

Biopiracy and Biological Smuggling in Türkiye: Case Analysis, Penalty Trends and Conservation Strategies (2014–2026)

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Özet

Biyolojik kaçakçılık (biyokaçakçılık), bir ülkeye ait bitki, hayvan türleri ve genetik kaynakların yasa dışı yollarla yurt dışına çıkarılmasıdır; biyokorsanlık ise genetik kaynakların veya geleneksel bilginin izinsiz biçimde patentlenerek ticari sömürüsüne karşılık gelir. Bu çalışma, Türkiye'nin biyolojik çeşitliliğini hedef alan biyokaçakçılık faaliyetlerini ulusal ve uluslararası vakalar ışığında analiz etmeyi amaçlamaktadır. Türkiye, Güner ve ark. (2012) kapsamlı listesine göre alttör ve varyeteler dahil yaklaşık 12.000 damar bitki taksonu barındırmakta; güncel tür düzeyindeki tahminlere göre yaklaşık 10.500 vasküler bitki türü bulunmakta ve bunların 3.400'ünden fazlası (%30–34) endemiktir (Int. Ref.-22; Genç and Çetin, 2013); bu durum Türkiye'yi dünyanın en önemli genetik kaynak merkezlerinden biri kılmaktadır. Çalışmada, 2014-2026 yılları arasında Türkiye'de tespit edilen vakalar, cezaların kronolojik değişimi ve uluslararası örnekler incelenmiştir. Bulgular, endemik türleri koparmanın cezasının 2017'de 42.479 TL iken 2026'da 699.245 TL'ye yükseldiğini göstermektedir. Sonuç olarak, biyokaçakçılıkla mücadelede caydırıcı cezalar, uluslararası işbirliği ve toplumsal farkındalık gerekmektedir.

Biyokaçakçılık | Endemik Türler | CITES | Türkiye | Biyolojik Çeşitlilik

Abstract

Biological smuggling is the illegal physical removal of plant and animal species and genetic resources from a country. This study aims to analyze biological smuggling activities targeting Türkiye's biological diversity in the light of national and international cases. Türkiye is one of the most important genetic resource centers in Europe. The Güner et al. (2012) checklist documents approximately 12,000 vascular plant taxa including infraspecific categories; at strict species level, current estimates indicate approximately 10,500 vascular plant species, of which over 3,400 (approximately 30–34%) are endemic (Int. Ref.-22; Genç and Çetin, 2013). The study examines cases detected in Türkiye between 2014-2026, the chronological change of penalties, and international examples. Findings show that the penalty for picking endemic species increased from 42,479 TL in 2017 to 699,245 TL in 2026. As a result, deterrent penalties, international cooperation, and public awareness are required in the fight against biological smuggling.

Biological Smuggling | Endemic Species | CITES | Türkiye | Biodiversity

Çalışmanın Önemi

Bu çalışma, Türkiye'de biyokaçakçılık konusunda 2014-2026 yıllarını kapsayan en güncel ve kapsamlı analizlerden birini sunmaktadır. Cezaların kronolojik değişimini tablolaştırarak 16 katlık artışı somut verilerle ortaya koyması, uluslararası vakaları (Kenya, Peru, Etiyopya) Türkiye örnekleriyle karşılaştırmalı olarak analiz etmesi ve Nagoya Protokolü'ne taraf olunmaması gibi stratejik eksiklikleri vurgulaması, çalışmanın özgün değerini oluşturmaktadır.

Significance

This study presents one of the most up-to-date and comprehensive analyses of biological smuggling in Türkiye covering the years 2014-2026. It tabulates the chronological change of penalties, revealing a 16-fold increase with concrete data. In addition, it compares international cases (Kenya, Peru, Ethiopia) with Turkish examples, highlighting strategic deficiencies such as the country's non-party status to the Nagoya Protocol.

1. Introduction

Biopiracy is defined as the unethical or illegal use or commercial exploitation of biological materials specific to a country or region, without providing fair financial compensation to the peoples or governments who are the owners of these materials (Robinson, 2010). This concept refers specifically to the process by which biological resources and traditional knowledge of developing countries are patented and commercialized by companies in developed countries.

In the international literature, a terminological distinction is drawn between two related but conceptually distinct phenomena. Biopiracy (In Turkish: biyokorsanlık) refers to the unauthorized commercial appropriation of a country's or community's genetic resources or traditional knowledge — without the prior informed consent of the source nation and without equitable benefit-sharing arrangements. It is typically perpetrated by multinational pharmaceutical or seed corporations through the patent system as the primary legal mechanism (Mgbeoji, 2006; Shiva, 1997). Although it operates within apparent legal

frameworks, it is fundamentally problematic from an ethical and equity standpoint, and occurs at the academic and institutional level. Biological smuggling (In Turkish: biyolojik kaçakçılık), by contrast, refers to the illegal physical translocation of biological materials — including living organisms, seeds, specimens, and tissue samples — across national borders, in violation of customs regulations and international conventions such as CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). It occurs at the field level, carried out by individuals or organized criminal networks. Based on the conceptual distinctions outlined above — particularly the distinction between institutional patent-based exploitation and the illegal physical movement of biological materials — it has been determined that the term “biological smuggling” is the appropriate designation for the Turkish cases examined in the present article. Cases involving the patenting of genetic resources or traditional knowledge — such as the *sacha inchi* and *teff* examples discussed in Section 3.4 — represent the narrower “biopiracy/biyokorsanlık” dimension and are included to provide international comparative context.

Illegal wildlife trade is the fourth largest transnational criminal activity in the world, after drug and counterfeit goods trafficking and human trafficking. The global biological smuggling market is estimated to be between 25-30 billion dollars, and this enormous economic size makes countries with high biological diversity targets (Int. Ref.-1).

Türkiye is one of the countries where biological smuggling is most intensely experienced due to its rich biological diversity. Located at the intersection of three phytogeographical regions (Euro-Siberian, Mediterranean and Irano-Turanian), the European continent has approximately 15,000 vascular plant species, while Türkiye alone hosts a disproportionately high share. The Güner et al. (2012) checklist — the most comprehensive catalogue of Turkish vascular plants — documents approximately 12,000 taxa including infraspecific categories (subspecies and varieties). At strict species level, current estimates from the national biodiversity database (Int. Ref.-22) indicate approximately 10,500 vascular plant species for Türkiye, of which over 3,400 are endemic, corresponding to an endemism rate of approximately 30–34% (Güner et al., 2012; Genç and Çetin, 2013; Özhatay and Kültür, 2006). This exceptionally high endemism rate makes Türkiye one of the world’s most significant genetic resource centers.

While biological smuggling primarily concerns the illegal physical collection and export of specimens, the misappropriation of biological resources also occurs through the patenting of genetic resources and traditional knowledge — the phenomenon referred to as biopiracy in the strict sense. Within the framework of the WIPO GRATK Treaty, the protection of genetic resources and associated traditional knowledge constitutes an important area of international law (Soysal, 2025).

This study has unique value as it presents the most comprehensive current analysis of biological smuggling in Türkiye covering the years 2014-2026. Its original aspects include tabulating the chronological change of penalties, revealing a 16-fold increase with concrete data, comparatively analyzing international cases (Kenya, Peru, Ethiopia) with Turkish examples, and highlighting strategic deficiencies such as the country’s non-party status to the Nagoya Protocol. Furthermore, unlike previous studies conducted in Türkiye, it provides a comparative evaluation with international imprisonment practices in addition to the increase in penalty amounts, strengthening the study’s contribution to the literature. While Topdağ and Ürker (2024) offer a valuable current assessment of institutional coordination and awareness frameworks in Türkiye’s biological smuggling management framework, the present study complements that work by providing systematic penalty trend data and case analysis across the extended 2014–2026 period. The aim of this study is to analyze biological smuggling cases in Türkiye from geographical, taxonomical and methodological perspectives, reveal the chronological change of administrative fines, and develop conservation strategies by providing a comparative evaluation with international examples.

2. Materials and Methods

This study employs document analysis, a systematic qualitative research method used to examine and interpret existing recorded materials as a source of data (Bowen, 2009). The study covers the period 2014–2026, selected because 2014 marks the first systematically documented biological smuggling interventions in Türkiye following the establishment of the Ministry of Agriculture and Forestry’s awareness and enforcement framework, while 2026 represents the most current available data point for administrative penalty amounts.

Data were collected from four primary source categories: (1) Official reports and documents, including publications and press releases of the Ministry of Agriculture and Forestry (T.C. Orman ve Su İşleri Bakanlığı, 2015) and workshop proceedings from three national biological smuggling awareness meetings: (i) İstanbul (2014) — the inaugural national workshop, organised in the aftermath of the first systematically documented biological smuggling intervention in Türkiye and reflecting the country’s growing institutional awareness of the threat (Int. Ref.-7; T.C. Orman ve Su İşleri Bakanlığı, 2015); (ii) Alanya (2015) — the second meeting, held in the Antalya province, the region with the highest documented biological smuggling intensity in Türkiye and where several landmark cases had been recorded; (iii) Sakarya (2015) — the third meeting, representing the expansion of the national awareness programme into Türkiye’s northwestern Marmara hinterland and signalling the campaign’s reach beyond major coastal biodiversity hotspots. These three meetings are the only ones for which officially published, publicly

accessible proceedings were available through the Ministry's documentation channels at the time of data collection. It is acknowledged that the national awareness programme initiated under the leadership of the Ministry subsequently expanded to cover all 81 provinces of Türkiye (T.C. Orman ve Su İşleri Bakanlığı, 2015); the non-inclusion of other provincial proceedings therefore constitutes a data limitation attributable to documentation accessibility rather than deliberate geographic selection, and is discussed further in Section 4; (2) Peer-reviewed academic literature, retrieved via Google Scholar, DergiPark, and Web of Science using the search terms "biopiracy Turkey," "biyokaçakçılık," "wildlife trafficking Turkey," and "biyolojik kaçakçılık"; (3) Data from international organizations, specifically INTERPOL and CITES operational reports; and (4) National press sources, obtained through systematic searches of major Turkish news agencies and newspapers (Hürriyet, Haber Türk, İHA, Yeni Şafak, and others) for the keywords listed above, covering the 2014–2026 period.

Source inclusion criteria were as follows: news reports were included only when they referenced a verifiable enforcement action (seizure, fine, arrest, or official warning) or a named official statement; penalty data were accepted only when traceable to an official governmental source or a verified news report of an official announcement. Press sources reporting unverified or anonymous claims were excluded. For the penalty chronology (Table 1), only sources that cited specific fine amounts with identifiable dates and legal basis were used.

The collected material was analysed thematically under four categories: (i) geographical and taxonomic profile of cases; (ii) smuggler profiles and methods; (iii) chronological evolution of administrative fines; and (iv) comparison with international criminal sanctions. International cases (Kenya, Peru, Ethiopia) were selected purposively to represent three distinct dimensions of the broader biological resource misappropriation problem: physical specimen trafficking (Kenya's ant case), traditional knowledge and patent disputes (Peru's sacha inchi case), and staple crop biopiracy (Ethiopia's teff case).

The use of press-based data entails inherent limitations. National media coverage is not systematic and may over-represent high-profile or unusually large-scale cases, while minor incidents go unreported; the resulting data set therefore constitutes a minimum estimate of actual biological smuggling activity in Türkiye. Furthermore, the direct deterrent effect of rising penalty amounts could not be evaluated quantitatively, as no longitudinal field data on recidivism or detection rates are publicly available. These limitations are discussed further in Section 4.

3. Findings

3.1. Türkiye's Biological Diversity Richness

Türkiye has the richest plant diversity in Europe due to its location at the intersection of three

phytogeographical regions. The Güner et al. (2012) checklist documents approximately 12,000 vascular plant taxa including infraspecific categories; at strict species level, current national biodiversity database estimates (Int. Ref.-22) indicate approximately 10,500 vascular plant species, of which over 3,400 are endemic, corresponding to an endemism rate of approximately 30–34% (Güner et al., 2012; Genç and Çetin, 2013).

In terms of fauna, Türkiye has more than 170 mammal species, over 400 bird species, more than 140 reptile species, around 30 amphibian species, and over 400 marine and freshwater fish species (T.C. Orman ve Su İşleri Bakanlığı, 2015; Yorulmaz, 2015).

3.2. Analysis of Biological Smuggling Cases in Türkiye

The analysis below draws on all documented cases retrieved through the methodology described in Section 2, comprising enforcement actions, press-confirmed seizures, and official statements recorded in Türkiye between 2014 and 2026. Cases are examined across three analytical dimensions: geographical distribution, biological group (flora vs. fauna and taxonomic category), and smuggler profile and method. Table 3 (see end of section) presents a systematic overview of key documented cases by province and biological group. Antalya is one of the provinces where biological smuggling cases are most intense. News articles with the headline "Pirate alert in the Mediterranean" emphasize that biological smuggling activities have intensified in the Mediterranean Region, especially in Antalya (Int. Ref.-2). According to the Ministry of Agriculture and Forestry data, provinces with high biological diversity such as Antalya, Muğla, Mersin and Artvin are regions where smugglers operate intensively (Yiğit et al., 2025).

Target species in terms of flora include bulbous plants (tulip, hyacinth, cyclamen, snowdrop, crocus), orchids, medicinal and aromatic plants, and endemic species (hairy bellflower, tülüşah, Kazdağı peony, Agave) (Genç and Çetin, 2013; Yiğit et al., 2025; Int. Ref.-3; Int. Ref.-4; Int. Ref.-5; Int. Ref.-6). In terms of fauna, butterflies, insects, songbirds, reptiles and other vertebrate animals are targeted (Aydın, 2022; Yorulmaz, 2015; Int. Ref.-1).

Examination of smuggler profiles reveals that foreign nationals of different nationalities such as French, Hungarian, German, Japanese, as well as domestic smugglers, are active (Int. Ref.-7; Int. Ref.-8; Yiğit et al., 2025). Particularly, foreigners posing as tourists collect endemic species and export them through various methods (Int. Ref.-9). In one notable case in 2015, Hungarian nationals including botanist Prof. Dr. Attila Molnar from the University of Debrecen were caught in Kaş, Antalya with orchid tubers they had collected. Molnar confessed in his statement that he had come to Türkiye four years earlier to collect plants and taken them to his country. Approximately 200 tubers belonging to 18 species were replanted in the Likya Kaş Orchid Special Protection Area, while 22 other species were transferred to Akdeniz

University Botanical Garden. The Hungarians were released after administrative proceedings and fined 116,000 TL. The case highlighted the discrepancy between Türkiye's fines and imprisonment practices in countries like the Netherlands (Int. Ref.-19).

Smuggling methods include hidden compartments in luggage at airports (Int. Ref.-10), specially designed tubes that can be hidden from X-ray devices (Int. Ref.-1; Int. Ref.-11), shipment by post and cargo (Arıkan et al., 2021), and illegal sales on online platforms (Arıkan et al., 2021).

The analysis below draws on all documented cases retrieved through the methodology described in Section 2, comprising enforcement actions, press-confirmed seizures, and official statements recorded in Türkiye between 2014 and 2026. Cases are examined across three analytical dimensions: geographical distribution, biological group (flora vs. fauna and taxonomic category), and smuggler profile and method. Table 3 presents a systematic overview of key documented cases by province and biological group.

Table 3. Key documented biological smuggling cases in Türkiye by province and biological group (2014–2026)

Province / İl	Year	Biological Group	Case Summary	Source
Antalya (Kaş)	2015	Flora – Orchidaceae	Hungarian nationals incl. Prof. Attila Molnár (Univ. of Debrecen) caught with 200 orchid tubers (18 spp.); fined 116,000 TL; released after admin. proceedings	Int. Ref.-8; Int. Ref.-19
Antalya	2014	Flora – Endemic geophytes	French plant smuggler apprehended by young biologists; bulbous endemic species seized	Int. Ref.-7
Antalya	2014	Flora – Endemic trees	Attempt to smuggle 3,500-year-old endemic plants; seized at checkpoint	Int. Ref.-10
Antalya	2015	Flora – Orchidaceae	Orchids stolen by a professor; specimens recovered and returned to nature	Int. Ref.-19
Multiple – 21 provinces	2007–2017	Flora + Fauna (mixed)	129 documented cases; 68 official interventions; total fines 3.7 million TL	Int. Ref.-12
Türkiye – Syrian border	2024	Fauna – Passeriformes	6,500 live songbirds seized in Operation Thunder 2024 (INTERPOL/WCO)	Int. Ref.-1
Nationwide (multiple)	2014–2026	Flora – Endemic spp.	Ongoing penalty cases: hairy bellflower (<i>Campanula tomentosa</i>), tülüşah, Kazdağı peony (<i>Paeonia cambessedesii</i>), Agave	Int. Ref.-3; Int. Ref.-4; Int. Ref.-5; Int. Ref.-6

Note: This table constitutes a minimum documented record; cases without official confirmation are excluded per Section 2 criteria. Provinces such as Muğla, Mersin and Artvin are reported smuggling zones (Yiğit et al., 2025) but lacked individual case-level data with verifiable sources.

3.3. Chronological Change of Administrative Fines

Table 1. Administrative fines for picking endemic species (2017-2026)

Year	Fine Amount (TL)	Source
2017	42,479	Int. Ref.-12
2020-2021	73,747	Int. Ref.-3; Int. Ref.-4
2023	244,000	Int. Ref.-5
2024	244,315 - 387,142	Int. Ref.-6; Int. Ref.-13
2026	699,245	Int. Ref.-14

From 2017 to 2026, the penalty for picking endemic species increased from 42,479 TL to 699,245 TL, an increase of approximately 16 times. The penalty applied in case of habitat destruction reaches up to 3,496,768 TL as of 2026 (Int. Ref.-14). The chronological trend of these penalties is visualized in Figure 1 below.

Figure 1. Chronological Change of Administrative Fines for Picking Endemic Species in Türkiye (2017-2026)

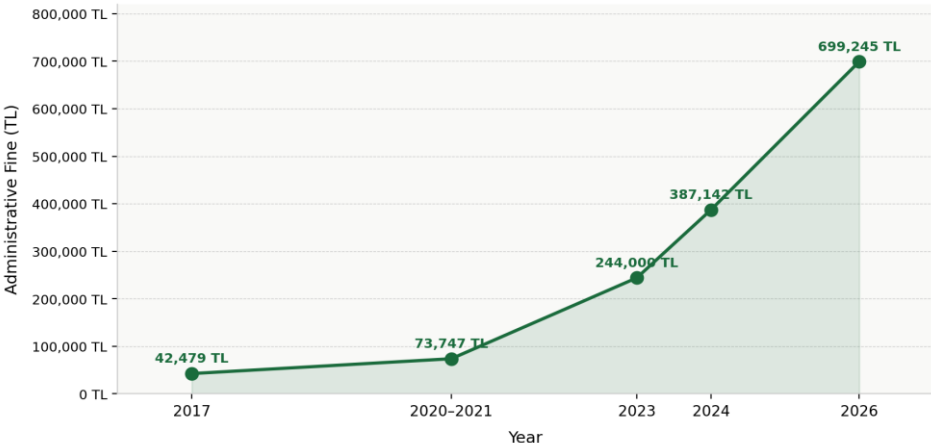


Figure 1. Chronological change of administrative fines for picking endemic species in Türkiye (2017–2026)

3.4. International Cases

In 2025, more than 5,000 live giant African harvester ants were caught in Kenya while being smuggled in specially designed cotton tubes hidden from X-ray devices. In this case, where a queen ant can find buyers for up to 180 Euros in Europe, the estimated value of the colony reached 1 million Euros (Int. Ref.-11; Int. Ref.-15; Int. Ref.-16).

The sacha inchi seed, grown in the Peruvian Amazon, has been used for thousands of years by indigenous communities. In the mid-2000s, French and German companies obtained patents monopolizing the cosmetic use of this seed, and the Peruvian National Commission for Combating Biopiracy successfully had these patents revoked (Int. Ref.-17). Similarly, teff, Ethiopia's staple food, was patented by a Dutch company in 2003 (Int. Ref.-18).

Coordinated by INTERPOL and the World Customs Organization, "Operation Thunder 2024" was carried out simultaneously in 138 countries, resulting in 365 arrests and the dismantling of 6 transnational crime networks. The operation included the seizure of 6,500 live songbirds at the Syrian border in Türkiye (Int. Ref.-1).

3.5. Comparison with International Criminal Sanctions

Table 2. Criminal sanctions for biological smuggling in different countries

Country	Fine (approx. TL)	Prison Sentence
New Zealand	2,000,000	Up to 2 years
Australia	4,500,000	Up to 7 years
South Africa	18,000,000	Up to 10 years
Türkiye	699,245	Primarily administrative fines

3.6. Legal Framework Governing the Collection and Transfer of Biological Materials in Türkiye

The collection, export, and transfer of biological materials in Türkiye are governed by a layered legal and institutional framework. The primary regulatory instrument is the Nature Conservation and National Parks Law (No. 2873, 1983), which establishes the general prohibition on the collection, uprooting, and export of wild plant species without authorization. Under this law, the General Directorate of Nature Conservation and National Parks (Doğa Koruma ve Milli Parklar Genel Müdürlüğü, DKMP) within the Ministry of Agriculture and Forestry (Tarım ve Orman Bakanlığı) is the principal competent authority for issuing scientific collection permits (bilimsel toplama izni).

Researchers and collectors — both domestic and foreign — who wish to collect plant specimens for scientific purposes must obtain a permit from DKMP. The application process requires submission of a research protocol, institutional affiliation, a species list, and collection location. Permits are species-specific and location-specific, and expressly prohibit the removal of

listed endemic, endangered, or specially protected species. The export of biological specimens is additionally subject to Customs Law (No. 4458) and requires a phytosanitary certificate issued by the Ministry; live organisms and CITES-listed species require separate export authorization. Foreign nationals are subject to the same permitting requirements and, under the current administrative framework, violations are prosecuted as administrative offences under Law No. 2872 (Environmental Law) and Law No. 2873, resulting in the administrative fines documented in Table 1 rather than criminal penalties (T.C. Orman ve Su İşleri Bakanlığı, 2015; Güler and Mutlu, 2022; Güler, 2024).

A critical gap in the current framework is the absence of criminal sanctions in the Turkish Penal Code (Türk Ceza Kanunu, No. 5237) specifically targeting biological smuggling. Unlike wildlife trafficking provisions in countries such as New Zealand, Australia, and South Africa (Table 2), Türkiye's enforcement regime relies exclusively on administrative fines rather than custodial sentences. Furthermore, Türkiye has not ratified the Nagoya Protocol on Access and Benefit-Sharing (Güler and Mutlu, 2022), which means it cannot invoke the international prior informed consent (PIC) and mutually agreed terms (MAT) mechanisms to pursue legal remedies against foreign entities that exploit genetic resources obtained from Türkiye. The absence of these instruments constitutes the principal structural weakness of the current legal framework and is central to the policy recommendations developed in Section 5 (Güler, 2024; Int. Ref.-20).

4. Discussion

The findings show that criminal sanctions in the fight against biological smuggling in Türkiye have increased significantly over the years. The fine for picking endemic species, which was 42,479 TL in 2017, rose to 699,245 TL in 2026, representing a nearly 16-fold nominal increase. This increase indicates that the seriousness of the issue is understood and deterrence is being increased (Topdağ and Ürker, 2024). Topdağ and Ürker (2024) similarly document a positive trajectory in Türkiye's biological smuggling management framework, noting increased institutional awareness following the 2013 Combating Biopiracy Guide (Int. Ref.-21) and greater inter-agency coordination efforts; yet they also stress that gaps in training, public awareness, and inter-institutional information sharing remain significant obstacles. The present study's penalty data corroborate and extend this assessment: while administrative fines have grown substantially, they have not been accompanied by commensurate advances in criminal enforcement capacity.

However, international comparisons reveal that penalties in Türkiye have not yet reached the level of imprisonment. Countries such as New Zealand, Australia and South Africa impose prison sentences ranging from 2 to 10 years in addition to fines. This situation shows that Türkiye's current administrative fine system lags behind

international standards in terms of deterrence. The 2015 Hungarian case, where the perpetrators were released after paying a fine, starkly illustrated this discrepancy compared to countries like the Netherlands where prison sentences are imposed for similar offenses (Int. Ref.-19). This pattern is consistent with the comparative literature: Mgbeoji (2006) argues that the inadequacy of financial penalties alone is a structural weakness shared by many biodiversity-rich nations, and that criminal sanctions with custodial provisions are necessary to shift the cost-benefit calculus for professional smugglers. The Kenya ant-trafficking case of 2025 reinforces this point — where a landmark criminal verdict was welcomed by international wildlife protection organizations precisely because it signalled a move beyond administrative fines toward criminal accountability (Int. Ref.-16). Türkiye's case profile, with repeated foreign national offenders and professionally organized collection trips (e.g., the 2015 Debrecen University botanist case), similarly points to the need for a deterrence framework that professional actors take seriously.

Research on biological smuggling and encountered problems in Türkiye highlights insufficient supervision, lack of personnel, technical infrastructure problems, and lack of international cooperation (Aydın, 2022). Topdağ and Ürker (2024) further identify the absence of a dedicated inter-ministerial coordination mechanism and the limited reach of existing training programmes as key structural weaknesses in Türkiye's current management framework. An examination of how wildlife trafficking is covered in the Turkish media shows that news is generally operation-focused, and the issue is not sufficiently addressed in terms of its ecosystem dimension, the importance of biological diversity, and long-term consequences (Arıkan et al., 2021). Together, these findings suggest that Türkiye's response to biological smuggling remains reactive and event-driven rather than proactive and systemic.

When evaluating the problem of biopiracy and policies towards biopiracy in Türkiye, the fact that Türkiye is not a party to the Nagoya Protocol stands out as an important deficiency (Güler and Mutlu, 2022). Examination of the approach to combating biopiracy in the Twelfth Development Plan and the Ministry of Agriculture and Forestry Strategic Plan emphasizes the need to take steps towards becoming a party to the Nagoya Protocol (Güler, 2024). Türkiye's non-party status to this protocol prevents it from benefiting from international mechanisms regarding fair sharing of benefits arising from the utilization of genetic resources.

Local protocols developed by indigenous communities such as the Endorois and Ogiek in Kenya stand out as effective methods in preventing biological smuggling (Int. Ref.-9). In Türkiye, citizens living in rural areas should be made aware of endemic species and encouraged to report suspicious situations.

This study has several limitations. First, the data used in the study are largely based on news reports and official

reports; therefore, undetected or unreported cases remained outside the analysis. Additionally, the direct effect of the increase in penalty amounts on deterrence could not be evaluated as it was not measured through field research. The penalty amounts used in international comparisons are approximate due to exchange rate fluctuations. Future studies are recommended to overcome these limitations through field research and interviews with smugglers.

5. Conclusion and Recommendations

Biological smuggling is a silent threat to Türkiye's biological wealth and genetic resources. From 2017 to 2026, the penalty for picking endemic species increased from 42,000 TL to 699,000 TL, and the penalty for habitat destruction reached 3.4 million TL. However, these penalties remain symbolic compared to the damage a lost species causes to the ecosystem.

As seen in the examples of *sacha inchi* in Peru, ants in Kenya, and *teff* in Ethiopia, the misappropriation of biological resources — whether through physical smuggling or patent-based biopiracy — represents a fundamental area of conflict between commercial interests in developed countries and the biological heritage of developing countries. International examples show that imprisonment in addition to fines significantly increases deterrence.

Türkiye's biological diversity constitutes a globally significant reservoir of genetic resources with both ecological and economic value. Endemic species targeted by biological smuggling are often functionally irreplaceable: their loss triggers cascading effects across dependent trophic levels, and many possess pharmacological or agricultural potential that has not yet been characterized (T.C. Orman ve Su İşleri Bakanlığı, 2015). The economic valuation of such losses is inherently difficult, but is systematically underestimated by the current penalty framework, which is calibrated to administrative fines rather than full ecosystem service replacement costs.

Within this framework, the following recommendations have been developed:

1. Strengthening legal regulations: Regulations providing for imprisonment for biological smuggling should be enacted in the Turkish Penal Code, and existing administrative fines should be regularly updated according to inflation and exchange rates.

2. Becoming a party to international conventions: Türkiye's early ratification of the Nagoya Protocol is critical for the protection of genetic resources and benefit sharing (Güler, 2024).

3. Strengthening supervision mechanisms: CITES experts should be assigned at airports, border gates and cargo centers, and the technological infrastructure (X-ray devices, etc.) used in detecting smuggling should be improved (Topdağ and Ürker, 2024). Topdağ and Ürker (2024) additionally recommend the establishment of a permanent inter-ministerial coordination body and the systematic training of field personnel as institutional capacity priorities. Specifically, regional directorates responsible for nature conservation and national parks should be staffed with specialist biologists with expertise in endemic flora and fauna identification. Formal collaboration protocols should be established between these directorates and nearby universities — particularly departments of biology, forestry engineering, and wildlife management — to enable rapid, scientifically informed responses to biological smuggling cases and to facilitate continuous training of field personnel (Int. Ref.-20).

4. Increasing public awareness: Public service announcements should be prepared on reporting to 112 when suspicious persons are seen in nature, and not forgetting that exotic pets may have been illegally obtained (Int. Ref.-1).

5. Supporting scientific studies: Universities should be supported in inventorying endemic species, developing conservation strategies, and scientifically analyzing biological smuggling cases (Yiğit et al., 2025). Additionally, the establishment of regional biodiversity museums in collaboration with relevant public institutions — such as provincial directorates, municipalities, and universities — should be considered. Such initiatives would raise awareness of endemic and population-restricted species at the provincial level, serve as educational and scientific platforms connecting research, conservation, and public engagement, and create institutional memory of biological diversity threats (Int. Ref.-20).

6. Developing international cooperation: Active participation in INTERPOL and World Customs Organization operations should be ensured, and intelligence sharing should be increased to dismantle smuggling networks (Int. Ref.-1).

7. Empowering local people: Citizens living in rural areas should be made aware of endemic species, and similar practices should be developed by taking example from local protocols in Kenya (Int. Ref.-9).

Addressing biological smuggling effectively requires Türkiye to transition from its current reactive, fine-based enforcement model toward a comprehensive legal and institutional framework — one that integrates criminal sanctions, international

treaty obligations, inter-agency coordination, and sustained public education. The evidence reviewed in this study suggests that neither the scale of the threat nor the pace of legal reform has yet reached a level commensurate with Türkiye's exceptional biological heritage and its responsibilities as a major centre of endemism.

Statement of Ethical Standards

The author declares that he complies with all ethical standards.

Author Contribution Statement

Abdullah ÇETİN: Conceptualization, research, methodology, data collection, writing – original draft, writing – review and editing, visualization.

Conflict of Interest Statement

The author declares that there is no known conflict of interest or personal relationship that could have influenced the work reported in this article.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

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