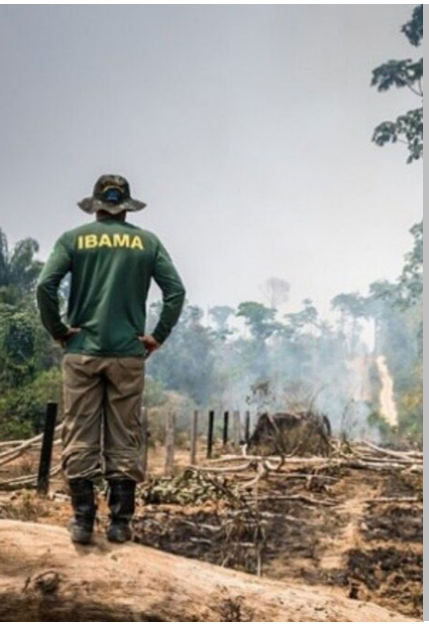

PROTECTED AND CONSERVED AREAS IN AN AGE OF ECOCIDE

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ABSTRACT

Ecocide, incorporating either wilful or large-scale destruction of the environment, is a well-recognised problem, although it has still to come under the jurisdiction of international law. As instances of ecocide increase in both war and peacetime, the integrity of protected and conserved areas is increasingly compromised. Here, we highlight two forms of ecocide, namely broad-sense or large-scale environmental damage and narrow-sense or large-scale damage with intent. Then we examine notable cases of both broad and narrow-sense ecocide affecting national parks. In the Supplementary Online Material, we review the historical and contemporary definitions of ecocide. There are now significant efforts to establish effective legal frameworks aimed at criminalising ecocide, but these are advancing only slowly, and the threats to protected and conserved areas remain.

Keywords: Environmental destruction, International Criminal Court, legal framework, National parks, Rome Statute

INTRODUCTION

Ecocide has proved difficult to define. It can either refer to large-scale incidental environmental destruction or narrowly defined deliberate destruction requiring intent and prior knowledge on the part of perpetrators to destroy the environment. The latter definition carries with it the hope that ecocide could eventually be defined as a criminal offence that can stand up to scrutiny in the courtroom. Historically, there are definitions of both types (see Supplementary Online Material). An example of the former is "*The extensive damage to, destruction of or loss of ecosystem(s) of a given territory, whether by human agency or by other causes, to such an extent that peaceful enjoyment by the inhabitants of that territory has been severely diminished*" (Higgins et al., 2013). A prominent example of the latter is in the Rome Statute, appearing in Article 8(2)(b)(iv) *"Intentionally launching an attack in the knowledge that such attack will cause widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to military advantage"* (Heller & Lawrence, 2007). The Rome Statute is the foundational treaty that established the International Criminal Court (ICC) (UN General Assembly, 1998) and an amendment to the Rome Statute is required to put an international law like ecocide into place. As illustrations, these two ways of thinking about ecocide might respectively involve actions of poverty-stricken people who clear land extensively and thereby cause ecocide accidentally, whereas the latter might refer to the deliberate actions of a government or big company with power and money.

In practice, proving intent for ecocide is challenging, particularly during peacetime when environmental harm often arises from profit-driven "disregarded risk" rather than explicit intent to cause damage (Minkova, 2021). Thus Greene (2018) suggests that "*ecocide can be seen as a crime of consequence rather than intent*", and Westing (1974) argued that "*intent may not only be impossible to establish […], it is essentially irrelevant*". It has even been suggested that the definition of ecocide should involve elements such as "recklessness, or negligence" (Minkova, 2021). Megret (2017) proposed that different elements should correlate to different severities of punishment; in other words, narrow-sense ecocide would involve a higher punishment than broad-sense.

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Nonetheless, and this is critical to our argument, from the point of view of conserving protected and conserved areas (PCAs), the result is the same: widespread habitat destruction. For grassland or Coconut Crabs (*Brigus latro*), it is irrelevant whether intent was involved in their destruction. Moreover, the definition of ecocide in the Rome Statute refers only to instances during wartime, and again this caveat does not materially affect the fauna and flora being destroyed. In this article, we draw attention to the ways in which both types of ecocide affect PCAs in both war and peacetime. By giving examples of each, we find that PCAs are affected by more general interpretations of ecocide and less often by intent.

CONSEQUENCES OF ECOCIDE

Ecocide, in both the broad and narrow sense, causes long-term environmental harm by degrading ecosystems through deforestation and pollution, loss of ecosystem services, increased disaster risks, and contributing to climate change (Brown & Pearce, 2023; Smith et al., 2023; WWF, 2018). It can affect environments within PCAs or outside them. Land and water contamination through mining, oil spills, pesticide overuse, and improper waste disposal degrade soil, reduce agricultural fertility, and harm aquatic ecosystems within PCAs (Zahoor & Mushtaq, 2023). As natural habitats are lost outside PCAs, pressure mounts on PCAs themselves, as people exploit natural resources and encroach on their borders (Laurance et al., 2012). Marine protected areas also suffer from oil spills and destructive fishing practices like bottom trawling both outside and inside PCAs, which disrupt food webs and compromise essential ecosystem services such as climate regulation and oxygen production (Kingston, 2002; Vikas & Dwarakish, 2015). More existentially, unregulated industrial activities, biomass burning, gas flaring, chemical disasters and weaponry degrade air quality, destabilise ecosystems, and contribute to climate change and ozone depletion, which affect PCAs (Manisalidis et al., 2020).

Ecocide affects not only the environment but has social and economic implications. It can cause forced displacement and migration of communities dependent on the environment for their livelihoods. For example, Indigenous tribes in Brazil, including those living in PCAs, have been forced to resettle due to increased infrastructural development in the Amazon (Crook & Short, 2014; United Nations, 2022). Depleted resources disrupt economies, as seen in Kuwait's fishing communities that suffered income loss due to oil spills during the Gulf War (Linden et al., 2004). Overfishing results in a decline in fish abundance even within PCAs, causing increased effort and expense per catch and thus demand for cheap labour, resulting in poverty, food insecurity and higher social vulnerability as, for example, occurred in Thailand (Brashares et al., 2014). More generally, ecocide often disproportionately affects marginalised communities, those with fewer resources and less political power. In addition, most cases of ecocide are committed by large industries and powerful governments that rarely experience the direct effects of their harm. Ecocide thus amplifies existing social inequalities (IPCC, 2023).

EXAMPLES OF WARTIME ECOCIDE AFFECTING PCAS

Conflict often results in severe environmental damage due to intensified resource exploitation, destructive weapons and weakened environmental oversight (Gaynor et al., 2016). PCAs are frequently disregarded, with forests cleared for fuel and habitats destroyed by artillery. Table 1 highlights selected cases of wartime ecocide since 1960, including impacts on national parks.

Broad-sense ecocide: Rwandan genocide

During and after the 1994 Rwandan genocide, Akagera National Park experienced severe ecological degradation. As governance in Rwanda collapsed, the park was overrun by hundreds of thousands of refugees and livestock leading to widespread habitat loss (Moodley et al., 2011). Forests and wetlands were cleared for agriculture and settlement, and large mammals were hunted or displaced (REMA, 2009). The influx of people led to overgrazing, poaching and the destruction of key habitats, pushing many native species towards local extinction and a 64 per cent decrease in forested areas. (Apio et al., 2015; REMA, 2009). The park's northern third was officially degazetted in 1997 to accommodate displaced communities resulting in a permanent loss of 1,380 km² of protected land (Kanyamibwa, 1998). This case illustrates how conflict-driven displacement and governance breakdowns can lead to ecological collapse, even without the direct use of military force against the environment (Moodley et al., 2011). The degradation of Akagera highlights the limits of current international law: while the Rome Statute criminalises environmental destruction in war under Article 8, the threshold is high and applies only to international armed conflict (Higgins et al., 2013). Peacetime or civil war-related environmental degradation, such as in Rwanda, falls outside its scope despite having equally devastating effects. The protection of designated conservation areas should not be contingent on political stability; rather, it should be a binding obligation under international law. Encouragingly, Akagera has undergone a remarkable recovery in recent years, with the

Table 1: Details and justification of environmental harms during wartime since 1960, in national parks and elsewhere. Article 8(2)(b)(IV) is used to define ecocide. "*Intentionally causing widespread, long-term and severe damage to the natural environment within a war context*". This table is not exhaustive; many cases of environmental harm during wartime are less well documented.

Conflict	Overview	Consequences	Justification of ecocide	Responsibility	National park / Damage description
National parks Broad-sense ecocide					
Colombian Conflict (1964–present)	Illicit plantations, deforestation, and drug trafficking.	Land and water contamination Deforestation	Illegal activities and the murder of conservationists imply intent (Arias-Gaviria et al., 2021).	Rebel parties	Sierra de la Macarena NP – illicit cocoa cultivation, armed presence, habitat destruction (Vargas, 2006).
Cold War Nuclear Testing (1970s–1991)	1,700+ nuclear tests in Siberia and Nevada.	Deforestation Ocean damage Land and water contamination Air pollution	Excessive in relation to military advantage (Khalturin et al., 2005).	Government	Nevada Test Site / near Death Valley NP – fallout risk, radioactive contamination (Rothman, 2004).
Angolan Civil War (1975–2002)	Deforestation and poaching due to conflict.	Deforestation Land and water contamination	Dismissal of poaching laws by armed groups (Braga-Pereira et al., 2020).	Government	Kissama NP – elephant and rhino populations decimated; rangers withdrawn (Erickson-Davis, 2014).
Indian Political unrest (1989–2003)	Ethnic militancy caused rangers to withdraw, leading to the destruction of the forest and poaching.	Deforestation Poaching	Systematic degradation of ecosystems under conflict, targeting wildlife and conservation assets.	Political factions	Manas NP – Militant occupation led to poaching, infrastructure loss, and biodiversity threats (Goswami & Tg, 2011).
Liberian Civil War (1989–2003)	Illegal mining to fund conflict. Deforestation and land clearing.	Deforestation Land and water contamination	Deliberate dismissal of mining regulations.	Militia groups	Mount Nimba NP – deforestation and habitat loss due to post-conflict settlements (Enaruvbe et al., 2019).
Croatian War of Independence (1991–1995)	Landmines and militant camps.	Deforestation Land and water contamination	Prolonged warfare damaging protected ecosystems.	Government	Plitvice Lakes NP— Hostilities caused landscape damage, loss of access, and pollution from military activity (Mužinić & Filipović, 2006).
Rwandan Genocide (1994)	Mass displacement of refugees led to deforestation and poaching.	Deforestation Poaching Land and water contamination	Collapse of environmental regulations.	Government and militia	Akagera NP— collapse of park's boundaries led to land clearing for agriculture and illegal mining (REMA, 2009).
Second Congolese War (1998–2003)	Land clearing, illegal charcoal mining.	Deforestation Poaching Land and water contamination	Intentional land clearing and ignorance of mining laws (UNESCO, 2024).	Militant groups	Virunga, Kahuzi-biega NP – Poaching of mountain gorillas and hippos (Virunga Foundation, 2022).
Côte d'Ivoire Civil War (2002–2011)	Illegal poaching by militia groups.	Deforestation Poaching	Prolonged disregard for infrastructure in place to protect environment.	Government, militia groups	Comoé NP – Unchecked exploitation and collapse of scientific monitoring systems (Fischer, 2013).
Sri Lankan Civil War (2006–2009)	Palmyra tree logging, mined landscapes.	Deforestation Land and water contamination	Systematic environmental degradation (Dathan, 2020).	Government and rebels	Wilpattu NP — mining and poaching (Akbarally, 2016).

Table 1: Continued

National parks Narrow-sense ecocide					
Russian Invasion of Ukraine (2022–present)	Kakhovka Dam destroyed, 12,000 Ha burnt.	Deforestation Land and water contamination Ocean damage	Indiscriminate and lasting harm (Solokha et al., 2023).	Government	Sviati Hory NP, Black Sea Biosphere Reserve – habitats submerged or eroded; fires and habitat (Peter & Hunder, 2024).
Iraqi Suppression of Marsh Arabs (1991)	Marshes drained using dams and canals.	Deforestation Ocean damage	Systematic destruction of an ecosystem (HRW, 2003).	Government	Hawizeh Marsh (UNESCO Wetland) – complete collapse of aquatic ecology (Moumin, 2007).
El Salvador Civil War (1980–1990)	Bombing of agricultural and forest lands.	Deforestation	Widespread long-term environmental damage (Hecht et al., 2006).	Government	El Impossible NP — forest loss from bombing, deforestation post-conflict (White, 2008).
Elsewhere Broad-sense ecocide					
Vietnam War (1961–1971)	Sprayed 76 million litres of herbicides (Agent Orange).	Deforestation Ocean damage Land and water contamination	Excessive damage in relation to military advantage (Frey et al., 2013).	Government	No record of damage to a national park.
Gulf War Oil Spills (1991)	One billion barrels of oil spilt into the Persian Gulf.	Deforestation Land and water contamination Ocean damage Air pollution	Deliberate environmental destruction (Linden et al., 2004).	Government and rebels	No record of damage to a national park.
East Timorese Crisis (1999)	Scorched earth tactics, forest fires.	Deforestation	Intentional burning of forest (Bouma & Kobryn, 2004).	Government and rebels	No record of damage to a national park.
Chechen Wars (1999–2009)	Fuel depots targeted, forests burned.	Deforestation Land and water contamination Air pollution	Intended destruction of environment (Yin et al., 2019).	Government and rebels	No record of damage to a national park.
Lebanon War (2006)	Bombing of power stations caused 30,000 tonnes of fuel to spill.	Land and water contamination Ocean damage	Disproportionate environmental impact (ICUN, 2007).	Government	No record of damage to a national park.

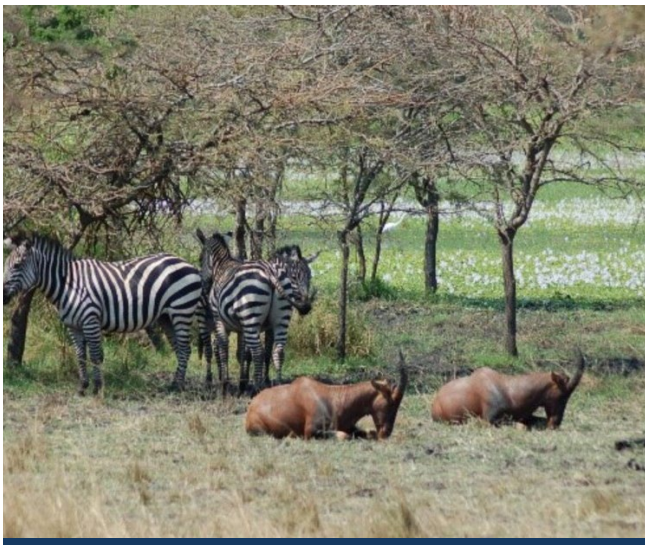

Figure 1: Large mammals in Akagera National Park, Rwanda © Tim Caro, 2023

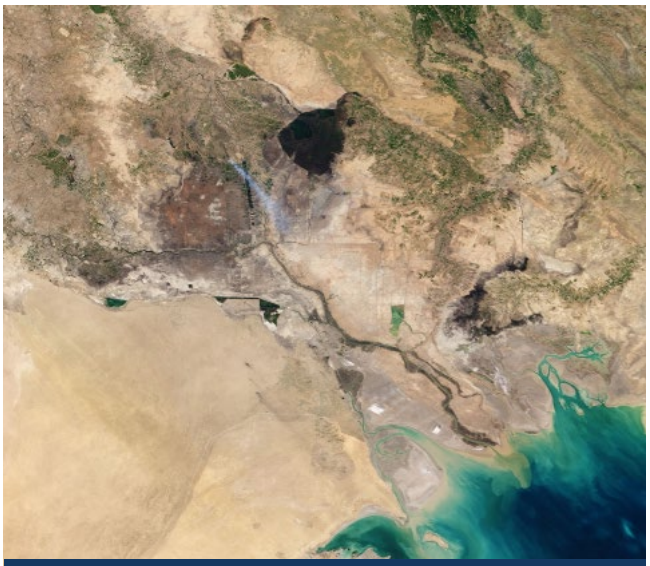

Figure 2: Dried up Mesopotamian Marshes in 2001 © NASA, 2009

successful reintroduction of rhinoceroses and improved biodiversity outcomes under the management of African Parks, demonstrating what is possible with sustained investment and effective conservation governance (Figure 1) (African Parks, 2017; Apio et al., 2015).

Narrow-sense ecocide: Iraqi suppression of Marsh Arabs

During the late 1980s and throughout the 1990s, the Iraqi regime under Saddam Hussein carried out a systematic campaign of repression against the Marsh Arabs (Ma'dan), an ethnocultural group inhabiting the Mesopotamian Marshes in southern Iraq. Following the 1991 Shi'a uprisings after the Gulf War, the Iraqi government responded with brutal military force, targeting the Marsh Arabs for their perceived disloyalty and opposition to the regime (UNEP, 2001). This campaign extended beyond direct violence: it involved ecocidal tactics that destroyed the ecological and cultural foundations of Marsh Arab life.

The Mesopotamian Marshes, once among the largest wetland ecosystems in the Middle East and a globally significant PCA, were deliberately drained through the construction of massive canal systems, embankments and dams, effectively transforming the wetlands into arid wasteland (Richardson & Hussain, 2006). By 2000, more than 90 per cent of the marshland had been desiccated, leading to the collapse of unique freshwater ecosystems, the local extinction of species such as the Marbled Teal (*Marmaronetta angustirostris*) and African Darter (*Anhinga rufa*), and the mass displacement of up to 500,000 Marsh Arabs (UNEP, 2001).

This act of environmental destruction served a dual purpose: erasing the ecological base of the Marsh Arab culture and punishing political dissent. The regime's actions meet the criteria of narrow-sense genocide by intentionally targeting a specific ethnoreligious group through both direct violence and indirect means, including environmental manipulation designed to force their displacement or cultural erasure (HRW, 2003). The Mesopotamian Marshes case reveals how civil conflict and state violence can weaponise ecosystems, transforming protected landscapes into instruments of oppression.

Yet, international legal frameworks struggled to respond effectively. While the Rome Statute prohibits environmental destruction in international conflict under Article 8(2)(b)(iv), it provides no clear recourse for ecocidal actions committed during internal conflicts or those targeting civilian ecosystems as part of broader campaigns of persecution (Higgins et al., 2013). This legal blind spot has allowed ecological devastation on a par with war crimes to go largely unpunished.

Following the fall of the regime in 2003, local communities and international organisations launched restoration efforts. Partial reflooding of the marshes has enabled some species and habitats to return. The area was designated (Figure 2) a national park in 2013 and later became a UNESCO World Heritage Site (National Parks Association, n.d.; UNESCO, 2016). However, recovery remains incomplete, with ecological fragmentation, upstream damming, and political instability continuing to threaten long-term restoration (Richardson & Hussain, 2006). The case of the Marsh Arabs underscores the urgent need for international legal instruments to recognise and prosecute ecocide as a standalone crime, particularly when it intersects with cultural genocide and PCA destruction.

Figure 3: Mining camp in Canaima National Park, Venezuela © Luis Bartolome Marcos, 2004

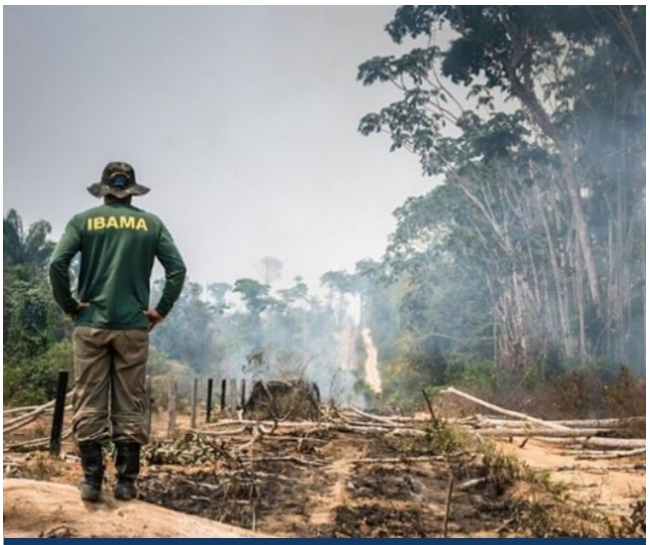

Figure 4: Deforestation in Brazilian FLONA Jamanxim © Vinícius Mendonça/Ibama, 2017

EXAMPLES OF PEACETIME ECOCIDE AFFECTING NATIONAL PARKS

Although Article 8 of the Rome Statute addresses ecocide only during wartime, peacetime ecocide, characterised by prolonged, profit-driven activities such as illegal logging, mining, industrial fishing, fossil fuel extraction, agricultural encroachment, and unsustainable tourism, poses an ongoing threat to protected areas (Greene, 2018; Minkova, 2021). These activities gradually degrade ecosystems both within and at the boundaries of national parks. Table 2 presents selected examples of peacetime ecocide since 1960 and their impacts on protected areas.

Broad-sense ecocide: Illegal gold mining

Venezuela's national parks face severe degradation from illegal gold mining under weakened environmental governance during Nicolás Maduro's administration (Figure 3) (SOS-Orinoco, 2024; Stachowicz et al., 2023). National Parks Yapacana and Canaima, in particular, have experienced "extreme ecocide", with nearly 5,000 acres of Yapacana cleared for mining infrastructure (SOS Orinoco, 2019). The mining operations, often protected by armed groups, have caused significant ecological damage, including mercury contamination, fires and the disruption of Indigenous communities. Under-funded park authorities struggle to enforce laws amid reports of collusion with miners. Indigenous groups like the Yanomami and Pemon suffer health crises, displacement and violent clashes (Rendon et al., 2020, Singh et al., 2021). The case challenges how we define ecocide. While mining isn't inherently illegal, its occurrence within protected areas transforms environmental harm into a potential international crime. The scale, permanence and illegality of the damage, alongside state inaction or complicity, align with emerging legal definitions of ecocide as unlawful or reckless acts causing severe and lasting environmental harm (Stop Ecocide International, 2021).

Despite strong evidence, including satellite images and field reports, UNESCO and IUCN have not formally intervened in Canaima National Park. SOS Orinoco seeks its designation as a "World Heritage Site in Danger" but Venezuela's government has ignored international appeals (SOS-Orinoco, 2019). This highlights how ecocide thrives amid state collapse and impunity, reinforcing the urgent need for an international legal framework to recognise and prosecute ecocide where national protections fail. The inclusion of ecocide as a crime under international law would provide a critical legal tool to hold perpetrators accountable and prevent such large-scale environmental destruction in the future.

Narrow-sense ecocide: Deforestation of the Amazon

From 2019 to 2022, Amazon deforestation increased by 85 per cent, largely due to President Bolsonaro's weakening of environmental protections and the Ministry of Environment's authority. A 95 per cent cut to funding for Brazil's National Climate Change Policy purposefully accelerated agricultural expansion and infrastructure projects. Loosened regulations led to reduced enforcement, with illegal logging prosecutions falling and fines dropping by 30 per cent (Raftopoulos & Morley, 2020). Despite their protected status, Brazilian Amazon National Forests like Jamanxim, Altamira and Itaituba faced widespread deforestation from 2018 to 2021, mainly due to illegal but unofficially sanctioned cattle ranching (Gusmão et al., 2024). This destruction led to reduced carbon capture of the forest, decreased rainfall, ecosystem fragmentation and loss of unique

Table 2: Details and justification of environmental harm during peacetime since 1960, in national parks and elsewhere. The Proposal to the Rome statute drafted by Stop Ecocide International's Independent Panel in 2021 is used to define ecocide. "*Unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment*" (Stop Ecocide International, 2021). This table is not exhaustive, and many cases of environmental harm go undocumented.

Case	Overview	Consequences	Justification	Responsibility	National park / Damage description
National parks Broad-sense Ecocide					
Oil dumping Ecuador (1964–1992)	68 billion litres of oil were dumped in the jungle.	Deforestation (4,500 km²) Land and water contamination	Surpassed regulations, resulting in long-term environmental damage (Akchurin, 2015; Durango-Cordero et al., 2018).	Corporation	Yasuní NP – Oil exploitation and spills. Deforestation and damage to ecosystems (Yasunidos, 2023).
Palm oil, Indonesia (1970s–current)	Peatland destruction for palm oil plantations.	Deforestation	Overruled scientific advice and surpassed regulations (Human Rights Watch, 2021).	Government	Gunung Leuser NP — Illegal plantations causing loss of critical habitat (Sullivan, 2005).
Alberta Tar Sands 1990–current)	Oil extraction site of 130 km².	Land and water contamination Air pollution Deforestation	Overruled scientific advice (Finkel, 2018; Timoney & Lee, 2009).	Corporation	Wood Buffalo NP — River contamination causing severe ecological stress (UNESCO, 2018).
Toxic waste dumping – Côte d'Ivoire (2006)	Illegal disposal of petroleum waste.	Land and water contamination	Surpassed regulations with no concern for safety (Amnesty International, 2012).	Corporation	Banco NP — waste dumping damaged forest habitat (Tia & Dago, 2016).
Belo Monte Dam (2011–Present)	Dam construction flooded/destroyed 6,500 km² of rainforest.	Land and water contamination Deforestation	Overruled scientific advice (Bratman, 2014).	Corporation	Xingu Indigenous NP — Floods and disrupted ecosystems (Royal Geographical Society, 2015).
National parks Narrow-sense ecocide					
Amazon rainforest deforestation (2019–2022)	Relaxed regulations led to an 85% increase in deforestation.	Deforestation Land and water contamination	Severe, long-lasting, and ignored warnings (Raftopoulos & Morley, 2020).	Government	Jamanxim, Altamira and Itaituba – affected heavily by deforestation (Gusmão et al., 2024).
Elsewhere Broad-sense ecocide					
Aral Sea disappearance (1960–2010)	The fourth-largest lake was drained by Soviet irrigation projects.	Ocean damage Land and water contamination	Knowledge of consequences implies intent (United Nations Economic Commission for Europe, 2005).	Government	No record of damage to a national park.
Mountaintop Removal Mining – West Virginia (1970s–2015)	Extraction of coal from mountaintops.	Deforestation (400 km²) Land and water contamination Air pollution	Overruled scientific advice (Greenberg, 2016).	Corporation	No record of damage to a national park.
Niger Delta oil exploration (1970s–current)	Illicit dumping, oil spills and gas flaring.	Land and water contamination Air pollution Ocean damage	Insufficient safety regulations imply intent (Sentamu et al.,, 2023; Ubani & Onyejekwe, 2013).	Corporation	No record of damage to a national park. Although in close proximity to Old Oyo NP.
BP oil spill (2010)	Millions of barrels of oil released into Gulf of Mexico.	Land and water contamination Ocean damage	Knowingly neglected environmental protection (Beyer et al., 2016).	Corporation	No record of damage to a national park. Although damage to MPAs was recorded.
Wastewater disposal – SW UK (2010–2015)	Billions of litres of raw sewage released into the sea.	Land and water contamination Ocean damage	Illegal disposal and attempted concealment (Ahmed et al., 2021; Environment Agency, 2022).	Corporation	No record of damage to a national park. Coastal marine reserves were affected.

biodiversity (Lapola et al., 2023) (Figure 4). Although ecocide lacks a legal definition during peacetime, extensive Amazon deforestation undeniably inflicts severe and far-reaching consequences on the environment. Ignoring NGO and international warnings, Brazil eased sanctions and promoted development in the region. In response, Indigenous chiefs and environmental organisations submitted an Article 15 communication to the International Criminal Court (ICC), citing harm to both Indigenous people and the ecosystem. However, prosecution is unlikely due to the absence of ecocide legislation outside wartime (Nascimento et al., 2023; Raftopoulos & Morley, 2020).

THE RELATIONSHIP BETWEEN ECOCIDE AND NATIONAL PARKS

Over the last century, the concept of PCAs, especially national parks, has grown from being a way to conserve elite hunting reserves or geological features to conserving the world's diminishing biodiversity, ecosystem services and cultural heritage. Over the last six decades, the concept of ecocide has gained increasing recognition as a crime against the environment (see Supplementary Online Material). At their core, both frameworks are underpinned by a shared imperative: to conserve nature by reducing large-scale destruction and stopping the continued onslaught on the natural world through a thousand cuts. They function as complementary approaches, ecocide as a potential legal mechanism to deter and punish environmental harm, and national parks as proactive conservation tools that protect vulnerable ecosystems before irreversible damage occurs. Moreover, within national parks ecocide not only affects biodiversity, it also constitutes cultural and economic loss. Many Indigenous communities live in or near PCAs and rely on them for their livelihoods and spiritual practices. When ecocide occurs, communities are displaced, their knowledge systems threatened, and their autonomy undermined (Crook & Short, 2014; United Nations, 2022).

International law has been slow to formally adopt ecocide as a criminal offence, in part because of legal and definitional issues, and with key proposals repeatedly blocked or diluted. In the face of this inertia, national-level park policy offers a practical opportunity: even if ecocide is not yet criminalised globally, its principles could be integrated into domestic environmental law, especially within protected area frameworks. National park legislation could adopt narrow ecocide-style language to define severe or intentional environmental damage as a criminal offence within park boundaries or buffer areas, creating a legal deterrent without waiting for international consensus. Some countries, like Ecuador, already recognise the rights of nature in their constitutions, providing a precedent for embedding strong environmental protections at the national level (Tanasescu, 2013). Moreover, several countries, including New Zealand, India and Colombia, have granted legal personhood to rivers, recognising them as rights-bearing entities. This legal innovation allows ecosystems to be represented in court, reinforcing accountability for environmental harm and offering a model for protecting natural areas through rights-based frameworks (O'Donnell & Talbot-Jones, 2018).

National parks can also help address some of the shortcomings of ecocide law. One major challenge for ecocide prosecution is proving intent, particularly when environmental harm is a byproduct of economic activity rather than an explicit goal (Westing, 1974). National parks, with their designated status, boundaries and management plans, provide a clear framework for monitoring changes, attributing responsibility, and measuring harm over time. The clarity of what is being protected can strengthen legal arguments and reduce ambiguity. Surveillance, ecological baselines and reports from parks can offer the evidence base that ecocide cases often lack in unprotected areas. Moreover, while ecocide law prosecutes after destruction has occurred, national parks operate on the principle of prevention. The existence of well-managed PCAs can reduce the likelihood of ecocide occurring in the first place by placing restrictions on resource extraction, deterring illegal activity through enforcement, and increasing public and political awareness of valuable ecosystems. Where ecocide law is weak or unenforced, PCAs can serve as a frontline defence.

In conflict zones or areas with weak governance, park boundaries are often ignored. Lack of funding, insufficient ranger presence, and poor community relations can leave parks vulnerable to illegal exploitation (National Park Service, 2006). Here, broad-scale ecocide law could fill the gap by providing an external legal framework to hold perpetrators accountable, even across borders or in post-conflict settings (Stop Ecocide International, 2021).

In summary, while ecocide law and national park and other conserved areas policies arise from different traditions, one legal, one conservationist, they are complementary. Where ecocide law falters in enforcement or definition, national parks provide specificity, visibility and ecological data. Where national parks struggle to deter large-scale destruction, ecocide law can provide the legal teeth. In the long term, embedding ecocide protections into all PCA laws could serve as a stepping stone towards broader international recognition and enforcement.

OUTSTANDING ISSUES

Laws to prevent ecocide, a concept very loosely defined as the extensive destruction of the natural environment by human activities, have been proposed by international and national bodies. However, there are still no international laws outlawing widespread habitat destruction and degradation. Nonetheless, to date, thirteen countries have incorporated variations of Article 26 of the Draft Code of Crimes Against the Peace into their domestic legislation, criminalising ecocide during peacetime (Vietnam, Uzbekistan, Tajikistan, Russia, Moldova, Kyrgyzstan, Kazakhstan, Ecuador, Belarus, Ukraine, Armenia, Georgia and France). None of these nations have established a means for measuring intent, despite using the term "intentionally" in their definition of ecocide (Higgins et al., 2013).

Environmental destruction often derives from cumulative small harms over time making it difficult to assign clear causation as no single person causes climate change or coral reef loss (Greene, 2018; Minkova, 2021). While laws against ecocide could address dramatic events, they might prove impractical against widespread environmental degradation caused by humanity at large.

Some would argue that corporations mining in sensitive areas, logging rainforests or producing polluting fertilisers are committing ecocide due to their widespread, long-term environmental harm. However, a key legal challenge is determining whether the harm is "wanton", clearly excessive in relation to anticipated social or economic benefits. Corporate leaders often argue they are meeting legitimate demands, such as providing raw materials, lowering food costs, and generating profits for shareholders, which they view as reasonable. In contrast, environmentalists may argue the ecological damage far outweighs these benefits, making the harm excessive. Such an argument leads to a slippery slope where a great many business enterprises could be classified as wanton and the meaning of ecocide could easily become diluted (Minkova, 2021). One proposed solution is to incorporate the valuation of nature into legal frameworks. With natural capital estimated at US$125 trillion annually (WWF, 2018), assigning monetary value to ecosystems could help courts assess environmental harm more objectively, although the scope of ecosystem services would have to be determined.

Apportioning blame for ecocide is a complex issue. For example, following the Rwandan genocide, hundreds of thousands of refugees caused deforestation, poaching and ecosystem degradation in Akagera National Park largely out of necessity for survival rather than malicious intent (REMA, 2009). This raises difficult questions about culpability in broader cases like Amazon deforestation, where perpetrators range from powerful multinational corporations to impoverished small-scale farmers. Determining who should be held responsible and where to draw the line is challenging. Assigning blame should consider both the severity of environmental damage and the intent behind the actions. Larger entities with greater resources, influence and control over environmental outcomes, such as multinational corporations, should arguably face stricter accountability standards. This is especially pertinent for less affluent countries that grapple with the imperative of development while mitigating ecological harm. Should these nations be granted the same developmental freedoms as their first-world counterparts historically had, even at the risk of ecocide? Policies should balance developmental needs with environmental protection, potentially offering support and alternatives to those who rely on environmentally harmful practices for their livelihoods.

CONCLUSIONS

Over the years, there have been considerable disagreements over the definition of ecocide, centring on intent, scale of damage, whether it is restricted to wartime, and responsibility. From the perspective of fauna and flora damaged by human activities, this debate may not be relevant except as a deterrent to prevent further instances of ecocide. Rather, the scale and severity of ecocide is important. We therefore propose a more relaxed definition of ecocide as "*The sufficiently extensive damage to, or destruction of the natural environment that results in substantial loss of biodiversity, wilderness and ecosystem function caused by human activity whether deliberate, reckless, or negligent*".

Using this definition, the number of instances of ecocide affecting PCAs since 1960 is of great concern (see Tables 1 and 2) and represents a serious threat to their integrity. Ecocide within PCAs is the manifestation of an extreme form of PADDD (Protected Area Downgrading, Downsizing and Degazettement), the legal changes that reduce or eliminate protected areas (Mascia & Pailler, 2011), which have been increasing rapidly over the last 20 years. They represent an ever-present threat to our ability to conserve habitats and species at a time when they are already under siege. Our goal of conserving 30 per cent of the world's area by 2030 (CBD, 2022) is insufficient if the integrity of those protected areas is not safeguarded.

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SUPPLEMENTARY ONLINE MATERIAL

Historical overview of the origin of the term ecocide

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RESUMEN

El ecocidio, que incluye la destrucción deliberada o a gran escala del medio ambiente, es un problema ampliamente reconocido, aunque aún no ha sido incorporado al ámbito de la jurisdicción del derecho internacional. A medida que aumentan los casos de ecocidio, tanto en tiempos de guerra como de paz, la integridad de las áreas protegidas y conservadas se ve cada vez más comprometida. Aquí destacamos dos formas de ecocidio, a saber, el daño ambiental en sentido amplio o a gran escala y el daño en sentido estricto o a gran escala con intención. A continuación, examinamos casos notables de ecocidio tanto en sentido amplio como en sentido estricto que afectan a los parques nacionales. En el material complementario en línea, revisamos las definiciones históricas y contemporáneas de ecocidio. En la actualidad se están realizando importantes esfuerzos para establecer marcos jurídicos eficaces destinados a tipificar como delito el ecocidio, pero estos avanzan lentamente y las amenazas a las áreas protegidas y conservadas siguen existiendo.

RÉSUMÉ

L'écocide, qui désigne la destruction délibérée ou à grande échelle de l'environnement, est un problème largement reconnu, même s'il ne relève pas encore de la juridiction du droit international. À mesure que les cas d'écocide se multiplient, tant en temps de guerre qu'en temps de paix, l'intégrité des zones protégées et conservées est de plus en plus compromise. Nous mettons ici en évidence deux formes d'écocide, à savoir les dommages environnementaux au sens large ou à grande échelle et les dommages au sens strict ou à grande échelle avec intention. Nous examinons ensuite des cas notables d'écocide au sens large et au sens strict affectant les parcs nationaux. Dans le matériel supplémentaire en ligne, nous passons en revue les définitions historiques et contemporaines de l'écocide. Des efforts importants sont actuellement déployés pour mettre en place des cadres juridiques efficaces visant à criminaliser l'écocide, mais ceux-ci ne progressent que lentement et les menaces qui pèsent sur les zones protégées et conservées demeurent.