LETTERS

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Bee conservation: Key role of managed bees

In their Perspective "Conserving honey bees does not help wildlife" (26 January, p. 392), J. Geldmann and J. P. González-Varo argue that because managed honey bees are an agricultural animal, their crop pollination does not fit the definition of an ecosystem service. This distinction, the authors suggest, is a key step to wild pollinator conservation. This argument highlights a fundamental misinterpretation of the ecology of ecosystem services: Services are delivered to beneficiaries through ecological processes and interactions, not by organisms alone. Geldmann and González-Varo have confounded the service (i.e., food production from insect pollination) with the organisms involved in the interactions underlying that service.

We disagree with the assumption that managed animals cannot be involved in delivering ecosystem services. Managed animals are recognized in current ecosystem service classifications (*1*) as vital contributors to ecosystem services delivery, both directly (through food and fiber products such as meat, milk, and wool) and indirectly (through interactions such as pollination and pest control). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) pollination assessment explicitly recognizes that both wild and managed pollinators have "globally significant" roles in crop pollination (*2*, *3*). This includes non-*Apis* managed pollinators, such as bumble bees (*Bombus* spp.), stingless bees (*Meliponini*), and solitary bees (*2*). The relationship between pollinator diversity and crop pollination services depends on a suite of ecological and environmental variables, including floral traits, landscape context, weather conditions, and on-farm management (*4*–*6*).

The concept of ecosystem services is not about humans passively receiving benefits from "wild" nature. Rather, it encourages mindful management and interaction with surrounding ecosystems that sustain natural processes and human well-being synergistically. Wild pollinator conservation will indeed benefit from more research and public communication about the differences and interactions between managed and wild pollinators. However, ignoring the global contribution of managed pollinators to ecosystem services will not facilitate wild pollinator conservation. Instead, it disregards a vital component of ecosystem services necessary to feed an increasingly populous planet.

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Bee conservation: Inclusive solutions

In their Perspective "Conserving honey bees does not help wildlife" (26 January, p. 392), J. Geldmann and J. P. González-Varo point out that promoting managed honey bees does not help wild pollinators.

Policies regarding managed bees, such as this bumble bee (*Bombus* spp.), affect wild pollinators as well.

We agree that, at high densities, honey bees can adversely affect wild pollinator populations. However, focusing only on the negative aspects of their interactions may be counterproductive for both wild and managed pollinators.

Countries such as the Netherlands (*1*) have increasingly restricted honey bee access to protected areas based on incomplete evidence for negative impacts on wild pollinators and plants (*2*, *3*). Such restrictions are mostly symbolic acts, given that honey bees can forage up to 10 km from their hive and continue to use resources within protected areas even when hives remain outside (*4*). However, the regulations fuel tensions between beekeepers and conservationists.

A more productive approach would be to promote the suite of pollinators—both wild and managed—that provide pollination services to crops and wild plants (*5*). A united front of beekeepers and conservation organizations, together representing millions of citizens, is more likely to succeed in driving policy changes and public awareness than different sectors advocating either wild or managed species. New generations of initiatives to promote pollinators, such as the Dutch Bee Strategy (*6*), the English National Pollinator Strategy (*7*), and the International Pollinator Initiative (*8*), all use this inclusive approach. Moreover, all of these initiatives include the agricultural and environmental sectors, as well as the private sectors, because only solutions that are supported by all parties can deliver sustainable results.

Whether considering food security, national economies, or nature conservation, we must safeguard both wild and managed pollinators. Arguing that one group is more important than another overlooks the key

global challenges and opportunities that wider society needs to address.

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Response

Saunders *et al.* argue that honey bees play a significant role in crop pollination and that managed species, in general, can deliver ecosystem services. We agree. In our Perspective, referencing the same source as Saunders *et al.* (*1*), we unequivocally state the importance of managed pollinators for food production and emphasize the significant role of honey bees for global food security. We also agree that managed animals can deliver ecosystem services, from grazing cattle maintaining meadows to chicken feathers used in cultural costumes.

However, we disagree with Saunders *et al.*'s assertion that all ecosystems and all types of services should be classified as ecosystem services. Saunders *et al.* advocate the Common International Classification of Ecosystem Services' definition, developed based on the Millennium Ecosystem Assessment (*2*), which lacks a qualifying definition of "ecosystem," meaning it could be interpreted to include any ecosystem, no matter how artificial, as well as any service, no matter how commercial. Even fossil fuels, the product of ecosystems that existed millions of years ago, could be considered an ecosystem service under the auspice of their definition. However, we question whether this definition is useful, generally accepted, or in line with the founding ideas, which emphasized the need to complement economic metrics, such as the gross domestic product (GDP), for services that were not easily captured by the market (*3*, *4*).

We advocate a definition where the services are provided by more natural, native, or wild elements, which are more likely to deliver biodiversity conservation benefits. Pest control by insectivorous birds and bats (*5*) cannot be equated with *Pyrethrum*-derived pesticides, and crop pollination by wild animals should not be equated with pollination by managed bees. In both cases, even if naturally derived, the pesticides and the managed bees are externalities to the local ecosystems with the only aim of improving crop yield.

Finally, we do not suggest removing the ecosystem service tag from crop pollination by managed honey bees as a key step for pollinator conservation, but rather for increasing public understanding of the difference between managed and wild pollinators. Key steps for wild pollinator conservation should focus on expanding and protecting natural areas that wild pollinators rely on and minimizing the effects of agricultural intensification (e.g., pesticides and fertilizers) in these areas. Furthermore, regulating managed honey bees in areas of importance to wild pollinators and increasing the availability and diversity of noncrop food sources (i.e., native wild flowers) in the more cultivated landscapes will help address the decline in wild pollinators.

In their Letter, Kleijn *et al.* feel that we only focus on the negative aspects of honey bees, which we find surprising. We clearly state that managed honey bees are a necessary agricultural tool for improving crop yield; that they serve as a "canary in a coal mine" because pressures affecting them are also affecting wild pollinators; and that honey bees have been important in raising awareness for conservation issues (*6*).

We agree with Kleijn *et al.* that inclusive solutions are important, if not essential, for the success of conservation strategies. However, inclusiveness should not be interpreted as permissiveness. We highlight two important reasons for site-specific regulations of managed pollinators. First, beekeeping extracts pollen and nectar from the environment, which are resources needed by wild pollinators. Cane and Tepedino (*7*) recently estimated that a 40-hive apiary located on natural habitats for 3 months collects the pollen equivalent of 4 million wild bees. We accept that extractive activities (logging, cattle grazing, and even hunting) are allowed and can be sustainable within certain protected areas. However, the impacts of such activities are normally assessed, and the activities regulated accordingly, which is rarely the case for beekeeping. Second, we must distinguish between the native and non-native range of the honey bee. Within the native range (Europe and Africa), restricting hive numbers at low densities in protected areas could mirror the past densities of wild honey bees. However, in their non-native range, any density of honey bees is unnatural, yet hive numbers in protected areas keep growing (*7*, *8*).

Kleijn *et al.* claim that restricting beekeeping in protected areas is a symbolic act because honey bees can forage up to 10 km from hives located outside. We disagree. The hives present in the landscape determine the density of foraging honey bees (*9*). Thus, restricting hive numbers will at least keep honey bee densities lower. Moreover, the long foraging distances invoked by Kleijn *et al.* are unlikely: Mean foraging distances are usually ~1 km from the hive (*10*, *11*) and the probability of foraging sharply declines beyond 1 km (*12*). Accordingly, the detrimental effects of honey bees on native bumble bees decreased markedly along 1200 m while moving away from apiaries (*13*).

Inclusive solutions bringing together different societal sectors should be compatible with pollinator conservation, and this requires case-specific regulations (*14*). Advocating a precautionary principle in our protected and vulnerable landscapes, where the need for crop pollination is negligible, is not the same as widely banning beekeeping.

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