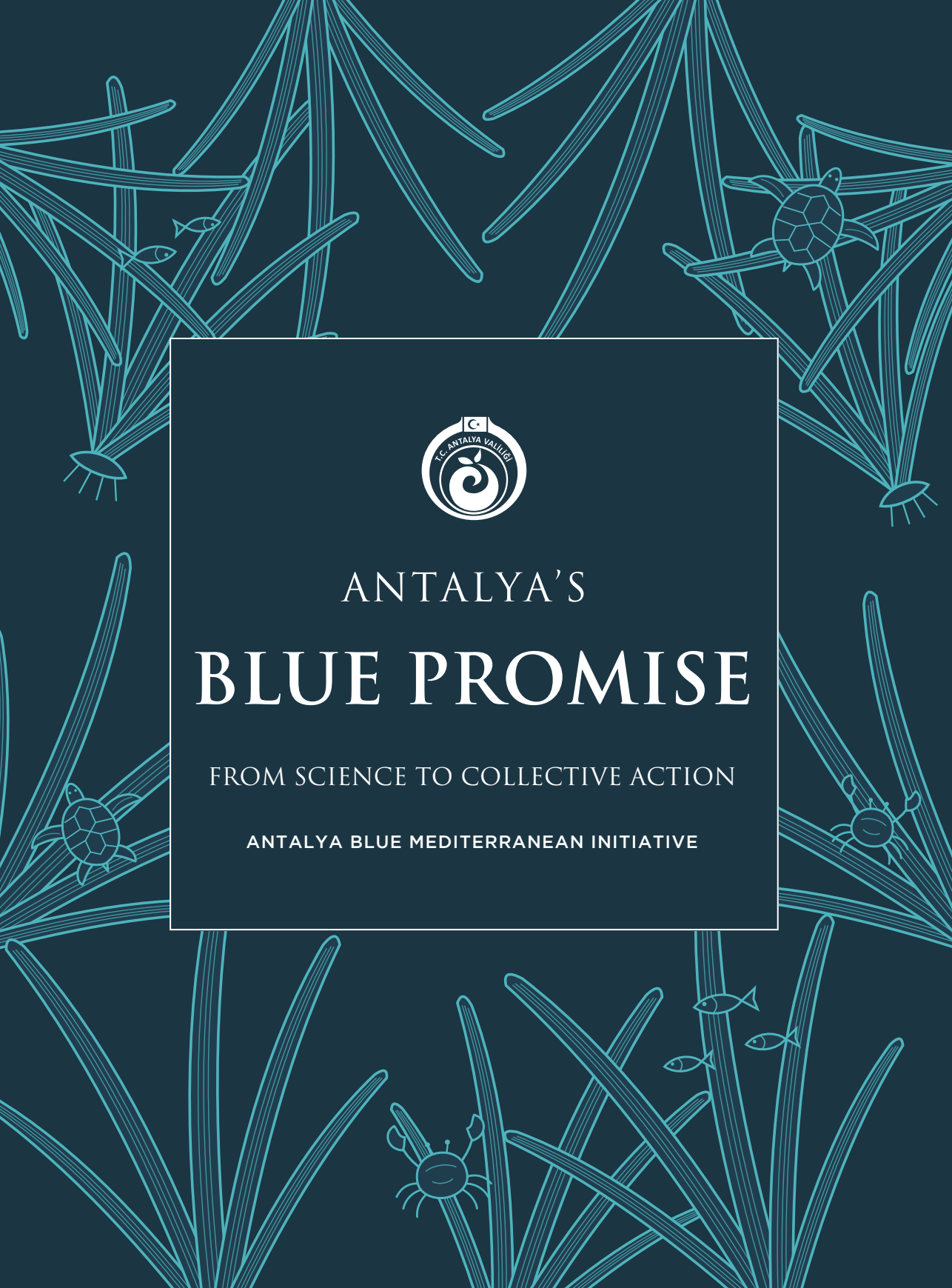


ANTALYA'S
BLUE PROMISE

FROM SCIENCE TO COLLECTIVE ACTION

ANTALYA BLUE MEDITERRANEAN INITIATIVE

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Oluklu Bridge, Köprülü Canyon [Ö.DONMAZ]



Sea cliffs, Muratpaşa [G.ACAR]





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Yivli minare - Kalekapısı [Ö.DONMAZ]

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President of the Republic of Türkiye



Murat Kurum
Minister of Environment, Urbanization and Climate Change

FOREWORD



For everyone who grew up in Antalya, the sea holds a prominent place in memory. For some, it is a rocky outcrop where they watched fish as children. For others, a secluded cove where they first learned to swim, or the dramatic sea cliffs (falezler) where they watched the sun set each evening. In this city, the sea is far more than a backdrop or part of the landscape; it is the essence of life itself.

Looking at this sea today, we have much to be proud of. In a metropolis inhabited by millions and welcoming guests from every corner of the world each year, we can still swim along almost every stretch of our coast. Yet this outcome did not happen by chance. It was made possible through the collective contributions of everyone who has labored for this city over generations.

However, our pride must not blind us to the environmental risks we face. We witness the marine litter deposited on our shores and the pollution carried to the sea by inland streams. We are acutely aware of the degradation in areas once celebrated for their rich marine life. We have no right to remain indifferent to such an invaluable heritage. We must ask ourselves honestly: Are we protecting this sea as it was entrusted to us?

In our cultural heritage, nature was never viewed as a commodity to be owned and consumed. The deep respect shown for trees, water, soil, and

every living creature was an expression of the ethos woven into the daily lives of our ancestors. This sea belongs to us; yet it is equally the shared legacy of our children and all humanity. It is our collective obligation not to deplete this heritage, but to pass it on to the next generation in a healthier, more resilient condition.

The Antalya Blue Mediterranean Initiative was launched with this profound sense of responsibility. Antalya's privilege of hosting COP31 served as a powerful catalyst for us. Yet our ambition was never limited to preparing for a two-week international gathering. We sought to transform this opportunity into the foundation of a permanent environmental movement across our city.

At the heart of this movement lies a simple question: What can each of us do in our own sphere? Everyone farming the land, working in tourism, producing in industry, serving in the public sector, or living in this city has an impact on the environment. Recognizing this impact is the first step toward change.

A reality we witness in the field also gives us hope: Nature responds generously to the hand extended to it. A cleaned cove comes back to life in a short time; a protected marine area regenerates over time. There are already many examples striving in this direction in Antalya. One of the most important goals of the Initiative is to make these examples visible and inspiring, awakening the enthusiasm of 'We can do it too' in others. A good practice initiated by a business, a school, or a neighborhood can pioneer a major transformation when expanded across the city.

The book in your hands recounts the first steps of this journey. Above all, it makes a promise: the promise to leave Antalya's sea, coasts, and nature to future generations in a better condition. This promise is the shared pledge of our public institutions, municipalities, universities, civil society organizations, business world, volunteers, and children.

I extend my heartfelt gratitude to everyone who spared no support, invested their labor, and assumed responsibility in this process.

Antalya's blue is entrusted to us all. Together, we will safeguard this legacy.

Hulusi ŞAHİN
Governor of Antalya





Kekova-Üçağız [Ö.DONMAZ]

INTRODUCTION

In preparing Antalya's Blue Promise, we wished to share the knowledge and labor that came together to get closer to this city's nature and protect it. We desired to introduce the city to readers discovering Antalya for the first time, while aiming to invite those residing here to look upon familiar places—and perhaps beauties to which they have grown indifferent—with fresh eyes. Comprehending the significance in our lives of a stream past which we walk daily, a small island viewed from the coast, or seagrass meadows stretching beneath the sea likewise imparts meaning to the steps that will be taken to safeguard them. This book bridges the research of scientists with the experience of field practitioners. Academics and experts from diverse disciplines examine Antalya's natural wealth, shifting conditions, and options concerning its future through their accumulated insights. Meanwhile, the efforts of public institutions, local governments, civil society organizations, enterprises, and volunteers reveal the practical counterparts of this knowledge in the field. Presenting these contributions jointly enables the knowledge generated and labor invested in the city to reach wider audiences.

The book opens with a section introducing Antalya's geography, history, and economic structure. How natural conditions extending from the Taurus range to the coast shape settlements and production is evaluated within relationships stretching from the past to the present. This framework establishes a foundation for comprehending the challenges confronting the city today. Subsequently, Antalya's biological diversity is addressed through seagrasses, sea turtles, the Mediterranean monk seal, plants, and birds. The habitats and ecological functions of species are elucidated alongside conditions requisite for preserving this wealth.

The future of natural assets is intimately linked with lifestyle patterns and decisions adopted within the city. Water utilization, waste management, tourism expansion, and the use and management of coastal and natural areas rank among the primary manifestations of this relationship in daily life. Because climate change exacerbates existing pressures, it renders the re-evaluation of resource utilization and planning decisions imperative. The scientific writings within the book contribute to understanding the causes of these problems and guiding the search for solutions.

In the preparatory process for COP31, the Antalya Blue Mediterranean Initiative set out to integrate the Zero Waste vision, brought to our country and the world by Mrs. Emine Erdoğan, with Antalya's sea. Around this objective, it converges diverse institutions and social segments to create a basis for cooperation on an urban scale. While recounting the birth and evolution of the Initiative, the book conveys how different areas of

expertise and experiences transformed into collaborative work. Marine and coastal cleanup, preventing pollution at its source, ecological conservation and restoration, and strengthening environmental awareness constitute the complementary domains of this joint endeavor.

The section titled "From Promise to Action" features field applications of this approach. A range of practices, from ghost nets retrieved from the seabed to drinking water fountains, stream barriers to environmental studies in schools, are narrated alongside the needs they address. Behind every endeavor stand individuals assuming responsibility, teams investing labor, and challenges that must be overcome jointly. Alongside steps executed, the enhancement of practices, sustained maintenance, and the monitoring of outcomes represent significant components of this narrative. The process of hosting the United Nations Climate Change Conference COP31 accelerates environmental work in Antalya while offering an opportunity to forge novel collaborations, leverage international experiences, and share local practices. The final section of the book focuses on how knowledge and experience acquired during this period can be transmitted to ensuing years. Scientific monitoring, social participation, financing, and institutional continuity are evaluated regarding the permanence of conservation efforts.

Antalya's Blue Promise bears witness to the initial phase of an ongoing endeavor. The knowledge and experiences shared herein are intended to contribute to the development of novel ideas, the refinement of practices, and broader participation. Responsibilities undertaken within a school, an enterprise, an institution, or in daily life can fortify this collective effort. The book's value will likewise find resonance in this bond established with its reader and the inspiration it imparts to future endeavors. We extend our gratitude to all our authors who contributed to this book with their knowledge and labor, as well as to everyone laboring in the field.



Konyaaltı Beach [G.ACAR]

01
UNDERSTANDING ANTALYA

Antalya's contemporary identity has been shaped through thousands of years of reciprocal interactions between natural processes and human life across the geography stretching from the Taurus Mountains to the Mediterranean. Mountains and mountain passes determined transport routes, water resources dictated the locations of settlements, and fertile plains governed agricultural practices. Harbors and rivers linked the city to Mediterranean trade networks, while its climate, coasts, and historical heritage laid the groundwork for today's tourism economy. Understanding Antalya requires evaluating together how these relationships have evolved from the past to the present and how they manifest in urban life.

The three articles comprising this section address Antalya's physical geography, historical development, and economic structure from complementary perspectives.

The first article explains the connections among natural systems extending from the Taurus Mountains to the coast. Geographical integrity is demonstrated through karstic groundwater, rivers, forests, and marine life, while discussing why issues such as drought, wildfires, urbanization, and resource utilization must be evaluated collectively.

The second article traces the historical progression spanning from Karain Cave and ancient cities to Seljuk harbors and contemporary settlements. The impact of rivers, mountains, winds, and shifting coastlines on settlements, trade, and human decision-making is conveyed through historical events and mythological narratives.

The final article of the section examines Antalya's economy through employment, income, and value-added generation. The structure of agriculture, tourism, and industry, their interrelationships, and their dependence on natural resources are evaluated, while discussing growth in relation to the city's carrying capacity and the transformation required for sustainable development.

This framework helps comprehend the place of Antalya's natural assets within urban life and their significance for the continuity of economic prosperity. Reading geography, history, and economy in unison establishes a shared foundation for evaluating natural values, environmental pressures, and conservation efforts explored in subsequent sections of the book.



Mount Tahtalı [G.ACAR]

1.1 From the Taurus Mountains to the Mediterranean: Antalya's Interconnected Geography

Prof. Dr. Tuncer DEMİR
Akdeniz University, Faculty of Letters, Department of Geography
Mediterranean Civilizations Research Institute

Describing Antalya solely through its coasts, tourist facilities, or long summer season leaves out the grand geographical totality that molds this city. Antalya's distinctive feature is the presence of natural systems interlinked across short distances between the sea and high mountains. Extending from the high massifs of the Western Taurus to coastal plains, from travertine plateaus to subterranean waters, and from forests to Mediterranean coastal ecosystems, this geography gains meaning through interrelationships rather than isolated elements. Climate, water, soil, vegetation, settlement, agriculture, and tourism constitute interacting components of the same geographical system in Antalya. This architecture of Antalya simultaneously generates immense environmental diversity over short distances. Reaching high mountain belts within a few tens of kilometers from areas near sea level along the coast gives rise to pronounced variations in temperature, precipitation, soil, and vegetation. This vertical diversity enables natural habitats

and human land-use patterns to coexist side by side. While intensive agriculture and urbanization characterize coastal plains, forests, uplands, and diverse rural land-use forms predominate in higher elevations. Consequently, Antalya's geographical identity is defined not merely by an east-west-stretching coastline, but also by these brief yet potent environmental transitions rising from the sea to the mountains.

One of the most prominent elements of this integrity is the Taurus Mountains. Rising to the north of Antalya, the Taurus range does not merely form the city's visual backdrop; it also influences precipitation distribution, the recharge of water resources, vegetation belts, and settlement patterns. Along the coast, the characteristic hot-dry summers and mild-wet winters of the Mediterranean climate prevail. In long-term climatological data published by the Turkish State Meteorological Service for Antalya, average temperatures for July and August hover around 29 °C, whereas average monthly total precipitation drops to mere millimeters during summer months [1]. This robust seasonality dictates water use, agricultural activities, and tourism alongside natural life.

A foundational feature endowed upon Antalya's geography by the Taurus range is its karstic structure. The dissolution of widespread limestone formations by water facilitates the development of caves, dolines, poljes, and underground drainage systems. The Antalya Travertine Plateau represents a striking product of this prolonged geological and hydrological process. It has been demonstrated that waters within the Kestel polje system drain via underground channels to the Kırkgöz



Karst waters from the Taurus Mountains flow directly into the Mediterranean over the travertine cliffs. Lower Düden Waterfall

karstic springs, and that the Antalya Travertine Plateau formed through the precipitation of calcium carbonate from karstic waters [2]. This relationship indicates that a spring, travertine step, or depression area visible on the surface in Antalya frequently forms part of a much larger subterranean hydrological system. Water's journey in Antalya does not terminate on land. Recent geophysical investigations conducted within coastal karstic aquifers reveal that fresh groundwater can reach the coastline and seabed, submarine groundwater discharges exist, and saltwater intrusion can be observed within the same system in certain areas [3]. This finding clearly demonstrates that land and sea do not constitute isolated environments. Water movement originating in the Taurus range and karstic zones behind the coast can persist underground to reach the marine realm. Therefore, groundwater volume and quality hold significance not merely regarding drinking water or agricultural utility, but equally for the coastal system. Antalya's rivers represent surface-visible components of the linkage between mountains and sea. Rivers such as the Manavgat, Köprüçay, and Aksu transport water and sediment between interior sectors and the coast, participating in processes shaping valleys and coastal plains. Consequently, land-use changes, erosion, or pollution occurring in the upper reaches of a watershed can be conveyed downstream. Evaluating water management in Antalya within the integrity of watersheds rather than isolated sources or dams is the natural outcome of this geographical connection. Variations in elevation and climate are likewise reflected in vegetation. While elements of Mediterranean



The Köprüçay River (known in antiquity as the Eurymedon), which rises in the Taurus Mountains and flows through the districts of Serik and Manavgat into the Mediterranean, and the Aspendos Bridge spanning it [Ö.DONMAZ]

vegetation and Calabrian pines (Pinus brutia) predominate in the coastal belt, distinct forest communities emerge as elevation increases. Forests are vital for soil conservation, the regulation of the water cycle, carbon sequestration, and habitat continuity. Conversely, Antalya's hot and dry summer conditions render wildfire risk a critical environmental issue, particularly in zones where forests interface with settlements. A recent wildfire susceptibility study conducted across Antalya's wildland-urban interfaces demonstrates that risk can be explained through the joint evaluation of topography, vegetation, climatic variables, and human-associated factors [4]. Wildfire thus transcends being purely a forestry issue, becoming a subject of settlement, disaster management, and spatial planning.

Drought constitutes another primary risk regarding Antalya's interdependent natural systems. A study covering the 1990–2024 period reveals that pronounced dry and wet periods succeeded one another in Antalya, with moderate droughts occurring frequently [5]. This finding is significant because a reduction in precipitation is not merely a meteorological variable. Dry periods can elevate agricultural irrigation demand, amplify pressures on underground and surface water resources, and contribute to the formation of wildfire-favorable conditions. Hence, water management, agriculture, forestry, and urban planning cannot be treated as completely independent policies in Antalya.

The continuity of natural systems persists within the sea. Research conducted in the Gulf of Antalya demonstrates that marine communities vary in relation to depth, season, substrate characteristics, and fishing pressure. A study performed across the transition between the continental shelf and continental slope of the gulf identified 59 megabenthic crustacean species, noting that 18 of them comprised invasive species, while community structure was shown to correlate particularly with seabed depth [6]. Spatial variations were also determined in the ecological characteristics of native and non-native demersal fishes within the Gulf of Antalya [7]. These findings reveal that Antalya's marine biodiversity represents a dynamic system open to fluctuating environmental conditions and shifts in species composition.

Antalya's human geography remains intertwined with this natural framework. While coastal plains and travertine surfaces historically furnished more favorable zones for settlement, transportation, and agriculture, settlement forms diverged across the high and fragmented topography of the Taurus Mountains. Today, rapid urbanization, tourist facilities, transportation infrastructure, and intensive seasonal population movements overlay this geographical architecture. Consequently, human activities have transformed from entities merely adapting to natural conditions into elements actively restructuring natural systems through pressures exerted on water use, land cover, and coastal zones. Tourism stands among the most explicit manifestations of this reciprocal relationship. Antalya's climate, coasts, and natural landscape rank among the foundational resources of its tourism economy; yet the environmental sustainability of tourism does not rely solely on the presence of natural attractions. Research executed within the Antalya tourism region indicates that environmentally sustainable tourism requires multi-scale governance networks, local cooperation, and institutional organization, whereas

economic concerns can supersede environmental motivations [8]. This outcome demonstrates that tourism's long-term success in Antalya cannot be decoupled from the preservation of environmental values.

All these relationships elucidate why Antalya's sea and coasts are not confined to a mere shoreline. The sea marks one of the terminal endpoints reached by terrestrial processes. Karstic groundwater can discharge into the sea, rivers can transport terrestrial sediment, and urbanization and tourism can alter the utilization of coastal zones. Accordingly, marine and coastal conservation must not remain restricted to activities executed on beaches alone. Watershed management, groundwater protection, the continuity of forests and natural areas, appropriate urbanization, and environmental governance constitute components of the same conservation chain.

This holistic approach clarifies the priorities of sustainability policies. For instance, water management concerns safeguarding existing resources and jointly evaluating sector-specific demands rather than merely discovering new sources. Coastal protection likewise transcends reducing marine pollution; land use in upper watersheds, wastewater management, groundwater quality, and coastal construction must be considered within the same framework. Similarly, wildfire mitigation rests upon planning wildland-urban interfaces and identifying high-risk zones preemptively, rather than merely responding after fires erupt. The interconnection of Antalya's natural systems mandates that conservation policies be engineered as mutually linked frameworks.

This perspective aligns with the Antalya Blue Mediterranean Initiative's approach to jointly safeguarding the sea, coasts, natural assets, and sensitive ecosystems. Effective conservation necessitates addressing problems not merely at the point where they manifest, but across all geographical processes generating or nurturing them.

The fact that Antalya will host the United Nations Climate Change Conference COP31 between November 9 and 20, 2026, carries special significance from this holistic viewpoint [9]. The convergence of the global climate agenda in Antalya offers an opportunity to evaluate the city not merely as a tourism and convention hub, but as a Mediterranean geography defined by its karstic water systems, forests, coasts, marine biodiversity, and economic activities inextricably linked to climate.

The fundamental issue determining Antalya's future is the capacity to comprehend and jointly manage these relationships extending from the Taurus range to the Mediterranean. Mountainous waters and forests, lowland agriculture and settlements, coastal urbanization, subterranean aquifers, and marine life are not independent of one another. Alterations within one can manifest directly or indirectly across the others. The approach strengthening Antalya's environmental resilience consists of treating natural values as components of the same living system rather than protecting them as disconnected fragments. Safeguarding this totality stretching from the Taurus to the Mediterranean stands as a fundamental prerequisite for Antalya to transmit its natural heritage to coming generations and remain better prepared for novel conditions introduced by climate change.

1.2 Antalya from Past to Present

Boran Eser KAVAZ
Historian-Author

Is knowing a city's history sufficient to understand it? Perhaps one must understand its geography first. Because cities are not founded solely by humans; mountains, rivers, winds, seas, and even earthquakes intervene in their histories.

Antalya stands among the finest examples of this. This geography, which we recognize today with its deep blue sea, fertile plains, majestic mountains, and historical cities, has furnished humans with extraordinary opportunities alongside formidable obstacles for thousands of years.

To understand Antalya's history, I enjoy posing the following question: Why on earth were these cities established precisely where they are?

The answer is frequently concealed in geography prior to history itself.

The First Pages Written by Geography

Antalya's place in human history predates the establishment of the modern city center by far. Prehistoric finds in and around Karain Cave demonstrate that this geography has served as a habitat for human communities for a very long time.



Karain Cave, preserving traces of human life dating back 500,000 years [G.ACAR]

In these lands where the Taurus Mountains approach the Mediterranean, caves provided shelter, forests served as sources of food and materials, and rivers constituted natural elements ensuring the continuity of life. Climate, vegetation, and water resources dictated where humans could reside. Over time, humans transitioned from caves to villages, and villages to cities. Yet geography's determinism did not vanish; it merely altered form.

While sheltered bays and harbors flourished along the mountainous coasts of Lycia, agriculture, animal husbandry, and river navigation gained prominence across the broad plains of Pamphylia. Natural boundaries forged by mountains occasionally safeguarded cities, while at other times hindering their relations with neighbors.

Consequently, Antalya's past represents the shared history of numerous settlements developing under divergent geographical conditions, rather than that of a single city.

Mediterranean History Altered at a River Mouth

Let us consider the Battle of the Eurymedon, fought in the 5th century BCE between Persians and forces spearheaded by Athens.

The ancient name of today's Köprüçay is Eurymedon. Ancient authors record that a significant naval and land victory was won here against the Persians. While details and precise dating of the battle remain debated, the river's strategic position is unambiguous.

River mouths offered transport and logistical provisioning opportunities for ships while influencing troop movements. The point where a stream meets the sea constituted not merely a geographical formation, but a theater of power struggles across the Mediterranean.

Reflecting that a river along whose banks we walk today played a role in the struggles of great states approximately two thousand five hundred years ago illustrates the sheer richness of Antalya's history.

Alexander the Great and the Sea Unconquerable from the Sea

In 334 BCE, Alexander the Great, embarking on his campaign against the Persian Empire, confronted a major problem: the formidable Persian navy.

Alexander's solution was exceptionally striking. He did not have to secure naval supremacy exclusively by fighting at sea. If coastal cities, harbors, and supply bases supporting the fleet were captured, the ships would lose significant power.

The speech prior to the siege of Tyre, recounted in Arrian's Anabasis of Alexander, explicitly reveals this strategy. Alexander calculated that capturing Phoenician cities would enable a major portion of the Persian fleet to join his forces [1, II.17].

Thus, the coasts of Lycia and Pamphylia lay along the route of this grand offensive stretching from western Anatolia through to Cilicia and Phoenicia.

Alexander's progression across Antalya's geography also staged one of the most intriguing nature-human encounters in history.

Proceeding from Phaselis to Perge, he dispatched part of his army via mountain tracks, choosing instead to march along the narrow passage hugging the coast. Yet traversability here depended entirely on wind direction. Arrian narrates that when southern winds blew, passage along the coast became impossible, whereas northern winds facilitated transit [1, I.26].

Strabo recounts the same event with different details. According to him, soldiers were forced to wade through water without waiting for waves to recede [2, XIV.3.9].

Consider this: the army of the sovereign destined to shatter the Persian Empire depended on wind direction along Antalya's shores!

It is understandable that ancient humans associated this event with divine assistance. Today, however, behind the occurrence we investigate coastal geomorphology, wave dynamics, and meteorological conditions. The same event acquires two divergent explanations across two distinct eras. What remains constant is nature's impact on human movements.

Harbors, Rivers, and the Wealth of Cities

Explaining the development of cities along Antalya's coasts solely through military events is impossible. Strabo notes that Phaselis possessed three harbors, illustrating the city's advantageous position in maritime transport. Bays opening in divergent directions offered ships shelter under changing marine conditions.



Phaselis, Kemer [Ö. DONMAZ]

More fascinatingly, Perge and Aspendos—which do not lie on the seashore today—were likewise connected to Mediterranean trade via rivers.

Strabo explains that Perge could be reached by ship via the Cestrus (Aksu) River, and Aspendos via the Eurymedon (Köprüçay) [2, XIV.4.2]. This demonstrates that maritime trade in antiquity was not confined to the shoreline. Rivers functioned as natural transport routes carrying the sea inland. Thus, Antalya's plains transformed into components of the Mediterranean economy alongside serving as agricultural production zones.

Attaleia, founded in the 2nd century BCE under the name of King Attalos II of Pergamon, must be evaluated within these geographical and economic ties. The city's sheltered harbor, connectivity with its hinterland, and maritime-trade-friendly location assist us in comprehending its post-foundational development.

While gazing upon today's Kaleiçi Harbor, we must perceive not merely a scenic vista, but a historical transit hub uniting people, goods, and ideas across centuries.

Yanartaş: Where Nature Transformed into Mythology

Reading Antalya's history exclusively through kings and wars constitutes a major omission. At Yanartaş near Çıralı, flames issuing from subterranean gases have fascinated humans for a very long time.

In the ancient world, this extraordinary natural phenomenon was associated with the fire-breathing Chimaera narrative. Pliny the Elder likewise mentions the perpetually burning fire in Lycia [3, II.110]. It is unsurprising that a phenomenon we can explain today through gas seepage was attributed to a mythological entity in the past. Humans strive to explain natural phenomena they fail to comprehend through narratives. Geography thus molds not only economic and political history, but the imaginative worlds of humans. The value of Yanartaş lies precisely here: natural and cultural heritage coexist at the exact same site.

Cities Nourished and Coasts Altered by the Sea

During the Roman period, Antalya's coasts assumed vital roles within the expansive trade networks of the Mediterranean.

The grand granary located in Andriake, the port of Myra, stands among tangible traces of these networks. Dating to the reign of Emperor Hadrian, the structure illustrates how closely maritime transport and food storage systems were intertwined.

Archaeological finds concerning purple dye production in Andriake similarly reveal that the sea functioned as an economic resource, not merely a transport route.

Yet nature does not preserve the opportunities it offers cities unchanged forever.

Alluvium transported by the Demre Stream (Myros) gradually buried the settlement fabric around Myra significantly over time. Alterations around the harbor likewise impacted trade and transport conditions.

Stated differently, while humans built cities, rivers continued building their own geographies.

Earthquakes represent the more sudden and destructive face of this relationship. Inscriptions in Lycia document aid extended to cities suffering damage from disasters during the Roman period. Opramoas of Rhodiapolis's support to cities demonstrates that solidarity following disasters constituted a social necessity two millennia ago. Today, as we strive to construct disaster-resilient cities, we confront an ancient problem.

Anatolia Opening to the Sea

Antalya's harbor identity retained its prominence following the Roman and Byzantine eras.

The incorporation of Antalya in 1207 and Alanya in 1221 into the Anatolian Seljuk dominion marked significant developments regarding Anatolia's opening to Mediterranean trade.

Roads connecting harbors to interior regions, caravanserais, and commercial ties forged a novel economic unity during this era. Mountains rendered transport arduous; yet humans carved passes, established roads, and fostered connections between the coast and interior regions. During the Ottoman period, Antalya's harbors, agricultural output, and trade relations continued shaping urban life. In the Republican era, developing transport opportunities, diversifying agricultural production, population growth, and particularly the rise of tourism elevated Antalya to an entirely different scale.

Bays where ships once sought shelter now host millions of visitors. Fertile plains transformed into intensive production zones, and coastal settlements into major tourism hubs.



Alanya Shipyard and the Red Tower [Ö.DONMAZ]

Yet this growth brings forth novel questions: How shall we utilize our water resources? To what extent shall we build upon our coasts? How shall we transmit our forests, rivers, marine life, and historical fabric to future generations?

What the Past Tells Us

Antalya's history spanning thousands of years reminds us of a fundamental truth: Humans cannot write a history independent of nature.

Waves halting Alexander's army, rivers nourishing ancient cities, alluvium altering harbors, flames birthing mythology, and earthquakes compelling cities to rebuild constitute divergent examples of this reality.

Today, while discussing climate change, marine pollution, coastal construction, and the consumption of natural resources, we are debating more than merely the future. We are living through a novel phase of the human-nature relationship persisting for millennia.

This represents one of the most meaningful messages Antalya can convey to the world during the COP31 process.

This city flourished in the past through opportunities furnished by its geography. In the future, it will remain habitable only to the extent that it preserves those opportunities.

Loving Antalya is easy. Gazing upon its sea, walking its mountains, and touring its ancient cities brings immense joy.

The principal challenge is ensuring that people living after us encounter those exact same beauties.

Because Antalya's past is a heritage bequeathed to us, whereas its future constitutes our responsibility.

1.3 Antalya's Economy: General Structure and Agriculture, Tourism and Industry Sectors

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Antalya has flourished following 1980 in tandem with rapidly mounting tourism investments, greenhouse agricultural production, primary and secondary housing development accelerated by domestic migration, and rapid urbanization, ascending to top ranks in socioeconomic indicators. Although migration and population growth rates are decelerating, Antalya's growth rate exceeds the Turkish average, amplifying questions regarding the sustainability of growth and Antalya's carrying capacity.

Antalya's economy, particularly tourism and agriculture, depends on natural capital and ecosystem services which dictates that sustainability must serve as a core determinant rather than a supplementary element; meaning a value-oriented regenerative development approach must be adopted in lieu of physical growth.

Considering the likelihood that the COP31 summit will place strong awareness, commitments, and concrete targets on the agenda in this direction, this section aims to comprehend these characteristics of Antalya's economy. Two vital dimensions of economic analysis comprise population economic activity and income sources. Within this framework, labor and employment are evaluated first, followed by Antalya's GDP structure, and finally sectoral structure analysis.

Antalya's Employment Structure

Ranking as Turkey's fifth most populous city, Antalya accommodates 2.8 million individuals across 918 thousand households as of 2025. While household count stands at 918 thousand, residences holding electricity subscriptions total 1.6 million, with this discrepancy pointing to the presence of the additional population associated with second homes in Antalya [1].

According to SSI (Social Security Institution) 2025 data, registered wage-earning and entrepreneurial employment in Antalya approaches 1 million. Proceeding from TurkStat regional employment data, approximately 1.3 million individuals can be estimated as active when factoring in informal labor and family agricultural labor. Over half a million individuals occupy retired or passive income status. The remaining population comprises children, youth, and other economically dependent groups.

Detailed data regarding the sectoral distribution of the active population is unavailable. Analyzing the sectoral distribution of Antalya's employment is complicated by the characteristics of agricultural sector employment (unpaid family labor, seasonal, temporary, and informal employment) and seasonality within the tourism sector. Proceeding from TurkStat and SSI data, it can be estimated roughly that 65% of the working population comprises salaried private sector employees, around 9% entrepreneurs, 8% public personnel, with the remainder consisting of farmers and particularly unpaid agricultural laborers. The significance of Antalya's tourism sector in direct and indirect employment is unequivocal. It can be stated that the accommodation sector alone ranks first with direct employment numbering around 250 thousand during high season, followed by agriculture supported by unpaid family labor. According to SSI data, employment in both commerce and construction sectors exceeds 100 thousand each. Registered SSI employment within manufacturing industry encompassing industrial production, maintenance-repair, bakery, and confectionery activities numbers around 80 thousand individuals.

Antalya's Income: GDP Analysis

The other dimension of economic structure vital alongside employment is income source, namely value-added generation. Neglecting the distinction between tourism revenue and value-added in Antalya can lead to erroneous assessments.

According to TurkStat National Accounts data, Antalya's share within Turkey's GDP stood at 3% in 2000, rose to 3.5% in 2019, receded to 2.5% in 2020 due to the COVID-19 pandemic, and currently approaches 3.5% once more.

Per TurkStat 2024 data, Antalya occupies the 6th position in value-added generation, closely tracking Kocaeli and Bursa. In agricultural value-added generation, it trails Konya, competing with İzmir for second place. It ranks 4th in the service sector incorporating tourism, and 15th in industrial sector value-added. Antalya's GDP level for 2025 can be estimated at approximately 2.2 trillion Turkish Lira. Nearly half of this value-added is generated by the commerce, tourism, and transportation sectors. Agriculture, industry, real estate, and professional services appear to hold shares around 8–9%. Construction, healthcare, and education sectors complete the production-value-added spectrum. In recent years, while agricultural value-added receded, the shares of sectors such as professional services and real estate expanded.

SECTORAL STRUCTURE

Agriculture

Antalya's agricultural land size has contracted from 414 thousand hectares in the 1990s to 327 thousand hectares, with cultivated agricultural land shrinking from 338 thousand hectares to 245 thousand hectares [2]. This contraction stems largely from the loss of cereal acreage and partially from vineyards, whereas expansions materialized in vegetable, fruit, forage crop, and olive grove lands. Over the past 30 years, qualified greenhouse cultivation acreage surged from 100 thousand decares to 322 thousand decares. In 2025, Antalya produced 1.1 million tons of field crops, 5 million tons of vegetables (4.5 million tons from greenhouse production), 1.8 million tons of fruit, and 707 million cut flowers. Antalya's share in national production equals 0.2% in cereals, 15% in vegetable production, 9% in fruit production, and 50% in greenhouse fruit and vegetable production. Antalya's share ranges between 20% and 50% in items such as tomatoes, peppers, eggplants, oranges, bananas, pomegranates, carobs, cultivated mushrooms, and ornamental plants [3].

Antalya's agricultural sector constitutes an integrated cluster encompassing a vast operational spectrum extending from seed research to seed and seedling production, fertilizer, packaging, and greenhouse equipment manufacturing, greenhouse climate control and automation systems production, to landscape architecture. Consequently, the magnitude and significance of the agricultural sector transcend the aforementioned figures. Of the 21 R&D centers in Antalya, 14 are agricultural, specifically seed research centers. Agricultural sector exports exceed 800 million dollars, with fresh fruits and



Greenhouses in Demre, an area of intensive agricultural production [G.ACAR]

vegetables accounting for 700 million dollars. Furthermore, it must be noted that a portion of fresh fruit and vegetable exports executed via other provinces likewise originates in Antalya.

It is redundant to reiterate how critically dependent such a vital sector is upon ecological balance. Climate change and drought impact Antalya's agriculture just as they affect the entire globe. The irrigated land ratio in Antalya approximates 30%, while well-water dependency and associated problems are escalating.

Alongside modern enterprises operating in seed research, agro-industrial production, agricultural technologies, and export domains within the agricultural sector, structural deficits persist, including the prevalence of traditional small production units, ineffective producer organization, and a lack of spatial management. Problems emerging in association with this structure—such as inefficiencies in water and energy management, inefficiencies in supply and logistics management, indiscriminate pesticide utilization, and plastic pollution—must be addressed from the perspective of economic and social sustainability.

Tourism

Antalya's tourism sector, initiated under public leadership and boasting over 40 years of accumulated experience and know-how, has transformed Antalya into a global destination while altering Antalya to a degree alongside itself.

According to Ministry of Culture and Tourism data, as of September 2026, Antalya hosts 1,353 operation- and investment-certified establishments with a bed capacity of 563 thousand, alongside



Kaputaş Beach, Kaş [Ö.DONMAZ]

95 thousand beds in 1367 simple accommodation facilities. Antalya's share in Turkey's tourism bed capacity exceeds 40% in the first group and stands at 17% in the second. When factoring in tourism activities conducted via short- and long-term rental methods in recent years, Antalya's accommodation capacity can be stated to exceed 700 thousand beds.
It remains useful to re-emphasize several points regarding the significance of the tourism sector. First, Antalya's tourism revenue is calculated through value-added rather than tourist volume. Antalya's tourism earnings comprise solely service activity profits and employee gross wages of accommodation, transport, commerce, and other sectors operating within Antalya. Input-output tables indicate that the tourism sector (accommodation, travel agencies, and food-beverage services) commands a share of approximately 25% within Antalya's value-added [4]. Indeed, while the Turkish economy expanded by 1.8% in 2020 when tourism activity contracted drastically, Antalya recorded a 24% contraction in GDP level.

Undoubtedly, Antalya tourism revenue and employment extend beyond direct accommodation and travel sector income and employment. A portion of incomes and employment within transport, industry, agriculture, and other service sectors in Antalya and other provinces constitutes indirect income and employment generated by Antalya tourism.

Beyond this, it must be noted that Antalya tourism's foreign exchange earnings effect represents a distinct yet paramount matter. Per Ministry data, Antalya hosted 16 million of the 52.7 million visitors arriving in our country in 2025, translating to roughly one-third. Moreover, Antalya stands out in the European market with a 50% share and commands a 60% share in foreign visitor overnight stays with 93 million overnights. Consequently, Antalya's share in tourism foreign exchange revenue surpasses its share in visitor numbers.

Tourism is impacted rapidly by all global, local, and environmental factors, prominently climate change. Antalya tourism has grown more resilient through advancements in product diversification, market diversification, and clustering efficiency toward economic sustainability. Efforts dedicated to environmental protection, reducing water and carbon footprints, and green energy investments are mounting. Nonetheless, per Ministry data as of September 2026, the number of establishments holding eco-friendly facility certificates equals 217. While Antalya sits well above the sector average across Turkey in this metric, ground remains to be covered. COP31 presents a vital opportunity for the tourism sector to assume more ambitious obligations.

Industry

Antalya exhibits an economic, social, and cultural structure weighted toward agriculture and tourism. Industrial sector development remained delayed and relatively restricted due to geographical and natural structural constraints alongside other factors, with input manufacturing oriented toward agriculture, construction, and tourism sectors gaining predominance. The absence of railway connectivity, the background position of Antalya port in maritime transit, limited industrial zones and Free Zone acreage, high land costs, lack of clustering, and a weak skilled-labor pool constrained further sector growth. In alignment with physical and geographical constraints and market necessities, a segment of large enterprises pursues investments in other provinces and abroad. Consequently, the count of Antalya firms within Istanbul Chamber of Industry First and Second 500 Largest

Industrial Enterprises rankings remains around 5 to 6.

Sectors standing out in production comprise food manufacturing, wood products, furniture, chemical manufacturing (fertilizers and plastics), marble, and yacht-boat construction. Industrial exports are likewise dominated by these sectors, excluding food.

Diversification within the industrial sector has mounted in recent years. Exports of machinery, electronics, HVAC equipment, medical device components, and iron-steel departing Antalya customs are expanding. Consequently, provincial exports surpass the 2.1 billion dollar threshold centered on Antalya firms, rising to 2.8 billion dollars via customs-exit figures [5]. The expansion of technoparks has likewise accelerated orientation toward innovative products, improvements in industrial services, and growth in domains such as software.

The retention of the industrial sector at this structure and level remains compatible with Antalya's agriculture- and tourism-based economy, securing an advantage for sustainable economic growth. The number of sectors and enterprises characterized by high carbon emissions and impacted by regulations such as the Carbon Border Adjustment Mechanism (CBAM) is low in Antalya. Still, the expansion of marble, quarrying, plastics, and recycling sectors can induce adverse impacts upon the environment, agriculture, and tourism.

Conclusion

The prioritization by Antalya of eco-friendly production domains and methods, technology services, biotechnology, healthcare, and software in lieu of traditional products and environmentally destructive production fields will prove compatible with its sustainability vision. The initiation recently of smart specialization strategies and incentives via Development Agencies generates opportunities in this direction. Completing the economic and sectoral digital-green transformation vision with a smart, digital-green city vision must likewise be contemplated as part of this transition.

Concluding Remarks

The geographical, historical, and economic evaluations presented in the chapter "Understanding Antalya" establish a general framework for readers unfamiliar with the city while illuminating the relationships shaping Antalya's development. Forests and water resources in the mountains, production across coastal plains, settlements expanding around harbors, and life within the sea constitute components of an interdependent totality.

In Antalya—which flourished through the opportunities furnished by this geography across history—the scale of urbanization and economic activities today amplifies pressures upon natural resources. Climate change similarly dictates that novel conditions be factored into water use, production, and settlement decisions. The collective evaluation of the writings points toward the significance of a developmental mindset prioritizing resource efficiency, generated value-added, and the regenerative capacity of natural systems for the continuity of urban prosperity.

This framework simultaneously serves as a starting point for comprehending the place of Antalya's natural assets within urban life. The subsequent section examines biological diversity stretching from seagrasses and endemic plants to monk seals, sea turtles, and birds, dwelling upon the habitats, ecological functions, and conservation requirements of these species.



Mediterranean monk seal, Monachus monachus, Kaş [T.CEYLAN]

02
NATURAL VALUES OF ANTALYA

Antalya constitutes one of the most vital ecological corridors embedding the biological, geological, and oceanographic diversity of the Mediterranean. Extending from coastal and marine ecosystems to the pristine peaks of the Taurus Mountains, and from karstic structures forming canyons and caves to shallow coastal waters, this geographical continuity elevates the city not only into a local natural wonder but also into a biological sanctuary that must be protected on a global scale.

The natural values of Antalya are not independent entities, but parts of a mutually nurturing system. Seagrass meadows trap the sediment nourishing beaches and protect the coast by reducing wave energy. Protected beaches serve as nesting grounds for sea turtles. Undeveloped rocky coasts provide a sanctuary for the Mediterranean monk seal, while small islands and coastal wetlands harbor seabirds and migratory species. Furthermore, the forests of the Taurus Mountains sustain valley ecosystems that host both endemic plants and species such as the brown fish owl. A loss in any link of this chain weakens the others. Therefore, these species act as living indicators that show the effects of change first and most clearly. Natural coasts, wetlands, and forests represent the city's most effective and cost-effective defense lines against changing conditions. Consequently, understanding Antalya's nature requires viewing these values not individually, but together with their interconnections.

This section presents comprehensive analyses prepared by domain-expert scientists with a holistic approach regarding:

•Posidonia oceanica (Seagrasses), extending from Kaş-Kekova to the Gulf of Antalya, playing a strategic role in the city's fight against the climate crisis with their long-term carbon storage capacities;

•Sea Turtles (Caretta caretta and Chelonia mydas), which are fundamental balancers of coastal and marine food webs through their millions of years of evolutionary processes, alongside human- and climate change-induced pressures on their nesting beaches;

•Mediterranean Monk Seals (Monachus monachus), serving as sensitive biological indicators of natural and undeveloped coastal strips and standing among the rarest marine mammals globally endangered;

•Antalya's Plant Biodiversity and Floral Richness, encompassing forest hotspots (İbradı-Akseki) with no substitutes on a European scale, over 800 endemic species, and a gene center character;

•Bird Diversity and Ecosystem Integrity, stretching from migratory species resting along the Eastern Mediterranean flyway to iconic species such as the brown fish owl living in pristine valleys and Audouin's gull breeding on islands.

As the Antalya Blue Mediterranean Initiative, we aim for this scientific and evidence-based evaluation to form the basis of environmental policies that aim to safeguard our city's natural heritage.

2.1
Antalya's Blue Carbon Habitats: Seagrass Meadows

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Mediterranean Fisheries Research, Production and Training Institute

Seagrasses are underwater habitats formed by flowering plants adapted to the marine environments in shallow coastal areas. Ranging from the tropics to temperate regions, the three-dimensional structure of these ecosystems—composed of leaves, roots, and rhizomes—provides shelter, feeding, breeding, and nursery grounds for fish, crustaceans, mollusks, and other invertebrates. Thus, they underpin the continuity of coastal biodiversity and fisheries resources [1].

The ecological function of seagrass habitats extends far beyond providing living space for organisms. Their dense canopy attenuates water movement, reducing the resuspension of sediment back into the water column, facilitating the settling of suspended particles, and limiting coastal erosion by dampening wave energy. They also contribute to nutrient cycling and produce oxygen via photosynthesis. The matte formed over time by the accumulation of rhizomes, roots, organic debris, and sediment beneath extensive and long-lived beds of Posidonia oceanica—endemic to the Mediterranean—can store carbon for hundreds or even thousands of years. These mattes make P. oceanica meadows



Seagrass meadows (Posidonia oceanica) [T.CEYLAN]

one of the primary blue carbon sinks of the Mediterranean [2, 3].

Conversely, seagrasses are increasingly exposed to the combined effects of anthropogenic pressures and climate change. Coastal development, port and marina operations, dredging, land reclamation, anchoring, trawling, and other physical interventions accelerate seagrass degradation by leading to reduced light transmittance, direct physical damage, and disrupting meadow integrity. Invasive species, diseases, rising sea temperatures driven by climate change, marine heatwaves, severe storms, and sea-level fluctuations further aggravate these pressures [1, 4].

The loss of seagrass meadows implies much more than a mere decline in marine vegetation. These losses adversely affect habitat structure, fish spawning and nursery grounds, coastal protection capacities, and water quality, while simultaneously introducing the risk of re-releasing long-sequestered carbon from the sediment back into the atmosphere. As a result, ecosystem services utilized by coastal-linked sectors—primarily fisheries and tourism—decline, and coastal protection and management costs may rise [2, 4].

In Antalya, which boasts a coastline of approximately 640 km, various research and conservation initiatives targeting seagrasses have been conducted by public institutions, universities, non-governmental organizations, and individual researchers across different periods and locales. The results regarding the diversity, distribution, and bio-ecological characteristics of seagrasses in coastal areas have been reported [5, 6, 7, 8, 9, 10]. Findings have revealed that seagrass beds reaching relatively high biomass are concentrated along the eastern and mid-eastern coasts of the Gulf of Antalya as well as within the Kaş-Kekova Special Environmental Protection Area (Figure 1.a).

Figure 1. (a) Point distribution of seagrass records along the Antalya coastline, and (b) distribution areas of Posidonia oceanica meadows in the Kaş-Kekova SEPA, superimposed on CORINE Land Cover and EMODnet bathymetry data.

Within the scope of the MedPROACT Project co-funded by the European Union—implemented under the Interreg NEXT MED Programme, with the Ministry of Foreign Affairs Directorate for EU Affairs of the Republic of Türkiye serving as the national authority—an up-to-date distribution map of P. oceanica beds in the Kaş-Kekova Special Environmental Protection Area (SEPA) is being prepared, and the status of habitats and health of populations are being determined. According to preliminary findings of the project, a total of 31.3 ha of P. oceanica meadows has been mapped, comprising 8.4 ha (735 ± 498 shoots/m^2) in Beşadalar, 2.3 ha (366 ± 317 shoots/m^2) in Ufakdere Bay, 7.3 ha (505 ± 516 shoots/m^2) in Aperlai Bay, and 8.4 ha (690 ± 472 shoots/m^2) in Eğriliman Bay, all located within the borders of the SEPA; alongside 4.9 ha (165 ± 115 shoots/m^2) in Limanağzı Bay located just outside the SEPA borders (Figure 1.b). Throughout project activities, it was also observed that P. oceanica meadows in the Kaş-Kekova SEPA have suffered severe physical damage in places.

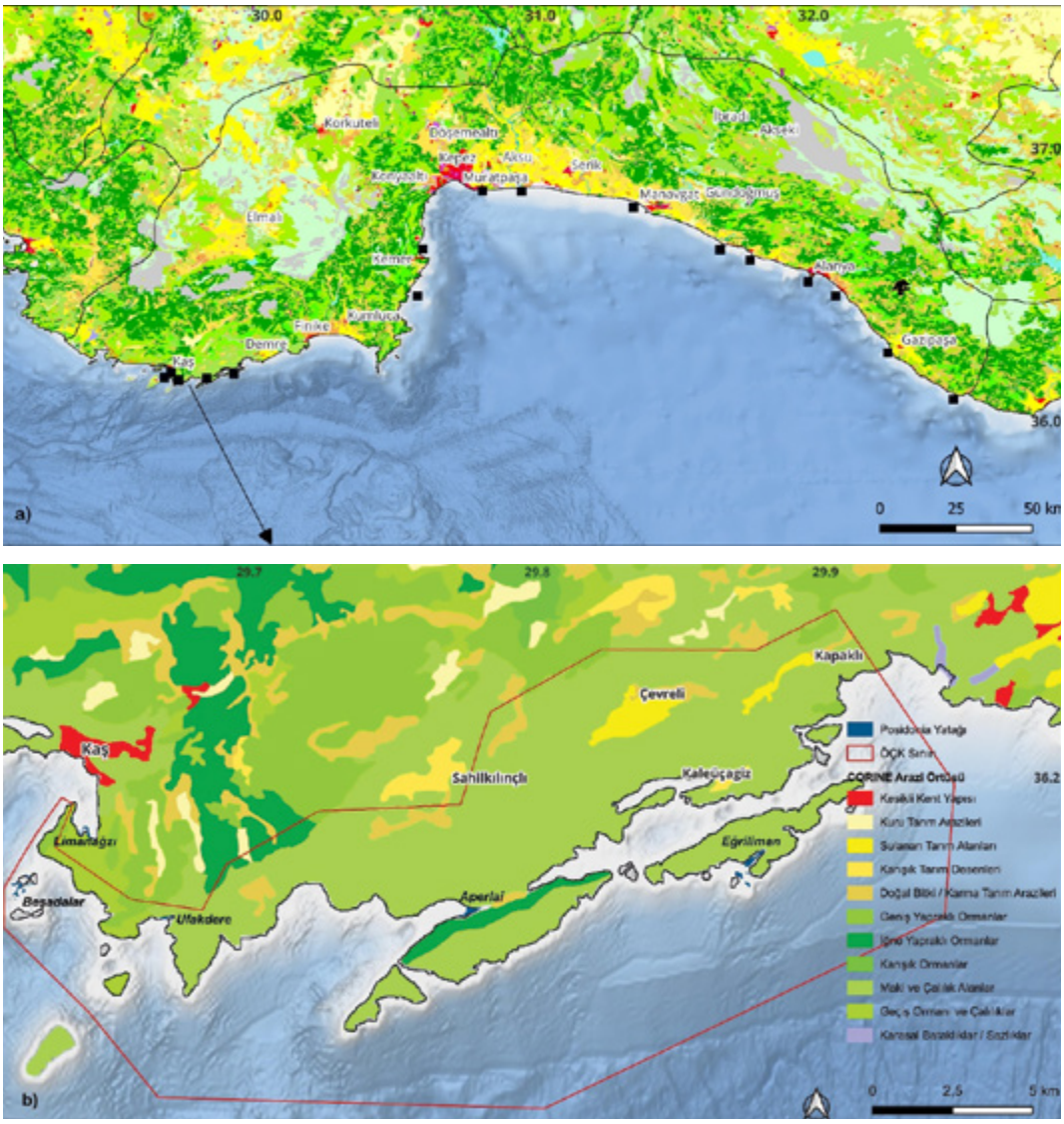
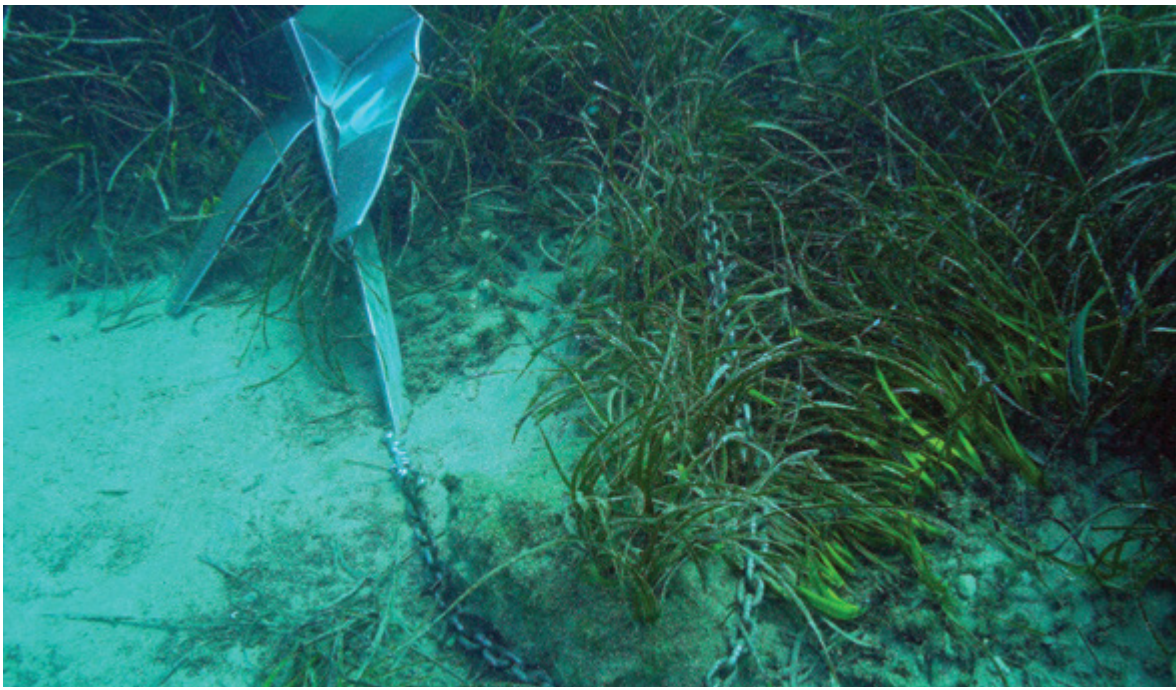


Figure 1. (a) Point distribution of seagrass records along the Antalya coastline, and (b) distribution areas of Posidonia oceanica meadows in the Kaş-Kekova SEPA, superimposed on CORINE Land Cover and EMODnet bathymetry data.

Although mitigating certain pressures on seagrasses demands comprehensive integrated coastal zone management applications, establishing conservation areas, restricting dredging activities within these zones, and installing ecological moorings in seagrass meadows are effective conservation strategies to prevent habitat losses. It is reported that regulating maritime spatial use and deploying appropriate ecological mooring systems can

significantly mitigate damage caused by anchoring [11]. Furthermore, fostering effective enforcement and collaborative management within protected areas through the active participation of fishers, boat operators, tourism enterprises, local authorities, scientists, and other stakeholders will substantially enhance management success [4, 12]. Ecological restoration, as part of conservation activities, should be viewed as a complementary tool rather than a substitute for protection [13]; the overriding priority in safeguarding seagrasses must be to prevent the loss of existing healthy habitats and the facilitation of conditions necessary for natural recovery.

In conclusion, seagrasses represent one of the fundamental ecosystems of the Mediterranean coasts regarding the sustainability of biodiversity, fisheries resources, water quality, coastal protection, and long-term carbon sequestration. To mitigate the combined effects of current anthropogenic pressures and climate change on these critical blue carbon habitats, updating distribution maps, regulating land and sea use to protect sensitive habitats, enhancing stakeholder awareness and co-management participation, implementing long-term monitoring using standard methods, and ensuring rigorous regulatory enforcement will be decisive for the future of seagrasses and the ecosystem services they provide in Antalya.



An example of damage to seagrass meadows caused by boat anchors, Alanya [T. CEYLAN]

2.2
Traces of Life in Antalya: Sea Turtles

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Maintaining their existence on Earth for millions of years, sea turtles rank among the most ancient biological indicators reflecting the health and balance of marine and coastal ecosystems. Tracking ocean currents since the age of dinosaurs, these animals today serve as global flagship species for the conservation of biodiversity. Two of the seven sea turtle species living worldwide nest regularly in the Mediterranean basin: the Loggerhead sea turtle (Caretta caretta) and the Green sea turtle (Chelonia mydas).

Both species undertake critical ecological functions in the marine food web. The carnivorous Caretta caretta, known for its powerful jaw structure, regulates benthic invertebrate balance by feeding on mollusks, crabs, and sea urchins. Meanwhile, Chelonia mydas, which transitions to a completely herbivorous diet during adulthood, feeds on seagrasses (Posidonia oceanica), ensuring the aeration of the seabed and the continuation of ecosystem productivity.



A Caretta caretta hatchling making its way across the beach to the sea



Caretta caretta hatchlings [M.YAVUZ]

The most striking mechanism in the life cycle of these creatures is the phenomenon of philopatry, which refers to the return of adult female individuals to the beaches where they were born for the purpose of egg-laying. Females traverse migration routes spanning thousands of kilometers by using Earth's magnetic field and geochemical cues like a compass, returning precisely to where they hatched. Following mating, they

emerge onto the beach at night between May and August, digging pits to deposit an average of 80 to 120 eggs. After an incubation period of approximately 45–60 days, hatchlings emerge from the sand under the cover of night, guided by the reflection of moonlight and starlight on the sea surface, and head toward the open waters. More interestingly, during embryonic development, the sex ratio of the hatchlings is directly dependent on incubation temperature: sand temperatures above the pivotal threshold of roughly 29 °C predominantly produce females, while temperatures below it produce males. Opening their eyes to the world in this manner, these hatchlings leave deep marks on the shore, in history, and in our hearts as they make their way from the sand to the sea.

The Mediterranean coasts form a semi-enclosed and sensitive basin regarding global sea turtle populations. Extending from the southern Aegean and Western Mediterranean beaches to the Eastern Mediterranean shores, this region serves as the primary breeding and feeding refuge for the survival of the species. Türkiye hosts approximately one-third of all Caretta caretta nesting activities across the Mediterranean and more than half of the critically endangered regional Chelonia mydas population. The more than twenty vital nesting sites identified along our country's coasts represent an internationally indispensable corridor for safeguarding the genetic pool and future heritage of these species.



Adult Caretta caretta [T. CEYLAN]



Adult green sea turtle (Chelonia mydas) [Ö.DONMAZ]

In this regard, Antalya's coastline holds a privileged place in Türkiye's sea turtle population. Nine main nesting beaches registered by the Ministry of Environment, Urbanisation and Climate Change and the Ministry of Agriculture and Forestry are located within Antalya provincial borders: Patara, Kale (Demre), Kumluca, Çıralı, Tekirova, Belek, Kızılot, Demirtaş, and Gazipaşa.

Among these beaches, Belek and Kızılot rank among the most intensive Caretta caretta nesting centers in the Mediterranean in terms of annual nest counts. Çıralı and Patara stand out nationally and internationally both through their Special Environmental Protection Area statuses and conservation models developed with the participation of local communities. Thousands of nests are identified and hundreds of thousands of hatchlings safely reach the sea every breeding season on Antalya beaches. The efforts of nature conservation associations, universities, local governments, and local residents in areas like Patara, Çıralı, Belek, and Kızılot—comprising monitoring, evaluations, and joint watch systems—represent prime examples of spreading conservation efforts across society.

Antalya is both a giant sanctuary for sea turtles and a risky geography where human pressure is felt most acutely. Intensive tourism pressure stands at the forefront of current and future threats. Heavy construction along the coastline, reluctance to comply with coastal laws, and fixed sunshades and sun loungers

placed on dunes prevent female turtles from finding suitable nesting areas. Furthermore, artificial lights illuminating the beach at night cause hatchlings trying to reach the sea to disorient and wander inland, onto roads, or into hotel gardens, exposing them to fatal dehydration. Moreover, uncontrolled vehicle entry onto beaches leads to sand compaction and egg crushing, while in the marine environment, speedboat propellers and bycatch (entanglement in fishing nets) result in the injury or drowning of dozens of adult individuals every year. Additionally, plastic waste mixing into the seas is swallowed by C. caretta under the mistaken identity of jellyfish, causing digestive tract blockages and even death. The most comprehensive threat of the coming period is the global climate crisis. Rising sea levels narrow beach widths, and storm-driven waves submerge nests. Rising sand temperatures trigger the risk of "feminization," i.e., an imbalanced population structure consisting almost entirely of female individuals.

Conversely, Antalya harbors significant opportunities. The region's high academic potential, active rehabilitation centers (such as DEKAMER and local facilities), and world-wide tourism recognition offer the chance to blend and plan sea turtle-focused conservation with ecotourism and sustainable coastal management.

To ensure these footprints—dating back to the age of dinosaurs—are not erased, and so that future generations can witness these ancient creatures, actionable policies that observe the balance between conservation and use must be implemented:

• Lighting Management Regulation: "Turtle-friendly lighting" (fixtures with red or monochromatic amber wavelengths, shielding, and low angles) must be made mandatory in all tourist facilities and settlements overlooking nesting beaches.

•Coastal Zoning and Usage Standards: Nighttime entry of humans and vehicles onto beaches during the breeding season (early May–late October) should be banned or restricted, and sun loungers and umbrellas must be pulled back at least 30–40 meters from the sea during evening hours and consolidated in designated areas.

•Marine Speed and Fishing Regulations: Speed limits for motorized watercraft should be enforced in breeding waters within 1 mile of the coast, boats should be encouraged to use propeller guard cages, and gear preventing bycatch must be mandated in fishing equipment.

•Climate-Based Monitoring: Beach and nest temperatures must be continuously monitored using micro-data loggers, and controlled shading or relocation protocols to safe hatching sites must be standardized for overheating and flood-prone nests.

•Participatory Governance Approach and Ecotourism: Local residents, fishermen, and tourism personnel should be integrated into conservation processes through training programs, events, and civil initiatives; turtle conservation work should be transformed into planned and rule-based responsible nature observation rather than mass tourism.

The tiny footprints cast every summer on Antalya's beaches represent not only the reproductive struggle of a single species, but also the most meaningful test of humanity's bond with nature and our shared future.

2.3 Antalya's Biological Heritage: Mediterranean Monk Seals, Coastal Use, and Conservation

Dr. Meltem OK
METU Institute of Marine Sciences

Among the most elusive yet eloquent inhabitants of Antalya's mesmerizing coastline is the Mediterranean monk seal. The Mediterranean monk seal (Monachus monachus) is the only resident pinniped species of the Mediterranean and one of the rarest marine mammals in the world. Once utilizing open beaches as well, the species has largely retreated to inaccessible, remote, and sheltered areas due to escalating human pressure along coasts. Today, the presence of the Mediterranean monk seal reminds us of the importance of protecting not only a single species, but also pristine coastlines.

Importance for Türkiye and the Mediterranean:

The primary habitats of the Mediterranean monk seal are located in Greece, Türkiye, and along the Mauritania–Western Sahara coasts in the Eastern Atlantic. Evaluated as endangered in the Mediterranean Sea by the International Union for Conservation of Nature (IUCN), the species has been adversely affected for many years by habitat loss, human-induced disturbances, and interactions with fisheries. Türkiye's Aegean and



Mediterranean monk seal (Monachus monachus) [METU-IMS Archives]

Mediterranean coasts carry great significance for maintaining the species' presence in the Eastern Mediterranean. However, the conservation of the Mediterranean monk seal does not simply mean protecting the spots where they are observed. Natural coasts, nearshore feeding grounds, and the connectivity between these areas must be evaluated collectively.

A Life Between Sea and Land:

The Mediterranean monk seal is a marine mammal that feeds primarily on fish, octopuses, and other cephalopods. Unlike fully aquatic marine mammals such as dolphins and whales, monk seals depend on suitable coastal habitats for resting and reproduction. They must haul out onto land to give birth, nurse their pups, rest, and molt. Access to safe haul-out sites is therefore not simply a habitat preference, but an essential biological requirement. Females typically give birth to a single pup after a gestation period of approximately 11 months. Pups remain dependent on maternal care for several months. Human disturbances, particularly during the sensitive periods of pregnancy, pupping, and nursing—such as entering breeding caves, boats approaching too closely, or excessive noise—can have serious consequences for reproductive success and pup survival. Severe or repeated disturbances may contribute to pregnancy loss, disrupt maternal care, or lead to mother–pup separation and potential pup abandonment, ultimately jeopardizing pup survival. Regardless of how clean the surrounding sea may be or how abundant its food resources are, the loss of safe coastal habitats for resting and reproduction can seriously threaten the long-term survival of the Mediterranean monk seal.

Current Status Along Antalya Coast:



Mediterranean monk seal (Monachus monachus) [METU-IMS Archives]

Antalya's remaining undeveloped natural coastlines provide important habitats for the Mediterranean monk seal in Türkiye. However, physical habitat characteristics alone do not determine an area's suitability for the species. The level of human disturbance and the availability of safe, undisturbed sites are equally important. Long-term monitoring conducted along the Antalya coastline since 2008 by the Middle East Technical University Institute of Marine Sciences (METU-IMS), through national and international research projects, has documented approximately 30 individually identified monk seals. This number should not be interpreted as an estimate of Antalya's total monk seal population, but rather as the number of distinct individuals identified during the monitoring period. These studies provide valuable information on habitat use, reproductive activity, individual movements, and temporal changes in the occurrence of monk seals. For a wide-ranging and elusive species such as the Mediterranean monk seal, short-term observations may lead to misleading conclusions. The absence of sightings at a particular site does not necessarily indicate that the habitat is unused or ecologically unimportant. Long-term scientific research and systematic monitoring are therefore essential for developing reliable, evidence-based conservation and coastal management strategies.

Human Use of Coastal areas and Associated Pressures:

Human activities along coastlines do not necessarily constitute a threat in themselves. The construction of roads, piers, coastal reclamation projects, or tourism facilities can make previously secluded coastal habitats accessible to intensive human use. Even when a habitat remains physically intact, repeated disturbance may compromise its ecological functionality for monk seals (and other organisms using coastal ecosystems).

Approaching breeding and resting areas by boat, entering these zones by swimming or diving, and noisy marine craft can cause severe disturbances. The risk of entanglement in fishing nets is particularly critical for young individuals. Lost or abandoned fishing nets, commonly referred to as ghost nets, can create additional entanglement hazards. Interactions with fishing activities may also result in damage to fishing gear, contributing to conflicts between seals and fishers. Reducing marine litter, recovering abandoned fishing gear, and conducting carefully planned coastal cleanup activities can help mitigate some of these pressures. However, such activities must themselves be carried out without disturbing sensitive monk seal habitats.

Climate Change, Risks, and Opportunities:

Climate change may introduce additional challenges for Mediterranean monk seal conservation. Sea-level rise, changes in storm intensity and wave conditions, and increasing seawater temperatures could affect the suitability and availability of coastal habitats. In particular, core zones such as breeding sites and other low-lying coastal sites may become increasingly vulnerable to wave exposure and flooding, potentially affecting pup survival. Changes in marine environmental conditions may also influence prey distribution and availability. Antalya's role as host of COP31 offers an important opportunity to integrate the conservation

of natural coastal ecosystems into broader climate change adaptation and biodiversity conservation policies. Maintaining the ecological integrity of undeveloped coastlines and protecting suitable breeding and resting habitats are important components of strengthening the resilience of coastal ecosystems and the species that depend on them.

Practical Conservation Measures and Policy Recommendations:
The conservation of the Mediterranean monk seal requires translating scientific knowledge into coastal management and ensuring coordinated action among different sectors:

•Protection of Coastal Ecosystems:
Ensuring the integrated conservation of Antalya's ecologically valuable natural coastlines, their marine biodiversity, and associated habitats, including those supporting emblematic species such as Mediterranean monk seals, sea turtles, and seabirds.

• Science-Based Planning:
Incorporating long-term monitoring data into coastal development plans, environmental impact assessments, and protected area management; assessing human activities and disturbance pressures in and around critical breeding and resting habitats.

•Management of Human Activities in Coastal Areas:
Establishing appropriate spatial zoning, minimum vessel approach distances, speed restrictions, and seasonal limitations where necessary; preventing unauthorized entry into sensitive breeding and resting habitats.
Collaboration with Tourism Operators: Developing targeted training programmes and codes of conduct for boat tour operators, diving centres, and kayaking businesses; promoting responsible wildlife observation practices that prohibit approaching, pursuing, feeding, or otherwise disturbing monk seals, particularly at breeding and resting habitats.

•Joint Solutions with Fishermen: Facilitating lost net reporting and supporting the removal of ghost nets.
Scientific Monitoring and Public Engagement: Strengthening coordination among universities, government agencies, local authorities, and civil society organizations; encouraging citizens to report monk seal sightings to researchers actively working on the species, including photographs, dates, and approximate locations, while refraining from sharing the locations of sensitive habitats on social media.

Sharing Our Coasts, Protecting Our Future: Protecting the Mediterranean monk seal is not only about safeguarding the future of one of the world's rarest marine mammals. It is also about preserving the ecological integrity and natural heritage of Antalya's exceptional coastline for future generations, while contributing to the conservation of Türkiye's, the Mediterranean's, and the world's shared natural heritage. As a species that feeds at sea but depends on undisturbed coastal habitats for resting and reproduction, the Mediterranean monk seal embodies the vital connection between marine and terrestrial ecosystems. Its continued presence along Antalya's coast is a powerful reflection of our ability to coexist with wildlife and to share our coastlines with the other species that depend on them.

2.4
Antalya's Plant Biodiversity

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Values Extending from Land to Sea

Conveying Antalya's rich plant diversity in an inclusive manner is quite difficult within a limited text due to the breadth of the subject. Even a quarter-century of academic accumulation and field work may fall short of presenting this richness in its entirety. This study has been penned to introduce Antalya's plant biodiversity at a foundational level and with a concise approach.

Antalya's Plant Biodiversity / Endemic Plants

While the Mediterranean Region stands out in Türkiye as the zone where the highest number of endemic plants are distributed, evaluations made on a provincial basis place Antalya as the city with the highest count and ratio of endemic plants [1, 2, 3, 4]. A total of 2,736 plants are recorded across Antalya's flora [5]. While 1,921 plants (accounting for 70.2% of this floristic richness) are non-endemic, the remaining 815 plants (29.8%) hold endemic status [5]. Looking closer at the endemic taxa, 798 plants (29.2%) possess general endemic characteristics, whereas 17 plants (0.6%) consist of local endemic plants growing exclusively in narrow, specific locations [5].

As is the case across Türkiye, Antalya's natural areas host broad plant families that stand out on a global scale in terms of species richness and endemism rates. Leading this richness are families such as Asteraceae (Figure 1), Fabaceae, Lamiaceae, Brassicaceae, Poaceae, Caryophyllaceae, Scrophulariaceae, Apiaceae, and Boraginaceae [6, 7].



Figure 1. Gül babuççа (Cota pestalozzae Boiss.) (Mediterranean Region Endemic – Near threatened category)

The survival of many endemic plant species in Antalya is under severe threat, placing them in the Critically Endangered (CR) category. One such sensitive species is Potentilla ulrichii, which is distributed solely across a narrow area specific to Antalya and holds vital importance for conservation (Figure 2) [8].



Figure 2. Yastıkparmakotu [Potentilla ulrichii Parolly & Nordt (Local endemic, Critically Endangered)].

Principal tree species forming Antalya's forest cover include Turkish pine (Brutian pine), Black pine, Stone pine, Taurus cedar (tar tree) (Figure 3), Calabrian juniper (tall juniper), Phoenician juniper, Stinking juniper, Cade juniper, Cilician fir, Turkish oak (hair-fruited oak), and Gall oak (Aleppo oak) [6,9].



Figure 3. Taurus cedar, Tar tree (Cedrus libani var. libani A.Rich)

Nature tours organized to areas rich in biodiversity across Türkiye, and particularly in Antalya, highlight the concept of botanical tourism [10].

Antalya's flora also exhibits remarkable diversity in terms of ethnobotanically utilized, edible, medicinal, or economically valuable species. Widely utilized by locals and holding significant places in traditional culture (Figure 4), prominent species include olives, bay laurel, thyme, sage, mountain tea, and carob, alongside hawthorn (Figure 5), rosehip (Figure 6), and wild pear (zingit).



Figure 4. Aromatic-medicinal plants in the local market



Figure 5. Hawthorn (Crataegus orientalis Pall. ex M.Bieb. subsp. orientalis)

Geophytic (tuberous, bulbous, cormous, or rhizomatous) plants have historically attracted attention particularly due to their aesthetic and visual appeal.

Lilies, peonies, snowdrops, daffodils, crocuses, saffron, fritillaries, and orchids represent the primary members of this group.



Figure 6. Rosehip, dog rose (Rosa canina L.)

Among the peony species in this group—which was also chosen as the symbolic flower of EXPO 2016 Antalya—the most commonly observed species in the Antalya region is the male peony (Paeonia mascula) (Figure 7).



Figure 7. Male peony, Peony [Paeonia mascula (L.) Mill. (Non-endemic)]

Geophytic plants distributed throughout Antalya reach extraordinary diversity especially in the districts of İbradı, Akseki, and Gündoğmuş. In this context, Gembos Plateau (Karamıklı locality) on the İbradı (Antalya)-Derebucak (Konya) border, Çimi and Geyran plateaus in Akseki, and Söbüçimen Plateau in Alanya stand out as the region's leading geophyte centers. Being located in such a geophytically rich geography is also clearly observed in the reflections of these plant species on the region's cultural identity and traditional art motifs (Figure 8).

In traditional Turkish culture and art, the tulip (Tulipa) occupies an exceptional place with its aesthetic form and symbolic meaning. Used for centuries both as an ornamental plant and as a fundamental motif in fields ranging from architecture to handicrafts, this geophytic species also displays itself in its natural habitat across Antalya's high-altitude plateaus (Figure 9). These city-specific wild tulip populations serve as living representatives of both floristic biodiversity and historical-artistic heritage.

Antalya's geophytic plants rank among sensitive natural assets that must be absolutely protected with their showy and striking flowers.

At the forefront of species with the highest awareness and popularity in this group is the sea daffodil (Pancratium maritimum) (Figure 10).



Figure 8. Geophytes "snowdrop, autumn crocus, crown imperial (ağlayangelin)" and their canvas paintings (paintings executed by Ms. Gülsima AĞILDERE BAYKAL)



Figure 9. Tulip [Tulipa foliosa Stapf (Endemic-Least Concern)]

Displaying its captivating flowers on Antalya's coastal dunes between August and October, both this species and its sensitive dune ecosystems have been placed under legal protection via regulatory measures.



Figure 10. Sea daffodil (Pancratium maritimum L.) (Non-endemic)

This conservation status not only ensures the survival of the sea daffodil, but also directly contributes to preserving the natural and undisturbed structure of coastal habitats.

A large proportion of newly discovered plant taxa in recent years consists of species distributed along the Taurus Mountains chain and the passes and routes providing access to this mountain mass. Local endemism growing naturally exclusively in Türkiye and even solely within Antalya provincial borders, alongside distinct species newly described to the scientific world, concentrate on both the eastern and western lines of the city (Figures 11–14) [11, 12, 13, 14, 15]. This situation once again reveals the key role of the Taurus Mountains' high topographic and microclimatic diversity in the evolution and conservation of new species.



Figure 11. Kırk şalba [Salvia caespitosa Montbret & Aucher ex Benth. (Turkish endemic, Least Concern)]



Figure 12. Gövrek, Kepez bugloss [Anchusa limbata Boiss. & Heldr. (Local endemic-Critically Endangered, discovered in 1845 and introduced to science in 1849)]



Figure 13. Çam düğmesi, Antalya knapweed [Centaurea antalyensis H. Duman & A. Duran (Local endemic-Critically Endangered, introduced to science in 2002)]



Figure 14. Gökce tülüşah [Rhaponticoides gokceoglui Çinbilgel, Eren & H. Duman (Endemic, Critically Endangered, introduced to science in 2014)]

As part of a study conducted in 1999 by the World Wide Fund for Nature (WWF), the 100 most valuable forest areas possessing extraordinary biodiversity across Europe that require urgent conservation measures were declared as "Forest Hotspots of Europe". One of the 9 hotspots from Türkiye that managed to enter this prestigious list is the "İbradı-Akseki Forests" located within Antalya borders [16]. This international status certifies that the region harbors an irreplaceable forest ecosystem and gene source not only on a local scale, but also on a continental scale.

At the foundation of Antalya's nature—and consequently its floral richness—possessing such unique and high diversity lies a unique combination of ecological and geographic factors on both global and local scales. The city is positioned within the Mediterranean Basin, which is of critical importance globally for biodiversity, and within Türkiye's Mediterranean Region. The Taurus Mountains, forming the core backbone of this geographical structure, constitute one of the region's most important resource values. Rising abruptly from sea level to reach an altitude of 3,070 meters (Kızlar Sivrisi), this mountain range offers a broad climatic spectrum ranging from the typical Mediterranean climate on the coast to continental and transitional climates in interior sections; these varying elevation steps house highly specialized habitat areas and life sources.

The city's climatic diversity extends over an extremely broad expanse. In a region dominated by Mediterranean aridity, rainy and very rainy Mediterranean bioclimate tiers are also present in line with long-term data. Winds blowing from varying directions—from sea breezes to northeasterly poyraz winds—constantly nourish and shape plains, valleys, and high mountain massifs. Furthermore, high relative humidity rates observed particularly during summer months, although challenging for urban life, serve a vital function for the water balance and vitality of natural ecosystems.

Sunshine duration and micro-topographic structure represent other factors supporting this richness. Alongside east-west solar movement, north-facing shaded areas locally termed "kuz" and south-facing sun-exposed rocky structures collectively offer unique micro-climatic environments. Antalya's forests, maquis, and other ecosystems naturally absorb incoming solar radiation to prevent overheating and create micro-habitats featuring differing temperature regimes.

From a geological perspective, all natural motifs originating from karst topography are observed to be sculpted across the region. Small and large limestone formations—such as lapyas, karren, dolines, uvalas, poljes (plains), sinkholes, caves, and valleys formed by precipitation dissolving rock strata—dominate the geography. Water resources within the city and the rich vegetation surrounding these sources complete ecological integrity. Especially valley interiors above 1,000 meters and block rocky outcrops stretching from sea level to high mountains host the city's most valuable and sensitive plant species. Indeed, areas where Antalya's flora is densest in terms of endemic species concentrate along the panoramic Taurus Mountains ridge stretching from east to west when turning one's back to the sea.

Alongside mountain massifs, ecosystems along the coastal strip must not be neglected. Coastal dunes, maquis communities, and Turkish and Stone pine forests offer high visual aesthetics while forming the keystones of the ecosystem. The sea daffodil (Pancratium maritimum), a captivating symbol of these coastal habitats, stands among the most concrete examples of this richness. With all these dynamics in its geography, Antalya resembles a symphony possessing a colorful palette where all of nature's instruments are played.

2.5 Antalya's Bird Diversity

Assoc. Prof. Korhan ÖZKAN
METU Institute of Marine Sciences

When nature and marine tourism are mentioned, Antalya is one of the first destinations that comes to mind not only in our country, but in many parts of the world. Stretching from the foothills of the Taurus Mountains to the shores of the Mediterranean with its long beaches, crystal-clear seas, forests, and ancient cities, Antalya welcomes millions of visitors every year. However, Antalya possesses another tourism potential that is far less known: birds.

Every year, birdwatchers from different countries around the world come to Antalya, sometimes for a single bird species they have waited years to see. Perhaps the most striking example of this is the brown fish owl. Reaching approximately 60 centimeters in height and a wingspan of up to 1.4 meters, this magnificent creature—one of the largest owls in the world—maintains its life intertwined with streams, ponds, and the forests surrounding them. Seeing such an imposing owl fishing from the water's surface at night amazes even people familiar with birds.

The brown fish owl is also one of the rarest birds in our region and one of those most in need of protection. Its global distribution extends from Türkiye to South and Southeast Asia; in Europe and



Brown fish owl, Manavgat [Ö.YILMAZ]

Western Asia, Türkiye is the sole country where the brown fish owl is found.

The brown fish owl nest located around the Oymapınar Dam in Manavgat has been visited for many years by hundreds of local and foreign birdwatchers wishing to see this rare bird. People traveling thousands of kilometers from different countries of the world to Antalya simply to catch a glimpse of a single bird serves as a fine example of the economic, cultural, and touristic value of biodiversity that we often overlook.

Unfortunately, this crucial habitat suffered severe damage during the major forest fires that affected Antalya and its surroundings in 2021. The life of the brown fish owl is not limited to the streams and lakes where it feeds; it requires healthy forests, mature trees, rocky outcrops, and the entire valley ecosystem surrounding these water systems. The Oymapınar example thus clearly demonstrates that nature conservation cannot consist merely of protecting a single species or a single habitat. We must protect ecosystems as a whole, from water to forest and from coast to mountain.

The loss in Oymapınar does not mark the end of the brown fish owl's story in Antalya. The species continues to survive in suitable stream valleys east of Antalya. The conservation of healthy water and forest ecosystems in these valleys holds great significance both for the future of this special bird and for Antalya's place in international birdwatching tourism.



Brown fish owl with its chick, Manavgat [Ö.YILMAZ]

The brown fish owl is not the sole example of this interest. Every year, numerous birdwatchers visit Antalya's coasts—particularly during the spring migration and winter months—to encounter species such as the desert wheatear and Asian desert warbler, which are extremely rare in our country. The most important stops for these visits are the coastal dunes and wetlands that remain well-preserved along our shores. These examples simultaneously enable us to view coastal protection from a different perspective. A well-preserved dune is not merely a beautiful beach; it is a living ecosystem with its own unique plant and animal communities, providing a habitat for resident species as well as unexpected visitors reaching Antalya's coasts during their journeys spanning thousands of kilometers. Therefore, protecting coastal dunes and wetlands in their natural form means safeguarding Antalya's potential for nature and birdwatching tourism alongside its biodiversity.

Today, a significant portion of the coastal plains housing Antalya's densest residential, agricultural, and tourism areas was covered in the past by wetlands, reed beds, floodplains, and seasonal water bodies. As Antalya grew, a substantial portion of these areas disappeared over time, replaced by the city we know today. Nevertheless, highly valuable coastal dunes and wetlands still persist along Antalya's coasts. River mouths where streams meet the sea, small lagoons, reed beds, beaches, and seasonal wetlands can carry immense importance



Blue rock thrush, Feslikan [H.İ.KESER]



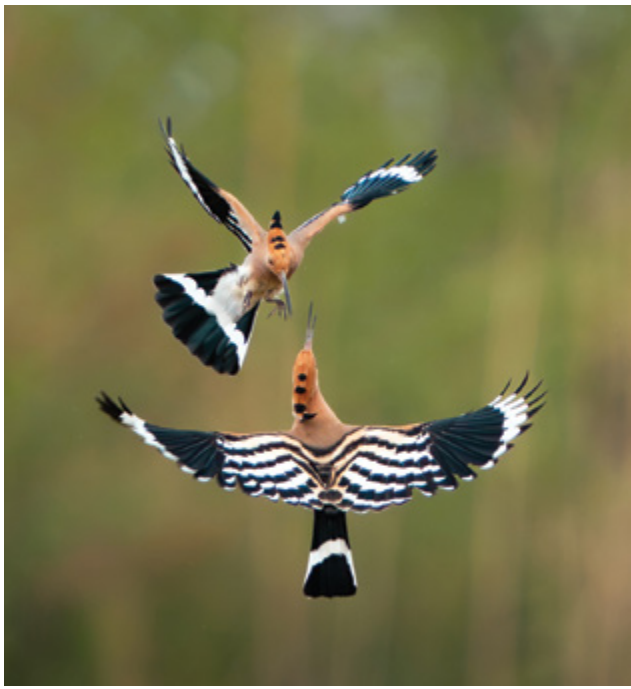
Audouin's gull, Kaş [Ö.NECİPOĞLU]

for birds and naturally other living organisms, even when small in surface area. The region where the Manavgat River reaches the sea stands out as a fine example of this. Protecting these special areas remaining in our hands after a long history of urbanization stands before us as an important duty.

Another example of habitats that are small in area yet carry great significance regarding our natural assets is the small islands and islets scattered along our coasts. Viewed from the land, these areas appear merely as small rocky outcrops, yet they constitute safe and often irreplaceable breeding habitats for seabirds. One of the finest examples of this is Audouin's gull (Larus audouinii), whose status is globally vulnerable. It is estimated that the breeding population of this Mediterranean-endemic seabird in Türkiye may be as low as approximately 70 pairs [1]. Our scarce island ecosystems hosting this rare species are highly sensitive to human impacts. In particular, human utilization during the breeding season and alien species introduced to islands by humans—such as rats and rabbits—can adversely affect the breeding success and habitats of seabirds by increasing predation on eggs and chicks or altering the islands' vegetation [2]. Therefore, protecting the natural structure of small islands, controlling human use particularly during breeding seasons, and managing introduced alien species represent keys to passing on these vital natural assets of our marine ecosystems to future generations.

Antalya's richness in terms of birds is certainly not limited to these few rare species. Over 350 bird species have been recorded in Antalya to date [3,4]. One of the primary reasons for this richness is the coexistence of vastly different ecosystems within very short distances. This habitat mosaic—stretching from Mediterranean coasts and islands to coastal wetlands, river mouths, maquis shrublands, Brutian pine forests, and the high mountain ecosystems of the Taurus range—brings forth an extraordinary bird diversity.

Antalya is not merely a habitat for birds; it forms a part of the Eastern Mediterranean geography where major avian movements between Anatolia and Africa take place. Consequently, Antalya's bird communities constantly shift with the seasons. While some species breed here, others spend the winter; many more utilize Antalya's coasts, wetlands, and valleys as resting and feeding grounds during spring and autumn migrations. Therefore, protecting Antalya's bird diversity means preserving not only a natural heritage belonging to Antalya or Türkiye, but a shared natural diversity moving across countries and continents.
Although Antalya ranks among Türkiye's fastest-growing and most intensively utilized regions for tourism, it has managed to preserve a portion of its vital natural values up to the present day. However, the challenge we will face in the upcoming period will not simply be the continuation of current human pressures.



Eurasian hoopoe, Manavgat [A.ÇOBANOĞLU]

Climate change will further magnify existing pressures, particularly on coastal and wetland ecosystems. Rising temperatures, shifts in precipitation regimes, drought, the depletion of freshwater resources, and sea-level rise could alter the water regime and habitat structure of coastal wetlands. Simultaneously, in heavily urbanized coastal zones, the space available for wetlands to adapt to changing conditions and retreat landward is progressively narrowing.

A habitat considered adequate for birds today may fail to fulfill the same function a few decades from now. Therefore, relying solely on the approach of "protecting the remaining areas" will



Pacific golden plover, Manavgat [B.IRMAK]

no longer suffice. To safeguard Antalya's future bird diversity, we are compelled to consider climate-resilient ecosystem management and ecological restoration alongside preservation.

Antalya today stands among the most important centers of world tourism. One of the ways to strengthen this position in coming years will be to make its natural values more visible and pass them on to future generations. Perhaps adding a new star to Antalya's tourism accolades depends not on constructing a new facility, but on protecting a forest valley, a pristine dune, a river mouth, a small wetland, or a rocky islet where a few pairs of seabirds nest.

When we protect all these areas, we will protect not only the birds, but also the nature that makes Antalya what it is and the "Blue Promise" made to the Mediterranean.

Concluding Remarks

This second section addressing Antalya's natural values clearly reveals that the city's terrestrial and marine ecosystems possess an inseparable, highly sensitive, and dynamic interaction network. From blue-carbon-storing seagrasses to coastal dunes, from streams nourished by karstic aquifer systems to the endemic plant paradises of the Taurus Mountains and the rocky islets where seabirds seek refuge, all these structures serve beyond biodiversity as the fundamental

guarantee of the city's economic and socio-economic sustainability.

When anthropogenic pressures—such as intensive tourism, coastal construction, uncontrolled boat anchoring, light pollution, and waste pollution—compound risks triggered by the global climate crisis, including seawater temperature increases, storm surges, drought, and habitat loss, it becomes increasingly important to sustain and strengthen existing conservation efforts through an integrated approach. To safeguard Antalya's unique natural heritage and bring to life a climate-resilient urban model fitting the spirit of COP31, priority must be given to the following strategic policies:

Holistic and Network-Based Marine/Coastal Conservation:

Expanding ecological mooring and anchor-buoy systems to prevent physical destruction caused by anchoring in sensitive zones with dense Posidonia oceanica meadows; rigorously enforcing lighting regulations and nighttime usage restrictions on sea turtle nesting beaches; strengthening protection measures to reduce human disturbance in areas encompassing the pupping and resting caves of the Mediterranean monk seal.

Conservation of Karstic and Floristic Richness (Hotspots):

Science-based management of the Taurus Mountains range, rich in endemism, and the İbradı–Akseki forest hotspots through botanical tourism and responsible ecotourism routes that take site-specific conservation needs into account; monitoring of Critically Endangered (CR) local endemic species.

Ecosystem Restoration and Climate-Resilient Area Management:

Implementing evidence-based ecological restoration projects where needed in burned forest areas, degraded wetlands and coastal dunes, taking into account each site's natural regeneration capacity and ecological characteristics; managing alien and invasive species on islands and in wetlands.

Multi-Stakeholder Participatory Governance and Data Transparency:

Establishing a transparent and trackable management mechanism based on SCADA, GIS, and biological databases, wherein public institutions, academics, local governments, mariners, fishermen, tourism enterprises, and non-governmental organizations are directly integrated into decision-making processes.

Antalya's blue and green heritage is a commitment we offer to the future as much as an heirloom received from the past. Protecting this chain of natural values extending from land to sea stands as the most concrete manifestation of the city's "Blue Promise" to the Mediterranean.



Boat congestion in Adrasan Bay, Kumluca

03
CHANGING CONDITIONS AND ENVIRONMENTAL PRESSURES

Antalya forms one of the most vital hubs of the Mediterranean Basin through its unique geography stretching from the Taurus Mountains to the depths of the Mediterranean, its rich biodiversity, and its global tourism power. However, the global climate crisis, rapid urban growth, intensive tourism mobility, and terrestrial waste pressures are subjecting this sensitive ecosystem and the socio-economic future of the city to an unprecedented test. Rising temperatures due to global warming, drying precipitation regimes, and depleted groundwater reserves transform the climate crisis from an unrealized future prediction into a dynamic reality that directly shapes our daily lives and urban economy. Similarly, the pollution load generated by our production and consumption habits on land increases pressure on coastal ecosystems and marine organisms by reaching the sea via streams and surface runoffs. In addition to this picture, our tourism sector—welcoming millions of visitors each year—creates a critical carrying capacity load on water, energy, and infrastructure that must be managed, alongside the major economic opportunities it provides. In this section, we present a synthesis of the tangible reflections of the climate crisis at the urban scale, integrated management models to secure Antalya's water future, waste transport pathways extending from land to sea, and scientific approaches that redefine the tourism economy based on carrying capacity principles. As the Antalya Blue Mediterranean Initiative, we hope these comprehensive analyses prepared by expert academics will lay the groundwork for evidence-based policy steps that will elevate the city's climate resilience, institutionalize resource efficiency, and carry the Mediterranean's blue heritage into the future.

3.1 Climate: Understanding Changing Conditions in Antalya

Prof. Dr. Barış SALIHOĞLU
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A City at the Hotspot of the Climate Crisis

Climate change is no longer an unrealized prediction about the future; it is a dynamic reality that directly impacts our daily lives, water resources, agricultural production, and coastal ecosystems. As clearly stated in Intergovernmental Panel on Climate Change (IPCC) reports, the Mediterranean Basin is defined as one of the "most sensitive hotspots of the climate crisis" due to temperature increases exceeding global warming averages and imbalances in precipitation regimes [1,2,3]. As one of the most critical biological, economic, and urban centers of this basin, Antalya is among the cities that feel the effects of the climate crisis most acutely due to its microclimate areas, steep topography extending from the Taurus Mountains to the coast, and intense urban activities.



Nature recovering in an area affected by past wildfires, Kaş–Kalkan [G.ACAR]

General Climate Trends in the Mediterranean Region

The Mediterranean Basin has reached a warming level of approximately 1.5°C, which is above the global average (approximately 1.1°C–1.2°C) compared to the pre-industrial period. If current emission scenarios continue, warming in the basin is projected to rise to the band of 2.2°C to 3.8°C by the end of the century [4]. Alongside temperature increases, total annual precipitation amounts are expected to decrease by 10% to 20%, while the temporal distribution of precipitation changes radically [5]. Instead of long-term light drizzles, precipitation occurs in the form of short-term but heavy downpours, which deepens hydrological drought. Furthermore, the continuous increase in sea surface temperatures increases physiological pressure on native species of the Mediterranean while paving the way for foreign and invasive species of Red Sea origin to rapidly become dominant in the basin.

Climate Change Indicators Observed in Antalya

Across the city, a marked increase is recorded in "tropical nights"—where night temperatures do not drop below 20°C—and the number of heatwave days. While extreme temperature records broken in summer reinforce the urban heat island effect, oceanographic indicators sound a similar alarm. Surface water temperatures in the Gulf of Antalya have risen above long-term averages; surface temperatures approaching 30°C in summer and maintaining high levels during the winter period have been detected. Long-term data belonging to the open Eastern Mediterranean confirm this trend. At the 33°N–30°E point located south of the Gulf of Antalya, the August surface water temperature increased by approximately 0.04°C per year during the 1980–2026 period, which corresponds to roughly 2.1°C of warming throughout the period [6]. In the wide belt covering longitudes 15°E–35°E along the 33°N latitude, the warming in the same period was calculated as approximately 1.9°C. In the precipitation regime, while the total number of rainy days decreases, extreme precipitations falling per square meter in short periods have increased the frequency of flash floods and hail events. On the other hand, in the Taurus Mountains, which serve as the city's natural water reservoir, the persistence period of temporal snow cover has shortened, and the snowline has retreated to higher altitudes. This situation has significantly reduced freshwater inputs fed by snowmelt during the summer months.

Projected Risks for Antalya

The reflections of the climate crisis at the urban scale create multi-layered risk areas that interact with one another, ranging from agriculture to forestry, and from marine ecosystems to socio-economic infrastructure. Decreasing precipitation, evaporation increasing with high temperatures, and retreating groundwater levels directly threaten the rich agricultural structure of the city—especially greenhouse cultivation and citrus production—while excessive extraction in groundwater reserves triggers saltwater intrusion into coastal aquifers and associated salinization, leading to the unproductivity of agricultural soils. Accompanied by these terrestrial pressures, the combination of rising temperatures, falling relative humidity, and dry winds such as Poyraz prolongs the wildfire season in the pine forests surrounding the city and maximizes fire sensitivity [7]; forest losses destroy the city's erosion prevention and carbon sink capacity alongside biodiversity. This negative picture on land also reflects on the marine environment; warming in the Gulf of Antalya causes the regression of critical habitats such as seagrasses (Posidonia oceanica), the contraction of commercial fish stocks [8], and the disruption of the trophic balance in the ecosystem by increasing the populations of invasive species such as pufferfish and lionfish as a result of changing marine dynamics [9]. All this ecological destruction also spills over into the socio-economic dimension, lowering the comfort index of the outdoor recreational tourism season due to extreme temperatures climbing in summer [10]; storm surges intensified by sea level rise face coastal infrastructures, beaches, and urban structures along the cliff borders with erosion and destruction risks.



Native to the Red Sea, lionfish have also become widespread along Antalya's coast as the Mediterranean warms. [T.CEYLAN]

Climate-Resilient Antalya Vision

To mitigate the impacts of the climate crisis and adapt to unavoidable impacts, integrated and strategic steps must be taken at the Antalya scale. In this context, spreading green infrastructure and "sponge city" applications that retain urban surface runoffs and direct rainwater to natural aquifers is a priority step. Circular approaches such as transitioning to smart and pressurized irrigation technologies in agriculture and reusing treated urban wastewaters in irrigation are of vital importance in combating deepening water scarcity. Moreover, establishing artificial intelligence and Geographic Information Systems (GIS)-based early warning infrastructures for wildfires, extreme precipitation, and urban floods will ensure that faced disaster risks are combated with a systematic and data-driven approach.

Antalya's future against the climate crisis depends on scientific, decisive, and holistic measures to be taken starting today. For Antalya preparing for the COP31 process, combating climate change is not merely an environmental obligation; it is a struggle to protect the city's economic sustainability, social welfare, and unique nature. The "Antalya Blue Mediterranean Initiative" is a historical decision-making and implementation ground to bring the scientific solutions that will elevate the city's climate resilience to life.



The forest fire in Kaş in August 2026

3.2
Antalya's Water Future

Prof. Dr. Ayşe MUHAMMETOĞLU
Akdeniz University, Department of Environmental Engineering

The Future of Water Resources from Türkiye to Antalya, Integrated Water Management

Türkiye's annual usable water resources amount to 112 billion m^3, corresponding to approximately 1,305 m^3 per capita per year based on the country's population in 2025. This value shows that our country is in the water stress class according to the Falkenmark index [1]. Climate projections indicate that the country's available water potential could decrease by approximately 10.5% by 2050 and 26.4% by 2100, while rainfall is expected to decline and dry periods to become longer in the Mediterranean Region [2]. While population growth, urbanization, agricultural production, tourism, and industrialization increase water demand, climate change adversely affects the quantity, quality, and seasonal availability of water resources. According to State Hydraulic Works (DSİ) 13th Regional Directorate data, gross water potential of Antalya province is 17,123.01 hm^3 (14,636.15 hm^3 surface water and 2,486.86 hm^3 groundwater), and Antalya province has a share of approximately 9% within our country's total gross water potential. However, within the past nine-year period (between 2017 and 2026), groundwater (GW) potential of Antalya province decreased by approximately 31%, reducing the province's gross GW potential to 1,705 hm^3/year [3]. This change demonstrates that the adverse effects of climate change are beginning to affect Antalya province much more rapidly.

The decline in GW potential of Antalya poses a significant risk to water supply security because approximately 97% of the water supplied for drinking and domestic use depends on GW resources. Population growth, the seasonal demand of tourism, and the intensification of agricultural irrigation needs, especially during summer months, increase the pressure on existing water resources during dry periods. Falling GW levels cause a reduction in well yields, increase the energy required for water supply and raise operating costs. In coastal aquifers, excessive GW abstraction causes salinization and reduces freshwater availability. These processes make it more difficult to meet agricultural irrigation requirements, adversely affecting crop yields and farmers' incomes, while also threatening service and production continuity in tourism and industry. Declining GW discharges to streams and wetlands also place pressure on natural habitats and biodiversity. These observed adverse impacts highlight the need to assess the vulnerability of Antalya's water resources to climate change and increasing demand, strengthen adaptation measures and implement integrated water management (Figure 1).

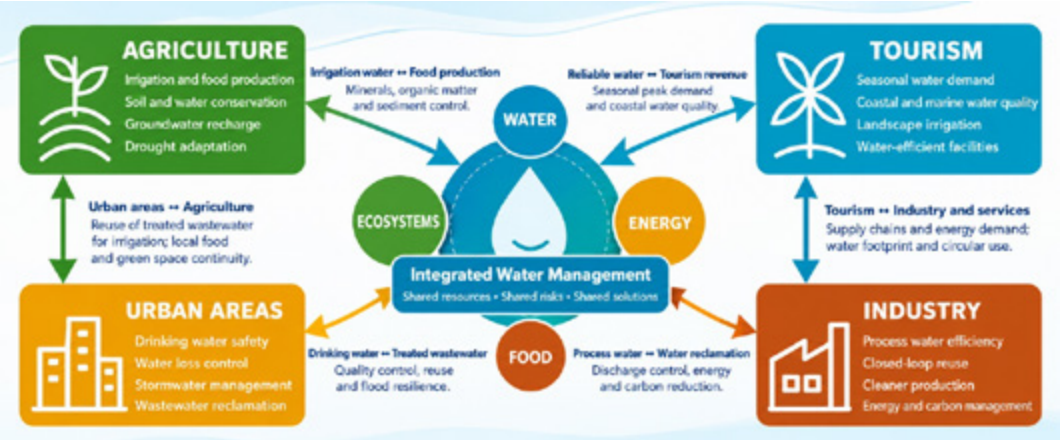


Figure 1. Integrated Water Management with Water-Energy-Food-Ecosystems nexus

Climate and Sectoral Demand Pressures in Antalya

The Intergovernmental Panel on Climate Change emphasizes that warming, prolonged heatwaves, droughts, and water scarcity risks will increase in the Mediterranean Basin [4]. Antalya province's urban quality of life, tourism economy, agricultural production, GW reserves, streams, and the ecological health of the Mediterranean Sea depend on the same water cycle, and climate change makes this cycle more vulnerable. Temperature increases observed in Antalya in recent years have increased evaporation and plants' water needs. Changes in the seasonal distribution of precipitation and long dry periods reduce the reliability of water resources, while heavy rainfalls increase the risk of floods and pollutant transport. Intense rainfall over short periods limits opportunities to store water for dry months or sufficiently recharge GW.

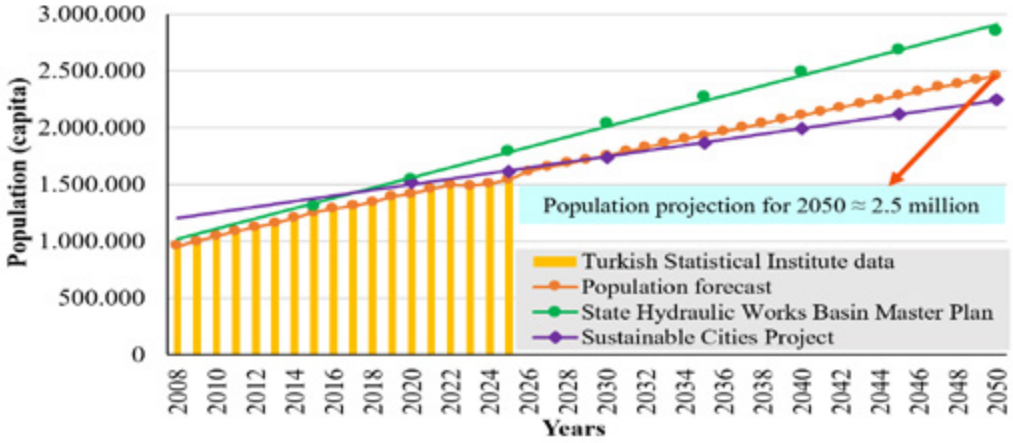


Figure 2. Population projections for Antalya city [5]

While population growth and urbanization generate water demand throughout the year, tourism and agricultural irrigation concentrate in the summer months. Consequently, sectoral demands converge on the same resources during periods when water is more limited. Population projections show that the population of Antalya city can reach approximately 2.5 million by 2050 (Figure 2) [5]. Under these conditions, water supply security cannot be provided merely by abstracting more water from resources.

Groundwater: A Strategic Reserve That Must Be Protected

Approximately 97% of Antalya province's urban drinking and domestic water is supplied from GW resources. This high and critical dependence on GW sources poses a significant risk to urban water supply security due to the reduction in GW potential. GW should be regarded as a strategic buffer reserve to be protected for dry years, rather than as a resource to be consumed without limits under normal conditions. Excessive abstraction from aquifers reduces Antalya's resilience to climate change, while saltwater intrusion in coastal areas can lead to long-term and hard-to-remedy quality problems. To protect the strategic reserve nature of GW, water abstractions must be limited to the recharge capacity of aquifers. Sustainable water management requires a complete inventory of existing wells, coordinated and regular monitoring



Kırkgöz Spring, one of Antalya's most important sources of drinking water and karst groundwater. [T.CEYLAN]

of abstraction volumes, GW levels and water quality, and the prevention of uncontrolled and illegal use. Aquifer recharge areas must be protected from urbanization and pollution pressures, and early warning and intervention thresholds for salinity must be established in coastal areas.

Urban Water Management: Lost Water is the Cheapest and Closest New Resource

In 2025, approximately 396 million m^3 of water was supplied for drinking and domestic use in Antalya Province, while total water losses in urban water supply and distribution systems amounted to 34.57%. Total water losses comprise physical (real) and apparent losses. Physical losses consist of leakage and bursts in pipes, valves and service connections within water transmission and distribution systems, together with leakage and overflows from storage reservoirs. Apparent losses arise from illegal water use, meter measurement errors, data recording/processing errors, and consequently represent the water volume that is used within the system but is not accurately recorded. Apparent losses result in revenue losses for water utilities. As of 2025, physical losses in the urban water distribution networks of Antalya province are approximately 20%, apparent losses are 14.5%, unbilled authorized consumption (free water use) is 11.4%, and Non-Revenue Water is at the level of 45.9% [6]. These indicators reveal a serious need to improve existing network infrastructure and operational performance. Reducing losses in the existing system should be both a strategic and an economic priority before searching for new water resources.

For the control of water losses, drinking water distribution network should be divided into isolated sub-zones (district metered areas); inlet flow rate, pressure, and minimum night flow values for each zone should be monitored regularly. Supervisory Control and Data Acquisition (SCADA), Geographic Information Systems (GIS), and subscriber/billing/asset management software should be used in an integrated manner to ensure monitoring of the water supply network, evaluation of pressure/consumption data, and effective management of water losses. Active leakage control, pressure management, rapid and high-quality repairs, and renewal of ageing pipes should be implemented effectively to control physical water losses. Measuring all billed/unbilled water consumptions, improving measurement accuracy of water meters, replacing old meters, preventing unauthorized/illegal uses, and improving data processing/recording processes are necessary to reduce apparent losses. Water consumptions in public areas such as public buildings, schools, and parks should also be monitored carefully. In these areas, the use of smart meters enables the early detection of unusual consumptions, helping to prevent leaks and water wastage occurring after the meter. With the reduction of water lost in the network, urban water demand, treatment requirements, energy use, operating cost, and greenhouse gas emissions will decrease. Therefore, the cheapest and closest new resource for urban water supply is actually the water lost in the network. The basic steps for protecting GW resources and ensuring climate-resilient urban water efficiency are shown in Figure 3.

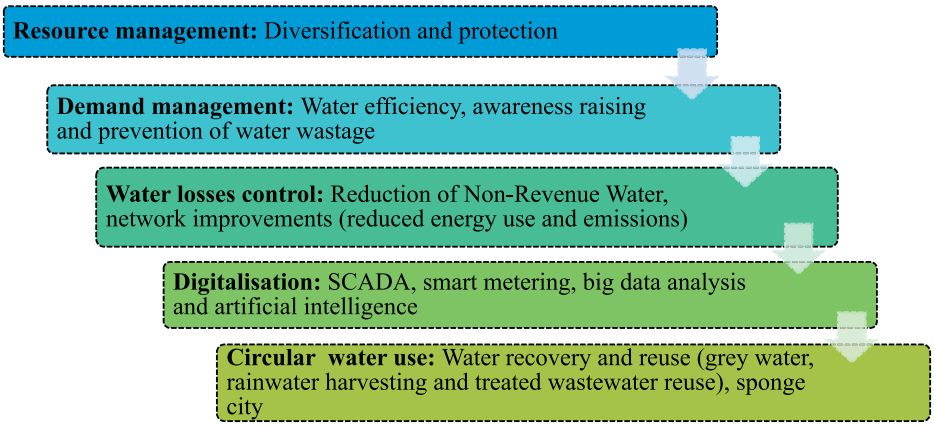


Figure 3. Urban water efficiency and climate-resilient management

Agriculture: Efficiency from Source to Field

Agricultural water management is not limited solely to the selection of irrigation methods used in agricultural fields. Of the 206,201 ha economically irrigable land in Antalya province, 145,376 ha has been opened for operation, and some open irrigation systems have completed their economic lifespans. Agricultural water management must jointly consider water transmission losses from source to field, ageing open-channel irrigation systems, uncontrolled and illegal well use, cropping patterns and water requirements, irrigation scheduling, soil properties, water quality and farmers' capacity to implement appropriate practices. Modernization of irrigation systems and regular measurements are priorities for improving irrigation performance. There is a need for an up-to-date inventory combining districts, crops, irrigated areas, water source types, and actual water consumption for Antalya province. The conversion of open-channel systems that have reached the end of their service life into closed/ pressurized pipe systems should be carried out with in-field irrigation improvements. Meteorological data, soil moisture, and crop growth stages should be reflected in irrigation decisions. The expansion of crops with high water demand should be evaluated together with the basin's water balance, and GW abstractions should be regulated. Practical technical support should be provided to producers, and modern irrigation investments and practices increasing soil water holding capacity should be supported [7].

Tourism: Managing Demand in the Summer Period

In tourism facilities, water in different amounts and qualities is used at many points such as rooms, kitchen, laundry room, pools, cooling systems, and landscape areas. Visitor numbers and temperatures increasing in summer raise water demand in the same period together with agricultural and urban needs. Monitoring only total billed consumption is insufficient to identify where and for what purposes water is used.

For effective water management in tourism, water-saving equipment usage, internal metering, leak detection, and operational improvements in areas such as laundries should be provided primarily. The spread of water recovery applications with drought-resistant landscaping, smart irrigation, and alternative water sources (greywater, rainwater, air conditioning condensate water, and reuse of treated wastewaters) is important for improving water efficiency in tourism facilities [8]. Limiting GW abstraction, especially in facilities located in coastal regions with large landscape areas, contributes to protecting coastal aquifers against salinization.

Industry: Monitoring Water in Production Processes

Although industry's share in total water use in Antalya province is much lower than agriculture, measuring consumption at facility and process levels is a priority for industrial water efficiency. While the official water allocation for industry is approximately 34.6 hm^3/year, average actual consumption in the 2021–2024 period was reported in the range of 93–146 hm^3/year. This difference requires allocation records, consumption from the public water supply network and GW abstraction to be assessed within a comprehensive and reliable inventory. Due to the restriction of surface water supply during dry periods and increasing demand for GW resources, water efficiency, reuse, resource diversification, and drought risk management should be planned together. Water consumptions in facilities' production, cooling, washing, cleaning and other processes should be measured separately. After unnecessary consumptions are reduced, the reuse of water of appropriate quality should be planned. A joint recovery infrastructure should be developed in organized industrial zones. Preparing alternative supply and water conservation plans for drought periods is also important for maintaining production continuity [9].

Treated Wastewater, Sea, and Shared Future

In Antalya province, approximately 850 thousand m^3 per day and more than 300 million m^3 of wastewater per year are treated, and approximately 80% of treated wastewater is currently discharged into the sea with 18 Deep

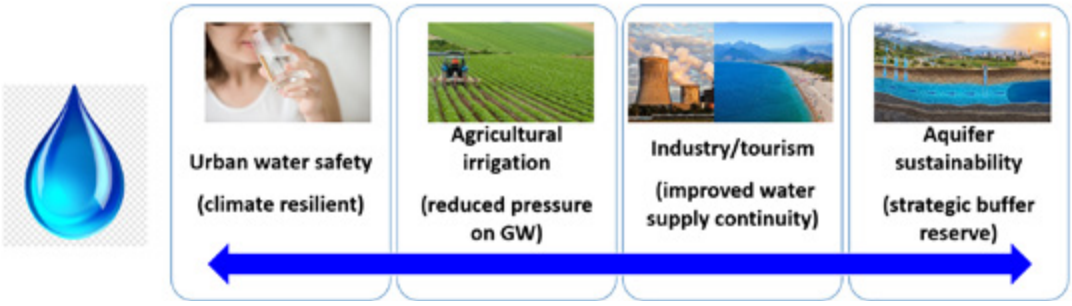


Figure 4. Joint water action securing Antalya's water future

Sea Outfall Systems [10]. In terms of wastewater management, protecting sea water quality is the primary priority, and treatment plants' performance, outfall pipe systems, and coastal water quality should be monitored together. While safe reuse of treated wastewater offers an important opportunity to reduce pressure on surface and GW resources, factors such as water quality, transmission distance, storage, seasonal demand, and cost factors should be evaluated carefully. Reuse in agriculture, industry, and landscape should be carried out with fit-for-purpose treatment and regular monitoring of public health risks. Water savings to be achieved with efficient use of water in households and industry will reduce wastewater generation. With the reduction of wastewater volume, treatment requirements, energy use, wastewater volume discharged into the sea, and emissions will decrease.

The impacts of land-based activities reach the sea via streams, surface runoff, and discharges. The Antalya Blue Mediterranean Initiative and Antalya's Blue Promise must rest upon a measurable transformation that protects water from source to sea, reduces losses, and observes ecosystems' needs. Public institutions, universities, sectors, and citizens must meet around a joint water action to secure Antalya's water future, and work together for integrated water management that reduces pressure on GW sources and dominates circular water use (Figure 4).

3.3 From Land to Sea: The Journey of Waste

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We tend to view seas generally as independent from land, closed within themselves, and infinite ecosystems. Yet the water cycle on our planet establishes a bond between lands and seas. Today, approximately 70-80% of pollution accumulating in marine environments on a global scale originates from land-based activities [1,2]. Wastes discharged from residential areas, agricultural lands, riverbeds, or urban solid waste facilities and inadequately managed reach the seas—the ultimate collection basin—sooner or later. This situation reveals that waste management is not merely a municipal or urban cleaning matter; it is directly a marine and coastal conservation strategy.

Protecting the sea begins with managing our footprints on land. The journey of waste from land to sea is a combination of complex physical and hydrodynamic processes. Wastes left on land are transported to drainage channels and river systems by rainwater, surface water runoff, and wind effects. Rivers function as "natural corridors" carrying terrestrial pollution to the marine environment. When we examine terrestrial pressure factors, key elements become clear: urban population density, periodic tourism fluctuations, industry and agricultural activities, and basin-based drainage channels. All these elements shape the invisible pressure of the production and consumption chain on land over marine ecosystems.



High population density and intensive development along Antalya's coast increase the pressure from waste.

Although the Mediterranean constitutes 0.7% of the world ocean surface, it is a unique ecosystem hosting approximately 4-18% of global marine biodiversity [3]. However, due to its semi-enclosed structure, intensive maritime traffic, and high population density around it, it is one of the seas with the highest waste accumulation sensitivity on a global scale. Türkiye has a long coastline in the Mediterranean and is under the influence of both wastes transported from its own terrestrial basins and transboundary pollution transported by the general current regimes of the Mediterranean. The pollution load reaching the sea from terrestrial basins via rivers directly threatens the mass balance and food chain in the Mediterranean ecosystem. The tendency of a plastic waste entering the Mediterranean to accumulate in this closed basin for many years demonstrates why terrestrial measures are essential.

Antalya is one of the Mediterranean's most important biological and economic centers with its cliffs, long sandy beaches, and clear waters. Nevertheless, the city possesses unique sensitivities regarding waste transport from land to sea:

•Important water resources such as Aksu, Düden, and Manavgat and drainage channels passing through intensive agricultural greenhouse areas play a critical role in transferring terrestrial-origin wastes to the marine environment. As a result of fertilizer and pesticide use above the Türkiye average in the region, high proportions of nutrient elements



After a day of rain, Düden Waterfall carries land-based pollution into the sea. [G.ACAR]

emerge and are transported to coastal waters via streams [4].

•The cliff structure and urban surface runoff lines in the city center lay the groundwork for transferring wastes on land directly to coastal waters during rainy periods [5,6].

•Direct bilge discharges and accident-sourced leaks in marinas, port environments, and coastal waters originating from tour boats, commercial ship traffic, and port operations cause regional pollution [7,8].

•Terrestrial wastes transported from Aksu, Köprüçay, and Manavgat river basins, intensive tourism mobility, and urban solid waste pressure together with abandoned fishing gear (ghost nets) have been recorded as marine litter and microplastic pollution directly threatening fishing grounds and the coastal ecosystem in the region [9].

•Besides, to understand the dimension reached by marine litter and plastic pollution on Antalya beaches, 2026 field observations and monitoring data present critical findings. Beyond macro-sized plastic garbage and invisible microplastics on our coasts, mesoplastics ranging in size between 5 and 25 millimeters stand out as the most prominent pollutant class constituting the intermediate stage of the ecological threat.

Indeed, in field studies conducted at the beginning of 2026, an unusual increase in mesoplastic accumulation and an extreme density anomaly were detected along the Antalya Gulf coastline and beach sediments. When the reason for this pollution event is investigated, it is seen that the situation is not limited only to Antalya's urban solid waste or local tourism pressure. The regional current regime makes such transport possible towards the west into the Gulf of Antalya via the Cilician Current and intra-basin circulation regimes of high pollution loads originating from industrial wastes and river inputs in the Mersin Bay and Eastern Mediterranean basin [10,11,12]. Polymeric material released from industrial facilities and terrestrial discharges in the eastern basin is transported by seasonal currents and accumulates in Antalya's sheltered coves and shallow sandy areas. Antalya coastal observations for the year 2026 show that managing terrestrial waste is imperative to be handled not only at the local urban scale, but also at the regional scale. In this direction, Geographic Information Systems (GIS)-based pollution mapping, polymer fingerprint analysis (FTIR/Raman), and an integrated inventory of local terrestrial pressure elements must be adopted as a strategic priority to determine the exact source and transport paths of future pollution problems[13,14].

The global COP31 summit that Antalya will host is a historical showcase for the city to present a pioneering "Blue Basin Model" blending terrestrial waste management with integrated marine conservation strategies. When this global vision is combined with a circular economy transformation where agricultural and urban wastes are separated and recovered right at the source, "Zero Waste Blue" targets will find the opportunity to turn from abstract declarations into measurable, concrete outputs.

Activities that must be done to improve and prevent the regional pollution problems make it mandatory to solve the problem not in the sea, but on land and while still at its source. To cut waste transport from land to sea, barrier systems capturing wastes without disrupting natural life must first be installed at river and stream mouths, and real-time monitoring mechanisms must be put into operation. In the agricultural field, expanding sectoral collection centers to collect plastic covers, drip irrigation pipes, and packaging wastes used intensively especially in greenhouse cultivation constitutes a critical step. These actions must be supported by mapping terrestrial pollution hotspots with GIS and database-based modellings and making priority interventions to risky areas. Ultimately, the realization of permanent success for all these technical steps depends on the awareness that "A large part of wastes that cannot be managed on land reach the sea" being embraced at the level of local communities and businesses through urban cleaning, coastal monitoring, and zero waste applications.

The way to protect our seas does not pass through standing on the coast and looking at the sea; it passes through changing our production, consumption, and waste management habits on land. The Antalya Blue Mediterranean Initiative offers a historical opportunity to bring this holistic perspective to life. Cutting the journey of waste extending from land to sea will secure not only our present, but also the Mediterranean's blue heritage to be passed on to future generations.

3.4 Understanding Antalya through Its Tourism Economy: Growth, Resources and Carrying Capacity

Prof. Dr. Mehmet YAZICI
Faculty of Tourism, Antalya Bilim University

Beyond Visitor Numbers

Reading Antalya through the tourism economy is easy at first glance: visitor numbers, overnight stays, bed capacity, occupancy, and revenue indicate the size of the sector. However, in a destination where tourism is intertwined with the urban economy, natural resources, and social life, looking solely at volume is not sufficient. The real question is with which resources growth is produced and to what extent it can be sustained in the long run.

According to data from the Ministry of Culture and Tourism, Türkiye completed 2025 with 64 million visitors and 65.2 billion dollars in tourism revenue, and growth continued in 2026. Antalya is the center of this success [1]. Therefore, alongside the question "how many more tourists?", the question "how much permanent economic value with existing resources?" must be added.

Carrying Capacity Is Not a "Magic Number"

In tourism literature, carrying capacity expresses the level of tourism a



Intensive use of Konyaaltı Beach reflects the pressure on infrastructure and natural resources when visitors concentrate in particular places and at particular times. [Ö.DONMAZ]

destination can sustain without creating unacceptable degradation in its environmental, social, and economic structure. Liu [2] emphasizes that capacity has different thresholds related to physical, ecological, economic, social, and visitor experience. Zekan et al. [3] state that capacity is not a single "magic number"; it must be evaluated together with time, space, resource use, and stakeholder expectations.

This approach is particularly important for Antalya. The concentration of the same number of visitors in the coastal belt during summer months versus their distribution across different districts throughout the year does not create the same impact on water, energy, traffic, waste, and local life. Therefore, the question "how many people?" must be complemented by the questions "where, when, and using which resources?". The core of the overtourism debate is also predominantly the failure to manage density rather than the number of tourists [4,5].

Between Growth and Resource Pressure

Antalya's development cannot be thought of independently of Türkiye's growth model based on coastal and mass tourism. Investments supported since the 1960s and accelerated after the Tourism Incentive Law dated 1982 have transformed Antalya into a major tourism center. While this process accelerated employment and urban growth, it also increased environmental and spatial pressures [6,7].

Antalya is simultaneously part of the Mediterranean tourism belt. High-season density, coastal pressure, and water demand are common problems of the region. While Duro and Turrión-Prats [8] show that seasonality is particularly pronounced in Mediterranean countries, UNEP/MAP [9] defines aligning economic activities with the carrying capacity of ecosystems as a priority. Antalya thus stands as one of Türkiye's strong examples of the "high tourism demand-limited natural resources" tension in the Mediterranean.

The Unseen Cost of Scale

The economic power of Antalya's tourism relies on a wide resource chain. While accommodation facilities intensively use water, energy, food, textiles, and transportation services, they also generate waste. Therefore, when evaluating tourism revenue, the resources utilized to produce this revenue must also be factored into the equation.

Water is one of the most visible examples. Examining accommodation facilities in Antalya, Şahin, Topkaya, and Civelekoğlu [10] showed that direct water use can vary between 103 and 1,209 liters per guest-night. This variance points to a serious efficiency potential alongside facility characteristics. Furthermore, tourism's water footprint is not limited to room consumption; it has been shown that food consumption has a significant share in the indirect water footprint in the Eastern Mediterranean [11]. Consequently, kitchen, purchasing, and food waste management are also parts of resource policy.

Another issue is the extent to which the created value remains in the destination. Although the all-inclusive system contributes to Antalya's economies of scale, it can limit out-of-hotel spending. Strengthening ties between hotels and local agriculture, food, and other suppliers is important to reduce

leakage in tourism revenues [12]. High-value tourism should therefore mean not only higher spending, but also the greater circulation of revenue in the local economy and higher value creation per resource.

Risks and Opportunities

The primary risk for Antalya is that climate and resource pressures increase during the same period as tourism density. High visitor numbers in summer months place simultaneous loads on water, energy, transportation, and waste infrastructure. Seasonality creates capacity pressure during the high season while leading to the idleness of facilities and labor force during the low season. The strengthening of local residents' perception of competition for housing, traffic, coastlines, or natural resources can strain social carrying capacity [5].

Climate change can also affect tourism seasons, energy and water costs, and investment decisions in the Mediterranean. In contrast, Antalya's long season, strong accommodation infrastructure, air transportation, and product diversity offer significant opportunities. The development of culture, gastronomy, sports, health, congress, nature, and rural tourism can spread demand throughout the year and to different regions. Digital meters, sensors, data analytics, and artificial intelligence can manage resource consumption more precisely; increasing local supply can also strengthen the multiplier effect of tourism revenue in the region. Thus, sustainability can transform from an environmental obligation into part of cost, risk, and competition management.



Named the world's most beautiful hiking route in 2025, the Lycian Way is a compelling example of Antalya's potential for year-round tourism. [G.ACAR]

An Applicable Policy Framework for Antalya

Antalya primarily needs a joint measurement infrastructure. Alongside visitor numbers, revenue, and occupancy, water and energy consumption per guest-night, local economic value per tourist, waste amount, local supply share, year-round employment continuity, and local resident and visitor satisfaction should be added. Research shows that sustainable destination indicators must encompass environmental, economic, social, and governance dimensions together [13,14].

Capacity should also be monitored not with a single Antalya figure, but on a district, season, and resource basis. Acceptable thresholds can be determined for critical indicators; when limits are exceeded, transportation, water management, visitor routing, or new capacity decisions can be activated [15].

Tourism policy should also steer toward producing "more value from existing capacity" instead of "more capacity." Extending the season, alternative tourism products, local supply chains, and applications increasing in-destination spending are tools of this transformation. Public authorities, sectors, universities, and technology startups should meet on joint data and pilot application platforms; hotels should be able to transform into living laboratories where energy, water, food waste, and digital efficiency solutions are tested.

Conclusion: Redefining the Nature of Growth

The power to create scale has been decisive in the past success of Antalya tourism. In the future, how smartly this scale is managed will gain importance. Carrying capacity should be viewed as a management tool to protect economic value in the long term rather than a concept limiting tourism.

The new equation can be built on more value per tourist instead of more tourists, more economic output per resource instead of more resource consumption, demand spread across the year instead of a more intensive season, and stronger local connections instead of out-of-destination inputs. This approach is not against growth; it redefines the nature of growth. Antalya's fundamental question should no longer be "How much more can we grow?", but rather "How can we build a more balanced, resilient, and high-value-producing tourism economy with the natural, economic, and social resources we possess?". Antalya's future position in the Mediterranean will be determined by the answer it gives to this question.

Concluding Remarks

The scientific data and field analyses we set forth under the heading of changing conditions and environmental pressures clearly demonstrate that Antalya's environmental sustainability and economic future draw nourishment from the same ecological balance. The escalating effects of the climate crisis, groundwater reserves strained by climate change and growing demand, marine plastic pollution transported to our coasts by Eastern Mediterranean currents, and the resource pressures driven by mass tourism compel holistic and ambitious interventions that transcend fragmented solutions. In this direction, the process of combating climate change and environmental pressures must be elevated on the following core pillars:

•Climate-Resilient Urban Infrastructure: "Sponge city" and green infrastructure applications must be widely adopted across the city to combat heat waves, extreme precipitation, and drought, while urban and natural disaster risks must be managed through data-driven methods using early warning systems.

•Integrated and Circular Water Management: Physical and administrative water losses in the distribution network must be minimized to reclaim lost water as the nearest and most cost-effective water source. Groundwater resources must be safeguarded as strategic buffer reserves, and the reuse of treated wastewater in landscaping, agriculture, and industry must be expanded.

•Severing the Waste Chain from Land to Sea: The transport of terrestrial waste to the sea must be prevented at the source through containment barrier systems installed at river and stream mouths. Pollution must be monitored and disposed of not only locally but also at a regional scale using GIS-based mapping, polymer fingerprinting analyses, and agricultural waste management systems.

•High-Quality and Resource-Efficient Tourism Economy: Success in tourism must be measured not merely by visitor numbers, but by economic value generated per tourist, resource efficiency, the strength of local supply chains, and the extended season approach. Destination carrying capacity must be monitored through real-time district, seasonal, and resource-based data to guarantee the tourist-environment balance.



Seabed clean-up at Kaleiçi Marina as part of World Environment Day activities

04
ANTALYA BLUE MEDITERRANEAN INITIATIVE

The destructive impacts of climate change, accelerating biodiversity loss, and an escalating global waste crisis can no longer be evaluated as isolated issues. Feeding and compounding one another, these forces form a complex environmental landscape that directly shapes the future, quality of life, and resilience of modern cities.

For Antalya, situated in the heart of the Mediterranean, this global crisis is not merely a statistical warning; it is an urgent, existential call to action. From its economy and daily culture to its tourism potential and deep-rooted urban identity, Antalya is fundamentally bound to the sea, its coastlines, and the unique Mediterranean ecosystem. The sea is not simply a blue horizon; it is the city's breath, source of prosperity, and key to its future.

This vital bond endows Antalya not only with the privilege of enjoying nature's generosity, but also with the solemn duty to safeguard this ecological heritage at all costs and transmit it unblemished to future generations. The Antalya Blue Mediterranean Initiative represents the city's resolute response to this historical call.

The Initiative defines our waters and coastlines not as passive conservation zones, but as an invaluable shared heritage. Moving beyond temporary reactive measures after pollution occurs, this visionary approach focuses on stopping pollution directly at its source, sheltering fragile Mediterranean ecosystems, and embedding environmental consciousness into daily urban culture.

The overarching objective extends beyond executing standalone projects; it aims to build a deep-rooted culture of nature conservation, uniting all citizens around a shared vision for generations to come. Protecting nature inherently safeguards the city's collective memory and future. A city that diligently cares for its sea and land preserves not only its ecosystem, but also its culture, livability, and distinct identity.

The Mediterranean is a living space of memory—carrying centuries of stories within its waves and connecting the experiences of all who have inhabited these lands. Every inch of coastline, water, and biodiversity protected stands as a testament to our respect for the past and our pledge to leave pristine shores for Antalya's children.

In this regard, the Antalya Blue Mediterranean Initiative is a unified city movement that collectively identifies challenges, formulates evidence-based solutions, and shares accountability. Every protective action extended toward Antalya's blue is a commitment to the city's tomorrow.

4.1 The Emergence of a Citywide Commitment

In November 2025, the confirmation of Antalya as the host city for COP31 initiated comprehensive regional preparations. The vision set forth by the Governor of Antalya, Mr. Hulusi Şahin, ensured that this process would extend well beyond hosting a successful event.

The primary objective was for Antalya to inspire through its environmental and sustainability vision during COP31, leveraging this historic milestone into a long-term conservation mobilization across the city.

The initial step was not the immediate enactment of pre-formulated project lists, but listening directly to the city. Inclusive consultations were conducted with public institutions, local governments, non-governmental organizations, private sector stakeholders, and academic experts. Priority environmental challenges, critical natural assets, and potential solutions were thoroughly evaluated, synthesizing perspectives across diverse disciplines.

As planning progressed, a central focus emerged: the sea and its interconnected coastal environments. Assessments demonstrated that many marine environmental problems originate on land. Coastal plastic pollution often stems from land-based activities, and rivers transport upstream pollutants directly into the marine environment. Every domain, from agriculture to tourism, influences this delicate ecosystem. Because pollution draws from multiple inland sources, solutions could not be limited to downstream clean-up operations alone.

Concurrently, international best practices were examined and adapted to Antalya's specific ecological and structural context. Concrete, actionable intervention strategies were mapped to each identified environmental pressure point to mitigate or eliminate pollution at its source.

Initial efforts were organized around four preliminary operational pillars: clean-up and direct intervention, prevention at source, recycling, and public awareness, education, and outreach. This framework marked a structured beginning rather than a final endpoint.

On April 3, 2026, a high-level consultation meeting hosted by Akdeniz University served as a key milestone. More than 70 stakeholders—including district governors, mayors, agency heads, and NGO leaders—jointly refined the diagnostic frameworks and proposed operational solutions.



The first assessment meeting, 3 April 2026

On April 15, 2026, the Initiative presented its framework in Ankara. A delegation led by Governor Hulusi Şahin conducted executive meetings with the Ministry of Environment, Urbanization and Climate Change, the Climate Change Presidency, and the Turkish Environment Agency. Strong institutional support was secured, accelerating field implementation.

Concurrently, specialized expert working groups were deployed. Underwater clean-up operations were intensified, and the installation of public drinking water refill stations commenced across high-density urban areas.

On May 12, 2026, the Antalya Blue Mediterranean Initiative was officially launched to the public—marking the beginning of an all-inclusive civic action call.

The Initiative thus evolved from a static project framework into an agile governance model that actively engages diverse citywide dynamics and mobilizes regional resources toward a unified environmental purpose.



The launch introducing the Antalya Blue Mediterranean Initiative to the city, 12 May 2026

4.2 A Holistic Approach

Through ongoing technical consultations, it became evident that each environmental challenge required a tailored form of intervention.

Certain degraded areas required immediate physical clean-up. In other contexts, the primary response was not collecting waste post-generation, but preventing its creation at the source. Elsewhere, priorities extended beyond waste management to ecological restoration, reducing physical pressures on marine habitats, and enhancing ecosystem resilience. Ensuring the longevity of these interventions required strengthening societal connections to the environment and embedding sustainable habits into daily life.

For example, the recognition that sensitive habitats such as seagrass meadows were heavily affected by physical pressures led to Ecological Conservation and Restoration becoming a distinct area of work. Recycling activities were brought under Prevention at Source, in line with the goal of managing waste before it enters the natural environment.

To address these requirements, the Initiative restructured its strategic domain into four core operational pillars:

•**Clean-Up:** Immediate, targeted removal of accumulated waste from natural and marine environments.

•**Prevention at Source:** Intercepting pollution prior to generation or preventing its transport into marine environments.

•**Ecological Conservation and Restoration:** Protecting biodiversity and restoring healthy, functioning ecosystem balances beyond basic cleanliness.

•**Awareness and Civic Engagement:** Fostering community ownership and embedding sustainable, eco-friendly practices into daily civic life.

The strength of this holistic approach lies in avoiding single-solution paradigms. Uniform interventions are insufficient for complex ecological systems: maintaining pristine beaches cannot be achieved solely by increasing waste receptacle collection frequencies. Preventing riverine waste transport into the sea requires intercepting pollution along river corridors rather than managing marine arrival. Overcoming plastic pollution necessitates encouraging a culture of reuse alongside expanding recycling infrastructure. In fragile marine habitats, the primary threat often stems from unregulated site usage rather than direct litter accumulation.

Consequently, the Antalya Blue Mediterranean Initiative targets the root drivers of environmental pressures rather than temporarily addressing symptoms. This philosophy aligns directly with the national Zero Waste vision, which emphasizes resource efficiency, circular economy principles, and source reduction. The Initiative represents the practical application of Zero Waste principles within Mediterranean marine and coastal governance.

4.3 The Structure of Collective Action

Under the governance framework of the Initiative, environmental conservation is recognized as a shared responsibility across institutions, economic sectors, and civil society. Environmental pressures naturally transcend administrative boundaries, impacting interconnected systems simultaneously.

River systems cross multiple administrative boundaries; marine plastic debris is carried across coastlines by hydrodynamics; agricultural chemical runoff impacts soil, groundwater, and coastal waters concurrently; and sector-wide tourism water and waste management directly shapes regional ecological resilience. Achieving shared environmental goals is only possible when stakeholders carry out complementary efforts within the framework of their respective expertise, authority, and responsibilities. The Initiative organizes these citywide dynamics into an inclusive, equitable and action-oriented framework for cooperation:



At the launch of the Antalya Blue Mediterranean Initiative on 12 May, we called on the whole city to act together to protect our natural environment.

Governorship: Provides strategic coordination and cross-institutional alignment across the metropolitan region.

Public Institutions: Integrate regulatory compliance, technical infrastructure, and administrative resources.

Local Governments (Municipalities): Drive field implementation and municipal service integration.

Universities and Academia: Provide scientific guidance, data analysis and expert support.

Non-Governmental Organizations (NGOs): Mobilize community volunteers, local ecological memory, and field monitoring.

Private Sector: Sectors that have grown through Antalya's natural assets become active contributors to the solution by adopting sustainable practices

Citizens and Residents: Drive systemic change through daily waste separation, sustainable consumption choices, and voluntary participation.

The true strength of the Antalya Blue Mediterranean Initiative lies not in a single centre trying to do everything, but in bringing the city's full potential together behind a common purpose.

This movement embodies a broad collective wisdom that reaches from public administration to academia, from local authorities to civil society, and from the business community to every citizen walking along our shores. An environmental vision on a scale that no institution could achieve alone can take concrete shape on the ground



The Zero Waste, Environment and Climate Change Workshop, bringing all stakeholders together around the same table for Antalya, 23 July 2026

only through this collective will and coordination. By directing all its resources and energy towards protecting its natural environment, Antalya is creating not merely an environmental project but a powerful, city-wide synergy that inspires the future.

4.4 Consultation, Learning, and Continuity

The Antalya Blue Mediterranean Initiative is designed as an adaptive, continuous governance mechanism rather than a time-bound project framework. It evolves dynamically through empirical field data, technical evaluations, and ongoing stakeholder feedback.

Continuous consultation forms the foundation of this process. Field implementations frequently highlight emerging baseline requirements or operational insights that inform refined methodologies. Project scopes and management protocols are systematically updated as scientific evidence and priorities evolve, anchored by an unwavering commitment to regional environmental protection.

This iterative approach requires continuous evaluation of environmental



At the consultation meeting at the COP31 venue, we brought together the knowledge and experience of different institutions to consider joint action.

outcomes. Project deployment alone does not constitute final success:

Expanding Public Water Refill Stations: Measured primarily by verifiable reductions in single-use plastic bottle consumption.

Deploying River Litter Barriers: Evaluated by analysing the types of waste collected and when they accumulate.

Establishing Smoke-Free Beach Zones: Assessed through changes in cigarette butt levels on the beach and in visitor habits.

The Initiative consistently measures operational progress against two primary metrics: "What have we done?" and "What has changed?"

The roadmap followed since the Initiative's inception summarises this approach:

- **First, listen.**
- **Identify problems through collective wisdom.**
- **Develop solutions.**
- **Take action.**
- **Learn from the results on the ground.**
- **And renew the vision as needed.**

This roadmap serves a broader goal for Antalya's future: advancing the city's



During the first site visit to Üç Adalar in Kemer, we listened to the experts' assessments.

development while safeguarding its natural assets. Across all sectors, from tourism and agriculture to infrastructure and coastal use, decisions must take into account both today's needs and their long-term environmental impacts. The aim is to support Antalya's economic and social life while preserving the opportunity for future generations to live in a healthy environment.

The following section presents the field implementation results, innovative solutions deployed to address chronic environmental pressures, and direct conservation actions executed to protect Antalya's marine and coastal assets.



A crab entangled in ghost nets

05
FROM PROMISE TO ACTION

In the previous chapter, we described how the Antalya Blue Mediterranean Initiative came into being, the principles on which it is founded, and the collaborative structure through which it operates. This chapter examines how that approach translates into practice: the problems we encountered, how we sought solutions, what we did on the ground, and what we aim to achieve next.

The fifteen activities presented in this chapter are organised around the Initiative's four core pillars:

•Clean-up (5.1–5.4): Seabed clean-ups, ghost net removal operations, coastal and cliff clean-ups, and the deployment of marine trash skimmers and floating litter traps illustrate direct interventions to remove pollution that has already reached the sea and coastline.

•Prevention at Source (5.5–5.9): Smoke-free beaches, river barrier systems, drinking water stations, agricultural waste management, and the expansion of the deposit refund system encompass measures to prevent waste generation or intercept waste before it reaches the sea.
•Ecological Conservation and Restoration (5.10–5.12): Üç Adalar Marine Conservation Project, seagrass conservation and propagation, and artificial reef projects focus on protecting and restoring marine habitats.

•Awareness (5.13–5.15): Environmental education in schools, public environmental events, and waste-to-art activities aim to encourage communities to embrace and support these efforts.

Each activity follows the same structure. An introductory information box identifies its area of work, location, the Initiative's role, and the institutions involved. Four questions follow: What did we observe? What solution did we seek? What did we do on the ground? What comes next? Each activity concludes with monitoring indicators that set out how progress will be assessed.

Some of these activities are carried out directly by the Initiative. Others are implemented by partner institutions within their respective mandates and brought together under the Initiative's umbrella. For example, the Coast Guard Command leads seabed clean-up operations, the Provincial Directorate of Agriculture and Forestry carries out ghost net removal operations, and the Turkish Environment Agency is responsible for the deposit return system. The "Initiative's role" entry in each information box makes this distinction clear, ensuring that each institution's contribution is duly recognised.

The activities are at different stages of development. Some have already begun to deliver measurable results: 32 tonnes of waste and 2,000 square metres of ghost nets have been removed from the seabed, and 55 drinking water fountains have been brought into service in the city centre. Others are still at the planning or initial implementation stage. This chapter should therefore be read as an early assessment of progress rather than a catalogue of achievements. The two questions the Initiative has asked since its inception continue to guide this chapter: "What have we done?" and "What has changed?"

* All field data and implementation outputs presented in this section are current as of October 2026.

5.1 Seabed Clean-Up Operations

Operational Domain
Clean-Up

Location
Designated zones under the Antalya Province Marine Litter Provincial Action Plan (2025–2030)

Role of the Initiative
Coordination

Institutions & Stakeholders
Coast Guard Command (implementing agency), local municipalities, diving clubs, non-governmental organizations, relevant public institutions

What Did We Observe?

Waste accumulated on the seabed represents an invisible, silent threat. A coastal cove that appears pristine and untouched from the surface may harbor a heavy load of long-term accumulated pollution below. Because this litter is out of sight, its sheer scale and the urgency of intervention often escape daily public awareness. Yet every piece of debris resting on the seabed exerts direct, destructive pressure on the Mediterranean's sensitive marine habitats and the organisms struggling to survive within these ecosystems.

What Solutions Did We Seek?

Seabed clean-ups demand high technical expertise, specialized equipment, and rigorous safety protocols. Accordingly, we established that operations must be executed in a controlled and planned manner by professional diving teams under the coordination of the Coast Guard Command.



One of the seabed clean-ups carried out by Muratpaşa Municipality's diving team

Locations were selected not at random, but in strict alignment with the Antalya Province Marine Litter Provincial Action Plan (2025–2030), prioritizing high-risk pollution zones. Furthermore, we placed particular emphasis on recording the type, quantity and recovery locations of the waste as an integral part of the process.

What Did We Accomplish in the Field?

Public institutions, municipalities, NGOs, and diving clubs participated in seabed clean-up operations across Antalya's coastal districts.

During the first month of field applications, 13 tons of waste were removed from the seabed across 11 distinct locations. By October 2026, the total amount of waste extracted from the marine environment reached 32 tons. The operational capacities of municipalities and the technical support of diving clubs contributed significantly to executing these efforts at scale.

What Comes Next?

We aim to ensure that field teams—carrying out periodic coastal and marine clean-ups—systematically input data from every intervention into the central database. Furthermore, relevant institutions will analyze recurring waste accumulations at specific points to pinpoint sources. The Governorship and stakeholder institutions will then concentrate preventive measures—such as river barriers, coastal management, and marine vessel controls—directly on these target zones.

Monitoring Indicators

√ Quantity, composition, and location of recovered waste

√ Recurrence interval of accumulation at identical coordinates



Seabed clean-up carried out by Antalya Metropolitan Municipality and Konyaaltı Municipality together with teams of volunteer divers

5.2
Ghost Net Removal Operations

Operational Domain
Clean-Up

Location
Antalya coastlines, identified sites

Role of the Initiative
Coordination

Institutions & Stakeholders
Antalya Provincial Directorate of Agriculture and Forestry (implementing agency), diving teams, local fishers

What Did We Observe?

Lost, abandoned, or discarded fishing gear—commonly known as "ghost nets"—remains suspended on the seabed, rocky outcrops, or within the water column, continuing to "fish" indiscriminately for years. These nets transform into lethal traps for fish, crustaceans, sea turtles, and other marine life. Manufactured from synthetic materials, they do not biodegrade organically; over time, they fragment into sources of microplastic pollution.

What Solutions Did We Seek?

Extracting ghost nets from the seabed requires precise coordinate mapping, strict diving safety, and delicate extraction protocols to avoid damaging surrounding fragile benthic habitats. Consequently, operations were mandated to run under the coordination of the Antalya



A diver working underwater to remove a ghost net from the seabed [DYKD]

Provincial Directorate of Agriculture and Forestry with experienced diving teams. Integrating local fishers into the process established vital cooperation for rapid net localization and the prevention of future gear losses.

What Did We Accomplish in the Field?

Through operations coordinated by the Antalya Provincial Directorate of Agriculture and Forestry, a total of 2,000 square meters of ghost nets were extracted from the seabed. During field operations, the rescue of a crab entangled in a discarded net once again underscored the direct threat posed by abandoned fishing gear to underwater biodiversity and the vital importance of field intervention.

What Comes Next?

While continuing operations, primary objectives include evaluating the root causes of gear loss alongside fishers and expanding the Mavi Atlas (Blue Atlas) digital application to enable citizen reporting for precise location tracking.

Reporting a detected ghost net in the sea with its coordinates via the mobile application will enable rapid deployment of diving teams to the exact site. Thus, the fight against ghost nets will evolve into a collaborative monitoring and intervention model supported by all marine stakeholders.

Monitoring Indicators

√ Area of nets recovered
√ Number of net reports submitted via Mavi Atlas
√ Response time from notification to intervention
√ Operational frequency



Ghost net removal operation carried out by the Antalya Provincial Directorate of Agriculture and Forestry in May 2026

5.3 Coastal and Sea Cliff Clean-Ups

Operational Domain
Clean-Up

Location
Antalya coastal strip

Role of the Initiative
Coordination

Institutions & Stakeholders
District Governorates, municipalities, public institutions, NGOs, AFAD (Disaster and Emergency Management Presidency) and Turkish Red Crescent volunteers, schools, volunteers

What Did We Observe?

The coastal strip forms the final threshold between land and sea. Litter deposited or accumulated here is readily washed into the marine environment by wind and wave action. In inaccessible areas, such as Antalya's steep limestone sea cliffs (falezler), accumulated waste can persist indefinitely where standard municipal sweeping services cannot reach.

What Solutions Did We Seek?

In our approach to coastal clean-ups, we established that routine municipal sweeping services must be complemented by volunteer-driven field campaigns and specialized interventions targeting inaccessible terrain. Furthermore, we designed coastal clean-up initiatives as immersive environmental awareness experiences where participants directly observe pollution loads in the field.



Sea cliff clean-up coordinated by AFAD as part of World Cleanup Day activities

What Did We Accomplish in the Field?

We conducted coastal clean-up operations across coastal districts with the participation of municipalities, NGOs, schools, and volunteers, while executing specialized clean-up interventions along inaccessible cliff formations. Events organized simultaneously across all districts during World Environment Day marked the largest participatory execution of these field actions.

We continued these efforts on September 19, World Cleanup Day, at the Manavgat Ulualan Coastline—which hosts approximately 300 bird species year-round. Accompanied by Antalya Governor Hulusi Şahin and his spouse, Mrs. Ebru Şahin, public institutions, environmental organizations, and volunteers cleared solid waste from a roughly 2-kilometer coastal stretch. During the field operations, a juvenile sea turtle entangled in discarded netting was rescued and safely released back into its natural habitat.

What Comes Next?

In the next phase, we aim to expand item-based waste tracking for collected materials, identify recurring accumulation hotspots, and progressively deploy preventive measures to intercept pollution at the source before it reaches the shoreline.

Monitoring Indicators

√ Quantity and composition of collected waste

√ Change in the number of recurring accumulation hotspots



Coastal clean-up at Ulualan Beach in Manavgat as part of World Cleanup Day activities

5.4
Marine Trash Skimmers and Floating Litter Traps

Operational Domain
Clean-Up

Location
Harbors, marinas, coves, and high-accumulation zones; Phaselis Cove

Role of the Initiative
Coordination

Institutions & Stakeholders
Municipalities, port and marina operators, relevant public institutions

What Did We Observe?
Marine surface litter is highly dynamic, driven by wind and currents to accumulate in harbors, marinas, river mouths, and sheltered coastal indentations. Given Antalya's extensive coastline, numerous ports, active marinas, and bustling maritime traffic, rapid surface pollution response capacity is a critical operational requirement.

What Solutions Did We Seek?
To combat surface pollution, we integrated the simultaneous deployment of mobile marine trash skimmers offering agile intervention capabilities with stationary automated litter traps (çöp kapar) stationed at critical nodes. For coves and sensitive areas requiring strict protection, barrier systems were planned to prevent surface litter influxes. We aim to continuously refine all intervention routes and equipment deployments based on regular field data and accumulation logs.

What Did We Accomplish in the Field?
In combating surface pollution, mobile trash skimmer vessels executed active



Port operators have begun using floating litter traps

collection sweeps across harbor and coastal basins, while stationary litter trap systems secured continuous waste extraction at designated critical coastal nodes.

One of the most exemplary applications in this domain was realized at Phaselis Cove. We secured Phaselis Cove, a designated first-degree natural and archaeological protected site, utilizing a 575-meter physical barrier system combined with two advanced automated litter trap units. This sensitive area, integrating historical and natural heritage, established a concrete field model for combining physical protection barriers with automated collection systems.

Technical evaluations aimed at expanding surface cleaning capacity are ongoing in coordination with relevant institutions. Because equipment selection, operational models, and periodic maintenance protocols require a multi-stakeholder governance approach, these efforts are proceeding under a long-term, phased planning framework.

What Comes Next?

Field teams will systematically record not only the volume of surface litter collected, but also its exact origin, timestamp, and material classification into the central database. Relevant institutions will identify high-accumulation coastal hotspots based on these analytics. The Governorship and stakeholder institutions will ground new equipment investments and barrier deployment decisions entirely on this empirical field data.

Monitoring Indicators

√ Quantity of recovered surface litter
√ Spatial and temporal distribution of accumulation hotspots
√ Number of active operational units



Marine trash skimmers deployed by the Turkish Environment Agency continue their clean-up operations in Antalya's waters.

5.5
Smoke-Free Beaches

Operational Domain
Prevention at Source

Location
Province-wide Antalya, over 60 beaches

Role of the Initiative
Implementation

Institutions & Stakeholders
Governorship of Antalya, Ministry of Culture and Tourism, municipalities, beach operators, hotels

What Did We Observe?

One of the most prevalent yet hardest-to-remove types of litter encountered in coastal clean-ups is the cigarette butt. Particularly along Antalya's pebbled beaches, butts lodge between stones, sand, and gravel, making manual removal practically impossible.

Discarded cigarette butts do not degrade when washed into the sea. Because their filters are composed of cellulose acetate (plastic), they gradually fragment into microplastics, while releasing nicotine, heavy metals, and other toxic chemicals into marine waters and aquatic life. Despite this, many individuals still fail to perceive cigarette butts as genuine litter. Furthermore, there is a vital public health dimension. Beaches serve as shared public spaces where children play and families spend time.

What Solutions Did We Seek?

Rather than attempting to collect cigarette butts after they are littered on the sand, we focused on preventing pollution at its source. By establishing



A smoke-free beach area established by Manavgat Municipality

designated smoke-free zones across selected beaches, we aimed to reduce coastal litter while creating healthier public spaces free from tobacco smoke exposure for children and citizens.

Similar practices exist in numerous countries. In Türkiye, this step was pioneered in Antalya. We implemented this measure not through a prohibitive or restrictive lens, but as a tangible awareness-raising initiative safeguarding our shared public spaces, our children's future, and the marine environment.

What Did We Accomplish in the Field?

The application launched initially at EKDAĞ Varyant Public Beach, Kaş Kaputaş Beach, the Ministry of Culture and Tourism's Çamyuva Public Beach, Lara Public Beach, and Çaltıcak Public Beach. Field teams installed visible informational signage, educated citizens on environmental pollution, and heightened enforcement. Thanks to positive public reception and strong hospitality industry backing, the number of smoke-free beach zones across Antalya surpassed 60 by October 2026.

What Comes Next?

To measure the tangible impact of the initiative, field teams will regularly compare pre- and post-implementation cigarette butt densities, monitoring user behavior and compliance levels. Relevant institutions will continue expanding smoke-free beach zones across Antalya based on outcomes derived from this field data.

Monitoring Indicators

√ Change in cigarette butt density per unit area
√ Number of participating beaches
√ User satisfaction and compliance levels



A primary school pupil who collected cigarette butts from the beach during the World Environment Day event

EXPERT OPINION

Tobacco Waste, Public Spaces and Healthy Beaches

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A cigarette butt is often perceived as an insignificant piece of litter because of its small size. In reality, a discarded cigarette butt is a complex form of waste consisting of residual tobacco, paper, and a plastic filter composed largely of cellulose acetate. This filter does not readily biodegrade under natural conditions. Although sunlight and physical abrasion may gradually break it down into smaller fragments, the plastic-based material itself persists in the environment. Cigarette butts should therefore be regarded not merely as an aesthetic nuisance, but as persistent waste capable of carrying toxic substances [1].

The problem is not limited to the plastic content of the filter. Used filters can retain nicotine, various metals, and other chemical compounds, some of which may be released into the aquatic environment when cigarette butts come into contact with seawater or rainwater. Studies have shown that cigarette butts can leach substances such as heavy metals, nicotine, and ethyl phenol into water, highlighting the need for their precautionary management from an environmental perspective [2]. Cigarette butts have also been reported to pose potential risks to marine and freshwater organisms and to exert toxic effects on certain aquatic species [3].

Healthy Beaches

A healthy beach is not simply one that has been cleaned in the morning and appears free of visible litter. The primary objective should be to prevent pollutants, as far as possible, from being generated or from reaching the beach in the first place.

From this perspective, the regular collection of cigarette butts is necessary, but it is not sufficient on its own. A beach from which hundreds of cigarette butts are collected every day may appear clean, yet this may simply indicate that the same quantity of waste is being generated day after day.

The way success is measured therefore needs to change. The question should not simply be, “How many cigarette butts were collected?” A more meaningful question is, “To what extent has the number of cigarette butts discarded on the beach been reduced?” This represents a shift in environmental management from cleaning up pollution to preventing it.

The Smoke-Free Beach Approach in Antalya

In Antalya, this issue was placed within a formal administrative framework in 2026. The Antalya Governor’s Office Circular No. 2026/6 on the Antalya Blue Mediterranean Initiative Smoke-Free Beach Implementation identifies the protection of Antalya’s coastline and marine ecosystem, the prevention of tobacco waste at source, and the safeguarding of individuals’ right to clean air as key objectives of the initiative. The Circular also introduces inspection and enforcement mechanisms to ensure that the measures go beyond purely advisory guidance.

Under the regulation, a designated portion of the total beach-use area is to be set aside as a "Smoke-Free Area – Clean Air Zone." These areas are to be located close to children's play areas, sports facilities, and accessible areas for people with disabilities, while remaining sufficiently separated from the effects of tobacco smoke. Beach management is also required to provide a transition corridor between smoking and non-smoking areas and to take the prevailing wind direction into account.

This approach moves the concept of a smoke-free beach beyond a simple prohibition and places it within the context of spatial planning. By requiring transition zones between smoking and non-smoking areas and consideration of the prevailing wind direction, the Circular recognizes the potential movement of tobacco smoke into smoke-free areas as an issue to be addressed through appropriate site management [4].

Preventing Cigarette Butts from Reaching the Sand

One of the notable features of the Circular is that it includes technical measures specifically targeting tobacco waste on beaches. To prevent the use of open, sand-filled containers and the direct disposal of cigarette butts onto the beach, the regulation provides for the use of purpose-designed beach ashtrays that do not come into direct contact with the sand, are covered, resistant to wind, designed to contain odours, and compatible with the visual character of the beach.

In addition, beach operators are required to provide portable personal beach ashtrays that may be made available to visitors through a deposit or return scheme.

This provision addresses an important behavioural aspect of the problem. In areas where tobacco use is permitted, ensuring access to appropriate disposal facilities is one of the basic measures for preventing cigarette butts from being discarded onto the sand. Infrastructure alone, however, is not sufficient. Observations have shown that cigarette butts may continue to be discarded on the ground even where dedicated receptacles are available. This demonstrates that physical infrastructure must be supported by education and behavioural change [5].

Beyond Prohibition: Behavioural Change

The long-term sustainability of a smoke-free beach programme depends on users accepting the regulation not merely as a prohibition, but as a behavioural norm intended to protect a shared public space.

For this reason, the multilingual communication component of the Antalya model is particularly important. The Circular requires signs, boundary markings, and warnings to be provided in Turkish, English, German, and Russian. It also introduces the "Beach Ambassador" model, under which beach staff are expected to guide visitors using an environmentally responsible, constructive, and supportive approach rather than an overtly prohibitive one.

This approach is particularly valuable in Antalya, an international tourism destination that receives large numbers of visitors from different countries. The effectiveness of environmental policies depends not only on regulation, but also on whether visitors understand the reasons behind the rules.

From Clean Beaches to Healthy Beaches

Cigarette butts are small items of waste, yet when poorly managed they can create a persistent environmental burden. Their plastic-based filter structure, the chemical substances they contain, and their potential for direct contact with beach sand and seawater make tobacco waste an issue that requires specific consideration in beach management.

The Smoke-Free Beach initiative introduced in Antalya is significant because it addresses the problem as more than a matter of routine cleaning. The combined use of smoke-free areas, physical waste collection infrastructure, multilingual information, Beach Ambassadors, monitoring, incentives, and enforcement mechanisms provides an integrated management model.

The next step is to support this model with measurable outcomes.

Ultimately, the success of a healthy beach should not be judged by how many cigarette butts are collected at the end of the day, but by how far the number discarded on the beach can be reduced.

5.6 River Barrier Systems

Operational Domain
Prevention at Source

Location
Province-wide Antalya, 33 discharging rivers

Role of the Initiative
Implementation

Institutions & Stakeholders
Antalya Metropolitan Municipality, State Hydraulic Works (DSİ), Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities

What Did We Observe?

A substantial portion of marine pollution originates on land. Litter discarded on streets, agricultural fields, or riverbeds is washed into rivers via precipitation and surface runoff, being transported directly into the sea. Consequently, rivers represent one of the closest intervention points to the source in combating marine pollution.

What Solutions Did We Seek?

To intercept surface pollution at the source, we planned barrier systems at strategic locations to capture waste before it reaches the sea. In siting barriers, we prioritized hydraulic flow safety,

flood risk mitigation, and ecological sensitivities, shaping all installation decisions through joint field inspections by stakeholder institutions.

What Did We Accomplish in the Field?

Following meetings held under the Initiative, the Antalya Metropolitan Municipality, State Hydraulic Works, and the Provincial Directorate of Environment, Urbanization and Climate Change conducted joint field inspections across rivers throughout Antalya. The initial barrier installations were executed on the Acısu and Akçay streams in the Finike district.

Drawing on insights from these early applications, operations were expanded region-wide. Litter-catching barriers were procured for all rivers discharging into the sea within Antalya's borders. Installations are proceeding progressively, accounting for the hydraulic flow and safety parameters of each watercourse.

What Comes Next?

We aim to transform these barriers into monitoring stations by recording the volume, composition, and timing of trapped waste alongside precipitation data, utilizing these logs to track the geographic sources and seasonal influx patterns of riverine pollution.

Monitoring Indicators

√ Quantity and composition of trapped waste

√ Number of installed barriers and maintenance continuity



A barrier system installed to intercept floating waste carried by rivers before it reaches the sea, Finike

5.7
Public Drinking Water Stations

Operational Domain
Prevention at Source

Location
Areas with high pedestrian traffic

Role of the Initiative
Implementation

Institutions & Stakeholders
Governorship of Antalya, municipalities

What Did We Observe?

Water and beverage packaging rank among the most frequently encountered litter items along coastlines and at sea. Accessing drinking water across high-traffic beaches and public spaces often implies purchasing single-use plastic bottles.

What Solutions Did We Seek?

Designing accessible drinking water stations where reusable bottles can be easily refilled, thereby turning carrying reusable flasks into an everyday habit. Locating these stations in areas with high pedestrian traffic to catalyze behavioral shifts.

What Did We Accomplish in the Field?

In the initial phase, 17 drinking water stations were commissioned and unveiled to the public during World



The Antalya Blue Mediterranean Initiative's first drinking water fountain, Antalya Millet Bahçesi (National Garden)

Environment Day events. The initiative expanded rapidly; by October 2026, 55 public drinking water fountains were operational across central Antalya.

What Comes Next?

Deploying new stations in high-traffic zones citywide. Monitoring usage volumes alongside point counts and tracking changes in surrounding single-use bottle waste to guide the placement of future stations using empirical utilization data.

Monitoring Indicators

√ Number of operational stations
√ Utilization rate per station
√ Change in single-use plastic bottle waste volumes



One of 20 drinking water fountains installed in cooperation with the People's Republic of China, Düden Park

5.8 Agricultural Waste Management

Operational Domain
Prevention at Source

Location
Agricultural production zones of Antalya

Role of the Initiative
Coordination

Institutions & Stakeholders
Antalya Provincial Directorate of Agriculture and Forestry (implementing agency), producer organisations, municipalities

What Did We Observe?

In an agricultural powerhouse like Antalya, managing agricultural waste is directly linked to marine conservation. Synthetic twines, packaging, and agrochemical containers utilized in production, when abandoned uncontrolled in nature, can reach soil, water and ultimately the sea via watercourses. Synthetic materials mixed with plant residues further impede collection and recovery.

What Solutions Did We Seek?

Segregating and collecting waste at its point of generation while bringing collection infrastructure closer to producers. Concurrently, promoting alternatives that reduce synthetic material consumption to mitigate the problem at the source.



Plastics mixed with plant waste make the waste more difficult to recycle.

What Did We Accomplish in the Field?

Under the leadership of the Antalya Provincial Directorate of Agriculture and Forestry, steps were taken to promote biodegradable twine in agricultural production. Agricultural waste bins were installed to facilitate the separate collection of pesticide containers.

What Comes Next?

Monitoring collected waste types, quantities, and producer participation; refining the collection system based on farmers' feedback regarding operational convenience.

Monitoring Indicators

√ Quantity of collected agricultural packaging
√ Participation rate per collection point
√ Change in biodegradable material utilization



An incentive is being developed to encourage the use of biodegradable twine instead of plastic twine.

5.9
Expansion of the Deposit Return System

Operational Domain
Prevention at Source

Location
Province-wide Antalya

Role of the Initiative
Supporting and Expanding

Institutions & Stakeholders
Turkish Environment Agency (system owner and implementing agency), commercial enterprises

What Did We Observe?

Used beverage packaging easily transforms into environmental litter the moment it loses economic value. In a destination like Antalya that hosts heavy visitor inflows year-round and maintains a highly dynamic hospitality and food-beverage sector, this packaging flow is exceptionally intense.

What Solutions Did We Seek?

The deposit-return packaging scheme is a national system established and operated by the Turkish Environment Agency under the Zero Waste vision. The system introduces economic value to packaging, reintegrating it into the recovery chain while engaging citizens alongside hotel, restaurant, and café operators as direct participants in this chain. The Initiative's target in this domain is to contribute to the rapid and widespread adoption of



Deposit-return machines were introduced by the Provincial Directorate of Environment, Urbanization and Climate Change on World Environment Day.

the national system across Antalya.

What Did We Accomplish in the Field?

The Provincial Directorate of Environment, Urbanization and Climate Change introduced deposit-return machines to the public during World Environment Day events. Following consultations with the Turkish Environment Agency, the number of machines deployed across Antalya was increased. Informational campaigns executed under the Initiative accelerated system adoption locally: the number of deposit-return machines in the city rose to 129, achieving the highest return figures nationwide.

What Comes Next?

Monitoring enterprise participation and returned packaging volumes in Antalya; identifying practical hurdles faced by businesses and providing feedback to the Turkish Environment Agency.

Monitoring Indicators

√ Volume of returned packaging in Antalya
√ Number of return points



A deposit return point for individual users in Antalya's Millet Bahçesi (National Garden)

5.10 Üç Adalar Conservation Project

Operational Domain
Ecological Conservation and Restoration

Location
Kemer, Üç Adalar

Role of the Initiative
Coordination

Institutions & Stakeholders
Governorship of Antalya, Ministry of Agriculture and Forestry, Marine Life Conservation Society (DYKD), Kemer District Governorate, Kemer Municipality, Provincial Directorate of Environment, Urbanization and Climate Change, Coast Guard Antalya Group Command

What Did We Observe?

Üç Adalar is one of Antalya's ecologically most valuable marine sites, featuring rocky reefs, seagrass meadows, and rich underwater biodiversity. The area witnesses intensive human circulation and marine utilization throughout the day due to diving activities, vessel traffic, and tourism mobility. Field observations indicated that underwater vitality had noticeably weakened in certain zones of the area.

Effective conservation in such sites requires establishing scientifically where conditions stand, which areas are sensitive, and which zones endure heavy pressures through empirical data.

What Solutions Did We Seek?

Evaluating the site holistically regarding its habitats, utilization types, and pressures. Grounding conservation



Üç Adalar, Kemer

priorities and sustainable use rules in scientific data and stakeholder participation; balancing protection and utilization through knowledge alongside regulatory restrictions.

What Did We Accomplish in the Field?

Within the framework of a cooperation protocol signed between the Governorship of Antalya and the Marine Life Conservation Society (DYKD), the Üç Adalar Integrated Ecosystem Assessment and Conservation Planning Project was implemented.

Following DYKD's application, the Ministry of Agriculture and Forestry declared the region a fisheries protected area and banned commercial and recreational fishing. The Marine Life Conservation Society initiated inventory and rehabilitation works. The project envisions drafting biological and ecological inventories of the region, mapping sensitive habitats and threats, protecting and propagating seagrasses in suitable zones, and conducting regular monitoring.

What Comes Next?

Establishing an actionable conservation and management model for the site. Upon success, adapting this experience to Antalya's other sensitive marine areas. In this regard, Üç Adalar serves as the Initiative's pilot application for the entire coastline.

Monitoring Indicators

√ Mapped habitat area
√ Monitoring continuity
√ Utilization pressure indicators
√ Presence and density of target species



A cardinalfish (Cheilodipterus novemstriatus) recorded during the marine life biodiversity surveys conducted by the Marine Life Conservation Society (DYKD) at Üç Adalar [DYKD]

EXPERT OPINION

Üç Adalar: Conservation Priorities, Ecological Values, and Sustainable Use

Volkan NARCI,
Assoc. Prof. Elizabeth BENGIL,
Gizem ECE
Marine Conservation Society

Towards a Marine Conservation Governance Model for Türkiye

Situated off the coast of Tekirova in Antalya's Kemer district, Üç Adalar (Three Islands) is well-known for tourism and recreational diving while serving as a vital hub for Eastern Mediterranean coastal biodiversity. The coexistence of rocky reefs and patchy Posidonia oceanica seagrass meadows provides foraging, sheltering, and breeding grounds for diverse marine species. Moreover, the largely preserved natural character of surrounding coastal areas creates notable ecological connectivity between marine and terrestrial ecosystems.

These attributes position Üç Adalar not merely as a natural site requiring protection, but as a benchmark area where conservation and sustainable utilization can be planned in tandem.

Changing Conditions and the Need for Conservation in the Mediterranean

The Mediterranean ranks among the world's premier seas for biodiversity; however, it simultaneously endures intense anthropogenic pressures and climate change impacts. Particularly in the Eastern Mediterranean, rising sea surface temperatures, marine heatwaves, and the proliferation of non-indigenous species are transforming ecosystem structures. Recent studies highlight that climate change and non-indigenous species impacts can compound one another, posing significant risks to the Eastern Mediterranean [1]. Unfortunately, much like many Mediterranean coastlines, Antalya and particularly the Üç Adalar region face severe pressures from invasive and non-indigenous species. This pressure escalates daily, fragmenting native species distributions and restricting them to isolated refugia, rendering populations increasingly vulnerable. Ultimately, every individual or colony attains critical conservation value.

An Experience from Türkiye: From Tavşan Island to Üç Adalar

Ensuring conservation decrees do not remain dead letters on paper requires field continuity. The Marine Life Conservation Society (DYKD) derived this lesson from its work at Tavşan Island in the Sea of Marmara since 2015. Over eleven years, more than 700 gorgonian coral colonies were transplanted under ecological restoration, over 650,000 m^2 of ghost nets were extracted from the seabed, and the site is monitored continuously via underwater cameras

and regular dives. This experience demonstrates that ecosystems recover only when conservation status is coupled with systematic monitoring, active protection, and ecological restoration. The Üç Adalar initiative—commencing via the 2026 protocol signed between the Antalya Governorship and DYKD—was designed to adapt this accumulated expertise to Mediterranean conditions.

Current Baseline for Antalya and Üç Adalar

The core challenge facing Üç Adalar is the convergence of ecological value and intensive human utilization within the same space. Tourism and recreational diving drive regional economic vitality. Nevertheless, intensive utilization, unregulated water sports, fishing, marine litter, plastics, ghost nets, and invasive species have generated cumulative pressures over time.

For fisheries and tourism, the challenge stems less from the activities themselves than from how activity intensity distributes across sensitive habitats. Studies in the Mediterranean show that physical contact with the seabed during recreational diving impacts benthic habitats [2]. Conversely, mindful small-scale artisanal fisheries can play a pivotal role in a site's defense against invasive species. Concentrating fishing pressure and consumption on these non-indigenous and/or invasive species supports both local fishers and native biodiversity. Therefore, the objective at Üç Adalar is not eliminating activities, but developing site utilization management that respects ecological carrying capacity. Banning fisheries in the area in September 2026 represents the first step of this management; instruments such as permitted fisheries targeting invasive species should be evaluated within zoning plans alongside local stakeholders.

A major deficiency has been the lack of a current, spatially detailed ecological database covering the entire site. Formulating an effective conservation plan remains challenging without jointly determining habitat distributions, sensitive species concentrations, human pressure zones, and temporal shifts.

Consequently, a core initial step of the Üç Adalar Integrated Ecosystem Assessment and Conservation Planning Project—executed by DYKD under the Antalya Blue Mediterranean Initiative cooperation protocol—involves establishing biological and ecological inventories, mapping habitat distributions, and jointly assessing pressures including pollution, fisheries, intensive usage, climate change, and invasive species.

Conservation Must Not Mean Total Closure

A common misconception regarding marine protected areas is that conservation equates to a total ban on human activities. Modern marine conservation approaches rely on establishing differentiated conservation and utilization levels tailored to site characteristics and human users.

Research examining Mediterranean marine protected areas demonstrates that well-managed protected zones enhance fish biomass and density. Fully protected reserves exhibit stronger effects, though success depends heavily on active enforcement and effective governance alongside legal status [3,4]. More recent evaluations reiterate that protection levels and enforcement efficacy determine ecological outcomes [5].

Accordingly, a zoning approach appears more viable for Üç Adalar than uniform management. Activities may be restricted in sensitive habitats or critical species zones while continuing in a controlled manner elsewhere. Thus, conservation and utilization cease to be mutually exclusive alternatives, becoming components of a unified spatial plan.

Risks and Opportunities Alike

The primary risk for Üç Adalar in coming years is the combined escalation of climate change and localized anthropogenic pressures. Rising sea temperatures, marine heatwaves, invasive species, intensive tourism, pollution, and habitat degradation do not operate independently; together, they erode ecosystem resilience. An institutional risk frequently overlooked is that if project timelines, budgets, or priorities change and interventions lapse, hard-won gains vanish rapidly.

Conversely, these conditions present significant opportunities. Because Üç Adalar is a renowned diving destination, when properly managed, dive schools, tourism operators, fishers, and visitors can transform into active stewards of site monitoring and protection. Hosting COP31 in Antalya is also an important opportunity, as is the way the Governorship of Antalya, DYKD and the Antalya Blue Mediterranean Initiative bring together public institutions, scientists, the private sector and civil society under one roof.

For instance, citizen science applications like Mavi Atlas can log species observations by divers; ghost nets can be extracted and channeled into recycling chains; economic utilization options for non-indigenous edible species can be evaluated. Relocating dive sites away from sensitive habitats or redistributing activity intensity helps mitigate ecological pressures. All these approaches demonstrate that coexistence between ecosystems and humanity is achievable.

Recommended Roadmap for Üç Adalar

1.Conservation decisions must be grounded in robust scientific data. Mapping habitats, species, and human activities within a unified spatial system is foundational.

2.Rather than a uniform conservation level, zoning based on ecological sensitivity should guide active or passive restoration plans.

3.Decisions must be co-developed with fishers, dive operators, tourism businesses, local governments, and residents, forming a governance plan rather than top-down decrees.

4.Conservation status must mark the beginning of a process, not an endpoint. Monitoring, enforcement, and governance decisions must adapt to incoming data, realizing an adaptive governance model backed by a marine ranger system coordinating with the Coast Guard.

5.Mitigating pressure may prove insufficient; damaged habitats may require ecological restoration.

6.Ensuring long-term continuity requires measurable targets, public annual reporting, and permanent financing backed by public, private, and civil society contributions.

The core question for Üç Adalar is not "Conservation or utilization?" The real question is: "How can nature and humanity be managed simultaneously to ensure specific activities occur at sustainable intensities without breaching ecological boundaries?" Combining scientific monitoring, spatial planning, local participation, and effective governance can transform Üç Adalar into a model marine conservation governance framework for Türkiye and the wider Mediterranean.

5.11 Conservation and Propagation of Seagrass Meadows

Operational Domain
Ecological Conservation and Restoration

Location
Antalya coastlines, initial pilot at Üç Adalar

Role of the Initiative
Coordination

Institutions & Stakeholders
Mediterranean Fisheries Research, Production and Training Institute (AKSAM), Marine Life Conservation Society (DYKD)

What Did We Observe?

Seagrass meadows appear unassuming underwater, yet they provide vital shelter, foraging, and breeding habitats for myriad marine organisms. They stabilize sediments, buffer coastlines against wave impacts, and sequester carbon over long timescales, while serving as bio-indicators of marine health. However, they remain highly vulnerable to anchoring, coastal development, pollution, and rising water temperatures, requiring extended timeframes to recover once degraded.



Seagrass conservation and restoration work [DYKD]

What Solutions Did We Seek?

Prioritizing the mapping and protection of existing meadows while mitigating anthropogenic pressures. Approaching restoration through scientifically validated methodologies backed by comparative monitoring.

Coral replanting efforts in the Marmara Sea demonstrate that patient, scientifically sound interventions yield positive results.

What Did We Accomplish in the Field?

Initiatives focused on protecting seagrasses and restoring them in suitable zones are planned in collaboration with scientific teams. Inventory and rehabilitation efforts initiated in Kemer Üç Adalar represent the first field application in this domain.

What Comes Next?

Executing long-term monitoring tracking cover percentage, shoot density, and survival rates in restoration plots, comparing outcomes against control sites.

Monitoring Indicators

√ Mapped seagrass area
√ Restoration plot area
√ Survival rate within restoration plots

5.12 Artificial Reef Initiatives

Operational Domain
Ecological Conservation and Restoration

Location
Antalya, offshore Düden and Finike

Role of the Initiative
Coordination

Institutions & Stakeholders
Antalya Metropolitan Municipality, Finike Municipality, Akdeniz University

What Did We Observe?

In certain marine zones, habitat structure has degraded, diminishing shelter and breeding grounds for fish and aquatic organisms. Artificial reefs represent tools for supporting habitat structure in such degraded areas; however, they are not universally applicable, and mismanaged deployments risk failing to deliver expected ecological benefits.



Artificial reefs being deployed in the sea off Finike

What Solutions Did We Seek?

Treating artificial reef deployment within a rigorous scientific framework assessing site selection, project objectives, materials, existing habitats, and utilization pressures concurrently. Designing applications upfront alongside monitoring protocols.

What Did We Accomplish in the Field?

Within the scope of the Artificial Reef Project executed by the Antalya Metropolitan Municipality and Akdeniz University, manufactured reefs were deployed offshore near the Düden stream discharge, alongside deployments in Finike by the Finike Municipality.

Prior to deployment, a symposium convened representatives from Akdeniz University, Antalya Metropolitan Municipality, Finike Municipality, AKSAM, Antalya Provincial Directorate of Agriculture and Forestry, and the Turkish Underwater Sports Federation to discuss national and global artificial reef applications, seagrass restoration, sustainable fisheries, and sustainable dive tourism.

What Comes Next?

Regularly monitoring species diversity and abundance surrounding reefs, comparing outcomes against baseline conditions and control sites. Evaluating positive and unintended effects concurrently and publishing findings transparently.

Monitoring Indicators

√ Species diversity and abundance surrounding reefs

√ Change compared with baseline conditions

EXPERT OPINION

Artificial Reefs: Under What Conditions Can They Be Effective?

Dr. Mustafa YILDIRIM
Antalya Metropolitan Municipality

Is Submerging a Structure Sufficient?

Globally and across Mediterranean coastlines, artificial reefs are frequently deployed instruments aimed at supporting degraded marine habitats, creating shelter and foraging grounds, curbing illegal fishing, and regulating recreational diving. Yet contrary to popular belief, simply placing a structure on the seabed does not guarantee that ecological added value will emerge spontaneously. The success of an artificial reef depends not merely on its submersion moment, but on accurate pre-deployment environmental analyses and long-term scientific monitoring of subsequent ecological changes.

As emphasized in guidelines published by the Food and Agriculture Organization (FAO) and the General Fisheries Commission for the Mediterranean (GFCM), artificial reef applications must be treated holistically across site selection, material properties, engineering stability, environmental impacts, and monitoring protocols [1]. Artificial reefs are not simple engineering blocks; from the moment of placement, they are candidates to become living components of the marine ecosystem.

Attracting Fish or Generating New Life?

A fundamental debate in artificial reef science centers on whether reefs act merely as "aggregation points" attracting existing species or provide genuine "biological production increases" at regional scales. Submerging a new structure may lure fish and invertebrates from the immediate vicinity, concentrating them locally. While this may superficially inflate apparent fauna counts near the reef, it may not represent a true increase in regional total living biomass.

Demonstrating this critical distinction requires more than counting individual fish. Assessing reef success necessitates simultaneously examining species diversity, size distributions, juvenile recruitment rates, biomass shifts, and how surrounding natural habitats (such as seagrass meadows) respond to the structure [2].

Furthermore, site selection dictates ecological efficacy. Seabed topography, hydrodynamic currents, water quality, and existing biological communities must be mapped exhaustively prior to deployment. Unplanned placements over sensitive natural reefs or ecologically vital Posidonia oceanica meadows can cause net ecological harm.

Distinctive Conditions of the Türkiye and Mediterranean Ecosystems

The Mediterranean represents a sensitive ecosystem experiencing simultaneous multiple pressures, including intense coastal use, overfishing, land-based pollution inputs, climate-driven warming, and invasive species invasions via the Suez Canal. Consequently, artificial reef models proven successful in different geographies like Oceania or the Atlantic may not apply directly to Mediterranean waters.

The history of artificial reef deployment in Türkiye spans several decades. As noted in academic literature, national applications pursued diverse objectives, including curbing illegal trawling, supporting small-scale coastal fisheries, developing dive tourism, and advancing scientific research [3]. However, managing a conservation-oriented site under rules identical to a fishery- or tourism-focused site is unfeasible. Project objectives must be explicitly defined upfront, aligning management strategies with these specific goals.

The Antalya Case Study

The Artificial Reef Project executed by the Antalya Metropolitan Municipality represents a pioneering model aiming not only to establish new habitats, but also to monitor physical, chemical, and biological shifts via a long-term, multidisciplinary approach.

Using innovative 3D concrete printing technology with custom surface roughness and indented geometries, 35 artificial reef blocks produced in cooperation with Akdeniz University and the Antalya Metropolitan Municipality were deployed offshore near the Düden stream mouth on June 25, 2026, under the Antalya Blue Mediterranean Initiative coordinated by the Antalya Governorship. The monitoring program deployed across this site is structured around five scientific pillars:

1.Periodic measurement of water column temperature, salinity, pH, and dissolved oxygen parameters.

2.Examination of phytoplankton, zooplankton, macrobenthic, and meiofaunal communities; tracking biodiversity indices (Shannon-Wiener, Margalef, Pielou) alongside ecological quality indicators such as AMBI/M-AMBI.

3.Analysis of environmental DNA from water samples to detect the presence and temporal shifts of fish, invertebrates, bacteria, and fungi, supporting classical sampling.

4.Analyzing PAHs, PCBs, and organochlorine / organophosphorus pesticides in sediment and water, factoring in Düden stream discharges to evaluate vitality against ambient pollution loads.

5.Tracking structural integrity, sediment burial, biological colonization, and fish passage across blocks every 6 months via ROV (Remotely Operated Vehicle) operations, scientific diving, and imaging techniques, with future phases aiming for automated AI image analysis.

Phases 2 and 3 of the project scheduled for 2027 will be shaped by empirical data from Phase 1, driving a dynamic, adaptive management approach.

Management Principles and Prospective Risks

The novel hard surfaces provided by artificial reefs can facilitate the settlement of non-indigenous and invasive species alongside native taxa. Thus, rising species counts alone do not indicate success; identifying which species colonize the site is critical. Technical risks such as module burial, shifting, or seabed disruption must also be factored into monitoring. The primary regional output of the Antalya application is the potential to establish a repeatable, standardized, and scientific "Artificial Reef Monitoring and Management Guide" at the Mediterranean scale.

Conclusion

Artificial reefs are not a silver bullet for marine challenges. Ecological added value requires correct site selection, sound engineering design, comprehensive data tracking, and management responsive to scientific findings.

This holistic approach spanning physics, genetics, chemistry, and AI-assisted underwater imaging proves that artificial reefs are not one-off concrete dumping events, but data-driven, living, sustainable coastal management instruments. The field insights generated will illuminate similar ecological restoration projects across Mediterranean coastlines.

5.13 Environmental Education in Schools

Operational Domain
Awareness

Location
Province-wide Antalya, schools

Role of the Initiative
Coordination

Institutions & Stakeholders
Antalya Provincial Directorate of National Education, schools and educators

What Did We Observe?

Modifying entrenched adult habits proves far more difficult than instilling correct habits during childhood. Furthermore, habits acquired by children migrate into households; a child utilizing a reusable flask or separating waste gradually influences family behavior.

What Solutions Did We Seek?

Lasting change begins with children. Consequently, we planned to deliver zero waste, marine conservation, and climate change modules to children using age-appropriate, clear, and engaging language. Alongside information delivery, we designed spaces where children engage in hands-on practical activities.

What Did We Accomplish in the Field?

Educational sessions covering Zero Waste, Zero Waste Blue, and COP31 were delivered across schools. Student-oriented activities were organized during Environment Week, with students participating in practical exercises such as beach clean-ups.

What Comes Next?

Expanding educational programming to additional schools; supporting permanent practices like waste separation and flask utilization in campuses. Developing methods to track behavioral changes alongside reach metrics.

Monitoring Indicators
√ Number of schools and students reached
√ Educator feedback

5.14 Public Environmental Events

Operational Domain
Awareness

Location
Province-wide Antalya

Role of the Initiative
Implementation

Institutions & Stakeholders
Governorship of Antalya, municipalities, public institutions, schools, NGOs, volunteers

What Did We Observe?

When environmental conservation remains confined to institutional agendas, societal ownership stays limited. A profound behavioral gap separates observing a process remotely from participating directly.

What Solutions Did We Seek?

Structuring events as genuine field actions. Bringing diverse segments together around a shared purpose on a single day to render environmental consciousness visible, experiential, and shareable.

What Did We Accomplish in the Field?

World Environment Day events were celebrated festively on June 4. Simultaneous volunteer clean-ups



World Environment Day beach clean-up, Beachpark

occurred across all districts, gathering approximately 3,000 students, public institution representatives, municipal employees, and environmental volunteers on beaches.

Awareness and information booths were established at the central event venue alongside recycling workshops, art sessions, and environmental project exhibitions. Deposit-return machines and public drinking water fountains were unveiled on the same day, culminating in a concert reaching broad audiences.

What Comes Next?

Transcending single-day events to establish a year-round sustainable volunteer program; tracking participant retention rates across subsequent initiatives.

Monitoring Indicators

√ Participant count and breakdown by participant group

√ Volume of waste collected during events



A live broadcast connected the World Environment Day events held simultaneously across all districts.

5.15
Waste to Art

Operational Domain
Awareness

Location
Antalya

Role of the Initiative
Coordination

Institutions & Stakeholders
Independent artists

What Did We Observe?
Figures and datasets regarding pollution rarely convey the scale of the challenge fully. Genuine public ownership requires individuals to see and feel the problem.

What Solutions Did We Seek?
Transforming a fraction of waste recovered during clean-up operations into raw materials for artistic works reinforcing environmental awareness—rendering environmental harm visible through an aesthetic medium.

What Did We Accomplish in the Field?
Work is underway with independent artists to transform collected litter and industrial waste generated by enterprises into art installations, scheduled for exhibition during COP31.



'Caretta Kumba', an artwork created from discarded fabric scraps by upcycling artist Aydın Yalçınkaya

What Comes Next?
Exhibiting resulting artworks in public spaces and evaluating visitor impact.

Monitoring Indicators
√ Number of artworks produced
√ Volume of waste utilized in artworks
√ Exhibition visitor count

Concluding Remarks

The interventions compiled in this section reflect efforts active or initiated as of October 2026. Because the Antalya Blue Mediterranean Initiative is not a closed project registry, this matrix remains dynamic; as emerging needs arise, new actions will find a place within one of the four operational pillars, while methodologies yielding suboptimal results or encountering shifting conditions will undergo review. The monitoring indicators concluding each section establish the criteria for these evaluations.

The following chapter evaluates how these efforts can serve as part of lasting transformation for Antalya alongside COP31.



Antalya Governorship Pavilion at COP31

06
A CATALYST FOR CHANGE: COP31 AND BEYOND

The process of hosting COP31 offers Antalya an opportunity to bring its environmental and climate initiatives together with international experiences and develop them in line with the city's long-term needs. The protection of water resources, the health of marine and coastal ecosystems, and the adaptation of production and daily life to changing climatic conditions directly concern Antalya's future. Ensuring that the collaborations and practices developing during the preparation process for the summit generate permanent solutions to these needs depends on joint efforts sustained in the coming years.

This section discusses how COP31 can support a long-term transition in Antalya. It emphasizes the reflection of scientific knowledge on local decisions, the regular monitoring of environmental changes, and the integration of climate adaptation into urban governance. Climate communication and social participation are evaluated in terms of ensuring that decisions are based on local needs and that the benefits of the transition are shared equitably. Meanwhile, recommendations in the field of tourism demonstrate how targets can be translated into practice through resource use measurement, financing of investments, and sector collaboration.

These evaluations also guide the future of the Antalya Blue Mediterranean Initiative. The initiative's current targets and monitoring indicators, the working experience developing among stakeholders, and knowledge acquired from the field establish a foundation where continuity can be established. Strengthening this foundation requires regular evaluation, long-term resource planning, and a working structure where responsibilities are clearly shared. At the end of the section, foundation establishment as an institutionalization option is addressed within the framework of these needs.

Antalya's opportunity lies in utilizing COP31's meeting and learning environment to strengthen the city's conservation efforts. Carrying today's knowledge and labor into the future will depend on these efforts finding a response in urban life and their results being monitored together with society.

6.1 How Can COP31 Become an Opportunity for Lasting Transformation in Antalya?

Prof. Dr. M. Levent KURNAZ
Boğaziçi University Center for Climate Change and Policy Studies (İklimBU)

Between November 9 and 20, 2026, the eyes of the world will be on Antalya. The 31st Conference of the Parties to the United Nations Framework Convention on Climate Change, COP31 for short, will bring together representatives of nearly two hundred countries, thousands of scientists, journalists, and civil society representatives at the Antalya EXPO area. Türkiye will manage the order, security, and action agenda as the host and president of the summit, while the conduct of political negotiations is entrusted to Australia. For the first time in the history of climate summits, leadership is shared between two countries in this manner.

However, the true value of a summit is measured not in the two weeks during which it takes place, but in the years that follow. For many host cities, COP remained an organization that ended the day the showcase was dismantled. The real question for Antalya is: What will remain behind when the delegates return to their homes at the end of November?

Scientific Framework: Why Does the Mediterranean Stand Apart?

The Mediterranean basin is one of the global hot spots of climate change. Climate models show that the region's



Aerial view of the COP31 venue

annual average temperature will increase approximately 20 percent faster than the global average, with this difference growing even larger during the summer months. The situation is no different in the marine environment. According to the assessment published at the end of 2025 by Copernicus, the European Union's climate monitoring program, the Mediterranean's surface water has warmed by an average of 0.41 degrees per decade since 1982, and in the eastern basin—where Antalya's coast is also located—this rate approaches 0.6 degrees per decade. The same study lists the northeastern Mediterranean, which also encompasses the offshore waters of Antalya, among the regions most vulnerable to marine heatwaves.

The counterpart of this in Antalya is tangible: Longer and hotter summers, warmer nights, precipitation that is expected to decrease in the future and become increasingly variable, mounting pressure on groundwater, and alien species multiplying in the warming sea. The lionfish, which entered the Mediterranean via the Suez Canal and expanded its distribution area thanks to the favorable conditions provided by the warming sea, stands out as one of the most readily observable signs of this change. The Intergovernmental Panel on Climate Change, affiliated with the United Nations, also highlights the Mediterranean among the regions where climate change will be felt most acutely. This is not pessimism; it is data-driven realism.

The Context of Türkiye and the Mediterranean

Türkiye is hosting COP31 as a country that has declared its net-zero target for 2053 and enacted the Climate Law in 2025. Net zero means reducing anthropogenic greenhouse gas emissions as much as possible and balancing the remaining emissions with greenhouse gas removals from the atmosphere.

Türkiye is neither a European Union member, nor an oil-exporting country, nor a small island state. In contrast, it is a country that both directly experiences the climate risks of the Mediterranean and maintains strong ties with developing nations. This position gives Türkiye a unique voice: a voice capable of demonstrating to the world that reducing emissions and preparing for a changing climate are not alternatives to one another, but must be pursued simultaneously. Antalya can and must be the stage for this voice.

Antalya's Current Situation

Antalya broke its own record in 2025 by hosting over 17.5 million visitors. In the same year, it ranked first by a wide margin in Türkiye with 233 Blue Flag beaches. This success rests upon two natural assets: a clean sea and a livable climate. Today, both are under pressure.
The city's starting point is not a blank page. Antalya possesses a Sustainable Energy and Climate Action Plan, an action plan addressing extreme heat is underway, and the Blue Mediterranean Initiative—the subject of this book—generates fieldwork ranging from the seabed to the shoreline. What has been missing is a spine that connects these efforts and will survive beyond the summit.

Risks and Opportunities of the Coming Period

The biggest risk is the showcase effect: the cleaning activities, events, and announcements carried out for the summit quietly fading away after

November. The second risk is postponing the impact of climate change on the tourism economy to tomorrow. Extreme heat waves becoming more frequent in July and August threaten the health of both visitors and the workers serving them. Water demand also peaks precisely during these months.

The opportunity lies in the exact opposite direction. COP31 brings Antalya the world's attention, doors opening to international climate finance, and a rare will capable of gathering the public sector, private sector, universities, and civil society around the same table. Antalya can serve as an example demonstrating what a climate-adapted tourism city on the Mediterranean coast looks like—a living laboratory, so to speak.

Five Recommendations for Permanent Transition:

1-Antalya Climate and Marine Observatory

A permanent structure must be established that regularly measures sea water temperature, the condition of seagrasses, the amount of waste on the coast, temperatures within the city, and water reserves, sharing its data openly with everyone. We cannot manage what we do not measure. This structure can be brought to life as a legacy of the summit, in collaboration with universities and initiative partners.

2-Redesigning Tourism According to Heat

It is necessary to extend the tourism season into spring and autumn, regulate working outdoors during the hottest hours, and increase shade and green spaces within the city. Generating their own electricity from solar energy on hotel roofs and parking lots will lower both bills and emissions. Antalya's sun is more than sufficient for this.

3-Protecting Water

The treatment and reuse of greywater (lightly polluted water originating from sinks and showers) for garden irrigation in hotels and housing complexes, the reduction of losses in distribution networks, the harvesting of rainwater, and the protection of groundwater must be priorities. The cheapest water is the water that is not consumed.

4-Protecting the Invisible Infrastructure of the Sea

Seagrasses serve both as a habitat for fish and as a natural storehouse capturing carbon. Keeping boat anchorages away from these areas, strengthening the conservation model initiated in the Three Islands (Üç Adalar), and expanding it to suitable areas can be counted as low-cost yet high-yield steps.

5-Institutional Continuity

Operating under the coordination of the Governorship, the Blue Mediterranean Initiative must transform into a permanent structure even after the summit and publish a public progress report every November on the anniversary of COP31. Such a report ensures that promises made can be monitored by everyone over the years.

COP31 will bring the world's attention to Antalya for two weeks. The way to turn this attention into a permanent transition is to view the summit not as a finish line, but as a starting line. If we can observe a measurable improvement in Antalya's sea, coast, and urban life following the summit, that will be the true legacy of COP31.

Antalya's Blue Promise becomes a true promise only when it is kept.

6.2 Green Transition, Climate Communication and Public Participation in Antalya

Prof. Dr. Murat TÜRKEŞ
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The Social Counterpart of the Green Transition

When green transition is mentioned, solar panels, wind turbines, or electric vehicles come to mind first. Yet for Antalya, the issue is much broader: energy, transportation, tourism, water, food, waste, coastal use, and disaster risk management are not disconnected subjects. The struggle against climate change, climate adaptation, social justice, and nature conservation goals must all be addressed at the same table, observing the public interest. The permanence of this transition depends on its reliance on science alongside the genuine participation of the people of Antalya in decisions. Climate communication must also not settle for merely conveying information; it must clearly articulate why a decision was made and how costs and benefits are distributed among whom.

Understanding Climate Risk Together in Antalya

Let us consider Antalya as a whole: the coasts, the Taurus Mountains, forests, agricultural lands, and tourism are tightly interconnected. While heat waves and water scarcity strain human health and livelihoods, severe precipitation, floods, storms, and fires can strike different communities in the same region in varying ways. Therefore, reducing the green transition merely to energy investment would be misleading; scientific knowledge, local decisions, and public participation must advance together.



The Antalya Blue Mediterranean Initiative at the Runtalya Marathon

Climatic conditions and vegetation in Antalya change over short distances from the coast to the mountains. If we fail to read coastal temperature and humidity together with the elevation and vegetation of interior regions, telling a single risk story for the province becomes misleading. The locator map in Figure 1 is necessary not only to show where the city is located, but also to observe the differences among the coast, travertine plain, plains and valleys, and the Taurus Mountains (Figure 1).

Observed and projected climate type changes in Türkiye point to the potential spread of warmer and drier conditions [4]. The vulnerability of the forest ecosystem in Antalya Düzlerçamı to this change varies from area to area [5]. The Manavgat wildfire served as a painful reminder of this: fire weather, combustible materials, settlements, and rural livelihoods must be considered together. The damage suffered by bee ecosystems and apiculture in burned areas is also a part of this picture [6,7].

Following a fire, looking merely at the question of "how many hectares burned" is insufficient. Forest recovery, bee food sources, producers' income loss, and villagers' livelihood conditions must be monitored together. Such monitoring can indicate who, where, and what kind of support is needed without disconnecting nature conservation from rural life.

What Does the Vulnerability Map Tell Us?

Disaster risk does not stem solely from the magnitude of the hazard. The impact experienced by people and infrastructure, how sensitive they are, and how capable they are of adapting also determine the outcome. Simply put, risk (R) is a composite of hazard (T), exposure (M), and vulnerability (E): R = f(T, M, E). Vulnerability is likewise related to sensitivity and adaptive capacity. It must be noted that this is a framework rather than a precise mathematical equation [8].



Figure 1. Antalya's location in the Eastern Mediterranean and its physical map. Sources: Natural Earth [1] and the General Directorate of Mapping [2]; boundaries: Ministry of Agriculture and Forestry [3].

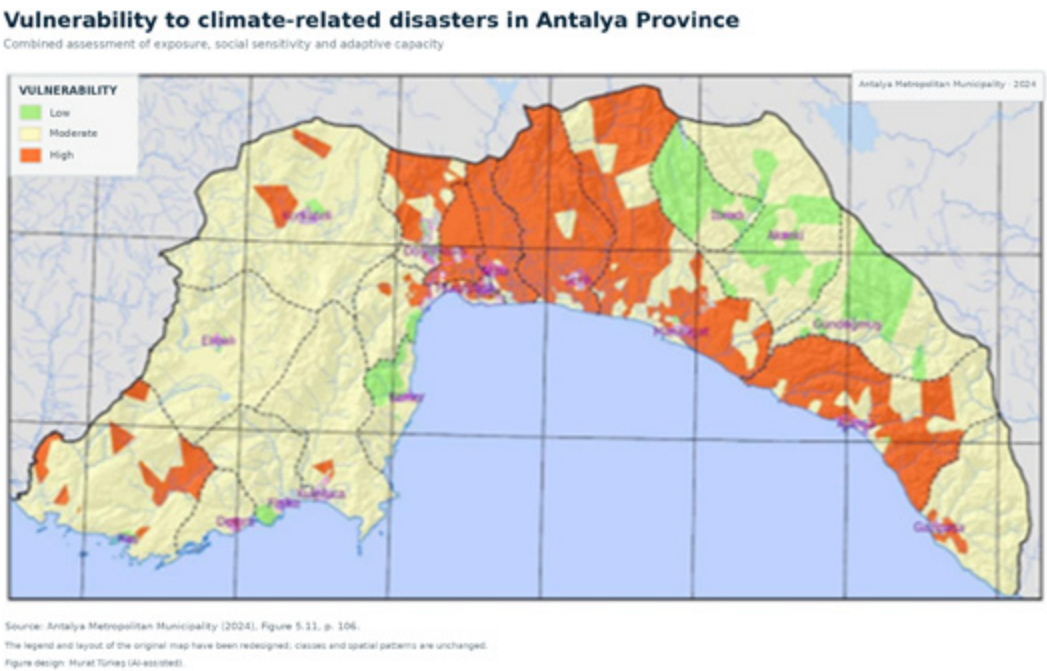


Figure 2. Relative vulnerability to climate-related disasters in Antalya. Source: Antalya Metropolitan Municipality [9, Figure 5.11, p. 106]; legend and layout adapted.

Antalya Metropolitan Municipality's 2024 study evaluated climate hazards, the exposure of population, urbanization, agricultural and forest areas, and social indicators together. Examining the map reveals that the city center along with parts of Serik, Manavgat, and Alanya fall into the high vulnerability class (Figure 2). But caution: neighborhood data is limited, and colors do not indicate individual neighborhoods' current risk or potential loss of life. At this exact juncture, a gratifying development exists: the MUHIR study under CLIMAAX took an important step in bringing this picture down to the neighborhood scale by identifying heat focal points and local temperature thresholds in central districts [9,10]. The multiplication of such studies and their continuation with the explicit sharing of result scopes and uncertainties will render Antalya's risk map increasingly realistic [9,10].

This map is not a terminal point, but a starting point. The weights assigned to criteria, the period of data utilized, and map resolution directly influence the outcome. Integrating local health records, age groups, income levels, housing quality, outdoor working conditions, and transportation facilities renders the picture much clearer. Assuming an entire district is "equally vulnerable" without discerning intra-district differences means overlooking the neighborhoods most in need of support.

Preparing for Tornadoes and Floods and Protecting Greenhouses

As global warming increases surface temperatures, evaporation, and the moisture capacity of the atmosphere, the hydrological cycle also accelerates; when appropriate meteorological conditions form, precipitation can become more effective and intense [11]. These changes can also create a favorable environment for the formation of rotating supercells (mesocyclones). However, caution is required: understanding the true trend of tornado frequency in Antalya necessitates examining long-term observation records and scientific studies; directly attributing a single tornado to climate change is incorrect [12,13].

Tornado-producing storms damage greenhouses not only through swirling winds, but also via downpours and hail. Proper site selection at coasts and valley mouths, early warning systems, and the strengthening of greenhouses can mitigate damage; they do not completely eliminate risk. Therefore, insurance and public support for small-scale producers are essential [12]. Within the city, the protection of stream beds, the safe drainage of rainwater, and neighborhood-scale warnings understandable to everyone constitute the foundation of flood preparedness [9].

Tornado and flood preparedness does not begin on the day of the event. State Meteorological Service (MGM) warnings must transform into a clear action chain among municipalities, AFAD (Disaster and Emergency Management Presidency), producer organizations, and neighborhoods: the pre-determination of safe locations, communication-responsible personnel, and damage recording methods is mandatory. This is because a greenhouse worker, a coastal boat owner, and someone living in a basement flat utilize the same warning in vastly different ways. Post-event recording of production, health, and income loss—rather than merely physical damage—guides subsequent zoning and infrastructure decisions.

Tourism, Participation, and Just Transition

Coastal tourism research covering Antalya's Manavgat, Alanya, Kemer, Serik, and Aksu districts indicates that heat-related discomforts may increase during the May–October period [14]. While reducing energy and water consumption in tourism, it is also necessary to safeguard worker health, local public access to the coast, and water needs. Coastal cleaning must likewise not remain limited to waste collected on the beach; it must be complemented by preventing pollution transport from the basin to the sea at its source [15].

Heat waves, drought, and wildfire risks coincide precisely with the period when summer tourism and agricultural water demand reach their peak. Therefore, alongside facility efficiency, reducing network losses, reusing treated wastewater in suitable areas, and multiplying cool public spaces hold great significance. While evaluating ideas to revitalize tourism in spring and autumn, the burden on coastal ecosystems and local life must also be monitored.

If climate communication turns into a one-way announcement, participation fails to strengthen. Coastal areas and high temperatures in Konyaaltı, fires and floods in Manavgat, and water and greenhouse agriculture in Kumluca and Finike stand out. Experiences of local residents and workers must be integrated into plans; the justifications for decisions and measured results must be shared transparently. Access to water,

secure housing, and cool public spaces must be provided through public support for low-income households, small-scale producers, and outdoor workers.

Antalya's Sustainable Energy and Climate Action Plan targets reducing greenhouse gas emissions by 40 percent by 2030 and becoming a carbon-neutral, climate-resilient city by 2050 [16]. The true counterpart of these targets will emerge through the joint execution of energy, water, transportation, and land-use decisions across districts. Sharing results regularly will also reveal which practices prove effective and which segments lag behind.

Municipal climate action and disaster risk reduction plans must be tied to neighborhood priorities and monitored regularly. Placing the cost of measures solely on individual savings is unjust; infrastructure investments, support for producers, and the responsibilities of major consumers must also be clearly defined. Participation acquires true meaning not merely through soliciting public opinion, but through contributing to the preparation of decisions and the auditing of outcomes.

Conclusion

Antalya's climate resilience depends on reading hazards on the map together with social vulnerability and implementing measures at the district and neighborhood scale. The enduring value of COP31 will be measured less by promises made and more by how water resources, coasts and forests are protected and people's living conditions are safeguarded. The green transition achieves success only through a collaborative effort whose outcomes are monitored and whose benefits are equitably shared.

6.3 From Commitment to Measurable Transformation in Tourism: KPIs, Finance, Sector Collaboration and an Implementation Model

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The Gap Between Commitment and Result

Antalya tourism stands out as one of the leading destinations in the Mediterranean with its scale and service production capacity. However, in the new phase of global competition, mere increases in visitor, bed, and overnight numbers no longer suffice as performance metrics. Pressures on resources such as water, energy, food, and land directly affect operating costs, destination resilience, and local quality of life [1]. Therefore, sustainability declarations must not remain as statements of intent; they must transform into measurable targets, financed investments, and accountable practices.

Within this scope, the "economic value per resource" approach is viewed as the starting point for transition in Antalya. A facility's sustainability should be evaluated not merely by possessing certification, but by its ability to maintain service quality and economic efficiency

while reducing consumption per guest-night. The Statistical Framework for Measuring the Sustainability of Tourism (SF-MST), adopted by the United Nations in 2024, provides a foundation for monitoring economic, environmental, and societal impacts collectively [2].

KPI: The Common Language of Measurable Transition

Key Performance Indicators (KPIs) link strategic targets to outcomes that can be regularly monitored. For Antalya, an initial set of indicators can be structured across five axes: water, energy and carbon, food, materials and waste, governance and local economic contribution. Within this framework, water consumption per guest-night (liters), energy consumption (kWh), greenhouse gas emissions (kg CO_2e), food waste (kg), total waste, and recovery rates constitute essential measures. The ratio of local procurement expenditures to total eligible purchases, employment continuity throughout the year, and employee satisfaction complete the economic and social dimensions.

To render indicators meaningful, definitions, measurement boundaries, data sources, and reporting frequencies must be harmonized. For instance, comparing solely total water consumption can mask differences in facility size and occupancy. Thus, absolute consumption should be published alongside intensity metrics normalized per guest-night. Hotels should be benchmarked against similar peer groups regarding category, service scope, and seasonality. The data verification process must be supported by anonymization safeguarding commercial confidentiality and independent control mechanisms. GSTC destination criteria also prescribe establishing measurable targets and reporting results regularly [3]. Marked variations in direct water use per



Sustainability in tourism takes shape when commitments become measurable results. (The sign reads: Thanks to our water refill stations and complimentary reusable water

overnight stay across accommodation facilities in Antalya concretize the importance of comparable indicators [4].

Finance: Converting Savings into Investment

Measurement alone does not secure transition; indicators must be tied to investment decisions. Water-saving technologies, heat recovery, high-efficiency cooling, building automation, renewable energy, and food waste prevention solutions represent priority investment areas for facilities in Antalya. For each project, initial investment outlays, annual resource savings, effects on operating expenditures, maintenance needs, and payback periods must be calculated. Prioritization should rely not solely on short payback periods, but also on resilience secured against drought, energy price fluctuations, and regulatory risks.

In financing models, facility equity, bank loans, appropriate incentive and support programs, and energy performance contracts can be evaluated jointly. To mitigate technical preparation and credit access hurdles—particularly for small and medium-sized enterprises—joint project development and bulk technology procurement mechanisms can be established. Measuring and verifying savings against baseline consumption facilitates risk assessment for lenders. Thus, sustainability transitions from an expenditure item into an investment portfolio that reduces costs, manages risks, and enhances competitiveness. To render financing decisions more transparent, projects can be scored through a joint evaluation matrix. This matrix evaluates expected water and energy savings per unit of investment, avoided emissions, economic payback, technical feasibility, and social benefit separately. While monetary values of savings are calculated using current unit prices, price fluctuation impacts must be illustrated separately. Accounting for differences in occupancy, weather conditions, and service scope in pre- and post-project measurements remains vital for determining genuine investment impacts.

Sector Collaboration and Governance

Enhancing individual facility performance is necessary yet insufficient to resolve destination-scale challenges. Safeguarding water basins, waste infrastructure, sustainable transportation, and local food procurement demands collective action. Under the facilitative and coordinating role of the Antalya Governorship, the Provincial Directorate of Culture and Tourism, metropolitan and district municipalities, relevant public institutions, AKTOB, POYD, trade and industry organisations, universities, and supplier representatives can converge within a joint implementation platform.

This platform's mandate must extend beyond organizing meetings to endorsing data standards, selecting priority projects, facilitating financing matches, and publishing annual performance reports. Working groups focusing on food, water, energy-carbon, materials-waste, and governance-KPI can execute technical applications. Universities can contribute to methodology development and independent impact assessment, sector associations to broadening participation, and public institutions to regulatory and infrastructure harmonization. Joint

procurement and producer linkages can further bolster the retention of tourism revenues within the local economy [5, p. 739]. Separating decision-making from technical monitoring functions within the governance structure proves beneficial. While a steering committee establishes strategic priorities and annual targets, a technical secretariat manages data collection, quality control, and reporting. Empowering enterprises to benchmark their performance against anonymized averages of peer groups can reinforce voluntary participation. Regular feedback from employees, suppliers, and local community representatives prevents social impacts from being reduced solely to numerical metrics. Such a framework can elevate public-private sector collaboration from periodic campaigns into enduring institutional capacity.

Phased Implementation Model for Antalya

During the initial phase (0–6 months), voluntary pilot facilities must be selected, existing data quality audited, and baseline year values established. Selecting facilities from diverse scales and regions prevents the model from remaining tailored solely to large hotels.
During the second phase (6–18 months), digital measurement infrastructure must be installed, employees trained, and rapid-yield efficiency projects executed. Responsible institutions, investment budgets, baseline values, targets, realization metrics, and verification methods must be explicitly defined for each pilot.

During the third phase (18–36 months), verified results must be integrated into a joint destination dashboard, and successful solutions disseminated to other facilities. For instance, targets such as a 15 percent reduction in water consumption per guest-night or a 20 percent drop in food waste should be utilized not as Antalya's current achievements, but as exemplary targets tested against pilots' baseline data. Annual reports must reflect not only successes, but also target deviations and corrective actions. Thus, the implementation model relies on a plan-do-check-act cycle. In practice, establishing measurement capability must precede targets for enterprises lacking data during the initial period, since performance improvement cannot be reliably calculated without sound baseline values. In subsequent periods, targets must be reviewed annually and adapted to seasonal fluctuations and technological shifts.

Conclusion: The New Metric of Competition

Antalya tourism's future preeminence will hinge not solely on scale and service quality, but on the capacity to generate identical economic value with reduced resource consumption. KPI systems reveal what shifts; finance dictates how transition is resourced; sector collaboration assigns accountability; and implementation models outline steps and timelines. True success is measured not by the volume of signed commitments, but by verifiable resource savings, reinforced local procurement, mitigated risks, and enduring economic value. Through this governance approach, Antalya can serve as an exemplary destination in the transition from sustainable tourism rhetoric to measurable outcomes.

Concluding Remarks:
The Future of the Antalya Blue Mediterranean Initiative

The Antalya Blue Mediterranean Initiative brings together diverse institutions, areas of expertise and segments of society around a shared aim: protecting the city's sea and natural environment. The work undertaken so far is building experience and know-how in acting together. The key task for the period ahead is to develop this experience further and to create the conditions under which the work can be sustained for many years. The attention and opportunities for cooperation brought by COP31 can accelerate the steps taken in this direction.

The approaches to scientific monitoring, public participation and measurable transformation discussed in this chapter complement one another in shaping the Initiative's future. The key performance indicators, financing, sector cooperation and phased implementation model proposed for tourism offer a management approach that can be adapted to the Initiative's own fields of work. This approach clarifies with which resources, under whose responsibility and on what timeline the targets will be achieved, while also making it possible to evaluate the results obtained.

Tracking Progress via Target Indicators

The monitoring indicators defined under each of the Initiative's work areas provide a ready foundation for measurable transformation. For seabed clean-ups, the amount and type of waste removed and the time it takes for waste



Antalya's blue future depends on a society that shares responsibility for protecting nature and passes it on from one generation to the next.

to accumulate again at the same site help assess the impact of the work. The same applies to cigarette butt density per unit area and user compliance on smoke-free beaches, and to the level of use and the change in plastic bottle waste at drinking water stations. For seagrass meadows, the condition of the meadows and the survival rate at propagation sites allow ecological protection to be tracked over the long term. For environmental education, the number of students reached, teacher feedback and changes reflected in everyday habits can be considered together.

Linking these indicators to a common monitoring framework will make visible how each activity contributes to the same long-term goal. For each indicator, the baseline, the target to be reached, the measurement method, the evaluation period and the party responsible for providing the data need to be defined. Where data are lacking, the first step should be to establish a reliable baseline record. Targets, in turn, should be set with field conditions and implementation capacity in mind.

Just as tracking consumption per overnight stay makes comparisons meaningful in tourism, the Initiative's work needs to take into account factors such as the size of the area, intensity of use, season and frequency of activities. For example, changes in the amount of waste collected should be interpreted together with the area cleaned and the frequency of clean-ups. Common methods developed with universities will strengthen the consistency of measurements. The Antalya Climate and Marine Observatory proposed by Kurnaz is an important opportunity to turn the Initiative's indicators into a long-term monitoring system.

Turning Cooperation into a Lasting Way of Working

The Initiative's strength lies in the ability of different institutions to contribute to shared goals with their own mandates, expertise and resources. This cooperation has developed under the coordination of the Governorship, and its continuity can be strengthened by clearly defining roles and decision-making processes. A steering mechanism that sets common priorities, technical groups organised by work area and a secretariat responsible for day-to-day follow-up can meet this need. The implementation platform proposed for tourism can take its place within this structure as a working group.

In such a structure, the technical secretariat can follow the implementation schedule, compile data from stakeholders, support the preparation of projects and funding applications, and prepare progress reports. Universities can contribute scientific methods and impact assessment, and sector organisations can help scale up good practices. Local authorities and relevant public institutions can contribute through services and infrastructure within their own remits. Keeping regular records of decisions, methods and field experience makes it easier to pass on accumulated knowledge when staff change.

This framework must also stay closely connected with society. The experiences of fishers, producers, tourism workers, beach operators and volunteers can reveal problems in implementation at an early stage. Regular feedback and review meetings ensure that local needs are reflected in the work programme. In this way, climate communication and public participation become part of the Initiative's decision-making and learning processes.

Planning Finance for the Full Lifetime of Each Activity

In tourism, the financing approach links resource savings to investment decisions. For the Initiative, the same approach means planning for the long-term needs of each activity as a whole. When a river barrier is installed, resources must also be planned for its maintenance, the removal of accumulated waste and the recording of data. Protecting and propagating seagrass meadows requires scientific monitoring spread over many years. The impact of drinking water stations, meanwhile, depends on regular maintenance and uninterrupted use.

Project budgets should therefore cover set-up, operation, maintenance, training and monitoring costs. When deciding where resources should go, the urgency of ecological need, the expected environmental benefit, implementation capacity and long-term cost should be assessed together. The value of work such as habitat protection should also be considered in terms of its ecological gains and social benefits.

Contributions from the business community, suitable grant programmes, research partnerships and in-kind support can complement one another within multi-year work plans. It is important that support also covers activities that require continuity, such as maintenance and monitoring. Sharing openly how resources are used and what results are achieved strengthens trust with contributors.

A Foundation as an Option for Institutionalisation

Establishing a foundation stands out as an institutional option that could support the Initiative's long-term aims. A foundation focused on protecting Antalya's marine and coastal ecosystems could provide a permanent institutional basis for resource development, scientific monitoring, education and project coordination. This option should be assessed by how far it would build regular working capacity and preserve the knowledge, relationships and experience accumulated over time.

The foundation model requires its founding purpose, fields of activity, assets, and management and oversight arrangements to be defined together. For the Initiative, this preparation should include a joint assessment of sustainable income opportunities, the need for a professional team and the responsibilities that stakeholders can take on.

In considering a foundation, preserving the Initiative's participatory character should be a key criterion. The credibility of the new structure will be strengthened

if the views of different groups are reflected in decision-making, scientific assessments guide practice, and income and expenditure can be tracked transparently. The value of whichever institutional form is chosen will lie in how well it responds to Antalya's conservation needs and contributes to the continuity of the shared effort.

Implementation and Joint Review after COP31

This framework can be put into practice in stages. In the first stage, existing indicators, data sources, stakeholder responsibilities and resource needs are reviewed together. Next, common measurement and reporting methods are piloted in selected areas of work. Drawing on this experience, the methods are refined and suitable practices are extended to other areas. Preparations for a foundation can also be developed further on the basis of the needs that become clear during this process.

A progress report published at the same time each year will serve as the shared review tool for this way of working. The report should set out targets, results achieved, resources used, challenges encountered and adjustments planned for the next period. Reviewing the results with stakeholders and the public will help identify new priorities and show the impact of the support provided.

The Antalya Blue Mediterranean Initiative will become permanent as the shared responsibility that has emerged in the city becomes part of its everyday functioning. Target indicators will make progress visible, financing will sustain that progress, and the institutional structure will allow knowledge and effort to accumulate over the years. The opportunity presented by COP31 can find a lasting place in Antalya's future if these elements are strengthened together. Antalya's Blue Promise will live on through sustained work, shared responsibility and the recovery seen in nature.



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05 FROM PROMISE TO ACTION
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06 A CATALYST FOR CHANGE: COP31 AND BEYOND

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6.3 From Commitment to Measurable Transformation in Tourism: KPIs, Finance, Sector Collaboration and an Implementation Model

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