Analysis and Selected Case Studies
on War and Conservation

# Protected Nature in Armed Conflict

*Colophon*
June 2026

PAX means peace. Together with people in conflict areas and concerned citizens around the world, PAX works to protect civilians from the violence of war, to end armed conflict, and to build inclusive peace. Make peace work!

See also www.paxforpeace.nl.

| | |
|---|---|
| Authors | Marie Schellens, Christina Parandii, Genevieve Hull and Wim Zwijnenburg |
| | |
| Case-study contributions | |
| Colombia: | Melissa Pellis, Mayia Giannakou, Lune Moorees de Rijk |
| Iran: | Genevieve Hull and Wim Zwijnenburg |
| Iraq: | Bassam Ahmed and Salman Khairalla |
| Myanmar: | Nathan Ruser |
| Palestine: | Enora Segeren, Jonathan Vince, and Liam Beechouk |
| Syria: | Angham Daiyoub and Simav Hasan |
| Ukraine: | Anna Hatzius Sarramona and Georgina Hekkelman |
| Yemen: | Maha Al-Salehi and Maram Al-Nabhani |
| | |
| Graphic Design | Frans van der Vleuten |
| Copy editor | Neil Hauer |
| Contact | zwijnenburg@paxforpeace.nl |

We are grateful for the thorough feedback and review by Helen Cecilia Obregon Gieseken, Daniëlla Dam-de Jong, and Karen Hulme. The views and conclusions expressed in this report are solely those of the authors and do not necessarily represent the views of the reviewers or the institutions with which they are affiliated.

Cover photo: Members of the Mandalay Region People›s Defence forces (PDF) are ready to participate in the training camp. The People›s Defence force (PDF) is the armed wing of Myanmar›s National Unity Government (NUG), formed following the Coup d›etat of February 1st, 2021.

David Mmr/SOPA Images

# Table of contents


**Introduction** 4

**Nature conservation in protected areas globally** 6

**How does armed conflict impact protected nature?** 9

Direct impacts 9

Indirect impacts 10

**Case highlights from the frontlines of nature and war** 13

Methodology 14

Ethical disclaimer 14

**Colombia**: Tinigua National Natural Park 16

**Iran**: the scorched ecosystems of Bisotun and Sefidkhu-e-Khorramabad 23

**Iraq**: a country overview of protected areas in a post-war landscape 28

**Myanmar**: subsistence resource extraction amidst the nationwide revolution 34

**Palestine**: Wadi Gaza Reserve 41

**Syria**: the war's impacts on forest and nature reserves 47

**Ukraine**: Chornomorskyi (Black Sea) Biosphere Reserve 53

**Yemen**: Utmah Reserve and Aden Wetlands 58

**How can nature be better protected in armed conflict?** 66

**Conclusions and recommendations** 72

# Introduction

**In times of war, the human cost is often immediate and visible: towns reduced to rubble, lives displaced, and futures fractured. Yet hidden beneath the headlines lies another, quieter victim: nature. It encompasses the full spectrum of the Earth's biological diversity, as well as geodiversity.[1] As the natural world has increasingly been placed under pressure by human development and exploitation, various international and national measures have been established over the last few decades to preserve its shrinking richness. Even these cannot shield nature from the destructive impacts of armed conflict, however. Protected areas, established as sanctuaries for biodiversity and ecological balance, are regularly caught in the crossfire.[2] From wetlands contaminated by toxic substances in ammunition and explosives to forests scarred by shelling, animals killed and injured by landmines, and land cleared to make way for military operations, the natural world bears consequences that are as far-reaching as they are insufficiently addressed.**

For natural areas that host unique ecosystems and endangered species, conflict-related environmental damage can be irreversible or take decades to recover. Additionally, many protected areas act as global carbon sinks, and are therefore essential in climate change mitigation strategies, yet their destruction in armed conflicts often results in the release of stored carbon. These environmental damages also directly and indirectly affect human wellbeing and livelihoods, and even survival.[3] When nature is damaged, communities can no longer rely on their related life-supporting systems such as clean water, fertile soil, pollinators, building materials, and natural elements that provide protection against climate extremes, compounding the suffering of communities already enduring the hardships of war. The destruction of nature undermines recovery, contributes to the climate crisis (while weakening communities' resilience to it), fuels future instability, and threatens long-term human security.[4] It is widely recognized that while natural ecosystems are declining globally at an unprecedented rate, expanding and strengthening protected natural areas is critical to preventing catastrophic tipping points and securing a livable future for both people and the planet.[5]

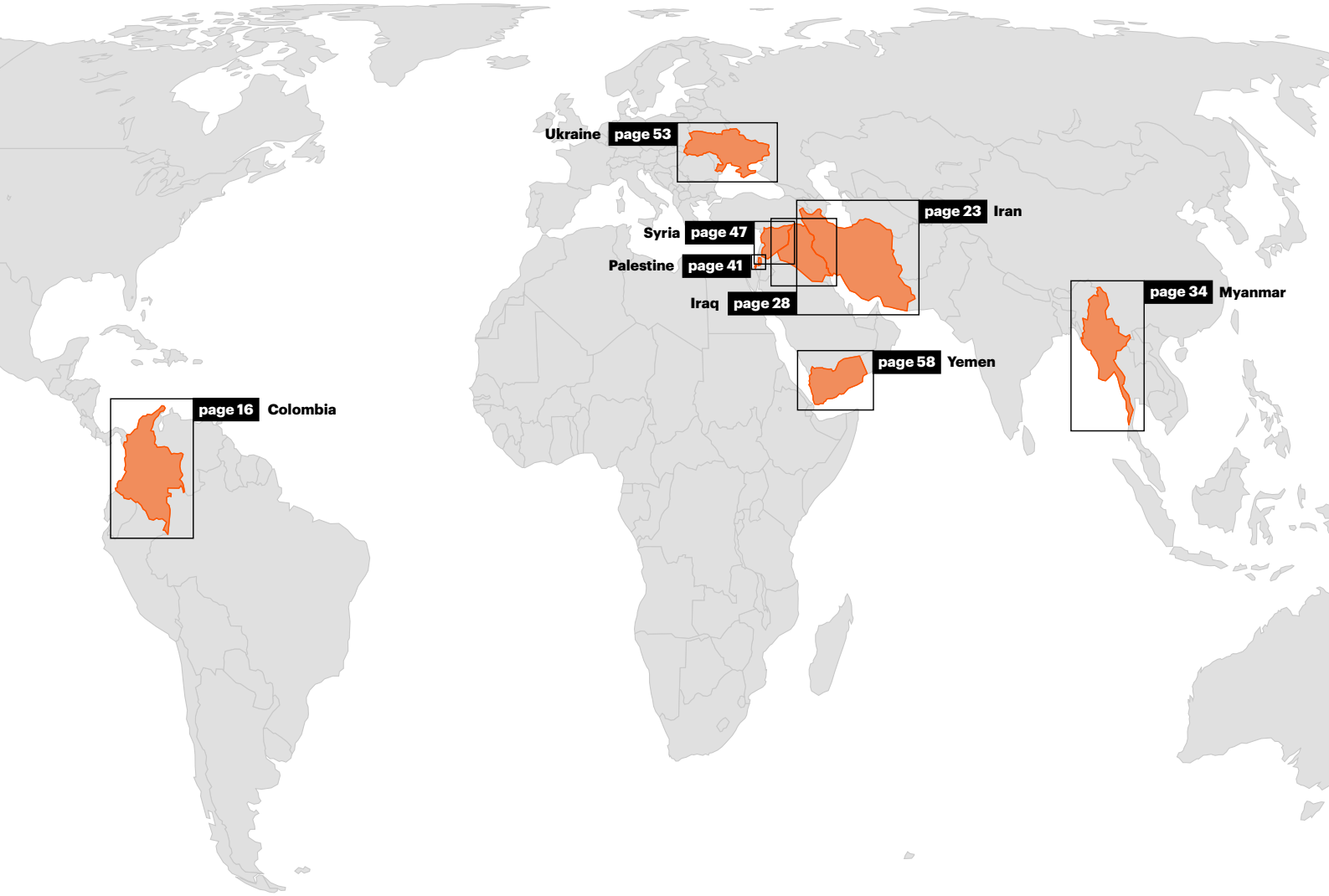
This report confronts the reality that even designated zones of conservation are not spared the devastations of war and argues that states and the wider international community must do more to shield them. Despite the existence of international legal frameworks, including international humanitarian law (IHL) and environmental law, that provide for the protection of nature during armed conflict, their practical effect is often limited. Some of those norms contain applicability thresholds that are too high; others face persistent gaps in operationalisation and enforcement, while many environmental norms set obligations that are too open-ended to be suitable for enforcement. In conflict-affected settings, protections offered by existing instruments like the World Heritage Convention and the Ramsar Convention do not seem sufficient to prevent

1 Justice, S., Crofts, R., Gordon. J.E. and Gray, M. (2025). The Meaning of Nature: Clarification for strengthened protection and management. IUCN WCPA Issues Paper Series No. 5, Gland, Switzerland: IUCN, 6-7.
2 IUCN (2021). Conflict and Conservation. Nature in a Globalised World Report No. 1, Gland, 11–17.
3 PAX (2025). Protecting the Environment is Protecting Civilians: Recommendations for UN Member States for the 2025 PoC Annual Debate.
4 ICRC (2020). When Rain Turns to Dust: Understanding and Responding to the Combined Impact of Armed Conflicts and the Climate and Environment Crisis on People's Lives. International Committee of the Red Cross Reference Report, 17-19.
5 IPBES (2019). Global Assessment Report on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.
UNEP (2021). Making Peace with Nature: A scientific blueprint to tackle the climate, biodiversity and pollution emergencies. United Nations Environment Programme, Nairobi.

the destruction of iconic natural sites. Moreover, many ecologically significant areas, especially in politically fragile regions, may fall outside of these high-profile designations.

This report seeks to spotlight both formally designated protected areas and ecologically important sites lacking international recognition that have been affected by armed conflict. By documenting their vulnerability, it aims to strengthen the evidence base and build political momentum for strengthening the use of international legal and policy frameworks to ensure better protection of nature amid hostilities.

The report is structured as follows: first, it begins with a general overview of protection systems for nature conservation globally and continues with an overview of wide-ranging impacts of armed conflict on protected nature, including biodiversity, ecological integrity, and conservation efforts. Then, to illustrate such impacts, the report delves into the selection of in-depth case studies from Colombia, Iran, Iraq, Myanmar, Palestine, Syria, Ukraine, and Yemen, spanning a wide range of ecosystems, conflict types (i.e. international and non-international armed conflicts), and governance contexts. The final section provides analysis of existing legal and policy frameworks, instruments and prospective pathways for better protection of nature in armed conflict, concluding with policy recommendations on addressing the identified gaps and strengthening enforcement and accountability.



# Nature conservation in protected areas globally

**Efforts to conserve nature around the world are implemented through a wide array of systems that vary in scope, governance, and legal authority. These systems operate at international, regional, and national levels, often integrating local communities to ensure long-term sustainability and ecological integrity.**

A key framework guiding these efforts is the definition of a protected area established by the International Union for Conservation of Nature (IUCN) in 1994 and updated most recently as 2008. According to the IUCN, a protected area is "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values".[6] This definition has been widely adopted by global and regional bodies, including the European Environment Agency (EEA)[7] and the African Union,[8] and serves as a foundation for conservation planning and reporting. It underpins several global conservation databases and tools, including the IUCN Red List of Ecosystems, the World Database on Protected Areas (WDPA), and the World Database of Key Biodiversity Areas (KBA).[9]

The IUCN uses this definition to classify 260,000 protected sites into seven categories based on each site's management objectives, providing a common language for conservation efforts worldwide.[10] At a global level, the United Nations Environmental Programme (UNEP) uses these classification types and categories to aggregate data on protected areas worldwide, most notably through the World Database on Protected Areas ("Protected Planet").[11] While the emphasis on 'management' is central to these definitions, it is important to acknowledge that during times of conflict, formal management systems often break down. Nevertheless, this does not diminish the ecological value or conservation significance of these areas – their clearly defined status and inherent ecological and cultural importance remain intact. One of the most widely recognized global mechanisms for protected area conservation is the UNESCO World Heritage Sites program, established by the 1972 World

6 IUCN (2008). Guidelines for Applying Protected Area Management Categories. Edited by Dudley, N., Gland, Switzerland.
7 EEA (2023). An introduction to Europe's Protected Areas. European Environment Agency.
8 AU (2003). African Convention on the Conservation of Nature and Natural Resources. African Union, Maputo, Mozambique, 11 July.
9 IUCN (no date). Resources.
10 IUCN (2008). Guidelines for Applying Protected Area Management Categories. Edited by Dudley, N., Gland, Switzerland.
IUCN, UNEP, and WCMC (no date). Protected Planet.
11 IUCN, UNEP, and WCMC (no date). Protected Planet.

Heritage Convention.[12] This framework identifies natural world heritage areas of exceptional biodiversity, ecological value, and natural beauty, encouraging the inclusion of local stakeholders in conservation efforts.[13] Today, over 250 natural sites are recognized, covering 3.5 million km² of protected terrestrial and marine territory across more than 100 countries. These sites not only preserve rare habitats and species but also provide crucial ecosystem services and economic opportunities. As such, many World Heritage sites have overlapping IUCN classifications.

Complementing this, UNESCO's Man and the Biosphere (MAB) program oversees 759 Biosphere Reserves across 136 countries.[14] These areas serve as experimental spaces to explore sustainable relationships between people and nature. The MAB program advocates cooperative management approaches that benefit both biodiversity and local livelihoods, recognizing that ultimately people and nature do not exist separately.

The Convention on Biological Diversity (CBD) is another key international instrument providing a global legal foundation for biodiversity protection.[15] Under Article 6 of the CBD, parties are required to develop and implement National Biodiversity Strategies and Action Plans (NBSAPs), which identify nationally important ecosystems, priority conservation areas, and strategic actions to achieve global biodiversity targets. One example is the goal to conserve at least 30% of terrestrial, inland water, and marine ecosystems by 2030, as stipulated in the CBD's Kunming-Montreal Global Biodiversity Framework. Complementing this strategic planning, Article 8 of the CBD outlines specific obligations for in-situ conservation, including the establishment and management of protected areas, the protection of ecosystems and natural habitats, and the rehabilitation of degraded ecosystems. Together, these provisions create a framework for both national-level biodiversity planning and site-level implementation. Wetlands, which support about 40% of global biodiversity, are the focus of the Ramsar Convention, the intergovernmental treaty adopted in 1971 in the Iranian city of Ramsar, which maintains the List of Wetlands of International Importance.[16] Over 2,400 Ramsar sites worldwide are conserved for their unique ecological roles, including water filtration, flood control, carbon storage, and biological diversity.[17] This initiative emphasizes collaborative governance involving states, local communities, and the private sector.[18]

Emerging frameworks like the new UN Agreement on Marine Biological Diversity of Areas Beyond National Jurisdiction (the BBNJ Agreement, known also as the High Seas Treaty) could complement these efforts by supporting the designation and protection of marine biodiversity areas beyond national jurisdiction.[19] Some sites are designated under multiple international frameworks, known as Multi-Internationally Designated Areas (MIDAs). These overlapping designations can offer significant benefits, such as enhanced recognition of an area's ecological value, which can help raise public and community awareness in support of conservation. However, MIDAs also present notable challenges: a key issue is the possible lack of coordination between the various legal and management frameworks involved, particularly when different governing bodies are responsible for overseeing the same site.[20]

Recognizing that ecosystems transcend political borders, regional conservation initiatives have also emerged. Networks like Natura2000 in Europe and KAZA in southern Africa illustrate the importance of transboundary cooperation in protecting migratory species and large landscapes.[21] Similarly, the Pantanal Declaration unites Brazil, Bolivia, and Paraguay in conserving the world's largest tropical wetland.[22] While there are inherent political and social challenges in establishing and maintaining transboundary conservation initiatives, the importance of these efforts lies in their ability to protect critical ecosystems, enhance biodiversity conservation, and foster long-term cooperation between neighbouring nations.[23]

At the national level, countries establish a variety of parks and reserves, often classified differently

12 UNESCO (no date). Natural World Heritage: Nature's most precious gift to humanity.
13 UNESCO (2004). The Criteria for Selection. UNESCO World Heritage Convention.
14 UNESCO (no date). Man and the Biosphere Programme (MAB).
15 UNEP (no date). Convention on Biological Diversity.
16 Ramsar (2011). Wetland Ecosystem Services: an introduction. Ramsar Convention on Wetlands, Gland, Switzerland.
17 Ramsar (no date). Ramsar Sites Criteria. Ramsar Convention on Wetlands.
18 Ramsar (2015). The Ramsar Convention: What's it all about? Ramsar Convention on Wetlands.
19 UN (2023). Agreement on Marine Biological Diversity of Areas beyond National Jurisdiction.
20 Schaaf, T. and Rodrigues, D.C. (2016). Managing MIDAs: Harmonising the management of MultiInternationally Designated Areas: Ramsar Sites, World Heritage sites, Biosphere Reserves and UNESCO Global Geoparks. IUCN.
21 EEA (2023). The Natura 2000 protected areas network. European Environment Agency.
KAZA TFCA (2019). Kavango Zambezi Transfrontier Conservation Area.
22 WWF (2018). An Unprecedented Agreement for the Pantanal is Signed.
23 Kark, S. et al. (2015). Cross-boundary collaboration: key to the conservation puzzle. Current Opinion in Environmental Sustainability, 12: 12-24.

▲ FARC guerrillas shoot towards Colombian soldiers in the mountains of Meta, Colombia, April 4, 2011. Photo by Carlos Villalon/Redux/eyevine

depending on domestic legal frameworks. While protection levels vary, such areas typically impose restrictions on access, use rights, and resource management. Management models can include top-down governance, community-led initiatives (such as Indigenous and Community-Conserved Areas), and hybrid systems that combine state oversight with local participation (e.g. Territorial Use Rights for Fishing).[24] Other Effective Area-Based Conservation Measures (OECMs) are gaining recognition as vital components of global conservation strategies.[25] Unlike formally designated protected areas that are defined by specific management objectives, OECMs focus more on delivering long-term conservation outcomes.[26] These areas include privately protected lands (such as those managed by individuals, communities, or research institutions), sacred natural sites, and Indigenous territories.[27] Notably, Indigenous lands have demonstrated exceptional effectiveness in preserving biodiversity.[28] As such, OECMs provide a valuable pathway for achieving broad conservation goals, such as the Aichi Biodiversity Targets.

24 See for example: Villanueva-Poot, R. et al. (2017). Distributional performance of a territorial use rights and co-managed small-scale fishery. Fisheries Research, 194: 135-145.
Jupiter, S.D. et al. (2014). Locally-managed marine areas: multiple objectives and diverse strategies. Pacific Conservation Biology, 20(2): 165-179.

25 UN (2018). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity 14/8. Protected areas and other effective area-based conservation measures. Conference of the Parties to the Convention on Biological Diversity, fourteenth meeting, Sharm El-Sheikh, Egypt, 17-29 November 2018, Agenda item 24 (CBD/COP/DEC/14/8).

26 Cook, C.N. (2024). Diverse approaches to protecting biodiversity: The different conservation measures discussed as possible other effective area-based conservation measures. Conservation Letters, 17(4): e13027.

27 Sinthumule, N.I. (2025). Sacred natural sites as other effective area-based conservation measures (OECMS) for biodiversity conservation in South Africa: Key opportunities and challenges for policy and practice. Journal for Nature Conservation, 86: 126935.
Mitchell, B.A., eet al. (2018). PPA or OECM? Differentiating Between Privately Protected Areas and Other Effective Area-Based Conservation Measures on Private Land. Parks, 24: 49-60.

28 O'Bryan, C.J. et al. (2020). The importance of Indigenous Peoples' lands for the conservation of terrestrial mammals. Conservation Biology, 35(3): 1002-1008.

# How does armed conflict impact protected nature?

**Armed conflict exerts profound and multifaceted impacts on biodiversity and protected areas. These arise both directly from hostilities and indirectly from socioeconomic disruption, such as reduced or collapsed institutional capacity for environmental management, the deterioration of infrastructure and services, population displacement, and the illicit and harmful exploitation of natural resources as a coping mechanism to sustain livelihoods or to finance war economies.**[29] **Additionally, a disproportionate number of armed conflicts occur in biodiversity hotspots, placing some of the world's most ecologically valuable areas at heightened risk.**[30]

## Direct impacts

The direct impacts of warfare on ecosystems and wildlife include physical destruction from weapons, explosives, and military infrastructure. Blast munitions, fragmentation and conflict-linked wildfires can degrade habitats and injure or kill wildlife.[31] Landmines, for example, threaten biodiversity by destroying vegetation and killing wildlife, and can have long-lasting effects on ecosystems via soil structure degradation.[32] In Mozambique's Maputo Reserve, elephants have been documented with bullet wounds and have directly suffered the consequences of landmines and snares.[33] At the same time, mine clearance activities can wipe out entire habitats in protected areas.[34]

Deliberately destroying nature for military infrastructure or strategic advantage is known as using the environment as a weapon of war, or 'scorched earth tactics.' For example, during the Iran-Iraq war in the 1980s and in 1991, Saddam Hussein, for military and political purposes, drained Iraq's marshes, a unique ecosystem that is also host to the Marsh Arabs, a minority ethnic group. This act caused significant destruction to both biodiversity and livelihoods.[35]

Military activities also introduce pollutants that significantly disrupt the physical and chemical properties of soil and vegetation.[36] Ecosystems are adversely affected by contamination from heavy metals, fuel, and poor waste disposal practices, resulting in habitat degradation and a decline in biodiversity.[37] Conflict zones often function both as sinks, where

29 Lawrence, M.J. et al. (2015). The effects of modern war and military activities on biodiversity and the environment. Environmental Reviews, 23: 443-460.
30 Hanson, T. et al. (2009). Warfare in Biodiversity Hotspots. Conservation Biology, 23: pp.578–587.
31 Lawrence, M.J. et al. (2015). The effects of modern war and military activities on biodiversity and the environment. Environmental Reviews, 23: 443-460.
32 Berhe, A.A. (2007). The Contribution of Landmines to Land Degradation. Land Degradation and Development, 18: 1-15.
33 De Boer, W.F. et al. (2000). Diet and distribution of elephants in the Maputo Elephant Reserve, Mozambique. African Journal of Ecology, 38: 188-201.
34 See the Geneva International Centre for Humanitarian Demining (GICHD) for more studies about environmental management of clearance activities.
35 UNEP (2016). Crunch time for Iraqi marshlands.
36 Lawrence, M.J. et al. (2015). The effects of modern war and military activities on biodiversity and the environment. Environmental Reviews, 23: 443-460.
Broomandi, P. et al. (2020). Soil Contamination in Areas Impacted by Military Activities: A Critical Review. Sustainability, 12(21): 9002.
37 Edwards, C.A. (2002). Assessing the effects of environmental pollutants on soil organisms, communities, processes and ecosystems. European Journal of Soil Biology, 38(3-4): 225-231.

A man stands amidst cut trees at the Tabqa Nature Reserve in Syria›s northeastern Raqqa governorate, on July 11, 2023. In Syria›s north, a spike in illegal logging due to twelve years of conflict along with the effects of climate change and other factors, have eroded what was once a lush forest to dispersed trees and decimated trunks poking out from dry, crumbly soil. Delil souleiman / AFP.

pollutants accumulate, and as sources, from which these contaminants disperse, allowing toxic residues to continue seeping into soil and water long after hostilities have ceased.[38]

## Indirect impacts

One of the most significant indirect effects on protected areas due to conflict is the ecological strain caused by population displacement, especially given protected areas' remoteness in many cases and resource abundance.[39] Refugees and internally displaced persons fleeing violence frequently rely on nearby natural resources for survival — harvesting wood for fuel, clearing forests for shelter, and hunting wildlife for food — leading to habitat degradation and biodiversity loss, as well as compromising swaths of land which act as carbon sinks.[40] For instance, between 1986 and 2003, Rwanda's Mukura and Gishwati Forest Reserves underwent severe fragmentation and deforestation, largely driven by the dependence of displaced populations on natural resources.[41] The Gishwati Forest Reserve was especially impacted, with its forest cover shrinking dramatically from 23,000 hectares in 1980 to just 600 hectares by 2002.[42] Spatial analyses of forest cover during this period highlight the disproportionate impact of conflict on protected areas, where both conflict-related activities and the establishment of internally displaced people (IDP) settlements accelerated environmental degradation.[43] This deforestation has had cascading effects, including soil erosion, water contamination, and heightened vulnerability to climate-related disasters.[44]

In some cases, protected areas are militarized —

38 Broomandi, P. et al. (2020). Soil Contamination in Areas Impacted by Military Activities: A Critical Review. Sustainability, 12(21): 9002.

39 Ordway, E.M. (2015). Political shifts and changing forests: Effects of armed conflict on forest conservation in Rwanda. Global Ecology and Conservation, 3: 448-460.

40 Hanson, T. (2018). Biodiversity conservation and armed conflict: a warfare ecology perspective. Annals of the New York Academy of Sciences, 1429(1), pp.1-117.
Duncanson et al. (2023). The effectiveness of global protected areas for climate change mitigation. Nature Communications, 14: 2908.

41 Ordway, E.M. (2015). Political shifts and changing forests: Effects of armed conflict on forest conservation in Rwanda. Global Ecology and Conservation, 3: 448-460.

42 UNEP (2011). Rwanda: From Post Conflict to Environmentally Sustainable Development. UN Environmental Programme, Nairobi.

43 Ordway, E.M. (2015). Political shifts and changing forests: Effects of armed conflict on forest conservation in Rwanda. Global Ecology and Conservation, 3: 448-460.

44 UNEP (2011). Rwanda: From Post Conflict to Environmentally Sustainable Development. UN Environmental Programme, Nairobi.

used by armed groups for tactical advantage due to their remote locations and forest cover. Conservation infrastructure, such as ranger stations and monitoring systems, get damaged or occupied and ecological monitoring and conservation programmes are disrupted, halting long-term research and protection. Armed groups may extract resources or poach wildlife to fund operations.[45] Opportunistic poaching, illegal logging and mining also surge during conflicts, as governance structures weaken and enforcement collapses.[46] The Manas Wildlife Sanctuary in India, a UNESCO World Heritage Site, exemplifies these dynamics. From 1987 to 2003, the park suffered from ethnopolitical unrest and insurgency, particularly involving the Bodo armed group, which used the sanctuary as a base.[47] This led to widespread poaching of key species like the greater one-horned rhinoceros R. unicornis — which was locally extirpated as a result — and the swamp deer R. duvaucelii, driven by both insurgent activity and opportunistic local hunting.[48] Additionally, the area experienced extensive land-use change: up to 40% of primary forest was converted into agricultural land or settlements during the conflict, as enforcement efforts collapsed and timber-yielding tree species were heavily exploited.[49]

In the situation of occupation, protected areas often suffer from halted conservation efforts, mismanagement, and illegal activities, as seen in Ukraine's UNESCO-protected Askania-Nova Reserve, where Russian occupation has disrupted ecological oversight and threatened biodiversity, including the illegal transfer of rare and endangered animals.

More recently, armed jihadist groups, most notably Jama'at Nasr al-Islam wal Muslimin (JNIM), and to a lesser extent the Islamic State Sahel Province (ISSP), have established a presence in W National Park, using it as a base for their operations.[50] W National Park, which spans the borders of Benin, Burkina Faso, and Niger, forms part of the larger W-Arly-Pendjari (WAP) Complex, a transboundary UNESCO World Heritage Site covering 1.7 million hectares.[51] This vast protected area plays a vital role in sustaining populations of large mammals, hosting approximately 90% of West Africa's remaining lion population P. leo and over 85% of the region's African forest elephants L. cyclotis; the latter is listed as Critically Endangered by the IUCN.[52] As in Manas, the presence of armed groups has coincided with a rise in poaching and illegal exploitation: between 2015 and 2021, the elephant population in W National Park was halved.[53] While multiple factors contributed to this decline, the presence of JNIM is believed to have facilitated increased poaching through access to illicit (wildlife) trade networks and the collapse of enforcement in the area.[54]

While some abandoned areas may recover post-conflict, the ecological scars, from species loss to altered landscapes, often persist for decades. Conflict-affected regions frequently face degraded ecosystem services, reduced biodiversity, and increased vulnerability to future environmental shocks.[55] On the other hand, a handful of case studies have demonstrated unintended positive conservation outcomes of armed conflict.[56] More specifically, biodiversity has benefited when

45 Gaynor K.M. et al. (2016). War and wildlife: linking armed conflict to conservation. Frontiers in Ecology & the Environment, 14(10): 533-542
46 De Merode, E. et al. (2007). The impact of armed conflict on protected-area efficacy in Central Africa. Biology Letters, 3(3): 299-301.
47 McKneely, J.A. (2000). War and biodiversity: an assessment of impacts. Chapter 14 in: Austin, J.E. and Bruch, C.E. (eds), The Environmental Consequences of War: Legal, Economic, and Scientific Perspectives, Cambridge University Press, 353-378.
48 Lahkar, D. et al. (2024). Post-conflict recovery of tigers (Panthera tigris) in a transboundary landscape: The case of Manas National Park, India. Biological Conservation: 110837.
Goswami, R. and Ganesh, T. (2014). Carnivore and Herbivore Densities in the Immediate Aftermath of Ethno-Political Conflict: The Case of Manas National Park, India. Tropical Conservation Science, 7(3): 475-487.
49 Lahkar, D. et al. (2024). Post-conflict recovery of tigers (Panthera tigris) in a transboundary landscape: The case of Manas National Park, India. Biological Conservation: 110837.
Sarma, P.K. et al. (2008). Land-use and land-cover change and future implication analysis in Manas National Park, India using multi-temporal satellite data. Current Science, 95(2): 223-227.
50 Sampaio, A. et al. (2023). Reserve Assets: Armed groups and conflict economies in the national parks of Burkina Faso, Niger and Benin. Global Initiative Against Transnational Organized Crime.
International Crisis Group (2023). Containing Militancy in West Africa's Park W.
51 UNESCO (no date). W-Arly-Pendjari Complex. UNESCO World Heritage Convention.
52 Sogbohossou (2023);
Gobush, K.S. et al. (2021). Loxodonta cyclotis. The IUCN Red List of Threatened Species 2021: e.T181007989A204404464.
53 Sampaio et al, 2023
54 Sampaio et al, 2023
WWF (2015). Ivory, non-State armed groups and terrorism. World Wildlife Fund.
Gerstenhaber, C. et al. (2024). Illegal wildlife trade: An analysis of carnivore products found in markets in Benin and Niger. Global Ecology and Conservation, 51: e02880.
55 Olsen, V.M. et al. (2021). The impact of conflict-driven cropland abandonment on food insecurity in South Sudan revealed using satellite remote sensing. Nature Food, 2, pp.990-996. Hanson, T. (2018). Biodiversity conservation and armed conflict: a warfare ecology perspective. Annals of the New York Academy of Sciences, 1429(1), pp.1-117.
56 Martin, P.S. and Szuter, C.R. (1999). War Zones and Game Sinks in Lewis and Clark's West. Conservation Biology, 31(1): 36-45.
Dudley, J.P. et al. (2002). Effects of War and Civil Strife on Wildlife and Wildlife Habitats. Conservation Biology, 16: 319-329.
Aveling et al. (2010). A Fighting Chance: Can Conservation Create a Platform for Peace within Cycles of Human Conflict? In N. Leader-Williams, W.M. Adams and R.J. Smith (eds), Trade-Offs in Conservation, Hoboken: Wiley, 253-272.

▲ Hawizah Marshes in Missan, southern Iraq. Murtadha Aljnubi, April 2026

insecurity creates de facto “no-go” zones that limit human disturbance, as seen in the Korean demilitarized zone[57]’ when occupying authorities establish protected areas, such as in the West Bank[58]; and in military training zones, where the distinctive mix of undisturbed areas and highly disturbed patches creates a fine-grained environmental heterogeneity that supports unusually high biodiversity.[59] An analysis of the positive conservation effects of armed conflicts lies outside the scope of this report, however.

57 Brady, L. (2008). Life in the DMZ: Turning a Diplomatic Failure into an Environmental Success. Diplomatic History, 32(4): 585–611. Special Forum with Environmental History (September 2008)

58 Palestine National Clearinghouse Mechanism (no date). Natural Reserves in Palestine. Convention on Biological Diversity.

59 Caudal, P. and Gallet, S. (204). Contribution of military training areas for the conservation of calcareous grasslands. Journal for Nature Conservation, 78: 126579. Reif, J. et al. (2023). Biodiversity changes in abandoned military training areas: relationships to different management approaches in multiple taxa. Frontiers in Environmental Science, Sec. Conservation and Restoration Ecology, 11. Warren, S.D. et al. (2007). Biodiversity and the Heterogeneous Disturbance Regime on Military Training Lands. Restauration Ecology, 15(4): 606-612.

# Case highlights from the frontlines of nature and war

**To provide an in-depth analysis of the multifaceted impacts of armed conflict on protected areas, this section presents eight case studies by collaborative experts, covering the continents of Asia, Europe, and South America. While most cases present an in-depth analysis of one or two protected areas in conflict affected contexts, the Iraq case provides a shorter countrywide snapshot.**

Each case study largely follows the same structure to allow for comparative insights across contexts. The structure includes:

A. **A brief overview of nature conservation systems** in the country of the case study, including customary governance practices, formal legal frameworks at the national level, and international environmental treaties that the state is signatory to relevant to the protected areas;

B. **Background on the selected protected area**, covering environmental, sociocultural, and political dimensions, including a description of the ecological condition prior to the conflict, as well as the area's importance to local communities and other stakeholders;

C. **A brief account of the conflict** affecting the region in which the protected area is located;

D. **Documented evidence of environmental degradation**, with a focus on: direct ecological damage from conflict, meaning directly as a result of armed hostilities and/or control of the area by armed groups; indirect ecological impacts, often the result of coping mechanisms by local or displaced population groups;

E. **The consequences of the documented environmental degradation** for local communities and other stakeholders.

Together, these case studies illustrate the varying ways in which war intersects with nature conservation and offer a grounded understanding of both the damage inflicted and the potential pathways for better protection, recovery and resilience.

# Methodology

The contributing case studies utilized a range of distinct methods to assess and describe the impact of conflict on protected nature in a given context. Many used open-source investigation (OSI) techniques, such as geolocation and chronolocation of social media sources and visual interpretation of satellite imagery, including for the identification of deforestation, mining operations, bulldozing activities, and vegetation fires. Other spectral indices derived from satellite sensors were also used, including the normalized difference vegetation index (NDVI) for vegetation health, the burned-area index for detecting fire-affected zones, and the normalized difference moisture index (NDMI) for soil moisture analysis. Additional data sources and analysis methods applied include field observations, interviews, and literature studies. The table below provides a detailed overview of the analysis methods, data sources, and time period analyzed per case study.

# Ethical disclaimer

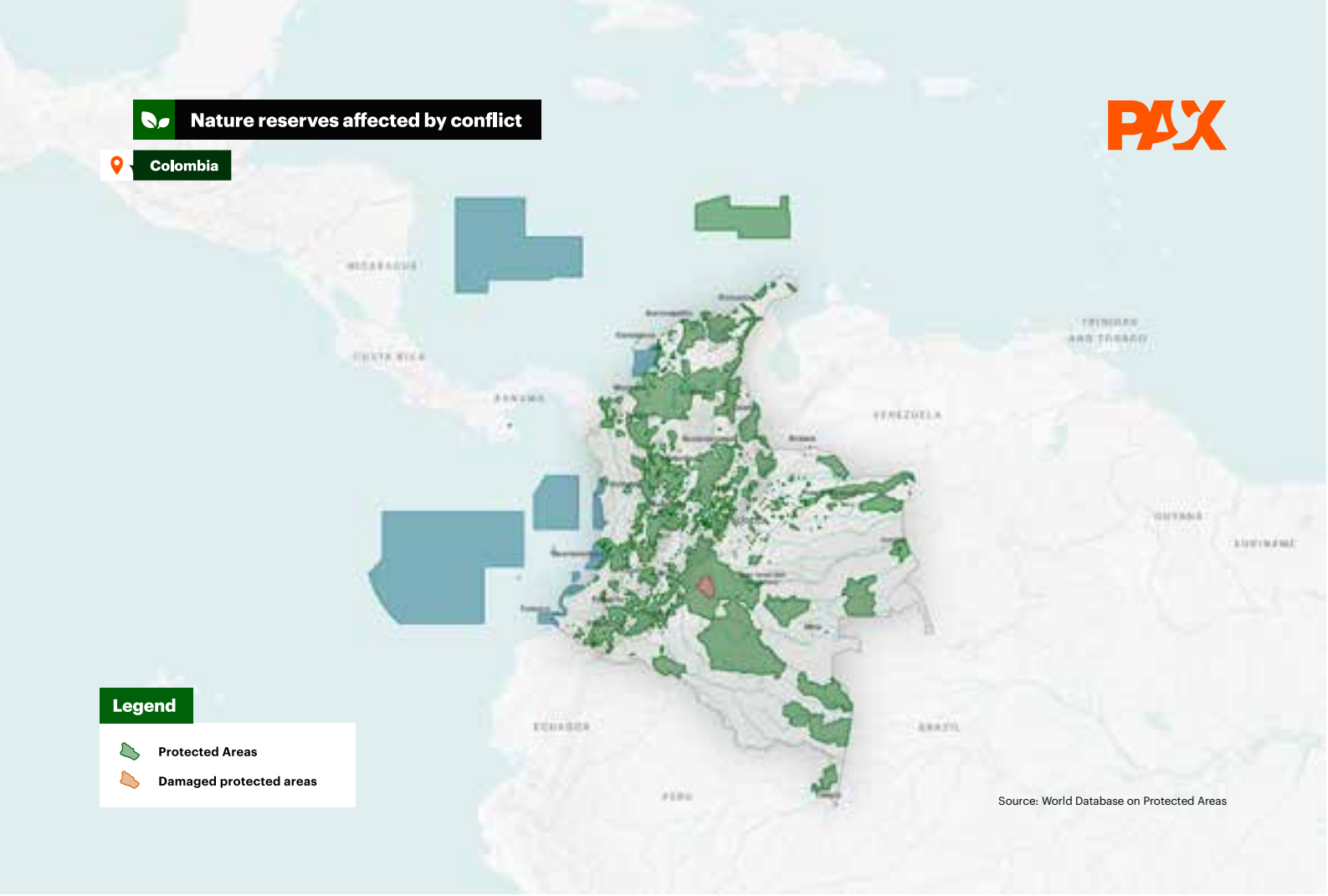
All research methods and findings presented in this report are subject to important ethical considerations. The study areas examined, protected nature reserves in conflict-affected regions, require particular sensitivity to the safety, dignity, and agency of all human and non-human actors involved. This research group unequivocally condemns any use of this data or analysis for purposes that may cause harm, including military intervention, advocacy, or lobbying directed against citizens, civil society organizations, or other local actors and the ecosystems they depend on. The case studies included here seek to shed light on patterns of war-related environmental degradation, emphasizing an urgent need for collective protection that encompasses both the ecosystems in question and the residential communities that depend upon them.

We acknowledge that protecting the environment necessarily involves questions of responsibility, accountability, and potential intervention. In this light, the report stresses that any interpretation or application of its findings must prioritize the protection and well-being of those living within these regions and recognize the complexities that unregulated or illicit extractive activities often entail.

Researchers inevitably bring their own perspectives, assumptions, and positionalities to their work. We recognize the influence of researcher bias, data selection bias, and interpretive bias in shaping both the analytical process and the resulting narratives. This research relies in part on open-source investigation methods, using publicly available satellite imagery, documents, and other online materials. The use of such data to document and reinterpret violence or environmental harm carries both potential for truth finding and justice, as well as ethical complexity. Open-source methods can democratize investigations by broadening who can contribute to research and whose stories are represented.[60] However, there are no universally recognized guidelines that outline what is legally or ethically appropriate in such work. Practitioners increasingly ask not just whether they can do something, but whether they should.[61] In response, we advocate for and implement in as far as possible practices that foreground transparency in methods, co-creation with regional stakeholders, care for affected communities and ecosystems, equity in attribution, and reflexivity in interpretation, recognizing that truth production in contested contexts must balance rigor with empathy.

60 Dyer, S. and Ivens, G. (2020). What would a feminist open source investigation look like? Digital War 1, 5–17.
61 Ibid.

| Case study | Methods | Sources | Time period analysed |
|---|---|---|---|
| **Colombia:** Tinigua National Park | OSI of deforestation by visual interpretation of satellite imagery;<br>NDVI index for vegetation health and density | MAXAR Airbus mosaics through Google Earth Pro;<br>Sentinel 2 L2A through EO Browser and NASA FIRMS | 2017-2023 |
| **Iran:** Bisotun and Sefidkhu-e-Khorramabad | Identification of burned vegetation through burned-area index | Sentinel 2 L2A through EO Browser and NASA FIRMS | June 2025 |
| **Iraq:** Country overview | Observations and literature study | | Marshes: 1980s & 1990s<br>Northern Iraq: since 2014 |
| **Myanmar:** Lenya National Park and Hukawng Valley Wildlife Sanctuary | OSI of mining operations by visual interpretation of high resolution satellite imagery;<br>identification of forest disturbance through satellite analysis; | MAXAR Airbus mosaics through Google Earth Pro; | 2020-2024 |
| **Palestine:** Wadi Gaza | OSI of bulldozing, mudbridges by visual interpretation of high resolution satellite imagery;<br>NDVI index for vegetation health and density, and NDMI for soil moisture | MAXAR Airbus mosaics through Google Earth Pro;<br>Sentinel 2 L2A through EO Browser | 2023-2025 |
| **Syria:** Country forest overview | OSI of deforestation by visual interpretation of high resolution satellite imagery;<br>Timeseries of automated deforestation identification from satellite analysis; | Maxar and Airbus satellite imagery through Google Earth Pro;<br>Landsat and PALSAR imagery | 2011-2025;<br>2010-2019 |
| **Ukraine:** Chornomorsky (Black Sea) Biosphere Reserve | OSI of vegetation fire events by visual interpretation and cross-verification of three independent satellite imagery sources | satellite imagery (Sentinel-II through EO Browser and Copernicus Browser), NASA FIRMS, and photographs from social media posts | February 2022 - March 2025 |
| **Yemen:** Utmah Reserve and Aden Wetlands | Interviews, field observations and literature study | | 2015-2025 |




# Colombia

**Tinigua National Natural Park**

*By Melissa Pellis (Utrecht University), Mayia Giannakou (Utrecht University), and Lune Moorees de Rijk (Utrecht University)*

This case study examines environmental protection and degradation around the Guayabero River in Tinigua National Natural Park,[62] Colombia. It considers the (inter-)national legal framework governing environmental protection during peace and conflict and discusses the dynamics involved in environmental destruction during the conflict and post-conflict periods. A small-scale open-source investigation was carried out into environmental degradation surrounding the Guayabero River, providing empirical evidence of environmental change in post-conflict contexts.

## A. The national and international environmental legal framework during peace and conflict

Colombia is among the most biodiverse countries in the world, estimated to hold 10% of the total global biodiversity, across 314 distinct ecosystems.[63] A total of 17% of Colombia's land and 41% of its coastal and marine areas are under some form of protection, amounting to 1,794 nationally protected areas.[64] Colombia is party to multiple international treaties and agreements which impose legal obligations on the State to protect the environment, also during armed conflict. The main core binding instruments during times of conflict include the Geneva Conventions (Common Article 3 for non-international conflicts), which indirectly protect ecosystems through the safeguarding of civilian property; Additional Protocol I (1977),[65] which explicitly protects the natural environment during international armed conflicts; and Additional Protocol II (1977),[66] which (indirectly) extends certain protections

62 IUCN and UNEP-WCMC (2025). Protected Area Profile for Colombia, WDPA ID 19995. The World Database on Protected Areas (WDPA).
63 CBD (2025). Colombia Country Profile. Convention on Biological Diversity.
64 IUCN, UNEP-WCMC (2025). Protected Area Profile for Colombia. World Database on Protected Areas (WDPA).
Ministerie van Landbouw, Natuur en Voedselkwaliteit (2024). Biodiversity and peace: Colombia's role in shaping conservation efforts. Agrospecials, Edition 3.
65 ICRC (2010). Additional Protocol I to the Geneva Convention of 12 August 1949. Article 35(3) and Article 55.
66 ICRC (2010). Additional Protocol II to the Geneva Convention of 12 August 1949. See, for example: Articles 13, 14, 15 & 17.

to non-international conflicts. Customary international humanitarian law rules also provide protection in both international and non-international armed conflict.[67] Colombia is also bound by environmental conventions, including but definitely not limited to, the Convention on Biological Diversity (CBD), the World Heritage Convention, the Convention on International Trade in Endangered Species (CITES), the Convention on Migratory Species (CMS), and the Ramsar Convention, which mandate conservation and responsible usage of ecosystems in both peacetime and conflict. Soft law and other guiding instruments, including the Rio Declaration, IUCN Protected Areas Categories, and UNESCO Man and the Biosphere (MAB) Programme, reinforce these duties, though they are not binding.

Tinigua National Natural Park is included in the La Macarena Special Management Area (Área de Manejo Especial de La Macarena: AMEM). These Special Management Areas have the intention of restoring ecological equilibriums in diverse regions and organising natural resource protection through coordinated environmental governance.[68]

With the ratification of the CBD through Law 165 of 1994, Colombia committed to establishing the National System of Protected Areas (SINAP), where special protection and conservation measures must be taken as a strategy for the in situ conservation of biodiversity.[69],[70] Protected Areas were already established in Colombia by this time: this was done as early as 1938.[71] Colombia's National Natural Parks (NNPs) and larger national system of Protected Areas are managed and coordinated by the Parque Nacionales Naturales de Colombia (PNNC).[72] National Natural Parks are subject to a specific management regime for their conservation, and receive the strongest protection of all protected areas in the country.[73] NNPs are constitutionally protected under Article 63,[74] which entails that their designated purpose cannot be altered and that commercial extractive activities, such as mining or logging, are generally prohibited.

In addition to this strong legal protection, Colombia's Penal Code contains provisions protecting the environment during both wartime and peacetime. Article 164 of Law 599 (2000) criminalizes the use of "methods or means of warfare (...) intended to cause widespread, long-term and serious damage to the natural environment."[75] This provision applies only during International and Non-International Armed Conflict, and closely resembles International Humanitarian Law provisions.[76] In post/non-conflict periods, such as after the 2016 Peace Accord, criminal environmental protection is governed by Title XI of the Penal Code, substituted by Law 2111 of 2021, which establishes offences such as the illicit use of renewable resources, trafficking of fauna, deforestation and the promotion and financing of such activities.[77]

Beyond legislation, Colombia has also set up the Special Jurisdiction for Peace, Colombia's transitional justice court tasked with investigating, judging and sanctioning serious crimes committed during the armed conflict with FARC. The court, as part of the peace process following the 2016 agreement, focuses on war crimes, with crimes against the environment falling well within its mandate.[78]

### B. Tinigua National Natural Park and the Guayabero River

Tinigua National Natural Park forms part of an important biogeographic corridor of contiguous forest, connecting the Andean Mountain Range to the Amazon and Orinoco River basins in the Orinoquía region.[79] The park forms part of the Picachos-Tinigua-Sierra de la Macarena-Chiribiquete megacorridor, acting as a natural corridor between the Colombian Andes and Amazon biogeographical regions.[80]

67 Customary IHL Rules 43–44: destruction of the natural environment is prohibited except when strictly required by imperative military necessity and proportionate to the aim pursued.
68 Lugo, D. A. (2019). Differentiated impacts of environmental policies on the Colombian frontier: coercive conservation and containment of illicit activities in the Pacific and the Ariari region. Journal of Land Use Science, 15(2-3).
69 Secretariat of the Convention on Biological Diversity (2011). Convention on Biological Diversity, Article 8(a). United Nations Environment Programme.
70 Departamento Nacional de Planeación (2021). Política para la consolidación del Sistema Nacional de Áreas Protegidas – SINAP.
71 Ibid.
72 Government of Colombia (2025). Parques Nationales Naturales de Colombia.
73 Parques Nacionales Naturales de Colombia (2025). Sistema Nacional de Parques Nacionales Naturales, relevant section: Categorías de áreas protegidas.
74 Colombia (1991). Constitution of Colombia. Article 63.
75 Colombia (2000). Código Penal, Law 599 of 2000, Art. 164.
Camacho Rincón A, Parra Gallego G (2024). Addressing environmental damages in contexts of armed conflict through transitional justice in Colombia. International Review of the Red Cross, 106(925): 424-449.
76 See Additional Protocol I to the Geneva Convention, 1977, Article 35(3); Article 55.
77 El Congreso de Colombia (2021. Ley N° 2111 de 2021 "Por Medio del Cual se Sustituye el Título XI "De los Delitos contra los Recursos Naturales y el Medio Ambiente" de la Ley 599 de 2000, se Modifica la Ley 906 de 2004 y se Dictan Otras Disposiciones". Article 328, 328A, 330, and 330A.
78 Camacho Rincón, A. and Parra-Gallego, G. (2024). Addressing environmental damages in contexts of armed conflict through transitional justice in Colombia International Review of the Red Cross, No. 925.
79 InfoAmazonia (2024). PNN Tinigua, Colombia.
Arellano, A. (2022). 'Panic' sets in as armed groups occupy, deforest Colombian national park. Mongabay
80 Clerici, N., et al. (2019). Peace in Colombia is a critical moment for Neotropical connectivity and conservation: Save the northern Andes-Amazon biodiversity bridge. Conservation Letters, 12(1): e12594.

Located in the Meta Department of Colombia, Tinigua extends over an area of at least 2,077 km2.81 86% of Tinigua NNP is covered by tropical rainforest, while the remaining 14% consists of seasonally flooded forests situated near the banks of the Perdido, Duda, Guayabero and La Lagartija rivers.82 While specific biodiversity counts (e.g. total species numbers) for Tinigua are not readily available, the park is considered essential in maintaining and connecting gene flow and biodiversity exchange.[83] It serves as a biodiversity corridor and refuge for jaguars, mountain lions, brown woolly monkeys and more.[84] Tinigua hosts a diverse array of flora and fauna,[85] including the critically endangered Orinoco crocodile, which calls the Guayabero River (and the larger Orinoco River basin) home.[86] According to the Venezuelan conservation foundation FUDECI, it is estimated that fewer than 100 Orinoco crocodiles remain in the wild.[87]

### C. The environment during conflict

The Guayabero region, situated between Tinigua and Sierra de la Macarena, has been a central point of armed conflict in Colombia for decades. Before the signing of the 2016 peace agreement, the region was a stronghold for the Revolutionary Armed Forces of Colombia (FARC), who used it as a base for operations, recruitment, and financing through illicit activities.[88] The state of the environment in Tinigua is closely tied to the ongoing conflict and peace process, as armed groups exploit natural resources for economic gain while using violence to maintain control over large territories.[89] Coca cultivation is one of the key drivers of deforestation in Colombia, but in addition to deforestation, the dumping of chemicals used in the processing of coca in jungle laboratories amounts to 700 litres of chemicals for every 1kg of cocaine.[90] In the process, not only are forests cut down and burnt, but water sources are often contaminated and the soil's chemical and physical conditions are altered.[91]

Additionally, the Colombian government, supported by the U.S. under 'Plan Colombia', launched military operations to weaken the FARC in the early 2000s, resulting in heavy fighting and the displacement of local populations.[92] As part of this U.S. sponsored war on drugs, Colombia and the US also sprayed approximately 1.8 million hectares of coca crops with glyphosate between 1994 and 2015. For every hectare of coca, "between 13 and 32 hectares of rural land were fumigated".[93] These pre-2015 fumigation practices forced coca farmers deeper into the forests, and thus into protected areas.[94]

On the other hand, armed groups actively disincentivized and limited public access to areas in their control, resulting in increased environmental protection.[95] FARC required settlers to conform to environmental sustainability norms, and even collaborated with local communities to protect the forest.[96] The guerrilla group valued the forest for its dense coverage and difficult terrain, aiding in fleeing from and fighting the Armed Forces.

### D. The environment during 'peace'

Colombia and FARC signed their peace accord in 2016. This section explores the treatment of the environment during the period of official peace that followed. It should be noted, however, that despite this official peace, in 2023 the ICRC identified seven non-international armed conflicts across Colombia, three of which were between armed groups and state forces and four of which were between various non-State armed groups.[97]

Deforestation in Colombia saw no significant improvement in the post-conflict phase. In 2017, the first year after the peace agreement, the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) found that the national deforestation rate had

81 IUCN and UNEP-WCMC (2025). Protected Area Profile for Colombia, WDPA ID 19995. The World Database on Protected Areas (WDPA).
82 Tobón Ramírez, C., et al. (2021). Deforestation in Tinigua National Natural Park: Socio-economic environmental consequences of the Peace Agreement in Colombia. ZEF Working Paper Series, No. 210, University of Bonn, Center for Development Research (ZEF).
83 Clerici, N., et al. (2019). Peace in Colombia is a critical moment for Neotropical connectivity and conservation: Save the northern Andes-Amazon biodiversity bridge. Conservation Letters, 12(1), e12594.
84 Lizcano, M. F. (2018). Colombia: Govt rushes to save national park from rampant deforestation. Mongabay.
85 Government of Colombia (2021). Parque Nacional Natural Tinigua.
86 Lizcano, M. F. (2021). A Colombian national park reveals its natural secrets through camera traps. Monabay.
87 Otero, E. and Oraa, G. (2025). The last-ditch race to save the Orinoco crocodile. Reuters.
88 Gilberti, B. (2020). The reconfiguration of violence in Colombia's post-peace agreement era. Master's thesis, Utrecht University.
89 Ibid.
90 International Crisis Group (2021). A Broken Canopy: Deforestation and Conflict in Colombia. Report No. 91.
91 Ibid.
92 Betancur, J. J., Eslava, A., and Quiroga, S. (2022). Understanding the geography of armed conflict in Colombia: A spatial analysis of violence and territorial control. GeoJournal, 87(2): 445-467.
93 International Crisis Group (2021). A Broken Canopy: Deforestation and Conflict in Colombia.
94 International Crisis Group (2021). A Broken Canopy: Deforestation and Conflict in Colombia.
95 Ibid.
96 Lizcano, M. F. (2018). Mongabay. Colombia: Govt rushes to save national park from rampant deforestation.
97 Comité Internacional de la Cruz Roja. (2023). Colombia: Retos Humanitarios 2023.

▲ True color satellite image of the investigated case study area from 2017-08-02 (above) and 2023-02-02 (below), between 2°38'N 74°18E and 2°28'N 73°56'E. The blocks indicate zoom-in examples that will be discussed below. Source: Sentinel-2 through Copernicus Data Space Ecosystem.

increased by 44% compared to 2016.[98] The International Crisis Group reported that across the nation, 225,000 hectares were deforested, equal to about 2.6% of the world's total deforestation for that year.[99]

Another study used high-resolution Global Forest Change datasets to research deforestation trends three years before and after the peace agreement in National Natural Parks across Colombia.[100] They found that deforestation had increased in the post-conflict period in 31 of the 39 National Natural Parks and National Natural Reserves studied, including Tinigua National Natural Park. Nationally, deforestation increased by 177%, amounting to a loss of 330 square kilometres of forest.[101]

This post-conflict increase in deforestation can be attributed to factors related to various agricultural land use dynamics: livestock farming, coca cultivation, land speculation, and land theft. Illicit activities have

98 Tobón Ramírez, C., et al. (2021). Deforestation in Tinigua National Natural Park: Socio-economic environmental consequences of the Peace Agreement in Colombia. ZEF Working Paper Series, No. 210.
IDEAM (2017). Monitoreo y seguimiento al fenómeno de la deforestación en Colombia.
99 International Crisis Group (2021). A Broken Canopy: Deforestation and Conflict in Colombia.
100 Clerici, N., et al. (2020). Deforestation in Colombian protected areas increased during post-conflict periods. Scientific Reports, 10, 4971.
101 Tobón Ramírez, C., et al. (2021). Deforestation in Tinigua National Natural Park: Socio-economic environmental consequences of the Peace Agreement in Colombia. ZEF Working Paper Series, No. 210.

been a driving force behind deforestation, mainly with regards to illicit crops, mining, and logging.[102] Notably, the government has long enabled cattle ranching in protected areas.[103] Cattle are commonly found in National Parks where grazing is illegal, yet the Colombian Agricultural Institute vaccinates, registers, and tracks their ownership—it even permits their transport to markets and slaughterhouses. Only in 2021 did the state-owned Agricultural Bank stop funding ranching in these areas.[104]

Moreover, much of the land that has been deforested since the ceasefire is in publicly owned, environmentally protected areas, such as Tinigua National Natural Park. Crisis Group interviews with local social leaders suggest that local authorities and notaries have fuelled a black market in real estate by illegally providing settlers, often land speculators, with paperwork that asserts ownership—despite this being in legal conflict with the status of the land as a National Natural Park.[105]

In Tinigua National Natural Park, land use figures are no more optimistic. FARC's departure from Tinigua NNP, together with delays in implementing the peace accord, created power vacuums, allowing new settlers (often displaced from other regions) to enter these territories through violent means amid weak state presence.[106] Since the peace agreement, threats, violence, and insecurity by armed groups persisted, with Tinigua NNP staff being considered 'military targets'.[107] Despite their presence in the Guayabero region, the military's response has been inconsistent. Reports suggest that the army has downplayed or kept silent on attacks and security incidents, thereby further eroding trust among local communities.[108]

Protected areas such as Tinigua and Sierra de la Macarena National Natural Parks have seen an increase in deforestation due to the expansion of a variety of illicit economies.[109] Notably, coca cultivation does not seem to play a great role in deforestation in post-conflict Tinigua, with the role of coca cultivation in deforestation differing per region.[110] In Tinigua, aforementioned alternative illicit economies such as logging and cattle ranching continue to incentivize deforestation. Before the conflict, deforestation in Tinigua NNP spanned 38 of the park's 2,078 km2. After the conflict, this number increased to 160 km2, amounting to a 326% increase in deforestation between the phases.[111]

### E. Evidence of environmental destruction around the Guayabero River, post-peace accord

This case study has investigated a delineated part of the Tinigua National Park, specifically where the Guayabero River cuts through the park from east to west, as visualized in the overview satellite image of the studied area of interest. EO browser[112] was used to visually interpret and measure the area with changes in vegetation cover in the approximately five-year post-conflict period between 2017-2022/3.[113]

The studied area of interest spans approximately 756.65 km², of which roughly 85.52 km² showed evidence of vegetation degradation or loss between 2017 and 2022. This amounts to a forest degradation (in km2) of 11.3% in the 5-year post-conflict period.[114] The following open-source investigation takes a closer look at a number of blocks as indicated in the overview satellite image, in an attempt to better visualize the local dynamics.[115]

Block 1 saw approximately 1.51 km2 of forest deforested in the period of 2017-2022. The entire block covers 13.92 km2. The annotated satellite image highlights the increase in deforested patches of land between 2017 and 2022. The image of 2017 also clearly shows a piece of land in an earlier stage of deforestation, just after logging or burning. The 2022 image shows the same patch of land in a later stage of deforestation, illustrating that the same pieces of land get logged and regrow

102 Clerici, N., et al. (2020). Deforestation in Colombian protected areas increased during post-conflict periods. Scientific Reports, 10, 4971.
103 International Crisis Group (2021). A Broken Canopy: Deforestation and Conflict in Colombia.
104 Ibid.
105 Ibid.
106 Ibid.
107 Arellano, Astrid (2022). Mongabay. 'Panic' sets in as armed groups occupy, deforest Colombian national park.
108 Rutas del Conflicto (2023). The Colombian Army Keeps Quiet on Reports of Attacks in the Guayabero Region.
109 Arellano, Astrid (2022). Mongabay. 'Panic' sets in as armed groups occupy, deforest Colombian national park.
110 Tobón Ramírez, C., et al. (2021). Deforestation in Tinigua National Natural Park: Socio-economic environmental consequences of the Peace Agreement in Colombia. ZEF Working Paper Series, No. 210.
111 Ibid.
112 By Sentinel Hub.
113 Due to methodological constraints and data availability, primarily extensive cloud coverage affecting satellite imagery, some blocks within the area of interest were analyzed for the period 2017–2022, while other blocks for 2017–2023. Although this introduced a minor temporal inconsistency, the decision ensured sufficient data quality for analysis.
114 EO browser's measure tool was used to quantify the changes in vegetation cover. While this approach provides a clear visual and quantitative assessment, results are subject to limitations—in this case, the most notable limitation is the potential of human error in interpreting satellite imagery and operating the measuring tool. Consequently, the figures should be understood as indicative of broader trends, rather than exact measurements.
115 The entire study area was split up into blocks of 2 arcminutes by 2 arcminutes, approximately 3.7km by 3.7km, and investigated block by block. In case of interest for the findings in the blocks not included in this publication, please contact the authors.

▲ Comparison of Block 1 between 2017 (left) and 2022 (right), showcasing approximately 1.51 km2 vegetation loss. Source: true-color image by Sentinel 2 via Copernicus Data Space Ecosystem.

over time. Higher-resolution imagery obtained from Google Earth Pro shows human-built structures in the deforested patches of land. The presence of house-like structures near deforested patches of land was observed across the total area of interest. Notably, the deforested patches did not seem burned but logged.

In other areas, such as in Block 2 as indicated on the overview map, fires were the cause of deforestation. Block 2 spans 13.15 km2, with 1.22 km2 of vegetation loss between 2017 and 2022. In January 2022, a significant forest fire occurred, as recorded by FIRMS,[116] in the area largely corresponding to the vegetation loss showcased in the satellite imagery.

Major deforestation was observed in various areas, such as Block 3. There, the deforestation in the six-year post-conflict period amounted to 6.06 km2, almost half the area of the entire block.

### F. Conclusion

The above visual interpretation of satellite imagery of Tinigua National Natural Park between 2017 and 2022 shows notable forest loss as a result of logging and fires, amounting to 85.52km2, or 11.3%, of the total area studied. This investigation was necessarily limited in scope, covering only selected areas of Tinigua National Natural Park and relying on medium-resolution satellite imagery. Nevertheless, the findings clearly illustrate the

116 FIRMS is NASA's Fire Information for Resource Management System.

▼ Comparison of Block 2 between 2017 (left) and 2022 (right), showcasing approximately 1.22 Km² vegetation loss. Source: true-color image by Sentinel 2 via Copernicus Data Space Ecosystem.

Brown woolly monkey - *Lagothrix lagothricha*

Jaguar - *Panthera Onca*

post-conflict pressures on the forest. The findings are consistent with patterns of land-use change influenced by both post-conflict dynamics and illicit economies in the region. Yet, causal attribution is not possible based solely on remote sensing, which instead requires additional qualitative data from the ground.

The findings, documenting deforestation in a protected Natural National Park during (official) peace time, illustrate that legal recognition and protection of areas like National Natural Parks does not automatically result in practical protection. This aligns with broader national and protected-area trends documented in aforementioned research,[117] which indicate that even in a post-conflict, official peace context, (inter-)nationally protected parks experience increasing deforestation, linked largely to the expansion of illicit economies and weak governance.[118] As discussed above, on paper, Colombia demonstrates a strong legal framework for environmental protection.[119] However, in practice, enforcement of these legal protections remains weak, a challenge made more difficult by the structural challenges of corruption and the logistical difficulties of monitoring and protecting difficult-to-access, and vast, rainforests from armed groups.

Open-source research can hopefully help fill this monitoring gap by providing valuable documentation of environmental degradation, thereby strengthening the evidence base for both policymaking and transitional justice. Further research needs to be complemented by qualitative, context-specific, information on the local peace and conflict dynamics in National Natural Parks, to be able to provide practical insights for sustainable and community-oriented environmental protection in post-conflict Colombia. Strengthening transparency and addressing the links between corruption and illicit economies, such as cattle ranching,[120] could be essential to preventing further harm. Moreover, participatory accountability mechanisms (such as the Special Jurisdiction for Peace) could also prove to be effective drivers of change by publicly promoting environmental responsibility and accountability in the transition to peace.

The link between conflict, peace, and the environment in Tinigua National Natural Park and across Colombia, may have created a narrative that nature is safer during war. However, conflict in protected areas consistently harms communities, wildlife, and vegetation. 'Protection' during war often reflects the environment's instrumental value to armed groups, such as strategic cover and inaccessibility, or economic and logistical constraints to exploitation, rather than genuine conservation.

117 Notably: Clerici, N., et al. (2020). Deforestation in Colombian protected areas increased during post-conflict periods. Scientific Reports, 10: pp. 4971.
118 Tobón Ramírez, C. et al. (2021). Deforestation in Tinigua National Natural Park: Socio-economic environmental consequences of the Peace Agreement in Colombia. ZEF Working Paper Series, No. 210.
119 Camacho Rincón A, Parra Gallego G (2024). Addressing environmental damages in contexts of armed conflict through transitional justice in Colombia. International Review of the Red Cross, 106(925): 424-449.
120 Ibid.

## Iran

**The scorched ecosystems of Bisotun and Sefidkhu-e-Khorramabad from the June 2025 airstrikes**
*By Genevieve Hull and Wim Zwijnenburg (PAX)*

Iran is one of the world's major centers of biodiversity, sitting at the crossroads of four major geographical regions and covering over 50% of the Irano-Anatolian biodiversity hotspot.[121] Though approximately 80% of the country is classified as arid or semi-arid, Iran's ecological diversity is significantly shaped by the Alborz and Zagros mountain ranges which create striking climatic variation across the country, contributing to the region's ample biodiversity.[122] These mountain ranges, due to their elevation gradient, topographic heterogeneity, and geographic isolation, contribute to significant areas of endemism, as well as high levels of speciation.[123] This is reflected in the high numbers of taxa found in Iran: over 8,000 species of plant, over 500 species of bird, 197 species of mammal, and over 200 species of reptile.[124]

In recent years, anthropogenic and climatic pressures have negatively affected Iran's varied habitats, particularly its protected areas. Irrigation for farming, roads, and military encroachment adversely affects 5-30% of the country's protected areas, while climate change exacerbates these stresses through drought, desiccation of wetlands, dust storms, extreme heat and flooding, threatening ecosystem integrity.[125] Overgrazing and overcutting of rangelands accelerates the desertification of arid and semi-arid land biomes, while poaching and illegal hunting remain widespread.[126]

### A. Iran's protected area system for nature conservation

Iran's Department of Environment, founded in 1972, is the primary agency responsible for the conservation and management of protected areas.[127] The legal framework includes the 1956 Protection Bill and the 1974 Environmental Protection and Enhancement Act, complemented by the National Biodiversity Strategy

121 Noroozi, J. et al. (2018). Hotspots within a global biodiversity hotspot - areas of endemism are associated with high mountain ranges. Scientific Reports, 8: 10345.
Kolahi et al. (2012). Challenges to the Future Development of Iran's Protected Areas System. Environmental Management, 50750-765.
122 Rahimi, E. et al. (2024). Assessing climate change threats to biodiversity and protected areas of Iran. European Journal of Wildlife Research, 70: 89.
123 Noroozi, J. et al. (2018). Hotspots within a global biodiversity hotspot - areas of endemism are associated with high mountain ranges. Scientific Reports, 8: 10345.
Farashi, A. and Shariati, M. (2017). Biodiversity hotspots and conservation gaps in Iran. Journal for Nature Conservation, 39: 37-57.
124 Rahimi, E. and Dong, P. (2022). What are the main human pressures affecting Iran's protected areas? Journal of Environmental Studies and Sciences, 12: 682-691.
125 Rahimi, E. et al. (2024). Assessing climate change threats to biodiversity and protected areas of Iran. European Journal of Wildlife Research, 70: 89.
126 Farashi, A. and Shariati, M. (2017). Biodiversity hotspots and conservation gaps in Iran. Journal for Nature Conservation, 39: 37-57.
127 Jowkar, H. et al. (2016). The Conservation of Biodiversity in Iran: Threats, Challenges and Hopes. Iranian Studies, 49(6): 1065-1077.

and Action Plan of 2001.[128] At present, the country has 169 protected areas, 46 wildlife refuges, and 31 national parks, totaling approximately 177,000 km².[129] Four official protected area categories exist: national parks, national natural monuments, wildlife refuges, and protected areas.[130]

At the time the Department of Environment was established in the 1970s, Iran was recognized as a global leader in national park conservation, a status which has not endured.[131] Iran has been a Contracting Party to the Ramsar Convention since 1975, with 27 current Ramsar sites covering almost 1.5 million hectares in the country.[132] The treaty itself was established in the Iranian city of Ramsar in 1971. It has been a UNESCO member since 1948 and participates in both the World Heritage Convention (accepted in 1975) with two natural heritage sites, the Hyrcanian Forests and the Lut Desert,[133] and the UNESCO Man and the Biosphere (MAB) Programme with 13 biosphere reserves.[134] Iran also ratified the UN Convention on Biological Diversity (CBD) in 1996. It is not currently listed as a member of the IUCN, however.[135]

Today, many sites lack clear boundaries, are subject to overgrazing (which is legally permissible in 80% of protected areas), and suffer from poor enforcement of existing laws.[136] It has been reported that the Department of Environment suffers a chronic shortage of rangers, which leaves ecosystems vulnerable to logging, smuggling, and wildlife trafficking.[137] Furthermore, the designation of protected areas has often prioritized symbolic area expansion rather than ecological effectiveness; studies show limited overlap between species distributions and protected area boundaries, suggesting that many habitats remain unprotected.[138]

### B. The 12-day Israel-Iran war in June 2025

On the 13th of June 2025, Israel launched a massive military offensive against Iran, joined by the United States in its later stages, marking the most intense direct confrontation between the two nations in history. Framed by Israel as a preemptive strike against an imminent Iranian nuclear threat, the operation targeted Iran's nuclear infrastructure, military command, missile bases, and strategic facilities across 27 provinces, including Tehran. Over 1,100 people were killed, around 40% of them civilians, and nearly 6,000 injured, with Israeli strikes hitting over 150 distinct locations.[139] Iran retaliated with the "True Promise III" operation, launching over 1,000 drones and several hundred ballistic and hypersonic missiles, killing 28 Israelis and injuring over 3,000. The US intervened on June 22 with airstrikes on Fordow, Natanz, and Isfahan, significantly damaging Iran's nuclear facilities. A US-brokered ceasefire was declared on June 24, but its terms remained vague, and tensions continued to simmer.[140]

The Iranian military has set up many bases in environmentally protected areas, despite protest from environmental groups.[141] Iranian state media claimed that, during the 12-day war, 13 areas under control of the Environmental Protection Agency in the provinces of Fars, Ilam, Kermanshah, Isfahan, Khuzestan, Hamadan, Lorestan, Kohgiluyeh and Boyer Ahmad, and Gilan were severely affected.[142] Open-source analysis and satellite imagery research identified 77 strikes that occurred in 6 different recognized national and international protected areas: the Arjan UNESCO MAB Biosphere Reserve, the Bijar Protect Area, the Jajrud Protected Area (including the Sorkeh Hesar National Park), the Bisotun Protected Area, the **Sefidkhu-e-Khorramabad Protected Area**, and the Shadegan Wildlife Refuge (which includes the Shadega Marshes, a Ramsar Wetland of International Importance). As the Iranian authorities stated that the fires affected 13 protected areas, their figure likely included locally recognized protected areas not included in international datasets used for this case study.

128 Kolahi et al. (2012). Challenges to the Future Development of Iran's Protected Areas System. Environmental Management, 50750-765.
129 Rahimi, E. et al. (2024). Assessing climate change threats to biodiversity and protected areas of Iran. European Journal of Wildlife Research, 70: 89.
130 Kolahi et al. (2012). Challenges to the Future Development of Iran's Protected Areas System. Environmental Management, 50750-765.
131 Jowkar, H. et al. (2016). The Conservation of Biodiversity in Iran: Threats, Challenges and Hopes. Iranian Studies, 49(6): 1065-1077.
132 Ramsar (2025). Protected Wetland Country Profile for Iran (Islamic Republic of). The Convention on Wetlands
133 UNESCO (2025). States Parties Profile for Iran (Islamic Republic of). World heritage Convention.
134 UNESCO (2025). Biosphere Reserves. Man and the Biosphere Programme (MAB).
135 IUCN (2025). Members directory.
136 Kolahi et al. (2012). Challenges to the Future Development of Iran's Protected Areas System. Environmental Management, 50750-765.
137 Parchizadeh, J. and Belant, J.L. (2021). Iran's protected areas need more rangers. Science: Letters, 373: 6554.
138 Farashi, A. and Shariati, M. (2017). Biodiversity hotspots and conservation gaps in Iran. Journal for Nature Conservation, 39: 37-57.
Rahimi, E. et al. (2024). Assessing climate change threats to biodiversity and protected areas of Iran. European Journal of Wildlife Research, 70: 89.
139 Crisis Group (2025). Iran June 2025 Report. CrisisWatch Database;
ACLED (2025). Twelve Days That Shook the Region: Inside the Iran-Israel War. ACLED Q&A Report.
140 Crisis Group (2025). Iran July 2025 Report. CrisisWatch Database
141 Kurdistan Human Rights Network (2024). IRGC extends military exercise in Kermanshah's protected areas.
142 Iranian Students' News Agency (2021). Destruction of approximately 9,000 hectares of the country's protected forests and pastures in the Zionist regime's aggression. Original title: تخریب حدود ۹۰۰۰ هکتار از جنگل‌ها و مراتع حفاظت شده کشور در تجاوز رژیم صهیونیستی

Most reserves faced no damage, as only one target on the fringes of the nature reserves was hit, with no observable wider damage. In Jajrud, the damage from the airstrikes was limited to the targeted facility. In Shiraz there was a large fire on June 22 in the Bamou National Park during the period of hostilities that was claimed by Iran to be caused by strikes. However, no observed strikes took place in that particular area at that time, making the claim difficult to correlate. The area has been known to be prone to wildfires in the past.[143] However, in the protected areas of Bisotun and Sefidkhu-e-Khorramabad, the June 2025 airstrikes ignited wildfires and severely damaged the valuable and vulnerable local ecosystems.

*Bisotun Protected Area*

Designated in 1975, the Bisotun Protected Area and Bisotun Wildlife Refuge in the Zagros Mountains of Kermanshah province continue to harbor rich biodiversity.[144] This area acts as home to large land mammals such as the Persian leopard P. pardus saxicolor and brown bear U. arctos.[145] Rapid population

143 Telegram Vahid Online (2020). Nighttime fire in the heights of Bemo National Park. Telegram post. Original title: آتش‌سوزی شبانه در ارتفاعات پارک ملی بمو

144 Reyahi-Khoram, M. et al. (2014). The threats on the biodiversity of Bisotun Wildlife Refuge and Bisotun Protected Area (BPA & BWR) in the west region of Iran. Biodiversitas, 15(1): 67-74.

145 Ashrafzadeh, M.R., et al. (2023). Determining the distribution factors of an endangered large carnivore: A case study of the brown bear Ursus arctos population in the Central Zagros Mountains, Southwest Iran. Global Ecology and Conservation, 46: e02590.

Persian wild goat – *Bezoar ibex*

Persian leopard – *Panthera pardus tuliana*

Asiatic caracal - *Caracal caracal*

Syrian brown bear - *Ursus arctos Syriacus*

growth and associated land use pressures present a major threat to the biodiversity of these protected areas.[146]

Several air strikes from the 12-day war on military facilities in the reserve led to roughly 65 km2 of burned vegetation, as seen on post-strike imagery using burned-area indices from Sentinel-2 satellite imagery. These widespread wildfires risk destroying habitats of protected flora and fauna, in particular as the reserve is a dedicated wildlife refuge.

The Sefidkuh-e-Khorramabad Protected Area is located near the city of Khorramabad in Lorestan Province, lying within the foothills of the Zagros Mountains and covering approximately 70,000 hectares at altitudes ranging from 1,000 to over 3,000 meters.[147] The area features a mountainous landscape dominated by dense oak forests that form part of an extensive hydrographic network including the Kashkan and Kakareza rivers.[148]

Sefidkuh-e-Khorramabad was originally designated as a prohibited hunting ground in 1968 and was upgraded to protected area status in 1990.[149] Studies have recorded over 270 plant and 130 animal species in the reserve, including wild goat, Persian leopard, brown bear, and the caracal (Caracal caracal).[150] The main threats to the area include habitat destruction, fragmentation, and overhunting, with climate change and prolonged drought identified as the most severe pressures, significantly impacting vegetation and wildlife.[151]

The Sefidkhu-e-Khorramabad Protected Area hosts a missile storage and launching facility. The airstrikes from the 12-day war scorched an estimated 73 km2 of protected vegetation and habitats. When combined with the burned vegetation areas from the Khorramabad and Kerrmanshah protected areas, the total affected area roughly aligns with the 9,000 hectares of burned area claimed by Iranian state media.[152]

146 Reyahi-Khoram, M. et al. (2014). The threats on the biodiversity of Bisotun Wildlife Refuge and Bisotun Protected Area (BPA & BWR) in the west region of Iran. Biodiversitas, 15(1): 67-74.

147 IUCN, UNEP-WCMC (2025). Protected Area Profile for Sefidkuh-e-Khorramabad. World Database on Protected Areas (WDPA).
Garavand, F. et al. (2018). Investigating the challenges of biodiversity management of Sefidkuh Khoramabad protected area by using the Delphi method. Journal of Fundamental and Applied Sciences, 10(1S): 918-935.

148 Garavand, F. et al. (2018). Investigating the challenges of biodiversity management of Sefidkuh Khoramabad protected area by using the Delphi method. Journal of Fundamental and Applied Sciences, 10(1S): 918-935.

149 IUCN, UNEP-WCMC (2025). Protected Area Profile for Sefidkuh-e-Khorramabad. World Database on Protected Areas (WDPA).
Garavand, F. et al. (2018). Investigating the challenges of biodiversity management of Sefidkuh Khoramabad protected area by using the Delphi method. Journal of Fundamental and Applied Sciences, 10(1S): 918-935.

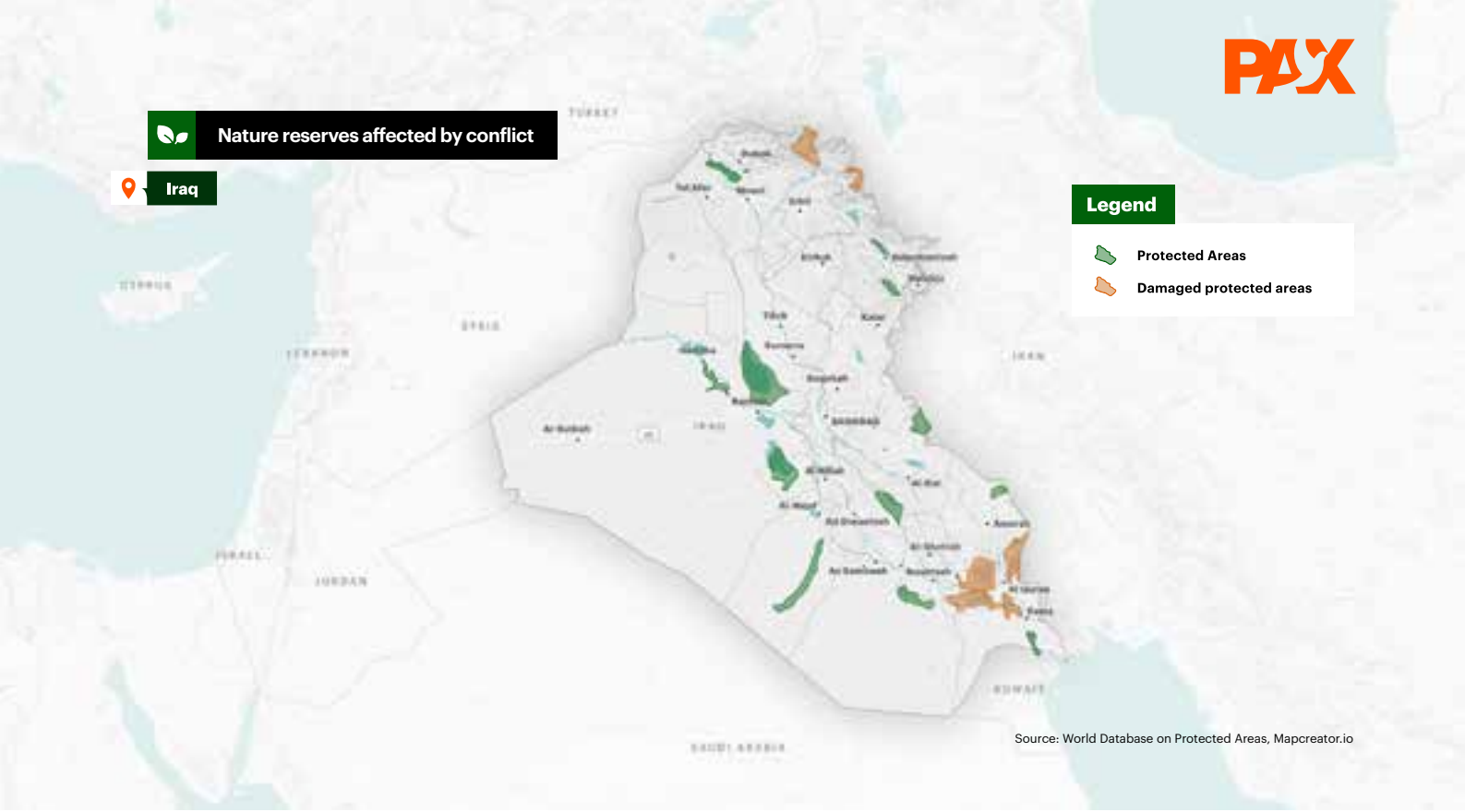
150 Derikvand, M., et al. (2023). Biodiversity of bird species in Sefidkuh protected area of Khorramabad, Lorestan. Journal of Environmental Sciences Studies, 8(3): 6968-6975.
Moqanaki, E.M., et al. (2016). The caracal in Iran – current state of knowledge and priorities for conservation. CATNews, Species Survival Commission IUCN.

151 Derikvand, M., et al. (2023). Biodiversity of bird species in Sefidkuh protected area of Khorramabad, Lorestan. Journal of Environmental Sciences Studies, 8(3): 6968-6975.
Asaholahi, Z. and Beyranvand, Z. (2024). Assessment and comparison of pressures and threats of Lorestan province mountain protected areas. Journal of Geographical Studies of Mountainous Areas, 5(1): 153-168.

152 Iranian Students' News Agency (2021). Destruction of approximately 9,000 hectares of the country's protected forests and pastures in the Zionist regime's aggression. Original title: تخریب حدود ۹۰۰۰ هکتار از جنگل‌ها و مراتع حفاظت شده کشور در تجاوز رژیم صهیونیستی

### C. The consequences of the documented environmental degradation

The strikes against military targets in both these nature reserves and subsequent fires have contributed to the degradation of protected flora and fauna. The exact extent of damage to the nature reserve and its ecosystems remains to be investigated, though this is likely to be hindered by the fact that parts of these areas are military zones. The impacts underscore the concerns from Iranian environmental groups on placing military installations in protected areas, not only due to peacetime military movements and loss of land to military bases, but also the wider conflict risks as they are likely to be targeted in case of war, with resulting consequences to key habitats, protected wildlife and wider ecosystems.




# Iraq

**A country overview of protected areas in a post-war landscape**

*By Bassam Alobaidi (Humat Dijlah) and Salman Khairalla (Save the Tigris)*

Iraq is a country with rich environmental diversity, encompassing many unique ecosystems such as marshes, mountains, deserts, lakes, and agricultural areas. There is local and international interest in nature conservation in Iraq, as these areas play a role in preventing the extinction of important species and preserving globally rare ecosystems. Despite the existence of dozens of qualified sites that meet international standards, Iraqi authorities are hesitant to designate protected areas formally. This is often political, with fears that, after designating a qualified site, major and complex issues related to the management of valuable natural resources await. The legacy of wars from the past few decades adds further challenges to the effective protection of nature in the country.

## A. National legal and customary systems

To align with the international Convention on Biological Diversity (CBD), which Iraq signed in 1992, and achieve its related targets,[153] nature conservation in Iraq is managed through a combination of legal and customary systems. National legal frameworks include environmental laws, the issuance of the Natural Reserves System,[154] the Environmental Protection and Improvement Law,[155] and water resources management laws.[156] In addition, local customs and traditions play a role in preserving natural resources, especially in rural and Bedouin communities with regards to lakes, birds, and biodiversity.[157] For example, the Barzan Reserve in Erbil, although not established as a protected area under national legislation, is recognized as a regional reserve under tribal administration and control.[158]

Iraqi law allows any individual who owns a natural site or date palm groves that they wish to protect to request that the Ministry of Environment declare it a nature reserve. According to the Natural Reserves System approved by the Ministry of Environment, the sites should encompass a distinct and clear richness in the components of biodiversity; a significant number

153 CBD (2022). Section H. Global targets for 2030. The Kunming-Montreal Global Biodiversity Framework (GBF).
154 Ministry of Environment of the Government of Iraq (2014). Natural Preserves. System No. 2 of 2014.
155 Government of Iraq (2009). Law No 27 of 2009 for Protection and Improvement of Environment.
156 Government of Iraq (2008). Ministry of Water Resources Law No. 50 of 2008.
157 For example: Osterhoudt, S., et al. (2024). The Role of Wild Plants in Cultural Restoration: Community Collaboration and Engaged Ethnobotany in the Nineveh Plains, Northern Iraq. Economic Botany 78: 109–125.
Central Statistical Organization of Iraq, the Iraqi Ministry of Planning, and UNDP (2025). Participatory Ecosystem Assessment of Mesopotamian Marshlands of Southern Iraq.
158 Iraq Biodiversity National Clearing House Mechanism (no date). Barzan Tribal Protected Area. Convention on Biological Diversity.

of unique or endemic species; one or more rare or endangered species; unique and distinct habitats; geologically valuable history of the region, social and cultural richness linked to the regional nature; and/or a landform of scientific and historical value. Declaring a reserve in Iraq requires approval from the National Committee for Protected Natural Sites, the Environmental Protection Council, and the Council of Ministers for final approval before the site can receive management plans and budget.

The National Committee for Protected Natural Sites, headed by the Ministry of Environment, was established in 2014 with the issuance of the Natural Reserves System and began holding meetings in 2015.[159] As part of its mandate, the Committee issued a study on "Areas Eligible for Designation as Nature Reserves in Iraq,"[160] prepared in collaboration with Nature Iraq and the Key Biodiversity Areas (KBA) Survey. They identified 82 sites eligible for protection across the country, based on the criteria of biodiversity and rare ecosystems. 35 of these sites have received initial approval by the Committee,[161] including such sites as Hor al-Hawizeh, Eastern Hammar Marsh, Western Hammar Marsh, a-Rifaiyya, Shawiya, Hadania, Wadi al-Dhaba, Fawara Flower, Flower Flood, Lake Sawa, al-Dilmaj Marsh, The Good, Zarbatiya, and others.[162] The Committee submitted its recommendations to the General Secretariat of the Council of Ministers to finalize the procedures of officially designating these sites as National Nature Reserves.[163]

Classifications and lists of Iraq's nature reserves vary, including those listed by the Ministry of Environment, Research and Geological Studies. The Iraqi Marshlands, in particular, are considered the most important water bodies in the country and are listed in the Ramsar Convention on Wetlands, encompassing the Eastern Hammar Marsh, Western Hammar Marsh, Hawizeh Marsh and the Central Marshes.[164]

### B. The state of the environment in Iraq's nature reserves

Most natural reserves in Iraq are neglected and encroached upon. There are issues related to a lack of awareness, interest, and demand for the protection of reserves as a result of the wars and conflicts that have exhausted Iraqi society. Iraqi environmental organizations and institutions are seeking to reinclude reserves under formal protection, however. Yet as a result of climate change, particularly, due to drought and water scarcity, some areas have suffered severe biodiversity loss, including Lake Sawa, Habbaniyah and others.

In Basra Governorate in southern Iraq, one can find Khor al-Zubair, a coastal wetland reserve located between the port of Umm Qasr and al-Zubair city. It is an important habitat for many species of migratory and resident birds and a natural refuge for fish, small mammals, and many local plant species, yet it suffers from overfishing and neglect.[165] Other important water-rich nature reserves are under pressure as well. Lake Razzaza has experienced a major decline in its water level, as well as high levels of pollution.[166] Lake Tharthar, the largest artificial lake in Iraq, also faces worrying drought conditions due to limited water inputs from upstream and elevated evaporation from dry, hot weather.[167] Similarly, the water levels of Mosul Dam Lake have decreased significantly, mainly due to reduced discharge upstream from Turkish dams.[168] As a consequence, Mosul Falls has completely dried up in Nineveh Governorate.[169]

Several other nature reserves are facing serious challenges from human disturbance and degradation in view of weak environmental protection, including poaching, human settlement near reserves, the conversion of agricultural land to residential use, and the deliberate destruction of green areas, often related to the construction of infrastructure and industrial activity, such as cement factories, brick factories, oil refineries, and sulfur plants. For instance, hunters conduct illegal poaching in the deer reserve in Mandali District in Diyala and in the Makhmur Mountain Deer Reserve in Nineveh Governorate.[170] The Sinjar Mountain Reserve in Nineveh Governorate[171] is facing wide-scale destruction as a result of logging for charcoal

159 Ministry of Environment of the Government of Iraq (2014). Natural Preserves. System No. 2 of 2014.
160 Nature Iraq (no date). The Key Biodiversity Area Inventory for Iraq.
161 Nature Iraq (2017). Nature Iraq Activity Report 2017.
162 Some protected areas are mentioned, but not all, because the ministry does not have an encompassing database.
163 Ministry of Environment of the Government of Iraq (2014). Natural Preserves. Original title: المحميات الطبيعية
164 Ramsar (2025). Protected Wetland Country Profile for Iraq. The Convention on Wetlands.
165 Communication between authors and local environmentalists.
166 The New Arab (2022). Iraq's second largest lake drying up, turning up dead fish.
167 964media (2024). Iraq's lakes and rivers facing drought conditions amid water management challenges.
168 Rudaw (2025). Water level plummets in Iraq's largest dam.
169 Humat Dijlah Environmental Monitoring Network (2022). From the Mosul Waterfalls tourist resort to a barren desert due to drought... and its banks have become a sewage route that flows into the Tigris River. Facebook post, 8 September 2022.
170 Communication between authors and local environmentalists.
171 Aliyas, I.M., Alazzam, A.K. and Hassen, S.A. (2016). Assessment the biodiversity in the nature reserve of Sinjar mountain. International Journal of Current Research 8(11): 40874-40878.

production.[172] The Mosul Forest Tree Reserve in Nineveh Governorate was also set ablaze, presumably to be converted into residential complexes.[173]

### C. Iraq's armed conflict

Over the past four decades, Iraq has endured a series of violent conflicts that have profoundly impacted both society and the environment.[174] The first was the 1980s war with Iran (1980–1988), which depleted resources and severely damaged infrastructure and agricultural areas. This was followed by the invasion of Kuwait in 1990, the 1991 Gulf War, and the subsequent prolonged economic sanctions, which hampered the country's development and environmental capabilities. Then came the 2003 US-led invasion and the ensuing internal unrest, sectarian conflicts, and widespread urban warfare, culminating in the 2014 ISIS takeover of much of the country, which devastated vast swathes of farmland and natural areas in Nineveh, Anbar, and Salah al-Din provinces.

### D. The wars' environmental destruction in Kurdistan's Mountain Reserves

These conflicts have collectively impacted Iraq's delicate ecosystems. Still, protecting the environment and restoring nature reserves in the post-conflict phase has been a national imperative in the country to ensure environmental sustainability and ecological balance.[175] In northwestern Iraq, the Sinjar Mountains continue to suffer from the effects of wars, including tribal conflicts, political disputes, illicit tree cutting, and encroachment on the mountain's historic ecosystem. When ISIS took over the area in 2014, the mountain was subjected to heavy shelling, resulting in the destruction of trees, the migration of birds, and the contamination of water sources with war debris. Large areas of the Sinjar Mountain Reserve were burned, whether naturally, accidentally or deliberately set on fire to scare away inhabitants and internally displaced persons.[176] Compounding these direct effects of armed conflict are the coping mechanism of the regions inhabitants due to economic hardship: cutting down and burning trees to produce charcoal for sale in the markets,[177] accompanied by the illegal hunting of birds and the pollution of water sources and springs with solid waste and charcoal residue. The Environmental Protection and Improvement Law No. 27 of 2009 has thereby been continuously violated. Due to neglect and violations, the mountain will likely soon cease to be a habitat for birds and plants. Following "conflict-related infrastructure damage, mismanagement of water resources, inefficient agricultural practices, and a 40% decline in rainfall over the past five years due to climate change," tribal conflicts have erupted over water resources and farm land on Mount Sinjar as many communities and villages have had no access to potable water.[178] The Tigris Protectors, in cooperation with the International Solidarity Organization and the Nonviolent Peace Force Organization, organized a reconciliation session between the conflicting parties to divide the water and ensure that the farms in the Sinjar Reserve are accessible to everyone.[179]

The Makhmur Deer Reserve has been affected by military operations and displacement. Combined with a lack of ecological awareness by the local communities, the conflict increased the disruption of wildlife habitats, poaching, and the contamination of soil and surface water sources.[180] Both the Sinjar and Makhmur mountain regions are disputed between Kurds and Arabs. This weak and contested governance, shaped by political struggles between the Iraqi government in Baghdad and the Kurdistan Region of Iraq, has led to poor protection of the reserves and its wildlife.

Further north, in the governorates of Dohuk, Erbil, and Suleymaniah, frequent forest fires in 2024 devastated wildlife habitats after the targeting of suspected militant positions by Turkey and broader clashes between the Kurdistan Workers' Party (PKK) and Turkish forces.[181] Additionally, in the Barzan Tribal Protected Area animals such as partridges were hunted for fun to the brink of extinction during the armed revolt of 1961-1975, when people had easy access to guns.[182]

The areas liberated from ISIS, more specifically in the districts of Sinjar, Tal Afar, southern Mosul, and Nimrud,

172 Kirkuk Now (2022). Shingal (Sinjar) trees turned into firewood. By Ammar Aziz, Ninewa.
173 Humat Dijlah Environmental Monitoring Network (2022). A massive fire is engulfing the forests of #Mosul... and the reason? No one knows officially, and official media outlets haven't reported it. Facebook Post.
174 Crisis Group (2025). Iraq country profile.
175 UNEP (2005). Assessment of Environmental Hotspots in Iraq. United Nations Environment Programme
176 Kirkuk Now (2020). Fire burns Sinjar mount and approaches IDP camps. By Ammar Aziz, Nineveh.
177 Humat Dijlah Environmental Monitoring Network (2022). The historic Mount Sinjar continues to face the threat of deforestation on its peaks and slopes. Facebook Post, 1 September 2024.
178 Solidarité International, Tigris River Protectors Association, Humat Dijlah and Nonviolent Peaceforce (2025). Water, conflict, and stability in Sinjar: a call for action towards equitable and conflict sensitive water resources management in a fragile region.
179 ibid.
180 Source: communication between authors and local environmentalists.
181 PAX (2025). Wildfire analyses in Iraqi Kurdistan.
182 raq Biodiversity National Clearing House Mechanism (no date). Barzan Tribal Protected Area. Convention on Biological Diversity.

▲ Water buffaloes in Iraq›s Hawizah Marshes Missan. Murtadha Aljnubi, April 2026

are still suffering from the destruction of infrastructure, landmines, and unexploded ordnance (UXO). Next to dangers for residential and agricultural areas, such remnants of war have led to significant challenges and the deterioration of these reserves. UXO puts people and wildlife at constant risk and hinders effective environmental monitoring, management, and touristic-recreational developments.[183]

### E. The wars' environmental destruction in the Mesopotamian Marshes

The marshes of southern Iraq, also known as the al-Ahwar or the Mesopotamian Marshes, form one of the Middle East's most important wetland ecosystems, a vast inland delta where the Tigris and Euphrates rivers disperse across a semi-arid landscape. Comprising the Eastern and Western Hammar, the Central (al-Chibaish) marshes and Hawizeh marsh transboundary with Iran, this network of wetlands is internationally recognized both as a Ramsar site[184] and as a UNESCO World Heritage Site[185] for both their exceptional value for biodiversity and their deep cultural significance.

Ecologically, the marshes constitute one of the region's most significant habitats for the in-situ conservation of biological diversity, supporting a remarkable array of endemic, range-restricted, and threatened species.[186] They are a critical last stopover for millions of migrating birds before entering the vast Arabian Desert. The marshes host endangered birds such as the Basra reed warbler and the Iraq babbler, along with restricted-range subspecies of the little grebe, the black francolin, and the hooded crow, as well as vulnerable waterfowl like the marbled teal. The marshes preserve relict populations of three African bird species (the African darter, the sacred ibis, and the Goliath heron) living thousands of kilometers away from their main global ranges. The wetlands also shelter unique mammals, including the endemic Bunn's short-tailed bandicoot rat, a distinct subspecies of the smooth-coated otter, and the range-restricted Mesopotamian gerbil and Euphrates jerboa. Six localized fish species are diadromous, migrating between salt and fresh waters. Reptile diversity includes the endangered Euphrates soft-shell turtle, found only in a handful of sites in Iraq and Iran, and Murray's comb-fingered gecko, whose

183 Source: communication between authors and local environmentalists.
184 Ramsar (2025). Protected Wetland Country Profile for Iraq. The Convention on Wetlands.
185 UNESCO (2025). The Ahwar of Southern Iraq: Refuge of Biodiversity and the Relict Landscape of the Mesopotamian Cities. World Heritage Convention.
186 Ibid.

distribution is limited to the Ahwar, Shatt al-Arab, and parts of western Iran.

The marshes also hold profound cultural and historical significance, forming the heartland of ancient southern Mesopotamia where the world's earliest cities first emerged.[187] In this dynamic deltaic landscape, shaped by shifting waterways and reed beds, urban centres such as Uruk, Ur, and Eridu developed, marking the origins of writing and monumental architecture such as mudbrick temples. Today, the wetlands continue to sustain the livelihoods of the Ma'dan (Marsh Arabs), whose long-standing traditions of fishing, water buffalo herding, aquatic plant harvesting, and seasonal agriculture reflect a deep, enduring relationship with the land and water.[188]

The Iraqi marshes enjoyed relative ecological balance prior to recent armed conflicts, despite the long-standing challenges related to water management and desertification. However, they suffered severe devastation during the armed conflicts of the 1980s and 1990s, when large areas were deliberately drained by Saddam Hussein's regime as a punitive measure against the Marsh Arabs for supporting insurgents during the southern uprising.[189] In addition, authorities employed large-scale drainage projects to disconnect the marshes from their water sources, constructing desert roads and canals to facilitate military patrols and control the area. The military operation and the expansion of strategic infrastructure destroyed natural habitats, displaced local communities, and left behind contaminated water and soil laden with chemicals and unexploded ordnance. Although parts of the marshes began to refill after 2003, reaching roughly half of their former extent and showing early signs of recovery, this progress has been fragile and uneven. Since 2015, water levels have continued to decline sharply, with regions such as the Hammar Marshes shrinking to less than a quarter of their expected coverage.[190] New threats have emerged, including the closure of water outlets and oil-exploration activities in Hawizeh Marsh, further reducing habitat quality and causing declines in waterfowl and deer populations.[191] Environmental protection systems in reserves such as Hawizeh and East Hammar have been weakened by prolonged conflict, altering water use and land access. Today, the marshes face a convergence of severe water security risks: recurrent droughts, rising temperatures, upstream dam construction in Turkey and Iran, diversion of water from tributaries,[192] pollution from oil operations and untreated agricultural and sewage runoff,[193] and salinization driven by reduced freshwater flow,[194] all of which collectively threaten the long-term survival of one of the world's most distinctive wetland landscapes.

### F. Impacts of protected nature's degradation on local communities

The degradation of northern Iraq's mountain ecosystems and its southern marshlands has led to the loss of traditional livelihoods for local communities. Many communities depend on the reserves' natural resources, such as water, firewood, grasses, pastures, fish and hunting, for their livelihoods. The loss or deterioration of these resources has affected food security and income, leading to increased poverty and unemployment rates. The loss of biodiversity and deteriorating water quality has also led to health problems, including higher risks for zoonoses with shrinking habitats[195] and higher risks for infectious diseases in case of limited sanitation.[196] Additionally, it has led to a change in traditional lifestyles, has created economic pressure and social tensions, and has increased migration to Iraq's cities.

Iraq is currently experiencing large-scale rural-to-urban population migration within the country due to the deteriorating ecosystems, climate change, and desertification.[197] For example, residents of the countryside in Tal Afar and Sinjar districts are migrating to the city centers of Mosul and Dohuk,

187 Ibid.
188 Ibid.
189 UNEP (2001). UNEP Study Sounds Alarm About the Disappearance of the Mesopotamian Marshlands. United Nations Environment Programme.
USIP (2002). The Marsh Arabs of Iraq: Hussein's Lesser Known Victims. Press Release. United States Institute of Peace
Human Rights Watch (2003). The Iraqi Government Assault on the Marsh Arabs. A Human Rights Watch Briefing Paper.
190 Al-Mada Press and Dhi Qar (no date, estimated 2015). Amount of water in the Central Marshes and Al-Hammar Marshes declines to less than 25%. Save the Tigris.
191 The Guardian (2025). 'It's destruction disguised as progress': how the oil industry is sucking Iraq's ancient wetlands dry. By Azhar Al-Rubaie, Sara Manisera and Daniela Sala, Hawizeh Marshes.
192 Fanack (2023). Iraq: Drought Threatens Marshes. By Hussein Ali Alzoubi, 1 August 2023.
193 Save the Tigris Foundation (2024). Letter by civil society organisations concerned with the protection of the Ahwar of Southern Iraq to the World Heritage Centre. 20 June 2024.
194 IUCN (2016). World Heritage Nomination – IUCN Technical Evaluation: The Ahwar of Southern Iraq: Refuge of Biodiversity and the Relict Landscape of the Mesopotamian Cities (Iraq). ID No. 1481.
195 CBD (2025). Biodiversity and Health: Biodiversity provides ecosystem goods and services essential to human, animal and ecosystem's health and well-being. Convention on Biological Diversity.
196 Al-Mada Press and Dhi Qar (no date, estimated 2015). Amount of water in the Central Marshes and Al-Hammar Marshes declines to less than 25%. Save the Tigris.
197 IOM (2022). Migration, Environment, and Climate Change in Iraq. International Organization for Migration.

and the residents of the marshes are moving to the city centers of Nasiriyah and Basra.[198] As the nature reserves have lost many of their ecosystem functions, job opportunities in agriculture, herding, and ecotourism have decreased. Migration to urban areas has caused overcrowding, unemployment, and increased rates of poverty.[199] The loss and damage of protected nature also deteriorates the intangible heritage of communities who have their traditions and identity linked to a nearby nature reserve, including elements relating to livelihoods, landuse, spirituality and recreation.[200]

### G. Impact on conservation agencies, government, and international collaboration

Due to the impacts of the wars, many reserves have lost their value as a model for environmental conservation and as important sites for biodiversity. This decline may complicate protection projects and hinder international cooperation. As a result, environmental agencies or organizations may incur higher costs to repair environmental damage or to provide alternative services such as clean water and support for affected communities. Ultimately, these challenges contribute to a decline in the state's ability to achieve sustainability and environmental goals.

### H. Environmental peacebuilding initiatives

Despite the challenges in Iraq, there are initiatives aimed at building environmental peace in Sinjar, southern Mosul, Basra, and the marshlands.[201] These initiatives include efforts to distribute resources fairly, ensure everyone has access to water and the possibility of agriculture, protecting marshlands, promoting community participation in resource management, and developing environmental awareness programs. Some NGOs also foster cooperation between local communities and authorities to improve natural resource management and build capacity to adapt to environmental changes. There are organizations and volunteer teams working to address the negative effects of wars by rehabilitating green spaces, small water networks, and protecting agricultural areas. In Mosul, Erbil, and Dohuk, many organizations are working on land reclamation, clean-up campaigns, and tree planting, along with lobbying and advocacy efforts to persuade decision-makers to adopt policies that protect the environment.[202] These include civil society organizations such as the Tigris River Protectors Association, the Hisar Environmental Protection Organization, Oxfam, Nature Iraq, International Solidarity, the United Nations Development Programme, and the International Organization for Migration (IOM). In conclusion, decades of armed conflict in Iraq have devastated the country's unique protected areas, including northern mountain reserves and the southern Mesopotamian Marshes, through deliberate destruction, drainage, shelling of opposing groups present in reserves, high levels of poaching due to easy access to weapons and the contamination of habitats. Unlike many other regions, Iraqi reserves have faced combined pressures from military operations, targeted infrastructure projects, upstream water diversion, and post-conflict governance gaps, which have weakened environmental protection systems and disrupted traditional livelihoods. These compounded impacts have led to severe biodiversity loss, declining water quality, habitat degradation, and a collapse of ecosystem services, especially important for agricultural livelihoods and health, driving rural populations to urban centers. On top of the environmental management gap, remnants of unexploded ordinances hinder environmental restoration and conservation efforts.

198 Source: communication between authors and local environmentalists.
199 IOM (2022). Migration, Environment, and Climate Change in Iraq. International Organization for Migration.
200 Source: communication between authors and local environmentalists.
201 Adyan Foundation and Rashad Center for Cultural Governance (2024). Report on the Environmental Assessment of Iraq.
202 United Nations Iraq (2022). 9,500 people in Sinjar now have access to clean water thanks to USAID and UNDP partnership. Press Release.

# Myanmar

**Subsistence resource extraction amidst the nationwide revolution in Lenya National Park and in Hukawng Valley Wildlife Sanctuary**

*By Nathan Ruser (The University of New South Wales and the Australian Strategic Policy Institute)*

In early 2021, as the Burmese military was launching a coup and sending tanks down the city streets of the capital Naypyidaw, a team of scientists was finalizing a plan to visit the country's remote north in search of a lost duck species. The pink-headed duck was last seen in the 1910s, but a series of unconfirmed sightings in the decades since left a faint glimmer of hope that the species might still be found along undisturbed stretches of riparian forests, far from the disturbance of politics or conflict.

When the team eventually reached the site, three years later, they found a vastly transformed landscape, and it was no longer just the pink-headed duck that appeared on the brink of extinction. The sites they surveyed, once considered pristine habitats, had been decimated by artisanal gold mining and pollution,[203] dampening hopes of finding the pink-headed duck and posing a potentially existential threat to populations of the white-winged duck and the masked finfoot - highly sensitive species reliant on undisturbed riparian woodland.[204]

While the fighting over Myanmar's political future was far away from these forests, its effects have reached into the heart of the country's forests. The "jewel" of Southeast Asia's remaining intact forest landscapes is being threatened by the conflict-affected hunt for minerals and precious gems that dot the country's valleys and hills.[205]

Across the country, thousands of people fleeing from the junta's draconian rule and the collapse in livelihoods[206] have turned to gold mining and resource extraction, extending the effects of the war far beyond the range of artillery and airstrikes. These extractive industries are tied closely to the country's conflict economy, with the ruling military administration buying the loyalty of armed groups across the country's periphery with exclusive rights to logging and mining.[207]This rapid shift to subsistence

203 https://searchforlostbirds.org/news/keeping-the-dream-alive-an-update-on-the-search-for-the-pink-headed-duck
204 https://www.iucnredlist.org/species/22680064/244637841#threats
205 Bhagwat T, Hess A, Horning N, Khaing T, Thein ZM, Aung KM, et al. (2017) Losing a jewel—Rapid declines in Myanmar's intact forests from 2002-2014. PLoS ONE 12(5): e0176364. https://doi.org/10.1371/journal.pone.0176364
206 https://www.frontiermyanmar.net/en/crackdown-triggers-exodus-from-myanmars-biggest-city/
207 Woods, Kevin. "Ceasefire capitalism: military–private partnerships, resource concessions and military–state building in the Burma–China borderlands." In New Frontiers of Land Control, 81-104. Routledge, 2013.

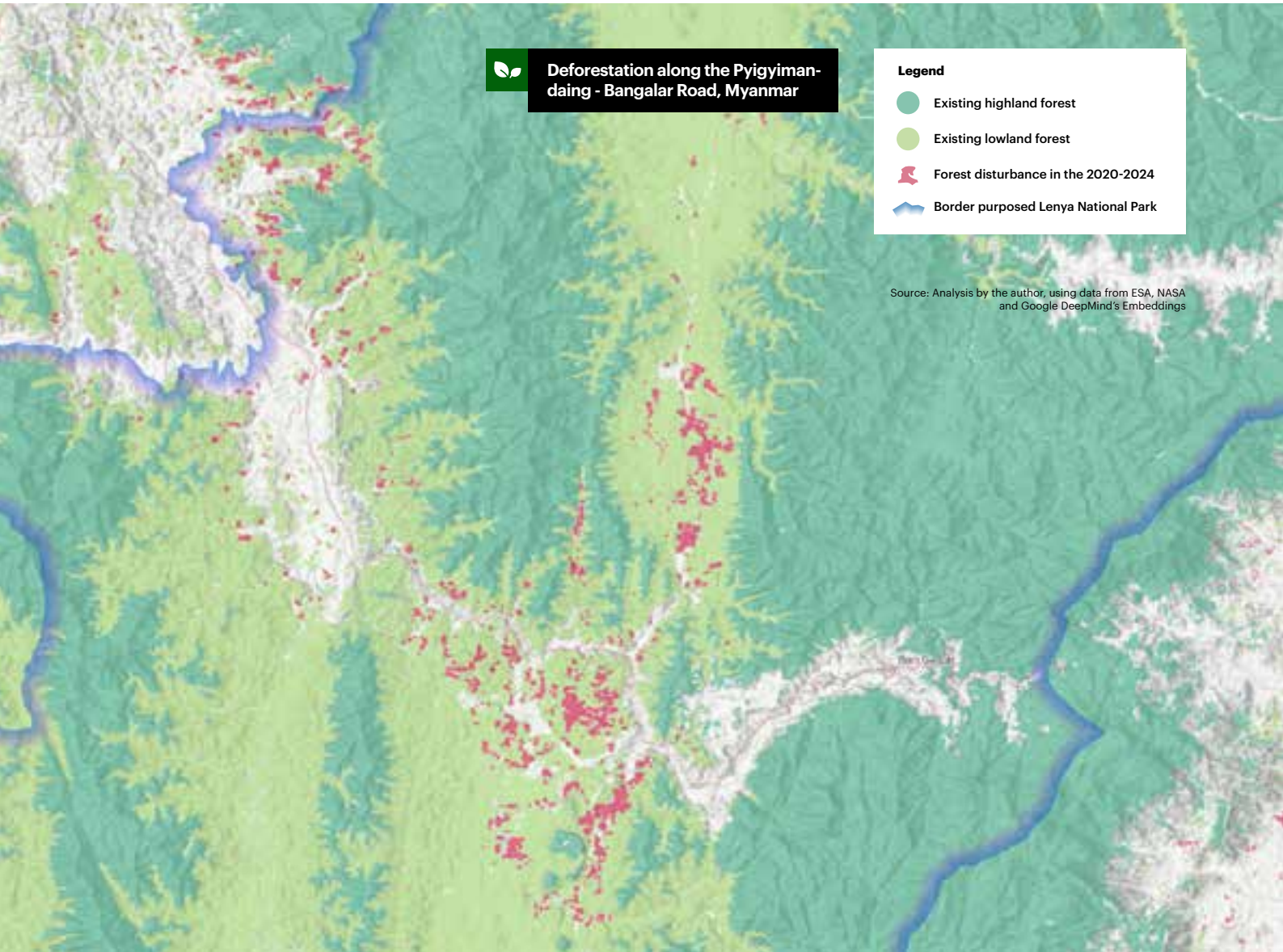
▲ Deforestation between January 2021 and January 2025 for agriculture along the river valley leading north from the road between Pyigyimandaing and Bangalar border post. Source: Airbus, via Google Earth,

extraction and the collapse of state capacity, including in conservation,[208] has also rapidly accelerated the intrusion of Myanmar's already limited protected area network.

This case study will explore the indirect impacts of conflict on vital ecosystems and protected areas across the country, focusing on the intrusion of slash-and-burn deforestation into the lowland rainforests of Tanintharyi, especially near the proposed Lenya National Park.

This activity threatens the iconic Gurney's pitta, a critically endangered bird species, with extinction. This case study will also examine the spread of artisanal and subsistence gold mining into the wild streams of Kachin State, particularly in the Hukawng Valley Wildlife Sanctuary. This habitat destruction constitutes a significant threat to the critically endangered white-winged duck and masked finfoot, while rapidly eroding any hope of rediscovering a living population of the pink-headed duck.

208 https://www.frontiermyanmar.net/en/the-gentle-giants-in-service-of-the-revolution/

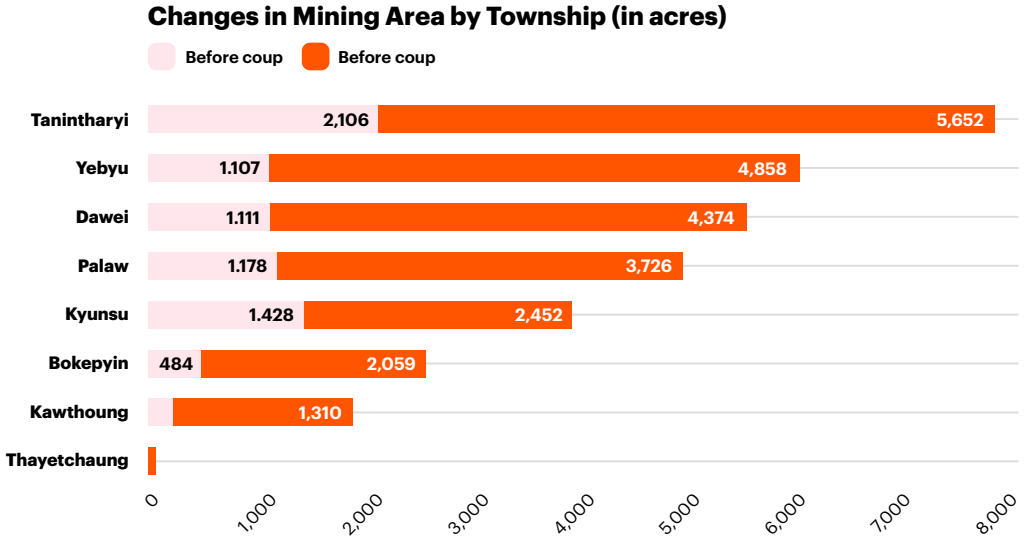


### A. Gurney's pitta in the lowland rainforest of Lenya National Park

Lowland tropical rainforests across the world represent some of the most biodiverse, but also some of the most threatened ecosystems. Their suitability for agriculture and other natural resource extraction, along with their ease of access and general proximity to areas of high population, creates a perfect storm for their degradation.[209] Moreover, this value to humans and economic development means that they are one of the most underrepresented ecosystems within protected areas.[210]

Southeast Asia's lowland rainforests stand out as an example of these trends of degradation and threat. The countries in the area have undergone rapid economic and population growth over the last 50 years, and there is increasing demand for natural resources and the economic opportunities associated with them.[211] Following the rediscovery in Thailand of the threatened Gurney's pitta, a lowland specialist species threatened precisely due to the conversion of lowland forest to agricultural land, the Thai Royal Forest Department scrambled to establish protections in the area. In doing

209 Loss and vulnerability of lowland forests in mainland Southeast Asia
210 10.3389/ffgc.2022.763131
211 10.3389/ffgc.2022.763131




▲ Post-coup mining expansion in Tanintharyi region, south Myanmar. Lenya National Park is predominantly in Bokepyin township. Data: Dawei Watch

▲ High-resolution satellite imagery of gold-mining spreading through the riparian valleys in Hukawng Wildlife Sanctuary. Source. Airbus, via Google Earth, 2025-04-14.

so, it excluded lowland areas from the protected area.[212] The species is now believed to be extinct in Thailand and endemic to Myanmar.

The creation of the Lenya National Park was proposed in 2002 and vastly expanded in 2004 to protect the remaining habitat for the Gurney's pitta and other lowland rainforest species. The government of Myanmar cancelled oil palm concessions in the area and managed the land under the Forest Department until the 2021 coup.[213] These forests harbour both undiscovered species, with a 2019 study of geckos in the Lenya National Park revealing two newly discovered species,[214] and the last remaining habitat for the critically endangered Gurney's pitta.

Territorial control in this region is intricate, as the Burmese junta holds several military garrisons and bases in Pyigyimandaing, along with the Bangalar border post in the national park. Nonetheless, resistance groups often operate within the town,[215] away from these bases, and they also control the road through the National Park between Pyigyimandaing and Bangalar. While nominally within a protected area, the site is

212 Round, Philip D. "Gurney's Pittas in Thailand—from rediscovery to extinction in just 28 years." Natural History Bulletin of the Siam Society 60, no. 1 (2014).
213 10.1007/s10745-019-0063-x
214 Lee, Justin L., Aryeh H. Miller, George R. Zug, and Daniel G. Mulcahy. "The discovery of Rock Geckos Cnemaspis Strauch, 1887 (Squamata: Gekkonidae) in the Tanintharyi Region, Myanmar with the description of two new species." (2019).
215 https://springrevpower.com/2024/05/19/post2024051902/#NEWS010

under overlapping claims by the Myanmar military, the Karen National Union (KNU), and local People's Defence Forces. In other areas of Tanintharyi, the military junta largely holds territorial control.

In Myanmar, the dynamics of conflict have paradoxically offered both pockets of protection for these critical lowland Tanintharyi forests and also the conditions to enable their rapid degradation. Following the 2021 coup and the nationwide Burmese Spring resistance movement, the overall trend has swung towards degradation.

Since the coup, the bulk of the deforestation in Lenya's lowland forest has occurred along the dirt road between Pyigyimandaing and Bangalar border post, as degradation and human influence has spread from the road and, to some extent, along the valleys perpendicular to the road.

The ecological degradation in the proposed Lenya National Park is gradual but relentless. Satellite images from 2022 to 2024 reveal expanding clearings in previously intact areas. These clearings are extensive, creating a patchwork of encroachment that damages habitat quality and connectivity vital for species like Gurney's pitta. This critically endangered and highly territorial bird relies on dense forest understorey, and even minor disturbances can lead to its disappearance, as demonstrated by its extirpation in Thailand.

Since the coup, a new form of degradation has emerged with the rise of subsistence and artisanal gold mining in the proposed National Park. Unlike traditional small-scale farming, gold mining is a far more aggressive and extractive form of land use. The arrival of many miners, driven by economic collapse, conflict, or conscription, has led to a frantic rush for extraction, neglecting long-term ecological impacts. Informal dredging has severely disturbed riverbanks, causing significant environmental damage to both terrestrial and aquatic ecosystems.

Outside of the proposed Lenya National Park, the broader region has also seen the proliferation of these mining operations. In areas like Ye Phyu township and the Zimbar Creek watershed, formally part of the Tanintharyi Nature Reserve, mining operations have proliferated amidst a complex mosaic of armed actor control. Zimbar Creek, once a vital freshwater source, now runs cloudy and metallic, scarred by dredging and mercury contamination, according to a recent investigation by Dawei Watch.[216]

This example is illustrative of the broader dynamics affecting the region. In other areas of Tanintharyi, where the military junta has retained control, mining continues with the overt complicity of military officials and militia leaders. Additionally, the potential direct impact of the armed conflict on the region's fauna was shown in 2004, when a Sumatran rhinoceros was injured and killed by a landmine in the rainforests of Tanintharyi.

The proposed Lenya National Park is one of the last strongholds of lowland rainforest in Southeast Asia. This ecosystem is globally threatened, biologically diverse, and underrepresented in protected areas. The presence of species like the critically endangered Gurney's pitta highlights its global conservation importance. However, the region's increasing deforestation, growth in artisanal gold mining, and habitat fragmentation mean these forests face growing pressures without proper protection and governance.

Without urgent conservation efforts from the diverse array of local actors, coupled with genuine community involvement and sustainable livelihood options, Lenya's lowland forests, the last global refuge for the Gurney's pitta and other unique biodiversity, remain greatly threatened.

### B. Artisanal Gold-mining in Hukawng Wildlife Sanctuary

In the northern stretches of Myanmar, the Kachin lowland forests are an expansive, formerly pristine ecosystem acting as a refuge for critical species such as tigers, dholes and elephants, while also conserving some of the last remaining habitat globally for threatened bird species such as the white-winged duck, the masked finfoot and the white-bellied heron. Experts consider both the white-winged duck and the masked finfoot to be among the most imperilled Asian bird species.[217] The region was also the final stronghold of the presumed extinct pink-headed duck.[218] These species all have similar requirements, namely a pristine riparian habitat, and are all extremely susceptible to human disturbance.

The Hukawng Valley Wildlife Sanctuary is the largest protected area aiming to conserve this landscape. It covers over 15,000 square kilometers and is contiguous with other nominally preserved wildlife sanctuaries to the east and north. Its natural value is so significant that it has been placed on UNESCO's tentative list of World Heritage Sites.[219]

216 https://news.mongabay.com/2025/04/armed-groups-and-junta-profit-as-toxic-mines-devour-southern-myanmar/
217 BirdLife International, 2024 https://datazone.birdlife.org/species/factsheet/white-winged-duck-asarcornis-scutulata
BirdLife International, 2022 https://datazone.birdlife.org/species/factsheet/masked-finfoot-heliopais-personatus
Berryman, A. J. Per Comms
218 BirdLife International. 2001. Threatened Birds of Asia: the BirdLife International Red Data Book
219 UNESCO, 2014. https://whc.unesco.org/en/tentativelists/5875/

Gurney's Pitta - *Hydrornis gurneyi*

White-bellied Heron - *Ardea insignis*

Bent-toed gecko – *Cyrtodactylus*

Dhole - *Cuon alpinus*

The size and significance of the site, however, are undercut by its degradation, with long-established and enormous gold mining areas around the town of Tanai cutting a hole through the middle of the conserved area. These mines were already active in 2004 when the protected area was formally declared by the government, and thus the protected area excluded these areas.

Much like in the country's south, territorial control in this area is complex. This area has traditionally been a stronghold of the Myanmar army and its associated militias; however, since the coup, the Kachin Independence Army, a resistance-aligned armed organization, has drastically extended its control into these areas. Both actors view the gold-mining areas as a strategic asset, and clashes have occurred to capture fortified junta outposts throughout the gold-mining zones. At present, junta control remains only in a few outposts and along key roads and towns leading through the Hukawng Valley.

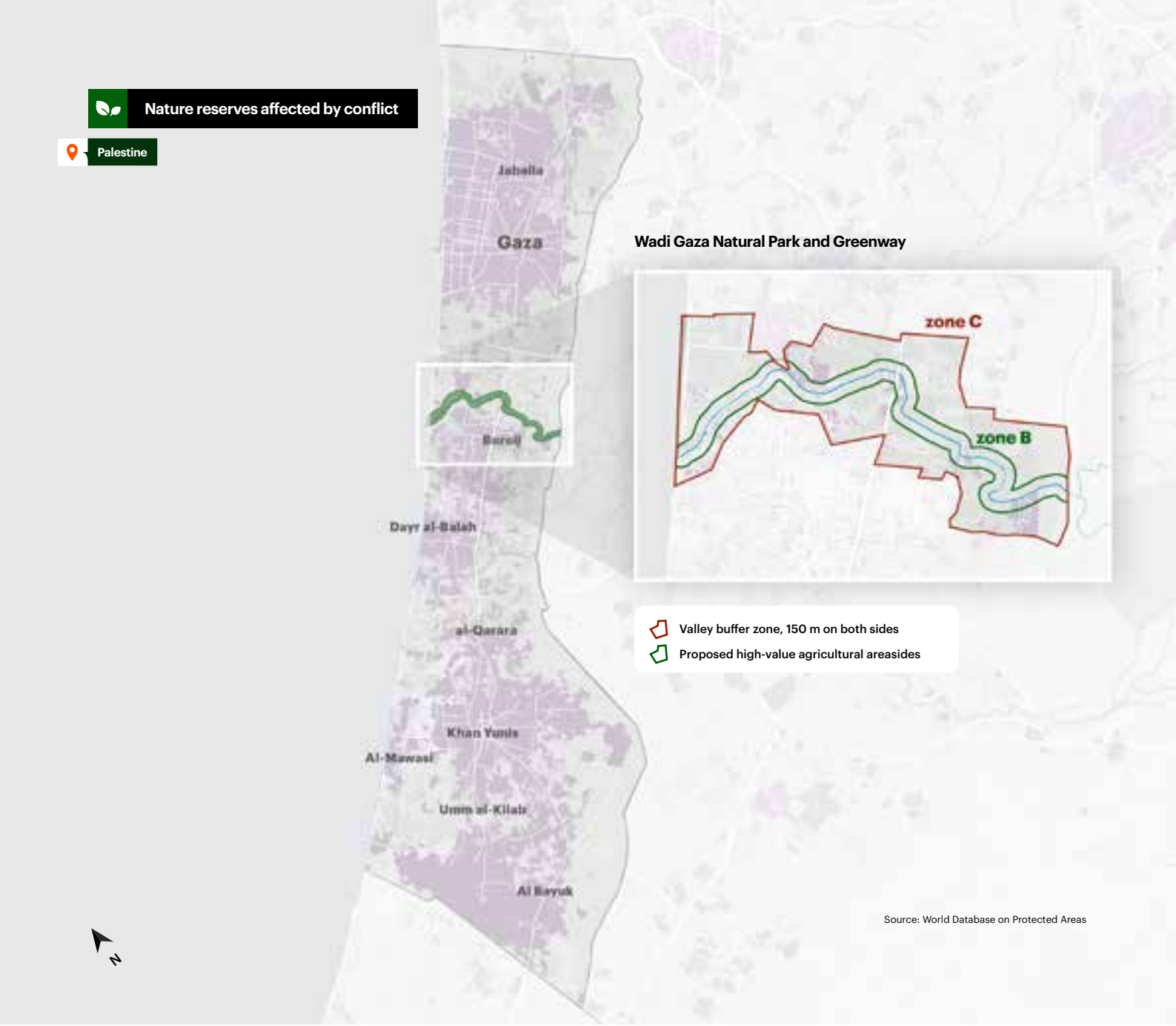
Before the coup, conservation efforts in the area were also hindered by a strained relationship between local communities and the Wildlife Conservation Society, which Myanmar's government brought in to oversee the site. Many locals perceived this as collusion with the ruling Burmese military regime and a way for the government to dispossess local communities.[220] This relationship was further worsened when a company with close ties to the regime was granted a licence, under military protection, to develop much of the region for agriculture, relocate villages, destroy subsistence croplands, and clear forests,[221] including areas within the formally designated Wildlife Sanctuary. Local communities saw conservation regulations as harmful to their livelihoods. At the same time, crucial natural resources such as timber and gemstones were pillaged by companies based in Yangon and connected to the military regime.

Since the 2021 coup, however, the rate of gold-mining activities has accelerated and artisanal mining is reaching far deeper into the once-pristine river valleys. The protected area has since seen similar trends to much of the rest of Myanmar. Loss of livelihoods and intense human rights abuses by the ruling junta have led locals to flee the cities, taking up subsistence resource extraction across a wide swath of Burma's wilderness.

220 https://news.mongabay.com/2020/04/indigenous-groups-in-myanmar-lash-out-at-restrictive-conservation-policies/

221 https://kdng.org/wp-content/uploads/2018/12/tyrants-tycoons-and-tigers.pdf

The Hukawng Wildlife Sanctuary illustrates the wider conflicts between conservation efforts, ongoing conflicts, and survival challenges in modern Myanmar. Since its establishment, contested governance, shifting control, industrial interests and weak protections have seen gold-mining activities extend into the protected area. Originally intended to be a large safe zone for critically endangered species, it now faces rising pressures from artisanal gold mining. This surge is driven by weakened central authority and worsening humanitarian issues following the 2021 coup. As governance breaks down and various state and non-state groups vie for the region's natural resources, maintaining effective conservation has become borderline impossible.




# Palestine

**Palestine: Wadi Gaza Reserve**

*By Enora Segeren, Jonathan Vince, and Liam Beechouk (Utrecht University)*

This case study examines environmental protection and damage around the Wadi Gaza Reserve, Palestine.[222] It considers the (inter-)national legal framework governing environmental protection, and discusses the environmental destruction since October 2023 through a small-scale open-source investigation.

## A. Protected nature in Palestine

The conservation systems in Palestine are inherently influenced by the political implications of Israeli occupation. There are a total of 48 nature reserves designated by Israel in the Occupied Palestinian Territory of the West Bank, with only 13 of those under formal jurisdiction of the Palestinian Authority due to the administrative division of the West Bank.[223] Yet, even for those 13 areas, Palestinians have faced significant

222 Protected Planet (2023). Wadi Gaza.

223 Palestine Museum of Natural History (PMNH), Bethlehem University, Palestine Institute for Biodiversity, and Environmental Quality Authority of the State of Palestine (2021). Academic Cooperation with the Environment Quality Authority to Refine Strategies for Biodiversity Conservation in Protected Areas in Palestine, Final Report, p. 3 and 22. Supported by Museum, Enabel, and CEBioS.

**River bend in eastern part of the valley,** August 2023

**Post-bulldozing,** January 2026

access limitations due to the Israeli occupation regime.[224] Thereby, Palestinians are strategically prevented access to and full sovereignty over their land.

The Wadi Gaza Nature Reserve is the only nature reserve in the Gaza Strip, unilaterally designated and established by Palestine in 2000 and added to the UNESCO Tentative List in 2012.[225] It is officially administered by the Environment Quality Authority and Ministry of Agriculture of the Palestinian Authority with support from the international community, though its administration and management has been hampered by Israel's blockade of Gaza. Furthermore, it is unknown what level of governance Hamas, as the de facto government in Gaza, has exerted over the reserve.[226]

### B. Wadi Gaza as a nature reserve

The Wadi Gaza ('Valley of Gaza') reserve is a biodiversity hotspot in Gaza, hosting both native species and migratory birds that use the valley as a stopover point. Before its environmental decline, exacerbated by the 2007 Israeli blockade of Gaza, it was also a place for recreation and leisure for inhabitants.[227] Reduced water flow due to upstream damming, unregulated solid waste dumps along the riverbanks, and untreated sewage flowing from surrounding municipalities have severely polluted the ecosystem. This has created a threat to human health and the biodiversity of the area.[228] A UNDP-funded program began rehabilitating the reserve in 2022. A thorough clean-up of the riverbed and banks had nearly been completed before the October 7, 2023, attacks by Hamas and subsequent Israeli incursion into Gaza.[229]

### C. Conflict-linked environmental destruction

Over 67,000 Palestinians have been killed since Israel's latest military campaign in the Gaza Strip.[230] Widely classified as a genocide, this violence is the result of decades of oppression, dispossession, and occupation.[231] Beyond the humanitarian crisis, the latest assault has inflicted severe environmental damage: over 91% of total cropland has been damaged and most of Gaza's water, sanitation and hygiene infrastructure has been decimated.[232] Violence against the Palestinian environment has led to accusations of ecocide and has sparked remote sensing investigations to compliment those investigating the genocide.[233]

The Wadi Gaza reserve has been particularly affected, with satellite imagery from October 2023 to December 2024 showing widespread damage to the area. Due to scarce on-the-ground information from Wadi Gaza, this report relies primarily on Google Earth Pro. However, post–October 7, 2023 coverage is limited to four dates (October 14 and 30, 2023, June 4 and December 1, 2024), limiting the ability to account for seasonal variance in vegetation and damages of the past year.

*Bulldozing*

Israeli bulldozing units have destroyed much vegetation along the riverbed and have razed topsoil in agricultural areas close to the reserve. Aerial imagery shows a clear spatial and temporal consistency in this process.

*Mud bridges*

Imagery shows that by December 2024 the Israeli Defence Forces (IDF) had built at least 15 bridges made from mud and soil dumped on top of the river. This has likely increased sediment deposition, resulting in the river becoming turbid and a decline in water quality and level. The following screenshot is from the only clear footage available of how these mud bridges appear on the ground. It is unclear whether the river has been dammed in the process. The pipes on the right side of the bridge may have been placed underneath the structure, but this cannot be confirmed.

224 Palestine National Clearinghouse Mechanism: Natural Reserves in Palestine https://ps.chm-cbd.net/protected-areas/natural-reserves-palestine
225 UNESCO World Heritage Centre. (no date). 'Wadi Gaza Coastal Wetlands'. UNESCO World Heritage Centre. Accessed 10 November 2025.
226 Ibid.
227 Marta Vidal (2023). From Wasteland to Wetlands: Nature's Comeback in the Gaza Strip. Euronews, 16 April 2023.
228 Amjad Yaghi (2019). Once a Vibrant Natural Reserve, Gaza's Coastal Wetland Is Now a Health Hazard. +972 Magazine, 5 March 2019.
229 UNDP, Global Vision Consultants, HydroNova, Timesis and Norwegian Ministry of Foreign Affairs (2022). Wadi Gaza Master Plan and Photo Album: Natural Park and Greenway.
230 Al-Mughrabi, Nidal, Emma Farge, Nidal Al-Mughrabi, and Emma Farge. (2025). 'Explainer: How Many Palestinians Has Israel's Gaza Offensive Killed?' Middle East. Reuters, October 7.
231 Amnesty International (2024). Amnesty International Concludes Israel Is Committing Genocide against Palestinians in Gaza, 5 December 2024.
Alexandre Skander Galand and Wim Muller (2024). The ICJ's Findings on Plausible Genocide in Gaza and Its Implications for the International Criminal Court. Opinio Juris, 5 April 2024, .
232 World Bank, European Union and United Nations (2025). Gaza and West Bank Interim Rapid Damage and Needs Assessment, February 2025. 18 February 2025.
United Nations Environment Programme (2025). Environmental Impact of the Escalation of Conflict in the Gaza Strip: Second assessment of environmental damage and recommendations for recovery and reconstruction planning. Nairobi.
Brian Perlman et al. (2025). Public Health Implications of Satellite-Detected Widespread Damage to WASH Infrastructure in the Gaza Strip. PLOS Global Public Health 5, no. 2 (2025),.
233 Kaamil Ahmed et al. (2024). Ecocide in Gaza: Does Scale of Environmental Destruction Amount to a War Crime? Environment, The Guardian, 29 March 2024.

▲ Mud bridges built by the IDF over the Wadi Gaza. Source: screenshot from a video posted by Times of Israel, April 14, 2024

*Loss of vegetation*

Due to the extensive bulldozing in the broader central Gaza region, the nature reserve has experienced significant vegetation loss. The Normalized Standard Deviation Index (NDVI), which was calculated for the area within the reserve's borders as indicated on the map, shows increases and decreases corresponding to the wet and dry seasons, as is seen in the graph with the NDVI timeline. In 2024, however, we see much lower and continually decreasing values during the dry season, ones that are not consistent with the three previous years. On August 28th, 2020, the NDVI was calculated at an average of 0.26 over the entire reserve, whereas five years later, on July 23rd, 2025, the average was 0.15, denoting more degraded land and bare soil in the area. This pattern is mirrored in the calculated Normalized Standard Moisture Index (NDMI), which measures moisture levels in the soil. The average moisture level grows and decreases within a consistent range until the summer of 2024, when the NDMI decreases to values below zero and decreases further in 2025, suggesting that the area experiences water stress. A preliminary environmental assessment by the UNEP has warned that bulldozing and loss of vegetation and top soil capable of retaining water may lead to desertification of the area.[234]

*Destruction of the wastewater plant*

Built in 2021 and situated at the beginning of the valley, the Bureij Central Wastewater Treatment Plant processed 60,000m3 of wastewater daily, serving around one million residents across eleven communities in the Gaza Strip and pumping the treated water into Wadi Gaza to revitalize its river flow.[235] The plant has been hit multiple times since October 7, 2023, first by airstrikes and later with more targeted destruction by the IDF affecting solar panels and biogas fields, as well as by bulldozing. The treatment plant lies within the initial IDF-designated buffer zone, extending approximately 1km inward from Gaza's border, where all infrastructure and vegetation were ordered destroyed or cleared by the IDF in the first weeks after October 7th, 2023. All wastewater treatment facilities in Gaza are reportedly out of order, exacerbating the sanitation crisis.[236]

The long-term impacts of Wadi Gaza's destruction

Prior to October 2023, the UNDP's Master Plan for Wadi Gaza had begun to revitalize the reserve after decades of pollution and health hazards caused by inadequate governance under the structural blockade implemented by Israel. The extensive destruction documented above has, however, reversed all progress made by the clean-up program, exacerbating many existing issues and creating additional environmental problems

234 UNEP (2024). Environmental Impact of the Conflict in Gaza: Preliminary Assessment of Environmental Impacts. June 2024, p. 35.
235 Kreditanstalt für Wiederaufbau (2021). Long Breath Required: Wastewater Treatment Plant in Gaza Put into Operation. Relief Web, 23 March 2021.
236 Forensic Architecture (2024). Report: A Spatial Analysis of the Israeli Military's Conduct in Gaza since October 2023.

▲ Comparison of NDVI in January (wet season) 2023-2025. The darker green shades indicate dense, healthy vegetation, while lighter green and beige suggest bare soil, stressed vegetation, or degraded land; white can be interpreted as buildings and infrastructure, whether damaged or not. Source: Sentinel-2 via CopernicusBrowser.

including debris and rubble pollution, destruction of the waste water treatment plant, and widespread loss of vegetation. The predominantly urban landscape of the Gaza Strip has been completely deprived of the ecosystem services provided by protected nature, such as habitats for migrating birds and other fauna, flash flood regulation, groundwater recharge, cooling of Gaza's urban microclimate, and the filtering of water and air pollutants. The reserve's destruction will also intensify desertification and vulnerability to climate change in both the short and long term.[237] UNEP has prioritized the protection of Wadi Gaza in its relief plans,[238] but under the current fragile ceasefire, the situation is not expected to improve, given the lack of relief on other urgent priorities such as humanitarian needs, economic collapse and so on.

In conclusion, Israel's recent invasion of Gaza has left the Wadi Gaza Nature Reserve devastated, causing extensive destruction of vegetation and habitats,

237 Fred Pearce (2025). As War Halts, the Environmental Devastation in Gaza Runs Deep. Yale e360, 6 February 2025.
238 United Nations Environment Programme (2025). Environmental Impact of the Escalation of Conflict in the Gaza Strip: Second assessment of environmental damage and recommendations for recovery and reconstruction planning. p.39. Nairobi. https://wedocs.unep.org/20.500.11822/48536.

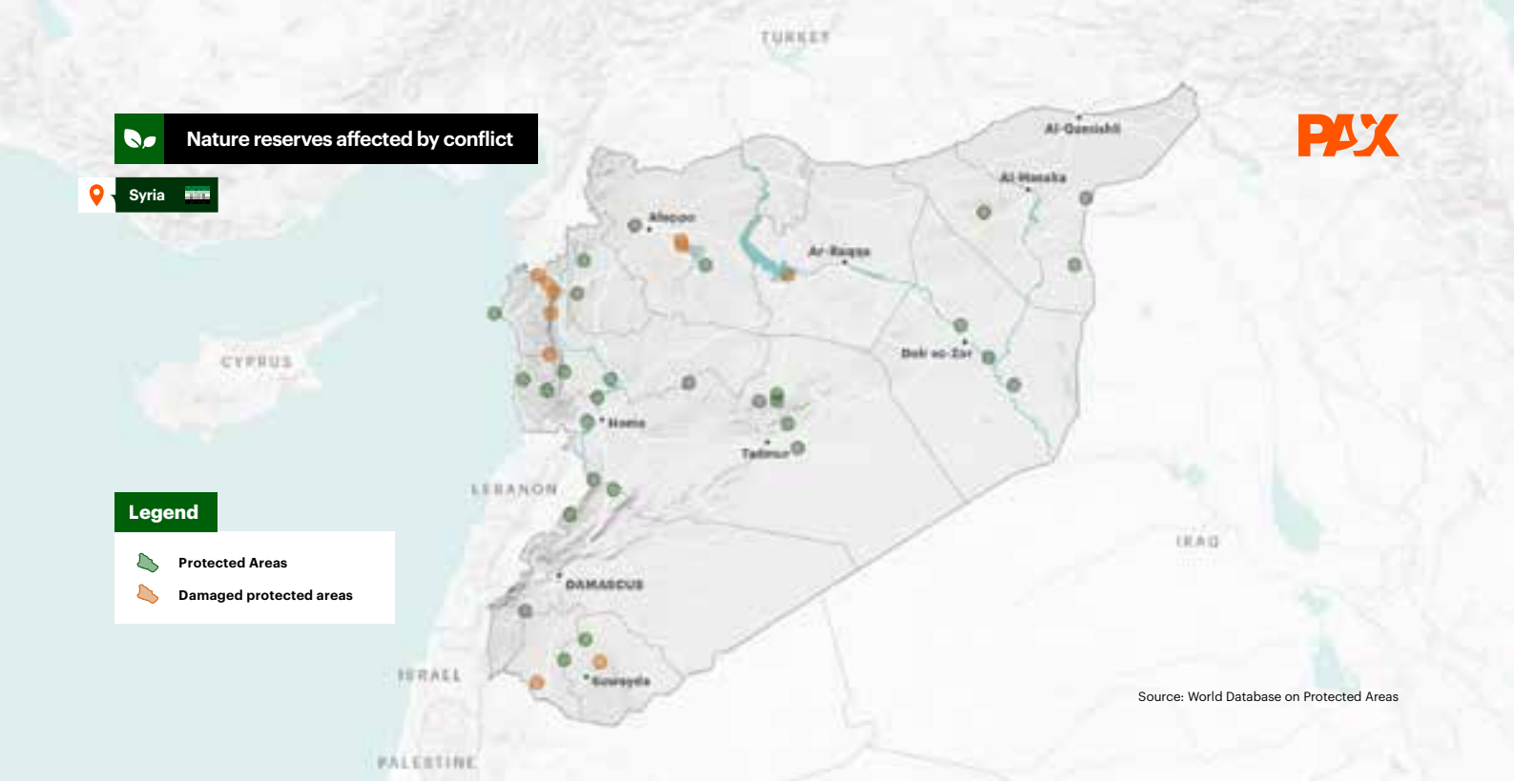
diminished water flow, and significant pollution. These effects compound and intensify longer-term challenges linked to weakened environmental governance, inadequate waste and water management infrastructure, and restricted access to funding, materials, and technical expertise under Israeli occupation.

Little bittern - *Botaurus minutus*

Palestine Sunbird - *Cinnyris osea*

Black-winged stilt - *Himantopus himantopus*

Black-winged kite - *Elanus caeruleus*




# Syria

**The war's impacts on forest and nature reserves**
*By Angham Daiyoub (CREAF239) and Simav Hasan (Syrians for Truth and Justice)*

Syria's nature conservation system has historically combined national environmental laws with customary, community-based practices. The Ministry of Local Administration and Environment, along with the Ministry of Agriculture and Agrarian Reform, oversaw forest and biodiversity protection through formal legislation. In parallel, traditional community structures regulated access to grazing lands and water resources, especially among rural and nomadic populations.[240] Syria is a signatory to the major multilateral environmental agreements for the protection of nature, such as UNESCO's World Heritage Convention (1975),[241] the UN Convention on Biological Diversity (CBD, 1995), the Ramsar Convention on Wetlands (1998),[242] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2003).

While the Syrian government submitted 33 nature reserves and protected areas in its 2016 report to the UN Convention on Biodiversity, the country has 19 designated protected sites in the World Database on Protected Areas.[243] Only two of those have undergone evaluations of management effectiveness. These assessments consistently fell within the 'basic' management range, highlighting the lack of national monitoring frameworks and action plans needed for systematic evaluation of protected area performance.[244] The country has one protected wetland registered under the Ramsar Convention, the Sabkhat al-Jabbul Nature Reserve (located 30km southeast of Aleppo city),[245] and one UNESCO biosphere reserve: Lajat, a rugged volcanic plateau in Suwayda Governorate.[246]

Threats to Syria's biodiversity predate the country's civil war but have been greatly intensified by it. Even before the war, conservation frameworks were weak, despite Syria's ratification of major international agreements. Chronic underfunding, poor enforcement,

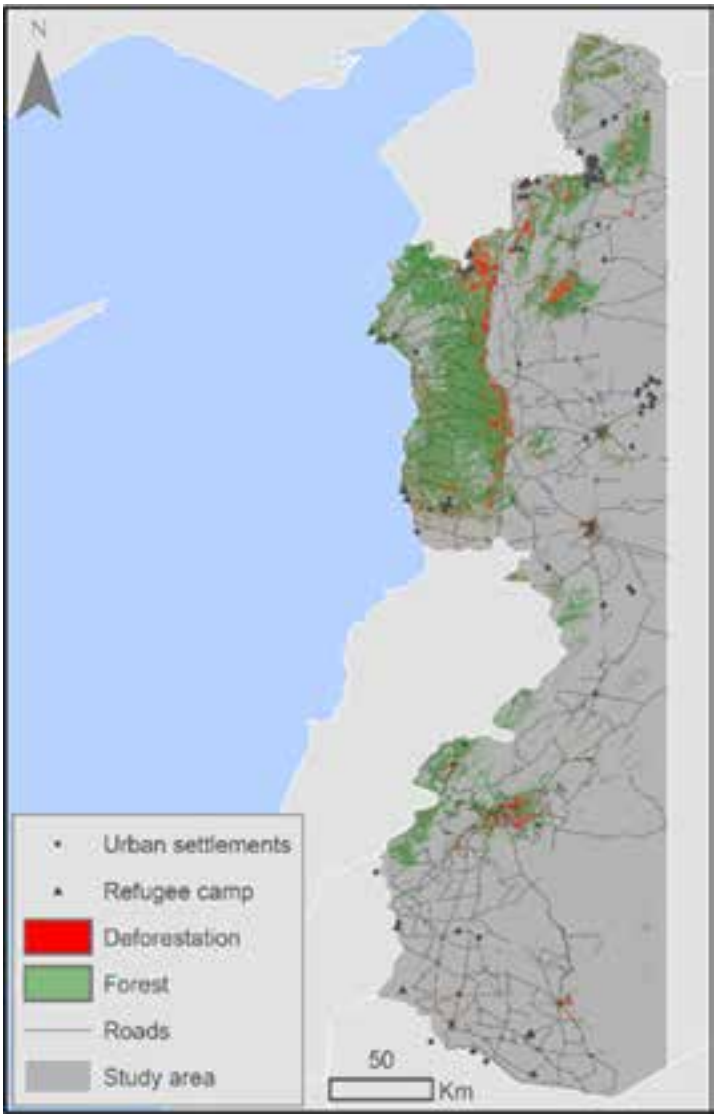
239 Centre for Ecological Research and Forestry Applications, Autónomos University of Barcelona
240 Arab Reform Initiative. The Environmental Impact of Syria's Conflict: A Preliminary Survey of Issues (2024). Available at: https://www.arab-reform.net/publication/the-environmental-impact-of-syrias-conflict-a-preliminary-survey-of-issues/
241 https://whc.unesco.org/en/statesparties/
242 https://www.ramsar.org/sites/default/files/documents/library/annotated_contracting_parties_list_e.pdf
243 IUCN and UNEP-WCMC (2025). Protected Planet: Syrian Arab Republic. The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM).
244 Anthony, B. P., Matar, D. A., Anthony, B. P., & Matar, D. A. (2012b). Protected Areas in Selected Arab Countries of the Levant Region (Syria, Lebanon & Jordan): An Evaluation of Management and Recommendations for Improvement. In Topics in Conservation Biology. IntechOpen. https://doi.org/10.5772/37579.
245 https://rsis.ramsar.org/ris/935
246 https://www.unesco.org/en/mab/lajat

and the absence of systematic monitoring left most protected areas without effective management. Before the conflict, Syria's ecosystems were under moderate pressure from rapid urbanization, recurrent droughts, and unsustainable agricultural expansion. Nonetheless, some protected areas like in Afrin remained relatively intact.

The 13-year civil war that began in 2011 had both direct and indirect consequences for protected areas. Military activities, including shelling, resulted in forest fires and burned vegetation, while indirect consequences were more widespread and long-lasting.

The war's direct impacts resulted in dramatic and wide-ranging environmental destruction. An estimated 19%[247] to 36%[248] of Syria's forests were lost during the conflict, with some regions losing up to 60% of their forest, such as Tadmur district in the Homs Governorate and districts in the Aleppo Governorate.[249] This deforestation occurred as a result of direct bombardment, fires sparked by fighting, a lack of forest management, and logging by armed groups for commercial sale and charcoal production.[250] Satellite-derived fire data demonstrates that a total of 15,240 hectares of forest cover were burned between 2010 and 2019, accounting for almost a quarter of all the forest loss seen in the study region.[251]

Indirect ecological impacts have also been significant. Widespread fuel shortages and economic collapse led to large-scale logging for firewood, seen in both protected forests and urban green spaces. Both legal and customary systems were deeply affected by the armed conflict, leading to the erosion of environmental governance across much of the country. The breakdown of Syria's environmental institutions has halted reforestation efforts, monitoring of protected areas, and law enforcement. In many regions, displaced people have settled near or within former nature reserves, increasing the demand for firewood, water, and arable land. The collapse of environmental governance has also affected biodiversity due to poaching and hunting,[252] though in some other areas the presence of unexploded ordnance may have resulted in the regeneration of flora and fauna.[253] Such unregulated pressures have accelerated the degradation of already vulnerable ecosystems.[254]




▲ War-induced deforestation in west Syria between 2010 and 2019. Source: Daiyoub at al. 2023 based on PALSAR and PALSAR2 radar-based satellite imagery. [256]

247 CREAF (2023). The war in Syria has wiped out 19% of the country's forests.
248 PAX. Axed and Burned: How conflict-caused deforestation impacts environmental, socio-economic and climate resilience in Syria (2023) Available at https://paxforpeace.nl/publications/axed-burned/ CREAF. The war in Syria has wiped out 19% of the country's forests (2023). Available at: https://www.creaf.cat/en/articles/war-syria-has-wiped-out-19-countrys-forests-equivalent-entire-metropolitan-area-barcelona
249 PAX. Axed and Burned: How conflict-caused deforestation impacts environmental, socio-economic and climate resilience in Syria (2023) Available at https://paxforpeace.nl/publications/axed-burned/ CREAF. The war in Syria has wiped out 19% of the country's forests (2023). Available at: https://www.creaf.cat/en/articles/war-syria-has-wiped-out-19-countrys-forests-equivalent-entire-metropolitan-area-barcelona
250 AFED Magazine. The War on Syria's Forests (2021). Available at: https://afedmag.com/web/ala3dadAlSabiaSections-details.aspx?id=1999&issue=&type=4&-cat=
251 Daiyoub A, Gelabert P, Saura-Mas S, and Vega-Garcia C (2023). War and Deforestation: Using Remote Sensing and Machine Learning to Identify the War-Induced Deforestation in Syria 2010–2019. Land. 2023; 12(8):1509.
252 OSME: Conservation is Syria is thriving. Available at (2021) https://osme.org/2021/02/conservation-is-syria-is-thriving/
253 Syria Direct: Syria's nature lovers lament ecological losses after a decade of war (2021) Available at https://syriadirect.org/syrias-nature-lovers-lament-ecological-losses-after-a-decade-of-war/
254 Global Protection Cluster. Protection Landscape in Syria (2025). Available at: https://globalprotectioncluster.org/sites/default/files/2025-04/250325_protection_landscape_in_syria_vfinal.pdf

### A. Sabkhat al-Jabbul: Ramsar wetland in Aleppo Governorate

The Sabkhat al-Jabbul wetland is a protected nature reserve under the Ramsar Convention.[255] During the decades before the Syrian revolution in 2011, the development of dykes and irrigation infrastructure modified the wetland from a seasonal saline lake (sabkhat) surrounded by semi-arid steppe into three separate water bodies composing a complex saline to brackish wetland ecosystem.[256] The wetland is an essential habitat as a stopover and wintering location for water birds, including unique species such as the greater flamingo, the lesser and great white-fronted goose, the ruddy shelduck, and the common crane.[257] [258] Despite this, the wetland has faced pollution, loss of vegetation due to overgrazing and fires, and water shortages.[259]

Analysis of satellite imagery from 2008 to 2020 estimated that farmland in the area surrounding the wetland declined sharply: while irrigated farmland covered 14.6% of the area in 2008, it fell to 8.7% in 2020, as non-irrigated farmland dropped from 37.2% to 28.1%. In contrast, bare soil expanded dramatically, rising from 21% in 2008 to 39% in 2020. Multiple salinity indices also showed that saline soils increased over time. Overall, the landscape shifted from productive farmland to increasingly degraded, bare, and saline land.[260] PAX could not find any information on the ecological status of the wetland throughout the civil war. Despite the devastation of war, Sabkhat al-Jabbul Nature Reserve has joined the Mediterranean Ramsar Site Managers Network in 2021, signaling hope and commitment to restoring its wetlands and collaborating internationally with other regional managers to improve conservation efforts.

A further point requiring careful consideration is that Sabkhat al-Jabbul's salt flats have been used for artisanal and industrial salt extraction. Among other uses, the reserve's rock salt is thought to have been used in the 'salt rooms' of Sednaya, the Assad regime's most notorious prison. In the absence of refrigerated morgues, the salt rooms were used as primitive mortuaries for the corpses of deceased inmates to "preserve the bodies, contain the stench … and protect the guards and prison staff from bacteria and infections."[261]

### B. Jabal Abdul Aziz Mountains Protected Area in Hasakah Governorate

Jabal Abdul Aziz is an semi-arid mountain ecosystem isolated in the Syrian Desert stretching roughly 50km across northeastern Syria, characterized by rocky slopes, sparse shrubby vegetation, and steppe grasslands (85% of the land cover)[262] with very limited agricultural potential aside from nomadic pastoralism. It supports rare and vulnerable species such as the Egyptian vulture and the marbled polecat, classified respectively as 'endangered' and 'vulnerable' according to the IUCN Red List.[263] Declared a protected area in 1994, it was managed through a centralized, top-down approach that appropriated communal lands for afforestation (already since 1987), restricted pastoral access, and placed newly planted forests under strict ranger control.[264] Despite intentions to re-green the region, the lack of community consultation and compensation, as well as the exclusion of local people from decision-making and job opportunities has created long-standing tensions.[265]

Before Syria's civil uprising in 2011, the area was struggling with extreme poverty, weak pastoral livelihoods, and mounting environmental stress. Families were further pushed into extreme poverty by the banning of wells and irrigation and restrictions on grazing inside the protected area - policies intended to curb land degradation - in combination with fragmented

255 Ramsar Sites Information Service (1998). Sabkhat al-Jabbul Nature Reserve.
256 Gianluca Serra, David Murdoch, Francis Turkelboom, François Travert, Yaseen Mujawer, Derek Scott (2006). Sabkhat al-Jabbul, a Threatened Ramsar Wetland in Syria. Sandgrouse, 28 (2), 127-141.
257 Gianluca Serra, David Murdoch, Francis Turkelboom, François Travert, Yaseen Mujawer, Derek Scott (2006). Sabkhat al-Jabbul, a Threatened Ramsar Wetland in Syria. Sandgrouse, 28 (2), 127-141.
258 Ayek, A., Zerouali, B., Ioho, m., Bailek, N., Santos, C., Eid, S., & Karmoka, S. (2025). Evaluating the impact of digital number to surface reflectance conversion on the accuracy of NDVI and NDWI: A case study of Sabkhat Al-Jabbul, Syria. DYSONA-Applied Science, 6(2), 452-464.
259 UNESCWA, Climate Change Impact on Biodiversity of a Land Under Conflict, at Multi-stakeholder Platform for Protecting Biodiversity (2023) Available at https://www.unescwa.org/sites/default/files/event/materials/3.3%20CC-Impact-on-BD-of-a-Land-under-Conflict_Mwaffak%20Chikhali_ELARD.pdf https://syriadirect.org/syrias-nature-lovers-lament-ecological-losses-after-a-decade-of-war/
260 AlHajjar, M. F. (2022). Assessment of the Impact of the Syrian Conflict on the Extent and Quality of Agricultural Land in the Sabkhat al-Jabbul Area. Master's thesis at Ryerson University, Toronto, Canada.
261 https://www.aljazeera.com/news/2022/9/15/syrian-ex-prisoners-haunted-by-horrors-of-salt-rooms
262 Key Biodiversity Areas Partnership (2025) Key Biodiversity Areas factsheet: Jabal Abdul Aziz. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, American Bird Conservancy, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Re:wild, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society.
263 ibid.
264 Géraldine Chatelard (2009). Jebel Abdel Aziz Protected Area, Syria. Socioeconomic situation. Unpublished text.
265 Schwarstein, P. (2021). A Recipe for Perpetual Insecurity? The Case of a Syrian Protected Area. Center for Climate & Security Council on Strategic Risks.

land ownership and the development of irrigated agriculture in the plains where their herds were no longer welcome.[266] Locals felt marginalized by state policies that eroded traditional land use, weakened their economy, and excluded them from the benefits of the protected area, contributing to frustration, insecurity, and deteriorating social conditions that helped set the stage for later unrest.[267]

Following the outbreak of the civil war in 2011, the situation has further worsened: access to pasture and markets has been disrupted, poverty has deepened, and social cohesion has frayed, leading to rising crime, out-migration, declining school attendance, and many local men joining various armed groups. Deforestation surged in the early years of the civil war, losing over 70,000 trees over 2013-2014, according to a local NGO.[268] Satellite imagery analysis and ground truthing shows little forest has been lost post 2014, however.[269] A small sign of hope has emerged in the community's growing willingness to protect the remaining forest cover, now valued as a critical resource, suggesting that more inclusive, locally grounded management could help stabilize both the ecosystem and the society that depends on it.

### C. Deforestation in Afrin and Azaz districts, Aleppo Governorate

Northwest Syria, more specifically the Afrin and Azaz districts in Aleppo Governorate, was known for its rich forests and ancient olive groves, which formed the economic backbone of local Kurdish communities. Both ecosystems supported livelihoods while also delivering vital ecosystem services, such as water regulation, carbon storage, and cultural values rooted in historical continuity and traditional land use.[270] Deforestation in the region has been especially severe following Turkey's 2018 military incursion. Local reports indicate that forests were deliberately cleared for economic exploitation and political control, affecting biodiversity, forest cover, and community livelihoods.[271] The consequences for local communities have been profound. In Afrin, the destruction of olive groves has devastated incomes and disrupted the agrarian economy.[272]

### D. Tabqa Nature Reserve in Raqqa Governorate

In Raqqa Governorate, the Tabqa Nature Reserve (also known as the al-Thawra Nature Reserve or the Ayed Reserve) is a forest reserve situated on an artificial island in Lake al-Assad, which was formed in 1974 as an irrigation reservoir behind the Tabqa Dam on the Euphrates River. The Tabqa Nature Reserve has faced severe logging during the civil war. The designated protected area is home to several unique tree species, birds and wildlife, and was popular among local communities and tourism as a green space. Since the occupation by the Islamic State and the subsequent liberation in 2017, individuals and groups have moved in to cut down the trees, while the governance vacuum has allowed for unhindered access. Since then, satellite imagery shows that most of the island's trees have been

266 Géraldine Chatelard (2009). Jebel Abdel Aziz Protected Area, Syria. Socioeconomic situation. Unpublished text.
267 Schwarstein, P. (2021). A Recipe for Perpetual Insecurity? The Case of a Syrian Protected Area. Center for Climate & Security Council on Strategic Risks.
268 Ibid.
269 By Wim Zwijnenburg, PAX.
270 Arab Reform Initiative (2024). The Environmental Impact of Syria's Conflict: A Preliminary Survey of Issues.
271 Untold Magazine (2023). Syria's Forests Are Vanishing.
272 Syrians for Truth and Justice (2025). Olive Levies in Afrin: "There Is No Law Protecting Farmers; What Prevails Is Jungle Law".

cleared, leaving it dry and desolate, with desertification continuing to degrade the region's ecosystems.[273]

### E. Al-Frounloq Protected Area in Latakia

Al-Frounloq Protected Area in Latakia became a battleground between the Assad regime and opposition forces during the Syrian conflict. An exclusive video report[274] published by Al Jazeera in 2013 shows an opposition fighter describing how they were targeted by regime barrel bombs and airstrikes while hiding in the dense forests of the reserve. He referred to the "scorched land" strategy employed by the Assad regime against opposition-held areas, which resulted in widespread forest fires within the protected zone. Al Jazeera also noted that some opposition fighters stationed in the area resorted to hunting deer whenever they had access to them. The footage further documented extensive damage to the reserve's infrastructure, including the main entrance and visitor center.[275]

After the Syrian civil war ended in 2024, the protected area suffered from devastating wildfires once again. Remnants of the armed conflict, such as unexploded ordnance and landmines, made firefighting efforts extremely difficult and dangerous, as emergency services were unable to safely reach the burning areas. These conditions greatly worsened the destruction of the forest ecosystem.[276]

Forest fires that occurred in 2025 affected the protected area, with some zones remaining inaccessible to forest fighters due to the presence of unexploded ordnance, 6 July 2025. Source: Syrian Civil Defense through Enab Baladi.

### F. Cedar and Fir Protected Area in Latakia

The Cedar and Fir Protected Area also experienced impacts of the armed conflict. This protected area is home to one of the last and largest remaining natural stands of Lebanese cedar (Cedrus libani) in Syria, including old-growth trees that are several centuries old. It supports exceptional biodiversity, providing habitat for numerous rare, endemic, and threatened species.

During the armed conflict, the area lost its conservation and management capacity as all protection activities were suspended.[277] In 2015, it came under the control of pro-government forces and was used as a military base. Although enforcement within the protected area had been weak even before the war, the situation deteriorated significantly afterward. A range of illegal and environmentally destructive activities resumed, including uncontrolled grazing, illegal logging, looting and vandalism of infrastructure, poaching, and habitat degradation associated with military operations.[278] Additional pressures, such as the illicit collection of plants and the establishment of fire pits, further accelerated the decline of this ecologically important site.[279]

273 Suleiman, D. Illegal logging turns Syria's forests into 'barren land (2023) Available at https://www.arabnews.com/node/2358456/middle-east
274 Al Jazeera Arabic (2013). Environmental disaster threatens the Al-Farnalaq reserve in Latakia. Original title: كارثة بيئية تهدد محمية الفرنلق في اللاذقية
275 ibid.
276 Enab Baladi (2025). The fires in Latakia reach the forests of "Al-Farnalaq". Original title: "حرائق اللاذقية تصل غابات الفرنلق"
277 Angham Daiyoub (forthcoming). Doctoral dissertation.
278 Angham Daiyoub (forthcoming). Doctoral dissertation.
279 Angham Daiyoub (forthcoming). Doctoral dissertation.

Marbled polecat - Vormela peregusna

Bald ibis - *Geronticus eremita*

Greater White-fronted goose - *Anser albifrons*

Lesser flamingo- Phoeniconaias minor

## G. Threatened species, armed conflict and extinction risk

Threatened and endemic species in Syria have been particularly vulnerable to the direct and indirect impacts of the armed conflict. Although species protection was already limited before the conflict, the armed conflict has intensified extinction risks by severely weakening conservation institutions and governance. The breakdown of law enforcement, the suspension of protection measures, and the halt of conservation funding have all contributed to the rapid deterioration of biodiversity.

One of the drivers of wildlife decline has been the widespread proliferation of arms, which became easily accessible and have been frequently used for illegal hunting. For example, the critically endangered Arabian sand gazelle (Gazella marica), formerly extinct in Syria and globally categorized as vulnerable on the IUCN red list, had been successfully reintroduced through a government program with individuals transferred from Saudi Arabia. However, following the outbreak of the armed conflict, these recovering populations were decimated by armed groups engaging in mass killings.[280]

Another example is the rise in the illegal capture and trade of rare falcons in eastern Syria. Species such as the saker falcon (Falco cherrug) became highly sought after in illicit markets. The sharp increase in trapping was fueled by widespread poverty and economic collapse, which pushed many individuals to engage in this activity as a means of survival during the war.[281] Other threatened species have also been targeted or traded illegally, including the northern lapwing (Vanellus vanellus), striped hyena (Hyaena hyaena syriaca), and Levantine tortoise (Testudo graeca terrestris).[282]

## H. Post-conflict opportunities

Despite these challenges, the post-conflict context presents opportunities for environmental peacebuilding. A 2025 report by the Arab Reform Initiative argues that protected areas in Syria have been widely neglected during the war, but this void creates a space for community-driven environmental management.[283] The report highlights participatory models involving local farmers, women's groups, and community councils, suggesting these groups could effectively manage restoration and conservation efforts in the absence of a strong state. By integrating ecological restoration with conflict-sensitive governance, these approaches could address both environmental and social vulnerabilities.[284] In conclusion, there are clear indications that Syrian protected areas have been devastated by the indirect and direct impacts of more than a decade of civil war, from scorched earth tactics to the coping mechanisms of local communities. Yet the Syrian case remains poorly studied with rather anecdotal evidence. Furthermore, the lack of environmental governance leads to a lack of clarity about the actual designation of various nature areas as officially protected and the applicable

280 Global Atlas of Environmental Justice (2023). The Mass Killing of the Arabian Sand Gazelle in As-Suwayda, Syria.
281 Global Atlas of Environmental Justice (2023). Illegal Falcon Trade in Syria.
282 Aidek, A., and Eid, E. (2025). Exploring the Animal Market on Facebook: A Case Study of the Syrian Wildlife Trade. Sustainability and Biodiversity Conservation, 4(1), 1–21.
283 Arab Reform Initiative (2025). Participatory Approaches to Conflict, Climate Change and Environment: Case Studies from the Middle East and North Africa.
284 Ibid

management and legal frameworks. For example, there are no monitoring or management reports available about the Lajat Man and Biosphere Reserve, designated by UNESCO in 2009, while the authors of the report received messages about repeated bombardments by the previous Syrian regime and land abandonment due to displacement and military occupation. At this moment of political transition, while violence and displacement continue with their consequent risks for protected areas, robust environmental monitoring of Syria's protected areas is urgently needed to prevent further degradation and to support an equitable and green recovery, with resilient ecosystems and communities in the face of post-war grievances and climate change challenges.

# Ukraine

**Chornomorskyi (Black Sea) Biosphere Reserve**
*By Anna Hatzius Sarramona (Utrecht University) & Georgina Hekkelman (Utrecht University)*

This case study examines environmental protection and damage in the Chornomorskyi Biosphere Reserve (Black Sea UNESCO Biosphere Reserve), comprised of Tendrivska Bay and Yagorlytska Bay on the occupied northern coasts of the Black Sea at the mouth of the Dnipro River Delta.[285] It considers the (inter-)national legal frameworks governing environmental protection, and discusses environmental destruction since the full-scale Russian invasion in February 2022 through a small-scale open-source investigation.

## A. Nature conservation in Ukraine

Ukraine is home to a diverse array of protected ecosystems, including grasslands, steppes, forests, semi-deserts, spits and dunes, rivers, lakes, and marine ecosystems.[286] These sites are protected by various national and international nature conservation frameworks. The most important protection frameworks are the Law of the Nature Fund of Ukraine,[287] UNESCO's Convention Concerning the Protection of the World Cultural and Natural Heritage,[288] the Emerald Network,[289] and the Ramsar Convention.[290] Some sites are protected by more than one of these frameworks.

The Law on the Nature Fund of Ukraine designates the outline of the Protected Areas, which are classified into different conservation categories established by the IUCN. These include nature reserves (IUCN cat. Ia), biosphere reserves (IUCN cat. II), national nature parks (IUCN cat. II), regional landscape parks (IUCN cat. V) along with other smaller protected sites.[291] Many of Ukraine's nationally designated protected areas also coincide with the UNESCO Man and Biosphere (MAB) Reserves, of which the country has eight.[292] Additionally, Ukraine is part of other international conservation

285 https://www.unesco.org/en/mab/chernomorskiy
https://rsis.ramsar.org/ris/116
https://rsis.ramsar.org/ris/768?__goaway_challenge=meta-refresh&__goaway_id=932d910083ff52ad00b76af0b8d2521f
286 Convention on Biological Diversity, "Sixth National Report of Ukraine on the Implementation of the Convention on Biological Diversity" (2018) 114 [English Version].
287 Legislation of Ukraine (2004). The Law of Ukraine: On Nature Reserve Fund of Ukraine. Entry into force on July 25, 1992. Original title: Про природно-заповідний фонд України.
288 UNESCO (2025). Ukraine: Conventions ratified. Visited on 28 October 2025.
289 Council of Europe (1982). Convention on the Conservation of European Wildlife and Natural Habitats (ETS No. 104).
290 Ramsar (2025). The Convention on Wetland: Ukraine Country Profile.
291 Law No. 2456-XII on natural reserves (16 June 1992). Available online.
292 UNESCO, Man and Biosphere Programme (MAB) https://www.unesco.org/en/mab

networks based on multilateral environmental treaties, with 50 Ramsar-protected wetlands and 271 sites within the Emerald Network, a pan-European ecological network aimed at conserving wild species and their habitats established under the Bern Convention on the Conservation of European Wildlife and Natural Habitats.[293]

### B. The Black Sea Biosphere Reserve

The Black Sea (Chornomorskyi) Biosphere Reserve is an area located along Ukraine's Black Sea coast. Its ecological importance is widely recognized by a number of conservation frameworks. The Reserve was established in 1984 and is one of Ukraine's eight MAB Biosphere Reserves. Yagorlytska Bay and Tendrivska Bay, which form part of the reserve, are Ramsar protected wetlands. Besides the two bays, the reserve encompasses diverse ecosystems, including coastal lakes, estuaries, wetlands, dunes, and forests, serving as vital habitats for numerous endemic species of flora and fauna.[294] More than 50% of the species found in the reserve are protected by the Bern convention.[295] The reserve comprises more than 80,000 hectares of terrestrial area and over 90,000 hectares of marine area.[296] Key habitats include Europe's largest field of wild orchids and the IUCN red-listed sandy blind mole-rat,[297] a species found exclusively within the reserve.[298]

Managed by the National Academy of Sciences of Ukraine, the Black Sea Biosphere Reserve was a hub for environmental research and education with an environmental education center that exhibits and serves as a learning base for schools and NGOs.[299] The local population depends on the reserve for growing fruits, vegetables and grain, for profits from sustainable tourism and for access to clean drinking water.[300] Even though some agricultural practices, tourism and illegal activities such as landfilling have had adverse ecological effects, the reserve was reported before 2022 to encompass healthy ecosystems and to serve as a vital nesting place for endangered birds, such as bustards, Pallas's gull, and the white-tailed eagle.[301] The reserve is considered by UNESCO MAB program a "place of preservation of many rare and protected species of plants and animals."[302]

It is worth noting that the reserve has occasionally been used as an area for military weapons testing by the Ukrainian military prior to 2022. In 2018, the Ukrainian Nature Conservation Group submitted complaints about such activity to the Council of Europe due to adverse effects on the protected area.[303] Nevertheless, the Ukrainian government decided, albeit with more safeguards, to continue the testing.[304] While these practices are likely to have left their mark on the reserve, they are not connected to any damage to the reserve since its occupation by the Russian military in 2022.

### C. Russian hostilities around the Black Sea Biosphere Reserve

Since the beginning of the full-scale Russian invasion of Ukraine in February 2022, the Black Sea Biosphere Reserve has been under Russian military occupation.[305] The area holds a key tactical position between Crimea and Ukraine's mainland, with the Dnipro River as a strategic barrier.[306] Since February 2022, the reserve has experienced extensive shelling.[307], [308]

293 The Ramsar Convention on Wetlands. Ukraine. https://www.ramsar.org/country-profile/ukraine; Council of Europe. The Emerald Network of Areas of Special Conservation Interest. https://www.coe.int/en/web/bern-convention/emerald-network
294 Simonov (2023). A million wild orchids and a bird sanctuary. What war is doing to the Kinburn Spit. Pravda
295 UNESCO, Man and the Biosphere (MAB) Programme. Chernomorskiy. https://www.unesco.org/en/mab/chernomorskiy
296 Ibid.
297 Rusin, M. (2024). "Spalax arenarius". IUCN Red List of Threatened Species. 2024 e.T20428A270136276. doi:10.2305/IUCN.UK.2024-2.RLTS.T20428A270136276.en. Retrieved 30 September 2025.
298 https://discover.ua/en/locations/the-kinburnska-kosa
299 WowNature 'The Black Sea Biosphere Reserve' https://wownature.in.ua/oberihaymo/biosferni-rezervaty-v-ukraini/chornomorskyy-biosfernyy-rezervat; https://www.unesco.org/en/mab/chernomorskiy
300 'BLACK SEA COASTAL WETLANDS IN UKRAINE Danube and Black Sea Biosphere Reserve. Waste Types and Quantities. Current State Analysis.' Report by NGO Agricola https://blacksea-cbc.net/wp-content/uploads/2021/02/BSB142_BioLearn_-Danube-and-Black-Sea-Biosphere-Reserve-from-Ukraine-Current-State-Analysis-of-Waste-types-and-quantities-_EN.pdf
301 Discover Ukraine, 'Black Sea Biosphere Reserve' https://discover.ua/en/en/locations/chernomorskiy-biosfernyy-zapovednik
302 UNESCO, Man and the Biosphere Programme (MAB), Chernomorskiy https://www.unesco.org/en/mab/chernomorskiy
303 Council of Europe (CoE), Bern Convention, 'Presumed threat to Emerald site "Black Sea Biosphere Reserve" (UA0000017) from military trainings' https://www.coe.int/en/web/bern-convention/-/presumed-threat-to-emerald-site-black-sea-biosphere-reserve-ua0000017-from-military-trainings
304 Ibid.
305 Institute for the Study of War, 'Interactive Time-lapse: Russia's War in Ukraine' (19.08.2022) https://storymaps.arcgis.com/stories/733fe90805894bfc8562d-90b106aa895
306 Simonov (2023). A million wild orchids and a bird sanctuary. What war is doing to the Kinburn Spit. Pravda.
307 Ibid.
308 Rubryka, Conservationists in captivity and "titans" of deciphering: how the Black Sea Biosphere Reserve lives during the war, 17 January 2024, https://rubryka.com/en/article/chornomorskyj-biosfernyj-rezervat/,

Fire at the Black Sea Biosphere Reserve, screenshot from video uploaded on Facebook on May 8, 2022

### D. Evidence of environmental destruction

The armed conflict and Russian occupation of the national park, specifically areas such as the Kinburn Spit, have devastated local ecosystems and wildlife, with frequent fires occurring in the region since February 2022, according to Ukrainian media reports.[309] The cause of the fires has been reported by Ukrainian media and international NGOs to be shelling.[310] Ukrainian media have also reported multiple instances where the local population was prevented from extinguishing the fires by the occupying Russian forces.[311] Ukrainian military actions aimed at regaining control of the area, including the destruction of Russian armoured vehicles and the targeting of Russian fortifications on the Kinburn Spit,[312] have added another layer of complexity to ongoing environmental degradation.

The environmental consequences of these events have been dire, as the fires destroy wildlife habitats and contribute to broader ecological degradation. The World Wildlife Fund (WWF) reported increased mortality rates among local animals and a decline in the number of nesting birds.[313] Additionally, the fires have released enormous quantities of CO2 into the atmosphere from otherwise stable carbon stocks.[314]

309 Nikvesti, '60% of the land has burned on the Kinburn spit' (10.06.2024) https://nikvesti.com/en/news/incidents/60-percent-land-burned-kinburn-spit; Ukrainska Pravda, 'Russians turn Ukraine's Kinburn Spit into combat zone: fires destroy natural reserve' (19.09.2024) https://www.pravda.com.ua/eng/news/2024/09/19/7475821/; NikVesti, 'More than 9.7 thousand hectares of valuable land have been affected by fires on the Kinburn Spit' (13.03.2025) https://nikvesti.com/en/news/public/302522-kinburn-spit-land-fires-2024.

310 Radio Svoboda, Massive shelling of Ochakov from the Kinburn Spit: which of the Russian military destroys the city?, February 1 2023, https://www.radiosvoboda.org/a/skhemy-ochakiv-kinburnska-kosa/32236175.html; WWF, "The future of protected areas in Ukraine: Discussion paper on protected areas recovery and reform" (2024) Available online.

311 Nikvesti, On the verge of destruction: How the protected Kinburn Spit suffers from the actions of the occupiers 18 October 18 2022, https://nikvesti.com/amp/articles/257682

312 Facebook, uploaded on 9 august 2024 https://www.facebook.com/DefenceIntelligenceofUkraine/videos/1920207315117374/

313 WWF, "The future of protected areas in Ukraine: Discussion paper on protected areas recovery and reform" (2024) p. 14. Available online.

314 Nikvesti, "Fires on the Kinburn Spit released 5.5 million tonnes of pollutants into the atmosphere," 15 January 2025, https://nikvesti.com/en/amp/news/incidents/300054-fires-kinburn-spit-pollutants-atmosphere-5-5-million-tonnes

According to figures released by the Mykolaiv Regional Prosecutor's Office, the total area affected by fires within the Kinburn Spit comprised 7,589.4 ha as of January 2025.[315] Ukraine's administration of the national park also published a map of the reserve with areas that were destroyed through fires caused by Russian aggression.[316] PAX has identified three instances of fires based on multiple sources which highly likely resulted from the military attacks. Each of these instances is supported by three independent sources: satellite imagery (Sentinel-II through EO Browser and Copernicus Browser), NASA FIRMS data and photographs or videos found on social media.

On May 9, 2022, satellite imagery recorded two large-scale fires in the eastern part of the Black Sea Biosphere Reserve, an area that falls inside the Kherson Oblast. As reported by residents and local news outlets, the fires had been burning for a few days, while firefighters could not reach the fires because of the Russian occupation.[317] A video uploaded to YouTube on May 8, 2022, claims to show fires from the previous day.[318] NASA FIRMS imagery confirms this and shows an area of at least 35 km2 burned between 7 and 9 May. Yet, the exact cause of the fires could not be identified.

A video posted on YouTube on 2 August 2022 shows a large-scale fire which it claims occurred on Kinburn Spit, part of the protected Kinburn peninsula in the west of the Black Sea Biosphere Reserve, located between the Dnipro-Buh estuary and the Black Sea.[319] Satellite imagery confirmed the location of the fire (46°31'09"N 31°46'33"E).

The date of the fire can be determined by means of satellite imagery. The fire occurred between July 28, 2022, when the forest was still visibly green, and August 2, 2022, the date when the video was uploaded. FIRMS Imagery records fires in the area on July 30, 2022, affecting an area of at least 6 km2 of forest. The Eyes on Russia team of the Center for Information Resilience verified shelling to have caused fires in the area on July 30.[320]

A video posted on Facebook on August 9, 2024, by the Defence Intelligence of Ukraine demonstrates Ukrainian special forces arriving on the Kinburn Spit and attacking Russian positions with drones, including ammunition depots. This attack resulted in fires in the surrounding areas.[321] The video shows the placement of the Ukrainian flag on the Suvorov monument, as identified by Ukrainska Pravda media outlet.[322] The position of the Suvorov monument (46.52531235395222, 31.58462289014366) indicates that the attack occurred on the northwest coast of the spit.

In conclusion, this case exemplifies the severe consequences of armed conflict for protected nature, where hostilities between the occupying and defending forces resulted in extensive collateral damage to a protected area. The destruction of habitat for endemic species underscores the scale of ecological loss. Moreover, the deliberate obstruction of firefighters' efforts to contain the damage highlights the compounded harm caused not only by direct military action but also by the denial of mitigation measures.

315 EcoPolitics, 300 billion hryvnias estimated damage to the Kinburn spit from fires during the war | EcoPolitics, 13 January 2025
316 'Monitoring of fires as a result of hostilities' https://www.arcgis.com/home/webmap/viewer.html?webmap=7cd4f4d4aa7e49118ccce9878d5c63a3&extent=31.5409,46.439,31.9,46.5674
317 Nikvesti, "A forest has been burning on the Kinburn Spit for more than a week - the fire will not be extinguished until it is successful" 8 May 2022 https://nikvesti.com/news/incidents/247718
318 Facebook, uploaded on 8 May 2022 https://www.facebook.com/100069258751760/videos/720018519229717/?ref=embed_video&t=16
319 Youtube, "Пожар в лесу на Кинбурнской косе, Херсонская область Fire in the forest on the Kinburn Spit" uploaded on 2 August 2022 https://www.youtube.com/watch?v=PcPTTrxCtjo
320 Bellingcat, 'A New Tool Shows What War Has Done to Ukraine's Forests' (18.08.2022) https://www.bellingcat.com/resources/2023/08/18/a-new-tool-shows-what-war-has-done-to-ukraines-forests/ and Eyes on Russia (2022). Entry UW11353: Forest fire near Vasylivka caused by shelling visible from satellite imagery. Centre for Information Resilience, C4ADS.
321 Facebook, uploaded on 9 August 2024 https://www.facebook.com/DefenceIntelligenceofUkraine/videos/1920207315117374/
322 Ukrainska Pravda, Ukrainian intelligence soldiers land on Russia-occupied Kinburn Spit - video https://www.pravda.com.ua/eng/news/2024/08/9/7469717/

Great bustard – *Otis tarda*

Bottlenose dolphin - *Tursiops truncatus*

*Otis tarda*

# Yemen

**Utmah Reserve and Aden Wetlands**
*By Maram Al-Nabhani (Sana'a University) and Maha Al-Salehi (Holm Akhdar for Environmental Studies & Consultancy)*

Yemen's nature reserves, once vital sanctuaries for biodiversity and sources of livelihoods for local communities, have suffered greatly under the pressures of conflict, weak environmental governance, institutional fragility, and escalating human pressures. In the absence of effective governance, protected areas have been greatly damaged, including the loss of vegetation cover and the erosion of their ecological integrity and social value. This section provides an overview of Yemen's conservation framework and highlights the damage to two key protected areas: the Utmah Reserve in Dhamar Governorate and the Wetlands Protected Areas in Aden Governorate.

## A. Protected areas in Yemen

Yemen's geographic location and topographical diversity have shaped a wide range of ecosystems and a high degree of biodiversity with national, economic, environmental, and international significance. Over 3,000 plant species have been recorded in the country, 15% of which are endemic.[323] The country's ecosystems also host numerous terrestrial and marine species, being among 57 globally recognized sites for endemic and migratory birds.[324]

As of November 2025, only six sites have been officially designated as protected areas in Yemen:[325]

- Utmah Reserve (terrestrial): pastures, forests, rare plants, animals, and birds; Dhamar Governorate, designated in June 1999.
- Socotra Archipelago (terrestrial & marine): unique flora and fauna, globally significant biodiversity hotspot; Socotra Governorate, designated in September 2000.
    - This protected area includes the Firmihin Reserve (Socotra National Park), a forest and the main habitat of the dragon trees, declared a protected area by the Yemeni government on October 9, 2021.[326]
- Hawf Reserve (terrestrial): seasonal tropical plants and diverse wildlife, including rare birds and mammals; al-Mahra Governorate, designated in August 2005. This protected area was recently added to UNESCO's Tentative List for World Heritage, submitted in July 2025.[327]
- Bara'a Forest (terrestrial): seasonal forests with rare and endemic plants; key site for terrestrial biodiversity; al-Hudayda Governorate, designated in January 2006.
- Wetlands in Aden (Caltex - al-Heswah Reserve,

323 UNDP and the Ministry of Water and Environment of the Republic of Yemen (2013). Protected areas in Yemen. Sustainable Natural Resource Management Project (Phase II). Original title: الهيئة العامة لحماية البيئة وصندوق الأمم المتحدة الإنمائي.
324 Ibid.
325 UNDP and the Ministry of Water and Environment of the Republic of Yemen (2013). Protected areas in Yemen. Sustainable Natural Resource Management Project (Phase II). Original title: الهيئة العامة لحماية البيئة وصندوق الأمم المتحدة الإنمائي.
326 Abdelghani Al Hadidi. (2021) Firmihin Reserve: Dragon's Blood Forest, Holm Akhdar. Yemen. URL: https://holmakhdar.org/nature_reserves/4761/
327 Barran Press (2025). Yemen Substantially Expands UNESCO Heritage List with 26 New Sites.

Swan Lake, Wadi al-Kabir Basin, Khor Bir Ahmed Reserve and Al-Mamlaḥ Reserve) (terrestrial-coastal wetlands): sanctuary for wildlife and birds, including endangered eagles, vultures, ibises, migratory birds, mammals, reptiles, and insects; Aden Governorate, designated in August 2006. This protected area was recently added to UNESCO's Tentative List for World Heritage, submitted in July 2025.[328]
- Kamaran Island (marine & terrestrial): mangrove forests, terrestrial wildlife, and habitats for birds and marine species; alHudayda Governorate, designated in August 2009.

Furthermore, there are three sites that are planned to be officially designated as protected areas in the near future:[329]

- Burum – Ber Ali (marine & coastal): coastal reefs and rich marine biodiversity; Hadramout Governorate. This area was recently added to UNESCO's Tentative List for World Heritage which was submitted in July 2025.[330]
- Jabal Erf Forest (terrestrial): mountainous plateau with juniper woodlands, endemic and rare plants, and diverse wildlife; Lahj Governorate. This area was recently added to UNESCO's Tentative List for World Heritage which was submitted in July 2025.[331]
- Sharma–Jathmun (marine & coastal): globally significant coastal ecosystem with endangered marine turtles, coral reefs, seagrass beds, and rich marine biodiversity; Hadramout Governorate. This area was also recently added to UNESCO's Tentative List for World Heritage which was submitted in July 2025.[332]

### B. Policy and legal framework for conservation

Yemen's environmental legal framework is based on Law No. (26) of 1995 on Environmental Protection,[333] which was preceded by the establishment of the Environmental Protection Council in 1990 and followed by executive regulations in 2000. This laid the foundation for the creation of the Environment Protection Authority (EPA) in 2001, currently operating under the Ministry of Water and Environment (MoWE). MoWE holds broad responsibilities for environmental and water policy, planning, external relations, and legal affairs, while EPA coordinates environmental activities among stakeholders, manages protected areas, enforces regulations, and serves as Yemen's national focal point for international agreements that Yemen has ratified, including CBD, UNFCCC, UNCCD, CITES, and the Ramsar Convention, which reflects the country's commitment to biodiversity conservation and sustainable resource management. Under the abovementioned laws, harmful activities within protected areas, such as habitat destruction, pollution, poaching, vegetation clearing and removal of native plants are prohibited.

Recognizing the multi-sectoral nature of biodiversity and environmental management, Yemen has also designated several ministries and institutions to implement environmental strategies. These include the Ministry of Planning and International Cooperation (MoPIC) for development planning and resource mobilization; the Ministry of Agriculture, Irrigation and Fish Wealth (MAIFW) for food security, agricultural development and fisheries management; the Ministry of Petroleum and Mineral Wealth for oil, gas, and mining oversight; the Ministry of Electricity; and the Ministry of Tourism for tourism infrastructure. Other institutions include the General Department of Forestry and Combating Desertification (GDFDC), the Civil Aviation and Meteorology Authority (CAMA), the Agricultural Research and Extension Authority (AREA), the National Water Resources Authority (NWRA), and the National Water and Sanitation Authority. NGOs and academic institutions, including Friends of the Environment, Yemen Ornithological Society, Holm Akhdar Environmental Foundation, IUCN, WWF, Birdlife International, and Wetlands International, also contribute technical support, research, advocacy and environmental awareness.[334]

Despite its legal and institutional foundations, Yemen's biodiversity governance faces major challenges. The current legal framework is limited, lacking protections for key species, invasive species control, and climate

328 Barran Press (2025). Yemen Substantially Expands UNESCO Heritage List with 26 New Sites. And UNESCO World Heritage Centre (2025). Wetland Natural Reserve, Aden. Tentative list entry.
329 UNDP and the Ministry of Water and Environment of the Republic of Yemen (2013). Protected areas in Yemen. Sustainable Natural Resource Management Project (Phase II). Original title: الهيئة العامة لحماية البيئة وصندوق الأمم المتحدة الإنمائي.
330 Barran Press (2025). Yemen Substantially Expands UNESCO Heritage List with 26 New Sites.
331 Ibid.
332 Ibid.
333 Republic of Yemen (1995). Law No. (26) of 1995 on Environmental Protection. Original title: قانون رقم (٢٦) لسنة ١٩٩٥م بشأن حماية البيئة، الجمهورية اليمنية,
334 Ministry of Water and Environment, EPA, UNDP, GEF (2017). National Biodiversity Strategy and Action Plan II, Achieving a resilient, productive and sustainable socio-ecosystem by 2050, Final Document, PIMS 4847.

Egyptian Vulture- Neophron *percnopterus*

Greater flamingo – *Phoenicopterus roseus*

Dragon blood trees - *Dracaena cinnabari*

White-eyed gull - *Ichthyaetus leucophthalmus*

adaptation measures.[335] Most of the protected areas also lack management plans.[336] These areas are not planned or managed through an ecosystem-based approach, which limits attention to ecological corridors, landscape connectivity, and external drivers of change such as urban expansion.[337] Additionally, the fragmented and unclear land ownership system in Yemen, whe re only 10–20% of land is formally registered, further complicates effective management,[338] with informal transactions (basira) and weak customary practices contributing to disputes. Ownership status within protected areas, whether public or private, is not publicly available and may require assessment. Under Article 11 of the environmental law, private ownership within protected areas must be respected; for example, the Utmah Reserve includes villages with privately owned lands. While private property rights are upheld, environmental regulations are still enforced on these landowners.

The EPA operates with insufficient funding, resources, and trained personnel, while the ongoing conflict has worsened these issues by weakening institutions, disrupting conservation projects, negligence and causing environmental degradation. Furthermore, data is often outdated or unavailable, and environmental assessments have largely stopped, hindering effective monitoring. Addressing these challenges requires legal reform, funding, stronger institutions, and approaches that empower local communities while safeguarding Yemen's natural capital.

### C. The Utmah Reserve

The Utmah Reserve, designated in 1999, is one of the most important natural reserves in Yemen due to its environmental diversity, including permanent green cover hosting diverse flora and fauna.[339] It is the oldest declared reserve in the country due to its historical environmental importance in ancient Yemen. It is located within the natural extension of the Sarat mountain range, roughly 55 km west of the city of Dhamar and 155 km south of the capital Sana'a. Its total area is estimated to be about 454 km². The Utmah Reserve consists of mountain ranges descending westward toward the coastal plain areas, with altitudes ranging from 880 to 2,800 meters above sea level.[340]

335 Republic of Yemen, Ministry of Water and Environment, Environment Protection Authority (2012). Action Plan for Implementing the Programme of Work on Protected Areas of the Convention on Biological Diversity. Submitted to the Secretariat of the Convention on Biological Diversity on 08/05/2012.
336 Ministry of Water and Environment, EPA (2012). Action Plan for Implementing the Programme of Work on Protected Areas of the Convention on Biological Diversity. Republic of Yemen.
337 Ministry of Water and Environment, EPA, UNDP, GEF (2017). National Biodiversity Strategy and Action Plan II, Achieving a resilient, productive and sustainable socio-ecosystem by 2050, Final Document, PIMS 4847.
338 United Nations Human Settlements Programme (UN-Habitat), Global Land Tool Network (GLTN), Urban Training and Studies Institute (UTI) of the Housing and Building National Research Center (HBRC), and the Arab Land Initiative (2023). Yemen Land Sector Assessment Background Paper.
339 Abo Alftooh, A.H. (2020). Natural reserves in Yemen.
340 Ibid.

According to data from the EPA,[341] the Utmah Wildlife Reserve contains pastures, forests, and a variety of perennial, aromatic, and rare plant species. It includes species of ferns, fungi, mosses, and lichens. Vegetation cover constitutes between 80 to 90% of the total area of the reserve, with mountainous agricultural terraces occupying an area of about 50 to 60% of the reserve's land. Forests, shrubs and natural pastures cover the remainder of the entire reserve, as shown by the land cover map.[342] The reserve is valued for its natural beauty, a mosaic landscape of natural pastures, forests and woods containing different species of trees and rare medicinal and aromatic plants, such as Acacia plants, Ehretia cymosa, Datura innoxia, Agava sisalana, and the salaf plant (locally known as "saʿaf"), in addition to rare animals and birds.

The area now designated as Utmah Reserve has been inhabited for thousands of years, with natural and environmental features historically attracting settlement by ancient Yemeni communities. It is characterized by fertile agricultural soils, high-quality pastures, dense forest lands, and high rates of rainfall, in addition to springs and water flows. Communities still reside in the reserve today, practicing agriculture, herding, and resource gathering. While this may seem at odds with conservation goals, IUCN Categories V (Protected Landscapes) and VI (Protected Areas with Sustainable Use of Natural Resources) allow and encourage traditional practices as part of sustainable reserve management.

Local communities in the reserve are primarily engaged in agriculture and herding, with agriculture employing 71% of the total workforce. Beekeeping and honey production are two common activities, while other economic activities include crafts and trade. The reserve is famous for its handicrafts made from palm fronds, such as decorated baskets and plates, produced for local use in homes and for selling. A type of strong local rope is also made from fibers of the salaf plant native to the reserve.

### D. Protected wetlands in Aden: Caltex - al-Heswah Reserve, Swan Lake, Wadi al-Kabir Basin, Khor Bir Ahmed Reserve and al-Mamlaḥ Reserve

The wetlands of Aden Governorate, designated as protected areas in 2006, form one of Yemen's most ecologically and culturally significant landscapes, supporting biodiversity of global importance. These reserves encompass mangroves, intertidal flats, lagoons, and saltworks that provide critical habitats for migratory and resident birds, seagrass beds, fish nurseries, and halophytic vegetation. They function as vital stopover sites for birds migrating between Europe, Asia, and Africa, while also sustaining fisheries, salt production, agriculture, and traditional livelihoods. Historically used for salt extraction and agriculture, the wetlands continue to hold economic and cultural importance while acting as natural barriers against flooding and sea level rise.[343]

Located on the western side of the Gulf of Aden, the reserves include both natural wetlands that depend on seawater and artificial ones sustained by treated wastewater. In total, Aden hosts five main wetland reserves: Caltex - al-Heswah Reserve, Swan Lake, Wadi al-Kabir Basin, Khor Bir Ahmed Reserve and al-Mamlaḥ Reserve. The region has a hot arid coastal climate with an annual average temperature of 28.8°C, low rainfall (rarely exceeding 50 mm annually), high humidity, and exposure to strong seasonal winds.

These wetlands support a wide variety of biodiversity. Plant species include grasses, sedges, mesquite, tamarisk, and palms, many of which have ecological and economic importance. The wetlands are also home to endangered bird species such as the white-eyed gull, the imperial eagle, the Egyptian vulture, and the sacred ibis, alongside numerous migratory and resident bird species. Marine life thrives as well, with seagrasses, crustaceans, mollusks, fish, and sea urchins forming an essential part of the food chain. Terrestrial wildlife such as foxes, rabbits, reptiles, and bats also inhabit the area.[344]

Beyond their ecological role, the wetlands contribute to the livelihoods of local communities. The reserve's sites were developed and managed in cooperation with the local community, represented by the al-Heswa Environmental Association. In the period before the 2014 conflict, the reserve achieved significant progress both locally and internationally, winning several international awards, most notably the United Nations Equator Prize, awarded to only 26 sites worldwide.[345] Many households depend on farming, particularly sorghum

341 UNDP and the Ministry of Water and Environment of the Republic of Yemen (2013). Protected areas in Yemen. Sustainable Natural Resource Management Project (Phase II). Original title: المناطق المحمية الساحلية وجزر اليمن المقترحة للانضمام إلى الهيئة العامة لحماية البيئة وصندوق الأمم المتحدة الإنمائي.

342 Abo Alftooh, A.H. (2020). Natural reserves in Yemen.

343 UNESCO (2025). Wetland Natural Reserve, Aden. Tentative Lists.
UNDP and the Ministry of Water and Environment of the Republic of Yemen (2013). Protected areas in Yemen. Sustainable Natural Resource Management Project (Phase II). Original title: الهيئة العامة لحماية البيئة وصندوق الأمم المتحدة الإنمائي.

344 Ibid.

345 Interview with the EPA in Aden, Holm Akhdar

cultivation, as well as palm products, fishing, grazing, and firewood collection. These activities not only support local families but also contribute to the broader national economy.

### E. Yemen's armed conflict around Utmah and Aden's wetlands

The war in Yemen, one of the Arab world's poorest countries, escalated in March 2015 when a Saudi-led coalition intervened on behalf of the internationally recognized government against Ansar Allah (better known as the Houthi movement).[346] Bombardment, hunger, displacement, and disease have pushed millions of Yemenis into a humanitarian catastrophe. The conflict has risked regional spillover and derailed repeated UN-mediated peace efforts. The years of 2022 to 2025 have been marked by intermittent de-escalation efforts, including the April 2022 UN-brokered truce, followed by recurring spikes in violence, cross-border and maritime attacks, and fragile negotiations.[347] The conflict is likely to remain locked in cycles of escalation without significant efforts to consolidate ceasefires, end foreign intervention, and allow Yemenis themselves to negotiate a sustainable peace.[348]

The Utmah Reserve area lies in Dhamar Governorate, part of Yemen's northern highlands. While the area has not been a major frontline in the conflict, sporadic airstrikes and armed activity across Dhamar have been documented in recent years.[349] This reflects how even areas away from the main frontlines face the structural effects of war: governance vacuums, resource scarcity, and environmental neglect. In contrast, Aden and its coastal wetlands have suffered directly from the southern front of the conflict. Throughout 2024, Aden Governorate and nearby coastal waters saw recurrent clashes, instability, maritime attacks in the Red Sea and Gulf of Aden and airstrikes.[350] These hostilities have devastated public infrastructure and environmental management.

### F. Evidence of conflict-induced environmental destruction in Utmah Reserve

In Utmah, the reserve center once housed a dedicated administration building staffed by a manager and team of residents, all of whom were local residents. NGOs implemented many donor-funded projects, and some

346 International Crisis Group (2024). Yemen. In Middle East & North Africa: Gulf and Arabian Peninsula.
Robinson (2023). Yemen's tragedy: War, stalemate, and suffering. Council on Foreign Relations.
347 International Crisis Group (2022–2025). CrisisWatch: Yemen entries.
348 Ibid.
349 Ibid.
350 Ibid.

local NGOs participated in the reserve's administrative body, even though no formal governance structure was in place. In 2018, the conflict destroyed the administrative facilities, forcing staff to move their remaining equipment into a rented single small room, where much of it deteriorated over time.[351]

Insecurity and poor environmental management, coupled with the economic collapse, has pushed local residents to clear rare trees and plants in order to plant qat, a widely cultivated narcotic.[352] The crop is a major source of income despite its lack of nutritional value. Discussions and interviews with locals also revealed that many households had shifted to firewood instead of gas. Most people's salaries were interrupted as the war split the country into north and south, making it difficult to afford gas. Additionally, gas and oil supplies were hard to reach in the north, arriving in small quantities and at high prices. In cities, people were forced to wait in long lines to obtain gas or oil supplies. In villages and agricultural areas like the Utmah Reserve, citizens resorted to cutting down trees for cooking fuel, further accelerating environmental degradation. Deforestation and the cultivation of unsustainable crops contribute to the destruction of natural habitats, biodiversity loss, soil degradation, and desertification.

Previously, the reserve had received significant support for training residents in crafts and other sustainable practices. For instance, there was an organization that trained local residents to set up beehives for honey production and sale, providing them with an additional source of income. They also used palm fronds to create bags, shoes, and simple souvenir items, which were sold to tourists. However, due to the war, tourism ceased, significantly affecting locals' ability to sell these products in large quantities and depriving communities of resources that once helped them conserve the environment and improve their livelihoods.

### G. Evidence of conflict-induced environmental destruction in Aden's Wetlands

In the protected Caltex - al-Heswah Reserve in Aden, the war has had devastating direct and indirect ecological impacts. Most directly, the reserve was used as a military site, leading to looting and damage to its infrastructure, including the entry gate and plant nursery.[353] The observation tower for birdwatching was raided, with all its equipment, including spotting scope, cameras, furniture, and even windows and doors stolen. Furthermore, fan palm trees were bulldozed, burned, and replaced with farmland. Old trees were cut for firewood and overgrazing led to a near-total loss of vegetation. The al-Arish wastewater treatment facility's malfunction has reduced the water quality in the marshes, and untreated sewage water has flowed into the wetlands, polluting the area and harming nearby marine life and salt basins.[354] Moreover, satellite imagery has revealed the resumption of an informal waste dump and infilling of water channels with building rubble, likely affecting the wetland's hydrology, while light industrial units have encroached on the site.[355]

Indirectly, the conflict caused a cessation of the government's financial and political support. Revenue from visitor fees and crops, which previously sustained protection and restoration activities, dropped drastically. Women and low-income families in particular produced goods from palm fronds, which attracted local visitors, traders, and researchers.

The Caltex - al-Heswah Reserve provides employment and a key source of livelihoods for the local community, while also contributing to the national income. As reported by the EPA and UNDP in 2016, around 175 men and women from neighboring areas benefit directly, including 158 families across eight regions.[356] Beneficiaries engage in various activities: farmers, who previously grew cotton alongside fodder, now focus on sorghum, which is well-suited to the local climate, tolerant to salinity, disease-resistant, and can be harvested multiple times per year. The Palm Behis stalk is used for vinegar production and as a digestive aid, yielding 20 to 30 liters daily. Additionally, 60 people in the region benefit from fishing and firewood collection, including 24 farmers who supplement their income through firewood.[357]

The lack of funding and overall neglect as a consequence of the conflict has allowed further encroachment and building on the reserve's land, destroying large areas of plants and making the wetlands unsafe for migratory birds. The reserve's previously successful community-managed operations

351 Source: conversation with person from the Utmah Reserve office during 2024. There are no photos available as taking such images is prohibited. Residents of the area are not allowed to capture photos of the devastation in these locations.
352 Source: field observations and conversations with inhabitants during sample collections in the reserve during February 2024.
353 Interview with the EPA in Aden, Holm Akhdar
354 Ummat al-Rahman al-Afour (2024). Al-Haswa Nature Reserve... Aden's threatened environmental treasure. Raseef22. Original title: محمية الحسوة الطبيعية الكنز البيئي المهدد في عدن
355 CEOBS (2021). Report: Protected area conservation in Yemen's conflict.
356 UNDP (2016). Protected areas in Yemen. Original title: المحميات الطبيعية في الجمهورية اليمنية
357 UNDP (2016). Protected areas in Yemen. Original title: المحميات الطبيعية في الجمهورية اليمنية

▲ Dragonblood tree (Dracaena cinnabari) on Homhil Plateau, Socutra Island, Yemen. 2023, Wikimedia

and generated revenue have entirely ceased.[358] The conflict has stripped the reserve of its biodiversity and socioeconomic functions.

Rehabilitation efforts are now underway, led by the Ministry of Water and Environment and the EPA in Aden. Caltex – al-Heswa has been included in the eighth cycle of the Global Environment Facility (GEF-8), a multilateral financing mechanism established in 1992 to help developing countries and economies in transition address environmental challenges in areas including agriculture, forestry, and marine resources.[359] Furthermore, the Aden Wetlands have been included in Yemen's tentative list of 26 new cultural and natural sites for consideration as World Heritage sites of UNESCO in June 2025.[360]

## H. Environmental peacebuilding initiatives

Although the need to tackle the root causes of the conflict go beyond environmental peacebuilding, there are some initiatives that have emerged during the war, both through organizations and individual efforts, to conserve Yemen's protected areas and its flora and fauna.
For instance, the Hayel Saeed Anam Group is partnering with the Yemeni government's EPA to support climate resilience, highlighting the critical role of private sector involvement.[361] Other efforts include the Environmental Pathways for Reconciliation in Yemen project by the European Institute of Peace, which addresses climate and environmental security through dialogue,[362] and the Urban Rainwater Harvesting project, supported by IHE Delft.[363]

Environmental advocacy and awareness initiatives, along with research and knowledge production on environmental issues, play a crucial role in generating data and informing policy and public understanding. Among the most prominent of these initiatives is Holm Akhdar,[364] an independent environmental group active for more than fifteen years in advocacy, reporting, public awareness, and analysis of environmental and climate challenges. The organization has highlighted threats to Yemen's protected areas and mobilized local and international responses, notably regarding rare species poaching in Shabwa and the FSO Safer oil tanker crisis. In recent years, new efforts such as the Green Voices[365] platform have also emerged, promoting environmental awareness, community engagement, and support for marginalized groups, especially women, in addressing climate issues amid conflict and institutional collapse.

358 Ibid. and Al Afouri (2024). Al-Haswa Nature Reserve, a threatened environmental treasure in Aden. Raseef 22. Original title: محمية-الحسوة-الطبيعية-الكنز-البيئي-المهدد-في-عدن.
359 Interview with the EPA in Aden, Holm Akhdar
360 UNESCO (2025). Wetland Natural Reserve, Aden. Tentative Lists.
361 HAS (2023). HSA Group signs MoU with Yemen's Environment Protection Authority to tackle climate vulnerability and build resilience.
362 EIP (2025). Environmental Pathways for Reconciliation in Yemen.
363 IHE Delft (2024). Rain of hope: Yemen's fight for water in a time of war.
364 Holm Akhdar (2025). Holm Akhdar. Original title: حلم اخضر
365 Green Voices (2025). About Green Voices. Original title: عن أصوات خضراء

International actors and programs such as the UNDP's Environmental Peace Initiative[366] and Swisspeace's environmental peacebuilding project[367] also play a crucial role in integrating climate action into peacebuilding strategies, providing funding for local initiatives, building institutional capacity, and fostering collaboration between environmental and peacebuilding actors. Additional examples include the Friends of Soqotra,[368] which works to conserve the island's unique biodiversity and support local communities; GIZ's[369] Peace for Water program, which promotes cooperation over shared water resources to reduce tensions and strengthen local governance; and various youth-driven initiatives that harness social media, community campaigns, and volunteer networks to raise environmental awareness and advocate for sustainable solutions. Additionally, citizen science initiatives help to monitor biodiversity, with recent evidence confirming the presence of Arabian leopards in areas where they were previously thought extinct.[370] On the individual level, local champions are playing a vital role in conservation and environmental awareness. For example, Mawla al-Dawila has established a sanctuary to protect Yemen's endangered ibex,[371] and Adeeb Abdullah cultivates dragon trees to preserve the iconic flora of Socotra.[372] These individual efforts complement broader conservation initiatives and demonstrate the importance of local knowledge and action in environmental protection.

366 Environmental Peace Initiative by the United Nations Development Programme (UNDP) Yemen (2021). Community-based initiatives for water resource management and peacebuilding.

367 Environmental Peacebuilding in Yemen Project, Swisspeace (2022). Environmental Peacebuilding in Conflict-Affected Yemen.

368 Friends of Soqotra (2025). About Friends of Soqotra. Original title: أصدقاء سقطرى.

369 Peace for Water Initiative, GIZ Yemen. (2020). Peace through Water: Conflict-sensitive water resource management in Yemen.

370 Aboalfotooh, A.A.H., Baeshen, O. and Saif, R. (2024). Arabian leopard in Yemen: an update. Cat News, n. 79 spring 2024.

371 Saeed Al-Batati (2025). One Man's Mission To Save Yemen's Ibex. New Lines Magazine.

372 Abdulmalik Alnemri (2024). The race to save the dragon's blood tree. The Revelator Environmental News and Commentary.

# How can nature be better protected in armed conflict?

**As demonstrated by both historical examples and the examined case studies, protected areas suffer from wide-ranging armed conflict impacts despite their formal designations, while informally designated areas enjoy even less protections. However, with the growing international recognition of the devastating environmental effects of armed conflicts and military actions, momentum has been mounting to enhance the enforcement of international norms and strengthen domestic and policy frameworks that protect nature from their impacts. Those pathways include both the broader agenda for the protection of the environment in armed conflict, which encompasses multiple dimensions of environmental harm, and efforts focused specifically on area-based protections to safeguard natural areas of particular environmental importance or fragility. This chapter will take stock of policy and legal developments in both segments to explore which frameworks can be most useful in ensuring better protection of nature in armed conflicts and where persistent gaps remain.**

## International frameworks for protection of the environment in armed conflict

While states establish domestic legal frameworks for nature protection and are bound by relevant international environmental treaties such as UNESCO World Heritage and the Ramsar Convention, international law has also defined protections for the natural environment specifically during armed conflict. In particular, International Humanitarian Law (IHL), or the law that regulates the conduct of armed conflict, recognizes the natural environment as a civilian object and contains relevant provisions for the protection of the environment.[373]

Although historically IHL took a largely anthropocentric approach to the protection of the natural environment, environmental devastation during conflicts in the 20th century, notably the Vietnam War, and the evolution of international environmental law prompted increased attention and understanding of the ecological consequences of warfare and a gradual codification of environmental provisions within IHL.[374] For instance, the 1977 Additional Protocol I to the Geneva Conventions introduces explicit environmental safeguards. Article 35(3) forbids warfare methods expected to cause "widespread, long-term and severe damage to the natural environment," and Article 55 formulates a duty of care to protect the environment "to prejudice the health or survival of the population"—an early recognition of the interdependence between human health and ecosystem vulnerability.[375] Beyond these environment-specific rules, IHL contains other rules that protect the natural

373 ICRC (2020) Guidelines on the Protection of the Natural Environment in Armed Conflict: Rules and Recommendations under IHL, with Commentary, 2020, paras. 18-21 and Rules 5-9; Available: shop.icrc.org/guidelines-on-the-protection-of-the-natural-environment-in-armed-conflict-pdf-en.html; ICRC (2024) International Humanitarian Law and the Challenges of Contemporary Armed Conflicts: Building a Culture of Compliance for IHL to Protect Humanity in Today's and Future Conflicts, Geneva, September 2024, 50-51. Available: https://www.icrc.org/en/report/2024-icrc-report-ihl-challenges#link-banner1773148

374 ICRC (2020) Guidelines, paras. 4-8.

375 ICRC (1977) Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 1125 UNTS 3, 8 June 1977. Available: https://ihl-databases.icrc.org/en/ihl-treaties/api-1977?activeTab=.

environment, such as the prohibitions of starvation and pillage. Other international norms, including disarmament treaties, complement IHL in regulating the conduct of military activities. For instance, the 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD) prohibits the military use of techniques that could alter the earth's "dynamics, composition or structure."[376]

The International Environmental Law (IEL), in its turn, despite being traditionally seen as the "law of peace" and hence viewed as a distinct domain from the IHL, may continue to apply in armed conflicts, similarly to other rules of international law protecting the natural environment, including international human rights law.[377] The fact that IHL and IEL are not mutually exclusive in wartime was confirmed by the 1996 International Court of Justice (ICJ) Advisory Opinion on the legality of nuclear weapons.[378]

Various multilateral environmental agreements (MEAs) also apply in times of armed conflict, and some contain conflict-related provisions. The 1972 World Heritage Convention allows sites to be placed on the "World Heritage in Danger" list during actual or threatened conflict, while Article XV of the 2003 African Convention on the Conservation of Nature and Natural Resources obligates parties to protect and, where needed, restore the environment during hostilities.[379] In contrast, some international treaties make specific exemptions for military activities and there are still open questions about the extent to which environmental obligations would apply to such activities. For example, the United Nations Convention on the Law of the Sea (UNCLOS) and environmental treaties such as the International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) permit certain exceptions for military vessels.[380]

Recent efforts have aimed to reaffirm, clarify and strengthen protections. In 2022, the International Law Commission adopted Principles on the Protection of the Environment in Relation to Armed Conflicts (PERAC), which clarify and codify existing international norms protecting the environment before, during, and after armed conflicts, and recommend further legal developments.[381] This represents the most significant advancement in the normative framework in recent decades. The International Committee of the Red Cross (ICRC) updated its Guidelines on the Protection of the Natural Environment in Armed Conflict in 2020, restating existing obligations under IHL in armed conflicts, including obligations to employ methods and means of warfare with due regard to the protection and preservation of the natural environment, to take "constant care" to spare the natural environment and to take all feasible precautions to avoid, and in any event to minimize incidental environmental harm.[382] The Guidelines also recommend the identification and designation of areas of particular environmental importance or fragility as 'demilitarized zones,' to prevent these from becoming military objectives and reduce the risk of incidental damage to them.[383]

The UN Environmental Assembly (UNEA) - the world's highest-level decision-making body on the environment - has also adopted several resolutions around the protection of the environment in armed conflict and addressing conflict impacts on the environment, including Resolution 2/15 on protection of the environment in armed conflict (2016),[384] Resolution 3/1 on conflict pollution (2017),[385] and Resolution 6/12 on environmental assistance and recovery in conflict-affected areas (2024).[386] In parallel, IUCN, which brings together states, civil society, and experts in global conservation policy, has also begun addressing these issues more directly. For instance, at its 2025 World Conservation Congress, IUCN adopted two motions, one

376 United Nations (1977) Convention on the prohibition of military or any other hostile use of environmental modification technique, 26.1. Available: https://treaties.un.org/doc/Treaties/1978/10/19781005%2000-39%20AM/Ch_XXVI_01p.pdf

377 ILC, Report of the International Law Commission on the Work of Its Seventy-Third Session, UN. Doc. A/77/10, 2022, Chap. V, "Protection of the Environment in Relation to Armed Conflicts" (ILC Commentaries on the Draft PERAC Principles), commentary on Draft Principle 3, para. 4, commentary on Part Three, para. 2, and commentary on Draft Principle 13, para. 4.

378 ICJ (1996) Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion of 8 July 1996. Available: https://www.icj-cij.org/case/95/advisory-opinions

379 United Nations (1972) Convention concerning the protection of the world cultural and natural heritage, Paris, 16 November. https://whc.unesco.org/archive/convention-en.pdf; African Union (2003) African Convention on the Conservation of Nature and Natural Resources, Maputo, Mozambique, 11 July. https://au.int/sites/default/files/treaties/41550-treaty-Charter_ConservationNature_NaturalResources.pdf

380 UNEP (2009) Protecting the Environment During Armed Conflict: An Inventory and Analysis of International Law. https://wedocs.unep.org/bitstream/handle/20.500.11822/7813/-Protecting%20the%20Environment%20During%20Armed%20Conflict_An%20Inventory%20and%20Analysis%20of%20International%20Law-2009891.pdf?sequence=3&amp%3BisAllowed=

381 United Nations (2022) Draft principles on protection of the environment in relation to armed conflicts, UNGA Res. 77/104. https://legal.un.org/ilc/texts/instruments/english/draft_articles/8_7_2022.pdf

382 ICRC (2020) Guidelines, Rules 1, 7 and 8 and commentaries thereto.

383 ICRC (2020) Guidelines; ICRC (2024) IHL and the challenges of contemporary armed conflicts. Available: https://www.icrc.org/en/report/2024-icrc-report-ihl-challenges#link-banner1773148

384 United Nations Environment Assembly (2016) Protection of the environment in areas affected by armed conflict, Res. 2/15. https://wedocs.unep.org/bitstream/handle/20.500.11822/11189/K1607252_UNEPEA2_RES15E.pdf?sequence=1&isAllowed=y

385 United Nations Environment Assembly (2017) Pollution mitigation and control in areas affected by armed conflict or terrorism, Res. 3/1. https://wedocs.unep.org/bitstream/handle/20.500.11822/30792/UNEA3_1EN.pdf?sequence=1&isAllowed=y

386 United Nations Environment Assembly (2024). Environmental assistance and recovery in areas affected by armed conflict, Res. 6/12.

calling for conflict-sensitive conservation and protection of the environment in fragile and conflict-affected areas[387] and another on establishing mechanisms for engagement with IUCN members operating in situations of armed conflict,[388] signifying growing recognition of the nature/armed conflict nexus within the conservation community.

Other relevant international legal and policy developments around strengthening environmental protections in conflicts include the UN Security Council's resolutions such as 2417 (2018) and 2573 (2021) that aim at enhancing the protection of food systems and critical civilian infrastructure; UN General Assembly resolutions that incorporate environmental dimensions of conflict and/or weapons use, including those adopted within its First Committee; and UN Human Rights Council resolutions including 46/7 (2021) that underscore the negative effects of conflict-linked environmental degradation on people in vulnerable situations.

Other initiatives – such as the 2022 Political Declaration on the Use of Explosive Weapons in Populated Areas (EWIPA) or the Global Alliance to Spare Water from Armed Conflict – also seek to enhance safeguards for the environment and environmental infrastructure in times of armed conflict. Furthermore, UN Special Rapporteurs on Human Rights and Toxics have sounded the alarm on the adverse effects of conflict-linked pollution and toxic remnants of war on human health and the environment.[389] There have also been notable sectoral developments, such as the development of environmental standards and guidance in the demining field,[390] while the interconnected challenges[391] of conflict, climate change, environmental degradation, recovery, and peacebuilding were recognized by the COP28 Declaration during the UNFCCC climate negotiations in 2023.[392]

Lastly, there is growing momentum around advancing accountability for environmental damage, including within the International Criminal Court (ICC)[393] and through the international campaign to recognize ecocide as an international crime.[394] The recent landmark advisory opinion by the International Court of Justice (ICJ) affirming states' legal obligations "to ensure the protection of the climate system and other parts of the environment from anthropogenic greenhouse gas emissions"[395] has further elevated the global profile of environmental protection. This builds on earlier jurisprudence from the International Tribunal for the Law of the Sea (ITLOS) on states' duties to prevent climate-related harm to the marine environment and from the Inter-American Court of Human Rights recognizing the right to a healthy environment. Together, this evolving legal trajectory increasingly affirms that human rights and environmental integrity are inseparable, as reflected in the UN General Assembly's 2022 recognition of the right to a clean, healthy, and sustainable environment,[396] strengthening the normative foundation for addressing environmental harm in armed conflict, where damage to nature can significantly undermine recovery and peacebuilding.

Despite these advancements, enforcement remains a challenge. Real-world application is inconsistent, and the balance between military necessity, civilian protection, and environmental preservation is complex.[397] Legally, progress is hampered by gaps in binding obligations, weak enforcement mechanisms, and the high thresholds for legal accountability, particularly under IHL. Politically, however, there is growing momentum to address the environmental dimensions of conflict, including through multilateral forums. These political processes can offer more flexible, faster-moving avenues to build norms, but their implementation is often limited or fragmented in the absence of mechanisms to mainstream these

387 IUCN (2025) Motion 057 – Ensuring conflict-sensitive conservation and protection of the environment in fragile and conflict situations. Available at: Motion 057 | iucncongress2025.org

388 IUCN (2025) Motion 065 – Establishing mechanisms for engagement with IUCN Members involved in armed conflict. Available at: https://iucncongress2025.org/assembly/motions/motion/065

389 UN General Assembly (2025) Military activities and toxics: Report of the Special Rapporteur, Marcos Orellana, on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes (Report No. A/80/174), Access: n2519095.pdf; UN Human Rights Council (2016) Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes (Report No. A/HRC/33/41), Access: Document Viewer; UN Human Rights Council (2007) Adverse effects of the illicit movement and dumping of toxic and dangerous products and wastes on the enjoyment of human rights: Report of the Special Rapporteur, Okechukwu Ibeanu (Report No.A/HRC/5/5), Access: Document Viewer.

390 GICHD (2021) Guide to Explosive Ordnance Pollution of the Environment. https://www.gichd.org/fileadmin/uploads/gichd/Publications/EO_Pollution_of_the_Environment_v17_web_01.pdf

391 Pantazopoulos, S. (2024). Navigating legal frontiers: Climate change, environmental protection and armed conflict. International Review of the Red Cross. Access: Navigating legal frontiers: Climate change, environmental protection and armed conflict

392 https://www.cop28.com/en/cop28-declaration-on-climate-relief-recovery-and-peace

393 ICC (2025). ICC Office of the Prosecutor launches Policy on Addressing Environmental Damage Through the Rome Statute | International Criminal Court

394 Stop Ecocide International (2024). DRC Joins Pacific Island Nations In Call For An International Crime Of Ecocide — Stop Ecocide International

395 ICJ (2025). Obligations of States in respect of Climate Change

396 UN General Assembly (2022). Resolution 76/300: The human right to a clean, healthy and sustainable environment, A/RES/76/300. Available at: https://documents.un.org/en/a/res/76/300

397 Dienelt, A. (2017) 'After the War is Before the War: The Environment, Preventive Measures Under International Humanitarian Law, and their Post- Conflict Impact', in C. Stahn et al (eds) Environmental Protection and Transitions from Conflict to Peace, Oxford: Oxford University Press, pp.420-437.

▲ Al-Haswa Reserve Gate, Aden, Yemen. Zainab Yahya

considerations across the conflict lifecycle. To address this gap, PAX has been advocating for the establishment of the international Environment, Peace and Security (EPS) agenda,[398] which would help to integrate the existing efforts into a coherent mechanism within the UN system and beyond in order to improve the international community's capacities to prevent, mitigate, and respond to environmental concerns in conflict and at-risk settings. Therefore, continuous policy influencing and evidence-based advocacy at the political level on these matters remains as crucial as further clarification and utilization of legal instruments to achieve progress in real-world implementation of effective protections and prevention of further environmental damage.

Furthermore, even though existing international rules on environmental protection in conflict undoubtedly have positive effects on nature at large, there is a need for effective and specific protection of areas of particular environmental importance or fragility to avoid damage. This explains the push for more focused area-based protections to designate specific natural areas as demilitarized zones.

## Targeted protection of areas of particular environmental importance or fragility

The identification and designation of areas of significant environmental importance or fragility as 'protected zones' in the event of armed conflict has been recommended by several of the key frameworks discussed above as a potential pathway to put in place enhanced protections specifically for such areas, as well as to facilitate the application of existing IHL rules to them. This concerns areas such as biodiversity hotspots, habitats for endangered species, and groundwater aquifers, as well as other areas that often contain ecosystems whose degradation would be irreversible or require decades to restore, and which are important for coastal protection, carbon sequestration or disaster prevention.

For instance, based on multiple IHL rules, the ICRC's 2020 Guidelines recommend that states and parties to a conflict identify and designate areas of particular

398 PAX (2025). Advancing the International Environment, Peace and Security Agenda: Recommendations for the UN and Beyond, Policy Report. Available at: PAX_Advancing-the-EPS-agenda_policy-report.pdf

environmental importance or fragility as demilitarized zones, keeping them off-limits to military operations by agreement.[399] This would require that conflict parties do not place their personnel or military equipment within these areas, and refrain from attacking such zones on territory controlled by their opponents. The Guidelines also note that refraining from locating troops or military material in important or fragile areas is one way precautions could be taken to protect the natural environment against the effects of attacks, as required by IHL.[400]

Similarly, the PERAC Principles provide that "states should designate areas of environmental importance as protected zones in the event of an armed conflict, including where those areas are of cultural importance," and – beyond any additional agreed protections – that such areas "shall be protected against any attack, except insofar as it contains a military objective."[401] Such protected zones could be established and implemented in peacetime or during an armed conflict. Doing so can significantly reduce the risk of incidental damage and provide clear operational guidance to commanders so that they avoid conducting military operations within such zones or take them into account when applying the principles of proportionality and precaution under IHL.

These recommendations by the ICRC and the International Law Commission build on earlier proposals for area-based protections dating back to the 1970s Additional Protocol I negotiations, as well as international expert discussions around the 1996 Draft Convention on the Prohibition of Hostile Military Activities in International Protected Areas, developed by the IUCN Commission on Environmental Law and the International Council of Environmental Law (ICEL).[402] While such initiatives have not yet resulted in binding laws, they indicate a growing recognition that areas of particular environmental importance or fragility deserve focused, area-based protection during conflict, as witnessed for instance by state expert discussions on the matter[403] and references to this issue at the UN level, particularly, by the UN Secretary-General.[404]

Given the number and variety of protected environmental areas, some prioritization of such areas will be needed to ensure the feasibility of area-based protection in armed conflicts. Among the resources that could be used to identify such zones, the ICRC Guidelines and the ILC's PERAC Principles refer to protected areas identified by multilateral environmental agreements (MEAs), including those designated under the UNESCO World Heritage Convention, the Convention on Biological Diversity (CBD), the Ramsar Convention, and those listed in IUCN's conservation databases, such as the Red List of Ecosystems, the World Database of Key Biodiversity Areas and the World Database on Protected Areas.[405] During a 2023 meeting of government experts, natural sites under the World Heritage Convention were identified as being particularly relevant.[406] Domestic legal frameworks defining areas of significant environmental importance can also be useful as a reference for designation of protected environmental zones, although they may be perceived as less objective than international instruments and frameworks.

While identifying protected environmental zones in armed conflicts based on existing MEA designations offers a promising pathway for strengthening the protection of nature during armed conflict - especially if established in peacetime as a preventive measure - several challenges stand in the way of its effective implementation. Most importantly, the operationalization of protected environmental zones relies on the political will of states and on compliance by warring parties. Targeted protection of specific natural areas as demilitarized zones – beyond the protection already provided to these areas by IHL rules – is conditioned upon securing mutual agreement between conflict parties. Given that environmental concerns have long been low on the list of considerations by armed forces, building international political recognition of the importance to uphold environmental protections in armed conflict and to strengthen protections for protected areas remains crucial, both at the international and national levels. This also requires enhancing mechanisms for state responsibility and, where applicable, individual criminal accountability for violations of these rules. It is beneficial to prioritize such measures in

399 Recommendation 17 in ICRC, Guidelines on the Protection of the Natural Environment in Armed Conflict: Rules and Recommendations Relating to the Protection of the Natural Environment under International Humanitarian Law, with Commentary, Geneva: ICRC, 2020, 82-84; ICRC, International Humanitarian Law and the Challenges of Contemporary Armed Conflicts: Building a Culture of Compliance for IHL to Protect Humanity in Today's and Future Conflicts, Geneva, September 2024, 51-52.
400 ICRC Guidelines, paras 144–145.
401 Principles 4 and 18, PERAC Principles, 2022.
402 Helen Obregón Gieseken & Vanessa Murphy, International Review of the Red Cross (2023), 105 (924), 1180–1207. Protecting the Environment in Armed Conflict, p. 1199.
403 ICRC-Switzerland (2023) State expert meeting on international humanitarian law: protecting the environment in armed conflicts, https://www.icrc.org/sites/default/files/document_new/file_list/chair_s-summary_en_0.pdf
404 Protection of Civilians in Armed Conflict: Report of the Secretary-General, UN Doc. S/2022/381, 10 May 2022, p. 19.
405 ILC Commentaries on the Draft PERAC Principles, commentary on Draft Principle 4, para. 5; ICRC ICRC Guidelines, p. 83.
406 ICRC-Switzerland (2023), section 3.2, 14–16.

▲ Rocket remains and war debris are scattered in Wadi Gaza, which was one of the most important nature reserves in the Gaza Strip, before military operations turned it into a polluted and deserted area in Al-Maghraqa, Gaza. November 12, 2025 : APA Images

peacetime to avoid military use of areas of significant environmental importance or fragility, and therefore prevent (parts of) those areas from becoming military objectives in case of armed conflict. Establishing a multilateral framework for this issue would yield greater effectiveness than depending on ad hoc arrangements between belligerents in individual conflict contexts. Emerging best practices by some states[407] to enhance protection of certain natural areas in their legislation or military manuals provide useful examples of how such measures could be operationalized.

Furthermore, most MEAs were not designed with armed conflict in mind and there are still questions on the applicability of specific MEA provisions in situations of armed conflict. This constitutes a gap both in terms of environmental protections during conflict and for the post-conflict recovery of an affected protected area. Another issue is that MEAs do not take into account specific challenges that conflict-affected countries are facing with regards to the designation and management of protected areas, as demonstrated by several case studies. As a result, valuable natural areas may not be adequately designated, monitored, or reported in international databases and frameworks, due to the limited institutional capacity of national authorities in conflict-affected countries. MEAs can therefore play a greater role in monitoring important natural sites in conflict-affected countries and mobilizing international support for nature conservation in such contexts, integrating peace and conflict considerations into biodiversity planning.

Beyond formally designated protected areas under MEAs, area-based protections in armed conflicts could extend to OECMs as well, especially given that many ecologically important sites in conflict zones fall under this category. Indeed, the eruption of conflict might prompt relevant government authorities to launch a formal designation process for affected OECMs, should they meet the requirements, which could enable their placement on UNESCO's World Heritage in Danger list in the future. However, recognizing that this may not be a likely scenario for many conflict contexts, it remains critical to strengthen the application of existing international obligations protecting the environment in armed conflict, including by implementing the PERAC Principles and ICRC Guidelines, as well as upholding other relevant international norms described in this chapter.

407 Helen Obregón Gieseken & Vanessa Murphy (2023), 1200-1201.

# Conclusions and recommendations

**From the direct destruction of biodiversity hotspots by military attacks to indirect impacts linked to conflict-related human displacement and unsustainable coping strategies to the disruption of conservation efforts, the effects of armed conflicts on protected environmental areas are multi-faceted and long-lasting. Both internationally designated zones of significant environmental importance or fragility and natural sites and conservation areas without formal designation often get caught in the crossfire of armed conflicts and bear the brunt of their consequences, as demonstrated by the case studies featured in this report.`**

However, with the growing recognition of the devastating impacts of biodiversity loss worldwide and their resulting consequences for societies' climate resilience and long-term well-being, initiatives to enhance better protection of nature from conflict-linked destruction - as one of the drivers of the catastrophic biodiversity loss - can offer a new momentum for designing more effective ways for safeguarding crucial protected areas. From strengthening respect for international norms protecting the environment during hostilities, to mainstreaming environmental considerations across the conflict lifecycle, to additional measures to demilitarize protected environmental zones in armed conflicts, ongoing policy and legal developments suggest useful pathways on how to advance this agenda.

Relying on protected areas objectively determined under multilateral environmental agreements to guide the identification of areas that could be designated as 'protected environmental zones' in situations of armed conflicts is a particularly promising avenue. The purpose of designating such zones is to provide effective and specific protection to them from the effects of hostilities via demilitarization. At the same time, other conservation-related protections afforded to protected environmental areas under other bodies of law, including by Multilateral Environmental Agreements (MEAs), may apply concurrently, and the establishment of such zones could potentially help ensure their conservation in the event of armed conflict.

However, this requires building stronger links between the environmental sector and the peace and security sector, as well as enhancing capacities for environmental action in conflict contexts at both the national and international levels. The below recommendations aim to provide specific suggestions in support of these objectives - to ensure the better protection of both nature and the people depending on it.

## Recommendations

1. **Increase international visibility and recognition of conflict impacts on nature:**

Documentation of devastating impacts of armed conflict on protected areas - both formally designated and OECMs - and raising awareness about them across environmental, climate, peace and security forums is crucial to build political support for more effective and specific protective measures at both international and national levels. Establishing an international Environment, Peace and Security agenda offers concrete avenues for breaking the silos between environmental, humanitarian and peacebuilding policies to ensure the prevention and mitigation of conflict-linked destruction of nature.

**2. Integrate conflict sensitivity into global conservation frameworks and environmental forums:**

Issues related to conflict-related environmental damage should be integrated into discussions about implementation of MEAs such as the CBD Global Biodiversity Framework, UNESCO World Heritage Convention, and the Ramsar Convention, as well as through IUCN Congress and UNEA processes. It is essential to include updates on threats to biodiversity in conflict areas on the agenda of such discussions to prevent the environmental damage in the first place, as well as to design practical measures on developing stronger monitoring and emergency response to those risks, and assisting conflict-affected countries with nature protection efforts amid the challenging circumstances.

**C. Strengthen the use of international legal and policy frameworks for environmental protection in armed conflict:**

States should endorse and implement the various frameworks dedicated to protection of the environment in armed conflict, including the PERAC Principles and the ICRC's Updated Guidelines on the Protection of the Natural Environment in Armed Conflict. States should integrate related international obligations into their military doctrines, national legislation and policies, and operational planning. They should take measures for the identification, designation and specific protection of particularly ecologically important or fragile areas as 'protected environmental zones,' ideally in peacetime, to avoid them from becoming military objectives and to reduce the risk of incidental damage to them during hostilities. Both states and non-state armed groups parties to armed conflicts should avoid placing troops and military assets and conducting military activities in areas of significant environmental importance or fragility.

**D. Improve monitoring, data collection, and archiving of conflict impacts on protected areas:**

It is crucial to invest in independent and systematic monitoring mechanisms to assess the environmental impacts of armed conflict on protected and conserved areas. This includes establishing pre-conflict baselines, continuous remote monitoring during escalations, and in-depth post-conflict environmental assessments, combining earth observation, contextualized local expertise, and the integration of qualitative and quantitative evidence toward developing transparent data repositories to support accountability, recovery planning, and policy responses, as well as for prevention of environmental damage in other conflict contexts. As part of this effort, the development of technical guidance on the collection of data on conflict-related environmental impacts, envisaged under UNEA-6 resolution 6/12 on environmental assistance and recovery in areas affected by armed conflict, should be supported and properly resourced.

**E. Support post-conflict recovery and remediation of protected areas:**

Protected areas and other critical ecosystems affected by conflict should be included in global ecosystem restoration initiatives, climate resilience funding, and environmental recovery frameworks for specific country contexts. Donors and implementing agencies should avoid 'risk aversion' to fragile settings and instead adopt conflict-sensitive approaches that link environmental action to peacebuilding and community recovery.

**F. Use protected areas as a tool for peacebuilding and conflict prevention:**

At the international, regional and local levels, the protected area management should be incorporated into peacebuilding strategies, including joint governance models, community-based conservation, and transboundary 'peace parks' in post-conflict settings. Environmental protection can serve as a platform for cooperation, reconciliation, and prevention of renewed violence, especially in regions with overlapping ecological and political tensions. The UN Peacebuilding Commission (PBC), backed by the Peacebuilding Fund (PBF), can play a particular role in incentivizing environmental peacebuilding initiatives related to protected areas in conflict-affected and at-risk settings.

**7. Advance justice and accountability for conflict-linked environmental destruction:**

Support efforts to strengthen international, regional and national mechanisms for justice and accountability for environmental damage in conflict. This should include enhancing the capacity of regional to international courts, particularly the ICC, to investigate and prosecute serious instances of conflict-linked environmental harm, as well as incorporating environmental considerations in the transitional justice processes, truth commissions and reparations mechanisms. It is essential to recognize communities affected by the ecological damage of armed conflict as rights-holders and to support local advocacy and restoration initiatives.