Caught on the Crossfire: Biodiversity Conservation Paradox of Sociopolitical Conflict

Bona Abigail Hilario-Husain
University of Southern Mindanao

Sarrah Jane Guerrero
University of Southern Mindanao

Krizler Tanalgo (tkrizler@gmail.com)
University of Southern Mindanao

Francisco Gil Garcia
University of Southern Mindanao

Tessie Lerios
University of Southern Mindanao

May Eva Garcia
University of Southern Mindanao

Renee Jane Alvaro-Ele
University of Southern Mindanao

Meriam Manampan-Rubio
University of Southern Mindanao

Sedra Murray
University of Southern Mindanao

Jamaica Delos Reyes
University of Southern Mindanao

Kier Celestial. Dela Cruz
University of Southern Mindanao

Sumaira Abdullah
University of Southern Mindanao

Sheila Mae Prince Balase
University of Southern Mindanao

Jeaneth Magelen Respicio
University of Southern Mindanao

Asraf Lidasan
University of Southern Mindanao

Zafrullah Buday

Lothy Casim
University of Southern Mindanao
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Abstract

Biodiversity loss is a growing concern globally, but there’s a lack of knowledge on where to focus conservation efforts. It is therefore essential to determine priorities and barriers to biodiversity knowledge generation. In this context, we present evidence from the Philippines on how sociopolitical instability drives biodiversity shortfall. Our study showed that conflict leads to fewer biodiversity records, with low-conflict areas having higher turnover by more than 50%. Further, tree cover loss is lower in high-conflict areas. Security risks due to sociopolitical conflicts can significantly affect biodiversity recording efforts, potentially leading to underestimating species diversity in these regions. This study highlights the link between conflicts and biodiversity shortfalls, and the negative impact on biodiversity documentation efforts. While rare positive consequences exist, they are incidental and overall negative. Addressing the convergence of conflict, extremism, and biodiversity conservation is crucial for safeguarding ecosystems and human and nature’s well-being.

Introduction

Armed conflicts and violent extremism have long been recognized as significant threats to human security and stability. Armed conflict is a state of organized, violent confrontation involving weapons and military force between two or more parties, including governments, non-state actors, or a combination of both\(^1\). While sociopolitical conflict is a type of conflict or discord that arises from differing social and political beliefs, values, interests, or ideologies within a society\(^2,3\). It typically involves disputes, disagreements, or tensions between different groups or individuals with distinct social, cultural, or political backgrounds and perspectives\(^4\). However, the impacts of these conflicts on the environment and biodiversity have gained considerable attention in recent years\(^5,6\). For instance, the world witnessed the destruction of forests during the Vietnam War\(^7,8\), the draining of Mesopotamian marshes during the Gulf War\(^9\), and a decline in wildlife during civil wars in the Democratic Republic of the Congo\(^10\). At the same time, post-millennium wars in Ukraine, Afghanistan, Syria, and some parts of Africa continue to devastate biodiversity at an alarming rate\(^11-14\). Undeniably, armed conflicts and violent extremism can lead to extensive habitat destruction. In fact, of the major armed conflicts between 1950 and 2000 within countries, over 90% were within biodiversity hotspots, and 80% occurred directly within hotspot areas\(^6\). The environmental footprint of military activities, explosives, and landmines causes lasting damage to ecosystems, leading to the loss of critical habitats for diverse plant and animal species\(^4\). In conflict zones, a pivotal concern is their transformation into channels and central hubs for illicit wildlife trafficking and unregulated exploitation of natural resources. These actions significantly worsen the problem of biodiversity depletion by involving unsustainable practices, such as overharvesting species, habitat destruction, and the disturbance of delicate ecological equilibrium\(^15,16\). Additionally, armed conflicts tend to undermine the effectiveness of environmental governance systems, rendering enforcing environmental regulations and safeguarding vulnerable ecosystems formidable. This, in turn, amplifies issues such as poaching, deforestation, and the unlawful extraction of resources, thereby posing even greater threats to biodiversity\(^17\).
These anthropogenic-driven threats to biodiversity prompted the United Nations (UN) General Assembly in 2001 to declare every 6th of November the *International Day for Preventing the Exploitation of the Environment in War and Armed Conflict*. Twenty-two years later, many gaps still need to be addressed, especially in the global south, where biodiversity capacity building is lacking. Biodiversity hotspots, protected areas, and indigenous territories lack protection under international humanitarian law during armed and sociopolitical conflicts. Previous analyses have demonstrated how warfare and conflict directly impact biodiversity, yet our understanding of how they drive biodiversity knowledge turnover is not well discussed in the current literature.

This perspective paper primarily aims to present empirical evidence drawn from the specific context of the Southern Philippines. We highlight the critical role that sociopolitical and armed conflicts play as limiting factors in generating comprehensive biodiversity information. However, in regions affected by sociopolitical and armed conflicts for decades, the collection and analysis of this information can be impeded significantly. Conflicts can disrupt research activities, hinder access to remote or affected areas, and create safety concerns for scientists and conservationists. This, in turn, limits our ability to gather accurate data about local flora and fauna, which is essential for making informed decisions about biodiversity conservation and management. Therefore, understanding the impact of such conflicts on biodiversity information generation is crucial to developing effective conservation strategies in conflict-prone regions, such as the Philippines.

**War and armed conflict in the Philippines: Why is Mindanao a ‘hotspot’?**

Mindanao is the second-largest group of islands in the Philippines, consisting of 27 provinces and 33 cities with six administrative regions with an estimated population of 26,252,442 (24% of the country's population), hailing it as the seventh-most populated area in the world. Its large fertile landmass makes it a major breadbasket of the Philippines, producing around 40% of the country's agricultural produce and 60% of agricultural exports. In addition, owing to its unique biogeographical history and location, Mindanao is renowned for its vast flora and fauna, making it a biodiversity hotspot. Mindanao has over 30 Key Biodiversity Areas (KBAs) that are globally significant sites for biodiversity conservation because of the high concentration of endemic and threatened species, including the globally threatened Philippine Eagle (*Pithecophaga jefferyi*) and other keystone species.

Whilst Mindanao is known for its rich and diverse wildlife and valuable natural resources, the region confronts a disconcerting reality marked by a confluence of sociopolitical adversities encompassing armed conflicts, religious tensions, feuds among clans, incidents of abduction, and other incidents of violence that paint a grim picture of the region. The UN Office for the Coordination of Humanitarian Affairs (OCHA) has estimated that Mindanao shared around 53% of sociopolitical conflicts in the
Philippines from 1989 to the present (Fig. 1). The history of war and armed conflict in Mindanao is complex, spanning several decades. Conflict in Mindanao can be traced back to the colonial era, when the Philippines was under Spanish rule, which started during the 16th century. The Spanish colonizers encountered resistance from the Muslim communities in Mindanao, who fought against their conversion to Christianity and the imposition of colonial rule. Today, the Philippine government is involved in multiple parallel, non-international armed conflicts and violence.

Continuous conflict spanning 60 years has probably led to considerable ecological and environmental degradation in the Philippines, especially in Mindanao. This damage could manifest in various forms, including deforestation, habitat destruction, pollution, and overexploitation of natural resources. As armed conflicts often involve the displacement of communities, pressure on local ecosystems may increase as displaced populations resort to unsustainable practices for their livelihoods. Furthermore, armed groups and the instability associated with conflicts can hinder effective environmental conservation efforts, exacerbating the environmental toll. In addition, socioeconomic challenges can also indirectly impact the environment, as people may resort to resource-intensive activities, such as illegal logging or mining, to cope with the economic hardships caused by the conflict.

Despite these apparent potential links between armed conflict and environmental and socioeconomic consequences, there remains a significant absence of empirical evidence explicitly exploring the connection between war and biodiversity shortfalls in the Mindanao region. While some Philippine-wide studies have shown apparent differences in biodiversity in Mindanao (for example, in bats and primates) in recent years, no clear evidence has shown the relationship between sociopolitical conflict and the generation of biodiversity information in the region. Addressing this knowledge gap is crucial for understanding the full extent of the environmental impacts of conflict, formulating effective policies and strategies to mitigate these effects, and promoting sustainable development and conservation in the region.

To gain insight into the influence of socio-political conflicts on biodiversity generation in Mindanao, we compared the information from the distribution of biodiversity data with conflict-related information for the Philippines between 2000 and 2021. We then investigated the differences between low (< 10 conflicts/year) and high (> 10 conflicts/year) conflict areas in both biodiversity turnover (i.e., species records) and tree cover loss (2000–2022), as a proxy to determine whether conflict events affect environmental disturbance. Finally, we also assessed the effects of taxonomic groups, conflict distance, and number of conflict events on species turnover.

Results

Our analysis reveals how sociopolitical conflict promote biodiversity shortfalls within hotspots. Firstly, a total of 2174 (103.52 conflict/year) was recorded in the entire Mindanao region from 2000 to 2021, with the highest percent records in Sulu (n = 382 per year, 18%) and Maguindanao province (n = 329 per year, 15%) (Fig. 2a). We found that there is a significant difference in the biodiversity record turnover between...
high (mean = 0.50 ± 1.60) and low (mean = 1.27 ± 2.37) conflict areas (Mann-Whitney U test = 1340, \( p = 0.0027 \)) (Fig. 2a-b).

Secondly, the best model that predicts biodiversity turnover (species record turnover \( \sim 1 + \) conflict events + average distance from conflict events + taxonomic groups, AIC = 7864.53) showed that an increase in the number of conflict events is associated with lower species records (\( \beta = -0.002, p < 0.0001 \)). Conversely, as conflict events moved farther away, our model showed an increasing turnover of species records (\( \beta = 0.003, p < 0.0001 \)). This association was particularly strong among insects (\( \beta = 2.067, p < 0.0001 \)) and birds (\( \beta = 1.545, p < 0.0001 \)) (Fig. 2c).

Contrary to our expectation, in terms of tree cover loss, we found a significantly lower tree cover loss within high-conflict areas (mean = 9262 ha) than in lower-conflict areas (mean = 3738 ha) in Mindanao (Mann-Whitney U test = 735, \( p < 0.0001 \)) (Fig. 3), with highest tree cover loss in Agusan del Sur province (22%).

**Discussion**

Our findings provide valuable insights into the link between sociopolitical conflicts and biodiversity shortfalls within a biodiverse region of the Philippines. Notably, a significant difference in biodiversity record turnover was observed between the high- and low-conflict areas within these regions. High-conflict areas exhibited a lower biodiversity record turnover (more than 50% difference). These differences and evident biodiversity shortfalls within highly conflicted areas may indicate that conflict events notably impact the stability of species populations in these areas\(^4\). In high-conflict areas, the number of species or their populations has likely declined, resulting in an observed biodiversity that falls well below the expected levels due to conflict-related pressures, such as habitat destruction and overexploitation. In addition, recording and inventories of biodiversity within highly conflicted areas are likely to hinder biologists due to security risks brought about by sociopolitical conflicts. Our analysis supports the notion that species turnover increases, especially among insects and birds, as the number of conflict events moves farther away from a conflict area.

These findings emphasize the detrimental impact of conflict events on biodiversity within biodiversity hotspots, and how conflict limits our understanding of biodiversity in biodiverse areas. Understanding these dynamics is crucial for conservation efforts in conflict-affected areas, where targeted strategies are needed to mitigate the consequences of conflicts on biodiversity, restore habitats, and promote sustainable recovery. Moreover, these insights may inform policy decisions to minimize the environmental and ecological consequences of armed conflicts, thereby reducing biodiversity shortfalls in these regions.

Our analysis sheds light on the complex and multifaceted interplay between sociopolitical conflicts and biodiversity. The negative correlation between the frequency of conflict events and species richness underscores the vulnerability of biodiversity in regions marked by unrest, particularly in terms of limiting
the generation of biodiversity information. Thus, we highlight the urgent need for conservation efforts and protective measures in conflict-affected areas. Conversely, the positive relationship between distance from conflicts and biodiversity records indicates the importance of the absence of war for biodiversity. Additionally, regions less affected by human disturbance act as refuges for various species, contributing to the overall conservation of biodiversity. This highlights the importance of creating wider safe zones. The positive relationship of species record turnover with distance to conflict areas suggests that some taxa thrive in environments with low conflict events.

Although most areas in Mindanao are now relatively accessible, conducting biodiversity research is still challenging due to fear brought about by the breakdown of local peace and order in some areas, such as the Liguasan Marsh\textsuperscript{25}. One of the important factors that greatly affects biodiversity shortfalls within conflicted areas is the threat to security associated with sociopolitical conflicts. Biologists and conservationists often face challenges when conducting fieldwork in regions with ongoing disputes or unstable political situations. These challenges range from personal safety concerns to logistical difficulties in accessing remote and unstable areas. As a result, comprehensive biodiversity inventories might be limited or even impossible to carry out in such high-conflict regions. Several non-state armed groups operate in Mindanao, particularly in Maguindanao, Lanao Del Sur, Basilan, Sulu, and Tawi-Tawi\textsuperscript{34}. Other violent tensions, such as clan wars or ‘rido’ and political disputes, brought brutal incidents, for example, the Maguindanao massacre in 2011\textsuperscript{35}.

Another example is the kidnapping of bird watchers in Tawi-Tawi by the \textit{Abu Sayyaf} group in 2012\textsuperscript{36}. This prompted foreign and local authorities to advise their citizens, including biodiversity researchers, to refrain from travelling or visiting Mindanao. Consequently, conflict areas such as Basilan, Zamboanga del Norte, Tawi-Tawi, Zamboanga Sibugay, Sulu, and Isabela remain lacking in biodiversity information. In regions where security risks impede the ability of scientists to conduct biodiversity assessments, the documented biodiversity may underrepresent the actual diversity of species. This disparity can have profound implications for conservation efforts and our comprehension of the true biodiversity status of conflict-stricken regions. Interestingly, our findings indicate that as conflicts recede, researchers may become more willing to conduct biodiversity assessments in previously conflicted areas.

\textbf{Conflict areas: Nature’s unintended refuge?}

We posit that armed conflict can positively impact biodiversity in certain instances. For example, conflict zones become inaccessible to tourists or dangerous for human activities, reducing human disturbances such as hunting, deforestation, and other destructive activities. This inadvertently safeguards wildlife and creates makeshift protected areas. During periods of armed conflict, local communities, including indigenous communities, may retreat to remote areas, where they rely on traditional knowledge and sustainable resource management. These practices often prioritise protecting and conserving biodiversity and safeguarding valuable ecosystems. In addition, armed conflicts can attract significant media
coverage and international attention, which may result in increased conservation funding, enabling the protection and restoration of ecosystems affected by conflicts, thus benefiting biodiversity.

Additionally, military activity may be beneficial under certain conditions, such as when an exclusion zone is created that generally results in population increases and population recovery in terrestrial and aquatic systems\textsuperscript{4}. Although war and armed conflicts can be acknowledged as offering transitory advantages to biodiversity conservation by creating no-go zones that inadvertently safeguard certain species and their fragile habitats, it is essential to understand that these are unintended and incidental and do not justify or outweigh their negative consequences. However, it is crucial to recognize that these areas remain inherently unstable and susceptible to transformation into active conflict zones with unpredictable impacts on biodiversity preservation. It is imperative to recognize that the consequences of war and conflict on socioeconomic stability are far-reaching and have significant long-term effects on the ecosystem, greatly outweighing any potential benefits.

**Addressing biodiversity shortfalls in a heavily conflicted area**

Conversation of the impact and recognition of armed conflict and violent extremism vis-à-vis biodiversity remains the elephant in the room, which is often neglected in biodiversity prioritisation\textsuperscript{6}, especially in Mindanao\textsuperscript{31}. Specific connections between armed conflict and biodiversity conservation have garnered limited attention\textsuperscript{3}. Schulte to Bühne (2022) state that the current legal and policy frameworks regulating global biodiversity conservation do not address the challenges of conducting activities in areas affected by conflicts\textsuperscript{38}. He adds that, to incorporate conflict-sensitive protection into international policymaking, these organizations should openly address the consequences of armed conflicts on biodiversity. Hulme (2022) suggests that international environmental laws (IEL) can be a tool for environmental protection during armed conflicts\textsuperscript{39}.

Moreover, the interplay among armed conflict, violent extremism, and biodiversity conservation is a multifaceted and complex issue that warrants greater scientific and political attention. Acknowledging the link between conflict and biodiversity is essential for shaping effective national and international policies and legal frameworks that can address the unique challenges posed by conservation efforts in conflict-ridden areas, ultimately contributing to protecting diverse ecosystems and species. To address these biodiversity shortfalls within conflicted areas, we recommend actions and considerations for biodiversity conservation (Fig. 4).

1. **More effort should be spent to document and monitor areas with high biodiversity shortfalls.** It is imperative that a concerted effort be made to thoroughly document and monitor regions with notable deficits in biodiversity, to identify areas where gaps exist in biodiversity data, and to establish comparative monitoring assessments that employ standardized, transparent, accessible, and reproducible methods to accurately record previously unrecorded biodiversity. This is crucial for
ensuring a comprehensive understanding of the state of biodiversity, and for making informed decisions regarding conservation and management efforts\textsuperscript{23,40}.

2. **Collaborate with local communities to promote biodiversity assessments and inventories.** Initiate meaningful engagement and foster collaboration with local communities residing in conflict-affected zones. Cultivate relationships grounded in trust, respect, and mutual comprehension. Include community members in decision-making processes, prioritizing and incorporating their perspectives and needs, as they are pivotal in safeguarding and overseeing natural resources.

3. **Strengthen capacity building in highly impacted areas.** Education and awareness programs play a significant role in fostering a sense of environmental stewardship and creating a supportive network for conservation efforts\textsuperscript{41}. It is imperative to invest in genuine capacity-building initiatives that empower local communities, conservation practitioners, and researchers in conflict zones. Long-term effective training on conservation techniques, sustainable resource management, and conflict-sensitive approaches should be provided to promote the conservation of biodiversity in these regions.

4. **Secure funding and establish equitable partnerships.** Collaborate with international organizations, non-governmental organizations, research institutions, and governmental agencies to harness resources, expertise, and funding for conservation projects in conflict zones, seeking support from donors and foundations that specialize in environmental and humanitarian issues. Strong partnerships and financial stability are crucial for the longevity of conservation efforts.

5. **Mainstream adaptive strategies to conflict contexts.** Recognize the unique challenges and risks associated with conducting biodiversity studies within a conflict zone. Adapt conservation strategies that account for security considerations, access limitations, and flexibility. Develop contingency plans and implement risk management strategies to ensure the safety and well-being of personnel and local communities involved in conservation efforts.

6. **Advocate for policy support towards biodiversity conservation:** It is imperative that appropriate policies are implemented to create a supportive environment for the success of long-term biodiversity conservation efforts. The advocacy of policies that enhance biodiversity conservation in areas of conflict is crucial in addressing the inadequacies in these regions. This involves collaborating with local and national authorities to develop and implement legislation that promotes biodiversity research to provide evidence for the effective protection of natural resources, the establishment of conservation areas, and the promotion of sustainable development practices in highly conflicted regions.

**Moving forward**

We presented clear evidence of the impact of sociopolitical conflicts on biodiversity. Conservation efforts in conflict zones require a multidimensional approach that addresses both the ecological and sociopolitical aspects of the situation. This requires resilience, adaptability, and a commitment to building peace and protecting biodiversity, even under challenging circumstances. Recognizing the need to address the intersection of armed conflict, violent extremism, and biodiversity conservation is crucial
for protecting ecosystems, and securing the well-being of humans and the natural world. Governmental efforts should focus on conflict prevention, post-conflict environmental restoration, initiatives to strengthen environmental governance, and engaging local communities to ensure sustainable management of natural resources. Peace, stability, and effective environmental governance are crucial for the long-term protection and conservation of biodiversity. Post-conflict reconstruction and peacebuilding efforts can provide opportunities to integrate sustainable development and conservation practices, promoting the recovery and preservation of biodiversity in conflict-affected regions, especially in the global south, where both conflict and biodiversity are highly concentrated.

**Methods**

We determined the association of sociopolitical conflicts on biodiversity turnover in Mindanao. We first obtained biodiversity data from the MOBIOS* database and conflict-related information for the Philippines from UN-OCHA spanning 2000 to 2021. For the biodiversity data, we only included frequency of data records for insects, arachnids, fishes, amphibians, reptiles, birds, and mammals. We normalised species record turnover by dividing the values to 22 years. We then examined the differences in biodiversity turnover by comparing the average species records per year between low (< 10 conflicts/year) and high (> 10 conflicts/year) conflict areas using the Mann-Whitney U test. Using the same analysis, we compared tree cover loss (2000–2022) using Global Forest Watch data as a proxy to determine whether conflict events contribute to environmental disturbance. We measured the distance (in metres) of biodiversity records to nearest conflict events using the ‘join attributes by nearest’ in QGIS. Furthermore, using a simple Poisson generalised linear model, we determined the effects of taxonomic groups, conflict distance, and number of conflict events on species turnover at the provincial level using Gamlj module in the open software JAMOVI.

**References**


**Figures**

![Figure 1](image-url)

**Figure 1**

Temporal trends in conflict events in the Philippines from 1989 to 2021 based on the UN OCHA28.
Figure 2

Relationship between sociopolitical conflict and biodiversity in Mindanao: a) distribution and overlapping of conflict events (red dots) and biodiversity records (blue dots); b) comparison of low- and high-conflict areas, c) visualised results of the generalised linear model (Poisson GLM) showing the association of conflict event and species record turnover. Note: *** indicates significance at $p < 0.0001$; whiskers and shading represent 95% CI.
Figure 3

Comparison of tree cover loss (in hectares) in Mindanao from 2001-2021 based on remotely sensed data from Global Forest Watch\textsuperscript{37}. The average tree cover loss was significantly different between the low- and high-conflict areas. Note: *** indicates significance at $p < .0001$; whiskers represent 95\% CI.

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1. More effort should be spent to document and monitor areas with high biodiversity shortfalls.
2. Collaborate with local communities to promote biodiversity assessments and inventories.
3. Strengthen capacity building in highly impacted areas.
4. Secure funding and establish equitable partnerships.
5. Mainstream adaptive strategies to conflict contexts.
6. Advocate for policy support towards biodiversity conservation.

Figure 4

Recommended strategies to address biodiversity shortfalls within conflicted areas.