

Domestic Livestock Resources of Turkey – Honey Bee

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Abstract: The aim of this paper is to review traditional beekeeping in Turkey. Beekeeping is a rapidly developing part of agriculture, as it is worldwide. It provides a natural balance to the maintenance of agricultural production. Turkey has a wide range of climatic and natural features and possesses millions of bee (*Apis mellifera anatoliaca*) colonies with a high genetic diversity. The wide range of climate environment is a great potential for bee keeping and honey production. It is said that 75% of honey plant species and varieties are in Turkey. In different regions there are plenty of honey plants which flower at different times, allowing more production than usual for bee-keeping. Turkey is currently a major country for bee-keeping for two reasons: first, bee colonies have increased in number in recent years; secondly, modern bee hives have become greater in number. Methods of bee keeping are generally traditional, and there are a few professional and migratory bee keepers among the total. Turkey is the 2nd for honey production after China and 3rd for bee colony after India and China in the World. The other honey bee products are pollen, royal jelly, propolis, bee venom and wax which are highly helpful for not only as human food but also necessary for human health. In this review bee keeping is reviewed in the context of different regions and bee breeds.

Keywords: *Apis mellifera anatoliaca*, native breed, genetic resource, honey, propolis, beeswax

INTRODUCTION

It is generally accepted that Turkey is one of the most important genetic resources centre of the World. Archeological evidences showed that sheep, cattle, goat and maybe pig could be domesticated in Turkey or its near [1]. Common Honey Bee (*Apis mellifera*) (Table 1) is also domesticated B.C. 5.000 in Central Anatolia [2].

Turkey has a great advantage of beekeeping potential because of available natural conditions, proper climate and rich flora. Especially beekeeping is available between April and September in the most part of Turkey [4]. In the long history, human used numerous kinds of insects for them such as honey bees. In addition, honey bees contributed to plants to give more yield. For example the benefit obtained from the pollination of flowers is 6-10 times more than the benefit obtained from honey harvest [2, 5]. There is a reciprocal indispensable relationship between plants and bees which plants need bees for pollination, on the other hand bees need pollination for feeding [6].

Table-1: Scientific classification of the honeybee [3].

Phylum	Artropoda
Class	Insecta/Hexapoda
Ordo	Hymenoptera
Subordo	Apocrita
Super Family	Apoidea
Family	Apidae
Genus	Apis
Species	A. mellifera L. 1758

History

In Asian Turcoman

In early period of history Turks used to live nomadic and rural life in Middle Asia which was not available for beekeeping. They used to deal with livestock production rather than vegetable production, therefore their cuisine is based on animal food sources. This situation was against to beekeeping for them, but they must have consumed exported honey or honey got from wild bees, because honey was not prohibited by their primitive beliefs or religious orders. For example Yakut Turks have a nomadic life in Siberia. A Polish scientist, W. Sieroszewski, lived among them for a long time and searched their life. He did not report that they had beekeeping in culture of Yakut Turks. In Turkish history the oldest references were reported by Samoylovich about beekeeping for Crimean Tatar Turks dated 14th and 17th centuries. Kipchak and Oguz Turks used 'ari' for bee and 'bal' for honey as just same words in present Turkish in Turkey. Volga Bulgarians and Hazar Turks were the most important honey and wax producers in history. Lutska and Troki Karaim Turks

used to trade wax together with flax and tobacco. A Russian source reported that Bashkir Turks consumed honey, livestock meat and fish [7].

In Ancient Anatolian Civilizations

Before Turks did not migrate to Anatolia from Middle Asia, other Ancient Anatolian Civilizations used to live there such as Hattians, Hurrians, Hittites, Assyrians, Phrygians, Lydians, Carians, Lycians, and Romans [8]. The honey is the only natural food which can not be spoiled for long term storage. Hence honey was one the most important food source since prehistoric times. It was an indispensable food additive source because of its high degree of digestible carbohydrate content. It was used to use in lots of dishes and especially in pastry [9]. In Hittites honey was an important food. In cuneiform tablets, honey bee was called as 'nim.lal', wax as 'duh.lal', honey production house as 'e.nim.lal', honey wine as 'gestin.lal', honey beer as 'kas.lal', bread with honey as 'ninda.lal', beekeeper as 'lu.nim.lal'. Dr. Sipahi reported a pilgrim flask found in a Hittite archeological site in Boyali Hoyuk in 2004. The pilgrim flask dated circa B.C. 1650 contained some ingredients. The ingredient was analyzed which was a mixture of some honey with nigella seeds. Hittites also legislated 2 laws about beekeeping. According to Law of 91, if someone steals a colony of beeswarm from a hive, he/she must be punished to be paid a fine of five sekels (35 gr) silver instead of fine of one mana (450 gr) silver. According to Law of 92, if someone steals two or three beehives, he used to be stung by bees of the hives, but now he/she must be punished to be paid a fine of six sekels (42 gr) silver. If the hive is empty, he/she must be punished to be paid a fine of three sekels (21 gr) silver. In Hittite culture there was a Legend of the Lost God. In a sentence of the legend it said that 'How honey is sweet and fluid, let your heart be like that honey' [10].

During Carians Civilization circa B.C. 1100-600, honey was one the most important food source as much as wine or dried fig were. The best quality honey used to produce in Aegean region among countries of Mediterranean Sea Region from Spain to Lebanon. Rostovtzeef reported that Kaunoser Zenon who was secretary of Apollonius (Ministry of Finance during Pharaoh of Ptolemaios II and III) prepared some import documents about honey imported from city of Theangela in Caria. It showed that honey was one the import food from Anatolia to Ancient Egypt [9].

Greek historian Xenophon of Athens (B.C. 430-354) reported that when Greek Army in Northeast of Black Sea Region, some soldiers ate honey which were in some villages. After for a while soldiers had symptoms of vomiting, diarrhea, fatigue and drunkenness. He informed that some soldiers recovered after a day but some them after 3-4 days, but there was not any death [11].

In Ottoman Empire

During Ottoman Empire Code of Common Law legislated between 1477-1481 mentioned about some taxes which got from beekeepers [7]. The taxes used to apply for honey and beehives in different amounts. Later than beehive tax was cancelled but honey tax continued to apply. The amount of the tax was 10% apart from self requirement of producer. In Istanbul there were about 35 wax shops in 1782. Ottomans conquered 'Eflak' (Southern Romania) in 1394 and 'Bogdan' (Moldova) in 1455. Eflak and Bogdan were important sources of grains, large ruminants, honey, wax and dairy products for Ottoman Empire. Those products were bought in local markets in Eflak and Bogdan by Balkanian merchants and sold in Istanbul bazaars. The commercial goods used to carry via The Danube River.



Fig-1: Former coat of arms of Abella de la Conca, Lleida, Spain [12].

Although honey were produced in Ottoman Empire lands of Balkans, Anatolia, Middle East, and Arabian countries, Eflak and Bogdan were the main honey and wax sources for Ottomans. Sugar cane started to be imported to Ottoman Lands from Egypt in 14th century, but it was too expensive and it could be bought by low-and middle-income people. Pekmez (boiled grape juice) and honey used to be consumed instead of sugar cane until late 18th century. Honey was not only consumed as food, but also it was added to some drinks. For example honey syrup was given to a Ottoman King to heal his cough. The honey was one of the most important basic foodstuffs for Ottoman palace cuisine. Beside flower and pine honey, desert flower honey were also consumed and the last one was too expensive [13]. Yunus Emre (1240-1321) was a Turkish poet and Sufi mystic [14]. He often used honey and bee in his poems. He sometimes likened or compared to honey and bee with human [15].

Royal Symbol

During the course of their long history, bee used to be used as a royal symbol in reign of arms by some civilizations (Figure 1). In Ancient Egypt bee was

the a royal symbol of Kings of Lower Egypt. The bee as hieroglyphused to write just before name box of the pharaoh. Bee meant 'bit' in Egyptian which was used as nick name of pharaoh. Childeric I, (reigned between 440 – 481/482) was a Merovingian king of the Salian Franks. His tomb was discovered in 1653 in church of Saint-Brice at Tournai (Belgium). In the tomb there were found about 300 golden bees with garnet insets which were symbol of the King Childeric [14, 16]. Louis XII (reigned between 1498 – 1515) proclaimed war against to Genoese. During declaration war ceremony Louis XII wore a special dress which had some queen and worker bees figures on it. The sentence of 'Rex non utitur aculo' (King does not use stings) in Latin was on the dress next to the bee figures. Family of Barberini, ruled Rome and the Vatican in 17th century, used three bees as family coat of arms. Maffeo Barberini, a member of Barberini Family, became Pope as name of Urban VIII in 1623. He had build or restore lots of building and put the three bees as an emblem on walls of every building. Pope Urban VIII sent a letter to Spanish by writing 'Gallis mella dabunt, Hispanis spicula figent' (Bees give honey to French, but they sting to Spanish). Spanish responded the Pope by writing 'Spicula si figent, emorientur apes' (If they sting, bees die) in the letter. Napoleon Bonaparte ordered to use the bee as a royal symbol in reign of arms instead of 'fleur-de-lis' (heraldic lily, former symbol of monarchy) by starting a coronation ceremony in Notre-Dame Cathedral in 1804 [16].

Bee Flora

Because of rich flora of Turkey, plants for honey production are abundant during any season of year in Turkey (Table 2). Bees are fed by various kinds of flora sources in different regions of Turkey. Bees produce honey from orange trees in provinces of Adana, Antalya, Hatay, Izmir, Mersin, and Mugla; from cotton in Adana, Aydin, Diyarbakir, Gaziantep, Izmir, Mardin, and Sanliurfa; from sunflower in Adana, Aksaray, Balikesir, Canakkale, Edirne, Istanbul, Kirklareli, Samsun, and Yozgat; from heather in Adana,

Canakkale, Istanbul, Kirklareli, Mersin, and Tekirdag; from chestnut in Balikesir, Bolu, Bursa, Canakkale, Giresun, Kastamonu, Samsun, Sinop, and Trabzon; from linden trees in Istanbul, Kirklareli, and Tekirdag. Bees also use to produce honey plants of acacia, clover, raspberry, and strawberry. Pollen yielding plants are also plenty in Turkey such as almond tree (*Amigdalus*), *Castanea sativa*, *Castanea vulgaris*, *Salix alba*, *Robinia pseudoacacia*, and Erica [4, 17, 18]. Another important source of honey production plant is pine (*Pinus*) tree. Bees do not directly produce the honey from the tree, but a kind of insect (*Marchalina hellenica*) called as 'basura' in Turkish only live on Turkish Pine/Calabria Pine, *Pinus brutia* (Kizil cam), Black Pine, *P. nigra* (Karacam), Scots Pine, *P. sylvestris* (Sari cam), Stone Pine, *P. pinea* (Fistik cami), and Aleppo Pine, *P. halepensis* (Halep cami) [4, 19, 20, 21]. Basura eats tree sap of pine and expel transparent, liquid, sweet feces. Bees collect this honeydew and convert it to pine honey. About 20% of honey production is pine honey in Turkey [4, 19, 21]. Apart from pine tree, other honeydew sources are *Papaver* (Hashas), *Carduus* (Devedikeni), *Rosa* (Gulgiller), *Tilia* (Ihlamur), *Salix* (Sogut), *Quercus* (Mese), *Castanea* (Kestane), *Populus* (Kavak), *Betula* (Hus), *Tamarix* (Ilgın), *Ulmus* (Karaagac), *Picea* (Ladin), *Prunus* (Sert cekirdekli meyveler), *Pyrus* (Armut), and *Malus* (Cicek elmasi) [4, 22] (Genc 1993, Sirali 2002). Another important vegetable source of honey is thyme (kekik) [4]. Species of *Rhododendron* (Orman gulu) are common in Nort and Northeast of Anatolia sea shore. *Rhododendron caucasicum* (Kafkas Orman Gulu), Yellow or Honeysuckle Azalea, *R. luteum* (Sari Cicekli Orman Gulu), Common Rhododendron/Pontic Rhododendron, *R. ponticum* (Mor Cicekli Orman Gulu), *R. smirnovii* (Pembe Cicekli Orman Gulu), and *R. ungeronii* (Beyaz Cicekli Orman Gulu) grow naturally. The species of *Rhododendron* contains high level of grayanotocsin. Honey produced from species of *Rhododendron* also contains grayanotocsin which causes some symptoms of disease in human [11, 23].

Table-2: The plants which supply nectar, honeydew, or pollen for honey bees [24].

Season	Plant Name (Italics in Latin, brackets in Turkish)
Late fall and winter	Paperflower, <i>Bougainvillea sp.</i> (Begonvil/Gelin Duvagi) Strawberry tree, <i>Arbutus unedo L.</i> (Kocayemis) Crocus, Saffron, <i>Crocus spp.</i> (Cigdem) Spurge, Pointsettia, <i>Euphorbia macroclada Boiss.</i> (Sutlegen) Dandelion, <i>Taraxacum officinale Weber</i> (Karahindiba) Almond tree, <i>Amygdalus communis L.</i> (Badem) Cornelian cherry, <i>Cornus mas L.</i> (Kizilcik)
Spring	Bay tree, Sweet bay, <i>Laurus nobilis L.</i> (Akdeniz defnesi) Maple, Box elder, <i>Acer spp.</i> (Akcaagac) Willow, Sallow, <i>Salix spp.</i> (Sogut) Wattle, Gumtree, <i>Acacia spp.</i> (Akasya) Black locust, Locust tree, <i>Robinia pseudoacacia L.</i> (Yalanci Akasya) Deadnettle, <i>Lamium spp.</i> (Ballibaba) Topped lavender, <i>Lavandula stoechas L.</i> (Lavanta/Karabas otu)

	<p>Wild pear, <i>Pyrus elaeagnifolia</i> Pall. (Ahlat/Yaban armudu) Crabapple, <i>Malus sylvestris</i> Mill. (Yabani elma) Brier rose, Dogrose, <i>Rosa spp.</i> (Yaban gulu) Sage, Clary, <i>Salvia spp.</i> (Adacayi) Judas tree, <i>Cercis siliquastrum</i> L. (Erguvan) Tamarisk, Manna plant, <i>Tamarix spp.</i> (Ilgin) Vetch, <i>Vicia spp.</i> Fig Wild mustard, <i>Sinapis arvensis</i> L. (Yabani hardal) Clover, <i>Trifolium spp.</i> (Ucgu)l Wild gumwood, <i>Pistacia lentiscus</i> L. (Yabani sakiz agaci) Nettle, <i>Urtica spp.</i> (Isirgan) Poterium, Thorny burnet, <i>Sarcopoterium spinosum</i> L. (Abdestbozan otu/Ceti) Alfalfa, Lucerne, <i>Medicago sativa</i> L. (Yonca) Melilot, Sweet clover, <i>Melilotus officinalis</i> (L.) Pall. (Tas yoncasi) Bee balm, <i>Melissa officinalis</i> L. (Ogul otu) Wild basil, <i>Clinopodium vulgare</i> L. (Yabani feslegen) Rosemary, <i>Rosmarinus officinalis</i> L. (Biberiye/Kusdili) Thyme, <i>Thymus spp.</i> (Kekik) Lime/Linden tree, <i>Tilia spp.</i> (Ihlamur) Poppy, <i>Papaver spp.</i> (Gelincik) Blue gum, Ironbark, <i>Eucalyptus camaldulensis</i> Dehnh. (Okaliptus) Oleaster, Silverberry, <i>Elaeagnus angustifolia</i> L. (Igde) Strawberry tree, Madrona, <i>Arbutus andrachne</i> L. (Sandal agaci) English hawthorn, <i>Crataegus monogyna</i> Jacq. (Adi Akdiken, Adi Alic) Prunus, <i>Laurocerasus officinalis</i> L. (Lazkirazi, Karayemiş, Taflan) Sloe, Plum, <i>Prunus spinosa</i> L. subsp. <i>dasyphylla</i> (Schur) Domin (Yababi erik/Cakal erigi) Firethorn, <i>Pyracantha coccinea</i> Roemer (Ates dikeni)</p>
Summer	<p>Sainfoin, <i>Onobrychis spp.</i> (Korunga) Musk thistle, <i>Onopordum bracteatum</i> Boiss. et Heldr. (Kangal dikedi/Esek dikeni) Blackberry, Raspberry, <i>Rubus spp.</i> (Bogurtlen/Ahududu) Rhododendron, <i>Rhododendron spp.</i> (Orman gulu/Komar) Blackthorn, Christ's thorn, <i>Paliurus spina-christi</i> Miller (Karacali) Chestnut, <i>Castanea sativa</i> Mill. (Kestane) Chaste tree, <i>Vitex agnus-castus</i> L. (Hayit) Astragalus, Astragal, <i>Astragalus spp.</i> (Geven) Chamomile, Mayweed, <i>Anthemis tinctoria</i> L. (Sarı Papatya, Köpek Papatyası) Eryngium, <i>Carduus nutans</i> L. (Deve dikeni) Yellow star-thistle, Diffuse knapweed, <i>Centaurea solstitialis</i> L. (Zerdali dikeni/Gunes cicegi) White knapweed, Starthistle, <i>Centaurea triumfettii</i> All. (Peygamber cicegi) Hawthorn, <i>Crataegus tanacetifolia</i> (Lam.) Pers. (Alic/Yemise/Akdiken) Persimmon, <i>Diospyros lotus</i> L. (Kucuk Meyveli Trabzon Hurmasi) Willow herb, Fireweed, <i>Epilobium angustifolium</i> L. (Yaki otu/Meragulu) Ivy, <i>Hedera helix</i> L. (Duvar sarmasigi/Orman sarmasigi) Honey suckle, Vetch, <i>Hedysarum varium</i> Willd. (Tirfil/Mecumek) Honeysuckle, <i>Lonicera etrusca</i> Santi (Hanimeli) Purple loosestrife, <i>Lythrum salicaria</i> L. (Krmizi hev hulma/Aklarotu) Oak, <i>Quercus robur</i> L. (Kizil mese) Savory, <i>Satureja spp.</i> (Kaya kekigi) Goldenrod, <i>Solidago virgaurea</i> L. (Altinbasak) Germander, White horehound, <i>Teucrium polium</i> L. (Mayasilotu/Beyazot/Yavsan) Blueberry, <i>Vaccinium spp.</i> (Yabanmersini/Likapa) Japanese sophora, <i>Sophora japonica</i> L. (Japon Soforasi)</p>
Fall	<p>Calabrian pine, Turkish pine, <i>Pinus brutia</i> Tenore (Kizilcam) Locust tree, <i>Ceratonia siliqua</i> L. (Harnup/Keci boynuzu) Heater, <i>Erica manipuliflora</i> Salisb. (Puren/Supurge calisi) White horehound, <i>Marrubium spp.</i> (Boz ot)</p>

Honey forests

The Ministry of Environment and Forests applied a project to establish 'Honey Forests' primarily for honey bees in 2000s [20, 24]. The first honey forest was established as 16 acres in Orhaneli county of Bursa province in 2007. There were established a total of 10.844 acres as 135 Honey Forests in 47 of 81 provinces of Turkey by spending 15.8 million TL until 2012 (about 6,9 million USD). In those forests there are some trees such as *Castanea sativa* (Sweet chestnut), *Acer platanoides* (Norway maple), *Morus nigra* (Black mulberry), *Crataegus monogyna* (Common hawthorn or single-seeded hawthorn), *Tilia tomentosa* (Silver lime/linden), *Juniperus excelsa* (Greek juniper), *Juniperus oxycedrus* (Prickly Juniper/Prickly Cedar), *Elaeagnus angustifolia* (Silver berry/Oleaster/Russian olive), *Prunus spinosa* (Blackthorn/Bair/Sloe), *Amygdalus orientalis* and *A. webbii* (Almond), *Pyrus elaeagnifolia* (Oleaster-leaved pear), *Quercus pubescens* (Downy Oak/Pubescent Oak), *Pinus nigra* subsp. *pallasiana* (Crimean pine). There are also some shrubs and plants such as *Cistus laurifolius* (Laurel-leaf cistus or Laurel-leaved rock rose), *Pyracantha coccinea* (a species of firethorn), *Berberis crataegina* (Barberry/Amberbaris), *Rhamnus rhodopaeus* and *R. thymifolius* (Buckthorn), *Astragalus microcephalus* and *A. angustifolius* (Gevan), and *Thymus* (Thyme). In the choice of location and space of a potential honey forest place, the following criteria should be considered. First it should be in place which is affected by the wind minimum. Secondly the place should be preferred in an area which is not to be affected by traffic. It should be

far away at least 200 m from heavy traffic roads and 30 m from gravel roads. It is also far from human and animal traffic. Thirdly there should be a clean water source for bees. Fifthly the area should be at least 20 acres [24].

Migratory Beekeeping

Because of topographic conditions, flowering seasons spread out different time of a year. Hence migratory beekeeping is very common in Turkey [25]. In this system bee hives are moved from one place to another place by following nectar flow seasons on different regions. The beekeepers are generally professional and they keep about 100-400 bee colonies, sometimes up to 1000. The most beekeepers are live in Province of Ordu located in Eastern Black Sea Region. On the other hand migratory beekeeping homogenize bee breeds and so genetic variation reduces [4]. For example percentage of local beekeeping (Figure 2) is about 8%, but percentage of migratory beekeeping is about 92% in Province of Agri. Although percentage of 50% belongs to migratory beekeeping, honey production percentage is about 80% in Turkey. It showed that migratory beekeeping increase the honey production [26, 27]. In Province of Bingol, ratio of 51% is migratory beekeeper. Generally middle age people deal with migratory beekeeping. Young people are not interested in migratory beekeeping because they are far away for months and long for their homes. Migratory beekeepers generally keep bee colonies more than 100 colonies [27].



Fig-2. A beekeeper on duty in fall season.

Eastern Anatolia generally has rich flora, but less population density, agricultural spraying and pollution, therefore this region is one of the most important region for beekeeping in Turkey. Migratory beekeepers commonly used to go to Eastern Anatolia as migratory beekeeping, but it was decreased in last 30

years because of security weakness for beekeepers [25]. The problem was derived from terrorist organization of PKK. A project applied between 2004-2005 in Ordu Province to develop migratory beekeeping by using a new trailer-mounted apiary system. In this system, beehives were mounted on a trailer and bee colonies

were migrated five times in different regions to follow nectar flow seasons. The results showed that this system

reduce human labor but increased honey and pollen production [28, 29].

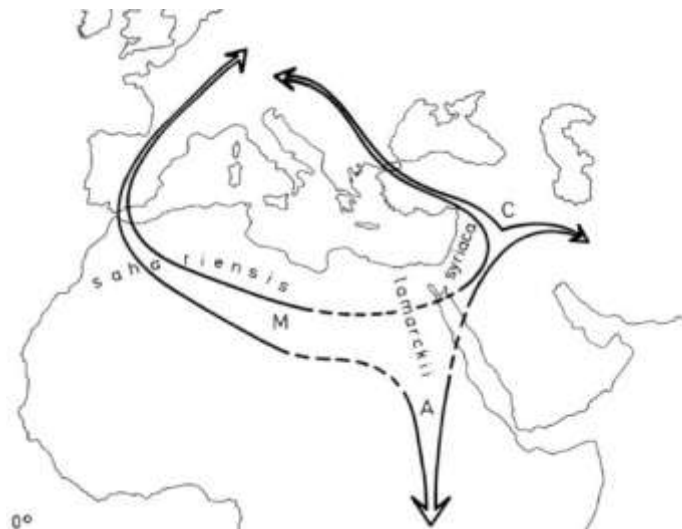


Fig-3. Three main branches of morphogenetic evolution of races [30].

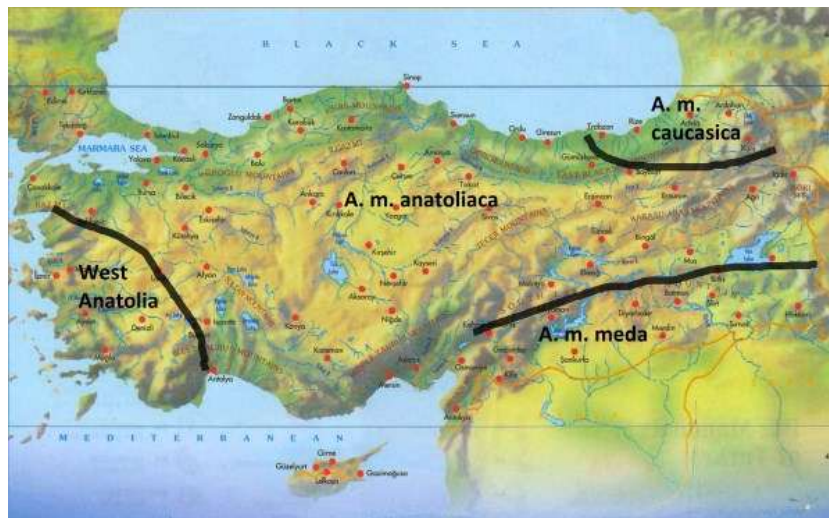


Fig-4: Bee breeds of Turkey

Breeds and Ecotypes

Turkish Honey Bee population is a one of the most important genetic resources of Honey Beepopulations (*A. mellifera*) in the World. Because of natural selection under various kinds of ecological conditions, there were happened different kinds of bee ecotypes [1, 31, 32]. There were not agreement among scientists about place and time of domestication of bee (Figure 3). Republic of Turkey is located between continentals of Europe and Asia and at the crossroads of Europe, Asia, and Middle East. It has received both human and biological influences from all those three sources. In addition, a wide range of climates, topographies, and habitats are found within borders of

Turkey. Hence not only numerous honey bee subspecies, breeds, or ecotypes, but also numerous subspecies, breeds, or ecotypes of other livestock species have been described from this region [31, 33]. In Turkey there is much greater honeybee diversity than in most other countries [4]. Anatolian Bee covers whole bee population of Turkey except Northeast of Turkey bees (*A. m. caucasica*) and Southeast of Turkey bees (*A. m. meda*) (Figure 4). Those breeds are different from some other important bee breeds morphologically (Table 3). It can be said that the West Anatolian bees are not a separate breed unlike *A. m. anatoliaca*, but they can be accepted as an ecotype of *A. m. anatoliaca* in West Anatolia Region [31].

Table-3: Morphological traits of some bee breeds [34].

Trait	Italian	Carniolan	Caucasian	Mugla	Anatolian	Africa
Hair length (mm)	0,28	0,29	0,33	0,30	0,28	0,22
Tongue length (mm)	6,36	6,40	6,66	6,58	6,49	5,86
Rear leg length (mm)	7,97	8,10	8,22	8,20	8,08	7,58
Front wing length (mm)	9,21	9,40	9,31	9,17	9,13	8,66
3 rd and 4 th tergite length (mm)	4,39	4,51	4,53	4,53	4,41	4,17
Colour of ceutellum	4,18	0,13	0,11	1,12	5,83	5,61
Cubital index	2,55	2,59	2,11	2,20	2,13	2,52

**Fig-5: A group of Anatolian Bee on a comb.****Anatolian, *A. m. anatoliaca* (Anadolu)**

Even though there is no consensus about Anatolian Bee (Figure 5), this breed is generally accepted as the bees reared in Anatolia except Caucasian and Syrian Bees. In Anatolia bees there are also some ecotypes such as Mugla, Gokceada, Hatay, Central Anatolia, North and Middle Black Sea Region Bees. Among those ecotypes the most commons are West Anatolia (Mugla) and Central Anatolia Bees. This breed is settled for arid Central Anatolian climate. They are not homogeneous and they have great variation for morphology, physiology and honey production. Central Anatolia bees are little in size, light-colored, short-tempered. They have good overwintering ability. Although their good features, professional beekeepers generally do not prefer to rear this breed which will cause to be extinct this breed soon [4, 33, 34]. *A. m. anatoliaca* genetically influenced to other adjacent country populations such as *A. m. cypria* in Northern Cyprus [35].

Caucasian, *A. m. caucasica* (Kafkas)

The Caucasian Bee is unfortunately the only registered bee breed in Turkey. It is registered in 2004, even though Anatolian Bee has not been registered yet [36]. It is originated from Northeast of Anatolia, Caucasia and Georgia. They are in dark gray or dark colour and have gray hairs. Swarming is low, but robbing other colonies and using propolis in hive are

high. Caucasians are very hardworking and quiet-natured animals. They produce high honey yield in high altitudes and cold climates. This breed is very compatible for cold and mountainous East Anatolia region [4, 33, 34].

Persian, *A. m. meda* (Iran)

This breed was first described by Skorikov in 1929 by measuring tongue length and shape of abdominal sternites [37]. The distribution of *A. m. meda* was extended to north Iraq, Syria, and southeastern parts of Turkey [35]. There were some claims that Syrian Bee (*A. m. syriaca*) and Yellow Trans-Caucasian Bee (*A. m. remipes*) were Persian Bee actually [31].

Western Anatolian/Mugla (Bati Anadolu)

Origin of this breed is Province of Mugla but it is reared in whole Aegean Region. Sizes of this breed are equal to Italian and Carniola. Colour is not homogeneous and can vary from dark colour to dark yellow from region to region. Bees have very high level of adaptability, growth rate and overwintering ability. Honey yield is high and they are very industrious bees [4, 33, 34]. Cretean Bee from Greece is very similar to West Anatolian Bees [37].

Products

Apiculture continuously increased in Turkey between 1936 and 2012. Modern type hives were about

2,9 % (33.489) in 1936 but it increased up to 97,5 % (6.191.232) in 2012. This achievement caused to 17 times more honey production and seven times more wax production (Table 4) [38]. Turkish apiculture has rank of 3rd for bee colonies and 2nd for honey production in the World, but honey production per hive is about 16 kg which is lower than world's average of 20 kg [24]. In Turkey there was started to rear organic beekeeping in 1980s. The organic beekeeping is made under

regulation of 'Organic Livestock Production' which was issued on the Gazette dated on 10 June 2005 and numbered as 25841. The organic beekeeping is mainly reared in Province of Mugla which realized about 67% production of Turkey [38]. The main product of beekeeping is honey, but beeswax, honeycomb, pollen, propolis, royal jelly, bee venom, bee swarm, package bee, queen bee, and bee hive are also in beekeeping ecoomy [4, 7].

Table-4: Production of apiculture [39, 40].

Year	Old Type Hives	Modern Type Hives	Honey Production	Wax Production
1936	1.128.071	33.489	5.261	602
1940	1.119.483	29.092	5.333	571
1950	972.631	56.500	5.200	644
1960	1.302.000	185.400	9.690	1.001
1970	1.253.568	567.394	14.889	1.249
1980	893.260	1.332.217	25.170	2.110
1990	293.948	2.989.510	51.286	2.758
2000	199.609	4.067.514	61.091	4.527
2012	156.777	6.191.232	89.162	4.222

Table-5: Some kind of uniflora honey and important properties [11, 41, 42, 43, 44, 45].

Types of honey (Turkish in brackets)	Important properties
Acacia (Akasya)	Anti- cancer and anti-stress, useful for metabolism and diabetic patients, prevention of osteoporosis and deficiency of zinc, selenium and iron
Alfalfa (Yonca)	Strengthen the visual and skin system, useful for children's growth, rheumatism removal and treatment of vascular congestion
Anzer	As an alternative therapy for gastrointestinal disorders (gastritis, peptic ulcer, constipation), hypertension, coronary heart disease and is believed to increase the sexual power against to impotence
Astragalus (Geven)	Strengthening the nervous system, sedative, blood maker, anti-inflammatory for bladder and prostate and beneficial for renal diseases
Black cumin (Corek otu)	Improves activity of nervous and brain system and, strengthening the kidney and urine system, useful for diabetic patients, lightening the skin and removing blood poisoning
Chestnut (Kestane)	Relieving upper respiratory tract infections like cold and flu,relieving stomach and liver fatigue; boosting immune system
Coriander (Kisnis)	Sedative and sleep adjustment, eliminate muscle spasms ,strengthening the digestive system and shortness of breath
Crazy (Deli)	Alternative therapy in gastritis, gastric ulcer, constipation, hypertension, coronary heart disease and is believed to increase sexual power is used in impotence
Eucalyptus (Okalıptus)	Treatment of lung disorders, asthma, cold
Linden (Ihlamur)	Protects and strengthens the nervous system, calms the body
Mint (Nane)	Prevents intestinal gas, cures colic, increases pancreatic secretion, helps digestion.
Orange (Portakal)	Calmness of the nerves, relievnees of cramps
Pine (Cam)	Treatment of throat disorders
Rosemary (Biberiye)	Treatment of liver diseases and digestive disorders.
Sunflower (Aycicegi)	Making young skin cells, cold removal,and useful for hoarseness
Thyme (Kekik)	Strong anti-bacterial, anti-cough and cold, may be useful for diabetic patients, strengthen the respiratory system and digestive
Zizipus (Hunnap)	Treatment of biliary diseases, boost libido, strengthen the hair and skin, febrifuge

Honey

Between 1936-2012 honey and beeswax production increased up 17 and 7 times respectively (Table 4). As unifloral honey there are produced numerous kinds of honey including 'yonca'(alfalfa), 'Anzer', 'kestane' (chestnut), 'deli' (crazy), 'okaliptus' (eucalyptus), 'ihlamur' (linden), 'nane' (mint), 'portakal' (orange), 'cam' (pine), 'kudili'/'biberiye' (rosemary), 'aycicegi' (sunflower), 'kekik' (thyme) honey in Turkey (Table 5) [4, 46]. Anzer Honey is produced in small region, Anzer Highland, located in Rize province of Northeast of Turkey [4, 47]. The most expensive honey is Anzer honey. Anzer honey is about 30 times more expensive than common flower honey [48].

Crazy Honey is produced by bees by using different kinds of *Rhododendron* plants [4, 11]. *Rhododendron* plants contains high level of grayanotoxin which penetrates to honey from the plant [11]. In case of being eaten crazy honey too much, some symptoms are seen such as burning sensation in skin and throat; mouth and nose itching; redness of the skin and eyes; vertigo and headache; urinary and fecal incontinence; blurred vision or temporary blindness; hypotension or collapse, nausea, vomiting, salivation, cramps style abdominal pain, gastroenteritis, feeling of lassitude, fatigue, malaria fever resembling seizures, deep bradycardia, delirium and even coma [4, 11]. Minimum 5 gr of honey poisons [49]. Pine honey is a kind of honeydew honey and produced by scale insect, *Marchalina hellenic* [4, 21]. Pine honey is used as diuretic and for respiratory diseases [4, 21]. Thyme honey is not only famous in Turkey, but it is also famous in some world countries [46].

Wax

It used to be as a candle to light at home, worship or work places. The wax and tallow used to mix and made candle to light. Some camphor used to add into the candle for fragrance. The wax also used use to seal envelopes [13].

Pollen

Pollen used by bees is a fine to coarse powder containing the microgametophytes of seed plants, which produce the male gametes (sperm cells) [50]. Truly pollen is not consumed by bees as collected by foragers. In fact the pollen pellets are stored in comb cells and honey, nectar, or glandular secretions are added to the mass of stored pollen. Pollen stored in this way undergoes a lactic acid fermentation and becomes what is called 'bee bread'. Stored pollen generally has a specific bacterial flora associated with it. Pain and Maugenet found three microbial genera in bee bread: *Pseudomonas*, *Lactobacillus*, and *Saccharomyces*. This suggests that microorganisms are probably involved in the storage of pollen [51].

Propolis

It is an antimicrobial, antifungal, antiviral, anti-inflammatory, and anesthetic substance [19, 52].

Propolis is a resinous substance and used by bees for protection, disinfection, and isolation of beehives [53]. In 20th century importance of propolis for human life were not known, but nowadays it is accepted that propolis is like a miracle substance. According to analysis there are at least 149 compounds and 22 minerals in propolis [52, 54]. Hence some bee breeds which produce and use propolis in hive are getting importance to be reared recently [19]. In a study 240 laying hens were divided into four groups and 0, 100, 200, and 400 gr of propolis doses added into the feed ration for four separate groups for 32 weeks. According to observed results there were statistically no difference for Haugh unit which is a measure of egg protein quality based on the height of its egg white (albumen) and egg shell thickness [55].

Royal jelly

Generally royal jelly is secreted by bees which 5-15 days old age. It is gel consistency, in bone colour, and has a peculiar odor, bitter taste, and pH 3.5. Some people believe that royal jelly provides vigor and fitness, moreover renews cells [23].

Bee venom

It is a sharp smell, bitter taste, yellowish coloured, crystallize when contact to air substance. Bee venom mainly contains mellitin, apamin, MCD-peptide, histamin, hyaluronidase, phospholipase-A2 substances. A bee can carry 0,05-0,3 ml bee venom. Bee venom were used for joint diseases, especially in arthritis and rheuma in Europe. It is also used for bacterial infections and orthopedic diseases. Bee venom affects as anti-inflammatory and analgesic [23].

Folklore

N. Boratav and A. Eberhard wrote books of Turkish Folk Tales. In those books bee, honey and beeswax were mentioned about lots of times [7]. In Turkey honey is a compassion word. For example spouses call each others or mother calls her children as 'Balim' (Honey). People believe that there are three rivers in heaven and one of them flows honey. One of the most famous tale hero is 'Balkiz' (Honey girl) [56]. In Turkish culture there are hundreds of proverbs and idioms [7, 57]. In Divrigi county of Sivas Province, a horse's skull is put near to beehives place to protect from evil eye. 'Balli borek' (honey pie), 'balli ekmek' (bread with honey), 'kaygana' (eggs with honey), 'kuymak' (made from flour, butter and honey), 'zulbiye' (yogurt with honey), 'balli helva' (halvah with honey), 'bal kaymak' (honey with thickened cream), and 'balli sirup' (honey syrup) are some dishes of Divrigi cuisine. Honey is used for lots of diseases as an alternative medicine [56]. In Edirne province while teenagers going or coming back from military service, parents prepare feast. The main dish of the feast is 'Gaziler Helvasi' (Veteran Halvah). Gaziler Helvasi is cooked from flour, butter, milk and honey. Gaziler Helvasi is also prepared for special dinners and

wedding parties. After 7 and 40 days of a funeral rites, Gaziler Helvasi is also prepared and served to visitors [58]. An Apiculture Museum of Cine was established in Cine county of Aydin province in 2010 to carry Apiculture messages for future generations. The museum was the first in Turkey and 71st in the World as an apiculture museum [59].

Genetics

Among honeybees there are variation about Mitochondrial DNA which provides to be determined different breed groups. The first group is called as Western (or 'W'). Western and northern European populations are in this group such as *A. m. mellifera* and *A. m. iberiensis*. The second group can be called as Eastern (or 'C') and southeastern European plus northern and eastern Mediterranean populations are in this group such as *A. m. carnica*, *A. m. ligustica*, *A. m. caucasica*, and *A. m. anatoliaca*. North and south of the Sahara populations in Africa consist of the group African (or 'A'). *A. m. capensis*, *A. m. intermissa*, *A. m. litorea*, *A. m. monticola*, *A. m. sahariensis*, and *A. m. scutellata* are in the group 'A'. The last group was discovered recently and called as Middle Eastern (or 'M'). *A. m. syriaca* is in this group 'M' [32, 60]. In a study six enzyme systems were studied to investigate the genetic variability in honeybee populations in Turkey. 10 morphometric characters were also measured to determine the extent of morphometric variation. Out of six enzyme systems, four were found to be polymorphic with 16 allozymes. In the populations the average heterozygosity was calculated as 0.072 ± 0.007 . Morphometric and electrophoretic variables were equally effective in discriminating honeybee populations. Anatolian and European honeybees were separated on the first axis, and Anatolian honeybees were further separated along a second canonical axis. The observation of rare alleles in isoenzymes, detection of high genetic diversity and the presence of four known subspecies supported the argument that Anatolia had been a genetic center for honeybee populations in the Near East [61]. In a research study the Central Anatolian honeybees (*A. mellifera* L.) were electrophoretically examined at six enzyme loci. Although four loci were polymorphic (Est-3, Pgm, Hk, and Mdh) and two loci were found to be monomorphic (Pgi and Me). Genotypic frequencies of enzymes agreed Hardy-Weinberg expectations. Low levels of genetic variability were detected. Heterozygosity was calculated as 0.033 ± 0.005 . Gene frequencies gained for Pgm, Est, Hk and Mdh were compared with those of the studies carried out in other countries, especially in neighboring countries [62].

Morphology and Biology

Enzyme polymorphism was investigated in honey bees which were collected from four different Anatolian regions. Three enzyme systems were analyzed and results showed that malate dehydrogenase and malic enzyme systems were monomorphic in all

populations, but Esterase enzyme system was found to be polymorphic only in West Anatolia [63]. In a study general protein (P-3) system was searched in 15 honey bee (*A. mellifera* L.) colonies from 3 different localities. Horizontal starch gel electrophoresis was performed on dark-eyed pupae (13-19 days old) using Poulik's (1) discontinuous buffer system. The frequencies of P-3F allele in three apiaries were 0.658, 0.333 and 0.442 [64]. Some ecotypes and crossbreeds were investigated in Beypazari and Tokat regions. According to results the following means were gained: 6.62 ± 0.008 mm for proboscis length, 0.36 ± 0.002 mm for length of cover hair on tergite 5, 9.15 ± 0.014 mm for wing length and 3.13 ± 0.007 mm for the width, 4.38 ± 0.004 mm for width of tergite 4, 4.40 ± 0.114 pigmentation on tergite, 2.12 ± 0.028 for cubital index, 34.21 for forewing index and 56.47 for metatarsal index [65]. In a field study a total of 42 honey bee colonies collected from 5 apiaries at 4 different localities in the Central Anatolia and breeder stock of Turkish Development Foundation (Turkiye Kalkinma Vakfi) was searched to define some morphologic traits in ecotype of Central Anatolia and breed of Caucasian Bees. As a result 32 morphological characteristics were determined for the Central Anatolian ecotypes (*A. m. anatoliaca*) obtained from Kirsehir, Beypazari, Cankiri and Eskisehir and for the Caucasian breed (*A. m. caucasica*). In additional 25 workers from each colony of Central Anatolian ecotypes and Caucasian race constituted two distinct groups. The Central Anatolian ecotypes formed an intermingled cluster when individual bee values were considered whereas colony averages made possible the discrimination of the regional population into corresponding ecotypes. According to analyses results the 57.62 % of the individual bees and 97.62 % of the colonies were included in their own groups. In conclusion, it was clear that Central Anatolia with its natural advantages preserved some original honey bee populations despite the extensive use of replacement queen bees and migratory beekeeping [31].

A field study was conducted to define some morphological characters of some important honeybee (*A. mellifera* L.) races and ecotypes in Turkey. Samples were collected from six different regions of Central Anatolia Region (Beypazari), North Eastern Anatolia Region (Posof), Marmara Region (Gokceada), Thrace Region (Saray), Aegean Region (Fethiye) and Mediterranean Region (Erdemli). 41 morphological characters were measured and twenty one morphological characters were evaluated in this research. There were not any variation between genotypes regarding length of tibia, length of metatarsus, length of 6th sternite, metatarsal, sternum index, length of fore wing (longitudinal), width of fore wing (transversal), cubital vein distance a, cubital vein distance b, angles of wing venation A4, B4, D7, E9, G12, J10, J16, K19, N23 and O26, pigmentation of tergite 2, 3, 4 and scutellum. In addition there were significant variation between genotypes in terms of

other 16 characters. It was also found that there were not any variation between genotypes regarding forewing weight, wing venations B4,E9, J10 and N23. However, there were significant variations between genotypes as for 16 characters. The results showed that some genotypes have differentiation characters regarding their morphological structure [66, 67]. A field study was conducted to investigate the morphological characteristics and moreover to identify the honeybee (*A. mellifera L.*) genotypes in the Artvin and Ardahan regions of the northeastern Anatolia Region. A total of 84 worker bee experimental samples was collected from 8 apiaries in different locations. For every sample 20 workers were used and 19 morphological characteristics were measured biometrically. The samples used were collected from 3 regions of Ardahan (Ardahan-Center, Posof-Yenikoy and Posof-Sungulu) and from 5 different regions of Artvin province (Hamurlu, Kasikci, Borcka-Camili, Savsat-Kocabey and Muratli). As a result there was no variation between bees from different areas in T4 and cubital vein length a on the front wing. Although seven discriminant functions were analysed, the first three functions accounted for 84.1 % of the total variation. The 24 samples taken from Artvin Borcka-Camili and 10 samples from Ardahan-Center and 10 samples from Ardahan Posof-Yenikoy were completely classified into their real groups. The those samples were distinguished from other groups and formed a distinct group. On the other hand the same

samples overlapped in the Hamurlu, Kasikci, Savsat-Kocabey and Muratli populations [68].

Pathology

Adequate nutrition supports the development of healthy honey bee colonies. Larvas are strongly affected by shortages of nutrient. Larval starvation, alone or in combination with other stressors, can weaken colonies [3, 69]. In Turkey there is sudden loss of bees since 2006 by agreeing the other world countries which threatens beekeeping of Turkey [70, 71]. In the near past 600.000 of 2.500.000 bee colonies of USA died suddenly. The same ratio was about 30% in Turkey and 60% in Spain and Poland. About 5 million bee colonies died just in two days in Croatia. Bee colonies die also in Canada, Australia, Greece, Switzerland, Italy, Germany, and Portugal [72]. Among all bee diseases (Table 6), viral diseases are the mostly responsible of the bee diseases in Turkey, but there are not enough information and research about viral bee diseases in Turkey [3, 73, 74]. In a study foulbrood diseases were investigated about 153 colonies from different places of Bursa province. According to results there were no evidence about American or European foulbrood diseases [75]. Varroa destructor is a pestilent problem for apiculture and a research was conducted in order to find a solution. Oxalic acid applied two times in 10 days. According to observed results oxalic acid was effective 84,5% and 93,4% for the first and second application respectively [76].

Table-6: Diseases and harmful creatures of honey bees [3, 71, 72, 77].

Bacterial diseases	1. American foulbrood (Amerikan Yavru Curuklugu) 2. European foulbrood (Avrupa Yavru Curuklugu)
Fungal diseases	1. Chalkbrood (Kirec Hastaligi) 2. Stonebrood (Tas Hastaligi)
Viral diseases	1. <i>Chronic Paralysis Virus</i> (Kronik Ari Felci Virusu) 2. <i>Acud Bee Paralysis Virus</i> (Akut Ari Felci Virusu) 3. <i>Israeli Acud Bee Paralysis Virus</i> (Israil Akut Ari Felci Virusu) 4. <i>Kashmir Acud Bee Paralysis Virus</i> (Kasmir Akut Ari Felci Virusu) 5. <i>Black Queen Cell Virus</i> (Siyah Kralice Hucre Virusu) 6. <i>Cloudy Wing Virus</i> (Bulanik Kanat Virusu) 7. <i>Sacbrood Virus</i> (Tulum/Torba Hastaligi) 8. <i>Deformed Wing Virus</i> (Deforme Kanat Virusu) 9. <i>Kakugo Virus</i> (Kakugo Virusu) 10. <i>Varroa Destructor Virus 1</i> (Varroa Virusu) 11. <i>Invertebrate Iridescent Virus</i> (Salkim Hastaligi) 12. <i>Tobacco Ringspot Virus</i> (Tutun Halkali Leke Virusu)
Pests and parasites	1. Varroa (Varoa) 2. Acarine (Tracheal) mites (Akar) 3. Nosema (Nozema) 4. Small hive beetle (Kucuk Kovan Bocegi) 5. Wax moths (Petek Guvesi) 6. <i>Tropilaelaps</i> (Ari Biti) 7. Others: Ant (karınca), wasp (esek arisi), bear (ayi), mouse/rat (fare/sican), bird (kus), spider (oruncuk), frog (kurbaga), hedgehog (kirpi)

Conservation Measures

Although apiculture increased in last 100 years, some livestock genetic resources of Turkey decreased which showed that livestock genetic resources of Turkey should be conserved [1]. A project of 'In Vitro Conservation and Preliminary Molecular identification of some Turkish Domestic Animal Genetic Resources (TURKHAYGEN-I)' was prepared by Genetic Engineering and Biotechnical Institute (GEBI), Marmara Research Centre (MRC) Gebze, Kocaeli and applied between 2007-2011. Numerous breeds were contained in this project under species of horse, water buffalo, cattle, sheep, goat, and silkworm [78], but unfortunately not bee. The Turkish Governments provided some subventions and supportings in different ways. The Caucasian Bee was contained among breed list which will be supported in 2012 [79]. On the other hand in structure of Ministry of Agriculture and some universities, there are some Apiculture Research and Development Centres.

In Israel there used to be Syrian Bee (*A. m. syriaca*) until 1990s. Israeli beekeepers preferred to rear Italian Bee (*A. m. ligustica*) instead of Syrian Bee because of aggression of it. Italian Bee could not be successfully reared, because they could not fight against to Oriental Hornet (*Vespa orientalis*). Syrian Bee was aggressive but successful to fight against to Oriental Hornet. In short term Italian beekeepers had high income but in long term ecosystem was deteriorated and ecologic balance was damaged [60]. For this reason Turkish native bee breeds should be saved. Institute of Aegean Agricultural Research (in Menemen county of Izmir province) has started a project to protect and develop bees in 'Esek Adasi' (Donkey Island). This island is free from any bees, near to city of Cesme, Izmir, and 11 km far from the mainland. Chosen colonies is taken to the island and bred there [80].

CONCLUSIONS

If the bees disappear from the world, people are just four years of life left. Without bees, there are not any pollination, plants, animals and people (Albert Einstein). Bee-keeping depends on nature much more than other agricultural activities. Turkey has a wide range of climate conditions and a rich flora, which make the country in advantage for beekeeping. In Turkey there are plenty of nectar plant sources, including some herbs such as thyme, clover, wild sainfoin, wild vetch, and heather; in addition, there are honeydew tree species such as pine, oak and fir, and some forest trees such as maple and chestnut. Apart from natural fields, there are orchards such as those for citrus and almond. Industrial crops such as anise, sunflower, and cotton also contribute, as well as forage crops such as clover and sainfoin. As well as all this, Turkey is one of the most important resources in the world of the native bee genetic diversity. There several bee breeds or ecotypes in the country, and it is clear that "native bee breeds genetic resource

conservation centres" should be created, and those native bee breeds or ecotypes should be conserved.

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