

## OPINION

## Carnivores as engines for sustainable development

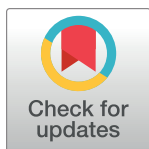
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Large carnivores, such as tigers and bears, are especially affected by human activities that have caused important population declines and range contractions. In addition, large carnivores often conflict with human socio-economic development [1], and this makes their conservation and management challenging. For the first time, as part of Target 4, the Convention on Biological Diversity's recently adopted [Kunming-Montreal Global Biodiversity Framework](#) has recognized the need for effectively managing human-wildlife interactions to minimize human-wildlife conflict for coexistence. While this is an important step to support the development of coexistence policies, reversing large carnivores' declines requires integration of policies for their conservation into broader policies for sustainable development. We argue that long-term success of carnivore conservation depends upon embedding coexistence policies within the United Nations Sustainable Development Goals (SDGs) as to recognize the crucial role carnivores play in supporting economic, social, and environmental dimensions of sustainable development and minimize conflicts with humans.



## OPEN ACCESS

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## Institutional misfits

Humans and large carnivores co-exist in landscapes where human interactions with carnivores are governed by effective institutions [2]. However, achieving coexistence is a dynamic state that can be plagued by institutional misfits—i.e., that the established governance structures are often spatially and temporally not well-aligned to support sustainable human-carnivore coexistence [3]. In part, these misfits are because coexistence is affected by a suite of direct and indirect effects from human activities that can act synergistically and over long distances. In India, for example, the combination of a stagnation in global coffee prices, a rise in regional rural labor costs, and enhanced law enforcement have fueled increasing tensions between human communities and large carnivores around Bandipur National Park [4]. Competing values and preferences over large carnivore conservation that are embedded in the social and governance contexts also contribute to institutional misfits. Lack of consideration of values and preferences of human actors, in fact, can increase social and economic costs to local people and hamper conservation success even where resources for conservation are vast [5]. Failing to consider social dimensions when making major institutional adjustments to improve wolf protection in Finland has resulted in an increase in human-wolf conflict and a decrease in the wolf population [6].

### Aligning coexistence with sustainable development goals

Large carnivores play an important role in supporting sustainable development and human well-being. In fact, carnivores contribute to numerous SDGs, including no poverty (SDG1), zero hunger (SDG2), good health and well-being (SDG3), climate action (SDG13), life below water (SDG14), and life on land (SDG15) (Fig 1A). Studies have shown, for example, that carnivore-centered tourism can generate substantial revenues for local communities and businesses [7]. By consuming other animals, carnivores can also enhance agricultural productivity, decrease disease prevalence in humans and livestock, reduce carbon emissions, and enhance species richness in aquatic and terrestrial systems [8,9].

Carnivores can thus be engines for sustainable development, yet to date these benefits have been overlooked in policy making and biodiversity monitoring frameworks, which still focus on mitigating human-carnivore conflict. To maximize benefits derived from carnivores, we recommend that coexistence outcomes be integrated into international and national sustainable development strategies. As the implementation of the 2030 Agenda for Sustainable Development requires a solid framework of indicators to monitor progress, inform policy and ensure accountability of all stakeholders, we propose developing new biodiversity indicators to monitor coexistence between large carnivores (and other wildlife) and humans. These indicators could use readily-available datasets related to carnivore presence, richness, and status to reflect global changes to their populations—and thus their benefits to humanity—and clarify the drivers of those changes. Other new indicators could reflect the social, cultural, and political dimensions of coexisting with risky wildlife, like carnivores (see, e.g. <https://www.hwctf.org/hwcindicatordevelopment>), such as the perceived benefits of these animals to different stakeholder groups, which could then be compared to measures of costs of living with carnivores. These indicators could also be integrated with indicators for other SDGs, for example those for good health and well-being (SDG3), to identify where large carnivore presence may be beneficial to reduce diseases.

In addition to new SDG indicators, we also recommend that the goal of achieving and maintaining coexistence in shared spaces—multi-use forests and rangelands, coastlines, croplands, and cities—be included into regional and national sustainable development and planning strategies to facilitate on-the-ground actions. National- and regional-level Coexistence Committees, for example, can be created to (i) coordinate actions among conservation actors, authorities, and stakeholders to align national-level leadership on both international and domestic aspects of coexistence; (ii) harmonize coexistence targets—e.g., lower human-carnivore conflicts, increase human tolerance to risks from carnivores, and foster self-sustaining carnivore populations—with other policy frameworks, such as infrastructure and agricultural development, and between countries or regions [10]; (iii) develop a national coexistence action plan that clearly delegates authority for coexistence initiatives among central, municipal, and community-based administrations; (iv) identify and secure consistent funding mechanisms to support and incentivize coexistence outcomes; and (v) encourage participation by the business and private sector, for example, by including coexistence indicators into investment strategies that include environmental, social, and governance factors.

### Fitting coexistence with local social-ecological systems

Policy support and resources from the international and national levels should go beyond conflict mitigation—the current situation in most places—to enhance the capacity of people and carnivores to adapt to each other at local levels. By increasing stakeholder engagement and supporting institutional fit, e.g., through co-development of coexistence strategies with local communities, these policies and resources would allow achieving multiple SDGs at the same



**Fig 1. Enhancing the roles large carnivores play to help achieve the United Nations Sustainable Development Goals (SDGs).** (a) How carnivores help achieve the SDGs. At left, carnivores are absent and thus ungulates, without predation pressure, may damage crops and collide with vehicles, slowing progress on SDGs. At right, carnivores are present and, if managed properly, can contribute to various SDGs, for example, by generating tourism revenues for local communities and maintaining healthy ecosystems. (b) Framework for coexistence between large carnivores and humans that can help maximize the SDGs. Moving from left to right, engaging more stakeholder groups can lead to better institutional fit to the local social-ecological system, creating greater opportunity to achieve multiple SDGs via carnivore presence in shared landscape.

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time and help build a more just and resilient coexistence (Fig 1B). This would entail providing spaces large enough that allow carnivores to move freely and reach ecologically meaningful densities. It would also entail incentivizing innovative strategies for coexisting with these animals and minimizing the costs to those communities for doing so, encompassing not only those areas where carnivores persist but also those in which they are returning. Coexistence

Committees could help design incentive programs, for example, whereby collaborative groups representing diverse interests compete for funding and certification schemes based on their ability to meet and sustain coexistence criteria. Local programs should aspire to address issues of equity and power and align the coexistence actions with actual local drivers of behavior. Further, by linking intact carnivore communities and habitats with opportunities for enhancing local livelihoods, such programs can improve the adaptive capacities of both carnivore populations and local communities.

### Concluding remarks

Both formal (e.g., rules and laws) and informal (e.g., values and preferences) attributes of institutions need to be well-aligned to support sustainable human-carnivore coexistence. Recognizing and accounting for the diversity of values and preferences for carnivores and their conservation will allow developing conservation strategies that are more just and sustainable and resilient to direct and indirect human pressures. Explicitly integrating coexistence with carnivores into the SDG framework, and not only into the Global Biodiversity Framework, is an intuitive and necessary step to help support carnivore conservation and help human communities achieve sustainable development.

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