



Geoconservation Strategies of Türkiye

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Abstract

Geoconservation has become a new trend worldwide, providing a rapid communication channel that directly affects all of humanity. In this context, the awareness of conservation and use of nature is directly proportional to the level of development/civilization. Especially in different countries and regions, the demand for continuous use should be evaluated due to the economic conditions of the Earth's population and also for nature conservation reasons. The present study for Türkiye focuses on studies conducted on international platforms (Web of Sciences database) and national journals (both Turkish and English). According to the results of the bibliometric study, the number of papers published in more than fifty journals has increased dramatically, especially in the last 10 years. A re-evaluation of the impact analysis between the first starting point of this topic, the 'Digne-Les-Bains Declaration' (France 1991), and the most recent one, the 'Chęciny Declaration' (Poland 2018), perspectives, trend axes and intended interpretations are developed. Finally, this study consists of an explanation of the focus, scope and level of detail of the data generated over the past 12 years and includes a detailed review of the studies conducted for the impact area. Based on the bibliometrics and the review of the accessible literature, this article provides an overview of the current status of geoconservation in Türkiye.

Keywords Geoconservation · Geoheritage · Strategy · Türkiye

Introduction

Earth's geological heritage and geoconservation have been increasingly focused on by multidisciplinary research groups since the twenty-first century. Geosite identification, geoconservation, geodiversity, geocultural heritage, geotourism and the geopark concept are closely interrelated and naturally serve conservation and also geoscience education and geotourism as an element of sustainable geoheritage (Theodossiou-Drandaki et al. 2004; Brilha et al. 2005; Dowling and Newsome 2005; Hose 2005; Ruban 2010; Henriques et al. 2011, 2019; Wimbledon and Smith-Meyers 2012;

Dowling 2011, 2014; Brilha 2016, 2018; Escorihuela 2018). The broad definition of a geosite is an exceptional region that is threatened with poverty, and with the disappearance of knowledge about the region and geological documentation, all geological records will also be lost (Wimbledon 1996; Kazancı, 2010). The word geosite is not scale or size-dependent and can refer to any degree of geological diversity in an area, including rocks, landforms and other elements (Kazancı 2010; Köroğlu and Kandemir 2019). As Serano and Ruis-Flano (2007) show, the term geosite is used in research as a broad term for specific sites and specific areas. Geoconservation is defined by Prosser et al. (2013) as an increasing activity that includes efforts to preserve and enhance 'geological, geomorphological and soil features, processes, fields and samples' as well as associated public outreach and awareness. Thus, geodiversity encompasses the diversification of the geoheritage and can be measured by defining geosite types, type equivalents and rank (Wang et al. 2015). The ProGEO group has compiled ten different categories covering all areas of the geoscience sector (ProGeo Group 1998; Kazancı et al. 2015). Another category, geoheritage, refers exclusively to the elements of geodiversity in each region of the world (Dixon 1996; Gray 2004,

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2008; Bruno et al. 2014) and assumes that geodiversity will be maintained if geoheritage sites are protected. In addition, the term ‘geosite’ which refers to a geoheritage site as a place of scientific, historical and cultural significance that is accessible for visitation and other research, is recognized worldwide (ProGeo Group 1998; Cleal et al. 1999; Todorov and Wimbledon 2004; Ruban 2010; Wang et al. 2015). Geotourism is a selected form of nature tourism that is specifically related to natural values; geological, geomorphological and landscape features are combined (Dowling and Newsome 2005; Hose 2005; Dowling and Newsome 2010; Kazancı 2010; Dowling 2011, 2014; Köroğlu and Kandemir 2019; Özpay 2020; Özer and Mülayim 2022). Through enjoyment and learning, it promotes tourism, the protection of geological diversity and the understanding of geoscience (Newsome and Dowling 2010). Earth science disciplines focus on geology and include both ‘*form*’ (landforms, rock outcrops, different rock types, sediments, soils and crystals) and ‘*process*’ (volcanism, erosion and glaciers) (Dowling and Newsome 2010). Dowling and Newsome (2010) noted that the concept of geotourism and its market is growing worldwide. This is due to the growth of geoparks, but also to the independence of many historic and modern natural and urban areas, where tourism focuses on geosites rather than geological environments as indicated by Köroğlu and Kandemir (2019). The uniqueness of the geopark structure as a means of disseminating the value for the conservation and promotion of geosites related to geological heritage was first mentioned in the eighth point of the ‘Declaration of Digne’ (DD 1991), which states that ‘*Man and the Earth share a common heritage of which we and our governments are the guardians*’ (1. International Conference on Geological Heritage in Digne, France 1991; <http://www.progeo.ngo/index.html>; Patzack and Eder 1998; Wang et al. 2015).

Despite the need for geosite inventories, the lack of a systematic, legal and cultural approach in Türkiye has had a significant impact on this field in both science and tourism (Kazancı 2010, 2012; Akbulut 2016; Köroğlu and Kandemir 2019; Özer and Mülayim 2022). Moreover, the non-fast bureaucracy means that the promotion and protection of geosites can take a long time with unconscious processes in all countries of the same class, including Türkiye (Çetiner et al. 2018).

Materials and Methods

This study provides an overview of the state of geoconservation in Türkiye. The three-step methodology described by Herrera-Franco et al. (2021)—(i) search criteria and source identification, (ii) data extraction and (iii) data analysis and interpretation—was considered in the preparation of this

tool. The source of publication data for this study is the Web of Science database. However, other published literature was also considered, including academic publications documenting journal articles and books if they are accessible online through other databases. In addition, they mainly refer to publications in the Turkish language that are not included in scientific databases. Data collection faced some limitations and may be incomplete due to the difficulty of accessing internal reports produced by national authorities and/or unpublished dissertations kept at universities, among other documents. All data collected are included in Tables 1 and 2.

The History of Geoconservation in Türkiye

The first approaches to culture, art, natural values and geological heritage in Türkiye date back to the Ottoman Empire period and have evolved with different concepts until today.

Osman Hamdi, who was appointed director of the Müze-i Hümayun (Turkish) in 1881, ushered in a new era of Turkish museology (<https://muze.gov.tr/muze-detay?SectionId=IAR01&DistId=IAR>). His work in the field of culture and art was intensified by the museum directorate. He tried to bring together all works of historical and artistic value within the borders of the Ottoman state in the spirit of museology (<https://islamansiklopedisi.org.tr/osman-hamdi-bey>; <https://muze.gov.tr/muze-detay?SectionId=IAR01&DistId=IAR>). Thanks to his efforts, the 30-year-old Müze-i Hümayun (Turkish) also became the İstanbul Museum of Archeology (<https://islamansiklopedisi.org.tr/osman-hamdi-bey>).

The main source of change is the scientific approach and issues of cultural change. In the phenomena that influence this development, man and science remain on one side, while the effectiveness of cultural structure and belief is more observable.

First stage

Since civilizations have settled down, we can closely observe and explore the production of detailed information about cultural heritage. The studies that can be considered as the first regulation for the protection of cultural heritage in our country are the Asar-ı Atika Regulations, the first of which was issued in 1869 (Madran 1996). Cultural heritage conservation activities in Türkiye began in the late nineteenth century and were intensified in the second half of the twentieth century. In this context, inventorying and registration began, sites and boundaries were defined and administrative and organizational institutions were established throughout the country (Şakar 2022). Thanks to the visionary understanding of the young Türkiye Republic in the mid-twentieth century, the legal provisions on national parks in article 25 of Forestry Law No: 6831 of 1956 are considered the official beginning of Türkiye nature conservation studies and are

Table 1 Geo- (geological)-heritage, -tourism and -conservation studies were conducted (Hatipoğlu 2010; Kazancı 2012; Akbulut 2014a, b, 2016; Üner et al. 2017; Citiroglu et al. 2017; Çetiner et al. 2018; Çetin et al. 2018; Yürür et al. 2019; Doğan et al. 2019; Ateş and Ateş 2019; Koroğlu and Kandemir 2019; İnaner et al. 2019; Kazancı et al. 2019; Güreç et al. 2019; Aydın and Yüceer 2020; Gökçe et al. 2020; Çelik and Sert 2020; Sümer et al. 2020; Güney 2020; Gül et al. 2020; Özpay 2020; Isık-Çakı et al. 2021; Erginal et al. 2021; Yüceer et al. 2021; Ertekin et al. 2021; Ertek 2021; Özçelik 2022; Özgeriş and Karahan 2021; Özer and Mülâyım 2022; Kazancı and Lopes 2022; Karadeniz et al. 2022; De Vries et al. 2022), in different branches is made, on the international platforms from Türkiye between 2010 and 2022 (Regional and Turkish publications, Ph.D or M.Sc theses and conference papers written in Turkish were not taken into consideration)

Number	Year	Journal (J) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact Area
1	2010	J Geoheritage	Science Citation Index Expanded (SCIE)	Hatipoğlu (2010)	Milas (Muğla, Türkiye)	Gemmology and Gem-Quality	Aegean Region
2	2012	J Geoheritage	Science Citation Index Expanded (SCIE)	Kazancı (2010)	Kızılcıhamam-Çamlıdere (Ankara, Türkiye)	Petrified forest, Columnar basalts, Lacustrine sequence with leaf, fish, and insect fossils	Central Anatolia Region
3	2014	B Volcanic Tourist Destinations	Non-SCIE	Akbulut (2014a, b)	Türkiye	Volcano Tourism	Türkiye
4	2016	B Alternative Tourism in Turkey	Non-SCIE	Akbulut (2016)	Türkiye	Geotourism	Türkiye
5	2017	J Geoheritage	Science Citation Index Expanded (SCIE)	Üner et al. (2017)	Lake Van (Van, Türkiye)	Seismites (Earthquake induced sedimentary structures)	Eastern Anatolia Region
6	2017	J Geoheritage	Science Citation Index Expanded (SCIE)	Citiroglu et al. (2017)	Zonguldak (Türkiye)	Geological diversity for sustainable regional development	Black Sea Region
7	2018	J Geoheritage	Science Citation Index Expanded (SCIE)	Çetiner et al. (2018)	Biga Peninsula (Çanakkale, Türkiye)	Evaluating scientific value of geodiversity for natural protected sites	Marmara Region
8	2018	J Arabian Journal of Geosciences	Science Citation Index Expanded (SCIE)	Çetin et al. (2018)	Taşköprü (Kastamonu, Türkiye)	Chronicles and geheritage, ancient Roman city of Pompeiopolis	Black Sea Region
9	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	Yürür et al. (2019)	Yapraklı District (Ankara, Türkiye)	What a geologist may do when the geological heritage is in danger	Central Anatolia Region
10	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	Doğan et al. (2019)	Ürgüp, Cappadocia (Nevşehir, Türkiye)	Fairy chimneys, geomorphosite	Central Anatolia Region
11	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	Ateş and Ateş (2019)	Marçık Valley (Tunceli, Türkiye)	Geotourism and rural tourism synergy for sustainable development	Eastern Anatolia Region
12	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	Koroğlu and Kandemir (2019)	Çayırbağı-Çalköy (Trabzon, Türkiye)	Vulnerable geosites, geotourism potential	Black Sea Region
13	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	İnaner et al. (2019)	Büyük Menderes Graben (Aydın, Türkiye)	New Geosite candidates, importance on science education	Aegean Region

Table 1 (continued)

Number	Year	Journal (J) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact Area
14	2019	J Geoheritage	Science Citation Index Expanded (SCIE)	Kazanç et al. (2019)	Türkiye	Mining heritage, relevant geosites, sustainable development	Türkiye
15	2019	J Arabian Journal of Geosciences	Science Citation Index Expanded (SCIE)	Gürer et al. (2019)	Soma District (Manisa, Türkiye)	Compound geotourism and mine tourism potentiality	Aegean Region
16	2020	J Geoheritage	Science Citation Index Expanded (SCIE)	Aydın and Yüceer (2020)	Gilindire Cave (Mersin, Türkiye)	Tourism-Led Constructions on Geoheritage Sites	Mediterranean Region
17	2020	J Geoheritage	Science Citation Index Expanded (SCIE)	Gökçe et al. (2020)	Konya, Karaman, Antalya, Mersin (Türkiye)	Antique quarry, building stone	Mediterranean Region
18	2020	J Geoheritage	Science Citation Index Expanded (SCIE)	Çelik and Sert (2020)	İsehisar (Afyonkarahisar, Türkiye)	Used as building stone of cultural heritages	Central Anatolia Region
19	2020	J Turkish Journal of Earth Sciences	Science Citation Index Expanded (SCIE)	Sümer et al. (2020)	Urla District (İzmir, Türkiye)	New geosite candidates, antique and modern cultural heritage	Aegean Region
20	2020	J Geoheritage	Science Citation Index Expanded (SCIE)	Güney (2020)	Küpyar (Manisa, Türkiye)	Geomorphosite Potential	Aegean Region
21	2020	J Geoheritage	Science Citation Index Expanded (SCIE)	Gül et al. (2020)	Kızkumu Spit (Marmaris, Türkiye)	Geotourism Site, Natural and Anthropogenic Factors	Aegean Region
22	2020	B The Geotourism Industry in the 21st Century	Non-SCIE	Özpay (2020)	Türkiye	Geotourism and Proposed Geopark Projects	Türkiye
23	2021	B Global Geographical Heritage, Geoparks and Geotourism	Non-SCIE	Isık-Çakrı et al. (2021)	Zonguldak (Türkiye)	Geosite evaluation of fossils, Zonguldak coal basin	Black Sea Region
24	2021	J Geoheritage	Science Citation Index Expanded (SCIE)	Erginal et al. (2021)	Dana Island (Mersin, Türkiye)	Geoarchaeological heritage	Mediterranean Region
25	2021	J Geoheritage	Science Citation Index Expanded (SCIE)	Yüceer et al. (2021)	Kadıoacak (Urla, İzmir, Türkiye)	Valuing groundwater heritage	Aegean Region
26	2021	J Geoheritage	Science Citation Index Expanded (SCIE)	Ertekin et al. (2021)	Nemrut Stratovolcano (Bitlis, Türkiye)	Geoheritage in a mythological and volcanic terrain, geopark and geotourism	Eastern Anatolia Region
27	2021	J Sustainability	Science Citation Index Expanded (SCIE)	Cengiz et al. (2021)	Güzeldelice Basalt Columns (Bartın, Türkiye)	Coastal geotourism, geoheritage potential, sustainable regional development	Black Sea Region
28	2021	J Zeitschrift für Geomorphologie	Science Citation Index Expanded (SCIE)	Ertek (2021)	Ürgüp-Göreme (Neveşehir, Türkiye)	Geoheritage of Göreme, rock sites of Cappadocia	Central Anatolia Region
29	2021	J Environment, Development and Sustainability	Science Citation Index Expanded (SCIE)	Özgeriş and Karahan (2021)	Uzundere (Erzurum, Türkiye)	Geopark resource, sustainable tourism, Cittaslow	Eastern Anatolia Region

Table 1 (continued)

Number	Year	Journal (J) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact Area
30	2022	J Geoheritage	Science Citation Index Expanded (SCIE)	Özçelik (2022)	Bogaçay Basin (Antalya, Türkiye)	Comparison of the environmental impact, aggregates, stream deposits and crushed rock quarries	Mediterranean Region
31	2022	J Geoheritage	Science Citation Index Expanded (SCIE)	Özer and Mülayim (2022)	Adıyaman, Hatay (Türkiye)	Geoconservation, geotourism, vulnerable rudist fossil geosites	Southeast Anatolia Region
32	2022	J Geoheritage	Science Citation Index Expanded (SCIE)	Kazancı and Lopes (2022)	Göbeklitepe (Şanlıurfa, Türkiye)	Shaping of cultural heritage by local geology since the early neolithic	Southeast Anatolia Region
33	2022	J Geoheritage	Science Citation Index Expanded (SCIE)	Karadeniz et al. (2022)	Levent Valley (Malatya, Türkiye)	Potential geotourism, GIS Route Analysis	Eastern Anatolia Region
34	2022	J International Journal of Geoheritage and Parks	Non-SCIE	De Vries et al. (2022)	Evren Ridge, Cappadocia (Nevşehir, Türkiye)	Volcanic relief, geotourism, age potential	Central Anatolia Region

the first steps towards institutionalizing nature conservation (<https://www.mevzuat.gov.tr/MevzuatMetin/1.3.6831.pdf>, in Turkish).

In 1973, Law No. 1710 (EEK) was enacted, and with this law, the concept of a site was discussed for the first time. This brought to the fore not only individual buildings but also the protection of historic environments (Şahin and Kurul 2009). The enactment of Law No. 2863 on the Protection of Cultural and Natural Heritage (KTVK) in 1983, Law No. 5226 fundamentally amends this law in 2004, and Decree-Law No. 648 (KHK) in 2011. They are the most critical points in the organization of the protected area in Türkiye.

These protective measures were also extended to Cappadocia, one of the first regions in Türkiye for which a long-term national park development plan was prepared in 1968. In addition, the boundaries of protected areas were defined at the regional scale and inventories of individual buildings were carried out by a decision of the High Council for Immovable Antiquities and Monuments in 1976. The designation as a World Heritage Site in 1985 and as a National Park in 1986 strengthened the conservation status of Cappadocia at the national and international levels. However, in the 1990s and 2000s, a series of regulations were issued to protect the site, and a special conservation law for Cappadocia came into force in 2019.

The founder of the Türkiye Republic, Mustafa Kemal Atatürk, made great efforts in the field of education in order to explore Türkiye’s multi-layered cultural and geologic heritage, which has a diverse richness, and to understand its significance. Thanks to the scientists who came from modern universities and from abroad, and the scientists who completed their education abroad and returned to the country, important scientific studies were carried out and their foundations were laid. The first studies started in the middle of the twentieth century, led by İstanbul Technical University (İTÜ) and İstanbul University (İÜ). Although the foundations of the first studies were laid by Professors Cazibe Sayar, Hamit Nafiz Pamir, Nezihi Canitez and İbrahim Enver Altınlı, the publications of Ketin (1970) and Öngür (1976) are considered the first studies on this subject.

Considering the great work mentioned above, geoscientists in Türkiye have always been sensitive to the geological heritage and have worked effectively to protect it within the limits of available resources. In the early 1970s, a group was formed within the framework of the Türkiye Geological Institute (TJK, in Turkish) to carry out publications and promotional activities. The ‘Earth and Human Journal’ partly served this purpose. Due to the development of the Natural History Museum (Ankara/Türkiye) in the General Directorate of Mineral Research and Exploration (MTA, in Turkish), the subject always remained on the agenda. However, all well-intentioned attempts had a short life span due to the lack of an organized system and ineffective legal regulations.

Table 2 Türkiye studies of this subject provide the geographic distribution of the study areas and their relationship to the fields where the study was managed. Most of the 90 national (in Turkish) articles, these and books directly relate to geoheritage, geoconservation, geotourism, assessment, geosite inventory, geoparks, geomorphosite and geoscience education (related studies are listed as references)

Number	Year	Journal (J), Thesis (T) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact area
1	1970	J TÜJK Bülteni	Non-SCIE	Ketin (1970)	Türkiye	Geoconservation	Türkiye
2	1972	J TÜJK Bülteni	Non-SCIE	Canik (1972)	Türkiye	Geoconservation	Türkiye
3	1976	J Yeryuvarı ve İnsan	Non-SCIE	Arpat (1976)	Köprübaşı, Gördes (Manisa, Türkiye)	Pleistocene human footprints	Western Anatolian Region
4	1976	J Yeryuvarı ve İnsan	Non-SCIE	Arpat and Yılmaz (1976)	Ağrı (Türkiye)	Ice cave	Eastern Anatolian Region
5	1976	J Yeryuvarı ve İnsan	Non-SCIE	Öngür (1976)	Türkiye	Geoconservation	Türkiye
6	1976	J Yeryuvarı ve İnsan	Non-SCIE	Tekkaya (1976)	Salihli (Manisa, Türkiye)	Human fossil footprints	Western Anatolia Region
7	1977	J Yeryuvarı ve İnsan	Non-SCIE	Aslan (1977)	Aksaray (Türkiye)	Geoconservation, protected sites	Türkiye
8	1978a	J Yeryuvarı ve İnsan	Non-SCIE	Altınlı (1978a)	Türkiye	Geotourism	Türkiye
9	1978b	J Yeryuvarı ve İnsan	Non-SCIE	Altınlı (1978b)	Bilecik (Türkiye)	Geotourism	Türkiye
10	1982	J Yeryuvarı ve İnsan	Non-SCIE	Yüksel and Korkmaz (1982)	Antalya (Türkiye)	Miths, Geotourism	Southern Anatolian Region
11	1992	J Ege Coğrafya Dergisi	Non-SCIE	Kayan (1992)	Demirköprü barajı, Salihli, (Manisa, Türkiye)	Çakallar volcanics Human fossil footprints geosite	Western Anatolia Region
12	1997	J Review	Non-SCIE	Doğaner (1997)	Pamukkale, (Denizli, Türkiye)	Geoheritage	Western Anatolia Region
13	2000	J Cumhuriyet Bilim Teknik Dergisi	Non-SCIE	Kazancı (2000)	Türkiye	Geoheritage	Türkiye
14	2001	J Mavi Gezegen	Non-SCIE	Gürsoy (2001)	Ürgüp (Nevşehir, Türkiye)	Geoheritage	Türkiye
15	2001	J Mavi Gezegen	Non-SCIE	Kazancı (2001)	Türkiye	Geoheritage	Türkiye
16	2001	J Mavi Gezegen	Non-SCIE	Gürler (2001)	Türkiye	Geoconservation	Türkiye
17	2002	B JEMIRKO	Non-SCIE	Jemirko (2002)	Türkiye	Türkiye Jeolojik Miras Ögeleri Envanteri	Türkiye
18	2002a	J TÜBİTAK Bilim ve Teknik Dergisi	Non-SCIE	Yılmaz (2002a)	Türkiye	Geopark	Türkiye
19	2002b	J TÜBİTAK Bilim ve Teknik Dergisi	Non-SCIE	Yılmaz (2002b)	Türkiye	Geoheritage	Türkiye
20	2004	J TÜBA-KED Türkiye Bilimler Akademisi Kültür Envanteri Dergisi	Non-SCIE	Yalçın et al. (2004)	Buldan, (Denizli, Türkiye)	Geoheritage	Western Anatolia Region
21	2004	J TÜBA-KED Türkiye Bilimler Akademisi Kültür Envanteri Dergisi	Non-SCIE	Gürpınar et al. (2004)	Birecik (Şanlıurfa, Türkiye)	Geoheritage	Southeastern Anatolia Region
22	2004	J Ege Coğrafya Dergisi	Non-SCIE	Koçman (2004)	Kula (Manisa, Türkiye)	Burnt Land Volcanic Features	Western Anatolia Region
23	2004	J Mavi Gezegen	Non-SCIE	Kazancı et al. (2004)	Türkiye	Geoheritage	Türkiye
24	2005	J TÜBA-KED Türkiye Bilimler Akademisi Kültür Envanteri Dergisi	Non-SCIE	Ustaömer et al. (2005)	Boyabat (Sinop, Türkiye)	Geological Heritage, Natural Building Materials, Inventory	Northern Anatolia Region

Table 2 (continued)

Number	Year	Journal (J), Thesis (T) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact area
25	2005	J Mavi Gezegen	Non-SCIE	Kazancı (2005)	Türkiye	Cultural Geology	Türkiye
26	2007	B Doğa Koruma ve Milli Parklar Genel Müdürlüğü, Jeolojik Mirası Koruma Derneği Yayını	Non-SCIE	Kazancı et al. (2007)	Türkiye	Soguk Su National Park, Geosite, Geoconservation	Türkiye
27	2008	J TÜBİTAK Bilim ve Teknik Dergisi	Non-SCIE	İnan (2008)	Türkiye	Natural museum Geoheritage	Türkiye
28	2008	J Ege Üniversitesi Ziraat Fakültesi Dergisi	Non-SCIE	Yıldırım and Koçan (2008)	Acıgöl (Nevşehir, Türkiye)	Caldera, Maar Geotourism	Central Anatolia Region
29	2008	T Thesis	Non-SCIE	Acar (2008)	Pamukkale (Denizli, Türkiye)	Geopark	Western Anatolia Region
30	2009	J Mavi Gezegen	Non-SCIE	Güngör (2009)	Türkiye	Geotourism	Türkiye
31	2009	J Mavi Gezegen	Non-SCIE	Gürler et al. (2009)	Türkiye	Geopark	Türkiye
32	2010	J Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi	Non-SCIE	Yıldırım and Karadoğan (2010)	Derik (Mardin, Türkiye)	Crater, Geopreservation	Southeastern Anatolia Region
33	2010	B Jemirko ve TMMOB Jeoloji Mühendisleri Odası Yayınları	Non-SCIE	Kazancı (2010)	Türkiye	Geoconservation	Türkiye
34	2011	J TÜBİTAK Bilim ve Teknik	Non-SCIE	İnan (2011)	Türkiye	Geological routes Geotourism	Türkiye
35	2011	J İğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi	Non-SCIE	Koçan (2011)	Kızılcahamam-Çamlidere (Ankara, Türkiye)	Geotourism, Geopark Geoheritage	Central Anatolia Region
36	2012	J Erciyes Üniversitesi Fen Bilimleri Enstitüsü Fen Bilimleri Dergisi	Non-SCIE	Koçan (2012a)	Kızılcahamam-Çamlidere (Ankara, Türkiye)	Geotourism, Geopark	Central Anatolia Region
37	2012	J Karadeniz Fen Bilimleri Dergisi	Non-SCIE	Koçan (2012b)	Kızılcahamam-Çamlidere (Ankara, Türkiye)	Geotourism, Geopark sustainable development	Central Anatolia Region
38	2012	B Geoheritage in Europe and its conservation	Non-SCIE	Kazancı et al. (2012)	Türkiye	Geoheritage Geoconservation	Türkiye
39	2012	J TMMOB Jeoloji Mühendisleri Odası Haber Bülteni	Non-SCIE	Boyras and Yedek (2012)	Kızılcahamam Çamlidere (Ankara, Türkiye)	Geopark	Central Anatolia Region
40	2013	J Turkish Studies	Non-SCIE	Özşahin (2013)	Altınözü (Hatay, Türkiye)	Pinnacle Lapias complexes Karstification	Southern Anatolia Region
41	2013	T Thesis	Non-SCIE	Yılmaz (2013)	Pamukkale (Türkiye)	Cultural features in Geotourism	Eastern Anatolian Region
42	2013	J Kastamonu Üniversitesi Orman Fakültesi Dergisi	Non-SCIE	Koçan (2013)	Kızılcahamam-Çamlidere (Ankara, Türkiye)	Geotourism, Geopark	Central Anatolia Region

Table 2 (continued)

Number	Year	Journal (J), Thesis (T) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact area
43	2014	J Türkiye Jeoloji Bülteni	Non-SCIE	Kazancı and Gürbüz (2014)	Türkiye	Geoheritage stones, Natural Stones	Türkiye
44	2014	J Cumhuriyet Üniversitesi Sosyal Bilimler Dergisi	Non-SCIE	Akbulut (2014a, b)	Levent Vadisi (Malatya, Türkiye)	Geopark Geosite	Eastern Anatolia Region
45	2015	J Bulletin of the Mineral Research and Exploration	Non-SCIE	Kazancı et al. (2015)	Türkiye	Framework List Geoheritage Geoconservation Geosites	Türkiye
46	2015	J GeoJournal of Tourism and Geosites	Non-SCIE	Kurt (2015)	Kapıdağ Peninsula (Türkiye)	Geomorphotourism Geomorphosite	Marmara Region
47	2016	J Bulletin of the Mineral Research and Exploration	Non-SCIE	Çiftçi and Güngör (2016)	Türkiye	Geopark	Türkiye
48	2016	J Yer Altı Kaynakları Dergisi	Non-SCIE	Ateş (2016)	Erciş (Van, Türkiye)	Geotourism	Eastern Anatolia Region
49	2016	J Bulletin of the Mineral Research and Exploration	Non-SCIE	Çiftçi and Güngör (2016)	Türkiye	Geopark	Türkiye
50	2017	J Sosyal Bilimler Dergisi	Non-SCIE	Özpay et al. (2017)	Emirhan Kayakları, (Sivas, Türkiye)	Geotourism Geosite, Geoheritage	Eastern Anatolia Region
51	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Uzun (2017)	Kocaeli (Türkiye)	Geomorphological heritage, Geopark	Northwestern Anatolian Region
52	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Toprak and Şahin (2017)	Nihsar (Tokat, Türkiye)	Geoheritage	Northern Anatolia Region
53	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Sinanoglu et al. (2017)	Hasankeyf (Batman, Türkiye)	Cultural Geology	Southeastern Anatolia Region
54	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Selçuk and Zorer (2017)	Başkale (Van, Türkiye)	Geoheritage	Eastern Anatolia Region
55	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Özkaymak et al. (2017)	Seydiler (Afyonkarahisar, Türkiye)	Geoheritage, Geotourism	Western Anatolia Region
56	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Kazancı et al. (2017)	Türkiye	Cultural geology, new initiatives for earth sciences, geoheritage, geosite, geoconservation	Türkiye
57	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Kaygılı et al. (2017)	Hasanağa Deresi, Akçadağ (Malatya, Türkiye)	Paleontological geosite	Eastern Anatolia Region
58	2017	J Frat Üniversitesi Mühendislik Bilimleri Dergisi	Non-SCIE	Kaygılı and Aksoy (2017)	Kovanclar (Elâzığ, Türkiye)	Paleontological geosite	Eastern Anatolia Region
59	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Günok (2017)	Türkiye	Geopark Geoheritage	Türkiye
60	2017	J Türkiye Jeoloji Bülteni	Non-SCIE	Erturaç et al. (2017)	Göllüdağ Volcanic Complex (Neveşehir, Türkiye)	Georoute Geoheritage	Central Anatolia Region
61	2017	J Frat Üniversitesi Sosyal Bilimler Dergisi	Non-SCIE	Dölek and Şaroğlu (2017)	Muş (Türkiye)	Geotourism Geosite Geoheritage	Eastern Anatolia Region

Table 2 (continued)

Number	Year	Journal (J), Thesis (T) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact area
62	2018	B Recent Advances in Social Sciences	Non-SCIE	Güney and Yasak (2018)	Türkiye	Geotourism	Türkiye
63	2018	J Türkiye Jeoloji Bülteni	Non-SCIE	Çalık et al. (2018)	Biga Yarımadası (Çanakkale, Türkiye)	Geheritage Geopark	Marmara Region
64	2018	J Batman Üniversitesi Yaşam Bilimleri Dergisi	Non-SCIE	Sinanoglu (2018)	Batman (Türkiye)	Geosite	Southeastern Anatolia Region
65	2019	J Yüzcüncü Yılı Üniversitesi Tanım Bilimleri Dergisi	Non-SCIE	Özcan and Aytaş (2019)	Çankırı (Türkiye)	Doline	Central Anatolia Region
66	2019	J Uluslararası Sosyal Araştırmalar Dergisi	Non-SCIE	Özdemir (2019)	Seydiler (Afyonkarahisar, Türkiye)	Geoheritage, Landscape Change Geomorphosite	Western Anatolia Region
67	2019	J Journal of Architecture Sciences and Applications	Non-SCIE	Yüksel and Eraslan (2019)	Türkiye	Natural Stones, Geoheritage	Türkiye
68	2019	J Mediterranean Journal of Humanities	Non-SCIE	Aytaş and Demir (2019)	Kula (Manisa, Türkiye)	Geoheritage Geosite Geopark	Western Anatolia Region
69	2019	J Journal of Tourism and Hospitality Management	Non-SCIE	Uncu and Karakoca (2019)	Harmankaya Canyon (Bilecik, Türkiye)	Geotourism	Marmara Region
70	2019	J Asia Minor Studies	Non-SCIE	Şahin and Balci-Akova (2019)	Türkiye	Geoheritage	Türkiye
71	2020	J Turkish Journal of Engineering	Non-SCIE	Kocalar (2020)	Bafa Lake (Aydın, Türkiye)	Geopark, Geoheritage, Geotourism, Geosite, Cultural Heritage	Western Anatolia Region
72	2020	J Yüzcüncü Yılı Üniversitesi Fen Bilimleri Enstitüsü Dergisi	Non-SCIE	Yakupoglu and Özcan (2020)	Bitlis (Türkiye)	Nemrut Caldera, Geopark	Eastern Anatolia Region
73	2020	J Jeomorfolojik Araştırmalar Dergisi	Non-SCIE	Canpolat et al. (2020)	Emecik Kanyonu- Şelalesi (Çameli, Denizli, Türkiye)	Geomorphotourism, Geotourism, Geomorphosite	Western Anatolia Region
74	2020	J The Journal of Academic Social Science Studies	Non-SCIE	Kılıç and Bağcı (2020)	Karaçay Kanyonu (Çıldır, Kars, Türkiye)	Geomorphosite Geomorphotourism	Northeastern Anatolia Region
75	2020	J Jeomorfolojik Araştırmalar Dergisi	Non-SCIE	Turoğlu (2020)	Karasu Graben (Hatay, Türkiye)	Geosite, Geomorphosite, Geoheritage	Southern Anatolia Region
76	2020	J Konya Mühendislik Bilimleri Dergisi	Non-SCIE	Öztürk and Horasan (2020)	Karapınar (Konya, Türkiye)	Geopark, Geosite, Karst Sinkhole	Central Anatolian Region
77	2020	J Mavi Atlas	Non-SCIE	Hatipoğlu and Bahadır (2020)	Alınordu (Ordu, Türkiye)	Geosite, Geomorphosite	Northern Anatolia Region
78	2021	J Iğdır Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi	Non-SCIE	Kocalar (2021)	Türkiye	Geoheritage, Geotourism	Türkiye

Table 2 (continued)

Number	Year	Journal (J), Thesis (T) and Book (B)	Index	Author (s) (bold text correspondences)	Location	Themes	Impact area
79	2021	J TÜBA-KED Türkiye Bilimler Akademisi Kültür Envanteri Dergisi	Non-SCIE	Özcan and Tarakcıo (2021)	Türkiye	Geoheritage, Geoconservation	Türkiye
80	2021	J MANAS Journal of Engineering	Non-SCIE	Yeşilova (2021)	Dereçi Travertines (Başkale, Van, Türkiye)	Geoheritage	Eastern Anatolia Region
81	2021	J Kesit Akademi Dergisi	Non-SCIE	Bahadır and Işık (2021)	Şavşat Peribacaları (Artvin, Türkiye)	Geomorphosite	Northeastern Anatolia Region
82	2021	J Jeomorfolojik Araştırmalar Dergisi	Non-SCIE	Karadurak and Bağcı (2021)	Durağan (Sinop, Türkiye)	Geotourism, Geoeducation	Northern Anatolia Region
83	2021	J Bulletin of the Mineral Research and Exploration	Non-SCIE	Çiftçi and Güngör (2021)	Bitlis (Türkiye)	Geopark, Geoconservation	Eastern anatolia Region
84	2021	J Motif Akademi Halkbilimi Dergisi	Non-SCIE	Derinöz (2021)	İncesu Kanyonu (Çorum, Türkiye)	Geotourism	Central Anatolia Region
85	2022	J Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi	Non-SCIE	Kıraşan (2022)	Ergani (Diyarbakır, Türkiye)	Geopark	Eastern Anatolia Region
86	2022	J Journal of Gastronomy, Hospitality and Travel	Non-SCIE	Yetiş (2022)	Cappadocia (Türkiye)	Geotourism,	Central Anatolia Region
87	2022	J TÜBA-KED Türkiye Bilimler Akademisi Kültür Envanteri Dergisi	Non-SCIE	Şakar (2022)	Cappadocia (Türkiye)	Cappadocia, Conservation, History, Cultural Heritage, Natural Heritage, World Heritage, Site National Park	Central Anatolia Region
88	2022	J Jeoloji Mühendisliği Dergisi	Non-SCIE	Güney (2022)	Türkiye	Geotourism, Geosite, Geoheritage	Türkiye
89	2022	J Geographies, Planning and Tourism Studios	Non-SCIE	Canpolat (2022)	Gündoğmuş (Antalya, Türkiye)	Geomorphosite	Southern Anatolia Region
90	2023	J Türkiye Jeoloji Bülteni	Non-SCIE	Gül and Özkul (2023)	Çal Kanyonu (Denizli, Türkiye)	Geotourism	Western Anatolia Region

Development stage

After the ‘first steps’ in geoheritage/geoconservation issues, institutional efforts rather than personal initiatives emerged in the 1990s and 2000s.

The first institutional structure in Türkiye is the Geological Heritage Preservation Association (JEMİRKO_ www.jemirko.org.tr), whose roots go back to the JEMİRKO (in Turkish) student community at Ankara University in 1997. Under the leadership of Prof. Dr. Nizamettin Kazancı and thanks to the joint initiatives of Ömer Emre and İbrahim Sönmez Sayılı, a meeting was held on May 27, 1999, with 77 delegates from geoscientists, academics and public institutions as the ‘*Research and Protection Group for the Geological Heritage of Türkiye*’. The Ministry of Culture and Tourism supported the establishment and participated with a representative. Ali Koçyiğit, Fuat Şaroğlu, Gerçek Saraç, Ömer Emre, Mutlu Gürler, Hülya İnaner, İbrahim Sönmez Sayılı and Nizamettin Kazancı were appointed to the provisional board, but the intervening earthquake disaster did not allow active work. In the course of time, the association was transformed into a society in December 2000 and held its first ordinary general assembly in March 2001. JEMİRKO (in Turkish) is the only non-governmental organization (NGO) on the subject and has been carrying out a series of activities on Geological Heritage for more than 20 years (İnaner et al. 2019). It has also conducted a study entitled ‘*Türkiye Geological Heritage Inventory*’ and published it in various publications (www.jemirko.org.tr).

Another institutional initiative launched in 2002 on the geological heritage was the Türkiye Academy of Sciences-Turkish Cultural Inventory (TÜBA-TÜKSEK, in Turkish) project under the Türkiye Academy of Sciences (TÜBA, in Turkish). This project is based on a study that aims to collect and organize all types of data describing Türkiye cultural assets in an integrated digital system and make them available for questionable use. Within the project, inventory sheets for elements and formations considered cultural heritage in the fields of archaeology, urban and rural architecture, ethnography, ethnobotany, oral history and geology were created and transferred to digital media (Yalçın 2021). Software with a wide range of algorithms has been developed for querying and generating new information in the digital environment. Geological heritage and geoarchaeology are covered under the title geology (Yalçın 2007). Prepared under the title ‘*Natural Monuments Inventory*’ for ‘*Geological Heritage*’ items. Unfortunately, since the TÜBA-TÜKSEK (in Turkish) project could not be continued due to the administrative changes within TÜBA, this second institutional initiative was no longer on the agenda and could not be continued (Yalçın 2021). However, some of the studies conducted in this project were published in the ‘*Cultural Inventory Journal*’, the publication organ of

TÜBA (in Turkish), and presented to relevant stakeholders (Gürpınar et al. 2004; Yalçın et al. 2004; Ustaömer et al. 2005; Yalçın 2021).

The scientific studies conducted in 2003 by the General Directorate of Mineral Research and Exploration (MTA, in Turkish) within the framework of the ‘*Research Project on Türkiye’s Geological Heritage*’ (TÜJEMAP, in Turkish) with expert scientists on national and international platforms. The project, which started its work with the aim of determining the potential of cultural heritage in the selected pilot areas, has made the necessary proposals for the protection of the areas with high potential of cultural heritage as a result of the studies carried out subsequently. At the same time, in cooperation with other public institutions and organizations, as well as with universities, it started to transfer the inventory data of 367 proposed areas that have the potential to be geological cultural heritage sites to the database GIS, and to date the inventory is almost completed (<https://www.mta.gov.tr/v3.0/birimler/tujemap>).

In fourth place, the topic of ‘*Cultural Geology and Geological Heritage*’ has increasingly been on the agenda of the TMMOB’s Chamber of Geological Engineers since 2010. While sessions on cultural geology and geologic heritage added to the program during the Geology Congresses provide opportunities to discuss studies being conducted at universities and implementing agencies, Chamber officials continue to emphasize the importance and need to protect geologic heritage to society and decision makers through a variety of activities. In the 2010s, a number of publications were published, mostly based on personal efforts and/or projects at universities (Kazancı et al. 2008; 2015; Kazancı 2010, 2012, 2014; Güngör et al. 2012a, b; Çiftçi and Güngör 2016; Yalçın 2017). However, the intended impact on the platforms where these publications are presented was limited and could not be brought to an international point. Kazancı et al. (2015) published in the MTA (in Turkish) Journal entitled ‘*Geological Heritage and Türkiye Geosites Roof List*’ is a detailed and outstanding contribution to this topic. The books in the series ‘*Geological Heritage in National Parks*’ published by JEMİRKO (in Turkish) are among the publications that clearly show the richness of Türkiye on this topic (www.jemirko.org.tr). The publication titled ‘*Geological Natural Heritage-The Importance of Geological Heritage and the Report on the Situation in Türkiye*’ discusses the basic concepts on this topic and especially the legislation related to conservation (TMMOB Chamber of Geological Engineers 2019).

Future stage

As part of the process that began with Kazancı’s (2010) study of basic concepts in Türkiye, some studies were conducted to discuss the feasibility of geoconservation in

areas with special geological structures and areas (Gümüş 2009, 2012, 2019; Hatipoğlu 2010; Kazancı 2012; Güngör et al. 2012a, b; Akbulut 2014a, b; Gümüş and Zouros 2014; Kazancı et al. 2015, 2019; Çiftçi et al. 2016; Üner et al. 2017; Citiroglu et al. 2017; Yürür et al. 2019; Çetiner et al. 2018; Doğan et al. 2019; Ateş and Ateş 2019; Köroğlu and Kandemir 2019; İnaner et al. 2019; Gürer et al. 2019; Güney 2020; Aydın and Yüceer 2020; Gül et al. 2020; Sümer et al. 2020; Çiftçi and Güngör 2021; Özer and Mülayim 2022).

Between 2010 and 2022, the next stage of international geoheritage and conservation research began in Türkiye. The

publications produced during the past period (12 years) were published on 11 different platforms by 19 different institutions (Fig. 1a). The total number of publications was 34 books and articles. There were about 3 publications on this topic per year (Fig. 1b). In terms of publications, it can be seen that the prominent universities in Ankara, the capital of Türkiye Ankara, are in the lead (Fig. 1a). Geo-(geological) heritage, tourism and conservation studies were conducted (Hatipoğlu 2010; Kazancı 2012; Akbulut 2014a, b, 2016; Üner et al. 2017; Citiroglu et al. 2017; Çetiner et al. 2018; Çetin et al. 2018; Yürür et al. 2019; Doğan et al. 2019; Ateş

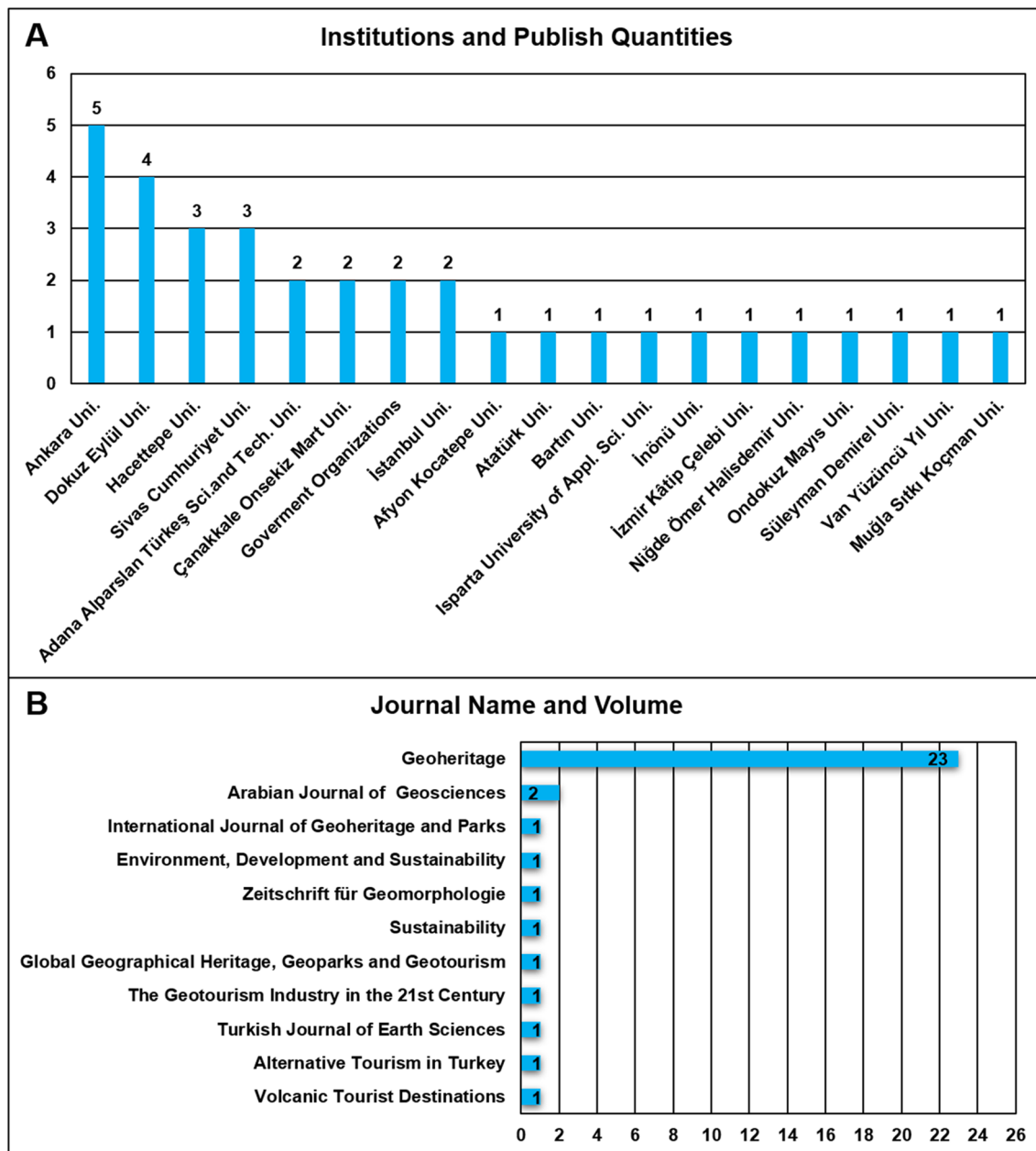


Fig. 1 Between 2010 and 2022 in Türkiye. a Institutions name and publish quantities. b Publish research and volume

and Ateş, 2019; Köroğlu and Kandemir 2019; İnaner et al. 2019; Kazancı et al. 2019; Gürer et al. 2019; Aydın and Yüceer 2020; Gökçe et al. 2020; Çelik and Sert 2020; Sümer et al. 2020; Güney 2020; Gül et al. 2020; Özpay 2020; Isık-Çaktı et al. 2021; Erginal et al. 2021; Yüceer et al. 2021; Ertekin et al. 2021; Ertek 2021; Özgeriş and Karahan 2021; Özçelik 2022; Özer and Mülayim 2022; Kazancı and Lopes 2022; Karadeniz et al. 2022; De Vries et al. 2022), in different branches is made, on the international platforms from Türkiye between 2010 and 2022 (Figs. 1a, b and 2a–c).

Specifically, asymmetric development and numerical differences can be observed in all scientific publications (Fig. 2a–c). The produced publications are represented by a total of 34 in Türkiye, mainly journals (30) and books (4) (Fig. 2a). It was found that the publications produced

are directly proportional to the academic title, and as the academic maturity increases, the number and effectiveness of publications increase (Fig. 2b). The most important issue is gender equality or social representation, and the fact that the ratio of men to women in publications is almost double shows that new female researchers working on the topic should be supported (Fig. 2c).

As mentioned above, the process of recording and protecting our geological heritage has been underway since the 1970s, and despite the efforts started 50 years ago, the level achieved today is unfortunately far from satisfactory.

UNESCO Global Geoparks are areas where conservation, sustainable development and community participation can be implemented together; they are increasingly recognized in the world. These areas of international importance are areas managed with an integrated approach to geoconservation, geoeducation, geotourism and sustainable development. In 2001, UNESCO began working with geoparks, and in 2004, the Global Geopark Network (GGN) was established in Paris. In 2015, at the 38th General Conference of UNESCO, the status of Geoparks was changed and it was decided by UNESCO to become a UNESCO program where international registration is possible. The ‘*Charter of the International Geoscience and Geoparks Program (IGGP)*’ was adopted and the concept of UNESCO Global Geopark was developed. As of 2021, there are 177 geoparks from 46 countries in the UNESCO Global Geopark Network. The first and only UNESCO Geopark in Türkiye is Kula-Salihli UNESCO Global Geopark in Manisa (Gümüş 2012). Although there have been various initiatives over time, none has been as large as the studies conducted specifically for Kula.

Recently, Pamukkale and Göreme National Park (the Rock Sites of Cappadocia) were included in the ‘*Top 100 Geological Heritage Sites*’ according to the World Heritage List UNESCO (<https://whc.unesco.org/en/list/485/>).

The Pamukkale contains calcite-rich waters of hot springs, springing from a cliff almost 200 m high above the plain, have created a breath-taking landscape in Pamukkale. This mineralized water has created a series of petrified waterfalls, stalactites and pools with step-like terraces, some of which are less than 1 m high, while others are up to 6 m high. Fresh deposits of calcium carbonate give these formations a brilliant white coating. The Turkish name Pamukkale, meaning ‘*cotton castle*’, derives from this impressive landscape (<https://whc.unesco.org/en/list/485/>).

Göreme National Park and the rocky sites of Cappadocia have a spectacular landscape in which the forces of erosion are dramatically expressed. The Göreme Valley and its surroundings offer a world-renowned and accessible display of hoodoo landforms and other erosional features that are of great beauty and interact with the cultural elements of the landscape (<https://whc.unesco.org/en/list/357/>).

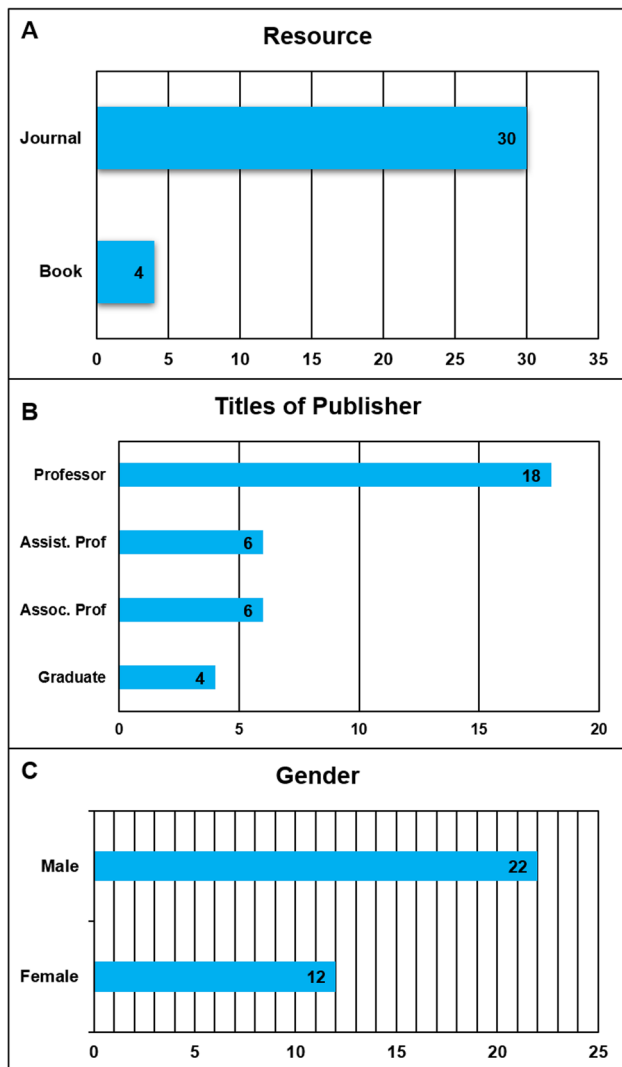


Fig. 2 Numerical comparisons in different titles. **a** Publication portal. **b** Number of publications by academic title. **c** Number of publications by gender

However, every year, many of our geological cultural assets are rapidly disappearing or are threatened with extinction. There are many approaches and methods to raise awareness of geological heritage and the need for its protection in society and to create awareness for conservation (Enniouar et al. 2015). Unfortunately, attempts to implement it and achieve results are still unsatisfactory. It is clear that this goal can be achieved with approaches such as the creation of registered geoparks and the identification and protection of geosites. However, the studies and legislative problems required to implement actions in this area should also be considered. By integrating other approaches, bureaucratic measures and practices that can be more easily and widely applied, it may be possible to solve the problems quickly and thus ensure sustainability.

The Situation Analysis in Türkiye

The use of WOS (Web of Science) in this study is due to the rigorous process of collecting scientific articles. This analysis reveals trends in the topics studied. The comparative analysis included correlations between institutions/publication numbers, journal names, resources (books and/or journals), publication trends, author details and genders. Figure 1a shows the number of publications in Türkiye between 2010 and 2022 compared to the ranking of universities. The top two universities (Ankara and Dokuz Eylül) stand out in terms of the number of publications. Figure 1b shows an overview of the journal name and the volume of major publications. The name of the leading journal is *Geoheritage*. Figure 2 a, b, and c indicates numerical comparisons in different titles, publication portals, number of publications by academic title and number of publications by gender. When comparing journal and book resources, journals lead (30%) compared to 4% of book resources. Regarding the title of the editor, the following structure emerged: 18% professors, 6% assistant professors, 6% assistant professors and 4% graduate students. Regarding demographic characteristics, such as gender, 12% were female and 22% were male. In summary, current developments include geoeducation, which can serve as a guide for future studies (Herrera-Franco et al. 2022). Learning opportunities and interactions for local people and visitors are also values of geoeducation (Németh and Moufti 2017; Herrera-Franco et al. 2022).

The collected tables and figures illustrate that the different aspects of geoconservation in Türkiye are regional. Most of them (62%) are related to geoheritage, i.e., they belong to the efforts of identifying and analysing regions located mainly on the west and south coasts of Türkiye, and thus to basic geoconservation (Figs. 3 and 4). Although the implementation of geoconservation is relatively limited to geotourism activities (29%), geoconservation is still underdeveloped (9%) (Fig. 4). The results also indicate that there

are several forms of geoheritage in Türkiye, an aspect that relates to actual geoconservation, but geoheritage diagnosis is only partially established. There is a lack of geoeducation and geoconservation in Türkiye. The development of geoeducational and geotourism resources that meet the goals of geoconservation is a great help in the development of geoheritage-based programs that promote social and economic progress (Köroğlu and Kandemir 2019; Özer and Mülayim 2022). This type of support for geoheritage exists mainly in countries where there are also legal instruments and public policies for conservation. These results will make it possible to create a roadmap for geoconservation in this field, which will help decision-makers to set specific priorities for geoconservation in Türkiye. Engaging society in geoconservation through formal and informal local efforts can be a critical component in jointly managing conservation plans and supporting local equity, with the goal of preserving geoheritage (Neto and Henriques 2022). This goal can be strongly promoted through geoconservation and geoeducation activities.

Discussion

Geoheritage Framework of Türkiye

Geoheritage theme related to the paper, we see that Türkiye is represented by thirteen different publications (Hatipoğlu 2010; Kazancı 2012; Akbulut 2014a, b, 2016; Üner et al. 2017; Citiroglu et al. 2017; Çetiner et al. 2018; Çetin et al. 2018; Yürür et al. 2019; Doğan et al. 2019; Ateş and Ateş 2019; Köroğlu and Kandemir 2019; İnaner et al. 2019; Kazancı et al. 2019; Gürer et al. 2019; Aydın and Yüceer 2020; Gökçe et al. 2020; Çelik and Sert 2020; Sümer et al. 2020; Güney 2020; Özpays 2020; Cengiz et al. 2021; Isık-Çaktı et al. 2021; Erginal et al. 2021; Yüceer et al. 2021; Ertekin et al. 2021; Ertek 2021; Özçelik 2022; Özgeriş and Karahan 2021; Özer and Mülayim 2022; Kazancı and Lopes 2022; Karadeniz et al. 2022; De Vries et al. 2022) (Table 1, Fig. 3).

Most of the 90 national articles are directly related to geoheritage, geoconservation, geotourism, assessment, geosite inventory, geoparks, geomorphosite and geoscience education (Table 2). The contents of Table 2 also provided a better understanding of the geographic distribution of the study area and its relationship to the fields where the study was managed. Most of these works aim to initiate and publicize the evaluation of the area from the description and characterization of the elements of geoconservation to the application of the methods established in the scientific literature for the evaluation and inventory of geosites. Regarding the methodological procedures used in the analyzed articles, many works are recommended as case studies. In these, in addition

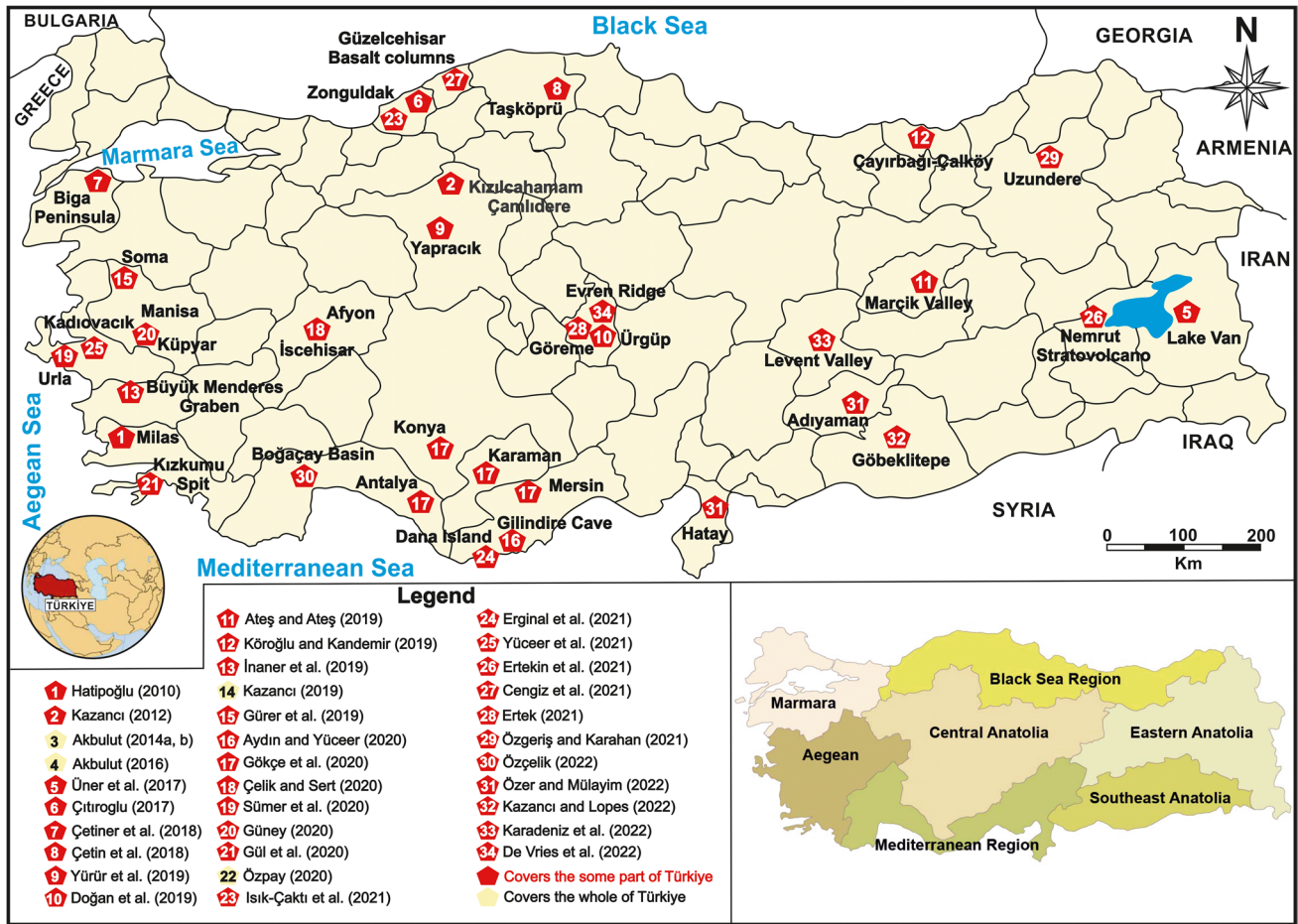


Fig. 3 Map showing the geo-(geological) heritage, tourism and conservation studies in different regions of Türkiye between 2010 and 2022 (references therein and Table 1)

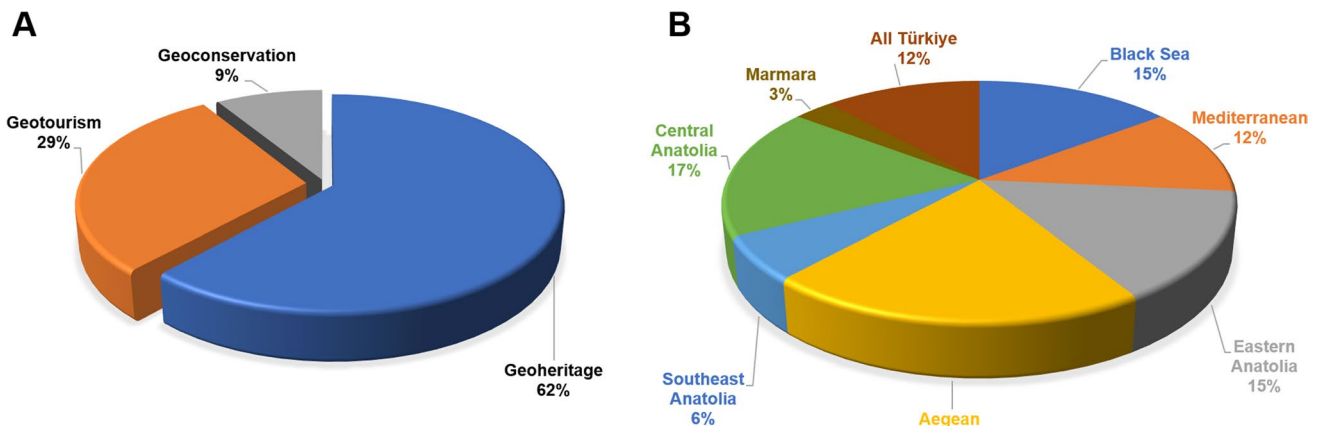


Fig. 4 Volumetric distribution of all studies in Türkiye. a Distribution of themes. b Distribution of studies by geographical regions

to presenting and inventorying the elements of geodiversity, a description and characterization of the main features and geosites present in the areas are made. These characterizations generally relate to theoretical aspects and knowledge of

geology, geomorphology and other fields related to the geosciences, and usually attempt to portray the unique character and scenic beauty or importance of each element of geodiversity in terms of potential, education, science and economy.

With the increase in the number of these publications, the attention of our country and the world can be attracted to some extent. To further increase the number of these publications, we can consider all geological values and our study areas as a common heritage of mankind and recognize the existence of this heritage everywhere on Earth. We cannot expect anyone to identify a geological object that they do not know, to have access to information about that object or to know its significance. The responsibilities associated with this position, therefore, require an above-average commitment from colleagues who can apply geoscience expertise to any field.

Geoconservation Framework of Türkiye

The issue of protection raises some legal and traditional problems both in Türkiye and in the rest of the world. Due to population growth, all non-renewable resources in the world are consumed by industrial production and demand for raw materials. These resources consist of 90% non-renewable material, and many of them are such that they cannot be recovered. Here, Türkiye, like all developing countries, is in a balance between conservation and utilization. However, in Türkiye, the preference for utilization over effective conservation has gained weight. Although it seems impossible to speak of an effective ‘Geoconservation Framework’ with these preferences, the structural and institutional developments described in ‘Discussion’, ‘Geoheritage Framework of Türkiye’, ‘Geoconservation Framework of Türkiye’ and ‘Where is the Problem?’ sections are not sufficient. Only when the global conservation perspective reaches US, European, and Chinese standards for Türkiye can we speak of a ‘Geoconservation Framework’.

At this stage, the ‘Geoconservation Framework’ in Türkiye is still in its infancy due to the fragmentation of government structures and bodies, problems with different responsibilities, scientific deficits, insufficient institutional coordination and problems with social knowledge and perspective.

Where is the Problem?

Türkiye, with its historical geological development, geographical location and the contributions of all civilizations living on it, has unique values on both regional and global levels. These values appear as conscious-unconscious and/or protected-destroyed. The success of countries that are strong in all aspects of protection, especially in all aspects of the system, increases significantly. However, underdeveloped countries or developing countries that are inferior both in terms of the efficiency of government agencies and in terms of legislation and bureaucracy are the factors that disrupt the concept of geoconservation and lead to failure.

In listing the inaccurate issues;

1. Principles and frameworks should be incorporated into the systems of the relevant organizations.
2. Geo-education curricula and the lack of implementation: curricula are about educational institutions.
3. Criminal penalties and deficiencies in the legal system: fewer deterrent penalties than on a world scale.
4. Inability to deal with special units or corporate identity: Lack of a single point of contact to follow up with a competent institution.
5. Lack of social awareness and non-governmental organizations: The main power is the population, but the lack of repressive and effective follow-up for the entire.

Suggestions for Future Potential

Social consciousness and academic culture, or the existence of universities in a universal sense, first reveal the concept of ‘Geoconservation’. However, the permanence and sustainability of these effects are only made possible by the existence of state institutions and legislative and enforcement structures. The effectiveness of the work carried out with the contributions of all components stems from the shared vision of both governmental and non-governmental organizations around the world. It is understood that instead of the existence of individual structures, a social, global or priority policy is required to unlock the potential in this area. The potential impact, respectively;

1. Türkiye: It has very important and special values that must be protected together with all other cultural and natural heritage via Geological Education (Van Loon 2008).
2. Due to its geographical location, the synergy between the geological history and the history of civilizations has characteristics that can be considered as a laboratory for the rest of the Earth.
3. Türkiye, which is in a globally important geopolitical position, should direct its future development plans to the preservation of cultural heritage and focus on tourism revenues.
4. One of the most important achievements of developing countries is tourism revenue, which does not require high investment because they have natural potential and natural resources. If Türkiye fulfils its duties and responsibilities in these areas, it will be a role model worldwide.
5. If we succeed in introducing the concepts of ‘Geoconservation’ and ‘Geoheritage’ into education and social life, the mistakes of the past will not be repeated in the future. In this way, we can bring a very bright future to conservation and heritage concerns.

Conclusions

This study examined Türkiye, which is a rare country that holds cultural, social and geological values. Studies on the historical process, major developments and milestones were examined in both the native language (Turkish) and international languages (English). From the data obtained, the concept of ‘Geoconservation’ has been present in the geography of Türkiye since the end of the nineteenth century. The concept, which was represented by individual studies rather than institutional contributions during the studied period, was institutionalized and systematized in the twentieth century. With the concept that is currently evolving, both the social and scientific sectors of the country are studying very openly and continue to contribute to the subject. Türkiye, which is an important platform with its contribution to scientific literature, diversity of research and increase in the number of experts (academics and interested citizens), has shown clear signs that it will take a more influential position in the future. In summary, the concept of protection that corresponds to the level of development does not yet occupy the desired position in Türkiye, but it is above the development standards in a global comparison.

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Declarations

Conflict of Interest The authors declare no conflict of interest.

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