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Insect and arthropod conservation policies: the need for a paradigm shift

Camila Leandro

To date, insect conservation policy mainly consists of species protection lists, with some requiring habitat or ecosystem preservation to protect insect ecology. While a landscape or habitat approach seems the most appropriate for insect conservation, cases are rare of protected areas designated specifically for insects or other arthropods. Moreover, neither of these conservation approaches (species or habitat protection) have halted the worldwide decline in insects: species protection lists and reserves at best serve as band-aids for a massive hemorrhage. The main drivers of insect decline (global changes) are only loosely addressed by national and international policies. So, if we know the causes, what stands in the way of prevention and treatment for the problem? To save insects, our civilization needs psychotherapy rather than first-aid gestures: a paradigm shift that would place value on insects, and give rise to ecocentric policies informed by a wide range of stakeholders.

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Only a very few find the way, and most of them don't recognize it when they do. Delusions, too, die hard. [...] But recovering the truth is worth the suffering, and our Wonderland, though damaged, is safe in memory. for now. — The Cheshire Cat to Alice, Alice's Adventures in Wonderland (Lewis Carroll, 1865)

Introduction

Insects and other terrestrial arthropods (spiders, myriapods, and springtails) represent ~90% of described animals [1] and significantly participate in ecosystem functioning [2]. Consequently, across time and space,

humankind has been associated directly or indirectly, positively or negatively, with a multitude of these species and their ecological functions.

Biodiversity loss due to anthropogenic global change is undeniable and represents a political challenge worldwide [3]. Arthropods are no exception. While their population dynamics are less documented than more charismatic species, they too are altered by human activities. This is not to say that global change disturbs all species equally [4], but across continents and biomes, in protected areas (PAs), and anthropized landscapes, long-term monitoring is revealing population declines [5,6]. With the loss of functional groups or phylogenetic lineages, ecological functioning and related ecosystem services deteriorate, posing a threat to ecosystem resilience and ultimately to human survival [7–9]. Unfortunately, our society suffers from low entomological literacy, leading to generally negative perceptions of 'creepy crawlies'; in addition to this, the decrease of nature experiences and the shifting baseline syndrome might lead to arthropod decline going unaddressed [10,11] until it is too late.

And yet, in the same way, humans have the power to act in the networks in which they are embedded, nonhumans have agency in the spaces they inhabit and in their interactions with other living forms [12,13]. If politics is defined as the collective choices we make and the way we organize society, particularly in attempting to resolve problems [14], human–arthropod interactions can be considered highly political, notably in terms of agricultural or public health issues, where arthropods are control agents, food suppliers, or disease carriers.

How is policy directly addressing insect decline? How are the major drivers of decline being tackled? Which system is compatible with a vision of 'living in harmony with arthropods' that could lead to effective conservation? This review on terrestrial arthropod conservation policy seeks to examine these questions.

Insect conservation policy

The species approach

The first instrument dedicated to arthropod conservation, which remains in wide use, was the legal protection of species (*Parnassius apollo* by the Bavarian state in 1835 [15]). Species protection lists have proliferated in many countries since the introduction in 1964 of the

International Union for Conservation of Nature (IUCN) flagship conservation tool, Red Lists.¹ These are based on scientific work on population dynamics and species conservation for many taxa, and have catalyzed public policy [16]. For instance, the IUCN Invertebrate Red Data Book [17] was key in the inclusion of an arthropod list in the Bern Convention and the European Habitat Directive appendices [18], the latter of which is legally binding for EU member states. The IUCN Species Survival Commission (SSC) currently hosts 17² specialist groups focused on terrestrial arthropods and reports that 8.3% of assessed species are insects.³ Of arthropods, insects benefit most from this conservation tool, but recent reviews on Myriapoda [19] and European spiders [20] suggest this is broadening to other groups. As such, the Convention on International Trade of Endangered Species, launched in 1973⁴ and with links to the SSC, provides international protection from overexploitation for tarantulas, scorpions, coleopterans, and lepidopterans.⁵

Species Action or Conservation Plans were a follow-up policy tool that became more prevalent after the Convention on Biological Diversity (CBD). They can lead to successful breeding or reintroduction programs [21,22] and have recently been adapted to functional groups. The 2016 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) global assessment on pollinators [23] and the CBD's 2018 document on pollinators⁶ led to action plans for this functional group in several countries as well as at an international level.⁷ But despite their relevance, UK conservation plans for nonvertebrates, for instance, receive less resources than those for vertebrates [42], illustrating the known bias toward 'fur and feathers' in conservation [25].

This bias for rare, charismatic, or useful taxa has been frequently demonstrated within arthropods as well [18,26,27]. Moreover, as species lists are more common in countries with high national incomes [28], geographical bias might lead to inconsistency between national and international legislation (i.e. Australia and Commonwealth treaties [29], Europe [30]), threatening species that do not acknowledge borders. One reason for

the protection focus on certain species is the dependency of conservation tools on expertise and data availability; however, arthropods are prone to knowledge bias and impediments in monitoring [25,31], particularly in biodiversity hotspots as the tropics [32], and expertise is declining [33]. Ensuring financial support and capacity-building for threat assessment and making a determined effort to reduce bias are first steps that could encourage the conservation of endangered species [33] or pertinent surrogates for wider conservation approaches. But, as governmental accountability is essential to evaluate if an objective is attained by the policy tool and to change it if not, policy evaluation baselines are also needed [32,35,36].

The landscape approach

Habitat conservation has been highlighted as a more relevant aim for arthropods, starting from microhabitats and moving to landscapes and ecosystems as the ultimate goal to conserve (meta)populations and (meta)communities [35,36]. The incorporation of insects in large-scale conservation planning can be done at different scales: national, such as the South African Working for Water Program [22]; regional, such as European Natura 2000 and Emerald networks⁸; and international, such as the Ramsar Convention on Wetlands, which highlights Odonata conservation, for example [37].

In Russia, the ecosystem services principle led to the first insect microreserve in 1972. Such PAs are not necessarily just zones that are 'set aside', but are managed to improve the breeding success of target taxa [38]. In Brazil, the methodology used to identify PAs has integrated entomological knowledge since the 1990s [39]. However, arthropods on their own are rarely used to define PAs. Although there is a widespread belief that PAs designed to protect larger animals should automatically benefit smaller organisms, this has often been contradicted [37,39,40]. Studies have shown that 76% of insect species are inadequately represented by PAs worldwide [41], and only 3% of PAs evaluate their performance for insect conservation [9]. Given the functional and interactional diversity of the group [2], defining PAs based on arthropod species would be a bold but efficient way to preserve biodiversity. Much effort is still needed to consider entomological diversity, as well as other underrepresented groups, in conservation policy, while planning for, expanding, or creating connectivity within and across PAs [9,35,41].

It is also impossible to overlook that animal populations dwelling in PAs are impacted by global change [6,9]:

¹ www.iucnredlist.org 'Background & History' consulted on 19/12/2022

² https://www.iucn.org/our-union/commissions/group/1445?cmsn_gp=1580&cmsn_category=1597 consulted on 27/02/2023

³ <https://www.iucnredlist.org/search> consulted on 27/02/2023

⁴ <https://cites.org/eng/disc/text.php>

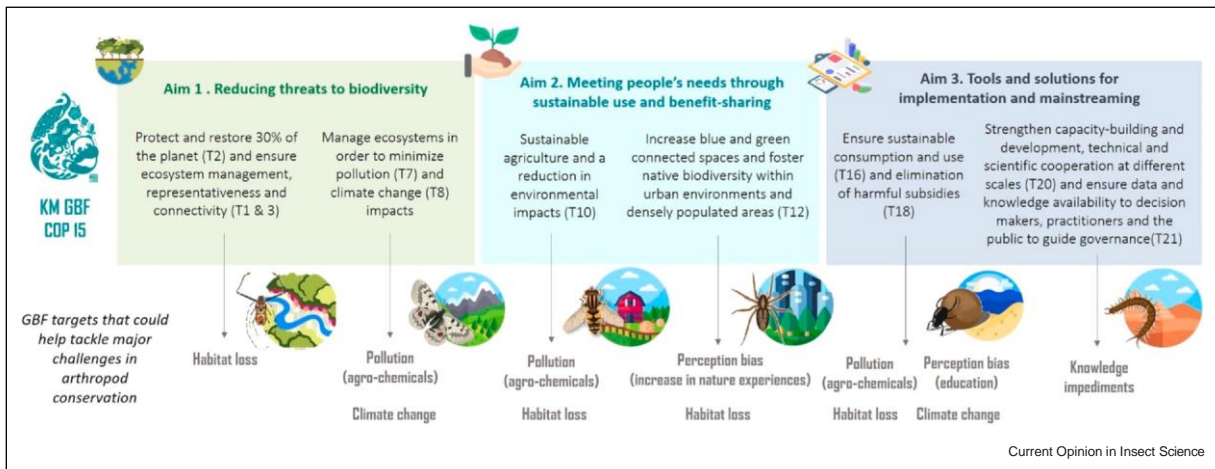
⁵ <https://cites.org/eng/app/appendices.php> consulted on 03/01/2023

⁶ Conservation and Sustainable Use of Pollinators document (2018) from the Convention on Biological Diversity CBD/COP/DEC/14/6 <https://www.cbd.int/sbstta/sbstta-22-sbi-2/sbstta-22-ipi-draft.pdf> consulted on 08/01/2023

⁷ List found here: <https://www.fao.org/pollination/major-initiatives/national-initiatives/en/>

⁸ https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.dspPage&n_proj_id=6288 and <https://www.coe.int/en/web/bern-convention/emerald-network> consulted on 08/01/2023

Figure 1



Opportunities provided by the GBF targets adopted at the Kunming-Montreal biodiversity summit in 2022 (Conference of the Parties n°15 of the CBD) to address major challenges of arthropod conservation. These include global changes (habitat loss, fertilizer, and synthetic pesticide use and climate change) and perception bias, also referred to as public and political dilemmas. (Icons from www.flaticon.com).

whether a PA is a zone restricted from human activity or balances nature conservation with socio-economic goals (e.g. EU Natura 2000 sites, Indigenous and Community Conservation Areas), habitat management must consider the ecological and spatial requirements of arthropods through their different life stages [9,32,35], as well as the internal and adjacent land use at a landscape scale. All of the following measures should be promoted and their implementation evaluated: habitat restoration (e.g. the Bonn Challenge for reforestation), mitigation of impacts on natural habitats (e.g. No Net Loss policies), and urban and agricultural buffer zones and corridors, minimizing human impact [9,30,35]. Ultimately, species and landscape approaches to conservation are entwined, as they are with socio-economic and cultural aspects of nature valuation.

Addressing the root cause of the problem

Habitat loss, fertilizer, and synthetic pesticide use pollution and climate change are the drivers of insect decline through their individual and combined effects [34,42–45]. Scientists have suggested ways to frontally address such threats, or at least help ecosystems adapt to change, instead of protection gestures [5,21,30,35,46]. In 2018, the recognition of pollinator (and particularly honeybee) loss by different stakeholders and backed by rigorous scientific work led to a much lauded EU policy change, including a ban on neonicotinoid insecticides [47]. But this measure, also taken by some US states and Canada, is subject to so many ‘exceptions’ that approvals of their use remain the norm [48,49]. Despite a growing number of pollinator-friendly agri-environmental initiatives in Europe, in fact, pesticide use has increased [49]. This political situation shows how core sustainable development goals (as outlined in the CBD) are subverted by the anthropocentric ethics of a market rationality, which is dominant in most mixed

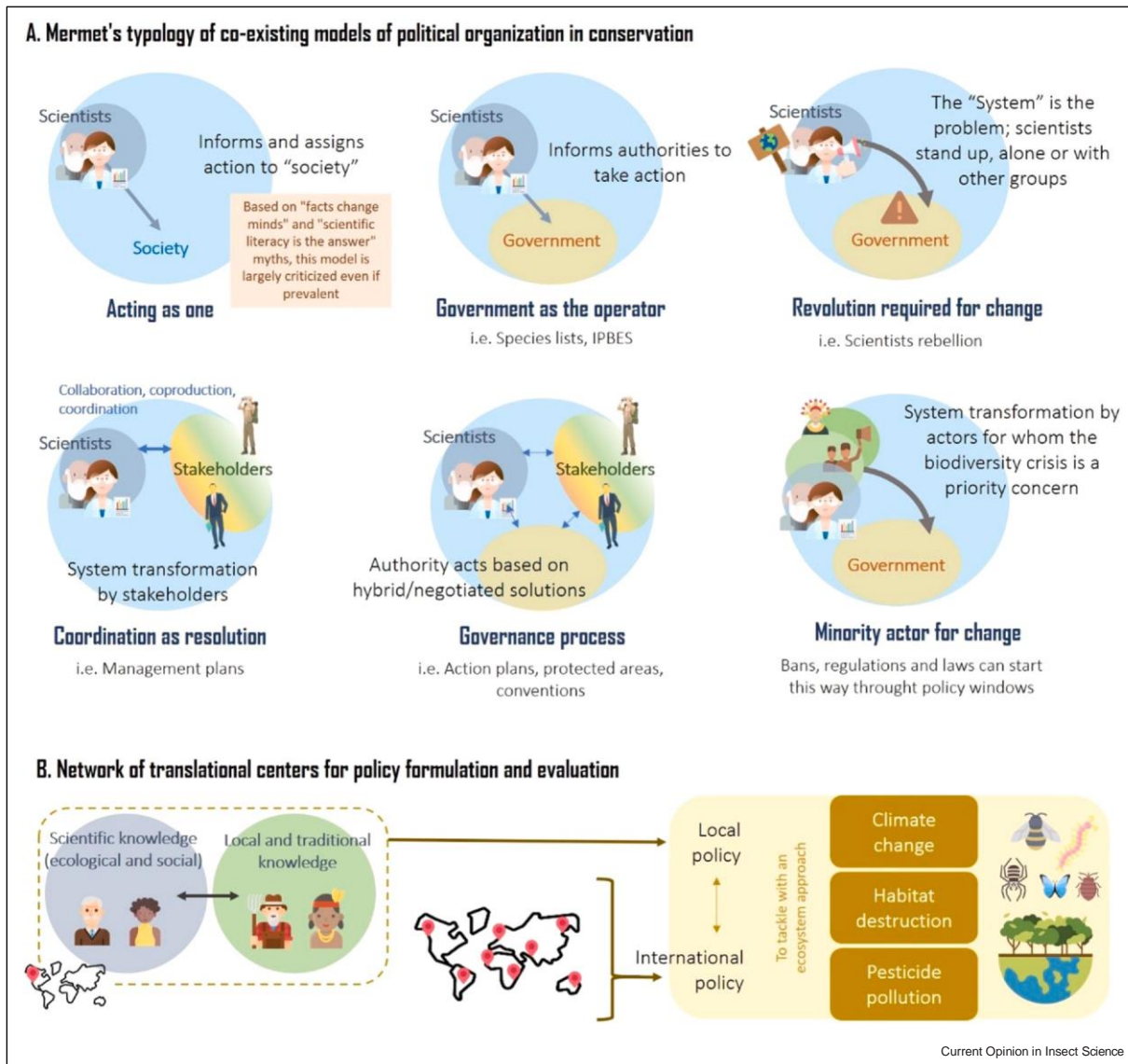
economies [50,51] in which insects are either enemies or allies viewed through the lens of the ecosystem (dis)ser- vices they provide [52].

Yet, the way we designate ‘enemies’ has an impact on species and habitats beyond the perimeter of manage- ment. The diversity and complexity of arthropods, on which human life depends, call for an ambitious, strict approach to conservation [21,31]. The old adage must become ‘think global, act local AND global’: interna- tional policy coordination is crucial to protect ecosystem integrity.

The Kunming-Montreal Global Biodiversity Framework (GBF),⁹ adopted in 2022, could be a useful tool for ar- thropod conservation (see Figure 1), as beyond direct measures toward nature, it highlights human behavior change toward nature in order to ‘live in harmony with nature’; overall, it could help go beyond the ‘arthropods as enemies or allies’ belief and see the whole group, in all its nuances, as valuable. Additionally, in the same way that sociocultural/party equitability is essential to fair resource and benefit sharing in this framework, this principle could and should be applied to taxa and geo- graphy to reduce bias in conservation. Nevertheless, while the parties of the framework are obliged to report on their national strategies, the lack of explicit aims for each target and the absence of global standards on how to evaluate policies and how to make parties accountable for their conservation progress, might lead to the failure

⁹ <https://www.cbd.int/article/cop15-final-text-kunming-montreal-gbf-221222> consulted on 27/02/2023

Figure 2



(a) Six models of organized action used in Mermet's conservation typology (2020): each model is illustrated by conservation tools used for insect conservation. (b) A summary that illustrates how insect science and conservation solutions could benefit from local collaboration between experts holding different forms of knowledge, and how the discussion and collaboration of these stakeholders on an international scale, as well as the hindsight gained from the evaluation of the actions implemented, can allow for local and global action toward a societal transformation where humans can live in harmony with nonhumans, including insects. (Icons from www.flaticon.com).

of this new framework, as it happened with the Aichi Biodiversity Targets [49,53,54].

The way forward for arthropod conservation

Entomologists at the science-policy interface

At the interface of science and policy, the primary role of ecologists is to measure and report biodiversity patterns. New technologies, such as metagenomics and machine learning, are changing how species are monitored (allowing more rapid and broader surveys) and how ecological studies are conducted [55]. Roadmaps have been

established on how to accurately aggregate and study temporal and spatial data for arthropod threat assessment [4,56]. But advancing technical tools and methods is not enough to translate ideas into action. Scientists must beware of the common belief that 'strong evidence is enough to change humanity' [59,60] (Figure 2a: 'Acting as one' model).

In addition to their primary role, scientists could be involved in conservation planning or PA committees, SSC specialist groups, Red List initiatives [57,58], the IPBES

platform, or the CDB's party or third-party delegations, allowing them to actively share knowledge with policy-makers and to suggest standardized frameworks for policy evaluation (Figure 2a: 'Government as the operator' model). On another note, the neonicotinoid ban and the ethical integrity of the IPBES pollinator report would not have been reached without the scientific rigor and advocacy of scientists [47,61] (Figure 2a: 'Revolution' model).

Through collaboration, scientists can empower NGOs, companies, and epistemic communities, among others, and even operationalize their findings [62,63] (Figure 2a: 'Coordination' model). Entomological 'translational centers' [52] could encourage transdisciplinary collaboration (Figure 2a: 'Governance' model) and help to avoid transferring policies and practices designed for the Global North to the Global South where they might be unsuitable [22]. This is complementary to the need to strengthen epistemic communities across the globe [64]. The imperative for actionable ideas grounded in science in which diverse types of knowledge (scientific, traditional, and local) are shared calls for interdisciplinary approaches (ecology, social sciences, etc.) and minority empowerment in insect science [65–67] (Figure 2b). These 'translational centers' could fall within the GBF's 'Capacity-building and development & technical and scientific cooperation'¹⁰ guidelines, benefit from targets 20 and 21 on conservation implementation, and ideally become entities able to evaluate policy effectiveness as regards GBF goals and targets at national and local scales.

The need for a paradigm shift

Public policy represents society's collective choices to pursue certain objectives through governmental decisions. Governments (national and international), driven by their values and motivations, try to balance biodiversity preservation and socio-economic goals, but individuals and stakeholders (public institutions, scientists, NGOs, companies, and countries) have different perceptions of this and different levels of power [14].

In cultures where anthropocentric values and market rationalities are deeply rooted, a political choice for arthropod conservation is not possible without a major ontological change in the human-nature relationship, accompanied by a profound transformation in our way of life [24,51,68,69]. To get there, governments and stakeholders must start with the GBF's call for a change toward 'a shared vision of living in harmony with nature.' This involves acknowledging resource limitation and the intertwining of social, economic, and ecological issues. For arthropods and other noncharismatic fauna, it also involves a cultural and perception change of the 'little

things that run the world' [21,35]. Acknowledging arthropod complexity, even ambiguity, as much as the provisioning, regulating, supporting, and, last but not least, cultural ecosystem services they provide is a first step [21,70]. This could be encouraged through innovative ecological literacy approaches that reconnect with nature [10,21,35] and forge the idea of human/nonhuman interdependency — 'living with' — in multiple ecosystems. These should pledge to governance in which nonhuman agency is recognized, leading by example toward the philosophy outlined in the GBF.

Transformative ideas can diffuse from small networks of informed stakeholders out to larger social groups, leading to collective change [53,71] (Figure 2a: 'Minority actor for change' model). Policymakers have the power to spur the transformative force that will lead to paradigm change, and we encourage them to

- 1) Beware of bias in conservation policies and promote taxonomic equity by supporting research and conservation of understudied groups as much as 'well-known' groups;
- 2) Foster policy forums in which different knowledge holders (scientific, traditional, and local) can collaborate and contribute to designing policy and evaluating its effectiveness;
- 3) Use the precautionary principle and be 'radical' if needed: encourage the transition to agroecological systems, ban pesticides, conserve as many ecosystems as possible, ban mitigation quotas based on trading schemes (carbon, land), and so on;
- 4) Ensure policy implementation by verifying and building the capacity of each party and providing a binding framework in which the nonrespect of obligations is penalized (economically or politically). Species, habitat or ecosystem protection, and management or restoration must be evaluated and governments made accountable for their success.

If our political representatives and policymakers are not up to the task of tackling biodiversity loss, nature advocacy groups must lead the transformative change required. Without bold and radical action that upends 'business as usual' and the delusion of 'clean-tech solutions,' we might be the last humans to have known a wonderland that is more than a memory.

Data Availability

No data were used for the research described in the article.

Declaration of Competing Interest

None.

¹⁰ <https://www.cbd.int/doc/c/f071/ba75/4aeaaa842acdaf622d1b6a18/cop-15-l-28-en.pdf>

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