

A new subspecies of *Phoenix theophrasti* Greuter (*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak) from Turkey

Phoenix theophrasti Greuter türünün Türkiye’de tanımlanan yeni bir alttürü (*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak)

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ABSTRACT

In the present study, a new subspecies (*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak) is described in Turkey. The unidentified *Phoenix* taxon native to Bodrum–Gölköy, Aegean Turkey and named as the “Gölköy *Phoenix* population” has been known to Gölköy’s inhabitants for centuries. The Gölköy *Phoenix* population was considered to be representative of *P. theophrasti*. Boydak made the first of a number of trips to Gölköy and immediately noticed some distinct differences between the Gölköy *Phoenix* population, *P. theophrasti* Greuter, and *Phoenix dactylifera* L in the early summer of 1990. He continued his investigations on this taxon for many years to shed light on the subject. He made two new trips to the three native stands of *P. theophrasti* and the Gölköy *Phoenix* populations in 2015 and 2018. Measurements and observations were made on the morphological characteristics that showed distinct differences among the Gölköy *Phoenix* population, *P. theophrasti*, and *P. dactylifera*. These were related to the length of male stalks and female inflorescences and some fruit and seed characteristics. The results indicate that some distinctive morphological characteristics of the “Gölköy *Phoenix* population” merit its being described as a new subspecies. “*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak” differs from *P. theophrasti* Greuter with respect to its longer fruiting-female stalk length and longer male stalk length, its fruiting stalks hold fruits marginally higher, and its having seeds with slightly visible striate surface crust structures and deeper-wider grooves.

Keywords: A new subspecies, Bodrum–Gölköy, *Phoenix theophrasti*

ÖZ

Bu makale kapsamında Türkiye’de yeni bir alttür tanımlanmıştır (*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak). Ege Bölgesi, Bodrum–Gölköy’de doğal olarak bulunan ve “Gölköy *Phoenix* popülasyonu” olarak adlandırılan tanımlanmamış bu takson, Gölköy halkı tarafından yüzlerce yıldan beri bilinmekteydi. Gölköy *Phoenix* popülasyonu *Phoenix theophrasti* türünün bir temsilcisi olarak kabul ediliyordu. Bu makalenin yazarı, Gölköy’e yaptığı çok sayıda bilimsel gezinin, 1990 yılının erken yazında yaptığı ilkinde, Gölköy *Phoenix* popülasyonu, *P. theophrasti* Greuter and *P. dactylifera* L. arasında önemli farklılıklar olduğunu gözlemledi. Yazar konuyu aydınlatmak için uzun yıllar bu takson ile ilgili çalışmalara devam etti. 2015 ve 2018 yıllarında, ülkemizde doğal olarak bulunan üç *P. theophrasti* popülasyonu ile Gölköy *Phoenix* popülasyonuna iki bilimsel gezi daha yaptı. Gölköy *Phoenix* popülasyonu, *P. theophrasti*, ve *P. dactylifera* arasında belirgin farklılıklar gösteren morfolojik özellikler üzerinde ölçmeler ve gözlemler yapıldı. Bunlar erkek çiçek sapları ve meyva saplarının uzunlukları ile bazı meyva ve tohum özelliklerini kapsamaktadır. Sonuçlar, “Gölköy *Phoenix* popülasyonu”nun bazı özgün ve farklı morfolojik özellikleri nedeniyle, onun yeni bir alttür olarak tanımlanmaya layık olduğunu ortaya koydu. “*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak”, *P. theophrasti* Greuter türünden daha uzun meyva sapları ve daha uzun erkek çiçek sapları, meyva saplarının marjinal olarak daha fazla meyva tutmaları, tohumlarının çok az belirli olan tohum kabuğu dokusu, daha derin ve daha geniş tohum oluğu ile ayrılmaktadır.

Anahtar Kelimeler: Bodrum–Gölköy, *Phoenix theophrasti*, yeni bir alttür

Cite this paper as:

Boydak, M., 2019. A new subspecies of *Phoenix theophrasti* Greuter (*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak) from Turkey. *Forestist* 69(2): 133-144.

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Received Date:

08.05.2019

Accepted Date:

19.06.2019



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INTRODUCTION

Turkey is one of the most important floral regions in the world, with >11,707 taxa of herbaceous and woody species, of which 3035 are endemic (Güner et al., 2012). The rich vegetation in Turkey is because of its geographic location and topography, leading to different climate and subclimate types (Boydak and Çalışkan, 2014; Çalışkan and Boydak, 2017). Many new taxa were described in recent years.

Phoenix theophrasti Greuter and *Phoenix dactylifera* L. are in the genus *Phoenix* L. (Barrow, 1998). The genus *Phoenix* L. (Phoeniceae: Coryphoideae) belongs to the order Principes (Arcales) and the family Palmae (Arecaceae) (Uhl and Dransfield, 1987).

P. theophrasti was first described by Greuter in 1967 from the famous grove at Vai in Crete (Greuter, 1967). The species is now known from nine coastal localities on the same island (Barclay, 1974; Turland et al., 1993), where it is possible to find it growing along damp valley floors, streamsides, springs, and coastal rocks and cliffs, in all cases by the seashore and from 0 to 230 m altitude (Figure 1). Greuter (1967) remarked that the "Cretan Date Palm" had been known since Classical antiquity, when it was recorded in the Theophrastus' writings. Many of them thought that it was an escaped cultivar of the Date Palm, *P. dactylifera* (e.g., Zohary, 1973). On the other hand, Greuter considered the Cretan palm to be a different species. He named it *P. theophrasti* on behalf of the Greek botanist-philosopher (Greuter, 1967).

The family Palmae was not known to occur naturally in Turkey until the first occurrence of *P. theophrasti* was recorded in the

Datça Peninsula in 1982 (Boydak and Yaka, 1983; Boydak, 1985). The second occurrence was found in Kumluca-Karaöz in Finike Bay (Boydak, 1987). Another unidentified *Phoenix* taxon native to Bodrum-Gölköy-Aegean Turkey and named as the "Gölköy *Phoenix* population" was found later (Boydak and Barrow, 1995) (Figure 1).

Several species of the genus *Phoenix*, some other members of *Palmae* (*P. dactylifera*, *Phoenix canariensis*, *Phoenix roebelenii*, *Trachycarpus fortunei*, *Chamaerops humilis*, *Washingtonia robusta*, *W. filifera*, and *Syagrus romanzoffiana*), and some other palms are being cultivated in the Mediterranean and Aegean areas of Turkey (Esener, 1999; Hazir and Buyukozturk, 2013). *P. dactylifera* is cultivated for fruits and ornamental purposes, whereas others are generally cultivated for ornamental purposes.

Greuter (1967), quoting from Evreinoff (1956), wrote that fossil research revealed that some members of the genus *Phoenix* were identified in central Europe Miocene formations, around the Aegean coastal regions, and also found in Pleistocene formations. The characteristics of the fossil form *P. dactylifera* fossils



Figure 1. Natural distribution of *Phoenix theophrasti* Greuter and *P. theophrasti* Greuter subspecies *golkoyana* Boydak

Drude were found to be very similar to the characteristics of the date palm *P. dactylifera* L.

Recent investigations in new early Miocene fossil forest sites (18–20 million years ago) in northwest Turkey–Bolu–Seben (900 m) revealed the first record of silicified palm wood in Turkey (Akkemik et al., 2016). Later, this palm wood and three more unpublished Neogene palm fossil woods (two from Çanakkale–Gökçeada and one from Edirne–Keşan–Erikli) were studied by lamandei et al. (2018). The palm woods were identified as *Palmoxydon coryphoides* Ambwani & Mehrotra from Gökçeada, *Palmoxydon* cf. *Trachycarpus* from Seben, and *Palmoxydon* cf. *Borasus* from Erikli (lamandei et al., 2018).

Greuter (1967) and Zohary (1973) accepted that *P. dactylifera* had its origin in the mid-eastern hot deserts. According to Zohary (1973), these assumptions are consistent with Fischer and Beccari (1890). He also stated that this supposition of the date palms' Irano-Arabian origin is very consistent with the fact that the Sumerians are the source of the earliest evidence on date cultivation. However, he admits that this does not eliminate the possibility of an ancestral relationship between the cultivated date palm and *P. theophrasti*.

Nevertheless, the *Phoenix* taxon indigenous to the coastal plains in southern Iran and Iraq at the locations of Sharqa, Bander Ab-

bas, and Basra was described as a wild form of *P. dactylifera* by Fischer (1881; in Greuter, 1967). It was stated that more research was necessary to determine if this taxon is actually *P. theophrasti* (Zohary, 1973). Barrow (1998) explained that *P. dactylifera* and *P. theophrasti* are difficult to differentiate on the basis of morphological and anatomical data. The author also added that molecular data supported the two species as close sisters; however, the author also accepted *P. theophrasti* as a different species when considering certain morphological features. Comprehensive research based on multiloci fingerprints supported the existing taxonomy, since all individuals from the same species clustered together. Specifically, *P. dactylifera*, *P. theophrasti*, and *Pinus sylvestris* were accepted as comprising the "*P. dactylifera* clade." The related species *P. atlanta* and *P. canariensis* appeared highly distinct from each other, with few or no alleles being mutual. These results showed that the date palm was preliminarily domesticated from wild populations of *P. dactylifera*, with only secondary and localized genetic contributions from other species (Pintaud et al., 2010).

P. theophrasti is distinguished from *P. dactylifera* by its erect fruit clusters and small, inedible fruits (Anon., 1983; Greuter, 1967). Both *P. theophrasti* and the Gökkyöy *Phoenix* population have sweet but in general thinner mesocarps. Turland et al. (1993) noted that *P. theophrasti* has smaller, shorter, and sharper leaves

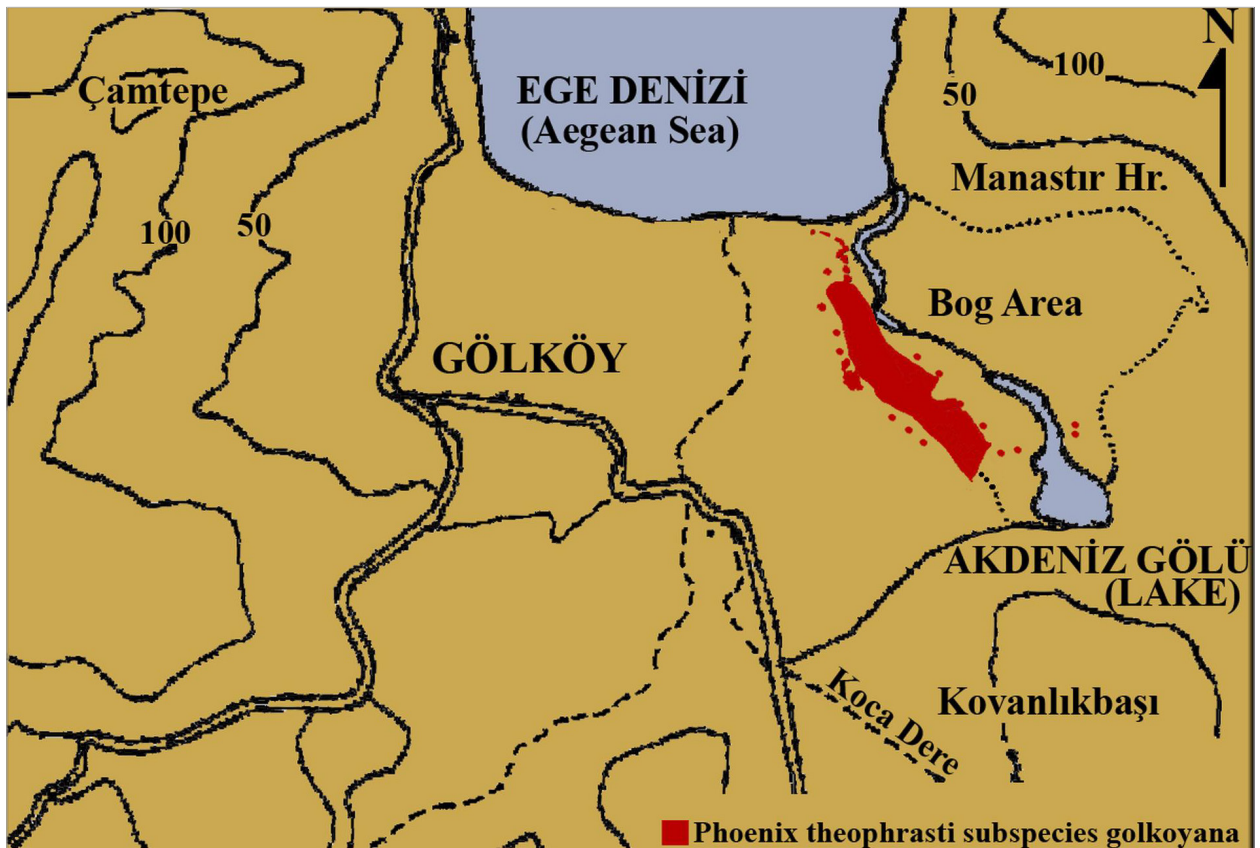


Figure 2. Location map of the *Phoenix theophrasti* Greuter subspecies *golkoyana* Boydak populations at Gökkyöy (Göltürkbükü), near Bodrum (adapted from Anon., 2013)

than *P. dactylifera*. The observations of the author of the present manuscript also suggest that the leaves of *P. theophrasti* are sharper than those of the Gök köy *Phoenix* population.

The unidentified *Phoenix* taxon native to Bodrum–Gök köy–Aegean Turkey and named as the “Gök köy *Phoenix* population” has been known to Gök köy’s inhabitants for centuries (Boydak and Barrow, 1995). Bayraktar and Aslanboga (Professors of Landscape Architecture, Ege University) made a visit to the Gök köy *Phoenix* population in 1989 and thought it was a member of *P. theophrasti*. Boydak, the author of the current paper, made the first of a number of trips to Gök köy in the early summer of 1990. He instantly recognized certain obvious differences between the Gök köy *Phoenix* population, *P. theophrasti*, and *P. dactylifera*. Samples were given to the Herbarium of İstanbul University, Faculty of Forestry (October 1990) and sent to the Royal Botanic Garden, Edinburgh (December 1990) and Royal Botanic Gardens, Kew (July 1993). Boydak and Barrow visited the Gök köy population and the two indigenous stands of *P. theophrasti* in Datça–Eksera Deresi and Kumluca–Karaöz in Finike Bay in April 1994, and they collected more herbarium materials (Boydak and Barrow, 1995). Boydak continued his investigations on this taxon for many years. He made two more trips to the three native stands of *P. theophrasti* and the Gök köy *Phoenix* population in 2015 and 2018, collected further herbarium materials, and delivered them to the Herbarium of the Faculty of Forestry, İstanbul University–Cerrahpaşa (ISTO).

This new *Phoenix* population is found growing on swampy ground surrounded by the Gök köy Lake, the boundaries of the

rapidly growing village of Gök köy, patches of *Pinus brutia* together with maquis, and the sea. A number of palms are currently included in the gardens of houses built recently (Boydak and Barrow, 1995). The Gök köy *Phoenix* population primarily covers an area of 3.9 ha according to the management plans of the Turkish Forest Service completed in 2013 (Anon., 2013). There are mainly four *Phoenix* groves covering 1.2 ha, 1.2 ha, 1.0 ha, and 0.5 ha inside or alongside the bog and/or bordering the village (Figures 2, 3).

Research based on anatomical data indicated a close relationship between *P. dactylifera*, *P. theophrasti*, and the Gök köy *Phoenix* population (Barrow, 1998). Boydak and Barrow (1995) stated that more sampling is necessary for understanding the precise nature of their relationships; however, they noted that morphological characteristics show several differences between the Gök köy palm and *P. theophrasti* and *P. dactylifera*. They discussed whether the Gök köy palm represents a new species or a subspecies or variety of *P. theophrasti* and *P. dactylifera*. As is explained above, Boydak continued his investigations on this taxon for many years to shed light on the subject.

When one sees the population so close to the village, one cannot help but ask if it is natural and native, rather than being the remnants of cultivated date palm grove. Reasons exist to think that it is natural and native. First, the palm yields small fruits that are slightly sweet but seldom fleshy; thus, it does not appear likely that they were planted as a fruit crop. No local record supports its usage as leaf or leaf-based fiber. Second, the population is robust and regenerating successfully by both seedlings



Figure 3. A view from the *Phoenix theophrasti* Greuter subspecies *golkoyana* Boydak populations

and suckers (Boydak and Barrow, 1995). Moreover, four Miocene and Neogene palm fossil wood sites representing different taxa were recently recorded in Anatolia, indicating that natural palm groves existed in the past in Anatolia (Akkemik et al. 2016; Iamandei et al., 2018). In addition, the "Gölköy *Phoenix* population" has been known to Gölköy's inhabitants for centuries.

The aim of the present study was to investigate the relationship and differences between *P. dactylifera*, *P. theophrasti*, and

the Gölköy *Phoenix* populations by comparing some morphological properties, especially those that exhibit distinct differences.

MATERIAL AND METHODS

Measurements and observations were made on the morphological characteristics that showed distinct differences among the Gölköy *Phoenix* population, *P. theophrasti*, and *P. dactylifera*.

Table 1. Male and female inflorescence lengths of the Gölköy *Phoenix* population

Male inflorescence				Female inflorescence			
Tree no.	Length (cm)	Tree no.	Length (cm)	Tree no.	Length (cm)	Tree no.	Length (cm)
1	85	11	94	1	200	11	146
2	73	12	107	2	210	12	166
3	94	13	91	3	187	13	168
4	120	14	74	4	160	14	210
5	114	15	94	5	196	15	176
6	92			6	147		
7	68			7	132		
8	70			8	195		
9	120			9	149		
10	83			10	175		

Table 2. Results of the measurements of the *Phoenix theophrasti* populations and the Gölköy *Phoenix* population in Turkey and other measurements cited in the related literature

Species and locality	Morphological characteristics			
	Male stalk length		Female-fruiting stalk length	
<i>P. theophrasti</i> : Datça–Eksera Deresi	Up to 45 cm		Up to 65 cm	
<i>P. theophrasti</i> : Datça–Hürmalibük	Up to 50 cm		Up to 70 cm	
<i>P. theophrasti</i> : Kumluca–Karaöz	Up to 55 cm		Up to 70 cm*	
Gölköy <i>Phoenix</i> population	Up to 120 cm		Up to 210 cm	
<i>P. theophrasti</i> (Barrow, 1998)	Up to 40 cm		Up to 70 cm	
<i>P. dactylifera</i> (Flora of China, 2019)	Up to 100 cm		Up to 200 cm	
	Fruit		Seed	
Fruit and seed dimensions	Thickness (mm)	Length (mm)	Thickness (mm)	Length (mm)
<i>P. theophrasti</i> : Datça–Eksera Deresi	11.0 (10–12)	17.5 (16–20)	8.9 (8–10)	15.3 (14–17)
<i>p. theophrasti</i> : Datça–Hürmalibük	11.6 (10–13)	18.2 (16–20)	9.0 (7–10)	16.0 (14–18)
<i>P. theophrasti</i> : Kumluca–Karaöz	10.3 (8–12)	15.1 (13–17)	8.5 (8–10)	13.1 (11–15)
Gölköy <i>Phoenix</i> population	11.5 (9–15)	20.8 (16–27)	8.0 (4–10)	16.6 (12–21)
<i>P. theophrasti</i> : Crete (Greuter 1967)	(8–10)	(14–16)	(6–7)	(8–13)
<i>P. theophrasti</i> (Barrow, 1998)	Oblong	10x15 mm	(6–7)	(11–13)
<i>P. dactylifera</i> (Flora of China, 2019)	Oblong 3 cm	7 cm		
<i>P. dactylifera</i> (Barrow, 1998)	2–3 cm	4–7 cm	5–8 mm	20–30 mm

*110 cm on one tree at the edge of the population in a camping area



Figure 4. Male inflorescences of *Phoenix theophrasti* Greuter subspecies *golkoyana* Boydak (a, up to 120 cm, erect) and *P. theophrasti* Greuter (b, up to 55 cm, erect)



Figure 5. Comparison of male inflorescence lengths of *Phoenix theophrasti* Greuter (a) and *P. theophrasti* Greuter subspecies *golkoyana* Boydak (b)

These were related to the length of male stalks and female inflorescences and some fruit and seed characteristics.

The length of female inflorescences and male stalks of the *P. theophrasti* populations at Datça-Eksera Deresi, Datça-Hurmalıbük,

and Antalya-Kumluca-Karaöz and the *Phoenix* population at Bodrum-Gölköy was measured on 15–20 female and 15–20 male trees using a tape measure. The longest female inflorescences and male stalks on each tree were selected for measurement. Observations were also made of the perpendicularity of the male and

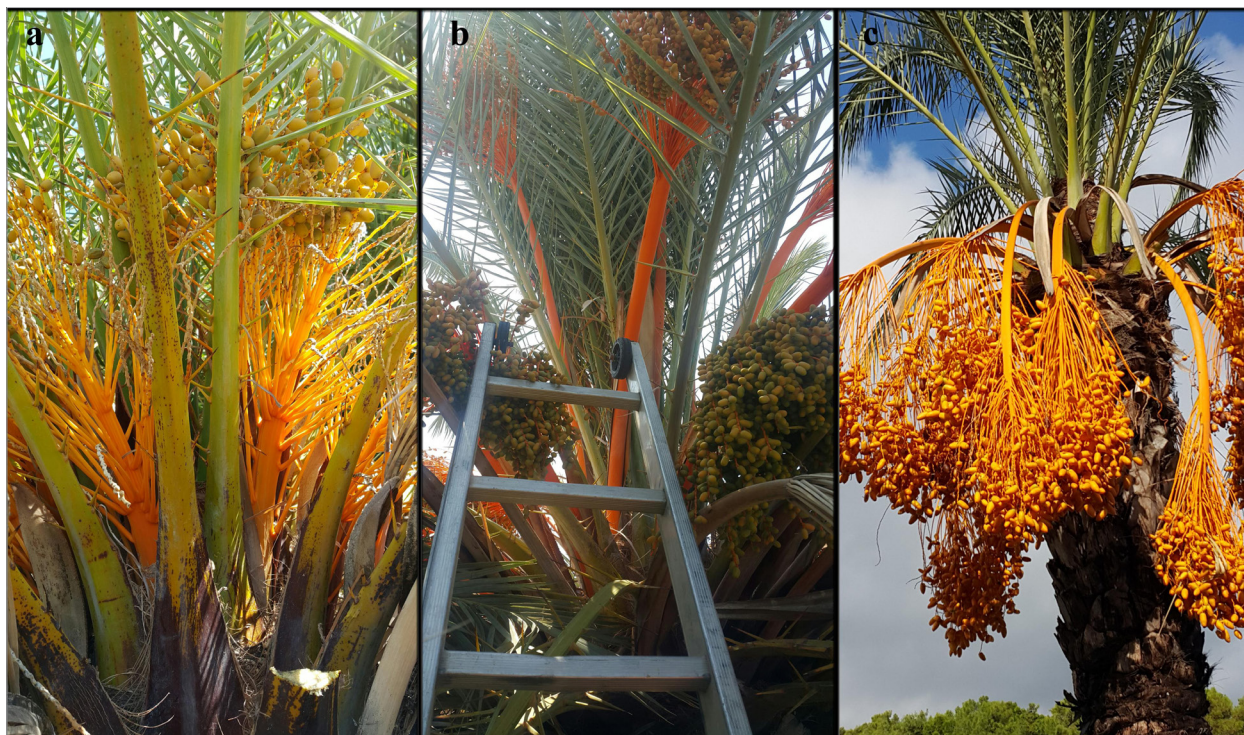


Figure 6. Female inflorescences of *Phoenix theophrasti* Greuter (a, up to 70 cm, erect), *P. theophrasti* Greuter subspecies *golkoyana* Boydak (b, up to 210 cm, erect or arching slightly), and *Phoenix dactylifera* L. (c, up to 200 cm, erect, becoming pendulous with fruit maturity)



Figure 7. Comparison of female inflorescence lengths of *Phoenix theophrasti* (a) and *P. theophrasti* Greuter subspecies *golkoyana* Boydak (b)

female flower stalks. The Bodrum–Gölköy *Phoenix* population was on a topographic plane, and so a water tender-sprinkler and ladder were used to reach the samples. Since the topographies were steeply sloped at the Datça–Eksera Deresi, Datça–Hürmalibük, and Antalya–Kumluca–Karaöz *P. theophrasti* populations, a portable ladder and long lever shears were used. Owing to the topography and the tree conditions in these populations, the length of some samples could only be estimated by close observations. However, only the direct measurements were considered.

The dimensions of fruits and seeds were measured in the laboratory by micrometer calipers at samples of hundred seeds

for each *Phoenix* population. Equal numbers of fruits from each sampled tree were separated and compiled as one hundred seeds for each population. In addition, the seed surface structures and the shapes of the grooves of seeds were observed.

RESULTS AND DISCUSSION

The results of male and female stalk length measurements at the Gölköy *Phoenix* population were tabulated (Table 1).

As it is shown in Table 1, the maximum male and female stalk lengths are 120 cm and 210 cm at the Gölköy *Phoenix* population, respectively.



Figure 8. Fruiting stalks of *Phoenix theophrasti* Greuter subspecies *golkoyana* Boydak (b¹ and b²), hold fruits marginally higher than *P. theophrasti* Greuter (a). The Gök köy *Phoenix* population's fruiting stalks hold fruits marginally higher than *P. theophrasti*. Specifically, the length of the fruiting area of the Gök köy *Phoenix* population is in general longer than that of female inflorescences together with the fruiting stalk of *P. theophrasti*

The maximum male and female stalk lengths and the other measurements of morphological features of the *P. theophrasti* population and the Gök köy *Phoenix* population, together with the measurements cited from the related literature, are compared in Table 2.

Similarities and differences of morphological properties among the Gök köy *Phoenix* population, *P. theophrasti*, and *P. dactylifera*

As is shown in Table 2, the Gök köy *Phoenix* population is different or similar to *P. theophrasti* and *P. dactylifera* in various morphological properties and fruit and seed characteristics:

The length of male inflorescences of the Gök köy *Phoenix* population is up to 120 cm (erect) and are over twice the male inflorescence lengths of *P. theophrasti* (up to 55 cm, erect), but the

Gök köy *Phoenix* population has nearly the same male inflorescence lengths as *P. dactylifera* (up to 100 cm, erect) (Figures 4, 5) (Barrow, 1998; Flora of China, 2019).

The length of female inflorescences of the Gök köy *Phoenix* population is up to 210 cm (female inflorescences erect or arching slightly), which is approximately three times the female inflorescence lengths of *P. theophrasti* (up to 70 cm, erect), but has about the same female inflorescence lengths with *P. dactylifera* (up to 200 cm, erect, becoming pendulous with fruit maturity) (Figures 6, 7). Although the lengths of female inflorescences of the Gök köy *Phoenix* population and *P. dactylifera* are similar, female inflorescences of the Gök köy *Phoenix* populations are erect or arching slightly, whereas those of *P. dactylifera* become pendulous with fruit maturity (Barrow, 1998; Flora of China, 2019).

The Gök köy *Phoenix* population's fruiting stalks hold fruits marginally higher than *P. theophrasti*. Specifically, the length of the fruiting area of the Gök köy *Phoenix* population is in general longer than that of female inflorescences together with the fruiting stalk of *P. theophrasti* (Figure 8).

The fruit size of the Gök köy *Phoenix* population is substantially smaller than that of *P. dactylifera*, but is slightly larger than the fruit sizes of the *P. theophrasti* populations. Moreover, the ranges of both fruit thickness and lengths of the Gök köy *Phoenix* populations are greater than the fruits of all the *P. theophrasti* populations (Table 2, Figure 9). The fruit size of the Kumluca-Karaöz population is clearly smaller than that of the other *P. theophrasti* populations. However, fruit characteristics were not used as a criteria for the description of new subspecies (Greuter, 1967; Barrow, 1998; Flora of China, 2019).

The seed thickness of the Gök köy *Phoenix* population is nearly equal to that of *P. dactylifera*. The seed thickness of the Gök köy *Phoenix* is slightly thinner than that of *P. theophrasti* with the exception that the seed thickness of the Kumluca-Karaöz population is nearly equal to it. In contrast, the seed length of the Gök köy *Phoenix* population is slightly longer than that of *P. theophrasti* but shorter than that of *P. dactylifera*. Ranges of both seed thickness and length of the Gök köy *Phoenix* population are greater than the seeds of all the *P. theophrasti* populations (Table 2, Figure 10) (Barrow, 1998; Flora of China, 2019; Greuter, 1967).

The other distinctive characteristics of the seeds of the Gök köy *Phoenix* population compared with the *P. theophrasti* and *P. dactylifera* populations are explained below.

The seeds of the Gök köy *Phoenix* population have slightly visible striate or smooth surfaces and deep-wider grooves, whereas those of *P. theophrasti* have clearly visible striate surfaces and shallow grooves. On the other hand, the seeds of *P. dactylifera* have smooth seed surfaces and deeper and wider grooves than those of both the *P. theophrasti* and Gök köy *Phoenix* populations. One can easily distinguish the seeds of the Gök köy *Phoenix* population from those of all the *P. theophrasti* populations and *P. dactylifera* trees (Figure 10). Differences in seed characteristics



Figure 9. Fruits of *Phoenix theophrasti* Greuter subspecies *golkoyana* Boydak (a), groves of *P. theophrasti* Greuter (b, Hurmalıbük; c, Eksera Deresi; d, Kumluca–Karaöz) and *Phoenix dactylifera* L. (e). Although there are differences among the fruit sizes that are explained in the study, fruit characteristics were not used as criteria for the description of the new subspecies

are accepted as important criteria in taxonomy. These are the most distinctive seed characteristics of the Gökölü *Phoenix* populations when compared with the seeds of the *P. theophrasti* Greuter and *P. dactylifera* L. populations; therefore, they are used among the criteria for the description of the new subspecies.

The Gökölü *Phoenix* population and *P. theophrasti* fruits are slightly sweet, but scarcely fleshy. They are not cultivated for fruit production; however, *P. dactylifera* has fruits that are sweet and fleshy and has been cultivated for many thousands of years for its fruit.

Evaluations and description of a new subspecies

As was described above, *P. theophrasti* was distinguished from *P. dactylifera* by its erect fruit clusters and small inedible fruits (Anon., 1983; Barrow, 1998; Greuter, 1967).

The results of this morphological study strongly indicate that various morphological features of the Gökölü *Phoenix* population appear similar to and/or different from either *P. theophrasti* or *P. dactylifera*. Therefore, the Gökölü *Phoenix* population merits being described as a new subspecies.

Since the Gökölü *Phoenix* population has a 50 km distance from the nearest *P. theophrasti* population (Datça–Eksera Deresi *P. theophrasti* population), a natural buffer zone has existed as barrier to interbreeding with other *Phoenix* populations. Therefore, the Gökölü *Phoenix* population can be described as a subspecies of *P. theophrasti* as follows:

P. theophrasti Greuter subsp. *golkoyana* Boydak subsp. nov.

Type:

TURKEY C1 Muğla: Bodrum, Gökölü (Göltürkbükü), female, latitude 37.1147° N, longitude 27.3981° E, Plain, 3 m., 27 August 2018, M. Boydak (holotype: ISTO 38308); ibid, (paratypes: (male) ISTO 38309, (female) ISTO 38310); ibid, 01 October 1990, M. Boydak (paratype: ISTO 27384).

“*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak” differs from *P. theophrasti* Greuter with respect to its longer fruiting-female stalk length and longer male stalk length, its fruiting stalks hold fruits marginally higher, and its having seeds with slightly visible striate surface crust structures and deeper-wider grooves.

An identification key is given for these two species:

1. Fruit clusters erect or slightly arching; fruits small and inedible; male inflorescences length up to 120 cm; female inflorescences length up to 210 cm; seed surfaces smooth and striate; seed grooves deep or shallow.

2. Male inflorescences length up to 55 cm; female inflorescences length up to 70 cm, erect; seed surfaces deeply striate; seed grooves very narrow and shallow.

P. theophrasti* Greuter subsp. *theophrasti

2. Male inflorescences length up to 120 cm; female inflorescences length up to 210 cm, erect, arching slightly; seed surfaces slightly striate or smooth; seed grooves wide and deep.

***P. theophrasti* Greuter subsp. *golkoyana* Boydak subsp. nov.**

1. Fruit clusters erect, becoming pendulous with fruit maturity; fruits larger and edible; female inflorescences length up to 200 cm; male inflorescences length up to 100 cm, erect; seed surfaces smooth; seed grooves wider and deeper.

P. dactylifera



Figure 10. The seeds of the Gölköy *Phoenix* population have slightly visible striate or smooth surfaces and deep-wider grooves (b), whereas the seeds of *Phoenix theophrasti* have clearly visible striate surfaces and shallow grooves (c, d). On the other hand, *P. dactylifera* has smooth seed surfaces and deeper and wider grooves than the seeds of both the *P. theophrasti* and Gölköy *Phoenix* populations (a). One can easily distinguish the seeds of the Gölköy *Phoenix* population from the seeds of all the *P. theophrasti* populations and *P. dactylifera* trees. These are the most distinctive seed characteristics of the Gölköy *Phoenix* populations when compared with the seeds of the *P. theophrasti* Greuter and *P. dactylifera* L. populations; therefore, they are used among the criteria for the description of the new subspecies

Conservation of *P. theophrasti* Greuter ssp. *golkoyana* Boydak

The *P. theophrasti* Greuter ssp. *golkoyana* Boydak population primarily covers an area of 3.9 ha according to the management plans of the Turkish Forest Service completed in 2013 (Anon., 2013). There are mainly four *Phoenix* groves covering 1.2 ha, 1.2 ha, 1.0 ha, and 0.5 ha inside or alongside the bog and/or bordering the village (Figures 2, 3). In addition, a number of palms are currently included in the gardens of houses built recently. This population is unique and of great importance as a natural palm grove in Turkey; therefore, it is imperative that positive action is taken to ensure its conservation and development.

The name Gölköy, which means "Lake Village," originates in the lake that surrounds the palm grove and the village. A drainage trench surrounding the whole area was constructed to establish a golf area in the early 1990s. The lake is fed by a number of copious springs; thus, the drainage ditch is unlikely to dry out the swamp completely. However, the sinking water-table did have adverse impacts on the local ecosystem which then could affect the conditions of the palm grove (Boydak and Barrow, 1994, 1995).

Therefore, in 1993, Boydak applied to the local and city governors to demand effective protective measures for the Gölköy grove, including bans on both the water drainage scheme and the village's expansion into the palm population. In addition, based on the authors' report, and other evidence, in 1994, Birgin, prepared another report and suggested breaking the agreement between the local authority and the private company developing the golf area. Later, the golf area and drainage activities were banned. By applying conservation status to the area, the grove is legally in a more protected condition now.

Fire also affected the grove in June 1993, but the grove recovered by a healthy abundance of suckers sprouting at the base and trunk together with healthy seedlings. Many palms flowered in the following years. Currently, they are very healthy and obviously living up to the meaning of the word *Phoenix*, "rising from the fire" (Boydak and Barrow, 1995).

Currently, tourism has become an important source of income for the locals; pressure grows to develop the village with new summer housing and tourist facilities (Boydak and Barrow, 1995).

The combined effect of the fire and expansion and development of the village necessitated that a conservation status be placed upon the grove, which the grove now has. In addition, non-governmental organizations are paying great attention to the grove.

P. theophrasti Greuter subsp. *golkoyana* Boydak is among the endangered species; however, Göltürkbükü–Gölköy consisting of the *P. theophrasti* Greuter ssp. *golkoyana* Boydak groves and other patches or individuals including those in private estate gardens are under conservation statutes as a natural protect-

ed area (Byfield and Özhatay, 2005). In addition, the *P. theophrasti* Greuter populations are under conservation regimes. The population and the palm trees that are currently included in the gardens of houses are also under protection according to the management plans of the Turkish Forest Service completed in 2013 (Anon., 2013).

CONCLUSION

"*Phoenix theophrasti* Greuter subsp. *golkoyana* Boydak" differs from *P. theophrasti* Greuter with respect to its longer fruiting-female stalk length and longer male stalk length, its fruiting stalks hold fruits marginally higher, and its having seeds with slightly visible striate surface crust structures and deeper-wider grooves. This population is unique and of great importance as a natural palm grove in Turkey; therefore, it is imperative that positive action is taken to ensure its conservation and development, together with the three native *P. theophrasti* stands in Turkey. In addition, its range could be expanded by planting in parks, streetsides, and gardens in the Mediterranean and Aegean regions both to expand its population and for ornamental purposes. This population has also great importance as a natural palm grove that contributes to the world's flora.

Peer-review: Externally peer-reviewed.

Acknowledgements: I am grateful to Prof. Dr. Chadwick D. Oliver for editing the English manuscript. I appreciate Doç. Dr. Servet Çalışkan and Emine Çalikoğlu for their valuable assistance during the field and laboratory works. I wish to thank Dr. Sasha Barrow, Prof. Dr. Adil Güner for their opinions and guidance regarding the article. I also thank to Assistant Professor Dilek Oral for her helps with the herbarium materials. My thanks to Doç. Dr. Ragıp Esener for his valuable assistance in sending seeds for controls. I also appreciate contributions of Dr. Neşat Erkan, Dr. Mehmet Çalikoğlu, Abdurrahman Çobanoğlu, Hakan Zeybek, Önder Barut, Uğur Orhon, Mutlu mercan, Cevdet Altaş, Saner Demirtaş, and Necati Saray for their valuable assistance during my field trips to their forest districts. My thanks to Ahmet Demirtaş, Yaşar Canbek, Sedat Taşoğlu, Ahmet Baş, Cem Akyol, Muhterem Kavcar, Ülfet Yıldız, and other foresters and forest workers who gave valuable assistance in the field during measuring and collecting materials. I also thank to Şehrişül Erdek and Selçuk Öziş for helping the arrangement of the photographs and Mustafa Ünlü for providing audio-visual materials. Gönül Boydak, my wife, contributed at every stage of the study and also joined the field trips.

Conflict of Interest: The author have no conflicts of interest to declare.

Financial Disclosure: The author declared that this study has received no financial support.

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