Agricultural land devoted to rose and levanter production on the conglomerate and sandstone near Yeşilyurt village in the north of Söğüt Mountains, NW of Burdur Basin

Photo 11: Lithobiome on the conglomerate which is suitable for the growth of forest and maquis in the northern part of Söğüt Mountains

Photo 12: Halobiome with very sparse halophytic vegetation on the regressed area of Lake Burdur in the south-western part of Lake Burdur