

Comment form for 2nd Review Phase of the Deliverable 3a) Thematic assessment of pollinators, pollination and food production

Chapter 6:

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Reviewers for Chapter 6		
Adolfo Pérez Piñeiro	Emily Marquez	Rebecca Chaplin-Kramer
Ahmad Mahdavi	German Government	Richard Corlett
Andony Melathopoulos	Jeff Ollerton	Sandhya Chandrasekharan
Andreas Kruess	Jens Dauber	Scott Black
Andrew Lewis	Kimiko Okabe	Scott Groom
Bienvenue ZAFINDRASILIVONONA	Les Davies	Serena Heckler
Charlotte Karibuhoye	Madeleine Chagnon	Thomas Brooks
Christopher Golden	Mahmood-ur-Rahman Ansari	Thomas Steeger
Claire Kremen	Maria Jose Suso	UK Government
Cynthia Scott-Dupree	Marie-Pierre Chauzat	USA government
David Aston	Marina Rosales Benites de Franco	Valentin Opfermann
David Cooper	Nils Simon	
Denise Matias	Noa Simon Delso	
Diane Castle	Peter Campbell	

***This report has been reviewed by scientists/researchers acting in their individual capacity as scientists and do not reflect the views of their company or institution.**

Reviewer ID	Chapter	From Page (start)	From Line (start)	To Page (end)	To Line (end)	Comment	Author Annotations
David Cooper	6	9	1	14	194	Executive summary is good. But perhaps too many points-- and some redundancy among them.	The Executive Summary has been re-drafted with fewer paragraphs.
David Cooper	6	9	3	9	10	Does this message apply just to agricultural systems or all ecosystems?	It applies to all ecosystems. We do not feel it is necessary to clarify this in the redrafted text.
Peter Campbell	6	9	3	9	10	Whilst pollinator declines certainly present a theoretical risk to crop security (yields & quality etc) as described in this paragraph, we need to be very clear in differentiating what is "possible" versus what is or has actually happened ie real field evidence of falling yields and quality due to pollination deficits. We certainly shouldn't be scaring Policy Makers that there is an immediate threat to food security of future crops (as is inferred in this paragraph) unless we have real field evidence of this. A recently published paper in Nature Communications (Kleijn et al, 2015: "Delivery of crop pollination services is an insufficient argument for wild pollinator conservation") stated that "Almost 80% of crop pollination by wild bees is provided by just 2% of the most common species", suggesting that the food security of crops is not currently threatened by a lack of pollination services, contrary to the statement being made here. It would be far more honest to recommend to policy makers to protect pollinators for conserving biodiversity reasons than prematurely or even wrongly stating the reason is to protect food / crop security.	The text is carefully worded to match Table 6.2.3, based on the combined judgement of all authors and description of evidence contained in the report. We clarify more carefully what is known about the link with loss of pollinator diversity and crop yield deficits or instability.
Ahmad Mahdavi	6	9	5	9	5	and direct adverse effects on speciation power and mechanisms of speciation (eg. prevention/ disturbances for geographical separation) of pollinator species	This is a very long term risk that was not identified by the author team as a direct or indirect risk from pollinator decline as relevant for this report. This is a very long term risk that was not identified by the author team as a direct or indirect risk from pollinator decline as relevant for this report.

Ahmad Mahdavi	6	9	10	9	10	Also by different disturbances by all aspects of industrialism like expanding megacities, roads, etc. noise and dust pollution	Some of these suggestions are covered by 'land cover change', Others (dust and noise) are not known to be prominent drivers of pollinator decline and it would not be appropriate to mention them here. Some of these suggestions are covered by 'land cover change', Others (dust and noise) are not known to be prominent drivers of pollinator decline and it would not be appropriate to mention them here.
Peter Campbell	6	9	12	9	13	In light of the comment above lets be specific and replace "reduce risks" with "benefit pollinators".	The report has to be policy relevant, and the IPBES plenary has specifically framed this chapter in the context of risks and opportunity. We have to describe the risks and assess responses to them. Avoiding the issue, as suggested here, would not be appropriate. The report has to be policy relevant, and the IPBES plenary has specifically framed this chapter in the context of risks and opportunity. We have to describe the risks and assess responses to them. Avoiding the issue, as suggested here, would not be appropriate.
Denise Matias	6	9	13	9	13	How about including planting nesting trees of wild bees and not just growing additional flowers on farmland?	This selected set of actions are those for which there is good evidence of benefits to pollinators (well established). Nesting trees are a valid suggestion, but not supported by the same weight of evidence, so not highlighted here. Protection of trees for nesting honey and stingless bees is added in section 6.4.3.1.1 This selected set of actions are those for which there is good evidence of benefits to pollinators (well established). Nesting trees are a valid suggestion, discussed in section ??????, but not supported by the same weight of evidence, so not highlighted here.
Noa Simon Delso	6	9	14	9	14	to be added "Integrated Pest Management (IPM) techniques, organic production and low input systems"	There is a whole paragraph in the Exec Summary about organic farming. Discuss why organic farming not mentioned in summary
David Cooper	6	9	16	9	19	This example addresses one of the three approaches in the bold statement. Perhaps examples should also be provided for the other two?	We have only chosen one example because of very tight word limits. More detail about the other actions can be found in the section numbers indicated. We have only chosen one example because of very tight word limits. More detail about the other actions can be found in the section numbers indicated.

Jeff Ollerton	6	9	16	9	18	Although local density of pollinators is indeed enhanced by flower strips, it is unclear whether this actually translates into an increase in the overall population size of those pollinators. Evidence is patchy to say the least.	We have added the word 'local' to the Exec Summary text to clarify that these effects are not population level. There is a new sentence in section 6.4.1.1.1 that covers the lack of evidence here. Two the same here. Check section and consider text.
UK Government	6	9	16	9	18	Although local density of pollinators is indeed enhanced by flower strips, it is unclear whether this actually translates into an increase in the overall population size of those pollinators. Evidence is patchy to say the least.	We have added the word 'local' to the Exec Summary text to clarify that these effects are not population level. There is a new sentence in section 6.4.1.1.1 that covers the lack of evidence here.
Ahmad Mahdavi	6	9	24	9	24	And also some benefits to local biodiversity, scientific research and recreational.	Thanks for the suggestion, but we did not make the change because this is a specific point about economic benefits.do we have the opportunities para right in the summary?
Noa Simon Delso	6	9	25	9	25	please define what is “good husbandry” of managed pollinators	This text has been changed in the third draft.
David Cooper	6	9	26	9	26	"although", replace by "and"	This text has been changed in the third draft. This changes the meaning. Good husbandry of managed pollinators for economic benefit in the long term is conditional on this regulation.
Cynthia Scott-Dupree	6	9	29	9	29	Pollinator should be "pollinators"	This is a matter of grammatical style. This is a matter of grammatical style.
Denise Matias	6	9	29	10	51	How about including the benefits of swidden plots to pollinators such as bees? Chapter 5 mentions this several times. Support may also be given to swidden plots in the form of legislation decriminilazing them in (most cases).	Swidden systems are described in chapter 5Not the right place, but what are swidden plots? Have we mentioned them?
Ahmad Mahdavi	6	9	31	9	31	And this need to be continued for a long time with no disturbances from toxic inputs so that give pollinators opportunity to well establish	We have not found specific evidence to support this, nor have you provided any, so we will not include it. We have not found specific evidence to support this, nor have you provided any, so we will not include it.
Les Davies	6	9	26		27	strong' need? Suggest delete 'strong'	This text has been changed. See line 99, comment 89.
Les Davies	6	9	30			Suggest define which organic farms, in the light of information at lines 35-38	Thanks for this suggestion, but we cannot, as the evidence that underlies the bold statement does not include information about yield. Thanks for this suggestion, but we cannot, as the evidence that underlies the bold statement does not include information about yield.

Les Davies	6	9	30			Quantity & quality of evidence for improved pollination services on organic farms which use lime-sulfur, rotenone and other bee-toxic compounds?	We do not have detailed information on the practices used in the organic farms where there is evidence on pollinators, so we can make no statement about this.
Les Davies	6	9	32			'poor' scientific evidence beyond Europe and North America? Or 'limited'? Or haven't looked?	This text has changed in the third draft. Change to limited. We certainly have looked.
Les Davies	6	9	34			increases in pollinator species with higher proportions of arable land - contradictory to implications of the rest of the section?	This is a 'contrast' effect, as you compare numbers on organic farms with paired conventional farms. I don't see a contradiction.
Thomas Steeger	6	9	3	9	3	What is meant by "medium to high risks"?	This text removed.
Noa Simon Delso	6	10	42	10	42	These farms also provide better opportunities for pest monitoring.	There is some discussion of synergies between pest regulation and pollination in section 6.7. You have not provided evidence for this statement about pest monitoring and we have not reviewed this evidence, so cannot include it here. There is some discussion of synergies between pest regulation and pollination in section 6.7. You have not provided evidence for this statement about pest monitoring and we have not reviewed this evidence, so cannot include it here.
Noa Simon Delso	6	10	43	10	45	Yes, BUT statement not to be generalised. In areas of conventional agriculture with small size fields, the exposure of pollinators to different pesticides happens very often. As a proof, the results of the different regions in Italy within the BeeNet could be used. Please contact either the CRA-API or the University of Bologna, Marco Lodesani or Claudio Porrini, respectively.	This text has changed in the third draft.
David Cooper	6	10	47	10	51	Combine with the message on page 11, line 89	The section on payments for ecosystem services has been removed from the Exec Summary
Mahmood-ur-Rahman Ansari	6	10	47	10	51	We can not compare the farmers of USA, Europe and Australia to the farmers of developing countries. Farmers have small land holdings and they can not afford to adopt many of the suggested responses to risks discussed. Moreover, the financial situation in developing countries do not allow the governments to support the farmers.	We are not comparing. Just presenting what evidence there is. Of course this depends on Government priorities and ability to pay. We are not comparing. Just presenting what evidence there is. Of course this depends on Government priorities and ability to pay.

Noa Simon Delso	6	10	55	10	56	It would be worthwhile to check the Millenium Assessment 2005, which developed the framework of the ecosyste services approach, and check all the socio-economic ecosystem services described. These “non-biological” services seem to be underestimated.	Thanks but we specifically searched the literature for evidence of tradeoffs between any ecosystem services, and this summarises what we found.
Sandhya Chandrasekharan	6	10	57	10	57	this is related to the above	Sorry I do not know what this is about.link to comment 40. Intercontinental trade-offs do not really apply for pollinators, surely.
Ahmad Mahdavi	6	10	58	10	58	solution could be band cropping with some bands in between for weeds to allow habitat for biodiversity and a little tillage to remove weeds from crop bands	Is this covered in the relevant section? No evidence supplied so could ignore. Thank you for your comment but there is no evidence to support this statement. Is this covered in the relevant section? No evidence supplied so could ignore.
Rebecca Chaplin-Kramer	6	10	58	10	58	What does "notional" mean in this case? That's it's possible in theory but there's no evidence for it? I think there's quite a lot of evidence that pests (as well as enemies) can come from natural habitat surrounding the farm.	this is a standard uncertainty term, as explained in the uncertainty guidance. Changed to 'speculative' throughout, this is a standard uncertainty term, as explained in the uncertainty guidance. Changed to 'speculative' throughout.
David Cooper	6	10	60	11	71	This message, especially sentence lines 63-66, should be refelcted in SPM and KM and in ES of Chapter 2	We think this belongs in chapter 6.
Noa Simon Delso	6	10	60	11	71	In this paragraph it is missing a recommendation to improve the assessment of the implementation of the pesticide or GMO legislations in place. For example, it is well established that user training and labelling help to improve pesticide use but, what is the degree of implementation in practice of training and labelling? How many users really read what is said in the labell? Taking into consideration the residues found in bees and bees' food or in water, one could think that in certain regions, the level of practical implementation is rather low.	This is partly, but not fully, covered by the reference to the extension of monitoring which would improve the understanding of the scale of risk to pollinators and the pollination service. Changed summary to include follow up monitoring of compliance “A more complete understanding of pesticide and GMO impacts on pollinators and pollination will be achieved if environmental monitoring is extended to include impacts on wild and managed pollinators, as well as pesticide users' compliance to use regulations and best practice recommendations and training”
Ahmad Mahdavi	6	10	62	10	62	Completely different situation for Developing countries, in most developing countries no regulations and absolutely no enforcement and we should note that developing countries constitute most land of the planet and most are situated in warmer areas with more possibility for insect pollinator survival, speciation, etc.	These differences are accounted for under 6.4.2.2.1.

						but unregulated use of pesticides/ other chemicals destroys all these possibilities...	
Noa Simon Delso	6	10	63	10	63	“this policy” refers to which policy?	Now specified.
Peter Campbell	6	10	63	10	66	This sentence that assessing risk to pollinators is assessed for pesticides only by looking at honey bee, rats and game birds is wrong. For example in Europe and in some countries in Asia non-target arthropods/insect species are also tested as standard. For Europe at least 4 non-target arthropod/insects species are tested as standard for all pesticides. For insecticides more often than not, full field trials are conducted, which investigate effects on all non-target arthropods/insects present in/around the field at the time of application (Society for Environmental Toxicology and Chemistry (SETAC): European Standard Characteristics of Non-Target Arthropod Regulatory Testing (ESCORT 2).	Correct. The respective sentence has been deleted.
UK Government	6	10	66	11	68	The 'management of herbicide tolerant crops' relates to the use of associated herbicides. The report's conclusion that the impact of herbicide management regimes on the environment/ biodiversity should be improved in GMO assessments suggests that herbicide use should be assessed/ regulated differently depending on whether the herbicide will be used with a GM or non GM crop (including non GM herbicide tolerant crops). This is contentious and as such, the report needs to explain/ argue why a different set of criteria or additional criteria are required for herbicide use with a GM crop. It is also worth noting that the comparative approach used in GMO assessments (rather than the use of threshold values in plant protection legislation) causes difficulties. Using two pieces of legislation to control herbicide use is also likely to be problematic, particularly in implementing risk management	I agree and deleted the sentence

						measures. Again, assessing herbicide use using GMO (as well as plant protection products legislation?)	
Ahmad Mahdavi	6	10	68	10	68	Different situation in developing countries with increasing day by day GM cropping and no regulations.	These differences are accounted for under 6.4.2.2.1.
UK Government	6	10	68	11	71	The rationale for extending existing monitoring is not clear. Existing surveillance of pollinator species is carried out in the UK because it is important; this would not change because GM crops are grown. If the suggestion is to carry out specific studies post-authorisation, this is a different proposition. The EU legislation requires such studies where there is a potential link between the characteristics of a GM crop and an adverse environmental impact, which could not be fully tested in the ERA. It is important to define the risk hypothesis behind such studies so that experiments can be designed that generate sufficient power to detect any change in a reasonable timeframe. It is extremely difficult to link changes detected through existing surveillance networks to particular stressor(s) in the environment. This is explained in EFSA's Scientific Opinion on the use of existing environmental surveillance networks to support the post-market environmental monitoring of genetically modified plants. EFSA Journal 2014;12(11):3883 [24 pp.].	Extension of monitoring would improve our understanding of the impact of various stressors and would make the available data basis more robust in rather general terms. Sentence adapted accordingly.

Noa Simon Delso	6	10	73	11	81	This paragraph lacks any reference to animal production. There are veterinary products that are highly toxic to pollinators. Again the reduction of the exposure to those is key to avoid pollinator losses and again the principles of IPM can be applied to animal production: pathogen/parasite monitoring, ensure hygiene, diversified food, favour zootechnical measures rather than chemical ones, etc.	Is this covered in the relevant section? No evidence supplied so could ignore. This is addressed in 6.4.4.1.4. Is this covered in the relevant section? No evidence supplied so could ignore.
Ahmad Mahdavi	6	10	585	10	585	Volatile compounds from plants attract insects from long distances, chemical ecology in-depth studies and better understanding of insect sensory organs are the way of future to improve plant-pollinators studies.	Not very relevant? Thank you for your comment but there is no evidence to support this statement. Not very relevant?
Ahmad Mahdavi	6	10	587	10	587	Plant-insect coevolution has been going for hundreds of million years and so better and in depth understanding about these gen by gen coevolution will help a lot to better management of pollinators, we have to go to more deep chemical and biochemical interactions between plants and pollinators and also plant pests, this will help a lot if a pesticide is also present (we showed that feeding on some plants increase plant resistance to pests and pest resistance to pesticides (Mahdavi et al. 1991).	Thank you for your comment, but we can see no connection between the highlighted text and the comment, so we are unable to respond appropriately.
Ahmad Mahdavi	6	10	595	10	595	One very important fact about insects is that: their evolution took place in terrestrial system, there are some aquatic insects but most orders are evolved in land and because of this they developed sophisticated systems to conserve water, resistance... ..and many insects coevolved with plants so that there are lots of similarities and a lot biochemical interaction for their enzymes, as I mentioned above going to these depths will help a lot to better understanding of pollinators....	seems irrelevant. Thank you for your comment, but we can see no connection between the highlighted text and the comment, so we are unable to respond appropriately. Seems irrelevant.
Les Davies	6	10	64			Use of rats and game birds as models for pollinator risk assessment??	In some parts of the world, birds and mammals are pollinators, so these are the relevant model organisms. In some parts of the world, birds and mammals are pollinators, so these are the relevant model organisms.

Thomas Steeger	6	10	62	10	64	North American and European risk assessment schemes include larval bee toxicity tests, a range of mammals (rats, mice, hamsters, rabbits) and birds (water fowl, upland game birds, passerines) and fish (coldwater and warmwater) all of which are responsive to actual data requirements; however, the assessments also consider studies reported in the open literature which may evaluate a much broader range of species across taxa. Whole colony testing , also required by regulatory authorities consider all life stages/castes. Chronic toxicity tests for other taxa also typically evaluate responses to pesticide exposure across multiple life stages. As such, this summary statement regarding the risk assessment process is relatively parochial and misleading.	Correct. The respective sentence has been deleted.
Ahmad Mahdavi	6	11	71	11	71	In most developing countries doing a proper/ correct and safe risk assessment is a myth, one important difference is number of active NGOs and support of UN agencies for them in developing countries and this need ro be changed soon.	These differences are accounted for under 6.4.2.2.1.
David Cooper	6	11	73	11	80	Appears to be a mismatch between the bold statement and the main text of the para. Perhaps the first non-bold sentacen should be bold statement?	Agree. Bold statement is about reducing exposure, and the rest is about reducing overall use. I have swapped the bold statement. Agree. Bold statement is about reducing exposure, and the rest is about reducing overall use.

Emily Marquez	6	11	73	11	74	<p>Technologies that reduce pesticide drift do not eliminate all aspects of pesticide drift. Incidents of pesticide drift occur every year, and a number of those cases are not always due to applicator error. Pesticide drift cases are frequently underreported and as a result are difficult to study, but one example is referenced here, a study of cases of drift that resulted in human illness (Lee et al. 2011). In addition, a summary of public record from Practical Farmers of Iowa documents spray drift case files as reported to Iowa Dept. of Agriculture and Land Stewardship, with cases of drift reported from 2008-2012 is cited here (PFI, 2013). Application practices should not be the first idea promoted here to reduce exposure of pollinators, because this approach does not actually reduce usage of pesticides. Reduction of use by reliance on integrated pest management, with pesticides used as a last resort, would reduce how much pesticide is used and thus how much pesticide a pollinator is exposed to. Technological solutions to reduce drift are not sufficient, given that post-application, pesticide residues can persist in the environment (Jones et al 2014).</p>	<p>Lee, Soo-Jeong, Louise Mehler, John Beckman, Brienne Diebolt-Brown, Joanne Prado, Michelle Lackovic, Justin Waltz, et al. "Acute Pesticide Illnesses Associated with Off-Target Pesticide Drift from Agricultural Applications: 11 States, 1998–2006." <i>Environmental Health Perspectives</i> 119, no. 8 (June 6, 2011): 1162–69. doi:10.1289/ehp.1002843; Practical Farmers of Iowa. "Summary of Public Record: IDALS Pesticide Bureau Case Files for Alleged Spray Drift to Organic, Fruits and Vegetables, and Horticulture. 2008-2012." Iowa, USA, 2013.; Jones, Ainsley, Paul Harrington, and Gordon Turnbull. "Neonicotinoid Concentrations in Arable Soils after Seed Treatment Applications in Preceding Years: Neonicotinoid Concentrations in Arable Soil." <i>Pest Management Science</i>, July 2014, n/a – n/a. doi:10.1002/ps.3836. Check references. Summary paragraph will be changed to make sentence 2 the bold statement. Check references. Summary paragraph will be changed to make sentence 2 the bold statement. Lee, Soo-Jeong, Louise Mehler, John Beckman, Brienne Diebolt-Brown, Joanne Prado, Michelle Lackovic, Justin Waltz, et al. "Acute Pesticide Illnesses Associated with Off-Target Pesticide Drift from Agricultural Applications: 11 States, 1998–2006." <i>Environmental Health Perspectives</i> 119, no. 8 (June 6, 2011): 1162–69. doi:10.1289/ehp.1002843; Practical Farmers of Iowa. "Summary of Public Record: IDALS Pesticide Bureau Case Files for Alleged Spray Drift to Organic, Fruits and Vegetables, and Horticulture. 2008-2012." Iowa, USA, 2013.; Jones, Ainsley, Paul Harrington, and Gordon Turnbull. "Neonicotinoid Concentrations in Arable Soils after Seed Treatment Applications in Preceding Years: Neonicotinoid Concentrations in Arable Soil." <i>Pest Management Science</i>, July 2014, n/a – n/a. doi:10.1002/ps.3836.</p>
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Ahmad Mahdavi	6	11	74	11	74	One very important issue that is not mentioned here is substituting dangerous synthetic pesticide with natural products and biopesticides. I am working on the neem tree in the Persian Gulf area, this is the species with high promises of pest control and it is well tailored for developing countries. We have to revive and develop natural pyrethrins and there are many other pesticidal plants/ animals and devices that need more work, in fact we have to start to think that conventional pesticides are the story of past and need to work and develop alternatives. Aerial spraying with wide drift must be stopped globally...	Could add something to main text? Biopesticides and "natural products" are not a priori less toxic to pollinators than synthetic products and need to go through risk-assessment. Could add something to main text?
Ahmad Mahdavi	6	11	76	11	76	But little practice & no enforcement of proper IPM in developing countries under pressure of pesticide corporations, pesticide mafias....etc.	For main text, not summary. Thank you for your comment. The positive feedback is greatly appreciated by the chapter authors. For main text, not summary.
Ahmad Mahdavi	6	11	78	11	78	We have to take into consideration that now other than some 1000s or 10000s pesticides (including biocides) we are facing with millions of different toxic chemicals and their metabolites finding their ways in all niches and habitats with high possibility of synergism between them, when they are already found in all human embryos (average of 30) all over the planet why not to be discovered in all bees embryos!?	These issues are covered in the main text (e.g. line 814). Is synergy between chemicals also mentioned? These issues are covered in the main text. These issues are covered in the main text (e.g. line 814). Is synergy between chemicals also mentioned?
Ahmad Mahdavi	6	11	80	11	80	Need immediate action for developing and in particular Middle Eastern countries for these training and education, Also the matter of pollinators in ever increasing city farming systems around cities.....must be considered. We better go to the basics of applied ecology to solve many of these IPM related problems, considering new beautiful sciences of chemical ecology, biochemical ecology, allelopathy etc. and now there are no knowledge about these sciences in many developing countries.	Thanks for this comment. The assessment report is mandated to provide policy-relevant information, not policy recommendations, so we would not be able to make the recommendation suggested.
Noa Simon Delso	6	11	83	11	87	These native vegetation patches ideally are interconnected.	We do not know of evidence that supports this for pollinators, and you have not supplied it. CHECK. Text on connectivity has been added. We do not

							know of evidence that supports this for pollinators, and you have not supplied it. CHECK.
Ahmad Mahdavi	6	11	93	11	93	What about small land owners? This method is the best for family farms	This level of detail is too great to be included in the summary section.
David Aston	6	11	95			Not all invasive species have a negative impact on pollinators, e.g. <i>Impatiens glandulifera</i> G39	Mentioned in main text? Mentioned in main text?
David Cooper	6	11	95	11	97	Is there any evidence or prospect for the use of biocontrol against invasive species?	There is little evidence available regarding the effectiveness or otherwise of this approach and so it has not been highlighted in the report.
Kimiko Okabe	6	11	95	11	7	I do not understand logic of these sentences.	This text has been re-written and is now more clear.
Ahmad Mahdavi	6	11	96	11	96	Eradication of any species might be possible in a very small area but always very difficult, the term "ERADICATION" is not an acceptable term in IPM system and is not allowed and not possible	This issue is addressed in the body of the report, but was considered too detailed to warrant a place in the executive summary.
Thomas Brooks	6	11	96	11	96	Add text to read "...on mitigating their impact and preventing new invasions...", to ensure consistency on this important point with Chapter 6 (page 38, lines 1255-1257).	The text has been edited in accordance with this recommendation
Kimiko Okabe	6	11	99	12	105	Japan has Invasive Alien Species Act, in which domestic transportation of <i>Bombus terrestris</i> is strongly restricted (https://www.env.go.jp/en/nature/as.html). Also, the same comment for 6.4.4.2. There is no distinctive conclusion -too broad- in this part.	Text regarding Japan's Invasive species act has now been added to section 6.4.3.2. The authors believe it is important to highlight the evidence that restricted trade in managed pollinators can be an effective tool in managing the risk of invasion and pathogen spread, so the text has been retained (with edits) in the executive summary.
Noa Simon Delso	6	11	99	12	105	This is positive, but please do not forget that pollinator predators can also be introduced via international trade of fruit, plants, or other goods. Furthermore, there is a market of wild pollinators, even more deregulated than that of managed pollinators. I would modify this paragraph by proposing a strong need for better regulation of trade in any goods possibly spreading parasites and pathogens of pollinators.	done (both in exec summary and also added mention of this to 6.4.4.2 LEGAL RESPONSES
Ahmad Mahdavi	6	11	101	11	101	Developing more scientifically safe quarantine methods, laws and regulations to be used/ acted in boundaries are needed	we feel that this is covered adequately in the summary for policy makers

Ahmad Mahdavi	6	11	603	11	603	Different insect traps (not killing traps) and in particular chemical traps are good for monitoring, we tested lots of chemical traps in the past, they also will help for understanding insect chemical communications that is a key factor for these studies...	Thank you for your comment. We aware that there are many short-term monitoring of pollinators around the world but what we are mentioning is that there is a lack of national programs of systematic long-term monitoring of pollinators
Ahmad Mahdavi	6	11	607	11	607	Considering high diversity of plants and insects in the big land of Iran and that many years of no such studies because of sanctions etc., I love to do a study in Iran.	Thanks for this comment. There is clearly a need for better pollinator monitoring in many parts of the world. This is highlighted here and in chapter 3. Thanks for this comment. There is clearly a need for better pollinator monitoring in many parts of the world. This is highlighted here and in chapter 3. Thanks for this comment. There is clearly a need for better pollinator monitoring in many parts of the world. This is highlighted here and in chapter 3.
Les Davies	6	11	99			See comments at 26-27 (above)	comment 32comment 32It is unclear what this refers to and as such it is hard to know what, if any, action to take
Thomas Steeger	6	11	69	11	69	monitoring studies also have inherent limitation which should be acknowledged (e.g., limited reference sites and similar to field toxicity studies, they can be subject to a wide range of confounding factors).	All approaches (studies as well as monitoring) have their specific limitations and shortcomings and advantages. Unfortunately, the space limit does not allow us to address these in detail
Ahmad Mahdavi	6	12	104	12	104	There are strict and carefully defined regulations for import/ export of any species between different countries and unfortunately they are not followed in most developing countries, this is because of lack of enough knowledge/ lack of organization and proper infrastructures and so stops/ prevent such beneficial species movements between countries...	This is an excellent point but is a very general one related to a very broad range of policies in the developing world (and even in some cases in the developed world), and thus we feel like it is beyond the scope of the executive summary to include

Ahmad Mahdavi	6	12	115	12	115	Bees including honey bees as the most important group of pollinators are the most evolved/ coevolved insects, their evolution happened only during the past 70 million years (as compared to many insect orders evolving since about 350 years ago...) and this is very important when we talk/ act for their genetic diversity/ improvements/ selection etc. For movement between countries, many aspects must be taken into considerations....	Thanks for the comment. We do not quite see the relevance of the evolutionary age of bees. We have discussed the importance of genetic diversity, especially in the Hymenoptera which are particularly at risk of inbreeding depression due to haplodiploidy (section 6.4.1.1.3) Thanks for the comment. We do not quite see the relevance of the evolutionary age of bees. We have discussed the importance of genetic diversity, especially in the Hymenoptera which are particularly at risk of inbreeding depression due to haplodiploidy. CHECK THIS. Thanks for the comment. We do not quite see the relevance of the evolutionary age of bees. We have discussed the importance of genetic diversity, especially in the Hymenoptera which are particularly at risk of inbreeding depression due to haplodiploidy. CHECK THIS.
David Cooper	6	12	119	11	121	this clause whoudl become the bold statement for this paragraph	We have edited this paragraph substantially and this point is reflected in the new version
Ahmad Mahdavi	6	12	122	12	122	Insects and in particular bees evolved a very different sophisticated sensory system beyond our imagination and even beyond our recent knowledge and these make the situation very complicated. Insect pollinators communicate with plants from long distances before visiting.....	Thanks for the comment. We do not quite see the relevance to the text highlighted. Thanks for the comment. We do not quite see the relevance to the text highlighted. Thanks for the comment. We do not quite see the relevance to the text highlighted.
David Cooper	6	12	125	12	135	Suggest to combine these two paragaphs	OK. We have combined the two paragraphs. OK.
Jeff Ollerton	6	12	125	12	128	Although it's true that active management of urban spaces for pollinators can have a positive impact on those pollinators, it should be mentioned somewhere that urban areas typically only comprise a small proporiton of the land area of a country (in UK it's about 6% I believe) and so this could never be a substitute for action in the wider agricultural landscape (about 70% of the UK).	Agree with this - link with chapter 2. This is explained in chapter 2 Agree with this - link with chapter 2.
UK Government	6	12	125	12	128	Although it's true that active management of urban spaces for pollinators can have a positive impact on those pollinators, it should be mentioned somewhere that urban areas typically only comprise a small proportion of the land area of a country and so this could	Same as comment 98 This is explained in chapter 2 Same as comment 98

						never be a substitute for action in the wider agricultural landscape.	
Ahmad Mahdavi	6	12	134	12	134	High Noise pollution around roads and railway banks may prevent this, in Northern Iran with dense insect population there are millions of insects killed by each car front windows every day.....	Are potential negative impacts of using roads considered in main text (I think so)? That is an impact covered by chapter 2 (impacts) and not chapter 6 (responses). However, I have read only one paper estimating road kill of bumble bees in Belgium concluding no significant effect at the population level. Are potential negative impacts of using roads considered in main text (I think so)?
Claire Kremen	6	12	134			what about the role of mortality from roadkill?	Are potential negative impacts of using roads considered in main text (I think so)? That is an impact covered by chapter 2 (impacts) and not chapter 6 (responses). However, I have read only one paper estimating road kill of bumble bees in Belgium concluding no significant effect at the population level. Are potential negative impacts of using roads considered in main text (I think so)?
Les Davies	6	12	134			metal contamination?	Not clear what is meant in this comment
German Government	6	13	138	13	139	Insert the bold words: " can guide research agendas, lead to important research outcomes and ... "	We did not insert this text because this statement makes the point that they can lead to outcomes, rather than listing everything strategic initiatives might achieve.
Ahmad Mahdavi	6	13	141	13	141	What I recommend is wide research in the World about insect plant interactions and coevolution, we need to do further research on insect sensory tactiles, chemical sensory receptors....etc this is a beautiful story of nature.	This kind of basic research on pollinators is greatly needed, but is not reviewed in this chapter. Thanks for this suggestion. CHECK - is there something on basic insect ecology and evolution in the knowledge gaps?
Ahmad Mahdavi	6	13	146	13	146	Again we have to point in lack of enough education relevant to natural issues in developing countries and in particular in Middle Eastern, when we compare a Western radio eg. CBC, a large amount of talks belong to insects, nature.....but what you here in Middle Eastern radios are only politics and religion...	We do not have time or resources to do a full global review of education provision on pollinators, so it is difficult to make this point specifically. Check whether any Middle Eastern examples.
Ahmad Mahdavi	6	13	148	13	148	Surely more work must be done for education in developing countries, eg; Iran as a very diverse country for any aspects of diversity has great potential for development of more/ better	We do not have time or resources to do a full global review of education provision on pollinators, so it is difficult to make this point specifically.

						pollinators to be used inside and outside the country.	
Ahmad Mahdavi	6	13	153	13	153	There are already supporting evidence about use of Neonicotinoid insecticides and CCD. CCD is very related to pollinators and their populations so at first we should define and enforce pesticide/ chemicals regulatory systems particularly for developing countries, I will discuss about this issue in detail in other parts.....	Our assessment of evidence on the impacts of neonics is in chapter 2.
David Cooper	6	13	157	13	158	and butterflyfiles?	This text has been edited out in the third draft. Add Butterfly Monitoring protocol.
David Aston	6	13	158			Which aspects could be monitored?	This is described in the relevant section. Abundance and diversity.
David Aston	6	13	154			Registration of beekeepers on BeeBase in the UK is still voluntary, not compulsory	This text has been edited out in the third draft. Check main text.
Rebecca Chaplin-Kramer	6	14	173	14	186	This one seems quite a bit longer and more nuanced and detailed than any of the other paragraphs. Maybe reduce for symmetry?	This paragraph has been revised.
Noa Simon Delso	6	14	175	14	180	This example is wrong and I would recommend reconsidering its inclusion here. The precautionary approach was applied because there were new scientific evidence showing that the approval criteria (Art. 4) were no longer met (see Art. 21 of Regulation 1107/2009). Uncertainty about exposure data of wild pollinators or lack of understanding of the effect on bees of different multistressors existed already for many years (scientific references available under request), without the precautionary principle being applied. In this case, decision makers applied the law, because as previously mentioned, the approval criteria were no longer met. The main source of uncertainty was the industry producing pesticide products containing these active ingredients, who had an interest in the existance of this uncertainty. These companies and their representatives shifted the relevant question to one that favour the existance of uncertainty. The legal framework says that	This example has been removed. Not sure what this is asking for.

						pesticides can be in the market if they are, among others, safe to the environment. Therefore the question the regulation needs to answer is: are the approved pesticides damaging, among others, bees? The legal framework does not aim to give answer to the question: are neonicotinoids the reason of pollinators decline?. I hope that with this explanation the authors can appreciate the difference in the approach.	
Peter Campbell	6	14	175	14	180	There is no evidence that EU Policy makers took any of the uncertainites listed in this text into consideration when they restricted the neonics? Ie where is the reference to support this statement. It is our understanding that the Neonics were restricted by EC in light of the evaluation conducted by EFSA which used a completely new and untested standard of regulatory testing, which Member State countries continue to be unable to agree on or adopt, 2 years after it was first published in the EFSA Bee Guidance Document.	This example has been removed.
Noa Simon Delso	6	14	176	14	176	temporarily restriction on neonicotinoids was in 2013.	Note from Christian: The restrictions came into force in 2013, the text should be adapted accordingly. However, the restrictions are NOT "temporary". Corrected check
Ahmad Mahdavi	6	14	177	14	177	There are now enough supporting evidence about effects of neonics on bees and birds, many references. Pesticides are designed to kill and very sophisticated killing pesticides like neonics should not be allowed to be used in any natural environment considering the already threatened situation by different chemicals.	Not sure what is asked for.
David Cooper	6	14	186	14	186	insert at end: "... to specific local conditions"	This text has been edited out in the third draft.
David Cooper	6	14	188	14	188	insert after trad-offs, "..and synergies..."	Done

German Government	6	14	188	14	190	<p>"..., <i>organic farming</i> ..., but usually results in lower food production at local scale". This assumption and this section altogether might not cover all facets of organic farming and also not cover e.g. issues regarding climate smart agriculture. We strongly encourage you to provide more information on the existing alternative farming systems and the opportunities for pollinators. This section of the report will clearly benefit from more substance.</p> <p>Bearing also in mind the global demographic trends and the growing demand for food, it strikes ironically that often vegetable crops are not harvested due to their failure to meet retailers'/consumers' standards. Also, a good portion of the food is thrown away by consumers or is lost due to suboptimal storage. We invite the authors to briefly sketch such trends as well in terms of a more <u>holistic approach</u>, and their possible implications for discussing pollinator-related responses across sectors to support more broad policy discussions/initiatives (see for also chapter 6, lines 522-524, page 32).</p>	A very detailed consideration of yield effects of organic farming is beyond the scope of this report, although we have tried to cover the literature and include this as far as possible.
Rebecca Chaplin-Kramer	6	14	188	14	194	<p>This is a strange argument to make; it's making the linkage between greater pollination in lower yielding systems again that I didn't like above (p 10 : 35-38) and this time it's even more confusing because on the one hand it's framed as a trade-off between pollination and yields but on the other yields may be reliant on pollination. I think a better trade-off would be that the same foraging resources that attract pollinators could also attract pests (especially lepidopteran). And that trade-off could be turned into a synergy if it turns out pollinators and pests are responding to slightly different resources and the habitat can be managed accordingly.</p>	We have retained the organic farming/yield example, although clarified it somehow. We think it is important to consider, given the clear benefits of organic farming to pollinators.
David Aston	6	14	190			Is synergy right in this context?	We have changed the wording.

Thomas Steeger	6	14	175	14	178	Do these uncertainties only pertain to neonicotinoids? If not, should similar restrictions be placed on pyrethroids, organophosphates, carbamates, conazole and strobularin fungicides, triazine and sulfonyl urea herbicides . . .? These are important questions that must be evaluated by regulatory authorities when determining whether older chemistries represent a risk to a broader number of taxa than newer chemistries where effects/uncertainties may be limited to a select few.	This example has been removed.
Claire Kremen	6	15	203	15	215	this seems like a good organization; thanks for the summary of it here	Thank you for this comment. Thank you for this comment.
Noa Simon Delso	6	15	204	15	205	why are pesticides separated from agriculture? Pesticides are tools used in agriculture, mainly, unless in the pesticides also other uses are included like urban gardens, forests, etc. Is this the case?	Pesticides are separated from agriculture because they are usually treated as different policy areas. We have clarified in the text. Pesticides are separated from agriculture because they are usually treated as different policy areas. We have clarified in the text.
Noa Simon Delso	6	15	205	15	205	beekeeping belongs to pollinator management	It is indeed in the same section. It is specified here because it is usually for a different purpose than pollination - honey production. It is indeed in the same section. It is specified here because it is usually for a different purpose than pollination - honey production.
Claire Kremen	6	15	219			"complex and much discussed" doesn't say much	This is an indication that there is a huge amount of literature here that we are not going to attempt to describe. I think it's fairly clear.
Noa Simon Delso	6	15	222	15	222	I would include "economy" on the list	done
Ahmad Mahdavi	6	15	731	15	731	For developing countries situated in arid dry land countries like Middle Eastern countries needs different natural and social methods to be practiced and followed. We need more work and education to be initiated in these countries, in most of them still no crop insurance, not enough knowledge..etc	You do not provide any supporting evidence that the social and behavioural responses required in arid developing countries are fundamentally different in some way, so we have not changed the text.
Ahmad Mahdavi	6	15	741	15	741	Farm field schools are a good method for these types of education. Recently there are good programs going in Northern Iran by the Caspian between farmers and educators of	Farmer field schools are mentioned in this section. You do not provide supporting evidence for the other suggestions. Cross reference to section 6.4.4.1

						agricultural organizations, but the big problems in all developing countries and in particular Middle Eastern countries are lack of enough active NGOs and community workers to help for these types of work.	
Thomas Steeger	6	15	204	15	207	consider: "the sectors, presented in Section 6.4.6 include:" then bullet out each of the sectors	I prefer not to make this stylistic change.
Thomas Steeger	6	15	219	15	219	for consistency sake, replace "for example" with "e.g.,"	an issue of style will be edited with the whole document.
Thomas Steeger	6	15	221	15	222	it's uncertain whether "politics" differs from "power"; recommend deleting "power" or using "economics"	done
Thomas Steeger	6	15	248	15	249	Each of the organizations/meetings listed should be referenced.	web links added.
Thomas Steeger	6	15	250	15	250	Define "Aichi"	This is the name of a place where targets were agreed. Reference is provided. I do not think it needs defining.
Thomas Steeger	6	15	253	15	253	are "particularly relevant" to what?	added "to pollinators and pollination"
German Government	6	16	248	16	251	We appreciate the consideration of ongoing international initiatives (e.g. SDGs, Aichi targets) as means to mainstream the issue of pollinators/pollination.	Thank you for this comment. Thank you for this comment.
Thomas Steeger	6	16	259	16	259	delete second period after "incorporated." It may be worth while to note that while local stakeholders can be an effective force if suitably organized, there are national-level stakeholders whose influence on economics/politics can dictate policy cycles.	Here the word 'local' means local at the relevant scale, which could be national.it may be worthwhile to note that while local stakeholders can be an effective force if suitably organized, there are national-level stakeholders whose influence on economics/politics can dictate policy cycles.
Rebecca Chaplin-Kramer	6	17	254	17	279	Figure 1 - I don't find this particularly helpful. It was interesting in the text to say the type of science from which chapter entered into which part of the process, and that could be shown as arrows of different science questions feeding into each step. Also - as this does not just apply to policy or decisions concerning pollination, I'm assuming this is linked to something broader for IPBES? Can that linkage be made more clear?	Thanks. We will consider your suggestion when re-drawing the figure with our graphic artist.

Peter Campbell	6	18	261	23	280	It should be made clear that this is a <u>Conceptual</u> risk analysis. In table 6.2.1 What would be useful is referencing the current scientific / data evidence base that supports each of the listed potential impacts. It would be good to be able to identify risks supported by real evidence from hypothetical risks based on personal opinions of authors.	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report. Think we should try to do this, with section numbers from the whole report.
Noa Simon Delso	6	19	278	20	280	Table 6.2.1. To be added in POTENTIAL IMPACTS AND OPPORTUNITIES – apitherapy (health treatments based on bee products) is not just a resource for research, but a market and part of our cultural heritage. Beekeeping products, like wax, also have technological uses. Pollinators (including managed ones, not just wild pollinators) are a source of inspiration, aside the aesthetic value, happiness or well-ness. There are a number of scientific technological inventions inspired in the bee biology (e.g. Development of visual guided flight robotics (Srinivasan MV (2011) Honeybees as a Model for the Study of Visually Guided Flight, Navigation, and Biologically Inspired Robotics. <i>Physiol Rev</i> 91: 413–460. doi:10.1152/physrev.00005.2010.)) Please consider these points as well in the table.	The wording of each impact was agreed by the whole group of authors, and the risk was evaluated on this basis, so we cannot change it. Apitherapy products are captured in 'fall in honey production (and other hive products), OR 'loss of distinctive ways of life and cultural practices', depending on the nature of the market or practice.
Noa Simon Delso	6	19	278	20	280	Table 6.2.1 Direct impacts on food production – Reduce availability of managed pollinators. This statement could be completed by adding “and increased honeybee disorders” (Kluser S, Peduzzi P (2007) Global pollinator decline: a literature review. UNEP/ GRID- Europe. β UNEP 2007. Switzerland.; Maxim L, van der Sluijs JP (2010) Expert explanations of honeybee losses in areas of extensive agriculture in France: Gaucho H compared with other supposed causal factors. <i>Environ Res Lett</i> 5: 014006. doi:10.1088/1748-9326/5/1/014006; vanEngelsdorp D, Meixner MD (2010) A historical review of managed honey bee populations in Europe and the United	The wording of each impact was agreed by the whole group of authors, and the risk was evaluated on this basis, so we cannot change it.

						States and the factors that may affect them. J Invertebr Pathol 103: S80–S95; Simon-Delso N, San Martin G, Bruneau E, Minsart L-A, Mouret C, et al. (2014) Honeybee Colony Disorder in Crop Areas: The Role of Pesticides and Viruses. PLoS ONE 9(7): e103073. doi:10.1371/journal.pone.0103073)	
Thomas Brooks	6	19	279	20	280	The use of the term "biocultural diversity" (simultaneous biological and cultural diversity) is not very appropriate, the three places it is used in Table 6.2.1. Change it to "biodiversity and its benefits to people" or something similar.	The use of this term has been agreed by the CLAs. It is defined and used extensively in chapter 5, including in the title.
Ahmad Mahdavi	6	19	762	19	762	This is what needed in most developing countries where there are lots of educated people but no relationship between them and farmers, we have to create a system like Farmer field schools to engage agrienvironmental educated people in helping farmers.	Thank you for your comment. The positive feedback is greatly appreciated by the chapter authors.
UK Government	6	19	Table 6.2.1	19	Table 6.2.1	Table 6.2.1: Suggest include possible changes in areas and proportions of different crops available as farmers could switch crops due to yield instability	This is captured by 'price changes and changes in demand, in response to yield changes'
Thomas Steeger	6	19	279	19	279	Delete space after "natural ecosystems" in second row of left column	done
Adolfo Pérez Piñeiro	6	20	279	20	280	Loss of knowledge about interaction pollinators-plants in pollination activity.	Sorry it is not clear what is meant here, and there is no reference or explanation provided. Sorry it is not clear what is meant here, and there is no reference or explanation provided.
Adolfo Pérez Piñeiro	6	20	279	20	280	Maintenance of pollinators as indicators of potential biological active substances as result of coevolution with pollinated plants.	Sorry it is not clear what is meant here, and there is no reference or explanation provided. Sorry it is not clear what is meant here, and there is no reference or explanation provided.
Adolfo Pérez Piñeiro	6	20	279	20	280	Loose of species as result of looses of specific pollinators	This is covered - loss of plant and wild pollinator diversity. This is covered - loss of plant and wild pollinator diversity.

Diane Castle	6	20	280	20	282	A qualitative summary of the probability and scale of impact for the direct drivers based on individual consultation with the authors does not seem to be a robust mechanism to underpin major policy advice. In addition any evidence based drivers used to set policy and resulting practical interventions should be subject to rigorous quantification in relation to pollination services with the associated the costs and effectiveness	Thanks for this comment. The treatment of risk has changed substantially. Rigorous quantification of relative costs and effectiveness of interventions for pollinators and pollination are not yet available at this global, or even regional scale. We feel that expert assessment of probability and impact based on the available evidence (as presented in draft 2) is an extremely valid approach, BUT we have withdrawn it from the report because the timing did not allow us to complete it with satisfactory and transparent links to the final contents of the report. Such an exercise needs to be completed in a workshop following the final draft of the report.
Ahmad Mahdavi	6	20	764	20	764	What I recommend to be substituted title is: Pesticides, chemicals....we need to include the term "chemicals" because now the problem of toxic pollution in farming is too much wider than only pesticides, like fertilizers, plant growth regulators, many more....	Pollutants is a wider term that include chemicals and we therefore keep this title.
Ahmad Mahdavi	6	20	771	20	771	Disagree for this definition for pesticides: instead must be:controlling insect pests.....	The term "pesticides" also includes herbicides, fungicides, etc., and not only insecticides.
Ahmad Mahdavi	6	20	776	20	776	The sentence is not correct: instead we have to write: and the exposure of pollinators to compound(s). Exposure is from the side of life "to" not from the chemical compound.	I agree with this change. I agree with this change. Text adapted accordingly. I agree with this change.
Ahmad Mahdavi	6	20	777	20	777	But unfortunately in many developing countries they do not perform separate risk assessment and accept the information provided by the company! or at most information provided by agencies in developed World like EPA, etc.	Mutual recognition of risk assessments from other countries are not specific to developing countries. In the text we clearly highlight the enormous variation in regulation among countries.
Ahmad Mahdavi	6	20	781	20	781	Should be added: but ecotoxicological tests are rarely done in most developing countries. As we are all aware there are big regulatory problems with most pesticide in most developing countries.	In the text we clearly highlight the enormous variation in regulation among countries, and different options and examples to improve regulation in countries with poor regulation.
Ahmad Mahdavi	6	20	783	20	783	Chronic toxicity testings? We need this for important creatures like bees.	Testing methods for evaluation chronic toxicity of pesticides to bees are available as described in the text.

Ahmad Mahdavi	6	20	788	20	788	In toxicity testing one important factor to be taken into consideration is heterogeneity/ homogeneity of the population under test and these are different in different species and even different strains of each population and so for very important (and may be very sensitive/ susceptible) insects like pollinators each bioassay must be conducted separately for separate species and strains...	In order to overcome potential issues with sensitivity differences between different strains, test methods are normally ring-tested before implementation, to make sure that test results are reproducible in spite of potential intraspecific variability. It is impossible to make risk assessments separately for all exposed species. Interspecies variability is covered by the use of extrapolation factors or by the choice of particularly sensitive species as surrogate test organisms. These problem are addressed in the assessment
Ahmad Mahdavi	6	20	789	20	789	Unfortunately these are methodologies of the past century and most are not and should not be accepted in our very scientifically sophisticated and on the other hand very polluted recent century. How we can accept LD50s of a compound found for rats, for very sensitive and very in dangered species like bird many of them on the top of the food chain and web? I as a member of CMS poisoning group would like to make some new procedure/ definitions for these types of exposure/ toxicity testing. Doing a scientifically safe bioassay for toxicity testing is another problem.	As is mentioned in the text, these methods are under constant scrutiny and development. Here we present the state-of-the-art for that research
Marina Rosales Benites de Franco	6	20		20		Table. Opportunities: I suggest to include:Restore degraded habitats to improve pollinators conservation and its ecosystem services, giving enhanced structure, and functions communities.	This statement is a combination of many things, and is covered by four opportunities already in the table: 'Improved conditions and habitats for other species' ; 'Maintenance of wild pollinator diversity' ; 'Improved or more stable yield' AND 'enhancement of other ecosystem services' 'This statement is a combination of many things, and is covered by four opportunities already in the table: 'Improved conditions and habitats for other species' ; 'Maintenance of wild pollinator diversity' ; 'Improved or more stable yield' AND 'enhancement of other ecosystem services'

Rebecca Chaplin-Kramer	6	21	286	21	300	This seems like it could just go in a figure legend. What I was hoping for that is missing from the table itself is an explanation of WHY certain regions are high risk (high probability + high impact). Even if this is treated in more detail in other chapters, it would be great as a summary here to provide example narratives for a few of the red boxes, like Asia Pacific for loss of wild pollinator diversity or Latin America for loss of distinctive ways of life/cultural practices, etc., with text explaining or even just hypothesizing why this region has a high probability of this occurring and a high magnitude of impact or number of people affected.	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report.
Claire Kremen	6	21	294	21	300	Are large, medium and small effects simply relative to one another, or is there a way of indicating the boundaries of numbers of people affected or area affected for each category?	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report.
Rebecca Chaplin-Kramer	6	21	299	21	299	Missing period	This text has gone.
Emily Marquez	6	21	301	21	309	It might be worth ranking which drivers of risk associated with pollinator decline can be addressed in a relatively quick fashion, by reducing usage of pesticides.	Sorry this is not possible.
Diane Castle	6	21	302	21	304	Same comment as above	Sorry it is not clear what is meant here, and there is no reference or explanation provided. Comment 150
Ahmad Mahdavi	6	21	796	21	796	As I mentioned in another place now that people and the whole nature are exposed to a mixture of compounds and their metabolites (cumulative exposure) always there are high possibility of synergism and synergistic effects between these compounds and usually the outcome is many times toxicity and not added one, most of time the mechanism is metabolic which means one compound stops the detoxifying enzyme (most of time and in most species all over the planet Cytochrome P-450 mix of enzymes) and the other compound(s) exert its effects (please see: Mahdavi et al. 1991, Environ. Entomol). And again I have to	We agree that interactive effects of compounds are potentially important and poorly studied, and this is mentioned in the main text.

						emphasis the importance of insect-plant interactions and enzyme studies for a more scientifically acceptable toxicity assessment for important creatures like pollinator insects, and also as much important insect sensory systems by methods like SEM (we did in the past).	
Ahmad Mahdavi	6	21	810	21	810	And chemicals and their metabolites.	This is included in the term "other stressors" and a reference is provided. No change made because of space limits
Ahmad Mahdavi	6	21	810	21	810	Like toxic air pollution etc.	This is included in the term "other stressors" and a reference is provided. No change made because of space limits
Ahmad Mahdavi	6	21	815	21	815	The number is much more higher.	No reference for another number is provided
Ahmad Mahdavi	6	21	825	21	825	These tools are very good, must be developed and employed widely on the planet, unfortunately there are now more exposure in developing countries that requires more work and activities.	Thank you for your comment. The positive feedback is greatly appreciated by the chapter authors.
Ahmad Mahdavi	6	21	827	21	827	Pesticide(s)/ chemicals types and....	Pesticides is a term defined in the glossary.
Thomas Steeger	6	21	290	21	290	Insert space between "unlikely.Impropable"	Done
Thomas Steeger	6	21	296	21	299	defining terminology using the very term that is being defined is not particularly informative, e.g., "Moderate means there is evidence of a moderate impact . . .over a moderate area or affecting some people moderately . . ."	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report.
Thomas Steeger	6	21	299	21	300	insert period after ". . .only slightly" and before "Again, . . ."	This text has gone.
Thomas Steeger	6	21	305	21	307	While this statement is based on "expert opinion" it is a little surprising that climate change is not considered a prominent driver especially given that preceding chapters identify it as a prominent factor.	Climate change does appear in Table 6.2.4, for two of the impacts (decline in wild fruit yields and decline in long term resilience of food production). It just does not come through as prominently as these other drivers when experts were asked to select the most important drivers for each impact separately.

Thomas Steeger	6	21	307	21	309	Again, it is a little surprising that pests and diseases are not considered as prominent pressures on pollinators.	Pollinator parasites and pathogens do appear in Table 6.2.4, for two of the impacts (decline in wild fruit yields and fall in honey production). They do not come through as prominently as these other drivers when experts were asked to select the most important drivers for each impact separately. I think this is correct. We do not have evidence linking these to crop pollination deficits, for example, or loss of wild pollinator diversity....
Thomas Steeger	6	21	314	21	314	hyphenate "long-term" planning	this is a style issue and subject to editorial control by IPBES.
Adolfo Pérez Piñeiro	6	22	338	22	340	It is a very big difference between beekeeping for honey production and beekeeping for pollination. It is possible to be a very good beekeeper producing honey and not be or not to have enough knowledge to handle hives for pollination; or to deal with farmers not prepared to handle or protect honey bees or other pollinators in their fields. Other pollinators than bees won't produce honey or other products than better fruits or seeds.	Thanks. Both elements are covered in this section.
Ahmad Mahdavi	6	22	831	22	831	Pesticide use and pesticide/ chemicals exposure.	Exposure and hazard are relevant for environmental safety, not the use as such.
Ahmad Mahdavi	6	22	835	22	835	This seems to me impossible if we are talking about synthetic conventional pesticides, these pesticide designed carefully to kill and designed carefully to target the nervous system...we have rather to think more about more alternatives for pesticides like natural products etc. and think more about the non-chemical control measures in framework of a well defined IPM program.	There exist synthetic insecticides with low toxicity to bees, that should be chosen if possible as has also been recommended in several instances. The term "pesticide" can include biologically derived compounds and organisms
Thomas Steeger	6	22	323	22	323	consider replacing "It says" with "According to the report. . ."	done
Peter Campbell	6	23	353	23	353	Table 6.2.2 - Again it should be made clear that this is a Conceptual analysis . It would be more <u>informative</u> to carry out the same exercise using "weight of scientific or data evidence". For example for some if not all of the potential impacts there must be some data available that could be referenced.	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report.

Diane Castle	6	23	866	23	867	The difficulty of finding new modes of action and the cost of developing and approving new products is a factor here and should be included. Ensuring adequate returns on investment is essential to innovation.	Text adapted accordingly: "However, the number of new active ingredients being developed and introduced is limited, due to economic and environmental challenges."
Ahmad Mahdavi	6	23	876	23	876	Best management practices are those related to economic lines for the pest, if we think correctly about the control and follow the "Economic Injury Level" and "Economic Threshold" "Equilibrium level" etc. and follow these lines carefully then we need no or least amount of pesticides in our IPM program if there will not be pressures from local pesticide companies and global TNCs. IPM includes any types of activity that we do to hold the pest population under economic lines.	Best management practice can include considerations that lie beyond the compliance to economic thresholds etc., e.g. the use of wind shields and less toxic compounds, not spraying in day time etc.
Sandhya Chandrasekharan	6	24	349	24	353	a similar table as given here can be drawn up for indirect/direct drivers. Ie. Connect to chapter 2, pg 11, pp.191-195	Yes, that would have been a very good idea. Unfortunately, we did not have the time or resources to conduct such an exercise for drivers as well, but we will consider this for a future output.
Ahmad Mahdavi	6	24	897	24	897	There are strict laws and regulations about using pesticides when bee hives are present, some extent distances must be followed and many other regulations unfortunately all for developed world, some regulations may exist in developing countries but rarely enforces.	No reference is provided
Ahmad Mahdavi	6	24	898	24	898	One important method is Sterile Male Technique or Sterile Insect technique for controlling important general pests in agriculture, health and veterinary pests, this types of methods must be more developed to substitute pesticides, the method is called areawide control and prevent use of pesticides in a large area.	These are included under biological control methods and mentioned in the text as key response in IPM
Ahmad Mahdavi	6	24	911	24	911	In controlling general pests like desert locust etc. lots of pesticides are used in a vast area with high effects on general biodiversity including pollinators. Effects on birds and other animals are high, usually they have committees under FAO and so the important matter of pollinators must be taken into consideration in this.	We thank the reviewer for the information. However, no reference is provided

Ahmad Mahdavi	6	24	919	24	919	I worked on this issue during the past decade in a global level and what I found is that "proper registration of pesticides and their regulations is a myth in most developing countries, in many of them still different types of pesticide mafias exists, the scary situation is that for example in Iran in the past there were pesticide importations most from West with some scientific cooperation but now from China and lately after lots of communications with China I found that they are scared to communicate scientifically.	The great variation among countries in regulation is highlighted in the text
Ahmad Mahdavi	6	24	925	24	925	And the outcome is finding lots of unregulated pesticide residues in food of these countries. For example a list of 12 dangerous insecticides that were found to be higher than MRL were given to me about 4 years ago and finally I was stopped ... and am not following the work.	We thank the reviewer for this feedback.
UK Government	6	24	Table 6.2.2	24	Table 6.2.2	Table 6.2.2: Is this Table really telling us anything useful about trends and areas of the world we should focus on? Too subjective to judge?	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report.
Christopher Golden	6	24				There is no health impact assessment listed and I would be in favor of seeing one.	Health impacts are indirect (decline in nutritional quality of human diets). We did not feel there was enough evidence to analyse the risks for indirect impacts. Health impacts are indirect. We did not feel there was anything like enough evidence to analyse the risks.
Les Davies	6	24	349		353	Table 6.2.2: There appears to be very little evidence of a fall in honey production in Europe overall	The treatment of risks has changed in this section. The tables are replaced by some text, with links to relevant sections of the report. Check chapter 3
Les Davies	6	25	354		355	Fall in honey production etc - societal factors (= social/behavioural) - ageing of apiarists - limited income source - production moving from eg. Western to Eastern Europe -move from honey collection to greater emphasis on provision of pollinator services.	This does not seem to require a change. Check chapter 3

Marina Rosales Benites de Franco	6	25	354	25	355	Table 6.2.3. I recomend include in main drivers of loss of wild pollinator diversity: pollinator disease 2.4.1 and loss of wild pollinator diversity 2.5.4.	Pollinator parasites and pathogens do appear in Table 6.2.4, for two of the impacts (decline in wild fruit yields and fall in honey production), but not for loss of wild pollinator diversity. Experts were asked to select the most important drivers for each impact separately. I think this is correct. Disease is suspected to be driving declines in some species, but there is not strong evidence linking it directly to loss of wild pollinator diversity. This was not selected by the authors as one of the main drivers.
Noa Simon Delso	6	25	354	25	355	Table 6.2.3 Main drivers for fall in honey production (and other hive products) – to be included – Land management, Changes in land cover and spacial configuration and Climate change – All these drivers have an impact on nectar, honeydew, propolis and pollen availability in the surroundings of the pollinators, impact being either and increase or a decrease of production capacity.	This table reports the drivers that the authors most frequently selected as the most important drivers, not a list of all possible drivers. This is made clear in a new Table legend.
Noa Simon Delso	6	25	354	25	355	Table 6.2.3. Reduced availability of managed pollinators “and increase honeybee disorders” (the last part to be added” - Main drivers include as well Changes in land cover and spacial configuration (as shown by Simon-Delso et al., 2014) and Land management. Climate change may also affect the availability of managed pollinators by affecting the availability of food resources in the surroundings of the location of these pollinators, ex. Availability of nectar resources reduced by troughs in souther mediterranean countries, modification of the pollen profile and availability before the winter in the northern european countries and a lack of adaptation of pollinators to these changes. More information can be provided under request.	This table reports the drivers that the authors most frequently selected as the most important drivers, not a list of all possible drivers. This is made clear in a new Table legend.
Peter Campbell	6	25	354	25	355	Again in table 6.2.3 this should be labelled as a Conceptual analysis. Is it not possible to rank these drivers? As I suspect whils there may be 3-4 possible main drivers, the potential contribution between each driver may vary	As we don’t have clear quantitative evidence on the relative importance of these different drivers, ranking is not possible. This approach, of listing the drivers considered to be most important by the wide author team for each impact, is the closest we

						quite significantly eg "Loss of Wild Pollinator Diversity " I suspect the opinions would be that "Changes in land cover and spatial configuration" and "land management" is likely to be a more impactful driver than pesticide use. This ranking would then help prioritize which remedial actions will offer the greatest impact for improvement.	can get to ranking without giving a misleading impression of certainty.
Serena Heckler	6	25	354	25	355	A discussion of how decisions are made about which responses make most sense is missing. For instance, collaborative, bottom-up, endogenous, participatory, human rights-based or biocultural approaches to identifying which kinds of responses most effectively meet the requirements in each case at each level. The disempowerment of indigenous peoples and local communities has, in many cases, prevented them from applying their management techniques--including technical, economic or social behavioural responses--innovating to meet new challenges, etc. This should be identified as an important driver of some of the key risks highlighted in Table 6.2.3.	These issues are covered in chapter 5.
Ahmad Mahdavi	6	25	936	25	936	According to my comprehensive work during the past decade with many talks and presentations in Iran and nearby countries (Turkey, Dubai etc.) I convinced that one of the worst situations for pesticide registration and generally talking regulations are worst in Middle Eastern countries (please see my paper in the proceedings of 10th, 12th ...of different Iranian congresses of toxicology titled: "Bridging the gap between North and South for pesticide regulations..." "Pesticide regulations in developing countries"	We thank the reviewer for this feedback. The great variation among countries in regulation is highlighted in the text

Ahmad Mahdavi	6	25	942	25	942	Please also see my resume (in English), during past decades I have been actively involved in cooperation with many different pesticide/chemicals regulatory agencies like EPA, different PAN sections, PMRA, ECHA, REACH for this important issue and considering the worst situation that I found in Middle Eastern countries I am trying to concentrate on that, I am preparing a comprehensive paper to be published in EU Tox. (I already talked to professor Aristidis head of the EU Tox soc. during our recent (13th) International Iranian congress of toxicology held in Oroumyeh, Iran, and also a paper in the ESA (Entomological soc of America) that I am a member. I strongly believe on EU REACH now and am in contact with REACH and ECHA regarding REACH implications for developing countries.	Not sure what is asked for.
Ahmad Mahdavi	6	25	961	25	961	Then you can imagine what is the situation in developing countries. Labeling is a very important issue that could improve misuse/unregulated use of pesticides in developing countries. I think EU REACH & OECD can help a lot for all these pesticide/chemicals regulatory problems in developing countries.	Yes, and labelling is also brought forward as an important tool by the assessment.
UK Government	6	25	Table 6.2.3	25	Table 6.2.3	Not clear why pollinator parasites and pathogens are not drivers of the crop pollination deficit, yield instability etc too. Particularly they are relevant to the availability of managed pollinators and the wild pollinator diversity.	This table reports the drivers that the authors most frequently selected as the most important drivers, not a list of all possible drivers. This is made clear in a new Table legend.
UK Government	6	25	Table 6.2.3	25	Table 6.2.3	It seems very odd to have pesticides as a main driver for "reduced availability of managed pollinators" when recent evidence is suggesting managed pollinators are more robust to these than wild ones. And pathogens and parasites are not even mentioned in this box	This table reports the drivers that the authors most frequently selected as the most important drivers, not a list of all possible drivers. This is made clear in a new Table legend. Pesticides were also selected as a main driver for loss of wild pollinator diversity. This specific issue probably comes about because the managed pollinators are less susceptible than wild pollinators to broader land use change and land management, as they are usually fed over winter for example.

Claire Kremen	6	26	372		380	Please work on the clarity of this paragraph. This could also be written more concisely, giving the reader what they really need to know. Arguably you could combine this paragraph and the next one, shortening it to something like: For our action based typology, we adapted the MEA model (MEA 2011), including their technological, legal, economic and social/behavioral categories, and modifying their cognitive category to one that included not only research and indigenous and traditional knowledge, but also education and awareness-raising (see definitions in Box x). Our definitions were informed also by the NEA and FAO reports. In Table 6.3.1., we provide a cross-walk between the FAO categories (Rose et al. 2014) the the typology used here.	Thanks we have made this change as suggested.
Ahmad Mahdavi	6	26	975	26	975	For many developing countries specially Middle Eastern countries there are no correct, scientifically safe relationships with these very important conventions and the big problem is: For example in many Middle Eastern countries: these conventions only accept and play with governmental agents and usually most knowledgeable scientists in these countries are free and not governmental related.	We thank the reviewer for this feedback. The great variation among countries in regulation is highlighted in the text
Thomas Steeger	6	26	369	26	369	by "actors" do you mean "stakeholders"? If so, consider using the term "stakeholders" since it is used in other chapters.	The term actors here are not the same as stakeholders. It specifically refers to the people or groups who would be acting, in the case of each action. 'Stakeholders' covers any person or group who has an interest in the outcomes. The term actors here are not the same as stakeholders. It specifically refers to the people or groups who would be acting, in the case of each action. 'Stakeholders' covers any person or group who has an interest in the outcomes.
Thomas Steeger	6	26	372	26	375	the paragraph states that the MEA model was used because it is clear and understandable and then goes on to say that one of the categories used in the model (<i>i.e.</i> , "cognitive") is unclear	This paragraph has been revised. This paragraph will be revised.

						and difficult to understand. By substituting another category (<i>i.e.</i> , knowledge), it's uncertain whether the MEI is now a suitable application since the model may not have been "tested/validated" against the substituted category.	
Claire Kremen	6	27	390		391	I think that you really mean that there is not much scientific documentation of management systems -- it is therefore a "knowledge gap" rather than "less good". In fact it would be very desirable to also have scientific assessment not only of specific management actions but also of systems (<i>i.e.</i> multiscale type of work)	sentence deleted.
Claire Kremen	6	27	391		395	work on writing and clarity here.	done
German Government	6	27	407	27	407	Instead of using the term "punish bad practices" you could consider using the term economic disincentives for ["bad"/unsustainable] practices.	We considered, but find the proposed wording far less clear.
Ahmad Mahdavi	6	27	999	27	999	As I see and understand this text is more about situation in developed world and we need more information about the situation in developing countries where most pollinator species (and also people population) are. in most developing countries there are no such regulations to cover biodiversity including bees.	We thank the reviewer for this feedback. The great variation among countries in regulation is highlighted in the text
Thomas Steeger	6	34	586	34	586	consider "More recently, there are going studies to identify crop flower traits (e.g., brighter colors, increased scent, increased nectar) . . ."	this sentence does not have to be a new paragraph. Thanks for this suggested change of wording. It is an improvement and we have adopted it. this sentence does not have to be a new paragraph.
Thomas Steeger	6	34	598	35	601	rephrase ". . .and diversity within and around crops, and for evaluation of crop pollination deficits."	Thanks for this suggested change of wording. It is an improvement and we have adopted it.
German Government	6	35	608	35	608	We strongly request the authors to consider deleting chapter 6.4.1.1.11 as "switching from dependent to non-dependent crops" here is seen in a purely economic sense and doesn't take natural systems into account. If seen in a more holistic dimension this issue is not central for IPBES because the aim of the pollinator assessment is to strengthen pollinators and their services. Therefore, this	Thank you for your suggestion but we have chosen not to accept it because switching to less pollinator dependent or independent crops is a hugely important topic because is an adaptive technique to maintain yields in the wake of pollinator decline.

						bullet is not considered constructive in this assessment.	
Rebecca Chaplin-Kramer	6	35	608	35	624	This is not exactly "strengthening pollination services" which is what is stated in p 29 L 425 as the focus of this section. It is true this could be an adaptive technique to maintain yields in the wake of pollinator decline, but the beginning of 6.4 needs to be reframed in that light rather than in terms of pollinator services if that is the goal	Thank you for your suggestion, we have considered this

Maria Jose Suso	6	35	612	35	613	<p>Please add: There are conceptual criticisms that call into question the overall suitability of this strategy, independence of pollinators by self-fertility and increased selfing. Three concerns, in regards to the independence of the pollinators approach may rise. It ignores that 1) diversity based - on the heterogeneity of genotypes and on heterozygosity within a cultivar contributes to higher and more stable yields (e.g. Link et al., 1994) (Link, W, D. Stelling and E. Ebmeyer, 1994. Factors determining the performance of synthetics in <i>Vicia faba</i> L. 1. Heterogeneity, heterozygosity, and degree of cross-fertilization. <i>Euphytica</i> 75: 77–84) , 2) the transition from outcrossing to high levels of self-fertilization may be accompanied by the evolution towards plants with lower pollinator attraction and altered morphology, which might reinforce pollinator declines (Fishman and Willis 2008). (Fishman L, Willis JH (2008) Pollen limitation and natural selection on floral characters in the yellow monkeyflower, <i>Mimulus guttatus</i>. <i>New Phytol</i> 177:802-810) and 3) From Maalouf et al. (2008) and Suso and Río (2015), in faba bean, it appears that breeding strategies which use and encourage open-pollinated conditions, with pollinator visitors and appropriate flowering patterns, result in cultivars with more yield and resilience than breeding strategies for independence of pollinators. The lack of adequate pollination is responsible of the poor results in breeding strategies and in developing cultivars. Maalouf et al. (2008) (Maalouf F, Ahmed KS, Munzir K et al (2008) The effect of mating system for developing combined resistance to chocolate spot and <i>Ascochyta</i> blight in faba bean. In: Prohens J, Badenes ML (eds.), <i>Modern Variety Breeding for Present and Future Needs. Proceedings of the 18th Eucarpia General Congress. Universidad Politécnica de Valencia, Valencia, Spain, p 416</i>) showed that, in faba bean,</p> <p>Thank you for your comments and references. We agree with your general view (i.e., the concerns about this strategy), which is actually included in different sections of this chapter and now particularly highlighted in the first paragraph of the new version ("As the global agriculture is becoming increasingly pollinator-dependent (see Chapter 3), an option to remove all the risk associated with biotic pollination is switching from dependent to non-dependent crop, but which can reduce overall crop genetic diversity, thus increasing potential vulnerability to pests and pathogens (see section 6.7.1). "). The example with <i>Mimulus guttatus</i> is very interesting but we preferred to avoid it because this is not a crop species.</p>
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					<p>developing cultivars under open-pollination conditions (with local pollinators present) results in lower disease severity and higher number of resistant lines for chocolate spot and Ascochyta blight when compared to exclusion of pollinators (selfing conditions). Suso and Río (2015) (Suso MJ, Río R (2015) A crop-pollinator inter-play approach to assessing seed production patterns in faba bean under two pollination environments. Euphytica 201: 231-251) developing cultivars under evolutionary breeding scheme showed that pollinators are crucial for achieving higher seeds per plant, main predictor of crop yield. The end should be embedding the cultivar in the agroecosystem by developing pollinator-friendly cultivars and a self-sustaining win-win strategy, for crop-pollinators-and farmer. Thus, the proposed breeding strategy is to combine highly self-fertile genotypes which respond optimally to the presence of pollinators to produce high-yielding cultivars. Thus, the presence of pollinators allows the exploitation of heterosis potential, in hybrids or heterotic populations, but in absence of pollinators a minimum yield is achieved (Suso et al. 1996. Reproductive biology of Vicia faba: role of pollination conditions. Field Crops Research 46: 81–91; Nadal et al. 2003. Management of Vicia faba genetic resources: changes associated to the selfing process in the major, equina and minor groups. Genet Resour Crop Evol 50:183–192)</p>	
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Claire Kremen	6	36	631		636	<p>"Regional farm diversity..." This sentence isn't really making sense and doesn't seem connected to pollinator issues. Next sentence is also very general and not related to pollination issues specifically. Here you could make a stronger case in general for how managing for a diverse pollinator community will buffer pollinator/pollination responses to climate change. More pollinator species means having species that respond differentially to climate, both btw years, btw seasons, and even within the day. Relevant papers include: Brittain, C., Kremen, C. & Klein, A.-M. (2013) Biodiversity buffers pollination from changes in environmental conditions. <i>Global Change Biology</i>, 19, 540–547; Klein, A.M., Mueller, C.M., Hoehn, P. & Kremen, C. (2009) Understanding the role of species richness for pollination services. <i>Biodiversity, Ecosystem Functioning, and Human Wellbeing: An Ecological and Economic Perspective</i> (eds D. Bunker, A. Hector, M. Loreau, C. Perrings & S. Naeem), pp. 195–208. Oxford University Press, Oxford and Rader, R., Reilly, J., Bartomeus, I. & Winfree, R. (2013) Native bees buffer the negative impact of climate warming on honey bee pollination of watermelon crops. <i>Global change biology</i>, 19, 3103–10.</p>	Thank you for your comment, we accepted your suggestion
Denise Matias	6	36	637	36	647	How about citing the EU proposal (Regulation No. 485/2013) in restricting the use of three pesticides clothianidin, imidacloprid, thiametoxam?	This material is covered in a different section (6.4.2.2). We have included a cross reference.

USA government	6	72	1525	72	1528	<p>Much of my career has been spent in biological control, and I have a fair amount of experience in research on biocontrol of Varroa mites (I have also published a number of papers on Small Hive Beetle). I find the selection of this particular example of "biological control" to be curious and not particularly helpful, since, as the author pointed out, this is not a treatment that solves an existing problem in a hive, nor has that approach been found effective. A number of research groups have worked on developing biological control of Varroa mites - Varroa mites are without a doubt the single most important pest of honey bees worldwide (small hive beetles are far less of a global problem and indeed seem to be important only in certain locations, like the SE U.S.). In addition, the authors implies that introduction of these nematodes might be problematic. Actually, that might be a problem for "classical" biocontrol in which a natural enemy from the pest's native range is introduced, but there are other kinds of biocontrol (for example, augmentative biocontrol in which a native natural enemy is introduced at much higher levels than they naturally occur) that do not involve release of non-native organisms. I recently wrote a review of the Varroa biocontrol efforts in which we dealt with these issues; here is the citation: Meikle, W.G., et al. 2012. Challenges for developing biopesticides against Varroa destructor (Mesostigmata: Varroidae). <i>Apidologie</i> 43(5): 501-514. DOI: 10.1007/s13592-012-0118-0. I have attached a copy. Of course I am not suggesting you cite that, but it has citations for lots of biocontrol papers that you might consider.</p>	<p>"...biocontrol, e.g. entomopathogenic fungi against Varroa mites (REF)..." "...biocontrol, e.g. entomopathogenic fungi against <i>Varroa</i> mites (REF)..." "Given the issues with this example (which several reviewers picked up on) we have changed this section and greatly de-emphasized this example. We have included biological control examples for some specific parasites and pathogens, including <i>Varroa</i>, in the revised and expanded treatment section. This includes the citation you mentioned.</p>
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Scott Black	6	72	1529	72	1533	<p>What is the basis of the statement that infection prevention as it relates to rearing facilities is speculative? It is unclear as I read it what is speculative. Certainly there are tradeoffs for the industry, but this is about improving pollinator health, right? I suspect that there are rearing practices that could greatly reduce the pathogen prevalence in commercially available bumble bees and other pollinators. There are plenty of studies that show higher infection rates in commercial bumble bees. Several examples below: Murray, T. E., M. F. Coffey, E. Kehoe, and F. G. Horgan. 2013. Pathogen prevalence in commercially reared bumble bees and evidence of spillover in conspecific populations. <i>Biological conservation</i> 159:269–276. Otterstatter, M. C., and J. D. Thomson. 2008. Does pathogen spillover from commercially reared bumble bees threaten wild pollinators? <i>PloS one</i> 3:e2771. Sachman-Ruiz, B., V. Narváez-Padilla, and E. Reynaud. 2015. Commercial <i>Bombus impatiens</i> as reservoirs of emerging infectious diseases in central México. <i>Biological invasions</i>:1–11. Springer International Publishing. Colla, S. R., M. C. Otterstatter, R. J. Gegear, and J. D. Thomson. 2006. Plight of the bumble bee: pathogen spillover from commercial to wild populations. <i>Biological conservation</i> 129:461–467.</p>	<p>We have clarified this statement such that "speculative" relates specifically to particular infection prevention management techniques in rearing facilities: "There is a high level of secrecy and protection of intellectual property in commercial bumble bee rearing operations, and thus any particular rearing facility practices focused on disease prevention remain speculative"</p>
Marie-Pierre Chauzat	6	72	1534	72	1535	<p><i>Varroa destructor</i> is a major threat to honeybees. It should be better emphasised.</p>	<p><i>Varroa</i> is given much more attention throughout the expansion of, and revisions to, this section</p>
Noa Simon Delso	6	72	1534	72	1537	<p>Swarming is a natural way of the colonies resulting in a reduction of pathogen and pathogen pressure, among others because it involves a broodless period within the colony. There are also combinations of beekeeping practices and acaricides available with excellent efficacy. The objective is to achieve a period of time in which there is no capped brood in the colony, moment in which a treatment for example with oxalic acid can be done. In this moment, all varroas are either on the combs or</p>	<p>swarming management is now included as a method of <i>Varroa</i> control in the <i>Varroa</i> treatment section, specifically under cultural/management practices for <i>Varroa</i> control</p>

						on the bees, maximizing the exposure to the acaricide. There are a wide variety of options to achieve the broodless period like directly removing the frames with capped cels, or forcing the queen to lay eggs in specific frames that will be removed after 21-24 days (e.g. Queen cages, supper underneath the brood chamber with a queen excluder, etc.).	
USA government	6	72	1534	72	1535	Some of the work on development of biopesticides against Varroa mites could also be mentioned here. Also, work has been done with plant compounds and organic acids, which are only "acaricides" in the broad sense. Chemical acaricides, which is what is implied here, have many issues of honey and wax contamination, pest resistance, effects on bee health, and other issues (please see the review cited above). Chemical acaricides have been the main approach for close to 30 years and have not yielded any long-term or even medium-term solution.	"...such as plant compounds, organic acids and biopesticides to manage <i>Varroa</i> destructor..." "...such as plant compounds, organic acids and biopesticides to manage <i>Varroa</i> destructor..." "this section has been greatly expanded and now included specific mention of organic acids and essential oils, as well as biological control of <i>Varroa</i>
Marie-Pierre Chauzat	6	72	1536	72	1537	There is no consensus on the RNAi technology: costs-benefit should be better assessed before promoting the technique.	excellent point and in the three places where RNAi technology is now covered (treatment of viruses, <i>Nosema</i> , and <i>Varroa</i>) we have included a statement about the lack of information on risks and costs of RNAi technology
USA government	6	72	1536	72	1537	Please bear in mind that the beekeeping community has been assured now for several years about the "strong" potential of RNAi technology against Varroa mites but no commercial products have been forthcoming.	We now make this point clearer in the three places where RNAi technology is now covered (treatment of viruses, <i>Nosema</i> , and <i>Varroa</i>)
Marie-Pierre Chauzat	6	73	1545	73	1545	Alaux et al. Transposing laboratory results to conclusions at colony level should be taken with care.	We have now added text to the end of this section reading: "More field-scale trials of supporting social immune mechanisms would assist pollinator managers and policy makers in evaluating their implementation."
Marie-Pierre Chauzat	6	73	1554	73	1556	Treatment rotations and combinations are already advised and performed in the field.	It is unclear what the reviewer is suggesting here and the type of comment is "no action", thus we have not changed the text here

Marie-Pierre Chauzat	6	73	1559	73	1559	you may consider adding the following reference	Martin, S. J., A. C. Highfield, L. Brettell, E. M. Villalobos, G. E. Budge, M. Powell, S. Nikaido, and D. C. Schroeder. 2012. Global honey bee viral landscape altered by a parasitic mite. <i>Science</i> 336:1304-1306. Martin, S. J., A. C. Highfield, L. Brettell, E. M. Villalobos, G. E. Budge, M. Powell, S. Nikaido, and D. C. Schroeder. 2012. Global honey bee viral landscape altered by a parasitic mite. <i>Science</i> 336:1304-1306. Martin et al. did not explicitly assess virulence in their study and as such we would prefer to leave this reference out
Noa Simon Delso	6	73	1617	73	1631	Endosymbiotic microorganisms are also essential for the production of bee bread and nutrient availability. Here a fragment of the publication of Simon-Delso et al. 2014: “[...] Fungicides may have an impact on the colony by modifying the existing microflora present in the food stores or in the bee intestinal tract [71]. Studies have already shown the possible modification of microbial composition both at beebread level [62,72] and at intestinal level [73]. This modification in the composition of microbiota may lead to dysbiosis [74]. The impact that such an unbalance in the bee gut microflora may have on bee health has already been considered. The link between the unspecific symptoms observed in our study and a possible microbial alteration could be subject of further research. In parallel, the potential impact of microbial modification on digestibility and availability of nutrients should be a target for further research. Indeed, the content of essential amino acids might be altered when beebread is contaminated with fungicides (DeGrandi-Hoffman, 2013, pers com.). Given the importance of nutrition, especially pollen, in the good development of the colony [75] alterations in composition or lack of essential nutrients would put the homeostasis of the colony at stake. Some studies have already shown the impact of nutritional lack on bee development and health [76]. Provided that pollen is the unique source	We have added mention of the effects of gut microbiota on nutrient availability, citing the Anderson paper (ref #73 in the paper you mention)

						of amino acids for honeybees, royal jelly production could also be affected [77,78] with unexpected potential consequences for its main consumers, larvae and the queen.”	
Thomas Steeger	6	73	1558	73	1560	inset reference to support statement	we have added a reference (Alizon et al. 2009) to support the statement about virulence evolution in a range of host-parasite systems
Marie-Pierre Chauzat	6	77	1696	77	1696	you may consider mentioning OIE and EU legislation on trade	EU and UK legislation mentioned
Marie-Pierre Chauzat	6	77	1704	77	1704	you may consider adding the following reference	Valerio da Silva. The first report of <i>Aethina tumida</i> in the European Union, Portugal in 2004. Bee world Valerio da Silva. The first report of <i>Aethina tumida</i> in the European Union, Portugal in 2004. Bee world the reference does not provide concrete evidence on this point and so we have not included it
Thomas Steeger	6	77	1699	77	1700	rephrase "...registratio of managed bee colony locations, ..."	We are concerned that adding "locations" could cause confusion and so we have left this as-is
Thomas Steeger	6	78	1736	78	1739	rephrase "...which were bred at Buckfast Abbey in an isolated, treeless moor lacking honey bee nesting habitat in the UK and thus allowing..."	much improved phrasing, thank you for the suggestion
Thomas Steeger	6	79	1744	79	1745	rephrase "In addition, to our knowledge, there is no evidence ...of market-building responses."	done

Marie-Pierre Chauzat	6	80	1784	80	1784	you may consider adding the following reference	Chauzat et al. 2014. EPILOBEEE A Pan-European epidemiological study on honeybee colony losses 2012-2013. Report 32p. Laurent et al. 2015. EPILOBEEE A Pan-European epidemiological study on honeybee colony losses 2012-2014. Report 44pChauzat et al. 2014. EPILOBEEE A Pan-European epidemiological study on honeybee colony losses 2012-2013. Report 32p. Laurent et al. 2015. EPILOBEEE A Pan-European epidemiological study on honeybee colony losses 2012-2014. Report 44pWe noted that the references we included here were "for example" using "e.g." and we would prefer to cite more easily-accessible peer reviewed papers rather than reports when possible
Thomas Steeger	6	80	1776	80	1776	insert URLfor NTFP-PRM or provide a reference	done