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RESEARCH ARTICLE

Genetic Resource Potential of Turkish Hazel (*Corylus colurna* L.) in Yukarı Çakırçay Village (Hanönü, Kastamonu)

Muhammet Emirhan Gündoğdu ✉ • Cansu Günay • Mehmet Kalkan

Bursa Technical University, Faculty of Forestry, Department of Forest Engineering, Bursa/Türkiye

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ABSTRACT

The Turkish hazel (*Corylus colurna* L.) is one of the two hazelnut species naturally occurring in Türkiye and differs from other hazel species by its single-stemmed tree form. This study was conducted to identify naturally growing Turkish hazel individuals in Yukarı Çakırçay Village of Hanönü District, Kastamonu Province, and to evaluate the genetic resource potential of the area. In order to confirm the presence of the species in the specified area, species identification, geolocation recording of the individuals, determination of morphological traits, site characteristics, ethnobotanical features, and morphological characteristics of the nuts were investigated. A total of nine Turkish hazel individuals were recorded in the study area. The average diameter at breast height was 33.6 cm, the average tree height was 11.4 m, and the mean crown diameter was 7.7 m. The slope of the terrain ranged from 20% to 45%. All individuals were located on southern aspect, at elevations ranging from 1118 to 1277 meters above sea level. The limited number of individuals and the large distances between them suggest that the Turkish hazel in this area could be considered a potential genetic resource. To ensure their conservation, these individuals should be propagated under ex situ conditions and conserved through in situ strategies.

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1. Introduction

The hazelnut belongs to the Betulaceae family and grows naturally in the temperate regions of the Northern Hemisphere. There are more than 25 species within the genus *Corylus* worldwide, and among them, the common hazel (*Corylus avellana* L.) and the Turkish hazel (*Corylus colurna* L.) grow naturally in Türkiye (Polat, 2014). In the literature, this species is also referred to as Balkan hazel, bear hazel, Turkish hazel, tree hazel, and in the Kastamonu region, as rock hazel (Yaltırık, 1993; Ayan et al., 2016).

Turkish hazel is widely distributed in the Anatolian forests of Türkiye. Some of the provinces where these trees are found are Kastamonu, Bolu, Ankara, Zonguldak, Balıkesir, Rize, Trabzon, Bursa, Uşak, and Kütahya (Ayan et al., 2016; Kalkan & Yılmaz, 2024; Oguzkan et al., 2018; Temel et al., 2017) (Figure 1). The species generally appears either as solitary individuals or in small groups beneath broadleaf forests (such as Oriental beech, Caucasian linden in Bolu, maple, European hornbeam, Turkey oak, and Hungarian oak) as well as within stands containing juniper species, Anatolian black pine, trembling poplar, and mixed beech–fir forests. Its altitudinal

✉ Corresponding author
E-mail address: emirhan373@outlook.com

distribution ranges between 800 and 1700 meters (Yaltırık, 1993; Yaltırık & Efe, 1994; Kalkan & Yılmaz, 2024).

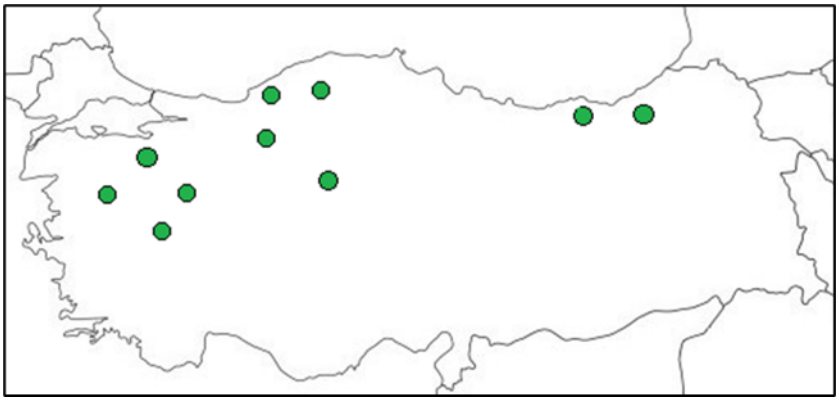

Figure 1. Some of the areas in Türkiye where Turkish hazel is distributed (Created by: Cansu Günay).

Turkish hazel is a straight-stemmed tree that can reach up to 25 meters in height. In mature trees, the bark is thick, deeply fissured longitudinally, corky, and dark gray in color. Young shoots are pale rusty-brown and densely pubescent (Yaltırık, 1993). The margins of the involucre are torn into irregular thin strips, the tips are curved backward, and the surface is covered with sticky hairs. The nuts measure 15–20 × 10–18 mm, are slightly flattened at the top, and have a broadly ovoid shape. Compared to other hazelnut species, the fruit shell is notably thicker (Yaltırık, 1993). The matte area where the nut attaches to the stem covers approximately half of the nut's surface, a feature characteristic of Turkish hazel (Yaltırık & Efe, 1994).

Although Turkish hazel is not currently classified as an endangered species, it faces the risk of becoming one (Arslan, 2009). Owing to its wood and fruit characteristics, it is an important species in terms of its contributions to ecosystems, biodiversity, and fauna elements. With its high nutritional value, it is also considered a valuable food resource (Doğanay, 2012).

Plant genetic resources are important sources of genetic diversity and encompass the variability and richness of hereditary information contained within the genome of a plant species. Genetic diversity is essential for the adaptation of plant species to changing environmental conditions (Altındal & Akgün, 2015).

Forest genetic resources and genetic diversity have long been negatively affected by natural and especially human-induced (anthropogenic) impacts. The methods applied to conserve genetic resources in forests can be grouped into two main categories: *in-situ* conservation, which is based on preserving these genetic resources in their natural environment, and *ex-situ* conservation, which aims to protect them outside their natural habitat. Within *in-situ* conservation, seed stands represent the most significant example. In *ex-situ* conservation, clonal seed orchards, clone banks, clone parks, arboreta, and pollen and seed banks are primarily utilized. Additionally, the cryopreservation of embryonic tissues under laboratory or artificial conditions is also an important component of this method (Dirik, 1994).

Ethnobotany fundamentally refers to the relationship between humans and plants. The term ethnobotany was first introduced in 1895 and has played an important role in understanding the use of plants in the treatment of many diseases. Ethnobotanical studies are generally based on long-term observations and the transmission of local knowledge (Kendir & Güvenç, 2010).

The identification of the morphological characteristics of Turkish hazel is a fundamental step in revealing its genetic resource potential and ethnobotanical significance. In this context, within the scope of the study, examinations conducted on naturally occurring Turkish hazel individuals in Yukarı Çakırçay Village aimed to obtain data on the species' current status, morphological features, and potential genetic resource value.

2. Materials and Methods

The Turkish hazel individuals examined in the study area are located within compartments 49 and 65 of the Çatalçam Forest Subdistrict, which is part of the Hanönü Forest District Directorate under the Kastamonu Regional Directorate of Forestry, and lie within the boundaries of Yukarı Çakırçay Village. The map of the areas where the species is distributed is presented in Figure 2.

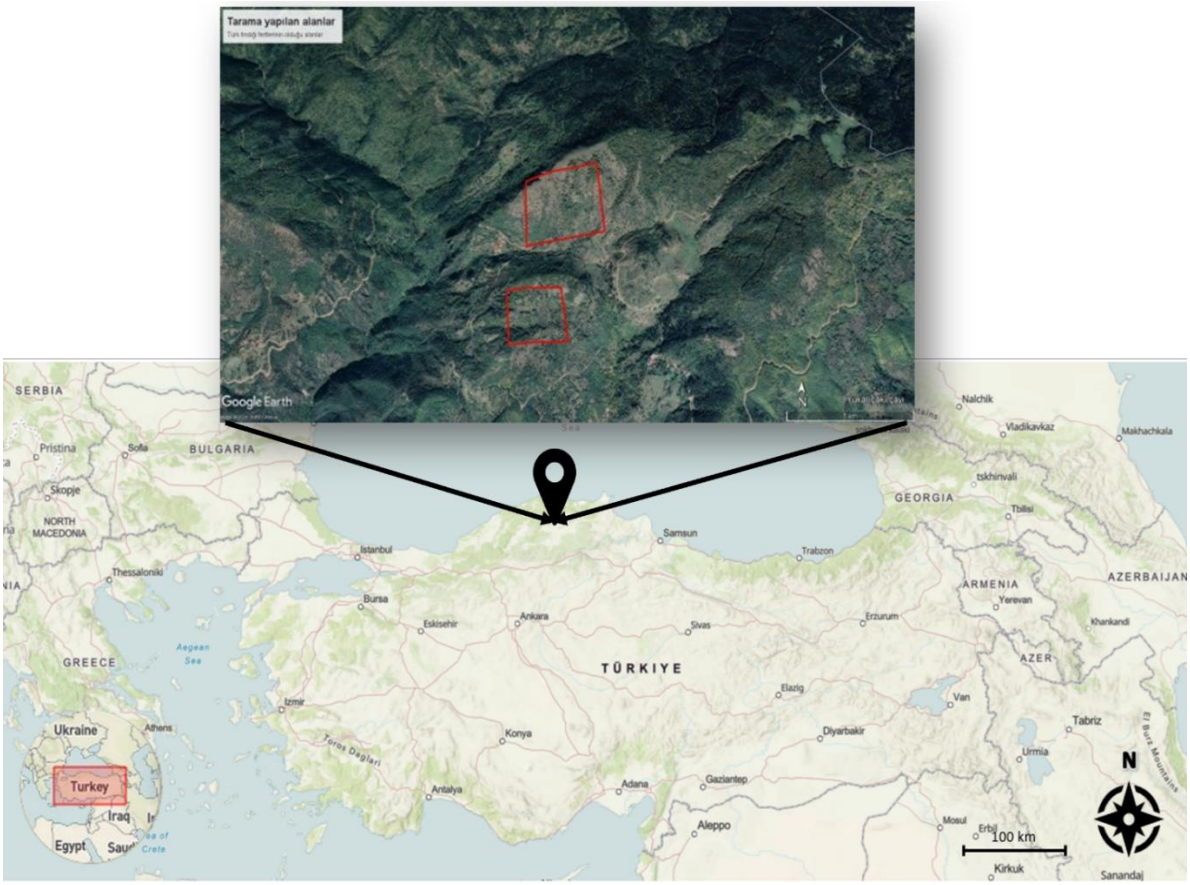

Figure 2. Turkish hazel tree locations in the Sekü and Çal Hill localities of Yukarı Çakırçay Village in Hanönü, Kastamonu.

Based on information obtained from local residents of Yukarı Çakırçay Village, potential areas where the species was reported to be present were examined, and Turkish hazel individuals were identified. Their coordinates, aspect, and elevation were recorded using a Garmin GPS device. In addition, the health status of the individuals and the plant species co-occurring with them were photographed.

The morphological characteristics of the identified individuals (diameter at breast height, age, height, and crown diameter) were measured. The diameter at breast height (dbh/$d_{1.30}$) of the Turkish hazel individuals was measured using a Haglöf Mantax Blue Mechanical Caliper. After recording the first measurement taken at dbh, a second measurement was made 90 degrees' perpendicular to the initial direction, from the right side of the tree. The average of the two measurements was recorded as the tree's dbh (Akgün et al., 2018).

Trees age were determined using a Haglöf increment borer. During age determination, annual rings were extracted from the tree at breast height using the increment borer, and the approximate age was determined. Care was taken to avoid areas with burls, wounds, forks, or similar irregularities when using the increment borer. The extracted core samples were placed in long plastic tubes for preservation. The ring counts were then examined under light and magnification (Akgün et al., 2018). Due to the presence of cavities in eight of the nine recorded individuals, age measurement could be performed on only one tree.

Height and slope measurements were carried out using a Carl Leiss Blume Leiss BL 6 height, distance, and slope meter. For tree height measurement, the leveling rod (lath) was adjusted and placed against the tree, and the measurement was taken from a distance equal to the length of the rod. For crown diameter measurement, a metal measuring tape was used to measure the radii between the crown projection and the ground in the north, south, east, and west directions. These radii were summed in the north–south and east–west directions to obtain the respective diameter values. The average crown width was then calculated by summing these diameter values and dividing by two (Özçelik, 2006).

A total of 150 hazelnut fruits were collected from the trees that had formed seeds. The length, width, and thickness of the collected nuts were measured using a Mahr 16 er digital caliper with 0.01 mm precision. Additionally, the fruit weights were measured with a Radwag AS220 R2 analytical balance sensitive to 0.0001 g (Figure 3).

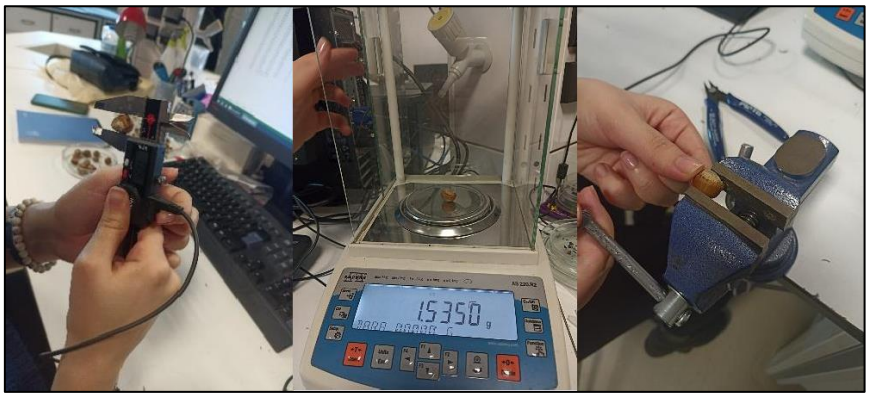

Figure 3. Measurement of morphological characteristics of hazelnuts and kernels.

Additionally, ethnobotanical information on the species' recognition and its uses was gathered through interviews with local residents.

3. Results

Within the scope of the study carried out in 2023 in Yukarı Çakırçay Village and its surroundings in the Hanönü District of Kastamonu Province, potential areas where Turkish hazelnut could naturally distribution were evaluated based on the knowledge and guidance of local residents. The potential distribution areas were carefully examined, and based on field observations and morphological assessments, the presence of natural individuals was identified in the Çal and Sekü Hill localities. No individuals of the species were encountered in other investigated areas. All identified individuals were located on south-facing slopes, at elevations between 1118 and 1277 meters, and on sites with varying slope gradients.

A total of nine individuals were recorded during the field studies (Figures 4–12). The dbh of these individuals ranged between 10–53 cm, while their heights varied between 5–16.5 m. Mean DBH and height were 33.6 cm and 11.4 m, respectively. The average crown diameter was of 7.9 m in the north–south direction, and 7.5 m in the east–west direction. The slope of the sites where the trees were located ranged between 20% and 45%, with an average slope of 34%. Due to the presence of cavities in the trunks, age determination could be performed on only one individual, which was measured to be 77 years old. For the remaining individuals, suitable increment cores could not be obtained (Table 1).

Table 1. Morphological and site characteristics of the identified Turkish hazelnut individuals.

Tree No	DBH (cm)	Height (m)	Age	Crown diam. (N–S / E–W, m)	Elevation (m)	Coordinates	Aspect	Slope (%)	Hill
1	49.0	16.5	77	11.3 / 10.8	1236	41.67406 34.56604	South	40	Çal
2	40.0	14	-	7.0 / 10.0	1250	41.67446 34.56615	South	38	Çal
3	53.0	14	-	10.3 / 9.7	1260	41.67464 34.56594	South	41	Çal
4	50.0	11	-	8.5 / 8.5	1277	41.67529 34.56629	South	35	Çal
5	45.0	10.5	-	9.4 / 9.2	1250	41.67446 34.56638	South	45	Çal
6	11.0	5	-	5.1 / 4.5	1250	41.67446 34.56638	South	45	Çal
7	10.0	6	-	5.3 / 4.5	1118	41.66585 34.56316	South	20	Sekü
8	17.0	10	-	6.4 / 4.2	1118	41.66584 34.56278	South	23	Sekü
9	27.0	16	-	7.9 / 5.7	1119	41.66582 34.56282	South	22	Sekü
Mean ± SD	**33.6 ± 17.5**	**11.4 ± 4.1**	**-**	**7.9 ± 2.2**	**1208 ± 68.6**	**-**	**South**	**34 ± 10**	**Çal, Sekü**

Figure 4. Turkish hazelnut individual No. 1.

Figure 5. Turkish hazelnut individual No. 2.

Figure 6. Turkish hazelnut individual No. 3.

Figure 7. Turkish hazelnut individual No. 4.

Figure 8. Turkish hazelnut individual No. 5.

Figure 9. Turkish hazelnut individual No. 6.

Figure 10. Turkish hazelnut individual No. 7.

Figure 11. Turkish hazelnut individual No. 8.

Figure 12. Turkish hazelnut individual No. 9.

A total of 150 hazelnut samples were collected on 8 October 2023 from the fruits present on the identified Turkish hazel individuals in the study area. The available fruits on the trees were sampled, and a total of 150 nuts could be obtained from the population. The morphological measurements of these samples were conducted in the laboratory. Based on these measurements, the fill rate of the nuts was determined 28%, while the empty rate was 72%. The average length, width, thickness, and weight of the hazelnut fruits were determined 15.74 mm, 17.05 mm, 13.85 mm, and 1.5599 g, respectively. For the kernels of the same samples, the average length, width, thickness, and weight were determined 11.29 mm, 10.92 mm, 7.03 mm, and 0.4413 g, respectively (Table 2).

Table 2. Morphological measurements of hazelnuts and kernels.

		Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
Hazelnut	Min–Max	13.61–17.72	9.94–20.17	8.64–16.35	0.3959–2.7054
	Mean ± SD	15.75 ± 0.81	17.05 ± 1.74	13.85 ± 1.63	1.5599 ± 0.4268
Kernel	Min–Max	8.09–13.20	6.38–14.13	5.20–9.17	0.1798–0.7632
	Mean ± SD	11.29 ± 1.13	11.15 ± 1.62	7.20 ± 0.99	0.4413 ± 0.1377

Ethnobotanical investigations revealed that Turkish hazelnut is well recognized by local residents, whose nuts are commonly consumed as a snack and occasionally collected for economic purposes. The wood of the species is also traditionally used in the manufacture of household items and agricultural tools due to its high durability. However, individuals are sparsely distributed, occur at considerable distances from one another, and are confined to a limited number of natural sites. These findings indicate a restricted local distribution of the species and provide baseline information for future genetic and conservation-oriented studies.

4. Discussion and Conclusion

This study identified a natural distribution area of Turkish hazelnut in and around Yukarı Çakırçay Village, Hanönü District, Kastamonu Province. The presence of this population is consistent with existing knowledge that the species exhibits a fragmented and scattered natural distribution in Türkiye.

The presence of individuals in the study area on slopes with a mean inclination of 34% and at elevations between 1118 and 1277 m aligns well with the topographic conditions reported from other regions where the species naturally occurs. Turkish hazelnut, which is distributed between 100–1300 m in the

Balkans and 800–1700 m in Türkiye, typically occupies similar elevation ranges and sloping terrains, indicating that the species prefers similar ecological conditions (Kalkan et al., 2023; Šeho et al., 2019).

The morphological characteristics of the individuals, including diameter, height, and crown width, are largely consistent with the ranges reported in previous studies from different regions of Türkiye. The mean diameter (33.6 cm) and height (11.4 m) observed in this study closely correspond to values reported from Bulkaz Mountain (Uşak), where stem diameters range from 30 to 100 cm and tree heights from 10 to 20 m (Polat & Güney, 2015). Similarly, studies conducted in the Dağakça and Çakallar regions of Bursa documented dbh values between 20 and 70 cm and heights ranging from 6 to 15 m, suggesting that individuals from Yukarı Çakırçay display comparable morphological characteristics (Kalkan & Yılmaz, 2024). In contrast, populations reported from Mount Şaphane include individuals reaching heights of up to 18 m (Kabak et al., 2020), indicating that the Yukarı Çakırçay population is relatively shorter. Such variation in growth form may be attributed to differences in environmental conditions, including site conditions, elevation, soil characteristics, and levels of intra-population competition.

The morphological measurements of *Corylus colurna* fruits obtained in this study show general agreement with values reported in the literature, although some minor differences are observed. For instance, Kalkan (2023) reported mean fruit dimensions of 15.91 × 15.34 × 12.02 mm and a fruit weight of 1.45 g, along with mean kernel dimensions of 12.93 × 11.07 × 7.62 mm and a kernel weight of 0.50 g across ten different populations. In the present study, the mean fruit length (15.74 mm) was comparable to those values, while fruit width (17.05 mm), thickness (13.85 mm), and mean fruit weight (1.56 g) were slightly higher. Kernel dimensions (11.29 × 11.15 × 7.20 mm) and kernel weight (0.4413 g) obtained in this study were slightly lower but generally within the range reported by Kalkan (2023). These differences may be related to local ecological conditions, site characteristics, sampling differences, or the limited number of fruit-bearing individuals available in the population. Nevertheless, the values obtained in the present study generally fall within the range reported for *Corylus colurna* in previous studies.

Ünalan (2016) and Ayan et al. (2018) reported that the mean fruit dimensions across four different populations were 15.45 × 15.53 × 12.04 mm, with an average fruit weight of 1.48 g, while the kernel dimensions were 12.46 × 11.37 × 7.56 mm with a kernel weight of 0.5 g. Similarly, Balık and Kayalak Balık (2016) reported higher average values, with a mean fruit weight of 2.6 g and a mean kernel weight of 0.8 g. When compared with these results, individuals from Yukarı Çakırçay generally fall within the overall morphological range reported for the species but display moderate differences in certain traits, particularly kernel size and weight. Such variation may reflect natural intraspecific variability and suggests that the Yukarı Çakırçay population may represent a locally important component of the species in terms of morphological diversity and its potential relevance for future genetic and conservation-oriented studies.

Popović et al. (2022) demonstrated that *Corylus colurna* populations in Serbia exhibit high morphological variation, while some populations are genetically weak. Therefore, the individuals identified in Yukarı Çakırçay should be considered for seed production using methods that preserve genetic diversity.

It is well documented that *Corylus colurna* forms mixed stands with various forest tree species within its natural distribution range. In this study, individuals were observed either as solitary trees or in small clusters, occurring alongside broadleaved species such as wild pear (*Pyrus elaeagnifolia*) and oak (*Quercus* spp.). The literature indicates that the species frequently coexists with Oriental beech (*Fagus orientalis*), Turkey oak (*Quercus cerris*), Hungarian oak (*Quercus frainetto*), and European hornbeam (*Carpinus betulus*) (Ayan et al., 2016; Kalkan & Yılmaz, 2024; Yaltırık, 1993).

Ethnobotanical observations in the Yukarı Çakırçay region indicate that local communities consume the fruits of Turkish hazelnut primarily as a snack and occasionally harvest them for economic purposes. The wood of the species has also been traditionally utilized in the manufacture of household items and agricultural tools, reflecting its high durability. These practices are consistent with reports from the Dağakça and Çakallar villages in Bursa, where the fruits are used in the preparation of bread, cakes, and desserts, and the shells serve as a fuel source, as well as with similar uses reported for Kastamonu and other regions (Ayan et al., 2016; Kalkan & Yılmaz, 2024). Likewise, Polat (2014) reported that local populations collected and consumed the fruits of *Corylus colurna* as a food resource. Taken together, these findings suggest that Turkish hazelnut has a broadly consistent pattern of traditional use across its natural distribution range.

Turkish hazelnut exhibits a characteristically fragmented distribution across its range, typically occurring in small and spatially isolated populations. Recent studies from the Balkans (particularly in Serbia and Bosnia-Herzegovina) have documented numerous small and isolated populations (Šeho et al., 2019, 2023), a pattern that is likewise evident in Türkiye (Kalkan, 2023; Kalkan & Yılmaz, 2024; Polat, 2014). Although the species is listed as "*Least Concern*" on the IUCN Red List, factors such as habitat loss, population isolation, and low fruit productivity indicate that it may be locally threatened. The fact that the individuals identified in Yukarı Çakırçay are relatively small in diameter, old, and dispersed, combined with habitat fragmentation and limited seed dispersal, suggests that maintaining genetic diversity in the long term could be

challenging. Consequently, treating this population as a candidate genetic reserve and securing its protection through integrated *in-situ* and *ex-situ* conservation measures should be considered a priority.

In conclusion, the individuals identified in Yukarı Çakırçay significantly enhance our understanding of the natural distribution of Turkish hazelnut in Türkiye and contribute original evidence on the species' morphological and ecological variability. Continued, systematic monitoring of this and comparable local populations is therefore imperative to support effective conservation and to inform their integration into sustainable forest management frameworks.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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