





# Addressing behavior in pollinator conservation policies to combat the implementation gap

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**Abstract:** Solutions for conserving biodiversity lie in changing people's behavior. Ambitious international and national conservation policies frequently fail to effectively mitigate biodiversity loss because they rarely apply behavior-change theories. We conducted a gap analysis of conservation behavior-change interventions advocated in national conservation strategies with the Behavior Change Wheel (BCW), a comprehensive framework for systematically characterizing and designing behavior-change interventions. Using pollinator conservation as a case study, we classified the conservation actions listed in national pollinator initiatives in relation to intervention functions and policy categories of the BCW. We included all national-level policy documents from the European Union available in March 2019 that focused on conservation of pollinators ( $n = 8$ ). A total of 610 pollinator conservation actions were coded using in-depth directed content analysis, resulting in the identification of 787 intervention function and 766 policy category codes. Overall, these initiatives did not employ the entire breadth of behavioral interventions. Intervention functions most frequently identified were education (23%) and environmental restructuring (19%). Least frequently identified intervention functions were incentivization (3%), and restriction (2%) and coercion were completely absent (0%). Importantly, 41% of all pollinator conservation actions failed to identify whose behavior was to be changed. Building on these analyses, we suggest that reasons for the serious implementation gap in national and international conservation policies is founded in insufficient understanding of which behavioral interventions to employ for most beneficial impacts on biodiversity and how to clearly specify the intervention targets. We recommend that policy advisors engage with behavior-change theory to design effective behavior-change interventions that underpin successful conservation policies.

**Keywords:** agent of change, Behavior Change Wheel, behavior change, biodiversity, intervention, policy targets, psychology

Atención al Comportamiento en las Políticas de Conservación de los Polinizadores para Combatir la Brecha de Implementación

**Resumen:** Las soluciones para conservar a la biodiversidad se encuentran en el cambio del comportamiento de las personas. Las políticas ambiciosas de conservación nacional e internacional con frecuencia fallan en mitigar efectivamente la pérdida de la biodiversidad porque rara vez aplican teorías de cambios en el comportamiento. Realizamos un análisis de brecha de las intervenciones de cambios en el comportamiento de conservación

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promovidas en las estrategias de conservación nacional usando la Rueda de Cambios en el Comportamiento (BCW), un marco de trabajo completo para caracterizar y diseñar sistemáticamente las intervenciones de cambios en el comportamiento. Con la conservación de los polinizadores como un estudio de caso, clasificamos las acciones de conservación listadas en las iniciativas nacionales para los polinizadores en relación con las funciones de la intervención y las categorías de las políticas de la BCW. Incluimos todos los documentos de políticas a nivel nacional de la Unión Europea disponibles en marzo de 2019 cuyo enfoque fuera la conservación de los polinizadores ( $n = 8$ ). Se codificó un total de 610 acciones para la conservación de los polinizadores mediante análisis profundos de contenido dirigidos, lo que resultó en la identificación de 787 códigos de función de la intervención y 766 códigos de categoría de las políticas. En general, estas iniciativas no emplearon la amplitud completa de las intervenciones de comportamiento. Las funciones de la intervención que fueron identificadas con mayor frecuencia fueron la educación (23%) y la reestructuración ambiental (19%); aquellas que fueron identificadas con menor frecuencia fueron la estimulación y el fomento (3%) y la restricción, mientras que la coerción estuvo totalmente ausente (0%). Es importante resaltar que el 41% de todas las acciones por la conservación de los polinizadores falló en la identificación de a quiénes se les debería cambiar el comportamiento. Con base en estos análisis sugerimos que las razones detrás de la brecha severa en la implementación de las políticas de conservación nacionales e internacionales están fundamentadas en el entendimiento insuficiente de cuáles intervenciones de comportamiento emplear para un impacto de mayor beneficio sobre la biodiversidad y cómo especificar claramente los objetivos de las intervenciones. Recomendamos que los asesores políticos se involucren con la teoría del cambio del comportamiento para así diseñar intervenciones efectivas de cambios en el comportamiento que respalden políticas exitosas de conservación.

**Palabras Clave:** agente de cambio, biodiversidad, cambio en el comportamiento, intervención, objetivos de políticas, psicología, Rueda de Cambios en el Comportamiento

## Introduction

A paradigm shift in the way that humans interact with nature is needed. Over 50 years of environmental policies have failed to prevent biodiversity loss and to safeguard ecosystem functions and services (IPBES 2019). The United Nations 2011–2020 Decade on Biodiversity is set to fall short of achieving global targets of the Convention on Biological Diversity (2010) (Tittensor et al. 2014), and negotiations for post-2020 targets are underway. However, much of the failure to halt biodiversity loss is not due to missing global and national policy aspirations, but due to a lack of specific goals, indicators, and actions (Tittensor et al. 2014; Mace et al. 2018). Current policies do not always lead to effective interventions that directly address drivers of change and lead to action.

Because most conservation problems are created and maintained by human activities (Potts et al. 2010; IPBES 2016; Díaz et al. 2019), the solution to them lies in changing people's behaviors, at both the individual and collective levels (Amel et al. 2017; Cinner 2018). Achieving the new 2050 Vision for Biodiversity requires successful framing of policies that lead to effective implementation. To do this, understanding of the behavioral drivers that can be leveraged to bring about such transformative change is needed. Effective conservation policies should thus integrate theories of behavioral change, yet the extent to which this is done in practice has seldom been assessed.

We focused on pollinator policy as a case study. Insect and pollinators declines are alarming (Hallmann et al. 2017; Eisenhauer et al. 2019; van Klink et al. 2020).

Thirty-seven percent of all bee and 31% of butterfly species populations are decreasing worldwide (IPBES 2016), affecting more than 75% of global food crops (Díaz et al. 2019) and threatening the health of other living organisms (Potts et al. 2010; IPBES 2016). Pollinators are in decline on all continents (van Klink et al. 2020), mostly due to intensive agriculture practices, including use of pesticides and herbicides and natural habitat loss and degradation (Potts et al. 2010). Although there is considerable consensus on the biophysical interventions that are effective for pollinator conservation (IPBES 2016; Sutherland et al. 2019), there is far less research on the “human factor”—the behavioral interventions required to get people to enhance habitats to conserve pollinators (Christmann 2019). With high-level political commitments to support pollinators only surfacing (Dicks et al. 2016; IEEP 2017), it remains unclear whether and how the conservation actions in these initiatives are consistent with behavior change theories and models. An assessment of the capacity of planned interventions for pollinators to deliver is urgently needed.

Changing human behaviors to conserve biodiversity requires drawing on appropriate behavioral models and theories from psychology and behavioral science (Amel et al. 2017; Papworth 2017; Fisher et al. 2019; Kidd et al. 2019). But behavioral science is rarely used in conservation research. For instance, only 0.3% of all papers published in the leading conservation journals are related to psychology or behavior change (Selinske et al. 2018). Consequently, behavior change interventions for conservation often lack grounding in human

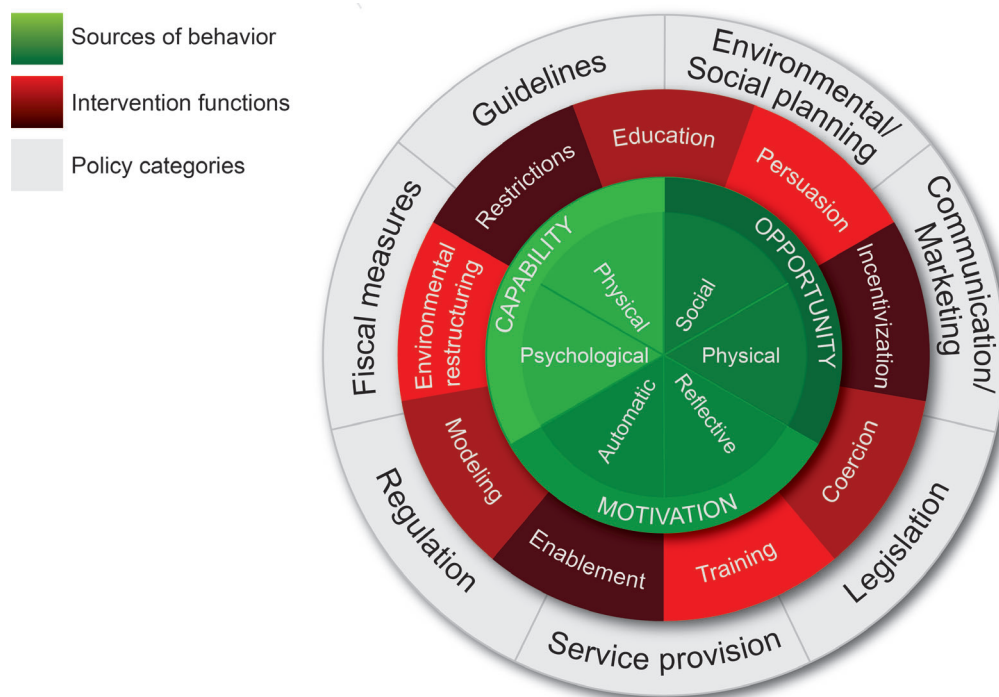


Figure 1. The Behavior Change Wheel by Michie et al. (2011) (CC BY 2.0).

behavior theories (Kidd et al. 2019; Nilsson et al. 2019). This is a missed opportunity for conservation because understanding human behavior is crucial to designing targeted and effective policies (European Commission 2016; Kovacic & Di Felice 2019; Public Health England 2019).

Insight into human behavior can improve conservation policies. For instance, behavior change frameworks can help identify the specific behavior or behaviors to be changed, the target group or groups whose behavior is to be changed, and the agents responsible for implementing the behavior intervention (Steg & Vlek 2009; Michie et al. 2014a; Nilsson et al. 2019). Notably, behavior change frameworks encourage decision-makers to identify the most important determinants or barriers that prevent the target group from performing the target behavior (Steg & Vlek 2009; Nilsson et al. 2019; Public Health England 2019). This information guides the selection of interventions. Because human behavior is influenced by a range of individual, social, technical, cultural, and contextual factors, policies typically gain in effectiveness by focusing on the most influential determinants of human behavior (Steg & Vlek 2009) and by broadening the types of interventions used (Nilsson et al. 2019). This is important because conservationists often rely on a few behavior change intervention options, such as education, incentives, and regulation (Byerly et al. 2018; Cinner 2018; Fisher et al. 2019) and underuse others (e.g., social norms, situational context) (Amel et al. 2017; Byerly et al. 2018; Cinner 2018). Unfortunately, these

overused intervention types are the least effective at promoting proenvironmental behavior change (Osaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019). Combining different types of interventions can boost the effectiveness of behavior change strategies (Osaldiston & Schott 2012) because there is often more than 1 determinant or barrier to any pro-environmental behavior (Steg & Vlek 2009; Osaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019).

There are a number of behavior change frameworks (Michie et al. 2014b). Because any one theory is insufficient for explaining proenvironmental behavior, there is a growing recognition of the need for integrative models of behavior change (e.g., Klöckner 2013). The Behavior Change Wheel (BCW) is such a model. Synthesized from 19 different behavior change models, the BCW is a comprehensive and systematic framework for designing, evaluating, and characterizing behavior change interventions (Michie et al. 2011, 2014a; Lokker et al. 2015). The BCW has 3 layers (Fig. 1). The inner layer describes 6 underlying sources, or determinants, of behavior. In the middle layer, 9 intervention functions—types of activity aimed at changing behavior—link to the various determinants. In the outer layer are 7 policy categories—actions of the responsible authorities to support delivery of the interventions. Definitions and examples of the 9 intervention functions and 7 policy categories of the BCW are in Table 1. A key benefit of the BCW is that it details the full range of options available for achieving behavioral change (Michie et al. 2011; Michie & West 2013).

**Table 1. Definitions and examples of intervention functions and policy categories from the Behavior Change Wheel (BCW) (after Michie et al. 2014a) and additional examples from EU pollinator initiatives.**

<i>Intervention Functions</i>	<i>Original BCW definition<sup>a</sup></i>	<i>Original BCW examples<sup>a</sup></i>	<i>Examples linking the BCW to other behavior change frameworks<sup>a</sup></i>	<i>Examples from the pollinator initiatives<sup>b</sup></i>
Education	“increasing knowledge or understanding”	“providing information to promote healthy eating”	“information about social & environmental consequences” “feedback on behaviour” “feedback on outcomes of behaviour”	Information about exposure of pollinators to pesticides information from cost-benefit analyses technical advice
Persuasion	“using communication to induce positive or negative feelings or stimulate action”	“using imagery to motivate increases in physical activity”	“credible source” “information about social & environmental consequences” “nudges”	encourage profile raising
Incentivization	“creating expectation of reward” creating an expectation of reduced cost <sup>b</sup>	“using prize draws to induce attempts to stop smoking”	“feedback on behaviour” “behaviour” “Monitoring of behaviour or outcomes of behaviour by others without evidence of feedback”	Common Agricultural Policy (CAP) incentives Award scheme (e.g. European Green Capital; Green Leaf; England Green Flag award)
Coercion	“creating expectation of punishment or cost”	“raising financial cost to reduce excessive alcohol consumption”	“punishment” “remove reward” “remove access to reward”	
Training	“imparting skills”	“advanced driver training to increase safe driving”	“demonstration and instruction on how to perform a behaviour” “behavioural practice” “feedback on the behaviour”	on-farm demonstrations and/or demonstration sites workshops training course
Restriction	“using rules to reduce the opportunity to engage in the target behaviour or to increase the target behaviour by reducing the opportunity to engage in competing behaviors”	“prohibiting sales of solvents to people under 18 to reduce use for intoxication”	“rules and regulations from formal institutions (e.g., government)”	banning of neonicotinoid pesticides

*Continued*

Table 1. Continued.

<i>Intervention Functions</i>	<i>Original BCW definition<sup>a</sup></i>	<i>Original BCW examples<sup>a</sup></i>	<i>Examples linking the BCW to other behavior change frameworks<sup>a</sup></i>	<i>Examples from the pollinator initiatives<sup>b</sup></i>
Environmental restructuring	“changing the physical or social context” removing objects from the environment <sup>b</sup>	“providing on-screen prompts for medical doctors to ask about smoking behaviour”	“adding objects to the environment” “prompts and cues” “restructuring the physical environment” “restructuring the social environment” “nudges”	greening measures (e.g. planting bee-friendly plants, managing buffer strips, land lying fallow, management of hedges, creation of urban meadows) land management or pollinator-friendly land management native wildflower seeds available for purchase or use signs declaring pollinator-friendly land product labeling (e.g. ecolabel; Perfect for Pollinators’ logo on plants for sale) incorporate pollinator-friendly plants into sustainable building certification schemes (e.g., BREEAM) join Coalition of the Willing on Pollinators case studies of good practice peer-to-peer learning use signs to declare garden is pollinator friendly
Modeling	“provide example for people to aspire to or imitate”	“use TV drama scenes involving safe-sex practices to increase condom use”	“demonstration of behaviour”	provide funding (e.g., for research and innovation, H2020) establish a pollinator monitoring scheme create an online platform collate data or information (e.g., spatial data) environmental charities
Enablement	“increasing means and reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)”	“behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity”	“add objects to the environment” “goal setting” “social support” “problem solving” “action planning” “commitment”	Examples from the pollinator initiatives <sup>b</sup> publishing awareness raising give presentations
<b>Policy Categories</b>	<b>Original BCW definition<sup>a</sup></b>	<b>Original BCW examples<sup>a</sup></b>	<b>Examples linking the BCW to other behavior change frameworks<sup>a</sup></b>	
Communication/marketing	“using print, electronic, telephonic or broadcast media”	“conducting mass media campaigns”		

Continued



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<i>Intervention Functions</i>	<i>Original BCW definition<sup>a</sup></i>	<i>Original BCW examples<sup>a</sup></i>	<i>Examples linking the BCW to other behavior change frameworks<sup>a</sup></i>	<i>Examples from the pollinator initiatives<sup>b</sup></i>
<b>Guidelines</b>	“creating documents that recommend or mandate practice; includes all changes to service provision” “using the tax system to reduce or increase the financial cost” using financial tools to reduce costs <sup>b</sup> “establishing rules or principles of behaviour or practice”	“producing and disseminating treatment protocols”  “increasing duty or increasing antismuggling activities”		guidance action plan recommendation about practice in specific pieces of legislation priority measures for pollinator habitats EU recommendations EU opinions
<b>Fiscal Measures</b>				subsidies, grants, loans economic incentives payment scheme of the Common Agricultural Policy
<b>Regulation</b>		“establishing voluntary agreements on advertising”		policy International Pollinators Initiative (IPD) voluntary agreements/measures standards certification scheme
<b>Legislation</b>	“making or changing laws”	“prohibiting sale or use”		EU Directives (e.g., Habitats Directive) EU Regulations (e.g., Common Agricultural Policy) Spray licensing
<b>Environmental/ social planning</b>	“designing and/or controlling the physical or social environment”	“using town planning”		sustainable building standards planning policies (e.g., national planning framework) hosting an award ceremony
<b>Service provision</b>	“delivering a service”	“establishing support services in workplaces, communities etc.”		organize workshops host annual events give tools create website that brings together different actors to create a network (e.g., EIP-AGRI) Collate and provide information about funding opportunities Research funding (e.g., Horizon 2020; EU LIFE program) establish a pollinator monitoring scheme peer-to-peer learning schemes

<sup>a</sup> Content from Michie et al. (2014a).<sup>b</sup> Added by current authors.

Listing all the intervention functions and policy categories available could serve as a useful basis for both the development and assessment of effective policies (Michie & West 2013).

The BCW can be retrospectively applied to categorize interventions in policy initiatives in order to evaluate how policy design can be improved (Michie et al. 2014a; Steinmo et al. 2015; Public Health England 2019). This retrospective approach involves applying the BCW to existing policies to categorize the types of interventions that are listed therein (Michie et al. 2014a; Steinmo et al. 2015). The BCW has, for example, been retrospectively applied to categorize behavior change interventions within national policy documents on obesity and tobacco use (Michie et al. 2011), nutrition and physical activity (Seppälä et al. 2018), and energy conservation (Wilson & Marselle 2016; Axon et al. 2018). We applied the BCW to pollinator policies as a case study to assess the underlying reasons why conservation policies may not yet be as effective as needed to lead to effective implementation. Specifically, we aimed to identify discrepancies and gaps between what works to change human behavior in the behavioral science literature and what is currently being employed within pollinator conservation policy.

Our objective was to use the BCW to analyze and categorize the conservation actions listed in national pollinator initiatives. We sought to identify which intervention functions and policy categories, as characterized by the BCW, are emphasized or lacking, and to classify the target groups whose behavior is being changed and the agents responsible for implementing the behavioral intervention. Building on this analysis, we identified gaps in pollinator conservation initiatives and considered the reasons they may fail to achieve their desired goal. Overall, we explored, based on our case study, how ineffective policy formulation can lead to inaction and ultimately result in a policy implementation gap. Our analyses may then foster informed policy framing to successfully bend the curve of biodiversity loss (Mace et al. 2018) to achieve the 2050 Vision for Biodiversity.

## Methods

### Materials and Data Selection

We systematically searched for policy documents on pollinator conservation in the European Union in March 2019. The search strategy and keywords are detailed in the Supporting Information (Appendix S1). Policy documents were included if they were related to conservation actions for pollinators in the EU; at the national level or above, because several EU countries committed to take national action to stop and reverse the decline of polli-

nators at the Convention for Biological Diversity's 14th Conference of the Parties (Convention on Biological Diversity 2018); and funded or written by a government agency (i.e., not written by lobby groups or charities). We analyzed all 8 pollinator initiatives that exist in the European Union, to date (Appendix S2).

### Coding

Data were analyzed using directed content analysis, an approach in which data are coded using predetermined categories from a theory (Hsieh & Shannon 2005)—in this case the BCW. This approach was used to gain an in-depth understanding of the behavior change interventions mentioned within the pollinator initiatives.

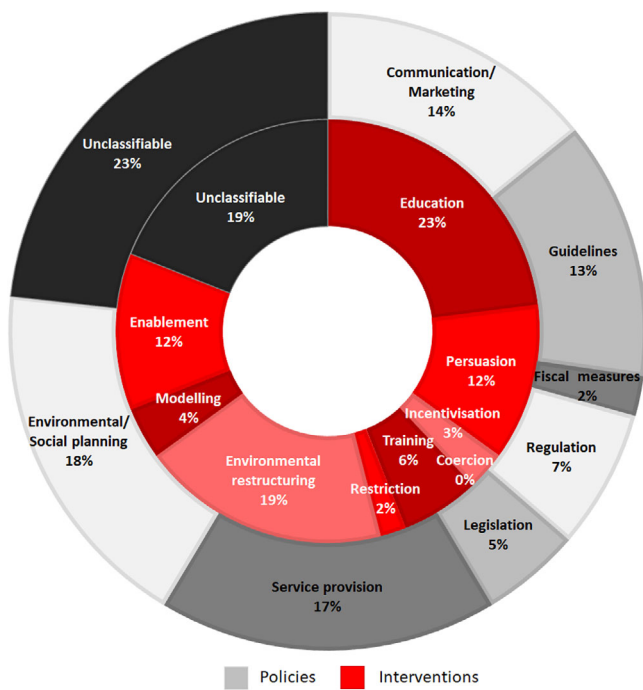
In each pollinator initiative, we identified all actions for conserving pollinators (Appendix S2) and built a coding matrix containing all conservation actions. Coding instructions are in the Supporting Information (Appendix S3). First, we coded the target of the intervention (whose behavior is being changed) and the agent of change (who is responsible for implementing the intervention) into 5 categories: government, community organizations, business, agricultural sector, and individuals. Second, the 2 outer layers of the BCW were coded: intervention functions and policy categories. The inner layer of the BCW—sources of behavior—was not coded because our focus was to retrospectively categorize the actions in the pollinator initiatives to the BCW's intervention functions and policy categories to identify gaps (Steinmo et al. 2015). Actions that did not specify an intervention or policy were coded as unclassifiable. To assure stringent classification, 2 authors independently coded all of the EU pollinator initiatives (A.C. and A.T. for Belgium and France and A.C. and M.M. for all others). For each document, respective codes of the 2 authors were compared and differences were resolved through discussion. The final coding matrices for all 8 initiatives are in the Supporting Information (Appendix S4).

### Analyses

In each of the 8 pollinator initiatives, we calculated the number and frequency of mentions of each intervention function, policy category, target, and agent of change. We also calculated the proportions in which the intervention functions and policy categories occurred either alone or in combination with other intervention functions or policy categories, respectively, within a conservation action.

## Results

The 8 pollinator initiatives contained 610 conservation actions (Appendix S5). Because most actions mentioned more than 1 intervention function or policy category, the



**Figure 2.** Intervention functions (inner, red layer) and policy categories (outer, grey layer) identified in the 8 European Union pollinator initiatives. Unclassifiable actions in both layers highlighted in black.

total number of intervention function codes was 787 and policy category codes was 766. However, 19% ( $n = 149$ ) and 23% ( $n = 177$ ) of all actions were coded as Unclassifiable for the intervention function and policy category, respectively (Fig. 2). The code Unclassifiable was given when actions were either too vague (66%,  $n = 218$ )—describing only the behavior goal but not how this was to be achieved (e.g., “Secure commitment from large-scale land managers.”)—or did not specify behavior change (e.g., advocated scientific research) (33%,  $n = 108$ ).

Overall, the pollinator initiatives did not include the full range of intervention functions (activities aimed at changing behavior) (Fig. 2). The most frequently coded intervention functions were education (23%) to increase knowledge and understanding, and environmental restructuring (19%) to change the situational or social context (e.g., creating buffer strips or urban meadows). In contrast, the least frequently coded intervention functions were modeling (4%; provide an example for people to imitate), incentivization (3%; create an expectation of reward), and restriction (2%; use rules to reduce opportunity to engage in the target behavior) (Fig. 2 & Appendix S5). The intervention function of coercion, comprising interventions that create an expectation of punishment or increased cost to discourage behavior, was not coded in any of the 8 pollinator initiatives.

All 7 policy categories were identified. The most frequently coded policy categories were environmen-

tal/social planning (18%) (e.g., use sustainable building standards or town planning policies) and service provision (17%) (e.g., organize workshops or establish a monitoring scheme). The least frequently coded policy categories were regulation (7%), legislation (5%), and fiscal measures (2%) (Fig. 2; Appendix S5). The development of new legal instruments was seldom considered (<1% of cases), as most actions classified as regulation or legislation referred to synergies with existing sectoral policies (29.8% and 77.5%, respectively). The policy category of regulation was also frequently used to classify voluntary agreements or certification schemes (21.3% each) that are nonbinding.

We also examined whether intervention functions and policy categories tended to occur in combination with other interventions or policies, respectively (Fig. 3). Most intervention functions and policy categories were mentioned on their own for about 50% of all actions. Except for the intervention functions of persuasion (70%) and modeling (80%) and the policy category of fiscal measures (77%), all of which were more likely to be mentioned in combination with other intervention functions or policy categories than alone.

The target of the pollinator conservation interventions—the individual, group, or population whose behavior is being changed—was very often left unspecified (i.e., in 41% of all actions) (Fig 4). When specified most common targets were individuals (29%) and the agricultural sector (16%). Agents of change responsible for enacting the behavior change intervention were specified in most cases (i.e., for 92% of all actions); the focus was on governments (38%), community organizations (29%), and the agricultural sector (14%). Examples of each category and results from each pollinator initiative are presented in the Supporting Information (Appendix S6).

## Discussion

Despite large efforts from conservation policy, biodiversity loss shows no sign of halting (IPBES 2019). Repeatedly, ambitious international and national policy targets are missed, most notably the 2010 and 2020 targets of the Conservation on Biological Diversity (CBD), due to lack of action (Tittensor et al. 2014; Mace et al. 2018). This implementation gap is a serious cause for concern. Human behavior does not change automatically with policy aspirations; rather, it needs effective interventions that address the drivers of biodiversity loss and lead to action. Given the current negotiations for the post-2020 Biodiversity Framework, it is crucial to understand how policies need to be framed to lead to effective implementation.

Although biodiversity policies strive to address behavioral transformation, research efforts exploring how it can be achieved remain scarce and lack grounding in human behavior change theories and models (Selinske



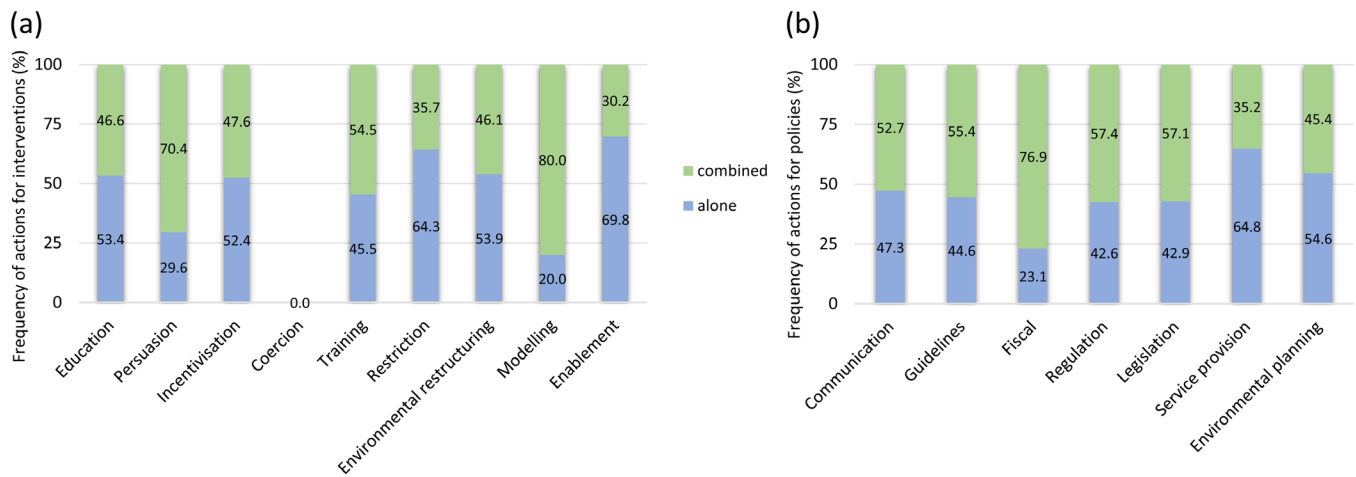


Figure 3. Frequency of actions for which each (a) intervention function and (b) policy category is used alone (blue) or in combination (green) with other intervention functions or policy categories, respectively, in the 8 European Union pollinator initiatives (numbers in bars are proportions of conservation actions used alone or in combination, respectively, for each type of intervention function or policy category).

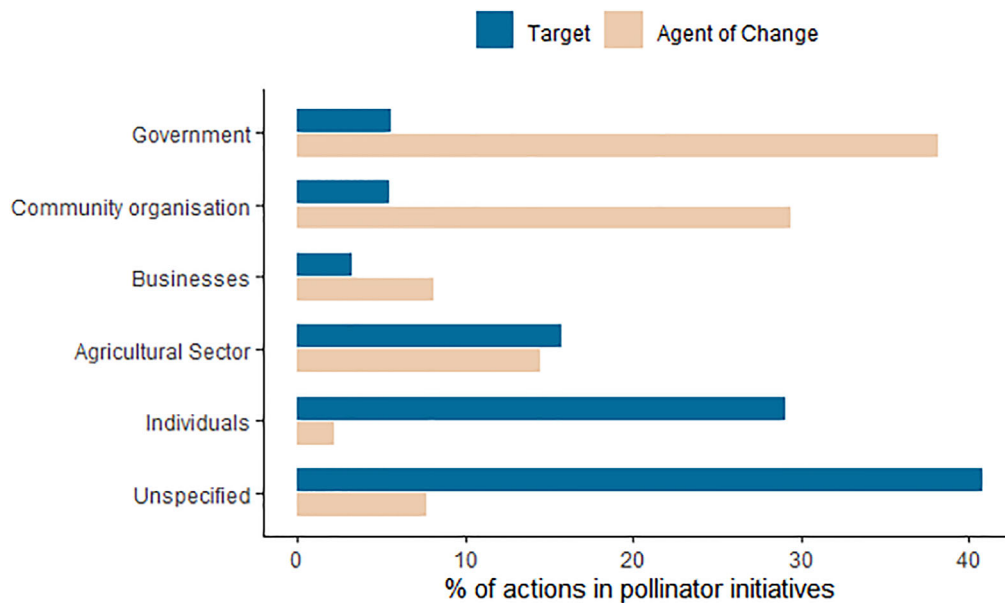


Figure 4. Targets (whose behavior is being changed) and agents of change (who is responsible for enacting the intervention) identified in the 8 European Union pollinator initiatives.

et al. 2018). Here, we showed, for the first time, that national initiatives for the conservation of bees and pollinators heavily rely on a small number of behavioral interventions that are relatively inefficient. Importantly, the actionability and thereby effective implementation of policies is severely compromised because target audience and actions are often not clearly specified or missing.

Regarding behavior interventions, education was the most frequently mentioned intervention function in our examination of all currently available EU national initiatives for pollinators. This is not surprising because edu-

cation (an information-based intervention) is one of the most common behavior change interventions used to address conservation (Byerly et al. 2018; Cinner 2018) and climate change (Wilson & Marselle 2016; Nisa et al. 2019). However, education is not very effective at changing pro-environmental behavior (Steg & Vlek 2009; Osbaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019). In contrast, there is evidence that conservation behaviors are better motivated by changes to situational and social contexts (Amel et al. 2017; Byerly et al. 2018; Cinner 2018), for example, through the intervention functions of environmental restructuring or modeling,

both of which were mentioned in our studied policies (19% and 4%, respectively). To be more effective, education should be combined with other intervention functions, as combinations of interventions are more effective at behavior change than education alone (Osbaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019). In the pollinator initiatives, education was mentioned on its own for 53% of all conservation actions, suggesting that many actions could be ineffective. Policy makers should rethink their use of educational strategies in designing future conservation policies. For example, combining education with modeling (e.g., using role models and peer groups to convey information) effectively supports pro-environmental behaviors (Steg & Vlek 2009). Farmers and landowners look to members of their own group for guidance on their behavior and are more likely to engage in sustainable agricultural practices if visible and respected in-group members also promote such practices (Fielding et al. 2008).

The European Union pollinator initiatives also extensively advocated for actions based on environmental restructuring. Actions coded as the intervention function of environmental restructuring were mostly about changing the physical environment to benefit pollinators (e.g., pollinator-friendly land management, greening measures). These actions, however, focus on technical and ecological land management approaches—interventions of what works for pollinator conservation (Sutherland et al. 2019)—instead of the behavioral interventions required to get people to manage habitats to conserve pollinators (Christmann 2019). This is an important difference. Environmental restructuring interventions altering the situational or social context in which pollinator conservation behaviors are made were rarely coded in the pollinator initiatives. Examples include enabling consumers to contribute to pollinator protection by having certification labels on products (e.g., ecolabels [Khachatryan et al. 2017; Christmann 2020]); using nudges to encourage farmers to engage in sustainable land management practices (Byerly et al. 2018); or changing the organizational culture (Amel et al. 2017) (e.g., corporate policies on the use of pollinator-friendly plants to achieve sustainable building certification). Changing the situational and social context are the most effective interventions for addressing environmental problems (Osbaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019). Yet, these forms of interventions were rarely coded when actions relating to changing the physical environment for pollinators were discussed in the pollinator initiatives. Together, the fact that the 2 most frequently mentioned intervention functions were not the most effective (education) and failed to specify a behavior change intervention to achieve a change in the sociophysical environment is concerning. This may impair the ability to achieve the desirable conservation behavior change.

Without a comprehensive list of the full range of behavioral intervention options, policy-makers are likely to underuse potentially effective intervention options and miss potential synergy gains of combined actions (Michie & West 2013). In the 8 pollinator initiatives, the intervention functions of restriction, incentivization, and modeling were rarely coded, and coercion was not mentioned at all. These intervention functions, however, are highly effective for changing proenvironmental behavior (Steg & Vlek 2009; Osbaldiston & Schott 2012; Byerly et al. 2018; Nisa et al. 2019; Thomas et al. 2019). For example, paying for plastic bags (coercion) led to a significant reduction in their use in the United Kingdom (Thomas et al. 2019), and government rules and regulations (restriction) that reduce the opportunity to engage in environmentally harmful behaviors are effective when enforced (e.g., restrictions on pesticide use [Cole et al. 2011] and biosecurity restrictions on honeybees [IPBES 2016]). Nevertheless, interventions that are effective in one context, may not work in another. For instance, while incentivization interventions are effective for changing land-use management practices (e.g., subsidies or payments for ecosystem services [Zabel & Holm-Müller 2008; Kemkes et al. 2010]), they are less effective than expected at reducing electricity demand (Davis et al. 2013). Moreover, a given intervention used in combination may enable or reinforce the effectiveness of another. In the European Union pollinator initiatives, several conservation actions provided examples for others to imitate (modeling) (e.g., best practice examples and peer-to-peer learning) as a way to increase knowledge or understanding (education). Similarly, the use of words or images to change the way people feel about a behavior (persuasion) was mostly used in combination with specific pollinator-friendly management interventions (environmental restructuring). This highlights the importance of using the full range of intervention functions available when designing policies to maximize their effectiveness in achieving the required behavioral transformations.

Policy categories in the BCW detail the different ways responsible authorities can support the delivery of an intervention. The most frequently coded policy categories were environmental/social planning (e.g., urban and rural planning policies) and service provision (e.g., providing data services, establishing a pollinator monitoring scheme). This is unsurprising, as these policy categories support the intervention functions of environmental restructuring and education, respectively (Michie et al. 2011). The least frequent policy categories were fiscal measures, legislation, and regulation, despite their demonstrated efficiency for pollinators (IPBES 2016). In particular, agrienvironmental schemes, such as reduced pesticide use, in developed countries effectively subsidize management actions that benefit pollinators (Dicks et al. 2019). Accordingly, the policy categories of regulation and legislation almost always identified

synergies with other sectoral policies and with the policy category of fiscal measures. This may also explain why dedicated legal instruments for pollinators remain fairly rare (Dicks et al. 2019) and were seldom considered by any of the pollinator initiatives. As a result, most of the policy actions in the European Union pollinator initiatives were non-binding and involved voluntary actions or self-regulation (e.g., policy categories of guidelines or service provision). This puts the weight of action on the target of the interventions, for example, farmers, rather than on the regulator. As such, policies for the provision of public goods are put on the voluntary individual level, which may not be effective if individual and public costs and benefits differ.

Targets of the interventions were often left unspecified (in 41% of all actions). Together with the non-binding nature of policy actions, this lack of specificity is likely to impair the quality of interventions and their success (Bartholomew et al. 2011). When specified, targets of pollinator interventions were largely at the individual level. Less focus was placed on systemic behavioral changes (e.g., at the business, community organization, or government levels). While effective behavior change can exist at the individual level (e.g., Dietz et al. 2009), large gains for conservation can arguably be realized through behavior changes at the sectorial level (e.g., business) (CDP 2017). This is because the main causes of pollinator and overall biodiversity decline are systemic (e.g., land-use change and intensive agriculture) (Potts et al. 2010; IPBES 2019). Leveraging transformative change therefore needs behavior change interventions targeted at systemic solutions that address different sectors beyond the individual (e.g., the agricultural sector and businesses) to generate the greatest impact for conservation.

### Limitations and Future Research

Our study has some limitations. First, as our analysis focused on all European Union pollinator initiatives available at the time of publication, and the interventions and policy categories are representative of those implemented in countries with relatively strong environmental governance. A different suite of interventions may be expected for countries of the Global South or on other continents with different governance schemes. Second, the high number of actions that were coded as Unclassifiable may suggest the unsuitability of the BCW in this context. However, previous authors found levels of vagueness similar to ours when applying the BCW to health policies (Seppälä et al. 2018) and energy conservation initiatives (Wilson & Marselle 2016), highlighting the unclear content of policy initiatives in general. Uncovering this lack of specificity, and thereby actionability of interventions, is therefore a strength of systematic application of the BCW framework. Finally, while application of the

BCW retrospectively is widespread (Wilson & Marselle 2016; Axon et al. 2018; Seppälä et al. 2018), it has limitations. The final outcome document is assessed with no information on the process leading up to it. Thus, it is unknown whether all intervention functions were considered, but discarded, or simply overlooked. Increased transparency about the design stages, in particular the intervention and policy-selection process and the evidence base used to build such documents, would facilitate their evaluation.

### Recommendations

To address the implementation gap, effective human behavior change in support of conservation action is urgently required to help mitigate against the loss of biodiversity—humanity's life support system. Our case study of pollinator conservation initiatives provides an overview of the behavior change interventions and policy categories advocated in biodiversity conservation. We found a highly skewed use of intervention functions in the pollinator initiatives; some intervention functions that are highly effective at pro-environmental behavior change were overlooked or little used, whereas intervention functions that are less effective were overused. Crucially, the analyzed conservation initiatives often failed to identify the interventions needed to change the situational or social context in which behavioral decisions are made. Decision-makers should rely on a diversity of intervention functions to address the different drivers of behavior, and embrace the high context-dependence of conservation policies, spatially, socially, and temporally. We call for further research aiming to improve understanding of which combinations of interventions are most effective for behavior change (in a given context) and reinforce each other to improve the resilience of policies. Moreover, we argue that decision-makers should stop thinking of education as the basis for all conservation policies, assuming that increased knowledge or awareness will lead to changes in behavior. As conservation behavior is also determined by the situational and social context (Steg & Vlek 2009), the focus should be on systemic intervention functions that address these determinants (e.g., restriction, environmental restructuring, modeling, enablement).

Our results also revealed a lack of specificity in the conservation initiatives, specificity that could be used to translate the recommended conservation actions into behavior change interventions. The targets and agents of change, in particular, should be clearly identified to ensure commitment and accountability. Doing this could be the first step toward improving the enforcement of conservation policies.

Moreover, identifying the target behavior to change is a prerequisite for selecting adequate behavior change strategies and achieving the required behavioral

transformation for conservation goals (Nilsson et al. 2019). Despite much empirical research on pro-environmental behaviors, research exploring and defining pro-biodiversity behaviors is only emerging (Selinske et al. 2020). In particular, although the effectiveness of interventions for enhancing biodiversity is well studied (Sutherland et al. 2019), there is little understanding of which behavioral interventions have the most beneficial impacts on biodiversity. Monitoring and evaluating changes in behavior to determine the effectiveness of behavior change interventions (Steg & Vlek 2009; Nilsson et al. 2019) and associated impacts on biodiversity would help address this knowledge gap. Ultimately, turning ambitious policy goals into effective conservation action, for example, to support the development of the 2050 Vision for Biodiversity, will require policy-makers to engage with behavioral science theory and concepts. We recommend policy makers consider the full range of interventions and specify both the targets and agents of change to deliver more specific and effective conservation policy solutions.

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## Supporting Information

Search strategy used to identify pollinator initiatives (Appendix S1), description of the selected pollinator initiatives and data-unit selection (Appendix S2), coding instructions (Appendix S3), BCW coding of the pollinator initiatives (Appendix S4), frequency of intervention functions and policy categories for each pollinator initiative (Appendix S5), and frequencies of targets and agents for each pollinator initiative (Appendix S6) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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