A Bibliometric Investigation of Ecocide Research: Tracing Trends and Shaping the Future

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Abstract. Nearly every single day, research reports testify new evidences of substantial environmental degradation occurring around the world, impacting the lives of millions of people. As a notion, this environmental degradation that pertains to both naturally existing mechanisms of environmental or ecosystem degradation and ecological destruction due to anthropogenic activities is commonly referred to as Ecocide. While there is a significant body of research on ecocide, there appears to be a noticeable absence of bibliometric analyses dedicated to comprehensively studying and exploring this field. While the majority of literature in the area of environmental degradation revolves around the detrimental impacts of ecocide, there is a dearth of studies exploring the past, present and future of extant literature using bibliometric analysis. This research adopts bibliometric methodology to glean significant insights into the progress made in this field, delving into research articles published from 1990 to 2022. The paper aims to classify the available literature on Ecocide based on bibliometric criteria, including publication year, geographical region, authorship, affiliated institution, and source. Also, a bibliometric analysis of keyword co-occurrence to understand the mainstream themes underpinning the Ecocide literature was performed. The paper also reviews the legal frameworks and comes up with future areas of research in the domain of ecocide. This work can help find commonalities and connections in the published works. With this knowledge, researchers might build stronger partnerships and reach a larger audience with their advances. This research can fill up the gaps in the extant literature and provide new directions for research and policymaking.

Key words: Ecocide, Environmental degradation, Bibliometric analysis, Genocide, SDGs,

Introduction

International law researcher Richard Falk, in 1973 confirmed that humans had begun to recognize the magnitude of the harm caused by anthropogenic activities. The use of dangerous weapons in armed conflicts, as well as the repercussions of resource extracting corporations such as mineral and fossil fuel extraction, farming, and logging, were noted to be progressively destroying the environment and, with it, humankind's well-being [9]. Forty-Nine years later, this work is a bibliometric investigation of if this predicament has changed for good or worsened in fact.

Nearly every single day, research reports testify new evidences of substantial environmental crime [17] and degradation occurring around the world, impacting the lives of millions of people. The disastrous environmental and societal impact of the industry extracting palm oil is one of the most recent of such environmental concerns. A huge area of tropical forests has been cleared to establish industrial palm oil plantation farms causing contamination of air, water, and soil, soil degradation, the ruination of indigenous plant and animal species' habitat, and promoting social squabbles amongst local communities whose living standards are being simply disregarded [22, 24]. Worryingly, this is just one of the numerous examples. In fact, environmental destruction is occurring at a rate faster than initially assumed [27]. The use of massively destructive armaments during times of war, as well as considering and using the earth as a consumer good to drive economic expansion in both conflict and non-conflict settings, has resulted in an increase in the violations of human rights and also environmental degradation. Due to their chronicity and severity, the disastrous effects of these actions have earned their own name- Ecocide. Ecocide is easily interpreted as pervasive and protracted damage and degradation of natural environment and ecosystems. Committed again and again over generations, Ecocide is a root reason for the current environmental and ecological crisis.

'Killing our home' (i.e., 'killing our environment') is a classic way of defining ecocide. However, ecocide not only degrades environment but also seriously violates human rights. Human rights and environmental conservation are inextricably linked; safe and healthy environment is crucial for individuals and social groups to exercise their most essential underlying human rights. In general, incidents of massive ecological destruction have an adverse effect on human well-being, as well as the well-being of all other living and non-living ecosystem elements, which is actually harmful to humanity's survival.
Ecocide is a term that refers to "a variety of human or natural actions and processes that all have one thing in common: they harm and decimate the ecosystems around the world to the detriment of flora and fauna"[10]. The concept of Ecocide encompasses both naturally occurring processes of environmental or ecosystem degradation and ecological harm resulting from human activities [32]. As per a legal definition coined by Stop Ecocide International [18], "Ecocide means unlawful or wanton acts committed with the knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment being caused by those acts." [23]. It is very important to understand the components of this definition as discussed below in table 1:

Table 1: Elements of definition of Ecocide

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Component</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wanton</td>
<td>&quot;Wanton&quot; implies careless indifference towards the degradation that is visibly excessive in context to the expected socioeconomic benefits;</td>
</tr>
<tr>
<td>2</td>
<td>Severe</td>
<td>&quot;Severe&quot; denotes environmental degradation with excessively negative changes, disturbances, or damage to any component of the natural environment, as well as severe consequences for human or natural life, society, or economic resources;</td>
</tr>
<tr>
<td>3</td>
<td>Widespread</td>
<td>&quot;Widespread&quot; refers to destruction that stretches beyond a specific geographic area, traverses states, or affects an ecosphere, organisms, or a huge amount of people;</td>
</tr>
<tr>
<td>4</td>
<td>Long-term</td>
<td>&quot;Long-term&quot; damage is defined as devastation that is irreversible or cannot be rectified within a reasonable time span through nature's recovery process;</td>
</tr>
<tr>
<td>5</td>
<td>Environment</td>
<td>&quot;Environment&quot; refers to biodiversity, frozen parts of earth, solid, outer part of the Earth, water that is on the surface of the planet, underground, and in the air, atmosphere including the outer space.</td>
</tr>
</tbody>
</table>

Source: Stop Ecocide International [18]

Ecocide and Sustainable Development Goals

Several SDGs and objectives that the United Nations set out are directly or indirectly related to ecocide. Global warming is exacerbated by ecocide, which is often associated with actions that release greenhouse gases (SDG 13: Climate Action). Ecocide must be reduced if SDG 13, which addresses climate change and its effects, is to be successful. Ecocide threatens biodiversity and the delicate balance of life on both land (Goal 15: Life on Land) and sea (Goal 14: Life below water). Preventing ecocidal actions requires protecting these ecosystems, as emphasized in SDGs 14 and 15. Pollution from ecocidal practices may pollute water sources, making it difficult to supply clean and safe drinking water, which is a major target of SDG 6, which focuses on water and sanitation. Further, the objective of ending world hunger by 2030 (SDG 2) is directly threatened by ecocide, which may diminish agricultural production and cause food insecurity. SDG 3 of the Sustainable Development Agenda is "Good Health and Well-being." Ecocide has both immediate and long-term consequences for human health, from the pollution of air and water to the loss of biodiversity that threatens our access to life-saving medicines. Ecocide must be addressed if SDG 3 on health and well-being is to be achieved. Ecocidal practices are a direct threat to the sustainable consumption and production patterns promoted by SDG 12. Promoting ethical and sustainable resource usage requires paying attention to ecocide. Sustainable development goals (SDGs) are aligned with efforts to avert ecocide. Communities and countries can help the world achieve these objectives of a healthier environment, greater biodiversity, and a more sustainable future for everyone by taking steps to reduce ecocidal actions [30,29].

Searching the keyword ‘Ecocide’ in the ‘Article title, Abstract, Keywords’ search option of the Scopus database leads to 364 publications addressing various aspects of Ecocide. While there is an abundance of literature on ecocide research, it was noticed that no bibliometric analysis was carried out to organize such a vast and evolving area of research scientifically. While the most of the literature in the area of ecocide revolves around the detrimental impacts of ecocide, a dearth of studies
exploring the extant literature (underlying themes, past, present and future research agendas) using bibliometric analysis could limit readers’ policy makers; and public’s understanding of this area of global interest. This research, therefore, adopts bibliometric methodology to extract valuable insights regarding the progress that has been examined within this field through research publications spanning from 1990 to 2023. This study therefore aims at achieving undermentioned research questions:

**RQ 1:** Classification of the Ecocide literature (performance analysis) based on bibliometric criteria including years, geographic regions, authorships, affiliated institutions, and sources.

**RQ 2:** A bibliometric analysis of conceptual structure (keyword co-occurrence) to understand the mainstream themes underpinning the Ecocide literature

**RQ 3:** A review of legal frameworks in the area of ecocide

**RQ 4:** A review of future research areas in the domain of ecocide

1. **Methodology**

In order to address the aforementioned research questions, a bibliometric analysis of research papers published between 1990 and 2023 was conducted. This involved the retrieval of pertinent articles from the Scopus database. Scopus was selected for bibliometric data due to its vast coverage of scientific literature, rigorous content evaluation, and continuous quality control. It provides comprehensive author and institutional profiles through advanced categorization algorithms, making it a reliable source for research assessments, ecosystem studies, policy evaluations, and university rankings. The keyword “Ecocide” was used to find and select relevant articles in the ‘article title’ search option of the Scopus. Figure 1 depicts the publications in Ecocide research from 1990 to 2023.

![Figure 1: Year wise publications on Ecocide](https://example.com/figure1.png)

Based on the abstracts, titles, and relevant keywords, 364 publications were extracted. Given the research’s specific focus on ecocide, only studies aligning with the defined research objectives were chosen. In this context, the PRISMA framework was employed to ensure the inclusion of relevant studies [2,3]. The PRISMA framework consists of four key phases: identifying and documenting studies through database searches, reviewing the documented studies, verifying eligibility, and making the final selection of studies. A visual representation of the PRISMA methodology employed for article selection is depicted in Figure 2 below.
Following PRISMA guidelines and critical evaluation of authors, books, conference papers, notes, erratum and short surveys not fulfilling the objectives of the study and not in English were eliminated. This process led to the selection of a final set of 174 articles, which were subsequently analyzed to fulfill the research’s defined objectives. The author keywords, citations, and bibliographic data from these 174 publications were exported into the VOSviewer and Biblioshiny. VOSviewer was used for creating, visualizing, and analyzing bibliometric networks and Biblioshiny was used to analyze trends and impact of sources, authors and documents.

2. Analysis and discussion on results

2.1 RQ1: Classification of the available Ecocide literature (performance analysis) based on bibliometric criteria including year, geographic region, authorship, affiliated institution, and source.

2.1.1 Publication Evolution Over the Time

To have a better clarity of the publication trajectory, the period of 31 years (1992-2023) was divided in six periods/clusters as visible in figure 3. As the main ideas and themes of a publication may be identified with the aid of keywords. This becomes even more essential for organising massive numbers of published works. Moreover, analysis of the steadiness, growth or decline in use of a set of keywords over time might reveal burgeoning tendencies in an area of study. Therefore, to enrich the understanding of publications, each period was investigated for keywords with highest frequency. This not only could help organize the central themes of each period but might as well serve to improve the assimilation of domain development amongst readers.

Figure 3 shows the spread of publications over time and emphasizes the most frequently used keywords from each period's publications. Seven publications appeared during the first time period (1992–1999), with terms like “ecocide” (n=5), “environmental protection” (n=5), and “genocide” (n=5) appearing most often. From 2000-2005, there were a total
of 5 publications that focused on keywords including "environmental degradation" (n=7), "ecocide" (n=6), "environmental protection" (n=6), and "genocide" (n=6). Eight papers were published during the third period (2006-2010), with a focus on keywords such as crime (n=8), anthropogenic influence (n=4), environmental degradation (n=10), ecocide (n=5), environmental protection (n=9), and genocide (n=9). Keywords for the fourth period (2011-2015) included crimes (n=11), anthropogenic effects (n=8), environmental degradation (n=14), criminal law (n=1), ecocide (n=7), environmental protection (n=10), and genocide (n=10). Crime (n=17), anthropogenic influence (n=13), environmental degradation (n=16), criminal law (n=5), ecocide (n=15), environmental protection (n=10), genocide (n=12), and Minas Gerais (n=2) were the most frequently used keywords for publications in the fifth period (2016-2020). The most commonly used keywords in publications published during the sixth period (2012-2023) were crime (n=16), anthropogenic effect (n=12), environmental degradation (n=12), criminal law (n=7), ecocide (n=9), environmental protection (n=8), genocide (n=9), and Minas Gerais (n=5).

This complex approach emphasizes the necessity for holistic viewpoints and cooperation across different fields, highlighting the multidisciplinary character of modern research. Changes in keywords reflect shifts in social concerns, legislation, and new difficulties, illustrating the ever-evolving character of scientific investigation. These tendencies may be used by researchers and policymakers to better guide future studies, build partnerships, and tackle urgent environmental and social problems.

![Publication Evolution Over Time](image)

**Figure 3:** Publication Evolution Over Time, Source: Scopus Database and Authors’ Compilation

### 2.1.2 Country Publication Analysis

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>No of publications</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>30</td>
<td>189</td>
</tr>
<tr>
<td>2</td>
<td>United Kingdom</td>
<td>21</td>
<td>226</td>
</tr>
<tr>
<td>3</td>
<td>Australia</td>
<td>14</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>Norway</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Netherlands</td>
<td>3</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 2: Most Productive Nations/Countries
Source: Biblioshiny and Authors’ compilation

As indicated in Table 2, around 27 percent of publications focused on exploring different facets of Ecocide were published in the United States as evident by the research carried out by various U.S agencies including the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA). Approximately 18% of the publications were contributed by United Kingdom. Australia, Norway and Netherlands contributed approximately 12%, 6% and 2% of the total publications in the domain of Ecocide. Therefore, United States, United Kingdom, Australia, Norway and Netherlands were some of the most productive nations publishing the research work in the area of Ecocide.

Surprisingly, there were few to no publications contributed from countries usually cited as the most severe victims of Ecocide. However, Niger delta has been disfigured by oil extraction for the past fifty years, there was not a single publication from Nigeria. For many years, oil companies have been conducting operations in this region with limited ecological supervision, leading the delta, which is well-known for its conflicts and severe poverty, towards an ongoing environmental crisis. The local residents grapple with the challenges of surviving in an environment tainted by decades of oil spills, as well as agricultural failures resulting from acid rain caused by emissions from gas plumes [3]. Linfen, located in China, is frequently cited as the world’s most polluted city. It is situated in the heart of a 12-mile industrial zone comprising iron casting foundries, pyrometallurgical facilities, and cement plants, all powered by the extraction of 50 million tonnes of coal annually, which is unrestricted due to rapid urban development. [3]. Ironically, the database didn’t mention a single publication from China. The database was found to be devoid of publications from countries which are some of the biggest victims of Ecocide.

2.1.3 Most Relevant Authors

The findings of the bibliometric analysis revealed the existence of five highly influential authors who have published extensively on various aspects of Ecocide. These prolific authors hail from three different countries, specifically the United Kingdom, Australia, and Norway, based on their significant number of publications and citations. In total, there were 15 distinct publications attributed to these authors, with four publications being co-authored. The combined citations for these top five authors’ 15 unique publications amounted to 307 citations. Table 3 provides details on these authors, including their publication titles, affiliations, citation counts, and H-index.

<table>
<thead>
<tr>
<th>Author</th>
<th>Publication Title</th>
<th>Affiliation</th>
<th>Citations</th>
<th>H-Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>White R.</td>
<td>&quot;Critical Criminology and the Struggle Against Climate Change Ecocide&quot;</td>
<td>&quot;University of Tasmania, Australia&quot;</td>
<td>22</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>&quot;Climate change, ecocide and crimes of the powerful&quot;</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Criminological Perspectives on Climate Change, Violence and Ecocide&quot;</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;The ecocide-genocide nexus: A green criminology perspective&quot;</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Imagining the unthinkable: Climate change, ecocide and children&quot;</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Carbon economics and transnational resistance to ecocide&quot;</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Ecocide&quot;</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Short D.</td>
<td>&quot;Protecting the planet: A proposal for a law of ecocide&quot;</td>
<td>&quot;School of Advanced Study, University of London, London&quot;</td>
<td>80</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>&quot;Marx, Lemkin and the genocide-ecocide nexus&quot;</td>
<td></td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Ecocide, genocide, capitalism and colonialism: Consequences for indigenous peoples and glocal ecosystems environments&quot;</td>
<td></td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>
Rob White, in his research on Ecocide focuses upon reviewing recent criminological writings on climate change and its implications for violence. His work examines climate change-related criminal activities through a criminological lens. His work accomplishes this by investigating the association between global warming and social interactions, climate change and social stressors, and reimagining potent crimes as ecocide because they damage the environment. Related issues such as contrarianism and natural resource securitization, both of which safeguard and preserve particular segmental interests rather than the interest of the public, are also addressed in his mainstream work.

Damien Short’s work revolves around explaining how Ecocide is another form of Genocide. His essays discuss various instances of how crimes that damage the climate, as well as human and other living species, as well as different styles of reactions that have asked for more efficient and suitable frameworks of justice and law than those presently in place.

In his work, Nigel South envisions that international law has the potential to address some severe instances of colonialism's injustices and harm by formally defining and addressing genocide. However, the related concept of ecocide, which concerns ecological sustainability, has not yet gained official recognition within the legal system. His argument posits that the concept of ecocide could serve as a potent tool within the context of this special issue, particularly when considering the application of environmental criminology. To illustrate this point, his research explores the connections between ecocide, genocide, capitalism, and colonialism, as well as their impacts on indigenous communities and both local and global ecological systems.

Martin Crook's research seeks to advance the ongoing shift towards an "ecological perspective" in genocide studies by emphasizing the critical role of the "non-human environment" in the physical and social well-being of communities, such as indigenous groups and location-dependent, community-based populations.

Alexander Dunlap contends that ongoing and systematic processes of resource exploration and exploitation lie at the core of techno-capitalist progress, often portrayed as "modernity," "advancement," or "development." In his mainstream research, he investigates the advancement of wind energy in Mexico, coal exploration in Germany, and copper extraction...
in Peru, aiming to support the post-liberal or institutional approach in genocide studies. These case studies, characterized by ethnic and geographic diversity, set the foundation for discussions about the intricate fault lines arising from extractive development. The central premise of his work is that both environmentally "friendly" and conventional natural resource extraction significantly contribute to the deterioration of human and ecological diversity, thereby aligning with broader trends of societal and environmental deterioration, species extinction, and the potential for both human and non-human destruction.

2.1.4 Most Relevant Journals

Table 4 displays the leading four journals and publishers that have made significant contributions to the body of ecocide literature. It is evident that the International Journal of Human Rights stands out by publishing six documents with a total of 219 citations. Following closely are Critical Criminology, Journal of Genocide Research, and Environmental Ethics, which have published 2, 5, and 2 documents, respectively, with citation counts of 73, 37, and 2. The table also provides relevant information about the publishers associated with these selected journals.

<table>
<thead>
<tr>
<th>Source Name</th>
<th>No of publications</th>
<th>Publisher</th>
<th>H-Index</th>
<th>Total Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Journal of Human Rights</td>
<td>6</td>
<td>Routledge</td>
<td>21</td>
<td>219</td>
</tr>
<tr>
<td>Critical Criminology</td>
<td>2</td>
<td>Springer Netherlands</td>
<td>26</td>
<td>73</td>
</tr>
<tr>
<td>Journal of Genocide research</td>
<td>5</td>
<td>Carfax Publishing Ltd.</td>
<td>26</td>
<td>37</td>
</tr>
<tr>
<td>Environmental Ethics</td>
<td>2</td>
<td>Environmental Philosophy Inc.</td>
<td>29</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Biblioshiny and Authors’ compilation

2.2 RQ2: A bibliometric analysis of keyword co-occurrence to understand the mainstream themes underpinning the Ecocide literature.

Based on the notion that keywords offer a robust and logical basis for elucidating the content of research papers, keyword analysis has emerged as a valuable analytical approach for investigating specific themes in marketing or other fields of literature, gaining increased recognition [2,3]. In the realm of bibliometrics, four distinct analysis techniques are applied: co-word association, co-word clustering, co-word frequency, and burst word monitoring. This study also incorporated keyword co-occurrence analysis as it was deemed an effective method for comprehending current research trends in the field of ecocide.

Importantly, co-word analysis involves the examination of keywords that co-occur in research papers. The strength of the relationship between two keywords is quantified, indicating their association [28]. This link strength signifies how often two specific keywords appear together within publications. The total count of such links represents the frequency with which any pair of keywords was used in searches. In this study, the assessment of author keyword co-occurrence encompassed 143 keywords. However, a significant portion of these keywords appeared only once, with 93 out of the 143 keywords having a single occurrence. To optimize the analysis, a decision was made to reclassify the keywords based on broader themes. After implementing this alteration, the total count of keywords was trimmed down to 50. These adjusted 50 keywords were subsequently input into VOSviewer, which necessitated a minimum frequency of occurrence of 2 to generate a visual representation of the compiled literature. The keyword co-occurrence analysis has been presented below in figure 4.
As previously discussed and evident from the analysis of keyword co-occurrence, Ecocide has emerged as a promising and continually expanding field with significant and extensive global implications. The following section, based on this keyword co-occurrence analysis, examines the primary keywords that are frequently addressed in the literature focused on ecocide. A concise discussion regarding the keywords most commonly recurring in ecocide-related literature is presented below.

2.2.1 Ecocide as Genocide

One of the most commonly recurring words in the Ecocide literature was found to be perceiving Ecocide and a Genocide. Ecocide, or the damaging of ecosystems, can be referred to as a method of mass slaughter commonly known as Genocide if, for instance, ecological degradation leads to living conditions that profoundly endanger the cultural or physical survival of a social community. Given the impending threat of catastrophic climate degradation, the resulting rapid mass extinction, loss of habitat, ecosystem collapse, and reliance of human race on biosphere, ecocide (both “organic” and “human made”) will be a key cause of genocide [6]. The long history of colonialism includes ongoing inequities and rejection of indigenous communities’ rights. In connection to nonhuman organisms and aspects of the natural environment, concurrent procedures of exploitation and unfairness can be recognized [5]. International law can resolve some egregious instances of colonialism’s offences and damages through the conceptual and legal definition of genocide, but the closely related concept of ecocide, which pertains to humanity and nature, has yet to be lawfully acknowledged within the legal system of international law [19].

2.2.2 Ecocide and climate change

Yet another commonly recurring keywords in the literature suggested the gravity of the concern raised by various researchers towards climate change due to ecocide. The current geological epoch is known as the Anthropocene because anthropogenic activities (anthrop) are affecting the Earth’s original environment in unprecedented ways [34]. The most visible example is the transformation of the atmosphere caused by the emissions of gases from using fossil fuels, such as carbon dioxide, methane, and cfcs. Researchers argue that this is a side effect of capitalism’s ever-increasing customer needs, coupled with an almost utter disrespect for the protracted destruction, mainly global warming and sea-level rise, induced by these greenhouse gases [35]. Patrick Hossay (2006), an U.S. environmental thinker and activist, contends that the human species is perpetrating ecocide through the effects of modern industrialized society on the global ecosystem.

2.2.3 Ecocide as an International Crime
In recent times, criminologists are increasingly focusing upon the dangers of global warming, as well as the political and economic systems and daily activities of industrial capitalism that nurture and solidify the circumstances for extreme weather events [20]. It was conceived in 1970 by Professor Arthur W. Galston to identify the impact of the United States' use of Agent Orange in Vietnam. At the time, Galston posited a global consensus to prohibit ecocide. It was later taken in account as an unlawful act in early editions of the Rome Statute of the International Criminal Court (ICC), along with the criminal offences put on trial at the Nuremberg trials (war crimes, genocide, and crimes against humanity), but was finally exempted [11]. The first world convention on ecological concerns, known as the UN Stockholm Conference, was held in 1972 to address concerns about environmental destruction. Expert reports such as the International Energy Agency's "Net Zero by 2050" [15] serve as a warning that the clock is running faster towards the Paris Agreement's objectives, as does the IPCC's "Special Report on Global Warming of 1.5°C" [32]. The world leaders will emphasize the legally enforceable principles and rules for considering ecocide as a crime at the ICC at the UN Conference on Sustainable Development to be held in Stockholm in June 2022.

### 2.2.4 Ecocide and environmental degradation

No other faded away human civilization has elicited as much consternation, skepticism, and speculation as the Pacific Island of Rapa Nui (Easter Island). This small segment of land was encountered by European explorers almost three centuries ago in the middle of the enormous South Pacific Ocean. Its human civilization developed to a degree of social sophistication that resulted in one of the most developed societies and technical feats of Neolithic communities anywhere else on the planet. Easter Island's stone-working abilities and competency were far better compared to those of any other Polynesian cultures, as was its distinct system of writing. This exceptional society grew, prospered, and persevered for possibly more than a thousand years – before collapsing and becoming extinct [36]. Easter Island's natives were thought to have damaged their woods, deteriorated the island's soils, obliterated out their vegetation, and driven their livestock to extinction. As a result of its own self-inflicted ecological destruction, its successful society crumbled, devolving into civil conflict and self-destruction [36]. Not surprisingly, how ecocide is another name of natural or human-caused environmental degradation was yet another most frequently used word in the academic literature on Ecocide. Below mentioned in Table 5 are some of the key activities reported in Ecocide literature, causing environmental degradation:

**Table 5: Some major environmental degradation activities causing Ecocide (based on more frequently recurring keywords)**

<table>
<thead>
<tr>
<th>Ocean Damage</th>
<th>Industrial fishing</th>
<th>Oil spills</th>
<th>Plastic Pollution</th>
<th>Deep sea mining</th>
<th>Deforestation</th>
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<tbody>
<tr>
<td></td>
<td>One of the methods through which individuals are inflicting irreversible harm on marine environments and underwater ecosystems is by engaging in deep-sea bottom trawling. This practice involves the dredging of the ocean floor, leading to the destruction of entire ecosystems. Additionally, overfishing is contributing to the extinction of numerous species.</td>
<td>Multiple occurrences have occurred, with the most significant being the Deepwater Horizon oil spill in 2010. This incident led to the spread of a vast oil slick covering over 57,500 square miles (149,000 square kilometres) and contaminating approximately 1,100 miles (1,770 kilometres) of shoreline.</td>
<td>Plastic debris constitutes a significant portion, accounting for 80 percent, of all marine litter detected from surface waters down to deep-ocean sediments. Annually, a minimum of 14 million tonnes of plastic waste finds its way into the oceans. This plastic waste is either ingested by marine organisms or causes entanglement, leading to severe injuries and fatalities among marine life.</td>
<td>The emerging mining and processing industry in this region is giving rise to demands for a comprehensive ban owing to the adverse consequences it brings about, including physical disturbance and environmental pollution in the Pacific.</td>
<td>The primary drivers of Amazon deforestation are beef production through cattle ranching and the cultivation of soy for use as animal feed. Deforestation and environmental damage to land and river systems are exacerbated by activities such as copper, iron ore, and gold mining, along with oil drilling, all of which result in contamination. In Indonesia and Malaysia, these factors serve as the primary drivers of deforestation. In the case of Indonesia, the extensive cultivation of palm oil has pushed orangutans and other wildlife species to the brink of extinction.</td>
</tr>
<tr>
<td>Land &amp; water contamination</td>
<td>Large-scale palm oil plantations have also led to pervasive worker exploitation, violations of human rights, and the displacement of Indigenous and rural communities.</td>
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<td>---------------------------</td>
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<td></td>
<td></td>
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<tr>
<td>Oil spills</td>
<td>Over numerous years of oil extraction, the Niger Delta has been heavily impacted by oil spills, remaining one of the most polluted regions globally.</td>
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<tr>
<td>Mining</td>
<td>Mining has a well-established track record of polluting both land and water, spanning from gold mining to the practice of mountaintop removal.</td>
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<tr>
<td>Tar sands</td>
<td>The Athabasca tar sands in Alberta, Canada, represent the most extensive of such operations, causing harm to wildlife, encroaching on indigenous lands, and leaving visible scars that are observable from outer space.</td>
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<td>Fracking</td>
<td>The harmful effects of unconventional oil and gas production have been widely acknowledged, and these impacts accumulate over time. Numerous residents of Pennsylvania residing in proximity to fracking sites encounter incidents of explosions occurring just a short distance from their residences. They are also forced to consume tap water contaminated with hazardous substances detrimental to their well-being and breathe in toxic fumes present in the atmosphere.</td>
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<tr>
<td>Textile chemicals</td>
<td>For instance, wastewater resulting from processes like dyeing and tanning exerts a significant contaminating influence on the textile industry.</td>
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<tr>
<td>Agricultural pollution</td>
<td>The utilization of chemicals in industrial agriculture and the adoption of monocropping methods have notable repercussions on soil quality, river ecosystems, and insect populations.</td>
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<tr>
<td>Chemical disasters &amp; weapons</td>
<td>Many instances can be cited, with the most severe being the Bhopal gas tragedy. The introduction of the chemical weapon Agent Orange marked the initial usage of the term &quot;ecocide.&quot;</td>
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<tr>
<td>Radioactive contamination</td>
<td>Prominent instances include nuclear catastrophes such as Chernobyl and Fukushima, along with the pollution stemming from nuclear testing and the utilization of nuclear weapons. Additionally, recent findings have implicated the oil industry in such environmental issues.</td>
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<tr>
<td>Industrial emissions</td>
<td>The stability of our climatic system, which functions as the overarching environment for all others, can be maintained only within specific planetary limits. As a result, the fossil fuel, agriculture, and cement industries are all implicated in the production phase.</td>
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Source: VOSviewer and Author’s compilation

2.2.5 Ecocide and need for International Law

The connection between humanity and the climate is inseparable and they shape each other mutually. The degradation of the environment has exerted a substantial impact on the current generation and poses a danger to future generations as well. The global health status and health-care costs imply the need for legislative proposals to save the climate in order to avoid the majority of health problems. The existing national scale laws for environmental sustainability have authority over a limited geographical boundary [25]. Therefore, majority of work in the discipline puts forth the establishment of an international law to protect the entire planet. Researchers believe that the international law must make environmental damage a crime while also encouraging its sustainable use of resources paving way for sustainable development. The sustainable use of the environmental resources is one thing, but restoring environment to its original state is quite another[13]. The need of the hour as per many studies is to make such advancements that aid in economic growth as well as the sustainability of the environment [21,26]. The recognition of ecocide as an international crime was deemed as the single most potent measure because of the increased loss of biodiversity globally and the lack of a reversal procedures to help make up for systemic failures, which help to emphasize that the safety of planet must be assured on a global scale [6].

2.3 RQ3: A review of legal frameworks in the area of ecocide

Environmental protection is primarily a civil matter, and where environmental offences are described, they are typically quite precise (e.g., a certain degree of pollution in a certain context). Because the majority of the world lacks legal plan to cope with mass widespread destruction, corporate actions tend to take the path of least opposition, able to operate most destructively in areas with the least safeguarding and merely budgeting for civil litigation. Ecocide establishes a new ethical benchmark, making anything that causes mass destruction of natural ecosystems unacceptable. Table 6 highlights some of the most prominent laws regarding ecocide in various nations:
<table>
<thead>
<tr>
<th>Country</th>
<th>Article</th>
<th>Ecocide Law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia 1999</td>
<td>Article 409</td>
<td>Ecocide, which is characterized as the contamination of the environment, soil, and water sources, extensive harm to flora and fauna, or any action that might lead to environmental catastrophe, is subject to imprisonment, with penalties ranging from eight to twenty years.</td>
</tr>
<tr>
<td>Armenia 2003</td>
<td>Article 394</td>
<td>Extensive harm to plants and animals, pollution of the atmosphere, soils, or water resources, and other activities resulting in ecological calamity are subject to imprisonment for a duration of 10 to 15 years.</td>
</tr>
<tr>
<td>Ukraine 2001</td>
<td>Article 441</td>
<td>Extensive harm to plants and animals, pollution of the atmosphere, soils, or water resources, and other activities resulting in ecological calamity are subject to imprisonment for a duration of 10 to 15 years.</td>
</tr>
<tr>
<td>Belarus 1999</td>
<td>Article 131</td>
<td>Intentional large-scale harm to plant or animal life, pollution of the Earth’s atmosphere (comprising air, soil, and water), or the adoption of other deliberate actions likely to result in an ecological catastrophe (referred to as ecocide) will lead to imprisonment for a period of ten to fifteen years.</td>
</tr>
<tr>
<td>Ecuador 2008 (Constitutional), and 2014 (Criminal Code)</td>
<td>Article 71</td>
<td>Although Ecuador doesn’t explicitly employ the term &quot;ecocide” in its legal framework, any purposeful harm to the environment, whether in times of conflict or peace, is considered a punishable offense. Furthermore, Ecuador holds the distinction of being the world’s first nation to grant robust constitutional safeguards and guarantees to the environment. According to Article 71 of the law, &quot;Nature or Mother Earth, where life occurs and thrives, possesses the right to full respect for its existence, as well as the preservation and regeneration of its essential cycles.&quot;</td>
</tr>
<tr>
<td>Kazakhstan 1997</td>
<td>Article 161</td>
<td>Global extinction of plants and animals, pollution of the environment, land, or water, and other actions that have induced or may cause an ecological disaster will be penalized by deprivation of freedom for a time frame of ten to fifteen years.</td>
</tr>
<tr>
<td>Kyrgyzstan 1997</td>
<td>Article 374</td>
<td>Extensive devastation of animal or plant ecosystems, contamination of the environment or water resources, and engaging in other activities that could lead to an environmental disaster, will result in a prison sentence ranging from 12 to 20 years.</td>
</tr>
<tr>
<td>Republic of Moldova 2002</td>
<td>Article 136</td>
<td>Intentional large-scale harm to plant or animal life, pollution of the Earth’s atmosphere (comprising air, soil, and water), or the adoption of other deliberate actions likely to result in an ecological catastrophe (referred to as ecocide) will lead to imprisonment for a period of ten to fifteen years.</td>
</tr>
<tr>
<td>Russian Federation 1996</td>
<td>Article 358</td>
<td>Extensive devastation of animal or plant ecosystems, contamination of the environment or water resources, and engaging in other activities that could lead to an environmental disaster, will result in a prison sentence ranging from 12 to 20 years.</td>
</tr>
<tr>
<td>Tajikistan 1998</td>
<td>Article 400</td>
<td>Extensive harm to plants and animals, pollution of the atmosphere, soils, or water resources, and other activities resulting in ecological calamity are subject to imprisonment for a duration of 10 to 15 years.</td>
</tr>
</tbody>
</table>
Those who engage in acts of widespread annihilation in a particular area, decimate their means of income, undermine a country’s culture and traditions, fundamentally alter the foundations of a society with the intent of subverting it, as well as other mass atrocities or ecocide or ruining the ecological landscape, shall be convicted to between ten and twenty years in prison, life in prison, or death penalty.

Source: Review of literature and secondary sources

### 2.4 RQ4: Identification of future areas of research in the domain of ecocide

To achieve this outcome, Biblioshiny was used as a bibliometric tool. Biblioshiny is an open and free tool for conducting quantitative research in scientometrics and bibliometrics. It supports all major bibliometric analytical techniques. In terms of conceptual model, Biblioshiny employs the thematic map to denote the study’s conceptual framework. This latter method employs a word co-occurrence matrix analysis to describe what existing literature is discussing in a given field, as well as key themes and patterns.

Thematic map [1] enables the visualization of four distinct thematic classifications, as illustrated in Figure 3 based on high and low density and centrality. While, high density represents the themes depicting the depth of literature dedicated to a specific domain of study (low density depicting lesser focused themes), high centrality represents themes most pertinent and relevant to the field of study (low centrality depicting less relevant themes). Further, thematic maps make use of the ‘KeyWords Plus’ field as analytical unit. Scopus editorial specialists equate these keywords with the assistance of a semi-automated algorithm. They review the titles of all references and highlight additional pertinent but unmentioned keywords that the authors did not include. The Keywords Plus field, in contrast to the authors' keywords, is normalized. Keywords Plus terms are more capable of capturing the depth, intensity and variety of a content of a publication. The motor concepts are depicted in the upper-right quadrant. They are defined by a high degree of centrality and density. One of the evolved “motor themes” in the literature, it was discovered that the significant area of focus in the extant literature is ecocide and climate change, as well as eco-anxiety.

Naturally, the analysis’s central theme was found to be climate change due to ecocide. This theme was associated with a variety of concepts, including environmental degradation and eco-anxiety to name a few. The term “Environmental degradation” refers to environmental damage that occurs when natural resources such as air, water, and soil are depleted; ecosystems are destroyed; habitats are eviscerated; wildlife is extirpated; and pollution increases unexpectedly. It is described as any alteration or disruption to the climate that is deemed detrimental or unacceptable. Environmental destruction and climate change have risen to the top of global concerns, with findings of Emissions of co2 reaching historic levels in 2020, 178 million hectares of forests – as big as about size of Libya – being compromised since 1990, and oil wells erupting, seeping into the sea, and wreaking havoc on coastal cities (while beneath, 70% of the planet’s coral reefs are threatened). More topsoil erosion, drought, wildfires, and flooding are all anticipated – at least according to the large percentage of the 1.2 million survey participants surveyed by the United Nations Development Programme who believe climate change is a worldwide crisis. And this is only pollution during the peace. Apart from the apparent destruction caused by dispute, War Junk – weapons and ammunition materials such as minefields, cluster bombs, chemical and radioactive armaments – also leaves environmental traces post-conflict, limiting farmland use and contaminating water and soil sources with explosives and lethal contaminants such as TNT, adamsite and mustard gas, to name a few [8]. A closely associated theme represents plethora of literature focusing upon climate change in Amazon due to ecocide. The scientists claim that forest and habitat destruction and climate change have wreaked havoc on the forest in the Amazon’s south-east area. Temperatures in this region have risen by 3.07°C in the two warmest month of the year – roughly equivalent to the rise witnessed in the Arctic region and roughly thrice the global average [4]. A closely related concept found as a central theme was eco-anxiety. Eco-anxiety is a concern of environmental degradation or ecosystem collapse. This anxiety is motivated primarily by the state of the environment in the present and anticipated future, as well as human-activity caused climate change. According to a 2018 national survey, nearly 70% of Americans were concerned about climate change, and approximately 51% feel anxiety towards their future [7].

With reference to the upper-left quadrant, it shows high density themes but unimportant external links and so are of only limited importance for the field (low centrality). In this quadrant, no pertinent themes were deciphered. In the lower-left quadrant are the emerging or declining themes. The theme of need for establishing ‘Environmental law’ that sets the premise for criminalizing the ecocide was witnessed as a major theme. What is interesting to notice that one of the most emerging themes in Ecocide literature currently getting the most traction is the work revolving around having an international environmental law that criminalizes the people/organizations responsible for Ecocide. The deterioration of environment has had a significant influence on the present generation and presents a threat to succeeding generations as well. The global health status and health-care costs imply the need for legislative proposals to save the climate in order to avoid the majority of health problems. The existing national scale laws for environmental sustainability have authority over a limited geographical boundary [25]. Therefore, the majority of work in the discipline puts forth the
establishment of an international law to protect the entire planet. Researchers believe that international law must make environmental damage a crime while also encouraging its sustainable use of resources paving way for sustainable development. This area is one of the most emerging themes in ecocide literature. The area is of interest to many. At last, the lower-right quadrant highlights fundamental and transversal themes. These themes address broad issues that populate across the fields of scholarly interests. Capitalist system and colonialism as a cause of ecocide, ecocide as a form of genocide, and green criminology were prominent themes in this area, to name a few. Figure 5 below represents thematic mapping of diverse themes identified in ecocide literature:

![Thematic Map](https://example.com/thematic_map.png)

**Figure 5: Thematic Map**

Source: Biblioshiny

### 3. Conclusion

A bibliometric analysis of 174 publications spanning the period from 1990 to 2023, focusing on the existing literature on Ecocide, revealed several noteworthy findings. The research identified prominent universities with a high percentage (26%) of publications in this field, including the University of London, University of Oslo, University of Tasmania, Medawar Institute of Medical and Environmental Research, and the University of Essex. The most prolific nations in terms of publications and citations were the United States (30 publications, 189 citations) and the United Kingdom (21 publications, 226 citations), followed by Australia, Norway, and the Netherlands.

The analysis further recognized the top five prolific writers in the field: Rob White, Damien Short, Nigel South, Martin Crook, and Alexander Dunlap, hailing from the United Kingdom, Australia, and Norway. Their collective 15 unique publications garnered 307 citations, with each writer contributing distinctive insights. Rob White's research explored climate change-related criminal activities within the framework of criminology, while Damien Short's work emphasized the connection between Ecocide and Genocide. Nigel South argued for the utility of the concept of ecocide in environmental criminology, and Martin Crook focused on the intersection of ecology and genocide research, particularly within indigenous communities. Alexander Dunlap's work delved into various environmental issues worldwide, contributing to ecocide-driven genocide research.

The analysis also examined the most influential journals in the field, with the International Journal of Human Rights being the most prolific, publishing 6 documents with 219 citations. Other notable journals included Critical Criminology, Journal of Genocide Research, and Environmental Ethics. Keyword co-occurrence analysis unveiled the prevailing themes in the literature, including the relationship between ecocide and genocide, ecocide's role in climate change and environmental degradation, the criminalization of ecocide, and the international legal framework governing ecocide.

One significant theme that emerged from the analysis was the urgent need for the establishment of environmental laws that would form the basis for criminalizing ecocide. This research also identified a growing theme in the literature, which emphasized the development of international environmental laws that would hold individuals and organizations accountable for ecocidal actions. A review of future research agenda section of the top five most cited articles published in
2022-23 was made to identify future research directions. Table 7 highlights the future research questions in the discipline of Ecocide:

Table 7: Future Research Questions

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Author</th>
<th>Title</th>
<th>TC</th>
<th>Future research agendas</th>
</tr>
</thead>
</table>
| 1      | Hall C.M. (2022) | Tourism and the Capitalocene: From Green Growth to Ecocide | 10 | 1. In what ways can the actual environmental and social costs of tourism be measured?  
2. To what extent does tourism affect various ecosystems and local communities?  
3. Is there a way to create tourism that is more fair and environmentally friendly for everyone involved?  
4. To what extent may tourism contribute to degrowth and post-tourism scenarios? |
2. How can law enforcement and armed forces aid in and facilitate ecological genocide?  
3. How does the use of force by police and the military affect communities on the front lines and those who work to protect the environment?  
4. When it comes to the police and military forces that facilitate and enforce ecocide, how can we create game-changing measures to oppose and bring them down? |
| 3      | Robinson D. (2022) | Ecocide - Puzzles and Possibilities | 7 | 1. How can we define ecocide in a way that is both clear and useful?  
2. What modifications need to be made to current environmental legislation in order to make ecocide a crime?  
3. How can we guarantee that the law against ecocide is administered uniformly and fairly?  
4. How can we stop ecocide from becoming an excuse for repression in the name of politics or economics?  
5. How can we better prepare for local and international prosecution of ecocide?  
6. How can we utilise the law to ensure that future generations may enjoy a healthy and fair environment? |
| 4      | Minkova L.G. (2023) | The Fifth International Crime: Reflections on the Definition of “Ecocide” | 7 | 1. To what extent may the current concept of ecocide be refined so that it is more specific, more practically applicable, and more in line with current international law?  
2. How can we get around the "cost-benefit" analysis and the word "knowledge" in the suggested ecocide definition?  
3. How can the environmental justice movement coexist with the anthropocentric component in the notion of ecocide?  
4. How do we make sure the crime of ecocide is administered uniformly and fairly?  
5. How might the difficulties associated with prosecuting ecocide in both local and international courts be overcome? |
4. Limitations of study

The research made efforts to mitigate the deficiencies in its methodology; however, it is important to acknowledge the limitations of this work, which can pave the way for future research opportunities. This study focused on collecting papers from Scopus that were published between 1990 and 2023 while omitting books, chapters, conference proceedings, and notes, which means that the study is not entirely free from bias. Moreover, there are other databases such as WOS that include rich content on ecocide. Future studies might involve bibliometric analysis from such databases along with Scopus to increase the depth and coverage of extant literature.

References

[32] The Intergovernmental Panel on Climate Change (IPCC), Special Report on Global Warming of 1.5°C, Available at URL: https://www.ipcc.ch/sr15/, Retrieved on March 15th, 2022