

## PERSPECTIVE

# How a 5% GDP military investment could impact European Union biodiversity

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**Handling Editor:** Marc W Cadotte**Abstract**

1. In response to recent geopolitical tensions, military budgets are rising across the European Union (EU). While NATO members commit to spending 2% of their gross domestic product on defence, European member states are now considering increasing this to 5% by 2035.
2. This growing militarization will likely impact biodiversity conservation by straining financial resources and causing environmental consequences, highlighting the need for policy adjustments and mitigation strategies.
3. *Practical implication:* The rise in military budgets across EU member states risks diverting funds from biodiversity conservation and environmental protection. Increased defence spending could weaken environmental policies and contribute to pollution, habitat loss, ecosystem degradation, introduction of non-native species, and climate change. Balancing national security with conservation efforts is crucial to safeguarding Europe's natural heritage. Greener military technologies, sustainable policies, and collaborative efforts may mitigate environmental impacts while ensuring security and ecological resilience.

**KEYWORDS**

conservation, defence, finances, geopolitical, research

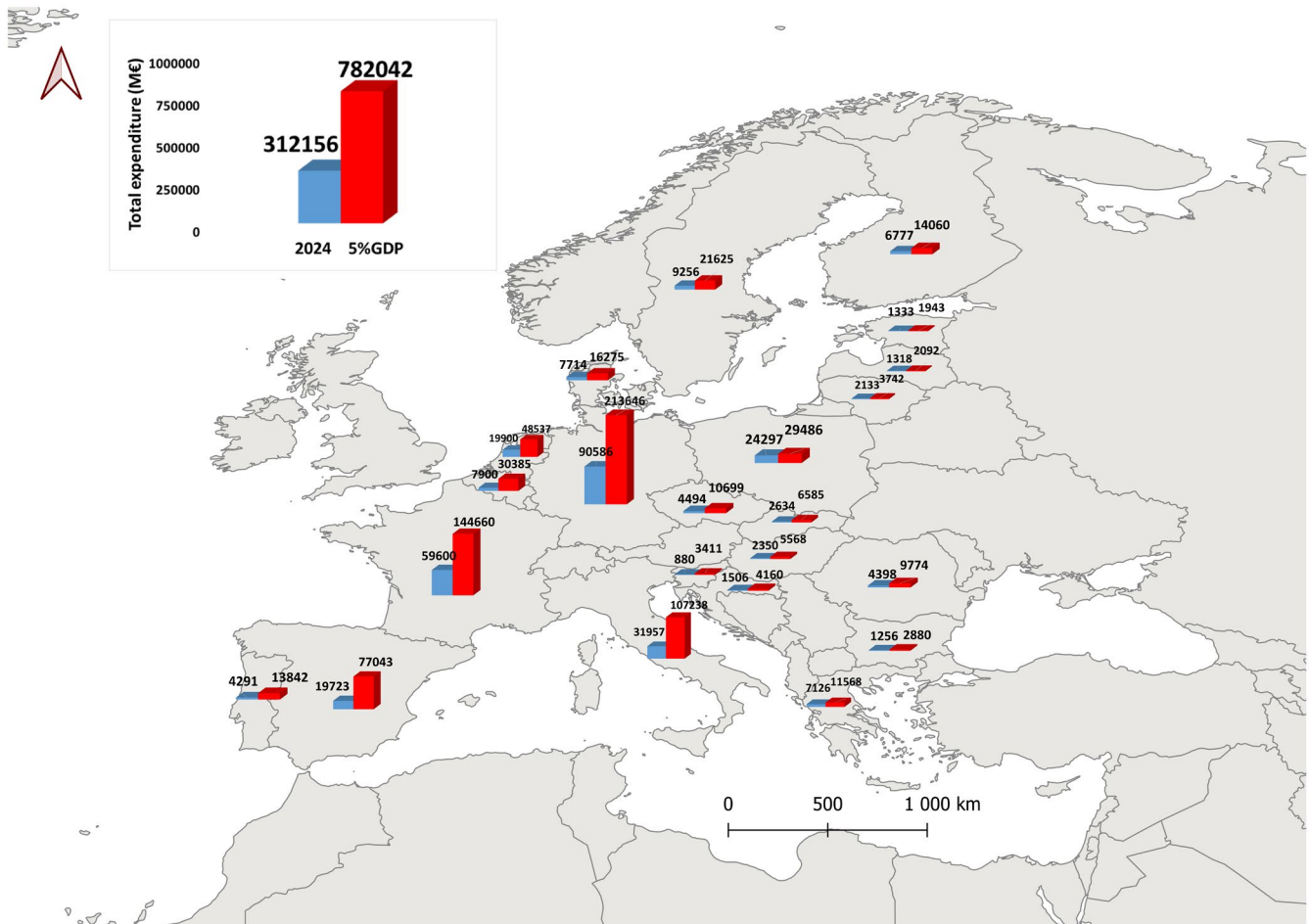
## 1 | INTRODUCTION

Amidst growing geopolitical tensions, there is a global trend of increasing military budgets. To be part of the North Atlantic Treaty

Organization (NATO), countries commit to spending 2% of their national gross domestic product (GDP) on defence, although some countries currently spend less. At the NATO Summit in The Hague, the Netherlands, on 24-25 June, 2025, NATO nations agreed to

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**FIGURE 1** Total defence expenditure of European Union member states that also belong to the North Atlantic Treaty Organization in 2024 (blue) compared to projected expenditure at 5% of gross domestic product (red), in millions of euros. The upper left plot displays the aggregated totals for all 23 countries. Data retrieved from [https://www.nato.int/nato\\_static\\_fl2014/assets/pdf/2024/6/pdf/240617-def-exp-2024-en.pdf](https://www.nato.int/nato_static_fl2014/assets/pdf/2024/6/pdf/240617-def-exp-2024-en.pdf).

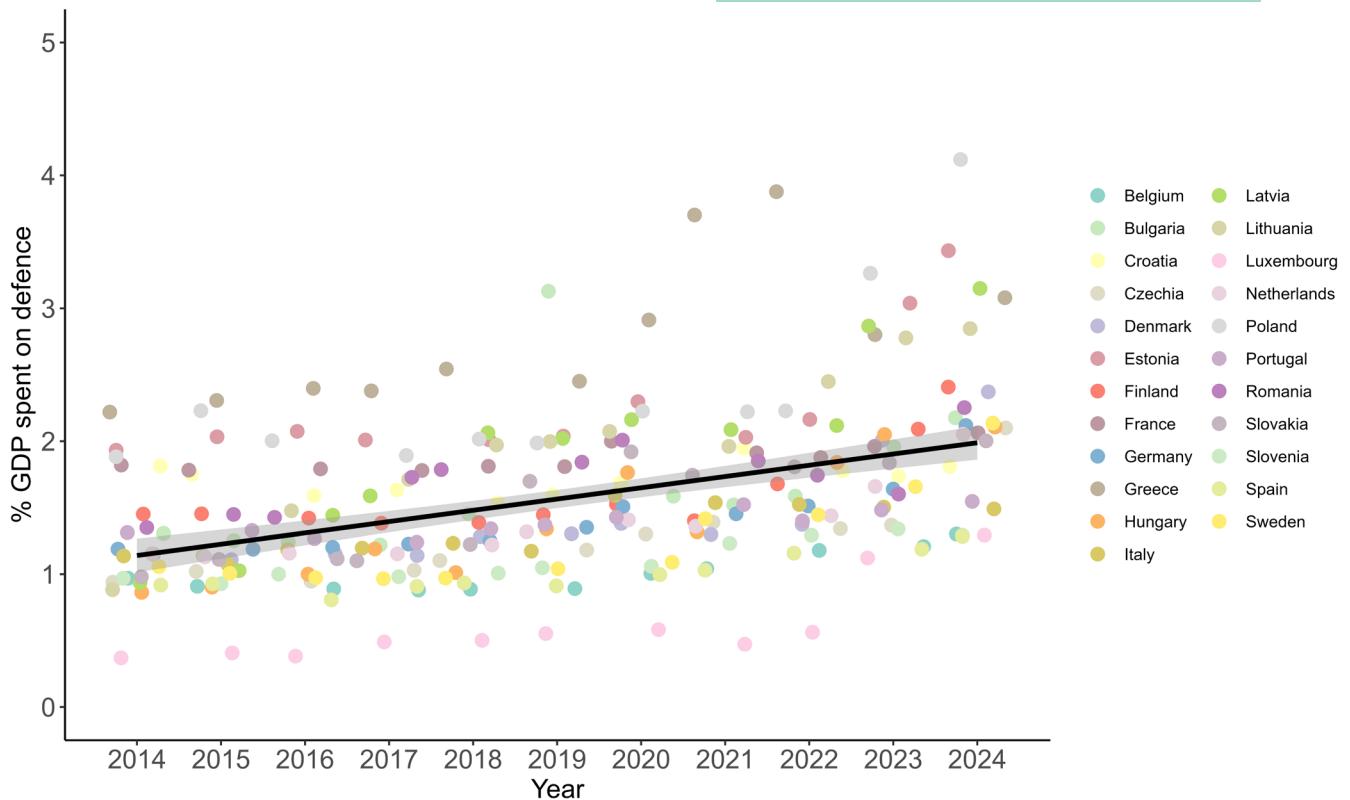
spend as much as 5% of their GDP on military expenditures by 2035. Accordingly, NATO allies (except Spain) committed to investing 5% of their respective GDP in defence—including 3.5% on core defence and 1.5% on security-related investments like infrastructure and industry. This commitment followed the recent European Union (EU) ReArm Europe plan (now labelled as Readiness 2030), which calls for €800 billion in investments in common defence and deterrence capabilities over the next 4 years. Although military spending can be a fundamental priority for a country, such resource allocation often comes at the expense of other crucial sectors. Here, we examine the potential consequences of increased militaristic investment in biodiversity conservation in the European Union, and beyond, addressing financial constraints, environmental impacts and future directions, including policy changes and mitigation strategies.

## 2 | FINANCIAL CONSTRAINTS AND REDUCED CONSERVATION FUNDING

Throughout history, increased military spending has often foreshadowed times of conflict. As Mark Twain aptly observed, ‘History does

not repeat itself, but it often rhymes’. As was the case during the Cold War, the current arms race carries immediate consequences, notably the diversion of public funds away from social, health, educational, and cultural causes, non-military scientific research and environmental initiatives. Governments operate within finite budgets, and while increased military expenditures can be financed through debt, taxation, or monetary expansion (e.g. the Readiness 2030 plan provides for €150 billion in loans to buy defence capabilities mostly made in the European Union), each with distinctive economic consequences shouldered by conservation and other public services, primarily leading to budget reallocations.

For the 23 EU member states that are also NATO members, defence expenditure in 2024 was approximately 300,000 M€. However, allocating 5% of their GDP to defence could raise this figure to nearly 800,000 M€ (Figure 1). Although still far from this 5% of GDP target (but see countries such as Poland, Estonia, Latvia, and Greece already spending more than 3%), the reality is that in the last years, and mainly after the Russian invasion of Ukraine in February 2022, we see a rapid increase in military investment by the EU member states that are also NATO members. We used a linear mixed model to test whether investment in defence has increased



**FIGURE 2** Percentage of gross domestic product (GDP) spent on defence by the 23 EU member states that also belong to the North Atlantic Treaty Organization between 2014 and 2024. The black line represents the overall positive trend in % GDP spent as predicted by a linear mixed model ( $R^2 = 0.195$ ).

over time across the 23 EU member states (which we included as a random effect), and found that the percentage GDP spent has grown steadily and significantly since 2014 ( $\beta \pm SE = 0.085 \pm 0.005$ ;  $p < 0.0001$ ; Figure 2).

Conservation programmes, which already struggle for adequate funding (McCarthy et al., 2012), may face further cuts as resources are diverted to military expansions, defence initiatives, and the buildup of a war economy. Although there is no unified international database that consistently tracks national-level conservation spending over time, using Germany as an example, we can observe that the federal spending on conservation-related sectors has varied significantly over the years. A total of €1.359 billion euros was allocated in 2021 to agriculture, forestry, natural landscapes, and biodiversity (Deutsche Finanzagentur, 2022), followed by €2.1–3.4 billion in climate adaptation-related expenditures in 2022 (German Environment Agency, 2023) and €717.9 million in 2023 being directed towards those same sectors, including €674.2 million specifically for biodiversity and ecosystem protection (Deutsche Finanzagentur, 2024). Such fluctuations could cause bottlenecks in protected area management and international conservation aid (Weir et al., 2024). Even many EU nations rely on public funding to manage protected areas (e.g. the LIFE funding scheme) while simultaneously playing a crucial role in financing biodiversity conservation in developing nations (McClanahan & Rankin, 2016). Predictably, reduced available funding will lead to inadequate staffing, less monitoring of illegal

activities, and weaker enforcement of conservation laws. Similarly, scientific research on biodiversity, climate change mitigation, pollution abatement and ecological restoration in the EU often depends on government investments. Therefore, a change in priorities towards military expansion and security initiatives could mean fewer resources and less international cooperation for studying and protecting endangered species and ecosystems. Finally, higher defence budgets will likely reduce overseas development assistance for conservation, leading to biodiversity losses in poor but highly diverse regions that depend on the availability of these funds (McClanahan & Rankin, 2016).

The EU is a major player in international environmental agreements such as the *Convention on Biological Diversity* and the *Paris Agreement*. However, governments that prioritize military spending should experience shifts in their political and legislative focus, with environmental protection and biodiversity conservation taking a backseat, possibly mirrored among the broader public (Gaynor et al., 2016). With greater emphasis on geopolitical tension, governments will likely relax climate and biodiversity agreements and regulations (European Green Deal, EU Biodiversity Strategy 2030, and the Nature Restoration Law), as they may be seen as obstacles to military expansion (Sousa et al., 2022). Indeed, these strategies have such ambitious targets that it is hard to believe that military investments will not impact overall budgets for conserving and restoring habitats in the EU. The same applies to other NATO

members, such as Canada, the United Kingdom, the United States and Turkey, among others, which also agreed to increase their military spending and will likely face the same environmental concerns described above. Finally, reduced government funding could push conservation efforts into the hands of private entities, leading to the commercialization and militarization of protected areas and the marginalization of local communities in biodiversity management (Duffy et al., 2019).

### 3 | ENVIRONMENTAL IMPACT OF MILITARY ACTIVITIES

Beyond causing financial constraints, military activities themselves cause wide-ranging environmental impacts. Increased military spending often leads to expanded military infrastructure, more frequent training exercises, and potentially armed conflicts, all of which can harm biodiversity (Durant & Brito, 2019; Sousa et al., 2022). For example, military bases, testing grounds, and training areas (e.g. nuclear test sites) require vast amounts of land, often leading to deforestation, wetland drainage, and the destruction of natural habitats (Hanson, 2018). In the United States, more land outside of Alaska is designated for military purposes than for National Parks or National Wildlife Refuges (Hanson, 2018). Trucks, tanks, and heavy-vehicle training are responsible for soil compaction affecting plant communities and can interact with other land uses such as grazing due to the creation of complex successional patterns (Guretzky et al., 2006; Machlis & Hanson, 2008). The use of explosives and heavy machinery can damage fragile ecosystems, sometimes irreparably, and infrastructure development for military purposes, such as airstrips and roads, can fragment ecosystems and disrupt wildlife corridors (Hanson, 2018). Furthermore, military activities contribute to environmental pollution through oil spills, heavy metal contamination, radioactive waste, and the release of hazardous chemicals associated with propellants, explosives, solvents, and fuels (Gaynor et al., 2016; Hanson, 2018). Munitions and explosives, for example, can introduce toxic substances into soil and water systems, affecting local biodiversity. All these compounds may persist in the environment for long periods and be accumulated by aquatic and terrestrial organisms with potential sublethal or even lethal effects (Johnson et al., 2007; Racine et al., 1992; Via & Zinnert, 2016). Military training exercises, especially those that involve heavy artillery, aircraft, and naval operations, also generate significant noise and nocturnal light pollution, which can alter animal communication, migration, and breeding patterns (Hanson, 2018). In extreme cases, such as those described for the Mururoa Atoll, the underwater shockwaves of nuclear tests were responsible for the disappearance of coral fish communities (Planes et al., 2005). Indirect impacts also arise from these military activities, such as the introduction of non-native species due to the modification of existing pathways, the creation of new routes that potentially facilitate their movement, an increase in the number of propagules transported, and the generation of disturbances

that may facilitate their establishment (Santini et al., 2023). A myriad of different organisms have been transported by military activities, from plants to mammals (see Santini et al., 2023). A textbook example is the introduction of the brown tree snake (*Boiga irregularis*) to the island of Guam during World War II, where this species has been linked to the extirpation of several species of birds, mammals, and reptiles, with cascading effects at several trophic levels (Fritts & Rodda, 1998; Rogers et al., 2017). Finally, the military apparatus as a whole is a major driver of climate change, contributing to 5.5% of global greenhouse gas emissions (Parkinson & Cottrell, 2022). All of these actions will accelerate habitat loss and fragmentation and inevitably modify the use of land and sea and irreversibly change the land and seascape.

### 4 | THE WAY FORWARD

From a biodiversity conservation perspective, the best way forward is to invest substantially more in research, monitoring, protection, and restoration, enacted in a peaceful environment. However, and without being naïve, growing geopolitical tensions and increased political rhetoric are already shifting the priorities of EU member states towards much higher spending in defence. To counterbalance this, conservation scientists and key stakeholders involved in environmental protection should start exploring ways to mitigate the negative consequences of defence spending on biodiversity conservation, even though most EU member states are still far from the 5% GDP reiterated threshold (Figures 1 and 2). While we strongly advocate for conservation at the expense of military spending, we also understand that sometimes conflicts are inevitable. Given this premise, and recognizing that the implementation of sustainable security strategies for protecting biodiversity is itself a form of long-term security—as healthy ecosystems are fundamental to economic stability, resilience to climate change and global peace (Loreau et al., 2021; Weir et al., 2024)—we propose several measures to mitigate the rise in military spending while prioritizing environmental considerations:

- *Use of greener military technology.* For example, the adoption of greener military technologies (embodied by the recently developed US military prototype of a hybrid-electric tactical vehicle called Electric Light Reconnaissance Vehicle [Harper, 2022]) and improved waste management practices can help reduce the overall environmental footprint (although recognizing that this will only be possible during preparation exercises).
- *Increase interdisciplinary collaboration.* Trans-boundary and interdisciplinary collaboration among governments, the military, and researchers (e.g. long tradition of cooperation between navy and marine researchers) remains key to minimizing environmental damage, enhancing conservation efforts and developing greener military practices.
- *Develop EU policies that balance national security with environmental sustainability.* This includes environmental impact assessments

for military projects and adherence to biodiversity conservation principles in defence planning.

- *Implement biosecurity measures concerning the introduction of non-native species.* These measures should include strict quarantine protocols, thorough equipment decontamination, habitat monitoring, and risk assessments to prevent non-native species introduction through military training, vehicle movements, and personnel deployment (Santini et al., 2023).
- *Establish protected areas in abandoned or even active military training grounds.* Insofar, some of the areas previously used by militaries have inadvertently become biodiversity hotspots due to restricted human access (Gaynor et al., 2016) and to the maintenance of a disturbance regime via training activities that favour several disturbance-dependent species such as butterflies and other insects (Smith et al., 2002; Warren & Büttner, 2008). Implementing conservation-friendly management practices could help preserve these ecosystems.
- *Increase awareness of biodiversity conservation on military areas.* It is necessary to create opportunities for integrated environmental management that both preserve training capacity and promote biodiversity while preventing long-term habitat degradation (Zentelis et al., 2017). Examples of dual-use land management using military areas for biodiversity conservation already exist in Europe and include Döberitzer Heide (Germany), Salisbury Plain (United Kingdom), and Camp des Garrigues (France), among many others. In reality, countries such as Denmark, the Netherlands, Belgium, and Germany have extensive military training areas included in the Natura 2000 network of protected areas (Warren et al., 2007).

## 5 | CONCLUSION

Allocating 5% of each EU member state's GDP to defence will have profound implications for biodiversity conservation. The most pressing concern is the financial trade-off, as increased military expenditures could reduce funding for conservation programmes, monitoring, research, and protected area management. Military activities pose direct environmental threats, including habitat destruction, pollution, introduction of non-native species, and greenhouse gas emissions. Policy shifts towards national security priorities risk weakening environmental regulations and slowing progress on international biodiversity agreements. Now, more than ever, it is important to balance national security and biodiversity conservation to ensure that Europe does not sacrifice its natural heritage and long-lasting legacy of nature conservation policies in pursuit of military preparedness. Addressing the root causes of geopolitical conflicts through diplomacy, peace agreements, and sustainable development initiatives can reduce the perceived need for excessive military spending while simultaneously supporting biodiversity conservation. Although wars may come and go, the loss of biodiversity is irreversible, undermining the very foundation of life on Earth and threatening humanity's own survival.

## AUTHOR CONTRIBUTIONS

Ronaldo Sousa conceived the study and wrote the first draft of the manuscript. Joana G. Nogueira, Stefano Mammola and Phillip J. Haubrock substantially revised the manuscript and contributed critically to the drafts and gave final approval for publication.

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## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

## PEER REVIEW

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## DATA AVAILABILITY STATEMENT

This manuscript does not use data.

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## REFERENCES

- Deutsche Finanzagentur. (2022). *Green bond allocation report 2022*.  
 Deutsche Finanzagentur. (2024). *Green bond allocation report 2024*.  
 Duffy, R., Massé, F., Smidt, E., Marijnen, E., Büscher, B., Verweijen, J., Ramutsindela, M., Simlai, T., Joanny, L., & Lunstrum, E. (2019). Why we must question the militarisation of conservation. *Biological Conservation*, 232, 66–73.  
 Durant, S. M., & Brito, J. C. (2019). Protect environment from armed conflicts. *Nature*, 571, 478.  
 Fritts, T. H., & Rodda, G. H. (1998). The role of introduced species in the degradation of island ecosystems: A case history of Guam. *Annual Review of Ecology, Evolution, and Systematics*, 29, 113–140.  
 Gaynor, G. M., Fiorella, K. J., Gregory, G. H., Kurz, D. J., Seto, K. L., Withey, L. S., & Brashares, J. S. (2016). War and wildlife: Linking armed conflict to conservation. *Frontiers in Ecology and the Environment*, 14, 533–542.  
 German Environment Agency. (2023). *Tracking climate adaptation spending in Germany*.

- Guretzky, J. A., Anderson, A. B., & Fehmi, J. S. (2006). Grazing and military vehicle effects on grassland soils and vegetation. *Great Plains Research*, 16, 51–61.
- Hanson, T. (2018). Biodiversity conservation and armed conflict: A warfare ecology perspective. *Annals of the New York Academy of Sciences*, 1429, 50–65.
- Harper, J. (2022). US military wants its vehicles to go electric—With Detroit's help. *National Defense*, 106(819), 33–36.
- Johnson, M. S., Suski, J., & Bazar, M. A. (2007). Toxicological responses of red-backed salamanders (*Plethodon cinereus*) to subchronic soil exposures of 2, 4-dinitrotoluene. *Environmental Pollution*, 147, 604–608.
- Loreau, M., Barbier, M., Filotas, E., Gravel, D., Isbell, F., Miller, S. J., Montoya, J. M., Wang, S., Aussenac, R., Germain, R., Thompson, P. L., Gonzalez, A., & Dee, L. E. (2021). Biodiversity as insurance: From concept to measurement and application. *Biological Reviews*, 96, 2333–2354.
- Machlis, G. E., & Hanson, T. (2008). Warfare ecology. *Bioscience*, 58(8), 729–736.
- McCarthy, D. P., Donald, P. F., Scharlemann, J. P., Buchanan, G. M., Balmford, A., Green, J. M., Bennun, L. A., Burgess, N. D., Fishpool, L. D. C., Garnett, S. T., Leonard, D. L., Maloney, R. F., Morling, P., Schaefer, H. M., Symes, A., Wiedenfeld, D. A., & Butchart, S. H. (2012). Financial costs of meeting global biodiversity conservation targets: Current spending and unmet needs. *Science*, 338, 946–949.
- McClanahan, T. R., & Rankin, P. S. (2016). Geography of conservation spending, biodiversity, and culture. *Conservation Biology*, 30, 1089–1101.
- Parkinson, S., & Cottrell, L. (2022). *Estimating the military's global greenhouse gas emissions*. <https://coilink.org/20.500.12592/1d4xn8>
- Planes, S., Galzin, R., Bablet, J. P., & Sale, P. F. (2005). Stability of coral reef fish assemblages impacted by nuclear tests. *Ecology*, 86, 2578–2585.
- Racine, C. H., Walsh, M. E., Roebuck, B. D., Collins, C. M., Calkins, D., Reitsma, L., Buchli, P., & Goldfarb, G. (1992). White phosphorus poisoning of waterfowl in an Alaskan salt marsh. *Journal of Wildlife Diseases*, 28(4), 669–673.
- Rogers, H. S., Buhle, E. R., HilleRisLambers, J., Fricke, E. C., Miller, R. H., & Tewksbury, J. J. (2017). Effects of an invasive predator cascade to plants via mutualism disruption. *Nature Communications*, 8(1), 14557.
- Santini, A., Maresi, G., Richardson, D. M., & Liebhold, A. M. (2023). Collateral damage: Military invasions beget biological invasions. *Frontiers in Ecology and the Environment*, 21(10), 469–478.
- Smith, M. A., Turner, M. G., & Rusch, D. H. (2002). The effect of military training activity on eastern lupine and the Karner blue butterfly at Fort McCoy, Wisconsin, USA. *Environmental Management*, 29, 102–115.
- Sousa, R., da Silva, J. P., Douda, K., & Mammola, S. (2022). The cost of wars for biodiversity: The ecocide in Ukraine. *Frontiers in Ecology and the Environment*, 20, 394–396.
- Via, S. M., & Zinnert, J. C. (2016). Impacts of explosive compounds on vegetation: A need for community scale investigations. *Environmental Pollution*, 208, 495–505.
- Warren, S. D., & Büttner, R. (2008). Active military training areas as refugia for disturbance-dependent endangered insects. *Journal of Insect Conservation*, 12, 671–676.
- Warren, S. D., Holbrook, S. W., Dale, D. A., Whelan, N. L., Elyn, M., Grimm, W., & Jentsch, A. (2007). Biodiversity and the heterogeneous disturbance regime on military training lands. *Restoration Ecology*, 15(4), 606–612.
- Weir, D., Durant, S. M., Schulte to Bühne, H., Hoffmann, M., Petrovych, O., Sua Carvajal, B., & Fernandes Elizalde, S. (2024). Conservation policies must address an overlooked issue: How war affects the environment. *Nature*, 634, 538–541.
- Zentelis, R., Lindenmayer, D., Roberts, J. D., & Dovers, S. (2017). Principles for integrated environmental management of military training areas. *Land Use Policy*, 63, 186–195.

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