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Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
Fifth session
Bonn, Germany, 7–10 March 2017
Item 5 of the provisional agenda*

Report of the Executive Secretary on the implementation of the work programme for the period 2014–2018

Update on activities of the thematic assessment of pollinators, pollination and food production (deliverable 3 (a))

Note by the secretariat

1. The Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in section IV of its decision IPBES-4/1, on the work programme of the Platform, approved the summary for policymakers of the report on the thematic assessment of pollinators, pollination and food production (decision IPBES-4/1, annex II), and accepted the individual chapters of the report and their executive summaries (IPBES/4/INF/1/Rev.1).

2. The annex to the present note sets out information on the finalization of the thematic assessment of pollinators, pollination and food production (section I), and on the dissemination and communication activities and outputs involving the assessment's key findings (section II). The annex is presented without formal editing.

* IPBES/5/1/Rev.1.

Annex

Update of activities on the thematic assessment of pollinators, pollination and food production (deliverable 3 (a))

I. Finalisation of the assessment report

1. The IPBES Plenary at its fourth session approved the summary for policymakers (SPM) of the thematic assessment on pollinators, pollination and food production, which is included in annex II to decision IPBES-4/1. A laid out version was placed online on the IPBES website on 25 August 2016.

2. The IPBES Plenary at its fourth session also accepted the individual chapters and their executive summaries, based on document IPBES/4/INF/1, with the understanding that they would be edited to reflect the changes made to the summary for policymakers, and subsequently made available, as IPBES/4/INF/1/Rev.1. The revised chapters and their executive summaries were placed on the IPBES website on 24 November 2016, and the information document (IPBES/4/INF/1/Rev.1) is being made available to the fifth session of the Plenary. In addition, the laid out version of the full assessment (including the summary for policymakers and the individual chapters and their executive summaries) will be made available on the IPBES website, prior to the fifth session of the IPBES Plenary. This version includes, in addition to the material presented to the fourth Plenary, the following sections: foreword, preface, acknowledgement, glossary, acronyms, list of experts and list of expert reviewers.

3. The expert review comments from the *First Review* by Experts and the *Second Review by Governments and Experts* together with author responses, which were completed under the guidance of the review editors, will be made available online in time for the fifth session of the Plenary.

II. Summary of dissemination and communication activities and outputs on the assessment key findings

Media campaign

4. After the approval of the summary for policymakers at the fourth session of the IPBES Plenary, the media campaign linked to the pollination assessment report and its key findings generated over 1346 online news sites and stories through 18 top international newswires with coverage in 28 languages in 81 countries (updated as of April 2016).

Convention on Biological Diversity

5. Parties to the Convention on Biological Diversity (CBD) were notified, on 8 March 2016, about the outcomes of the fourth session of the IPBES Plenary, and, in particular, of the approval/acceptance of thematic assessment on pollinators, pollination and food production.

6. The key findings of the summary for policymakers of the pollination assessment report were presented to the plenary of the 20th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA, Montreal, Canada, 25-30 April 2016) in document UNEP/CBD/SBSTTA/20/9 (*Implications of the IPBES Assessment on Pollinators, Pollination and Food Production for the Work of the Convention)*. SBSTTA adopted 15 recommendations, one of which included the key findings from the pollination assessment: Recommendation XX/9: *Implications of the IPBES assessment on pollinators, pollination and food production for the work of the Convention*. The draft decisions contained within the recommendations were submitted to the Conference of the Parties to the Convention on Biological Diversity for consideration at its thirteenth meeting (COP-13) (see below).

7. The Plenary of SBSTTA 20 heard a presentation by Dr Adam Vanbergen, lead author of the pollination assessment, on key messages for policymakers on the values of pollinators, status and trends, drivers, and options for policy responses. A side event was held (Tuesday 24 April 2016) where Dr Vera Imperatriz-Fonseca, co-chair of the pollination assessment, highlighted key findings from the summary for policymakers from the IPBES thematic assessment on pollinators, pollination and food production. Ms Irene Hoffmann, Secretary of the Commission on Genetic Resources for Food and Agriculture (FAO), Ms Sarah Webster, Head of Protected and Invasive

Non-Native Species team at Department for Environment Food and Rural Affair (Defra – UK), and Mr Carlos Alberto de Mattos Scaramuzza (Ecosystem Conservation Director at Brazilian Ministry of the Environment, Brazilian Ministry of the Environment (MMA) also spoke at the side event on the implications of the pollination assessment report on international initiatives and national biodiversity strategies.

8. At COP-13, which was held from 4 to 17 December, 2016, in Cancun, Mexico, Dr Anne Larigauderie (IPBES Executive Secretary) delivered a statement during the high-level segment on the implications of the pollination assessment and its key findings at the round table on agriculture, as well as in Plenary. Representatives of the governments of France (Ms Barbara Pompili, State Secretary for Biodiversity, represented by Mr Jean-Patrick Leduc), the Netherlands (Mr Lejo van der Heiden, Head of delegation, Department of Agriculture and Nature), China (Mr Bai Chengshou, acting head of Chinese delegation), South Africa (Mr Shonisani Munzhedzi, Deputy Director General, Biodiversity and Conservation, Department of Environmental Affairs) and Brazil (Mr Carlos Scaramuzza, Director of Ecosystems, Ministry of Environment), were invited at a side event on 6 December 2016, to explain how their countries were using or planning to use the findings of the pollination assessment.

9. COP-13 adopted decision XIII/15 on the *Implications of the IPBES assessment on pollinators, pollination and food production for the work of the Convention*, in which the Conference of the Parties welcomed the IPBES summary for policymakers of the thematic assessment on pollinators, pollination and food production and endorsed its key messages. The full decision is presented as appendix II to this annex.

United Nations Environment Assembly

10. At the second session of the United Nations Environment Assembly (23 to 27 May 2016, Nairobi) both co-chairs of the pollination assessment, Drs. Simon Potts and Vera Imperatriz-Fonseca along with Dr Anne Larigauderie participated in a media roundtable event disseminating the key messages of the pollination assessment. Mr Vidar Helgesen, Minister of Climate and the Environment in Norway and Ms Barbara Pompili, State Secretary for Biodiversity in France also participated in the media roundtable event highlighting how the key findings from the pollination assessment would be taken into account in national policies regarding pollinators.

Initiatives at the national level

11. Various events hosted by governments and non-governmental stakeholders, and involving pollination experts, and/or members of the secretariat, MEP or Bureau, have taken place after the fourth session of the Plenary of IPBES to present the findings of the pollination assessment to various audiences. The secretariat has not received updated information on all these events, which include the following:

(a) At a national event (22 November 2016) hosted by the French Minister of Environment, Energy and the Sea, Ms Ségolène Royal, participants were invited to highlight actions being undertaken in various sectors across France to protect pollinators and pollination services essential to food security and wider human wellbeing, in reference to the French National Pollinator Action Plan, which made use of the IPBES pollination assessment report. Ivar Baste (IPBES Bureau member), Anne Larigauderie, and pollination assessment authors Jean Michel Salles (lead author) and Nicola Gallai (coordinating lead author) spoke at this event.

(b) The Government of the Netherlands announced at the high level segment of COP-13, the launch of a new initiative, called the *Coalition of the Willing on Pollinators*. Signatories include France, Germany, the United Kingdom, Belgium, Austria, Denmark, Luxembourg, Finland, Spain, the Netherlands and Uruguay. The *Coalition of the Willing on Pollinators* was inspired by the IPBES thematic assessment report on pollinators, pollination and food production, and calls for the use of its findings. The *Declaration on the Coalition of the Willing on Pollinator* was signed at a small ceremony in the margins of the high level segment at COP-13. It is presented in appendix I. Peru and Slovenia have joined also the *Coalition of the Willling on Pollinators*. Additional information can be found on the dedicated web site: www.promotepollinators.org.

Scientific publications

12. Abstracts (or the first page) of the scientific publications in high impact journals resulting directly from the pollination assessment report are presented in appendix III. Others are in preparation:

(a) Settele, J. et al. 2016. Climate change impacts on pollination. Nature Plants 2: 16092

(b) Potts, S. G. et al. 2016. Safeguarding Pollinators and Their Values to Human Well-Being. Nature 540 (7632): 220-229

(c) Dicks, L. V. et al. 2016. Ten policies for pollinators. Science 354 (6315): 975-976. DOI: 10.1126/science.aai9226

(d) Breeze, T. D. et al. 2016. Economic Measures of Pollination Services: Shortcomings and Future Directions. Trends in Ecology and Evolution 31(12): 927–939

Appendix I

Declaration on the Coalition of the Willing on Pollinators

We, founding partners of the Coalition of the Willing on Pollinators, being France, Germany, The United Kingdom, Belgium, Austria, Denmark, Luxemburg, Finland, Spain, and the Netherlands:

Recalling that pollinators are fundamental for the conservation of biological diversity and the maintenance of natural terrestrial ecosystems and key ecosystem services, including food production, and for the adaptation of our food production systems to climate change, thereby providing a compelling example of how biodiversity underpins sustainable development, including the improvement of food security for the world's population;

Deeply concerned about the current and future state of pollinators and animal pollination, as outlined in the key message of the IPBES thematic assessment on pollinators, pollination and food production, stating that pollinators are threatened for example by land use change, inappropriate intensive agricultural management including pesticide use, environmental pollution, invasive alien species, pathogens and climate change

Welcoming the tools and guidance developed by the Food and Agriculture Organization of the United Nations and partners under the International Initiative for the Conservation and Sustainable Use of Pollinators, and convinced that further developments should be built on them.

Convinced that political impetus has the potential to foster policy measures and innovative action with a view to protect pollinators;

COMMIT TO:

1. **take action** to protect pollinators and their habitats in order to stop and reverse their decline, taking into account our national, regional and international capabilities and priorities, including through strategies to:

- promote pollinator-friendly habitats including through sustainable agricultural practices such as
- agro-ecology;
- improve the management of pollinators, and reduce risks from pests, pathogens and invasive
- species
- avoid or reduce the use of pesticides harmful to wild and domestic pollinators, apply
- appropriate risk management measures, and develop alternatives to their use.
- We will do so by developing, facilitating (if not already done) and implementing pollinator strategies,
- consistent with the IPBES thematic assessment on pollinators, pollination and food production;

2. share, in an open and transparent manner, experience and lessons learnt in developing, facilitating and implementing these pollinator strategies, especially knowledge on new approaches, innovations and best practices;

3. reach out to, and seek collaboration with, a broad spectrum of stakeholders (among which, businesses, NGOs, farmers and smallholders, and local communities) on the need to protect pollinators;

4. develop research that will help to fill knowledge gaps on the subject of pollinator conservation;

5. mutually support and collaborate with each other and with all countries and partner organizations willing to join us.

In order to do so, we hereby establish a Coalition of the Willing on Pollinators. We will reach out to potential new partners with the aim of continuously expanding the Coalition of the Willing.

We will report in this respect our results to the meetings of the Conference of the Parties to the Convention on Biological Diversity.

Declaration on the Coalition of the Willing on Pollinators

Signed in Cancun, Mexico, December 2016

Gunter Liebel
Director General for Environment and Climate Change
On behalf of the Austrian Government

Ines Verleye
Senior biodiversity expert
On behalf of the Kingdom of Belgium

Hendrik Hedeman Olsen
Head of EU and International Affairs
On behalf of His Excellency Mr. Esben Lunde Larsen,
Minister of Environment and Food
Denmark

(Ministerial adviser Marina von Weisenberg)
(on behalf of the)
H.E. Kimmo Tiilikainen
Minister of Agriculture and the Environment
Finland

Barbara Pompili
Minister of State for Biodiversity
On behalf of the French government

Carole Dieschbourg
Minister for the Environment
Luxembourg

Margriet Leemhuis
Embassador for the Kingdom of the Netherlands
On behalf of the Ministry of Economic Affairs,
The Netherlands

Luis Fernandez- Cid de las Alas
Pumarino
Agriculture
Ambassador of Spain in Mexico

Barbara Kosack
Head of Division of the Ministry of Agriculture
Germany

Dr. Elsa Nickel
Director General of the Ministry Of Environment
Germany

Clare Hamilton
Deputy Head, UK Department for
Environment, Food and Affairs
On behalf of the government of the Unite Kingdom Of Great Britain and Northern Ireland

Ing. Quim. Alejandro Nario,
National Director of Environment,
On behalf of the Government of Uruguay
The Minister of External Affairs Dir. de Medio Ambiente

Appendix II - CBD Decision XIII/15

UNEP

CBD

Convention on Biological Diversity

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CBD/COP/DEC/XIII/15
9 December 2016

ORIGINAL: ENGLISH

CONFERENCE OF THE PARTIES TO THE
CONVENTION ON BIOLOGICAL DIVERSITY
Thirteenth meeting
Cancun, Mexico, 4-17 December 2016
Agenda item 17

DECISION ADOPTED BY THE CONFERENCE OF THE PARTIES TO THE CONVENTION ON BIOLOGICAL DIVERSITY

XIII/15. Implications of the IPBES assessment on pollinators, pollination and food production for the work of the Convention

The Conference of the Parties,

Recalling decision III/11, annex III, decision V/5, annex I, and decision VI/5, annex II,

Highlighting the essential role of the abundance and diversity of pollinators, especially wild pollinators as well as managed pollinators, for food production, nutrition and human well-being, the need to address threats to pollinators and pollination, and *recognizing* the contribution of pollinators to the Sustainable Development Goals, especially Goals 2, 3, 8 and 15,

Recognizing the potential to enhance and secure crop production by increasing the abundance and diversity of pollinators through protection of the plants and habitats on which they depend for foraging and nesting,

Noting the relevance of the conservation and sustainable use of pollinators for the mainstreaming of biodiversity in the food and agriculture sectors,

Noting also the importance of pollinators and pollination for all terrestrial ecosystems, including those beyond agricultural and food production systems, and *recognizing* pollination as a key ecosystem function that is central to the conservation and sustainable use of biodiversity,

Aware of the trade-offs and synergies that exist between pollinator management options and other elements of agricultural systems,

1. *Welcomes* the Summary for Policymakers of the thematic assessment on pollinators, pollination and food production approved by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services at its fourth session, in Kuala Lumpur, on 26 February 2016,[1] as well as the full assessment report that was accepted by the Plenary;

2. *Endorses* the key messages of the Assessment;

3. *Encourages* Parties, other Governments, relevant United Nations and other organizations, as well as multilateral environment agreements, and stakeholders to use, as appropriate, the Assessment, in particular the examples of responses outlined in table SPM.1,

[1] UNEP/CBD/COP/13/INF/31.

to help guide their efforts to improve conservation and management of pollinators, address drivers of pollinator declines, and work towards sustainable food production systems and agriculture;

4. *Welcomes* the tools and guidance developed by the Food and Agriculture Organization of the United Nations and partners under the International Initiative for the Conservation and Sustainable Use of Pollinators, including those for the rapid assessment of pollinators' status, the economic valuation of pollination, the determination of the risk of pesticides, the evaluation of pollination deficit, the evaluation of pollinator-friendly practices, and policy mainstreaming;

5. *Takes note* of the establishment of the coalition of the willing on pollinators in the context of the "Cancun Commitments and Coalitions" and invites other Parties to consider joining this coalition;[2]

6. *Encourages* businesses involved in the development, manufacturing and sale of pesticides, as appropriate, to take into account the findings of the Assessment in their activities, including in developing and revising risk assessments of products, applying the precautionary approach in line with the preamble to the Convention and be fully transparent in releasing the results of all toxicity studies consistent with applicable international, regional and national standards and frameworks;

7. *Encourages* Parties, and *invites* other Governments and other relevant organizations and stakeholders, taking into account national circumstances, as appropriate:

POLICIES AND STRATEGIES

(a) To integrate consideration of issues related to the conservation and sustainable use of pollinators in agriculture and forestry policies, national biodiversity strategies and action plans, national adaptation plans for climate change, national action programmes for combating desertification and other relevant national policies plans, and programmes, taking into account the values of pollinators and pollination, inter alia, to promote the implementation of the actions below, to improve the management of pollinators, to address drivers of pollinator declines and to reduce the crop yield gaps due to pollination deficit;

PROMOTING POLLINATOR-FRIENDLY HABITATS

(b) To promote diversity of habitats and production systems in the landscape through, inter alia, support to ecologically based agriculture (including organic agriculture) and diversified agricultural systems (such as forest gardens, home gardens, agroforestry, crop rotation and mixed cropping and livestock systems), and through conservation, management and restoration of natural habitats, to enhance the extent and connectivity of pollinator-friendly habitat;

(c) To promote conservation, management and restoration of patches of natural and semi-natural habitats on farms, and in urban and other developed areas, as appropriate, to maintain floral resources and nesting sites for pollinators;

(d) To promote cropping systems and conservation, management and restoration of grasslands and rangelands that enhance the availability of floral resources and nesting sites over time and space;

IMPROVING THE MANAGEMENT OF POLLINATORS, AND REDUCING RISK FROM PESTS, PATHOGENS AND INVASIVE SPECIES

(e) To enhance the floral diversity available to pollinators using mainly native species and reduce the dependence of managed pollinators on nectar-replacements, thereby improving pollinator nutrition and immunity to pests and diseases;

(f) To promote genetic diversity within populations of managed pollinators;

(g) To improve hygiene and control of pests (including the *Varroa* mite and the Asiatic wasp, *Vespa velutina*) and pathogens in managed pollinator populations;

(h) To monitor and manage the movement of managed pollinator species, sub-species and breeds where appropriate, among countries, and as appropriate within countries, to

[2] www.cbd.int/ccc

limit the spread of parasites and pathogens to managed and wild pollinator populations, and to prevent the introduction of potentially invasive pollinator species outside their native ranges;

(i) To prevent or minimize the risk of introducing invasive alien species harmful to wild and managed pollinators and the plant resources on which they depend and to identify and evaluate such risk;

REDUCING RISK FROM PESTICIDES, INCLUDING INSECTICIDES, HERBICIDES AND FUNGICIDES

(j) To develop and implement national and as appropriate regional pesticide risk reduction strategies and to avoid or reduce the use of pesticides harmful for pollinators, for example, by adopting Integrated Pest Management practices and biocontrol, taking into account the International Code of Conduct on Pesticide Management of the Food and Agriculture Organization of the United Nations and the World Health Organization;

(k) Where pesticides pose a risk to pollinators, to improve pesticide application practices, including technologies to reduce drift, to reduce exposure of pollinators;

(l) To promote weed management strategies that take into account the need for pollinator forage, nutrition and nesting sites;

(m) To improve, as appropriate, risk assessment procedures for pesticides and, where necessary, for living modified organisms to better take into account possible impacts, including sublethal and indirect effects, on both wild and managed pollinators, *including*, inter alia, a wider range of pollinator taxa, beyond honeybees and managed bumblebees, and toxicological studies, in risk assessment protocols, applying the precautionary approach in line with the preamble of the Convention, consistent with international obligations and taking into account climate variations and cumulative effects;

(n) To avoid or minimize the synergistic *effects* of pesticides with other drivers that have been proven to pose serious or irreversible harm to pollinators;

ENABLING POLICIES AND ACTIVITIES

(o) To promote education and public awareness of the value of pollinators and of the habitats that support them, and of the need to reduce threats to these species and their habitats;

(p) To integrate consideration of issues related to the conservation and sustainable use of pollinators, including wild pollinators, into agricultural extension services, using approaches, as appropriate, such as farmer field schools;

(q) To develop and implement incentives for farmers and indigenous peoples and local communities to protect pollinators and pollinator habitats, for example through benefit-sharing schemes, including payments for pollinator services schemes, and remove or reduce perverse incentives consistent with applicable international obligations, such as causing the destruction of pollinator habitats, overuse of pesticides and simplification of agricultural landscapes and production systems;

(r) To promote and support access to data and use of decision support tools, including, where appropriate, land-use planning and zoning, to enhance the extent and connectivity of pollinator habitats in the landscape, with the participation of farmers and local communities;

(s) To protect and promote traditional knowledge, innovations and practices, protect traditional and established land rights and tenure, as appropriate, and to promote biological and cultural diversity, and the links between them,[3] for the conservation and sustainable use of pollinators including diverse farming systems;

RESEARCH, MONITORING AND ASSESSMENT

(t) To enhance monitoring of the status and trends of all pollinators, pollinator-friendly habitats and pollinator community structure as well as the identification of potential pollinator deficits using consistent and comparable methodologies;

(u) To build taxonomic capacity on pollinators;

[3] Identified in the Assessment as “biocultural diversity”.

(v) To assess the benefits of pollinators and pollination, taking into account the economic value to agriculture and food production and the value to conservation and sustainable use of biodiversity, as well as cultural and other values;

(w) To undertake research on the socioeconomic implications of pollinator decline in the agricultural sector;

(x) To promote and share further research to address gaps in knowledge identified in the Assessment, as appropriate and in accordance with national legislation, including the effects of the partial loss of pollinators on crop production, and potential impacts of pesticides, in particular neonicotinoids and other systemic pesticides, taking into account their possible cumulative effects, and of living modified organisms, on pollinator populations, under field conditions, including differential impacts on managed and wild pollinators, and on social versus solitary pollinators, and the impacts on pollination of both crop and non-crop plants over both the short and long term, and under different climatic conditions;

(y) To promote further research to identify practical ways that pollinator-friendly practices can be integrated into farming systems as part of efforts to increase production and mainstreaming of biodiversity into agricultural production systems;

(z) To promote further research to identify risks to pollination under climate change and potential adaption measures, including the potential loss of keystone species and their effect on ecosystem resilience;

(aa) To promote further research and analysis on pest management, taking into account the impact of drivers of pollinator decline, to support development of more feasible and sustainable alternatives;

8. *Invites* Parties, other Governments and relevant organizations to provide the Executive Secretary with information on relevant national initiatives and activities to promote the conservation and sustainable use of pollinators and *requests* the Executive Secretary, subject to the availability of resources, to compile this information, including information in the national reports, for consideration by the Subsidiary Body on Scientific, Technical and Technological Advice at a meeting held prior to the fourteenth meeting of the Conference of the Parties;

9. *Encourages* academic and research bodies, and relevant international organizations and networks to promote further research to address gaps in knowledge identified in the Assessment, including the issues identified in paragraph 7, subparagraphs (t) to (aa), above, to expand research to cover a wider variety of pollinators and to support coordinated global regional and national monitoring efforts and build relevant taxonomic capacity, especially in developing countries, where there have been fewer research and monitoring efforts to date;

10. *Requests* the Executive Secretary, subject to the availability of resources, together with the Food and Agriculture Organization of the United Nations, and in collaboration with other partners, to review the implementation of the International Initiative on the Conservation and Sustainable Use of Pollinators and prepare a draft updated and streamlined plan of action, including capacity-building, based on the Assessment and including the most recent knowledge, for consideration by the Subsidiary Body on Scientific, Technical and Technological Advice at a meeting held prior to the fourteenth meeting of the Conference of the Parties;

11. *Also requests* the Executive Secretary, subject to the availability of resources, in partnership with relevant organizations and indigenous peoples and local communities, to compile and summarize information on pollinators and pollination relevant to the conservation and sustainable use of biodiversity in all ecosystems, beyond their role in agriculture and food production for consideration by the Subsidiary Body on Scientific, Technical and Technological Advice at a meeting held prior to the fourteenth meeting of the Conference of the Parties;

12. *Further requests* the Executive Secretary to bring the present decision to the attention of the Food and Agriculture Organization of the United Nations and its Commission on Genetic Resources for Food and Agriculture;

13. *Requests* the Executive Secretary, in view of the variance in the amount of information on the status and trends of pollinators and pollination among regions, with significant gaps in data, and also limitations in capacity for the identification, monitoring and

management of pollinators, in many developing countries, in particular the least developing countries and small island developing States, and in countries with economies in transition, in cooperation with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, the Food and Agriculture Organization of the United Nations, and other relevant organizations, subject to the availability of resources and avoiding duplication of efforts:

(a) To promote, as a priority, efforts to address data gaps and capacity for monitoring the status and trends of pollinators and pollination in developing countries, in particular those in Africa, Latin America, Asia and Oceania;

(b) To identify and develop proposals for strengthening capacity related to pollinators and pollination, and supplementary regional assessments, in particular for Africa, Latin America, Asia and Oceania, to be integrated into the updated and streamlined plan of action of the International Initiative on the Conservation and Sustainable Use of Pollinators referred to in paragraph 10 above;

14. *Invites* the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services to give due attention to the theme of pollinators and pollination in the ongoing regional/subregional assessments on biodiversity and ecosystem services, and the thematic assessment on land degradation and restoration and in the work of the task force on capacity-building;

15. *Encourages* Parties, other Governments and organizations in a position to do so, to support capacity-building and technical and scientific cooperation, to address the gaps and limitations referred to in paragraph 13, inter alia building upon relevant traditional and local knowledge;

16. *Requests* the Executive Secretary, subject to the availability of resources, to compile information on best practices, tools and lessons learned related to the monitoring and management of pollinators and pollination and make them available through the clearing-house mechanism and other means.

Appendix III - Publications from the pollination assessment (abstract/first page)

Settele, J. et al. 2016. Climate change impacts on pollination. Nature Plants 2: 16092

PUBLISHED: 1 JULY 2016 | ARTICLE NUMBER: 16092 | DOI: 10.1038/NPLANTS.2016.92

comment

Climate change impacts on pollination

Climate change will pose diverse challenges for pollination this century. Identifying and addressing these challenges will help to mitigate impacts, and avoid a scenario whereby plants and pollinators are in the 'wrong place at the wrong time'.

Josef Settele, Jacob Bishop and Simon G. Potts

Biotic pollination improves the yield of 75% of crop types globally, and therefore has great nutritional importance for humans[1]. However, the future of animal pollination is severely threatened. Changes in land use, pesticide applications, agricultural monocultures and the spread of non-native species and pathogens all contribute to this threat, which is likely to be exacerbated by climate change[2] (Fig. 1).

The consensus of the Intergovernmental Panel on Climate Change (IPCC) is that substantial climate change has already occurred since the 1950s. It is likely that in the short term (2016–2035), the global mean surface air temperature will increase to between 0.3 and 0.7 °C higher than 1986–2005 levels. Greater increases of between 0.4 and 2.6 °C are projected later in the century (2046–2065), although the extent of this warming will depend on future greenhouse gas emissions[3]. As the global average temperature increases, extreme high temperatures are also expected to become more frequent: this is indicated by previous warming and greater-than-expected increases in heatwave frequency and magnitude[4].

In order to meet food security challenges for a growing global population, it will be necessary to safeguard and sustainably manage pollination services against the backdrop of increasing climate unpredictability and a changing world. In this Comment, we explore how climate change impacts pollinator–plant relationships, and the future challenges these relationships will face. Filling the research gaps that we identify will help to address these challenges.

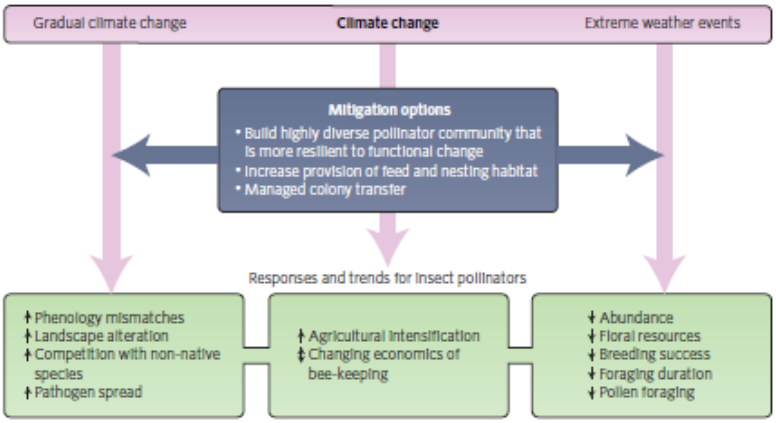

Figure 1 | Projected impacts of climate change (both gradual change and extreme weather events) on insect pollinators, and potential mitigation options[2]. Upregulation and downregulation of a process is indicated by up and down arrows, respectively, and uncertain outcomes by double-ended arrows.

Climate-driven shifts in phenology

Temperature plays an important regulatory role in the timing of plant and insect development[5]. Climate change can cause phenological decoupling of plant–pollinator mutualisms (Fig. 1); a change in temperature can result in different rates of change in the timing of key development stages in plants (for example, first flowering) and their pollinators (for example, first emergence date)[5]. Spring advancement in phenology was three times more rapid in some butterflies than their host plants, suggesting increasing asynchrony between these two groups[6]. Such phenological decoupling could result in reduced food availability for insect pollinators and, at the same time, result in reduced pollinator visitation to the plants that depend on them. Modelling studies using a highly resolved empirical network of interactions among 1,420 pollinator and 429 plant species indicate that climate change over the last 120 years has caused phenological shifts and interaction mismatches between flowering plants and their pollinators[7]. However, in some cases, phenological effects on pollinator–plant synchrony may not cause mismatches, as more generalist pollinator species may keep pace with changes in forage-plant flowering by switching between host plants. Plants and pollinators may also change synchronously. For instance, it was found that while 10 bee species in North America emerged ~10 days earlier over a period of 130 years, this advance seemed to be matched by an earlier appearance of co-occurring forage plants[8]. But with only a few empirical studies available, it is still too early to draw any broad conclusions on the direction and magnitude of phenological shifts in plant–pollinator networks.

Climate-driven shifts in ranges

While many plants and animals appear to be keeping pace with recent changes in climate, there is also evidence that many species are lagging far behind[9] (Fig. 1). Species that cannot migrate will see their

(b) Potts, S. G. et al. 2016. Safeguarding Pollinators and Their Values to Human Well-Being. **Nature** 540 (7632): 220-229

REVIEW

doi:10.1038/nature20588

Safeguarding pollinators and their values to human well-being

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Wild and managed pollinators provide a wide range of benefits to society in terms of contributions to food security, farmer and beekeeper livelihoods, social and cultural values, as well as the maintenance of wider biodiversity and ecosystem stability. Pollinators face numerous threats including changes in land-use and management intensity, climate change, pesticides and genetically modified crops, pollinator management and pathogens, and invasive alien species. There are well-documented declines in some wild and managed pollinators in several regions of the world. However, many effective policy and management responses can be implemented to safeguard pollinators and sustain pollination services.

Pollinators are inextricably linked to human well-being through the maintenance of ecosystem health and function, wild plant reproduction, crop production and food security. Pollination, the transfer of pollen between the male and female parts of flowers that enables fertilization and reproduction, can be achieved by wind and water, but the majority of the global cultivated and wild plants depend on pollination by animals. Although most animal pollinators are insects (for example, bees, flies, butterflies, moths, wasps, beetles and thrips), some vertebrate pollinators exist (for example, birds, bats and other mammals and lizards). Bees are the most important group of pollinators, visiting more than 90% of the leading 107 global crop types[1]. Over 20,000 bee species have been described worldwide[2], of which up to 50 species are managed, and about 12 are commonly used for crop pollination, such as the western honeybee (*Apis mellifera*), the eastern honeybee (*Apis cerana*), some bumblebees, stingless bees and solitary bees. *Apis mellifera* is the most commonly managed bee in the world, although there is growing evidence highlighting the roles of wild pollinators and of diverse pollinator assemblages in contributing to global crop production[3].

Our knowledge and response actions have not kept pace with the threats to pollinators and pollination services. Although there has been increased interest from science[4], policymakers[5,6] and the public, a mismatch remains between scientific evidence of impacts and conservation, and management responses. As a step towards further outreach to a wider audience, here we review the diverse values of pollinators, their status and trends, risks from environmental pressures and consequent management and policy response options, and highlight key knowledge gaps. Our review is robustly underpinned by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services *Pollinators, Pollination and Food Production* assessment[5], whose 77 international experts critically evaluated the available global evidence up until May 2015; we have also drawn upon key publications arising after this date.

Diversity of values of pollinators and pollination

Pollinators provide numerous benefits to humans, such as securing a reliable and diverse seed and fruit supply, sustaining populations of wild plants that underpin biodiversity and ecosystem function, producing honey and other beekeeping products, and supporting cultural values. Much of the recent international focus on pollination services has been on the benefits to food production. Animal pollination directly affects the yield and/or quality of approximately 75% of globally important crop types including most fruits, seeds and nuts and several high-value commodity crops such as coffee, cocoa and oilseed rape[1,7]. An estimated 5–8% of global crop production would be lost without pollination services, necessitating changes in human diets and a disproportionate expansion of agricultural land to fill this shortfall in crop production by volume[8]. Over the past 50 years, yields of crops with greater pollinator dependence have increased at a lower rate, and become more variable than crops that are less pollinator dependent, suggesting that pollination services can be compromised by pollinator decline[9]. However, these estimates are often based on broad categorizations of pollinator dependence[1] derived from older, less standardized literature. A better understanding of the relationships between pollination services and crop productivity is therefore essential to quantify correctly how changing pollinator populations or diversity will affect food production.

Recent research indicates that pollinator-dependent crop productivity is important for balanced human diets. Pollinator-dependent crops are the principal sources of many micronutrients, including vitamins A and C, calcium, fluoride and folic acid[10]. Nutritional dependency on pollination overlaps geographically with the incidence of malnutrition of these nutrients. For example, areas with a high vitamin A deficiency are estimated to be three times more reliant on pollinator-dependent crops for plant-based vitamin A[11]. Pollinator losses could therefore result in a substantial rise in the global rate of preventable diseases, such as ischaemic heart disease, potentially resulting in around 1.4 million additional deaths per year and approximately 29 million lost years of healthy life[10]. Although

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POLICY FORUM

BIODIVERSITY

Ten policies for pollinators

What governments can do to safeguard pollination services

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Earlier this year, the first global thematic assessment from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) evaluated the state of knowledge about pollinators and pollination (*1*, *2*). It confirmed evidence of large-scale wild pollinator declines in northwest Europe and North America and identified data shortfalls and an urgent need for monitoring elsewhere in the world. With high-level political commitments to support pollinators in the United States (*3*), the United Kingdom (*4*), and France (*5*); encouragement from the Convention on Biological Diversity's (CBD's) scientific advice body (*6*); and the issue on the agenda for next month's Conference of the Parties to the CBD, we see a chance for global-scale policy change. We extend beyond the IPBES report, which we helped to write, and suggest 10 policies that governments should seriously consider to protect pollinators and secure pollination services. Our suggestions are not the only available responses but are those we consider most likely to succeed, because of synergy with international policy objectives and strategies or formulation of international policy creating opportunities for change. We make these suggestions as independent scientists and not on behalf of IPBES.

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RISK REDUCTION

Pesticides are the most heavily regulated of the interacting drivers of pollinator declines (*7*). Risk assessment and use regulation can reduce pesticide hazards at national scales (*2*), yet such regulation is uneven globally. Many countries do not have national pesticide regulation and control systems or adhere to the International Code of Conduct on Pesticide Management (ICCPM), recently updated by the United Nations (*8*, *9*). International pressure to raise pesticide regulatory standards across the world should be a priority. This includes consideration of sublethal and indirect effects in risk assessment and evaluating risks to a range of pollinator species, not just the honey bee, *Apis mellifera*.

Another priority is to capitalize on the profile of integrated pest management (IPM) in international policies, such as the ICCPM (*9*) and the European Union's (EU's) Sustainable Use of Pesticides Directive (*10*). IPM combines pest monitoring with a range of pest control methods, such as crop rotation, field margin management, and biological control; pesticides are used as a last resort, only when other strategies are insufficient (*11*). IPM can decrease pesticide use and reduces risks to nontarget organisms, so it should be linked to pollinator health and pollination.

A bumblebee (*Bombus terrestris*) collecting pollen from a blueberry flower. Unregulated trade in bumblebees puts them outside their native range.

Genetically modified (GM) crops pose potential risks to pollinators through poorly understood sublethal and indirect effects (*1*). For example, GM herbicide-tolerant crops lead to increased herbicide use, reducing the availability of flowers in the landscape, but consequences for pollinators are unknown. GM crop risk assessments in most countries do not capture these effects. They evaluate only direct effects of acute exposure to proteins expressed in the GM plants, usually in terms of the dose that kills 50% of adults (LD_{50}), and only for honey bees, not other pollinators. International guidance to improve GM organism risk assessment is being developed under the CBD's Cartagena Protocol on Biosafety (*12*); this presents an opportunity to encourage inclusion of indirect and sublethal effects on a range of pollinator species.

There are substantial risks from movement of managed pollinators around the world (*1*). Managed pollinators, including newly domesticated species, offer opportunities to grow businesses and improve pollination services. Commercial bumble bee trade has grown dramatically, leading to invasions of *Bombus terrestris* beyond its native range and increasing the risk of disease transfer to native wild bee populations, potentially including other bee species (*13*). The issue of invasive species has been highlighted in the UN Sustainable Development Goals and the CBD's Strategic Plan for Biodiversity, which parties to the CBD are implementing in national strategies and action plans. This creates momentum and opportunity for regulators to consider limiting and better managing pollinator movement within and between countries.

SUSTAINABLE FARMING

Agriculture is a major driver of pollinator declines, through land-use change; intensive practices, such as tillage and agrochemical use; and declines in traditional farming practices. Agriculture also provides opportunities to support wild pollinators (*1*). We propose two complementary policy objectives: (i) promote ecological intensification of agriculture (*14*) and (ii)

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Review

Economic Measures of Pollination Services: Shortcomings and Future Directions

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Over the past 20 years, there has been growing interest in the possible economic impacts of pollination service loss and management. Although the literature area has expanded rapidly, there remains ongoing debate about the usefulness of such exercises. Reviewing the methods and findings of the current body of literature, this review highlights three major trends: (i) estimated benefits are heterogeneous, even when using the same method, due to several often-neglected factors. (ii) The current body of literature focuses heavily on the developed world, neglecting the effects on developing countries. (iii) Very few studies are suitable for informing management and policy. The review highlights the need for fully interdisciplinary work that embeds stakeholders and economic impacts into primary ecological research.

Trends

Pollination is a major, economically significant ecosystem service that is threatened by biodiversity losses. Economic measures of ecosystem services are thought to support better, more sustainable management strategies and are increasingly used to justify pollinator conservation.

Converting 63 available studies that economically measure pollination services into a common currency (2015 US$), this review identifies three major shortcomings within the current literature: highly heterogeneous results, biases towards the developed world and producers, and limited adaptability for decision-making. The review proposes next steps to enhance the effectiveness and applicability of future economic studies.

Valuing Pollination Services

The concept of ecosystems services, the **benefits** (see Glossary) received by human society from natural ecological processes, is a major catalyst for current ecological and interdisciplinary research. Quantitative measures of ecosystem service benefits are often expressed in monetary terms. Monetisation of ecosystem service benefits is alleged to support biodiversity and ecosystem service conservation by raising awareness of impacts and facilitating budget-efficient management [1]. However, critics of monetisation argue that it has produced some political impetus but seldom any observable benefits to biodiversity or sustainable land management, with most studies remaining largely illustrative [2,3]. Furthermore, many 'payments for ecosystem services' schemes, which aim to develop markets for ecosystem service provision with defined buyers and sellers, do not base their exchanges on estimates of the monetary benefits (e.g., [4]). This has resulted in substantial debate about the worth of economic valuation in current biodiversity conservation [2,5,6].

Pollination is one of the most widely studied ecosystem services globally, underpinning 78% of global flowering plant reproduction [7] and enhancing production in 75% of globally important crops [8]. As such, monetisation of this service has attracted great interest and scrutiny, particularly regarding the methods used to elicit benefit estimates and the quality of input data [9,10]. This review presents a detailed overview of trends within the methods, locations and findings of the current literature to highlight a number of shortcomings that limit the capacity of the current knowledge base to support decisions.

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